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October 30, 2009

383194.AP.PM

DOCKET
09-AFC-2
DATE OCT 30 2009
RECD OCT 30 2009

Ms. Felicia Miller
California Energy Commission
1516 Ninth Street
Sacramento, CA 95814-5512

Subject: Almond 2 Power Plant (09-AFC-02)
Data Response Set 1C, Responses to CEC Staff Data Requests 61b, 68 and 72

Dear Ms. Miller:

Attached please find 13 hard copies and 1 electronic copy on CD-ROM of the Almond 2 Power Plant's Data Response Set 1C (61b, 68 and 72). This Data Response Set was prepared in response to California Energy Commission Staff Data Request Set 1 for the Application for Certification for the Almond 2 Power Plant (09-AFC-02) dated August 13, 2009.

Due to size, 3 hard copies of Attachment DR68-1, Draft Stormwater Pollution Prevention Plan and Attachment DR72-1, System Impact Study, have been provided. Additional electronic copies are available upon request.

If you have any questions about this matter, please contact me at (916) 286-0249 or contact Susan Strachan at (530) 757-7038.

Sincerely,

CH2M HILL

Sarah Madams
AFC Project Manager

Attachment
cc: S. Strachan, Strachan Consulting
R. Baysinger, TID

(TRNSMTL_LTR_DR_SET_1C.DOC)

# Almond 2 Power Plant

**(09-AFC-02)**

# Data Responses, Set 1C

**(Response to Data Requests 61b, 68 and 72)**

Submitted to

**California Energy Commission**

Submitted by

WATER & POWER

Serving Central California since 1887

With Assistance from

CH2MHILL
2485 Natomas Park Drive
Suite 600
Sacramento, CA 95833

October 2009

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# Introduction

Attached are Turlock Irrigation District's (TID or the Applicant) responses to the California Energy Commission (CEC) Data Request Set 1 (numbers 61b, 68, and 72) regarding the Almond 2 Power Plant (A2PP) (09-AFC-02) Application for Certification (AFC).

The responses are grouped by individual discipline or topic area. Within each discipline area, the responses are presented in the same order as the CEC presented them and are keyed to the Data Request numbers (61b, 68 and 72). New or revised graphics or tables are numbered in reference to the Data Request number. For example, the first table used in response to Data Request 36 would be numbered Table DR36-1. The first figure used in response to Data Request 42 would be Figure DR42-1, and so on.

Additional tables, figures, or documents submitted in response to a data request or workshop query (supporting data, stand-alone documents such as plans, folding graphics, etc.) are found at the end of each discipline-specific section and are not sequentially page-numbered consistently with the remainder of the document, though they may have their own internal page numbering system.

# Soils and Water Resources (61b and 68)

## Background

In the AFC, under a subsection of Section 5.15.1.4 Water Supply, the Applicant stated that a will serve letter from the City of Ceres was included in Appendix 2A of the submittal. This will serve letter did not discuss —water supply.

The City's Will Serve Letter for Almond Power Generation Facility Process Wastewater (AFC, Appendix 2A) dated April 7, 2009 includes the following text:

> *The City of Ceres is willing to provide service to the Turlock Irrigation District Almond Power Generation Facility in the form of receiving process wastewater and disposing of it in the Treatment Plant evaporation ponds. However, this service will be contingent upon the City and TID agreeing on mutually beneficial terms in the form of a Second Amendment to the Water Services Agreement dated September 14, 1992.*
>
> *The amendment must include provisions defining maximum gallons per day and per annum wastewater flows and an "Out" clause should the Regional Board impose new restrictions to treatment or receipt of wastewater flows that would prevent the City from accepting the process wastewater. In such an event TID must be prepared to follow an alternate course of action for disposal of the Power Generation Facility process wastewater.*

This letter primarily addresses acceptance of the APP and A2PP process wastewater and does not describe the City's willingness to provide wastewater to the WWTP. The City's WWTP will benefit from groundwater withdrawals near the P-E basins because the drawdown from pumping will increase percolation and improve storage capacity in the P-E basins. Staff is concerned that there is no agreement in place to ensure an adequate water supply is available to meet the needs of the APP and A2PP. Staff is also concerned that the pump near the Ceres WWTP may extract high quality groundwater in the vicinity of the WWTP P-E basins.

61. Please provide:

    b. If the second amendment has not been settled, provide staff with a status update on when approval of an amendment would be expected.

**Response:**

b. The second amendment to the water agreement between TID and the City of Ceres WWTP Water Agreement, dated October 12, 2009, is provided as Attachment DR61-3.

## Background

During construction, approximately 6.45 acres of land associated with the A2PP project would be disturbed for proposed project laydown, temporary parking, and the proposed A2PP site. The General Permit for Stormwater Discharges associated with Construction

Activity, administered by the SWRCB, requires a Stormwater Pollution Prevention Plan (SWPPP) be prepared for the construction site. The SWPPP would include best management practices (BMPs) for erosion and sediment control. The SWPPP would be prepared prior to construction of the A2PP project. The draft Construction SWPPP was not provided with the AFC.

To mitigate potential impacts to water and soil resources from the construction of the A2PP project, the Energy Commission requires preparation and implementation of a Drainage Erosion and Sediment Control Plan (DESCP). The DESCP would be updated and revised as the project moves through the design process. The DESCP is a complement to the Construction SWPPP. The DESCP submitted prior to site mobilization must be designed and sealed by a professional engineer/erosion control specialist.

## Data Requests

68. Please provide a draft construction SWPPP.

**Response:** The draft construction SWPPP is provided as Attachment DR68-1.

ATTACHMENT DR61-3

# Water Agreement, Second Amendment

# EXHIBIT A

## Second Amendment to the Water Services Agreement

This Amendment dated October 12, 2009, to the Water Services Agreement dated September 14, 1992, and amended October 24, 2000, between the CITY OF CERES, a municipal corporation, and the Turlock Irrigation District, a public entity.

### Recitals

A. The DISTRICT desires to expand the Power Generation Facility and increase the pumping at the groundwater extraction well as a source of process water for the Power Generation Facility.

B. The CITY desires to maintain capacity at the Treatment Plant. However, if the Regional Water Quality Control Board restricts the CITY's ability to accept the process water, the DISTRICT may need to provide for alternate disposal of the process water.

Now therefore, the parties agree as follows:

1. To amend Section 2.2 of the agreement to read: The Power Generation Facility will require up to a maximum of 1,135,000 gallons per day of process water to be pumped from the groundwater extraction well.

2. To amend Section 3.1 of the agreement to read: They CITY agrees to allow the Power Generation Facility's process wastewater to be disposed of in the CITY's evaporation ponds at a maximum rate of 560,000 gallons per day with a maximum annual total of 52,000,000 gallons per year.

3. To delete Section 4 of the agreement.

4. To amend Section 5 by adding 5.5 to read: In the event the California Regional Water Quality Control Board issues a new Waste Discharge Requirement or provides stricter requirements for the Wastewater Treatment Plant that restricts or eliminates the CITY's ability to receive the process wastewater this agreement may be suspended, nullified or amended. Amendment of the agreement may be dependent on the DISTRICT modifying the process wastewater to meet the new requirements or the feasibility of the CITY modifying its treatment process to continue or resume accepting the Power Generation Facility's process wastewater. Any cost associated with modifying the treatment process solely to continue or resume accepting the process wastewater will be borne by the DISTRICT.

   If either party learns that the CRWQCB plans to review or revise the CITY's current Waste Discharge Requirements or plans to consider ordering new requirements for the Wastewater Treatment Plant that restrict or eliminate the CITY's ability to receive the District's process wastewater, the party agrees to notify the other party as soon as practicable. The CITY and the District agree to cooperate in good faith with each other and to use commercially reasonable efforts to find options and alternatives to modify the process wastewater to meet any new requirements and to modify the CITY's treatment process in order to continue or resume accepting the Power Generation Facility's process wastewater.

5. To amend Section 11.1 to read: The term of this agreement shall commence upon execution of the agreement by both parties and shall terminate on July 31, 2031.

6. To amend Section 11.2 to read:.....not later than January 31, 2031.

Except as amended by this Second Amendment to the Water Services Agreement, all of the remaining terms and conditions of the Water Services Agreement, dated 9/14/92, and the First Amendment to the Water Services Agreement, dated 10/24/2000, shall remain in full force and effect.

IN WITNESS WHEREOF, the parties have executed this Agreement on the dates indicated below.

Dated October 12, 2009

CITY OF CERES, a municipal corporation

By _____
Brad Kilger, City Manager

Cindy Heidorn
Cindy Heidorn, City Clerk

APPROVED AS TO FORM

Michael L. Lyons
CITY ATTORNEY

Dated October 12, 2009

TURLOCK IRRIGATION DISTRICT

By Charles Fernandes
Charles Fernandes, President

Steve Boyd
Steve Boyd, Secretary

Roger K. Masuda
Roger Masuda, General Counsel

RESOLUTION NO. 2009-64

RESOLUTION APPROVING SECOND AMENDMENT TO THE WATER SERVICES AGREEMENT BETWEEN THE CITY OF CERES AND THE TURLOCK IRRIGATION DISTRICT FOR THE ALMOND POWER GENERATION FACILITY

WHEREAS, the Turlock Irrigation District (District) and the City of Ceres (City) entered into that certain Water Service Agreement dated September 14, 1992, as amended by the First Amendment dated October 24, 2000, whereby the City agreed to provide reclaimed water from the City's Wastewater Reclamation Plant to be used as process water for the District's Almond Power Generation Facility; and

WHEREAS, the District desires to expand the Almond Power Generation Facility and to increase the amount of reclaimed water used for process water for the Almond Power Generation Facility; and

WHEREAS, the City's Wastewater Reclamation Plant will continue to receive and dispose of all of the reject water from the power generation process; and

WHEREAS, the Turlock Irrigation District and the City of Ceres will both benefit from the proposed amendment to the Water Services agreement; and

WHEREAS, the Assistant General Manager for Power Supply has reviewed with and recommended to the Board of Directors that the Board approve the Second Amendment to the Water Services Agreement; and

WHEREAS, the Board of Directors has reviewed the terms and conditions of the Second Amendment to the Water Services Agreement, which amendment is incorporated herein by reference, and finds the terms and conditions of the Second Amendment to be reasonable and in the best interest of the District.

NOW, THEREFORE, BE IT HEREBY RESOLVED that the Board of Directors of the Turlock Irrigation District does hereby approve the Second Amendment to the Water Services Agreement between the City and the District and authorizes and directs the President and Secretary to sign the Second Amendment on behalf of the District.

Moved by Director Fiorini, seconded by Director Berryhill, that the foregoing resolution be adopted.

Upon roll call the following vote was had:

| | |
|---|---|
| Ayes: | Directors Berryhill, Fiorini, Santos, Fernandes |
| Noes: | Directors None |
| Absent: | Directors None |

The President declared the resolution adopted.

I, Tami Wallenburg, Deputy Secretary of the Board of Directors of the TURLOCK IRRIGATION DISTRICT, do hereby CERTIFY that the foregoing is a full, true and correct copy of a resolution duly adopted at a regular meeting of said Board of Directors held the 20th day of October, 2009.

Deputy Secretary of the Board of
Directors of the Turlock Irrigation District

ATTACHMENT DR68-1

# Draft Stormwater Pollution Prevention Plan

**ATTACHMENT DR68-1**

# Draft Stormwater Pollution Prevention Plan

Due to the size of this document, three hard copies have been provided to the California Energy Commission. Additional electronic copies will be provided upon request.

# Transmission System Engineering (72)

## Background

The California Environmental Quality Act (CEQA) requires the identification and description of the "Direct and indirect significant effects of the project on the environment." Consideration of the AFC requires discussion of the energy resource impacts which may result from the construction or operation of the power plant. For the identification of impacts on the transmission system resources and the indirect or downstream transmission impacts, staff relies on the System Impact and Facilities Studies to insure the interconnecting grid meets reliability standards. The studies analyze the effect of the proposed project on the ability of the transmission network to meet reliability standards. When the studies determine the project will cause a violation of reliability standards, the potential mitigation or upgrades required to bring the system into compliance are identified. The mitigation measures often include the construction of downstream transmission facilities. CEQA requires the analysis of any downstream facilities for potential indirect impacts of the proposed project. Without a complete System Impact Study or Facility Study, staff is not able to fulfill the CEQA requirement to identify the indirect effects of the proposed project.

## Data Request

72. Please provide the final System Impact Study. The Study should analyze the system impacts with and without the project during peak and off-peak system conditions, and demonstrate conformance or non-conformance with the utility reliability and planning criteria with the following provisions:

    a. Identify major assumptions in the base cases including imports to the system, major generation and load changes in the system and queue generation.

    b. Analyze the system for N-0, important N-1 and critical N-2 contingency conditions and provide a list of criteria violations in a table showing the loadings before and after adding the new generation.

    c. Analyze short circuit duties.

    d. Analyze system for Transient Stability and Post-transient voltage conditions under critical N-1 and N-2 contingencies, and provide related plots, switching data and a list for voltage violations in the studies.

    e. Provide a list of contingencies evaluated for each study.

    f. List mitigation measures considered and those selected for all criteria violations.

    g. Provide electronic copies of *.sav and *.drw PSLF files.

    h. Provide power flow diagrams (MW, percent loading & P. U. voltage) for base cases with and without the project. Power flow diagrams must also be provided for all N-0, N-1 and N-2 studies where overloads or voltage

violations appear. Provide the pre and post project diagrams only for an elements largest overload.

**Response:** The System Impact Study (SIS) is provided as Attachment DR72-1, however in preparation of the SIS it was noted that Section 3 of the AFC required some minor changes. Figure 3.1-3B Revised, Grayson Substation One-Line Diagram, has been revised slightly to reflect a switch in nomenclature for the Hughson and Taylor transmissions lines, a misspelling of "Taylor", and to change a dashed line to a solid line. Section 3.2.2 of the AFC also had a minor revision in the amount of kiloamperes. The revised Section 3.2.2 is provided in red line/strikeout.

### 3.2.2 115-kV Interconnection Switchyard Characteristics

The interconnection 115-kV switchyard will use 115-kV gas-insulated circuit breakers in a ring bus arrangement to obtain a high level of service reliability. The switchyard and all equipment will be designed for an interrupting capacity of at least 40~~15,000~~ kiloamperes (kA). The main buses, as well as the bays, will be designed to carry at least 1,200 amperes on a continuous basis.

In addition, as noted in the AFC, the transmission planning studies indicated that the Almond-Crows Landing line is of insufficient capacity for all contingencies as a result of the A2PP project. This insufficiency was temporary – existing only until native growth occurred in the area of the new substation. The initial study as identified in the AFC indicated that reconductoring the line with a smaller-diameter lower-sag conductor such as ACSS would increase the capacity at high cost. However, in a recent study of survey data obtained during TID's recent LIDAR (Light Detection and Radar) Project[1], a simpler lower-cost approach would be to increase the clearance at approximately 12 locations on the line and re-rate[2] the conductor temperature and ampacity rating. Therefore, upon completion of the work, the line will be re-rated to 105° C operating temperature for emergency operations. As a result, Section 3.2.3 of the AFC has been revised as follows and is provided in red line/strikeout.

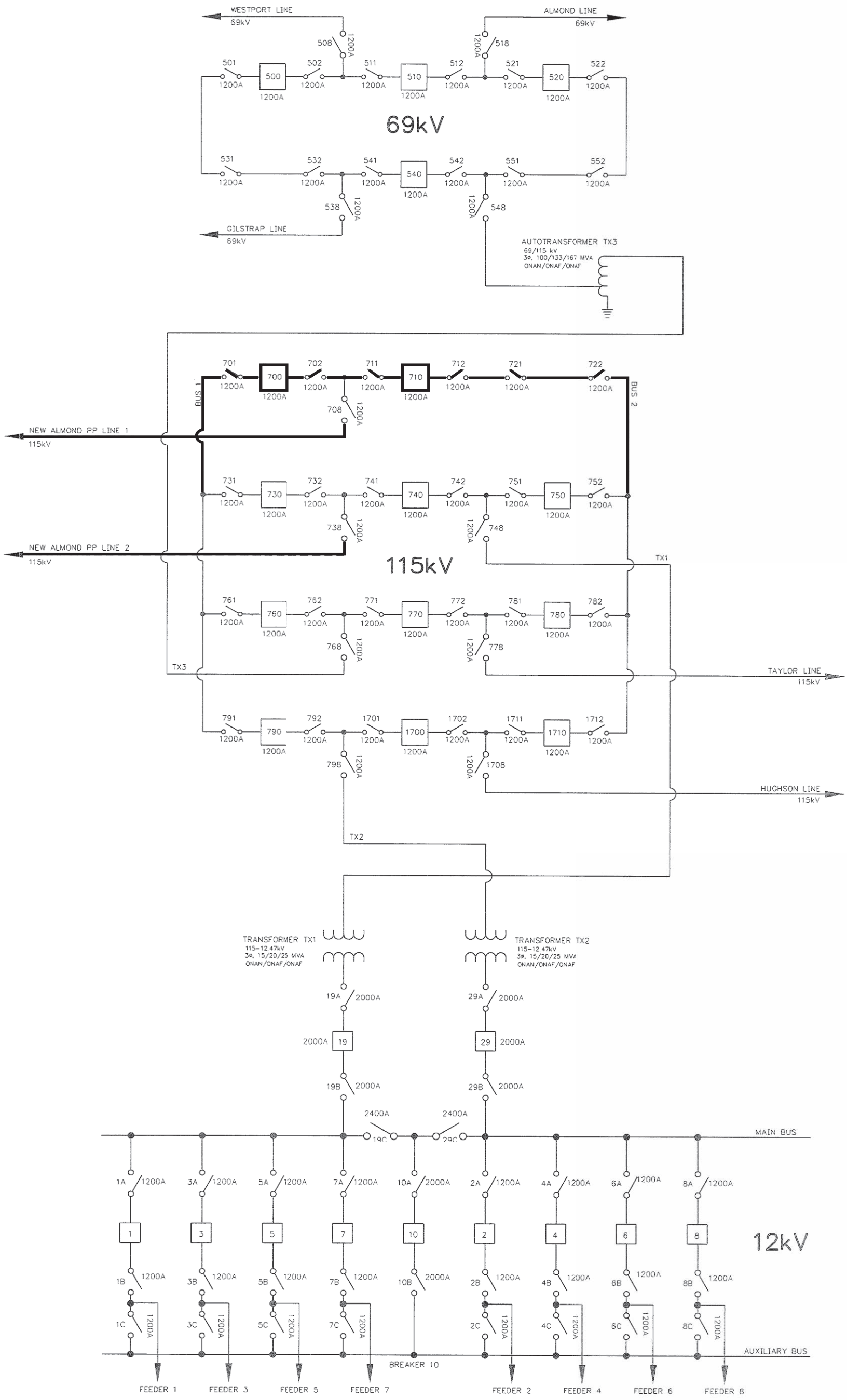
### 3.2.3 Almond-Crows Landing 69 KV ~~Reconductoring~~ Re-rating

The 2.9-mile-long 69-kV sub-transmission line (Almond-Crows Landing) will require ~~reconductoring~~ work to increase clearances so thermal loading and resulting sag can be increased for emergency loading conditions. The existing 636 kcmil AA, orchid conductor will be re-rated to 105° C operating temperature for emergency operations. ~~orchid conductor will be replaced with 477 kcmil ACCR, Hawk, or similar conductor that will allow increased thermal loading with no increase in sag or significant increase in tension/loading.~~ Construction will involve lowering underbuilt 12kV conductors to increase the clearance required

[1] With LIDAR a helicopter flies at low elevation (500') directly over transmission wires. A device on the helicopter shoots billions of radar points. These points or pixels are loaded into a supercomputer. The computer then puts the pixels together and creates a futuristic survey. The survey is so accurate, it will pick up individual tree leafs, or in this case the catenary of the conductors. During the helicopter survey, temperature measurements are taken of both the ambient temperature, and the temperature of the conductor. With this information as well as the amperage of the conductor, TID is then able to predict what types of clearances are needed to meet code requirements under operating and emergency conditions.

[2] Re-rate a line means that the conductor can accept greater load flows (more current) than previously.

for the increased sag at the higher operating temperature. ~~hanging travelers onto the insulators of the existing line and using the existing conductors as a pull line for the new conductor.~~ A new hole will be drilled in the pole and the crossarm that supports the 12kV conductors will be lowered.




Would not be included if A2PP is not constructed

**FIGURE 3.1-3B REVISED GRAYSON SUBSTATION ONE LINE DIAGRAM**
ALMOND 2 POWER PLANT
*CERES, CALIFORNIA*

CH2MHILL

EY012009003SAC Figure_3.1-3b_R.ai 10-26-09 tdaus

ATTACHMENT DR72-1

# System Impact Study

**ATTACHMENT DR72-1**

# System Impact Study

Due to the size of this document, three hard copies have been provided to the California Energy Commission. Additional electronic copies will be provided upon request.

# APPLICATION FOR CERTIFICATION

SUBMITTED TO

California
Energy Commission

FOR

# TID Almond 2 Power Plant

SUBMITTED BY

Turlock Irrigation District

TECHNICAL ASSISTANCE BY

CH2MHILL

October 2009

## Attachment DR68
## Draft Stormwater Pollution Prevention Plan

*Administrative Draft*

# Almond 2 Power Plant Project Construction Stormwater Pollution Prevention Plan

Prepared for

**Turlock Irrigation District**

October 2009

CH2MHILL
2525 Airpark Dr.
Redding, CA 96001

# Stormwater Pollution Prevention Plan

**For:**
Almond 2 Power Plant Project

**Prepared for:**
TBD

**Project Site Location/Address:**
4500 Crows Landing Road, Modesto, California

**Contractor:**
To Be Determined

**Contractor's Qualified SWPPP Practitioner**
To Be Determined

**SWPPP Prepared by:**
CH2M HILL
2525 Airpark Dr.
Redding, CA 96001
(530) 229-3340
Mieke Sheffield, CPSWQ #520

**SWPPP Preparation Date:**
Administrative Draft
October 2009

**Estimated Project Dates:**
Start of Construction: Third Quarter 2010
Completion of Construction: Third Quarter 2011

**WDID No.:** To Be Determined

CH2MHILL

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# Acronyms and Abbreviations

| | |
|---|---|
| A2PP | Almond 2 Power Plant |
| BMP | best management practice |
| CASQA | California Storm Water Quality Association |
| CDFG | California Department of Fish and Game |
| COC | constituents of concern |
| CSMP | Construction Site Monitoring Program |
| bgs | below ground surface |
| BAT | best available technology |
| BCT | best conventional technology |
| EPA | U.S. Environmental Protection Agency |
| GE | General Electric |
| General Permit | State Water Resources Control Board Order No. 2009-0009-DWQ National Pollutant Discharge Elimination System General Permit No. CAS000002 Waste Discharge Requirements for Discharges of Stormwater Runoff Associated with Construction and Land Disturbance Activities |
| kV | kilovolt |
| LRP | Legally Responsible Person |
| MSDS | material safety data sheet |
| MW | megawatt |
| NAL | Numeric Action Level |
| NPDES | National Pollutant Discharge Elimination System |
| NTU | Nephelometric Turbidity Units |
| PCC | Portland cement concrete |
| QA/QC | quality assurance/quality control |
| QSD | Qualified SWPPP Developer |
| QSP | Qualified SWPPP Practitioner |
| REAP | Rain Event Action Plan |

| | |
|---|---|
| RWQCB | Regional Water Quality Control Board |
| RUSLE2 | Revised Universal Soil Loss Equation |
| SWPPP | Stormwater Pollution Prevention Plan |
| SWRCB | State Water Resources Control Board |
| TID | Turlock Irrigation District |
| TSP | total suspended particulate |
| WDR | Waste Discharge Requirement |
| WinCo | WinCo Foods |
| WPCD | Water Pollution Control Drawing |

SECTION 1

# SWPPP Certifications and Approval

## 1.1 SWPPP Certification by Preparer

Project Name: Almond 2 Power Plant Project

Project Number: _____

"I certify under a penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to ensure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system or those persons directly responsible for gathering the information, to the best of my knowledge and belief, the information submitted is true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."

| _____ | _____ |
|---|---|
| Preparer's Signature | Date |
| _____ | _____ |
| Name and Title | Telephone Number |

## 1.2 SWPPP Certification by Legally Responsible Person

Project Name: Almond 2 Power Plant Project

Project Number: _____

"I certify under a penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to ensure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system or those persons directly responsible for gathering the information, to the best of my knowledge and belief, the information submitted is true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."

| | |
|---|---|
| Owner (or Authorized Representative ) Signature | Date |
| Name and Title | Telephone Number |

## 1.3 Annual Report

By September 1 of each year, an Annual Report will be prepared and electronically submitted by the Legally Responsible Person (LRP) or the LRP's approved signatory.

- Each Annual Report will be certified in accordance with the Special Provisions of the General Permit.
- An electronic or paper copy of each Annual Report will be retained for a minimum of three years after the date the annual report is filed.
- The following information will be included in the Annual Report:
    1. A summary and evaluation of all sampling and analysis results, including copies of laboratory reports.
    2. The analytical method(s), method reporting unit(s), and method detection limit(s) of each analytical parameter (analytical results that are less than the method detection limit shall be reported as "less than the method detection limit").
    3. A summary of all corrective actions taken during the compliance year.
    4. Identification of any compliance activities or corrective actions that were not implemented.
    5. A summary of all violations of the General Permit.
    6. The names of individual(s) who performed the facility inspections, sampling, visual observation (inspections), and/or measurements.
    7. The date, place, time of facility inspections, sampling, visual observation (inspections), and/or measurements, including precipitation (rain gauge).
    8. The visual observation and sample collection exception records and report.
- Training information will be provided in the Annual Report consisting of:
    1. Documentation of all training for individuals responsible for all activities associated with compliance with this General Permit.
    2. Documentation of all training for individuals responsible for BMP installation, inspection, maintenance, and repair.
    3. Documentation of all training for individuals responsible for overseeing, revising, and amending the SWPPP.

SECTION 2

# Introduction

State Water Resources Control Board Order No. 2009-0009-DWQ National Pollutant Discharge Elimination System General Permit No. CAS000002 Waste Discharge Requirements for Discharges of Stormwater Runoff Associated with Construction and Land Disturbance Activities (General Permit) regulates discharges of pollutants in stormwater associated with construction activity to waters of the United States from construction sites that disturb one or more acres of land surface. This General Permit serves as a National Pollutant Discharge Elimination System (NPDES) permit in compliance with Clean Water Act § 402 and will take effect on July 1, 2010.

## 2.1 Objectives

This Stormwater Pollution Prevention Plan (SWPPP) was developed to address the construction activity associated with the proposed Almond 2 Power Plant project (A2PP or Project). As required by the State Water Resources Control Board (SWRCB), this SWPPP was developed and will be amended or revised, when necessary, to address the following objectives:

1. All pollutants and their sources, including sources of sediment associated with construction, construction site erosion, and all other activities associated with construction activity are controlled.
2. Where not otherwise required to be under a Regional Water Quality Control Board (RWQCB) permit, all non-stormwater discharges are identified and either eliminated, controlled, or treated.
3. Site best management practices (BMPs) are effective and result in the reduction or elimination of pollutants in stormwater discharges and authorized non-stormwater discharges from construction activity to the best available technology/best conventional technology (BAT/BCT) standard.
4. Calculations and design details as well as BMP controls for site run-on are complete and correct.
5. Stabilization BMPs installed to reduce or eliminate pollutants after construction are completed.

The SWPPP will be available at the construction site during working hours while construction is occurring and shall be made available upon request by a State or Municipal inspector. When the original SWPPP is retained by a crewmember in a construction vehicle and is not currently at the construction site, current copies of the BMPs and map/drawing will be left with the field crew, and the original SWPPP shall be made available via a request by radio/telephone.

## 2.2 SWPPP Amendments

This SWPPP shall be amended:

- Whenever there is a change in construction or operations which may affect the discharge of pollutants to surface waters, groundwater(s), or a municipal separate storm sewer system (MS4); or
- If any condition of the General Permit is violated or the general objective of reducing or eliminating pollutants in stormwater discharges has not been achieved. If the RWQCB determines that a General Permit violation has occurred, the SWPPP shall be amended and implemented within 14 calendar days after notification by the RWQCB;
- Annually, prior to the defined rainy season; and
- When deemed necessary by the LRP.

The following items will be included in each amendment:

- Name of person who requested the amendment
- Location of proposed change
- Reason for the change
- Original BMP proposed, if any
- New BMP proposed

The amendments for this SWPPP, along with the Preparer's and LRP's Certifications, can be found in the following pages and Amendment Log.

**SWPPP Amendment No.**

Project Name: Almond 2 Power Plant Project

Project Number: _____

**Amendment Certification by Preparer**

"I certify under a penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to ensure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system or those persons directly responsible for gathering the information, to the best of my knowledge and belief, the information submitted is true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."

| _____ | _____ |
|---|---|
| Preparer's Signature | Date |
| _____ | _____ |
| Name and Title | Telephone Number |

**Amendment Certification by Legally Responsible Person**

"I certify under a penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to ensure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system or those persons directly responsible for gathering the information, to the best of my knowledge and belief, the information submitted is true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."

| _____ | _____ |
|---|---|
| Owner (or Authorized Representative) Signature | Date |
| _____ | _____ |
| Name and Title | Telephone Number |

# 2.3 Amendment Log

Project Name: Almond 2 Power Plant Project

Project Number:

## 2.3.1 Example:

| Amendment No. | Date | Brief Description of Amendment | Prepared By |
|---|---|---|---|
| 001 | Dec 10, 2000 | Grading schedule changed to begin on Feb 10, 2001, and will include additional 2 acres. Amended plans attached to SWPPP. | John Doe, Superintendent |

| Amendment No. | Date | Brief Description of Amendment | Prepared By |
|---|---|---|---|
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SECTION 3

# Project Description

Turlock Irrigation District (TID) proposes to construct, own, and operate an electrical generating plant in Ceres, Stanislaus County, California. The Almond 2 Power Plant (A2PP) would be a nominal 174-megawatt (MW) facility consisting of three General Electric (GE) Energy LM6000PG SPRINT natural gas-fired turbine generators and associated equipment. The A2PP is to be located on an approximately 4.6-acre parcel adjacent to and north of the existing 48-MW TID Almond Power Plant. The project address is 4500 Crows Landing Road, Modesto, California. Although the site address identifies the site in Modesto, the project site is located within the city limits of Ceres and is approximately 2 miles from the Ceres city center. Modesto is approximately 5 miles to the north. The approximately 1.85-acre construction laydown and parking area will be adjacent to the northern border of the project site on property owned by WinCo Foods (WinCo). The project location is shown in Figure 1 (all figures are included in Attachment A).

The A2PP project will include a natural gas supply, which is still being finalized by PG&E. The gas line route will be available in November 2009. Additionally, the A2PP will be interconnected to the TID transmission system via two 115-kV transmission lines (Corridor 1, approximately 0.9 mile long, and Corridor 2, approximately 1.2 miles long), which will extend south to the proposed Grayson Substation.[1] The project will also require that TID re-rate 2.9 miles of an existing 69-kilovolt (kV) sub-transmission line from the Almond Power Plant to the TID Crows Landing Substation that currently serves parts of the cities of Ceres and Modesto as well as surrounding rural areas.

Figure 2 is an artistic rendering of the project. The main project features include the following components:

- A nominal 174-MW, natural gas-fired, simple-cycle plant, which will consist of three 58-MW GE LM6000PG turbines with SPRINT (spray intercooling) natural gas-fired combustion turbine; and associated support equipment
- A new 115- kV switchyard
- Two 115-kV transmission line corridors; Corridor 1 is approximately 0.9 mile long, and Corridor 2 is approximately 1.2 miles long
- The re-rating of approximately 2.9 miles of an existing 69-kV sub-transmission line to enhance system reliability
- A new natural gas supply that will connect to PG&E gas line #215

[1] The proposed Grayson Substation is a component of the TID Hughson-Grayson 115-kV Transmission Line and Substation Project. In addition to the substation, the Hughson-Grayson project consists of an approximately 10-mile-long, 115-kV transmission line; a 0.5-mile-long, 69-kV transmission line from the existing TID Almond Power Plant; and a second 69-kV transmission line that extends 0.8 mile east from the proposed substation. An environmental impact report for the Hughson-Grayson project (State Clearinghouse Number 2009012075) is currently being prepared. The Notice of Preparation was issued on January 26, 2009, and reissued February 10, 2009. The Draft Environmental Impact Report was issued in August 2009.

- Onsite interconnection to the existing water treatment and discharge systems for the Almond Power Plant. Reclaimed water for these systems is provided by and discharged to the City of Ceres Wastewater Treatment Plant.

Because the existing Almond Power Plant and the A2PP will be adjacent to each other and both will be owned and operated by TID, some existing facilities will be shared between the two plants without modification, while the maintenance shop / warehouse building will require minor modification to allow for the A2PP (see Figure 3 for the general arrangement). Facilities of the existing Almond Power Plant that are not shared between the two sites are not part of the A2PP project and, therefore, have not been considered further.

A new stormwater retention pond will be constructed to accommodate the stormwater runoff from both the A2PP and the existing Almond Power Plant.

# 3.1 Unique Site Features

## 3.1.1 Watercourses

The project site is approximately 3 miles south of the Tuolumne River and approximately 8 miles east of the San Joaquin River. Proximity of watercourses, swales, storm drains, and ditches is shown in Figure 4; pre-construction project site topography and drainage are shown in Figure 5. The nearby watercourses including swales, storm drains, and drainage ditches will be identified in greater detail at a later time in the project construction drawings.

## 3.1.2 Other Critical Areas

The A2PP project site is within a developed area surrounded by highly managed lands (agricultural fields) and would have minimal impacts to natural habitats and communities. Given the existing development and ongoing construction in the area, the potential for special-status species to occur on site is considered relatively low; however, some species are more tolerant to human disturbance and others may incidentally occur in the area as a result of suitable habitat in adjacent areas. Special-status species that are considered to have some potential to occur in the A2PP project area include: big tarplant (*Blepharizonia plumosa*), conservancy fairy shrimp (*Branchinecta conservatio*), longhorn fairy shrimp (*B. longiantenna*), vernal pool fairy shrimp (*B. lynchi*), vernal pool tadpole shrimp (*Lepidurus packardi*), western pond turtle, giant garter snake, cackling Canada goose (*Branta hutchinsii leucopareia*), western burrowing owl *(Athene cunicularia*), Swainson's hawk (*Buteo swainsoni*), tricolored blackbird (*Agelaius tricolor*), and San Joaquin kit fox (*Vulpes macrotis mutica*).

No threatened or endangered plants or wildlife were observed in the agricultural fields or developed and disturbed lands within or adjacent to the project area during the field surveys conducted on January 15 and March 10, 2009. Nevertheless, preconstruction field surveys (conducted under California Department of Fish and Game [CDFG] guidelines) to locate active nests or other signs for the presence of Swainson's hawks, burrowing owls, vernal pool crustaceans, San Joaquin kit fox, and migratory birds will be conducted. If active nest sites or other signs are found, protection measures will be implemented in cooperation with CDFG and U.S. Fish and Wildlife Service to avoid impacts.

The area surrounding the project site is dominated by industrial development and, although the area most likely does not support habitat for any special-status plant species, additional botanical surveys will be conducted during the spring 2010 blooming period to verify these results. No natural wetland or other aquatic sites were observed in the A2PP project site, laydown and parking area, or the transmission line corridors[2].

## 3.2 Construction Site Estimates

### 3.2.1 Precipitation

Average annual rainfall is about 12 inches in the City of Modesto, just north of the project site. Most of the precipitation occurs between November and April, while the summer months are virtually rainless. Table 1 provides average historical rainfall from the meteorological station in Modesto. Additional preliminary hydrology calculations are located in Attachment B.

**TABLE 1**
*Average Rainfall near the Project Site*
*Modesto, California (1906-2007)*

| Precipitation | Annual | Oct | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Average | 12.26 | 0.62 | 1.25 | 2.07 | 2.45 | 2.07 | 1.96 | 1.03 | 0.46 | 0.12 | 0.03 | 0.04 | 0.18 |

Source: WRCC, 2009.

### 3.2.2 Drainage

Figure 4 shows the location of nearby drainages and watercourses in relation to A2PP. A preliminary drainage plan is presented in Figure 6. Site drainage and drainage area boundaries will be further defined in the final design phase of the project and its features will be incorporated into the SWPPP. Preliminary hydrology calculations are provided in Attachment B.

The A2PP project area is within the Middle San Joaquin-Lower Merced-Lower Stanislaus Hydrologic Unit (Hydrologic Unit Code 18040002), which encompasses approximately 433,300 acres. Major waterways include the Middle San Joaquin, Lower Tuolumne, Lower Merced, Mokelumne, Old, and Middle rivers, as well as Bear Creek. Drainage is generally to the west from the Sierra Nevada Foothills and then to the north into the Sacramento-San Joaquin Delta.

Currently no active stormwater management system exists on portions of the A2PP site; drainage is via percolation or sheetflow. Stormwater at the existing Almond Power Plant drains to an onsite retention pond. As the existing onsite retention pond will be filled to allow for construction of the A2PP, a new retention pond will be constructed on the northern end of the property to be used by both the A2PP and the existing Almond Power Plant for stormwater.

[2] Observations adjacent to the natural gas line will be provided in the final SWPPP.

The stormwater system for the A2PP will include a series of inlets and storm drain pipes that would convey the project area's runoff to an onsite stormwater retention pond on the north end of the site (Figure 6). The retention pond will be sized at 2.41 acre-feet capacity to accommodate the 100-year peak runoff with 2.65 feet of freeboard (refer to Attachment B).

The following are estimates at the construction site:

- Construction site area — Acres
- Percentage impervious area before construction — %
- Runoff coefficient before construction
- Percentage impervious area after construction — %
- Runoff coefficient after construction
- Anticipated stormwater flow onto the construction site: 10-year, 6-hour — cfs<br>ac-ft
- Anticipated stormwater flow off the construction site: 10-year, 6-hour — cfs<br>ac-ft

# 3.3 Project Schedule/Water Pollution Control Schedule

## 3.3.1 A2PP Project Site

Construction of the generating facility, from site preparation and grading to commercial operation, is expected to take 12 months, from the third quarter of 2010 to the third quarter of 2011. Major milestones are listed in Table 2. (Table 2 will be updated once this information becomes available).

It is assumed that 100 percent of the A2PP project site will be exposed during grading, and that approximately 10 percent of the site will be bare soil at any given time during construction. It is anticipated that grading the site will take 2 months and construction will take 12 months.

## 3.3.2 Construction Laydown and Parking Area

Grading for the laydown and parking area will take one month, and the area will be covered (gravelled or paved) immediately thereafter to allow for wet season use. Once construction is complete, the gravel will either be removed from the site or it will be incorporated into site paving.

## 3.3.3 Linear Areas

The natural gas pipeline will be installed within a 4-ft-wide trench within a construction corridor along existing roadways over a period of 6 months.

The overhead transmission lines will have poles outside of the project footprint. Each pole will have a 4-ft-by-4-ft footprint. Installation of the transmission line poles would be completed within 4 months.

**TABLE 2**
A2PP Project Schedule Major Milestones

| Activity | Date |
|---|---|
| Begin Construction | Third Quarter 2010 |
| Startup and Test | Third Quarter 2011 |
| Commercial Operation | Fourth Quarter 2011 |
| | |
| Mobilization. | Third Quarter 2010 |
| Delineate and mark the boundaries of the construction zone. | |
| Stabilize construction entrance/exit and roadway (BMP TR-1 and BMP TR-2); tire wash in accordance with BMP TR-3. | |
| Establish parking and staging areas for vehicle and equipment storage, maintenance, and fueling in accordance with BMPs NS-8, NS-9, and NS-10. | |
| Establish laydown area(s) for materials storage/staging in accordance with BMPs WM-1 through WM-6. | |
| Establish concrete washout area in accordance with BMPs WM-8, NS-12, and NS-13. | |
| Clear & Grub - Strip topsoil. | |
| …to be completed… | |
| **All Phases** | |
| Inspect and maintain BMPs. | All Phases Continuously |
| Store additional soil stabilization and sediment control products onsite. | All Phases Continuously |

After final site design and prior to any soil disturbance, TID will prepare the Final SWPPP. The Final SWPPP will include the location of BMPs to be used, installation instructions, and maintenance schedules for each BMP.

## 3.4 Clearing and Grading Narrative

The information provided in this section is preliminary and will be updated and expanded once the clearing and grading plans are completed and prior to the start of construction. A detailed site delineation that includes the boundary lines of all areas subject to disturbance and the location of existing and project structures, pipelines, roads, and drainage facilities will be provided in the final SWPPP. The plans will provide contours and cross sections, elevations, slopes, locations, and the extent of all project grading.

Site grading design will comply with applicable land development regulations. Graded areas will be smooth, compacted, free from irregular surface changes, and sloped to drain to onsite drainage features and to the stormwater retention pond when constructed.

Because conditions that could lead to excessive soil erosion are not present at the A2PP project site (e.g., no long, steep slopes or erodible soils), little soil erosion is expected during the construction period.

The project site will require earthwork to construct the A2PP and associated facilities. Soil-disturbing activities will include clear and grub operations, grading operations, and excavation and fill operations. For all areas where earthwork will be executed, materials suitable for compaction will be stockpiled in designated onsite locations. Materials not suitable for compaction will be stored in separate stockpiles for reuse onsite or disposed of at a licensed facility. If needed, only licensed, commercial fill will be used onsite. Any contaminated materials encountered during excavation will be disposed of in accordance with applicable laws, ordinances, regulations, and standards.

Construction equipment anticipated to be used onsite includes scrapers, graders, vibrating rollers, front loaders, dump trunks, trenching machines, concrete mixers, water trucks, and fuel trucks (list is not all inclusive).

Table 3 outlines the amount of cut and fill planned for specific components of the project (Table 3 will be updated once this information becomes available).

**TABLE 3**
Clearing and Grading

| Description | Stockpile ($yd^3$) | Total Cut ($yd^3$) | Total Fill ($yd^3$) |
|---|---|---|---|
| To be determined. | | | |
| Total | | | |

$yd^3$ = cubic yards

## 3.5 Contact Information/List of Responsible Parties

Table 4 lists the individuals responsible for stormwater pollution prevention.

**TABLE 4**
List of Responsible Individuals

| Name/Company | Responsibility | Phone Number | Address |
|---|---|---|---|
| TBD | Project Manager | | |
| TBD | Qualified SWPPP Developer | | |
| TBD | Qualified SWPPP Practitioner | | |

The Qualified SWPPP Practitioner (QSP) shall have primary responsibility and significant authority for the implementation, maintenance, and inspection of the BMPs detailed in the SWPPP. Duties of the QSP include but are not limited to:

- Ensuring full compliance with the SWPPP and the General Permit
- Implementing all elements of the SWPPP, including but not limited to:
  - Implementation of prompt and effective erosion and sediment control measures
  - Implementing all non-stormwater management and materials and waste management activities such as: monitoring discharges (dewatering, diversion devices); general site clean-up; vehicle and equipment cleaning, fueling, and maintenance; spill control; ensuring that no materials other than stormwater are discharged in quantities that will have an adverse effect on receiving waters or storm drain systems; etc.
- Pre-storm inspections
- Storm event inspections
- Post-storm inspections
- Routine inspections as specified in the project's specifications or as described in the SWPPP
- Ensuring elimination of all unauthorized discharges
- The QSP shall be assigned authority by TID or their designated Contractor to mobilize crews to make immediate repairs to the control measures
- Coordinate with TID or their designated representative to assure all necessary corrections/repairs are made immediately and to assure that the project complies with the SWPPP, the General Permit, and approved plans at all times.

SECTION 4

# References

The following documents are made a part of this SWPPP by reference:

- State Water Resources Control Board Order No. 99-08-DWQ, National Pollutant Discharge Elimination System General Permit No. CAS000002, Waste Discharge Requirements for Discharges of Stormwater Runoff Associated with Construction Activity
- State Water Resources Control Board Order No. 2009-0009-DWQ National Pollutant Discharge Elimination System General Permit No. CAS000002 Waste Discharge Requirements for Discharges of Stormwater Runoff Associated with Construction and Land Disturbance Activities
- California Stormwater BMP Handbook – Construction, January 2003

SECTION 5

# Body of SWPPP

This SWPPP conforms to the required elements of the State Water Resources Control Board Order No. 2009-0009-DWQ National Pollutant Discharge Elimination System General Permit No. CAS000002 Waste Discharge Requirements for Discharges of Stormwater Runoff Associated with Construction and Land Disturbance Activities.

## 5.1 Vicinity Map

The project address is 4500 Crows Landing Road, Modesto, California (Assessor's Parcel Number is 041-006-039), a 4.6-acre parcel adjacent to and north of the existing 48-MW TID Almond Power Plant. Surrounding land uses include a WinCo distribution warehouse to the west, a farm supply facility to the north, and various industrial facilities (modular building distributor and drilling equipment storage laydown area) to the east. The project site was previously used by WinCo as a borrow pit during construction of the WinCo distribution warehouse before being filled and graded to the current site elevation. Construction access will be from Crows Landing Road.

Project vicinity maps are shown in Figures 7A through 7D with project features identified. These features include the power plant site, natural gas pipeline routes, electrical transmission lines, and the construction laydown and parking areas.

Figures 8A, 8B, and 8C show general grading and drainage plans. Figures 3 and 7A through 7D show the project features and associated areas subject to soil disturbance. Boundary lines of all construction areas, including the construction laydown and parking areas and linear facilities, will be further defined in the final design phase of the project; the SWPPP will be updated accordingly.

## 5.2 Existing Data Describing the Soil

In general, surface soils at the project site consist of loose silty to relatively clean sands that extend to depths of approximately 4 to 9-1/2 feet below ground surface (bgs). At these depths, alternating layers and mixtures of very stiff to hard sandy silts and partially cemented medium dense to very dense silty and relatively clean sands are encountered to at least 51-1/2 feet bgs. Free groundwater is encountered at approximately 22 feet bgs. Soil map unit characteristics for the area potentially affected by project construction are summarized in Table 5.[3]

[3] Natural gas line details will be provided once the final route has been selected. Table 4 will be updated in a future DESCP update.

**TABLE 5**
Soil Mapping Unit Descriptions and Characteristics

| Map Unit | Description |
|---|---|
| **DrA** | **Dinuba sandy loam, 0 to 1 percent slopes** |
| | Portions of the project transmission lines cross this soil unit. |
| | Parent material: Developed from moderately coarse textured dominantly granitic alluvium |
| | Typical profile: Sandy loam over stratified silts and very fine sands |
| | Shrink-swell capacity: Low |
| | Depth and drainage: Very deep; naturally moderately well drained but due to pumping may be better drained or, where over-irrigated, imperfectly drained |
| | Permeability: Moderate to moderately rapid in A horizon and less permeable below |
| | Runoff: Medium |
| | Farmland class: Prime farmland if irrigated |
| | Storie index: 82 (Grade 1), Excellent |
| | Capability class: 2w irrigated, 4s nonirrigated |
| | Taxonomic class: Coarse-loamy, mixed, active, thermic Typic Haploxeralfs |
| **HdA** | **Hanford sandy loam, 0 to 3 percent slopes:** |
| | A portion of the A2PP project site and portions of the transmission lines fall within this soil unit. |
| | Parent material: Formed in moderately coarse textured alluvium dominantly from granite |
| | Typical profile: Fine sandy loam throughout |
| | Shrink-swell capacity: Low |
| | Depth and drainage: Very deep; well drained |
| | Permeability: Moderately rapid |
| | Runoff: Negligible to low |
| | Farmland class: Prime farmland if irrigated |
| | Storie index: 92 (Grade 1), Excellent |
| | Capability class: 4c |
| | Taxonomic class: Coarse-loamy, mixed, superactive, nonacid, thermic Typic Xerorthents |
| **HdpA** | **Hanford sandy loam, moderately deep over silt, 0 to 1 percent slopes:** |
| | A portion of the A2PP project site and portions of the transmission lines fall within this soil unit. |
| | Parent material: Formed in alluvium derived from igneous rock |
| | Typical profile: Sandy loam over silt loam |
| | Shrink-swell capacity: Low |
| | Depth and drainage: Very deep; well drained |
| | Permeability: Moderately rapid |
| | Runoff: Negligible to low |
| | Farmland class: Prime farmland if irrigated |
| | Storie index: 93 (Grade 1), Excellent |
| | Capability class: 2s irrigated, 4s nonirrigated |
| | Taxonomic class: Coarse-loamy, mixed, superactive, nonacid, thermic Typic Xerorthents |
| **HdsA** | **Hanford sandy loam, deep over silt, 0 to 1 percent slopes** |
| | A portion of the project re-rated 69-kV sub-transmission route crosses this soil unit. |
| | Parent material: Formed in alluvium derived from igneous rock |
| | Typical profile: Sandy loam over silt loam |
| | Shrink-swell capacity: Low |
| | Depth and drainage: Very deep; well drained |
| | Permeability: Moderately rapid |
| | Runoff: Negligible to low |
| | Farmland class: Prime farmland if irrigated |
| | Storie index: 93 (Grade 1), Excellent |
| | Capability class: 1 irrigated, 4c nonirrigated |
| | Taxonomic class: Coarse-loamy, mixed, superactive, nonacid, thermic Typic Xerorthents |

**TABLE 5**
Soil Mapping Unit Descriptions and Characteristics

| Map Unit | Description | |
|---|---|---|
| **TuA** | **Tujunga loamy sand, 0 to 3 percent slopes:** | |
| | A portion of the re-rated transmission line cross this soil unit. | |
| | Parent material: | Formed in alluvium weathered mostly from granitic sources |
| | Typical profile: | Loamy sand throughout |
| | Shrink-swell capacity: | Low |
| | Depth and drainage: | Very deep; somewhat excessively drained |
| | Permeability: | Rapid |
| | Runoff: | Negligible or very low runoff |
| | Farmland class: | Prime farmland if irrigated |
| | Storie index: | 62 (Grade 2), Good |
| | Capability class: | 3e irrigated, 6e nonirrigated |
| | Taxonomic class: | Mixed, thermic, Typic Xeropsamments |

Notes:

Soil characteristics are based on soil mapping descriptions provided in the online soil survey (USDA-NRCS, 2008), in the published soil survey (NRCS, 1964), and in the online Official Series Descriptions (http://www2.ftw.nrcs.usda.gov/osd/dat) (Soil Survey Staff, 2008).

Soil descriptions provided above are limited to those soil units that could be directly affected by the A2PP project. Other soil mapping units, which are well outside of the project area but are shown on Figures 5.11-1A, B, C, and D, are listed below:

Within the "Soil Survey of Eastern Stanislaus Area": **CeA** - Columbia loam, 0 to 1 percent slopes, **CsB** - Columbia soils, channeled, 0 to 8 percent slopes, **DtA** - Dinuba sandy loam, deep, 0 to 1 percent slopes; **DuA** - Dinuba sandy loam, poorly drained variant, 0 to 1 percent slopes; **DzA** - Dinuba sandy loam, very poorly drained variant, slightly saline-alkali, 0 to 1 percent slopes; **FrA** - Fresno fine sandy loam, moderately saline-alkali, 0 to 1 percent slopes; **HbA -** Hanford fine sandy loam, 0 to 3 percent slopes; **HdB** - Hanford sandy loam, 3 to 8 percent slopes; **HddA** - Handford sandy loam, poorly drained variant, 0 to 1 percent slopes; and **WeA** - Waukena sandy loam, moderately saline-alkali, 0 to 1 percent slopes. Within the "Stanislaus County, Western Part" soil survey: **153** - Columbia fine sandy loam, channeled, partially drained, 0 to 2 percent slopes, frequently flooded; **159 -** Columbia complex, 0 to 2 percent slopes, frequently flooded; and **W** - Water.

As indicated in Table 5, the soil mapping units in the project area are generally sandy loams or loamy sands formed in alluvial deposits. These soils are very deep and well drained with moderately rapid permeability. Due to the developed, industrial nature of the project area and vicinity, it is possible that soil conditions could vary significantly from those shown in the NRCS soil survey. Industrial development often entails significant mixing of local soils from grading and the import of construction fill soils beneath foundations and roadways. These imported soils would have to be suitable for engineered structures and roadways and would be expected to consist of well-graded materials containing a mix of particle sizes (ranging from silt to gravel and not anticipated to be smaller than 0.02 millimeters in size).

Soils in the adjoining areas are not expected to be contaminated (i.e., past spills or leaks, non-stormwater discharges). No existing site features have, as a result of past usage, contributed pollutants to stormwater (e.g., toxic materials that have been treated, stored, disposed of, spilled, or leaked onto the construction site).

## 5.3 Soil Loss Estimates

Construction impacts on soil resources can include increased soil erosion and soil compaction. Because conditions that could lead to excessive soil erosion are not present at the A2PP project site (e.g., no long, steep slopes or erodible soils), little soil erosion is expected during the construction period. While the potential for soil erosion on the A2PP project site is expected to be nominal, quantitative estimates of erosion by water and wind are provided.

An estimate of soil loss during construction by water erosion was developed using the Revised Universal Soil Loss Equation (RUSLE2) and is summarized in Table 6.[4] Detailed calculations for the soil loss estimates, including assumptions and conditions, are found in Attachment C.

**TABLE 6**
Construction Soil Loss Estimates Using the Revised Universal Soil Loss Equation[a]

| Feature (acreage)[b] | Activity | Duration (months) | Soil Loss (tons) without BMPs | Soil Loss (tons) with BMPs | Soil Loss (tons/yr) No Project |
|---|---|---|---|---|---|
| Project Site (4.60 acres) | Grading | 2 | 0.84 | 0.0010 | 0.0078 |
| | Construction | 12 | 0.22 | 0.0061 | — |
| Laydown and Parking Area (1.85 acres) | Grading | 1 | 0.28 | 0.0017 | 0.0043 |
| (0.925 acres exposed; 0.925 paved or graveled) | Construction | 12 | 0.74 | 0.020 | — |
| **Transmission Lines** | | | | | |
| Corridor 1 (1.56 acres for construction; 0.0066 acre for pole footprints) | Grading | 2 | 0.0016 | 0.0045 | 0.0000 |
| | Construction | 4 | 0.33 | 0.0090 | — |
| Corridor 2 (2.16 acres for construction; 0.0092 acre for pole footprints) | Grading | 2 | 0.0023 | 0.0065 | 0.0000 |
| | Construction | 4 | 0.47 | 0.013 | — |
| Re-rated 69-kV sub-transmission line (0.00 acre for construction; 0.00 acre for pole footprints - Re-rating only) | Grading | 0 | 0.0000 | 0.0000 | 0.0000 |
| | Construction | 0 | 0.0000 | 0.0000 | — |
| **Natural Gas Pipeline[c]** | | | | | |

[a]Soil losses (tons/acre/year) are estimated using RUSLE2 software available online at: http://fargo.nserl.purdue.edu/rusle2_dataweb/ (verified January 23, 2009).

[b]Acreages assume 30-foot corridors for the transmission lines. Transmission line pole holes are assumed to have a 4-foot-by-4-foot excavation footprint.

[c]Gas line construction estimates to be provided in final SWPPP.

[4] Natural gas line details will be provided once the final route has been selected.

With the implementation of appropriate BMPs, the total project soil loss is estimated to be 1.53 tons. This is considered to be a minimal amount.

The potential for wind erosion of surface soil was estimated by calculating the total suspended particulates (TSP) that could be emitted as a result of grading and the wind erosion of exposed soil; refer to Attachment C for detailed calculations for the soil loss estimates, including assumptions and conditions.

Table 7[5] summarizes the mitigated TSP predicted to be emitted from the site from grading and the wind erosion of exposed soil.

**TABLE 7**
Soil Loss (TSP) from Grading and Wind Erosion

| Emission Source | Acreage | Duration (months) | Unmitigated TSP (tons) | Mitigated TSP (tons) |
|---|---|---|---|---|
| **Grading Dust** | | | | |
| Project Site | 4.60 | 2 | 0.158 | 0.055 |
| Laydown and Parking Area | 1.85 | 1 | 0.032 | 0.011 |
| Transmission Line Pole Holes | | | | |
| Corridor 1 | 0.007 | 2 | 0.0002 | 0.0001 |
| Corridor 2 | 0.009 | 2 | 0.0003 | 0.0001 |
| Re-rated 69-kV sub-transmission line | 0.000 | 2 | 0.0000 | 0.0000 |
| Transmission Line Total | 0.016 | | 0.0005 | 0.0002 |
| **Wind Blown Dust** | | | | |
| Project Site | 4.60 | 10 | 0.146 | 0.051 |
| Laydown and Parking Area | 0.00 | 11 | 0.000 | 0.000 |
| Transmission Line Corridor | | | | |
| Corridor 1 | 1.557 | 4 | 0.197 | 0.069 |
| Corridor 2 | 2.164 | 4 | 0.274 | 0.096 |
| Re-rated 69-kV sub-transmission line | 0.000 | 4 | 0.000 | 0.000 |
| Transmission Line Total | 3.721 | 4 | 0.471 | 0.165 |
| **Estimated Total** | | | **0.81** | **0.28** |

Note:

Gas line construction estimates to be provided in final SWPPP.

[5] Natural gas line details will be provided once the final route has been selected.

With implementing basic BMPs, the maximum predicted erosion of material from the site is estimated at 3.36 tons over the course of the project construction cycle.

## 5.4 Assessment of Overall Risk Level

The General Permit requires assessment of a site's risk level based on both sediment transport and receiving water risk during periods of soil exposure.

### 5.4.1 Sediment Risk

Sediment Risk was manually calculated using the RUSLE2 equation (refer to Attachment D for the Risk Determination Worksheet) with the following values:

R = 15
K = 0.43
LS = 100 feet – 1.5%= 0.22
C = 1.0
P = 1.0

The rate of sheet and rill erosion is 1.42 tons/acre, which is considered **low** sediment risk.

### 5.4.2 Receiving Water Risk

Water quality objectives and beneficial uses for the Tuolumne River are contained in the Water Quality Control Plan for the Sacramento River and San Joaquin River Basins (Basin Plan; RWQCB, 1998). The lower Tuolumne River between Don Pedro Reservoir and the San Joaquin River is considered an impaired water body. Table 8 lists the pollutants for which the Tuolumne River does not meet water quality objectives and proposed TMDL completion dates.

**TABLE 8**
Clean Water Act Section 303(d) List of Water Quality Impairments
*Lower Tuolumne River (Don Pedro Reservoir to San Joaquin River)*

| Pollutant/Stressor | Potential Sources | Proposed TMDL Completion |
|---|---|---|
| Diazinon | Agriculture | 2008* |
| Group A Pesticides | Agriculture | 2011 |
| Unknown Toxicity | Unknown | 2019 |

*In progress

The Tuolumne River is not listed as impaired by sediment, nor does it have an applicable U.S. Environmental Protection Agency- (EPA-) approved TMDL implementation plan for sediment. However, the Tuolumne River does have the designated beneficial uses of SPAWN & COLD & MIGRATORY, which is considered a **high** receiving water risk for discharge off the project site.

### 5.4.3 Combined Risk Level

Project Sediment Risk: Low
Project Receiving Water Risk: High
Project Combined Risk: Level 2

## 5.5 Pollutant Source Identification and BMP Selection

### 5.5.1 Inventory of Materials and Activities that May Pollute Stormwater

The following is a list of construction materials that will be used and/or expected to be used and the end products that are produced and/or expected to be produced during the project[6] and activities that will be performed that will potentially contribute pollutants, other than sediment, to stormwater runoff (control practices for each activity are identified in the Water Pollution Control Drawings (WPCDs) and/or in Section 5.6):

- Vehicle fluids, including oil, grease, petroleum, and coolants
- Asphaltic emulsions associated with asphalt-concrete paving operations
- Cement materials associated with Portland cement concrete (PCC)
- Base and subbase material
- Joint and curing compounds
- Concrete curing compounds
- Paints
- Solvents, thinners, acids
- BMP materials
- Treated lumber (materials and waste)
- PCC rubble
- General litter

Construction activities that have the potential to contribute sediment to stormwater discharges include:

- Clear and grub operations
- Grading operations
- Paving operations
- Boring operations
- Delivery/transportation operations
- Utility excavation operations
- Foundation/structure construction operations
- Vehicle and equipment cleaning, fueling, and maintenance
- Painting

Attachment E lists BMPs that have been selected for implementation in this project. Implementation and location of BMPs are shown on the WPCDs in Attachment A. Narrative descriptions of BMPs to be used during the project are listed by category in each of the following SWPPP sections. Attachment F includes a list and/or copies of the fact sheets of

[6] This does not include materials and equipment that are designed to be outdoors and exposed to environmental conditions (i.e., poles, equipment pads, cabinets, conductors, insulators, bricks, etc.).

all the BMPs selected for this project. Attachments E and F will be updated by TID or their designated contractor and will be included in the Final SWPPP.

### 5.5.2 Existing (Pre-construction) Control Measures

None.

## 5.6 Best Management Practices

Stormwater discharges and authorized non-stormwater discharges regulated by this General Permit shall not contain a hazardous substance equal to or in excess of reportable quantities established in 40 C.F.R. §§ 117.3 and 302.4, unless a separate NPDES Permit has been issued to regulate those discharges.

The dischargers minimize or prevent pollutants in stormwater discharges and authorize non-stormwater discharges through the use of controls, structures, and management practices that achieve BAT for toxic and non-conventional pollutants and BCT for conventional pollutants.

The location of BMPs to be implemented during construction will be indentified on a topographic site map and provided in a future SWPPP update.

Run-on from offsite shall be directed away from all disturbed areas or shall collectively be in compliance with the effluent limitations in the General Permit.

### 5.6.1 Erosion Control

Erosion control, also referred to as soil stabilization, is a source control measure designed to prevent soil particles from detaching and becoming transported in stormwater runoff. Erosion control BMPs protect the soil surface by covering or binding soil particles. The project will incorporate erosion control measures required by regulatory agency permits, contract documents, and other measures selected by TID or their designated contractor.

BMPs will be implemented to follow the progress of grading and construction. As the locations of soil disturbances change, erosion and sedimentation controls will be adjusted accordingly to control stormwater runoff at the downgrade perimeter. BMPs will be in place throughout the entire construction period.

Non-active areas and all finished slopes, open space, utility backfill, and completed lots, will be stabilized with effective soil cover as soon as feasible after construction is complete and no later than 14 days after construction in that portion of the site has temporarily or permanently ceased.

The use of plastic materials will be limited when more sustainable, environmentally friendly alternatives exist. Where plastic materials are deemed necessary, they will be resistant to solar degradation.

Sufficient erosion control materials will be maintained onsite to allow implementation in conformance with Permit requirements and as described in this SWPPP. This includes implementation requirements for active areas and non-active areas that require deployment before the onset of rain.

Maintenance of BMPs will be according to measures outlined in the applicable California Storm Water Quality Association (CASQA) Handbook BMP factsheets.

Site-specific BMPs will be designed by TID or their designated Contractor, and associated figures are to be included in Attachment A. Attachment E is to be updated by TID or their designated Contractor and lists the BMPs selected for this project. Attachment F contains BMP fact sheets with applicable detailed descriptions of suitability, implementation, and inspection and maintenance measures. The following general erosion control measures may be used during various phases of the project:

- Proper scheduling and sequencing of activities (EC-1)
- Preservation of existing vegetation (EC-2)
- Hydraulic mulch (EC-3)
- Hydroseeding (EC-4)
- Soil binders (EC-5)
- Straw mulch (EC-6)
- Placement of geotextiles, plastic covers, and erosion control blankets/mats (EC-7)
- Wood mulching (EC-8)
- Earth dikes and drainage swales (EC-9)
- Velocity dissipation devices (EC-10)

### 5.6.2 Sediment Control

Sediment controls are intended to complement and enhance the selected erosion control measures and to reduce sediment discharges from active construction areas. Sediment controls are designed to intercept and settle out soil particles that have been detached and transported by the force of water. The project will incorporate sediment control measures required by regulatory agency permits, contract documents, and other measures selected by TID or their designated Contractor.

Effective sediment perimeter controls will be established and maintained. Linear sediment controls will be used along the toe and face of the slope and at the grade breaks of exposed slopes to comply with sheet flow lengths[7] in accordance with Table 9. Sediment basins, if applicable at the site, will at a minimum be designed according to the method provided in CASQA's Construction BMP Guidance Handbook. All storm drain inlets and perimeter controls, runoff control BMPs, and pollutant controls at entrances and exits (e.g., tire washoff locations) will be maintained and protected from activities that reduce their effectiveness.

**TABLE 9**
Critical Slope/Sheet Flow Length Combinations

| Slope Percentage | Slope Percentage Sheet Not to Exceed |
|---|---|
| 0 – 25% | 20 feet |
| 25 – 50% | 15 feet |
| Over 50% | 10 feet |

[7] Sheet flow length is the length that shallow, low velocity flow travels across a site.

BMPs will be deployed in a sequence to follow the progress of grading and construction. As the locations of soil disturbance change, sedimentation controls will be adjusted accordingly to control stormwater runoff at the downgrade perimeter.

Sufficient quantities of temporary sediment control materials will be maintained onsite throughout the duration of the project to allow implementation of temporary sediment controls in the event of predicted rain and for rapid response to failures or emergencies in conformance with other Permit requirements and as described in this SWPPP. This includes implementation requirements for active areas and non-active areas before the onset of rain.

Maintenance of BMPs will be according to measures outlined in the applicable CASQA Handbook BMP factsheets.

Site-specific BMPs will be designed by TID or their designated Contractor, and associated figures are to be included in Attachment A. Attachment E is to be updated by TID or their designated Contractor and lists the BMPs selected for this project. Attachment F contains BMP fact sheets with applicable detailed descriptions of suitability, implementation, and inspection and maintenance measures. The following general sediment control measures may be used during various phases of the project:

- Silt fences (SE-1)
- Sediment basin (SE-2)
- Sediment trap (SE-3)
- Check dams (SE-4)
- Fiber rolls (SE-5)
- Gravel bag berm (SE-6)
- Street sweeping and vacuuming (SE-7)
- Sandbag barrier (SE-8)
- Storm drain inlet protection (SE-10)

### 5.6.3 Tracking Control

All construction entrances and exits will be stabilized to sufficiently control erosion, sediment, and other loose construction material discharges from being tracked off the project site.

All immediate access roads will be inspected daily. At a minimum, any sediment or other construction activity-related materials that are deposited on the roads shall be removed (by vacuuming or sweeping) daily when necessary and before any rain event. Streets will be cleaned in such a manner as to prevent unauthorized non-stormwater discharges from reaching surface water or MS4 drainage systems.

Construction activity traffic to and from the project will be limited to entrances and exits that employ effective controls to prevent offsite tracking of sediment.

Site-specific BMPs will be designed by TID or their designated Contractor, and associated figures are to be included in Attachment A. Attachment E is to be updated by TID or their designated Contractor and lists the BMPs selected for this project. Attachment F contains BMP fact sheets with applicable detailed descriptions of suitability, implementation, and

inspection and maintenance measures. The following control methods will be considered for offsite vehicle tracking, as necessary:

- Stabilized construction entrance/exit (TC-1)
- Stabilized construction roadway (TC-2)
- Tire wash (TC-3)
- Street sweeping and vacuuming (SE-7)

### 5.6.4 Wind Erosion Control

During construction of the project and the related linear facilities, dust erosion control measures would be implemented to minimize the wind-blown loss of soil from the site.

Disturbed soil areas of the project site will be regularly watered to control dust and to maintain optimum moisture levels for compaction as needed, but the areas will not be excessively watered so as to generate runoff. Sediment controls may be used at the edges of these areas as necessary to minimize sediment discharge.

Site-specific BMPs will be designed by TID or their designated Contractor, and associated figures are to be included in Attachment A. Attachment E is to be updated by TID or their designated Contractor and lists the BMPs selected for this project. Attachment F contains BMP fact sheets with applicable detailed descriptions of suitability, implementation, and inspection and maintenance measures. The following control method will be considered for dust suppression, as necessary:

- Wind erosion control (WE-1)

### 5.6.5 Non-Stormwater Control

Hazardous materials such as vehicle fluids, including oil, grease, petroleum, coolants, paints, solvents, and curing compounds will be used during construction. The project will comply with good engineering practices, applicable laws, and regulations for the storage and use of these materials to minimize the potential for a release of hazardous materials. The project will conduct emergency response planning to address public health concerns regarding hazardous materials use and storage.

A dedicated fueling, maintenance, and vehicle storage area will be protected with berms and/or dikes to prevent runon and runoff and to contain spills. Self-propelled vehicles will be fueled offsite or at the temporary fueling area. Fuel trucks will be used for onsite fueling, whether at the temporary fueling area or for mobile fueling elsewhere on the site. Drip pans will be used for mobile fueling. Each fuel truck will be equipped with absorbent spill cleanup materials and a spill containment boom at all times. Drip pans or absorbent pads will be used for vehicle and equipment maintenance activities that involve grease, oil, solvents, or other vehicle fluids.

Vehicles will be washed in such a manner as to prevent non-stormwater discharges to surface waters or MS4 drainage systems. Vehicles and equipment will be inspected daily and before coming onsite for signs of leaks and will be on a regular maintenance schedule. Drip pans or absorbent materials will be placed under paving equipment when not in use; paving equipment will be parked over plastic to prevent soil contamination. If during dewatering activities any contamination is detected via odors or visible sheens, the collected

stormwater will be handled and properly disposed of in a manner consistent with federal, state, and local regulations.

Site-specific BMPs will be designed by TID or their designated Contractor, and associated figures are to be included in Attachment A. Attachment E is to be updated by TID or their designated Contractor and lists the BMPs selected for this project. Attachment F contains BMP fact sheets with applicable detailed descriptions of suitability, implementation, and inspection and maintenance measures. The following control methods will be considered for non-stormwater controls, as necessary:

- Water Conservation Practices (NS-1)
- Dewatering Operations (NS-2)
- Paving and Grinding Operations (NS-3)
- Illicit Connection/Illegal Discharge Detection and Reporting (NS-6)
- Potable Water/Irrigation (NS-7)
- Vehicle and Equipment Cleaning (NS-8)
- Vehicle and Equipment Refueling (NS-9)
- Vehicle and Equipment Maintenance (NS-10)
- Concrete Curing (NS-12)
- Concrete Finishing (NS-13)

### 5.6.6 Waste Management and Materials Pollution Control

Loose stockpiled construction materials that are not actively being used (i.e., soil, spoils, aggregate, fly-ash, stucco, hydrated lime, landscaping materials) will be covered and bermed. Stockpiled waste material will be contained and protected from wind and rain at all times unless actively being used.

Chemicals will be stored in watertight containers (with appropriate secondary containment to prevent any spillage or leakage) or in a storage shed (completely enclosed). Exposure of construction materials (not including materials designed to be outside such as equipment pads) to precipitation will be minimized. Rinse or wash waters or materials will be collected and disposed of offsite in accordance with applicable regulations. Waste disposal containers will be covered at the end of every business day and during a rain event. Drainage from the waste disposal containers, if any, will be captured and will not be allowed to enter the stormwater drainage system. Concrete washout areas and other washout areas that may contain additional pollutants will be provided with an impermeable containment so there is no discharge into the underlying soil and onto the surrounding areas.

No erodible landscape material will be applied within 2 days before a forecasted rain event or during periods of precipitation. Erodible landscape material will be applied at quantities and application rates according to manufacturer recommendations or based on written specifications by knowledgeable and experienced field personnel. Erodible landscape material will be stored on pallets and covering when not being used or applied.

All hazardous materials will be handled and stored in accordance with applicable codes and regulations. A Hazardous Materials Business Plan will be prepared if it is required by Title 19 California Code of Regulations and the Health and Safety Code (Section 25504). In accordance with these regulations, the Hazardous Materials Business Plan would include an

inventory and location map of hazardous materials onsite and an emergency response plan for hazardous materials incidents. Specific topics to be covered in the plan include:

- Facility identification
- Emergency contacts
- Chemical inventory information (for every hazardous material above threshold limits)
- Site map
- Emergency notification data
- Procedures to control actual or threatened releases
- Emergency response procedures
- Training procedures
- Certification

Cover and secondary containment will be provided for the storage of hazardous materials (i.e., oil drums, solvents, grease). Temporary containment facilities for hazardous materials will provide for a spill containment volume able to contain precipitation from a 25-year storm event, plus 10 percent of the aggregate volume of all containers or 100 percent of the capacity of the largest container within its boundary, whichever is greater. It will be impervious to the materials stored therein for a minimum contact time of 72 hours.

Spill cleanup materials, material safety data sheets (MSDSs), a material inventory, and emergency contact numbers will be maintained at the laydown area. Site personnel will be instructed on spill cleanup procedures, and TID or their designated Contractor's site manager will be responsible for implementing these practices.

Spill prevention and cleanup practices will be as follows:

- A2PP's site manager or appointee is responsible for informing construction personnel of the manufacturer's recommended spill cleanup methods and the location of that information and cleanup supplies.
- Materials and equipment for the cleanup of a relatively small spill will be kept in the laydown and parking area. These facilities may include brooms, rags, gloves, shovels, goggles, sand, sawdust, absorbent, plastic or metal trash containers, and protective clothing.
- All containers will be labeled, tightly sealed, and stacked or stored neatly and securely.

Spill response procedures will be as follows:

- Step 1: Upon discovery of a spill, stop the source of the spill.
- Step 2: Cease all spill material transfer until the release is stopped and waste is removed from the spill site.
- Step 3: Initiate containment to prevent spill from reaching State waters.
- Step 4: Notify supervisor and A2PP's site manager of the spill.
- Step 5: A2PP's site manager will immediately notify the A2PP emergency coordinator and coordinate further cleanup activities.

- Step 6: Any significant spill of hazardous material will be reported to the appropriate state and/or local agencies by A2PP personnel or qualified contractors. Table 10 lists the project's environmental emergency contacts.
- Step 7: Record a description of the spill, cause, and cleanup measures taken.
- Step 8: Review and amend the SWPPP to address the violation that the general objective of reducing or eliminating pollutants in stormwater discharges has not been achieved.

**TABLE 10**
Environmental Emergency Telephone List

| Company/Organization | Telephone Numbers |
|---|---|
| Primary Facility Emergency Coordinator: | TBD |
| 24-Hour Telephone Number: | TBD |
| Alternate Facility Emergency Coordinator: | TBD |
| **Other Resources** | |
| 3E Company (MSDS by FAX): | (800) 451-8346 |
| Chemtrec (emergency chemical information): | (800) 424-9300 |
| Poison Control Center: | (800) 662-9886 |
| **Federal Agency** | |
| U.S. Coast Guard/National Response Center: | (800) 424-8802 |
| **State Agencies** | |
| California Office of Emergency Services (OES): | (800) 852-7550 |
| California Department of Toxic Substances Control (DTSC)*: | (800) 852-7550 |
| California Department of Fish and Game*: | (800) 852-7550 |
| California State Lands Commission: | (562) 590-5201 |
| Regional Water Quality Control Board (RWQCB)*: | (800) 852-7550 |
| **Local Contacts** | |
| Stanislaus County Environmental Health Department: | |
| Fire –: | 911 |
| Police –: | |
| Hospital –: | |
| Ambulance/Paramedics: | |

*DTSC, RWQCB and California Department of Fish and Game have requested that emergency notifications to these offices be made through the OES 800 number.

TID or their designated Contractor will implement BMP WM-9, Sanitary and Septic Waste Management. Weekly maintenance will be provided and wastes will be disposed of offsite. The toilets will be located away from concentrated flow paths and traffic flow, and containment will be provided as needed to prevent the offsite discharge of pollutants.

During construction, the primary waste generated will be solid nonhazardous waste. However, some nonhazardous liquid waste and hazardous waste (solid and liquid) will also be generated. Most of the hazardous wastes will be generated at the plant site. The types of waste are described below.

### Nonhazardous Solid Waste

Listed below are nonhazardous waste streams that could potentially be generated from construction activities.

**Paper, Wood, Glass, and Plastics.** Paper, wood, glass, and plastics will be generated from packing materials, waste lumber, insulation, and empty nonhazardous chemical containers during project construction. These wastes will be recycled where practical. Waste that cannot be recycled will be disposed of weekly in a Class III landfill. Onsite, the waste will be placed in dumpsters.

**Concrete.** Waste concrete will be disposed of in a Class III landfill or at clean fill sites, if available, or will be recycled and disposed of at a construction and demolition site. Dumping of excess concrete and washing out of delivery vehicles will be prohibited at other locations onsite. Notices will be posted to inform all drivers.

**Metal.** Waste metal, including steel from welding/cutting operations, packing materials, empty nonhazardous chemical containers, and aluminum waste from packing materials and electrical wiring will be recycled where practical. Nonrecyclable waste will be deposited in a Class III landfill.

### Wastewater

Depending on the chemical quality of wastewaters potentially generated during construction, the wastewaters could be classified as hazardous or nonhazardous. The wastewaters would be sampled and, if hazardous, they would be disposed of in accordance with applicable regulations.

### Hazardous Waste

Most of the hazardous waste generated during construction will consist of liquid waste such as water from flushing and cleaning fluids, passivating fluid (to prepare pipes for use), and solvents. Some hazardous solid waste, such as welding materials, batteries, and dried paint, may also be generated.

Flushing and cleaning waste liquid will be generated as pipes are cleaned and flushed. The volume of flushing and cleaning liquid waste generated is estimated to be one to two times the internal volume of the pipes cleaned. The quantity of welding, solvent, batteries, and paint waste is expected to be minimal. Wastewaters generated during construction could also be considered hazardous, if demonstrated so by sampling.

The construction contractor will be considered the generator of hazardous construction waste and will be responsible for proper handling of hazardous waste in compliance with all applicable federal, state, and local laws and regulations. This responsibility will include licensing, personnel training, accumulation limits and times, and reporting and recordkeeping. The hazardous waste will be collected in satellite accumulation containers near the points of generation. It will be moved daily to the contractor's 90-day hazardous waste storage area located at the site construction laydown area. The waste will be removed from the site by a certified hazardous waste collection company and will be delivered to an authorized hazardous waste management facility before expiration of the 90-day storage limit.

#### Potential Contaminated Soil

It is unlikely that contaminated soil will be encountered during construction. However, operators and construction personnel will be asked to report unusual conditions to the appropriate personnel, and the area and/or material will be properly contained during investigative actions. If soils require temporary stockpiling, piles will be placed on and covered with plastic sheeting or tarps that are secured safely with sand bags and bermed with fiber rolls or silt fencing to prevent runoff from leaving the area. Samples will be collected and sent to a certified analytical laboratory for characterization. If contamination is detected, the waste will be handled and properly disposed of in an authorized waste management facility. In addition, the appropriate local, State (including the RWQCB), and federal agency(ies) shall be notified. Any contaminated soils resulting from spills will be dug up as quickly as possible and removed from the site for proper disposal.

Site-specific BMPs will be designed by TID or their designated Contractor, and associated figures are to be included in Attachment A. Attachment E is to be updated by TID or their designated Contractor and lists the BMPs selected for this project. Attachment F contains BMP fact sheets with applicable detailed descriptions of suitability, implementation, and inspection and maintenance measures. The following BMPs will be considered for waste management and materials pollution control:

- Material delivery and storage (WM-1)
- Material use (WM-2)
- Stockpile management (WM-3)
- Spill prevention and control (WM-4)
- Solid waste management (WM-5)
- Hazardous waste management (WM-6)
- Contaminated soil management (WM-7)
- Concrete waste management (WM-8)
- Sanitary/septic waste management (WM-9)
- Liquid waste management (WM-10)

### 5.6.7 Cost Breakdown for Water Pollution Control

A cost breakdown itemizing the contract lump sum for water pollution control for this project will be developed and included in the Final SWPPP as Attachment G. The cost breakdown will reflect the items of work and quantities and costs for BMPs shown in the SWPPP. Items not included will be those construction site BMPs and permanent BMPs that are shown on the project plans and for which there is a contract item of work.

## 5.7 Water Pollution Control Drawings

The WPCDs can be found in Attachment A. Construction BMP plans will be further developed during the final project design phase. The Final SWPPP will include locations and details of all BMPs to be used during the construction, including BMPs for linear features such as roads and pipelines.

## 5.8 Construction BMP Maintenance, Inspection, and Repair

Inspections will be conducted as follows:

- Weekly
- Prior to a forecast storm
- After a rain event that causes runoff from the construction site
- At 24-hour intervals during extended rain events
- At any other time(s) or intervals of time specified in the contract documents

Completed inspection checklists will be submitted to the Project Manager within 24 hours of inspection. Copies of the completed checklists will be kept with the SWPPP.

A tracking or follow-up procedure shall follow any inspection that identifies deficiencies in BMPs. A Maintenance, Inspection, and Repair Program of BMPs is to be completed by TID or their designated Contractor; a template is shown in Attachment H. BMP fact sheets in Attachment F will be referenced for inspection and maintenance measures for each selected BMP.

At a minimum, erosion and sediment controls should be cleaned, repaired, or replaced under these conditions:

- In advance of the rainy season and prior to a storm event
- When sediment or other debris has accumulated to greater than one-third the height of the barrier
- When sediment accumulation reaches one-third of the trap capacity
- When more than one-third of the cross-section of a conveyance structure, such as a drainage swale or ditch, is plugged or blocked

## 5.9 Post-Construction Stormwater Management

### 5.9.1 Post-Construction Control Practices

The stormwater system for the A2PP will include a series of inlets and storm drain pipes that would convey the project area's runoff to an onsite stormwater retention pond located on the north end of the site. The retention pond will be sized at 2.41 acre-feet capacity to accommodate the 100-year peak runoff with 2.65 feet of freeboard (refer to Attachment B).

Once the project grading plan has been finalized, a figure will be added to that shows the post-construction runoff and drainage patterns. In addition, the Final SWPPP will include a schedule for maintenance of post-construction BMPs.

### 5.9.2 Operation/Maintenance of Post-Construction Control Practices

The post-construction BMPs described above will be funded and maintained by Turlock Irrigation District.

## 5.10 Training

**Qualified SWPPP Developer (QSD):** This Administrative Draft SWPPP was prepared by CH2M HILL under the direction of Mieke Sheffield, CPSWQ #520. The Final SWPPP and all future amendments to the SWPPP will be prepared by a QSD.

The designated QSD is: To Be Determined

The designated QSD can be contacted at: To Be Determined

**Qualified SWPPP Practitioner (QSP):** All the BMPs outlined in the project's SWPPP and required by the General Permit will be implemented by a QSP.

The designated QSP is: To Be Determined

The designated QSP can be contacted at: To Be Determined

Prior to project startup, all designated onsite representatives will participate in a pre-project stormwater training workshop. The workshop will cover basic stormwater information, the requirements of the General Permit, and the SWPPP. Specifically, the workshop will focus on implementation, inspection, and maintenance of stormwater controls.

- Contractors are responsible for familiarizing their personnel with the information contained in the SWPPP. Contractors will be informed of this obligation.
- All new employees will be trained by staff familiar with these topics.
- Contractors are responsible for familiarizing subcontractors with information contained in the SWPPP.

Ongoing, formal training sessions will be selected from one of the following organizations:

- California Regional Water Quality Control Board
- International Erosion Control Association
- EPA
- Recognized municipal stakeholder organizations throughout California
- Professional organizations and societies in building and construction

Documentation of all training for persons responsible for implementing the requirements of the General Permit will be provided in the Annual Reports. Informal training will include tailgate site briefings to be conducted bi-weekly and will address proper installation methods and maintenance for the following topics:

- Erosion control BMPs
- Sediment control BMPs
- Tracking control BMPs
- Wind erosion control BMPs
- Non-stormwater BMPs
- Waste management and materials pollution control BMPs
- Emergency procedures specific to the construction site stormwater management
- The training log showing formal and informal training of various Contractor personnel is shown in Attachment I.

## 5.11 List of Subcontractors

Contractors and subcontractors will be notified of the requirements for stormwater management measures during the project. A list of contractors, subcontractors, and individuals who will be directed by the QSP will be maintained and included in the SWPPP. This list shall include telephone numbers and work addresses. Each subcontractor's specific areas of responsibility and emergency contact numbers shall be included. The list will be updated as needed. The subcontractor notification letter and log is included in Attachment J.

## 5.12 Other Plans/Permits

Attachment K includes copies of the following local, state, and federal plans and permits:

- State Water Resources Control Board Order No. 2009-0009-DWQ National Pollutant Discharge Elimination System General Permit No. CAS000002 Waste Discharge Requirements for Discharges of Stormwater Runoff Associated with Construction and Land Disturbance Activities regulates discharges of pollutants in stormwater associated with construction activity to waters of the United States from construction sites that disturb one or more acres of land surface.
- Other plans and permits will be included as applicable.

SECTION 6

# Monitoring Program and Reports

## 6.1 Site Inspections

All inspection, maintenance repair, and sampling activities at the project location shall be performed or supervised by a QSP. The QSP may delegate any or all of these activities to an employee appropriately trained to do the task(s).

The QSP or designated representative will perform inspections and observations weekly, prior to a forecast storm, after a rain event that causes runoff from the construction site, at 24-hour intervals during extended rain events, and as specified in the contract documents. SWPPP inspections may be conducted in conjunction with other facility inspections. For instance, if a regulated amount of petroleum materials is onsite and there is a Spill Prevention, Control, and Countermeasures Plan (SPCC), the SWPPP inspections may be conducted in conjunction with SPCC inspections.

The goals of these inspections are (1) to identify areas contributing to a stormwater discharge; (2) to evaluate whether measures to reduce pollutant loadings identified in the SWPPP are adequate, properly installed, and functioning in accordance with the terms of the General Permit; and (3) to determine whether additional control practices or corrective maintenance activities are needed.

Upon identifying failures or other shortcomings, repairs or design changes to BMPs will be started within 72 hours of identification and completed as soon as possible as directed by the QSP.

The results of inspections and assessments will be documented. Copies of the completed inspection checklists will be maintained with the SWPPP; a copy will be provided to the Project Manager within 24 hours of the inspection. Site inspections conducted for monitoring purposes will be performed using the inspection checklist shown in Attachment L.

## 6.2 Rain Event Action Plan

A QSP will develop a Rain Event Action Plan (REAP) 48 hours prior to any likely precipitation event. A likely precipitation event is any weather pattern that is forecast to have a 50 percent or greater probability of producing precipitation in the project area. The QSP will obtain a printed copy of precipitation forecast information from the National Weather Service Forecast Office (e.g., by entering the zip code of the project's location at http://www.srh.noaa.gov/forecast). The REAP will be available onsite and will be implemented no later than 24 hours prior to the likely precipitation event. Copies of the REAP will be maintained with the SWPPP.

A REAP will be developed for all phases of construction (i.e., Grading and Land Development, Streets and Utilities, Vertical Construction, Final Landscaping, and Site Stabilization) and areas of inactive construction.

The REAP will include, at a minimum, the following site information:

- Site address
- Calculated risk level (2 or 3)
- Site stormwater manager information including the name, company, and 24-hour emergency telephone number
- Erosion and sediment control provider information including the name, company, and 24-hour emergency telephone number
- Stormwater sampling agent information including the name, company, and 24-hour emergency telephone number

In addition, the REAP at a minimum will include the following project phase information:

- Activities associated with each construction phase
- Trades active on the construction site during each construction phase
- Trade contractor information
- Suggested actions for each project phase

At a minimum, the REAP addressing inactive construction will include:

- Site address
- Calculated risk level (2 or 3)
- Site stormwater manager information including the name, company, and 24-hour emergency telephone number
- Erosion and sediment control provider information including the name, company, and 24-hour emergency telephone number
- Stormwater sampling agent information including the name, company, and 24-hour emergency telephone number
- Trades active on site during inactive construction
- Trade contractor information
- Suggested actions for inactive construction sites

SECTION 7

# Construction Site Monitoring Program

The Construction Site Monitoring Program (CSMP) was developed and implemented to address the following objectives:

1. To demonstrate that the site is in compliance with the Discharge Prohibitions and applicable Numeric Action Levels (NALs)/Numeric Effluent Limitations (NELs) of this General Permit.
2. To determine whether non-visible pollutants are present at the construction site and are causing or contributing to exceedances of water quality objectives.
3. To determine whether immediate corrective actions, additional BMP implementation, or SWPPP revisions are necessary to reduce pollutants in stormwater discharges and authorized non-stormwater discharges.
4. To determine whether BMPs included in the SWPPP/REAP are effective in preventing or reducing pollutants in stormwater discharges and authorized non-stormwater discharges.

The CSMP will be developed prior to the commencement of construction activities and will be revised as necessary to reflect project revisions.

## 7.1 Visual Monitoring

1. Stormwater discharges at all discharge locations will be visually observed (inspected) within two business days (48 hours) after each qualifying rain event.
2. The discharge of stored or contained stormwater that is derived from and discharged subsequent to a qualifying rain event producing precipitation of 1/2 inch or more at the time of discharge will be visually observed (inspected). Stored or contained stormwater that will likely discharge after operating hours as a result of anticipated precipitation shall be observed prior to the discharge during operating hours.
3. Visual observations (inspections) will be conducted during business hours only.
4. The time, date, and rain gauge reading of all qualifying rain events will be recorded.
5. Within 2 business days (48 hours) prior to each qualifying rain event, the QSP or designated representative will visually observe (inspect) for the presence or absence of floating and suspended materials, a sheen on the surface, discolorations, turbidity, odors, and source(s) of any observed pollutants:

    5.1. Visually observe (inspect) all stormwater drainage areas to identify any spills, leaks, or uncontrolled pollutant sources. If needed, appropriate corrective actions will be implemented.

5.2. Check all BMPs to identify whether they have been properly implemented in accordance with the SWPPP/REAP. If needed, appropriate corrective actions will be implemented.

5.3. Inspect any stormwater storage and containment areas to detect leaks and ensure maintenance of adequate freeboard.

6. Within two business days (48 hours) after each qualifying rain event, a post-rain-event visual observation (inspection) will be conducted (1) to identify whether BMPs were effective, adequately designed, and implemented; and (2) to identify additional BMPs and revise the SWPPP accordingly.

Records of all visual observations (inspections), personnel performing the observations, visual observation procedures, observation dates, weather conditions, locations observed, and corrective actions taken in response to the observations will be maintained onsite.

## 7.2 Water Quality Sampling and Analysis

At a minimum, 3 stormwater grab samples will be collected per day of the qualifying event. The grab samples will be collected of stored or contained stormwater discharges subsequent to a qualifying rain event (producing precipitation of 1/2 inch or more at the time of discharge) and will be representative of the flow and characteristics of the discharge.

Effluent samples will be analyzed for pH, turbidity, and any additional parameters requested by the RWQCB.

Samples will not be collected and visual observations (inspections) will not be conducted during dangerous weather conditions such as flooding and electrical storms or outside of scheduled site business hours. Explanations of why sampling or observations were not conducted will be documented in the SWPPP and in the Annual Report.

### 7.2.1 Effluent Sampling Locations

Sampling and analysis of stormwater discharges will be conducted to characterize discharges associated with construction activity from the entire project disturbed area.

- Effluent samples will be collected at all discharge points where stormwater is discharged offsite. The Final SWPPP will include a map identifying all sampling locations.
- The stormwater discharge collected and observed will represent the effluent in each drainage area based on visual observation of the water and upstream conditions.
- Site run-on from surrounding areas will be monitored and reported if there is reason to believe run-on may contribute to an exceedance of NALs.

### 7.2.2 Collection and Handling Instructions

Analytical test methods will be in accordance with the information outlined in Table 11.

**TABLE 11**
Test Methods, Detection Limits, Reporting Units, and Applicable NALs

| Parameter | Test Method/Protocol | Discharge Type | Minimum Detection Limit | Reporting Units | Numeric Action Level |
|---|---|---|---|---|---|
| pH | Field test with calibrated portable instrument | Risk Level 2 Discharges | 0.2 | pH units | lower NAL = 6.5<br>upper NAL = 8.5 |
| Turbidity | EPA 0180.1 and/or field test with calibrated portable instrument | Risk Level 2 Discharges other than ATS | 1 | NTU | 250 NTU |
| | | For ATS Discharges | 1 | NTU | N/A |

Note:
NTU = Nephelometric Turbidity Unit

Immediately following collection, sample bottles for laboratory analytical testing will be capped, labeled, and documented on a chain-of-custody form provided by the analytical laboratory; sealed in a re-sealable storage bag; placed in an ice-chilled cooler, as close to 4°C as practicable; and delivered within 48 hours to the California-certified laboratory (unless otherwise required by the laboratory). Only the sample containers provided by the laboratory to collect and store samples will be used. Refer to Attachment M for an example chain-of-custody form used when handling and shipping samples.

Operable backup portable instruments for field tests will be available onsite.

All personnel designated to collect, maintain, and ship samples will be trained in accordance with the Surface Water Ambient Monitoring Program's 2008 Quality Assurance Program Plan: (http://www.waterboards.ca.gov/water_issues/programs/swamp/docs/qapp/swamp_qapp_master090108a.pdf).

### 7.2.3 Monitoring Methods

All sampling and sample preservation will be in accordance with the current edition of "Standard Methods for the Examination of Water and Wastewater" (American Public Health Association). All monitoring instruments and equipment (including a discharger's own field instruments for measuring pH and turbidity) will be calibrated and maintained in accordance with manufacturers' specifications to ensure accurate measurements.

All laboratory analyses will be conducted according to test procedures under 40 CFR Part 136, unless other test procedures have been specified in this General Permit or by the Regional Water Board. With the exception of in-field analysis of turbidity and pH, all analyses will be sent to and conducted at a laboratory certified for such analyses by the State Department of Health Services.

### 7.2.4 Analytical Methods

Refer to Table 11 for test methods, detection limits, and reporting units.

pH analysis shall be performed onsite with a calibrated pH meter or a pH test kit. pH monitoring results will be documented on paper and maintained with the SWPPP. Turbidity analysis will be performed onsite using a calibrated turbidity meter. The results will be recorded in the site log book in Nephelometric Turbidity Units (NTUs) and maintained with the SWPPP.

## 7.3 Non-Stormwater Discharge Monitoring

### 7.3.1 Visual Monitoring

The following visual monitoring actions will be performed:

- Each drainage area will be visually observed for the presence of (or indications of earlier) unauthorized and authorized non-stormwater discharges and their sources.
- One visual observation (inspection) will be conducted quarterly in each of the following periods: January–March, April–June, July–September, and October–December. Visual observation (inspection) will be conducted only during daylight hours (sunrise to sunset).
- Visual observation (inspection) will document the presence or evidence of any non-stormwater discharge (authorized or unauthorized), pollutant characteristics (floating and suspended material, sheen, discoloration, turbidity, odor, etc.), and source.
- Onsite records will be maintained of the personnel performing the visual observations (inspections), the dates and approximate time each drainage area and non-stormwater discharge was observed, and the response taken to eliminate unauthorized non-stormwater discharges and to reduce or prevent pollutants from contacting non-stormwater discharges.

### 7.3.2 Effluent Sampling Locations

These effluent sampling procedures will be followed:

- Effluent at all discharge points where non-stormwater and/or authorized non-stormwater is discharged offsite will be sampled.
- All non-stormwater sample analyses will be sent to a laboratory certified for such analyses by the State Department of Health Services.
- Run-on from surrounding areas will be monitored and reported if there is reason to believe run-on may contribute to an exceedance of NALs.

## 7.4 NAL Exceedance Report

The project site is subject to a storm event average pH NAL of 6.5–8.5 and a storm event average turbidity NAL of 250 NTU.

Whenever the results from a storm event daily average indicate that the discharge is below the lower NAL for pH, exceeds the upper NAL for pH, or exceeds the turbidity NAL, the

construction site and run-on will be evaluated to determine whether pollutant source(s) associated with the site's construction activity may have caused or contributed to the NAL exceedance. Corrective actions will be implemented immediately, if they are needed.

The site evaluation shall be documented in the SWPPP and specifically address whether the source(s) of the pollutants causing the exceedance of the NAL are related to the construction activities and whether additional BMPs are required:

- To meet BAT/BCT requirements
- To reduce or prevent pollutants in stormwater discharges from causing exceedances of receiving water objectives
- To determine what corrective action(s) were taken or will be taken along with a description of the schedule for completion

The site evaluation shall be documented in the SWPPP and specifically address whether the source(s) of the pollutants causing the exceedance of the NAL are related to the run-on associated with the construction site location and whether additional BMPs measures are required:

- To meet BAT/BCT requirements
- To reduce or prevent pollutants in stormwater discharges from causing exceedances of receiving water objectives
- To determine what corrective action(s) were taken or will be taken along with a description of the schedule for completion

The SWPPP will be revised accordingly to either prevent pollutants and authorized non-stormwater discharges from contaminating stormwater or to substantially reduce the pollutants to levels consistently below the NALs.

In the event that any effluent sample exceeds an applicable NAL, all storm event sampling results shall be submitted electronically to the SWRCB SMARTS system no later than 10 days after the conclusion of the storm event.

If the RWQCB requests a NAL Exceedance Report, the following shall occur:

- Each NAL Exceedance Report will be certified in accordance with the Special Provisions for Construction Activity.
- An electronic or paper copy of each NAL Exceedance Report will be retained for a minimum of three years after the date the annual report is filed.
- The NAL Exceedance Report will include:
  - The analytical method(s), method reporting unit(s), and method detection limit(s) of each analytical parameter (analytical results that are less than the method detection limit shall be reported as "less than the method detection limit").
  - The date, place, time of sampling, visual observation (inspection), and/or measurements, including precipitation.

- A description of the current BMPs associated with the effluent sample that exceeded the NAL and the proposed corrective actions taken.

## 7.5 Notice of Non-Compliance

If a discharge occurs or if the project receives a written notice of non-compliance, TID or their designated Contractor will immediately notify the Project Manager and file a written report to the RWQCB within 30 days of identification of non-compliance. Corrective measures will be implemented immediately following the discharge, notice, or order. A sample Notice of Non-Compliance form is provided in Attachment N. Discharges will be documented on a Discharge Reporting Log using the example form in Attachment O.

The report will contain the following items:

- The date, time, location, nature of operation, and type of unauthorized discharge, including the cause or nature of the notice or order
- The BMPs deployed before the discharge event or prior to receiving the notice or order
- The date of deployment and type of BMPs deployed after the discharge event or after receiving the notice or order, including additional measures installed or planned to reduce or prevent re-occurrence
- An implementation and maintenance schedule for any affected BMPs

## 7.6 Record Keeping2 and Reports

Records of all stormwater monitoring information and copies of all reports (including Annual Reports) will be retained for a period of at least three years. All records will be maintained onsite while construction is ongoing. These records include the following:

- The date, place, time of facility inspections, sampling, visual observation (inspection), and/or measurements, including precipitation
- The individual(s) who performed the facility inspections, sampling, visual observation (inspections), and or measurements
- The date and approximate time of analyses
- The individual(s) who performed the analyses
- A summary of all analytical results from the last three years, the method detection limits and reporting units, the analytical techniques or methods used, and the chain-of-custody forms
- Rain gauge readings from site inspections
- Quality assurance/quality control records and results
- Non-stormwater discharge inspections and visual observations (inspections) and stormwater discharge visual observation records

- The records of any corrective actions and follow-up activities that resulted from analytical results, visual observations (inspections), or inspections
- Visual observation and sample collection exception records

## 7.7 Sampling and Analysis Plan for Sediment

This project does not have the potential to discharge directly to a water body listed as impaired due to sedimentation/siltation or turbidity pursuant to Clean Water Act, Section 303(d); therefore, a Sampling and Analysis Plan for sedimentation is not required.

SECTION 8

# Sampling and Analysis Plan for Non-visible Pollutants

This section describes the sampling and analysis strategy and schedule for monitoring non-visible pollutants in stormwater discharges from the project site and offsite activities directly related to the project.

## 8.1 Monitoring Activities

The following construction materials, wastes, or activities are potential sources of non-visible pollutants to stormwater discharges from a project. Identification, storage, use, and operational locations of potential sources of non-visible pollutants at this project site will be updated, identified on site maps, and incorporated into the Final SWPPP by TID or their designated Contractor:

- Vehicle batteries
- Concrete curing
- Sealants
- Adhesives
- Cleaning products
- Solvents; thinners
- Fertilizers; herbicides
- Dust palliatives
- Soil binders
- Painting products
- Line flushing products
- Masonry products

No soil amendments are anticipated to be used on the project sites that have the potential to change the chemical properties, engineering properties, or erosion resistance of the soil.

Stormwater run-on to this site does not have the potential to contribute non-visible pollutants to stormwater discharges from the project.

Sampling for non-visible pollutants will be conducted when (1) a breach, leakage, malfunction, or spill is observed; (2) the leak or spill has not been cleaned up prior to the rain event; and (3) the potential exists for discharge of non-visible pollutants to surface waters or drainage system.

# 8.2 Monitoring Strategy

## 8.2.1 Sampling Schedule

Samples for the applicable non-visible pollutant(s) and a sufficiently large uncontaminated background sample will be collected during the first two hours of discharge from rain events that result in a sufficient discharge for sample collection. Samples will be collected during daylight hours (sunrise to sunset) and will be collected regardless of the time of year, status of the construction site, or day of the week.

In conformance with the EPA definition, a minimum of 72 hours of dry weather will be used to distinguish between separate rain events. Collection of discharge samples for non-visible pollutant monitoring will be triggered when any of the following conditions are observed during inspections conducted before or during rain events:

- Materials or wastes containing potential non-visible pollutants are not stored under watertight conditions. Watertight conditions are defined as (1) storage in a watertight container, (2) storage under a watertight roof or within a building, or (3) storage protected by temporary cover and containment that prevents stormwater contact and runoff from the storage area.
- Materials or wastes containing potential non-visible pollutants are stored under watertight conditions, but (1) a breach, malfunction, leakage, or spill is observed, (2) the leak or spill is not cleaned up prior to the rain event, and (3) there is the potential for discharge of non-visible pollutants to surface waters or a storm sewer system.
- An operational activity with the potential to contribute non-visible pollutants (1) was occurring during or within 24 hours prior to the rain event, (2) applicable BMPs were observed to be breached, malfunction, or be improperly implemented, and (3) there is the potential for discharge of non-visible pollutants to surface waters.
- Soil amendments that have the potential to change the chemical properties, engineering properties, or erosion resistance of the soil have been applied, and there is the potential for discharge of non-visible pollutants to surface waters.
- Stormwater runoff from an area contaminated by historical usage of the site has been observed to combine with stormwater runoff from the site; the potential exists for discharge of non-visible pollutants to surface waters or to a storm sewer system.

## 8.2.2 Sampling Locations

Sampling locations will be based on proximity to planned non-visible pollutant storage, occurrence, or use; accessibility for sampling; personnel safety; and other factors in accordance with the applicable requirements in the General Permit. Sampling locations will be chosen by TID or their designated Contractor as appropriate to discharges and are shown on the WPCDs in the Final SWPPP Attachment A.

- [TBD] sampling locations have been identified for the collection of runoff samples that drain areas where soil amendments that have the potential to change the chemical properties, engineering properties, or erosion resistance of the soil will be applied.

  - If applicable: Sample location number(s) are located
- [TBD] sampling locations have been identified for the collection of runoff samples that drain areas contaminated by historical usage of the site.
  - If applicable: Sample location number(s) are located
- [TBD] sampling locations have been identified for the collection of samples of run-on to the project site with the potential to combine with discharges being sampled for non-visible pollutants. These samples are intended to identify sources of potential non-visible pollutants that originate at the project site.
  - If applicable: Sample location number(s) are located
- [TBD] A location has been identified for the collection of an uncontaminated runoff sample as a background sample for comparison with the samples being analyzed for non-visible pollutants. This location was selected so the sample will not have come in contact with (1) operational or storage areas associated with the materials, wastes, and activities identified in Section 500.3.1; (2) potential non-visible pollutants resulting from historical use of the site as identified in Section 500.3.3; (3) areas in which soil amendments that have the potential to change the chemical properties, engineering properties, or erosion resistance of the soil have been applied; or (4) disturbed soils areas.
  - If applicable: Sample location number(s) are located

Sampling locations will be selected using the same rationale as that used to identify planned locations if an operational activity or stormwater inspection conducted 24 hours prior to or during a rain event identifies the presence of a material storage, waste storage, or operations area with spills or the potential for the discharge of non-visible pollutants to surface waters that was an unplanned location and has not been identified on the WPCDs.

## 8.3 Monitoring Preparation

Samples on the project site will be collected by the following Contractor sampling personnel:

Name/Telephone Number: TBD

An adequate stock of monitoring supplies and equipment for monitoring non-visible pollutants will be available on the project site prior to a sampling event. Monitoring supplies and equipment will be stored in a cool-temperature environment away from rain or direct sunlight. Sampling personnel will be available to collect samples in accordance with the sampling schedule.

Supplies maintained at the project site will include surgical gloves, sample collection equipment, coolers, appropriate number and volume of sample bottles, identification labels, re-sealable storage bags, paper towels, personal rain gear, ice, Sampling Activity Log forms, and chain-of-custody forms. TID or their designated Contractor will obtain and maintain the field-testing instruments for analyzing samples in the field by sampling personnel.

Safety practices for sample collection will be in accordance with TID or their designated Contractor's Health and Safety Plan.

The QSP will contact sampling personnel 24 hours prior to a predicted rain event and if one of the triggering conditions is identified during an inspection before, during, or after a storm event. This will ensure availability of adequate sample collection personnel, supplies, and field test equipment for monitoring non-visible pollutants. It will also ensure sample collection on the project site in accordance with the sampling schedule.

# 8.4 Analytical Constituents

## 8.4.1 Identification of Non-Visible Pollutants

Table 12 lists specific sources and types of potential non-visible pollutants anticipated to be on the project site as well as the applicable water quality indicator constituent(s) for that pollutant. This table will be updated as appropriate and will be shown in the Final SWPPP.

**TABLE 12**
Potential Non-visible Pollutants and Water Quality Indicator Constituents

| Pollutant Source | Pollutant | Water Quality Indicator Constituent |
|---|---|---|
| Batteries | Acid, Lead | pH. Lead, Sulfuric acid |
| Cleaners | Acid, Phosphate, Solvents | pH, Phosphate, VOC, SVOC |
| Painting Products | Paint strippers, Solvents, Thinners | COD, VOC, SVOC |
| Thinners | VOC, COD | COD, VOC |
| Sealant | Sealants | COD |
| AC and PCC | Curing compounds | pH, Alkalinity, VOC, SVOC |
| Adhesives | Adhesives | COD, Phenols, SVOC |

# 8.5 Sample Collection and Handling

## 8.5.1 Sample Collection Procedures

Samples of discharge will be collected at the designated sampling locations for observed breaches, malfunctions, leakages, spills, operational areas, soil amendment application areas, and/or historical site usage areas that triggered the sampling event.

Grab samples will be collected and preserved in accordance with the methods identified in Table 13. Only personnel trained in proper water quality sampling will collect samples.

Samples will be collected by placing a separate lab-provided sample container directly into a stream of water downgradient and near the potential non-visible pollutant discharge location. This separate lab-provided sample container will be used to collect water, which will be transferred to sample bottles for laboratory analysis. The upgradient and

uncontaminated background samples will be collected before collecting the downgradient sample to minimize cross-contamination. Sampling personnel will collect the water upgradient of where they are standing. Once the separate lab-provided sample container is filled, the water sample will be poured directly into sample bottles provided by the laboratory for the analyte(s) being monitored.

**TABLE 13**
Sample Collection, Preservation, and Analysis for Monitoring Non-visible Pollutants

| Constituent | Analytical Method | Minimum Sample Volume | Sample Bottle | Sample Preservation | Reporting Limit | Maximum Holding Time |
|---|---|---|---|---|---|---|
| VOCs-solvents | EPA 8260B | 3 × 40 mL | VOA-glass | Store at 4˚ C, HCl to pH<2 | 1 µg/L | 14 days |
| SVOCs | EPA 8270C | 1 × 1 L | Glass-amber | Store at 4˚ C | 10 µg/L | 7 days |
| Pesticides | EPA 8081A | 1 × 1 L | Glass-amber | Store at 4˚ C | 0.1 µg/L | 7 days |
| Herbicides | EPA 8151A | 1 × 1 L | Glass-amber | Store at 4˚ C | Check lab | 7 days |
| COD | EPA 410.4 | 1 × 250 mL | Glass-amber | Store at 4˚ C, $H_2SO_4$ to pH<2 | 5 mg/L | 28 days |
| TDS | EPA 160.1 (TDS) | 1 × 100 mL | Polypropylene | None | ppm | Immediate |
| pH | EPA 150.1 | 1 × 100 mL | Polypropylene | None | Unitless | Immediate |
| Alkalinity | SM 2320B | 1 × 250 mL | Polypropylene | Store at 4˚ C | 1 mg/L | 14 days |
| Nitrate | EPA 353.2 | 1 × 125 mL | Polypropylene | Store at 4˚ C, $H_2SO_4$ to pH<2 | Check lab | 28 days |
| Phosphate | EPA 365.3 | 1 × 125 mL | Polypropylene | Store at 4˚ C | Check lab | 28 days |
| Organic nitrogen | TKN – $NH_3$ | 1 × 1 L | Glass-amber | Store at 4˚ C, $H_2SO_4$ to pH<2 | Check lab | 28 days |
| TOC | EPA 415.1 | 1 × 250 mL | Glass | Store at 4˚ C, $H_2SO_4$ to pH<2 | Check lab | 28 days |
| Potassium | EPA 200.7 | 1 × 250 mL | Polypropylene | Store at 4˚ C, $HNO_3$ to pH<2 | 0.1 mg/L | 6 months |
| Phenols | EPA 8270C | 1 × 1 L | Glass-amber | Store at 4˚ C | Check lab | 7 days |
| Metals (Al, Sb, As, Ba, Be, Cd, Ca, Cr, Co, Cu, Fe, Pb, Mg, Mn, Mo, Ni, Se, Na, Th, Va, Zn) | EPA 6010B/ 7470A | 1 × 250 mL | Polypropylene | Store at 4˚ C, $HNO_3$ to pH<2 | 0.1 mg/L | 6 months |
| Metals (chromium VI) | EPA 7199 | 1 × 500 mL | Polypropylene | Store at 4˚ C | 1 µg/L | 24 hours |

Notes:

°C = degree(s) Celsius
µg/L = microgram(s) per Liter
COD = chemical oxygen demand
DO = dissolved oxygen
EPA = Environmental Protection Agency
HCl = hydrogen chloride
H2SO4 = hydrogen sulfide
HNO3 = nitric acid
L = liter
mg/L = milligrams per liter
mL = milliliter(s)
ppm = parts per million
PCB = polychlorinated biphenyl
SVOC = semi-volatile organic compound
TDS = total dissolved solids
VOA = volatile organic analysis
VOC = volatile organic compound

To maintain sample integrity and prevent cross-contamination, sampling collection personnel will:

- Wear a clean pair of surgical gloves before collecting and handling each sample at each location.
- Prevent the inside of the sample bottle from contacting any material other than the water sample.
- Discard sample bottles or sample lids that have been dropped onto the ground prior to sample collection.
- Prevent the cooler lid from remaining open for an extended time once samples are placed inside.
- Avoid sampling near a running vehicle where exhaust fumes may affect the sample.
- Avoid touching the exposed end of a sampling tube, if applicable.
- Prevent rainwater from rain gear or other surfaces dripping into sample bottles.
- Avoid eating, smoking, or drinking during sample collection.
- Avoid sneezing or coughing in the direction of an open sample bottle.
- Minimize the exposure of the samples to direct sunlight, as sunlight may cause biochemical transformation of the sample.
- Decontaminate sampling equipment before sample collection using a TSP-soapy water wash, distilled water rinse, and final rinse with distilled water.
- Dispose of decontamination water/soaps appropriately; for example, avoid discharge to the receiving water.

### 8.5.2 Sample Handling Procedures

Immediately following collection, sample bottles for laboratory analytical testing will be capped, labeled, and documented on a chain-of-custody form provided by the analytical laboratory; sealed in a re-sealable storage bag; placed in an ice-chilled cooler as close to 4°C as practicable; and delivered within 24 hours to the California-certified laboratory:

Laboratory Name: TBD
Address: TBD
Telephone Number: TBD
Point of Contact: TBD

Immediately following collection, samples for field analysis will be tested in accordance with the field instrument manufacturer's instructions; results will be recorded on the Sampling Activity Log (Attachment P).

## 8.6 Sample Documentation Procedures

Original data documented on sample bottle identification labels, chain-of-custody forms, Sampling Activity Logs, and Inspection Checklists will be recorded using waterproof ink. These will be considered accountable documents. If an error is made on an accountable document, the individual will make corrections by lining through the error and entering the correct information. The erroneous information will not be obliterated. Corrections will be initialed and dated.

Sampling and field analysis activities will be documented using the following:

- Sample Bottle Identification Labels: Sampling personnel will attach an identification label to each sample bottle. At a minimum, the following information will be recorded on the label:
  - Project name
  - Project number
  - Unique sample identification number and location:
    - [Project Number]-[Six digit sample collection date]-[Location](Example: 0G5304-081801-Inlet472)
    - Quality assurance/quality control (QA/QC) samples will be identified similarly using a unique sample number or designation (Example: 0G5304-081801-DUP1)
  - Collection date/time (no time applied to QA/QC samples)
  - Analysis constituent
- Sampling Activity Logs: A log of sampling events will identify:
  - Sampling date
  - Separate times for collected samples and QA/QC samples recorded to the nearest minute
  - Unique sample identification number and location
  - Analysis constituent
  - Names of sampling personnel
  - Weather conditions (including precipitation amount)
  - Field analysis results
  - Other pertinent data
- Chain-of-custody Forms: Samples to be analyzed by a laboratory will be accompanied by a contaminant of concern (COC) form provided by the laboratory. Only the sample collectors will sign the COC form over to the lab. COC procedures will be strictly adhered to for QA/QC purposes.

- Stormwater Quality Construction Inspection Checklists: When applicable, TID or their designated Contractor's stormwater inspector will document on the checklist that samples for non-visible pollutants were taken during a rain event.

## 8.7 Sample Analysis

Samples will be analyzed for the applicable constituents using the analytical methods identified in Table 13. For samples collected for field analysis, the collection, analysis, and equipment calibration will be in accordance with the field instrument manufacturer's specifications.

## 8.8 Quality Assurance/Quality Control

For an initial verification of laboratory or field analysis, duplicate samples will be collected at a rate of 10 percent or 1 duplicate per sampling event. The duplicate sample will be collected, handled, and analyzed using the same protocols as primary samples. A duplicate sample will be collected at each location immediately after the primary sample has been collected. Duplicates will be collected where contamination is likely and not on the background sample. Duplicate samples will not influence evaluations or conclusions; however, they will be used as a check on laboratory quality assurance.

## 8.9 Data Management and Reporting

A copy of water quality analytical results and QA/QC data will be submitted to the Project Manager and TID within 5 days of sampling for field analyses and within 30 days for laboratory analyses.

Lab reports and chain-of-custody will be reviewed for consistency in lab methods, sample identifications, dates, and times for both primary samples and QA/QC samples. Data, including chain-of-custody forms and Sampling Activity Logs, shall be kept with the SWPPP.

## 8.10 Data Evaluation

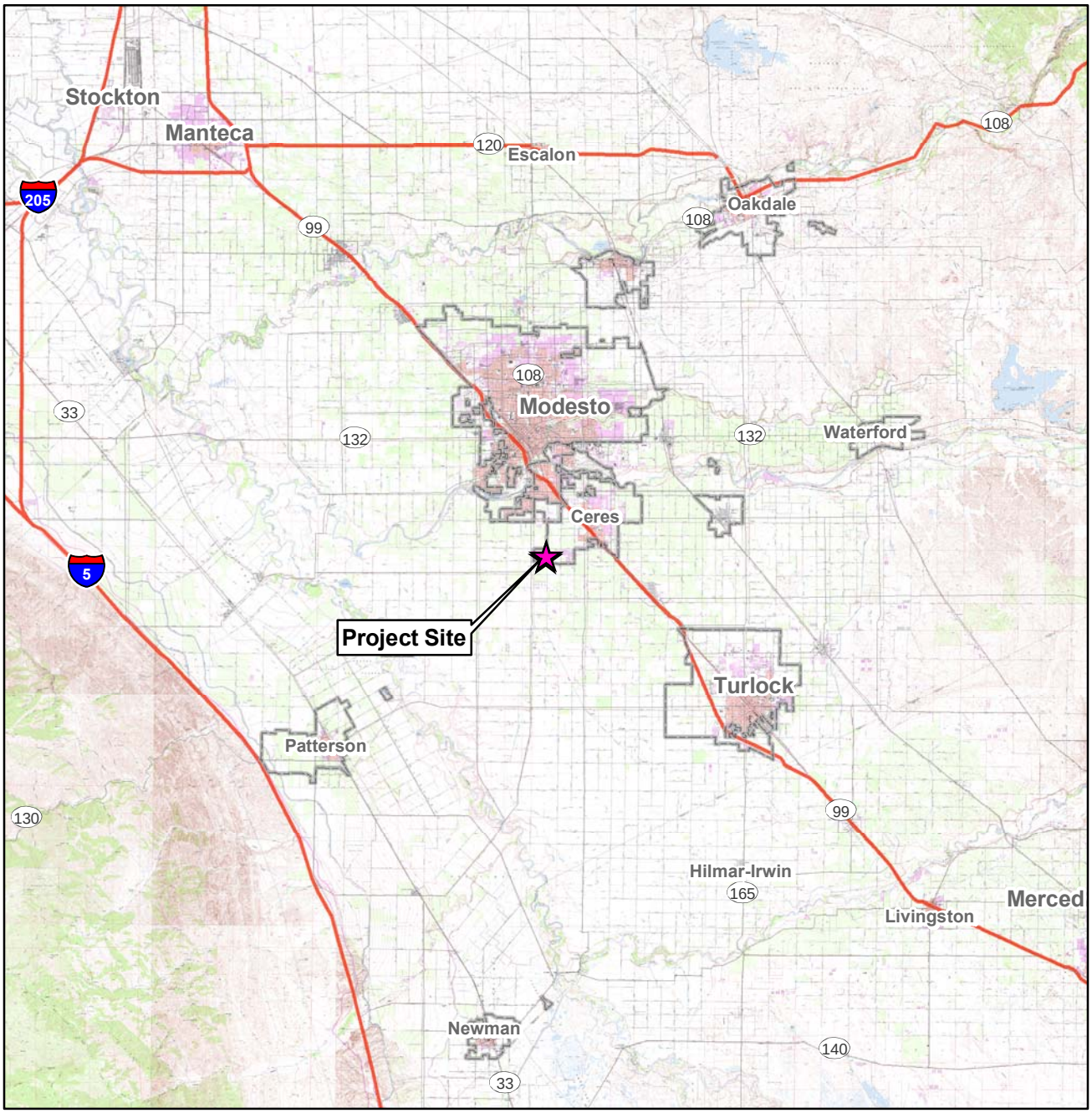
An evaluation of the water quality sample analytical results, including figures with sample locations, the water quality analytical results, and the QA/QC data, will be included in the onsite SWPPP.

Should the runoff/downgradient sample show an increased level of the tested analyte relative to the background sample, the BMPs, site conditions, and surrounding influences will be assessed to determine the probable cause for the increase. As determined by the site and data evaluation, appropriate BMPs will be repaired or modified to mitigate discharges of non-visual pollutant concentrations. Any revisions to the BMPs will be recorded as an amendment to the SWPPP.

## 8.11 Change of Conditions

Whenever SWPPP monitoring indicates a change in site conditions that might affect the appropriateness of sampling locations or might introduce additional non-visible pollutants of concern, testing protocols will be revised accordingly. All such revisions will be recorded as amendments to the SWPPP.

# Attachment A
# Figures

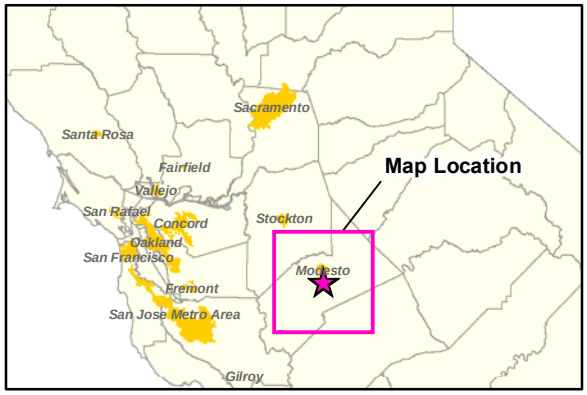



**LEGEND**

Project Site

City Boundaries

VICINITY MAP




N

0 3 6

Miles

This map was compiled from various scale source data and maps and is intended for use as only an approximate representation of actual locations.

**FIGURE 1**
**LOCATION MAP**
ALMOND 2 POWER PLANT
*CERES, CALIFORNIA*

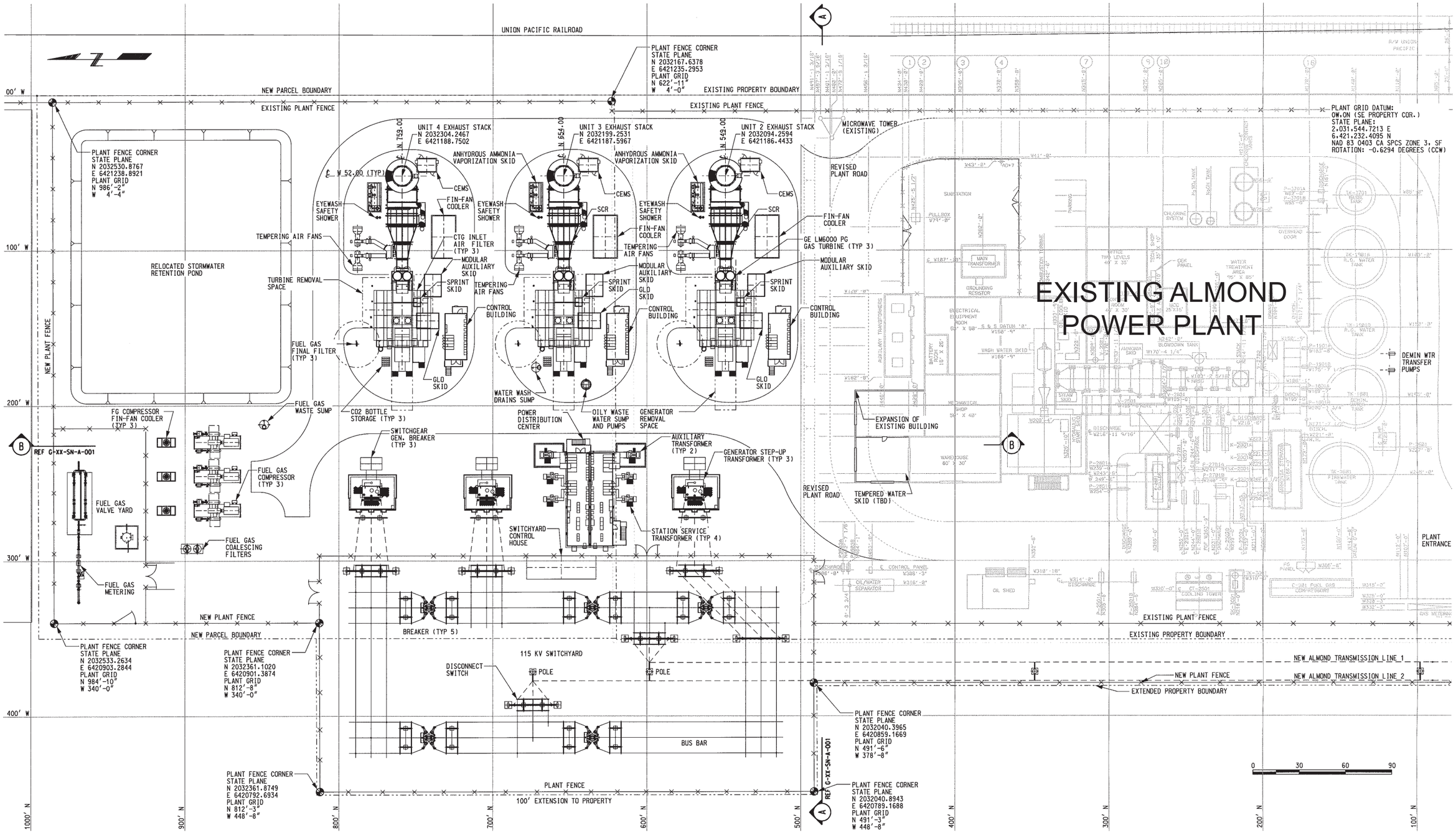
CH2MHILL

SAC\\ZION\SACGIS\PROJ\TURLOCKIRRIGATIONDIS\383194\MAPFILES\VICINITYMAP.MXD MHASKELL 2/24/2009 14:54:42

**FIGURE 2**
**ARCHITECTURAL RENDERING**
ALMOND 2 POWER PLANT
*CERES, CALIFORNIA*

CH2MHILL

EY012009003SAC Figure_1.1-1.ai 04-16-09 dash



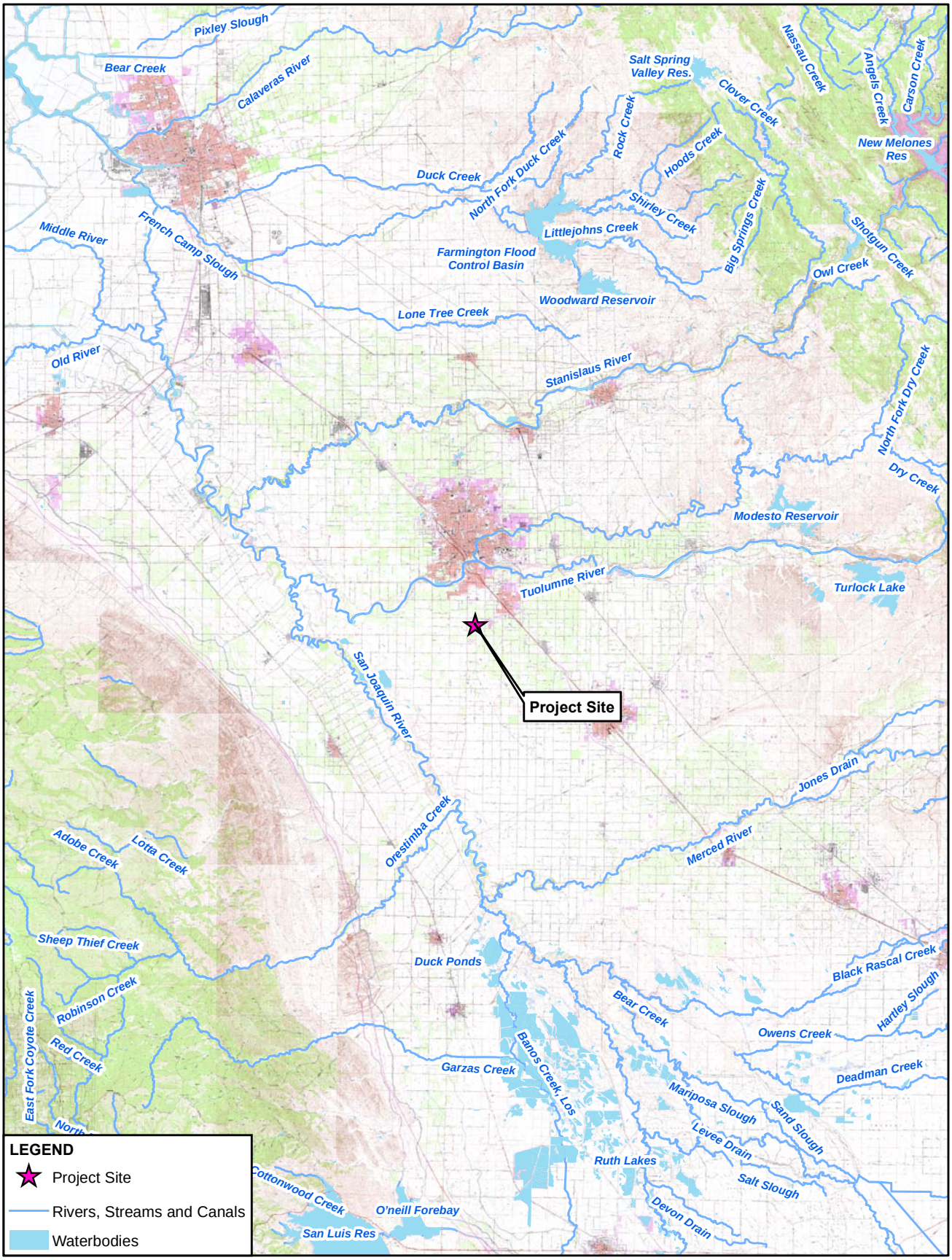

Notes:
"Shaded" facilities indicate the existing Almond Power Plant
Dark lines indicate the proposed A2PP

Source: CH2M HILL, Drawing G-XX-PL-1-A-003, Revision F

**FIGURE 3**
**GENERAL ARRANGEMENT**
ALMOND 2 POWER PLANT
*CERES, CALIFORNIA*



CH2MHILL




Notes:
1. The Department of Water Resources, Groundwater Basin Map, 2004

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N

0 4 8
Miles

# FIGURE 4
# SURFACE WATER RESOURCES

ALMOND 2 POWER PLANT
*CERES, CALIFORNIA*

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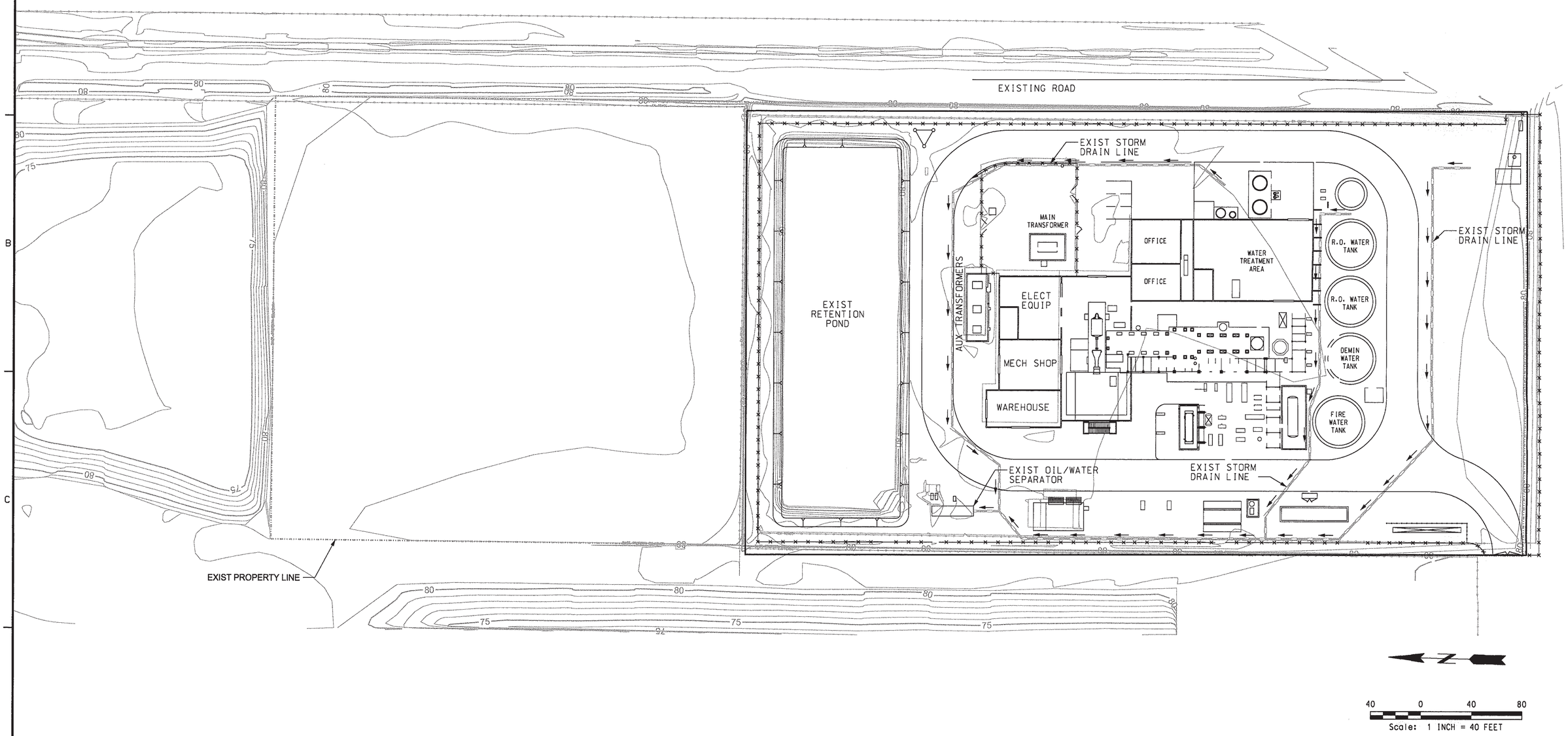


| NO. | DATE | REVISION | BY | CHK |
|---|---|---|---|---|
| A | 01/23/09 | ISSUED FOR REVIEW | TC | JP |

| REVISION APPROVAL | | REV A | DATE 01/23/09 |
|---|---|---|---|
| DISCIPLINE | REVIEWED | DISCIPLINE | REVIEWED |
| CIVIL | JMP | ELECTRICAL | |
| STRUCTURAL | JMP | INST & CONT. | |
| MECHANICAL | | ARCH. | |
| PROCESS | | GEN. ARRANG. | |
| PIPING | | | |

RESPONSIBLE ENGINEER

PE #

| STATUS | | | | | |
|---|---|---|---|---|---|
| ISSUED | REV | DATE | DM | SDE | PEM |
| PRELIMINARY | P1 | | | | |
| FOR REVIEW AND APPROVAL | A | 1-23-09 | JMP | JMP | JOH |
| APPROVED FOR CONSTRUCTION | | | | | |
| REVISED & APPROVED FOR CONSTRUCTION | | | | | |

SCALE AS SHOWN

TURLOCK IRRIGATION DISTRICT
Almond 2 Power Plant
Ceres, CA

PROJECT NO. 383416

CH2MHILL

**FIGURE 5**
**EXISTING SITE PRE-CONSTRUCTION TOPOGRAPHY AND DRAINAGE**
ALMOND 2 POWER PLANT
CERES, CALIFORNIA

DWG. NO. C-000-W-0-001 REV. A

FILENAME: PLOT DATE: PLOT TIME:

BAR IS ONE INCH ON ORIGINAL DRAWING.
0 1"

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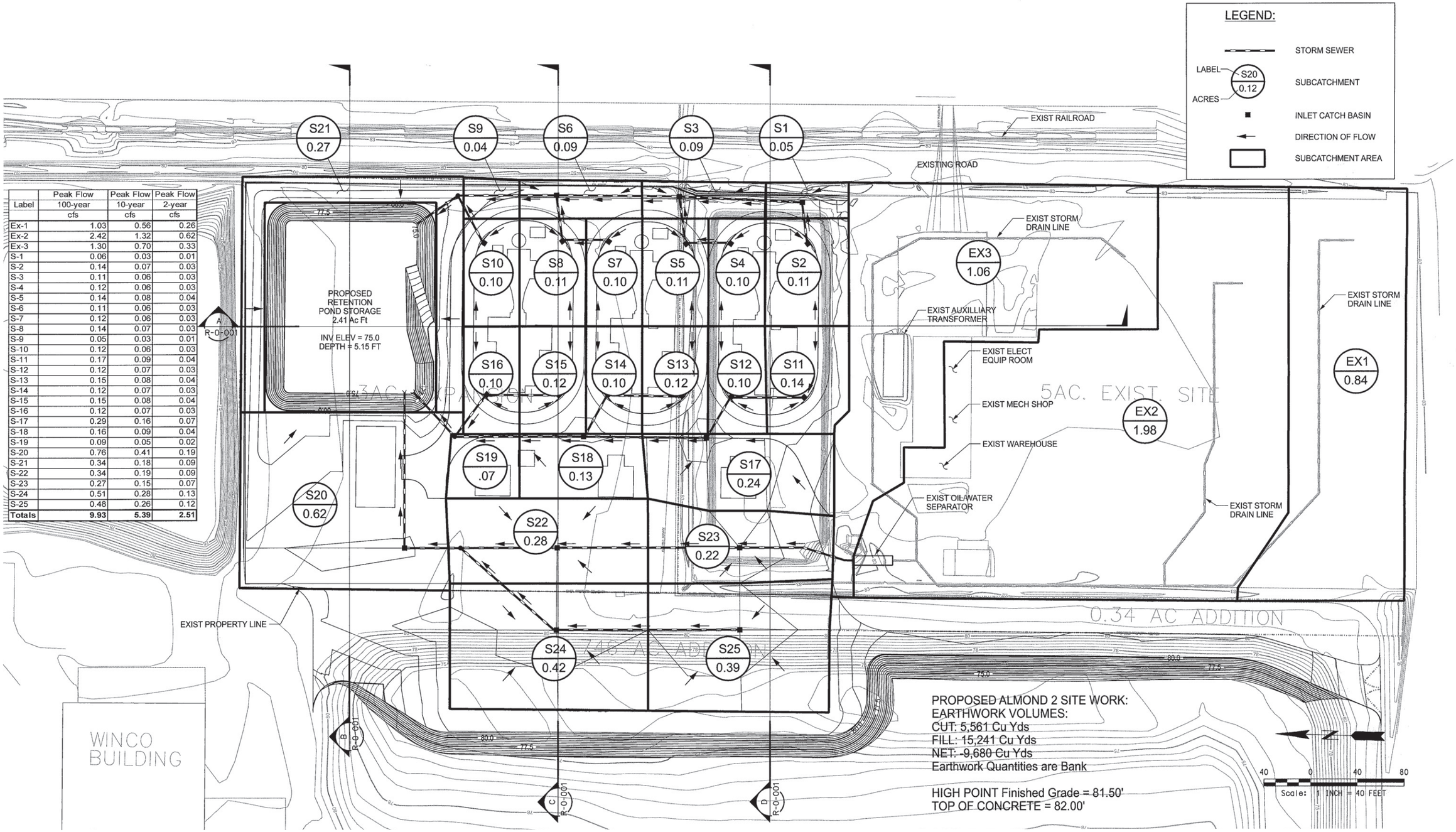
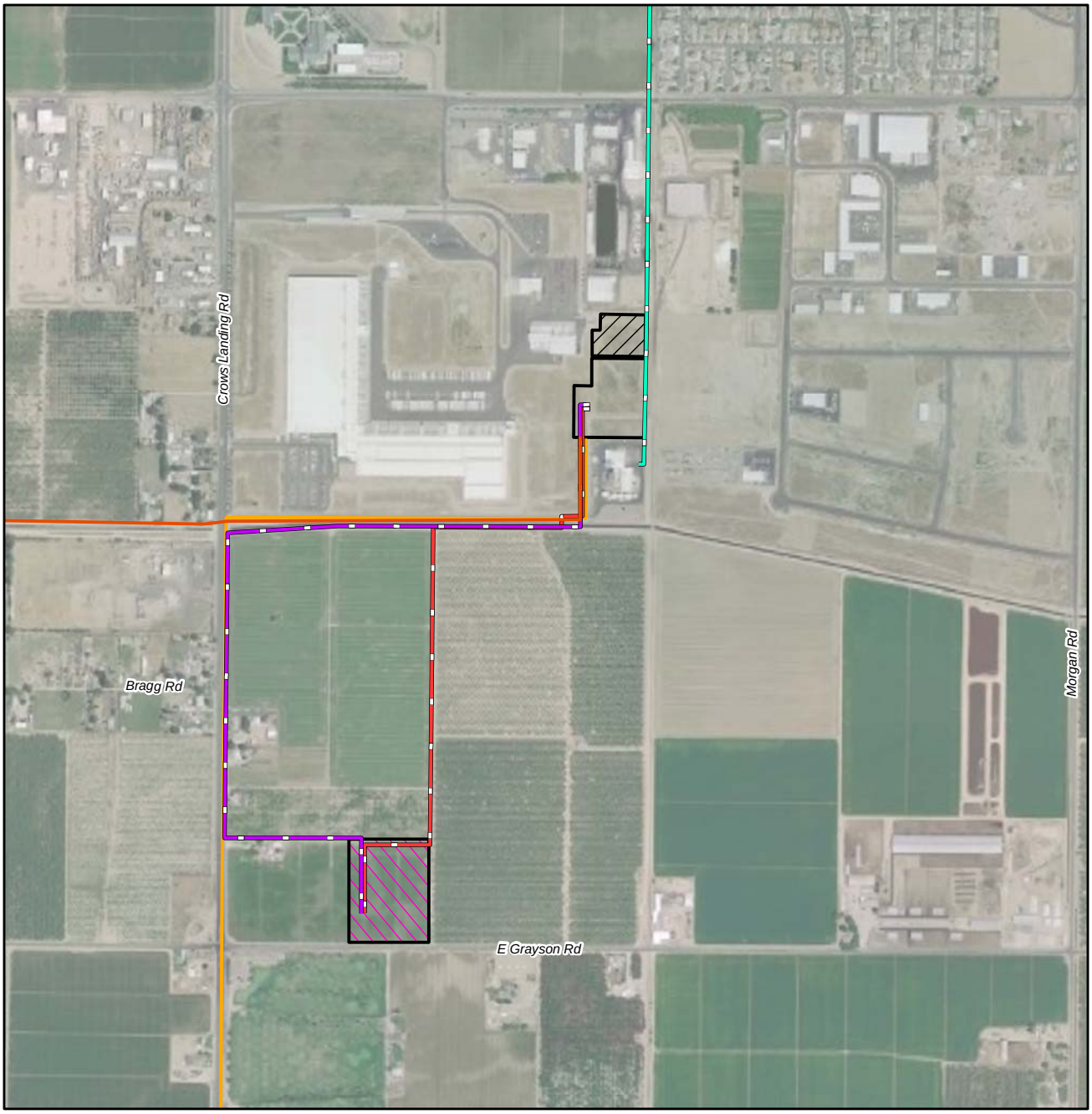



| Label | Peak Flow 100-year cfs | Peak Flow 10-year cfs | Peak Flow 2-year cfs |
|---|---|---|---|
| Ex-1 | 1.03 | 0.56 | 0.26 |
| Ex-2 | 2.42 | 1.32 | 0.62 |
| Ex-3 | 1.30 | 0.70 | 0.33 |
| S-1 | 0.06 | 0.03 | 0.01 |
| S-2 | 0.14 | 0.07 | 0.03 |
| S-3 | 0.11 | 0.06 | 0.03 |
| S-4 | 0.12 | 0.06 | 0.03 |
| S-5 | 0.14 | 0.08 | 0.04 |
| S-6 | 0.11 | 0.06 | 0.03 |
| S-7 | 0.12 | 0.06 | 0.03 |
| S-8 | 0.14 | 0.07 | 0.03 |
| S-9 | 0.05 | 0.03 | 0.01 |
| S-10 | 0.12 | 0.06 | 0.03 |
| S-11 | 0.17 | 0.09 | 0.04 |
| S-12 | 0.12 | 0.07 | 0.03 |
| S-13 | 0.15 | 0.08 | 0.04 |
| S-14 | 0.12 | 0.07 | 0.03 |
| S-15 | 0.15 | 0.08 | 0.04 |
| S-16 | 0.12 | 0.07 | 0.03 |
| S-17 | 0.29 | 0.16 | 0.07 |
| S-18 | 0.16 | 0.09 | 0.04 |
| S-19 | 0.09 | 0.05 | 0.02 |
| S-20 | 0.76 | 0.41 | 0.19 |
| S-21 | 0.34 | 0.18 | 0.09 |
| S-22 | 0.34 | 0.19 | 0.09 |
| S-23 | 0.27 | 0.15 | 0.07 |
| S-24 | 0.51 | 0.28 | 0.13 |
| S-25 | 0.48 | 0.26 | 0.12 |
| **Totals** | **9.93** | **5.39** | **2.51** |

**FIGURE 6**
**DRAINAGE PLAN**
ALMOND 2 POWER PLANT
*CERES, CALIFORNIA*



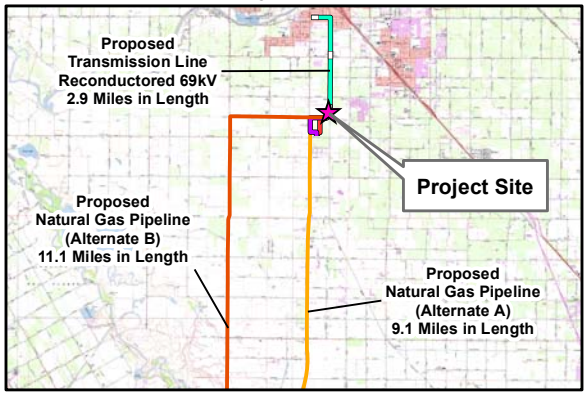

**LEGEND**

- Natural Gas Pipeline (Alternate A)
- Natural Gas Pipeline (Alternate B)
- 115-kV Circuit 1 Line (Corridor 1)
- 115-kV Circuit 2 Line (Corridor 2)
- Reconductored 69kV Sub-Transmission Line
- Proposed Grayson Substation
- Laydown Area
- Project Site

N

0 500 1,000
Feet

VICINITY MAP




Note:
The Grayson Substation is being developed as a separate Project

This map was compiled from various scale source data and maps and is intended for use as only an approximate representation of actual locations.

**FIGURE 7A**
**SITE LOCATION**
ALMOND 2 POWER PLANT
*CERES, CALIFORNIA*

CH2MHILL

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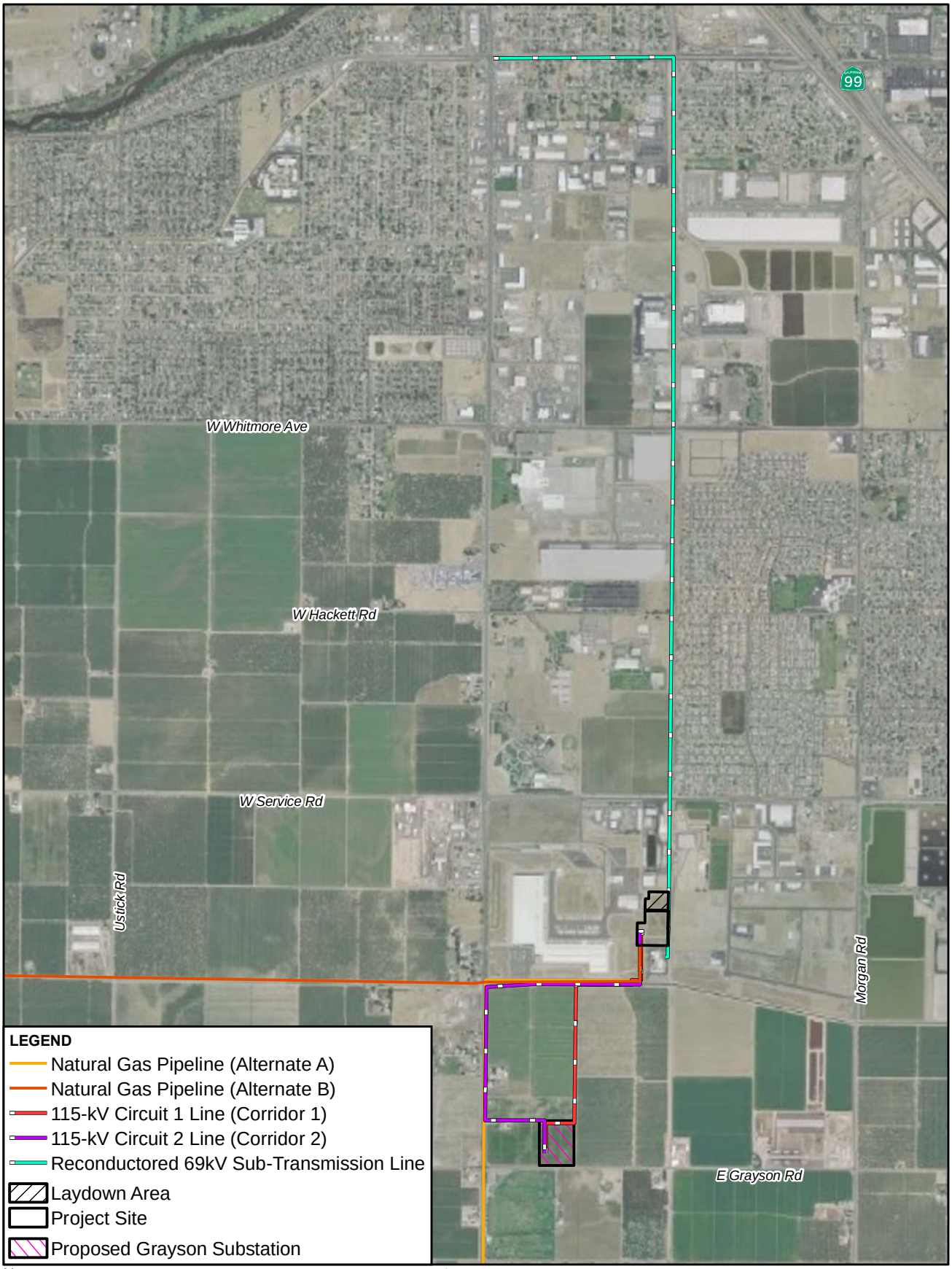


Note:
The Grayson Substation is being developed as a separate Project

This map was compiled from various scale source data and maps and is intended for use as only an approximate representation of actual locations.

N

0 1,000 2,000
Feet

**FIGURE 7B**
**PLANNED TRANSMISSION FACILITIES**
ALMOND 2 POWER PLANT
*CERES, CALIFORNIA*

CH2MHILL

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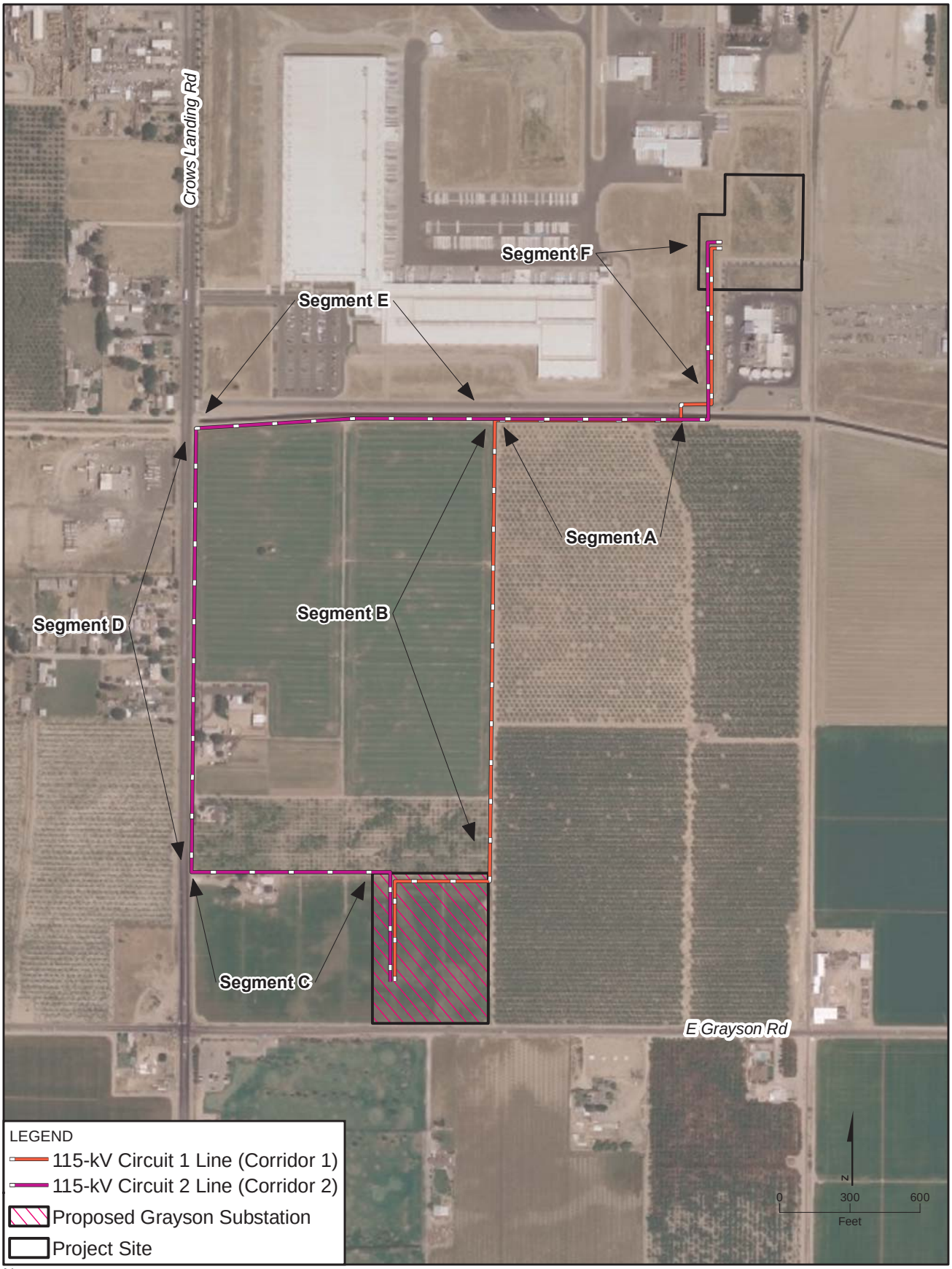


Note:
The Grayson Substation is being developed as a separate Project

This map was compiled from various scale source data and maps and is intended for use as only an approximate representation of actual locations.

**FIGURE 7C**
**NEW A2PP 115kV**
**TRANSMISSION LINE SEGMENTS**
ALMOND 2 POWER PLANT
*CERES, CALIFORNIA*

CH2MHILL

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**LEGEND**

- Natural Gas Pipeline (Alternate A)
- Natural Gas Pipeline (Alternate B)
- Project Site

This map was compiled from various scale source data and maps and is intended for use as only an approximate representation of actual locations.

N

0 2,500 5,000
Feet

**FIGURE 7D**
**NATURAL GAS PIPELINE ROUTE**
ALMOND 2 POWER PLANT
*CERES, CALIFORNIA*

CH2MHILL

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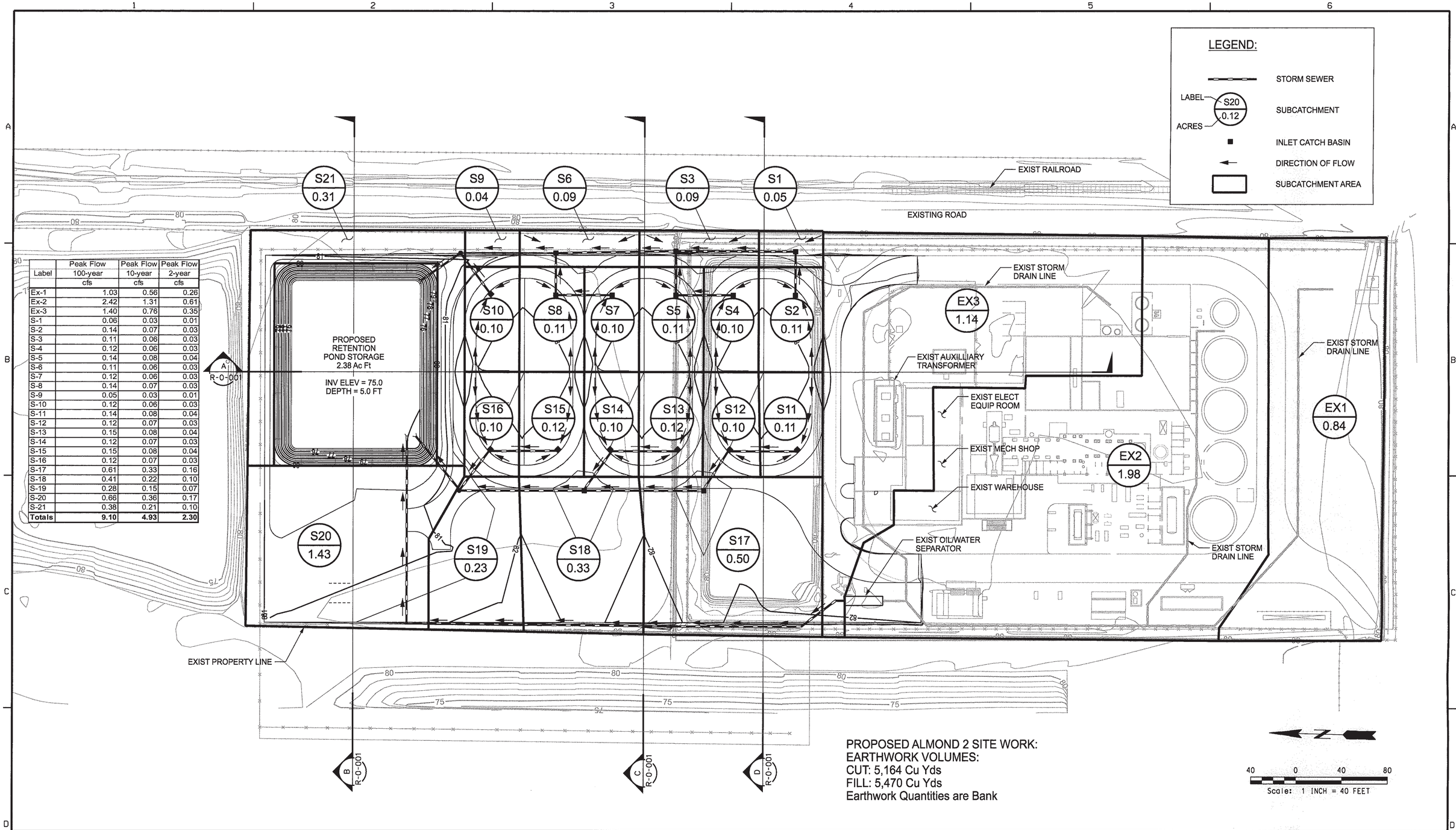


| Label | Peak Flow 100-year cfs | Peak Flow 10-year cfs | Peak Flow 2-year cfs |
|---|---|---|---|
| Ex-1 | 1.03 | 0.56 | 0.26 |
| Ex-2 | 2.42 | 1.31 | 0.61 |
| Ex-3 | 1.40 | 0.76 | 0.35 |
| S-1 | 0.06 | 0.03 | 0.01 |
| S-2 | 0.14 | 0.07 | 0.03 |
| S-3 | 0.11 | 0.06 | 0.03 |
| S-4 | 0.12 | 0.06 | 0.03 |
| S-5 | 0.14 | 0.08 | 0.04 |
| S-6 | 0.11 | 0.06 | 0.03 |
| S-7 | 0.12 | 0.06 | 0.03 |
| S-8 | 0.14 | 0.07 | 0.03 |
| S-9 | 0.05 | 0.03 | 0.01 |
| S-10 | 0.12 | 0.06 | 0.03 |
| S-11 | 0.14 | 0.08 | 0.04 |
| S-12 | 0.12 | 0.07 | 0.03 |
| S-13 | 0.15 | 0.08 | 0.04 |
| S-14 | 0.12 | 0.07 | 0.03 |
| S-15 | 0.15 | 0.08 | 0.04 |
| S-16 | 0.12 | 0.07 | 0.03 |
| S-17 | 0.61 | 0.33 | 0.16 |
| S-18 | 0.41 | 0.22 | 0.10 |
| S-19 | 0.28 | 0.15 | 0.07 |
| S-20 | 0.66 | 0.36 | 0.17 |
| S-21 | 0.38 | 0.21 | 0.10 |
| **Totals** | **9.10** | **4.93** | **2.30** |

PROPOSED ALMOND 2 SITE WORK:
EARTHWORK VOLUMES:
CUT: 5,164 Cu Yds
FILL: 5,470 Cu Yds
Earthwork Quantities are Bank

| NO. | DATE | REVISION | BY | CHK |
|---|---|---|---|---|
| A | 1/23/09 | ISSUED FOR REVIEW | TC | JP |

REVISION APPROVAL — REV A — DATE 01/23/09

| DISCIPLINE | REVIEWED | DISCIPLINE | REVIEWED |
|---|---|---|---|
| CIVIL | | ELECTRICAL | |
| STRUCTURAL | | INST & CONT. | |
| MECHANICAL | | ARCH. | |
| PROCESS | | GEN. ARRANG. | |
| PIPING | | | |

| STATUS | REV | DATE | DM | SDE | PEM |
|---|---|---|---|---|---|
| PRELIMINARY | P1 | | | | |
| FOR REVIEW AND APPROVAL | A | 1-23-09 | | | |
| APPROVED FOR CONSTRUCTION | | | | | |
| REVISED & APPROVED FOR CONSTRUCTION | | | | | |

RESPONSIBLE ENGINEER
PE #

TURLOCK IRRIGATION DISTRICT
Almond 2 Power Plant
Ceres, CA

PROJECT NO. 383416

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FIGURE 8A
GRADING AND DRAINAGE PLAN
ALMOND 2 POWER PLANT
CERES, CALIFORNIA

DWG. NO. C-000-W-0-002 REV. A

FILENAME: PLOT DATE: PLOT TIME:

BAR IS ONE INCH ON ORIGINAL DRAWING.
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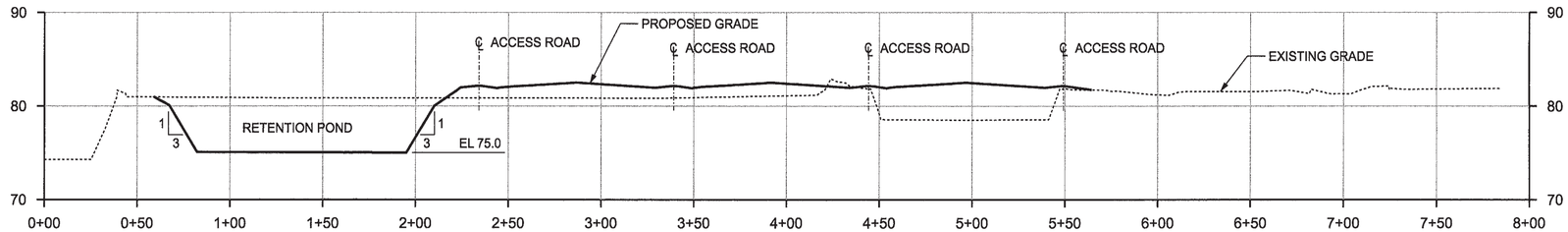


SECTION A W-0-002
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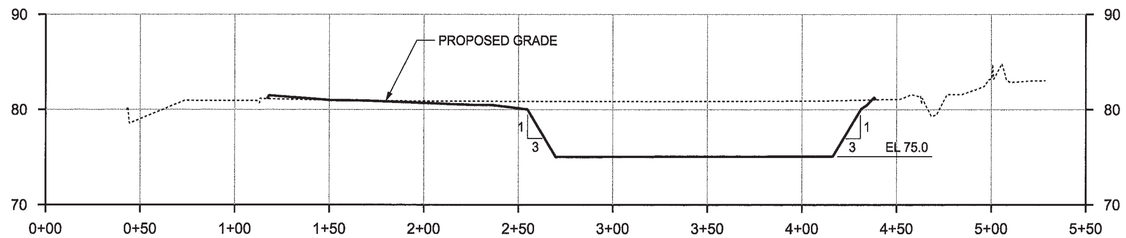
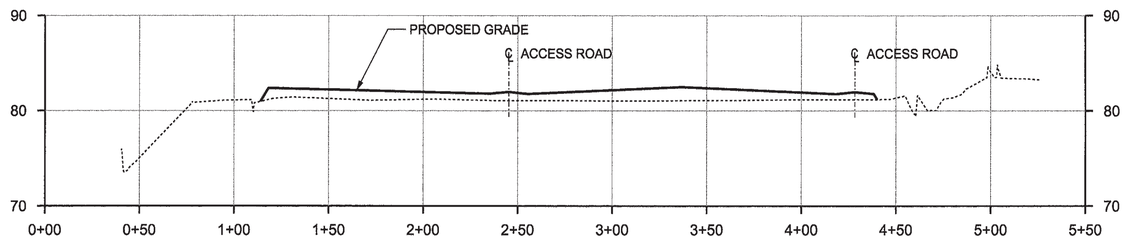
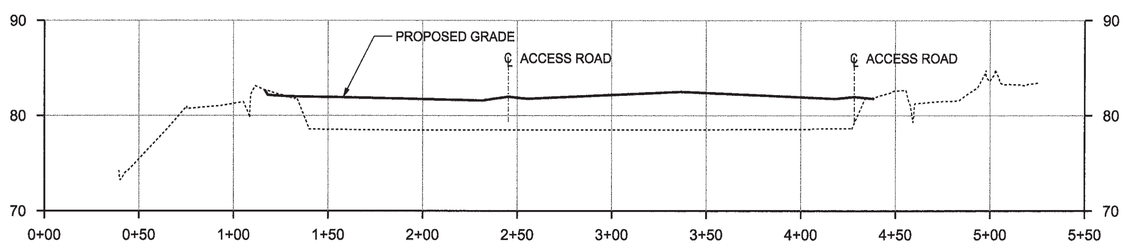



SECTION B W-0-002
SCALE: 1" = 40'




SECTION C W-0-002
SCALE: 1" = 40'




SECTION D W-0-002
SCALE: 1" = 40'

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| A | 01/23/09 | ISSUED FOR REVIEW | TC | JP |

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| DISCIPLINE | REVIEWED | DISCIPLINE | REVIEWED |
| CIVIL | | ELECTRICAL | |
| STRUCTURAL | | INST & CONT. | |
| MECHANICAL | | ARCH. | |
| PROCESS | | GEN. ARRANG. | |
| PIPING | | | |

| STATUS | | | | | |
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| ISSUED | REV | DATE | DM | SDE | PEM |
| PRELIMINARY | P1 | | | | |
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TURLOCK IRRIGATION DISTRICT
Almond 2 Power Plant
Ceres, CA

PROJECT NO. 383416

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**FIGURE 8B**
**CIVIL AND DRAINAGE SECTIONS**
ALMOND 2 POWER PLANT
*CERES, CALIFORNIA*

DWG. NO. C-000-R-0-001 REV. A

BAR IS ONE INCH ON ORIGINAL DRAWING.
0 1"

FILENAME: PLOT DATE: PLOT TIME:

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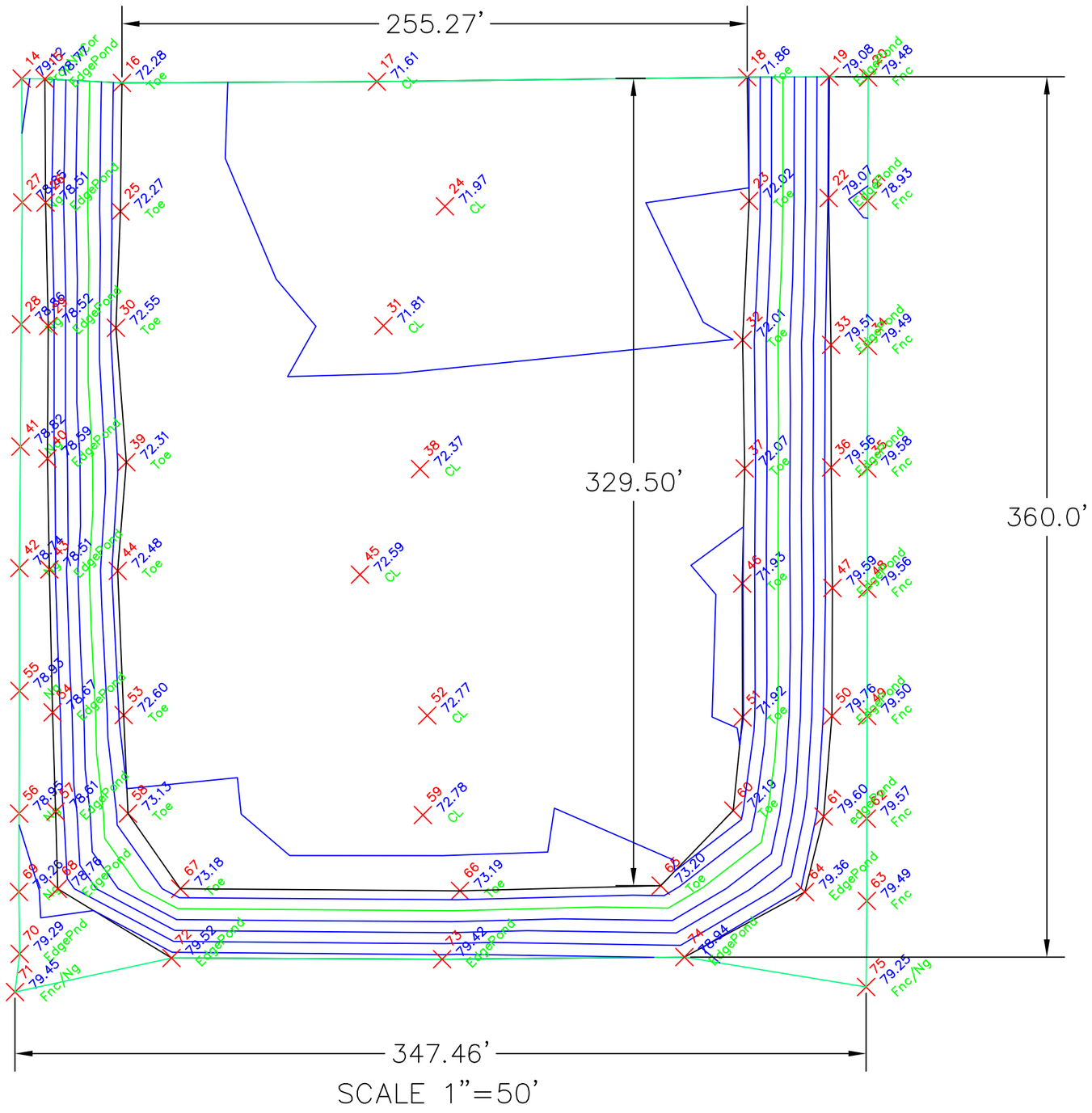



ALMOND POWER PLANT EXPANSION SITE NOTES:

1. TOTAL UNADJUSTED VOLUME 24,245 CU.YDS.
2. TOTAL ESTIMATED VOLUME W/ 23.73% ADJ. 30,000 CU.YDS.
3. CONTRACTOR TO BRING SITE TO MATCH EXISTING PERIMETER
4. TOTAL YARDS ARE YARD PLACED ON SITE
5. SITE SHALL BE FILLED IN 1FT LIFTS AND COMPACTED TO 90% RELATIVE COMPACTION
6. TID GEOTECH ENG. SHALL INSPECT COMPACTION

**FIGURE 8C**
**GRADING PLAN**
ALMOND 2 POWER PLANT
CERES, CALIFORNIA

CH2MHILL

WB082009009RDD_5C

# Attachment B
# Hydrology Calculations

CH2MHILL

**CALCULATION SUMMARY & CONTROL SHEET**

**CALCULATION SET NO. 383416-CE-01**

| PRELIM. | FINAL | VOID | REVISION |
|---|---|---|---|
| X | | | A |

Sheet 1 of 21

Discipline Civil

CLIENT: Turlock Irrigation District Water & Power

PROJECT TITLE: Almond Two Power Plant

Project No. 383416

SUBJECT: Drainage calculations for Peak Runoff and Retention Pond sizing.

COMPLETED BY: *John Purdy, P.E.* JMP DATE: 1-23-09

CHECKED BY: *Mario Scacco, P.E.* MMS DATE: 1-23-09

APPROVED BY: N/A DATE:

REVISION SUMMARY: *Initial submittal*

TOTAL NUMBER OF SHEETS IN THIS ISSUE:

SHEETS REVISED, ADDED, or DELETED: *None*

PROBLEM STATEMENT: *Calculate subbasin peak runoff flows and confirm the size of the site stormwater retention pond.*

RESULTS & CONCLUSIONS: *The final pond size of 2.83 acre-feet will accommodate the calculated 100 -year storm runoff volume of 0.95 Ac-Ft with 2.74-feet of freeboard.*

DESIGN BASIS & ASSUMPTIONS: *See page 2*

UNVERIFIED ASSUMPTIONS/OPEN ITEMS: N/A

REFERENCES: NOAA Atlas 2, Volume XI

ATTACHMENTS (Including number of pages): *Drainage System Schematic (1p), Bentley CivilStorm Output Report (9p), California Precipitation Frequency Data Output (1p), Hydrologic Soil Group (4p), Retention Pond Stage-Storage for Rectangular Basin Calculation (1), 100-Year Storm Stormdrain Profiles (3)*

COMPUTER PROGRAM DISCLOSURE INFORMATION:

| Program Used | Rev No./Issue Date | CH2M Verified |
|---|---|---|
| *Bentley Civil Storm* | *V8 XM /* | X Yes ____ No |

**Site hydrology will be based on the following criteria:**

Method: SCS Unit Hydrograph Method
Rainfall Distribution: SCS Type I
Hydrologic Soil Group: Group B (See Attachment from NRCS)
Curve Number: 88 - Urban industrial, 72% imp (conservative), HSG B
Drainage Area: 8.03 Acres – Calculation takes into account the proposed project area of 3.01 Acres and the existing Almond Power Plant which is sited on 5.02 Acres.
Minimum Pipe Size for Storm Drain Main Line: 18-inches

**Design Storms:**

2-year 24 hour - 1.33 inches (Prec. Freq. Data Output, NOAA Atlas 2, See Attachment)
10-year 24 hour – 1.9 inches (NOAA Atlas 2, Volume XI, Figure 17, not Attached)
100-year 24 hour – 2.70 inches Prec. Freq. Data Output, NOAA Atlas 2, See Attachment)

**Computed runoff volume tributary to the On-Site Retention Pond:**

2-year 24 hour – 0.29 Acre-ft, peak elevation 75.72 ft
10-year 24 hour - 0.54 Acre-ft, peak elevation 76.34 ft
100-year 24 hour – 0.95 Acre-ft, peak elevation 77.26 ft with 2.74 ft of freeboard

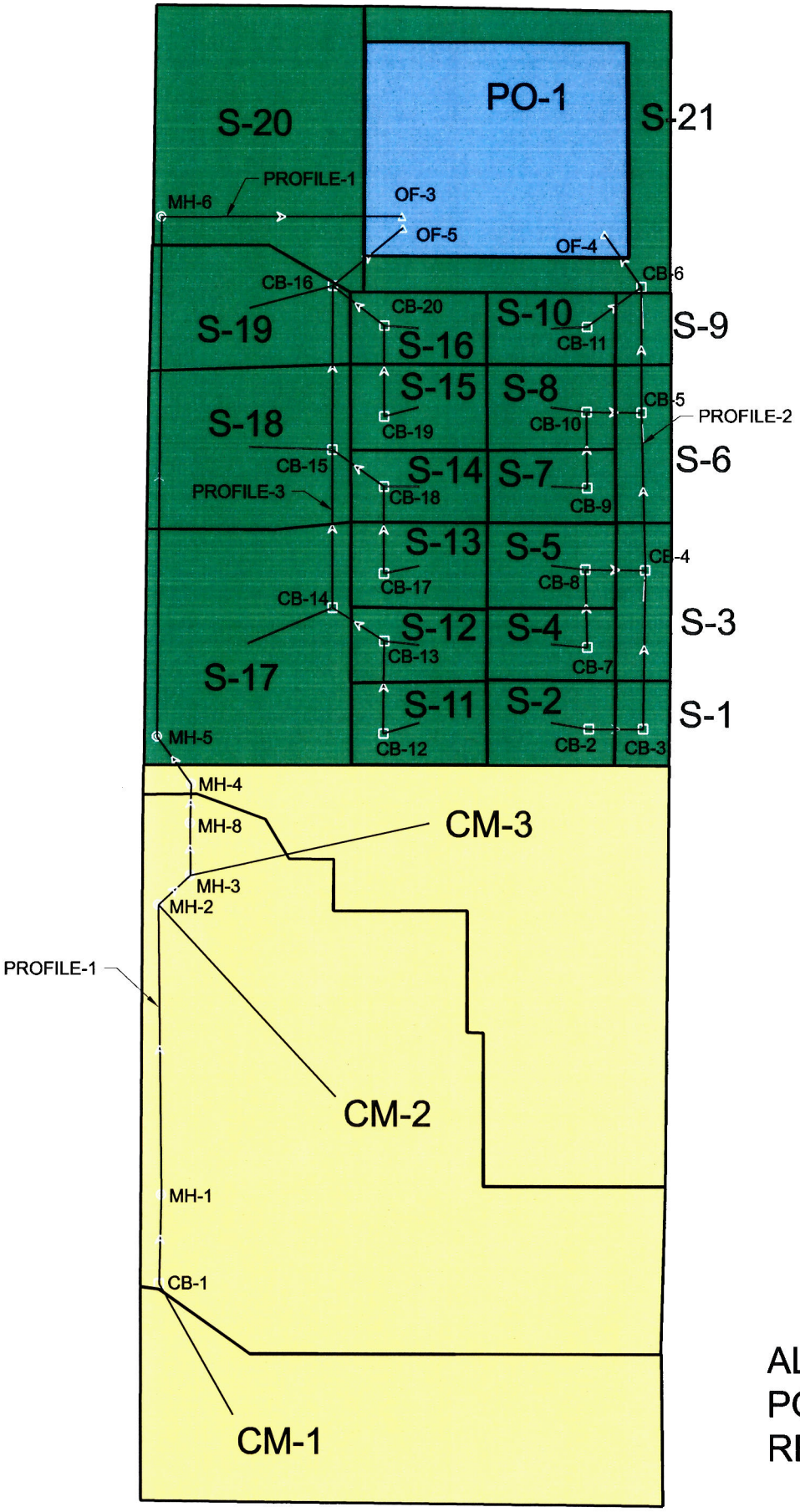
**System Description:**

The Almond Power Plant is an existing facility in Stanislaus County located near the Town of Ceres, California. The existing plant storm system incorporates a series of inlets and drainage pipes which convey runoff to a oil water separator, which is then discharged to an on-site retention pond.

The proposed project, Almond 2 Power Plant, involves expanding the facility to the north on an adjacent three acre parcel, which includes the existing on-site retention pond, bringing the total area of the facility to just over eight acres. The proposed facility will mitigate storm runoff with a series of inlets and storm drain pipes which will convey the runoff to a proposed on-site retention pond located on the north end of the site. Areas of potential oil contamination will be sited inside containments which will prevent potential contaminates from being conveyed to the storm system. Storm water that is contained will be treated and disposed of per the regulatory requirements. The implementation of these containments will enable for the balance of site runoff to be conveyed directly to the retention pond without prior treatment through an oil water separator.

The existing plant storm system will be tied into at the downstream end of the oil water separator and conveyed to the proposed retention pond by a separate storm drain pipe system. This system is over 550-feet long and therefore incorporates a 0.3 % slope to keep pond and trench depths reasonable. Referring to Profile-1 this system can convey the 100-year peak runoff without ponding at the existing facility even though the pipe invert at the oil water separator is about 2.5 feet above the oil water separator invert. A mechanical system will be implemented to drain the system up stream of the oil water separator when standing water is present.

# DRAINAGE SYSTEM SCHEMATIC




NORTH

ALMOND 2
POWER PLANT
REV A 1/23/09

ALMOND TWO POWER PLANT 1/23/2009
100-YEAR
CATCHMENT SUMMARY

| Label | Runoff Method | Loss Method | Total Rainfall Depth (in) | Area (acres) | Volume Total Runoff (ac-ft) | Flow (Peak) ($ft^3/s$) | Time To Peak (min) |
|---|---|---|---|---|---|---|---|
| CM-1 | Unit Hydrograph | SCS CN | 2.70 | 0.84 | 0.11 | 1.03 | 595.00 |
| CM-2 | Unit Hydrograph | SCS CN | 2.70 | 1.98 | 0.26 | 2.42 | 595.00 |
| CM-3 | Unit Hydrograph | SCS CN | 2.70 | 1.14 | 0.15 | 1.40 | 595.00 |
| S-1 | Unit Hydrograph | SCS CN | 2.70 | 0.05 | 0.01 | 0.06 | 595.00 |
| S-2 | Unit Hydrograph | SCS CN | 2.70 | 0.11 | 0.01 | 0.14 | 595.00 |
| S-3 | Unit Hydrograph | SCS CN | 2.70 | 0.09 | 0.01 | 0.11 | 595.00 |
| S-4 | Unit Hydrograph | SCS CN | 2.70 | 0.10 | 0.01 | 0.12 | 595.00 |
| S-5 | Unit Hydrograph | SCS CN | 2.70 | 0.11 | 0.01 | 0.14 | 595.00 |
| S-6 | Unit Hydrograph | SCS CN | 2.70 | 0.09 | 0.01 | 0.11 | 595.00 |
| S-7 | Unit Hydrograph | SCS CN | 2.70 | 0.10 | 0.01 | 0.12 | 595.00 |
| S-8 | Unit Hydrograph | SCS CN | 2.70 | 0.11 | 0.01 | 0.14 | 595.00 |
| S-9 | Unit Hydrograph | SCS CN | 2.70 | 0.04 | 0.01 | 0.05 | 595.00 |
| S-10 | Unit Hydrograph | SCS CN | 2.70 | 0.10 | 0.01 | 0.12 | 595.00 |
| S-11 | Unit Hydrograph | SCS CN | 2.70 | 0.11 | 0.01 | 0.14 | 595.00 |
| S-12 | Unit Hydrograph | SCS CN | 2.70 | 0.10 | 0.01 | 0.12 | 595.00 |
| S-13 | Unit Hydrograph | SCS CN | 2.70 | 0.12 | 0.02 | 0.15 | 595.00 |
| S-14 | Unit Hydrograph | SCS CN | 2.70 | 0.10 | 0.01 | 0.12 | 595.00 |
| S-15 | Unit Hydrograph | SCS CN | 2.70 | 0.12 | 0.02 | 0.15 | 595.00 |
| S-16 | Unit Hydrograph | SCS CN | 2.70 | 0.10 | 0.01 | 0.12 | 595.00 |
| S-17 | Unit Hydrograph | SCS CN | 2.70 | 0.50 | 0.06 | 0.61 | 595.00 |
| S-18 | Unit Hydrograph | SCS CN | 2.70 | 0.33 | 0.04 | 0.41 | 595.00 |
| S-19 | Unit Hydrograph | SCS CN | 2.70 | 0.23 | 0.03 | 0.28 | 595.00 |
| S-20 | Unit Hydrograph | SCS CN | 2.70 | 1.43 | 0.07 | 0.66 | 595.00 |
| S-21 | Unit Hydrograph | SCS CN | 2.70 | 0.31 | 0.04 | 0.38 | 595.00 |

ALMOND TWO POWER PLANT 1/23/2009
100-YEAR
GENERAL SUMMARY

| Label | Element Type | Branch | Time to Max Flow (min) | Flow (Max) ($ft^3/s$) | Velocity (Max) (ft/s) | Hydraulic Grade (Max) (ft) |
|---|---|---|---|---|---|---|
| MH-1 | Manhole | 8 | --- | --- | --- | 78.75 |
| MH-2 | Manhole | 8 | --- | --- | --- | 77.86 |
| MH-3 | Manhole | 8 | --- | --- | --- | 77.82 |
| MH-4 | Manhole | 8 | --- | --- | --- | 77.49 |
| MH-5 | Manhole | 8 | --- | --- | --- | 77.39 |
| MH-6 | Manhole | 8 | --- | --- | --- | 77.26 |
| MH-8 | Manhole | 8 | --- | --- | --- | 77.58 |
| CB-1 | Catch Basin | 8 | --- | --- | --- | 78.76 |
| CB-2 | Catch Basin | 4 | --- | --- | --- | 78.67 |
| CB-3 | Catch Basin | 4 | --- | --- | --- | 78.52 |
| CB-4 | Catch Basin | 4 | --- | --- | --- | 78.08 |
| CB-5 | Catch Basin | 4 | --- | --- | --- | 77.64 |
| CB-6 | Catch Basin | 4 | --- | --- | --- | 77.26 |
| CB-7 | Catch Basin | 5 | --- | --- | --- | 78.66 |
| CB-8 | Catch Basin | 5 | --- | --- | --- | 78.43 |
| CB-9 | Catch Basin | 6 | --- | --- | --- | 78.67 |
| CB-10 | Catch Basin | 6 | --- | --- | --- | 78.41 |
| CB-11 | Catch Basin | 7 | --- | --- | --- | 78.61 |
| CB-12 | Catch Basin | 1 | --- | --- | --- | 78.68 |
| CB-13 | Catch Basin | 1 | --- | --- | --- | 78.43 |
| CB-14 | Catch Basin | 1 | --- | --- | --- | 78.34 |
| CB-15 | Catch Basin | 1 | --- | --- | --- | 77.94 |
| CB-16 | Catch Basin | 1 | --- | --- | --- | 77.48 |
| CB-17 | Catch Basin | 2 | --- | --- | --- | 78.68 |
| CB-18 | Catch Basin | 2 | --- | --- | --- | 78.38 |
| CB-19 | Catch Basin | 3 | --- | --- | --- | 78.68 |
| CB-20 | Catch Basin | 3 | --- | --- | --- | 78.35 |
| CO-1 | Conduit | 8 | 598 | 0.97 | 1.24 | 78.76 |
| CO-2 | Conduit | 8 | 595 | 3.28 | 4.18 | 78.23 |
| CO-3 | Conduit | 8 | 595 | 3.27 | 4.17 | 77.83 |
| CO-6 | Conduit | 8 | 598 | 4.51 | 4.52 | 77.43 |
| CO-7 | Conduit | 8 | 598 | 4.54 | 4.42 | 77.26 |
| CO-10 | Conduit | 8 | 598 | 4.21 | 4.14 | 77.26 |
| CO-11 | Conduit | 8 | 595 | 4.63 | 5.89 | 77.60 |
| CO-12 | Conduit | 8 | 598 | 4.51 | 4.52 | 77.52 |
| CO-13 | Conduit | 4 | 595 | 0.13 | 0.74 | 78.60 |
| CO-14 | Conduit | 4 | 595 | 0.18 | 1.65 | 78.27 |
| CO-15 | Conduit | 4 | 598 | 0.53 | 2.31 | 77.82 |
| CO-16 | Conduit | 4 | 598 | 0.88 | 2.75 | 77.41 |
| CO-17 | Conduit | 4 | 598 | 1.03 | 2.91 | 77.26 |
| CO-18 | Conduit | 5 | 595 | 0.11 | 0.64 | 78.53 |
| CO-19 | Conduit | 5 | 595 | 0.24 | 2.46 | 78.20 |
| CO-20 | Conduit | 6 | 595 | 0.11 | 0.65 | 78.55 |
| CO-21 | Conduit | 6 | 595 | 0.24 | 3.34 | 77.98 |
| CO-22 | Conduit | 7 | 595 | 0.12 | 0.64 | 77.87 |
| CO-23 | Conduit | 1 | 595 | 0.13 | 0.76 | 78.53 |
| CO-24 | Conduit | 1 | 595 | 0.25 | 1.67 | 78.34 |
| CO-25 | Conduit | 1 | 595 | 0.83 | 2.70 | 78.08 |
| CO-26 | Conduit | 1 | 598 | 1.46 | 3.17 | 77.67 |
| CO-27 | Conduit | 1 | 598 | 1.99 | 3.56 | 77.30 |
| CO-28 | Conduit | 2 | 595 | 0.14 | 0.80 | 78.55 |
| CO-29 | Conduit | 2 | 595 | 0.26 | 2.95 | 78.00 |
| CO-30 | Conduit | 3 | 595 | 0.14 | 0.79 | 78.53 |
| CO-31 | Conduit | 3 | 595 | 0.26 | 3.51 | 77.71 |
| PO-1 | Pond | 1 | --- | --- | --- | 77.26 |

ALMOND TWO POWER PLANT
100-YEAR
NODE SUMMARY

1/23/2009

| Label | Element Type | Branch | Time to Maximum Inflow (min) | Flow (Total In Max) (ft³/s) | Time To Max Inlet Flow (min) | Flow (Surface Maximum) (ft³/s) | Time To Max Captured Flow (min) | Flow (Captured Max) (ft³/s) |
|---|---|---|---|---|---|---|---|---|
| MH-1 | Manhole | 8 | 595 | 3.37 | --- | --- | --- | --- |
| MH-2 | Manhole | 8 | 595 | 3.28 | --- | --- | --- | --- |
| MH-3 | Manhole | 8 | 595 | 4.67 | --- | --- | --- | --- |
| MH-4 | Manhole | 8 | 598 | 4.51 | --- | --- | --- | --- |
| MH-5 | Manhole | 8 | 598 | 4.51 | --- | --- | --- | --- |
| MH-6 | Manhole | 8 | 598 | 4.54 | --- | --- | --- | --- |
| MH-8 | Manhole | 8 | 595 | 4.63 | --- | --- | --- | --- |
| CB-1 | Catch Basin | 8 | 595 | 1.03 | 595 | 1.03 | 595 | 1.03 |
| CB-2 | Catch Basin | 4 | 595 | 0.14 | 595 | 0.14 | 595 | 0.14 |
| CB-3 | Catch Basin | 4 | 595 | 0.19 | 595 | 0.06 | 595 | 0.06 |
| CB-4 | Catch Basin | 4 | 595 | 0.53 | 595 | 0.11 | 595 | 0.11 |
| CB-5 | Catch Basin | 4 | 598 | 0.86 | 595 | 0.11 | 595 | 0.11 |
| CB-6 | Catch Basin | 4 | 598 | 1.03 | 595 | 0.05 | 595 | 0.05 |
| CB-7 | Catch Basin | 5 | 595 | 0.12 | 595 | 0.12 | 595 | 0.12 |
| CB-8 | Catch Basin | 5 | 595 | 0.25 | 595 | 0.14 | 595 | 0.14 |
| CB-9 | Catch Basin | 6 | 595 | 0.12 | 595 | 0.12 | 595 | 0.12 |
| CB-10 | Catch Basin | 6 | 595 | 0.25 | 595 | 0.14 | 595 | 0.14 |
| CB-11 | Catch Basin | 7 | 595 | 0.12 | 595 | 0.12 | 595 | 0.12 |
| CB-12 | Catch Basin | 1 | 595 | 0.14 | 595 | 0.14 | 595 | 0.14 |
| CB-13 | Catch Basin | 1 | 595 | 0.26 | 595 | 0.12 | 595 | 0.12 |
| CB-14 | Catch Basin | 1 | 595 | 0.86 | 595 | 0.61 | 595 | 0.61 |
| CB-15 | Catch Basin | 1 | 595 | 1.49 | 595 | 0.41 | 595 | 0.41 |
| CB-16 | Catch Basin | 1 | 598 | 1.98 | 595 | 0.28 | 595 | 0.28 |
| CB-17 | Catch Basin | 2 | 595 | 0.15 | 595 | 0.15 | 595 | 0.15 |
| CB-18 | Catch Basin | 2 | 595 | 0.26 | 595 | 0.12 | 595 | 0.12 |
| CB-19 | Catch Basin | 3 | 595 | 0.15 | 595 | 0.15 | 595 | 0.15 |
| CB-20 | Catch Basin | 3 | 595 | 0.26 | 595 | 0.12 | 595 | 0.12 |
| OF-3 | Outfall | 0 | (N/A) | (N/A) | --- | --- | --- | --- |
| OF-4 | Outfall | 0 | (N/A) | (N/A) | --- | --- | --- | --- |
| OF-5 | Outfall | 0 | (N/A) | (N/A) | --- | --- | --- | --- |
| PO-1 | Pond | 1 | 598 | 8.37 | --- | --- | --- | --- |

RETENTION POND
SUMMARY

| Time to Max Inflow (min) | Flow (Total In Maximum) (ft³/s) | Time to Max Hydraulic Grade & Storage (min) | Depth (Maximum) (ft) | Hydraulic Grade (Maximum) (ft) | Storage (Maximum) (ac-ft) |
|---|---|---|---|---|---|
| 598 | 8.37 | 1437.98 | 2.26 | 77.26 | 0.95 |

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ALMOND TWO POWER PLANT 1/23/2009
10-YEAR
CATCHMENT SUMMARY

| Label | Runoff Method | Loss Method | Total Rainfall Depth (in) | Area (acres) | Volume Total Runoff (ac-ft) | Flow (Peak) ($ft^3/s$) | Time To Peak (min) |
|---|---|---|---|---|---|---|---|
| CM-1 | Unit Hydrograph | SCS CN | 1.90 | 0.84 | 0.06 | 0.56 | 595.00 |
| CM-2 | Unit Hydrograph | SCS CN | 1.90 | 1.98 | 0.15 | 1.31 | 595.00 |
| CM-3 | Unit Hydrograph | SCS CN | 1.90 | 1.14 | 0.08 | 0.76 | 595.00 |
| S-1 | Unit Hydrograph | SCS CN | 1.90 | 0.05 | 0.00 | 0.03 | 595.00 |
| S-2 | Unit Hydrograph | SCS CN | 1.90 | 0.11 | 0.01 | 0.07 | 595.00 |
| S-3 | Unit Hydrograph | SCS CN | 1.90 | 0.09 | 0.01 | 0.06 | 595.00 |
| S-4 | Unit Hydrograph | SCS CN | 1.90 | 0.10 | 0.01 | 0.06 | 595.00 |
| S-5 | Unit Hydrograph | SCS CN | 1.90 | 0.11 | 0.01 | 0.08 | 595.00 |
| S-6 | Unit Hydrograph | SCS CN | 1.90 | 0.09 | 0.01 | 0.06 | 595.00 |
| S-7 | Unit Hydrograph | SCS CN | 1.90 | 0.10 | 0.01 | 0.06 | 595.00 |
| S-8 | Unit Hydrograph | SCS CN | 1.90 | 0.11 | 0.01 | 0.07 | 595.00 |
| S-9 | Unit Hydrograph | SCS CN | 1.90 | 0.04 | 0.00 | 0.03 | 595.00 |
| S-10 | Unit Hydrograph | SCS CN | 1.90 | 0.10 | 0.01 | 0.06 | 595.00 |
| S-11 | Unit Hydrograph | SCS CN | 1.90 | 0.11 | 0.01 | 0.08 | 595.00 |
| S-12 | Unit Hydrograph | SCS CN | 1.90 | 0.10 | 0.01 | 0.07 | 595.00 |
| S-13 | Unit Hydrograph | SCS CN | 1.90 | 0.12 | 0.01 | 0.08 | 595.00 |
| S-14 | Unit Hydrograph | SCS CN | 1.90 | 0.10 | 0.01 | 0.07 | 595.00 |
| S-15 | Unit Hydrograph | SCS CN | 1.90 | 0.12 | 0.01 | 0.08 | 595.00 |
| S-16 | Unit Hydrograph | SCS CN | 1.90 | 0.10 | 0.01 | 0.07 | 595.00 |
| S-17 | Unit Hydrograph | SCS CN | 1.90 | 0.50 | 0.04 | 0.33 | 595.00 |
| S-18 | Unit Hydrograph | SCS CN | 1.90 | 0.33 | 0.02 | 0.22 | 595.00 |
| S-19 | Unit Hydrograph | SCS CN | 1.90 | 0.23 | 0.02 | 0.15 | 595.00 |
| S-20 | Unit Hydrograph | SCS CN | 1.90 | 1.43 | 0.04 | 0.36 | 595.00 |
| S-21 | Unit Hydrograph | SCS CN | 1.90 | 0.31 | 0.02 | 0.21 | 595.00 |

ALMOND TWO POWER PLANT
10-YEAR
GENERAL SUMMARY

1/23/2009

| Label | Element Type | Branch | Time to Max Flow (min) | Flow (Max) ($ft^3/s$) | Velocity (Max) (ft/s) | Hydraulic Grade (Max) (ft) |
|---|---|---|---|---|---|---|
| MH-1 | Manhole | 8 | --- | --- | --- | 77.44 |
| MH-2 | Manhole | 8 | --- | --- | --- | 77.37 |
| MH-3 | Manhole | 8 | --- | --- | --- | 77.36 |
| MH-4 | Manhole | 8 | --- | --- | --- | 77.26 |
| MH-5 | Manhole | 8 | --- | --- | --- | 77.13 |
| MH-6 | Manhole | 8 | --- | --- | --- | 76.34 |
| MH-8 | Manhole | 8 | --- | --- | --- | 77.34 |
| CB-1 | Catch Basin | 8 | --- | --- | --- | 77.44 |
| CB-2 | Catch Basin | 4 | --- | --- | --- | 78.64 |
| CB-3 | Catch Basin | 4 | --- | --- | --- | 78.48 |
| CB-4 | Catch Basin | 4 | --- | --- | --- | 78.01 |
| CB-5 | Catch Basin | 4 | --- | --- | --- | 77.54 |
| CB-6 | Catch Basin | 4 | --- | --- | --- | 77.14 |
| CB-7 | Catch Basin | 5 | --- | --- | --- | 78.63 |
| CB-8 | Catch Basin | 5 | --- | --- | --- | 78.38 |
| CB-9 | Catch Basin | 6 | --- | --- | --- | 78.64 |
| CB-10 | Catch Basin | 6 | --- | --- | --- | 78.38 |
| CB-11 | Catch Basin | 7 | --- | --- | --- | 78.58 |
| CB-12 | Catch Basin | 1 | --- | --- | --- | 78.64 |
| CB-13 | Catch Basin | 1 | --- | --- | --- | 78.38 |
| CB-14 | Catch Basin | 1 | --- | --- | --- | 78.25 |
| CB-15 | Catch Basin | 1 | --- | --- | --- | 77.81 |
| CB-16 | Catch Basin | 1 | --- | --- | --- | 77.33 |
| CB-17 | Catch Basin | 2 | --- | --- | --- | 78.64 |
| CB-18 | Catch Basin | 2 | --- | --- | --- | 78.34 |
| CB-19 | Catch Basin | 3 | --- | --- | --- | 78.64 |
| CB-20 | Catch Basin | 3 | --- | --- | --- | 78.32 |
| CO-1 | Conduit | 8 | 598 | 0.53 | 0.68 | 77.44 |
| CO-2 | Conduit | 8 | 595 | 1.76 | 2.24 | 77.40 |
| CO-3 | Conduit | 8 | 598 | 1.76 | 2.24 | 77.36 |
| CO-6 | Conduit | 8 | 598 | 2.46 | 3.72 | 77.20 |
| CO-7 | Conduit | 8 | 598 | 2.48 | 3.77 | 76.62 |
| CO-10 | Conduit | 8 | 598 | 2.45 | 3.79 | 76.34 |
| CO-11 | Conduit | 8 | 595 | 2.49 | 3.17 | 77.35 |
| CO-12 | Conduit | 8 | 598 | 2.46 | 3.72 | 77.30 |
| CO-13 | Conduit | 4 | 595 | 0.07 | 0.42 | 78.56 |
| CO-14 | Conduit | 4 | 598 | 0.10 | 0.58 | 78.22 |
| CO-15 | Conduit | 4 | 598 | 0.29 | 1.87 | 77.76 |
| CO-16 | Conduit | 4 | 598 | 0.48 | 2.25 | 77.33 |
| CO-17 | Conduit | 4 | 598 | 0.56 | 2.40 | 77.03 |
| CO-18 | Conduit | 5 | 595 | 0.06 | 0.37 | 78.50 |
| CO-19 | Conduit | 5 | 595 | 0.13 | 0.73 | 78.16 |
| CO-20 | Conduit | 6 | 595 | 0.06 | 0.37 | 78.51 |
| CO-21 | Conduit | 6 | 595 | 0.13 | 0.71 | 77.95 |
| CO-22 | Conduit | 7 | 595 | 0.06 | 0.36 | 77.85 |
| CO-23 | Conduit | 1 | 595 | 0.07 | 0.43 | 78.49 |
| CO-24 | Conduit | 1 | 598 | 0.13 | 0.76 | 78.27 |
| CO-25 | Conduit | 1 | 595 | 0.45 | 2.21 | 78.00 |
| CO-26 | Conduit | 1 | 598 | 0.80 | 2.64 | 77.55 |
| CO-27 | Conduit | 1 | 598 | 1.09 | 2.98 | 77.16 |
| CO-28 | Conduit | 2 | 595 | 0.08 | 0.45 | 78.51 |
| CO-29 | Conduit | 2 | 595 | 0.14 | 0.76 | 77.97 |
| CO-30 | Conduit | 3 | 595 | 0.08 | 0.45 | 78.49 |
| CO-31 | Conduit | 3 | 595 | 0.14 | 0.75 | 77.68 |
| PO-1 | Pond | 1 | --- | --- | --- | 76.34 |

ALMOND TWO POWER PLANT
10-YEAR
NODE SUMMARY

1/23/2009

| Label | Element Type | Branch | Time to Maximum Inflow (min) | Flow (Total In Max) (ft³/s) | Time To Max Inlet Flow (min) | Flow (Surface Maximum) (ft³/s) | Time To Max Captured Flow (min) | Flow (Captured Max) (ft³/s) |
|---|---|---|---|---|---|---|---|---|
| MH-1 | Manhole | 8 | 595 | 1.81 | --- | --- | --- | --- |
| MH-2 | Manhole | 8 | 595 | 1.76 | --- | --- | --- | --- |
| MH-3 | Manhole | 8 | 595 | 2.51 | --- | --- | --- | --- |
| MH-4 | Manhole | 8 | 598 | 2.46 | --- | --- | --- | --- |
| MH-5 | Manhole | 8 | 598 | 2.46 | --- | --- | --- | --- |
| MH-6 | Manhole | 8 | 598 | 2.46 | --- | --- | --- | --- |
| MH-8 | Manhole | 8 | 595 | 2.49 | --- | --- | --- | --- |
| CB-1 | Catch Basin | 8 | 595 | 0.56 | 595.00 | 0.56 | 595 | 0.56 |
| CB-2 | Catch Basin | 4 | 595 | 0.07 | 595.00 | 0.07 | 595 | 0.07 |
| CB-3 | Catch Basin | 4 | 595 | 0.10 | 595.00 | 0.03 | 595 | 0.03 |
| CB-4 | Catch Basin | 4 | 595 | 0.28 | 595.00 | 0.06 | 595 | 0.06 |
| CB-5 | Catch Basin | 4 | 598 | 0.47 | 595.00 | 0.06 | 595 | 0.06 |
| CB-6 | Catch Basin | 4 | 598 | 0.56 | 595.00 | 0.03 | 595 | 0.03 |
| CB-7 | Catch Basin | 5 | 595 | 0.06 | 595.00 | 0.06 | 595 | 0.06 |
| CB-8 | Catch Basin | 5 | 595 | 0.13 | 595.00 | 0.08 | 595 | 0.08 |
| CB-9 | Catch Basin | 6 | 595 | 0.06 | 595.00 | 0.06 | 595 | 0.06 |
| CB-10 | Catch Basin | 6 | 595 | 0.13 | 595.00 | 0.07 | 595 | 0.07 |
| CB-11 | Catch Basin | 7 | 595 | 0.06 | 595.00 | 0.06 | 595 | 0.06 |
| CB-12 | Catch Basin | 1 | 595 | 0.08 | 595.00 | 0.08 | 595 | 0.08 |
| CB-13 | Catch Basin | 1 | 595 | 0.14 | 595.00 | 0.07 | 595 | 0.07 |
| CB-14 | Catch Basin | 1 | 595 | 0.47 | 595.00 | 0.33 | 595 | 0.33 |
| CB-15 | Catch Basin | 1 | 595 | 0.80 | 595.00 | 0.22 | 595 | 0.22 |
| CB-16 | Catch Basin | 1 | 598 | 1.08 | 595.00 | 0.15 | 595 | 0.15 |
| CB-17 | Catch Basin | 2 | 595 | 0.08 | 595.00 | 0.08 | 595 | 0.08 |
| CB-18 | Catch Basin | 2 | 595 | 0.14 | 595.00 | 0.07 | 595 | 0.07 |
| CB-19 | Catch Basin | 3 | 595 | 0.08 | 595.00 | 0.08 | 595 | 0.08 |
| CB-20 | Catch Basin | 3 | 595 | 0.14 | 595.00 | 0.07 | 595 | 0.07 |
| OF-3 | Outfall | 0 | (N/A) | (N/A) | --- | --- | --- | --- |
| OF-4 | Outfall | 0 | (N/A) | (N/A) | --- | --- | --- | --- |
| OF-5 | Outfall | 0 | (N/A) | (N/A) | --- | --- | --- | --- |
| PO-1 | Pond | 1 | 598 | 4.60 | --- | --- | --- | --- |

RETENTION POND
SUMMARY

| Time to Max Inflow (min) | Flow (Total In Maximum) (ft³/s) | Time to Max Hydraulic Grade & Storage (min) | Depth (Maximum) (ft) | Hydraulic Grade (Maximum) (ft) | Storage (Maximum) (ac-ft) |
|---|---|---|---|---|---|
| 598 | 4.6 | 1437.98 | 1.34 | 76.34 | 0.54 |

ALMOND TWO POWER PLANT
2-YEAR
CATCHMENT SUMMARY

1/23/2009

| Label | Runoff Method | Loss Method | Total Rainfall Depth (in) | Area (acres) | Volume Total Runoff (ac-ft) | Flow (Peak) ($ft^3/s$) | Time To Peak (min) |
|---|---|---|---|---|---|---|---|
| CM-1 | Unit Hydrograph | SCS CN | 1.33 | 0.84 | 0.03 | 0.26 | 595.00 |
| CM-2 | Unit Hydrograph | SCS CN | 1.33 | 1.98 | 0.08 | 0.61 | 595.00 |
| CM-3 | Unit Hydrograph | SCS CN | 1.33 | 1.14 | 0.04 | 0.35 | 595.00 |
| S-1 | Unit Hydrograph | SCS CN | 1.33 | 0.05 | 0.00 | 0.01 | 595.00 |
| S-2 | Unit Hydrograph | SCS CN | 1.33 | 0.11 | 0.00 | 0.03 | 595.00 |
| S-3 | Unit Hydrograph | SCS CN | 1.33 | 0.09 | 0.00 | 0.03 | 595.00 |
| S-4 | Unit Hydrograph | SCS CN | 1.33 | 0.10 | 0.00 | 0.03 | 595.00 |
| S-5 | Unit Hydrograph | SCS CN | 1.33 | 0.11 | 0.00 | 0.04 | 595.00 |
| S-6 | Unit Hydrograph | SCS CN | 1.33 | 0.09 | 0.00 | 0.03 | 595.00 |
| S-7 | Unit Hydrograph | SCS CN | 1.33 | 0.10 | 0.00 | 0.03 | 595.00 |
| S-8 | Unit Hydrograph | SCS CN | 1.33 | 0.11 | 0.00 | 0.03 | 595.00 |
| S-9 | Unit Hydrograph | SCS CN | 1.33 | 0.04 | 0.00 | 0.01 | 595.00 |
| S-10 | Unit Hydrograph | SCS CN | 1.33 | 0.10 | 0.00 | 0.03 | 595.00 |
| S-11 | Unit Hydrograph | SCS CN | 1.33 | 0.11 | 0.00 | 0.04 | 595.00 |
| S-12 | Unit Hydrograph | SCS CN | 1.33 | 0.10 | 0.00 | 0.03 | 595.00 |
| S-13 | Unit Hydrograph | SCS CN | 1.33 | 0.12 | 0.00 | 0.04 | 595.00 |
| S-14 | Unit Hydrograph | SCS CN | 1.33 | 0.10 | 0.00 | 0.03 | 595.00 |
| S-15 | Unit Hydrograph | SCS CN | 1.33 | 0.12 | 0.00 | 0.04 | 595.00 |
| S-16 | Unit Hydrograph | SCS CN | 1.33 | 0.10 | 0.00 | 0.03 | 595.00 |
| S-17 | Unit Hydrograph | SCS CN | 1.33 | 0.50 | 0.02 | 0.16 | 595.00 |
| S-18 | Unit Hydrograph | SCS CN | 1.33 | 0.33 | 0.01 | 0.10 | 595.00 |
| S-19 | Unit Hydrograph | SCS CN | 1.33 | 0.23 | 0.01 | 0.07 | 595.00 |
| S-20 | Unit Hydrograph | SCS CN | 1.33 | 1.43 | 0.02 | 0.17 | 595.00 |
| S-21 | Unit Hydrograph | SCS CN | 1.33 | 0.31 | 0.01 | 0.10 | 595.00 |

ALMOND TWO POWER PLANT 1/23/2009
2-YEAR
GENERAL SUMMARY

| Label | Element Type | Branch | Time to Max Flow (min) | Flow (Max) ($ft^3/s$) | Velocity (Max) (ft/s) | Hydraulic Grade (Max) (ft) |
|---|---|---|---|---|---|---|
| MH-1 | Manhole | 8 | --- | --- | --- | 77.18 |
| MH-2 | Manhole | 8 | --- | --- | --- | 77.15 |
| MH-3 | Manhole | 8 | --- | --- | --- | 77.15 |
| MH-4 | Manhole | 8 | --- | --- | --- | 77.06 |
| MH-5 | Manhole | 8 | --- | --- | --- | 76.94 |
| MH-6 | Manhole | 8 | --- | --- | --- | 75.90 |
| MH-8 | Manhole | 8 | --- | --- | --- | 77.14 |
| CB-1 | Catch Basin | 8 | --- | --- | --- | 77.19 |
| CB-2 | Catch Basin | 4 | --- | --- | --- | 78.59 |
| CB-3 | Catch Basin | 4 | --- | --- | --- | 78.44 |
| CB-4 | Catch Basin | 4 | --- | --- | --- | 77.95 |
| CB-5 | Catch Basin | 4 | --- | --- | --- | 77.47 |
| CB-6 | Catch Basin | 4 | --- | --- | --- | 77.06 |
| CB-7 | Catch Basin | 5 | --- | --- | --- | 78.58 |
| CB-8 | Catch Basin | 5 | --- | --- | --- | 78.35 |
| CB-9 | Catch Basin | 6 | --- | --- | --- | 78.58 |
| CB-10 | Catch Basin | 6 | --- | --- | --- | 78.35 |
| CB-11 | Catch Basin | 7 | --- | --- | --- | 78.55 |
| CB-12 | Catch Basin | 1 | --- | --- | --- | 78.60 |
| CB-13 | Catch Basin | 1 | --- | --- | --- | 78.34 |
| CB-14 | Catch Basin | 1 | --- | --- | --- | 78.18 |
| CB-15 | Catch Basin | 1 | --- | --- | --- | 77.71 |
| CB-16 | Catch Basin | 1 | --- | --- | --- | 77.21 |
| CB-17 | Catch Basin | 2 | --- | --- | --- | 78.60 |
| CB-18 | Catch Basin | 2 | --- | --- | --- | 78.31 |
| CB-19 | Catch Basin | 3 | --- | --- | --- | 78.60 |
| CB-20 | Catch Basin | 3 | --- | --- | --- | 78.29 |
| CO-1 | Conduit | 8 | 598 | 0.25 | 0.35 | 77.19 |
| CO-2 | Conduit | 8 | 598 | 0.84 | 1.07 | 77.17 |
| CO-3 | Conduit | 8 | 598 | 0.84 | 1.07 | 77.15 |
| CO-6 | Conduit | 8 | 598 | 1.17 | 3.02 | 77.00 |
| CO-7 | Conduit | 8 | 598 | 1.15 | 3.01 | 76.42 |
| CO-10 | Conduit | 8 | 600 | 1.15 | 3.01 | 75.72 |
| CO-11 | Conduit | 8 | 598 | 1.18 | 1.50 | 77.14 |
| CO-12 | Conduit | 8 | 598 | 1.17 | 3.02 | 77.10 |
| CO-13 | Conduit | 4 | 598 | 0.03 | 0.21 | 78.52 |
| CO-14 | Conduit | 4 | 598 | 0.05 | 0.30 | 78.19 |
| CO-15 | Conduit | 4 | 598 | 0.14 | 0.76 | 77.70 |
| CO-16 | Conduit | 4 | 598 | 0.23 | 1.71 | 77.25 |
| CO-17 | Conduit | 4 | 598 | 0.26 | 1.84 | 76.94 |
| CO-18 | Conduit | 5 | 598 | 0.03 | 0.18 | 78.45 |
| CO-19 | Conduit | 5 | 598 | 0.06 | 0.36 | 78.13 |
| CO-20 | Conduit | 6 | 598 | 0.03 | 0.19 | 78.46 |
| CO-21 | Conduit | 6 | 598 | 0.06 | 0.35 | 77.93 |
| CO-22 | Conduit | 7 | 595 | 0.03 | 0.17 | 77.81 |
| CO-23 | Conduit | 1 | 598 | 0.03 | 0.22 | 78.45 |
| CO-24 | Conduit | 1 | 598 | 0.06 | 0.39 | 78.23 |
| CO-25 | Conduit | 1 | 598 | 0.21 | 1.67 | 77.93 |
| CO-26 | Conduit | 1 | 598 | 0.38 | 2.06 | 77.45 |
| CO-27 | Conduit | 1 | 598 | 0.52 | 2.35 | 77.04 |
| CO-28 | Conduit | 2 | 598 | 0.04 | 0.23 | 78.47 |
| CO-29 | Conduit | 2 | 598 | 0.07 | 0.38 | 77.94 |
| CO-30 | Conduit | 3 | 598 | 0.04 | 0.23 | 78.45 |
| CO-31 | Conduit | 3 | 598 | 0.07 | 0.37 | 77.65 |
| PO-1 | Pond | 1 | --- | --- | --- | 75.72 |

1 2

ALMOND TWO POWER PLANT
2-YEAR
NODE SUMMARY

1/23/2009

| Label | Element Type | Branch | Time to Maximum Inflow (min) | Flow (Total In Max) (ft³/s) | Time To Max Inlet Flow (min) | Flow (Surface Maximum) (ft³/s) | Time To Max Captured Flow (min) | Flow (Captured Max) (ft³/s) |
|---|---|---|---|---|---|---|---|---|
| MH-1 | Manhole | 8 | 595 | 0.84 | --- | --- | --- | --- |
| MH-2 | Manhole | 8 | 598 | 0.84 | --- | --- | --- | --- |
| MH-3 | Manhole | 8 | 598 | 1.17 | --- | --- | --- | --- |
| MH-4 | Manhole | 8 | 598 | 1.17 | --- | --- | --- | --- |
| MH-5 | Manhole | 8 | 598 | 1.16 | --- | --- | --- | --- |
| MH-6 | Manhole | 8 | 600 | 1.15 | --- | --- | --- | --- |
| MH-8 | Manhole | 8 | 598 | 1.18 | --- | --- | --- | --- |
| CB-1 | Catch Basin | 8 | 595 | 0.26 | 595.00 | 0.26 | 595 | 0.26 |
| CB-2 | Catch Basin | 4 | 595 | 0.03 | 595.00 | 0.03 | 595 | 0.03 |
| CB-3 | Catch Basin | 4 | 595 | 0.05 | 595.00 | 0.01 | 595 | 0.01 |
| CB-4 | Catch Basin | 4 | 598 | 0.14 | 595.00 | 0.03 | 595 | 0.03 |
| CB-5 | Catch Basin | 4 | 598 | 0.22 | 595.00 | 0.03 | 595 | 0.03 |
| CB-6 | Catch Basin | 4 | 598 | 0.26 | 595.00 | 0.01 | 595 | 0.01 |
| CB-7 | Catch Basin | 5 | 595 | 0.03 | 595.00 | 0.03 | 595 | 0.03 |
| CB-8 | Catch Basin | 5 | 595 | 0.06 | 595.00 | 0.04 | 595 | 0.04 |
| CB-9 | Catch Basin | 6 | 595 | 0.03 | 595.00 | 0.03 | 595 | 0.03 |
| CB-10 | Catch Basin | 6 | 595 | 0.06 | 595.00 | 0.03 | 595 | 0.03 |
| CB-11 | Catch Basin | 7 | 595 | 0.03 | 595.00 | 0.03 | 595 | 0.03 |
| CB-12 | Catch Basin | 1 | 595 | 0.04 | 595.00 | 0.04 | 595 | 0.04 |
| CB-13 | Catch Basin | 1 | 595 | 0.06 | 595.00 | 0.03 | 595 | 0.03 |
| CB-14 | Catch Basin | 1 | 595 | 0.22 | 595.00 | 0.16 | 595 | 0.16 |
| CB-15 | Catch Basin | 1 | 598 | 0.38 | 595.00 | 0.10 | 595 | 0.1 |
| CB-16 | Catch Basin | 1 | 598 | 0.52 | 595.00 | 0.07 | 595 | 0.07 |
| CB-17 | Catch Basin | 2 | 595 | 0.04 | 595.00 | 0.04 | 595 | 0.04 |
| CB-18 | Catch Basin | 2 | 595 | 0.07 | 595.00 | 0.03 | 595 | 0.03 |
| CB-19 | Catch Basin | 3 | 595 | 0.04 | 595.00 | 0.04 | 595 | 0.04 |
| CB-20 | Catch Basin | 3 | 595 | 0.07 | 595.00 | 0.03 | 595 | 0.03 |
| OF-3 | Outfall | 0 | (N/A) | (N/A) | --- | --- | --- | --- |
| OF-4 | Outfall | 0 | (N/A) | (N/A) | --- | --- | --- | --- |
| OF-5 | Outfall | 0 | (N/A) | (N/A) | --- | --- | --- | --- |
| PO-1 | Pond | 1 | 600 | 2.14 | --- | --- | --- | --- |

RETENTION POND
SUMMARY

| Time to Max Inflow (min) | Flow (Total In Maximum) (ft³/s) | Time to Max Hydraulic Grade & Storage (min) | Depth (Maximum) (ft) | Hydraulic Grade (Maximum) (ft) | Storage (Maximum) (ac-ft) |
|---|---|---|---|---|---|
| 600 | 2.14 | 1437.98 | 0.72 | 75.72 | 0.29 |

# Precipitation Frequency Data Output

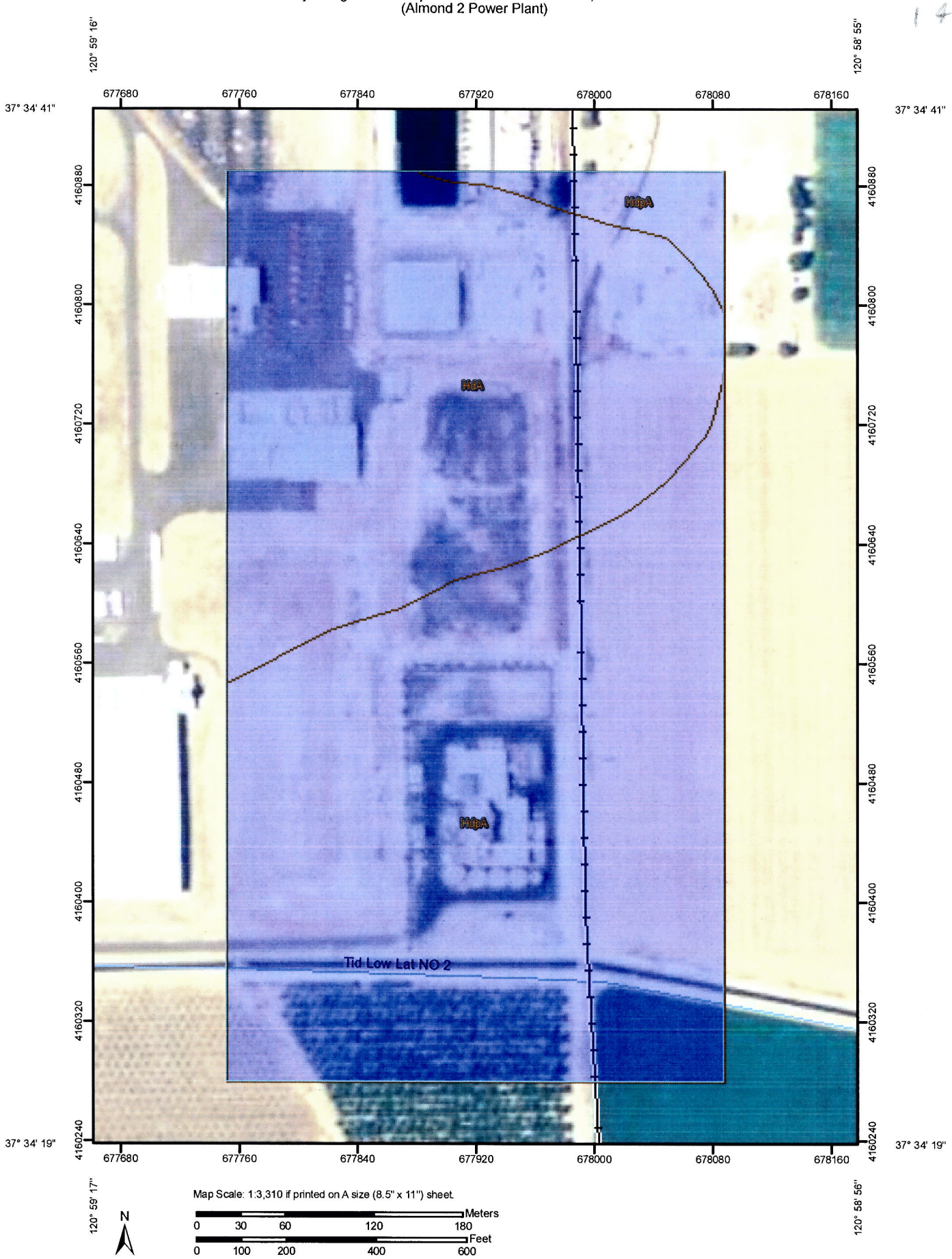
NOAA Atlas 2
California 37.5753?N 120.9853?W
*Site-specific Estimates*

| Map | Precipitation (inches) | Precipitation Intensity (in/hr) |
|---|---|---|
| 2-year 6-hour | 0.89 | 0.15 |
| 2-year 24-hour | 1.33 | 0.06 |
| 100-year 6-hour | 1.85 | 0.31 |
| 100-year 24-hour | 2.70 | 0.11 |
| | | |

Hydrometeorological Design Studies Center - NOAA/National Weather Service
1325 East-West Highway - Silver Spring, MD 20910 - (301) 713-1669

Thu Jan 8 16:09:54 2009

Hydrologic Soil Group—Eastern Stanislaus Area, California
(Almond 2 Power Plant)



## MAP LEGEND

**Area of Interest (AOI)**

Area of Interest (AOI)

**Soils**

Soil Map Units

**Soil Ratings**

A

A/D

B

B/D

C

C/D

D

Not rated or not available

**Political Features**

Cities

**Water Features**

Oceans

Streams and Canals

**Transportation**

Rails

Interstate Highways

US Routes

Major Roads

Local Roads

## MAP INFORMATION

Map Scale: 1:3,310 if printed on A size (8.5" × 11") sheet.

The soil surveys that comprise your AOI were mapped at 1:24,000.

Please rely on the bar scale on each map sheet for accurate map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: UTM Zone 10N NAD83

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Eastern Stanislaus Area, California
Survey Area Data: Version 5, Dec 17, 2007

Date(s) aerial images were photographed: 6/12/2005

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

# Hydrologic Soil Group

| Hydrologic Soil Group— Summary by Map Unit — Eastern Stanislaus Area, California | | | | |
|---|---|---|---|---|
| **Map unit symbol** | **Map unit name** | **Rating** | **Acres in AOI** | **Percent of AOI** |
| HdA | Hanford sandy loam, 0 to 3 percent slopes | B | 20.6 | 40.7% |
| HdpA | Hanford sandy loam, moderately deep over silt, 0 to 1 percent slopes | B | 30.0 | 59.3% |
| **Totals for Area of Interest** | | | **50.7** | **100.0%** |

## Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

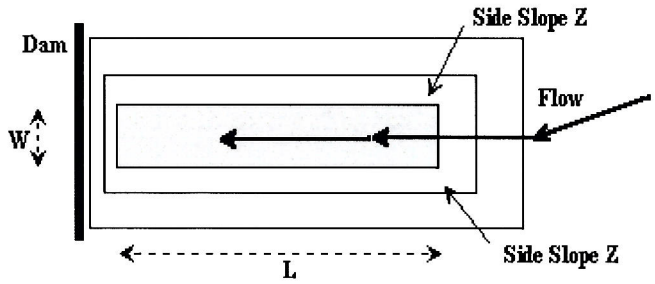
## Rating Options

*Aggregation Method:* Dominant Condition

*Component Percent Cutoff:* *None Specified*

*Tie-break Rule:* Lower

# STAGE-STORAGE FOR RECTANGULAR BASIN




**Design Information (Input):**

| | | | |
|---|---|---|---|
| Width of Basin Bottom | W = | 112.80 | ft |
| Length of Basin Bottom | L = | 146.50 | ft |
| Side-Slope of Dam (H:V) | Zd = | 3.00 | ft/ft |

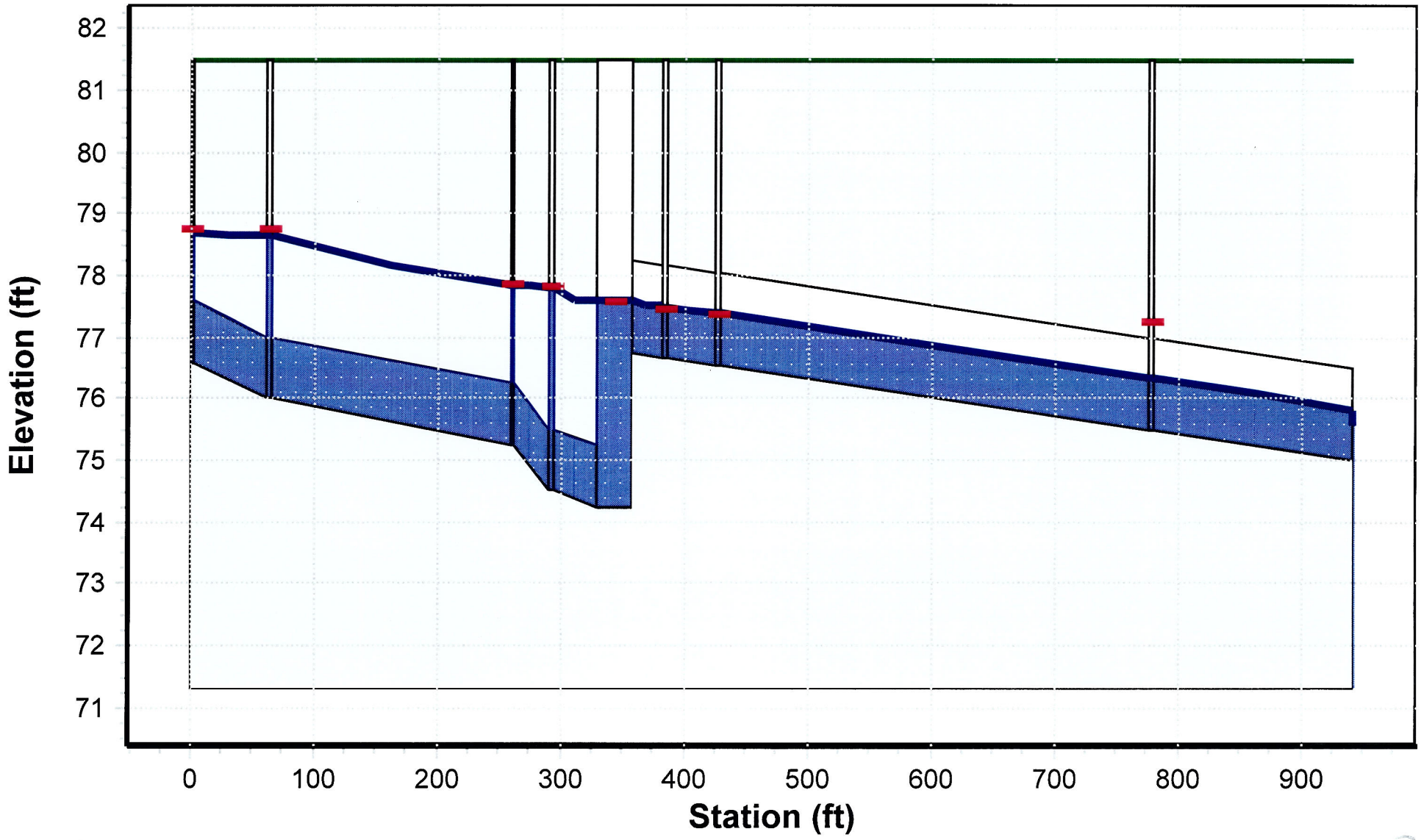
**Stage-Storage Relationship:**

**Enter water surface elevations in ascending order.**

| Water Surface Elevation ft (input) | Side-slope for next depth stage ft/ft (H:V) (input) | Width of Cross Section ft (output) | Length of Cross Section ft (output) | Cross Section Area acres (output) | Volume above Datum acre-ft (output) |
|---|---|---|---|---|---|
| 75.00 | 3.00 | 112.80 | 146.50 | 0.38 | 0.00 |
| 76.00 | 3.00 | 118.80 | 152.50 | 0.42 | 0.40 |
| 77.00 | 3.00 | 124.80 | 158.50 | 0.45 | 0.83 |
| 78.00 | 3.00 | 130.80 | 164.50 | 0.49 | 1.31 |
| 79.00 | 3.00 | 136.80 | 170.50 | 0.54 | 1.82 |
| 80.00 | 3.00 | 142.80 | 176.50 | 0.58 | 2.38 |
| 81.00 | 3.00 | 148.80 | 182.50 | 0.62 | 2.98 |

1000 - YEAR STORM

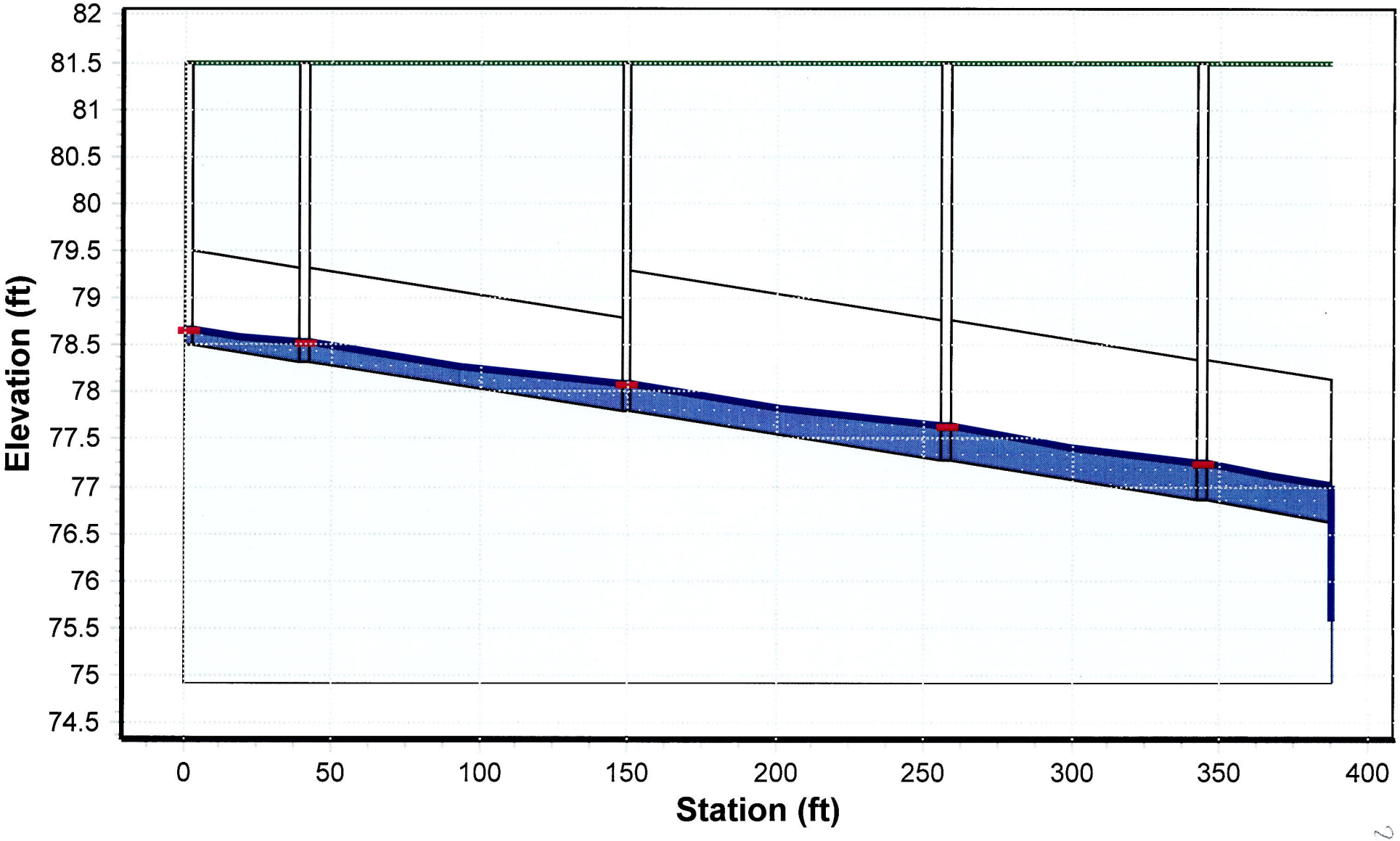
## Profile - 1 - Base Time: 09:58:00




5

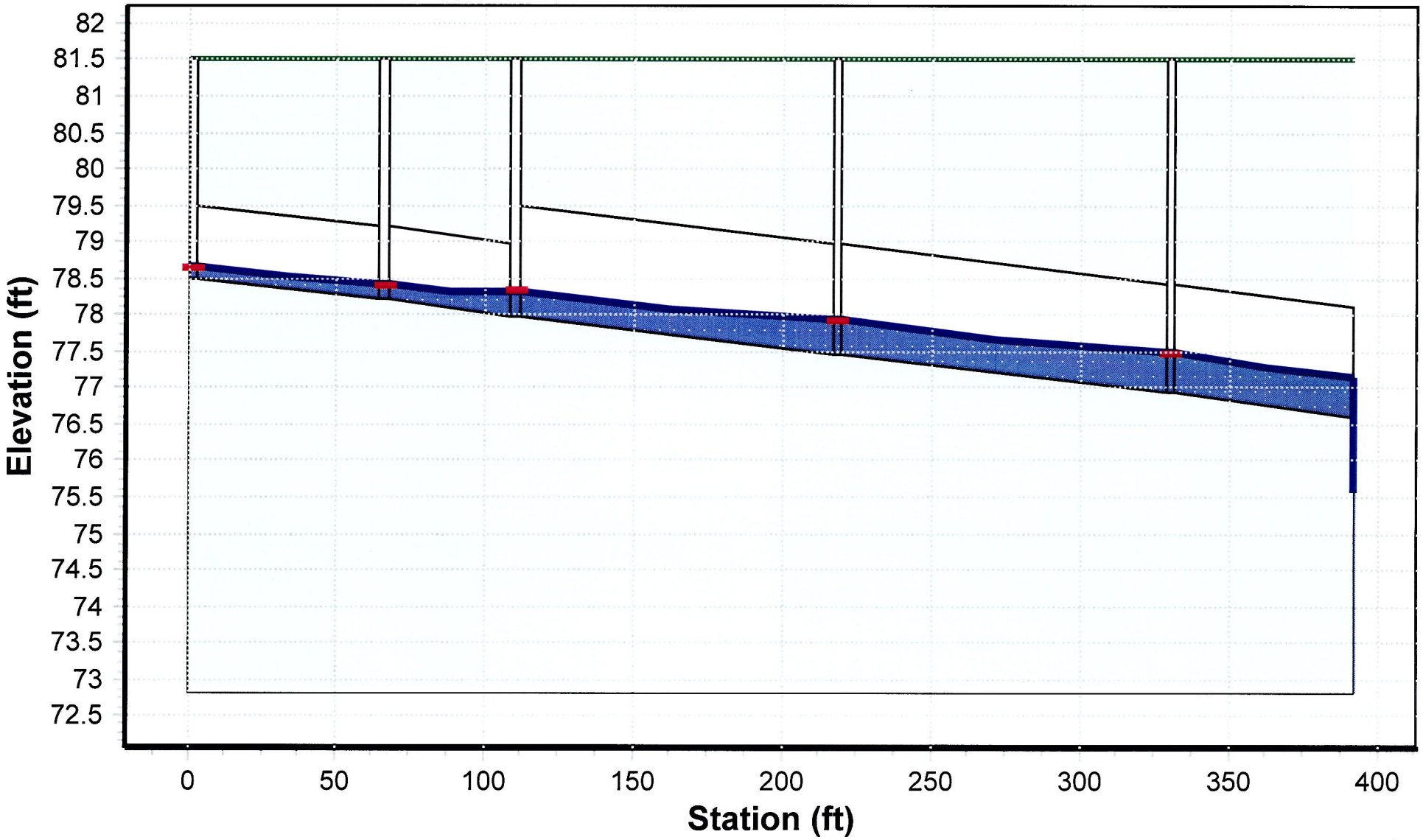
100-YEAR STORM

# Profile - 2 - Base Time: 09:58:00



100-YEAR STORM

## Profile - 3 - Base Time: 09:58:00




12

# Attachment C
# Calculations for Soil Loss Estimates

APPENDIX 5.11A

# Soil Loss Estimates Calculations

## Table 5.11-3. Estimate of Soil Loss by Water Erosion Using Revised Universal Soil Loss Equation (RUSLE2)

| Feature (acreage)[2] | Activity | Duration (months) | Estimates Using Revised Universal Soil Loss Equation[1] | | |
|---|---|---|---|---|---|
| | | | Soil Loss (tons) without BMPs | Soil Loss (tons) with BMPs | Soil Loss (tons/yr) No Project |
| **Project Site (4.60 acres)** | Grading | 2 | 0.84 | 0.0010 | 0.0078 |
| | Construction | 12 | 0.22 | 0.0061 | - |
| **Laydown Area (1.90 acres) (0.95 acres exposed; 0.95 paved or gravelled)** | Grading | 1 | 0.29 | 0.0017 | 0.0044 |
| | Construction | 12 | 0.76 | 0.021 | - |
| ***Transmission Lines*** | | | | | |
| **Corridor 1 (1.56 acres for construction; 0.0066 acre for pole footprints)** | Grading | 2 | 0.0016 | 0.0045 | 0.0000 |
| | Construction | 4 | 0.33 | 0.0090 | - |
| **Corridor 2 (2.16 acres for construction; 0.0092 acre for pole footprints)** | Grading | 2 | 0.0023 | 0.0065 | 0.0000 |
| | Construction | 4 | 0.47 | 0.013 | - |
| **Corridor 3 (0.00 acre for construction; 0.00 acre for pole footprints) - Reconductoring only** | Grading | 0 | 0.0000 | 0.0000 | 0.00000 |
| | Construction | 0 | 0.000 | 0.0000 | - |
| ***Natural Gas Lines*** | | | | | |
| **Alternative A (27.60 acres for construction; 4.22 acres for trench)** | Grading | 6 | 2.22 | 0.33 | 0.0075 |
| | Construction | 6 | 11.74 | 0.33 | - |
| **Alternative B (33.82 acres for construction; 5.41 acres for trench)** | Grading | 6 | 2.77 | 0.41 | 0.0092 |
| | Construction | 6 | 14.73 | 0.41 | - |
| **Project Soil Loss Estimates** | All activities listed abo | 12 | **34.37** | **1.53** | **0.029** |

**Notes:**

1. Soil losses (tons/acre/year) are estimated using RUSLE2 software available online [http://fargo.nserl.purdue.edu/rusle2_dataweb/].
   -The soil characteristics were estimated using RUSLE2 soil profiles corresponding to the mapped NRCS soil unit.
   -Soil loss (R-factors) were estimated using 2-year, 6-hour point precipitation frequency amount for the Almond Power Plant 2 project site found at [http://www.nws.noaa.gov/ohd/hdsc/noaaatlas2.htm].
   -Estimates of actual soil losses use the RUSLE2 soil loss times the duration and the affected area. The No Project Alternative estimate does not have a specific duration so loss is given as tons/year.
2. Acreages assume 30 ft corridors for the transmission lines and 100 ft corridors for the natural gas pipeline construction. Trenches for the natural gas pipeline are assumed to be 4 ft wide. The transmission line pole holes will each have a 4 ft by 4 ft excavation footprint.

**Other Project Assumptions as follows:**

-It is assumed that 100% of the Almond Power Plant 2 project site **and laydown area** will be exposed during grading, and approximately 10% of the site will be bare soil during construction.
-It is assumed that grading the site will take 2 months and construction will take 12 months.
-It is assumed that grading for the laydown area will take 1 month and the area will be covered (gravelled or paved) immediately thereafter.
-It is assumed that soil loss will be negligible from the laydown area once it is covered.
-It is assumed that the natural gas pipeline will be installed within a 4 ft wide trench and a 100 ft construction corridor along existing roadways.
-It is assumed that the natural gas pipeline will take 6 months to construct and will take another 2 months before permanent cover is established.
-The overhead transmission lines will have poles outside of the project footprint. Each pole will have a 4 ft by 4 ft footprint.
-It is assumed that the grading/excavation for the transmission line poles will be completed within 2 months and the entire installation will be completed within 4 months.
-The water and sewer lines will be completed on-site, so no additional soil losses are estimated for them.

**RUSLE2 Assumptions as follows:**

100-ft slope length. Estimated soil unit slope is the midpoint of the minimum and maximum of the unit slope class.
**Construction** soil losses assume the following inputs: Management - Bare ground; Contouring - None, rows up and down hill; Diversion/terracing - None; Strips and Barriers - None.
**Grading** soil losses assume the following inputs: Management - Bare ground/rough surface; Contouring - None, rows up and down hill; Diversion/terracing - None; Strips and Barriers - None.
**Construction with BMP** soil losses assume the following inputs: Management - Silt fence; Contouring - Perfect, no row grade; Diversion/terracing - None; Strips and Barriers - 2 fences, 1 at end of RUSLE slope.
**No Project** soil losses assume the following inputs: Management - Dense grass, not harvested; Contouring - None, rows up and down hill; Diversion/terracing - None; Strips and Barriers - None.

| Soil Type | Acreage | | Soil Loss Estimates Using RUSLE2 software (tons/ac/year) | | | |
|---|---|---|---|---|---|---|
| **Site** | | **Slope** | **Grading** | **Construction w/o BMPs** | **Construction with BMPs** | **No Project** |
| HdA | 1.5 | 1.5 | 1.8 | 0.80 | 0.022 | 0.0023 |
| HdpA | 3.1 | 0.5 | 0.76 | 0.32 | 0.0091 | 0.0014 |
| | **4.6** | **Subtotal** | **5.06** | **0.219** | **0.006** | **0.0078** |
| **Laydown Area** | | | | | | |
| HdA | 1.90 | 1.5 | 1.8 | 0.80 | 0.022 | 0.0023 |
| | **0.95** | **Subtotal** | **3.42** | **0.76** | **0.021** | **0.0044** |
| **Transmission Lines** | | | | | | |
| **Corridor 1 (Circuit 1)** | | | | | | |
| HdA | 0.0042 | 1.5 | 1.8 | 0.80 | 0.022 | 0.0023 |
| HdpA | 0.0024 | 0.5 | 0.76 | 0.32 | 0.0091 | 0.0014 |
| | **1.56** | **Subtotal** | **0.009** | **0.975** | **0.027** | **0.0000** |
| **Corridor 2 (Circuit 2)** | | | | | | |
| HdA | 0.0064 | 1.5 | 1.8 | 0.80 | 0.022 | 0.0023 |
| HdpA | 0.0023 | 0.5 | 0.76 | 0.32 | 0.0091 | 0.0014 |
| DrA | 0.0006 | 0.5 | 0.88 | 0.37 | 0.010 | 0.0016 |
| | **2.16** | **Subtotal** | **0.014** | **1.415** | **0.039** | **0.00002** |
| | | | | | | |
| **Corridor 3 (Reconductored Line)** | | | | | | |
| DrA | NA | 0.5 | 0.88 | 0.37 | 0.010 | 0.0016 |
| HdA | NA | 1.5 | 1.8 | 0.80 | 0.022 | 0.0023 |
| HdpA | NA | 0.5 | 0.76 | 0.32 | 0.0091 | 0.0014 |
| HdsA | NA | 0.5 | 0.76 | 0.32 | 0.0091 | 0.0014 |
| TuA | NA | 1.5 | 1.2 | 0.50 | 0.014 | 0.0014 |
| | | **Subtotal** | **0.000** | **0.000** | **0.000** | **0.000** |
| | | | | | | |
| **Natural Gas Lines** | | | | | | |
| **Alternative A** | | | | | | |
| DrA | 0.81 | 0.5 | 0.88 | 0.37 | 0.01 | 0.0016 |
| DwA | 1.34 | 0.5 | 1.0 | 0.42 | 0.012 | 0.0018 |
| FsA | 0.09 | 0.5 | 1.0 | 0.42 | 0.012 | 0.0018 |
| FtA | 0.17 | 0.5 | 1.0 | 0.42 | 0.012 | 0.0019 |
| FuA | 0.17 | 0.5 | 1.0 | 0.42 | 0.012 | 0.0019 |
| FwA | 0.24 | 0.5 | 1.0 | 0.42 | 0.012 | 0.00185 |
| HdA | 0.45 | 1.5 | 1.8 | 0.80 | 0.022 | 0.0023 |
| HdpA | 0.12 | 0.5 | 0.76 | 0.32 | 0.0091 | 0.0014 |
| HfA | 0.50 | 0.5 | 0.59 | 0.24 | 0.0068 | 0.0010 |
| HkbA | 0.04 | 0.5 | 0.59 | 0.24 | 0.0068 | 0.0010 |
| TrA | 0.19 | 0.5 | 1.0 | 0.43 | 0.012 | 0.0018 |
| TuA | 0.14 | 1.5 | 1.2 | 0.50 | 0.014 | 0.0014 |
| WaA | 0.16 | 0.5 | 0.88 | 0.37 | 0.010 | 0.0016 |
| | **55.20** | **Subtotal** | **4.43** | **23.48** | **0.66** | **0.0075** |
| | | | | | | |
| **Alternative B** | | | | | | |
| DeA | 0.12 | 1.5 | 0.59 | 0.25 | 0.0072 | 0.001 |
| DgA | 0.12 | 1.5 | 0.59 | 0.25 | 0.0072 | 0.001 |
| DrA | 1.79 | 0.5 | 0.88 | 0.37 | 0.01 | 0.0016 |
| DwA | 0.59 | 0.5 | 1.0 | 0.42 | 0.012 | 0.0018 |
| FtA | 0.04 | 0.5 | 1.0 | 0.42 | 0.012 | 0.0019 |
| FuA | 0.39 | 0.5 | 1.0 | 0.42 | 0.012 | 0.0019 |
| HdA | 0.71 | 1.5 | 1.8 | 0.80 | 0.022 | 0.0023 |
| HdpA | 0.12 | 0.5 | 0.76 | 0.32 | 0.0091 | 0.0014 |
| HfA | 0.02 | 0.5 | 0.59 | 0.24 | 0.0068 | 0.0010 |
| TuA | 0.28 | 1.5 | 1.2 | 0.50 | 0.014 | 0.0014 |
| WbA | 1.13 | 0.5 | 0.88 | 0.37 | 0.01 | 0.0016 |
| WdA | 0.11 | 0.5 | 0.88 | 0.37 | 0.01 | 0.0016 |
| | **67.64** | **Subtotal** | **5.54** | **29.47** | **0.81** | **0.0092** |

**Assumptions:**
**Assumes slope is the mid-point of the slope class**
**100% of project site would be bare soil during grading.**
**100% of transmission pole holes and trench areas will be bare soil during grading/excavation.**
**Assumes 50% of transmission line and natural gas pipeline corridors are currently unprotected.**
**It is assumed that transmission line poles will be placed every 250 ft along the transmission corridor.**
**Transmission pole impact area assumes a 4 ft by 4 ft footprint times the number of poles.**
**Transmission line construction impacts based on a 100 ft corridor along entire length.**
The No Project soil loss assumes a 'dense grass, not harvested' management scenario.

**Project: TID Almond Power Plant 2 - Jenny Krenz input for areas on 02/25/09 - subject to revision**

| OBJECTID | AREASYMBOL | Length (miles) | Length (feet) | Acres | Acreage_tot | |
|---|---|---|---|---|---|---|
| Almond Power Plant 2 Site | HdA | | | 1.50 | 1.50 | Acreage received from Mike Haskell (04/07/09). |
| | HdpA | | | 3.10 | 3.10 | Acreage received from Mike Haskell (04/07/09). |
| | | | | **Sum** | 4.60 | |
| | | | | | **0.15** | Assumes only 10% of site is bare soil during construction |
| Laydown Area | HdA | | | 1.90 | 1.90 | Acreage received from Mike Haskell (04/07/09). |
| | | | | **Sum** | **0.95** | Assumes 50% of site is bare soil during construction |
| Natural gas pipeline (Alternative A) - trench | DrA | 1.67 | 8792 | 0.81 | 0.81 | Assumes 4 foot wide trench; Miles received in e-mail from Mike Haskell (02/25/09). |
| | DwA | 2.77 | 14614 | 1.34 | 1.34 | Assumes 4 foot wide trench; Miles received in e-mail from Mike Haskell (02/25/09). |
| | FsA | 0.18 | 937 | 0.09 | 0.09 | Assumes 4 foot wide trench; Miles received in e-mail from Mike Haskell (02/25/09). |
| | FtA | 0.36 | 1899 | 0.17 | 0.17 | Assumes 4 foot wide trench; Miles received in e-mail from Mike Haskell (02/25/09). |
| | FuA | 0.36 | 1885 | 0.17 | 0.17 | Assumes 4 foot wide trench; Miles received in e-mail from Mike Haskell (02/25/09). |
| | FwA | 0.49 | 2578 | 0.24 | 0.24 | Assumes 4 foot wide trench; Miles received in e-mail from Mike Haskell (02/25/09). |
| | HdA | 0.92 | 4855 | 0.45 | 0.45 | Assumes 4 foot wide trench; Miles received in e-mail from Mike Haskell (02/25/09). |
| | HdpA | 0.26 | 1356 | 0.12 | 0.12 | Assumes 4 foot wide trench; Miles received in e-mail from Mike Haskell (02/25/09). |
| | HfA | 1.03 | 5441 | 0.50 | 0.50 | Assumes 4 foot wide trench; Miles received in e-mail from Mike Haskell (02/25/09). |
| | HkbA | 0.09 | 472 | 0.04 | 0.04 | Assumes 4 foot wide trench; Miles received in e-mail from Mike Haskell (02/25/09). |
| | TrA | 0.39 | 2038 | 0.19 | 0.19 | Assumes 4 foot wide trench; Miles received in e-mail from Mike Haskell (02/25/09). |
| | TuA | 0.28 | 1504 | 0.14 | 0.14 | Assumes 4 foot wide trench; Miles received in e-mail from Mike Haskell (02/25/09). |
| | WaA | 0.33 | 1719 | 0.16 | 0.16 | Assumes 4 foot wide trench; Miles received in e-mail from Mike Haskell (02/25/09). |
| | | 9.11 | | | **4.42** | Assumes 100% exposed during construction |
| Natural gas pipeline (Alternative A) - corridor | DrA | 1.67 | 8792 | 20.18 | 20.18 | Assumes 100 foot wide construction corridor (S. Madams, 03/02/09); Miles received in e-mail from Mike Haskell (02/25/09). |
| | DwA | 2.77 | 14614 | 33.55 | 33.55 | Assumes 100 foot wide construction corridor (S. Madams, 03/02/09); Miles received in e-mail from Mike Haskell (02/25/09). |
| | FsA | 0.18 | 937 | 2.15 | 2.15 | Assumes 100 foot wide construction corridor (S. Madams, 03/02/09); Miles received in e-mail from Mike Haskell (02/25/09). |
| | FtA | 0.36 | 1899 | 4.36 | 4.36 | Assumes 100 foot wide construction corridor (S. Madams, 03/02/09); Miles received in e-mail from Mike Haskell (02/25/09). |
| | FuA | 0.36 | 1885 | 4.33 | 4.33 | Assumes 100 foot wide construction corridor (S. Madams, 03/02/09); Miles received in e-mail from Mike Haskell (02/25/09). |
| | FwA | 0.49 | 2578 | 5.92 | 5.92 | Assumes 100 foot wide construction corridor (S. Madams, 03/02/09); Miles received in e-mail from Mike Haskell (02/25/09). |
| | HdA | 0.92 | 4855 | 11.15 | 11.15 | Assumes 100 foot wide construction corridor (S. Madams, 03/02/09); Miles received in e-mail from Mike Haskell (02/25/09). |
| | HdpA | 0.26 | 1356 | 3.11 | 3.11 | Assumes 100 foot wide construction corridor (S. Madams, 03/02/09); Miles received in e-mail from Mike Haskell (02/25/09). |
| | HfA | 1.03 | 5441 | 12.49 | 12.49 | Assumes 100 foot wide construction corridor (S. Madams, 03/02/09); Miles received in e-mail from Mike Haskell (02/25/09). |
| | HkbA | 0.09 | 472 | 1.08 | 1.08 | Assumes 100 foot wide construction corridor (S. Madams, 03/02/09); Miles received in e-mail from Mike Haskell (02/25/09). |
| | TrA | 0.39 | 2038 | 4.68 | 4.68 | Assumes 100 foot wide construction corridor (S. Madams, 03/02/09); Miles received in e-mail from Mike Haskell (02/25/09). |
| | TuA | 0.28 | 1504 | 3.45 | 3.45 | Assumes 100 foot wide construction corridor (S. Madams, 03/02/09); Miles received in e-mail from Mike Haskell (02/25/09). |
| | WaA | 0.33 | 1719 | 3.95 | 3.95 | Assumes 100 foot wide construction corridor (S. Madams, 03/02/09); Miles received in e-mail from Mike Haskell (02/25/09). |
| | | ***9.11*** | | **Sum** | 110.40 | |
| | | | | | **55.20** | Assumes only 50% of the corridor is exposed during construction. |
| Natural gas pipeline (Alternative B) - trench | DeA | 0.25 | 1330 | 0.12 | 0.12 | Assumes 4 foot wide trench; Miles received in e-mail from Mike Haskell (02/25/09). |
| | DgA | 0.24 | 1259 | 0.12 | 0.12 | Assumes 4 foot wide trench; Miles received in e-mail from Mike Haskell (02/25/09). |
| | DrA | 3.69 | 19508 | 1.79 | 1.79 | Assumes 4 foot wide trench; Miles received in e-mail from Mike Haskell (02/25/09). |
| | DwA | 1.22 | 6439 | 0.59 | 0.59 | Assumes 4 foot wide trench; Miles received in e-mail from Mike Haskell (02/25/09). |
| | FtA | 0.08 | 397 | 0.04 | 0.04 | Assumes 4 foot wide trench; Miles received in e-mail from Mike Haskell (02/25/09). |
| | FuA | 0.80 | 4232 | 0.39 | 0.39 | Assumes 4 foot wide trench; Miles received in e-mail from Mike Haskell (02/25/09). |
| | HdA | 1.47 | 7753 | 0.71 | 0.71 | Assumes 4 foot wide trench; Miles received in e-mail from Mike Haskell (02/25/09). |
| | HdpA | 0.25 | 1343 | 0.12 | 0.12 | Assumes 4 foot wide trench; Miles received in e-mail from Mike Haskell (02/25/09). |
| | HfA | 0.04 | 214 | 0.02 | 0.02 | Assumes 4 foot wide trench; Miles received in e-mail from Mike Haskell (02/25/09). |
| | TuA | 0.57 | 2998 | 0.28 | 0.28 | Assumes 4 foot wide trench; Miles received in e-mail from Mike Haskell (02/25/09). |
| | WbA | 2.33 | 12303 | 1.13 | 1.13 | Assumes 4 foot wide trench; Miles received in e-mail from Mike Haskell (02/25/09). |
| | WdA | 0.22 | 1149 | 0.11 | 0.11 | Assumes 4 foot wide trench; Miles received in e-mail from Mike Haskell (02/25/09). |
| | | 11.16 | | | **5.41** | Assumes 100% exposed during construction |
| Natural gas pipeline (Alternative B) - corridor | DeA | 0.25 | 1330 | 3.05 | 3.05 | Assumes 100 foot wide construction corridor (S. Madams, 03/02/09); Miles received in e-mail from Mike Haskell (02/25/09). |
| | DgA | 0.24 | 1259 | 2.89 | 2.89 | Assumes 100 foot wide construction corridor (S. Madams, 03/02/09); Miles received in e-mail from Mike Haskell (02/25/09). |
| | DrA | 3.69 | 19508 | 44.78 | 44.78 | Assumes 100 foot wide construction corridor (S. Madams, 03/02/09); Miles received in e-mail from Mike Haskell (02/25/09). |
| | DwA | 1.22 | 6439 | 14.78 | 14.78 | Assumes 100 foot wide construction corridor (S. Madams, 03/02/09); Miles received in e-mail from Mike Haskell (02/25/09). |
| | FtA | 0.08 | 397 | 0.91 | 0.91 | Assumes 100 foot wide construction corridor (S. Madams, 03/02/09); Miles received in e-mail from Mike Haskell (02/25/09). |
| | FuA | 0.80 | 4232 | 9.72 | 9.72 | Assumes 100 foot wide construction corridor (S. Madams, 03/02/09); Miles received in e-mail from Mike Haskell (02/25/09). |
| | HdA | 1.47 | 7753 | 17.80 | 17.80 | Assumes 100 foot wide construction corridor (S. Madams, 03/02/09); Miles received in e-mail from Mike Haskell (02/25/09). |
| | HdpA | 0.25 | 1343 | 3.08 | 3.08 | Assumes 100 foot wide construction corridor (S. Madams, 03/02/09); Miles received in e-mail from Mike Haskell (02/25/09). |
| | HfA | 0.04 | 214 | 0.49 | 0.49 | Assumes 100 foot wide construction corridor (S. Madams, 03/02/09); Miles received in e-mail from Mike Haskell (02/25/09). |
| | TuA | 0.57 | 2998 | 6.88 | 6.88 | Assumes 100 foot wide construction corridor (S. Madams, 03/02/09); Miles received in e-mail from Mike Haskell (02/25/09). |
| | WbA | 2.33 | 12303 | 28.24 | 28.24 | Assumes 100 foot wide construction corridor (S. Madams, 03/02/09); Miles received in e-mail from Mike Haskell (02/25/09). |
| | WdA | 0.22 | 1149 | 2.64 | 2.64 | Assumes 100 foot wide construction corridor (S. Madams, 03/02/09); Miles received in e-mail from Mike Haskell (02/25/09). |
| | | ***11.16*** | | **Sum** | 135.28 | |
| | | | | | **67.64** | Assumes only 50% of the corridor is exposed during construction. |
| | | | | **Pole Holes** | **Construction Corridor** | |
| Tranmission Line - Circuit 1 | HdA | 0.55 | 2885 | 0.0042 | 1.9870 | Assumes 4x4 ft hole for each pole spaced at 250 ft. Assumes 30 ft construction corridor. Spacing and corridor from "Transmission" memo 1/5/09; miles in e-mail from Mike H |
| 115-kV Circuit 1 Line | HdpA | 0.31 | 1636 | 0.0024 | 1.1269 | Assumes 4x4 ft hole for each pole spaced at 250 ft. Assumes 30 ft construction corridor. Spacing and corridor from "Transmission" memo 1/5/09; miles in e-mail from Mike H |
| | | 0.86 | **Sum** | 0.0066 | 3.1139 | |
| | | 4521 | | **0.0066** | - | Assumes pole hole footprint will be unprotected until pole installed |
| | # T poles | 18 | | - | **1.56** | Assumes 50% of the corridor is unprotected during construction |
| Tranmission Line - Circuit 2 | HdA | 0.82 | 4330 | 0.0064 | 2.9818 | Assumes 4x4 ft hole for each pole spaced at 250 ft. Assumes 30 ft construction corridor. Spacing and corridor from "Transmission" memo 1/5/09; miles in e-mail from Mike H |
| 115-kV Circuit 2 Line | HdpA | 0.30 | 1560 | 0.0023 | 1.0743 | Assumes 4x4 ft hole for each pole spaced at 250 ft. Assumes 30 ft construction corridor. Spacing and corridor from "Transmission" memo 1/5/09; miles in e-mail from Mike H |
| | DrA | 0.07 | 396 | 0.0006 | 0.2726 | Assumes 4x4 ft hole for each pole spaced at 250 ft. Assumes 30 ft construction corridor. Spacing and corridor from "Transmission" memo 1/5/09; miles in e-mail from Mike H |
| | | 1.19 | **Sum** | 0.0092 | 4.3287 | |
| | | 6285 | | **0.0092** | - | Assumes pole hole footprint will be unprotected until pole installed |
| | # T poles | 25 | | - | **2.16** | Assumes 50% of the corridor is unprotected during construction |
| Transmission Line - Reconductored | DrA | 0.37 | 1968 | NA | 0.9036 | Assumes no construction on ground, only vehicle traffic & parking. Assumes area under transmission line is currently 100% vegetated. Area of disturbance = 20 ft (Greg Tuc |
| 69kV T-Line | HdA | 0.86 | 4528 | NA | 2.0789 | Assumes no construction on ground, only vehicle traffic & parking. Assumes area under transmission line is currently 100% vegetated. Area of disturbance = 20 ft (Greg Tuc |
| | HdpA | 1.17 | 6154 | NA | 2.8254 | Assumes no construction on ground, only vehicle traffic & parking. Assumes area under transmission line is currently 100% vegetated. Area of disturbance = 20 ft (Greg Tuc |
| | HdsA | 0.24 | 1288 | NA | 0.5915 | Assumes no construction on ground, only vehicle traffic & parking. Assumes area under transmission line is currently 100% vegetated. Area of disturbance = 20 ft (Greg Tuc |
| | TuA | 0.29 | 1530 | NA | 0.7024 | Assumes no construction on ground, only vehicle traffic & parking. Assumes area under transmission line is currently 100% vegetated. Area of disturbance = 20 ft (Greg Tuc |
| | | 2.93 | **Sum** | NA | 7.1018 | |
| | | | | | - | Assumes no work will be taking place on ground. |
| | | | | | **0.00** | Assumed 100% of construction corridor is vegetated or covered. |
| | | | | **Trench acres** | **Construction Corridor acres** | |
| Service Water | - | 0 | 0 | **0** | **0** | On-site connection, according to fact sheet dated 12/30/08 |
| Construction Water | - | 0 | 0 | **0** | **0** | On-site connection, according to fact sheet dated 12/30/08 |
| Potable Water | - | 0 | 0 | **0** | **0** | Will be delivered, according to fact sheet dated 12/30/08 |
| Process Water | - | 0 | 0 | **0** | **0** | On-site connection, according to fact sheet dated 12/30/08 |

## Table 5.11-4. Estimate of Total Suspended Particulates (TSP) Emitted from Grading and Wind Erosion

| Emission Source | Acreage | Duration (months) | Unmitigated TSP (tons) | Mitigated TSP (tons) |
|---|---|---|---|---|
| **Grading Dust:** | | | | |
| Project Site | 4.60 | 2 | 0.158 | 0.055 |
| Laydown Area | 1.90 | 1 | 0.033 | 0.011 |
| *Natural Gas Pipeline (4 ft trench)* | | | | |
| Alternative A | 4.42 | 6 | 0.455 | 0.159 |
| Alternative B | 5.41 | 6 | 0.558 | 0.195 |
| *Transmission Line Pole Holes* | | | | |
| Corridor 1 | 0.007 | 2 | 0.0002 | 0.0001 |
| Corridor 2 | 0.009 | 2 | 0.0003 | 0.0001 |
| Corridor 3 | 0.000 | 2 | 0.0000 | 0.0000 |
| *Transmission Line Total* | *0.016* | | *0.0005* | *0.0002* |
| **Wind Blown Dust:** | | | | |
| Project Site | 4.60 | 10 | 0.146 | 0.051 |
| Laydown Area | 0.00 | 11 | 0.000 | 0.000 |
| *Natural Gas Pipeline Corridor* | | | | |
| Alternative A | 55.20 | 2 | 3.496 | 1.224 |
| Alternative B | 67.64 | 2 | 4.284 | 1.499 |
| *Transmission Line Corridor* | | | | |
| Corridor 1 | 1.557 | 4 | 0.197 | 0.069 |
| Corridor 2 | 2.164 | 4 | 0.274 | 0.096 |
| Corridor 3 | 0.000 | 4 | 0.000 | 0.000 |
| *Transmission Line Total* | *3.721* | *4* | *0.471* | *0.165* |
| **Estimated Total** | | | **9.60** | **3.36** |

**Notes:**
All linear feature impacts noted above are for portions outside of the project areas footprint.

**Project Assumptions:**
Grading for the project site will be completed in a 2 month period and construction will extend an additional 10 months.
Grading for the laydown area will be completed in a 1 month period and the site will be covered (gravelled or paved) immediately.
Approximately 1/10th of the project site will have bare soil exposure during the length of the construction period.
Water and sewer line connections will be made on site.
One of the two natural gas line alternatives will be chosen for this project. Alternative A is 9.11 miles long, and Alternative B is 11.16 miles long.
The natural gas supply line will be installed along roadway rights-of-way in a 4-ft trench with 100-ft construction corridor.

**Data Sources:**
[a] PM10 Emission Factor Source: Midwest Research Institute, South Coast AQMD Project No. 95040, Level 2 Analysis Procedure, March 1996
[b] PM10 to TSP Conversion Factor Source: Bay Area Air Quality Management District CEQA Guidelines, Assessing the Air Quality Impacts of Projects, December 1999.
SCAQMD CEQA Handbook (1993) Table 11-4 for mitigation efficiency rates (as summarized in Table 8.9-4)

**Project: TID Almond Power Plant 2** **Reverified 04/07/09 JLK**

**Dust from Wind Erosion - With and Without Mitigation**

**Grading** MRI factor of 0.011 tons/acre/month is based on 168 hours per month of construction activity.

| | | |
|---|---|---|
| PM10 Emission Factor (ton/acre/month)[a] | 0.011 | Fact Sheet, 4/26/2007. |
| **Project Site** | | |
| Duration (months): | 2 | Assumes 2 months of active grading. |
| Site Acreage: | 4.60 | Assumes 100% of site is graded |
| PM10 Emitted (tons): | 0.10 | |
| TSP Emitted (tons)[b]: | **0.158** | assume TSP is 64% PM10 |
| Mitigated TSP Emitted (tons): | **0.055** | Assume 65% reduction in PM10 with watering thrice daily per SCAQMD CEQA Handbook (1993) Table 11-4 |
| **Laydown Area** | | |
| Duration (months): | 1 | Assumes one month to grade |
| Site Acreage: | 1.90 | Assumes 100% of site is graded |
| PM10 Emitted (tons): | 0.02 | |
| TSP Emitted (tons)[b]: | **0.033** | Assume TSP is 64% PM10 |
| Mitigated TSP Emitted (tons): | **0.011** | Assume 65% reduction in PM10 with watering thrice daily per SCAQMD CEQA Handbook (1993) Table 11-4 |
| **Natural Gas Pipeline Trenches** | | |
| ***Alternative A*** | | |
| Duration (months): | 6 | Assumes 6 months to grade pipeline |
| Site Acreage: | 4.416 | Assumes a 4 ft wide trench |
| PM10 Emitted (tons): | 0.2915 | |
| TSP Emitted (tons)[b]: | **0.4554** | assume TSP is 64% PM10 |
| Mitigated TSP Emitted (tons): | **0.1594** | Assume 65% reduction in PM10 with watering thrice daily per SCAQMD CEQA Handbook (1993) Table 11-4 |
| ***Alternative B*** | | |
| Duration (months): | 6 | Assumes 6 months to grade pipeline |
| Site Acreage: | 5.411 | Assumes a 4 ft wide trench |
| PM10 Emitted (tons): | 0.3571 | |
| TSP Emitted (tons)[b]: | **0.5580** | assume TSP is 64% PM10 |
| Mitigated TSP Emitted (tons): | **0.1953** | Assume 65% reduction in PM10 with watering thrice daily per SCAQMD CEQA Handbook (1993) Table 11-4 |
| **Transmission Line Pole Holes** | | |
| ***Corridor 1*** | | |
| Duration (months): | 2 | Assumes 2 months to grade transmission line |
| Site Acreage: | 0.007 | Assumes 18 4 ft by 4 ft pole holes |
| PM10 Emitted (tons): | 0.0001 | |
| TSP Emitted (tons)[b]: | **0.0002** | Assume TSP is 64% PM10 |
| Mitigated TSP Emitted (tons): | **0.0001** | Assume 65% reduction in PM10 with watering thrice daily per SCAQMD CEQA Handbook (1993) Table 11-4 |
| ***Corridor 2*** | | |
| Duration (months): | 2 | Assumes 2 months to grade transmission line |
| Site Acreage: | 0.009 | Assumes 25 4 ft by 4 ft pole holes |
| PM10 Emitted (tons): | 0.0002 | |
| TSP Emitted (tons)[b]: | **0.0003** | Assume TSP is 64% PM10 |
| Mitigated TSP Emitted (tons): | **0.0001** | Assume 65% reduction in PM10 with watering thrice daily per SCAQMD CEQA Handbook (1993) Table 11-4 |
| ***Corridor 3*** | | |
| Duration (months): | 0 | Assumes no grading is necessary to reconductor line |
| Site Acreage: | 0.000 | Assumes only reconductoring to take place (on existing poles) |
| PM10 Emitted (tons): | 0.0000 | |
| TSP Emitted (tons)[b]: | **0.0000** | Assume TSP is 64% PM10 |
| Mitigated TSP Emitted (tons): | **0.0000** | Assume 65% reduction in PM10 with watering thrice daily per SCAQMD CEQA Handbook (1993) Table 11-4 |
| **Water Line Trench** | | |
| Duration (months): | 0 | Assumes on-site construction |
| Site Acreage: | 0.000 | |
| PM10 Emitted (tons): | 0.000 | |
| TSP Emitted (tons)[b]: | **0.000** | Assume TSP is 64% PM10 |
| Mitigated TSP Emitted (tons): | **0.000** | Assume 65% reduction in PM10 with watering thrice daily per SCAQMD CEQA Handbook (1993) Table 11-4 |
| **Sewer Line Trench** | | |
| Duration (months): | 0 | Assumes on-site construction |
| Site Acreage: | 0.000 | |
| PM10 Emitted (tons): | 0.000 | |
| TSP Emitted (tons)[b]: | **0.000** | Assume TSP is 64% PM10 |
| Mitigated TSP Emitted (tons): | **0.000** | Assume 65% reduction in PM10 with watering thrice daily per SCAQMD CEQA Handbook (1993) Table 11-4 |
| **Total Unmitigated TSP Emitted (tons)** | **1.205** | |
| **Total Mitigated TSP Emitted (tons)** | **0.422** | Assume 65% reduction in PM10 with watering thrice daily per SCAQMD CEQA Handbook (1993) Table 11-4 |

[a]Emission Factor Source: Midwest Research Institute, South Coast AQMD Project No. 95040, March 1996, Level 2 Analysis Procedure

[b] Conversion Factor Source: Bay Area Air Quality Management District (BAAQMD) BAAQMD CEQA Guidelines, Assessing the Air Quality Impacts of Projects and Plans. December 1999

**Wind Blown Dust**

| | | |
|---|---|---|
| TSP Emission Factor (ton/acre/year) | 0.38 | Emission Factor Source: AP-42, Section 11.9 Western Surface Coal Mining Table 11.9-4, January 1995. |
| **Project Site** | | |
| Acres exposed | 4.60 | |
| Duration (months) | 10 | Assumes 10 months of construction (after 2 months of grading) |
| TSP Emitted for Site (tons): | **0.146** | Assumes 1/10th of the site is bare soil during 10 month construction period |
| Mitigated TSP Emitted (tons): | **0.051** | Assume 65% reduction in TSP with watering thrice daily per SCAQMD CEQA Handbook (1993) Table 11-4 |
| **Laydown Area** | | |
| Acres exposed | 0.000 | Assumes laydown area is completely covered following grading |
| Duration (months) | 11 | Assume 11 months for construction period (minus 1 month for grading) |
| TSP Emitted for Site (tons): | **0.000** | |
| Mitigated TSP Emitted (tons): | **0.000** | Assume 65% reduction in TSP with watering thrice daily per SCAQMD CEQA Handbook (1993) Table 11-4 |
| **Natural Gas Pipeline** | | |
| ***Alternative A*** | | |
| Acres exposed | 55.20 | Assumes 9.11 mile pipeline with 100 ft construction corridor along side of road |
| Duration (months) | 2 | Assumes 2 months after excavating trench that permanent cover (revegetation, paving, etc) is established |
| TSP Emitted for Site (tons): | **3.496** | |
| Mitigated TSP Emitted (tons): | **1.224** | Assume 65% reduction in TSP with watering thrice daily per SCAQMD CEQA Handbook (1993) Table 11-4 |
| ***Alternative B*** | | |
| Acres exposed | 67.638 | Assumes 11.16 mile pipeline with 100 ft construction corridor along side of road |
| Duration (months) | 2 | Assumes 2 months after excavating trench that permanent cover (revegetation, paving, etc) is established |
| TSP Emitted for Site (tons): | **4.284** | |
| Mitigated TSP Emitted (tons): | **1.499** | Assume 65% reduction in TSP with watering thrice daily per SCAQMD CEQA Handbook (1993) Table 11-4 |
| **Transmission Line Corridor** | | |
| ***Corridor 1*** | | |
| Acres exposed | 1.557 | Assumes only 50% of construction corridor is exposed soil |
| Duration (months) | 4.0 | |
| TSP Emitted for Site (tons): | **0.197** | |
| Mitigated TSP Emitted (tons): | **0.069** | Assume 65% reduction in TSP with watering thrice daily per SCAQMD CEQA Handbook (1993) Table 11-4 |
| ***Corridor 2*** | | |
| Acres exposed | 2.164 | Assumes only 50% of construction corridor is exposed soil |
| Duration (months) | 4.0 | |
| TSP Emitted for Site (tons): | **0.274** | |
| Mitigated TSP Emitted (tons): | **0.096** | Assume 65% reduction in TSP with watering thrice daily per SCAQMD CEQA Handbook (1993) Table 11-4 |
| ***Corridor 3*** | | |
| Acres exposed | 0.000 | Assumes only 50% of construction corridor is exposed soil |
| Duration (months) | 4.0 | |
| TSP Emitted for Site (tons): | **0.000** | |
| Mitigated TSP Emitted (tons): | **0.000** | Assume 65% reduction in TSP with watering thrice daily per SCAQMD CEQA Handbook (1993) Table 11-4 |
| **Water Line Corridor** | | |
| Acres exposed | 0.000 | Assumes on-site construction |
| Duration (months) | 0 | |
| TSP Emitted for Site (tons): | **0.000** | |
| Mitigated TSP Emitted (tons): | **0.000** | Assume 65% reduction in TSP with watering thrice daily per SCAQMD CEQA Handbook (1993) Table 11-4 |
| **Sewer Line Corridor** | | |
| Acres exposed | 0.000 | Assumes on-site construction |
| Duration (months) | 0 | |
| TSP Emitted for Site (tons): | **0.000** | |
| Mitigated TSP Emitted (tons): | **0.000** | Assume 65% reduction in TSP with watering thrice daily per SCAQMD CEQA Handbook (1993) Table 11-4 |
| **Total (tons) without mitigation** | **8.397** | |
| **Total (tons) with mitigation** | **2.939** | Assume 65% reduction in PM10 with watering thrice daily per SCAQMD CEQA Handbook (1993) Table 11-4 |

| MUSYM | MUKEY | muname | NAME | Acres | |
|---|---|---|---|---|---|
| HdA | 462607 | Hanford sanc | Laydown Area | 1.90 | updated 04/08/09 |
| | | | | | |
| HdpA | 462613 | Hanford sanc | Project Site | 3.10 | updated 04/08/09 |
| HdA | 462607 | Hanford sanc | Project Site | 1.50 | updated 04/08/09 |

| NAME | LENGTH MILES | | |
|---|---|---|---|
| Natural Gas Pipeline Alternate A | 9.11 | Entire line | ok 04/08/09 |
| Natural Gas Pipeline Alternate B | 11.16 | Entire line | ok 04/08/09 |
| 115-kV Circuit 1 | 0.86 | Entire line | ok 04/08/09 |
| 115-kV Circuit 2 | 1.19 | Entire line | ok 04/08/09 |
| Reconductored 69-kV line | 2.93 | Entire line | ok 04/08/09 |

| NAME | LENGTH | Soil Type | Length Miles |
|---|---|---|---|
| 115-kV Circuit 1 Line | 1636.28 | HdpA | 0.31 |
| 115-kV Circuit 1 Line | 2885.12 | HdA | 0.55 |
| | 4521.40 | | 0.86 |
| | | | |
| 115-kV Circuit 2 Line | 1559.85 | HdpA | 0.30 |
| 115-kV Circuit 2 Line | 395.85 | DrA | 0.07 |
| 115-kV Circuit 2 Line | 4314.93 | HdA | 0.82 |
| | 6270.63 | | 1.19 |
| | | | |
| Natural Gas Pipeline (Alternate A) | 1165.67 | DrA | 0.22 |
| Natural Gas Pipeline (Alternate A) | 151.71 | DrA | 0.03 |
| Natural Gas Pipeline (Alternate A) | 1181.29 | DrA | 0.22 |
| Natural Gas Pipeline (Alternate A) | 19.98 | DrA | 0.00 |
| Natural Gas Pipeline (Alternate A) | 3140.10 | DrA | 0.59 |
| Natural Gas Pipeline (Alternate A) | 941.09 | DrA | 0.18 |
| Natural Gas Pipeline (Alternate A) | 2191.86 | DrA | 0.42 |
| Natural Gas Pipeline (Alternate A) | 1700.38 | DwA | 0.32 |
| Natural Gas Pipeline (Alternate A) | 476.95 | DwA | 0.09 |
| Natural Gas Pipeline (Alternate A) | 21.69 | DwA | 0.00 |
| Natural Gas Pipeline (Alternate A) | 2565.03 | DwA | 0.49 |
| Natural Gas Pipeline (Alternate A) | 2130.91 | DwA | 0.40 |
| Natural Gas Pipeline (Alternate A) | 29.72 | DwA | 0.01 |
| Natural Gas Pipeline (Alternate A) | 866.15 | DwA | 0.16 |
| Natural Gas Pipeline (Alternate A) | 6381.71 | DwA | 1.21 |
| Natural Gas Pipeline (Alternate A) | 441.81 | DwA | 0.08 |
| Natural Gas Pipeline (Alternate A) | 936.88 | FsA | 0.18 |
| Natural Gas Pipeline (Alternate A) | 456.84 | FtA | 0.09 |
| Natural Gas Pipeline (Alternate A) | 760.42 | FtA | 0.14 |
| Natural Gas Pipeline (Alternate A) | 681.75 | FtA | 0.13 |
| Natural Gas Pipeline (Alternate A) | 223.83 | FuA | 0.04 |
| Natural Gas Pipeline (Alternate A) | 1491.22 | FuA | 0.28 |
| Natural Gas Pipeline (Alternate A) | 169.89 | FuA | 0.03 |
| Natural Gas Pipeline (Alternate A) | 1969.15 | FwA | 0.37 |
| Natural Gas Pipeline (Alternate A) | 608.92 | FwA | 0.12 |
| Natural Gas Pipeline (Alternate A) | 82.46 | HdA | 0.02 |
| Natural Gas Pipeline (Alternate A) | 3207.22 | HdA | 0.61 |
| Natural Gas Pipeline (Alternate A) | 1565.45 | HdA | 0.30 |
| Natural Gas Pipeline (Alternate A) | 1356.10 | HdpA | 0.26 |
| Natural Gas Pipeline (Alternate A) | 1009.13 | HfA | 0.19 |
| Natural Gas Pipeline (Alternate A) | 1578.75 | HfA | 0.30 |
| Natural Gas Pipeline (Alternate A) | 933.83 | HfA | 0.18 |
| Natural Gas Pipeline (Alternate A) | 1918.89 | HfA | 0.36 |
| Natural Gas Pipeline (Alternate A) | 471.79 | HkbA | 0.09 |
| Natural Gas Pipeline (Alternate A) | 1390.43 | TrA | 0.26 |
| Natural Gas Pipeline (Alternate A) | 647.75 | TrA | 0.12 |
| Natural Gas Pipeline (Alternate A) | 1504.35 | TuA | 0.28 |
| Natural Gas Pipeline (Alternate A) | 1718.86 | WaA | 0.33 |
| | 48089.96 | | 9.11 |

| | Miles |
|---|---|
| DrA | 1.67 |
| DwA | 2.77 |
| FsA | 0.18 |
| FtA | 0.36 |
| FuA | 0.36 |
| FwA | 0.49 |
| HdA | 0.92 |
| HdpA | 0.26 |
| HfA | 1.03 |
| HkbA | 0.09 |
| TrA | 0.39 |
| TuA | 0.28 |
| WaA | 0.33 |
| | 9.11 |

| | | | |
|---|---|---|---|
| Natural Gas Pipeline (Alternate B) | 1330.05 | DeA | 0.25 |
| Natural Gas Pipeline (Alternate B) | 1259.23 | DgA | 0.24 |
| Natural Gas Pipeline (Alternate B) | 193.98 | DrA | 0.04 |
| Natural Gas Pipeline (Alternate B) | 2378.81 | DrA | 0.45 |
| Natural Gas Pipeline (Alternate B) | 1691.50 | DrA | 0.32 |
| Natural Gas Pipeline (Alternate B) | 5980.02 | DrA | 1.13 |
| Natural Gas Pipeline (Alternate B) | 1598.91 | DrA | 0.30 |
| Natural Gas Pipeline (Alternate B) | 6779.63 | DrA | 1.28 |
| Natural Gas Pipeline (Alternate B) | 885.20 | DrA | 0.17 |
| Natural Gas Pipeline (Alternate B) | 140.35 | DwA | 0.03 |
| Natural Gas Pipeline (Alternate B) | 1915.85 | DwA | 0.36 |
| Natural Gas Pipeline (Alternate B) | 2890.08 | DwA | 0.55 |
| Natural Gas Pipeline (Alternate B) | 1493.18 | DwA | 0.28 |
| Natural Gas Pipeline (Alternate B) | 397.00 | FtA | 0.08 |
| Natural Gas Pipeline (Alternate B) | 928.95 | FuA | 0.18 |
| Natural Gas Pipeline (Alternate B) | 2523.79 | FuA | 0.48 |
| Natural Gas Pipeline (Alternate B) | 779.53 | FuA | 0.15 |
| Natural Gas Pipeline (Alternate B) | 3461.62 | HdA | 0.66 |
| Natural Gas Pipeline (Alternate B) | 2017.89 | HdA | 0.38 |
| Natural Gas Pipeline (Alternate B) | 1453.19 | HdA | 0.28 |
| Natural Gas Pipeline (Alternate B) | 820.57 | HdA | 0.16 |
| Natural Gas Pipeline (Alternate B) | 1342.96 | HdpA | 0.25 |
| Natural Gas Pipeline (Alternate B) | 213.89 | HfA | 0.04 |
| Natural Gas Pipeline (Alternate B) | 2592.80 | TuA | 0.49 |
| Natural Gas Pipeline (Alternate B) | 404.86 | TuA | 0.08 |
| Natural Gas Pipeline (Alternate B) | 1231.01 | WbA | 0.23 |
| Natural Gas Pipeline (Alternate B) | 2638.88 | WbA | 0.50 |
| Natural Gas Pipeline (Alternate B) | 8432.74 | WbA | 1.60 |
| Natural Gas Pipeline (Alternate B) | 1149.35 | WdA | 0.22 |
| | 58925.85 | | 11.16 |

| | Miles |
|---|---|
| DeA | 0.25 |
| DgA | 0.24 |
| DrA | 3.69 |
| DwA | 1.22 |
| FtA | 0.08 |
| FuA | 0.80 |
| HdA | 1.47 |
| HdpA | 0.25 |
| HfA | 0.04 |
| TuA | 0.57 |
| WbA | 2.33 |
| WdA | 0.22 |
| | 11.16 |

| | | | |
|---|---|---|---|
| Reconductored 69kV Transmission Line | 56.64 | DrA | 0.01 |
| Reconductored 69kV Transmission Line | 587.22 | DrA | 0.11 |
| Reconductored 69kV Transmission Line | 1324.19 | DrA | 0.25 |
| Reconductored 69kV Transmission Line | 378.56 | HdA | 0.07 |
| Reconductored 69kV Transmission Line | 611.66 | HdA | 0.12 |
| Reconductored 69kV Transmission Line | 749.68 | HdA | 0.14 |
| Reconductored 69kV Transmission Line | 810.69 | HdA | 0.15 |
| Reconductored 69kV Transmission Line | 557.46 | HdA | 0.11 |
| Reconductored 69kV Transmission Line | 700.92 | HdA | 0.13 |
| Reconductored 69kV Transmission Line | 190.80 | HdA | 0.04 |
| Reconductored 69kV Transmission Line | 528.00 | HdA | 0.10 |
| Reconductored 69kV Transmission Line | 2362.75 | HdpA | 0.45 |
| Reconductored 69kV Transmission Line | 577.81 | HdpA | 0.11 |
| Reconductored 69kV Transmission Line | 1146.66 | HdpA | 0.22 |
| Reconductored 69kV Transmission Line | 797.77 | HdpA | 0.15 |
| Reconductored 69kV Transmission Line | 345.07 | HdpA | 0.07 |
| Reconductored 69kV Transmission Line | 923.61 | HdpA | 0.17 |
| Reconductored 69kV Transmission Line | 100.00 | HdsA | 0.02 |
| Reconductored 69kV Transmission Line | 474.30 | HdsA | 0.09 |
| Reconductored 69kV Transmission Line | 713.95 | HdsA | 0.14 |
| Reconductored 69kV Transmission Line | 300.03 | TuA | 0.06 |
| Reconductored 69kV Transmission Line | 509.33 | TuA | 0.10 |
| Reconductored 69kV Transmission Line | 296.30 | TuA | 0.06 |
| Reconductored 69kV Transmission Line | 424.25 | TuA | 0.08 |
| | 15467.65 | | 2.93 |

| | Miles |
|---|---|
| DrA | 0.37 |
| HdA | 0.86 |
| HdpA | 1.17 |
| HdsA | 0.24 |
| TuA | 0.29 |
| | 2.93 |

| Add to text | Add to bottom of table |
|---|---|
| ? | 153 |
| DeA | 159 |
| DgA | CeA |
| WbA | CsB |
| WdA | DtA |
| | DuA |
| | DzA |
| | FrA |
| | HbA |
| | HdB |
| | HddA |
| | W |
| | WeA |

Project Site

| MUSYM | Acres |
|---|---|
| HdA | 1.47 |
| HdpA | 2.54 |
| | 4.01 |

Linear Features

| NAME | Soil Type | LENGTH FEET | Length Miles |
|---|---|---|---|
| 115-kV Circuit 1 (Corridor 1) | HdA | 3223.20 | 0.61 |
| 115-kV Circuit 1 (Corridor 1) | HdA | 1282.18 | 0.24 |
| 115-kV Circuit 1 (Corridor 1) | HdpA | 1564.62 | 0.30 |
| 115-kV Circuit 1 (Corridor 1) | DrA | 406.29 | 0.08 |
| | | 6476.29 | 1.23 |
| 115-kV Circuit 2 Line (Corridor 2) | HdA | 2730.07 | 0.52 |
| 115-kV Circuit 2 Line (Corridor 2) | HdpA | 1636.11 | 0.31 |
| | | 4366.17 | 0.83 |
| Proposed 69-kV T-Line (Corridor 3) | HdA | 2429.14 | 0.46 |
| Proposed 69-kV T-Line (Corridor 3) | HdpA | 1827.90 | 0.35 |
| | | 4257.04 | 0.81 |
| Reconductored 69kV T-Line (Corridor 4) | DrA | 587.22 | 0.11 |
| Reconductored 69kV T-Line (Corridor 4) | DrA | 1324.19 | 0.25 |
| Reconductored 69kV T-Line (Corridor 4) | HdA | 378.56 | 0.07 |
| Reconductored 69kV T-Line (Corridor 4) | HdA | 611.66 | 0.12 |
| Reconductored 69kV T-Line (Corridor 4) | HdA | 620.06 | 0.12 |
| Reconductored 69kV T-Line (Corridor 4) | HdA | 810.69 | 0.15 |
| Reconductored 69kV T-Line (Corridor 4) | HdA | 557.46 | 0.11 |
| Reconductored 69kV T-Line (Corridor 4) | HdA | 700.92 | 0.13 |
| Reconductored 69kV T-Line (Corridor 4) | HdA | 190.80 | 0.04 |
| Reconductored 69kV T-Line (Corridor 4) | HdA | 584.64 | 0.11 |
| Reconductored 69kV T-Line (Corridor 4) | HdpA | 2362.75 | 0.45 |
| Reconductored 69kV T-Line (Corridor 4) | HdpA | 1146.66 | 0.22 |
| Reconductored 69kV T-Line (Corridor 4) | HdpA | 797.77 | 0.15 |
| Reconductored 69kV T-Line (Corridor 4) | HdpA | 345.07 | 0.07 |
| Reconductored 69kV T-Line (Corridor 4) | HdpA | 923.61 | 0.17 |
| Reconductored 69kV T-Line (Corridor 4) | HdsA | 713.95 | 0.14 |
| Reconductored 69kV T-Line (Corridor 4) | HdsA | 100.00 | 0.02 |
| Reconductored 69kV T-Line (Corridor 4) | HdsA | 474.30 | 0.09 |
| Reconductored 69kV T-Line (Corridor 4) | TuA | 300.03 | 0.06 |
| Reconductored 69kV T-Line (Corridor 4) | TuA | 509.33 | 0.10 |
| Reconductored 69kV T-Line (Corridor 4) | TuA | 296.30 | 0.06 |
| Reconductored 69kV T-Line (Corridor 4) | TuA | 424.25 | 0.08 |
| | | 14760.21 | 2.80 |
| Natural Gas Pipeline | DrA | 1165.67 | 0.22 |
| Natural Gas Pipeline | DrA | 151.71 | 0.03 |
| Natural Gas Pipeline | DrA | 1181.29 | 0.22 |
| Natural Gas Pipeline | DrA | 19.98 | 0.00 |
| Natural Gas Pipeline | DrA | 3140.10 | 0.59 |
| Natural Gas Pipeline | DrA | 941.09 | 0.18 |
| Natural Gas Pipeline | DrA | 2191.86 | 0.42 |
| Natural Gas Pipeline | DwA | 1700.38 | 0.32 |
| Natural Gas Pipeline | DwA | 476.95 | 0.09 |
| Natural Gas Pipeline | DwA | 21.69 | 0.00 |
| Natural Gas Pipeline | DwA | 6381.71 | 1.21 |
| Natural Gas Pipeline | DwA | 441.81 | 0.08 |
| Natural Gas Pipeline | DwA | 2565.03 | 0.49 |
| Natural Gas Pipeline | DwA | 2130.91 | 0.40 |
| Natural Gas Pipeline | DwA | 29.72 | 0.01 |
| Natural Gas Pipeline | DwA | 866.15 | 0.16 |
| Natural Gas Pipeline | FsA | 936.88 | 0.18 |
| Natural Gas Pipeline | FtA | 456.84 | 0.09 |
| Natural Gas Pipeline | FtA | 760.42 | 0.14 |
| Natural Gas Pipeline | FtA | 681.75 | 0.13 |
| Natural Gas Pipeline | FuA | 223.83 | 0.04 |
| Natural Gas Pipeline | FuA | 1491.22 | 0.28 |
| Natural Gas Pipeline | FuA | 169.89 | 0.03 |
| Natural Gas Pipeline | FwA | 1969.15 | 0.37 |
| Natural Gas Pipeline | FwA | 608.92 | 0.12 |
| Natural Gas Pipeline | HdA | 3164.57 | 0.60 |
| Natural Gas Pipeline | HdA | 1565.45 | 0.30 |
| Natural Gas Pipeline | HdA | 82.46 | 0.02 |
| Natural Gas Pipeline | HdpA | 2002.81 | 0.38 |
| Natural Gas Pipeline | HfA | 1009.13 | 0.19 |
| Natural Gas Pipeline | HfA | 1578.75 | 0.30 |
| Natural Gas Pipeline | HfA | 933.83 | 0.18 |
| Natural Gas Pipeline | HfA | 1918.89 | 0.36 |
| Natural Gas Pipeline | HkbA | 471.79 | 0.09 |
| Natural Gas Pipeline | TrA | 1390.43 | 0.26 |
| Natural Gas Pipeline | TrA | 647.75 | 0.12 |
| Natural Gas Pipeline | TuA | 1504.35 | 0.28 |
| Natural Gas Pipeline | WaA | 1718.86 | 0.33 |
| | | 48694.03 | 9.22 |

| Affected Soil Units | |
|---|---|
| DrA | 0.36 |
| HdA | 0.84 |
| HdpA | 1.06 |
| HdsA | 0.24 |
| TuA | 0.29 |
| DrA | 1.67 |
| DwA | 2.77 |
| FsA | 0.18 |
| FtA | 0.36 |
| FuA | 0.36 |
| FwA | 0.49 |
| HdA | 0.91 |
| HdpA | 0.38 |
| HfA | 1.03 |
| HkbA | 0.09 |
| TrA | 0.39 |
| TuA | 0.28 |
| WaA | 0.33 |

| Soils w/in 1 mile |
|---|
| DtA |
| DuA |
| DzA |
| FrA |
| HbA |
| HdB |
| HddA |
| WbA |

| | |
|---|---|
| HdA | 0.85 |
| HdpA | 0.30 |
| DrA | 0.08 |

# Attachment D
# Risk Determination Worksheet

ATTACHMENT D

# Risk Determination Worksheet

To be determined

# Attachment E
# BMP Consideration Checklist

# Attachment E

## BMP Consideration Checklist

| CONSTRUCTION SITE BMPs<br>CONSIDERATION CHECKLIST | | | | | |
|---|---|---|---|---|---|
| **The BMPs listed here should be considered for every project. Those BMPs that are not included in the SWPPP must be checked as "Not Used" with a brief statement describing why it is not being used.** | | | | | |
| **EROSION CONTROL BMPs** | | | | | |
| **BMP No.** | **BMP** | **CONSIDERED FOR PROJECT** | **CHECK IF USED** | **CHECK IF NOT USED** | **IF NOT USED, STATE REASON** |
| EC-1 | Scheduling | | | | |
| EC-2 | Preservation of Existing Vegetation | | | | |
| EC-3 | Hydraulic Mulch | | | | |
| EC-4 | Hydroseeding | | | | |
| EC-5 | Soil Binders | | | | |
| EC-6 | Straw Mulch | | | | |
| EC-7 | Geotextiles & Mats | | | | |
| EC-8 | Wood Mulching | | | | |
| EC-9 | Earth Dikes & Drainage Swales | | | | |
| EC-10 | Velocity Dissipation Devices | | | | |
| EC-11 | Slope Drains | | | | |
| EC-12 | Streambank Stabilization | | | | |
| EC-13 | Polyacrylamide | | | | |

## CONSTRUCTION SITE BMPs
## CONSIDERATION CHECKLIST

**The BMPs listed here should be considered for every project. Those BMPs that are not included in the SWPPP must be checked as "Not Used" with a brief statement describing why it is not being used.**

| BMP No. | BMP | CONSIDERED FOR PROJECT | CHECK IF USED | CHECK IF NOT USED | IF NOT USED, STATE REASON |
|---|---|---|---|---|---|
| **SEDIMENT CONTROL BMPs** | | | | | |
| SE-1 | Silt Fence | | | | |
| SE-2 | Sediment Basin | | | | |
| SE-3 | Sediment Trap | | | | |
| SE-4 | Check Dam | | | | |
| SE-5 | Fiber Rolls | | | | |
| SE-6 | Gravel Bag Berm | | | | |
| SE-7 | Street Sweeping and Vacuuming | | | | |
| SE-8 | Sand Bag Barrier | | | | |
| SE-9 | Straw Bale Barrier | | | | |
| SE-10 | Storm Drain Inlet Protection | | | | |
| SE-11 | Chemical Treatment | | | | |
| **WIND EROSION CONTROL BMPs** | | | | | |
| WE-1 | Wind Erosion Control | | | | |
| **TRACKING CONTROL BMPs** | | | | | |
| TR-1 | Stabilized Construction Entrance/Exit | | | | |
| TR-2 | Stabilized Construction Roadway | | | | |
| TR-3 | Entrance/Outlet Tire Wash | | | | |

## CONSTRUCTION SITE BMPs
## CONSIDERATION CHECKLIST

**The BMPs listed here should be considered for every project. Those BMPs that are not included in the SWPPP must be checked as "Not Used" with a brief statement describing why it is not being used.**

### NON-STORM WATER MANAGEMENT BMPs

| BMP No. | BMP | CONSIDERED FOR PROJECT | CHECK IF USED | CHECK IF NOT USED | IF NOT USED, STATE REASON |
|---|---|---|---|---|---|
| NS-1 | Water Conservation Practices | | | | |
| NS-2 | Dewatering Operations | | | | |
| NS-3 | Paving and Grinding Operations | | | | |
| NS-4 | Temporary Stream Crossing | | | | |
| NS-5 | Clear Water Diversion | | | | |
| NS-6 | Illicit Connection/ Discharge | | | | |
| NS-7 | Potable Water/Irrigation | | | | |
| NS-8 | Vehicle and Equipment Cleaning | | | | |
| NS-9 | Vehicle and Equipment Fueling | | | | |
| NS-10 | Vehicle and Equipment Maintenance | | | | |
| NS-11 | Pile Driving Operations | | | | |
| NS-12 | Concrete Curing | | | | |
| NS-13 | Concrete Finishing | | | | |
| NS-14 | Material and Equipment Use Over Water | | | | |
| NS-15 | Demolition Adjacent to Water | | | | |
| NS-16 | Temporary Batch Plants | | | | |

## CONSTRUCTION SITE BMPs
## CONSIDERATION CHECKLIST

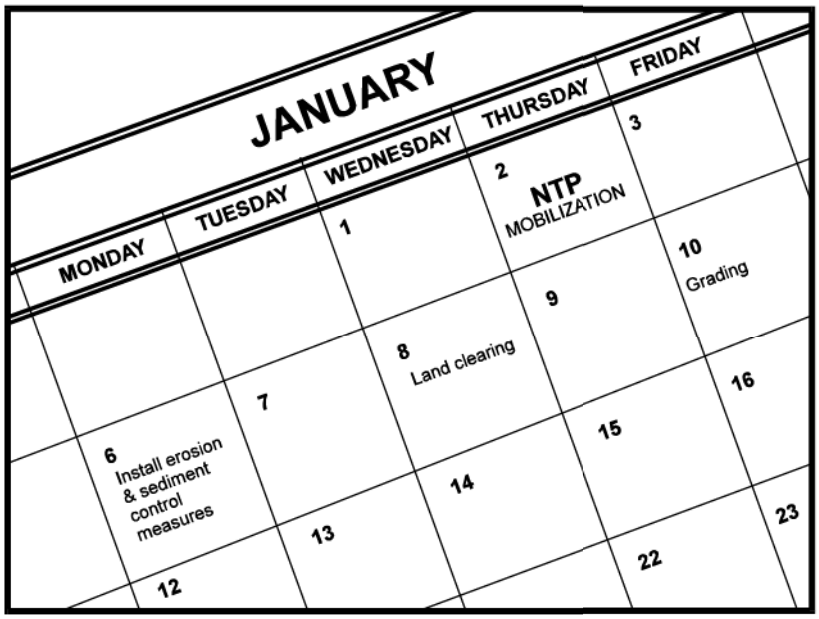
**The BMPs listed here should be considered for every project. Those BMPs that are not included in the SWPPP must be checked as "Not Used" with a brief statement describing why it is not being used.**

### WASTE MANAGEMENT AND MATERIALS POLLUTION CONTROL BMPs

| BMP No. | BMP | CONSIDERED FOR PROJECT | CHECK IF USED | CHECK IF NOT USED | IF NOT USED, STATE REASON |
|---|---|---|---|---|---|
| WM-1 | Material Delivery and Storage | | | | |
| WM-2 | Material Use | | | | |
| WM-3 | Stockpile Management | | | | |
| WM-4 | Spill Prevention and Control | | | | |
| WM-5 | Solid Waste Management | | | | |
| WM-6 | Hazardous Waste Management | | | | |
| WM-7 | Contaminated Soil Management | | | | |
| WM-8 | Concrete Waste Management | | | | |
| WM-9 | Sanitary/Septic Waste Management | | | | |
| WM-10 | Liquid Waste Management | | | | |

# Attachment F
# BMP Fact Sheets

# Scheduling EC-1




## Objectives

| | | |
|---|---|---|
| EC | Erosion Control | ☑ |
| SE | Sediment Control | ☒ |
| TR | Tracking Control | ☒ |
| WE | Wind Erosion Control | ☒ |
| NS | Non-Stormwater Management Control | |
| WM | Waste Management and Materials Pollution Control | |

**Legend:**

☑ **Primary Objective**

☒ **Secondary Objective**

## Targeted Constituents

| | |
|---|---|
| Sediment | ☑ |
| Nutrients | |
| Trash | |
| Metals | |
| Bacteria | |
| Oil and Grease | |
| Organics | |

## Potential Alternatives

None

## Description and Purpose

Scheduling is the development of a written plan that includes sequencing of construction activities and the implementation of BMPs such as erosion control and sediment control while taking local climate (rainfall, wind, etc.) into consideration. The purpose is to reduce the amount and duration of soil exposed to erosion by wind, rain, runoff, and vehicle tracking, and to perform the construction activities and control practices in accordance with the planned schedule.

## Suitable Applications

Proper sequencing of construction activities to reduce erosion potential should be incorporated into the schedule of every construction project especially during rainy season. Use of other, more costly yet less effective, erosion and sediment control BMPs may often be reduced through proper construction sequencing.

## Limitations

- Environmental constraints such as nesting season prohibitions reduce the full capabilities of this BMP.

## Implementation

- Avoid rainy periods. Schedule major grading operations during dry months when practical. Allow enough time before rainfall begins to stabilize the soil with vegetation or physical means or to install sediment trapping devices.

- Plan the project and develop a schedule showing each phase of construction. Clearly show how the rainy season relates to soil

disturbing and re-stabilization activities. Incorporate the construction schedule into the SWPPP.

- Include on the schedule, details on the rainy season implementation and deployment of:
  - Erosion control BMPs
  - Sediment control BMPs
  - Tracking control BMPs
  - Wind erosion control BMPs
  - Non-stormwater BMPs
  - Waste management and materials pollution control BMPs
- Include dates for activities that may require non-stormwater discharges such as dewatering, sawcutting, grinding, drilling, boring, crushing, blasting, painting, hydro-demolition, mortar mixing, pavement cleaning, etc.
- Work out the sequencing and timetable for the start and completion of each item such as site clearing and grubbing, grading, excavation, paving, foundation pouring utilities installation, etc., to minimize the active construction area during the rainy season.
  - Sequence trenching activities so that most open portions are closed before new trenching begins.
  - Incorporate staged seeding and re-vegetation of graded slopes as work progresses.
  - Schedule establishment of permanent vegetation during appropriate planting time for specified vegetation.
- Non-active areas should be stabilized as soon as practical after the cessation of soil disturbing activities or one day prior to the onset of precipitation.
- Monitor the weather forecast for rainfall.
- When rainfall is predicted, adjust the construction schedule to allow the implementation of soil stabilization and sediment treatment controls on all disturbed areas prior to the onset of rain.
- Be prepared year round to deploy erosion control and sediment control BMPs. Erosion may be caused during dry seasons by un-seasonal rainfall, wind, and vehicle tracking. Keep the site stabilized year round, and retain and maintain rainy season sediment trapping devices in operational condition.
- Apply permanent erosion control to areas deemed substantially complete during the project's defined seeding window.

## Costs

Construction scheduling to reduce erosion may increase other construction costs due to reduced economies of scale in performing site grading. The cost effectiveness of scheduling techniques should be compared with the other less effective erosion and sedimentation controls to achieve a cost effective balance.

## Inspection and Maintenance

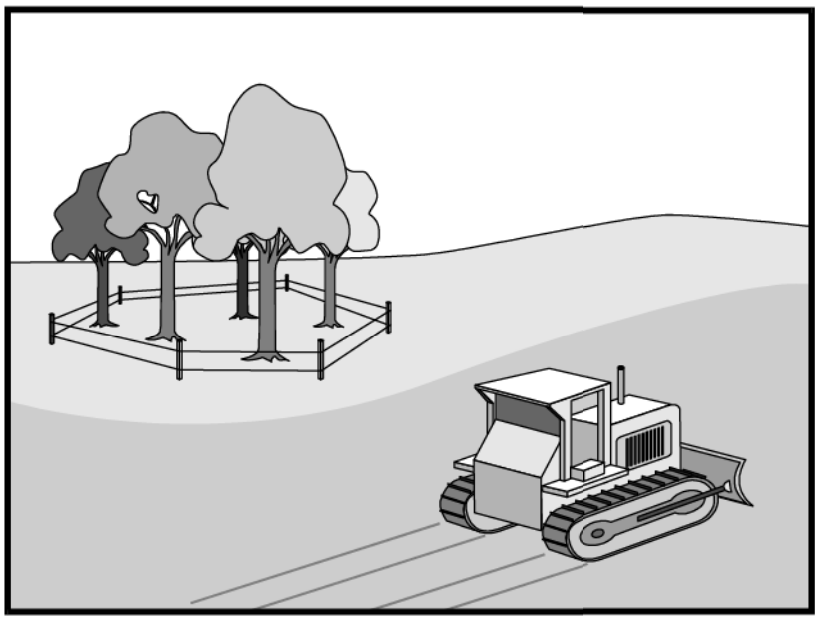
- Verify that work is progressing in accordance with the schedule. If progress deviates, take corrective actions.
- Amend the schedule when changes are warranted.
- Amend the schedule prior to the rainy season to show updated information on the deployment and implementation of construction site BMPs.

## References

Stormwater Quality Handbooks Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

Stormwater Management for Construction Activities Developing Pollution Prevention Plans and Best Management Practices (EPA 832-R-92-005), U.S. Environmental Protection Agency, Office of Water, September 1992.

# Preservation Of Existing Vegetation EC-2



## Objectives

| | | |
|---|---|---|
| EC | Erosion Control | ☑ |
| SE | Sediment Control | |
| TR | Tracking Control | |
| WE | Wind Erosion Control | |
| NS | Non-Stormwater Management Control | |
| WM | Waste Management and Materials Pollution Control | |

**Legend:**

☑ **Primary Objective**

☒ **Secondary Objective**

## Targeted Constituents

| | |
|---|---|
| Sediment | ☑ |
| Nutrients | |
| Trash | |
| Metals | |
| Bacteria | |
| Oil and Grease | |
| Organics | |

## Potential Alternatives

None

## Description and Purpose

Carefully planned preservation of existing vegetation minimizes the potential of removing or injuring existing trees, vines, shrubs, and grasses that protect soil from erosion.

## Suitable Applications

Preservation of existing vegetation is suitable for use on most projects. Large project sites often provide the greatest opportunity for use of this BMP. Suitable applications include the following:

- Areas within the site where no construction activity occurs, or occurs at a later date. This BMP is especially suitable to multi year projects where grading can be phased.
- Areas where natural vegetation exists and is designated for preservation. Such areas often include steep slopes, watercourse, and building sites in wooded areas.
- Areas where local, state, and federal government require preservation, such as vernal pools, wetlands, marshes, certain oak trees, etc. These areas are usually designated on the plans, or in the specifications, permits, or environmental documents.
- Where vegetation designated for ultimate removal can be temporarily preserved and be utilized for erosion control and sediment control.

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# EC-2 Preservation Of Existing Vegetation

## Limitations

- Requires forward planning by the owner/developer, contractor, and design staff.
- Limited opportunities for use when project plans do not incorporate existing vegetation into the site design.
- For sites with diverse topography, it is often difficult and expensive to save existing trees while grading the site satisfactory for the planned development.

## Implementation

The best way to prevent erosion is to not disturb the land. In order to reduce the impacts of new development and redevelopment, projects may be designed to avoid disturbing land in sensitive areas of the site (e.g., natural watercourses, steep slopes), and to incorporate unique or desirable existing vegetation into the site's landscaping plan. Clearly marking and leaving a buffer area around these unique areas during construction will help to preserve these areas as well as take advantage of natural erosion prevention and sediment trapping.

Existing vegetation to be preserved on the site must be protected from mechanical and other injury while the land is being developed. The purpose of protecting existing vegetation is to ensure the survival of desirable vegetation for shade, beautification, and erosion control. Mature vegetation has extensive root systems that help to hold soil in place, thus reducing erosion. In addition, vegetation helps keep soil from drying rapidly and becoming susceptible to erosion. To effectively save existing vegetation, no disturbances of any kind should be allowed within a defined area around the vegetation. For trees, no construction activity should occur within the drip line of the tree.

### *Timing*

- Provide for preservation of existing vegetation prior to the commencement of clearing and grubbing operations or other soil disturbing activities in areas where no construction activity is planned or will occur at a later date.

### *Design and Layout*

- Mark areas to be preserved with temporary fencing. Include sufficient setback to protect roots.
  - Orange colored plastic mesh fencing works well.
  - Use appropriate fence posts and adequate post spacing and depth to completely support the fence in an upright position.
- Locate temporary roadways, stockpiles, and layout areas to avoid stands of trees, shrubs, and grass.
- Consider the impact of grade changes to existing vegetation and the root zone.
- Maintain existing irrigation systems where feasible. Temporary irrigation may be required.
- Instruct employees and subcontractors to honor protective devices. Prohibit heavy equipment, vehicular traffic, or storage of construction materials within the protected area.

## Costs

There is little cost associated with preserving existing vegetation if properly planned during the project design, and these costs may be offset by aesthetic benefits that enhance property values. During construction, the cost for preserving existing vegetation will likely be less than the cost of applying erosion and sediment controls to the disturbed area. Replacing vegetation inadvertently destroyed during construction can be extremely expensive, sometimes in excess of $10,000 per tree.

## Inspection and Maintenance

During construction, the limits of disturbance should remain clearly marked at all times. Irrigation or maintenance of existing vegetation should be described in the landscaping plan. If damage to protected trees still occurs, maintenance guidelines described below should be followed:

- Verify that protective measures remain in place. Restore damaged protection measures immediately.
- Serious tree injuries shall be attended to by an arborist.
- Damage to the crown, trunk, or root system of a retained tree shall be repaired immediately.
- Trench as far from tree trunks as possible, usually outside of the tree drip line or canopy. Curve trenches around trees to avoid large roots or root concentrations. If roots are encountered, consider tunneling under them. When trenching or tunneling near or under trees to be retained, place tunnels at least 18 in. below the ground surface, and not below the tree center to minimize impact on the roots.
- Do not leave tree roots exposed to air. Cover exposed roots with soil as soon as possible. If soil covering is not practical, protect exposed roots with wet burlap or peat moss until the tunnel or trench is ready for backfill.
- Cleanly remove the ends of damaged roots with a smooth cut.
- Fill trenches and tunnels as soon as possible. Careful filling and tamping will eliminate air spaces in the soil, which can damage roots.
- If bark damage occurs, cut back all loosened bark into the undamaged area, with the cut tapered at the top and bottom and drainage provided at the base of the wood. Limit cutting the undamaged area as much as possible.
- Aerate soil that has been compacted over a trees root zone by punching holes 12 in. deep with an iron bar, and moving the bar back and forth until the soil is loosened. Place holes 18 in. apart throughout the area of compacted soil under the tree crown.
- Fertilization
  - Fertilize stressed or damaged broadleaf trees to aid recovery.
  - Fertilize trees in the late fall or early spring.

- Apply fertilizer to the soil over the feeder roots and in accordance with label instructions, but never closer than 3 ft to the trunk. Increase the fertilized area by one-fourth of the crown area for conifers that have extended root systems.

- Retain protective measures until all other construction activity is complete to avoid damage during site cleanup and stabilization.

## References

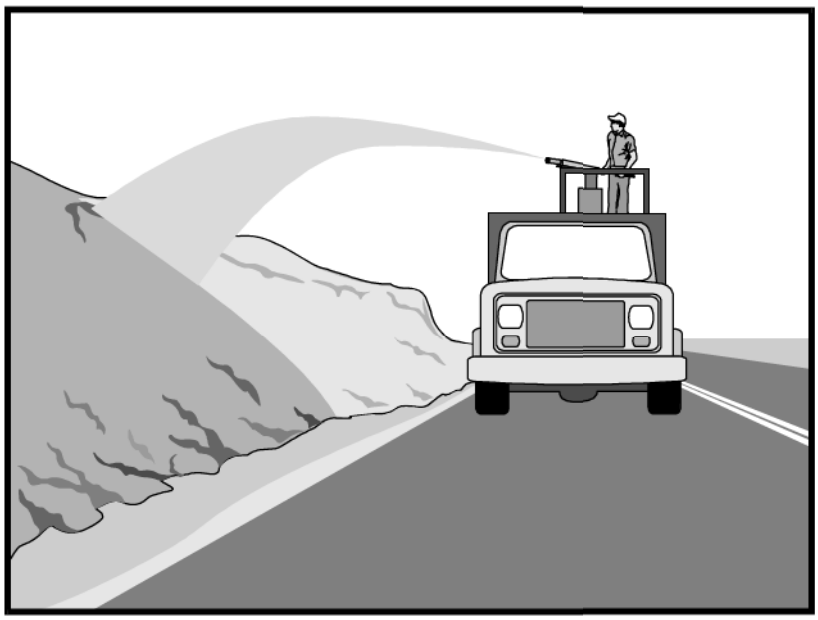
County of Sacramento Tree Preservation Ordinance, September 1981.

Stormwater Quality Handbooks Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

Stormwater Management of the Puget Sound Basin, Technical Manual, Publication #91-75, Washington State Department of Ecology, February 1992.

Water Quality Management Plan for The Lake Tahoe Region, Volume II, Handbook of Management Practices, Tahoe Regional Planning Agency, November 1988.

# Hydraulic Mulch EC-3



## Objectives

| | | |
|---|---|---|
| EC | Erosion Control | ☑ |
| SE | Sediment Control | |
| TR | Tracking Control | |
| WE | Wind Erosion Control | ☒ |
| NS | Non-Stormwater Management Control | |
| WM | Waste Management and Materials Pollution Control | |

**Legend:**

☑ **Primary Objective**

☒ **Secondary Objective**

## Targeted Constituents

| | |
|---|---|
| Sediment | ☑ |
| Nutrients | |
| Trash | |
| Metals | |
| Bacteria | |
| Oil and Grease | |
| Organics | |

## Potential Alternatives

EC-4 Hydroseeding

EC-5 Soil Binders

EC-6 Straw Mulch

EC-7 Geotextiles and Mats

EC-8 Wood Mulching

## Description and Purpose

Hydraulic mulch consists of applying a mixture of shredded wood fiber or a hydraulic matrix, and a stabilizing emulsion or tackifier with hydro-mulching equipment, which temporarily protects exposed soil from erosion by raindrop impact or wind.

## Suitable Applications

Hydraulic mulch is suitable for soil disturbed areas requiring temporary protection until permanent stabilization is established, and disturbed areas that will be re-disturbed following an extended period of inactivity.

## Limitations

Wood fiber hydraulic mulches are generally short lived and need 24 hours to dry before rainfall occurs to be effective. May require a second application in order to remain effective for an entire rainy season.

## Implementation

- Prior to application, roughen embankment and fill areas by rolling with a crimping or punching type roller or by track walking. Track walking shall only be used where other methods are impractical.
- To be effective, hydraulic matrices require 24 hours to dry before rainfall occurs.
- Avoid mulch over spray onto roads, sidewalks, drainage channels, existing vegetation, etc.

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- Paper based hydraulic mulches alone shall not be used for erosion control.

### *Hydraulic Mulches*

Wood fiber mulch can be applied alone or as a component of hydraulic matrices. Wood fiber applied alone is typically applied at the rate of 2,000 to 4,000 lb/acre. Wood fiber mulch is manufactured from wood or wood waste from lumber mills or from urban sources.

### *Hydraulic Matrices*

Hydraulic matrices include a mixture of wood fiber and acrylic polymer or other tackifier as binder. Apply as a liquid slurry using a hydraulic application machine (i.e., hydro seeder) at the following minimum rates, or as specified by the manufacturer to achieve complete coverage of the target area: 2,000 to 4,000 lb/acre wood fiber mulch, and 5 to 10% (by weight) of tackifier (acrylic copolymer, guar, psyllium, etc.)

### *Bonded Fiber Matrix*

Bonded fiber matrix (BFM) is a hydraulically applied system of fibers and adhesives that upon drying forms an erosion resistant blanket that promotes vegetation, and prevents soil erosion. BFMs are typically applied at rates from 3,000 lb/acre to 4,000 lb/acre based on the manufacturer's recommendation. A biodegradable BFM is composed of materials that are 100% biodegradable. The binder in the BFM should also be biodegradable and should not dissolve or disperse upon re-wetting. Typically, biodegradable BFMs should not be applied immediately before, during or immediately after rainfall if the soil is saturated. Depending on the product, BFMs typically require 12 to 24 hours to dry and become effective.

## Costs

Average cost for installation of wood fiber mulch is $900/acre. Average cost for installation of BFM is $5,500/acre.

## Inspection and Maintenance

- Inspect BMPs prior to forecast rain, daily during extended rain events, after rain events, weekly during the rainy season, and at two-week intervals during the non-rainy season.

- Areas where erosion is evident shall be repaired and BMPs re-applied as soon as possible. Care should be exercised to minimize the damage to protected areas while making repairs, as any area damaged will require re-application of BMPs.

- Maintain an unbroken, temporary mulched ground cover throughout the period of construction when the soils are not being reworked.

## References

Controlling Erosion of Construction Sites Agricultural Information #347, U.S. Department of Agriculture (USDA), Natural Resources Conservation Service (NRCS) (formerly Soil Conservation Service – SCS).

Guides for Erosion and Sediment Control in California, USDA Soils Conservation Service, January 1991.

Manual of Standards of Erosion and Sediment Control Measures, Association of Bay Area Governments, May 1995.

Sedimentation and Erosion Control, An Inventory of Current Practices Draft, US EPA, April 1990.

Soil Erosion by Water, Agriculture Information Bulletin #513, U.S. Department of Agriculture, Soil Conservation Service.

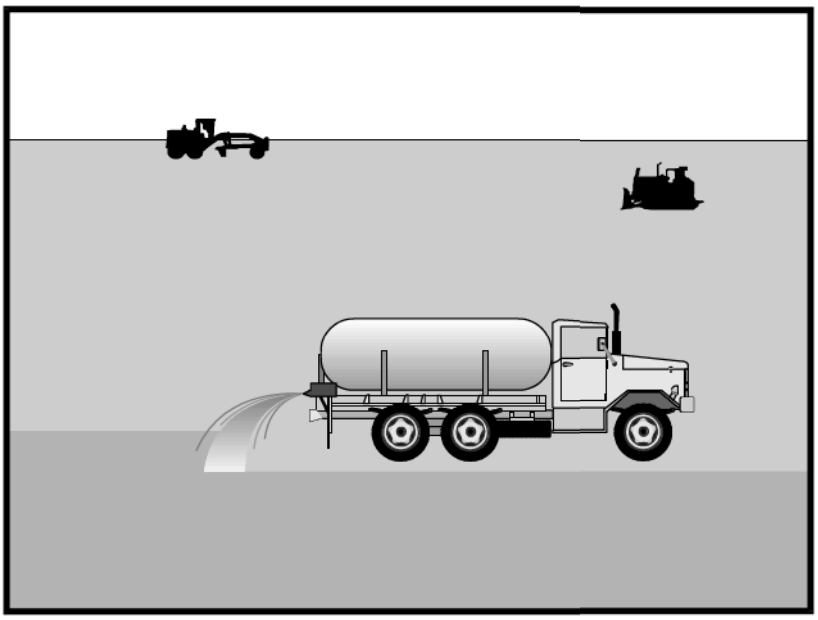
Stormwater Quality Handbooks Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

Guidance Document: Soil Stabilization for Temporary Slopes, State of California Department of Transportation (Caltrans), November 1999

Stormwater Management of the Puget Sound Basin, Technical Manual, Publication #91-75, Washington State Department of Ecology, February 1992.

Water Quality Management Plan for the Lake Tahoe Region, Volume II, Handbook of Management Practices, Tahoe Regional Planning Agency, November 1988.

# Soil Binders EC-5



## Objectives

| | | |
|---|---|---|
| EC | Erosion Control | ☑ |
| SE | Sediment Control | |
| TR | Tracking Control | |
| WE | Wind Erosion Control | ☒ |
| NS | Non-Stormwater Management Control | |
| WM | Waste Management and Materials Pollution Control | |

**Legend:**

☑ **Primary Objective**

☒ **Secondary Objective**

## Targeted Constituents

| | |
|---|---|
| Sediment | ☑ |
| Nutrients | |
| Trash | |
| Metals | |
| Bacteria | |
| Oil and Grease | |
| Organics | |

## Potential Alternatives

EC-3 Hydraulic Mulch

EC-4 Hydroseeding

EC-6 Straw Mulch

EC-7 Geotextiles and Mats

EC-8 Wood Mulching

## Description and Purpose

Soil binders consist of applying and maintaining a soil stabilizer to exposed soil surfaces. Soil binders are materials applied to the soil surface to temporarily prevent water induced erosion of exposed soils on construction sites. Soil binders also prevent wind erosion.

## Suitable Applications

Soil binders are typically applied to disturbed areas requiring short term temporary protection. Because soil binders can often be incorporated into the work, they are a good alternative to mulches in areas where grading activities will soon resume. Soil binders are also suitable for use on stockpiles.

## Limitations

- Soil binders are temporary in nature and may need reapplication.
- Soil binders require a minimum curing time until fully effective, as prescribed by the manufacturer. Curing time may be 24 hours or longer. Soil binders may need reapplication after a storm event.
- Soil binders will generally experience spot failures during heavy rainfall events. If runoff penetrates the soil at the top of a slope treated with a soil binder, it is likely that the runoff will undercut the stabilized soil layer and discharge at a point further down slope.

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- Soil binders do not hold up to pedestrian or vehicular traffic across treated areas.
- Soil binders may not penetrate soil surfaces made up primarily of silt and clay, particularly when compacted.
- Some soil binders may not perform well with low relative humidity. Under rainy conditions, some agents may become slippery or leach out of the soil.
- Soil binders may not cure if low temperatures occur within 24 hours of application.
- The water quality impacts of soil binders are relatively unknown and some may have water quality impacts due to their chemical makeup.
- A sampling and analysis plan must be incorporated into the SWPPP as soil binders could be a source of non-visible pollutants.

## Implementation

### *General Considerations*

- Regional soil types will dictate appropriate soil binders to be used.
- A soil binder must be environmentally benign (non-toxic to plant and animal life), easy to apply, easy to maintain, economical, and should not stain paved or painted surfaces. Soil binders should not pollute stormwater.
- Some soil binders may not be compatible with existing vegetation.
- Performance of soil binders depends on temperature, humidity, and traffic across treated areas.
- Avoid over spray onto roads, sidewalks, drainage channels, existing vegetation, etc.

### *Selecting a Soil Binder*

Properties of common soil binders used for erosion control are provided on Table 1 at the end of this BMP. Use Table 1 to select an appropriate soil binder. Refer to WE-1, Wind Erosion Control, for dust control soil binders.

Factors to consider when selecting a soil binder include the following:

- Suitability to situation - Consider where the soil binder will be applied, if it needs a high resistance to leaching or abrasion, and whether it needs to be compatible with any existing vegetation. Determine the length of time soil stabilization will be needed, and if the soil binder will be placed in an area where it will degrade rapidly. In general, slope steepness is not a discriminating factor for the listed soil binders.
- Soil types and surface materials - Fines and moisture content are key properties of surface materials. Consider a soil binder's ability to penetrate, likelihood of leaching, and ability to form a surface crust on the surface materials.
- Frequency of application - The frequency of application can be affected by subgrade conditions, surface type, climate, and maintenance schedule. Frequent applications could

lead to high costs. Application frequency may be minimized if the soil binder has good penetration, low evaporation, and good longevity. Consider also that frequent application will require frequent equipment clean up.

### *Plant-Material Based (Short Lived) Binders*

Guar: Guar is a non-toxic, biodegradable, natural galactomannan based hydrocolloid treated with dispersant agents for easy field mixing. It should be mixed with water at the rate of 11 to 15 lb per 1,000 gallons. Recommended minimum application rates are as follows:

**Application Rates for Guar Soil Stabilizer**

| Slope (H:V): | Flat | 4:1 | 3:1 | 2:1 | 1:1 |
|---|---|---|---|---|---|
| lb/acre: | 40 | 45 | 50 | 60 | 70 |

Psyllium: Psyllium is composed of the finely ground muciloid coating of plantago seeds that is applied as a dry powder or in a wet slurry to the surface of the soil. It dries to form a firm but rewettable membrane that binds soil particles together but permits germination and growth of seed. Psyllium requires 12 to 18 hours drying time. Application rates should be from 80 to 200 lb/acre, with enough water in solution to allow for a uniform slurry flow.

Starch: Starch is non-ionic, cold water soluble (pre-gelatinized) granular cornstarch. The material is mixed with water and applied at the rate of 150 lb/acre. Approximate drying time is 9 to 12 hours.

### *Plant-Material Based (Long Lived) Binders*

Pitch and Rosin Emulsion: Generally, a non-ionic pitch and rosin emulsion has a minimum solids content of 48%. The rosin should be a minimum of 26% of the total solids content. The soil stabilizer should be non-corrosive, water dilutable emulsion that upon application cures to a water insoluble binding and cementing agent. For soil erosion control applications, the emulsion is diluted and should be applied as follows:

- For clayey soil: 5 parts water to 1 part emulsion
- For sandy soil: 10 parts water to 1 part emulsion

Application can be by water truck or hydraulic seeder with the emulsion and product mixture applied at the rate specified by the manufacturer.

### *Polymeric Emulsion Blend Binders*

Acrylic Copolymers and Polymers: Polymeric soil stabilizers should consist of a liquid or solid polymer or copolymer with an acrylic base that contains a minimum of 55% solids. The polymeric compound should be handled and mixed in a manner that will not cause foaming or should contain an anti-foaming agent. The polymeric emulsion should not exceed its shelf life or expiration date; manufacturers should provide the expiration date. Polymeric soil stabilizer should be readily miscible in water, non-injurious to seed or animal life, non-flammable, should provide surface soil stabilization for various soil types without totally inhibiting water infiltration, and should not re-emulsify when cured. The applied compound should air cure within a maximum of 36 to 48 hours. Liquid copolymer should be diluted at a rate of 10 parts water to 1 part polymer and the mixture applied to soil at a rate of 1,175 gallons/acre.

Liquid Polymers of Methacrylates and Acrylates: This material consists of a tackifier/sealer that is a liquid polymer of methacrylates and acrylates. It is an aqueous 100% acrylic emulsion blend of 40% solids by volume that is free from styrene, acetate, vinyl, ethoxylated surfactants or silicates. For soil stabilization applications, it is diluted with water in accordance with manufacturer's recommendations, and applied with a hydraulic seeder at the rate of 20 gallons/acre. Drying time is 12 to 18 hours after application.

Copolymers of Sodium Acrylates and Acrylamides: These materials are non-toxic, dry powders that are copolymers of sodium acrylate and acrylamide. They are mixed with water and applied to the soil surface for erosion control at rates that are determined by slope gradient:

| Slope Gradient (H:V) | lb/acre |
|---|---|
| Flat to 5:1 | 3.0 – 5.0 |
| 5:1 to 3:1 | 5.0 – 10.0 |
| 2:2 to 1:1 | 10.0 – 20.0 |

Poly-Acrylamide and Copolymer of Acrylamide: Linear copolymer polyacrylamide is packaged as a dry flowable solid. When used as a stand alone stabilizer, it is diluted at a rate of 11lb/1,000 gal of water and applied at the rate of 5.0 lb/acre.

Hydro-Colloid Polymers: Hydro-Colloid Polymers are various combinations of dry flowable poly-acrylamides, copolymers and hydro-colloid polymers that are mixed with water and applied to the soil surface at rates of 55 to 60 lb/acre. Drying times are 0 to 4 hours.

### *Cementitious-Based Binders*

Gypsum: This is a formulated gypsum based product that readily mixes with water and mulch to form a thin protective crust on the soil surface. It is composed of high purity gypsum that is ground, calcined and processed into calcium sulfate hemihydrate with a minimum purity of 86%. It is mixed in a hydraulic seeder and applied at rates 4,000 to 12,000 lb/acre. Drying time is 4 to 8 hours.

### *Applying Soil Binders*

After selecting an appropriate soil binder, the untreated soil surface must be prepared before applying the soil binder. The untreated soil surface must contain sufficient moisture to assist the agent in achieving uniform distribution. In general, the following steps should be followed:

- Follow manufacturer's written recommendations for application rates, pre-wetting of application area, and cleaning of equipment after use.
- Prior to application, roughen embankment and fill areas.
- Consider the drying time for the selected soil binder and apply with sufficient time before anticipated rainfall. Soil binders should not be applied during or immediately before rainfall.
- Avoid over spray onto roads, sidewalks, drainage channels, sound walls, existing vegetation, etc.

- Soil binders should not be applied to frozen soil, areas with standing water, under freezing or rainy conditions, or when the temperature is below 40°F during the curing period.
- More than one treatment is often necessary, although the second treatment may be diluted or have a lower application rate.
- Generally, soil binders require a minimum curing time of 24 hours before they are fully effective. Refer to manufacturer's instructions for specific cure time.
- For liquid agents:
  - Crown or slope ground to avoid ponding.
  - Uniformly pre-wet ground at 0.03 to 0.3 gal/yd$^2$ or according to manufacturer's recommendations.
  - Apply solution under pressure. Overlap solution 6 to 12 in.
  - Allow treated area to cure for the time recommended by the manufacturer; typically at least 24 hours.
  - Apply second treatment before first treatment becomes ineffective, using 50% application rate.
  - In low humidities, reactivate chemicals by re-wetting with water at 0.1 to 0.2 gal/yd$^2$.

## Costs

Costs vary according to the soil stabilizer selected for implementation. The following are approximate costs:

| Soil Binder | Cost per Acre |
|---|---|
| Plant-Material Based (Short Lived) Binders | $400 |
| Plant-Material Based (Long Lived) Binders | $1,200 |
| Polymeric Emulsion Blend Binders | $400 (1) |
| Cementitious-Based Binders | $800 |

(1) $1,200 for Acrylic polymers and copolymers

Source: Caltrans Guidance for Soil Stabilization for Temporary Slopes, Nov. 1999

## Inspection and Maintenance

- Inspect BMPs prior to forecast rain, daily during extended rain events, after rain events, weekly during the rainy season, and at two-week intervals during the non-rainy season.
- Areas where erosion is evident shall be repaired and BMPs re-applied as soon as possible. Care should be exercised to minimize the damage to protected areas while making repairs, as any area damaged will require re-application of BMPs.
- Reapply the selected soil binder as needed to maintain effectiveness.

## References

Manual of Standards of Erosion and Sediment Control Measures, Association of Bay Area Governments, May 1995.

Sedimentation and Erosion Control, An Inventory of Current Practices Draft, US EPA, April 1990.

Stormwater Quality Handbooks Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

Guidance Document: Soil Stabilization for Temporary Slopes, State of California Department of Transportation (Caltrans), November 1999.

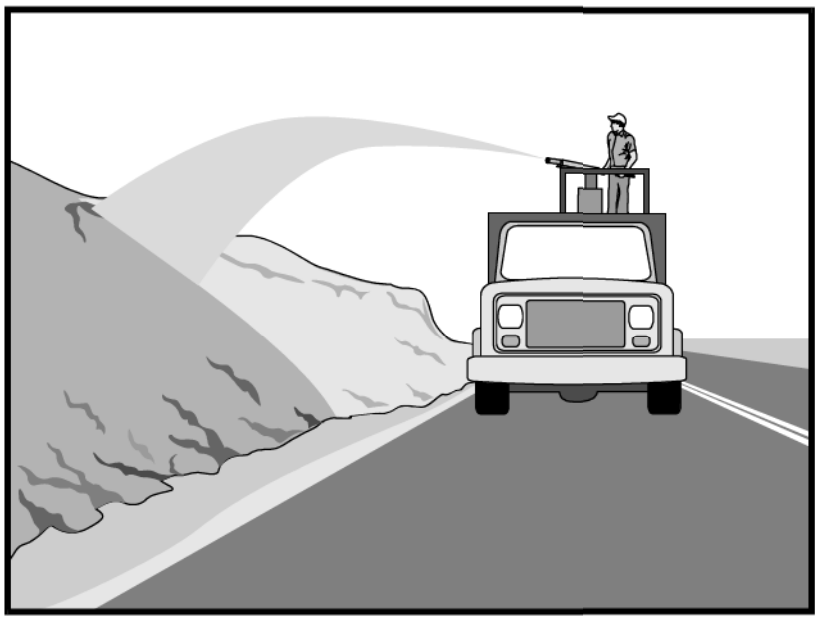
Stormwater Management for Construction Activities, Developing Pollution Prevention Plans and Best Management Practices, EPA 832-R-92005; USEPA, April 1992.

**Table 1 Properties of Soil Binders for Erosion Control**

| Evaluation Criteria | Binder Type | | | |
|---|---|---|---|---|
| | Plant Material Based (Short Lived) | Plant Material Based (Long Lived) | Polymeric Emulsion Blends | Cementitious-Based Binders |
| Relative Cost | Low | Low | Low | Low |
| Resistance to Leaching | High | High | Low to Moderate | Moderate |
| Resistance to Abrasion | Moderate | Low | Moderate to High | Moderate to High |
| Longevity | Short to Medium | Medium | Medium to Long | Medium |
| Minimum Curing Time before Rain | 9 to 18 hours | 19 to 24 hours | 0 to 24 hours | 4 to 8 hours |
| Compatibility with Existing Vegetation | Good | Poor | Poor | Poor |
| Mode of Degradation | Biodegradable | Biodegradable | Photodegradable/ Chemically Degradable | Photodegradable/ Chemically Degradable |
| Labor Intensive | No | No | No | No |
| Specialized Application Equipment | Water Truck or Hydraulic Mulcher | Water Truck or Hydraulic Mulcher | Water Truck or Hydraulic Mulcher | Water Truck or Hydraulic Mulcher |
| Liquid/Powder | Powder | Liquid | Liquid/Powder | Powder |
| Surface Crusting | Yes, but dissolves on rewetting | Yes | Yes, but dissolves on rewetting | Yes |
| Clean Up | Water | Water | Water | Water |
| Erosion Control Application Rate | Varies (1) | Varies (1) | Varies (1) | 4,000 to 12,000 lbs/acre |

(1) See Implementation for specific rates.

# Straw Mulch EC-6



## Objectives

| | | |
|---|---|---|
| EC | Erosion Control | ☑ |
| SE | Sediment Control | |
| TR | Tracking Control | |
| WE | Wind Erosion Control | |
| NS | Non-Stormwater Management Control | |
| WM | Waste Management and Materials Pollution Control | |

**Legend:**

☑ **Primary Objective**

☒ **Secondary Objective**

## Targeted Constituents

| | |
|---|---|
| Sediment | ☑ |
| Nutrients | |
| Trash | |
| Metals | |
| Bacteria | |
| Oil and Grease | |
| Organics | |

## Potential Alternatives

EC-3 Hydraulic Mulch

EC-4 Hydroseeding

EC-5 Soil Binders

EC-7 Geotextiles and Mats

EC-8 Wood Mulching

## Description and Purpose

Straw mulch consists of placing a uniform layer of straw and incorporating it into the soil with a studded roller or anchoring it with a tackifier stabilizing emulsion. Straw mulch protects the soil surface from the impact of rain drops, preventing soil particles from becoming dislodged.

## Suitable Applications

Straw mulch is suitable for soil disturbed areas requiring temporary protection until permanent stabilization is established. Straw mulch is typically used for erosion control on disturbed areas until soils can be prepared for permanent vegetation. Straw mulch is also used in combination with temporary and/or permanent seeding strategies to enhance plant establishment.

## Limitations

- Availability of straw and straw blowing equipment may be limited just prior to the rainy season and prior to storms due to high demand.
- There is a potential for introduction of weed seed and unwanted plant material.
- When straw blowers are used to apply straw mulch, the treatment areas must be within 150 ft of a road or surface capable of supporting trucks.
- Straw mulch applied by hand is more time intensive and potentially costly.

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- Wind may limit application of straw and blow straw into undesired locations.
- May have to be removed prior to permanent seeding or prior to further earthwork.
- "Punching" of straw does not work in sandy soils, necessitating the use of tackifiers.

## Implementation

- Straw shall be derived from wheat, rice, or barley. Where required by the plans, specifications, permits, or environmental documents, native grass straw shall be used.
- A tackifier is the preferred method for anchoring straw mulch to the soil on slopes.
- Crimping, punch roller-type rollers, or track walking may also be used to incorporate straw mulch into the soil on slopes. Track walking shall only be used where other methods are impractical.
- Avoid placing straw onto roads, sidewalks, drainage channels, sound walls, existing vegetation, etc.
- Straw mulch with tackifier shall not be applied during or immediately before rainfall.
- In San Diego, use of straw near wood framed home construction has been frowned on by the Fire Marshall.

## Application Procedures

- Apply straw at a minimum rate of 4,000 lb/acre, either by machine or by hand distribution.
- Roughen embankments and fill rills before placing the straw mulch by rolling with a crimping or punching type roller or by track walking.
- Evenly distribute straw mulch on the soil surface.
- Anchor straw mulch to the soil surface by "punching" it into the soil mechanically (incorporating). Alternatively, use a tackifier to adhere straw fibers.
- Methods for holding the straw mulch in place depend upon the slope steepness, accessibility, soil conditions, and longevity.
    - On small areas, a spade or shovel can be used to punch in straw mulch.
    - On slopes with soils that are stable enough and of sufficient gradient to safely support construction equipment without contributing to compaction and instability problems, straw can be "punched" into the ground using a knife blade roller or a straight bladed coulter, known commercially as a "crimper".
    - On small areas and/or steep slopes, straw can also be held in place using plastic netting or jute. The netting shall be held in place using 11 gauge wire staples, geotextile pins or wooden stakes as described in EC-7, Geotextiles and Mats.
    - A tackifier acts to glue the straw fibers together and to the soil surface. The tackifier shall be selected based on longevity and ability to hold the fibers in place. A tackifier is

typically applied at a rate of 125 lb/acre. In windy conditions, the rates are typically 180 lb/acre.

## Costs

Average annual cost for installation and maintenance (3-4 months useful life) is $2,500 per acre. Application by hand is more time intensive and potentially costly.

## Inspection and Maintenance

- Inspect BMPs prior to forecast rain, daily during extended rain events, after rain events, weekly during the rainy season, and at two-week intervals during the non-rainy season.
- Areas where erosion is evident should be repaired and BMPs re-applied as soon as possible. Care should be exercised to minimize the damage to protected areas while making repairs, as any area damaged will require re-application of BMPs.
- The key consideration in inspection and maintenance is that the straw needs to last long enough to achieve erosion control objectives.
- Maintain an unbroken, temporary mulched ground cover while disturbed soil areas are inactive. Repair any damaged ground cover and re-mulch exposed areas.
- Reapplication of straw mulch and tackifier may be required to maintain effective soil stabilization over disturbed areas and slopes.

## References

Controlling Erosion of Construction Sites, Agricultural Information Bulletin #347, U.S. Department of Agriculture (USDA), Natural Resources Conservation Service (NRCS) (formerly Soil Conservation Service – SCS).

Guides for Erosion and Sediment Control in California, USDA Soils Conservation Service, January 1991.

Manual of Standards of Erosion and Sediment Control Measures, Association of Bay Area Governments, May 1995.

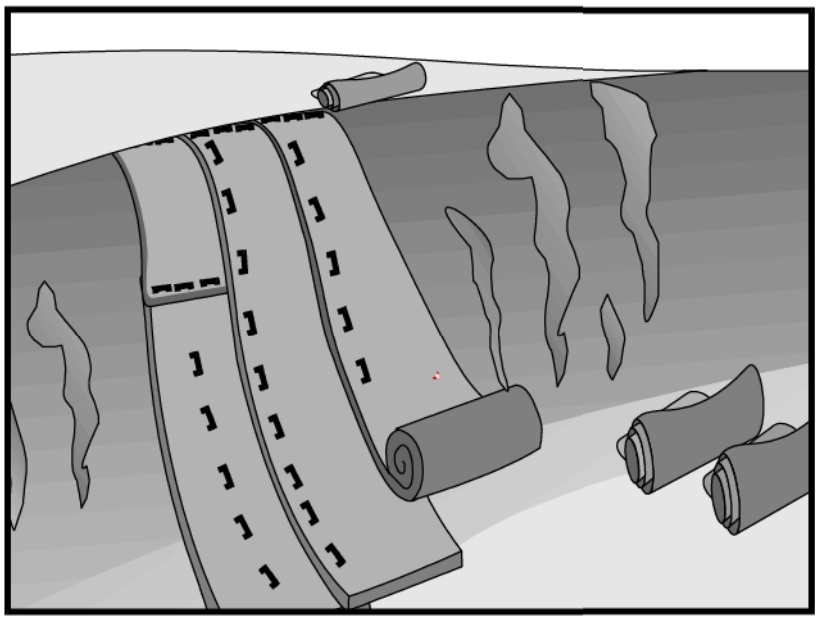
Soil Erosion by Water, Agricultural Information Bulletin #513, U.S. Department of Agriculture, Soil Conservation Service.

Stormwater Quality Handbooks Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

Stormwater Management of the Puget Sound Basin, Technical Manual, Publication #91-75, Washington State Department of Ecology, February 1992.

Water Quality Management Plan for the Lake Tahoe Region, Volume II, Handbook of Management Practices, Tahoe Regional Planning Agency, November 1988.

# Geotextiles and Mats EC-7



## Objectives

| | | |
|---|---|---|
| EC | Erosion Control | ☑ |
| SE | Sediment Control | |
| TR | Tracking Control | |
| WE | Wind Erosion Control | 3 |
| NS | Non-Stormwater Management Control | |
| WM | Waste Management and Materials Pollution Control | |

**Legend:**

☑ **Primary Objective**

☒ **Secondary Objective**

## Targeted Constituents

| | |
|---|---|
| Sediment | ☑ |
| Nutrients | |
| Trash | |
| Metals | |
| Bacteria | |
| Oil and Grease | |
| Organics | |

## Potential Alternatives

EC-3 Hydraulic Mulch

EC-4 Hydroseeding

EC-5 Soil Binders

EC-6 Straw Mulch

EC-8 Wood Mulching

## Description and Purpose

Mattings of natural materials are used to cover the soil surface to reduce erosion from rainfall impact, hold soil in place, and absorb and hold moisture near the soil surface. Additionally, matting may be used to stabilize soils until vegetation is established.

## Suitable Applications

Mattings are commonly applied on short, steep slopes where erosion hazard is high and vegetation will be slow to establish. Mattings are also used on stream banks where moving water at velocities between 3 ft/s and 6 ft/s are likely to wash out new vegetation, and in areas where the soil surface is disturbed and where existing vegetation has been removed. Matting may also be used when seeding cannot occur (e.g., late season construction and/or the arrival of an early rain season). Erosion control matting should be considered when the soils are fine grained and potentially erosive. These measures should be considered in the following situations.

- Steep slopes, generally steeper than 3:1 (H:V)
- Slopes where the erosion potential is high
- Slopes and disturbed soils where mulch must be anchored
- Disturbed areas where plants are slow to develop
- Channels with flows exceeding 3.3 ft/s

- Channels to be vegetated
- Stockpiles
- Slopes adjacent to water bodies of Environmentally Sensitive Areas (ESAs)

## Limitations

- Properly installed mattings provide excellent erosion control but do so at relatively high cost. This high cost typically limits the use of mattings to areas of concentrated channel flow and steep slopes.
- Mattings are more costly than other BMP practices, limiting their use to areas where other BMPs are ineffective (e.g. channels, steep slopes).
- Installation is critical and requires experienced contractors. The contractor should install the matting material in such a manner that continuous contact between the material and the soil occurs.
- Geotextiles and Mats may delay seed germination, due to reduction in soil temperature.
- Blankets and mats are generally not suitable for excessively rocky sites or areas where the final vegetation will be mowed (since staples and netting can catch in mowers).
- Blankets and mats must be removed and disposed of prior to application of permanent soil stabilization measures.
- Plastic sheeting is easily vandalized, easily torn, photodegradable, and must be disposed of at a landfill.
- Plastic results in 100% runoff, which may cause serious erosion problems in the areas receiving the increased flow.
- The use of plastic should be limited to covering stockpiles or very small graded areas for short periods of time (such as through one imminent storm event) until alternative measures, such as seeding and mulching, may be installed.
- Geotextiles, mats, plastic covers, and erosion control covers have maximum flow rate limitations; consult the manufacturer for proper selection.
- Not suitable for areas that have heavy foot traffic (tripping hazard) – e.g., pad areas around buildings under construction.

## Implementation

### *Material Selection*

Organic matting materials have been found to be effective where re-vegetation will be provided by re-seeding. The choice of matting should be based on the size of area, side slopes, surface conditions such as hardness, moisture, weed growth, and availability of materials.

The following natural and synthetic mattings are commonly used:

***Geotextiles***

- Material should be a woven polypropylene fabric with minimum thickness of 0.06 in., minimum width of 12 ft and should have minimum tensile strength of 150 lbs (warp), 80 lbs (fill) in conformance with the requirements in ASTM Designation: D 4632. The permittivity of the fabric should be approximately 0.07 $sec^{-1}$ in conformance with the requirements in ASTM Designation: D4491. The fabric should have an ultraviolet (UV) stability of 70 percent in conformance with the requirements in ASTM designation: D4355. Geotextile blankets must be secured in place with wire staples or sandbags and by keying into tops of slopes to prevent infiltration of surface waters under geotextile. Staples should be made of minimum 11 gauge steel wire and should be U-shaped with 8 in. legs and 2 in. crown.

- Geotextiles may be reused if they are suitable for the use intended.

***Plastic Covers***

- Plastic sheeting should have a minimum thickness of 6 mils, and must be keyed in at the top of slope and firmly held in place with sandbags or other weights placed no more than 10 ft apart. Seams are typically taped or weighted down their entire length, and there should be at least a 12 in. to 24 in. overlap of all seams. Edges should be embedded a minimum of 6 in. in soil.

- All sheeting must be inspected periodically after installation and after significant rainstorms to check for erosion, undermining, and anchorage failure. Any failures must be repaired immediately. If washout or breakages occur, the material should be re-installed after repairing the damage to the slope.

***Erosion Control Blankets/Mats***

- Biodegradable rolled erosion control products (RECPs) are typically composed of jute fibers, curled wood fibers, straw, coconut fiber, or a combination of these materials. In order for an RECP to be considered 100% biodegradable, the netting, sewing or adhesive system that holds the biodegradable mulch fibers together must also be biodegradable.

  - **Jute** is a natural fiber that is made into a yarn that is loosely woven into a biodegradable mesh. It is designed to be used in conjunction with vegetation and has longevity of approximately one year. The material is supplied in rolled strips, which should be secured to the soil with U-shaped staples or stakes in accordance with manufacturers' recommendations.

  - **Excelsior** (curled wood fiber) blanket material should consist of machine produced mats of curled wood excelsior with 80 percent of the fiber 6 in. or longer. The excelsior blanket should be of consistent thickness. The wood fiber must be evenly distributed over the entire area of the blanket. The top surface of the blanket should be covered with a photodegradable extruded plastic mesh. The blanket should be smolder resistant without the use of chemical additives and should be non-toxic and non-injurious to plant and animal life. Excelsior blankets should be furnished in rolled strips, a minimum of 48 in. wide, and should have an average weight of 0.8 $lb/yd^2$, ±10 percent, at the time of manufacture. Excelsior blankets must be secured in place with wire staples. Staples

should be made of minimum 11 gauge steel wire and should be U-shaped with 8 in. legs and 2 in. crown.

- **Straw blanket** should be machine produced mats of straw with a lightweight biodegradable netting top layer. The straw should be attached to the netting with biodegradable thread or glue strips. The straw blanket should be of consistent thickness. The straw should be evenly distributed over the entire area of the blanket. Straw blanket should be furnished in rolled strips a minimum of 6.5 ft wide, a minimum of 80 ft long and a minimum of 0.5 lb/yd$^2$. Straw blankets must be secured in place with wire staples. Staples should be made of minimum 11 gauge steel wire and should be U-shaped with 8 in. legs and 2 in. crown.

- **Wood fiber blanket** is composed of biodegradable fiber mulch with extruded plastic netting held together with adhesives. The material is designed to enhance re-vegetation. The material is furnished in rolled strips, which must be secured to the ground with U-shaped staples or stakes in accordance with manufacturers' recommendations.

- **Coconut fiber blanket** should be a machine produced mat of 100 percent coconut fiber with biodegradable netting on the top and bottom. The coconut fiber should be attached to the netting with biodegradable thread or glue strips. The coconut fiber blanket should be of consistent thickness. The coconut fiber should be evenly distributed over the entire area of the blanket. Coconut fiber blanket should be furnished in rolled strips with a minimum of 6.5 ft wide, a minimum of 80 ft. long and a minimum of 0.5 lb/yd$^2$. Coconut fiber blankets must be secured in place with wire staples. Staples should be made of minimum 11 gauge steel wire and should be U-shaped with 8 in. legs and 2 in. crown.

- **Coconut fiber mesh** is a thin permeable membrane made from coconut or corn fiber that is spun into a yarn and woven into a biodegradable mat. It is designed to be used in conjunction with vegetation and typically has longevity of several years. The material is supplied in rolled strips, which must be secured to the soil with U-shaped staples or stakes in accordance with manufacturers' recommendations.

- **Straw coconut fiber blanket** should be machine produced mats of 70 percent straw and 30 percent coconut fiber with a biodegradable netting top layer and a biodegradable bottom net. The straw and coconut fiber should be attached to the netting with biodegradable thread or glue strips. The straw coconut fiber blanket should be of consistent thickness. The straw and coconut fiber should be evenly distributed over the entire area of the blanket. Straw coconut fiber blanket should be furnished in rolled strips a minimum of 6.5 ft wide, a minimum of 80 ft long and a minimum of 0.5 lb/yd$^2$. Straw coconut fiber blankets must be secured in place with wire staples. Staples should be made of minimum 11 gauge steel wire and should be U-shaped with 8 in. legs and 2 in. crown.

- Non-biodegradable RECPs are typically composed of polypropylene, polyethylene, nylon or other synthetic fibers. In some cases, a combination of biodegradable and synthetic fibers is used to construct the RECP. Netting used to hold these fibers together is typically non-biodegradable as well.

- **Plastic netting** is a lightweight biaxially oriented netting designed for securing loose mulches like straw or paper to soil surfaces to establish vegetation. The netting is photodegradable. The netting is supplied in rolled strips, which must be secured with U-shaped staples or stakes in accordance with manufacturers' recommendations.

- **Plastic mesh** is an open weave geotextile that is composed of an extruded synthetic fiber woven into a mesh with an opening size of less than ¼ in. It is used with re-vegetation or may be used to secure loose fiber such as straw to the ground. The material is supplied in rolled strips, which must be secured to the soil with U-shaped staples or stakes in accordance with manufacturers' recommendations.

- **Synthetic fiber with netting** is a mat that is composed of durable synthetic fibers treated to resist chemicals and ultraviolet light. The mat is a dense, three dimensional mesh of synthetic (typically polyolefin) fibers stitched between two polypropylene nets. The mats are designed to be re-vegetated and provide a permanent composite system of soil, roots, and geomatrix. The material is furnished in rolled strips, which must be secured with U-shaped staples or stakes in accordance with manufacturers' recommendations.

- **Bonded synthetic fibers** consist of a three dimensional geomatrix nylon (or other synthetic) matting. Typically it has more than 90 percent open area, which facilitates root growth. It's tough root reinforcing system anchors vegetation and protects against hydraulic lift and shear forces created by high volume discharges. It can be installed over prepared soil, followed by seeding into the mat. Once vegetated, it becomes an invisible composite system of soil, roots, and geomatrix. The material is furnished in rolled strips that must be secured with U-shaped staples or stakes in accordance with manufacturers' recommendations.

- **Combination synthetic and biodegradable RECPs** consist of biodegradable fibers, such as wood fiber or coconut fiber, with a heavy polypropylene net stitched to the top and a high strength continuous filament geomatrix or net stitched to the bottom. The material is designed to enhance re-vegetation. The material is furnished in rolled strips, which must be secured with U-shaped staples or stakes in accordance with manufacturers' recommendations.

### *Site Preparation*

- Proper site preparation is essential to ensure complete contact of the blanket or matting with the soil.

- Grade and shape the area of installation.

- Remove all rocks, clods, vegetation or other obstructions so that the installed blankets or mats will have complete, direct contact with the soil.

- Prepare seedbed by loosening 2 to 3 in. of topsoil.

### *Seeding*

Seed the area before blanket installation for erosion control and revegetation. Seeding after mat installation is often specified for turf reinforcement application. When seeding prior to blanket

installation, all check slots and other areas disturbed during installation must be re-seeded. Where soil filling is specified, seed the matting and the entire disturbed area after installation and prior to filling the mat with soil.

Fertilize and seed in accordance with seeding specifications or other types of landscaping plans. When using jute matting on a seeded area, apply approximately half the seed before laying the mat and the remainder after laying the mat. The protective matting can be laid over areas where grass has been planted and the seedlings have emerged. Where vines or other ground covers are to be planted, lay the protective matting first and then plant through matting according to design of planting.

### *Check Slots*

Check slots are made of glass fiber strips, excelsior matting strips or tight folded jute matting blanket or strips for use on steep, highly erodible watercourses. The check slots are placed in narrow trenches 6 to 12 in. deep across the channel and left flush with the soil surface. They are to cover the full cross section of designed flow.

### *Laying and Securing Matting*

- Before laying the matting, all check slots should be installed and the friable seedbed made free from clods, rocks, and roots. The surface should be compacted and finished according to the requirements of the manufacturer's recommendations.

- Mechanical or manual lay down equipment should be capable of handling full rolls of fabric and laying the fabric smoothly without wrinkles or folds. The equipment should meet the fabric manufacturer's recommendations or equivalent standards.

### *Anchoring*

- U-shaped wire staples, metal geotextile stake pins, or triangular wooden stakes can be used to anchor mats and blankets to the ground surface.

- Wire staples should be made of minimum 11 gauge steel wire and should be U-shaped with 8 in. legs and 2 in. crown.

- Metal stake pins should be 0.188 in. diameter steel with a 1.5 in. steel washer at the head of the pin, and 8 in. in length.

- Wire staples and metal stakes should be driven flush to the soil surface.

### *Installation on Slopes*

Installation should be in accordance with the manufacturer's recommendations. In general, these will be as follows:

- Begin at the top of the slope and anchor the blanket in a 6 in. deep by 6 in. wide trench. Backfill trench and tamp earth firmly.

- Unroll blanket down slope in the direction of water flow.

- Overlap the edges of adjacent parallel rolls 2 to 3 in. and staple every 3 ft.

- When blankets must be spliced, place blankets end over end (shingle style) with 6 in. overlap. Staple through overlapped area, approximately 12 in. apart.
- Lay blankets loosely and maintain direct contact with the soil. Do not stretch.
- Staple blankets sufficiently to anchor blanket and maintain contact with the soil. Staples should be placed down the center and staggered with the staples placed along the edges. Steep slopes, 1:1 (H:V) to 2:1 (H:V), require a minimum of 2 staples/yd$^2$. Moderate slopes, 2:1 (H:V) to 3:1 (H:V), require a minimum of 1 ½ staples/yd$^2$.

***Installation in Channels***

Installation should be in accordance with the manufacturer's recommendations. In general, these will be as follows:

- Dig initial anchor trench 12 in. deep and 6 in. wide across the channel at the lower end of the project area.
- Excavate intermittent check slots, 6 in. deep and 6 in. wide across the channel at 25 to 30 ft intervals along the channels.
- Cut longitudinal channel anchor trenches 4 in. deep and 4 in. wide along each side of the installation to bury edges of matting, whenever possible extend matting 2 to 3 in. above the crest of the channel side slopes.
- Beginning at the downstream end and in the center of the channel, place the initial end of the first roll in the anchor trench and secure with fastening devices at 12 in. intervals. Note: matting will initially be upside down in anchor trench.
- In the same manner, position adjacent rolls in anchor trench, overlapping the preceding roll a minimum of 3 in.
- Secure these initial ends of mats with anchors at 12 in. intervals, backfill and compact soil.
- Unroll center strip of matting upstream. Stop at next check slot or terminal anchor trench. Unroll adjacent mats upstream in similar fashion, maintaining a 3 in. overlap.
- Fold and secure all rolls of matting snugly into all transverse check slots. Lay mat in the bottom of the slot then fold back against itself. Anchor through both layers of mat at 12 in. intervals, then backfill and compact soil. Continue rolling all mat widths upstream to the next check slot or terminal anchor trench.
- Alternate method for non-critical installations: Place two rows of anchors on 6 in. centers at 25 to 30 ft. intervals in lieu of excavated check slots.
- Staple shingled lap spliced ends a minimum of 12 in. apart on 12 in. intervals.
- Place edges of outside mats in previously excavated longitudinal slots; anchor using prescribed staple pattern, backfill, and compact soil.
- Anchor, fill, and compact upstream end of mat in a 12 in. by 6 in. terminal trench.

- Secure mat to ground surface using U-shaped wire staples, geotextile pins, or wooden stakes.
- Seed and fill turf reinforcement matting with soil, if specified.

***Soil Filling (if specified for turf reinforcement)***

- Always consult the manufacturer's recommendations for installation.
- Do not drive tracked or heavy equipment over mat.
- Avoid any traffic over matting if loose or wet soil conditions exist.
- Use shovels, rakes, or brooms for fine grading and touch up.
- Smooth out soil filling just exposing top netting of mat.

***Temporary Soil Stabilization Removal***

- Temporary soil stabilization removed from the site of the work must be disposed of if necessary.

## Costs

Relatively high compared to other BMPs. Biodegradable materials: $0.50 - $0.57/yd$^2$. Permanent materials: $3.00 - $4.50/yd$^2$. Staples: $0.04 - $0.05/staple. Approximate costs for installed materials are shown below:

| Rolled Erosion Control Products | | Installed Cost per Acre |
|---|---|---|
| Biodegradable | Jute Mesh | $6,500 |
| | Curled Wood Fiber | $10,500 |
| | Straw | $8,900 |
| | Wood Fiber | $8,900 |
| | Coconut Fiber | $13,000 |
| | Coconut Fiber Mesh | $31,200 |
| | Straw Coconut Fiber | $10,900 |
| Non-Biodegradable | Plastic Netting | $2,000 |
| | Plastic Mesh | $3,200 |
| | Synthetic Fiber with Netting | $34,800 |
| | Bonded Synthetic Fibers | $50,000 |
| | Combination with Biodegradable | $32,000 |

Source: Caltrans Guidance for Soil Stabilization for Temporary Slopes, Nov. 1999

***Inspection and Maintenance***

- Inspect BMPs prior to forecast rain, daily during extended rain events, after rain events, weekly during the rainy season, and at two-week intervals during the non-rainy season, and at two-week intervals during the non-rainy season.
- Inspect BMPs subject to non-stormwater discharges daily while non-stormwater discharges occur.

- Areas where erosion is evident shall be repaired and BMPs reapplied as soon as possible. Care should be exercised to minimize the damage to protected areas while making repairs, as any area damaged will require reapplication of BMPs.
- If washout or breakage occurs, re-install the material after repairing the damage to the slope or channel.
- Make sure matting is uniformly in contact with the soil.
- Check that all the lap joints are secure.
- Check that staples are flush with the ground.
- Check that disturbed areas are seeded.

### References

Guides for Erosion and Sediment Controls in California, USDA Soils Conservation Service, January 1991.

National Management Measures to Control Nonpoint Source Pollution from Urban Areas, United States Environmental Protection Agency, 2002.

Stormwater Quality Handbooks Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

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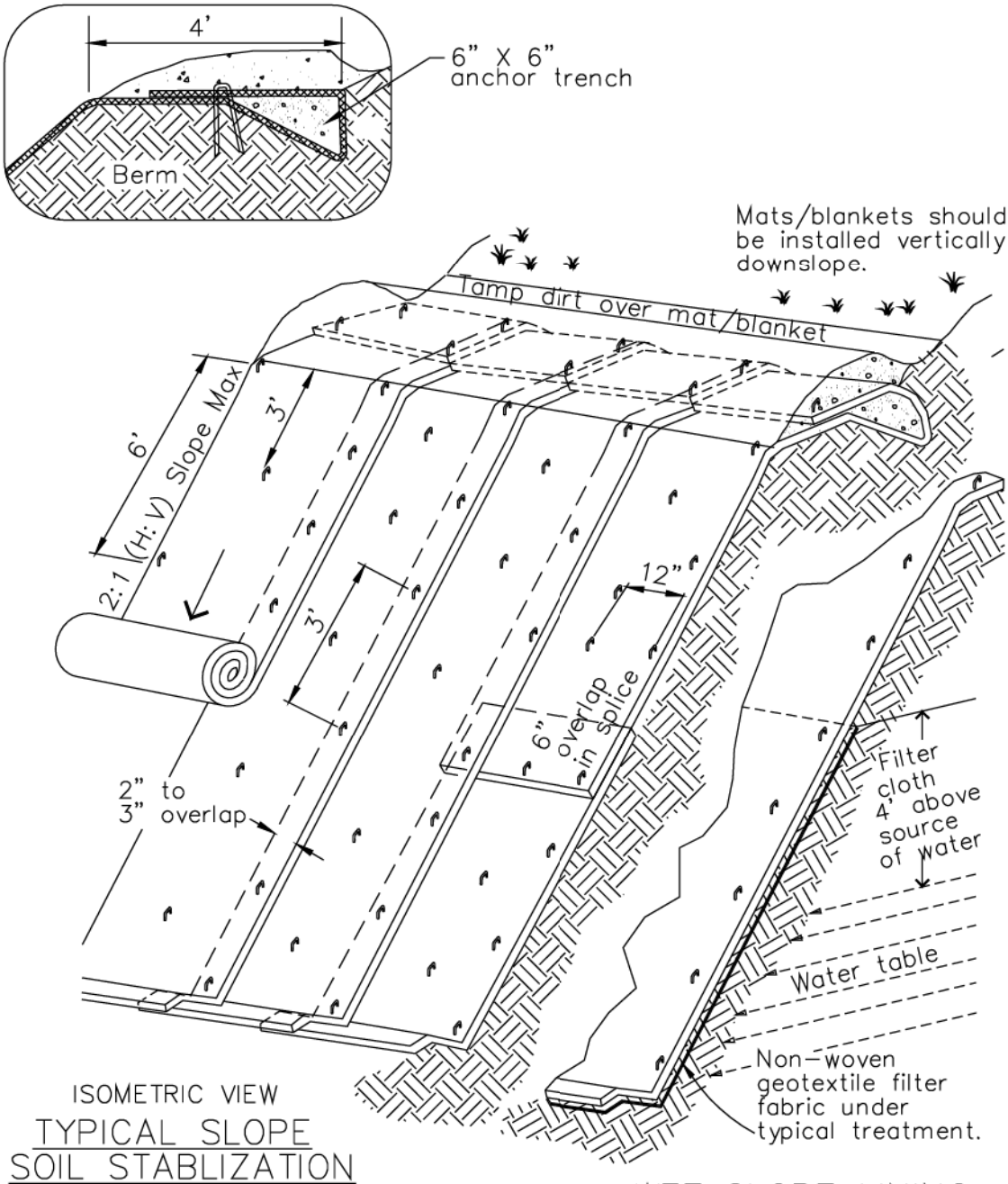



ISOMETRIC VIEW

TYPICAL SLOPE SOIL STABLIZATION

NTS

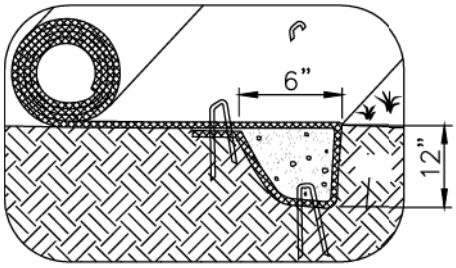
WET SLOPE LINING

NTS

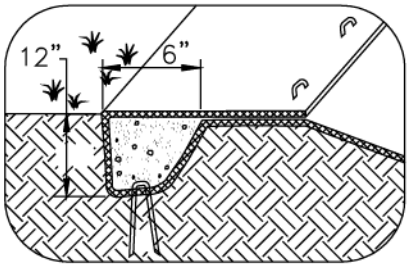
NOTES:

1. Slope surface shall be free of rocks, clods, sticks and grass. Mats/blankets shall have good soil contact.
2. Lay blankets loosely and stake or staple to maintain direct contact with the soil. Do not stretch.
3. Install per manufacturer's recommendations

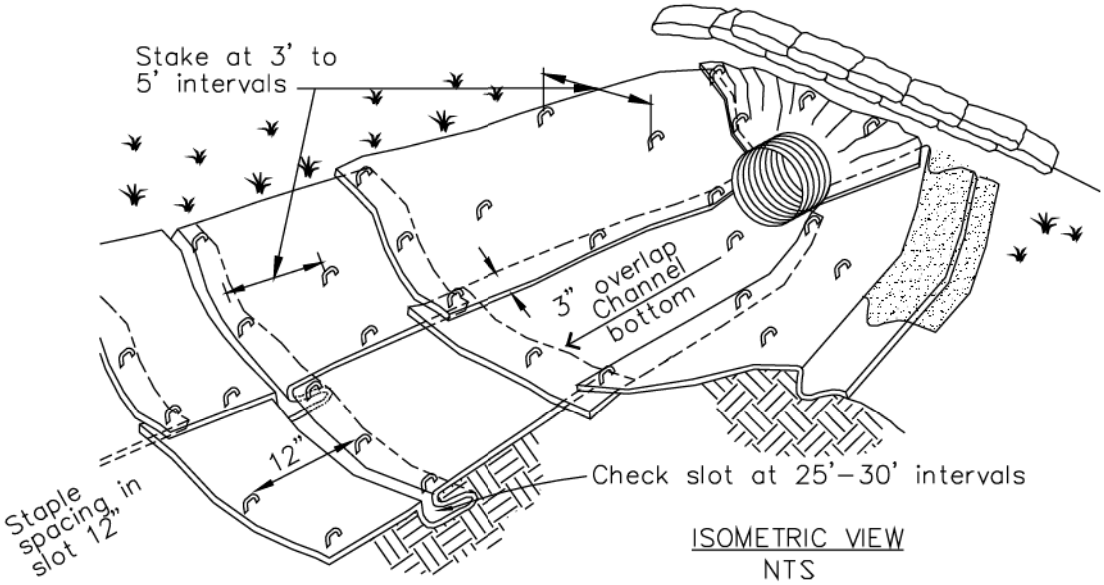
TYPICAL INSTALLATION DETAIL



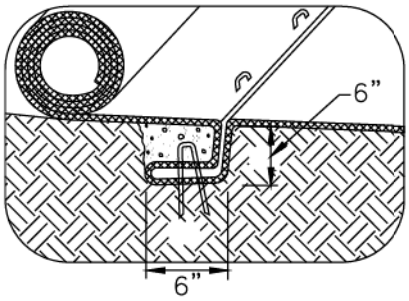

INITIAL CHANNEL ANCHOR TRENCH
NTS



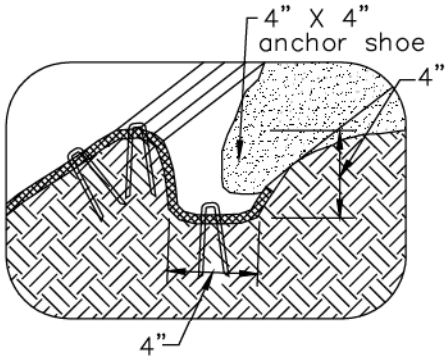

TERMINAL SLOPE AND CHANNEL ANCHOR TRENCH
NTS




ISOMETRIC VIEW
NTS




INTERMITTENT CHECK SLOT
NTS

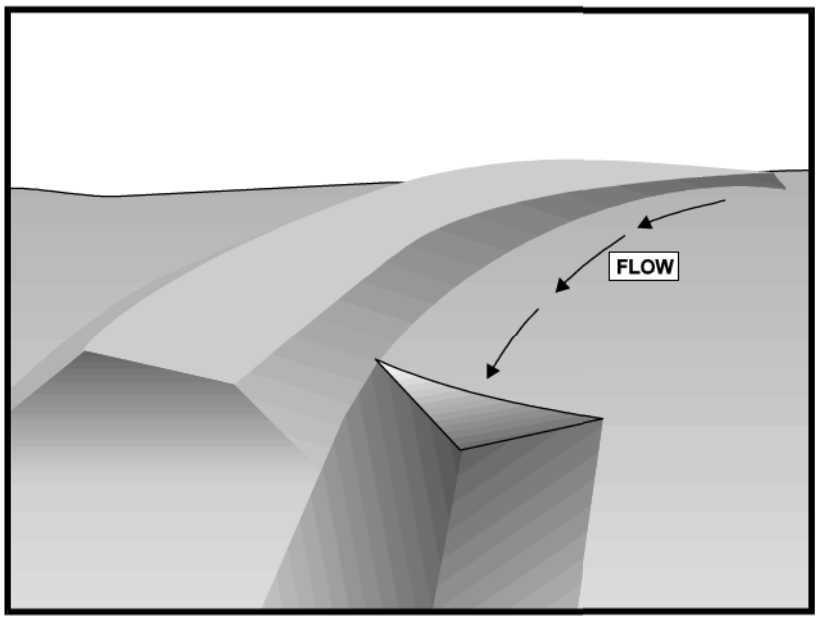



LONGITUDINAL ANCHOR TRENCH
NTS

NOTES:
1. Check slots to be constructed per manufacturers specifications.
2. Staking or stapling layout per manufacturers specifications.
3. Install per manufacturer's recommendations

TYPICAL INSTALLATION DETAIL

# Earth Dikes and Drainage Swales EC-9




## Objectives

| | | |
|---|---|---|
| EC | Erosion Control | ☑ |
| SE | Sediment Control | |
| TR | Tracking Control | |
| WE | Wind Erosion Control | |
| NS | Non-Stormwater Management Control | |
| WM | Waste Management and Materials Pollution Control | |

**Legend:**

☑ **Primary Objective**

☒ **Secondary Objective**

## Targeted Constituents

| | |
|---|---|
| Sediment | ☑ |
| Nutrients | |
| Trash | |
| Metals | |
| Bacteria | |
| Oil and Grease | |
| Organics | |

## Potential Alternatives

None

## Description and Purpose

An earth dike is a temporary berm or ridge of compacted soil used to divert runoff or channel water to a desired location. A drainage swale is a shaped and sloped depression in the soil surface used to convey runoff to a desired location. Earth dikes and drainage swales are used to divert off site runoff around the construction site, divert runoff from stabilized areas and disturbed areas, and direct runoff into sediment basins or traps.

## Suitable Applications

Earth dikes and drainage swales are suitable for use, individually or together, where runoff needs to be diverted from one area and conveyed to another.

- Earth dikes and drainage swales may be used:
  - To convey surface runoff down sloping land
  - To intercept and divert runoff to avoid sheet flow over sloped surfaces
  - To divert and direct runoff towards a stabilized watercourse, drainage pipe or channel
  - To intercept runoff from paved surfaces
  - Below steep grades where runoff begins to concentrate
  - Along roadways and facility improvements subject to flood drainage

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- At the top of slopes to divert runon from adjacent or undisturbed slopes
- At bottom and mid slope locations to intercept sheet flow and convey concentrated flows
- Divert sediment laden runoff into sediment basins or traps

## Limitations

Dikes should not be used for drainage areas greater than 10 acres or along slopes greater than 10 percent. For larger areas more permanent drainage structures should be built. All drainage structures should be built in compliance with local municipal requirements.

- Earth dikes may create more disturbed area on site and become barriers to construction equipment.
- Earth dikes must be stabilized immediately, which adds cost and maintenance concerns.
- Diverted stormwater may cause downstream flood damage.
- Dikes should not be constructed of soils that may be easily eroded.
- Regrading the site to remove the dike may add additional cost.
- Temporary drains and swales or any other diversion of runoff should not adversely impact upstream or downstream properties.
- Temporary drains and swales must conform to local floodplain management requirements.
- Earth dikes/drainage swales are not suitable as sediment trapping devices.
- It may be necessary to use other soil stabilization and sediment controls such as check dams, plastics, and blankets, to prevent scour and erosion in newly graded dikes, swales, and ditches.

## Implementation

The temporary earth dike is a berm or ridge of compacted soil, located in such a manner as to divert stormwater to a sediment trapping device or a stabilized outlet, thereby reducing the potential for erosion and offsite sedimentation. Earth dikes can also be used to divert runoff from off site and from undisturbed areas away from disturbed areas and to divert sheet flows away from unprotected slopes.

An earth dike does not itself control erosion or remove sediment from runoff. A dike prevents erosion by directing runoff to an erosion control device such as a sediment trap or directing runoff away from an erodible area. Temporary diversion dikes should not adversely impact adjacent properties and must conform to local floodplain management regulations, and should not be used in areas with slopes steeper than 10%.

Slopes that are formed during cut and fill operations should be protected from erosion by runoff. A combination of a temporary drainage swale and an earth dike at the top of a slope can divert runoff to a location where it can be brought to the bottom of the slope (see EC-11, Slope Drains). A combination dike and swale is easily constructed by a single pass of a bulldozer or grader and

compacted by a second pass of the tracks or wheels over the ridge. Diversion structures should be installed when the site is initially graded and remain in place until post construction BMPs are installed and the slopes are stabilized.

Diversion practices concentrate surface runoff, increasing its velocity and erosive force. Thus, the flow out of the drain or swale must be directed onto a stabilized area or into a grade stabilization structure. If significant erosion will occur, a swale should be stabilized using vegetation, chemical treatment, rock rip-rap, matting, or other physical means of stabilization. Any drain or swale that conveys sediment laden runoff must be diverted into a sediment basin or trap before it is discharged from the site.

### *General*

- Care must be applied to correctly size and locate earth dikes, drainage swales. Excessively steep, unlined dikes, and swales are subject to erosion and gully formation.
- Conveyances should be stabilized.
- Use a lined ditch for high flow velocities.
- Select flow velocity based on careful evaluation of the risks due to erosion of the measure, soil types, overtopping, flow backups, washout, and drainage flow patterns for each project site.
- Compact any fills to prevent unequal settlement.
- Do not divert runoff onto other property without securing written authorization from the property owner.
- When possible, install and utilize permanent dikes, swales, and ditches early in the construction process.
- Provide stabilized outlets.

### *Earth Dikes*

Temporary earth dikes are a practical, inexpensive BMP used to divert stormwater runoff. Temporary diversion dikes should be installed in the following manner:

- All dikes should be compacted by earth moving equipment.
- All dikes should have positive drainage to an outlet.
- All dikes should have 2:1 or flatter side slopes, 18 in. minimum height, and a minimum top width of 24 in. Wide top widths and flat slopes are usually needed at crossings for construction traffic.
- The outlet from the earth dike must function with a minimum of erosion. Runoff should be conveyed to a sediment trapping device such as a Sediment Trap (SE-3) or Sediment Basin (SE-2) when either the dike channel or the drainage area above the dike are not adequately stabilized.

- Temporary stabilization may be achieved using seed and mulching for slopes less than 5% and either rip-rap or sod for slopes in excess of 5%. In either case, stabilization of the earth dike should be completed immediately after construction or prior to the first rain.
- If riprap is used to stabilize the channel formed along the toe of the dike, the following typical specifications apply:

| Channel Grade | Riprap Stabilization |
|---|---|
| 0.5-1.0% | 4 in. Rock |
| 1.1-2.0% | 6 in. Rock |
| 2.1-4.0% | 8 in. Rock |
| 4.1-5.0% | 8 in. -12 in. Riprap |

- The stone riprap, recycled concrete, etc. used for stabilization should be pressed into the soil with construction equipment.
- Filter cloth may be used to cover dikes in use for long periods.
- Construction activity on the earth dike should be kept to a minimum.

***Drainage Swales***

Drainage swales are only effective if they are properly installed. Swales are more effective than dikes because they tend to be more stable. The combination of a swale with a dike on the downhill side is the most cost effective diversion.

Standard engineering design criteria for small open channel and closed conveyance systems should be used (see the local drainage design manual). Unless local drainage design criteria state otherwise, drainage swales should be designed as follows:

- No more than 5 acres may drain to a temporary drainage swale.
- Place drainage swales above or below, not on, a cut or fill slope.
- Swale bottom width should be at least 2 ft
- Depth of the swale should be at least 18 in.
- Side slopes should be 2:1 or flatter.
- Drainage or swales should be laid at a grade of at least 1 percent, but not more than 15 percent.
- The swale must not be overtopped by the peak discharge from a 10-year storm, irrespective of the design criteria stated above.
- Remove all trees, stumps, obstructions, and other objectionable material from the swale when it is built.
- Compact any fill material along the path of the swale.

- Stabilize all swales immediately. Seed and mulch swales at a slope of less than 5 percent, and use rip-rap or sod for swales with a slope between 5 and 15 percent. For temporary swales, geotextiles and mats (EC-7) may provide immediate stabilization.
- Irrigation may be required to establish sufficient vegetation to prevent erosion.
- Do not operate construction vehicles across a swale unless a stabilized crossing is provided.
- Permanent drainage facilities must be designed by a professional engineer (see the local drainage design criteria for proper design).
- At a minimum, the drainage swale should conform to predevelopment drainage patterns and capacities.
- Construct the drainage swale with a positive grade to a stabilized outlet.
- Provide erosion protection or energy dissipation measures if the flow out of the drainage swale can reach an erosive velocity.

## Costs

- Cost ranges from $15 to $55 per ft for both earthwork and stabilization and depends on availability of material, site location, and access.
- Small dikes: $2.50 - $6.50/linear ft; Large dikes: $2.50/yd$^3$.
- The cost of a drainage swale increases with drainage area and slope. Typical swales for controlling internal erosion are inexpensive, as they are quickly formed during routine earthwork.

## Inspection and Maintenance

- Inspect BMPs prior to forecast rain, daily during extended rain events, after rain events, weekly during the rainy season, and at two-week intervals during the non-rainy season.
- Inspect BMPs subject to non-stormwater discharges daily while non-stormwater discharges occur.
- Inspect ditches and berms for washouts. Replace lost riprap, damaged linings or soil stabilizers as needed.
- Inspect channel linings, embankments, and beds of ditches and berms for erosion and accumulation of debris and sediment. Remove debris and sediment and repair linings and embankments as needed.
- Temporary conveyances should be completely removed as soon as the surrounding drainage area has been stabilized or at the completion of construction

## References

Erosion and Sediment Control Handbook, S.J. Goldman, K. Jackson, T.A. Bursetynsky, P.E., McGraw Hill Book Company, 1986.

Manual of Standards of Erosion and Sediment Control Measures, Association of Bay Area Governments, May 1995.

National Association of Home Builders (NAHB). Stormwater Runoff & Nonpoint Source Pollution Control Guide for Builders and Developers. National Association of Home Builders, Washington, D.C., 1995

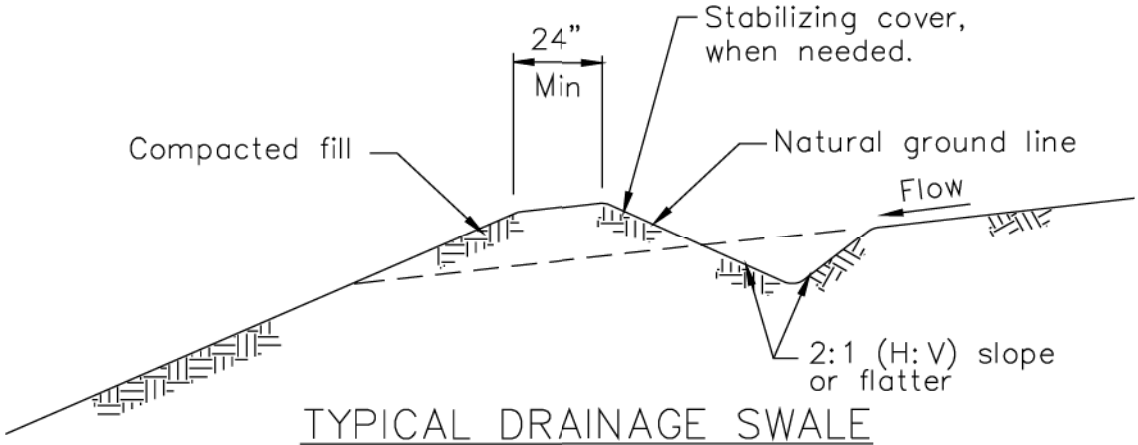
National Management Measures to Control Nonpoint Source Pollution from Urban Areas, United States Environmental Protection Agency, 2002.

Southeastern Wisconsin Regional Planning Commission (SWRPC). Costs of Urban Nonpoint Source Water Pollution Control Measures. Technical Report No. 31. Southeastern Wisconsin Regional Planning Commission, Waukesha, WI. 1991

Stormwater Quality Handbooks Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

Stormwater Management of the Puget Sound Basin, Technical Manual, Publication #91-75, Washington State Department of Ecology, February 1992.

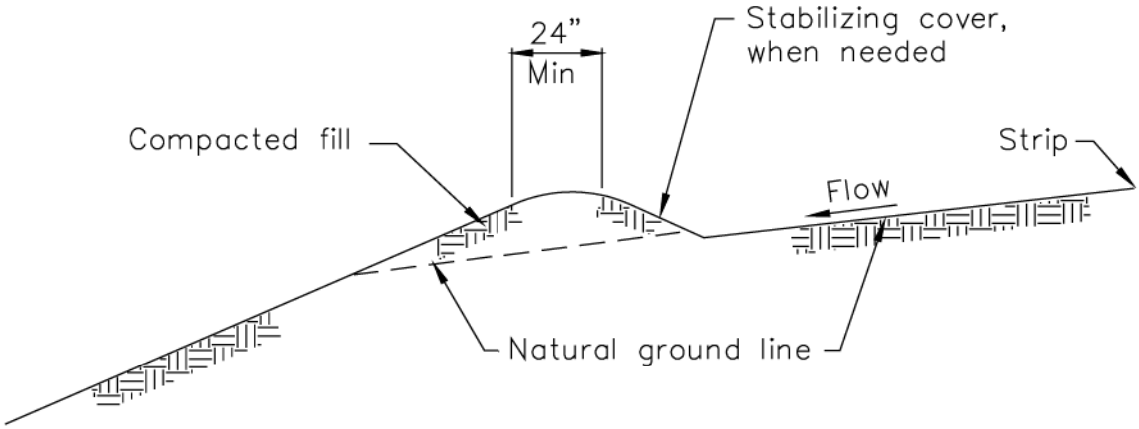
Water Quality Management Plan for the Lake Tahoe Region, Volume II, Handbook of Management Practices, Tahoe Regional Planning Agency, November 1988.




TYPICAL DRAINAGE SWALE
NOT TO SCALE

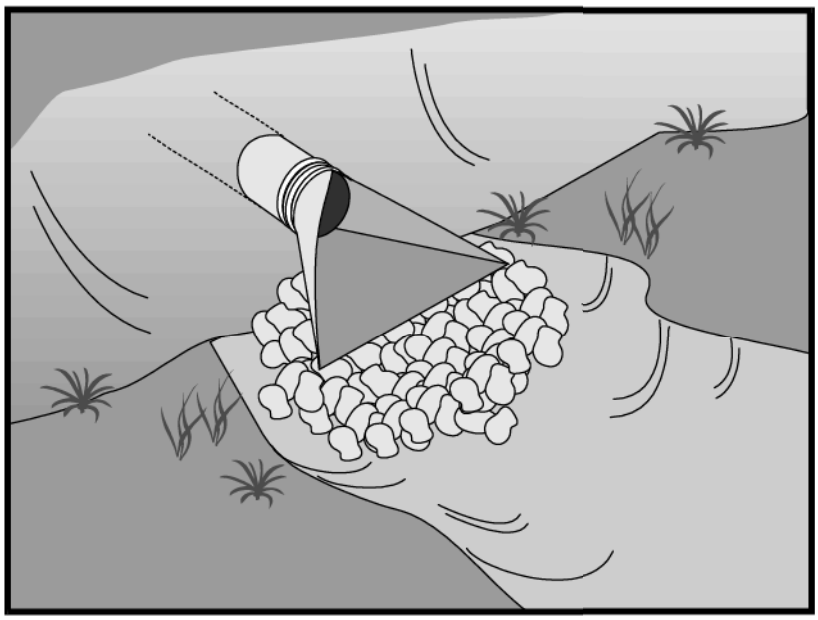
NOTES:

1. Stabilize inlet, outlets and slopes.
2. Properly compact the subgrade.




TYPICAL EARTH DIKE
NOT TO SCALE

# Velocity Dissipation Devices EC-10



## Objectives

| | | |
|---|---|---|
| EC | Erosion Control | ☑ |
| SE | Sediment Control | |
| TR | Tracking Control | |
| WE | Wind Erosion Control | |
| NS | Non-Stormwater Management Control | |
| WM | Waste Management and Materials Pollution Control | |

**Legend:**

☑ **Primary Objective**

☒ **Secondary Objective**

## Targeted Constituents

| | |
|---|---|
| Sediment | ☑ |
| Nutrients | |
| Trash | |
| Metals | |
| Bacteria | |
| Oil and Grease | |
| Organics | |

## Potential Alternatives

None

## Description and Purpose

Outlet protection is a physical device composed of rock, grouted riprap, or concrete rubble, which is placed at the outlet of a pipe or channel to prevent scour of the soil caused by concentrated, high velocity flows.

## Suitable Applications

Whenever discharge velocities and energies at the outlets of culverts, conduits, or channels are sufficient to erode the next downstream reach. This includes temporary diversion structures to divert runon during construction.

- These devices may be used at the following locations:
  - Outlets of pipes, drains, culverts, slope drains, diversion ditches, swales, conduits, or channels.
  - Outlets located at the bottom of mild to steep slopes.
  - Discharge outlets that carry continuous flows of water.
  - Outlets subject to short, intense flows of water, such as flash floods.
  - Points where lined conveyances discharge to unlined conveyances

## Limitations

- Large storms or high flows can wash away the rock outlet protection and leave the area susceptible to erosion.

- Sediment captured by the rock outlet protection may be difficult to remove without removing the rock.
- Outlet protection may negatively impact the channel habitat.
- Grouted riprap may break up in areas of freeze and thaw.
- If there is not adequate drainage, and water builds up behind grouted riprap, it may cause the grouted riprap to break up due to the resulting hydrostatic pressure.

## Implementation

### *General*

Outlet protection is needed where discharge velocities and energies at the outlets of culverts, conduits or channels are sufficient to erode the immediate downstream reach. This practice protects the outlet from developing small eroded pools (plange pools), and protects against gully erosion resulting from scouring at a culvert mouth.

### *Design and Layout*

As with most channel design projects, depth of flow, roughness, gradient, side slopes, discharge rate, and velocity should be considered in the outlet design. Compliance to local and state regulations should also be considered while working in environmentally sensitive streambeds. General recommendations for rock size and length of outlet protection mat are shown in the rock outlet protection figure in this BMP and should be considered minimums. The apron length and rock size gradation are determined using a combination of the discharge pipe diameter and estimate discharge rate: Select the longest apron length and largest rock size suggested by the pipe size and discharge rate. Where flows are conveyed in open channels such as ditches and swales, use the estimated discharge rate for selecting the apron length and rock size. Flows should be same as the culvert or channel design flow but never the less than the peak 5 year flow for temporary structures planned for one rainy season, or the 10 year peak flow for temporary structures planned for two or three rainy seasons.

- There are many types of energy dissipaters, with rock being the one that is represented in the attached figure.
- Best results are obtained when sound, durable, and angular rock is used.
- Install riprap, grouted riprap, or concrete apron at selected outlet. Riprap aprons are best suited for temporary use during construction. Grouted or wired tied rock riprap can minimize maintenance requirements.
- Rock outlet protection is usually less expensive and easier to install than concrete aprons or energy dissipaters. It also serves to trap sediment and reduce flow velocities.
- Carefully place riprap to avoid damaging the filter fabric.
    - Stone 4 in. to 6 in. may be carefully dumped onto filter fabric from a height not to exceed 12 in.
    - Stone 8 in. to 12 in. must be hand placed onto filter fabric, or the filter fabric may be covered with 4 in. of gravel and the 8 in. to 12 in. rock may be dumped from a height not to exceed 16 in.

- Stone greater than 12 in. shall only be dumped onto filter fabric protected with a layer of gravel with a thickness equal to one half the $D_{50}$ rock size, and the dump height limited to twice the depth of the gravel protection layer thickness.

- For proper operation of apron: Align apron with receiving stream and keep straight throughout its length. If a curve is needed to fit site conditions, place it in upper section of apron.

- Outlets on slopes steeper than 10 percent should have additional protection.

### Costs

Costs are low if material is readily available. If material is imported, costs will be higher. Average installed cost is $150 per device.

### Inspection and Maintenance

- Inspect BMPs prior to forecast rain, daily during extended rain events, after rain events, weekly during the rainy season, and at two-week intervals during the non-rainy season.

- Inspect BMPs subjected to non-stormwater discharges daily while non-stormwater discharges occur.

- Inspect apron for displacement of the riprap and damage to the underlying fabric. Repair fabric and replace riprap that has washed away. If riprap continues to wash away, consider using larger material.

- Inspect for scour beneath the riprap and around the outlet. Repair damage to slopes or underlying filter fabric immediately.

- Temporary devices should be completely removed as soon as the surrounding drainage area has been stabilized or at the completion of construction.

### References

County of Sacramento Improvement Standards, Sacramento County, May 1989.

Erosion and Sediment Control Handbook, S.J. Goldman, K. Jackson, T.A. Bursztynsky, P.E., McGraw Hill Book Company, 1986.

Handbook of Steel Drainage & Highway Construction, American Iron and Steel Institute, 1983.

Manual of Standards of Erosion and Sediment Control Measures, Association of Bay Area Governments, May 1995.

Stormwater Quality Handbooks Construction Site Best Management Practices (BMPs) Manual, state of California Department of Transportation (Caltrans), November 2000.

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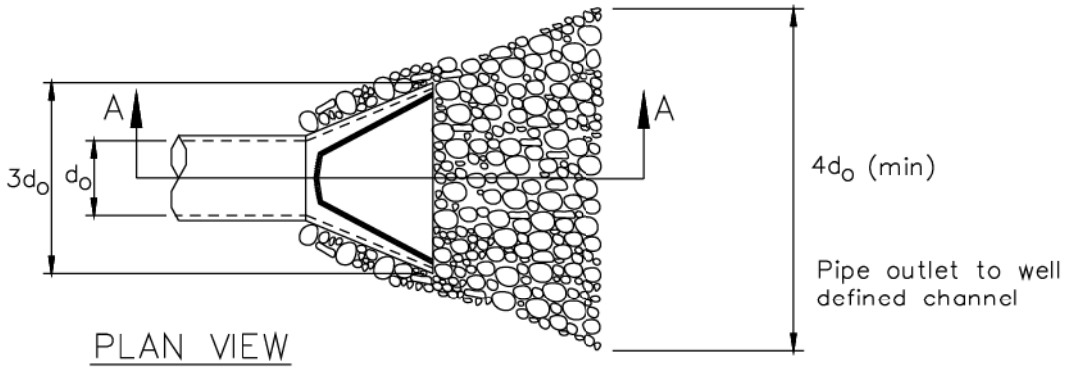
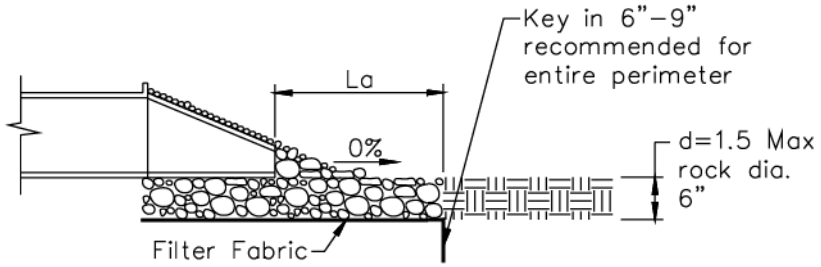



PLAN VIEW

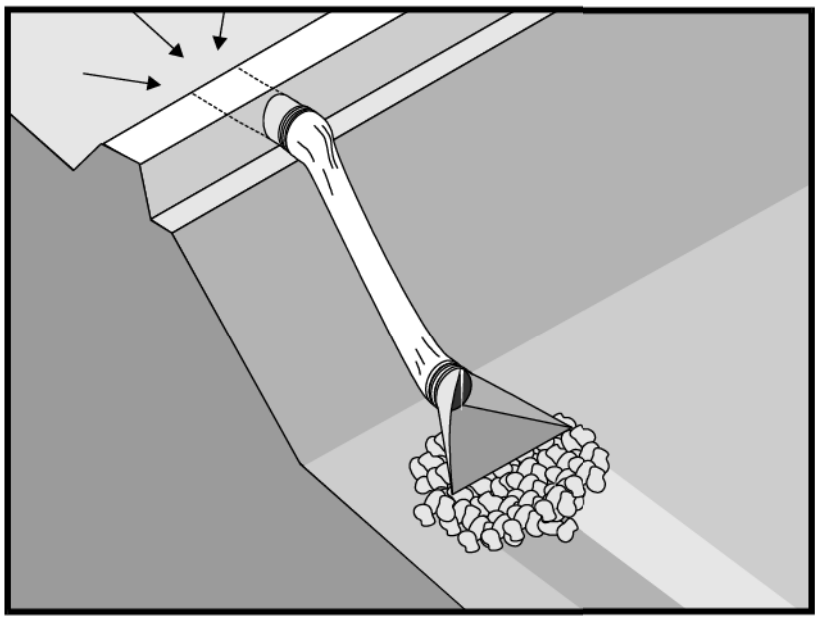



SECTION A–A

| Pipe Diameter inches | Discharge $ft^3/s$ | Apron Length, La ft | Rip Rap $D_{50}$ Diameter Min inches |
|---|---|---|---|
| 12 | 5 | 10 | 4 |
| | 10 | 13 | 6 |
| 18 | 10 | 10 | 6 |
| | 20 | 16 | 8 |
| | 30 | 23 | 12 |
| | 40 | 26 | 16 |
| 24 | 30 | 16 | 8 |
| | 40 | 26 | 8 |
| | 50 | 26 | 12 |
| | 60 | 30 | 16 |

For larger or higher flows consult a Registered Civil Engineer
Source: USDA - SCS

# Slope Drains EC-11



## Objectives

| | | |
|---|---|---|
| EC | Erosion Control | ☑ |
| SE | Sediment Control | |
| TR | Tracking Control | |
| WE | Wind Erosion Control | |
| NS | Non-Stormwater Management Control | |
| WM | Waste Management and Materials Pollution Control | |

**Legend:**

☑ **Primary Objective**

☒ **Secondary Objective**

## Targeted Constituents

| | |
|---|---|
| Sediment | ☑ |
| Nutrients | |
| Trash | |
| Metals | |
| Bacteria | |
| Oil and Grease | |
| Organics | |

## Potential Alternatives

EC-9 Earth Dike, Drainage Swales

## Description and Purpose

A slope drain is a pipe used to intercept and direct surface runoff or groundwater into a stabilized watercourse, trapping device, or stabilized area. Slope drains are used with earth dikes and drainage ditches to intercept and direct surface flow away from slope areas to protect cut or fill slopes.

## Suitable Applications

- Where concentrated flow of surface runoff must be conveyed down a slope in order to prevent erosion.
- Drainage for top of slope diversion dikes or swales.
- Drainage for top of cut and fill slopes where water can accumulate.
- Emergency spillway for a sediment basin.

## Limitations

Installation is critical for effective use of the pipe slope drain to minimize potential gully erosion.

- Maximum drainage area per slope drain is 10 acres. (For large areas use a paved chute, rock lined channel, or additional pipes.)
- Severe erosion may result when slope drains fail by overtopping, piping, or pipe separation.

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- During large storms, pipe slope drains may become clogged or over charged, forcing water around the pipe and causing extreme slope erosion.
- If the sectional downdrain is not sized correctly, the runoff can spill over the drain sides causing gully erosion and potential failure of the structure.

- Dissipation of high flow velocities at the pipe outlet is required to avoid downstream erosion.

## Implementation

### *General*

The slope drain is applicable for any construction site where concentrated surface runoff can accumulate and must be conveyed down the slope in order to prevent erosion. The slope drain is effective because it prevents the stormwater from flowing directly down the slope by confining all the runoff into an enclosed pipe or channel. Due to the time lag between grading slopes and installation of permanent stormwater collection systems and slope stabilization measures, temporary provisions to intercept runoff are sometimes necessary. Particularly in steep terrain, slope drains can protect unstabilized areas from erosion.

### *Installation*

The slope drain may be a rigid pipe, such as corrugated metal, a flexible conduit, or a lined terrace drain with the inlet placed on the top of a slope and the outlet at the bottom of the slope. This BMP typically is used in combination with a diversion control, such as an earth dike or drainage swale at the top of the slope.

The following criteria must be considered when siting slope drains.

- Permanent structures included in the project plans can often serve as construction BMPs if implemented early. However, the permanent structure must meet or exceed the criteria for the temporary structure.
- Inlet structures must be securely entrenched and compacted to avoid severe gully erosion.
- Slope drains must be securely anchored to the slope and must be adequately sized to carry the capacity of the design storm and associated forces.
- Outlets must be stabilized with riprap, concrete or other type of energy dissipator, or directed into a stable sediment trap or basin. See EC-10, Velocity Dissipation Devices.
- Debris racks are recommended at the inlet. Debris racks located several feet upstream of the inlet can usually be larger than racks at the inlet, and thus provide enhanced debris protection and less plugging.
- Safety racks are also recommended at the inlet and outlet of pipes where children or animals could become entrapped.
- Secure inlet and surround with dikes to prevent gully erosion and anchor pipe to slope.
- When using slope drains, limit drainage area to 10 acres per pipe. For larger areas, use a rock lined channel or a series of pipes.

- Size to convey at least the peak flow of a 10-year storm. The design storm is conservative due to the potential impact of system failures.
- Maximum slope generally limited to 2:1 (H:V) as energy dissipation below steeper slopes is difficult.
- Direct surface runoff to slope drains with interceptor dikes. See BMP EC-9, Earth Dikes and Drainage Swales. Top of interceptor dikes should be 12 in. higher than the top of the slope drain.
- Slope drains can be placed on or buried underneath the slope surface.
- Recommended materials include both metal and plastic pipe, either corrugated or smooth wall. Concrete pipe can also be used.
- When installing slope drains:
  - Install slope drains perpendicular to slope contours.
  - Compact soil around and under entrance, outlet, and along length of pipe.
  - Securely anchor and stabilize pipe and appurtenances into soil.
  - Check to ensure that pipe connections are watertight.
  - Protect area around inlet with filter cloth. Protect outlet with riprap or other energy dissipation device. For high energy discharges, reinforce riprap with concrete or use reinforced concrete device.
  - Protect outlet of slope drains using a flared end section when outlet discharges to a flexible energy dissipation device.
  - A flared end section installed at the inlet will improve flow into the slope drain and prevent erosion at the pipe entrance. Use a flared end section with a 6 in. minimum toe plate to help prevent undercutting. The flared section should slope towards the pipe inlet.

### *Design and Layout*

The capacity for temporary drains should be sufficient to convey at least the peak runoff from a 10-year rainfall event. The pipe size may be computed using the Rational Method or a method established by the local municipality. Higher flows must be safely stored or routed to prevent any offsite concentration of flow and any erosion of the slope. The design storm is purposely conservative due to the potential impacts associated with system failures.

As a guide, temporary pipe slope drains should not be sized smaller than shown in the following table:

| Minimum Pipe Diameter (Inches) | Maximum Drainage Area (Acres) |
|---|---|
| 12 | 1.0 |
| 18 | 3.0 |
| 21 | 5.0 |
| 24 | 7.0 |
| 30 | 10.0 |

Larger drainage areas can be treated if the area can be subdivided into areas of 10 acres or less and each area is treated as a separate drainage. Drainage areas exceeding 10 acres must be designed by a Registered Civil Engineer and approved by the agency that issued the grading permit.

***Materials:***

Soil type, rainfall patterns, construction schedule, local requirements, and available supply are some of the factors to be considered when selecting materials. The following types of slope drains are commonly used:

- **Rigid Pipe:** This type of slope drain is also known as a pipe drop. The pipe usually consists of corrugated metal pipe or rigid plastic pipe. The pipe is placed on undisturbed or compacted soil and secured onto the slope surface or buried in a trench. Concrete thrust blocks must be used when warranted by the calculated thrust forces. Collars should be properly installed and secured with metal strappings or watertight collars.

- **Flexible Pipe**: The flexible pipe slope drain consists of a flexible tube of heavy-duty plastic, rubber, or composite material. The tube material is securely anchored onto the slope surface. The tube should be securely fastened to the metal inlet and outlet conduit sections with metal strappings or watertight collars.

- **Section Downdrains**: The section downdrain consists of pre-fabricated, section conduit of half round or third round material. The sectional downdrain performs similar to a flume or chute. The pipe must be placed on undisturbed or compacted soil and secured into the slope.

- **Concrete-lined Terrace Drain:** This is a concrete channel for draining water from a terrace on a slope to the next level. These drains are typically specified as permanent structures and, if installed early, can serve as slope drains during construction, which should be designed according to local drainage design criteria.

## Costs

- Cost varies based on pipe selection and selected outlet protection.

| Corrugated Steel Pipes, Per Foot | |
|---|---|
| Size | Supplied and Installed Cost (No Trenching Included) |
| 12” | $19.60 per LF |
| 15” | $22.00 |
| 18” | $26.00 |
| 24” | $32.00 |
| 30” | $50.00 |
| **PVC Pipes, Per Foot** | |
| Size | Supplied and Installed Cost (No Trenching Included) |
| 12” | $24.50 |
| 14” | $49.00 |
| 16” | $51.00 |
| 18” | $54.00 |
| 20” | $66.00 |
| 24” | $93.00 |
| 30” | $130.00 |

## Inspection and Maintenance

- Inspect BMPs prior to forecast rain, daily during extended rain events, after rain events, weekly during the rainy season, and at two-week intervals during the non-rainy season.
- Inspect BMPs subjected to non-stormwater discharges daily while non-stormwater discharges occur.
- Inspect outlet for erosion and downstream scour. If eroded, repair damage and install additional energy dissipation measures. If downstream scour is occurring, it may be necessary to reduce flows being discharged into the channel unless other preventative measures are implemented.
- Insert inlet for clogging or undercutting. Remove debris from inlet to maintain flows. Repair undercutting at inlet and if needed, install flared section or rip rap around the inlet to prevent further undercutting.
- Inspect pipes for leakage. Repair leaks and restore damaged slopes.
- Inspect slope drainage for accumulations of debris and sediment.
- Remove built up sediment from entrances and outlets as required. Flush drains if necessary; capture and settle out sediment from discharge.

- Make sure water is not ponding onto inappropriate areas (e.g., active traffic lanes, material storage areas, etc.).
- Pipe anchors must be checked to ensure that the pipe remains anchored to the slope. Install additional anchors if pipe movement is detected.

## References

Draft – Sedimentation and Erosion Control, An Inventory of Current Practices, U.S.E.P.A., April 1990.

National Association of Home Builders (NAHB). Stormwater Runoff & Nonpoint Source Pollution Control Guide for Builders and Developers. National Association of Home Builders, Washington, D.C., 1995

National Management Measures to Control Nonpoint Source Pollution from Urban Areas, United States Environmental Protection Agency, 2002.

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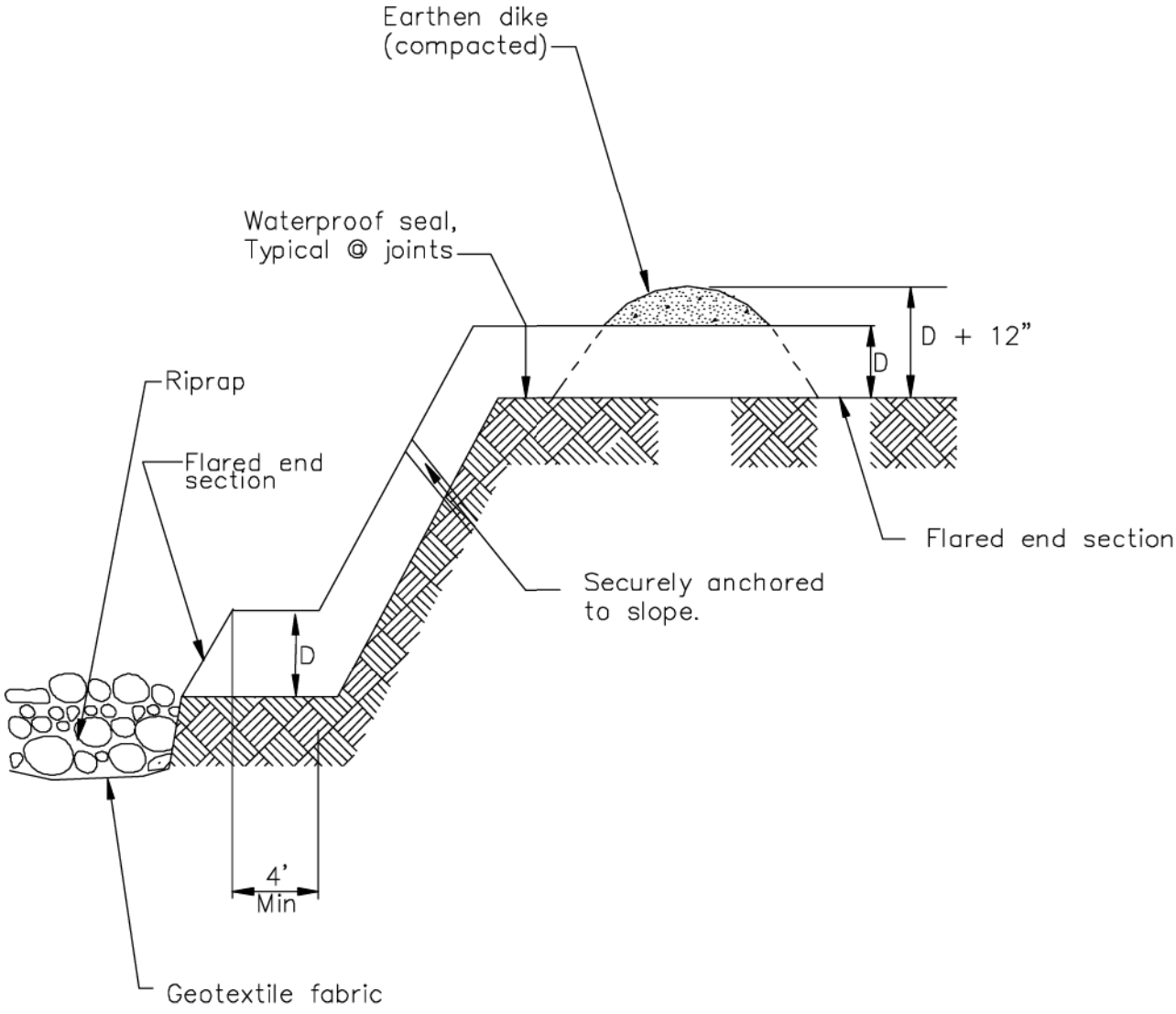



TYPICAL SLOPE DRAIN
NOT TO SCALE

# Streambank Stabilization EC-12

## Objectives

| | | |
|---|---|---|
| EC | Erosion Control | ☑ |
| SE | Sediment Control | ☒ |
| TR | Tracking Control | |
| WE | Wind Erosion Control | |
| NS | Non-Stormwater Management Control | ☒ |
| WM | Waste Management and Materials Pollution Control | |

**Legend:**

☑ **Primary Objective**

☒ **Secondary Objective**

## Targeted Constituents

| | |
|---|---|
| Sediment | ☑ |
| Nutrients | |
| Trash | |
| Metals | |
| Bacteria | |
| Oil and Grease | |
| Organics | |

## Potential Alternatives

Combination of erosion and sediment controls.

## Description and Purpose

Stream channels, streambanks, and associated riparian areas are dynamic and sensitive ecosystems that respond to changes in land use activity. Streambank and channel disturbance resulting from construction activities can increase the stream's sediment load, which can cause channel erosion or sedimentation and have adverse affects on the biotic system. BMPs can reduce the discharge of sediment and other pollutants to minimize the impact of construction activities on watercourses. Streams on the 303(d) list and listed for sediment may require numerous measures to prevent any increases in sediment load to the stream.

## Suitable Applications

These procedures typically apply to all construction projects that disturb or occur within stream channels and their associated riparian areas.

## Limitations

Specific permit requirements or mitigation measures such as Regional Water Quality Control Board (RWQCB) 401 Certification, U.S. Army Corps of Engineers 404 permit and approval by California Department of Fish and Game supercede the guidance in this BMP.

- If numerical based water quality standards are mentioned in any of these and other related permits, testing and sampling may be required. Streams listed as 303(d) impaired for sediment, silt, or turbidity, are required to conduct sampling

to verify that there is no net increase in sediment load due to construction activities.

## Implementation

### *Planning*

- Proper planning, design, and construction techniques can minimize impacts normally associated with in stream construction activities. Poor planning can adversely affect soil, fish, wildlife resources, land uses, or land users. Planning should take into account: scheduling; avoidance of in-stream construction; minimizing disturbance area and construction time period; using pre-disturbed areas; selecting crossing location; and selecting equipment.

*Scheduling*

- Construction activities should be scheduled according to the relative sensitivity of the environmental concerns and in accordance with EC-1, Scheduling. Scheduling considerations will be different when working near perennial streams vs. ephemeral streams and are as follows.

- When in-stream construction is conducted in a perennial stream, work should optimally be performed during the rainy season. This is because in the summer, any sediment-containing water that is discharged into the watercourse will cause a large change in both water clarity and water chemistry. During the rainy season, there is typically more and faster flowing water in the stream so discharges are diluted faster. However, should in-stream work be scheduled for summer, establishing an isolation area, or diverting the stream, will significantly decrease the amount of sediment stirred up by construction work. Construction work near perennial streams should optimally be performed during the dry season (see below).

- When working in or near ephemeral streams, work should be performed during the dry season. By their very nature, ephemeral streams are usually dry in the summer, and therefore, in-stream construction activities will not cause significant water quality problems. However, when tying up the site at the end of the project, wash any fines (see Washing Fines) that accumulated in the channel back into the bed material, to decrease pollution from the first rainstorm of the season.

- When working near ephemeral or perennial streams, erosion and sediment controls (see silt fences, straw bale barriers, etc.) should be implemented to keep sediment out of stream channel.

*Minimize Disturbance*

- Minimize disturbance through: selection of the narrowest crossing location; limiting the number of equipment trips across a stream during construction; and, minimizing the number and size of work areas (equipment staging areas and spoil storage areas). Place work areas at least 50 ft from stream channel. Field reconnaissance should be conducted during the planning stage to identify work areas.

*Use of Pre-Disturbed Areas*

- Locate project sites and work areas in areas disturbed by prior construction or other activity when possible.

*Selection of Project Site*

- Avoid steep and unstable banks, highly erodible or saturated soils, or highly fractured rock.
- Select project site that minimizes disturbance to aquatic species or habitat.

*Equipment Selection*

- Select equipment that reduces the amount of pressure exerted on the ground surface, and therefore, reduces erosion potential and/or use overhead or aerial access for transporting equipment across drainage channels. Use equipment that exerts ground pressures of less than 5 or 6 lb/in$^2$, where possible. Low ground pressure equipment includes: wide or high flotation tires (34 to 72 in. wide); dual tires; bogie axle systems; tracked machines; lightweight equipment; and, central tire inflation systems.

## Streambank Stabilization

### *Preservation of Existing Vegetation*

- Preserve existing vegetation in accordance with EC-2, Preservation of Existing Vegetation. In a streambank environment, preservation of existing vegetation provides the following benefits.

*Water Quality Protection*

- Vegetated buffers on slopes trap sediment and promote groundwater recharge. The buffer width needed to maintain water quality ranges from 15 to 100 ft. On gradual slopes, most of the filtering occurs within the first 30 ft. Steeper slopes require a greater width of vegetative buffer to provide water quality benefits.

*Streambank Stabilization*

- The root system of riparian vegetation stabilizes streambanks by increasing tensile strength in the soil. The presence of vegetation modifies the moisture condition of slopes (infiltration, evapo transpiration, interception) and increases bank stability.

*Riparian Habitat*

- Buffers of diverse riparian vegetation provide food and shelter for riparian and aquatic organisms. Minimizing impacts to fisheries habitat is a major concern when working near streams and rivers. Riparian vegetation provides shade, shelter, organic matter (leaf detritus and large woody debris), and other nutrients that are necessary for fish and other aquatic organisms. Buffer widths for habitat concerns are typically wider than those recommended for water quality concerns (100 to 1500 ft).
- When working near watercourses, it is important to understand the work site's placement in the watershed. Riparian vegetation in headwater streams has a greater impact on overall water quality than vegetation in downstream reaches. Preserving existing vegetation upstream is necessary to maintain water quality, minimize bank failure, and maximize riparian habitat, downstream of the work site.

*Limitations*

- Local county and municipal ordinances regarding width, extent and type of vegetative buffer required may exceed the specifications provided here; these ordinances should be investigated prior to construction.

*Streambank Stabilization Specific Installation*

- As a general rule, the width of a buffer strip between a road and the stream is recommended to be 50 ft plus four times the percent slope of the land, measured between the road and the top of stream bank.

### *Hydraulic Mulch*

- Apply hydraulic mulch on disturbed streambanks above mean high water level in accordance with EC-3, Hydraulic Mulch to provide temporary soil stabilization.

*Limitations*

- Do not place hydraulic mulch or tackifiers below the mean high water level, as these materials could wash into the channel and impact water quality or possibly cause eutrophication (eutrophication is an algal bloom caused by excessively high nutrient levels in the water).

### *Hydroseeding*

- Hydroseed disturbed streambanks in accordance with EC-4, Hydroseeding.

*Limitations*

- Do not place tackifiers or fertilizers below the mean high water level, as these materials could wash into the channel and impact water quality or possibly cause eutrophication.

### *Soil Binders*

- Apply soil binders to disturbed streambanks in accordance with EC-5, Soil Binders.

*Limitations*

- Do not place soil binders below the mean high water level. Soil binder must be environmentally benign and non-toxic to aquatic organisms.

### *Straw Mulch*

- Apply straw mulch to disturbed streambanks in accordance with EC-6, Straw Mulch.

*Limitations*

- Do not place straw mulch below the mean high water level, as this material could wash into the channel and impact water quality or possibly cause eutrophication.

### *Geotextiles and Mats*

- Install geotextiles and mats as described in EC-7, Geotextiles and Mats, to stabilize disturbed channels and streambanks. Not all applications should be in the channel, for example, certain geotextile netting may snag fish gills and are not appropriate in fish bearing streams. Geotextile fabrics that are not biodegradable are not appropriate for in stream use. Additionally, geotextile fabric or blankets placed in channels must be adequate to sustain anticipated hydraulic forces.

### *Earth Dikes, Drainage Swales, and Lined Ditches*

- Convey, intercept, or divert runoff from disturbed streambanks using EC-9, Earth Dikes and Drainage Swales.

*Limitations*

- Do not place earth dikes in watercourses, as these structures are only suited for intercepting sheet flow, and should not be used to intercept concentrated flow.
- Appropriately sized velocity dissipation devices (EC-10) must be placed at outlets to minimize erosion and scour.

***Velocity Dissipation Devices***

- Place velocity dissipation devices at outlets of pipes, drains, culverts, slope drains, diversion ditches, swales, conduits or channels in accordance with EC-10, Velocity Dissipation Devices.

***Slope Drains***

- Use slope drains to intercept and direct surface runoff or groundwater into a stabilized watercourse, trapping device or stabilized area in accordance with EC-11, Slope Drains.

*Limitations*

- Appropriately sized outlet protection and velocity dissipation devices (EC-10) must be placed at outlets to minimize erosion and scour.

## Streambank Sediment Control

***Silt Fences***

- Install silt fences in accordance with SE-1, Silt Fence, to control sediment. Silt fences should only be installed where sediment laden water can pond, thus allowing the sediment to settle out.

***Fiber Rolls***

- Install fiber rolls in accordance with SE-5, Fiber Rolls, along contour of slopes above the high water level to intercept runoff, reduce flow velocity, release the runoff as sheet flow and provide removal of sediment from the runoff. In a stream environment, fiber rolls should be used in conjunction with other sediment control methods such as SE-1, Silt Fence or SE-9 Straw Bale Barrier. Install silt fence, straw bale barrier, or other erosion control method along toe of slope above the high water level.

***Gravel Bag Berm***

- A gravel bag berm or barrier can be utilized to intercept and slow the flow of sediment laden sheet flow runoff in accordance with SE-6, Gravel Bag Berm. In a stream environment gravel bag barriers can allow sediment to settle from runoff before water leaves the construction site and can be used to isolate the work area from the live stream.

*Limitations*

- Gravel bag barriers are not recommended as a perimeter sediment control practice around streams.

***Straw Bale Barrier***

- Install straw bale barriers in accordance with SE-9, Straw Bale Barrier, to control sediment. Straw bale barriers should only be installed where sediment laden water can pond, thus allowing the sediment to settle out. Install a silt fence in accordance with SE-1, Silt Fence,

on down slope side of straw bale barrier closest to stream channel to provide added sediment control.

***Rock Filter***

*Description and Purpose*

Rock filters are temporary erosion control barriers composed of rock that is anchored in place. Rock filters detain the sediment laden runoff, retain the sediment, and release the water as sheet flow at a reduced velocity. Typical rock filter installations are illustrated at the end of this BMP.

*Applications*

- Near the toe of slopes that may be subject to flow and rill erosion.

*Limitations*

- Inappropriate for contributing drainage areas greater than 5 acres.
- Requires sufficient space for ponded water.
- Ineffective for diverting runoff because filters allow water to slowly seep through.
- Rock filter berms are difficult to remove when construction is complete.
- Unsuitable in developed areas or locations where aesthetics is a concern.

*Specifications*

- Rock: open graded rock, 0.75 to 5 in. for concentrated flow applications.
- Woven wire sheathing: 1 in. diameter, hexagonal mesh, galvanized 20gauge (used with rock filters in areas of concentrated flow).
- In construction traffic areas, maximum rock berm heights should be 12 in. Berms should be constructed every 300 ft on slopes less than 5%, every 200 ft on slopes between 5% and 10%, and every 100 ft on slopes greater than 10%.

*Maintenance*

- Inspect and verify that activity-based BMPs are in place prior to the commencement of associated activities. While activities associated with the BMP are under way, inspect weekly during the rainy season and at two-week intervals in the non-rainy season to verify continued BMP implementation.
- Inspect BMPs subject to non-stormwater discharges daily while non-stormwater discharges occur.
- Reshape berms as needed and replace lost or dislodged rock, and filter fabric.
- Sediment that accumulates in the BMP must be periodically removed in order to maintain BMP effectiveness. Sediment should be removed when the sediment accumulation reaches one third of the barrier height. Sediment removed during maintenance may be incorporated into earthwork on the site or disposed at an appropriate location.

### *K-rail*

*Description and Purpose*

This is temporary sediment control that uses K-rails to form the sediment deposition area, or to isolate the near bank construction area. Install K-rails at toe of slope in accordance with procedures described in NS-5, Clear Water Diversion.

Barriers are placed end to end in a pre-designed configuration and gravel filled bags are used at the toe of the barrier and at their abutting ends to seal and prevent movement of sediment beneath or through the barrier walls.

*Appropriate Applications*

- This technique is useful at the toe of embankments, cuts or fills slopes.

*Limitations*

- The K-rail method should not be used to dewater a project site, as the barrier is not watertight.

*Implementation*

- Refer to NS-5, Clear Water Diversion, for implementation requirements.

## Instream Construction Sediment Control

There are three different options currently available for reducing turbidity while working in a stream or river. The stream can be isolated from the area in which work is occurring by means of a water barrier, the stream can be diverted around the work site through a pipe or temporary channel, or one can employ construction practices that minimize sediment suspension.

Whatever technique is implemented, an important thing to remember is that dilution can sometimes be the solution. A probable "worst time" to release high TSS into a stream system might be when the stream is very low; summer low flow, for example. During these times, the flow may be low while the biological activity in the stream is very high. Conversely, the addition of high TSS or sediment during a big storm discharge might have a relatively low impact, because the stream is already turbid, and the stream energy is capable of transporting both suspended solids, and large quantities of bedload through the system. The optimum time to "pull" in-stream structures may be during the rising limb of a storm hydrograph.

### *Techniques to minimize Total Suspended Solids (TSS)*

- **Padding** - Padding laid in the stream below the work site may trap some solids that are deposited in the stream during construction. After work is done, the padding is removed from the stream, and placed on the bank to assist in re-vegetation.

- **Clean, washed gravel** - Using clean, washed gravel decreases solid suspension, as there are fewer small particles deposited in the stream.

- **Excavation using a large bucket** - Each time a bucket of soil is placed in the stream, a portion is suspended. Approximately the same amount is suspended whether a small amount of soil is placed in the stream, or a large amount. Therefore, using a large excavator bucket instead of a small one, will reduce the total amount of soil that washes downstream.

- **Use of dozer for backfilling -** Using a dozer for backfilling instead of a backhoe follows the same principles – the fewer times soil is deposited in the stream, the less soil will be suspended.

- **Partial dewatering with a pump** - Partially dewatering a stream with a pump reduces the amount of water, and thus the amount of water that can suspend sediment.

***Washing Fines***

*Definition and Purpose*

- Washing fines is an "in-channel" sediment control method, which uses water, either from a water truck or hydrant, to wash stream fines that were brought to the surface of the channel bed during restoration, back into the interstitial spaces of the gravel and cobbles.

- The purpose of this technique is to reduce or eliminate the discharge of sediment from the channel bottom during the first seasonal flow. Sediment should not be allowed into stream channels; however, occasionally in-channel restoration work will involve moving or otherwise disturbing fines (sand and silt sized particles) that are already in the stream, usually below bankfull discharge elevation. Subsequent re-watering of the channel can result in a plume of turbidity and sedimentation.

- This technique washes the fines back into the channel bed. Bedload materials, including gravel cobbles, boulders and those fines, are naturally mobilized during higher storm flows. This technique is intended to delay the discharge until the fines would naturally be mobilized.

*Appropriate Applications*

- This technique should be used when construction work is required in channels. It is especially useful in intermittent or ephemeral streams in which work is performed "in the dry", and which subsequently become re-watered.

*Limitations*

- The stream must have sufficient gravel and cobble substrate composition.

- The use of this technique requires consideration of time of year and timing of expected stream flows.

- The optimum time for the use of this technique is in the fall, prior to winter flows.

- Consultation with, and approval from the Department of Fish and Game and the Regional Water Quality Control Board may be required.

*Implementation*

- Apply sufficient water to wash fines, but not cause further erosion or runoff.

- Apply water slowly and evenly to prevent runoff and erosion.

- Consult with Department of Fish and Game and the Regional Water Quality Control Board for specific water quality requirements of applied water (e.g. chlorine).

*Inspection and Maintenance*

- None necessary

## Costs

Cost may vary according to the combination of practices implemented.

## Inspection and Maintenance

- Inspect and verify that activity-based BMPs are in place prior to the commencement of associated activities. While activities associated with the BMP are under way, inspect weekly during the rainy season and at two-week intervals in the non-rainy season to verify continued BMP implementation.
- Inspect BMPs subject to non-stormwater discharges daily while non-stormwater discharges occur.
- Inspect and repair equipment (for damaged hoses, fittings, and gaskets).

## References

Manual of Standards of Erosion and Sediment Control Measures, Association of Bay Area Governments, May 1995.

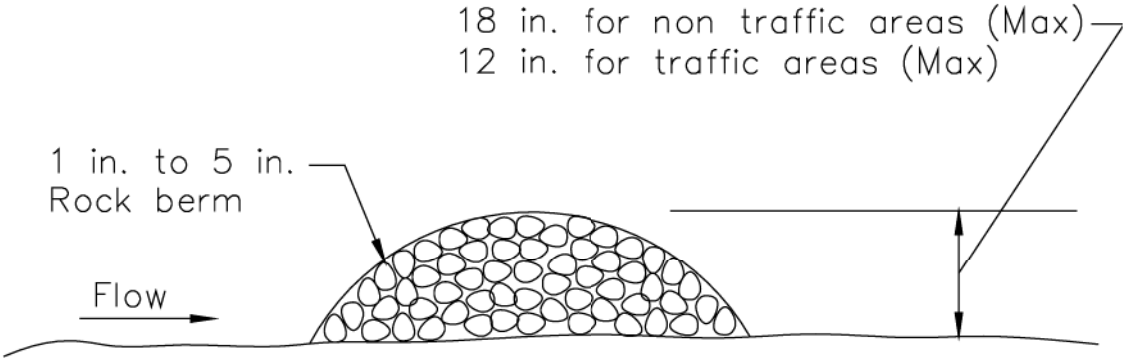
Proposed Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters, Work Group Working Paper, USEPA, April 1992.

Sedimentation and Erosion Control Practices, An Inventory of Current Practices (Draft), UESPA, 1990.

Stormwater Quality Handbooks Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

Stormwater Management for Construction Activities, Developing Pollution Prevention Plans and Best Management Practices, EPA 832-R-92005; USEPA, April 1992.

Water Quality Management Plan for the Lake Tahoe Region, Volume II, Handbook of Management Practices, Tahoe Regional Planning Agency, November 1988.

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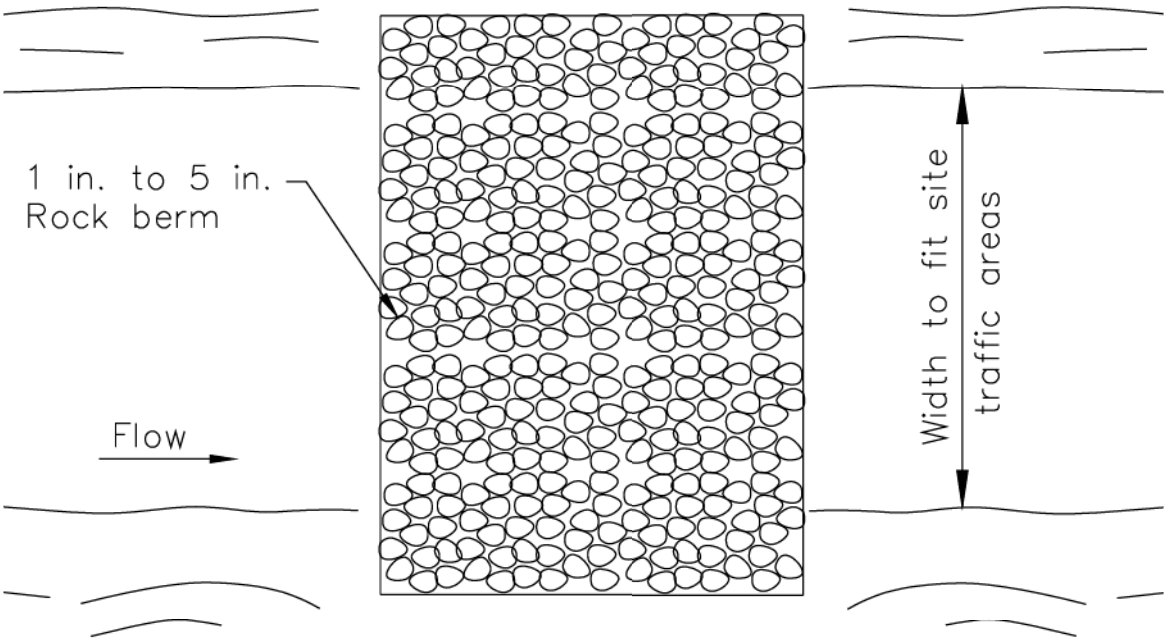
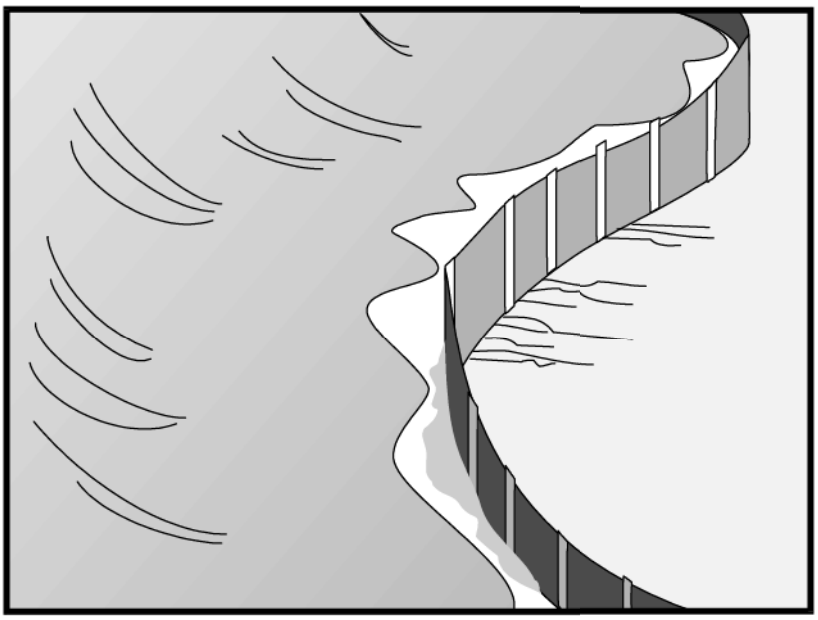



PLAN

TYPICAL ROCK FILTER
NOT TO SCALE

# Silt Fence SE-1



## Objectives

| | | |
|---|---|---|
| EC | Erosion Control | ☑ |
| SE | Sediment Control | |
| TR | Tracking Control | |
| WE | Wind Erosion Control | |
| NS | Non-Stormwater Management Control | |
| WM | Waste Management and Materials Pollution Control | |

**Legend:**

☑ **Primary Objective**

☒ **Secondary Objective**

## Targeted Constituents

| | |
|---|---|
| Sediment | ☑ |
| Nutrients | |
| Trash | |
| Metals | |
| Bacteria | |
| Oil and Grease | |
| Organics | |

## Potential Alternatives

SE-5 Fiber Rolls

SE-6 Gravel Bag Berm

SE-8 Sandbag Barrier

SE-9 Straw Bale Barrier

## Description and Purpose

A silt fence is made of a filter fabric that has been entrenched, attached to supporting poles, and sometimes backed by a plastic or wire mesh for support. The silt fence detains sediment-laden water, promoting sedimentation behind the fence.

## Suitable Applications

Silt fences are suitable for perimeter control, placed below areas where sheet flows discharge from the site. They should also be used as interior controls below disturbed areas where runoff may occur in the form of sheet and rill erosion. Silt fences are generally ineffective in locations where the flow is concentrated and are only applicable for sheet or overland flows. Silt fences are most effective when used in combination with erosion controls. Suitable applications include:

- Along the perimeter of a project.
- Below the toe or down slope of exposed and erodible slopes.
- Along streams and channels.
- Around temporary spoil areas and stockpiles.
- Below other small cleared areas.

## Limitations

- Do not use in streams, channels, drain inlets, or anywhere flow is concentrated.

- Do not use in locations where ponded water may cause flooding.
- Do not place fence on a slope, or across any contour line. If not installed at the same elevation throughout, silt fences will create erosion.
- Filter fences will create a temporary sedimentation pond on the upstream side of the fence and may cause temporary flooding. Fences not constructed on a level contour will be overtopped by concentrated flow resulting in failure of the filter fence.
- Improperly installed fences are subject to failure from undercutting, overlapping, or collapsing.
  - Not effective unless trenched and keyed in.
  - Not intended for use as mid-slope protection on slopes greater than 4:1 (H:V).
  - Do not allow water depth to exceed 1.5 ft at any point.

## Implementation

### *General*

A silt fence is a temporary sediment barrier consisting of filter fabric stretched across and attached to supporting posts, entrenched, and, depending upon the strength of fabric used, supported with plastic or wire mesh fence. Silt fences trap sediment by intercepting and detaining small amounts of sediment-laden runoff from disturbed areas in order to promote sedimentation behind the fence.

Silt fences are preferable to straw bale barriers in many cases. Laboratory work at the Virginia Highway and Transportation Research Council has shown that silt fences can trap a much higher percentage of suspended sediments than can straw bales. While the failure rate of silt fences is lower than that of straw bale barriers, there are many instances where silt fences have been improperly installed. The following layout and installation guidance can improve performance and should be followed:

- Use principally in areas where sheet flow occurs.
- Don't use in streams, channels, or anywhere flow is concentrated. Don’t use silt fences to divert flow.
- Don't use below slopes subject to creep, slumping, or landslides.
- Select filter fabric that retains 85% of soil by weight, based on sieve analysis, but that is not finer than an equivalent opening size of 70.
- Install along a level contour, so water does not pond more than 1.5 ft at any point along the silt fence.
- The maximum length of slope draining to any point along the silt fence should be 200 ft or less.
- The maximum slope perpendicular to the fence line should be 1:1.

- Provide sufficient room for runoff to pond behind the fence and to allow sediment removal equipment to pass between the silt fence and toes of slopes or other obstructions. About 1200 $ft^2$ of ponding area should be provided for every acre draining to the fence.
- Turn the ends of the filter fence uphill to prevent stormwater from flowing around the fence.
- Leave an undisturbed or stabilized area immediately down slope from the fence where feasible.
- Silt fences should remain in place until the disturbed area is permanently stabilized.

***Design and Layout***

Selection of a filter fabric is based on soil conditions at the construction site (which affect the equivalent opening size (EOS) fabric specification) and characteristics of the support fence (which affect the choice of tensile strength). The designer should specify a filter fabric that retains the soil found on the construction site yet that it has openings large enough to permit drainage and prevent clogging. The following criteria is recommended for selection of the equivalent opening size:

1. If 50 percent or less of the soil, by weight, will pass the U.S. Standard Sieve No. 200, select the EOS to retain 85 % of the soil. The EOS should not be finer than EOS 70.
2. For all other soil types, the EOS should be no larger than the openings in the U.S. Standard Sieve No. 70 except where direct discharge to a stream, lake, or wetland will occur, then the EOS should be no larger than Standard Sieve No. 100.

To reduce the chance of clogging, it is preferable to specify a fabric with openings as large as allowed by the criteria. No fabric should be specified with an EOS smaller than U.S. Standard Sieve No. 100. If 85% or more of a soil, by weight, passes through the openings in a No. 200 sieve, filter fabric should not be used. Most of the particles in such a soil would not be retained if the EOS was too large and they would clog the fabric quickly if the EOS were small enough to capture the soil.

The fence should be supported by a plastic or wire mesh if the fabric selected does not have sufficient strength and bursting strength characteristics for the planned application (as recommended by the fabric manufacturer). Filter fabric material should contain ultraviolet inhibitors and stabilizers to provide a minimum of six months of expected usable construction life at a temperature range of 0 °F to 120 °F.

- Layout in accordance with attached figures.
- For slopes steeper than 2:1 (H:V) and that contain a high number of rocks or large dirt clods that tend to dislodge, it may be necessary to install additional protection immediately adjacent to the bottom of the slope, prior to installing silt fence. Additional protection may be a chain link fence or a cable fence.
- For slopes adjacent to sensitive receiving waters or Environmentally Sensitive Areas (ESAs), silt fence should be used in conjunction with erosion control BMPs.

### *Materials*

- Silt fence fabric should be woven polypropylene with a minimum width of 36 in. and a minimum tensile strength of 100 lb force. The fabric should conform to the requirements in ASTM designation D4632 and should have an integral reinforcement layer. The reinforcement layer should be a polypropylene, or equivalent, net provided by the manufacturer. The permittivity of the fabric should be between 0.1 $sec^{-1}$ and 0.15 $sec^{-1}$ in conformance with the requirements in ASTM designation D4491.

- Wood stakes should be commercial quality lumber of the size and shape shown on the plans. Each stake should be free from decay, splits or cracks longer than the thickness of the stake or other defects that would weaken the stakes and cause the stakes to be structurally unsuitable.

- Staples used to fasten the fence fabric to the stakes should be not less than 1.75 in. long and should be fabricated from 15 gauge or heavier wire. The wire used to fasten the tops of the stakes together when joining two sections of fence should be 9 gauge or heavier wire. Galvanizing of the fastening wire will not be required.

- There are new products that may use prefabricated plastic holders for the silt fence and use bar reinforcement instead of wood stakes. If bar reinforcement is used in lieu of wood stakes, use number four or greater bar. Provide end protection for any exposed bar reinforcement.

### *Installation Guidelines*

Silt fences are to be constructed on a level contour. Sufficient area should exist behind the fence for ponding to occur without flooding or overtopping the fence.

- A trench should be excavated approximately 6 in. wide and 6 in. deep along the line the proposed silt fence.

- Bottom of the silt fence should be keyed-in a minimum of 12 in.

- Posts should be spaced a maximum of 6 ft apart and driven securely into the ground a minimum of 18 in. or 12 in. below the bottom of the trench.

- When standard strength filter fabric is used, a plastic or wire mesh support fence should be fastened securely to the upslope side of posts using heavy–duty wire staples at least 1 in. long. The mesh should extend into the trench. When extra-strength filter fabric and closer post spacing are used, the mesh support fence may be eliminated. Filter fabric should be purchased in a long roll, then cut to the length of the barrier. When joints are necessary, filter cloth should be spliced together only at a support post, with a minimum 6 in. overlap and both ends securely fastened to the post.

- The trench should be backfilled with compacted native material.

- Construct silt fences with a setback of at least 3 ft from the toe of a slope. Where a silt fence is determined to be not practicable due to specific site conditions, the silt fence may be constructed at the toe of the slope, but should be constructed as far from the toe of the slope as practicable. Silt fences close to the toe of the slope will be less effective and difficult to maintain.

- Construct the length of each reach so that the change in base elevation along the reach does not exceed 1/3 the height of the barrier; in no case should the reach exceed 500 ft.

### Costs

- Average annual cost for installation and maintenance (assumes 6 month useful life): $7 per lineal foot ($850 per drainage acre). Range of cost is $3.50 - $9.10 per lineal foot.

### Inspection and Maintenance

- Inspect BMPs prior to forecast rain, daily during extended rain events, after rain events, weekly during the rainy season, and at two-week intervals during the non-rainy season.
- Repair undercut silt fences.
- Repair or replace split, torn, slumping, or weathered fabric. The lifespan of silt fence fabric is generally 5 to 8 months.
- Silt fences that are damaged and become unsuitable for the intended purpose should be removed from the site of work, disposed of, and replaced with new silt fence barriers.
- Sediment that accumulates in the BMP must be periodically removed in order to maintain BMP effectiveness. Sediment should be removed when the sediment accumulation reaches one-third of the barrier height. Sediment removed during maintenance may be incorporated into earthwork on the site or disposed at an appropriate location.
- Silt fences should be left in place until the upstream area is permanently stabilized. Until then, the silt fence must be inspected and maintained.
- Holes, depressions, or other ground disturbance caused by the removal of the silt fences should be backfilled and repaired.

### References

Manual of Standards of Erosion and Sediment Control Measures, Association of Bay Area Governments, May 1995.

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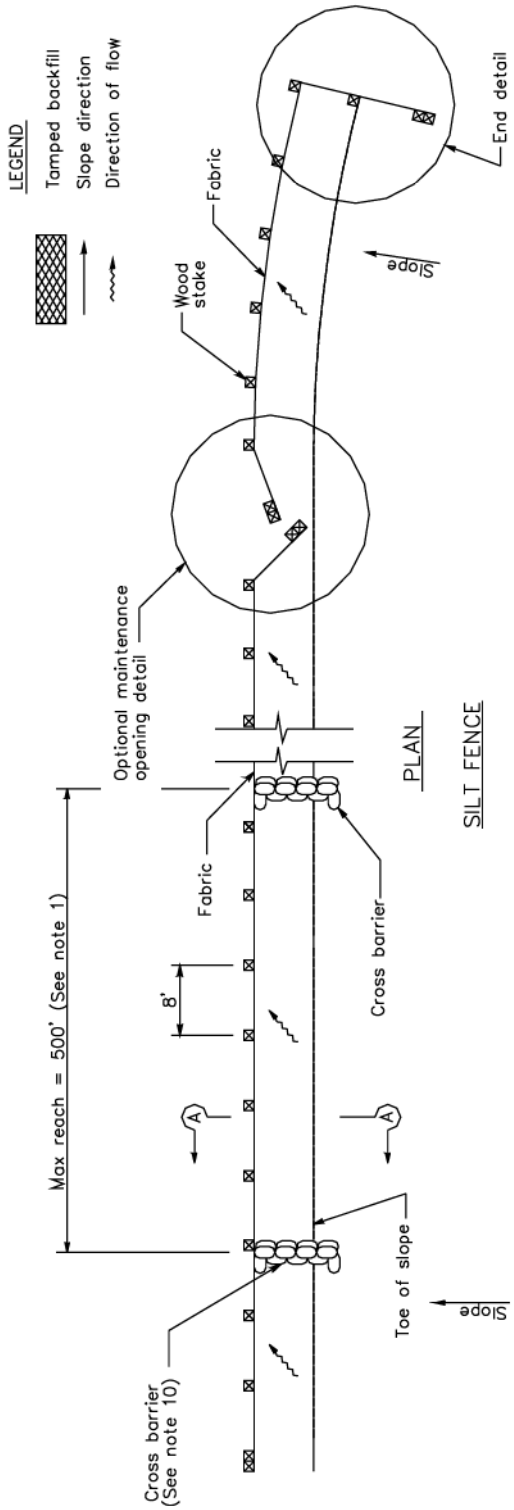
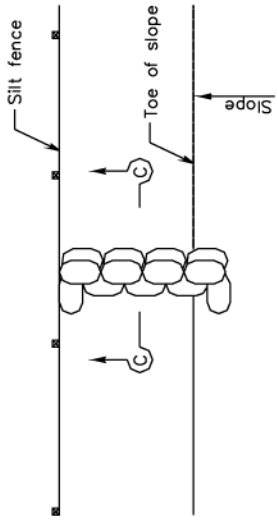
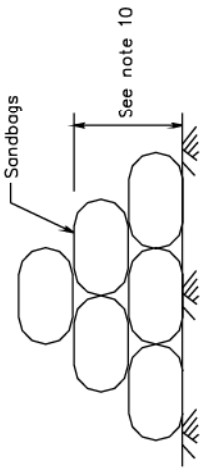
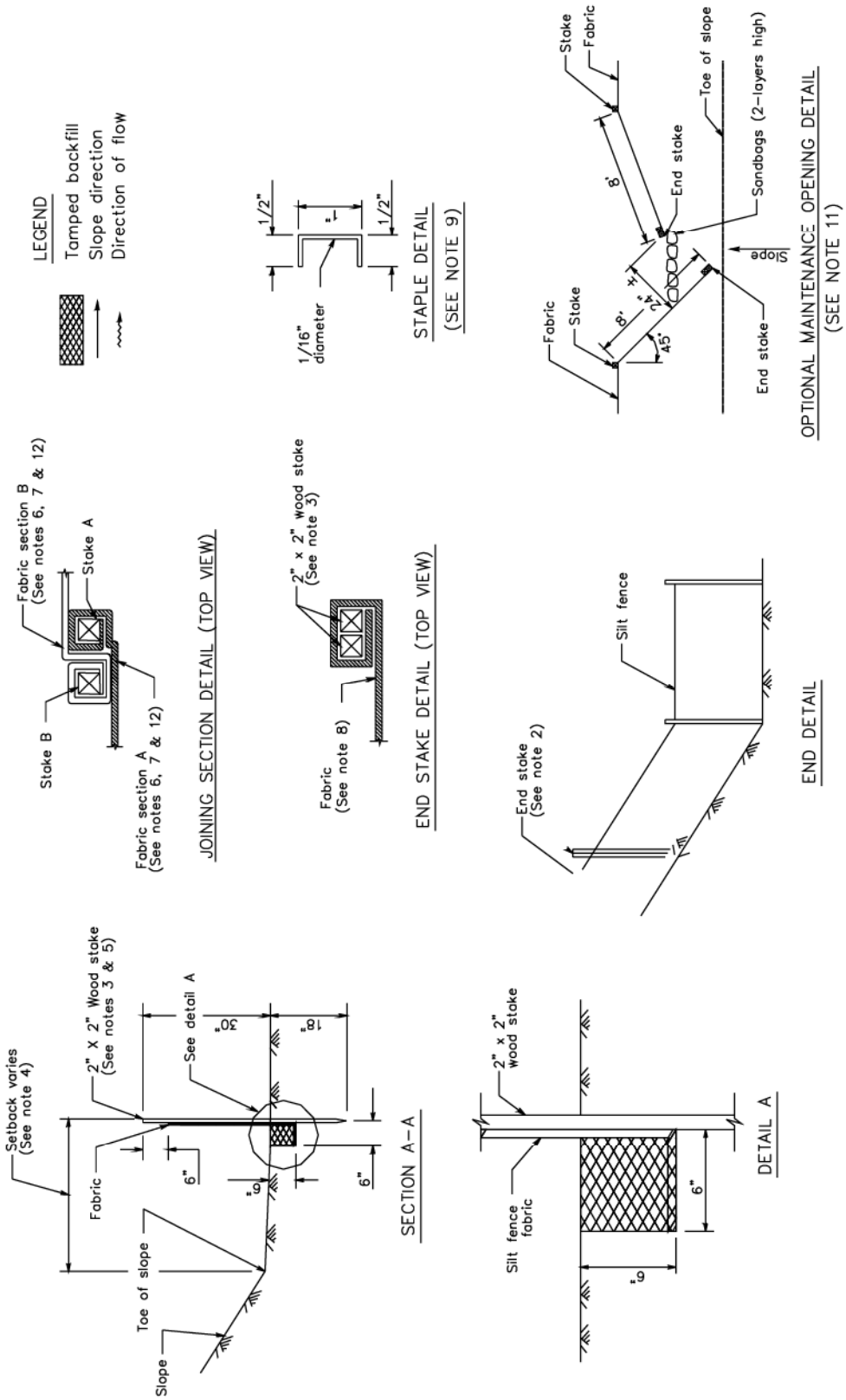


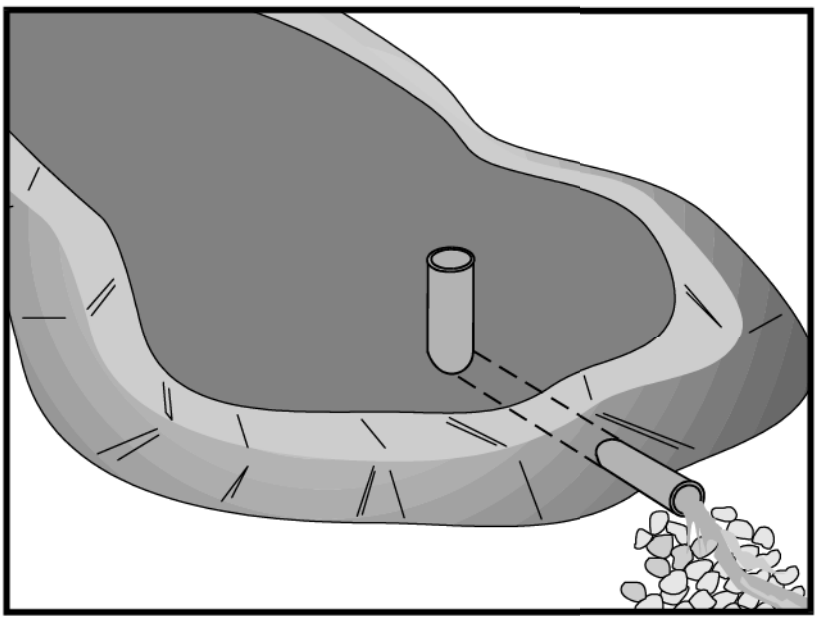




NOTES

1. Construct the length of each reach so that the change in base elevation along the reach does not exceed 1/3 the height of the linear barrier, in no case shall the reach length exceed 500'.
2. The last 8'–0" of fence shall be turned up slope.
3. Stake dimensions are nominal.
4. Dimension may vary to fit field condition.
5. Stakes shall be spaced at 8'–0" maximum and shall be positioned on downstream side of fence.
6. Stakes to overlap and fence fabric to fold around each stake one full turn. Secure fabric to stake with 4 staples.
7. Stakes shall be driven tightly together to prevent potential flow–through of sediment at joint. The tops of the stakes shall be secured with wire.
8. For end stake, fence fabric shall be folded around two stakes one full turn and secured with 4 staples.
9. Minimum 4 staples per stake. Dimensions shown are typical.
10. Cross barriers shall be a minimum of 1/3 and a maximum of 1/2 the height of the linear barrier.
11. Maintenance openings shall be constructed in a manner to ensure sediment remains behind silt fence.
12. Joining sections shall not be placed at sump locations.
13. Sandbag rows and layers shall be offset to eliminate gaps.


LEGEND
Tamped backfill
Slope direction
Direction of flow
Fabric section B (See notes 6, 7 & 12)
Stake A
Stake B
Fabric section A (See notes 6, 7 & 12)
JOINING SECTION DETAIL (TOP VIEW)
1/2"
1"
1/2"
1/16" diameter
STAPLE DETAIL
(SEE NOTE 9)
2" x 2" wood stake (See note 3)
Fabric (See note 8)
END STAKE DETAIL (TOP VIEW)
Stake
Fabric
Toe of slope
End stake
Sandbags (2-layers high)
8'
4'
2'
8'
45°
Slope
Fabric
Stake
End stake
OPTIONAL MAINTENANCE OPENING DETAIL
(SEE NOTE 11)
Silt fence
End stake (See note 2)
END DETAIL
Setback varies (See note 4)
2" X 2" Wood stake (See notes 3 & 5)
See detail A
30"
10"
Fabric
6"
6"
6"
Toe of slope
Slope
SECTION A–A
2" x 2" wood stake
Silt fence fabric
6"
6"
DETAIL A

# Sediment Basin SE-2



## Objectives

| | | |
|---|---|---|
| EC | Erosion Control | |
| SE | Sediment Control | ☑ |
| TR | Tracking Control | |
| WE | Wind Erosion Control | |
| NS | Non-Stormwater Management Control | |
| WM | Waste Management and Materials Pollution Control | |

**Legend:**

☑ **Primary Objective**

☒ **Secondary Objective**

## Targeted Constituents

| | |
|---|---|
| Sediment | ☑ |
| Nutrients | |
| Trash | ☑ |
| Metals | |
| Bacteria | |
| Oil and Grease | |
| Organics | |

## Potential Alternatives

SE-3 Sediment Trap (for smaller areas)

## Description and Purpose

A sediment basin is a temporary basin formed by excavation or by constructing an embankment so that sediment-laden runoff is temporarily detained under quiescent conditions, allowing sediment to settle out before the runoff is discharged.

## Suitable Applications

Sediment basins may be suitable for use on larger projects with sufficient space for constructing the basin. Sediment basins should be considered for use:

- Where sediment-laden water may enter the drainage system or watercourses
- On construction projects with disturbed areas during the rainy season
- At the outlet of disturbed watersheds between 5 acres and 75 acres
- At the outlet of large disturbed watersheds, as necessary
- Where post construction detention basins are required
- In association with dikes, temporary channels, and pipes used to convey runoff from disturbed areas

## Limitations

Sediment basins must be installed only within the property limits and where failure of the structure will not result in loss of life, damage to homes or buildings, or interruption of use or service of

public roads or utilities. In addition, sediment basins are attractive to children and can be very dangerous. Local ordinances regarding health and safety must be adhered to. If fencing of the basin is required, the type of fence and its location should be shown in the SWPPP and in the construction specifications.

- Generally, sediment basins are limited to drainage areas of 5 acres or more, but not appropriate for drainage areas greater than 75 acres.
- Sediment basins may become an "attractive nuisance" and care must be taken to adhere to all safety practices. If safety is a concern, basin may require protective fencing.
- Sediment basins designed according to this handbook are only practically effective in removing sediment down to about the medium silt size fraction. Sediment-laden runoff with smaller size fractions (fine silt and clay) may not be adequately treated unless chemical treatment is used in addition to the sediment basin.
- Sites with very fine sediments (fine silt and clay) may require longer detention times for effective sediment removal.
- Basins with a height of 25 ft or more or an impounding capacity of 50 ac-ft or more must obtain approval from Division of Safety of Dams.
- Standing water may cause mosquitoes or other pests to breed.
- Basins require large surface areas to permit settling of sediment. Size may be limited by the available area.

## Implementation

### *General*

A sediment basin is a controlled stormwater release structure formed by excavation or by construction of an embankment of compacted soil across a drainage way, or other suitable location. It is intended to trap sediment before it leaves the construction site. The basin is a temporary measure with a design life of 12 to 28 months in most cases and is to be maintained until the site area is permanently protected against erosion or a permanent detention basin is constructed.

Sediment basins are suitable for nearly all types of construction projects. Whenever possible, construct the sediment basins before clearing and grading work begins. Basins should be located at the stormwater outlet from the site but not in any natural or undisturbed stream. A typical application would include temporary dikes, pipes, and/or channels to divert runoff to the basin inlet.

Many development projects in California will be required by local ordinances to provide a stormwater detention basin for post-construction flood control, desilting, or stormwater pollution control. A temporary sediment basin may be constructed by rough grading the post-construction control basins early in the project.

Sediment basins trap 70-80 % of the sediment that flows into them if designed according to this handbook. Therefore, they should be used in conjunction with erosion control practices such as

temporary seeding, mulching, diversion dikes, etc., to reduce the amount of sediment flowing into the basin.

***Planning***

To improve the effectiveness of the basin, it should be located to intercept runoff from the largest possible amount of disturbed area. The best locations are generally low areas. Drainage into the basin can be improved by the use of earth dikes and drainage swales (see BMP EC-9). The basin must not be located in a stream but it should be located to trap sediment-laden runoff before it enters the stream. The basin should not be located where its failure would result in the loss of life or interruption of the use or service of public utilities or roads.

- Construct before clearing and grading work begins when feasible.
- Do not locate in a stream.
- Basin sites should be located where failure of the structure will not cause loss of life, damage to homes or buildings, or interruption of use or service of public roads or utilities.
- Large basins are subject to state and local dam safety requirements.
- Limit the contributing area to the sediment basin to only the runoff from the disturbed soil areas. Use temporary concentrated flow conveyance controls to divert runoff from undisturbed areas away from the sediment basin.
- The basin should be located: (1) by excavating a suitable area or where a low embankment can be constructed across a swale, (2) where post-construction (permanent) detention basins will be constructed, and (3) where the basins can be maintained on a year-round basis to provide access for maintenance, including sediment removal and sediment stockpiling in a protected area, and to maintain the basin to provide the required capacity.

***Design***

Sediment basins must be designed in accordance with Section A of the State of California NPDES General Permit for Stormwater Discharges Associated with Construction Activities (General Permit) where sediment basins are the only control measure proposed for the site. If there is insufficient area to construct a sediment basin in accordance with the General Permit requirements, then the alternate design standards specified herein may be used.

Sediment basins designed per the General Permit shall be designed as follows:

*Option 1:*

Pursuant to local ordinance for sediment basin design and maintenance, provided that the design efficiency is as protective or more protective of water quality than Option 3.

OR

*Option 2:*

Sediment basin(s), as measured from the bottom of the basin to the principal outlet, shall have at least a capacity equivalent to 3,600 cubic feet (133 $yd^3$) of storage per acre draining into the sediment basin. The length of the basin shall be more than twice the width of the basin. The

length is determined by measuring the distance between the inlet and the outlet; and the depth must not be less than 3 ft nor greater than 5 ft for safety reasons and for maximum efficiency.

OR

*Option 3:*
Sediment basin(s) shall be designed using the standard equation:

$$As=1.2Q/Vs \qquad \text{(Eq. 1)}$$

Where:

As = Minimum surface area for trapping soil particles of a certain size

Vs = Settling velocity of the design particle size chosen

Q = C I A

Where

Q = Discharge rate measured in cubic feet per second

C = Runoff coefficient

I = Precipitation intensity for the 10-year, 6-hour rain event

A = Area draining into the sediment basin in acres

The design particle size shall be the smallest soil grain size determined by wet sieve analysis, or the fine silt sized (0.01 mm [or 0.0004 in.]) particle, and the *Vs* used shall be 100 percent of the calculated settling velocity.

The length is determined by measuring the distance between the inlet and the outlet; the length shall be more than twice the dimension as the width; the depth shall not be less than 3 ft nor greater than 5 ft for safety reasons and for maximum efficiency (2 ft of sediment storage, 2 ft of capacity). The basin(s) shall be located on the site where it can be maintained on a year-round basis and shall be maintained on a schedule to retain the 2 ft of capacity.

OR

*Option 4:*
The use of an equivalent surface area design or equation, provided that the design efficiency is as protective or more protective of water quality than Option 3.

Other design considerations are:

- The volume of the settling zone should be sized to capture runoff from a 2-year storm or other appropriate design storms specified by the local agency. A detention time of 24 to 40 hours should allow 70 to 80 % of sediment to settle.
- The basin volume consists of two zones:
  - A sediment storage zone at least 1 ft deep.
  - A settling zone at least 2 ft deep.
- The length to settling depth ratio (L/SD) should be less than 200.
- Sediment basins are best used in conjunction with erosion controls. Sediment basins that will be used as the only means of treatment, without upstream erosion and sediment controls, must be designed according to the four options required by the General Permit (see Options 1-4 above). Sediment basins that are used in conjunction with upstream erosion and sediment controls should be designed to have a capacity equivalent to 67 $yd^3$ of sediment storage per acre of contributory area.
- The length of the basin should be more than twice the width of the basin; the length should be determined by measuring the distance between the inlet and the outlet.
- The depth must be no less than 3 ft.
- Basins with an impounding levee greater than 4.5 ft tall, measured from the lowest point to the impounding area to the highest point of the levee, and basins capable of impounding more than 35,000 $ft^3$, should be designed by a Registered Civil Engineer. The design should include maintenance requirements, including sediment and vegetation removal, to ensure continuous function of the basin outlet and bypass structures.
- Basins should be designed to drain within 72 hours following storm events. If a basin fails to drain within 72 hours, it must be pumped dry.
- Sediment basins, regardless of size and storage volume, should include features to accommodate overflow or bypass flows that exceed the design storm event.
  - Include an emergency spillway to accommodate flows not carried by the principal spillway. The spillway should consist of an open channel (earthen or vegetated) over undisturbed material (not fill) or constructed of a non-erodible riprap.
  - The spillway control section, which is a level portion of the spillway channel at the highest elevation in the channel, should be a minimum of 20 ft in length.
- Rock or vegetation should be used to protect the basin inlet and slopes against erosion.
- A forebay, constructed upstream of the basin may be provided to remove debris and larger particles.

- The outflow from the sediment basin should be provided with velocity dissipation devices (see BMP EC-10) to prevent erosion and scouring of the embankment and channel.
- Basin inlets should be located to maximize travel distance to the basin outlet.
- The principal outlet should consist of a corrugated metal, high density polyethylene (HDPE), or reinforced concrete riser pipe with dewatering holes and an anti-vortex device and trash rack attached to the top of the riser, to prevent floating debris from flowing out of the basin or obstructing the system. This principal structure should be designed to accommodate the inflow design storm.
- A rock pile or rock-filled gabions can serve as alternatives to the debris screen; although the designer should be aware of the potential for extra maintenance involved should the pore spaces in the rock pile clog.
- The outlet structure should be placed on a firm, smooth foundation with the base securely anchored with concrete or other means to prevent floatation.
- Attach riser pipe (watertight connection) to a horizontal pipe (barrel). Provide anti-seep collars on the barrel.
- Cleanout level should be clearly marked on the riser pipe.
- Proper hydraulic design of the outlet is critical to achieving the desired performance of the basin. The outlet should be designed to drain the basin within 24 to 72 hours (also referred to as "drawdown time"). The 24-hour limit is specified to provide adequate settling time; the 72-hour limit is specified to mitigate vector control concerns.
- The two most common outlet problems that occur are: (1) the capacity of the outlet is too great resulting in only partial filling of the basin and drawdown time less than designed for; and (2) the outlet clogs because it is not adequately protected against trash and debris. To avoid these problems, the following outlet types are recommended for use: (1) a single orifice outlet with or without the protection of a riser pipe, and (2) perforated riser. Design guidance for single orifice and perforated riser outlets follow:
  - *Flow Control Using a Single Orifice At The Bottom Of The Basin (Figure 1)*: The outlet control orifice should be sized using the following equation:

$$a = \frac{2A(H - Ho)^{0.5}}{3600CT(2g)^{0.5}} = \frac{(7x10^{-5})A(H - Ho)^{0.5}}{CT} \qquad \text{(Eq. 2)}$$

where:

a = area of orifice ($ft^2$)

A = surface area of the basin at mid elevation ($ft^2$)

C = orifice coefficient

T = drawdown time of full basin (hrs)

g = gravity (32.2 ft/s²)

H = elevation when the basin is full (ft)

Ho = final elevation when basin is empty (ft)

With a drawdown time of 40 hours, the equation becomes:

$$a = \frac{(1.75x10^{-6})A(H - Ho)^{0.5}}{C} \qquad \text{(Eq. 3)}$$

- *Flow Control Using Multiple Orifices (see Figure2):*

$$a_t = \frac{2A(h_{\max})}{3600CT(2g[h_{\max} - h_{centroid\ of\ orifices}])^{0.5}} \qquad \text{(Eq. 4)}$$

With terms as described above except:

$a_t$ = total area of orifices

$h_{max}$ = maximum height from lowest orifice to the maximum water surface (ft)

$h_{centroid\ of\ orifices}$ = height from the lowest orifice to the centroid of the orifice configuration (ft)

Allocate the orifices evenly on two rows; separate the holes by 3x hole diameter vertically, and by 120 degrees horizontally (refer to Figure 2).

Because basins are not maintained for infiltration, water loss by infiltration should be disregarded when designing the hydraulic capacity of the outlet structure.

Care must be taken in the selection of "C"; 0.60 is most often recommended and used. However, based on actual tests, GKY (1989), "Outlet Hydraulics of Extended Detention Facilities for Northern Virginia Planning District Commission", recommends the following:

C = 0.66 for thin materials; where the thickness is equal to or less than the orifice diameter, or

C = 0.80 when the material is thicker than the orifice diameter

### *Installation*

- Securely anchor and install an anti-seep collar on the outlet pipe/riser and provide an emergency spillway for passing major floods (see local flood control agency).
- Areas under embankments must be cleared and stripped of vegetation.
- Chain link fencing should be provided around each sediment basin to prevent unauthorized entry to the basin or if safety is a concern.

## Costs

Average annual costs for installation and maintenance (2 year useful life) are:

- Basin less than 50,000 $ft^3$: Range, \$0.24 - \$1.58/$ft^3$. Average, \$0.73 per $ft^3$. \$400 - \$2,400, \$1,200 average per drainage acre.
- Basin size greater than 50,000 $ft^3$: Range, \$0.12 – \$0.48/$ft^3$. Average, \$0.36 per $ft^3$. \$200 - \$800, \$600 average per drainage acre.

## Inspection and Maintenance

- Inspect BMPs prior to forecast rain, daily during extended rain events, after rain events, weekly during the rainy season, and at two-week intervals during the non-rainy season.
- Examine basin banks for seepage and structural soundness.
- Check inlet and outlet structures and spillway for any damage or obstructions. Repair damage and remove obstructions as needed.
- Check inlet and outlet area for erosion and stabilize if required.
- Check fencing for damage and repair as needed.
- Sediment that accumulates in the BMP must be periodically removed in order to maintain BMP effectiveness. Sediment should be removed when sediment accumulation reaches one-half the designated sediment storage volume. Sediment removed during maintenance may be incorporated into earthwork on the site or disposed of at appropriate locations.
- Remove standing water from basin within 72 hours after accumulation.
- BMPs that require dewatering shall be continuously attended while dewatering takes place. Dewatering BMPs shall be implemented at all times during dewatering activities.
- To minimize vector production:
  - Remove accumulation of live and dead floating vegetation in basins during every inspection.
  - Remove excessive emergent and perimeter vegetation as needed or as advised by local or state vector control agencies.

## References

A Current Assessment of Urban Best Management Practices: Techniques for Reducing Nonpoint Source Pollution in the Coastal Zones, Metropolitan Washington Council of Governments, March 1992.

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Guidelines for the Design and Construction of Small Embankment Dams, Division of Safety of Dams, California Department of Water Resources, March 1986.

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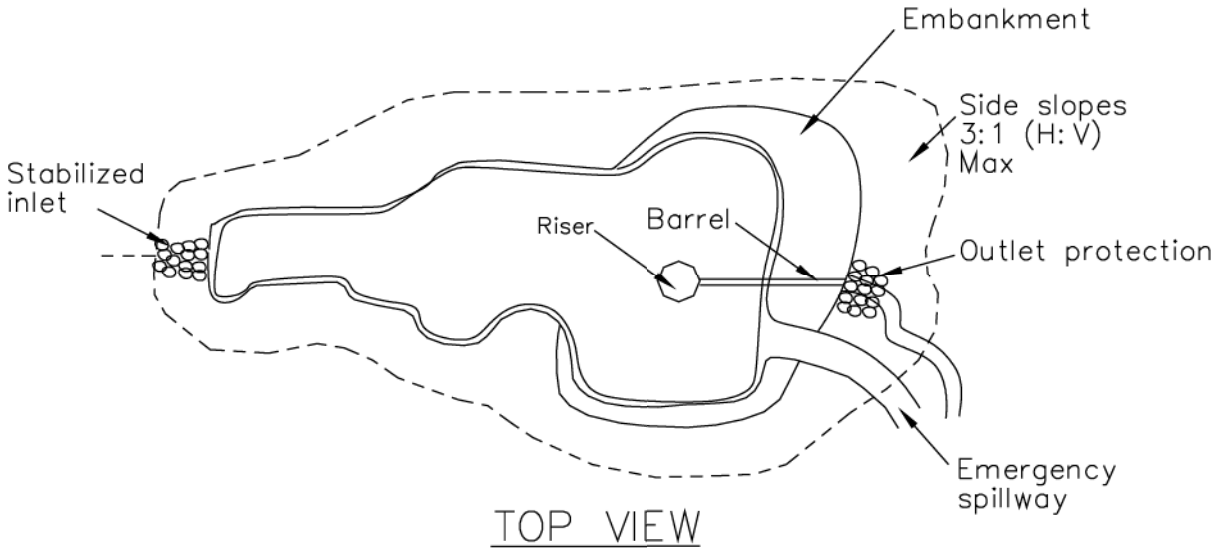
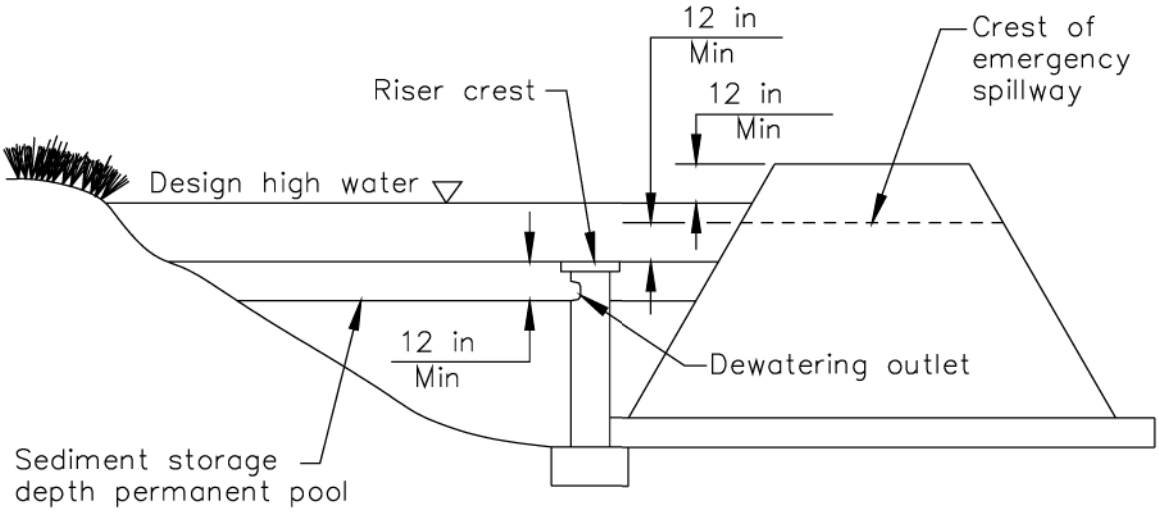
Stormwater Management of the Puget Sound Basin, Technical Manual, Publication #91-75, Washington State Department of Ecology, February 1992.

U.S. Environmental Protection Agency (USEPA). Guidance Specifying Management Measures for Nonpoint Pollution in Coastal Waters. EPA 840-B-9-002. U.S. Environmental Protection Agency, Office of Water, Washington, DC, 1993

Water Quality Management Plan for the Lake Tahoe Region, Volume II Handbook of Management Practices, Tahoe Regional Planning Agency, November 1988.




NOTE:
This outlet provides no drainage for permanent pool.

FIGURE 1: TYPICAL TEMPORARY SEDIMENT BASIN
SINGLE ORIFICE DESIGN
NOT TO SCALE

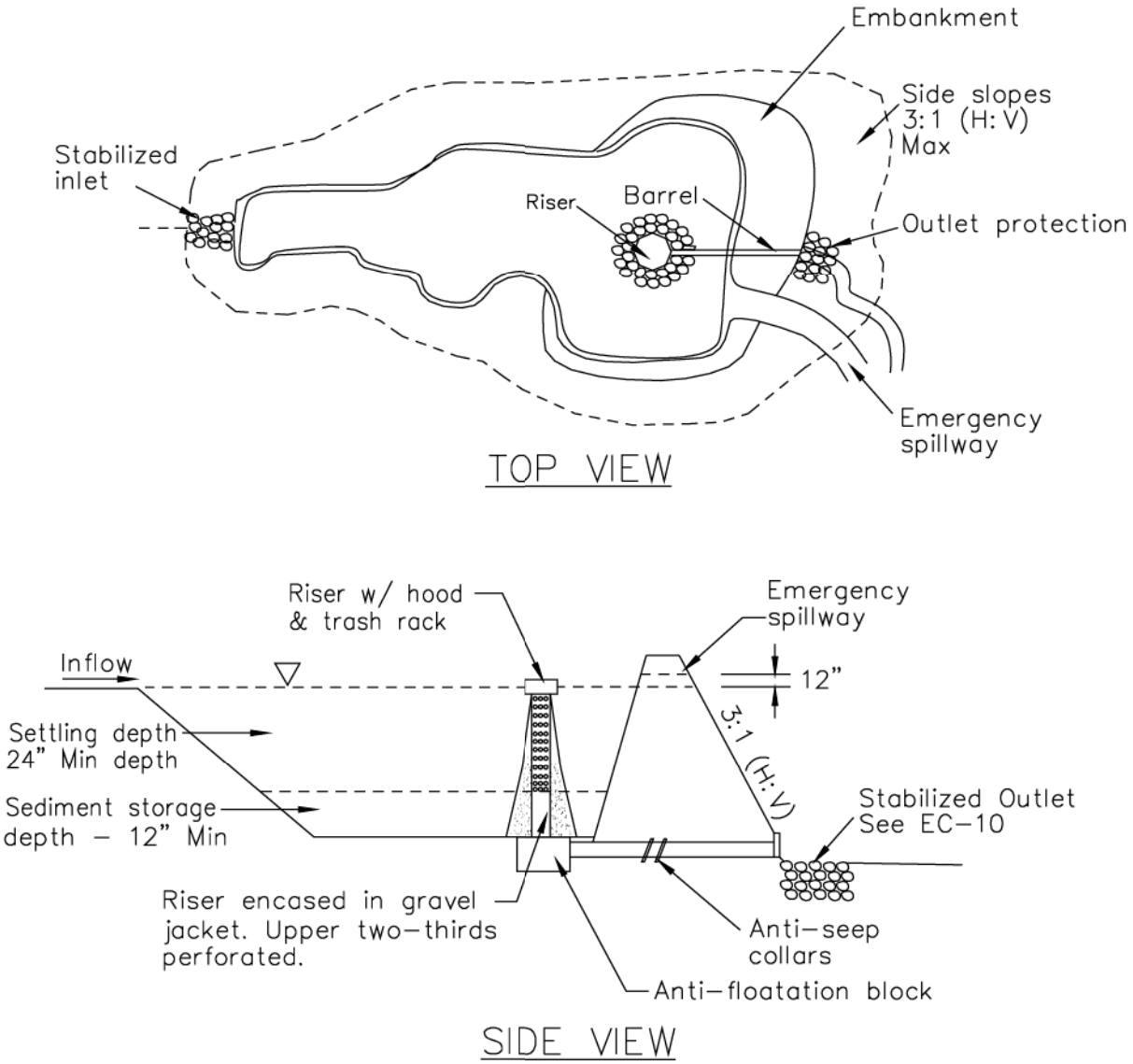



FIGURE 2: TYPICAL TEMPORARY SEDIMENT BASIN

MULTIPLE ORIFICE DESIGN

NOT TO SCALE

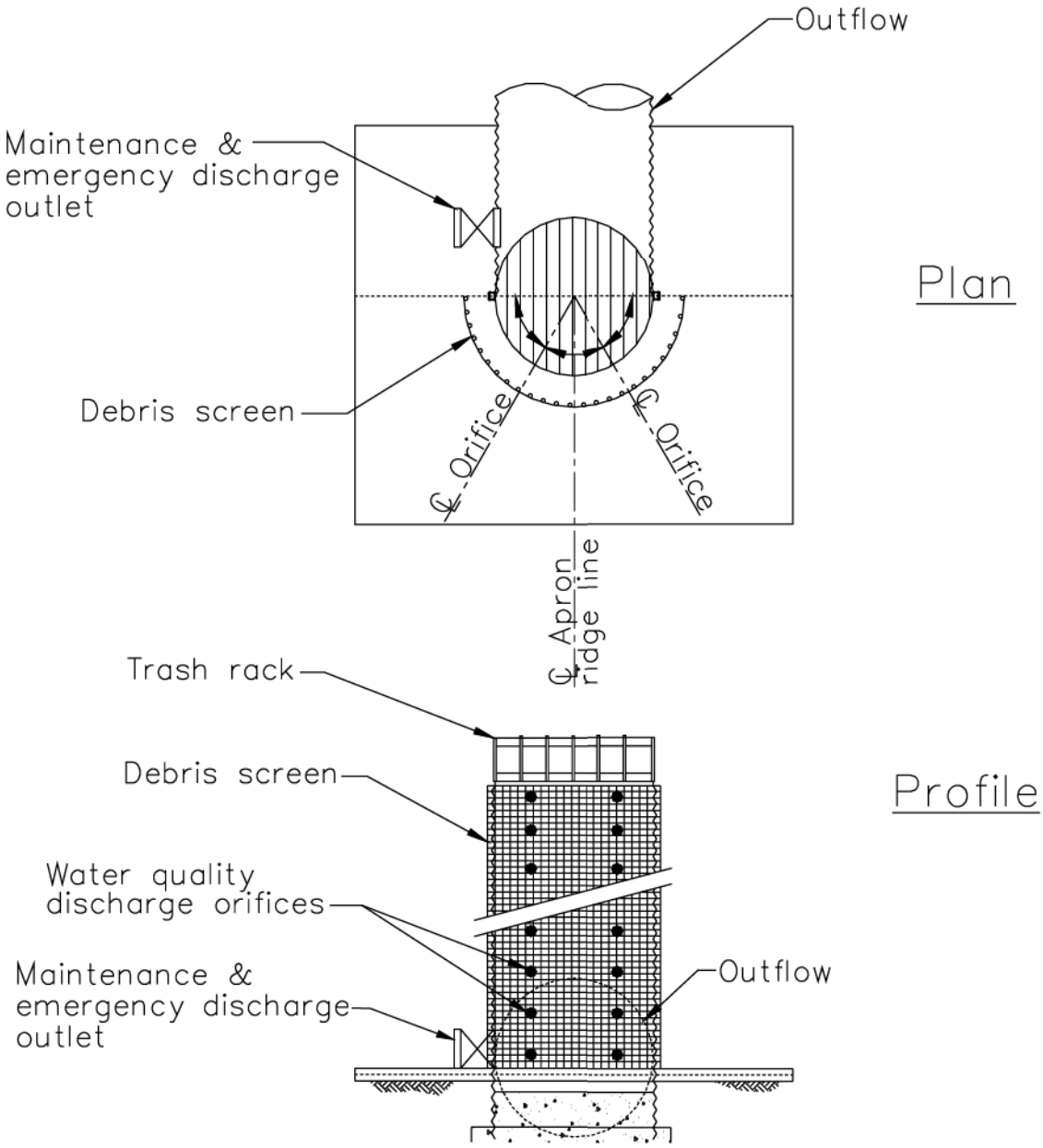
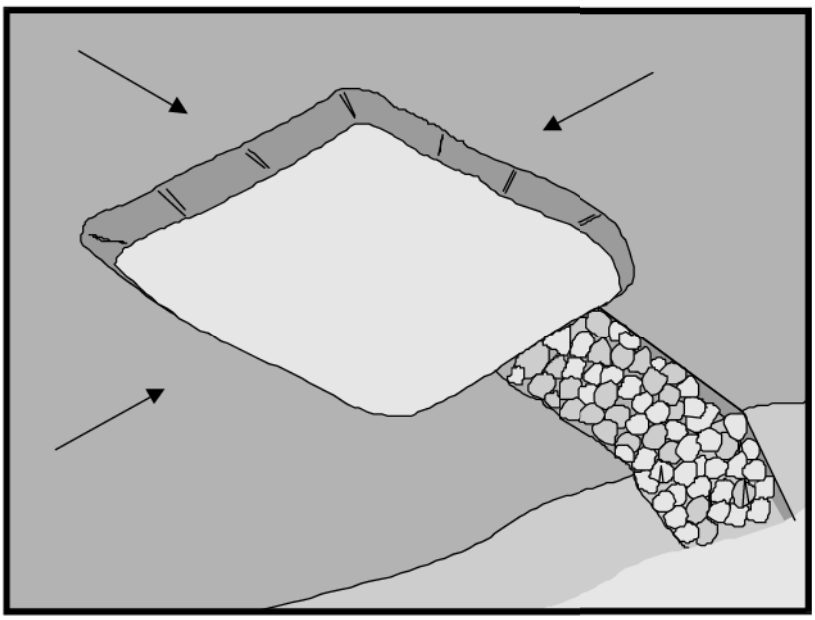



FIGURE 3: MULTIPLE ORIFICE OUTLET RISER

NOT TO SCALE

# Sediment Trap SE-3



## Objectives

| | | |
|---|---|---|
| EC | Erosion Control | |
| SE | Sediment Control | ☑ |
| TR | Tracking Control | |
| WE | Wind Erosion Control | |
| NS | Non-Stormwater Management Control | |
| WM | Waste Management and Materials Pollution Control | |

**Legend:**

☑ **Primary Objective**

☒ **Secondary Objective**

## Targeted Constituents

| | |
|---|---|
| Sediment | ☑ |
| Nutrients | |
| Trash | ☑ |
| Metals | |
| Bacteria | |
| Oil and Grease | |
| Organics | |

## Potential Alternatives

SE-2 Sediment Basin (for larger areas)

## Description and Purpose

A sediment trap is a containment area where sediment-laden runoff is temporarily detained under quiescent conditions, allowing sediment to settle out or before the runoff is discharged. Sediment traps are formed by excavating or constructing an earthen embankment across a waterway or low drainage area.

## Suitable Applications

Sediment traps should be considered for use:

- At the perimeter of the site at locations where sediment-laden runoff is discharged offsite.
- At multiple locations within the project site where sediment control is needed.
- Around or upslope from storm drain inlet protection measures.
- Sediment traps may be used on construction projects where the drainage area is less than 5 acres. Traps would be placed where sediment-laden stormwater may enter a storm drain or watercourse. SE-2, Sediment Basins, must be used for drainage areas greater than 5 acres.
- As a supplemental control, sediment traps provide additional protection for a water body or for reducing sediment before it enters a drainage system.

## Limitations

- Requires large surface areas to permit infiltration and settling of sediment.
- Not appropriate for drainage areas greater than 5 acres.
- Only removes large and medium sized particles and requires upstream erosion control.
- Attractive and dangerous to children, requiring protective fencing.
- Conducive to vector production.
- Should not be located in live streams.

## Implementation

### *Design*

A sediment trap is a small temporary ponding area, usually with a gravel outlet, formed by excavation or by construction of an earthen embankment. Its purpose is to collect and store sediment from sites cleared or graded during construction. It is intended for use on small drainage areas with no unusual drainage features and projected for a quick build-out time. It should help in removing coarse sediment from runoff. The trap is a temporary measure with a design life of approximately six months to one year and is to be maintained until the site area is permanently protected against erosion by vegetation and/or structures.

Sediment traps should be used only for small drainage areas. If the contributing drainage area is greater than 5 acres, refer to SE-2, Sediment Basins, or subdivide the catchment area into smaller drainage basins.

Sediment usually must be removed from the trap after each rainfall event. The SWPPP should detail how this sediment is to be disposed of, such as in fill areas onsite, or removal to an approved offsite dump. Sediment traps used as perimeter controls should be installed before any land disturbance takes place in the drainage area.

Sediment traps are usually small enough that a failure of the structure would not result in a loss of life, damage to home or buildings, or interruption in the use of public roads or utilities. However, sediment traps are attractive to children and can be dangerous. The following recommendations should be implemented to reduce risks:

- Install continuous fencing around the sediment trap or pond. Consult local ordinances regarding requirements for maintaining health and safety.
- Restrict basin side slopes to 3:1 or flatter.

Sediment trap size depends on the type of soil, size of the drainage area, and desired sediment removal efficiency (see SE-2, Sediment Basin). As a rule of thumb, the larger the basin volume the greater the sediment removal efficiency. Sizing criteria are typically established under the local grading ordinance or equivalent. The runoff volume from a 2-year storm is a common design criteria for a sediment trap. The sizing criteria below assume that this runoff volume is 0.042 acre-ft/acre (0.5 in. of runoff). While the climatic, topographic, and soil type extremes make it difficult to establish a statewide standard, the following criteria should trap moderate to high amounts of sediment in most areas of California:

- Locate sediment traps as near as practical to areas producing the sediment.
- Trap should be situated according to the following criteria: (1) by excavating a suitable area or where a low embankment can be constructed across a swale, (2) where failure would not cause loss of life or property damage, and (3) to provide access for maintenance, including sediment removal and sediment stockpiling in a protected area.
- Trap should be sized to accommodate a settling zone and sediment storage zone with recommended minimum volumes of 67 $yd^3$/acre and 33 $yd^3$/acre of contributing drainage area, respectively, based on 0.5 in. of runoff volume over a 24-hour period. In many cases, the size of an individual trap is limited by available space. Multiple traps or additional volume may be required to accommodate specific rainfall, soil, and site conditions.
- Traps with an impounding levee greater than 4.5 ft tall, measured from the lowest point to the impounding area to the highest point of the levee, and traps capable of impounding more than 35,000 $ft^3$, should be designed by a Registered Civil Engineer. The design should include maintenance requirements, including sediment and vegetation removal, to ensure continuous function of the trap outlet and bypass structures.
- The outlet pipe or open spillway must be designed to convey anticipated peak flows.
- Use rock or vegetation to protect the trap outlets against erosion.
- Fencing should be provided to prevent unauthorized entry.

### *Installation*

Sediment traps can be constructed by excavating a depression in the ground or creating an impoundment with a small embankment. Sediment traps should be installed outside the area being graded and should be built prior to the start of the grading activities or removal of vegetation. To minimize the area disturbed by them, sediment traps should be installed in natural depressions or in small swales or drainage ways. The following steps must be followed during installation:

- The area under the embankment must be cleared, grubbed, and stripped of any vegetation and root mat. The pool area should be cleared.
- The fill material for the embankment must be free of roots or other woody vegetation as well as oversized stones, rocks, organic material, or other objectionable material. The embankment may be compacted by traversing with equipment while it is being constructed.
- All cut-and-fill slopes should be 3:1 or flatter.
- When a riser is used, all pipe joints must be watertight.
- When a riser is used, at least the top two-thirds of the riser should be perforated with 0.5 in. diameter holes spaced 8 in. vertically and 10 to 12 in. horizontally. See SE-2, Sediment Basin.
- When an earth or stone outlet is used, the outlet crest elevation should be at least 1 ft below the top of the embankment.

- When crushed stone outlet is used, the crushed stone used in the outlet should meet AASHTO M43, size No. 2 or 24, or its equivalent such as MSHA No. 2. Gravel meeting the above gradation may be used if crushed stone is not available.

### Costs

Average annual cost per installation and maintenance (18 month useful life) is $0.73 per $ft^3$ ($1,300 per drainage acre). Maintenance costs are approximately 20% of installation costs.

### Inspection and Maintenance

- Inspect BMPs prior to forecast rain, daily during extended rain events, after rain events, weekly during the rainy season, and at two-week intervals during the non-rainy season.
- Inspect outlet area for erosion and stabilize if required.
- Inspect trap banks for seepage and structural soundness, repair as needed.
- Inspect outlet structure and spillway for any damage or obstructions. Repair damage and remove obstructions as needed.
- Inspect fencing for damage and repair as needed.
- Inspect the sediment trap for area of standing water during every visit. Corrective measures should be taken if the BMP does not dewater completely in 72 hours or less to prevent vector production.
- Sediment that accumulates in the BMP must be periodically removed in order to maintain BMP effectiveness. Sediment should be removed when the sediment accumulation reaches one-third of the trap capacity. Sediment removed during maintenance may be incorporated into earthwork on the site or disposed of at an appropriate location.
- Remove vegetation from the sediment trap when first detected to prevent pools of standing water and subsequent vector production.
- BMPs that require dewatering shall be continuously attended while dewatering takes place. Dewatering BMPs shall be implemented at all times during dewatering activities.

### References

Brown, W., and T. Schueler. The Economics of Stormwater BMPs in the Mid-Atlantic Region. Prepared for Chesapeake Research Consortium, Edgewater, MD, by the Center for Watershed Protection, Ellicott City, MD, 1997.

Draft – Sedimentation and Erosion Control, an Inventory of Current Practices, USEPA, April 1990.

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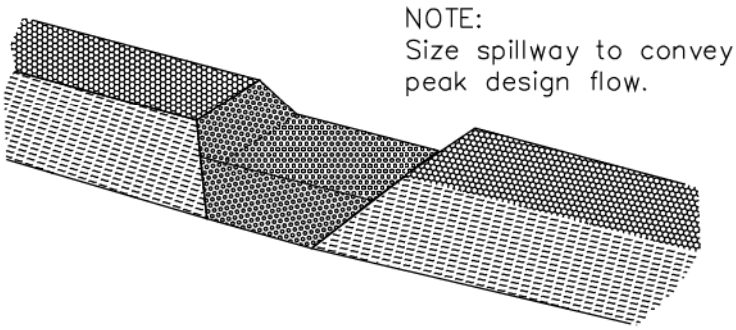
Proposed Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters, Work Group-Working Paper, USEPA, April 1992.

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

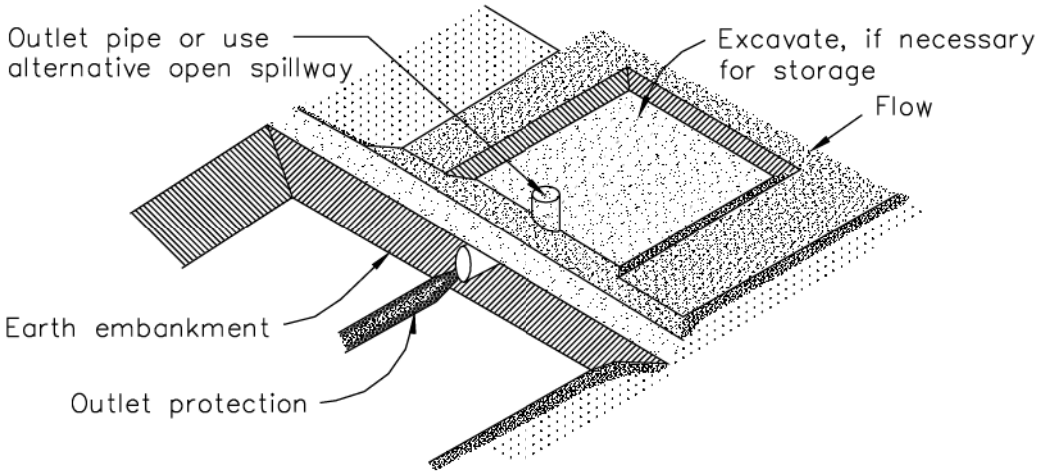
Stormwater Management Manual for The Puget Sound Basin, Washington State Department of Ecology, Public Review Draft, 1991.

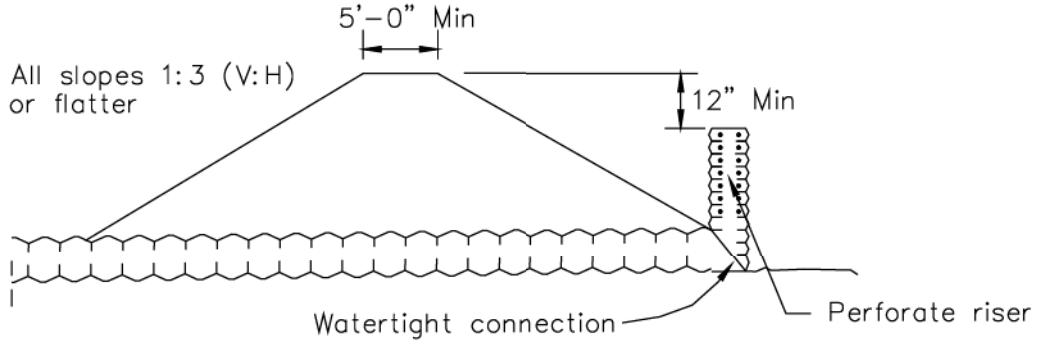
U.S. Environmental Protection Agency (USEPA). Guidance Specifying Management Measures for Nonpoint Pollution in Coastal Waters. EPA 840-B-9-002. U.S. Environmental Protection Agency, Office of Water, Washington, DC, 1993.

Water Quality Management Plan for the Lake Tahoe Region, Volume II, Handbook of Management Practices, Tahoe Regional Planning Agency, November 1988.




TYPICAL OPEN SPILLWAY

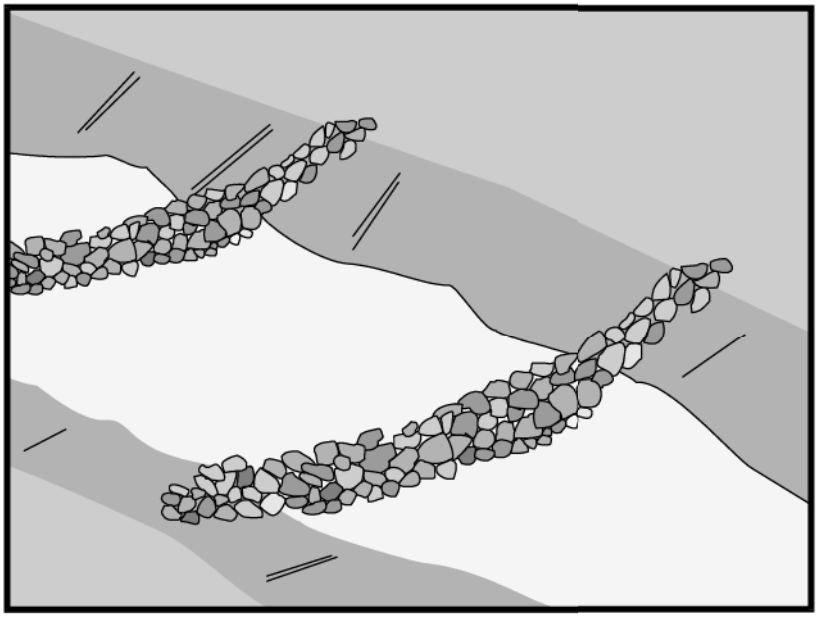



EMBANKMENT SECTION THRU RISER

TYPICAL SEDIMENT TRAP
NOT TO SCALE

# Check Dams SE-4



## Objectives

| | | |
|---|---|---|
| EC | Erosion Control | ☒ |
| SE | Sediment Control | ☑ |
| TR | Tracking Control | |
| WE | Wind Erosion Control | |
| NS | Non-Stormwater Management Control | |
| WM | Waste Management and Materials Pollution Control | |

**Legend:**

☑ **Primary Objective**

☒ **Secondary Objective**

## Targeted Constituents

| | |
|---|---|
| Sediment | ☑ |
| Nutrients | |
| Trash | |
| Metals | |
| Bacteria | |
| Oil and Grease | |
| Organics | |

## Potential Alternatives

SE-5 Fiber Rolls

SE-6 Gravel Bag Berm

SE-8 Sandbag Barrier

## Description and Purpose

A check dam is a small barrier constructed of rock, gravel bags, sandbags, fiber rolls, or reusable products, placed across a constructed swale or drainage ditch. Check dams reduce the effective slope of the channel, thereby reducing the velocity of flowing water, allowing sediment to settle and reducing erosion.

## Suitable Applications

Check dams may be appropriate in the following situations:

- To promote sedimentation behind the dam.
- To prevent erosion by reducing the velocity of channel flow in small intermittent channels and temporary swales.
- In small open channels that drain 10 acres or less.
- In steep channels where stormwater runoff velocities exceed 5 ft/s.
- During the establishment of grass linings in drainage ditches or channels.
- In temporary ditches where the short length of service does not warrant establishment of erosion-resistant linings.

## Limitations

- Not to be used in live streams or in channels with extended base flows.

- Not appropriate in channels that drain areas greater than 10 acres.
- Not appropriate in channels that are already grass-lined unless erosion is expected, as installation may damage vegetation.
- Require extensive maintenance following high velocity flows.
- Promotes sediment trapping which can be re-suspended during subsequent storms or removal of the check dam.

## Implementation

### *General*

Check dams reduce the effective slope and create small pools in swales and ditches that drain 10 acres or less. Reduced slopes reduce the velocity of stormwater flows, thus reducing erosion of the swale or ditch and promoting sedimentation. Use of check dams for sedimentation will likely result in little net removal of sediment because of the small detention time and probable scour during longer storms. Using a series of check dams will generally increase their effectiveness. A sediment trap (SE-3) may be placed immediately upstream of the check dam to increase sediment removal efficiency.

### *Design and Layout*

Check dams work by decreasing the effective slope in ditches and swales. An important consequence of the reduced slope is a reduction in capacity of the ditch or swale. This reduction in capacity must be considered when using this BMP, as reduced capacity can result in overtopping of the ditch or swale and resultant consequences. In some cases, such as a "permanent" ditch or swale being constructed early and used as a "temporary" conveyance for construction flows, the ditch or swale may have sufficient capacity such that the temporary reduction in capacity due to check dams is acceptable. When check dams reduce capacities beyond acceptable limits, there are several options:

- Don't use check dams. Consider alternative BMPs.
- Increase the size of the ditch or swale to restore capacity.

Maximum slope and velocity reduction is achieved when the toe of the upstream dam is at the same elevation as the top of the downstream dam. The center section of the dam should be lower than the edge sections so that the check dam will direct flows to the center of the ditch or swale.

Check dams are usually constructed of rock, gravel bags, sandbags, and fiber rolls. A number of products manufactured specifically for use as check dams are also being used, and some of these products can be removed and reused. Check dams can also be constructed of logs or lumber, and have the advantage of a longer lifespan when compared to gravel bags, sandbags, and fiber rolls. Straw bales can also be used for check dams and can work if correctly installed; but in practice, straw bale check dams have a high failure rate. Check dams should not be constructed from straw bales or silt fences, since concentrated flows quickly wash out these materials.

Rock check dams are usually constructed of 8 to 12 in. rock. The rock is placed either by hand or mechanically, but never just dumped into the channel. The dam must completely span the ditch

or swale to prevent washout. The rock used must be large enough to stay in place given the expected design flow through the channel.

Log check dams are usually constructed of 4 to 6 in. diameter logs. The logs should be embedded into the soil at least 18 in. Logs can be bolted or wired to vertical support logs that have been driven or buried into the soil.

Gravel bag and sandbag check dams are constructed by stacking bags across the ditch or swale, shaped as shown in the drawings at the end of this fact sheet.

Manufactured products should be installed in accordance with the manufacturer's instructions.

If grass is planted to stabilize the ditch or swale, the check dam should be removed when the grass has matured (unless the slope of the swales is greater than 4%).

The following guidance should be followed for the design and layout of check dams:

- Install the first check dam approximately 16 ft from the outfall device and at regular intervals based on slope gradient and soil type.
- Check dams should be placed at a distance and height to allow small pools to form between each check dam.
- Backwater from a downstream check dam should reach the toes of the upstream check dam.
- A sediment trap provided immediately upstream of the check dam will help capture sediment. Due to the potential for this sediment to be resuspended in subsequent storms, the sediment trap must be cleaned following each storm event.
- High flows (typically a 2-year storm or larger) should safely flow over the check dam without an increase in upstream flooding or damage to the check dam.
- Where grass is used to line ditches, check dams should be removed when grass has matured sufficiently to protect the ditch or swale.
- Gravel bags may be used as check dams with the following specifications:

### *Materials*

Gravel bags used for check dams should conform to the requirements of SE-6, Gravel Bag Berms. Sandbags used for check dams should conform to SE-8, Sandbag Barrier. Fiber rolls used for check dams should conform to SE-5, Fiber Rolls. Straw bales used for check dams should conform to SE-9, Straw Bale Barrier.

### *Installation*

- Rock should be placed individually by hand or by mechanical methods (no dumping of rock) to achieve complete ditch or swale coverage.
- Tightly abut bags and stack according to detail shown in the figure at the end of this section. Gravel bags and sandbags should not be stacked any higher than 3 ft.
- Fiber rolls and straw bales must be trenched in and firmly staked in place.

## Costs

Cost consists of only installation costs if materials are readily available. If material must be imported, costs may increase. For material costs, see SE-5, SE-6, SE-8 and SE-9.

## Inspection and Maintenance

- Inspect BMPs prior to forecast rain, daily during extended rain events, after rain events, weekly during the rainy season, and at two-week intervals during the non-rainy season.
- Replace missing rock, bags, bales, etc. Replace bags or bales that have degraded or have become damaged.
- If the check dam is used as a sediment capture device, sediment that accumulates in the BMP must be periodically removed in order to maintain BMP effectiveness. Sediment should be removed when the sediment accumulation reaches one-third of the barrier height. Sediment removed during maintenance may be incorporated into earthwork on the site or disposed at an appropriate location.
- If the check dam is used as a grade control structure, sediment removal is not required as long as the system continues to control the grade.
- Remove accumulated sediment prior to permanent seeding or soil stabilization.
- Remove check dam and accumulated sediment when check dams are no longer needed.

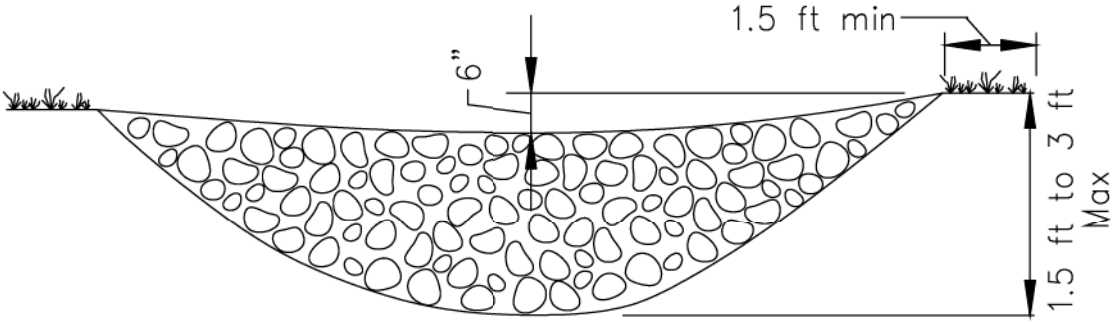
## References

Draft – Sedimentation and Erosion Control, and Inventory of Current Practices, USEPA, April 1990.

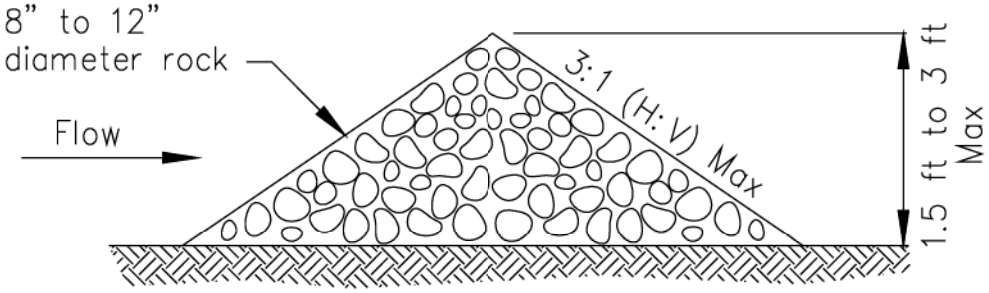
Manual of Standards of Erosion and Sediment Control Measures, Association of Bay Area Governments, May 1995.

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

Stormwater Management of the Puget Sound Basin, Technical Manual, Publication #91-75, Washington State Department of Ecology, February 1992.

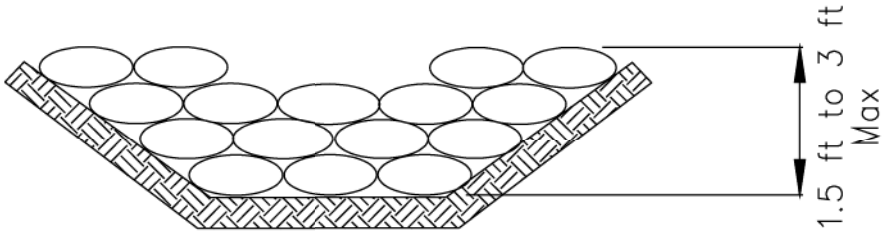



ELEVATION



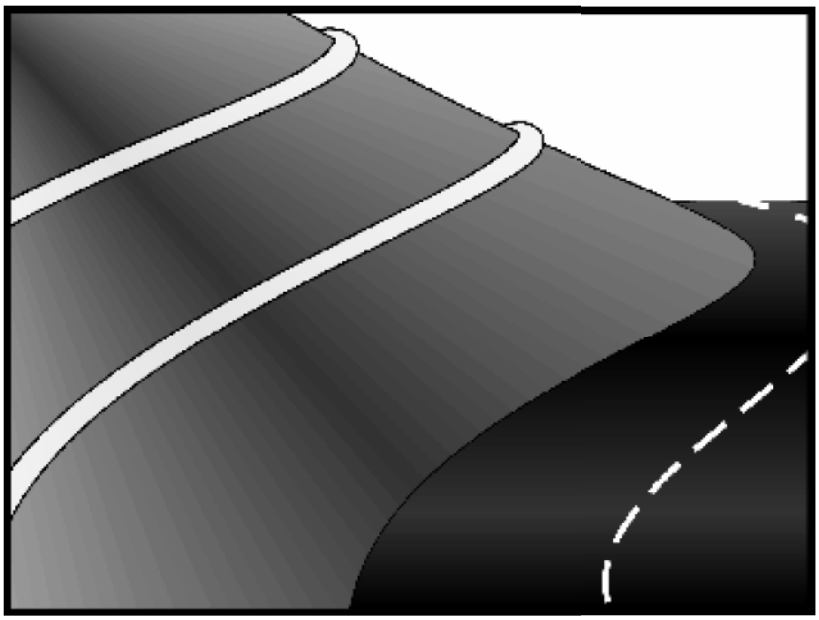

TYPICAL ROCK CHECK DAM SECTION

ROCK CHECK DAM
NOT TO SCALE




GRAVEL BAG CHECK DAM ELEVATION
NOT TO SCALE

# Fiber Rolls SE-5



## Objectives

| | | |
|---|---|---|
| EC | Erosion Control | ☒ |
| SE | Sediment Control | ☑ |
| TR | Tracking Control | |
| WE | Wind Erosion Control | |
| NS | Non-Stormwater Management Control | |
| WM | Waste Management and Materials Pollution Control | |

**Legend:**

☑ **Primary Objective**

☒ **Secondary Objective**

## Targeted Constituents

| | |
|---|---|
| Sediment | ☑ |
| Nutrients | |
| Trash | |
| Metals | |
| Bacteria | |
| Oil and Grease | |
| Organics | |

## Potential Alternatives

SE-1 Silt Fence

SE-6 Gravel Bag Berm

SE-8 Sandbag Barrier

SE-9 Straw Bale Barrier

## Description and Purpose

A fiber roll consists of straw, flax, or other similar materials bound into a tight tubular roll. When fiber rolls are placed at the toe and on the face of slopes, they intercept runoff, reduce its flow velocity, release the runoff as sheet flow, and provide removal of sediment from the runoff. By interrupting the length of a slope, fiber rolls can also reduce erosion.

## Suitable Applications

Fiber rolls may be suitable:

- Along the toe, top, face, and at grade breaks of exposed and erodible slopes to shorten slope length and spread runoff as sheet flow
- At the end of a downward slope where it transitions to a steeper slope
- Along the perimeter of a project
- As check dams in unlined ditches
- Down-slope of exposed soil areas
- Around temporary stockpiles

## Limitations

- Fiber rolls are not effective unless trenched

- Fiber rolls at the toe of slopes greater than 5:1 (H:V) should be a minimum of 20 in. diameter or installations achieving the same protection (i.e. stacked smaller diameter fiber rolls, etc.).
- Difficult to move once saturated.
- If not properly staked and trenched in, fiber rolls could be transported by high flows.
- Fiber rolls have a very limited sediment capture zone.
- Fiber rolls should not be used on slopes subject to creep, slumping, or landslide.

## Implementation

### *Fiber Roll Materials*

- Fiber rolls should be either prefabricated rolls or rolled tubes of erosion control blanket.

### *Assembly of Field Rolled Fiber Roll*

- Roll length of erosion control blanket into a tube of minimum 8 in. diameter.
- Bind roll at each end and every 4 ft along length of roll with jute-type twine.

### *Installation*

- Locate fiber rolls on level contours spaced as follows:
  - Slope inclination of 4:1 (H:V) or flatter: Fiber rolls should be placed at a maximum interval of 20 ft.
  - Slope inclination between 4:1 and 2:1 (H:V): Fiber Rolls should be placed at a maximum interval of 15 ft. (a closer spacing is more effective).
  - Slope inclination 2:1 (H:V) or greater: Fiber Rolls should be placed at a maximum interval of 10 ft. (a closer spacing is more effective).
- Turn the ends of the fiber roll up slope to prevent runoff from going around the roll.
- Stake fiber rolls into a 2 to 4 in. deep trench with a width equal to the diameter of the fiber roll.
  - Drive stakes at the end of each fiber roll and spaced 4 ft maximum on center.
  - Use wood stakes with a nominal classification of 0.75 by 0.75 in. and minimum length of 24 in.
- If more than one fiber roll is placed in a row, the rolls should be overlapped, not abutted.

### *Removal*

- Fiber rolls are typically left in place.

- If fiber rolls are removed, collect and dispose of sediment accumulation, and fill and compact holes, trenches, depressions or any other ground disturbance to blend with adjacent ground.

### Costs

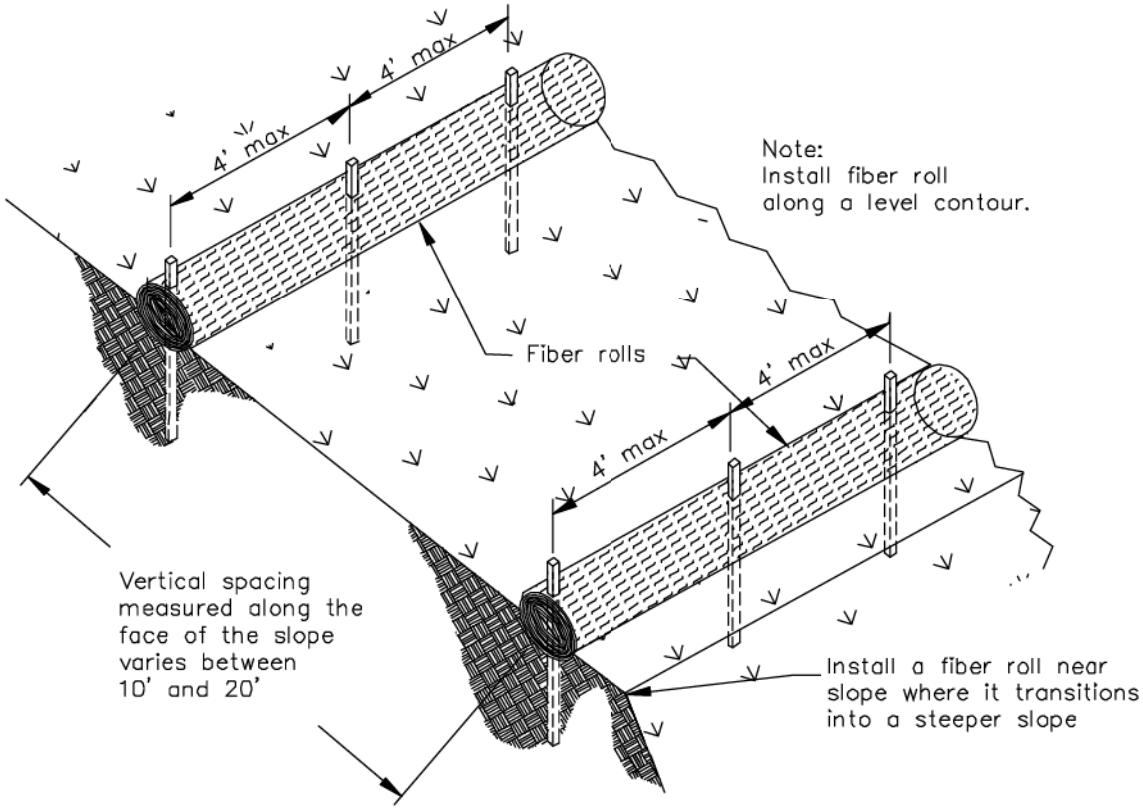
Material costs for fiber rolls range from $20 - $30 per 25 ft roll.

### Inspection and Maintenance

- Inspect BMPs prior to forecast rain, daily during extended rain events, after rain events, weekly during the rainy season, and at two-week intervals during the non-rainy season.
- Repair or replace split, torn, unraveling, or slumping fiber rolls.
- If the fiber roll is used as a sediment capture device, or as an erosion control device to maintain sheet flows, sediment that accumulates in the BMP must be periodically removed in order to maintain BMP effectiveness. Sediment should be removed when sediment accumulation reaches one-half the designated sediment storage depth, usually one-half the distance between the top of the fiber roll and the adjacent ground surface. Sediment removed during maintenance may be incorporated into earthwork on the site of disposed at an appropriate location.
- If fiber rolls are used for erosion control, such as in a mini check dam, sediment removal should not be required as long as the system continues to control the grade. Sediment control BMPs will likely be required in conjunction with this type of application.

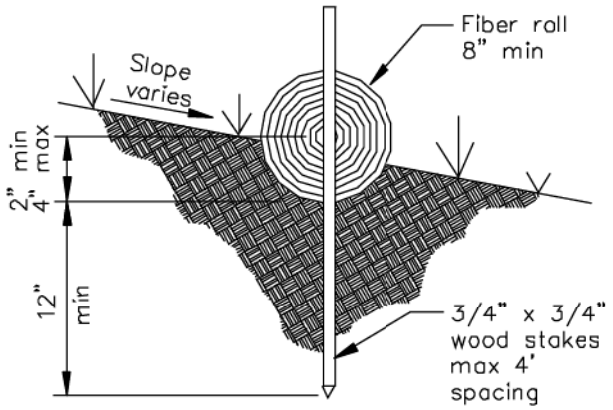
### References

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.




TYPICAL FIBER ROLL INSTALLATION

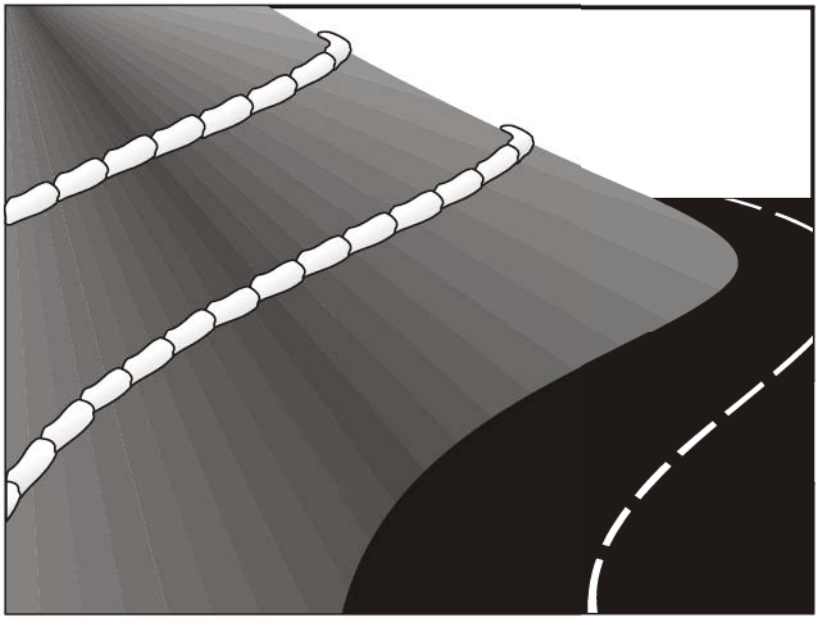
N.T.S.




ENTRENCHMENT DETAIL

N.T.S.

# Gravel Bag Berm SE-6



## Objectives

| | | |
|---|---|---|
| EC | Erosion Control | ☒ |
| SE | Sediment Control | ☑ |
| TR | Tracking Control | |
| WE | Wind Erosion Control | |
| NS | Non-Stormwater Management Control | |
| WM | Waste Management and Materials Pollution Control | |

**Legend:**

☑ **Primary Objective**

☒ **Secondary Objective**

## Targeted Constituents

| | |
|---|---|
| Sediment | ☑ |
| Nutrients | |
| Trash | |
| Metals | |
| Bacteria | |
| Oil and Grease | |
| Organics | |

## Potential Alternatives

SE-1 Silt Fence

SE-5 Fiber Roll

SE-8 Sandbag Barrier

SE-9 Straw Bale Barrier

## Description and Purpose

A gravel bag berm is a series of gravel-filled bags placed on a level contour to intercept sheet flows. Gravel bags pond sheet flow runoff, allowing sediment to settle out, and release runoff slowly as sheet flows, preventing erosion.

## Suitable Applications

Gravel bag berms may be suitable:

- As a linear sediment control measure:
  - Below the toe of slopes and erodible slopes
  - As sediment traps at culvert/pipe outlets
  - Below other small cleared areas
  - Along the perimeter of a site
  - Down slope of exposed soil areas
  - Around temporary stockpiles and spoil areas
  - Parallel to a roadway to keep sediment off paved areas
  - Along streams and channels
- As linear erosion control measure:

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- Along the face and at grade breaks of exposed and erodible slopes to shorten slope length and spread runoff as sheet flow
- At the top of slopes to divert runoff away from disturbed slopes
- As check dams across mildly sloped construction roads

## Limitations

- Gravel berms may be difficult to remove.
- Removal problems limit their usefulness in landscaped areas.
- Gravel bag berm may not be appropriate for drainage areas greater than 5 acres.
- Runoff will pond upstream of the filter, possibly causing flooding if sufficient space does not exist.
- Degraded gravel bags may rupture when removed, spilling contents.
- Installation can be labor intensive.
- Berms may have limited durability for long-term projects.
- When used to detain concentrated flows, maintenance requirements increase.

## Implementation

### *General*

A gravel bag berm consists of a row of open graded gravel–filled bags placed on a level contour. When appropriately placed, a gravel bag berm intercepts and slows sheet flow runoff, causing temporary ponding. The temporary ponding provides quiescent conditions allowing sediment to settle. The open graded gravel in the bags is porous, which allows the ponded runoff to flow slowly through the bags, releasing the runoff as sheet flows. Gravel bag berms also interrupt the slope length and thereby reduce erosion by reducing the tendency of sheet flows to concentrate into rivulets, which erode rills, and ultimately gullies, into disturbed, sloped soils. Gravel bag berms are similar to sand bag barriers, but are more porous.

### *Design and Layout*

- Locate gravel bag berms on level contours.
  - Slopes between 20:1 and 2:1 (H:V): Gravel bags should be placed at a maximum interval of 50 ft (a closer spacing is more effective), with the first row near the slope toe.
  - Slopes 2:1 (H:V) or steeper: Gravel bags should be placed at a maximum interval of 25 ft (a closer spacing is more effective), with the first row placed the slope toe.
- Turn the ends of the gravel bag barriers up slope to prevent runoff from going around the berm.
- Allow sufficient space up slope from the gravel bag berm to allow ponding, and to provide room for sediment storage.

- For installation near the toe of the slope, consider moving the gravel bag barriers away from the slope toe to facilitate cleaning. To prevent flows behind the barrier, bags can be placed perpendicular to a berm to serve as cross barriers.
- Drainage area should not exceed 5 acres.
- In Non-Traffic Areas:
  - Height = 18 in. maximum
  - Top width = 24 in. minimum for three or more layer construction
  - Top width = 12 in. minimum for one or two layer construction
  - Side slopes = 2:1 or flatter
- In Construction Traffic Areas:
  - Height = 12 in. maximum
  - Top width = 24 in. minimum for three or more layer construction.
  - Top width = 12 in. minimum for one or two layer construction.
  - Side slopes = 2:1 or flatter.
- Butt ends of bags tightly
- On multiple row, or multiple layer construction, overlapp butt joints of adjacent row and row beneath.
- Use a pyramid approach when stacking bags.

### *Materials*

- ***Bag Material:*** Bags should be woven polypropylene, polyethylene or polyamide fabric or burlap, minimum unit weight of 4 ounces/yd$^2$, Mullen burst strength exceeding 300 lb/in$^2$ in conformance with the requirements in ASTM designation D3786, and ultraviolet stability exceeding 70% in conformance with the requirements in ASTM designation D4355.
- ***Bag Size:*** Each gravel-filled bag should have a length of 18 in., width of 12 in., thickness of 3 in., and mass of approximately 33 lbs. Bag dimensions are nominal, and may vary based on locally available materials.
- ***Fill Material:*** Fill material should be 0.5 to 1 in. Class 2 aggregate base, clean and free from clay, organic matter, and other deleterious material, or other suitable open graded, non-cohesive, porous gravel.

## Costs

Gravel filter: Expensive, since off-site materials, hand construction, and demolition/removal are usually required. Material costs for gravel bags are average of $2.50 per empty gravel bag. Gravel costs range from $20-$35 per yd$^3$.

## Inspection and Maintenance

- Inspect BMPs prior to forecast rain, daily during extended rain events, after rain events, weekly during the rainy season, and at two-week intervals during the non-rainy season.
- Gravel bags exposed to sunlight will need to be replaced every two to three months due to degrading of the bags.
- Reshape or replace gravel bags as needed.
- Repair washouts or other damage as needed.
- Sediment that accumulates in the BMP must be periodically removed in order to maintain BMP effectiveness. Sediment should be removed when the sediment accumulation reaches one-third of the barrier height. Sediment removed during maintenance may be incorporated into earthwork on the site or disposed at an appropriate location.
- Remove gravel bag berms when no longer needed. Remove sediment accumulation and clean, re-grade, and stabilize the area. Removed sediment should be incorporated in the project or disposed of.

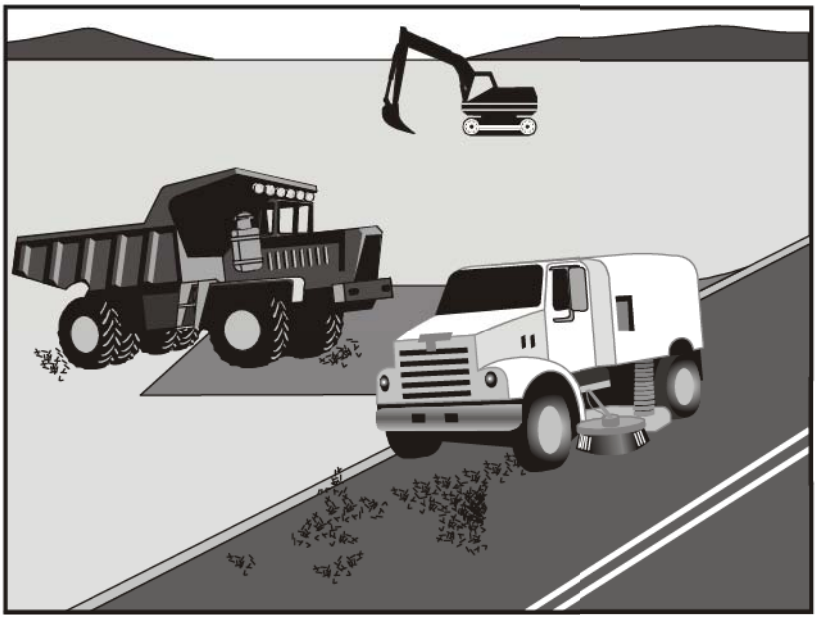
## References

Handbook of Steel Drainage and Highway Construction, American Iron and Steel Institute, 1983.

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

Stormwater Pollution Plan Handbook, First Edition, State of California, Department of Transportation Division of New Technology, Materials and Research, October 1992.

# Street Sweeping and Vacuuming SE-7



## Objectives

| | | |
|---|---|---|
| EC | Erosion Control | |
| SE | Sediment Control | ☒ |
| TR | Tracking Control | ☑ |
| WE | Wind Erosion Control | |
| NS | Non-Stormwater Management Control | |
| WM | Waste Management and Materials Pollution Control | |

**Legend:**

☑ **Primary Objective**

☒ **Secondary Objective**

## Targeted Constituents

| | |
|---|---|
| Sediment | ☑ |
| Nutrients | |
| Trash | ☑ |
| Metals | |
| Bacteria | |
| Oil and Grease | ☑ |
| Organics | |

## Potential Alternatives

None

## Description and Purpose

Street sweeping and vacuuming includes use of self-propelled and walk-behind equipment to remove sediment from streets and roadways, and to clean paved surfaces in preparation for final paving. Sweeping and vacuuming prevents sediment from the project site from entering storm drains or receiving waters.

## Suitable Applications

Sweeping and vacuuming are suitable anywhere sediment is tracked from the project site onto public or private paved streets and roads, typically at points of egress. Sweeping and vacuuming are also applicable during preparation of paved surfaces for final paving.

## Limitations

Sweeping and vacuuming may not be effective when sediment is wet or when tracked soil is caked (caked soil may need to be scraped loose).

## Implementation

- Controlling the number of points where vehicles can leave the site will allow sweeping and vacuuming efforts to be focused, and perhaps save money.
- Inspect potential sediment tracking locations daily.
- Visible sediment tracking should be swept or vacuumed on a daily basis.

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- Do not use kick brooms or sweeper attachments. These tend to spread the dirt rather than remove it.
- If not mixed with debris or trash, consider incorporating the removed sediment back into the project

### Costs

Rental rates for self-propelled sweepers vary depending on hopper size and duration of rental. Expect rental rates from $58/hour (3 $yd^3$ hopper) to $88/hour (9 $yd^3$ hopper), plus operator costs. Hourly production rates vary with the amount of area to be swept and amount of sediment. Match the hopper size to the area and expect sediment load to minimize time spent dumping.

### Inspection and Maintenance

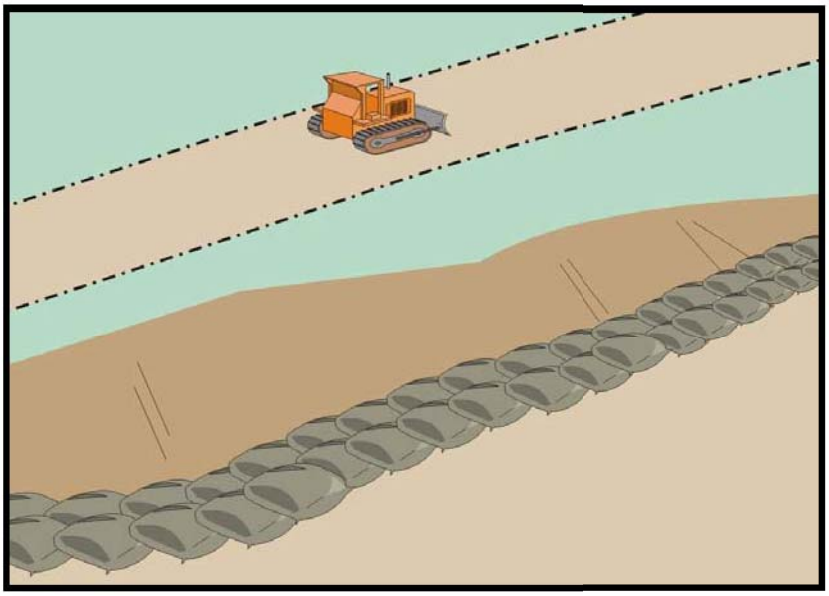
- Inspect BMPs prior to forecast rain, daily during extended rain events, after rain events, weekly during the rainy season, and at two-week intervals during the non-rainy season.
- When actively in use, points of ingress and egress must be inspected daily.
- When tracked or spilled sediment is observed outside the construction limits, it must be removed at least daily. More frequent removal, even continuous removal, may be required in some jurisdictions.
- Be careful not to sweep up any unknown substance or any object that may be potentially hazardous.
- Adjust brooms frequently; maximize efficiency of sweeping operations.
- After sweeping is finished, properly dispose of sweeper wastes at an approved dumpsite.

### References

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

Labor Surcharge and Equipment Rental Rates, State of California Department of Transportation (Caltrans), April 1, 2002 – March 31, 2003.

# Sandbag Barrier SE-8



## Objectives

| | | |
|---|---|---|
| EC | Erosion Control | ☒ |
| SE | Sediment Control | ☑ |
| TR | Tracking Control | |
| WE | Wind Erosion Control | |
| NS | Non-Stormwater Management Control | |
| WM | Waste Management and Materials Pollution Control | |

**Legend:**

☑ **Primary Objective**

☒ **Secondary Objective**

## Targeted Constituents

| | |
|---|---|
| Sediment | ☑ |
| Nutrients | |
| Trash | |
| Metals | |
| Bacteria | |
| Oil and Grease | |
| Organics | |

## Potential Alternatives

SE-1 Silt Fence

SE-5 Fiber Rolls

SE-6 Gravel Bag Berm

SE-9 Straw Bale Barrier

## Description and Purpose

A sandbag barrier is a series of sand-filled bags placed on a level contour to intercept sheet flows. Sandbag barriers pond sheet flow runoff, allowing sediment to settle out.

## Suitable Applications

Sandbag barriers may be suitable:

- As a linear sediment control measure:
  - Below the toe of slopes and erodible slopes
  - As sediment traps at culvert/pipe outlets
  - Below other small cleared areas
  - Along the perimeter of a site
  - Down slope of exposed soil areas
  - Around temporary stockpiles and spoil areas
  - Parallel to a roadway to keep sediment off paved areas
  - Along streams and channels
- As linear erosion control measure:
  - Along the face and at grade breaks of exposed and erodible slopes to shorten slope length and spread runoff as sheet flow

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- At the top of slopes to divert runoff away from disturbed slopes
- As check dams across mildly sloped construction roads

## Limitations

- It is necessary to limit the drainage area upstream of the barrier to 5 acres.
- Degraded sandbags may rupture when removed, spilling sand.
- Installation can be labor intensive.
- Barriers may have limited durability for long-term projects.
- When used to detain concentrated flows, maintenance requirements increase.
- Burlap should not be used for sandbags.

## Implementation

### *General*

A sandbag barrier consists of a row of sand-filled bags placed on a level contour. When appropriately placed, a sandbag barrier intercepts and slows sheet flow runoff, causing temporary ponding. The temporary ponding provides quiescent conditions allowing sediment to settle. While the sand-filled bags are porous, the fine sand tends to quickly plug with sediment, limiting the rate of flow through the barrier. If a porous barrier is desired, consider SE-1, Silt Fence, SE-5, Fiber Rolls, SE-6, Gravel Bag Berms, or SE-9, Straw Bale Barriers. Sandbag barriers also interrupt the slope length and thereby reduce erosion by reducing the tendency of sheet flows to concentrate into rivulets which erode rills, and ultimately gullies, into disturbed, sloped soils. Sandbag barriers are similar to ground bag berms, but less porous.

### *Design and Layout*

- Locate sandbag barriers on a level contour.
  - Slopes between 20:1 and 2:1 (H:V): Sandbags should be placed at a maximum interval of 50 ft (a closer spacing is more effective), with the first row near the slope toe.
  - Slopes 2:1 (H:V) or steeper: Sandbags should be placed at a maximum interval of 25 ft (a closer spacing is more effective), with the first row placed near the slope toe.
- Turn the ends of the sandbag barrier up slope to prevent runoff from going around the barrier.
- Allow sufficient space up slope from the barrier to allow ponding, and to provide room for sediment storage.
- For installation near the toe of the slope, consider moving the barrier away from the slope toe to facilitate cleaning. To prevent flow behind the barrier, sandbags can be placed perpendicular to the barrier to serve as cross barriers.
- Drainage area should not exceed 5 acres.

- Stack sandbags at least three bags high.
- Butt ends of bags tightly.
- Overlapp butt joints of row beneath with each successive row.
- Use a pyramid approach when stacking bags.
- In non-traffic areas
  - Height = 18 in. maximum
  - Top width = 24 in. minimum for three or more layer construction
  - Side slope = 2:1 or flatter
- In construction traffic areas
  - Height = 12 in. maximum
  - Top width = 24 in. minimum for three or more layer construction.
  - Side slopes = 2:1 or flatter.

### *Materials*

- ***Sandbag Material:*** Sandbag should be woven polypropylene, polyethylene or polyamide fabric, minimum unit weight of 4 ounces/yd$^2$, Mullen burst strength exceeding 300 lb/in$^2$ in conformance with the requirements in ASTM designation D3786, and ultraviolet stability exceeding 70% in conformance with the requirements in ASTM designation D4355. Use of burlap may not acceptable in some jurisdictions.
- ***Sandbag Size:*** Each sand-filled bag should have a length of 18 in., width of 12 in., thickness of 3 in., and mass of approximately 33 lbs. Bag dimensions are nominal, and may vary based on locally available materials.
- ***Fill Material:*** All sandbag fill material should be non-cohesive, Class 1 or Class 2 permeable material free from clay and deleterious material.

## Costs

Sandbag barriers are more costly, but typically have a longer useful life than other barriers. Empty sandbags cost $0.25 - $0.75. Average cost of fill material is $8 per yd$^3$. Pre-filled sandbags are more expensive at $1.50 - $2.00 per bag.

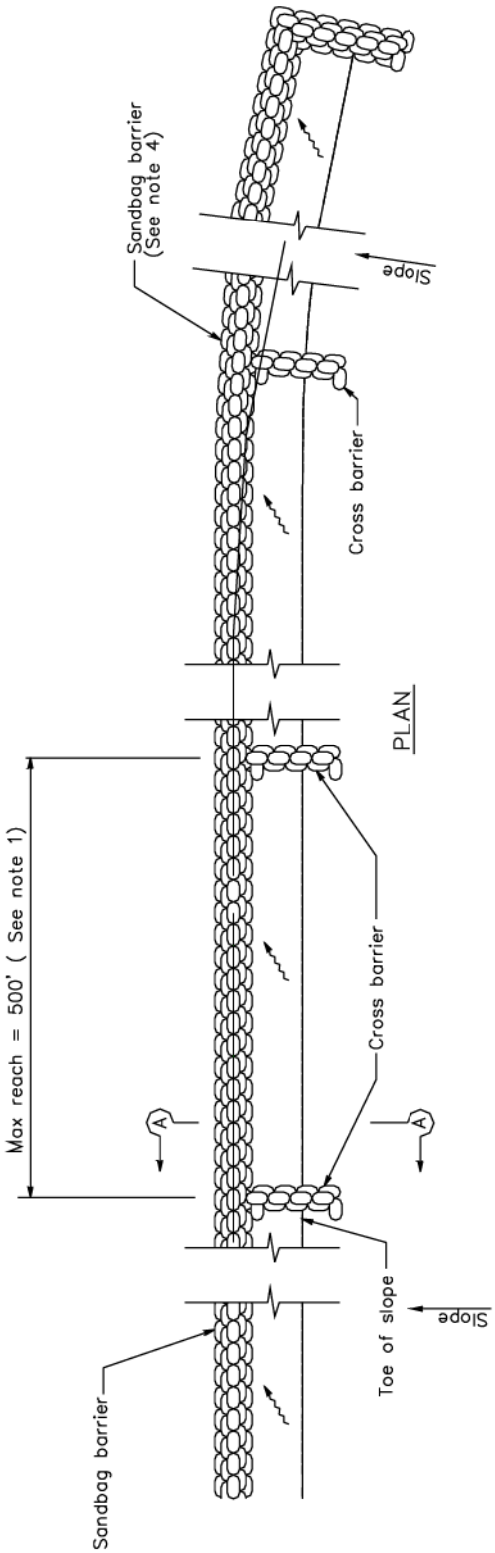
## Inspection and Maintenance

- Inspect BMPs prior to forecast rain, daily during extended rain events, after rain events, weekly during the rainy season, and at two-week intervals during the non-rainy season.
- Sandbags exposed to sunlight will need to be replaced every two to three months due to degradation of the bags.
- Reshape or replace sandbags as needed.

- Repair washouts or other damage as needed.
- Sediment that accumulates in the BMP must be periodically removed in order to maintain BMP effectiveness. Sediment should be removed when the sediment accumulation reaches one-third of the barrier height. Sediment removed during maintenance may be incorporated into earthwork on the site or disposed at an appropriate location.
- Remove sandbags when no longer needed. Remove sediment accumulation, and clean, re-grade, and stabilize the area.

## References

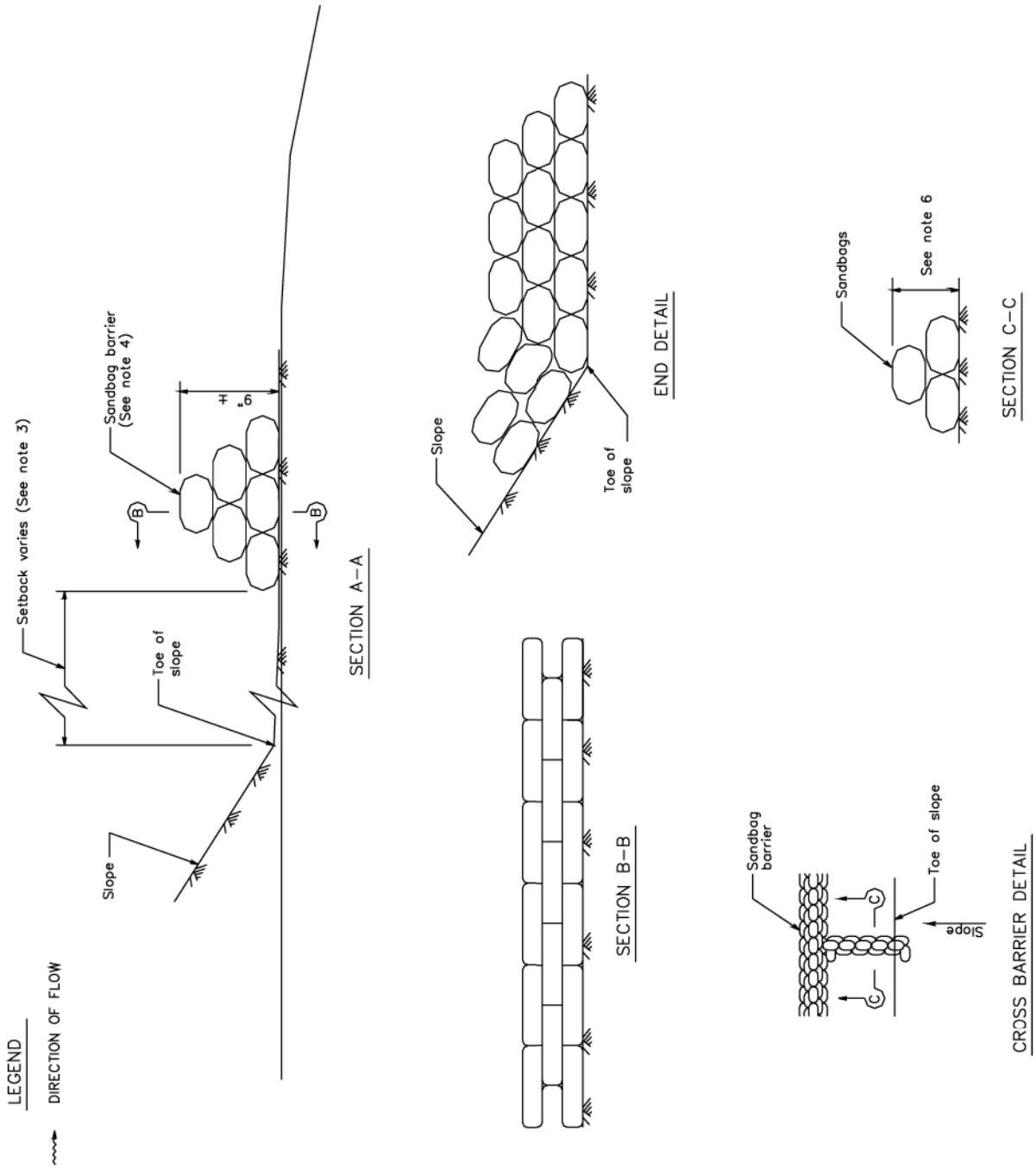
Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.



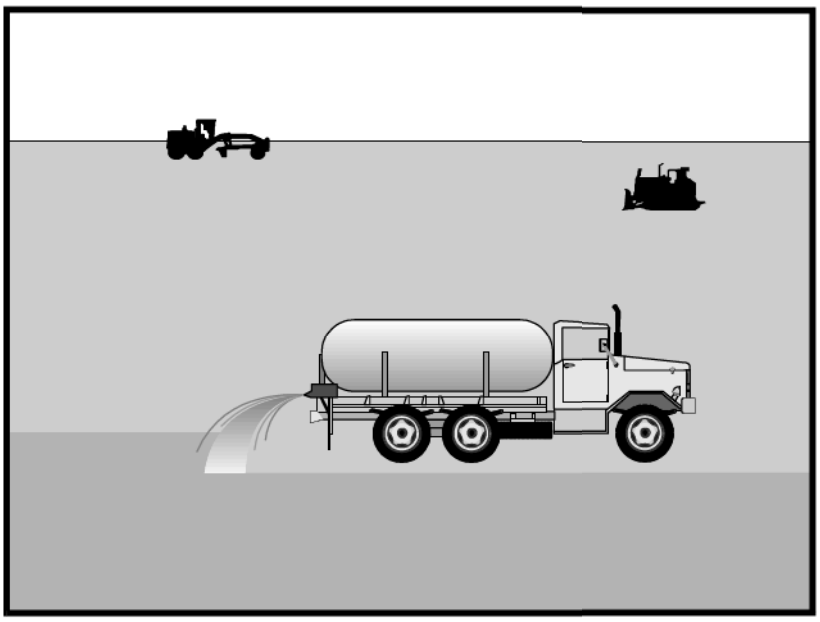

SANDBAG BARRIER

NOTES

1. Construct the length of each reach so that the change in base elevation along the reach does not exceed 1/2 the height of the linear barrier. In no case shall the reach length exceed 500'.
2. Place sandbags tightly.
3. Dimension may vary to fit field condition.
4. Sandbag barrier shall be a minimum of 3 bags high.
5. The end of the barrier shall be turned up slope.
6. Cross barriers shall be a min of 1/2 and a max of 2/3 the height of the linear barrier.
7. Sandbag rows and layers shall be staggered to eliminate gaps.


LEGEND
DIRECTION OF FLOW
Setback varies (See note 3)
Sandbag barrier (See note 4)
9"
B
B
Toe of slope
Slope
SECTION A–A
Slope
Toe of slope
END DETAIL
SECTION B–B
Sandbags
See note 6
SECTION C–C
Sandbag barrier
Toe of slope
Slope
C
C
CROSS BARRIER DETAIL

# Wind Erosion Control WE-1



## Objectives

| | | |
|---|---|---|
| EC | Erosion Control | |
| SE | Sediment Control | ☒ |
| TC | Tracking Control | |
| WE | Wind Erosion Control | ☑ |
| NS | Non-Stormwater Management Control | |
| WM | Waste Management and Materials Pollution Control | |

**Legend:**

☑ **Primary Objective**

☒ **Secondary Objective**

## Targeted Constituents

| | |
|---|---|
| Sediment | ☑ |
| Nutrients | |
| Trash | |
| Metals | |
| Bacteria | |
| Oil and Grease | |
| Organics | |

## Potential Alternatives

None

## Description and Purpose

Wind erosion or dust control consists of applying water or other dust palliatives as necessary to prevent or alleviate dust nuisance generated by construction activities. Covering small stockpiles or areas is an alternative to applying water or other dust palliatives.

## Suitable Applications

Wind erosion control BMPs are suitable during the following construction activities:

- Construction vehicle traffic on unpaved roads
- Drilling and blasting activities
- Sediment tracking onto paved roads
- Soils and debris storage piles
- Batch drop from front-end loaders
- Areas with unstabilized soil
- Final grading/site stabilization

## Limitations

- Watering prevents dust only for a short period and should be applied daily (or more often) to be effective.
- Over watering may cause erosion.

- Oil or oil-treated subgrade should not be used for dust control because the oil may migrate into drainageways and/or seep into the soil.
- Effectiveness depends on soil, temperature, humidity, and wind velocity.
- Chemically treated sub grades may make the soil water repellant, interfering with long-term infiltration and the vegetation/re-vegetation of the site. Some chemical dust suppressants may be subject to freezing and may contain solvents and should be handled properly.
- Asphalt, as a mulch tack or chemical mulch, requires a 24-hour curing time to avoid adherence to equipment, worker shoes, etc. Application should be limited because asphalt surfacing may eventually migrate into the drainage system.
- In compacted areas, watering and other liquid dust control measures may wash sediment or other constituents into the drainage system.

## Implementation

### *General*

California's Mediterranean climate, with short wet seasons and long hot dry seasons, allows the soils to thoroughly dry out. During these dry seasons, construction activities are at their peak, and disturbed and exposed areas are increasingly subject to wind erosion, sediment tracking and dust generated by construction equipment.

Dust control, as a BMP, is a practice that is already in place for many construction activities. Los Angeles, the North Coast, and Sacramento, among others, have enacted dust control ordinances for construction activities that cause dust to be transported beyond the construction project property line.

Recently, the State Air Resources Control Board has, under the authority of the Clean Air Act, started to address air quality in relation to inhalable particulate matter less than 10 microns (PM-10). Approximately 90 percent of these small particles are considered to be dust. Existing dust control regulations by local agencies, municipal departments, public works department, and public health departments are in place in some regions within California.

Many local agencies require dust control in order to comply with local nuisance laws, opacity laws (visibility impairment) and the requirements of the Clean Air Act. The following are measures that local agencies may have already implemented as requirements for dust control from contractors:

- Construction and Grading Permits: Require provisions for dust control plans.
- Opacity Emission Limits: Enforce compliance with California air pollution control laws.
- Increase Overall Enforcement Activities: Priority given to cases involving citizen complaints.
- Maintain Field Application Records: Require records of dust control measures from contractor;
- Stormwater Pollution Prevention Plan: (SWPPP): Integrate dust control measures into SWPPP.

### *Dust Control Practices*

Dust control BMPs generally stabilize exposed surfaces and minimize activities that suspend or track dust particles. The following table shows dust control practices that can be applied to site conditions that cause dust. For heavily traveled and disturbed areas, wet suppression (watering), chemical dust suppression, gravel asphalt surfacing, temporary gravel construction entrances, equipment wash-out areas, and haul truck covers can be employed as dust control applications. Permanent or temporary vegetation and mulching can be employed for areas of occasional or no construction traffic. Preventive measures would include minimizing surface areas to be disturbed, limiting onsite vehicle traffic to 15 mph, and controlling the number and activity of vehicles on a site at any given time.

| SITE CONDITION | DUST CONTROL PRACTICES | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Permanent Vegetation | Mulching | Wet Suppression (Watering) | Chemical Dust Suppression | Gravel or Asphalt | Silt Fences | Temporary Gravel Construction Entrances/Equipment Wash Down | Haul Truck Covers | Minimize Extent of Disturbed Area |
| Disturbed Areas not Subject to Traffic | X | X | X | X | X | | | | X |
| Disturbed Areas Subject to Traffic | | | X | X | X | | X | | X |
| Material Stock Pile Stabilization | | | X | X | | X | | | X |
| Demolition | | | X | | | | X | X | |
| Clearing/ Excavation | | | X | X | | X | | | X |
| Truck Traffic on Unpaved Roads | | | X | X | X | | X | X | |
| Mud/Dirt Carry Out | | | | | X | | X | | |

Additional preventive measures include:

- Schedule construction activities to minimize exposed area (EC-1, Scheduling).
- Quickly stabilize exposed soils using vegetation, mulching, spray-on adhesives, calcium chloride, sprinkling, and stone/gravel layering.
- Identify and stabilize key access points prior to commencement of construction.
- Minimize the impact of dust by anticipating the direction of prevailing winds.
- Direct most construction traffic to stabilized roadways within the project site.
- Water should be applied by means of pressure-type distributors or pipelines equipped with a spray system or hoses and nozzles that will ensure even distribution.
- All distribution equipment should be equipped with a positive means of shutoff.
- Unless water is applied by means of pipelines, at least one mobile unit should be available at all times to apply water or dust palliative to the project.

- If reclaimed waste water is used, the sources and discharge must meet California Department of Health Services water reclamation criteria and the Regional Water Quality Control Board requirements. Non-potable water should not be conveyed in tanks or drain pipes that will be used to convey potable water and there should be no connection between potable and non-potable supplies. Non-potable tanks, pipes, and other conveyances should be marked, "NON-POTABLE WATER - DO NOT DRINK."

- Materials applied as temporary soil stabilizers and soil binders also generally provide wind erosion control benefits.

- Pave or chemically stabilize access points where unpaved traffic surfaces adjoin paved roads.

- Provide covers for haul trucks transporting materials that contribute to dust.

- Provide for wet suppression or chemical stabilization of exposed soils.

- Provide for rapid clean up of sediments deposited on paved roads. Furnish stabilized construction road entrances and vehicle wash down areas.

- Stabilize inactive construction sites using vegetation or chemical stabilization methods.

- Limit the amount of areas disturbed by clearing and earth moving operations by scheduling these activities in phases.

For chemical stabilization, there are many products available for chemically stabilizing gravel roadways and stockpiles. If chemical stabilization is used, the chemicals should not create any adverse effects on stormwater, plant life, or groundwater.

### Costs

Installation costs for water and chemical dust suppression are low, but annual costs may be quite high since these measures are effective for only a few hours to a few days.

### Inspection and Maintenance

- Inspect and verify that activity-based BMPs are in place prior to the commencement of associated activities. While activities associated with the BMP are under way, inspect weekly during the rainy season and at two-week intervals in the non-rainy season to verify continued BMP implementation.

- Check areas protected to ensure coverage.

- Most dust control measures require frequent, often daily, or multiple times per day attention.

### References

Best Management Practices and Erosion Control Manual for Construction Sites, Flood Control District of Maricopa County, Arizona, September 1992.

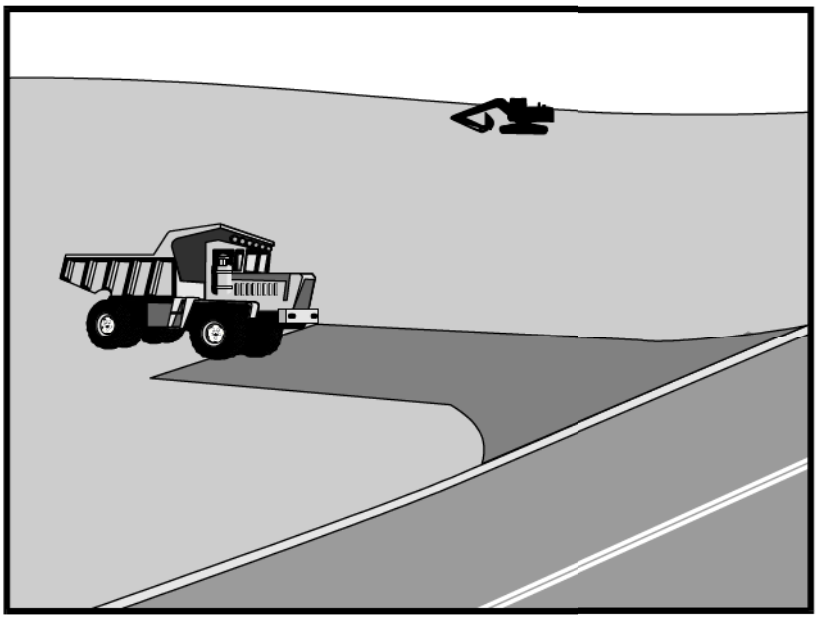
California Air Pollution Control Laws, California Air Resources Board, 1992.

Caltrans, Standard Specifications, Sections 10, “Dust Control”; Section 17, “Watering”; and Section 18, “Dust Palliative”.

Prospects for Attaining the State Ambient Air Quality Standards for Suspended Particulate Matter (PM10), Visibility Reducing Particles, Sulfates, Lead, and Hydrogen Sulfide, California Air Resources Board, April 1991.

Stormwater Quality Handbooks Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

# Stabilized Construction Entrance/Exit TC-1



## Objectives

| | | |
|---|---|---|
| EC | Erosion Control | ☒ |
| SE | Sediment Control | ☒ |
| TC | Tracking Control | ☑ |
| WE | Wind Erosion Control | |
| NS | Non-Stormwater Management Control | |
| WM | Waste Management and Materials Pollution Control | |

**Legend:**

☑ **Primary Objective**

☒ **Secondary Objective**

## Targeted Constituents

| | |
|---|---|
| Sediment | ☑ |
| Nutrients | |
| Trash | |
| Metals | |
| Bacteria | |
| Oil and Grease | |
| Organics | |

## Potential Alternatives

None

## Description and Purpose

A stabilized construction access is defined by a point of entrance/exit to a construction site that is stabilized to reduce the tracking of mud and dirt onto public roads by construction vehicles.

## Suitable Applications

Use at construction sites:

- Where dirt or mud can be tracked onto public roads.
- Adjacent to water bodies.
- Where poor soils are encountered.
- Where dust is a problem during dry weather conditions.

## Limitations

- Entrances and exits require periodic top dressing with additional stones.
- This BMP should be used in conjunction with street sweeping on adjacent public right of way.
- Entrances and exits should be constructed on level ground only.
- Stabilized construction entrances are rather expensive to construct and when a wash rack is included, a sediment trap of some kind must also be provided to collect wash water runoff.

## Implementation

### *General*

A stabilized construction entrance is a pad of aggregate underlain with filter cloth located at any point where traffic will be entering or leaving a construction site to or from a public right of way, street, alley, sidewalk, or parking area. The purpose of a stabilized construction entrance is to reduce or eliminate the tracking of sediment onto public rights of way or streets. Reducing tracking of sediments and other pollutants onto paved roads helps prevent deposition of sediments into local storm drains and production of airborne dust.

Where traffic will be entering or leaving the construction site, a stabilized construction entrance should be used. NPDES permits require that appropriate measures be implemented to prevent tracking of sediments onto paved roadways, where a significant source of sediments is derived from mud and dirt carried out from unpaved roads and construction sites.

Stabilized construction entrances are moderately effective in removing sediment from equipment leaving a construction site. The entrance should be built on level ground. Advantages of the Stabilized Construction Entrance/Exit is that it does remove some sediment from equipment and serves to channel construction traffic in and out of the site at specified locations. Efficiency is greatly increased when a washing rack is included as part of a stabilized construction entrance/exit.

### *Design and Layout*

- Construct on level ground where possible.
- Select 3 to 6 in. diameter stones.
- Use minimum depth of stones of 12 in. or as recommended by soils engineer.
- Construct length of 50 ft minimum, and 30 ft minimum width.
- Rumble racks constructed of steel panels with ridges and installed in the stabilized entrance/exit will help remove additional sediment and to keep adjacent streets clean.
- Provide ample turning radii as part of the entrance.
- Limit the points of entrance/exit to the construction site.
- Limit speed of vehicles to control dust.
- Properly grade each construction entrance/exit to prevent runoff from leaving the construction site.
- Route runoff from stabilized entrances/exits through a sediment trapping device before discharge.
- Design stabilized entrance/exit to support heaviest vehicles and equipment that will use it.
- Select construction access stabilization (aggregate, asphaltic concrete, concrete) based on longevity, required performance, and site conditions. Do not use asphalt concrete (AC) grindings for stabilized construction access/roadway.

- If aggregate is selected, place crushed aggregate over geotextile fabric to at least 12 in. depth, or place aggregate to a depth recommended by a geotechnical engineer. A crushed aggregate greater than 3 in. but smaller than 6 in. should be used.
- Designate combination or single purpose entrances and exits to the construction site.
- Require that all employees, subcontractors, and suppliers utilize the stabilized construction access.
- Implement SE-7, Street Sweeping and Vacuuming, as needed.
- All exit locations intended to be used for more than a two-week period should have stabilized construction entrance/exit BMPs.

## Inspection and Maintenance

- Inspect and verify that activity–based BMPs are in place prior to the commencement of associated activities. While activities associated with the BMPs are under way, inspect weekly during the rainy season and of two-week intervals in the non-rainy season to verify continued BMP implementation.
- Inspect local roads adjacent to the site daily. Sweep or vacuum to remove visible accumulated sediment.
- Remove aggregate, separate and dispose of sediment if construction entrance/exit is clogged with sediment.
- Keep all temporary roadway ditches clear.
- Check for damage and repair as needed.
- Replace gravel material when surface voids are visible.
- Remove all sediment deposited on paved roadways within 24 hours.
- Remove gravel and filter fabric at completion of construction

## Costs

Average annual cost for installation and maintenance may vary from $1,200 to $4,800 each, averaging $2,400 per entrance. Costs will increase with addition of washing rack, and sediment trap. With wash rack, costs range from $1,200 - $6,000 each, averaging $3,600 per entrance.

## References

Manual of Standards of Erosion and Sediment Control Measures, Association of Bay Area Governments, May 1995.

National Management Measures to Control Nonpoint Source Pollution from Urban Areas, USEPA Agency, 2002.

Proposed Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters, Work Group Working Paper, USEPA, April 1992.

Stormwater Quality Handbooks Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

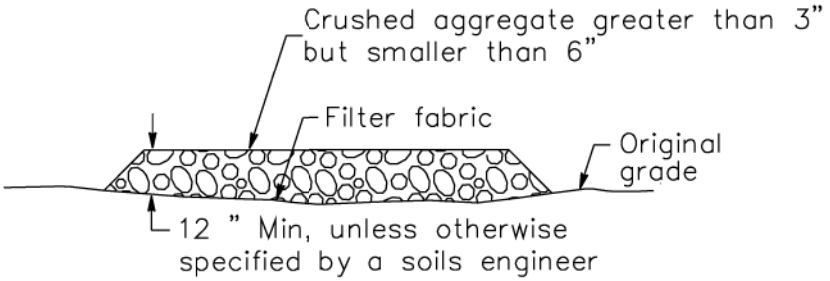
Stormwater Management of the Puget Sound Basin, Technical Manual, Publication #91-75, Washington State Department of Ecology, February 1992.

Virginia Erosion and Sedimentation Control Handbook, Virginia Department of Conservation and Recreation, Division of Soil and Water Conservation, 1991.

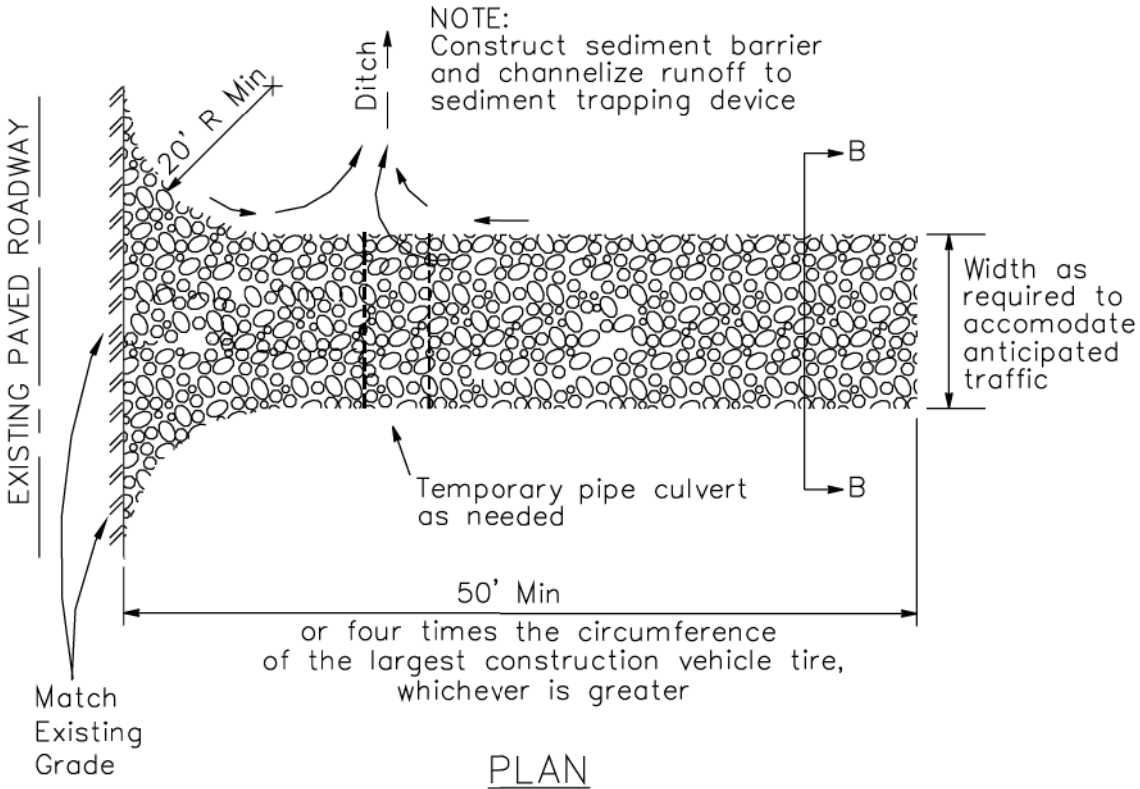
Guidance Specifying Management Measures for Nonpoint Pollution in Coastal Waters, EPA 840-B-9-002, USEPA, Office of Water, Washington, DC, 1993.

Water Quality Management Plan for the Lake Tahoe Region, Volume II, Handbook of Management Practices, Tahoe Regional Planning Agency, November 1988.

# Stabilized Construction Entrance/Exit TC-1

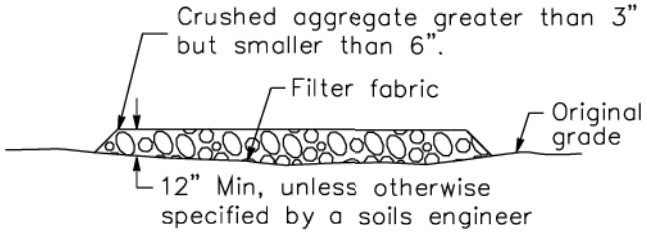



SECTION B–B
NTS




PLAN
NTS

# Stabilized Construction Entrance/Exit TC-1




SECTION B–B
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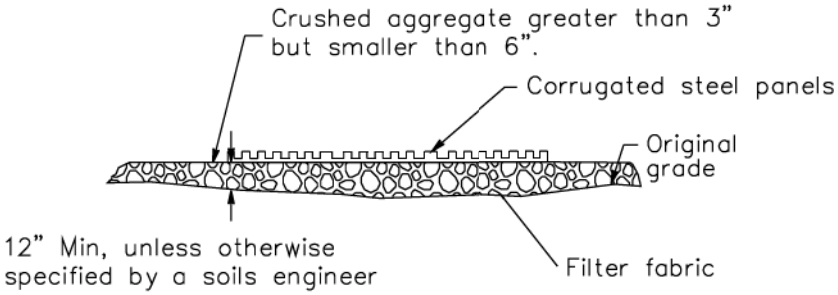
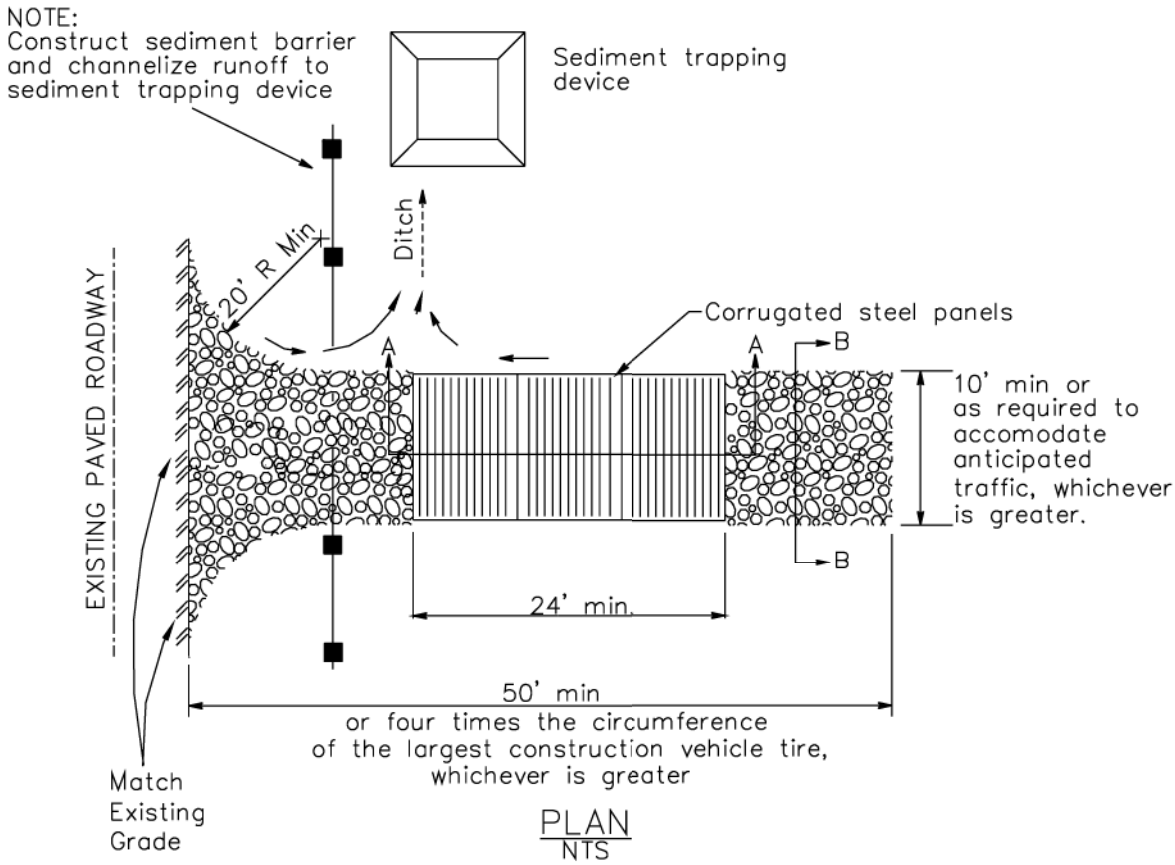



SECTION A–A
NOT TO SCALE




PLAN
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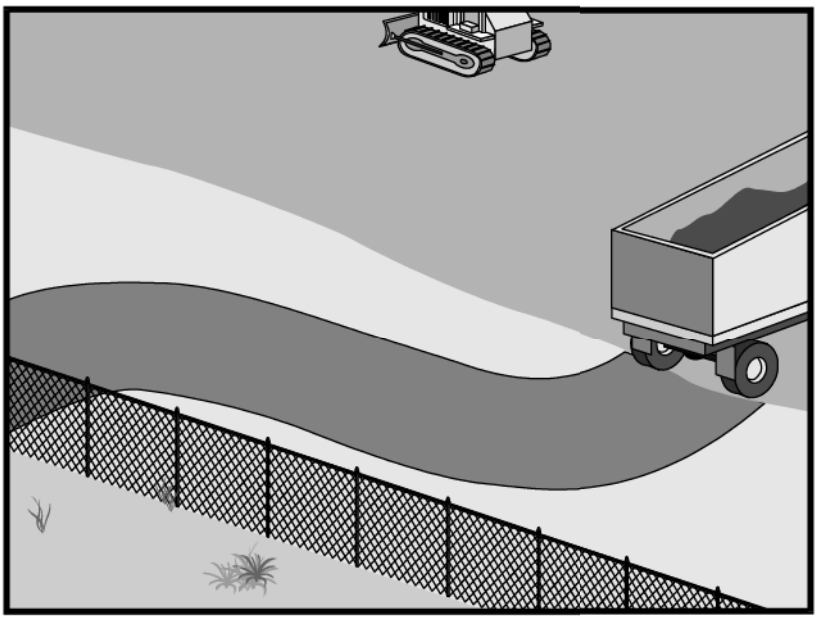
# Stabilized Construction Roadway TC-2



## Objectives

| | | |
|---|---|---|
| EC | Erosion Control | ☒ |
| SE | Sediment Control | ☒ |
| TC | Tracking Control | ☑ |
| WE | Wind Erosion Control | |
| NS | Non-Stormwater Management Control | |
| WM | Waste Management and Materials Pollution Control | |

**Legend:**

☑ **Primary Objective**

☒ **Secondary Objective**

## Targeted Constituents

| | |
|---|---|
| Sediment | ☑ |
| Nutrients | |
| Trash | |
| Metals | |
| Bacteria | |
| Oil and Grease | |
| Organics | |

## Potential Alternatives

None

## Description and Purpose

Access roads, subdivision roads, parking areas, and other onsite vehicle transportation routes should be stabilized immediately after grading, and frequently maintained to prevent erosion and control dust.

## Suitable Applications

This BMP should be applied for the following conditions:

- Temporary Construction Traffic:
  - Phased construction projects and offsite road access
  - Construction during wet weather
- Construction roadways and detour roads:
  - Where mud tracking is a problem during wet weather
  - Where dust is a problem during dry weather
  - Adjacent to water bodies
  - Where poor soils are encountered

## Limitations

- The roadway must be removed or paved when construction is complete.

- Certain chemical stabilization methods may cause stormwater or soil pollution and should not be used. See WE-1, Wind Erosion Control.
- Management of construction traffic is subject to air quality control measures. Contact the local air quality management agency.
- Materials will likely need to be removed prior to final project grading and stabilization.
- Use of this BMP may not be applicable to very short duration projects.

## Implementation

### *General*

Areas that are graded for construction vehicle transport and parking purposes are especially susceptible to erosion and dust. The exposed soil surface is continually disturbed, leaving no opportunity for vegetative stabilization. Such areas also tend to collect and transport runoff waters along their surfaces. During wet weather, they often become muddy quagmires that generate significant quantities of sediment that may pollute nearby streams or be transported offsite on the wheels of construction vehicles. Dirt roads can become so unstable during wet weather that they are virtually unusable.

Efficient construction road stabilization not only reduces onsite erosion but also can significantly speed onsite work, avoid instances of immobilized machinery and delivery vehicles, and generally improve site efficiency and working conditions during adverse weather

### *Installation/Application Criteria*

Permanent roads and parking areas should be paved as soon as possible after grading. As an alternative where construction will be phased, the early application of gravel or chemical stabilization may solve potential erosion and stability problems. Temporary gravel roadway should be considered during the rainy season and on slopes greater than 5%.

Temporary roads should follow the contour of the natural terrain to the maximum extent possible. Slope should not exceed 15%. Roadways should be carefully graded to drain transversely. Provide drainage swales on each side of the roadway in the case of a crowned section or one side in the case of a super elevated section. Simple gravel berms without a trench can also be used.

Installed inlets should be protected to prevent sediment laden water from entering the storm sewer system (SE-10, Storm Drain Inlet Protection). In addition, the following criteria should be considered.

- Road should follow topographic contours to reduce erosion of the roadway.
- The roadway slope should not exceed 15%.
- Chemical stabilizers or water are usually required on gravel or dirt roads to prevent dust (WE-1, Wind Erosion Control).
- Properly grade roadway to prevent runoff from leaving the construction site.
- Design stabilized access to support heaviest vehicles and equipment that will use it.

- Stabilize roadway using aggregate, asphalt concrete, or concrete based on longevity, required performance, and site conditions. The use of cold mix asphalt or asphalt concrete (AC) grindings for stabilized construction roadway is not allowed.
- Coordinate materials with those used for stabilized construction entrance/exit points.
- If aggregate is selected, place crushed aggregate over geotextile fabric to at least 12 in. depth. A crushed aggregate greater than 3 in. but smaller than 6 in. should be used.

## Inspection and Maintenance

- Inspect and verify that activity–based BMPs are in place prior to the commencement of associated activities. While activities associated with the BMP are under way, impact weekly during the rainy season and of two-week intervals in the non-rainy season to verify continued BMP implementation.
- Keep all temporary roadway ditches clear.
- When no longer required, remove stabilized construction roadway and re-grade and repair slopes.
- Periodically apply additional aggregate on gravel roads.
- Active dirt construction roads are commonly watered three or more times per day during the dry season.

## Costs

Gravel construction roads are moderately expensive, but cost is often balanced by reductions in construction delay. No additional costs for dust control on construction roads should be required above that needed to meet local air quality requirements.

## References

Blueprint for a Clean Bay: Best Management Practices to Prevent Stormwater Pollution from Construction Related Activities; Santa Clara Valley Nonpoint Source Pollution Control Program, 1995.

Coastal Nonpoint Pollution Control Program; Program Development and Approval Guidance, Working Group, Working Paper; USEPA, April 1992.

Manual of Standards of Erosion and Sediment Control Measures, Association of Bay Area Governments, May 1995.

Stormwater Quality Handbooks Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

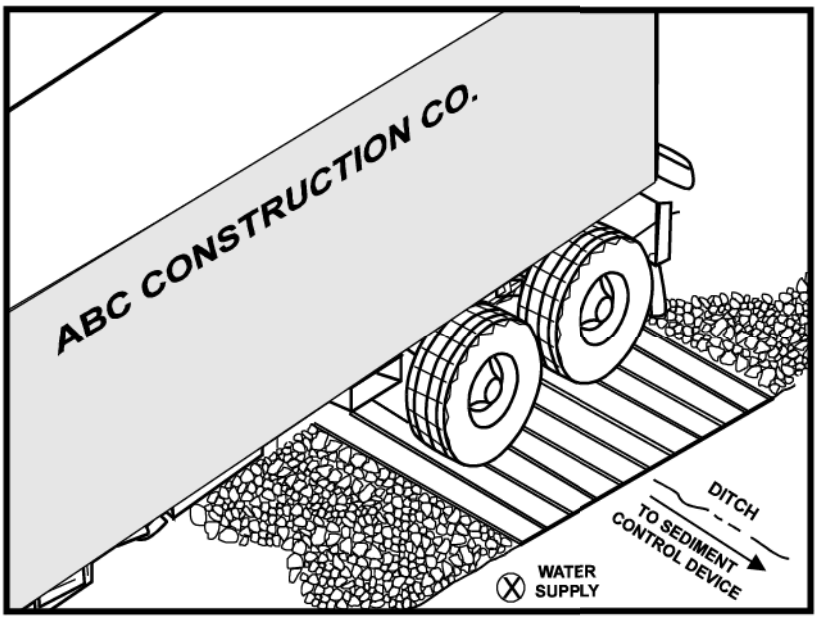
Stormwater Management for Construction Activities, Developing Pollution Prevention Plans and Best Management Practices, EPA 832-R-92005; USEPA, April 1992.

Stormwater Management of the Puget Sound Basin, Technical Manual, Publication #91-75, Washington State Department of Ecology, February 1992.

Virginia Erosion and Sedimentation Control Handbook, Virginia Department of Conservation and Recreation, Division of Soil and Water Conservation, 1991.

Water Quality Management Plan for the Lake Tahoe Region, Volume II, Handbook of Management Practices, Tahoe Regional Planning Agency, November 1988.

# Entrance/Outlet Tire Wash TC-3




## Objectives

| | | |
|---|---|---|
| EC | Erosion Control | |
| SE | Sediment Control | ☒ |
| TC | Tracking Control | ☑ |
| WE | Wind Erosion Control | |
| NS | Non-Stormwater Management Control | |
| WM | Waste Management and Materials Pollution Control | |

**Legend:**

☑ **Primary Objective**

☒ **Secondary Objective**

## Targeted Constituents

| | |
|---|---|
| Sediment | ☑ |
| Nutrients | |
| Trash | |
| Metals | |
| Bacteria | |
| Oil and Grease | |
| Organics | |

## Potential Alternatives

TC-1 Stabilized Construction Entrance/Exit

## Description and Purpose

A tire wash is an area located at stabilized construction access points to remove sediment from tires and under carriages and to prevent sediment from being transported onto public roadways.

## Suitable Applications

Tire washes may be used on construction sites where dirt and mud tracking onto public roads by construction vehicles may occur.

## Limitations

- The tire wash requires a supply of wash water.
- A turnout or doublewide exit is required to avoid having entering vehicles drive through the wash area.
- Do not use where wet tire trucks leaving the site leave the road dangerously slick.

## Implementation

- Incorporate with a stabilized construction entrance/exit. See TC-1, Stabilized Construction Entrance/Exit.
- Construct on level ground when possible, on a pad of coarse aggregate greater than 3 in. but smaller than 6 in. A geotextile fabric should be placed below the aggregate.
- Wash rack should be designed and constructed/manufactured for anticipated traffic loads.

- Provide a drainage ditch that will convey the runoff from the wash area to a sediment trapping device. The drainage ditch should be of sufficient grade, width, and depth to carry the wash runoff.
- Use hoses with automatic shutoff nozzles to prevent hoses from being left on.
- Require that all employees, subcontractors, and others that leave the site with mud caked tires and undercarriages to use the wash facility.
- Implement SC-7, Street Sweeping and Vacuuming, as needed.

## Costs

Costs are low for installation of wash rack.

## Inspection and Maintenance

- Inspect and verify that activity–based BMPs are in place prior to the commencement of associated activities. While activities associated with the BMP are under way, inspect weekly during the rainy season and of two-week intervals in the non-rainy season to verify continued BMP implementation.
- Inspect BMPs subject to non-stormwater discharge daily while non-stormwater discharges occur.
- Remove accumulated sediment in wash rack and/or sediment trap to maintain system performance.
- Inspect routinely for damage and repair as needed.

## References

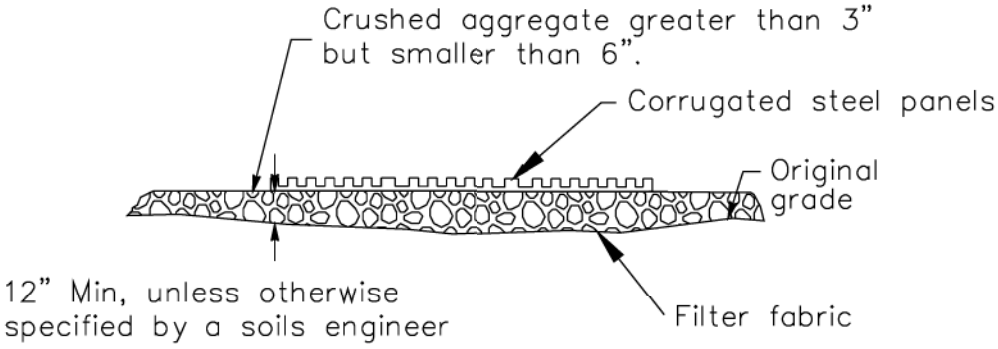
Blueprint for a Clean Bay: Best Management Practices to Prevent Stormwater Pollution from Construction Related Activities; Santa Clara Valley Nonpoint Source Pollution Control Program, 1995.

Coastal Nonpoint Pollution Control Program; Program Development and Approval Guidance, Working Group, Working Paper; USEPA, April 1992.

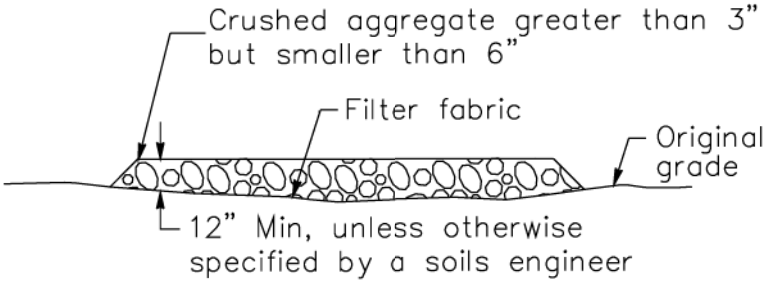
Manual of Standards of Erosion and Sediment Control Measures, Association of Bay Area Governments, May 1995.

Stormwater Quality Handbooks Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

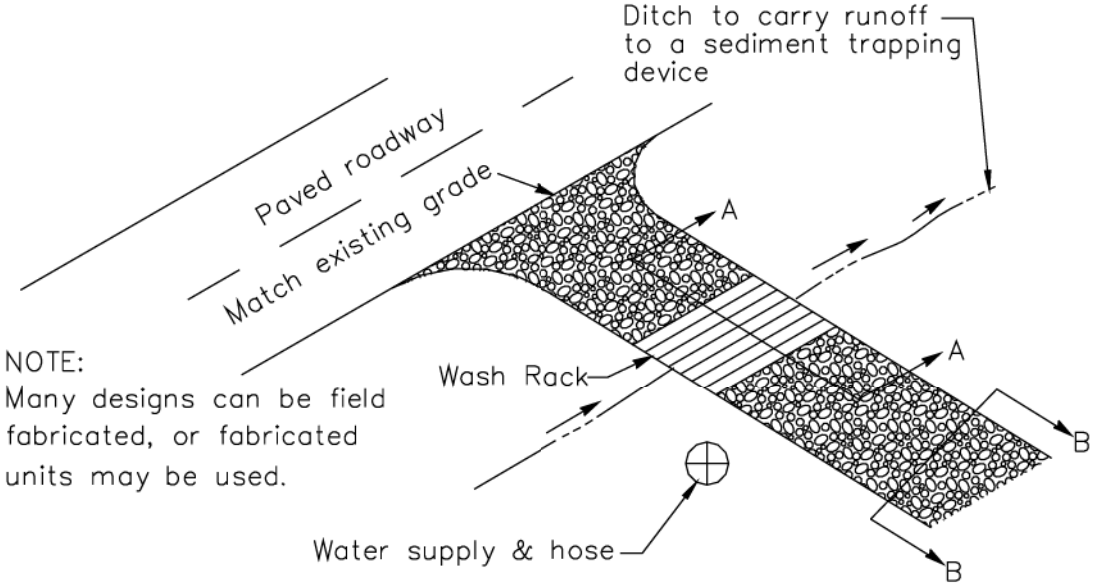
Stormwater Management for Construction Activities, Developing Pollution Prevention Plans and Best Management Practices, EPA 832-R-92005; USEPA, April 1992.




SECTION A–A
NOT TO SCALE

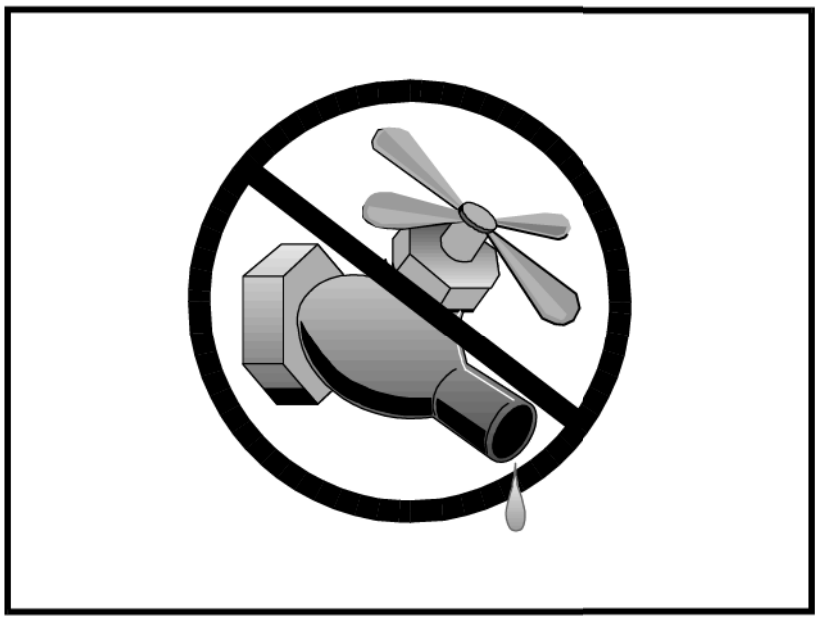



SECTION B–B
NTS




TYPICAL TIRE WASH
NOT TO SCALE

# Water Conservation Practices NS-1



## Objectives

| | | |
|---|---|---|
| EC | Erosion Control | ☒ |
| SE | Sediment Control | ☒ |
| TR | Tracking Control | |
| WE | Wind Erosion Control | |
| NS | Non-Stormwater Management Control | ☑ |
| WM | Waste Management and Materials Pollution Control | |

Legend:

☑ Primary Objective

☒ Secondary Objective

## Targeted Constituents

| | |
|---|---|
| Sediment | ☑ |
| Nutrients | |
| Trash | |
| Metals | |
| Bacteria | |
| Oil and Grease | |
| Organics | |

## Potential Alternatives

None

## Description and Purpose

Water conservation practices are activities that use water during the construction of a project in a manner that avoids causing erosion and the transport of pollutants offsite. These practices can reduce or eliminate non-stormwater discharges.

## Suitable Applications

Water conservation practices are suitable for all construction sites where water is used, including piped water, metered water, trucked water, and water from a reservoir.

## Limitations

- None identified.

## Implementation

- Keep water equipment in good working condition.
- Stabilize water truck filling area.
- Repair water leaks promptly.
- Washing of vehicles and equipment on the construction site is discouraged.
- Avoid using water to clean construction areas. If water must be used for cleaning or surface preparation, surface should be swept and vacuumed first to remove dirt. This will minimize amount of water required.

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- Direct construction water runoff to areas where it can soak into the ground or be collected and reused.
- Authorized non-stormwater discharges to the storm drain system, channels, or receiving waters are acceptable with the implementation of appropriate BMPs.
- Lock water tank valves to prevent unauthorized use.

## Costs

The cost is small to none compared to the benefits of conserving water.

## Inspection and Maintenance

- Inspect and verify that activity based BMPs are in place prior to the commencement of authorized non-stormwater discharges.
- Inspect BMPs subject to non-stormwater discharges daily while non-stormwater discharges are occuring.
- Repair water equipment as needed to prevent unintended discharges.
  - Water trucks
  - Water reservoirs (water buffalos)
  - Irrigation systems
  - Hydrant connections

## References

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

# Dewatering Operations NS-2

## Objectives

| | | |
|---|---|---|
| EC | Erosion Control | |
| SE | Sediment Control | ☒ |
| TR | Tracking Control | |
| WE | Wind Erosion Control | |
| NS | Non-Stormwater Management Control | ☑ |
| WM | Waste Management and Materials Pollution Control | |

**Legend:**

☑ **Primary Objective**

☒ **Secondary Objective**

## Description and Purpose

Dewatering operations are practices that manage the discharge of pollutants when non-stormwater and accumulated precipitation must be removed from a work location so that construction work may be accomplished.

## Suitable Applications

These practices are implemented for discharges of non-stormwater from construction sites. Non-stormwaters include, but are not limited to, groundwater, water from cofferdams, water diversions, and waters used during construction activities that must be removed from a work area.

Practices identified in this section are also appropriate for implementation when managing the removal of accumulated precipitation (stormwater) from depressed areas at a construction site.

## Limitations

- Site conditions will dictate design and use of dewatering operations.
- The controls discussed in this best management practice (BMP) address sediment only.
- The controls detailed in this BMP only allow for minimal settling time for sediment particles. Use only when site conditions restrict the use of the other control methods.
- Dewatering operations will require, and must comply with, applicable local permits.

## Targeted Constituents

| | |
|---|---|
| Sediment | ☑ |
| Nutrients | |
| Trash | |
| Metals | |
| Bacteria | |
| Oil and Grease | ☑ |
| Organics | |

## Potential Alternatives

SE-5: Fiber Roll

SE-6: Gravel Bag Berm

SE-9: Straw Bale Barrier

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- Avoid dewatering discharges where possible by using the water for dust control, by infiltration, etc.

## Implementation

- Dewatering non-stormwater cannot be discharged without prior notice to and approval from the Regional Water Quality Control Board (RWQCB) and local stormwater management agency. This includes stormwater that is co-mingled with groundwater or other non-stormwater sources. Once the discharge is allowed, appropriate BMPs must be implemented to ensure the discharge complies with all permit requirements and regional and watershed-specific requirements.

- RWQCB may require a separate NPDES permit prior to the dewatering discharge of non-stormwater. These permits will have specific testing, monitoring, and discharge requirements and can take significant time to obtain.

- The flow chart shown in Figure 1 should be utilized to guide dewatering operations.

- The owner will coordinate monitoring and permit compliance.

- Additional permits or permissions from other agencies may be required for dewatering cofferdams or diversions.

- Dewatering discharges must not cause erosion at the discharge point.

A variety of methods can be used to treat water during dewatering operations. Several devices are presented below and provide options to achieve sediment removal. The size of particles present in the sediment and Permit or receiving water limitations on sediment are key considerations for selecting sediment treatment option(s); in some cases, the use of multiple devices may be appropriate.

### *Sediment Basin (see also SE-2)*

*Description:*

- A sediment basin is a temporary basin with a controlled release structure that is formed by excavation or construction of an embankment to detain sediment-laden runoff and allow sediment to settle out before discharging. Sediment basins are generally larger than Sediment Traps (SE-3).

*Appropriate Applications:*

- Effective for the removal of gravel, sand, silt, some metals that settle out with the sediment, and trash.

*Implementation:*

- Excavation and construction of related facilities is required.

- Temporary sediment basins must be fenced if safety is a concern.

- Outlet protection is required to prevent erosion at the outfall location.

*Maintenance:*

- Maintenance is required for safety fencing, vegetation, embankment, inlet and outfall structures, as well as other features.
- Removal of sediment is required when the storage volume is reduced by one-half.

***Sediment Trap (See also SE-3)***

*Description:*

- A sediment trap is a temporary basin formed by excavation and/or construction of an earthen embankment across a waterway or low drainage area to detain sediment-laden runoff and allow sediment to settle out before discharging. Sediment traps are generally smaller than Sediment Basins (SE-2).

*Appropriate Applications:*

Effective for the removal of large and medium sized particles (sand and gravel) and some metals that settle out with the sediment.

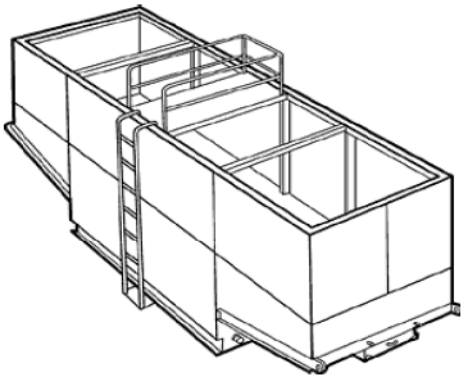
*Implementation:*

- Excavation and construction of related facilities is required.
- Trap inlets should be located to maximize the travel distance to the trap outlet.
- Use rock or vegetation to protect the trap outlets against erosion.

*Maintenance:*

- Maintenance is required for vegetation, embankment, inlet and outfall structures, as well as other features.
- Removal of sediment is required when the storage volume is reduced by one-third.

***Weir Tanks***



*Description:*

- A weir tank separates water and waste by using weirs. The configuration of the weirs (over and under weirs) maximizes the residence time in the tank and determines the waste to be removed from the water, such as oil, grease, and sediments.

*Appropriate Applications:*

- The tank removes trash, some settleable solids (gravel, sand, and silt), some visible oil and grease, and some metals (removed with sediment). To achieve high levels of flow, multiple tanks can be used in parallel. If additional treatment is desired, the tanks can be placed in series or as pre-treatment for other methods.

*Implementation:*

- Tanks are delivered to the site by the vendor, who can provide assistance with set-up and operation.
- Tank size will depend on flow volume, constituents of concern, and residency period required. Vendors should be consulted to appropriately size tank.

*Maintenance:*

- Periodic cleaning is required based on visual inspection or reduced flow.
- Oil and grease disposal must be by licensed waste disposal company.

***Dewatering Tanks***

*Description:*

- A dewatering tank removes debris and sediment. Flow enters the tank through the top, passes through a fabric filter, and is discharged through the bottom of the tank. The filter separates the solids from the liquids.

*Appropriate Applications:*

- The tank removes trash, gravel, sand, and silt, some visible oil and grease, and some metals (removed with sediment). To achieve high levels of flow, multiple tanks can be used in parallel. If additional treatment is desired, the tanks can be placed in series or as pre-treatment for other methods.

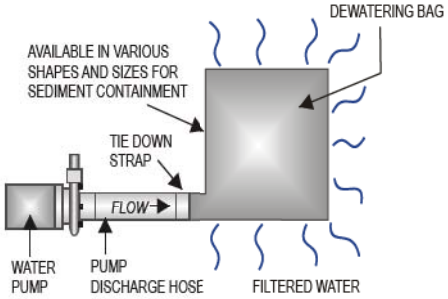
*Implementation:*

- Tanks are delivered to the site by the vendor, who can provide assistance with set-up and operation.
- Tank size will depend on flow volume, constituents of concern, and residency period required. Vendors should be consulted to appropriately size tank.

*Maintenance:*

- Periodic cleaning is required based on visual inspection or reduced flow.
- Oil and grease disposal must be by licensed waste disposal company.

### *Gravity Bag Filter*




*Description:*

- A gravity bag filter, also referred to as a dewatering bag, is a square or rectangular bag made of non-woven geotextile fabric that collects sand, silt, and fines.

*Appropriate Applications:*

- Effective for the removal of sediments (gravel, sand, and silt). Some metals are removed with the sediment.

*Implementation:*

- Water is pumped into one side of the bag and seeps through the bottom and sides of the bag.
- A secondary barrier, such as a rock filter bed or straw/hay bale barrier, is placed beneath and beyond the edges of the bag to capture sediments that escape the bag.

*Maintenance:*

- Inspection of the flow conditions, bag condition, bag capacity, and the secondary barrier is required.
- Replace the bag when it no longer filters sediment or passes water at a reasonable rate.
- The bag is disposed of offsite.

***Sand Media Particulate Filter***

*Description:*

- Water is treated by passing it through canisters filled with sand media. Generally, sand filters provide a final level of treatment. They are often used as a secondary or higher level of treatment after a significant amount of sediment and other pollutants have been removed using other methods.

*Appropriate Applications:*

- Effective for the removal of trash, gravel, sand, and silt and some metals, as well as the reduction of biochemical oxygen demand (BOD) and turbidity.
- Sand filters can be used for stand-alone treatment or in conjunction with bag and cartridge filtration if further treatment is required.
- Sand filters can also be used to provide additional treatment to water treated via settling or basic filtration.

*Implementation:*

- The filters require delivery to the site and initial set up. The vendor can provide assistance with installation and operation.

*Maintenance:*

- The filters require regular service to monitor and maintain the level of the sand media. If subjected to high loading rates, filters can plug quickly.
- Venders generally provide data on maximum head loss through the filter. The filter should be monitored daily while in use, and cleaned when head loss reaches target levels.
- If cleaned by backwashing, the backwash water may need to be hauled away for disposal, or returned to the upper end of the treatment train for another pass through the series of dewatering BMPs.

***Pressurized Bag Filter***

*Description:*

- A pressurized bag filter is a unit composed of single filter bags made from polyester felt material. The water filters through the unit and is discharged through a header. Vendors provide bag filters in a variety of configurations. Some units include a combination of bag filters and cartridge filters for enhanced contaminant removal.

*Appropriate Applications:*

- Effective for the removal of sediment (sand and silt) and some metals, as well as the reduction of BOD, turbidity, and hydrocarbons. Oil absorbent bags are available for hydrocarbon removal.

- Filters can be used to provide secondary treatment to water treated via settling or basic filtration.

*Implementation:*

- The filters require delivery to the site and initial set up. The vendor can provide assistance with installation and operation.

*Maintenance:*

- The filter bags require replacement when the pressure differential equals or exceeds the manufacturer's recommendation.

***Cartridge Filter***

*Description:*

- Cartridge filters provide a high degree of pollutant removal by utilizing a number of individual cartridges as part of a larger filtering unit. They are often used as a secondary or higher (polishing) level of treatment after a significant amount of sediment and other pollutants are removed. Units come with various cartridge configurations (for use in series with bag filters) or with a larger single cartridge filtration unit (with multiple filters within).

*Appropriate Applications:*

- Effective for the removal of sediment (sand, silt, and some clays) and metals, as well as the reduction of BOD, turbidity, and hydrocarbons. Hydrocarbons can effectively be removed with special resin cartridges.

- Filters can be used to provide secondary treatment to water treated via settling or basic filtration.

*Implementation:*

- The filters require delivery to the site and initial set up. The vendor can provide assistance.

*Maintenance:*

- The cartridges require replacement when the pressure differential equals or exceeds the manufacturer's recommendation.

## Costs

- Sediment controls are low to high cost measures depending on the dewatering system that is selected. Pressurized filters tend to be more expensive than gravity settling, but are often more effective. Simple tanks are generally rented on a long-term basis (one or more months) and can range from $360 per month for a 1,000 gallon tank to $2,660 per month for a 10,000 gallon tank. Mobilization and demobilization costs vary considerably.

## Inspection and Maintenance

- Inspect and verify that activity-based BMPs are in place prior to the commencement of associated activities. While activities associated with the BMP are under way, inspect weekly during the rainy season and at two-week intervals in the non-rainy season to verify continued BMP implementation.

- Inspect BMPs subject to non-stormwater discharges daily while non-stormwater discharges occur.
- Unit-specific maintenance requirements are included with the description of each unit.
- Sediment removed during the maintenance of a dewatering device may be either spread onsite and stabilized, or disposed of at a disposal site as approved by the owner.
- Sediment that is commingled with other pollutants must be disposed of in accordance with all applicable laws and regulations and as approved by the owner.

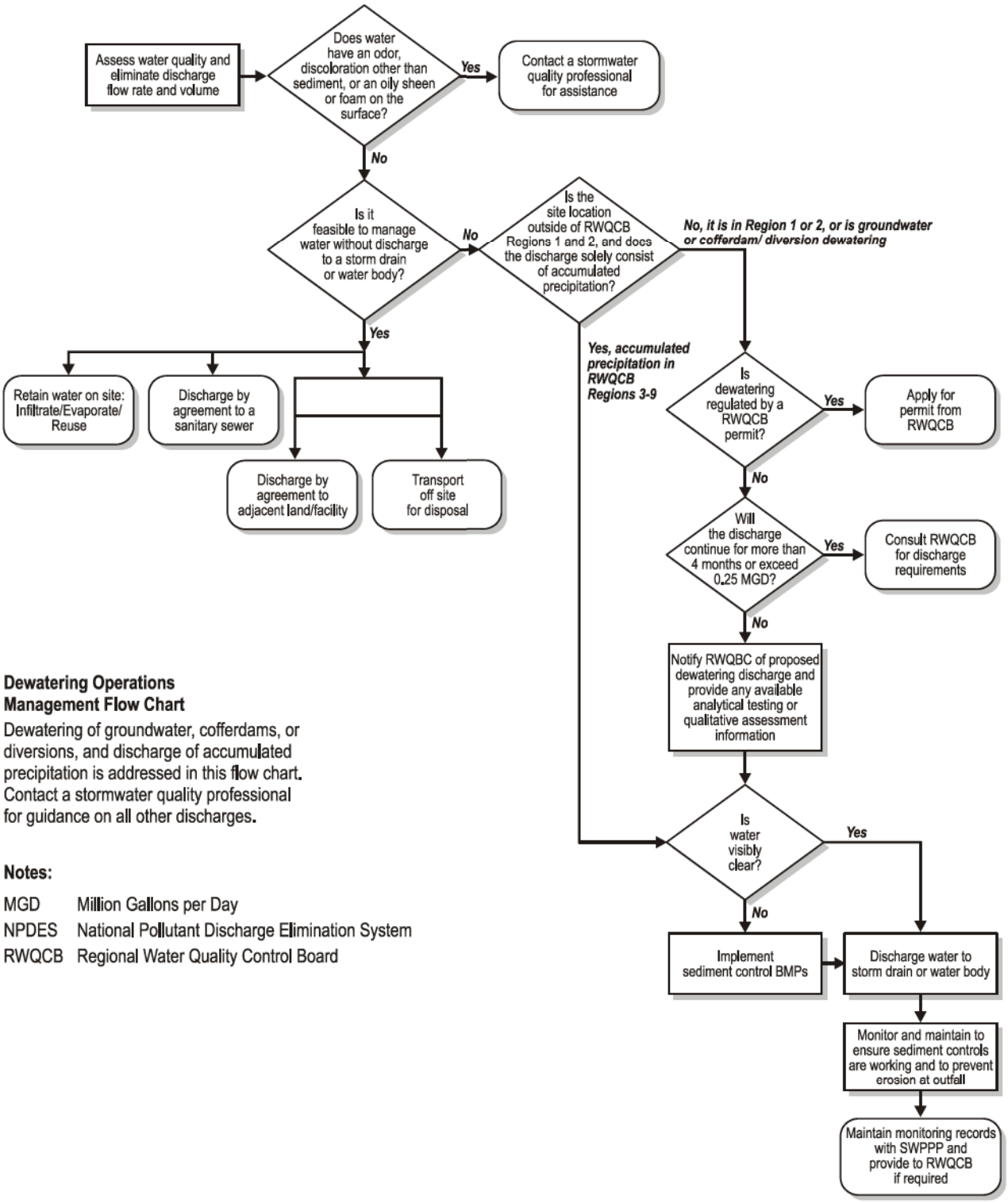
## References

Blueprint for a Clean Bay: Best Management Practices to Prevent Stormwater Pollution from Construction Related Activities; Santa Clara Valley Nonpoint Source Pollution Control Program, 1995.

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

Stormwater Management for Construction Activities, Developing Pollution Prevention Plans and Best Management Practices, EPA 832-R-92005; USEPA, April 1992.

Labor Surcharge & Equipment Rental Rates, April 1, 2002 through March 31, 2003, California Department of Transportation (Caltrans).




**Dewatering Operations Management Flow Chart**

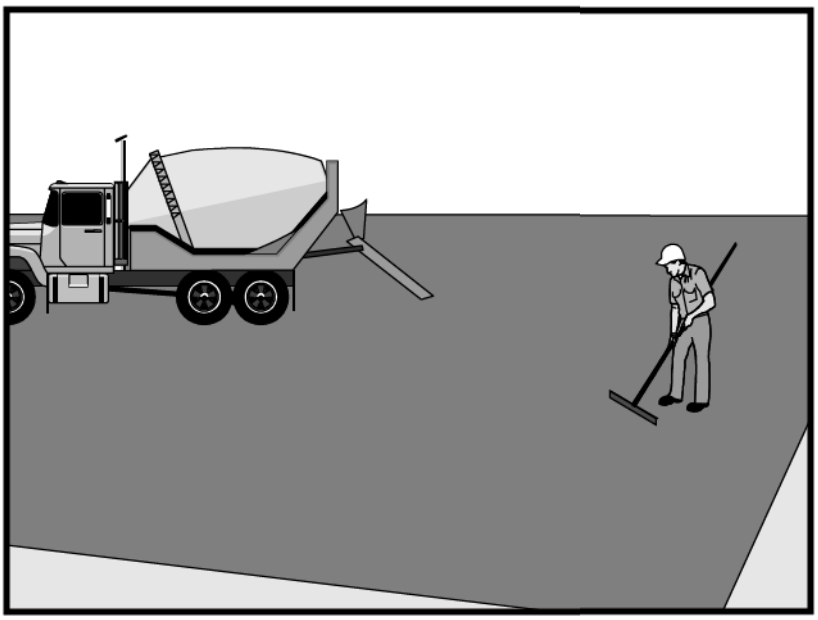
Dewatering of groundwater, cofferdams, or diversions, and discharge of accumulated precipitation is addressed in this flow chart. Contact a stormwater quality professional for guidance on all other discharges.

**Notes:**

MGD Million Gallons per Day
NPDES National Pollutant Discharge Elimination System
RWQCB Regional Water Quality Control Board

**Figure 1**
**Operations Flow Chart**

# Paving and Grinding Operations NS-3



## Objectives

| | | |
|---|---|---|
| EC | Erosion Control | |
| SE | Sediment Control | |
| TR | Tracking Control | |
| WE | Wind Erosion Control | |
| NS | Non-Stormwater Management Control | ☑ |
| WM | Waste Management and Materials Pollution Control | ☒ |

**Legend:**

☑ **Primary Objective**

☒ **Secondary Objective**

## Targeted Constituents

| | |
|---|---|
| Sediment | ☑ |
| Nutrients | |
| Trash | |
| Metals | |
| Bacteria | |
| Oil and Grease | ☑ |
| Organics | |

## Potential Alternatives

None

## Description and Purpose

Prevent or reduce the discharge of pollutants from paving operations, using measures to prevent runon and runoff pollution, properly disposing of wastes, and training employees and subcontractors.

## Suitable Applications

These procedures are implemented where paving, surfacing, resurfacing, or sawcutting, may pollute stormwater runoff or discharge to the storm drain system or watercourses.

## Limitations

- Finer solids are not effectively removed by filtration systems.
- Paving opportunities may be limited during wet weather.

## Implementation

### *General*

- Avoid paving during the wet season when feasible.
- Reschedule paving and grinding activities if rain is in the forecast.
- Train employees and sub-contractors in pollution prevention and reduction.
- Store materials away from drainage courses to prevent stormwater runon (see WM-1, Material Delivery and Storage).

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- Protect drainage courses, particularly in areas with a grade, by employing BMPs to divert runoff or to trap and filter sediment.
- If paving involves an onsite mixing plant, follow the stormwater permitting requirements for industrial activities.
- Stockpile material removed from roadways away from drain inlets, drainage ditches, and watercourses, These materials should be stored consistent with WM-3, Stockpile Management.
- Disposal of PCC and AC waste should be in conformance with WM-8, Concrete Waste Management.

***Saw Cutting, Grinding, and Pavement Removal***

- Shovel or vacuum saw-cut slurry and remove from site. Cover or barricade storm drains during saw cutting to contain slurry.
- When paving involves AC, the following steps should be implemented to prevent the discharge of grinding residue, uncompacted or loose AC, tack coats, equipment cleaners, or unrelated paving materials:
  - AC grindings, pieces, or chunks used in embankments or shoulder backing must not be allowed to enter any storm drains or watercourses. Install silt fence until structure is stabilized or permanent controls are in place. Examples of temporary perimeter controls can be found in EC-9, Earth Dikes and Drainage Swales; SE-1, Silt Fence; or SE-5, Fiber Rolls.
  - Collect and remove all broken asphalt and recycle when practical. Old or spilled asphalt must be recycled or disposed.
  - Any AC chunks and pieces used in embankments must be placed above the water table and covered by at least 1 ft of material.
- Do not allow saw-cut slurry to enter storm drains or watercourses. Residue from grinding operations should be picked up by means of a vacuum attachment to the grinding machine, should not be allowed to flow across the pavement, and should not be left on the surface of the pavement. See also WM-8, Concrete Waste Management, and WM-10, Liquid Waste Management.
- Dig out activities should not be conducted in the rain.
- Collect dig out material by mechanical or manual methods. This material may be recycled for use as shoulder backing or base material.
- If dig out material cannot be recycled, transport the material back to an approved storage site.

***Asphaltic Concrete Paving***

- If paving involves asphaltic cement concrete, follow these steps:

- Do not allow sand or gravel placed over new asphalt to wash into storm drains, streets, or creeks. Vacuum or sweep loose sand and gravel and properly dispose of this waste by referring to WM-5, Solid Waste Management.

- Old asphalt must be disposed of properly. Collect and remove all broken asphalt from the site and recycle whenever possible.

***Portland Cement Concrete Paving***

- Do not wash sweepings from exposed aggregate concrete into a storm drain system. Collect and return to aggregate base stockpile or dispose of properly.

- Allow aggregate rinse to settle. Then, either allow rinse water to dry in a temporary pit as described in WM-8, Concrete Waste Management, or pump the water to the sanitary sewer if allowed by the local wastewater authority.

***Sealing Operations***

- During chip seal application and sweeping operations, petroleum or petroleum covered aggregate must not be allowed to enter any storm drain or water courses. Apply temporary perimeter controls until structure is stabilized.

- Drainage inlet structures and manholes should be covered with filter fabric during application of seal coat, tack coat, slurry seal, and fog seal.

- Seal coat, tack coat, slurry seal, or fog seal should not be applied if rainfall is predicted to occur during the application or curing period.

***Paving Equipment***

- Leaks and spills from paving equipment can contain toxic levels of heavy metals and oil and grease. Place drip pans or absorbent materials under paving equipment when not in use. Clean up spills with absorbent materials rather than burying. See NS-10, Vehicle and Equipment Maintenance, WM-4, Spill Prevention and Control, and WM-10, Liquid Waste Management.

- Substances used to coat asphalt transport trucks, and asphalt spreading equipment should not contain soap and should be non-foaming and non-toxic.

- Use only non-toxic substances to coat asphalt transport trucks and asphalt spreading equipment.

- Paving equipment parked onsite should be parked over plastic to prevent soil contamination.

- Clean asphalt coated equipment offsite whenever possible. When cleaning dry, hardened asphalt from equipment, manage hardened asphalt debris as described in WM-5, Solid Waste Management. Any cleaning onsite should follow NS-8, Vehicle and Equipment Cleaning.

***Thermoplastic Striping***

- Thermoplastic striper and pre-heater equipment shutoff valves should be inspected to ensure that they are working properly to prevent leaking thermoplastic from entering drain inlets, the stormwater drainage system, or watercourses.
- Pre-heaters should be filled carefully to prevent splashing or spilling of hot thermoplastic. Leave six inches of space at the top of the pre-heater container when filling thermoplastic to allow room for material to move when the vehicle is deadheaded.
- Do not pre-heat, transfer, or load thermoplastic near drain inlets or watercourses.
- Clean truck beds daily of loose debris and melted thermoplastic. When possible, recycle thermoplastic material.

***Raised/Recessed Pavement Marker Application and Removal***

- Do not transfer or load bituminous material near drain inlets, the stormwater drainage system, or watercourses.
- Melting tanks should be loaded with care and not filled to beyond six inches from the top to leave room for splashing when vehicle is deadheaded.
- When servicing or filling melting tanks, ensure all pressure is released before removing lids to avoid spills.
- On large-scale projects, use mechanical or manual methods to collect excess bituminous material from the roadway after removal of markers.

## Costs

- All of the above are low cost measures.

## Inspection and Maintenance

- Inspect and verify that activity-based BMPs are in place prior to the commencement of associated activities. While activities associated with the BMP are under way, inspect weekly during the rainy season and at two-week intervals in the non-rainy season to verify continued BMP implementation.
- Keep ample supplies of drip pans or absorbent materials onsite.
- Inspect and maintain machinery regularly to minimize leaks and drips.

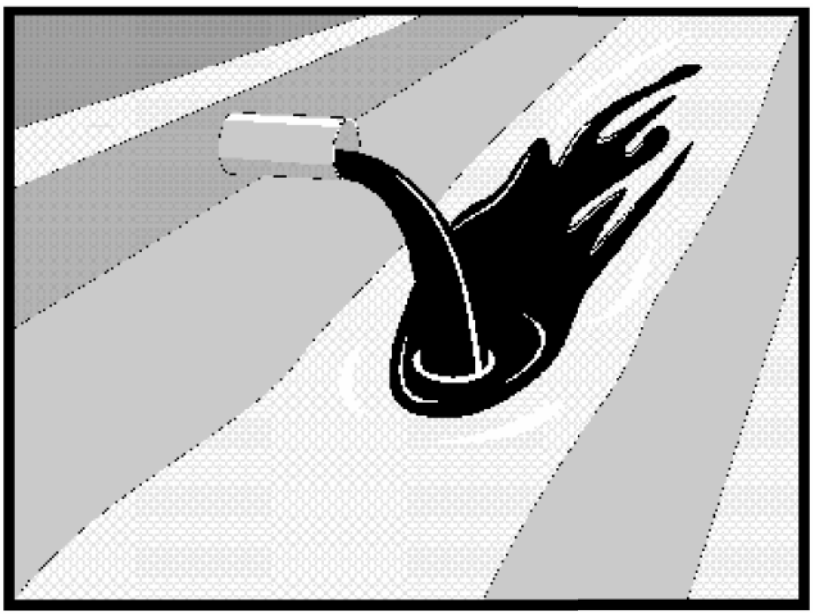
## References

Blueprint for a Clean Bay: Best Management Practices to Prevent Stormwater Pollution from Construction Related Activities; Santa Clara Valley Nonpoint Source Pollution Control Program, 1995.

Hot Mix Asphalt-Paving Handbook AC 150/5370-14, Appendix I, U.S. Army Corps of Engineers, July 1991.

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

# Illicit Connection/Discharge NS-6



## Objectives

| | | |
|---|---|---|
| EC | Erosion Control | |
| SE | Sediment Control | |
| TR | Tracking Control | |
| WE | Wind Erosion Control | |
| NS | Non-Stormwater Management Control | ☑ |
| WM | Waste Management and Materials Pollution Control | |

**Legend:**

☑ **Primary Objective**

☒ **Secondary Objective**

## Targeted Constituents

| | |
|---|---|
| Sediment | |
| Nutrients | ☑ |
| Trash | ☑ |
| Metals | ☑ |
| Bacteria | ☑ |
| Oil and Grease | ☑ |
| Organics | ☑ |

## Potential Alternatives

None

## Description and Purpose

Procedures and practices designed for construction contractors to recognize illicit connections or illegally dumped or discharged materials on a construction site and report incidents.

## Suitable Applications

This best management practice (BMP) applies to all construction projects. Illicit connection/discharge and reporting is applicable anytime an illicit connection or discharge is discovered or illegally dumped material is found on the construction site.

## Limitations

Illicit connections and illegal discharges or dumping, for the purposes of this BMP, refer to discharges and dumping caused by parties other than the contractor. If pre-existing hazardous materials or wastes are known to exist onsite, they should be identified in the SWPPP and handled as set forth in the SWPPP.

## Implementation

### *Planning*

- Review the SWPPP. Pre-existing areas of contamination should be identified and documented in the SWPPP.
- Inspect site before beginning the job for evidence of illicit connections, illegal dumping or discharges. Document any pre-existing conditions and notify the owner.

- Inspect site regularly during project execution for evidence of illicit connections, illegal dumping or discharges.
- Observe site perimeter for evidence for potential of illicitly discharged or illegally dumped material, which may enter the job site.

***Identification of Illicit Connections and Illegal Dumping or Discharges***

- **General –** unlabeled and unidentifiable material should be treated as hazardous.
- **Solids** - Look for debris, or rubbish piles. Solid waste dumping often occurs on roadways with light traffic loads or in areas not easily visible from the traveled way.
- **Liquids** - signs of illegal liquid dumping or discharge can include:
  - Visible signs of staining or unusual colors to the pavement or surrounding adjacent soils
  - Pungent odors coming from the drainage systems
  - Discoloration or oily substances in the water or stains and residues detained within ditches, channels or drain boxes
  - Abnormal water flow during the dry weather season
- **Urban Areas** - Evidence of illicit connections or illegal discharges is typically detected at storm drain outfall locations or at manholes. Signs of an illicit connection or illegal discharge can include:
  - Abnormal water flow during the dry weather season
  - Unusual flows in sub drain systems used for dewatering
  - Pungent odors coming from the drainage systems
  - Discoloration or oily substances in the water or stains and residues detained within ditches, channels or drain boxes
  - Excessive sediment deposits, particularly adjacent to or near active offsite construction projects
- **Rural Areas** - Illicit connections or illegal discharges involving irrigation drainage ditches are detected by visual inspections. Signs of an illicit discharge can include:
  - Abnormal water flow during the non-irrigation season
  - Non-standard junction structures
  - Broken concrete or other disturbances at or near junction structures

***Reporting***

Notify the owner of any illicit connections and illegal dumping or discharge incidents at the time of discovery. For illicit connections or discharges to the storm drain system, notify the local stormwater management agency. For illegal dumping, notify the local law enforcement agency.

***Cleanup and Removal***

The responsibility for cleanup and removal of illicit or illegal dumping or discharges will vary by location. Contact the local stormwater management agency for further information.

## Costs

Costs to look for and report illicit connections and illegal discharges and dumping are low. The best way to avoid costs associated with illicit connections and illegal discharges and dumping is to keep the project perimeters secure to prevent access to the site, to observe the site for vehicles that should not be there, and to document any waste or hazardous materials that exist onsite before taking possession of the site.

## Inspection and Maintenance

- Inspect and verify that activity-based BMPs are in place prior to the commencement of associated activities. While activities associated with the BMP are under way, inspect weekly during the rainy season and at two-week intervals in the non-rainy season to verify continued BMP implementation.
- Inspect the site regularly to check for any illegal dumping or discharge.
- Prohibit employees and subcontractors from disposing of non-job related debris or materials at the construction site.
- Notify the owner of any illicit connections and illegal dumping or discharge incidents at the time of discovery.

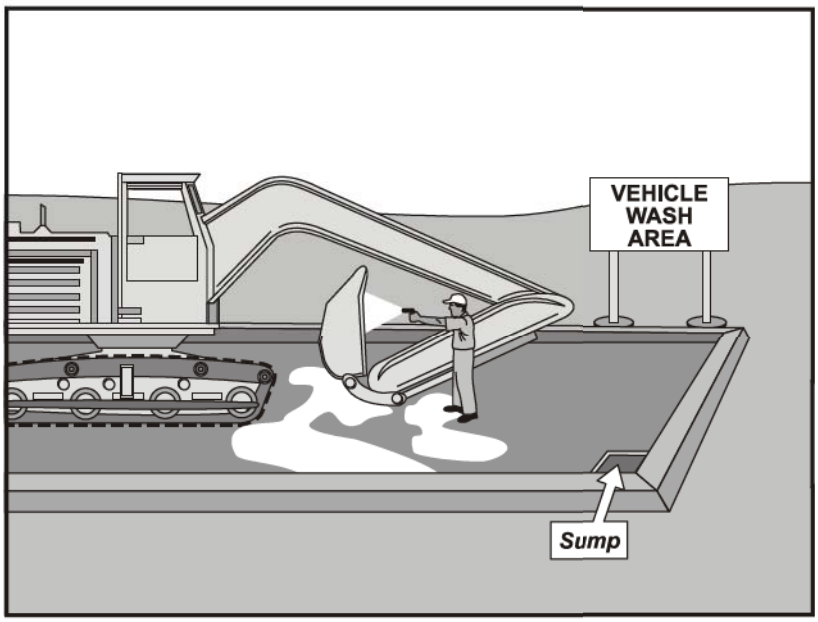
## References

Blueprint for a Clean Bay: Best Management Practices to Prevent Stormwater Pollution from Construction Related Activities; Santa Clara Valley Nonpoint Source Pollution Control Program, 1995.

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

Stormwater Management for Construction Activities, Developing Pollution Prevention Plans and Best Management Practices, EPA 832-R-92005; USEPA, April 1992.

# Vehicle and Equipment Cleaning NS-8




## Objectives

| | | |
|---|---|---|
| EC | Erosion Control | |
| SE | Sediment Control | |
| TR | Tracking Control | |
| WE | Wind Erosion Control | |
| NS | Non-Stormwater Management Control | ☑ |
| WM | Waste Management and Materials Pollution Control | |

**Legend:**

☑ **Primary Objective**

☒ **Secondary Objective**

## Targeted Constituents

| | |
|---|---|
| Sediment | ☑ |
| Nutrients | ☑ |
| Trash | |
| Metals | |
| Bacteria | |
| Oil and Grease | ☑ |
| Organics | ☑ |

## Potential Alternatives

None

## Description and Purpose

Vehicle and equipment cleaning procedures and practices eliminate or reduce the discharge of pollutants to stormwater from vehicle and equipment cleaning operations. Procedures and practices include but are not limited to: using offsite facilities; washing in designated, contained areas only; eliminating discharges to the storm drain by infiltrating the wash water; and training employees and subcontractors in proper cleaning procedures.

## Suitable Applications

These procedures are suitable on all construction sites where vehicle and equipment cleaning is performed.

## Limitations

Even phosphate-free, biodegradable soaps have been shown to be toxic to fish before the soap degrades. Sending vehicles/equipment offsite should be done in conjunction with TR-1, Stabilized Construction Entrance/Exit.

## Implementation

Other options to washing equipment onsite include contracting with either an offsite or mobile commercial washing business. These businesses may be better equipped to handle and dispose of the wash waters properly. Performing this work offsite can also be economical by eliminating the need for a separate washing operation onsite.

If washing operations are to take place onsite, then:

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- Use phosphate-free, biodegradable soaps.
- Educate employees and subcontractors on pollution prevention measures.
- Do not permit steam cleaning onsite. Steam cleaning can generate significant pollutant concentrates.
- Cleaning of vehicles and equipment with soap, solvents or steam should not occur on the project site unless resulting wastes are fully contained and disposed of. Resulting wastes should not be discharged or buried, and must be captured and recycled or disposed according to the requirements of WM-10, Liquid Waste Management or WM-6, Hazardous Waste Management, depending on the waste characteristics. Minimize use of solvents. Use of diesel for vehicle and equipment cleaning is prohibited.
- All vehicles and equipment that regularly enter and leave the construction site must be cleaned offsite.
- When vehicle and equipment washing and cleaning must occur onsite, and the operation cannot be located within a structure or building equipped with appropriate disposal facilities, the outside cleaning area should have the following characteristics:
  - Located away from storm drain inlets, drainage facilities, or watercourses
  - Paved with concrete or asphalt and bermed to contain wash waters and to prevent runon and runoff
  - Configured with a sump to allow collection and disposal of wash water
  - No discharge of wash waters to storm drains or watercourses
  - Used only when necessary
- When cleaning vehicles and equipment with water:
  - Use as little water as possible. High-pressure sprayers may use less water than a hose and should be considered
  - Use positive shutoff valve to minimize water usage
  - Facility wash racks should discharge to a sanitary sewer, recycle system or other approved discharge system and must not discharge to the storm drainage system, watercourses, or to groundwater

## Costs

Cleaning vehicles and equipment at an offsite facility may reduce overall costs for vehicle and equipment cleaning by eliminating the need to provide similar services onsite. When onsite cleaning is needed, the cost to establish appropriate facilities is relatively low on larger, long-duration projects, and moderate to high on small, short-duration projects.

## Inspection and Maintenance

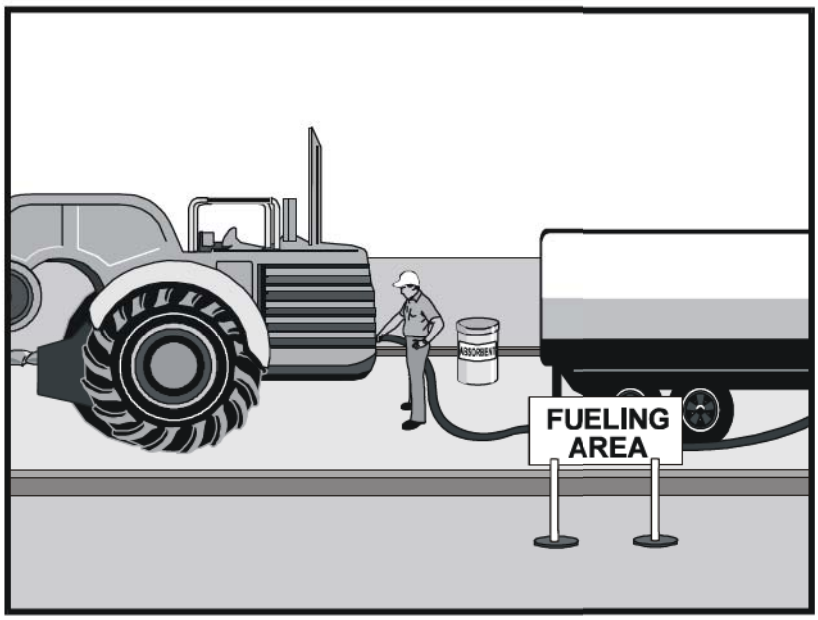
- Inspect and verify that activity-based BMPs are in place prior to the commencement of associated activities. While activities associated with the BMP are under way, inspect weekly during the rainy season and at two-week intervals in the non-rainy season to verify continued BMP implementation.
- Inspect BMPs subject to non-stormwater discharges daily while non-stormwater discharges occur.
- Inspection and maintenance is minimal, although some berm repair may be necessary.
- Monitor employees and subcontractors throughout the duration of the construction project to ensure appropriate practices are being implemented.
- Inspect sump regularly and remove liquids and sediment as needed.
- Prohibit employees and subcontractors from washing personal vehicles and equipment on the construction site.

## References

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

Swisher, R.D. Surfactant Biodegradation, Marcel Decker Corporation, 1987.

# Vehicle and Equipment Fueling NS-9




## Objectives

| | | |
|---|---|---|
| EC | Erosion Control | |
| SE | Sediment Control | |
| TR | Tracking Control | |
| WE | Wind Erosion Control | |
| NS | Non-Stormwater Management Control | ☑ |
| WM | Waste Management and Materials Pollution Control | |

**Legend:**

☑ **Primary Objective**

☒ **Secondary Objective**

## Targeted Constituents

| | |
|---|---|
| Sediment | |
| Nutrients | |
| Trash | |
| Metals | |
| Bacteria | |
| Oil and Grease | ☑ |
| Organics | |

## Potential Alternatives

None

## Description and Purpose

Vehicle equipment fueling procedures and practices are designed to prevent fuel spills and leaks, and reduce or eliminate contamination of stormwater. This can be accomplished by using offsite facilities, fueling in designated areas only, enclosing or covering stored fuel, implementing spill controls, and training employees and subcontractors in proper fueling procedures.

## Suitable Applications

These procedures are suitable on all construction sites where vehicle and equipment fueling takes place.

## Limitations

Onsite vehicle and equipment fueling should only be used where it is impractical to send vehicles and equipment offsite for fueling. Sending vehicles and equipment offsite should be done in conjunction with TR-1, Stabilized Construction Entrance/ Exit.

## Implementation

- Use offsite fueling stations as much as possible. These businesses are better equipped to handle fuel and spills properly. Performing this work offsite can also be economical by eliminating the need for a separate fueling area at a site.
- Discourage "topping-off" of fuel tanks.

- Absorbent spill cleanup materials and spill kits should be available in fueling areas and on fueling trucks, and should be disposed of properly after use.
- Drip pans or absorbent pads should be used during vehicle and equipment fueling, unless the fueling is performed over an impermeable surface in a dedicated fueling area.
- Use absorbent materials on small spills. Do not hose down or bury the spill. Remove the adsorbent materials promptly and dispose of properly.
- Avoid mobile fueling of mobile construction equipment around the site; rather, transport the equipment to designated fueling areas. With the exception of tracked equipment such as bulldozers and large excavators, most vehicles should be able to travel to a designated area with little lost time.
- Train employees and subcontractors in proper fueling and cleanup procedures.
- When fueling must take place onsite, designate an area away from drainage courses to be used. Fueling areas should be identified in the SWPPP.
- Dedicated fueling areas should be protected from stormwater runon and runoff, and should be located at least 50 ft away from downstream drainage facilities and watercourses. Fueling must be performed on level-grade areas.
- Protect fueling areas with berms and dikes to prevent runon, runoff, and to contain spills.
- Nozzles used in vehicle and equipment fueling should be equipped with an automatic shutoff to control drips. Fueling operations should not be left unattended.
- Use vapor recovery nozzles to help control drips as well as air pollution where required by Air Quality Management Districts (AQMD).
- Federal, state, and local requirements should be observed for any stationary above ground storage tanks.

### Costs

- All of the above measures are low cost except for the capital costs of above ground tanks that meet all local environmental, zoning, and fire codes.

### Inspection and Maintenance

- Vehicles and equipment should be inspected each day of use for leaks. Leaks should be repaired immediately or problem vehicles or equipment should be removed from the project site.
- Keep ample supplies of spill cleanup materials onsite.
- Immediately clean up spills and properly dispose of contaminated soil and cleanup materials.

## References

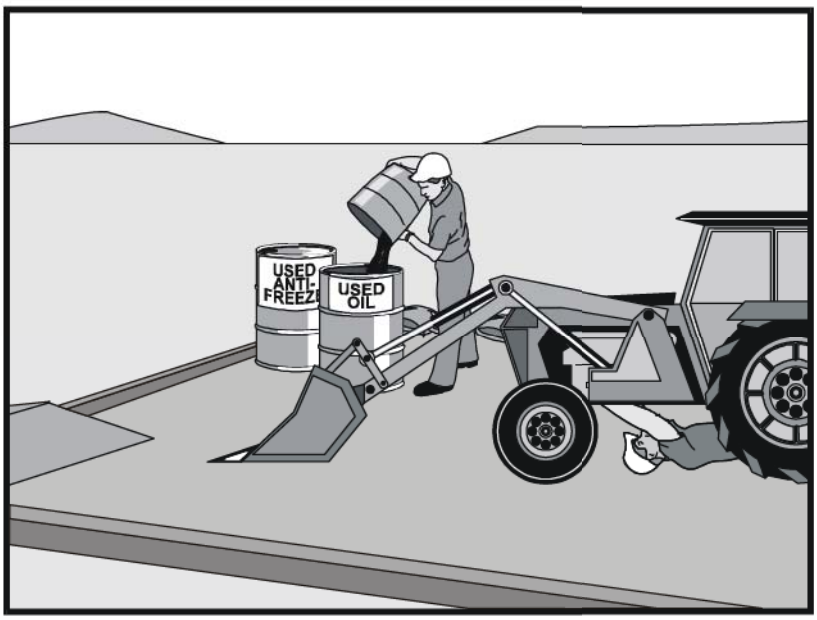
Blueprint for a Clean Bay: Best Management Practices to Prevent Stormwater Pollution from Construction Related Activities; Santa Clara Valley Nonpoint Source Pollution Control Program, 1995.

Coastal Nonpoint Pollution Control Program: Program Development and Approval Guidance, Working Group Working Paper; USEPA, April 1992.

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

Stormwater Management for Construction Activities, Developing Pollution Prevention Plans and Best Management Practices, EPA 832-R-92005; USEPA, April 1992.

# Vehicle & Equipment Maintenance NS-10




## Objectives

| | | |
|---|---|---|
| EC | Erosion Control | |
| SE | Sediment Control | |
| TR | Tracking Control | |
| WE | Wind Erosion Control | |
| NS | Non-Stormwater Management Control | ☑ |
| WM | Waste Management and Materials Pollution Control | |

**Legend:**

☑ **Primary Objective**

☒ **Secondary Objective**

## Targeted Constituents

| | |
|---|---|
| Sediment | |
| Nutrients | ☑ |
| Trash | ☑ |
| Metals | |
| Bacteria | |
| Oil and Grease | ☑ |
| Organics | ☑ |

## Potential Alternatives

None

## Description and Purpose

Prevent or reduce the contamination of stormwater resulting from vehicle and equipment maintenance by running a "dry and clean site". The best option would be to perform maintenance activities at an offsite facility. If this option is not available then work should be performed in designated areas only, while providing cover for materials stored outside, checking for leaks and spills, and containing and cleaning up spills immediately. Employees and subcontractors must be trained in proper procedures.

## Suitable Applications

These procedures are suitable on all construction projects where an onsite yard area is necessary for storage and maintenance of heavy equipment and vehicles.

## Limitations

Onsite vehicle and equipment maintenance should only be used where it is impractical to send vehicles and equipment offsite for maintenance and repair. Sending vehicles/equipment offsite should be done in conjunction with TR-1, Stabilized Construction Entrance/Exit.

Outdoor vehicle or equipment maintenance is a potentially significant source of stormwater pollution. Activities that can contaminate stormwater include engine repair and service, changing or replacement of fluids, and outdoor equipment storage and parking (engine fluid leaks). For further information on vehicle or equipment servicing, see NS-8, Vehicle and Equipment Cleaning, and NS-9, Vehicle and Equipment Fueling.

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# NS-10 Vehicle & Equipment Maintenance

## Implementation

- Use offsite repair shops as much as possible. These businesses are better equipped to handle vehicle fluids and spills properly. Performing this work offsite can also be economical by eliminating the need for a separate maintenance area.
- If maintenance must occur onsite, use designated areas, located away from drainage courses. Dedicated maintenance areas should be protected from stormwater runon and runoff, and should be located at least 50 ft from downstream drainage facilities and watercourses.
- Drip pans or absorbent pads should be used during vehicle and equipment maintenance work that involves fluids, unless the maintenance work is performed over an impermeable surface in a dedicated maintenance area.
- Place a stockpile of spill cleanup materials where it will be readily accessible.
- All fueling trucks and fueling areas are required to have spill kits and/or use other spill protection devices.
- Use adsorbent materials on small spills. Remove the absorbent materials promptly and dispose of properly.
- Inspect onsite vehicles and equipment daily at startup for leaks, and repair immediately.
- Keep vehicles and equipment clean; do not allow excessive build-up of oil and grease.
- Segregate and recycle wastes, such as greases, used oil or oil filters, antifreeze, cleaning solutions, automotive batteries, hydraulic and transmission fluids. Provide secondary containment and covers for these materials if stored onsite.
- Train employees and subcontractors in proper maintenance and spill cleanup procedures.
- Drip pans or plastic sheeting should be placed under all vehicles and equipment placed on docks, barges, or other structures over water bodies when the vehicle or equipment is planned to be idle for more than 1 hour.
- For long-term projects, consider using portable tents or covers over maintenance areas if maintenance cannot be performed offsite.
- Consider use of new, alternative greases and lubricants, such as adhesive greases, for chassis lubrication and fifth-wheel lubrication.
- Properly dispose of used oils, fluids, lubricants, and spill cleanup materials.
- Do not place used oil in a dumpster or pour into a storm drain or watercourse.
- Properly dispose of or recycle used batteries.
- Do not bury used tires.
- Repair leaks of fluids and oil immediately.

Listed below is further information if you must perform vehicle or equipment maintenance onsite.

### *Safer Alternative Products*

- Consider products that are less toxic or hazardous than regular products. These products are often sold under an "environmentally friendly" label.
- Consider use of grease substitutes for lubrication of truck fifth-wheels. Follow manufacturers label for details on specific uses.
- Consider use of plastic friction plates on truck fifth-wheels in lieu of grease. Follow manufacturers label for details on specific uses.

### *Waste Reduction*

Parts are often cleaned using solvents such as trichloroethylene, trichloroethane, or methylene chloride. Many of these cleaners are listed in California Toxic Rule as priority pollutants. These materials are harmful and must not contaminate stormwater. They must be disposed of as a hazardous waste. Reducing the number of solvents makes recycling easier and reduces hazardous waste management costs. Often, one solvent can perform a job as well as two different solvents. Also, if possible, eliminate or reduce the amount of hazardous materials and waste by substituting non-hazardous or less hazardous materials. For example, replace chlorinated organic solvents with non-chlorinated solvents. Non-chlorinated solvents like kerosene or mineral spirits are less toxic and less expensive to dispose of properly. Check the list of active ingredients to see whether it contains chlorinated solvents. The "chlor" term indicates that the solvent is chlorinated. Also, try substituting a wire brush for solvents to clean parts.

### *Recycling and Disposal*

Separating wastes allows for easier recycling and may reduce disposal costs. Keep hazardous wastes separate, do not mix used oil solvents, and keep chlorinated solvents (like,-trichloroethane) separate from non-chlorinated solvents (like kerosene and mineral spirits). Promptly transfer used fluids to the proper waste or recycling drums. Don't leave full drip pans or other open containers lying around. Provide cover and secondary containment until these materials can be removed from the site.

Oil filters can be recycled. Ask your oil supplier or recycler about recycling oil filters.

Do not dispose of extra paints and coatings by dumping liquid onto the ground or throwing it into dumpsters. Allow coatings to dry or harden before disposal into covered dumpsters.

Store cracked batteries in a non-leaking secondary container. Do this with all cracked batteries, even if you think all the acid has drained out. If you drop a battery, treat it as if it is cracked. Put it into the containment area until you are sure it is not leaking.

## Costs

All of the above are low cost measures. Higher costs are incurred to setup and maintain onsite maintenance areas.

# NS-10 Vehicle & Equipment Maintenance

## Inspection and Maintenance

- Inspect and verify that activity-based BMPs are in place prior to the commencement of associated activities. While activities associated with the BMP are under way, inspect weekly during the rainy season and at two-week intervals in the non-rainy season to verify continued BMP implementation.
- Inspect BMPs subject to non-stormwater discharges daily while non-stormwater discharges occur.
- Keep ample supplies of spill cleanup materials onsite.
- Maintain waste fluid containers in leak proof condition.
- Vehicles and equipment should be inspected on each day of use. Leaks should be repaired immediately or the problem vehicle(s) or equipment should be removed from the project site.
- Inspect equipment for damaged hoses and leaky gaskets routinely. Repair or replace as needed.

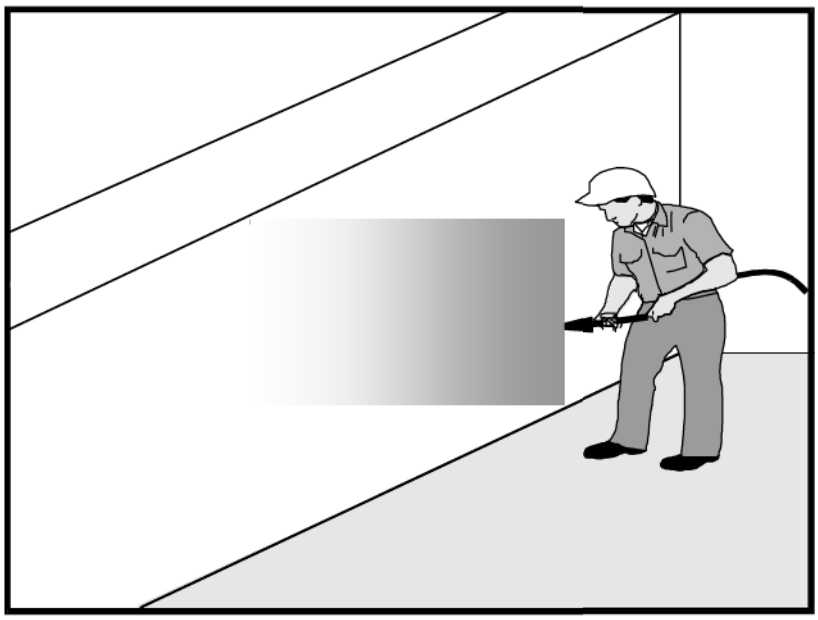
## References

Blueprint for a Clean Bay: Best Management Practices to Prevent Stormwater Pollution from Construction Related Activities; Santa Clara Valley Nonpoint Source Pollution Control Program, 1995.

Coastal Nonpoint Pollution Control Program; Program Development and Approval Guidance, Working Group, Working Paper; USEPA, April 1992.

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

# Concrete Curing NS-12



## Objectives

| | | |
|---|---|---|
| EC | Erosion Control | |
| SE | Sediment Control | |
| TR | Tracking Control | |
| WE | Wind Erosion Control | |
| NS | Non-Stormwater Management Control | ☑ |
| WM | Waste Management and Materials Pollution Control | ☑ |

**Legend:**

☑ **Primary Objective**

☒ **Secondary Objective**

## Targeted Constituents

| | |
|---|---|
| Sediment | ☑ |
| Nutrients | |
| Trash | |
| Metals | ☑ |
| Bacteria | |
| Oil and Grease | ☑ |
| Organics | |

## Potential Alternatives

None

## Description and Purpose

Concrete curing is used in the construction of structures such as bridges, retaining walls, pump houses, large slabs, and structured foundations. Concrete curing includes the use of both chemical and water methods. Discharges of stormwater and non-stormwater exposed to concrete during curing may have a high pH and may contain chemicals, metals, and fines. Proper procedures reduce or eliminate the contamination of stormwater runoff during concrete curing.

## Suitable Applications

Suitable applications include all projects where Portland Cement Concrete (PCC) and concrete curing chemicals are placed where they can be exposed to rainfall, runoff from other areas, or where runoff from the PCC will leave the site.

## Limitations

None identified.

## Implementation

### *Chemical Curing*

- Avoid over spray of curing compounds.
- Minimize the drift of chemical cure as much as possible by applying the curing compound close to the concrete surface. Apply an amount of compound that covers the surface, but does not allow any runoff of the compound.

- Use proper storage and handling techniques for concrete curing compounds. Refer to WM-1, Material Delivery and Storage.
- Protect drain inlets prior to the application of curing compounds.
- Refer to WM-4, Spill Prevention and Control.

***Water Curing for Bridge Decks, Retaining Walls, and other Structures***

- Direct cure water away from inlets and watercourses to collection areas for infiltration or other means of removal in accordance with all applicable permits.
- Collect cure water at the top of slopes and transport or dispose of water in a non-erodible manner. See EC-9 Earth Dikes and Drainage Swales, EC-10, Velocity Dissipation Devices, and EC-11, Slope Drains.
- Utilize wet blankets or a similar method that maintains moisture while minimizing the use and possible discharge of water.

## Costs

All of the above measures are generally low cost.

## Inspection and Maintenance

- Inspect and verify that activity-based BMPs are in place prior to the commencement of associated activities. While activities associated with the BMP are under way, inspect weekly during the rainy season and at two-week intervals in the non-rainy season to verify continued BMP implementation.
- Inspect BMPs subject to non-stormwater discharges daily while non-stormwater discharges occur.
- Ensure that employees and subcontractors implement appropriate measures for storage, handling, and use of curing compounds.
- Inspect cure containers and spraying equipment for leaks.

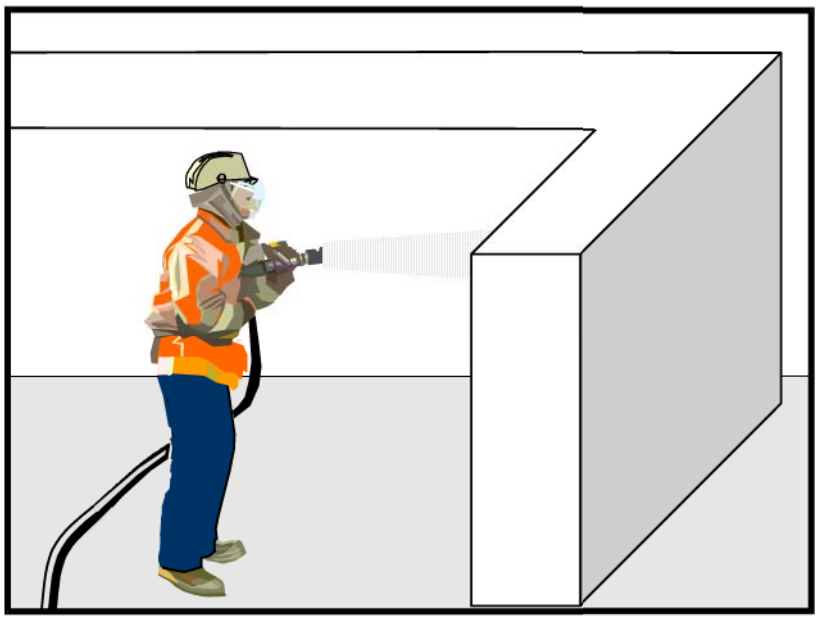
## References

Blue Print for a Clean Bay-Construction-Related Industries: Best Management Practices for Stormwater Pollution Prevention; Santa Clara Valley Non Point Source Pollution Control Program, 1992.

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

Stormwater Management for Construction Activities, Developing Pollution Prevention Plans and Best Management Practices, EPA 832-R-92005; USEPA, April 1992.

# Concrete Finishing NS-13



## Objectives

| | | |
|---|---|---|
| EC | Erosion Control | |
| SE | Sediment Control | |
| TR | Tracking Control | |
| WE | Wind Erosion Control | |
| NS | Non-Stormwater Management Control | ☑ |
| WM | Waste Management and Materials Pollution Control | ☑ |

**Legend:**

☑ **Primary Objective**

☒ **Secondary Objective**

## Targeted Constituents

| | |
|---|---|
| Sediment | ☑ |
| Nutrients | |
| Trash | |
| Metals | ☑ |
| Bacteria | |
| Oil and Grease | |
| Organics | ☑ |

## Potential Alternatives

None

## Description and Purpose

Concrete finishing methods are used for bridge deck rehabilitation, paint removal, curing compound removal, and final surface finish appearances. Methods include sand blasting, shot blasting, grinding, or high pressure water blasting. Stormwater and non-stormwater exposed to concrete finishing by-products may have a high pH and may contain chemicals, metals, and fines. Proper procedures and implementation of appropriate BMPs can minimize the impact that concrete-finishing methods may have on stormwater and non-stormwater discharges.

## Suitable Applications

These procedures apply to all construction locations where concrete finishing operations are performed.

## Limitations

None identified.

## Implementation

- Collect and properly dispose of water from high-pressure water blasting operations.
- Collect contaminated water from blasting operations at the top of slopes. Transport or dispose of contaminated water while using BMPs such as those for erosion control. Refer to EC-9, Earth Dikes and Drainage Swales, EC-10, Velocity Dissipation Devices, and EC-11, Slope Drains.

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- Direct water from blasting operations away from inlets and watercourses to collection areas for infiltration or other means of removal (dewatering). Refer to NS-2 De-Watering Operations.
- Protect inlets during sandblasting operations. Refer to SE-10, Storm Drain Inlet Protection.
- Refer to WM-8, Concrete Waste Management for disposal of concrete based debris.
- Minimize the drift of dust and blast material as much as possible by keeping the blasting nozzle close to the surface.
- When blast residue contains a potentially hazardous waste, refer to WM-6, Hazardous Waste Management.

## Costs

These measures are generally of low cost.

## Inspection and Maintenance

- Inspect and verify that activity-based BMPs are in place prior to the commencement of associated activities. While activities associated with the BMP are under way, inspect weekly during the rainy season and at two-week intervals in the non-rainy season to verify continued BMP implementation.
- Inspect BMPs subject to non-stormwater discharges daily while non-stormwater discharges occur.
- Sweep or vacuum up debris from sandblasting at the end of each shift.
- At the end of each work shift, remove and contain liquid and solid waste from containment structures, if any, and from the general work area.

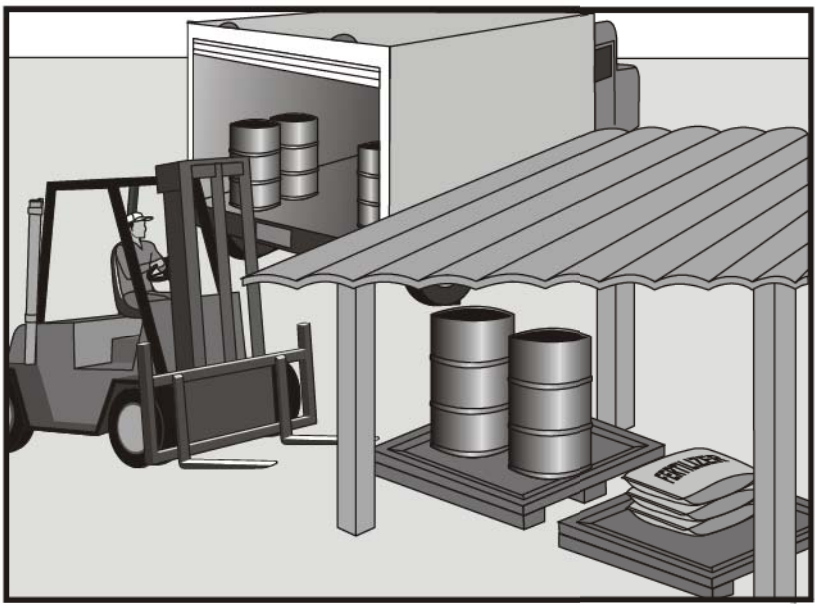
## References

Blueprint for a Clean Bay: Best Management Practices to Prevent Stormwater Pollution from Construction Related Activities; Santa Clara Valley Nonpoint Source Pollution Control Program, 1995.

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

Stormwater Management for Construction Activities, Developing Pollution Prevention Plans and Best Management Practices, EPA 832-R-92005; USEPA, April 1992.

# Material Delivery and Storage WM-1




## Objectives

| | | |
|---|---|---|
| EC | Erosion Control | |
| SE | Sediment Control | |
| TC | Tracking Control | |
| WE | Wind Erosion Control | |
| NS | Non-Stormwater Management Control | |
| WM | Waste Management and Materials Pollution Control | ☑ |

**Legend:**

☑ **Primary Objective**

☒ **Secondary Objective**

## Targeted Constituents

| | |
|---|---|
| Sediment | ☑ |
| Nutrients | ☑ |
| Trash | ☑ |
| Metals | ☑ |
| Bacteria | |
| Oil and Grease | ☑ |
| Organics | ☑ |

## Potential Alternatives

None

## Description and Purpose

Prevent, reduce, or eliminate the discharge of pollutants from material delivery and storage to the stormwater system or watercourses by minimizing the storage of hazardous materials onsite, storing materials in a designated area, installing secondary containment, conducting regular inspections, and training employees and subcontractors.

This best management practice covers only material delivery and storage. For other information on materials, see WM-2, Material Use, or WM-4, Spill Prevention and Control. For information on wastes, see the waste management BMPs in this section.

## Suitable Applications

These procedures are suitable for use at all construction sites with delivery and storage of the following materials:

- Soil stabilizers and binders
- Pesticides and herbicides
- Fertilizers
- Detergents
- Plaster
- Petroleum products such as fuel, oil, and grease
- Asphalt and concrete components

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- Hazardous chemicals such as acids, lime, glues, adhesives, paints, solvents, and curing compounds
- Concrete compounds
- Other materials that may be detrimental if released to the environment

### Limitations

- Space limitation may preclude indoor storage.
- Storage sheds often must meet building and fire code requirements.

### Implementation

The following steps should be taken to minimize risk:

- Temporary storage area should be located away from vehicular traffic.
- Material Safety Data Sheets (MSDS) should be supplied for all materials stored.
- Construction site areas should be designated for material delivery and storage.
- Material delivery and storage areas should be located near the construction entrances, away from waterways, if possible.
  - Avoid transport near drainage paths or waterways.
  - Surround with earth berms. See EC-9, Earth Dikes and Drainage Swales.
  - Place in an area which will be paved.
- Storage of reactive, ignitable, or flammable liquids must comply with the fire codes of your area. Contact the local Fire Marshal to review site materials, quantities, and proposed storage area to determine specific requirements. See the Flammable and Combustible Liquid Code, NFPA30.
- An up to date inventory of materials delivered and stored onsite should be kept.
- Hazardous materials storage onsite should be minimized.
- Hazardous materials should be handled as infrequently as possible.
- During the rainy season, consider storing materials in a covered area. Store materials in secondary containments such as earthen dike, horse trough, or even a children's wading pool for non-reactive materials such as detergents, oil, grease, and paints. Small amounts of material may be secondarily contained in "bus boy" trays or concrete mixing trays.
- Do not store chemicals, drums, or bagged materials directly on the ground. Place these items on a pallet and, when possible, in secondary containment.

- If drums must be kept uncovered, store them at a slight angle to reduce ponding of rainwater on the lids to reduce corrosion. Domed plastic covers are inexpensive and snap to the top of drums, preventing water from collecting.
- Chemicals should be kept in their original labeled containers.
- Employees and subcontractors should be trained on the proper material delivery and storage practices.
- Employees trained in emergency spill cleanup procedures must be present when dangerous materials or liquid chemicals are unloaded.
- If significant residual materials remain on the ground after construction is complete, properly remove materials and any contaminated soil. See WM-7, Contaminated Soil Management. If the area is to be paved, pave as soon as materials are removed to stabilize the soil.

***Material Storage Areas and Practices***

- Liquids, petroleum products, and substances listed in 40 CFR Parts 110, 117, or 302 should be stored in approved containers and drums and should not be overfilled. Containers and drums should be placed in temporary containment facilities for storage.
- A temporary containment facility should provide for a spill containment volume able to contain precipitation from a 25 year storm event, plus the greater of 10% of the aggregate volume of all containers or 100% of the capacity of the largest container within its boundary, whichever is greater.
- A temporary containment facility should be impervious to the materials stored therein for a minimum contact time of 72 hours.
- A temporary containment facility should be maintained free of accumulated rainwater and spills. In the event of spills or leaks, accumulated rainwater and spills should be collected and placed into drums. These liquids should be handled as a hazardous waste unless testing determines them to be non-hazardous. All collected liquids or non-hazardous liquids should be sent to an approved disposal site.
- Sufficient separation should be provided between stored containers to allow for spill cleanup and emergency response access.
- Incompatible materials, such as chlorine and ammonia, should not be stored in the same temporary containment facility.
- Throughout the rainy season, each temporary containment facility should be covered during non-working days, prior to, and during rain events.
- Materials should be stored in their original containers and the original product labels should be maintained in place in a legible condition. Damaged or otherwise illegible labels should be replaced immediately.

- Bagged and boxed materials should be stored on pallets and should not be allowed to accumulate on the ground. To provide protection from wind and rain throughout the rainy season, bagged and boxed materials should be covered during non-working days and prior to and during rain events.
- Stockpiles should be protected in accordance with WM-3, Stockpile Management.
- Materials should be stored indoors within existing structures or sheds when available.
- Proper storage instructions should be posted at all times in an open and conspicuous location.
- An ample supply of appropriate spill clean up material should be kept near storage areas.
- Also see WM-6, Hazardous Waste Management, for storing of hazardous materials.

***Material Delivery Practices***

- Keep an accurate, up-to-date inventory of material delivered and stored onsite.
- Arrange for employees trained in emergency spill cleanup procedures to be present when dangerous materials or liquid chemicals are unloaded.

***Spill Cleanup***

- Contain and clean up any spill immediately.
- Properly remove and dispose of any hazardous materials or contaminated soil if significant residual materials remain on the ground after construction is complete. See WM-7, Contaminated Soil Management.
- See WM-4, Spill Prevention and Control, for spills of chemicals and/or hazardous materials.

## Cost

- The largest cost of implementation may be in the construction of a materials storage area that is covered and provides secondary containment.

## Inspection and Maintenance

- Inspect and verify that activity–based BMPs are in place prior to the commencement of associated activities. While activities associated with the BMP are under way, inspect weekly during the rainy season and of two-week intervals in the non-rainy season to verify continued BMP implementation.
- Keep an ample supply of spill cleanup materials near the storage area.
- Keep storage areas clean, well organized, and equipped with ample cleanup supplies as appropriate for the materials being stored.
- Repair or replace perimeter controls, containment structures, covers, and liners as needed to maintain proper function.

## References

Blueprint for a Clean Bay: Best Management Practices to Prevent Stormwater Pollution from Construction Related Activities; Santa Clara Valley Nonpoint Source Pollution Control Program, 1995.

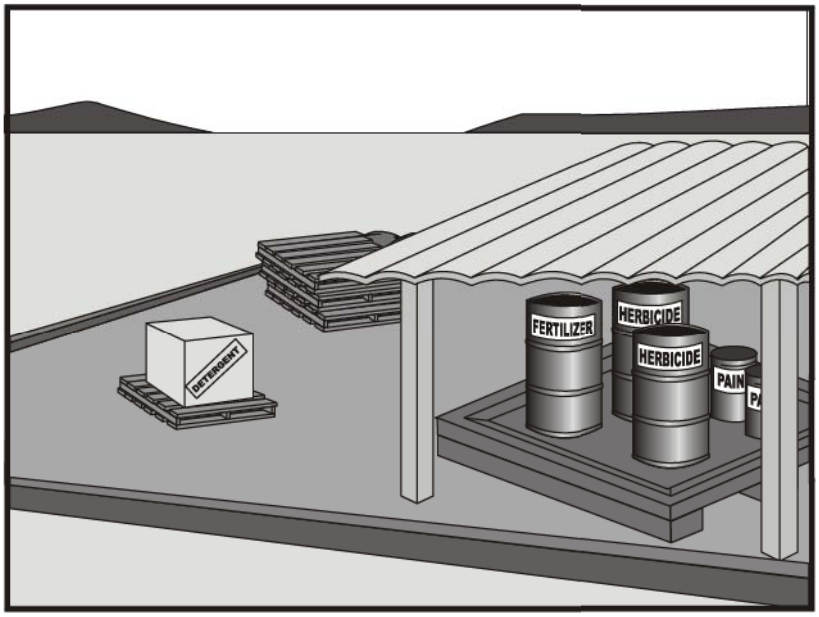
Coastal Nonpoint Pollution Control Program: Program Development and Approval Guidance, Working Group Working Paper; USEPA, April 1992.

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

Stormwater Management for Construction Activities; Developing Pollution Prevention Plans and Best Management Practice, EPA 832-R-92005; USEPA, April 1992.

# Material Use

# WM-2




## Objectives

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| TC | Tracking Control | |
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| NS | Non-Stormwater Management Control | |
| WM | Waste Management and Materials Pollution Control | ☑ |

**Legend:**

☑ **Primary Objective**

☒ **Secondary Objective**

## Targeted Constituents

| | |
|---|---|
| Sediment | ☑ |
| Nutrients | ☑ |
| Trash | ☑ |
| Metals | ☑ |
| Bacteria | |
| Oil and Grease | ☑ |
| Organics | ☑ |

## Potential Alternatives

None

## Description and Purpose

Prevent or reduce the discharge of pollutants to the storm drain system or watercourses from material use by using alternative products, minimizing hazardous material use onsite, and training employees and subcontractors.

## Suitable Applications

This BMP is suitable for use at all construction projects. These procedures apply when the following materials are used or prepared onsite:

- Pesticides and herbicides
- Fertilizers
- Detergents
- Plaster
- Petroleum products such as fuel, oil, and grease
- Asphalt and other concrete components
- Other hazardous chemicals such as acids, lime, glues, adhesives, paints, solvents, and curing compounds
- Concrete compounds
- Other materials that may be detrimental if released to the environment

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## Limitations

Safer alternative building and construction products may not be available or suitable in every instance.

## Implementation

The following steps should be taken to minimize risk:

- Minimize use of hazardous materials onsite.
- Follow manufacturer instructions regarding uses, protective equipment, ventilation, flammability, and mixing of chemicals.
- Train personnel who use pesticides. The California Department of Pesticide Regulation and county agricultural commissioners license pesticide dealers, certify pesticide applicators, and conduct onsite inspections.
- Do not over-apply fertilizers, herbicides, and pesticides. Prepare only the amount needed. Follow the recommended usage instructions. Over-application is expensive and environmentally harmful. Unless on steep slopes, till fertilizers into the soil rather than hydro seeding. Apply surface dressings in several smaller applications, as opposed to one large application, to allow time for infiltration and to avoid excess material being carried offsite by runoff. Do not apply these chemicals just before it rains.
- Train employees and subcontractors in proper material use.
- Supply Material Safety Data Sheets (MSDS) for all materials.
- Dispose of latex paint and paint cans, used brushes, rags, absorbent materials, and drop cloths, when thoroughly dry and are no longer hazardous, with other construction debris.
- Do not remove the original product label; it contains important safety and disposal information. Use the entire product before disposing of the container.
- Mix paint indoors or in a containment area. Never clean paintbrushes or rinse paint containers into a street, gutter, storm drain, or watercourse. Dispose of any paint thinners, residue, and sludge(s) that cannot be recycled, as hazardous waste.
- For water-based paint, clean brushes to the extent practicable, and rinse to a drain leading to a sanitary sewer where permitted, or into a concrete washout pit or temporary sediment trap. For oil-based paints, clean brushes to the extent practicable, and filter and reuse thinners and solvents.
- Use recycled and less hazardous products when practical. Recycle residual paints, solvents, non-treated lumber, and other materials.
- Use materials only where and when needed to complete the construction activity. Use safer alternative materials as much as possible. Reduce or eliminate use of hazardous materials onsite when practical.

- Require contractors to complete the "Report of Chemical Spray Forms" when spraying herbicides and pesticides.
- Keep an ample supply of spill clean up material near use areas. Train employees in spill clean up procedures.
- Avoid exposing applied materials to rainfall and runoff unless sufficient time has been allowed for them to dry.

## Costs

All of the above are low cost measures.

## Inspection and Maintenance

- Inspect and verify that activity–based BMPs are in place prior to the commencement of associated activities. While activities associated with the BMP are under way, inspect weekly during the rainy season and at two–week intervals in the non-rainy season to verify continued BMP implementation.
- Maintenance of this best management practice is minimal.
- Spot check employees and subcontractors throughout the job to ensure appropriate practices are being employed.

## References

Blueprint for a Clean Bay: Best Management Practices to Prevent Stormwater Pollution from Construction Related Activities; Santa Clara Valley Nonpoint Source Pollution Control Program, 1995.

Coastal Nonpoint Pollution Control Program: Program Development and Approval Guidance, Working Group Working Paper; USEPA, April 1992.

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

Stormwater Management for Construction Activities; Developing Pollution Prevention Plans and Best Management Practice, EPA 832-R-92005; USEPA, April 1992.

# Stockpile Management WM-3

## Objectives

| | | |
|---|---|---|
| EC | Erosion Control | |
| SE | Sediment Control | |
| TC | Tracking Control | |
| WE | Wind Erosion Control | |
| NS | Non-Stormwater Management Control | |
| WM | Waste Management and Materials Pollution Control | ☑ |

**Legend:**

☑ **Primary Objective**

☒ **Secondary Objective**

## Targeted Constituents

| | |
|---|---|
| Sediment | ☑ |
| Nutrients | ☑ |
| Trash | ☑ |
| Metals | ☑ |
| Bacteria | |
| Oil and Grease | ☑ |
| Organics | ☑ |

## Potential Alternatives

None

## Description and Purpose

Stockpile Management procedures and practices are designed to reduce or eliminate air and stormwater pollution from stockpiles of soil, paving materials such as portland cement concrete (PCC) rubble, asphalt concrete (AC), asphalt concrete rubble, aggregate base, aggregate sub base or pre-mixed aggregate, asphalt minder (so called "cold mix" asphalt), and pressure treated wood.

## Suitable Applications

Implement in all projects that stockpile soil and other materials.

## Limitations

None identified.

## Implementation

Protection of stockpiles is a year-round requirement. To properly manage stockpiles:

- Locate stockpiles a minimum of 50 ft away from concentrated flows of stormwater, drainage courses, and inlets.
- Protect all stockpiles from stormwater runon using a temporary perimeter sediment barrier such as berms, dikes, fiber rolls, silt fences, sandbag, gravel bags, or straw bale barriers.

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- Implement wind erosion control practices as appropriate on all stockpiled material. For specific information, see WE-1, Wind Erosion Control.
- Manage stockpiles of contaminated soil in accordance with WM-7, Contaminated Soil Management.
- Place bagged materials on pallets and under cover.

***Protection of Non-Active Stockpiles***

Non-active stockpiles of the identified materials should be protected further as follows:

*Soil stockpiles*

- During the rainy season, soil stockpiles should be covered or protected with soil stabilization measures and a temporary perimeter sediment barrier at all times.
- During the non-rainy season, soil stockpiles should be covered or protected with a temporary perimeter sediment barrier prior to the onset of precipitation.

*Stockpiles of Portland cement concrete rubble, asphalt concrete, asphalt concrete rubble, aggregate base, or aggregate sub base*

- During the rainy season, the stockpiles should be covered or protected with a temporary perimeter sediment barrier at all times.
- During the non-rainy season, the stockpiles should be covered or protected with a temporary perimeter sediment barrier prior to the onset of precipitation.

*Stockpiles of "cold mix"*

- During the rainy season, cold mix stockpiles should be placed on and covered with plastic or comparable material at all times.
- During the non-rainy season, cold mix stockpiles should be placed on and covered with plastic or comparable material prior to the onset of precipitation.

*Stockpiles/Storage of pressure treated wood with copper, chromium, and arsenic or ammonical, copper, zinc, and arsenate*

- During the rainy season, treated wood should be covered with plastic or comparable material at all times.
- During the non-rainy season, treated wood should be covered with plastic or comparable material at all times and cold mix stockpiles should be placed on and covered with plastic or comparable material prior to the onset of precipitation.

***Protection of Active Stockpiles***

Active stockpiles of the identified materials should be protected further as follows:

- All stockpiles should be protected with a temporary linear sediment barrier prior to the onset of precipitation.
- Stockpiles of "cold mix" should be placed on and covered with plastic or comparable material prior to the onset of precipitation.

## Costs

All of the above are low cost measures.

## Inspection and Maintenance

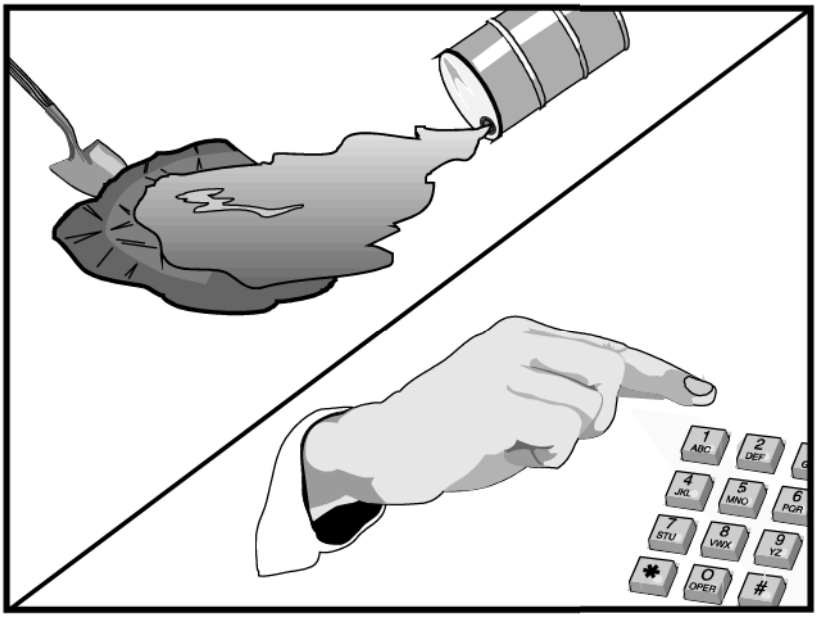
- Inspect and verify that activity–based BMPs are in place prior to the commencement of associated activities. While activities associated with the BMP are under way, inspect weekly during the rainy season and of two-week intervals in the non-rainy season to verify continued BMP implementation

- Repair and/or replace perimeter controls and covers as needed to keep them functioning properly.

## References

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

# Spill Prevention and Control WM-4



## Objectives

| | | |
|---|---|---|
| EC | Erosion Control | |
| SE | Sediment Control | |
| TC | Tracking Control | |
| WE | Wind Erosion Control | |
| NS | Non-Stormwater Management Control | |
| WM | Waste Management and Materials Pollution Control | ☑ |

**Legend:**

☑ **Primary Objective**

☒ **Secondary Objective**

## Targeted Constituents

| | |
|---|---|
| Sediment | ☑ |
| Nutrients | ☑ |
| Trash | ☑ |
| Metals | ☑ |
| Bacteria | |
| Oil and Grease | ☑ |
| Organics | ☑ |

## Potential Alternatives

None

## Description and Purpose

Prevent or reduce the discharge of pollutants to drainage systems or watercourses from leaks and spills by reducing the chance for spills, stopping the source of spills, containing and cleaning up spills, properly disposing of spill materials, and training employees.

This best management practice covers only spill prevention and control. However, WM-1, Materials Delivery and Storage, and WM-2, Material Use, also contain useful information, particularly on spill prevention. For information on wastes, see the waste management BMPs in this section.

## Suitable Applications

This BMP is suitable for all construction projects. Spill control procedures are implemented anytime chemicals or hazardous substances are stored on the construction site, including the following materials:

- Soil stabilizers/binders
- Dust palliatives
- Herbicides
- Growth inhibitors
- Fertilizers
- Deicing/anti-icing chemicals

- Fuels
- Lubricants
- Other petroleum distillates

## Limitations

- In some cases it may be necessary to use a private spill cleanup company.
- This BMP applies to spills caused by the contractor and subcontractors.
- Procedures and practices presented in this BMP are general. Contractor should identify appropriate practices for the specific materials used or stored onsite

## Implementation

The following steps will help reduce the stormwater impacts of leaks and spills:

### *Education*

- Be aware that different materials pollute in different amounts. Make sure that each employee knows what a "significant spill" is for each material they use, and what is the appropriate response for "significant" and "insignificant" spills.
- Educate employees and subcontractors on potential dangers to humans and the environment from spills and leaks.
- Hold regular meetings to discuss and reinforce appropriate disposal procedures (incorporate into regular safety meetings).
- Establish a continuing education program to indoctrinate new employees.
- Have contractor's superintendent or representative oversee and enforce proper spill prevention and control measures.

### *General Measures*

- To the extent that the work can be accomplished safely, spills of oil, petroleum products, substances listed under 40 CFR parts 110,117, and 302, and sanitary and septic wastes should be contained and cleaned up immediately.
- Store hazardous materials and wastes in covered containers and protect from vandalism.
- Place a stockpile of spill cleanup materials where it will be readily accessible.
- Train employees in spill prevention and cleanup.
- Designate responsible individuals to oversee and enforce control measures.
- Spills should be covered and protected from stormwater runon during rainfall to the extent that it doesn't compromise clean up activities.
- Do not bury or wash spills with water.

- Store and dispose of used clean up materials, contaminated materials, and recovered spill material that is no longer suitable for the intended purpose in conformance with the provisions in applicable BMPs.
- Do not allow water used for cleaning and decontamination to enter storm drains or watercourses. Collect and dispose of contaminated water in accordance with WM-10, Liquid Waste Management.
- Contain water overflow or minor water spillage and do not allow it to discharge into drainage facilities or watercourses.
- Place proper storage, cleanup, and spill reporting instructions for hazardous materials stored or used on the project site in an open, conspicuous, and accessible location.
- Keep waste storage areas clean, well organized, and equipped with ample cleanup supplies as appropriate for the materials being stored. Perimeter controls, containment structures, covers, and liners should be repaired or replaced as needed to maintain proper function.

***Cleanup***

- Clean up leaks and spills immediately.
- Use a rag for small spills on paved surfaces, a damp mop for general cleanup, and absorbent material for larger spills. If the spilled material is hazardous, then the used cleanup materials are also hazardous and must be sent to either a certified laundry (rags) or disposed of as hazardous waste.
- Never hose down or bury dry material spills. Clean up as much of the material as possible and dispose of properly. See the waste management BMPs in this section for specific information.

***Minor Spills***

- Minor spills typically involve small quantities of oil, gasoline, paint, etc. which can be controlled by the first responder at the discovery of the spill.
- Use absorbent materials on small spills rather than hosing down or burying the spill.
- Absorbent materials should be promptly removed and disposed of properly.
- Follow the practice below for a minor spill:
  - Contain the spread of the spill.
  - Recover spilled materials.
  - Clean the contaminated area and properly dispose of contaminated materials.

***Semi-Significant Spills***

- Semi-significant spills still can be controlled by the first responder along with the aid of other personnel such as laborers and the foreman, etc. This response may require the cessation of all other activities.

- Spills should be cleaned up immediately:
  - Contain spread of the spill.
  - Notify the project foreman immediately.
  - If the spill occurs on paved or impermeable surfaces, clean up using "dry" methods (absorbent materials, cat litter and/or rags). Contain the spill by encircling with absorbent materials and do not let the spill spread widely.
  - If the spill occurs in dirt areas, immediately contain the spill by constructing an earthen dike. Dig up and properly dispose of contaminated soil.
  - If the spill occurs during rain, cover spill with tarps or other material to prevent contaminating runoff.

***Significant/Hazardous Spills***

- For significant or hazardous spills that cannot be controlled by personnel in the immediate vicinity, the following steps should be taken:
  - Notify the local emergency response by dialing 911. In addition to 911, the contractor will notify the proper county officials. It is the contractor's responsibility to have all emergency phone numbers at the construction site.
  - Notify the Governor's Office of Emergency Services Warning Center, (916) 845-8911.
  - For spills of federal reportable quantities, in conformance with the requirements in 40 CFR parts 110,119, and 302, the contractor should notify the National Response Center at (800) 424-8802.
  - Notification should first be made by telephone and followed up with a written report.
  - The services of a spills contractor or a Haz-Mat team should be obtained immediately. Construction personnel should not attempt to clean up until the appropriate and qualified staffs have arrived at the job site.
  - Other agencies which may need to be consulted include, but are not limited to, the Fire Department, the Public Works Department, the Coast Guard, the Highway Patrol, the City/County Police Department, Department of Toxic Substances, California Division of Oil and Gas, Cal/OSHA, etc.

***Reporting***

- Report significant spills to local agencies, such as the Fire Department; they can assist in cleanup.
- Federal regulations require that any significant oil spill into a water body or onto an adjoining shoreline be reported to the National Response Center (NRC) at 800-424-8802 (24 hours).

Use the following measures related to specific activities:

### *Vehicle and Equipment Maintenance*

- If maintenance must occur onsite, use a designated area and a secondary containment, located away from drainage courses, to prevent the runon of stormwater and the runoff of spills.
- Regularly inspect onsite vehicles and equipment for leaks and repair immediately
- Check incoming vehicles and equipment (including delivery trucks, and employee and subcontractor vehicles) for leaking oil and fluids. Do not allow leaking vehicles or equipment onsite.
- Always use secondary containment, such as a drain pan or drop cloth, to catch spills or leaks when removing or changing fluids.
- Place drip pans or absorbent materials under paving equipment when not in use.
- Use absorbent materials on small spills rather than hosing down or burying the spill. Remove the absorbent materials promptly and dispose of properly.
- Promptly transfer used fluids to the proper waste or recycling drums. Don't leave full drip pans or other open containers lying around
- Oil filters disposed of in trashcans or dumpsters can leak oil and pollute stormwater. Place the oil filter in a funnel over a waste oil-recycling drum to drain excess oil before disposal. Oil filters can also be recycled. Ask the oil supplier or recycler about recycling oil filters.
- Store cracked batteries in a non-leaking secondary container. Do this with all cracked batteries even if you think all the acid has drained out. If you drop a battery, treat it as if it is cracked. Put it into the containment area until you are sure it is not leaking.

### *Vehicle and Equipment Fueling*

- If fueling must occur onsite, use designate areas, located away from drainage courses, to prevent the runon of stormwater and the runoff of spills.
- Discourage "topping off" of fuel tanks.
- Always use secondary containment, such as a drain pan, when fueling to catch spills/ leaks.

## Costs

Prevention of leaks and spills is inexpensive. Treatment and/ or disposal of contaminated soil or water can be quite expensive.

## Inspection and Maintenance

- Inspect and verify that activity–based BMPs are in place prior to the commencement of associated activities. While activities associated with the BMP are under way, inspect weekly during the rainy season and of two-week intervals in the non-rainy season to verify continued BMP implementation.
- Inspect BMPs subject to non-stormwater discharge daily while non-stormwater discharges occur.

- Keep ample supplies of spill control and cleanup materials onsite, near storage, unloading, and maintenance areas.
- Update your spill prevention and control plan and stock cleanup materials as changes occur in the types of chemicals onsite.

## References

Blueprint for a Clean Bay: Best Management Practices to Prevent Stormwater Pollution from Construction Related Activities; Santa Clara Valley Nonpoint Source Pollution Control Program, 1995.

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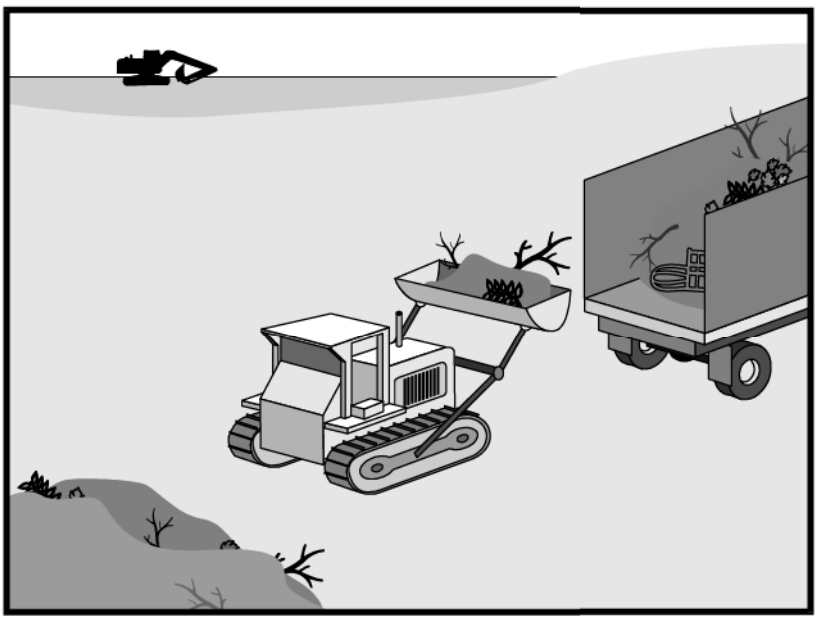
# Solid Waste Management WM-5



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| WM | Waste Management and Materials Pollution Control | ☑ |

**Legend:**

☑ **Primary Objective**

☒ **Secondary Objective**

## Targeted Constituents

| | |
|---|---|
| Sediment | ☑ |
| Nutrients | ☑ |
| Trash | ☑ |
| Metals | ☑ |
| Bacteria | |
| Oil and Grease | ☑ |
| Organics | ☑ |

## Potential Alternatives

None

## Description and Purpose

Solid waste management procedures and practices are designed to prevent or reduce the discharge of pollutants to stormwater from solid or construction waste by providing designated waste collection areas and containers, arranging for regular disposal, and training employees and subcontractors.

## Suitable Applications

This BMP is suitable for construction sites where the following wastes are generated or stored:

- Solid waste generated from trees and shrubs removed during land clearing, demolition of existing structures (rubble), and building construction
- Packaging materials including wood, paper, and plastic
- Scrap or surplus building materials including scrap metals, rubber, plastic, glass pieces and masonry products
- Domestic wastes including food containers such as beverage cans, coffee cups, paper bags, plastic wrappers, and cigarettes
- Construction wastes including brick, mortar, timber, steel and metal scraps, pipe and electrical cuttings, non-hazardous equipment parts, styrofoam and other materials used to transport and package construction materials

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- Highway planting wastes, including vegetative material, plant containers, and packaging materials

## Limitations

Temporary stockpiling of certain construction wastes may not necessitate stringent drainage related controls during the non-rainy season or in desert areas with low rainfall.

## Implementation

The following steps will help keep a clean site and reduce stormwater pollution:

- Select designated waste collection areas onsite.
- Inform trash-hauling contractors that you will accept only watertight dumpsters for onsite use. Inspect dumpsters for leaks and repair any dumpster that is not watertight.
- Locate containers in a covered area or in a secondary containment.
- Provide an adequate number of containers with lids or covers that can be placed over the container to keep rain out or to prevent loss of wastes when it is windy.
- Plan for additional containers and more frequent pickup during the demolition phase of construction.
- Collect site trash daily, especially during rainy and windy conditions.
- Remove this solid waste promptly since erosion and sediment control devices tend to collect litter.
- Make sure that toxic liquid wastes (used oils, solvents, and paints) and chemicals (acids, pesticides, additives, curing compounds) are not disposed of in dumpsters designated for construction debris.
- Do not hose out dumpsters on the construction site. Leave dumpster cleaning to the trash hauling contractor.
- Arrange for regular waste collection before containers overflow.
- Clean up immediately if a container does spill.
- Make sure that construction waste is collected, removed, and disposed of only at authorized disposal areas.

### *Education*

- Have the contractor's superintendent or representative oversee and enforce proper solid waste management procedures and practices.
- Instruct employees and subcontractors on identification of solid waste and hazardous waste.
- Educate employees and subcontractors on solid waste storage and disposal procedures.

- Hold regular meetings to discuss and reinforce disposal procedures (incorporate into regular safety meetings).
- Require that employees and subcontractors follow solid waste handling and storage procedures.
- Prohibit littering by employees, subcontractors, and visitors.
- Minimize production of solid waste materials wherever possible.

***Collection, Storage, and Disposal***

- Littering on the project site should be prohibited.
- To prevent clogging of the storm drainage system, litter and debris removal from drainage grates, trash racks, and ditch lines should be a priority.
- Trash receptacles should be provided in the contractor's yard, field trailer areas, and at locations where workers congregate for lunch and break periods.
- Litter from work areas within the construction limits of the project site should be collected and placed in watertight dumpsters at least weekly, regardless of whether the litter was generated by the contractor, the public, or others. Collected litter and debris should not be placed in or next to drain inlets, stormwater drainage systems, or watercourses.
- Dumpsters of sufficient size and number should be provided to contain the solid waste generated by the project.
- Full dumpsters should be removed from the project site and the contents should be disposed of by the trash hauling contractor.
- Construction debris and waste should be removed from the site biweekly or more frequently as needed.
- Construction material visible to the public should be stored or stacked in an orderly manner.
- Stormwater runon should be prevented from contacting stored solid waste through the use of berms, dikes, or other temporary diversion structures or through the use of measures to elevate waste from site surfaces.
- Solid waste storage areas should be located at least 50 ft from drainage facilities and watercourses and should not be located in areas prone to flooding or ponding.
- Except during fair weather, construction and highway planting waste not stored in watertight dumpsters should be securely covered from wind and rain by covering the waste with tarps or plastic.
- Segregate potentially hazardous waste from non-hazardous construction site waste.
- Make sure that toxic liquid wastes (used oils, solvents, and paints) and chemicals (acids, pesticides, additives, curing compounds) are not disposed of in dumpsters designated for construction debris.

- For disposal of hazardous waste, see WM-6, Hazardous Waste Management. Have hazardous waste hauled to an appropriate disposal and/or recycling facility.

- Salvage or recycle useful vegetation debris, packaging and surplus building materials when practical. For example, trees and shrubs from land clearing can be used as a brush barrier, or converted into wood chips, then used as mulch on graded areas. Wood pallets, cardboard boxes, and construction scraps can also be recycled.

## Costs

All of the above are low cost measures.

## Inspection and Maintenance

- Inspect and verify that activity–based BMPs are in place prior to the commencement of associated activities. While activities associated with the BMP are under way, inspect weekly during the rainy season and of two-week intervals in the non-rainy season to verify continued BMP implementation.

- Inspect BMPs subject to non-stormwater discharge daily while non-stormwater discharges occur

- Inspect construction waste area regularly.

- Arrange for regular waste collection.

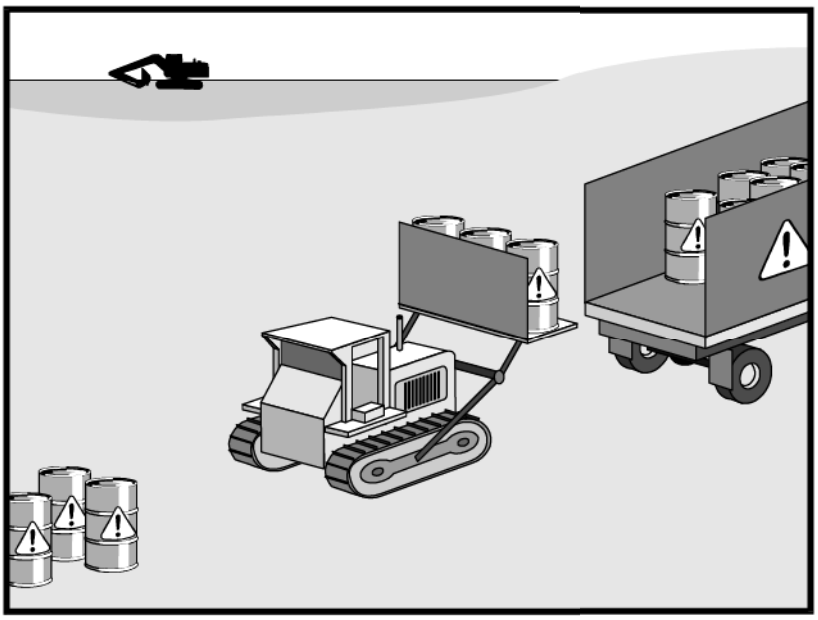
## References

Processes, Procedures and Methods to Control Pollution Resulting from All Construction Activity, 430/9-73-007, USEPA, 1973.

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

Stormwater Management for Construction Activities; Developing Pollution Prevention Plans and Best Management Practice, EPA 832-R-92005; USEPA, April 1992.

# Hazardous Waste Management WM-6



## Objectives

| | | |
|---|---|---|
| EC | Erosion Control | |
| SE | Sediment Control | |
| TC | Tracking Control | |
| WE | Wind Erosion Control | |
| NS | Non-Stormwater Management Control | |
| WM | Waste Management and Materials Pollution Control | ☑ |

**Legend:**

☑ **Primary Objective**

☒ **Secondary Objective**

## Targeted Constituents

| | |
|---|---|
| Sediment | |
| Nutrients | ☑ |
| Trash | ☑ |
| Metals | ☑ |
| Bacteria | ☑ |
| Oil and Grease | ☑ |
| Organics | ☑ |

## Potential Alternatives

None

## Description and Purpose

Prevent or reduce the discharge of pollutants to stormwater from hazardous waste through proper material use, waste disposal, and training of employees and subcontractors.

## Suitable Applications

This best management practice (BMP) applies to all construction projects. Hazardous waste management practices are implemented on construction projects that generate waste from the use of:

- Petroleum Products
- Concrete Curing Compounds
- Palliatives
- Septic Wastes
- Stains
- Wood Preservatives
- Asphalt Products
- Pesticides
- Acids
- Paints
- Solvents
- Roofing Tar
- Any materials deemed a hazardous waste in California, Title 22 Division 4.5, or listed in 40 CFR Parts 110, 117, 261, or 302

In addition, sites with existing structures may contain wastes, which must be disposed of in accordance with federal, state, and local regulations. These wastes include:

- Sandblasting grit mixed with lead-, cadmium-, or chromium-based paints
- Asbestos
- PCBs (particularly in older transformers)

## Limitations

- Hazardous waste that cannot be reused or recycled must be disposed of by a licensed hazardous waste hauler.
- Nothing in this BMP relieves the contractor from responsibility for compliance with federal, state, and local laws regarding storage, handling, transportation, and disposal of hazardous wastes.
- This BMP does not cover aerially deposited lead (ADL) soils. For ADL soils refer to WM-7, Contaminated Soil Management.

## Implementation

The following steps will help reduce stormwater pollution from hazardous wastes:

### *Material Use*

- Wastes should be stored in sealed containers constructed of a suitable material and should be labeled as required by Title 22 CCR, Division 4.5 and 49 CFR Parts 172, 173, 178, and 179.
- All hazardous waste should be stored, transported, and disposed as required in Title 22 CCR, Division 4.5 and 49 CFR 261-263.
- Waste containers should be stored in temporary containment facilities that should comply with the following requirements:
  - Temporary containment facility should provide for a spill containment volume equal to 1.5 times the volume of all containers able to contain precipitation from a 25 year storm event, plus the greater of 10% of the aggregate volume of all containers or 100% of the capacity of the largest tank within its boundary, whichever is greater.
  - Temporary containment facility should be impervious to the materials stored there for a minimum contact time of 72 hours.
  - Temporary containment facilities should be maintained free of accumulated rainwater and spills. In the event of spills or leaks, accumulated rainwater and spills should be placed into drums after each rainfall. These liquids should be handled as a hazardous waste unless testing determines them to be non-hazardous. Non-hazardous liquids should be sent to an approved disposal site.
  - Sufficient separation should be provided between stored containers to allow for spill cleanup and emergency response access.

- Incompatible materials, such as chlorine and ammonia, should not be stored in the same temporary containment facility.
- Throughout the rainy season, temporary containment facilities should be covered during non-working days, and prior to rain events. Covered facilities may include use of plastic tarps for small facilities or constructed roofs with overhangs.

- Drums should not be overfilled and wastes should not be mixed.
- Unless watertight, containers of dry waste should be stored on pallets.
- Do not over-apply herbicides and pesticides. Prepare only the amount needed. Follow the recommended usage instructions. Over application is expensive and environmentally harmful. Apply surface dressings in several smaller applications, as opposed to one large application. Allow time for infiltration and avoid excess material being carried offsite by runoff. Do not apply these chemicals just before it rains. People applying pesticides must be certified in accordance with federal and state regulations.
- Paint brushes and equipment for water and oil based paints should be cleaned within a contained area and should not be allowed to contaminate site soils, watercourses, or drainage systems. Waste paints, thinners, solvents, residues, and sludges that cannot be recycled or reused should be disposed of as hazardous waste. When thoroughly dry, latex paint and paint cans, used brushes, rags, absorbent materials, and drop cloths should be disposed of as solid waste.
- Do not clean out brushes or rinse paint containers into the dirt, street, gutter, storm drain, or stream. "Paint out" brushes as much as possible. Rinse water-based paints to the sanitary sewer. Filter and reuse thinners and solvents. Dispose of excess oil-based paints and sludge as hazardous waste.
- The following actions should be taken with respect to temporary contaminant:
  - Ensure that adequate hazardous waste storage volume is available.
  - Ensure that hazardous waste collection containers are conveniently located.
  - Designate hazardous waste storage areas onsite away from storm drains or watercourses and away from moving vehicles and equipment to prevent accidental spills.
  - Minimize production or generation of hazardous materials and hazardous waste on the job site.
  - Use containment berms in fueling and maintenance areas and where the potential for spills is high.
  - Segregate potentially hazardous waste from non-hazardous construction site debris.
  - Keep liquid or semi-liquid hazardous waste in appropriate containers (closed drums or similar) and under cover.

- Clearly label all hazardous waste containers with the waste being stored and the date of accumulation.
- Place hazardous waste containers in secondary containment.
- Do not allow potentially hazardous waste materials to accumulate on the ground.
- Do not mix wastes.
- Use all of the product before disposing of the container.
- Do not remove the original product label; it contains important safety and disposal information.

***Waste Recycling Disposal***

- Select designated hazardous waste collection areas onsite.
- Hazardous materials and wastes should be stored in covered containers and protected from vandalism.
- Place hazardous waste containers in secondary containment.
- Do not mix wastes, this can cause chemical reactions, making recycling impossible and complicating disposal.
- Recycle any useful materials such as used oil or water-based paint.
- Make sure that toxic liquid wastes (used oils, solvents, and paints) and chemicals (acids, pesticides, additives, curing compounds) are not disposed of in dumpsters designated for construction debris.
- Arrange for regular waste collection before containers overflow.
- Make sure that hazardous waste (e.g., excess oil-based paint and sludge) is collected, removed, and disposed of only at authorized disposal areas.

***Disposal Procedures***

- Waste should be disposed of by a licensed hazardous waste transporter at an authorized and licensed disposal facility or recycling facility utilizing properly completed Uniform Hazardous Waste Manifest forms.
- A Department of Health Services certified laboratory should sample waste to determine the appropriate disposal facility.
- Properly dispose of rainwater in secondary containment that may have mixed with hazardous waste.
- Attention is directed to "Hazardous Material", "Contaminated Material", and "Aerially Deposited Lead" of the contract documents regarding the handling and disposal of hazardous materials.

### *Education*

- Educate employees and subcontractors on hazardous waste storage and disposal procedures.
- Educate employees and subcontractors on potential dangers to humans and the environment from hazardous wastes.
- Instruct employees and subcontractors on safety procedures for common construction site hazardous wastes.
- Instruct employees and subcontractors in identification of hazardous and solid waste.
- Hold regular meetings to discuss and reinforce hazardous waste management procedures (incorporate into regular safety meetings).
- The contractor's superintendent or representative should oversee and enforce proper hazardous waste management procedures and practices.
- Make sure that hazardous waste is collected, removed, and disposed of only at authorized disposal areas.
- Warning signs should be placed in areas recently treated with chemicals.
- Place a stockpile of spill cleanup materials where it will be readily accessible.
- If a container does spill, clean up immediately.

## Costs

All of the above are low cost measures.

### *Inspection and Maintenance*

- Inspect and verify that activity–based BMPs are in place prior to the commencement of associated activities. While activities associated with the BMP are under way, inspect weekly during the rainy season and of two week intervals in the non-rainy season to verify continued BMP implementation.
- Inspect BMPs subject to non-stormwater discharge daily while non-stormwater discharges occur
- Hazardous waste should be regularly collected.
- A foreman or construction supervisor should monitor onsite hazardous waste storage and disposal procedures.
- Waste storage areas should be kept clean, well organized, and equipped with ample cleanup supplies as appropriate for the materials being stored.
- Perimeter controls, containment structures, covers, and liners should be repaired or replaced as needed to maintain proper function.
- Hazardous spills should be cleaned up and reported in conformance with the applicable Material Safety Data Sheet (MSDS) and the instructions posted at the project site.

- The National Response Center, at (800) 424-8802, should be notified of spills of federal reportable quantities in conformance with the requirements in 40 CFR parts 110, 117, and 302. Also notify the Governors Office of Emergency Services Warning Center at (916) 845-8911.
- A copy of the hazardous waste manifests should be provided.

## References

Blueprint for a Clean Bay: Best Management Practices to Prevent Stormwater Pollution from Construction Related Activities; Santa Clara Valley Nonpoint Source Pollution Control Program, 1995.

Processes, Procedures and Methods to Control Pollution Resulting from All Construction Activity, 430/9-73-007, USEPA, 1973.

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

Stormwater Management for Construction Activities; Developing Pollution Prevention Plans and Best Management Practice, EPA 832-R-92005; USEPA, April 1992.

# Contaminated Soil Management WM-7

## Objectives

| | | |
|---|---|---|
| EC | Erosion Control | |
| SE | Sediment Control | |
| TC | Tracking Control | |
| WE | Wind Erosion Control | |
| NS | Non-Stormwater Management Control | |
| WM | Waste Management and Materials Pollution Control | ☑ |

**Legend:**

☑ **Primary Objective**

☒ **Secondary Objective**

## Description and Purpose

Prevent or reduce the discharge of pollutants to stormwater from contaminated soil and highly acidic or alkaline soils by conducting pre-construction surveys, inspecting excavations regularly, and remediating contaminated soil promptly.

## Suitable Applications

Contaminated soil management is implemented on construction projects in highly urbanized or industrial areas where soil contamination may have occurred due to spills, illicit discharges, aerial deposition, past use and leaks from underground storage tanks.

## Limitations

Contaminated soils that cannot be treated onsite must be disposed of offsite by a licensed hazardous waste hauler. The presence of contaminated soil may indicate contaminated water as well. See NS-2, Dewatering Operations, for more information.

The procedures and practices presented in this BMP are general. The contractor should identify appropriate practices and procedures for the specific contaminants known to exist or discovered onsite.

## Implementation

Most owners and developers conduct pre-construction environmental assessments as a matter of routine. Contaminated soils are often identified during project planning and development with known locations identified in the plans, specifications and in the SWPPP. The contractor should review applicable reports and investigate appropriate call-outs in the plans, specifications, and

## Targeted Constituents

| | |
|---|---|
| Sediment | |
| Nutrients | ☑ |
| Trash | ☑ |
| Metals | ☑ |
| Bacteria | ☑ |
| Oil and Grease | ☑ |
| Organics | ☑ |

## Potential Alternatives

None

CASQA
CALIFORNIA STORMWATER QUALITY ASSOCIATION

SWPPP. Recent court rulings holding contractors liable for cleanup costs when they unknowingly move contaminated soil highlight the need for contractors to confirm a site assessment is completed before earth moving begins.

The following steps will help reduce stormwater pollution from contaminated soil:

- Conduct thorough, pre-construction inspections of the site and review documents related to the site. If inspection or reviews indicated presence of contaminated soils, develop a plan before starting work.
- Look for contaminated soil as evidenced by discoloration, odors, differences in soil properties, abandoned underground tanks or pipes, or buried debris.
- Prevent leaks and spills. Contaminated soil can be expensive to treat and dispose of properly. However, addressing the problem before construction is much less expensive than after the structures are in place.
- The contractor may further identify contaminated soils by investigating:
  - Past site uses and activities
  - Detected or undetected spills and leaks
  - Acid or alkaline solutions from exposed soil or rock formations high in acid or alkaline forming elements
  - Contaminated soil as evidenced by discoloration, odors, differences in soil properties, abandoned underground tanks or pipes, or buried debris.
  - Suspected soils should be tested at a certified laboratory.

### *Education*

- Have employees and subcontractors complete a safety training program which meets 29 CFR 1910.120 and 8 CCR 5192 covering the potential hazards as identified, prior to performing any excavation work at the locations containing material classified as hazardous.
- Educate employees and subcontractors in identification of contaminated soil and on contaminated soil handling and disposal procedures.
- Hold regular meetings to discuss and reinforce disposal procedures (incorporate into regular safety meetings).

### *Handling Procedures for Material with Aerially Deposited Lead (ADL)*

- Materials from areas designated as containing (ADL) may, if allowed by the contract special provisions, be excavated, transported, and used in the construction of embankments and/or backfill.
- Excavation, transportation, and placement operations should result in no visible dust.
- Caution should be exercised to prevent spillage of lead containing material during transport.

- Quality should be monitored during excavation of soils contaminated with lead.

***Handling Procedures for Contaminated Soils***

- Minimize onsite storage. Contaminated soil should be disposed of properly in accordance with all applicable regulations. All hazardous waste storage will comply with the requirements in Title 22, CCR, Sections 66265.250 to 66265.260.
- Test suspected soils at an approved certified laboratory.
- Work with the local regulatory agencies to develop options for treatment or disposal if the soil is contaminated.
- Avoid temporary stockpiling of contaminated soils or hazardous material.
- Take the following precautions if temporary stockpiling is necessary:
  - Cover the stockpile with plastic sheeting or tarps.
  - Install a berm around the stockpile to prevent runoff from leaving the area.
  - Do not stockpile in or near storm drains or watercourses.
- Remove contaminated material and hazardous material on exteriors of transport vehicles and place either into the current transport vehicle or into the excavation prior to the vehicle leaving the exclusion zone.
- Monitor the air quality continuously during excavation operations at all locations containing hazardous material.
- Procure all permits and licenses, pay all charges and fees, and give all notices necessary and incident to the due and lawful prosecution of the work, including registration for transporting vehicles carrying the contaminated material and the hazardous material.
- Collect water from decontamination procedures and treat or dispose of it at an appropriate disposal site.
- Collect non-reusable protective equipment, once used by any personnel, and dispose of at an appropriate disposal site.
- Install temporary security fence to surround and secure the exclusion zone. Remove fencing when no longer needed.
- Excavate, transport, and dispose of contaminated material and hazardous material in accordance with the rules and regulations of the following agencies (the specifications of these agencies supersede the procedures outlined in this BMP):
  - United States Department of Transportation (USDOT)
  - United States Environmental Protection Agency (USEPA)
  - California Environmental Protection Agency (CAL-EPA)

- California Division of Occupation Safety and Health Administration (CAL-OSHA)
- Local regulatory agencies

***Procedures for Underground Storage Tank Removals***

- Prior to commencing tank removal operations, obtain the required underground storage tank removal permits and approval from the federal, state, and local agencies that have jurisdiction over such work.
- To determine if it contains hazardous substances, arrange to have tested, any liquid or sludge found in the underground tank prior to its removal.
- Following the tank removal, take soil samples beneath the excavated tank and perform analysis as required by the local agency representative(s).
- The underground storage tank, any liquid or sludge found within the tank, and all contaminated substances and hazardous substances removed during the tank removal and transported to disposal facilities permitted to accept such waste.

***Water Control***

- All necessary precautions and preventive measures should be taken to prevent the flow of water, including ground water, from mixing with hazardous substances or underground storage tank excavations. Such preventative measures may consist of, but are not limited to, berms, cofferdams, grout curtains, freeze walls, and seal course concrete or any combination thereof.
- If water does enter an excavation and becomes contaminated, such water, when necessary to proceed with the work, should be discharged to clean, closed top, watertight transportable holding tanks, treated, and disposed of in accordance with federal, state, and local laws.

## Costs

Prevention of leaks and spills is inexpensive. Treatment or disposal of contaminated soil can be quite expensive.

## Inspection and Maintenance

- Inspect and verify that activity–based BMPs are in place prior to the commencement of associated activities. While activities associated with the BMP are under way, inspect weekly during the rainy season and of two-week intervals in the non-rainy season to verify continued BMP implementation.
- Arrange for contractor's Water Pollution Control Manager, foreman, and/or construction supervisor to monitor onsite contaminated soil storage and disposal procedures.
- Monitor air quality continuously during excavation operations at all locations containing hazardous material.
- Coordinate contaminated soils and hazardous substances/waste management with the appropriate federal, state, and local agencies.

- Implement WM-4, Spill Prevention and Control, to prevent leaks and spills as much as possible.

## References

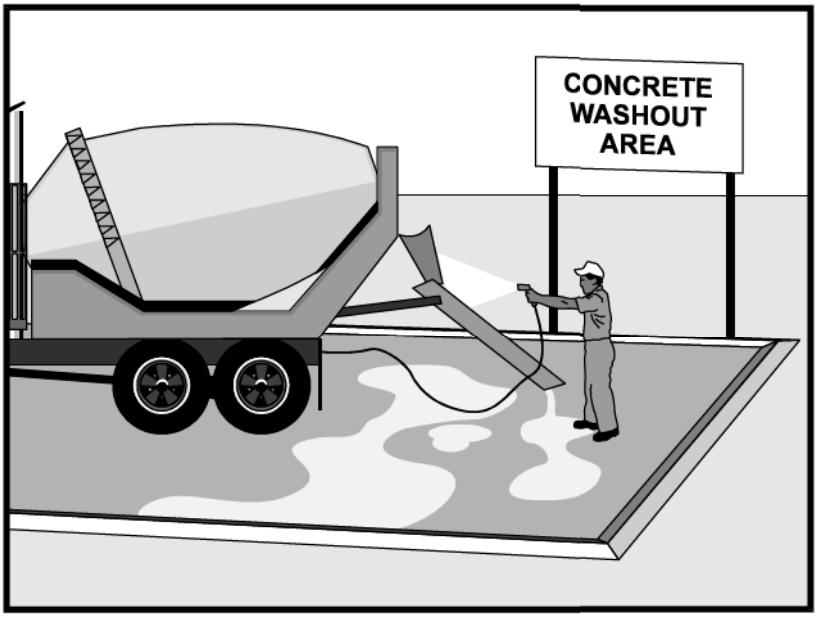
Blueprint for a Clean Bay: Best Management Practices to Prevent Stormwater Pollution from Construction Related Activities; Santa Clara Valley Nonpoint Source Pollution Control Program, 1995.

Processes, Procedures and Methods to Control Pollution Resulting from All Construction Activity, 430/9-73-007, USEPA, 1973.

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

Stormwater Management for Construction Activities; Developing Pollution Prevention Plans and Best Management Practice, EPA 832-R-92005; USEPA, April 1992.

# Concrete Waste Management WM-8




## Objectives

| | | |
|---|---|---|
| EC | Erosion Control | |
| SE | Sediment Control | |
| TC | Tracking Control | |
| WE | Wind Erosion Control | |
| NS | Non-Stormwater Management Control | |
| WM | Waste Management and Materials Pollution Control | ☑ |

**Legend:**

☑ **Primary Objective**

☒ **Secondary Objective**

## Targeted Constituents

| | |
|---|---|
| Sediment | ☑ |
| Nutrients | |
| Trash | |
| Metals | ☑ |
| Bacteria | |
| Oil and Grease | |
| Organics | |

## Potential Alternatives

None

## Description and Purpose

Prevent or reduce the discharge of pollutants to stormwater from concrete waste by conducting washout offsite, performing onsite washout in a designated area, and training employee and subcontractors.

## Suitable Applications

Concrete waste management procedures and practices are implemented on construction projects where:

- Concrete is used as a construction material or where concrete dust and debris result form demolition activities
- Slurries containing portland cement concrete (PCC) or asphalt concrete (AC) are generated, such as from saw cutting, coring, grinding, grooving, and hydro-concrete demolition
- Concrete trucks and other concrete-coated equipment are washed onsite
- Mortar-mixing stations exist
- See also NS-8, Vehicle and Equipment Cleaning

## Limitations

- Offsite washout of concrete wastes may not always be possible.

## Implementation

The following steps will help reduce stormwater pollution from concrete wastes:

- Discuss the concrete management techniques described in this BMP (such as handling of concrete waste and washout) with the ready-mix concrete supplier before any deliveries are made.
- Incorporate requirements for concrete waste management into material supplier and subcontractor agreements.
- Store dry and wet materials under cover, away from drainage areas.
- Avoid mixing excess amounts of fresh concrete.
- Perform washout of concrete trucks offsite or in designated areas only.
- Do not wash out concrete trucks into storm drains, open ditches, streets, or streams.
- Do not allow excess concrete to be dumped onsite, except in designated areas.
- For onsite washout:
  - Locate washout area at least 50 feet from storm drains, open ditches, or water bodies. Do not allow runoff from this area by constructing a temporary pit or bermed area large enough for liquid and solid waste.
  - Wash out wastes into the temporary pit where the concrete can set, be broken up, and then disposed properly.
- Avoid creating runoff by draining water to a bermed or level area when washing concrete to remove fine particles and expose the aggregate.
- Do not wash sweepings from exposed aggregate concrete into the street or storm drain. Collect and return sweepings to aggregate base stockpile or dispose in the trash.

### *Education*

- Educate employees, subcontractors, and suppliers on the concrete waste management techniques described herein.
- Arrange for contractor's superintendent or representative to oversee and enforce concrete waste management procedures.

### *Concrete Slurry Wastes*

- PCC and AC waste should not be allowed to enter storm drains or watercourses.
- PCC and AC waste should be collected and disposed of or placed in a temporary concrete washout facility.
- A sign should be installed adjacent to each temporary concrete washout facility to inform concrete equipment operators to utilize the proper facilities.

- Below grade concrete washout facilities are typical. Above grade facilities are used if excavation is not practical.
- A foreman or construction supervisor should monitor onsite concrete working tasks, such as saw cutting, coring, grinding and grooving to ensure proper methods are implemented.
- Saw-cut PCC slurry should not be allowed to enter storm drains or watercourses. Residue from grinding operations should be picked up by means of a vacuum attachment to the grinding machine. Saw cutting residue should not be allowed to flow across the pavement and should not be left on the surface of the pavement. See also NS-3, Paving and Grinding Operations; and WM-10, Liquid Waste Management.
- Slurry residue should be vacuumed and disposed in a temporary pit (as described in OnSite Temporary Concrete Washout Facility, Concrete Transit Truck Washout Procedures, below) and allowed to dry. Dispose of dry slurry residue in accordance with WM-5, Solid Waste Management.

***Onsite Temporary Concrete Washout Facility, Transit Truck Washout Procedures***

- Temporary concrete washout facilities should be located a minimum of 50 ft from storm drain inlets, open drainage facilities, and watercourses. Each facility should be located away from construction traffic or access areas to prevent disturbance or tracking.
- A sign should be installed adjacent to each washout facility to inform concrete equipment operators to utilize the proper facilities.
- Temporary concrete washout facilities should be constructed above grade or below grade at the option of the contractor. Temporary concrete washout facilities should be constructed and maintained in sufficient quantity and size to contain all liquid and concrete waste generated by washout operations.
- Temporary washout facilities should have a temporary pit or bermed areas of sufficient volume to completely contain all liquid and waste concrete materials generated during washout procedures.
- Washout of concrete trucks should be performed in designated areas only.
- Only concrete from mixer truck chutes should be washed into concrete wash out.
- Concrete washout from concrete pumper bins can be washed into concrete pumper trucks and discharged into designated washout area or properly disposed of offsite.
- Once concrete wastes are washed into the designated area and allowed to harden, the concrete should be broken up, removed, and disposed of per WM-5, Solid Waste Management. Dispose of hardened concrete on a regular basis.
- Temporary Concrete Washout Facility (Type Above Grade)
    - Temporary concrete washout facility (type above grade) should be constructed as shown on the details at the end of this BMP, with a recommended minimum length and

minimum width of 10 ft, but with sufficient quantity and volume to contain all liquid and concrete waste generated by washout operations.

- Straw bales, wood stakes, and sandbag materials should conform to the provisions in SE-9, Straw Bale Barrier.
- Plastic lining material should be a minimum of 10 mil in polyethylene sheeting and should be free of holes, tears, or other defects that compromise the impermeability of the material.

- Temporary Concrete Washout Facility (Type Below Grade)
  - Temporary concrete washout facilities (type below grade) should be constructed as shown on the details at the end of this BMP, with a recommended minimum length and minimum width of 10 ft. The quantity and volume should be sufficient to contain all liquid and concrete waste generated by washout operations.
  - Lath and flagging should be commercial type.
  - Plastic lining material should be a minimum of 10 mil polyethylene sheeting and should be free of holes, tears, or other defects that compromise the impermeability of the material.

***Removal of Temporary Concrete Washout Facilities***

- When temporary concrete washout facilities are no longer required for the work, the hardened concrete should be removed and disposed of. Materials used to construct temporary concrete washout facilities should be removed from the site of the work and disposed of.
- Holes, depressions or other ground disturbance caused by the removal of the temporary concrete washout facilities should be backfilled and repaired.

## Costs

All of the above are low cost measures.

## Inspection and Maintenance

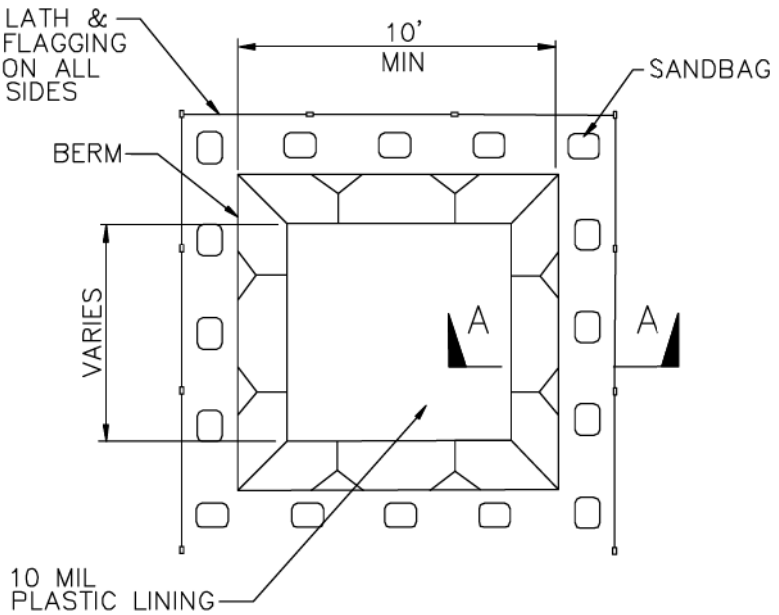
- Inspect and verify that activity–based BMPs are in place prior to the commencement of associated activities. While activities associated with the BMP are under way, inspect weekly during the rainy season and of two-week intervals in the non-rainy season to verify continued BMP implementation.
- Temporary concrete washout facilities should be maintained to provide adequate holding capacity with a minimum freeboard of 4 in. for above grade facilities and 12 in. for below grade facilities. Maintaining temporary concrete washout facilities should include removing and disposing of hardened concrete and returning the facilities to a functional condition. Hardened concrete materials should be removed and disposed of.
- Washout facilities must be cleaned, or new facilities must be constructed and ready for use once the washout is 75% full.

## References

Blueprint for a Clean Bay: Best Management Practices to Prevent Stormwater Pollution from Construction Related Activities; Santa Clara Valley Nonpoint Source Pollution Control Program, 1995.

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

Stormwater Management for Construction Activities; Developing Pollution Prevention Plans and Best Management Practice, EPA 832-R-92005; USEPA, April 1992.

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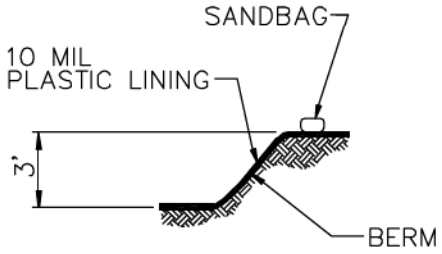
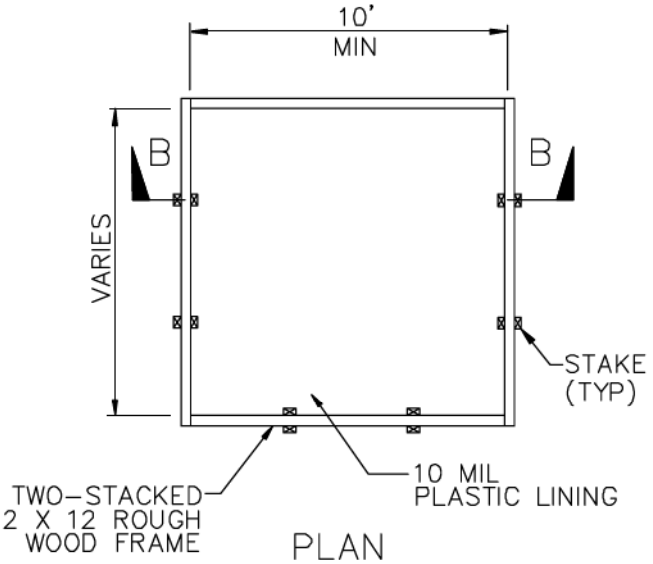
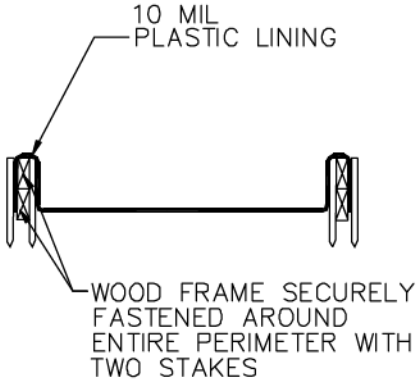
TYPE "BELOW GRADE"




SECTION A–A
NOT TO SCALE



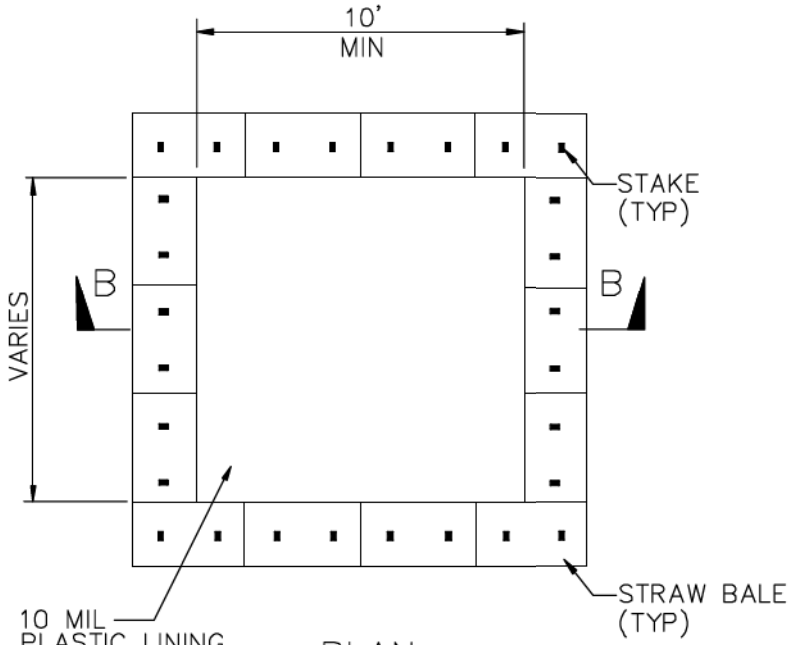

PLAN
NOT TO SCALE
TYPE "ABOVE GRADE"



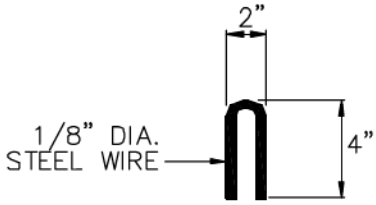

SECTION B–B
NOT TO SCALE

NOTES

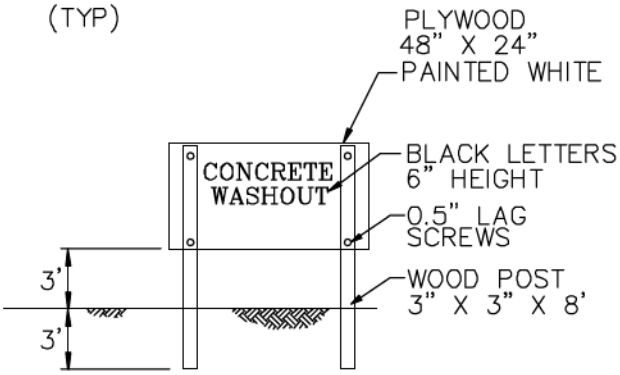
1. ACTUAL LAYOUT DETERMINED IN FIELD.
2. THE CONCRETE WASHOUT SIGN SHALL BE INSTALLED WITHIN 30 FT. OF THE TEMPORARY CONCRETE WASHOUT FACILITY.



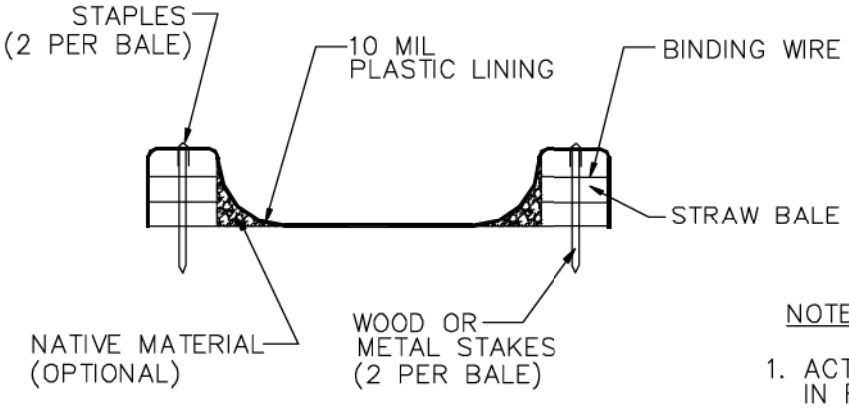

PLAN
NOT TO SCALE
TYPE "ABOVE GRADE"
WITH STRAW BALES




STAPLE DETAIL




CONCRETE WASHOUT
SIGN DETAIL
(OR EQUIVALENT)

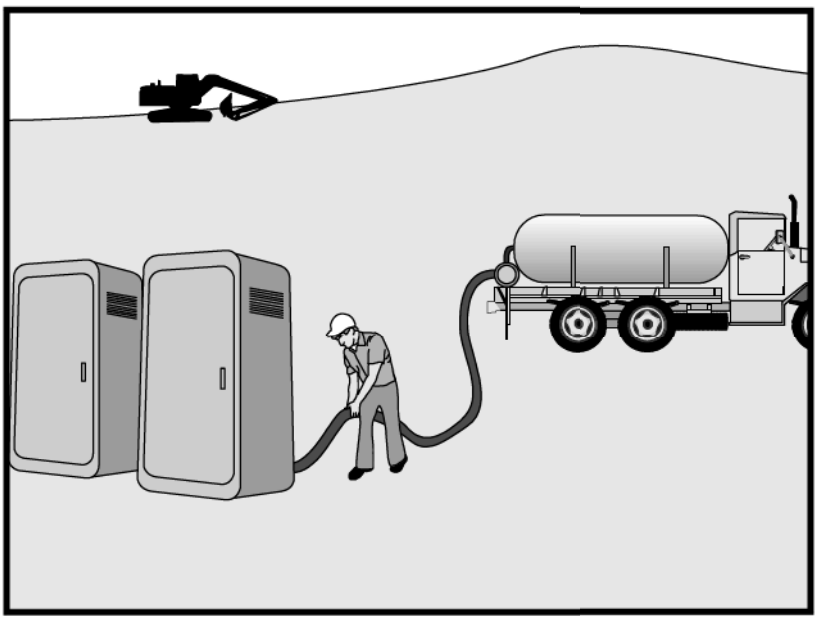



SECTION B–B
NOT TO SCALE

NOTES

1. ACTUAL LAYOUT DETERMINED IN FIELD.
2. THE CONCRETE WASHOUT SIGN SHALL BE INSTALLED WITHIN 30 FT. OF THE TEMPORARY CONCRETE WASHOUT FACILITY.

# Sanitary/Septic Waste Management WM-9



## Objectives

| | | |
|---|---|---|
| EC | Erosion Control | |
| SE | Sediment Control | |
| TC | Tracking Control | |
| WE | Wind Erosion Control | |
| NS | Non-Stormwater Management Control | |
| WM | Waste Management and Materials Pollution Control | ☑ |

**Legend:**

☑ **Primary Objective**

☒ **Secondary Objective**

## Targeted Constituents

| | |
|---|---|
| Sediment | |
| Nutrients | ☑ |
| Trash | ☑ |
| Metals | |
| Bacteria | ☑ |
| Oil and Grease | |
| Organics | ☑ |

## Potential Alternatives

None

## Description and Purpose

Proper sanitary and septic waste management prevent the discharge of pollutants to stormwater from sanitary and septic waste by providing convenient, well-maintained facilities, and arranging for regular service and disposal.

## Suitable Applications

Sanitary septic waste management practices are suitable for use at all construction sites that use temporary or portable sanitary and septic waste systems.

## Limitations

None identified.

## Implementation

Sanitary or septic wastes should be treated or disposed of in accordance with state and local requirements. In many cases, one contract with a local facility supplier will be all that it takes to make sure sanitary wastes are properly disposed.

### *Storage and Disposal Procedures*

- Temporary sanitary facilities should be located away from drainage facilities, watercourses, and from traffic circulation. When subjected to high winds or risk of high winds, temporary sanitary facilities should be secured to prevent overturning.
- Wastewater should not be discharged or buried within the project site.

- Sanitary and septic systems that discharge directly into sanitary sewer systems, where permissible, should comply with the local health agency, city, county, and sewer district requirements.
- Only reputable, licensed sanitary and septic waste haulers should be used.
- Sanitary facilities should be located in a convenient location.
- Untreated raw wastewater should never be discharged or buried.
- Temporary septic systems should treat wastes to appropriate levels before discharging.
- If using an onsite disposal system (OSDS), such as a septic system, local health agency requirements must be followed.
- Temporary sanitary facilities that discharge to the sanitary sewer system should be properly connected to avoid illicit discharges.
- Sanitary and septic facilities should be maintained in good working order by a licensed service.
- Regular waste collection by a licensed hauler should be arranged before facilities overflow.

***Education***

- Educate employees, subcontractors, and suppliers on sanitary and septic waste storage and disposal procedures.
- Educate employees, subcontractors, and suppliers of potential dangers to humans and the environment from sanitary and septic wastes.
- Instruct employees, subcontractors, and suppliers in identification of sanitary and septic waste.
- Hold regular meetings to discuss and reinforce disposal procedures (incorporate into regular safety meetings).
- Establish a continuing education program to indoctrinate new employees.

## Costs

All of the above are low cost measures.

## Inspection and Maintenance

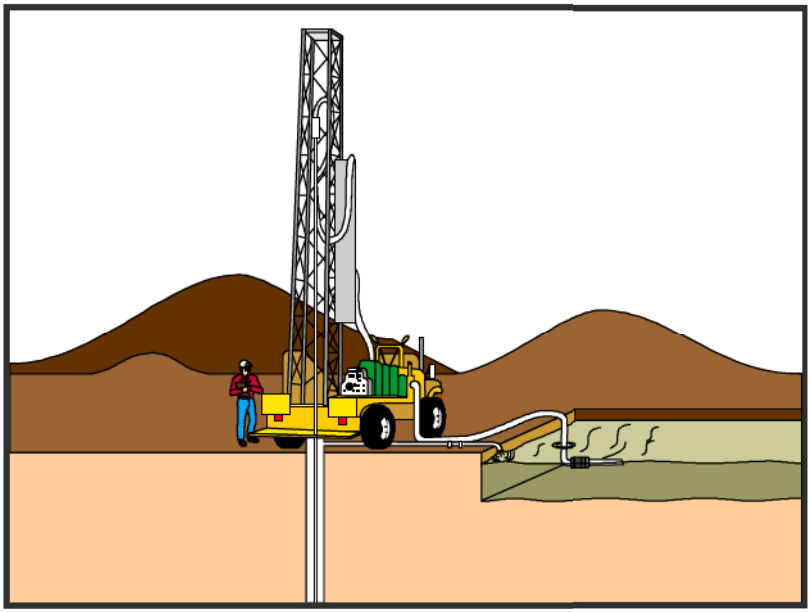
- Inspect and verify that activity–based BMPs are in place prior to the commencement of associated activities. While activities associated with the BMP are under way, inspect weekly during the rainy season and of two-week intervals in the non-rainy season to verify continued BMP implementation.
- Arrange for regular waste collection.
- If high winds are expected, portable sanitary facilities must be secured with spikes or weighed down to prevent over turning.

## References

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

Stormwater Management for Construction Activities; Developing Pollution Prevention Plans and Best Management Practice, EPA 832-R-92005; USEPA, April 1992.

# Liquid Waste Management WM-10



## Objectives

| | | |
|---|---|---|
| EC | Erosion Control | |
| SE | Sediment Control | |
| TC | Tracking Control | |
| WE | Wind Erosion Control | |
| NS | Non-Stormwater Management Control | |
| WM | Waste Management and Materials Pollution Control | ☑ |

**Legend:**

☑ **Primary Objective**

☒ **Secondary Objective**

## Targeted Constituents

| | |
|---|---|
| Sediment | ☑ |
| Nutrients | ☑ |
| Trash | ☑ |
| Metals | ☑ |
| Bacteria | |
| Oil and Grease | ☑ |
| Organics | |

## Potential Alternatives

None

## Description and Purpose

Liquid waste management includes procedures and practices to prevent discharge of pollutants to the storm drain system or to watercourses as a result of the creation, collection, and disposal of non-hazardous liquid wastes.

## Suitable Applications

Liquid waste management is applicable to construction projects that generate any of the following non-hazardous by-products, residuals, or wastes:

- Drilling slurries and drilling fluids
- Grease-free and oil-free wastewater and rinse water
- Dredgings
- Other non-stormwater liquid discharges not permitted by separate permits

## Limitations

- Disposal of some liquid wastes may be subject to specific laws and regulations or to requirements of other permits secured for the construction project (e.g., NPDES permits, Army Corps permits, Coastal Commission permits, etc.).
- Liquid waste management does not apply to dewatering operations (NS-2 Dewatering Operations), solid waste management (WM-5, Solid Waste Management), hazardous

CASQA
CALIFORNIA STORMWATER QUALITY ASSOCIATION

wastes (WM-6, Hazardous Waste Management), or concrete slurry residue (WM-8, Concrete Waste Management).

- Typical permitted non-stormwater discharges can include: water line flushing; landscape irrigation; diverted stream flows; rising ground waters; uncontaminated pumped ground water; discharges from potable water sources; foundation drains; irrigation water; springs; water from crawl space pumps; footing drains; lawn watering; flows from riparian habitats and wetlands; and discharges or flows from emergency fire fighting activities.

## Implementation

### *General Practices*

- Instruct employees and subcontractors how to safely differentiate between non-hazardous liquid waste and potential or known hazardous liquid waste.
- Instruct employees, subcontractors, and suppliers that it is unacceptable for any liquid waste to enter any storm drainage device, waterway, or receiving water.
- Educate employees and subcontractors on liquid waste generating activities and liquid waste storage and disposal procedures.
- Hold regular meetings to discuss and reinforce disposal procedures (incorporate into regular safety meetings).
- Verify which non-stormwater discharges are permitted by the statewide NPDES permit; different regions might have different requirements not outlined in this permit.
- Apply NS-8, Vehicle and Equipment Cleaning for managing wash water and rinse water from vehicle and equipment cleaning operations.

### *Containing Liquid Wastes*

- Drilling residue and drilling fluids should not be allowed to enter storm drains and watercourses and should be disposed of.
- If an appropriate location is available, drilling residue and drilling fluids that are exempt under Title 23, CCR § 2511(g) may be dried by infiltration and evaporation in a containment facility constructed in conformance with the provisions concerning the Temporary Concrete Washout Facilities detailed in WM-8, Concrete Waste Management.
- Liquid wastes generated as part of an operational procedure, such as water-laden dredged material and drilling mud, should be contained and not allowed to flow into drainage channels or receiving waters prior to treatment.
- Liquid wastes should be contained in a controlled area such as a holding pit, sediment basin, roll-off bin, or portable tank.
- Containment devices must be structurally sound and leak free.
- Containment devices must be of sufficient quantity or volume to completely contain the liquid wastes generated.

- Precautions should be taken to avoid spills or accidental releases of contained liquid wastes. Apply the education measures and spill response procedures outlined in WM-4, Spill Prevention and Control.

- Containment areas or devices should not be located where accidental release of the contained liquid can threaten health or safety or discharge to water bodies, channels, or storm drains.

***Capturing Liquid Wastes***

- Capture all liquid wastes that have the potential to affect the storm drainage system (such as wash water and rinse water from cleaning walls or pavement), before they run off a surface.

- Do not allow liquid wastes to flow or discharge uncontrolled. Use temporary dikes or berms to intercept flows and direct them to a containment area or device for capture.

- Use a sediment trap (SE-3, Sediment Trap) for capturing and treating sediment laden liquid waste or capture in a containment device and allow sediment to settle.

***Disposing of Liquid Wastes***

- A typical method to handle liquid waste is to dewater the contained liquid waste, using procedures such as described in NS-2, Dewatering Operations, and SE-2, Sediment Basin, and dispose of resulting solids per WM-5, Solid Waste Management.

- Methods of disposal for some liquid wastes may be prescribed in Water Quality Reports, NPDES permits, Environmental Impact Reports, 401 or 404 permits, and local agency discharge permits, etc. Review the SWPPP to see if disposal methods are identified.

- Liquid wastes, such as from dredged material, may require testing and certification whether it is hazardous or not before a disposal method can be determined.

- For disposal of hazardous waste, see WM-6, Hazardous Waste Management.

- If necessary, further treat liquid wastes prior to disposal. Treatment may include, though is not limited to, sedimentation, filtration, and chemical neutralization.

## Costs

Prevention costs for liquid waste management are minimal. Costs increase if cleanup or fines are involved.

## Inspection and Maintenance

- Inspect and verify that activity–based BMPs are in place prior to the commencement of associated activities. While activities associated with the BMP are under way, inspect weekly during the rainy season and of two-week intervals in the non-rainy season to verify continued BMP implementation.

- Inspect BMPs subject to non-stormwater discharge daily while non-stormwater discharges occur.

- Remove deposited solids in containment areas and capturing devices as needed and at the completion of the task. Dispose of any solids as described in WM-5, Solid Waste Management.
- Inspect containment areas and capturing devices and repair as needed.

## References

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

# Attachment G
# Cost Breakdown for Water Pollution Control

ATTACHMENT G

# Cost Breakdown for Water Pollution Control

To be determined

# Attachment H
# Program For Maintenance, Inspection, and Repair of Construction Site BMPs

# Attachment H

## Program for Maintenance, Inspection, and Repair of Construction Site BMPs

| ***The contractor shall use the following guidelines for maintenance, inspection, and repair of BMPs identified in the SWPPP*** | | |
|---|---|---|
| **BEST MANAGEMENT PRACTICES (BMPs)** | **INSPECTION FREQUENCY (all controls)** | **MAINTENANCE/REPAIR PROGRAM** |
| **TEMPORARY EROSION CONTROL BMPs** | | |
| | | ■<br>■<br>■ |
| | | ■<br>■<br>■ |
| **TEMPORARY SEDIMENT CONTROL BMPs** | | |
| | | ■<br>■<br>■<br>■<br>■<br>■ |
| | | ■<br>■ |
| | | ■<br>■<br>■<br>■<br>■<br>■ |
| **WIND EROSION CONTROL BMPs** | | |
| | | ■ |
| **TRACKING CONTROL BMPs** | | |
| | | ■<br>■<br>■ |

| ***The contractor shall use the following guidelines for maintenance, inspection, and repair of BMPs identified in the SWPPP*** | | |
|---|---|---|
| **BEST MANAGEMENT PRACTICES (BMPs)** | **INSPECTION FREQUENCY (all controls)** | **MAINTENANCE/REPAIR PROGRAM** |
| **NON-STORM WATER MANAGEMENT BMPs** | | |
| | | ■<br>■<br>■<br>■<br>■<br>■<br>■ |
| **WASTE MANAGEMENT AND MATERIALS POLLUTION CONTROL BMPs** | | |
| | | ■<br>■<br>■<br>■<br>■<br>■<br>■ |
| | | ■ |

# Attachment I
# Trained Contractor Personnel Log

# Attachment I

## Trained Contractor Personnel Log

### Storm Water Management Training Log

Project Name: _____

Project Number/Location: _____

Storm Water Management Topic: (check as appropriate)

- ❑ Erosion Control
- ❑ Sediment Control
- ❑ Wind Erosion Control
- ❑ Tracking Control
- ❑ Non-storm water management
- ❑ Waste Management and Materials Pollution Control
- ❑ Storm Water Sampling

Specific Training Objective: _____

Location: _____ Date: _____

Instructor: _____ Telephone: _____

Course Length (hours): _____

### Attendee Roster (attach additional forms if necessary)

| Name | Company | Phone |
|---|---|---|
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |

| Name | Company | Phone |
|---|---|---|
| | | |
| | | |
| | | |
| | | |

COMMENTS:

# Attachment J
# Subcontractor Notification Letter and Notification Log

# Attachment J

## Subcontractor Notification Letter and Notification Log

### SWPPP Notification

Company
Address
City, State, ZIP

Dear Sir/Madam,

Please be advised that the California State Water Resources Control Board has adopted the General Permit (General Permit) for Storm Water Discharges Associated with Construction Activity (CAS000002). The goal of these permits is prevent the discharge of pollutants associated with construction activity from entering the storm drain system, ground and surface waters.

[Owner] has developed a Storm Water Pollution Prevention Plan (SWPPP) in order to implement the requirements of the Permits.

As a subcontractor, you are required to comply with the SWPPP and the Permits for any work that you perform on site. Any person or group who violates any condition of the Permits may be subject to substantial penalties in accordance with state and federal law. You are encouraged to advise each of your employees working on this project of the requirements of the SWPPP and the Permits. A copy of the Permits and the SWPPP are available for your review at the construction office. Please contact me if you have further questions.

Sincerely,

Name
Title

# SUBCONTRACTOR NOTIFICATION LOG

Project Name: _____

Project Number/Location: _____

| SUBCONTRACTOR COMPANY NAME | CONTACT NAME | ADDRESS | PHONE NUMBER | PAGER/ FIELD PHONE | DATE NOTIFICATION LETTER SENT | TYPE OF WORK |
|---|---|---|---|---|---|---|
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |

*USE ADDITIONAL PAGES AS NECESSARY*

# Attachment K
# Permit

# Attachment L
# Stormwater Quality Construction Site Inspection List

# Attachment L

## Storm Water Quality Construction Site Inspection Checklist

| GENERAL INFORMATION | | | | |
|---|---|---|---|---|
| Project Name | | | | |
| Project N$^{o}$ | | | | |
| Contractor | | | | |
| Inspector's Name | | | | |
| Inspector's Title | | | | |
| Signature | | | | |
| Date of Inspection | | | | |
| Inspection Type (Check Applicable) | ❒ Prior to forecast rain<br>❒ 24-hr intervals during extended rain | | ❒ After a rain event<br>❒ Other _____ | |
| Season (Check Applicable) | ❒ Rainy | | ❒ Non-Rainy | |
| Storm Data | Storm Start Date & Time: | | Storm Duration (hrs): | |
| | Time elapsed since last storm (Circle Applicable Units) | Min. Hr. Days | Approximate Rainfall Amount (inches) | |

| PROJECT AREA SUMMARY AND DISTURBED SOIL AREA (DSA) SIZE | | |
|---|---|---|
| Total Project Area | _____ | Acres |
| Field Estimate of Active DSAs | _____ | Acres |
| Field Estimate of Non-Active DSAs | _____ | Acres |

| INSPECTION OF BMPs | | | | |
|---|---|---|---|---|
| **BMP** | **Yes** | **No** | **N/A** | **Corrective Action** |
| **Preservation of Existing Vegetation** | | | | |
| Is temporary fencing provided to preserve vegetation in areas where no construction activity is planned? | | | | |
| Location: | | | | |
| Location: | | | | |
| Location: | | | | |
| Location: | | | | |
| **Erosion Control** | | | | |
| Does the applied temporary erosion control provide 100% coverage for the affected areas? | | | | |
| Are any non-vegetated areas that may require temporary erosion control? | | | | |
| Is the area where erosion controls are used required free from visible erosion? | | | | |
| Location: | | | | |
| Location: | | | | |
| Location: | | | | |
| Location: | | | | |
| **Temporary Linear Sediment Barriers (Silt Fence, Fiber Rolls, Sandbag Barriers, etc.)** | | | | |
| Are temporary linear sediment barriers properly installed, functional and maintained? | | | | |
| Are temporary linear sediment barriers free of accumulated litter? | | | | |
| Is the built-up sediment less than 1/3 the height of the barrier? | | | | |
| Are cross barriers installed where necessary and properly spaced? | | | | |
| Location: | | | | |
| Location: | | | | |
| Location: | | | | |
| Location: | | | | |
| Location: | | | | |
| **Storm Drain Inlet Protection** | | | | |
| Are storm drain inlets internal to the project properly protected? | | | | |
| Are storm drain inlet protection devices in working order and being properly maintained? | | | | |
| Location: | | | | |
| Location: | | | | |
| Location: | | | | |
| Location: | | | | |
| Location: | | | | |
| **Sediment Basins** | | | | |

| INSPECTION OF BMPs | | | | |
|---|---|---|---|---|
| **BMP** | **Yes** | **No** | **N/A** | **Corrective Action** |
| Are basins designed in accordance with the requirements of the General Permit? | | | | |
| Are basins maintained to provide the required retention/detention? | | | | |
| Are basin controls (inlets, outlets, diversions, weirs, spillways, and racks) in working order? | | | | |
| Location: | | | | |
| Location: | | | | |
| Location: | | | | |
| Location: | | | | |
| **Stockpiles** | | | | |
| Are all locations of temporary stockpiles, including soil, hazardous waste, and construction materials in approved areas? | | | | |
| Are stockpiles protected from run-on, run-off from adjacent areas and from winds? | | | | |
| Are stockpiles located at least 15 m from concentrated flows, downstream drainage courses and storm drain inlets? | | | | |
| Are required covers and/or perimeter controls in place? | | | | |
| Location: | | | | |
| Location: | | | | |
| Location: | | | | |
| Location: | | | | |
| **Concentrated Flows** | | | | |
| Are concentrated flow paths free of visible erosion? | | | | |
| Location: | | | | |
| Location: | | | | |
| Location: | | | | |
| Location: | | | | |
| **Tracking Control** | | | | |
| Is the entrance stabilized to prevent tracking | | | | |
| Is the stabilized entrance inspected daily to ensure that it is working properly | | | | |
| Are points of ingress/egress to public/private roads inspected and swept and vacuumed as needed? | | | | |
| Are all paved areas free of visible sediment tracking or other particulate matter? | | | | |
| Location: | | | | |
| Location: | | | | |
| Location: | | | | |
| Location: | | | | |
| **Wind Erosion Control** | | | | |
| Is dust control implemented? | | | | |

| INSPECTION OF BMPs | | | | |
|---|---|---|---|---|
| **BMP** | **Yes** | **No** | **N/A** | **Corrective Action** |
| Location: | | | | |
| Location: | | | | |
| Location: | | | | |
| Location: | | | | |
| **Dewatering Operations** | | | | |
| Are all one-time dewatering operations covered by the General Permit inspected before and as they occur and BMPs implemented as necessary during discharge? | | | | |
| Is ground water dewatering handled in conformance with the dewatering permit issued by the RWQCB? | | | | |
| Is required treatment provided for dewatering effluent? | | | | |
| Location: | | | | |
| Location: | | | | |
| Location: | | | | |
| Location: | | | | |
| **Vehicle & Equipment Fueling, Cleaning, and Maintenance** | | | | |
| Are vehicle and equipment fueling, cleaning and maintenance areas reasonably clean and free of spills, leaks, or any other deleterious material? | | | | |
| Are vehicle and equipment fueling, cleaning and maintenance activities performed on an impermeable surface in dedicated areas? | | | | |
| If no, are drip pans used? | | | | |
| Are dedicated fueling, cleaning, and maintenance areas located at least 15 m away from downstream drainage facilities and watercourses and protected from run-on and runoff? | | | | |
| Is wash water contained for infiltration/ evaporation and disposed of appropriately? | | | | |
| Is on-site cleaning limited to washing with water (no soap, soaps substitutes, solvents, or steam)? | | | | |
| On each day of use, are vehicles and equipment inspected for leaks and if necessary, repaired? | | | | |
| Location: | | | | |
| Location: | | | | |
| Location: | | | | |
| Location: | | | | |
| **Waste Management & Materials Pollution Control** | | | | |
| Are material storage areas and washout areas protected from run-on and runoff, and located at least 15 m from concentrated flows and downstream drainage facilities? | | | | |
| Are all material handling and storage areas clean; organized; free of spills, leaks, or any other deleterious material; and stocked with appropriate clean-up supplies? | | | | |
| Are liquid materials, hazardous materials, and hazardous wastes stored in temporary containment facilities? | | | | |

| INSPECTION OF BMPs | | | | |
|---|---|---|---|---|
| **BMP** | **Yes** | **No** | **N/A** | **Corrective Action** |
| Are bagged and boxed materials stored on pallets? | | | | |
| Are hazardous materials and wastes stored in appropriate, labeled containers? | | | | |
| Are proper storage, clean-up, and spill-reporting procedures for hazardous materials and wastes posted in open, conspicuous and accessible locations adjacent to storage areas? | | | | |
| Are temporary containment facilities free of spills and rainwater? | | | | |
| Are temporary containment facilities and bagged/boxed materials covered? | | | | |
| Are temporary concrete washout facilities designated and being used? | | | | |
| Are temporary concrete washout facilities functional for receiving and containing concrete waste and are concrete residues prevented from entering the drainage system? | | | | |
| Do temporary concrete washout facilities provide sufficient volume and freeboard for planned concrete operations? | | | | |
| Are concrete wastes, including residues from cutting and grinding, contained and disposed of off-site or in concrete washout facilities? | | | | |
| Are spills from mobile equipment fueling and maintenance properly contained and cleaned up? | | | | |
| Is the site free of litter? | | | | |
| Are trash receptacles provided in the yard, field trailer areas, and at locations where workers congregate for lunch and break periods? | | | | |
| Is litter from work areas collected and placed in watertight dumpsters? | | | | |
| Are waste management receptacles free of leaks? | | | | |
| Are the contents of waste management receptacles properly protected from contact with storm water or from being dislodged by winds? | | | | |
| Are waste management receptacles filled at or beyond capacity? | | | | |
| Location: | | | | |
| Location: | | | | |
| Location: | | | | |
| Location: | | | | |
| **Temporary Water Body Crossing or Encroachment** | | | | |
| Are temporary water body crossings and encroachments constructed appropriately? | | | | |
| Does the project conform to the requirements of the 404 permit and/or 1601agreement? | | | | |
| Location: | | | | |
| Location: | | | | |
| Location: | | | | |
| Location: | | | | |
| **Illicit Connection/ Discharge** | | | | |

| INSPECTION OF BMPs | | | | |
|---|---|---|---|---|
| **BMP** | **Yes** | **No** | **N/A** | **Corrective Action** |
| Is there any evidence of illicit discharges or illegal dumping on the project site? | | | | |
| If yes, has the Owner/Operator been notified? | | | | |
| Location: | | | | |
| Location: | | | | |
| Location: | | | | |
| Location: | | | | |
| **Discharge Points** | | | | |
| Are discharge points and discharge flows free from visible pollutants? | | | | |
| Are discharge points free of any significant sediment transport? | | | | |
| Location: | | | | |
| Location: | | | | |
| Location: | | | | |
| Location: | | | | |
| **SWPPP Update** | | | | |
| Does the SWPPP and Project Schedule adequately reflect the current site conditions and contractor operations? | | | | |
| Are all BMPs shown on the water pollution control drawings installed in the proper location(s) and according to the details in the SWPPP? | | | | |
| Location: | | | | |
| Location: | | | | |
| Location: | | | | |
| Location: | | | | |
| **General** | | | | |
| Are there any other potential concerns at the site? | | | | |
| Location: | | | | |
| Location: | | | | |
| Location: | | | | |
| Location: | | | | |
| **Storm Water Monitoring** | | | | |
| Does storm water discharge directly to a water body listed in the General Permit as impaired for sediment/sedimentation or turbidity? | | | | |
| If yes, were samples for sediment/sedimentation or turbidity collected pursuant to the sampling and analysis plan in the SWPPP? | | | | |
| Did the sampling results indicate that the discharges are causing or contributing to further impairment? | | | | |

| INSPECTION OF BMPs | | | | |
|---|---|---|---|---|
| **BMP** | **Yes** | **No** | **N/A** | **Corrective Action** |
| If yes, were the erosion/sediment control BMPs improved or maintained to reduce the discharge of sediment to the water body? | | | | |
| Were there any BMPs not properly implemented or breaches, malfunctions, leakages or spills observed which could result in the discharge of pollutants to surface waters that would not be visually detectable in storm water? | | | | |
| If yes, were samples for non-visually detectable pollutants collected pursuant to the sampling and analysis plan during rain events? | | | | |
| If sampling indicated pollution of the storm water, were the leaks, breaches, spills, etc. cleaned up and the contaminated soil properly disposed of? | | | | |
| Were the BMPs maintained or replaced? | | | | |
| Were soil amendments (e.g., gypsum, lime) used on the project? | | | | |
| If yes, were samples for non-visually detectable pollutants collected pursuant to the sampling and analysis plan in the SWPPP? | | | | |
| If sampling indicated pollution of the storm water by the use of the soil amendments, is there a contingency plan for retention onsite of the polluted storm water? | | | | |
| Did storm water contact stored materials or waste and run off the construction site? (Materials not in watertight containers, etc.) | | | | |
| If yes, were samples for non-visually detectable pollutants collected pursuant to the sampling and analysis plan in the SWPPP? | | | | |

# Attachment M
# Constituents of Concern

ATTACHMENT M

# Constituents of Concern

To be determined

# Attachment N
# Notice of Non-compliance

# Attachment N

## Notice of Non-Compliance

To: Date:

Subject: Notice of Non-Compliance

Project Name: _____

Project Number/Location: _____

---

In accordance with the NPDES Statewide Permit for Storm Water Discharges Associated with Construction Activity, the following instance of discharge is noted:

**Date, time, and location of discharge**

**Nature of the operation that caused the discharge**

**Initial assessment of any impact cause by the discharge**

**Existing BMP(s) in place prior to discharge event**

**Date of deployment and type of BMPs deployed after the discharge.**

**Steps taken or planned to reduce, eliminate and/or prevent recurrence of the discharge**

**Implementation and maintenance schedule for any affected BMPs**

If further information or a modification to the above schedule is required, notify the contact person below.

| | |
|---|---|
| Name of Contact Person | Title |
| Company | Telephone Number |
| Signature | Date |

# Attachment O
# Discharge Reporting Log

# Attachment O

## *Discharge Reporting Log*

Project Name: _____

Project Number: _____

| Date | Material(s) Discharged | Estimated Quantity | Observed By |
|---|---|---|---|
| | | | |
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# Attachment P
# Sampling Activity Log

# Attachment P

## Sampling Activity Log

| RAIN EVENT GENERAL INFORMATION | | | | |
|---|---|---|---|---|
| Project Name | | | | |
| Project Number | | | | |
| Contractor | | | | |
| Sampler's Name | | | | |
| Signature | | | | |
| Date of Sampling | | | | |
| Season (Check Applicable) | ❒ Rainy | | ❒ Non-Rainy | |
| Storm Data | Storm Start Date & Time: | | Storm Duration (hrs): | |
| | Time elapsed since last storm (Circle Applicable Units) | Min. Hr. Days | Approximate Rainfall Amount (inches) | |

For rainfall information: http://cdec.water.ca.gov/weather.html or http://www.wrh.noaa.gov/wrhq/nwspage.html

| SAMPLE LOG | | |
|---|---|---|
| **Sample Identification** | **Sample Location** | **Sample Collection Date and Time** |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |

Specific sample locations descriptions may include: 100 ft upstream from discharge at eastern boundary, runoff from northern waste storage area, downgradient of inlet located near the intersection of A Street and B avenue, etc.

| FIELD ANALYSIS | | |
|---|---|---|
| ❑Yes | ❑ No | |
| **Sample Identification** | **Test** | **Result** |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |

# Turlock Irrigation District
# Almond 2 Power Plant
# (09-AFC-2)

# System Impact Study
# Volume I

October 22, 2009

Prepared by
Ron S. Daschmans
Vice President, Technical Services
Utility System Efficiencies, Inc.

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# I. Executive Summary

At the request of Turlock Irrigation District (TID), Utility System Efficiencies, Inc. (USE) performed an initial interconnection system impact study for the Almond 2 Power Plant (A2PP). This report outlines all study procedures and results of the interconnection of the A2PP to the existing electric transmission system. The purpose of the studies is to identify any system reliability concerns as well as potential congestion impacts resulting from the addition of the A2PP.

TID proposes to construct, own, and operate an electrical generating plant in Ceres, Stanislaus County, California. The A2PP would be a natural gas-fired, simple-cycle peaking facility rated at a gross generating capacity of 174 megawatts (MW). The A2PP is proposed to be located on an approximately 4.6-acre parcel adjacent to (and north of) the existing 48-MW TID Almond Power Plant. The A2PP will be interconnected with the TID electrical grid via two (2) new 115 kV transmission lines (one 0.9 mile long, the other 1.2 miles long) from the A2PP to the proposed Grayson Substation. The 115 kV transmission lines will follow two (2) separate corridors for reliability purposes. In addition, the existing 2.9-mile-long Almond-Crows Landing 69 kV single-circuit transmission line will be re-rated to prevent possible thermal overloads under certain contingencies.

The anticipated date of operation for the A2PP is 2012. Three (3) base case scenarios, modeling anticipated 2012 system conditions, were developed and evaluated to ensure the reliable interconnection, delivery and operation of the A2PP at full power output. The following power flow base cases were developed for the purposes of the A2PP system impact study evaluation:

- 2012 Spring Peak Case
- 2012 Summer Off-Peak Case
- 2012 Summer Central Valley 1:10 Peak Load Case

Power flow (thermal and voltage), transient stability and voltage stability (Q-V curve and P-V curve) results indicate the interconnection of the A2PP to the TID electric transmission system will not adversely impact local and regional system performance. No impacts to downstream facilities were observed/identified.

For an unlikely generation dispatch scenario (all TID generation modeled at full output during anticipated 2012 summer off-peak periods) thermal overloads on the Grayson-Westport 69 kV line and Walnut-WEC 115 kV line were observed. Based on economics and historical operation, the Almond CT is operated as a ‘pseudo-peaking unit’; it is run during peak and shoulder-peak periods, but typically shut off at night (off-peak). Turning off the existing Almond CT alleviated the identified thermal overloads. The thermal overloads identified during anticipated 2012 summer off-peak periods are not only a function of system generation, but system load as well. As system load increases over time, the thermal overloads identified during 2012 summer off-peak studies will reduce (and likely disappear). Furthermore, TID, as owner of all generation within its Balancing Authority, can (and does) manage its generation portfolio to ensure reliable system operation during off-peak periods.

Short-circuit study results indicate that three (3) circuit breakers at the TID Walnut 69 kV station (CB 510, CB 530 and CB 550) may need an upgrade due to an increase in observed single line-to-ground fault current. The single line-to-ground fault current of 27,699 Amperes at Walnut 69 kV station exceeds the three (3) circuit breakers’ existing 27,000 Ampere interrupting capability.

As proposed, interconnection of the A2PP requires that the existing 2.9-mile-long Almond-Crows Landing 69 kV single-circuit transmission line be re-rated to prevent possible thermal overloads under certain contingencies. Aside from the aforementioned Almond-Crows Landing 69 kV re-rate, no additional mitigation measures were identified as part of the initial interconnection system impact study for the A2PP.

## II. Introduction

At the request of Turlock Irrigation District (TID), Utility System Efficiencies, Inc. (USE) performed an initial interconnection system impact study for the Almond 2 Power Plant (A2PP). This report outlines all study procedures and results of the interconnection of the A2PP to the existing electric transmission system. The purpose of the studies is to identify any system reliability concerns as well as potential congestion impacts resulting from the addition of the A2PP. The anticipated date of operation for the A2PP is 2012.

Turlock Irrigation District (TID) proposes to construct, own, and operate an electrical generating plant in Ceres, Stanislaus County, California. The A2PP would be a natural gas-fired, simple-cycle peaking facility rated at a gross generating capacity of 174 megawatts (MW). The A2PP is proposed to be located on an approximately 4.6-acre parcel adjacent to (and north of) the existing 48-MW TID Almond Power Plant. Surrounding land uses include a WinCo Foods (WinCo) distribution warehouse to the west, a farm supply facility to the north, and various industrial facilities (modular building distributor and drilling equipment storage laydown area) to the east. The project address is 4500 Crows Landing Road, Modesto, California. Although the site address identifies the site in Modesto, the project site is located within the city limits of Ceres, and is approximately two (2) miles from the Ceres city center. Modesto is approximately five (5) miles to the north. The project site was previously used by WinCo as a borrow pit during construction of the WinCo distribution warehouse before being filled and graded to the current site elevation. The approximately 1.85-acre construction laydown and parking area will be adjacent to the northern border of the proposed site within the WinCo property.

The A2PP will be interconnected with the TID electrical grid via two (2) new 115 kV transmission lines (one 0.9 mile long, the other 1.2 miles long) from the A2PP to the proposed Grayson Substation. The 115 kV transmission lines will follow two (2) separate corridors for reliability purposes. In addition, the existing 2.9-mile-long Almond-Crows Landing 69 kV single-circuit transmission line will be re-rated to prevent possible thermal overloads under certain contingencies.

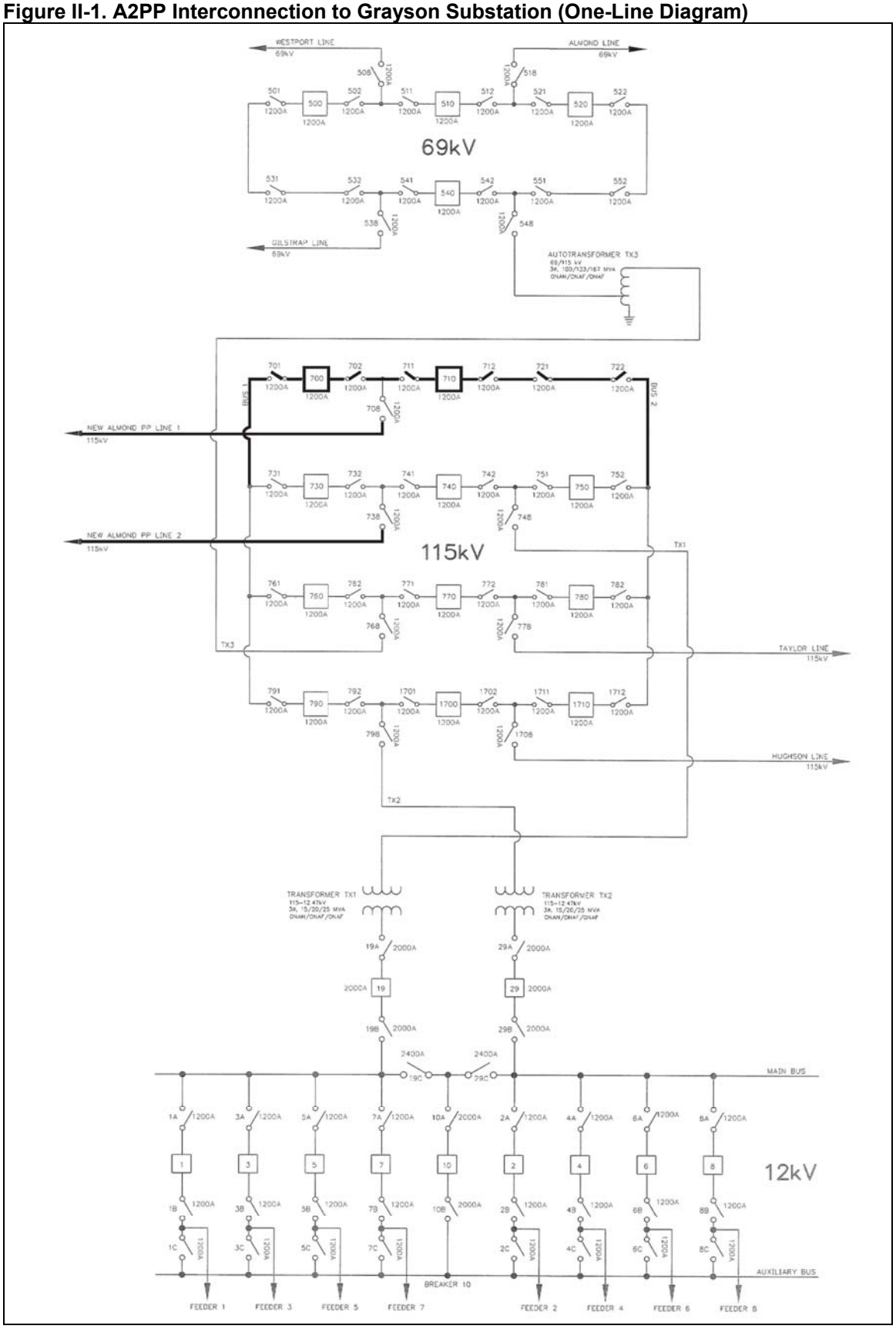
The proposed Grayson Substation is a component of the TID Hughson-Grayson 115 kV Transmission Line and Substation Project (the 'Hughson-Grayson Project'). In addition to the substation, the Hughson-Grayson Project consists of an approximately 10-mile-long, 115 kV transmission line; a 0.5-mile-long, 69 kV transmission line from the existing TID Almond Power Plant; and a second 69 kV double-circuit transmission line that extends 0.8 mile east from the proposed substation. An environmental impact report for the Hughson-Grayson Project (State Clearinghouse Number 2009012075) is currently being prepared. The Notice of Preparation was issued on January 26, 2009, and reissued February 9, 2009. The Draft Environmental Impact Report is anticipated to be issued in July 2009.

The interconnection 115 kV switchyard will use 115 kV gas-insulated circuit breakers in a ring bus arrangement to obtain a high level of service reliability. The switchyard and all equipment will be designed for an interrupting capability of at least 15,000 amperes. The main buses, as well as the bays, will be designed to carry at least 1,200 amperes on a continuous basis.

Station service power will be provided via the local TID/A2PP distribution facilities near the switchyard or by a 13.8/4.16 kV step-down transformer. Auxiliary controls and protective relay systems for the 115 kV switchyard will be located in a control building separate from the power plant.

**Figure II-1** consists of a one-line diagram of the proposed Grayson substation, into which the A2PP 115 kV transmission lines will interconnect. The one-line diagram shows the substation with the A2PP project interconnection specifics (in bold).

**Figure II-1. A2PP Interconnection to Grayson Substation (One-Line Diagram)**



## III. Base Cases & Assumptions

This section of the report details the base cases and assumptions outlined in the A2PP Final Study Plan Outline (provided in **Appendix 1**). The study plan for the initial interconnection system impact study for the A2PP was developed in coordination and/or communication with TID, the Merced Irrigation District (MeID), the Modesto Irrigation District (MID), the Sacramento Municipal Utility District (SMUD), the California ISO (CAISO), the Pacific Gas & Electric Company (PG&E), and the California Energy Commission (CEC).

The anticipated date of operation for the A2PP is 2012. Three (3) base case scenarios, modeling anticipated 2012 system conditions, were developed and evaluated to ensure the reliable interconnection, delivery and operation of the A2PP at full power output.

The following power flow base cases were developed for the purposes of the A2PP system impact study evaluation:

- 2012 Spring Peak Case
- 2012 Summer Off-Peak Case
- 2012 Summer Central Valley 1:10 Peak Load Case

The 2009-series PG&E Electric Transmission Assessment power flow/dynamic data sets served as the cornerstone for 2012 summer power flow base case development.

The 2012 spring peak case was sourced from the WECC 2010 Heavy Spring power/dynamic data set (10hsp1a1). Transmission system infrastructure from the PG&E Assessment case series was transplanted into the WECC 10hsp1a1 case, thus elevating the electric transmission system model from 2010 to 2012. Both PG&E and CAISO supplied load profile information to further develop the 2012 spring peak case power flow base case.

PG&E Assessment data was acquired from the CAISO via the execution of a non-disclosure and non-distribution agreement between the CAISO, TID and USE. As such, electronic copies of the power flow base cases and accompanying dynamic data cannot be distributed with this report.

**Table III-1** itemizes the load profiles for each of the cases developed.

**Table III-1. 2012 Power Flow Base Case Load Summary**

| Area | 2012 Spring Peak (MW) | 2012 Summer Off-Peak (MW) | 2012 Summer Peak (MW) |
|---|---|---|---|
| Humboldt | 137 | 97 | 144 |
| N. Coast | 459 | 315 | 694 |
| N. Valley | 498 | 405 | 908 |
| Sacramento | 890 | 539 | 1,229 |
| Sierra | 944 | 453 | 1,295 |
| North Bay | 606 | 372 | 672 |
| East Bay | 842 | 644 | 844 |
| Diablo | 1,306 | 824 | 1,604 |
| S.F. | 852 | 490 | 871 |
| Peninsula | 934 | 621 | 936 |
| Stockton | 1,188 | 745 | 1,442 |
| Stanislaus | 198 | 127 | 239 |
| Yosemite | 734 | 466 | 845 |
| Fresno | 1,986 | 1,202 | 2,335 |
| Kern | 1,391 | 1,116 | 1,637 |
| Mission | 1,101 | 620 | 1,377 |
| De Anza | 811 | 584 | 921 |
| San Jose | 1,219 | 742 | 1,629 |
| Central Coast | 683 | 434 | 643 |
| Los Padres | 511 | 349 | 558 |
| Silicon Valley Power | 390 | 282 | 501 |
| SMUD | 2,327 | 1,359 | 3,359 |

| Area | 2012 Spring Peak (MW) | 2012 Summer Off-Peak (MW) | 2012 Summer Peak (MW) |
|---|---|---|---|
| MID | 577 | 364 | 728 |
| TID | 580 | 368 | 730 |
| Western | 174 | 114 | 230 |
| LMUD | 27 | 27 | 27 |
| CDWR | 40 | 40 | 40 |
| NCPA | 670 | 397 | 902 |
| Redding | 135 | 115 | 266 |
| Total | 22,210 | 14,211 | 27,606 |

**Table III-2** documents major path flow and generation assumptions for each of the cases developed.

**Table III-2. Power Flow Base Case Major Path & Generation Summary**

| Power System Parameter | 2012 Spring Peak (MW) | 2012 Summer Off-Peak (MW) | 2012 Summer Peak (MW) |
|---|---|---|---|
| Path 15 (S-N) | -992 | 3,089 | -1,278 |
| Path 24 PG&E to SPP (W-E) | 23 | 18 | 26 |
| Path 26 Northern CA to Southern CA (N-S) | 3,055 | -1,424 | 4,002 |
| Path 66 COI (N-S) | 3,790 | -3,678 | 4,804 |
| Northern CA Hydro | 2,732 (67%) | 1,849 (45%) | 3,386 (82%) |
| Helms Generation | 403 | -620 | 404 |

### *A2PP Generation & Interconnection Modeling*

TID proposes to construct, own, and operate an electrical generating plant in Ceres, Stanislaus County, California. The A2PP would be a natural gas-fired, simple-cycle peaking facility rated at a gross generating capacity of 174 megawatts (MW). The A2PP is proposed to be located on an approximately 4.6-acre parcel adjacent to (and north of) the existing 48-MW TID Almond Power Plant. The A2PP will be interconnected with the TID electrical grid via two (2) new 115 kV transmission lines (one 0.9 mile long, the other 1.2 miles long) from the A2PP to the proposed Grayson Substation. The 115 kV transmission lines will follow two (2) separate corridors for reliability purposes. In addition, the existing 2.9-mile-long Almond-Crows Landing 69 kV single-circuit transmission line will be re-rated to prevent possible thermal overloads under certain contingencies.

A2PP generation and interconnection modeling details include:

- Three (3) 58 MW General Electric LM6000PG Turbines
- 58 MW/unit (174 MW Total Gross Output)
- 71 MVAr/unit boosting capability
- 0 MVAr/unit bucking capability (study purposes only)
- Three (3) 2 MW + 1 MVAr Station Aux Loads (6 MW + 3 MVAr Total)
- Three (3) 72.5 MVA Generator Step-Up (GSU) Transformers
- Two (2) 115 kV Lines to Grayson Substation

The A2PP power flow and dynamic models employed in the system impact study analysis, contained herein, are provided in **Appendix 2** and **Appendix 3** respectively. The models are in raw (flat text) format, which can be read directly into GE PSLF/PSDS/SCSC software.

### *CEC Generation Queue Modeling*

System impact studies, filed as part of an AFC, must include CEC generation queue projects that are either operational, under construction or approved. The CEC generation queue, within proximity to the A2PP, totals 4,227 MW (3,613 MW operational + 0 MW under construction + 614 MW on-hold). **Table III-3** catalogs the status, capacity and location of the verified/modeled CEC generation queue contained in the 2012 spring peak, summer off-peak and summer peak data sets.

**Table III-3. CEC Generation Queue**

| Docket No. | Project Name | Status | Capacity (MW) | Location |
|---|---|---|---|---|
| 1997-AFC-02 | Sutter - Calpine | Operational | 525 | Sutter |
| 1998-AFC-01 | Los Medanos - Calpine | Operational | 564 | Contra Costa |
| 1998-AFC-03 | Delta - Calpine | Operational | 895 | Contra Costa |
| 2000-AFC-01 | Gateway - PG&E | Operational | 530 | Contra Costa |
| 2001-AFC-16 | Tracy Peaker - GWF | Operational | 169 | San Joaquin |
| 2001-AFC-19 | Cosumnes - SMUD | Operational | 500 | Sacramento |
| 2001-SPPE-01 | Woodland II - Modesto Irrigation District | Operational | 80 | Stanislaus |
| 2002-AFC-04 | Walnut - Turlock Irrigation District | Operational | 255 | Stanislaus |
| 2003-SPPE-01 | Ripon - Modesto Irrigation District | Operational | 95 | San Joaquin |
| 2001-AFC-07 | Russell City - Calpine & GE | On-Hold | 614 | Alameda |

### *CAISO Generation Queue (Transition Cluster) Modeling*

In addition to the CEC generation queue (transition cluster), there exists and active CAISO generation queue. As of the writing of this report, there are 1,128 MW of proposed generation within a 40-mile radius of TID's Walnut 230 kV Substation. A map, illustrating the CAISO generation queue in the PG&E area, is provided in **Appendix 4**.

Power flow models of the CAISO generation queue and associated transmission interconnections were extracted from transition cluster base cases, which were acquired from the CAISO via the execution of a non-disclosure and non-distribution agreement between the CAISO, TID and USE.

Project-specific dynamic models, associated with the CAISO generation queue, are not available for public use; therefore, typical data was assumed.

**Table III-4** catalogs the status, capacity, location, type and distance (from TID) of the modeled CAISO generation queue contained in the 2012 spring peak, summer off-peak and summer peak data sets.

**Table III-4. CAISO Generation Queue (Transition Cluster)**

| Queue No. | Project Name | Application Status | Capacity (MW) | Location | Type | Distance (Miles) |
|---|---|---|---|---|---|---|
| 76 | Merced #1 Circuit | Complete | 13 | Merced | Steam | 30 |
| 268 | Tesla-Manteca Line (via Schulte Switchyard) | Active-Serial | 155 | San Joaquin | Steam | 30 |
| 172 & 248 | Tesla-Bellota Lines | Active-Serial | 589 | San Joaquin | Natural Gas | 40 |
| 269 | Tesla-Westley Lines | Transition-Serial | 371 | San Joaquin | Natural Gas | 40 |

### *Existing TID Generation Modeling*

TID owns and operates approximately 514 MW of internal system generation. **Table III-5** outlines the existing TID power plants contained in the 2012 spring peak, summer off-peak and summer peak data sets.

**Table III-5. Existing TID Generation**

| Name | Unit ID | Capacity (MW) | Comment |
|---|---|---|---|
| Don Pedro | 1 | 55 | Due to Canal Limitations Don Pedro Normal Operating Maximum Dispatch Assumed to be 90 MW Total |
| Don Pedro | 2 | 55 | |
| Don Pedro | 4 | 38 | |
| Almond CT | 1 | 50 | |
| Walnut CT | 1 | 24 | Peaking Unit<br>Used in Emergency Situations & for Reserves<br>See Section Entitled Generation Sensitivity |
| Walnut CT | 2 | 24 | Peaking Unit<br>Used in Emergency Situations & for Reserves<br>See Section Entitled Generation Sensitivity |
| WEC | 1 | 82.3 | |
| WEC | 2 | 82.3 | |
| WEC | 3 | 93.6 | |

| Name | Unit ID | Capacity (MW) | Comment |
|---|---|---|---|
| La Grange | 1 | 5 | |
| Dawson | 1 | 5 | |

### *Existing MID Generation Modeling*

Approximately 418 MW of generation is interconnected to the MID system. **Table III-6** outlines the existing MID power plants contained in the 2012 spring peak, summer off-peak and summer peak data sets.

**Table III-6. Existing MID Generation**

| Name | Unit ID | Capacity (MW) | Comment |
|---|---|---|---|
| Don Pedro | 3 | 55 | |
| Hershey | 1 | 5.7 | Normally Off-Line |
| McClure | 1 | 62 | Peaking Unit<br>See Section Entitled Generation Sensitivity |
| McClure | 2 | 62 | Peaking Unit<br>See Section Entitled Generation Sensitivity |
| New Hogan Dam | 1 | 2.2 | |
| New Hogan Dam | 2 | 2.2 | |
| Ripon | 1 | 50 | |
| Ripon | 2 | 50 | |
| Woodland | 1 | 49 | |
| Woodland II | 2 | 80 | |

### *Other Planned Generation Modeling*

In conversation with MID, plans were revealed for the Woodland III generation project. Falling under the CEC Small Power Plant Exemption (SPPE) process, the anticipated on-line date for the proposed 49.2 MW project (6 x 8.2 MW reciprocating engines) is 2012. Per MID's request, the Woodland III generation project is contained in the 2012 spring peak, summer off-peak and summer peak data sets.

### *Sensitivity Generation*

In addition to 2012 spring peak, summer off-peak and summer peak analysis, a summer peak sensitivity case was developed (from the 2012 summer peak case) that examines the impact of peaking units and select CEC on-hold projects. **Table III-7** itemizes the sensitivity generation, totaling 2,428 MW.

**Table III-7. Sensitivity Generation**

| Name | Unit ID | Capacity (MW) | Comment |
|---|---|---|---|
| Walnut CT | 1 | 24 | Peaking Unit<br>Used in Emergency Situations & for Reserves |
| Walnut CT | 2 | 24 | Peaking Unit<br>Used in Emergency Situations & for Reserves |
| McClure | 1 | 62 | Peaking Unit |
| McClure | 2 | 62 | Peaking Unit |
| Tesla Substation 230 kV (Bus E) | - | 1,156 | 2001-AFC-21 Tesla – FPL<br>Alameda<br>CEC Status On Hold<br>CAISO Generation Queue No. 6 |
| East Altamont – Calpine | - | 1,100 | 2001-AFC-04<br>Alameda<br>CEC Status On Hold |

### *Transmission Infrastructure Project Modeling*

As documented earlier, the transmission system infrastructure from the PG&E Assessment case series was transplanted into the WECC 10hsp1a1 case, thus elevating the electric transmission system model from 2010 to 2012. This model contains 102 electric transmission system projects

approved by the CAISO. All electric transmission system projects approved by the CAISO are contained in the 2012 spring peak, summer off-peak and summer peak data sets. A listing of CAISO/PG&E approved projects is provided in **Appendix 5**.

In addition to CAISO/PG&E approved projects, select CAISO generation queue (transition cluster) transmission reinforcements were also added to the 2012 spring peak, summer off-peak and summer peak data sets. Limited to the re-rating and/or re-conductoring of existing and/or new facilities, to mitigate N-0 (all elements in service) overloads, it was necessary to add the transmission reinforcements documented in **Table III-8** to the 2012 spring peak, summer off-peak and summer peak data sets.

**Table III-8. CAISO Generation Queue (Transition Cluster) Transmission Reinforcements**

| Transmission Line | Normal Rating (Amps) | | Emergency Rating (Amps) | |
|---|---|---|---|---|
| | Existing | Proposed | Existing | Proposed |
| Q074SWST-Round Mountain 230 kV Line | 399 | 612 | 399 | 703 |
| Warnerville-Wilson 230 kV Line | 675 | 911 | 793 | 1,049 |
| GWF Tracy-Schulte 115 kV Line | 1,506 | 2,269 | 1,506 | 2,269 |

## IV. Study Criteria

A system reliability evaluation consists primarily of determining if there would be thermal overloads, that voltages are within criteria (not too high or low), and that the system is stable (the system should not oscillate excessively and generators should remain synchronized with one another). Additional criteria may include assurance that there is sufficient reactive power available. The evaluation of these criteria must be conducted for credible emergency conditions that the system might sustain, such as the loss of a single or double circuit line, a transformer, a generator, or a combination of these facilities. Planning analysis is conducted sufficiently in advance of potential system changes – such as the insertion of A2PP power into the system – that necessary system facility additions or modifications can take place in time to prevent a criteria violation.

Performance of the transmission system is measured against the following planning criteria: the California ISO Reliability Criteria, the Western Electricity Coordinating Council (WECC) Reliability Criteria, and the North American Electric Reliability Council (NERC) Planning Standards. If system reliability problems resulting from the interconnection of a generation project are discovered, the study will identify the system facilities or operational measure that will be necessary to mitigate reliability criteria violations. Addition of these new facilities would maintain and avoid the degradation of reliability to the transmission network.

A System Impact Study investigates a transmission interconnection for a new generation project. A System Impact Study assesses the project's impact on:

- Power system equipment thermal loading, including transmission lines, transformers, and series compensation
- Power system equipment voltage performance, ultimately effecting generators and customer loads (regionally or locally)
- Power system transient stability performance, ultimately effecting generators and customer loads (regionally or locally)
- Power system equipment fault duty, including circuit breakers and switches

### *Power Flow*

All power flow analysis was conducted with version 16.3_02 of General Electric's PSLF/PSDS/SCSC software. Power flow analysis considers a snapshot in time where nothing has had time to adjust. In addition, a swing bus balances the system during a contingency scenario. Traditional power flow analysis was used to evaluate thermal and voltage performance

of the system under Category A (all elements in service), Category B, Category C and Category D conditions.

The applicable WECC reliability planning criteria is listed below.

- Changes in bus voltages from pre- to post-contingency must be less than 5% and 10% for single and double contingencies, respectively.
- All equipment loadings must be below their normal ratings under normal conditions.
- All equipment loadings must be below their emergency ratings for single contingencies.

**Thermal**

Reported thermal overloads were limited to the condition where a modeled transmission component was loaded over 90% of its appropriate normal or emergency rating (as entered in the power flow database).

Any new thermal violations triggered by the A2PP were identified as follows:

- Pre-Project Thermal Loading Less than or Equal 100% & Post-Project Thermal Loading Greater than 100%

Any thermal violations exacerbated by the A2PP were identified as follows:

- Pre-Project Thermal Loading Greater than 100% & Post-Project Thermal Loading Greater than 100%

**Voltage**

The voltage study criteria employed in this analysis adheres to the Western Electricity Coordinating Council (WECC) Reliability Criteria for Transmission System Planning.

Any new voltage violations triggered by the A2PP were identified as follows:

- Pre-Project Voltage Deviations Less than or Equal 5% & Post-Project Thermal Voltage Deviations Greater than 5% for Category B
- Pre-Project Voltage Deviations Less than or Equal 10% & Post-Project Voltage Deviations Greater than 10% for Category C

Any voltage violations exacerbated by the A2PP were identified as follows:

- Pre-Project Voltage Deviations Greater than 5% & Post-Project Thermal Voltage Deviations Greater than 5% for Category B
- Pre-Project Voltage Deviations Greater than 10% & Post-Project Thermal Voltage Deviations Greater than 10% for Category C

### *Transient Stability*

Transient stability analysis is a time-based simulation that assesses the performance of the power system during (and shortly following) a contingency. Transient stability studies were performed to ensure system stability following a critical fault on the system. Transient stability simulations were performed out to 20 seconds. Prior to the finalization of the power flow and dynamics data set a flat-run and bump test were run to ensure true power system behavior was not masked by any remote dynamic modeling anomalies.

All transient stability simulations were conducted using version 16.3_02 of General Electric's PSLF/PSDS/SCSC software. A modified version of the WECC-distributed *alldyns.p* EPCL program, which is employed in 500 kV bulk transmission system analysis (Operating Studies

Subcommittee and California ISO), was used to model operations specific to transient stability analysis.

With respect to the transient stability assessment of the TID system, the reliability criteria contained within the WECC disturbance-performance table of allowable effects on *other* systems was applied.

The consensus of the NERC/WECC Planning Standards interpretation is as follows:

- Table W-1 and Figure W-1, which deal with transient voltage and frequency deviations and post-transient voltage deviations, apply only to external systems.
- Section 1.A (including Table I), but excluding Table W-1 and Figure W-1 discussed above, dealing with thermal and voltage limits, system stability, and loss of firm load, applies to both internal and external systems.
- The voltage stability criteria, (Section 1.D) apply to both internal and external systems.

Table W-1 and Figure W-1, excerpts from the NERC/WECC Planning Standards, are transcribed within the report. Table I, entitled NERC/WECC Transmission Systems Standards Normal & Contingency Conditions may be found in **Appendix 6**.

**Table IV-1. WECC Disturbance-Performance Table of Allowable Effects on Other Systems[1]**

| NERC and WECC Categories | Transient Voltage Dip Standard | Minimum Transient Frequency Standard | Post Transient Voltage Deviation Standard (See Note 2) |
|---|---|---|---|
| A | Nothing in addition to NERC | | |
| B | Not to exceed 25% at load buses or 30% at non-load buses. Not to exceed 20% for more than 20 cycles at load buses. | Not below 59.6Hz for 6 cycles or more at a load bus. | Not to exceed 5% at any bus. |
| C | Not to exceed 30% at any bus. Not to exceed 20% for more than 40 cycles at load buses. | Not below 59.0Hz for 6 cycles or more at a load bus. | Not to exceed 10% at any bus. |
| D | Nothing in addition to NERC | | |

***Notes:***

*1. The WECC Disturbance-Performance Table applies equally to either a system with all elements in service, or a system with one element removed and the system adjusted.*

*2. As an example in applying the WECC Disturbance-Performance Table, a Category B disturbance in one system shall not cause a transient voltage dip in another system that is greater than 20% for more than 20 cycles at load buses, or exceed 25% at load buses or 30% at non-load buses at any time other than during the fault.*

*3. Additional voltage requirements associated with voltage stability are specified in Standard ID. If it can be demonstrated that post transient voltage deviations that are less than the values in the table will result in voltage instability, the system in which the disturbance originated and the affected system(s) should cooperate in mutually resolving the problem.*

*4. Refer to Figure W-1 for voltage performance parameters.*

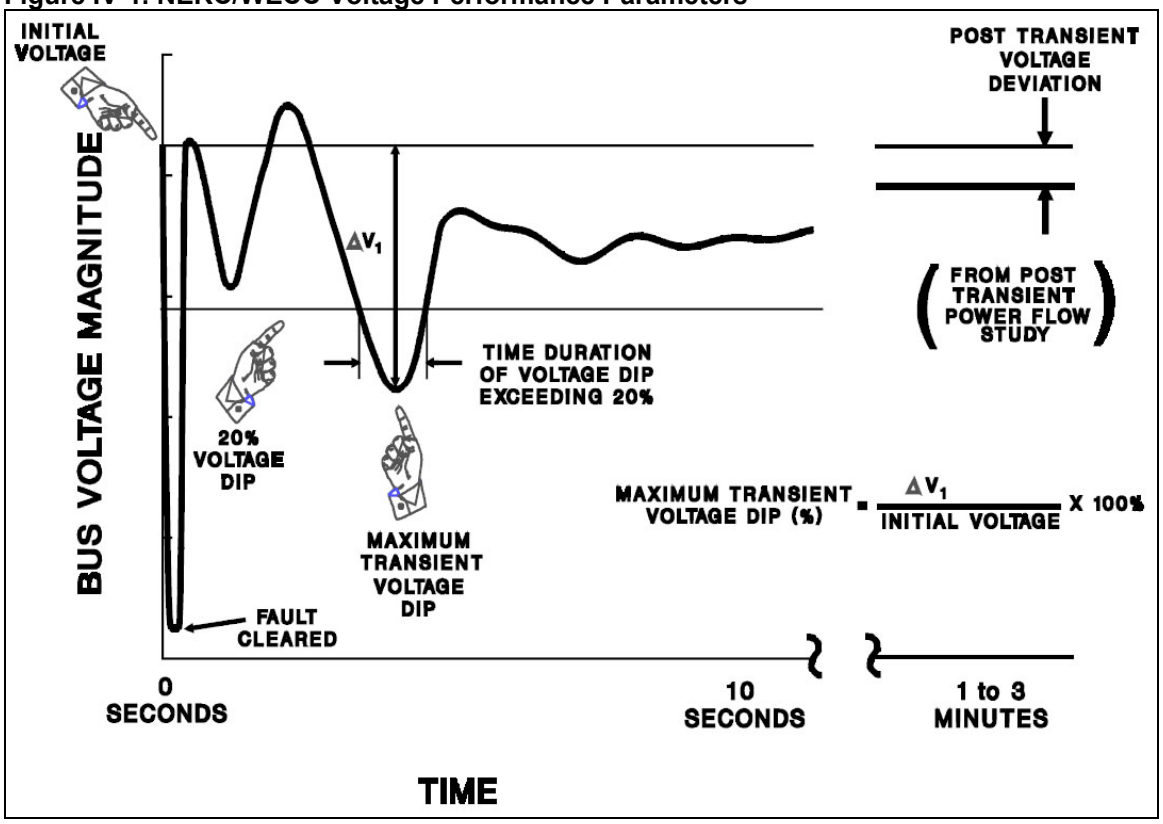
*5. Load buses include generating unit auxiliary loads.*

*6. To reach the frequency categories shown in the WECC Disturbance-Performance Table for Category C disturbances, it is presumed that some planned and controlled islanding has occurred. Under-frequency load shedding is expected to arrest this frequency decline and assure continued operation within the resulting islands.*

*7. For simulation test cases, the interconnected transmission system steady state loading conditions prior to a disturbance should be appropriate to the case. Disturbances should be simulated at locations on the system that result in maximum stress on other systems. Relay action, fault clearing time, and re-closing practice should be represented in simulations according to the planning and operation of the actual or planned systems. When simulating post transient conditions, actions are limited to automatic devices and no manual action is to be assumed.*

[1] Table W-1 taken from the NERC/WECC Planning Standards document approved by the Planning Coordination Committee (PCC) at its June 27-28, 2002 meeting. Approved by the Board of Directors at its August 8-9, 2002 meeting.

**Figure IV-1. NERC/WECC Voltage Performance Parameters[2]**




Subsequent a system disturbance, the power system exhibits an oscillatory response. Simulations must exhibit positive or marginal damping. In other words, system oscillations must not perpetually increase, causing a local or regional system collapse.

In addition to damping, the Western Electricity Coordinating Council (WECC) requires that the following Disturbance Performance Criteria be met:

After a Category B disturbance, the transmission system performance should meet the following criteria:

- Transient voltage dip should not be below 25 percent at load buses or 30 percent at non-load buses at any time.
- The duration of the transient voltage dip greater than 20 percent should not exceed 20 cycles at load buses.
- The minimum transient frequency should not fall below 59.6 Hz for more than 6 cycles at load buses.

After a Category C disturbance, the transmission system performance should meet the following criteria:

- Transient voltage dip should not be below 30 percent at any bus at any time.
- The duration of a transient voltage dip greater than 20 percent should not exceed 40 cycles at load buses.
- The minimum transient frequency should not fall below 59.0 Hz for more than 6 cycles at load buses.

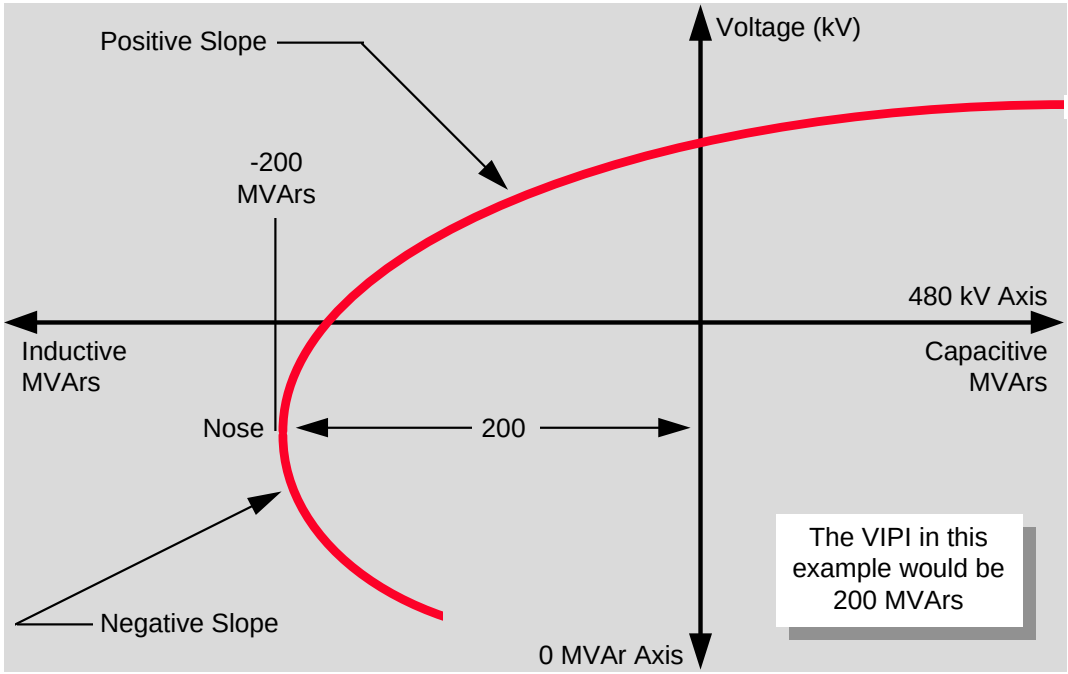
[2] Illustration taken from the NERC/WECC Planning Standards document approved by the Planning Coordination Committee (PCC) at its June 27-28, 2002 meeting. Approved by the Board of Directors at its August 8-9, 2002 meeting.

Transient stability performance was measured against the aforementioned criteria. This was accomplished via the worst-condition analysis (*wca*) activity available within the PSDS software package. A specially written EPCL tool was employed to extract worst-condition analysis information. Worst-condition analysis tracks and records the transient stability behavior of all output channels (voltage, frequency, etc.) contained within the binary channel output file. The monitoring of channel output was set to begin two (2) cycles after fault clearing. This was done to ensure that all stability behavior would be captured – including voltage recovery. Damping was assessed visually.

### *Voltage Stability*

Voltage stability analysis was conducted to determine how close the system is from collapse for each contingency based on a reactive limit. Voltage stability is an indicator that gives the relative strength of a system. This indicator is designed to cover for modeling discrepancies, operational differences, and equipment failures that fall outside of reliability criteria. The intent of reactive margin criteria application is to ensure reliable operation of the power system by bridging the gap between the studied system and real-world operation.

**Figure IV-2. Illustration of the Voltage Proximity Indicator (VIPI)**




Proximity to the point of certain voltage instability is measured by the amount of additional reactive load at a bus necessary to change the slope of the voltage vs. reactive requirement nose curve (dV/dQ) from positive to negative. A positive slope implies that voltage rises as capacitive support is added - as is usually the case under normal operating conditions. A negative slope implies that voltage decreases as capacitive support is added. It should be noted that the point at which the slope changes from positive to negative, or the nose of the voltage vs. reactive curve, is the point of certain voltage instability. One method used in analyzing voltage stability is to model a fictitious synchronous condenser at a specific bus, and record the reactive requirements for variations in bus voltage. The starting voltage for Q-V curve development was 1.09 p.u. The voltage step size was 0.005 p.u. Q-V curves, voltage versus reactive requirement, are developed from these data.

In previous years, TID has performed exhaustive post-transient voltage stability assessments of their system by the generation of Q-V curves. Assessment of reactive margin was employed in both Transmission Planning and Operations Engineering analysis. These studies verified that TID does not have a post-transient voltage stability concern. As such, the A2PP initial interconnection system impact study employed the 5.0% and 2.5% validation tests to confirm post-transient voltage stability with limited/select Q-V curve development. By increasing either system load or import by the appropriate percentage, only a valid power flow solution is needed to prove voltage stability for any contingency.

For the A2PP initial interconnection system impact study, the forecast modeled load was incremented by an additional 5.0% to evaluate Category A and Category B events. The forecast modeled load was incremented by 2.5% to evaluate Category C and Category D events. If the event simulations yield a solved (converged) post-transient power flow case, post-transient voltage stability is verified/achieved.

Load handling capability (P-V curve) analysis is a compliment to Q-V analysis. P-V curves illustrate the voltage performance at a specific system location as a function of either increasing system load or increasing import. For the A2PP initial interconnection system impact study, the forecast modeled load was incremented in the development of limited/select P-V curves. Load handling capability is defined as the maximum load a system can support just prior to experiencing voltage collapse.

## V. Study Results

This section of the report details the technical results and findings of the A2PP initial interconnection system impact study. Documentation of the technical analysis is broken into subsections of power flow (thermal and voltage), transient stability, voltage stability (Q-V curve and P-V curve) and short-circuit analysis.

### *Power Flow*

An extensive power flow thermal and voltage analysis was conducted to assess the impact of interconnecting the A2PP to the TID electric transmission system. **Table V-1** enumerates the 413 contingencies (outages) simulated and compared under anticipated 2012 spring peak, summer off-peak and summer peak conditions. A complete list of the evaluated contingencies (outages) is provided in **Appendix 7**.

**Table V-1. Contingency (Outage) List Summary**

| WECC/NERC Category | Initiating Event(s) & Contingency Element(s) | Elements Out of Service | No. Evaluated |
|---|---|---|---|
| B1 | Generator (G-1) | Single | 22 |
| B2 | Transmission Line (L-1) | Single | 74 |
| B3 | Transformer (T-1) | Single | 16 |
| CAISO B | Generator followed by Transmission Line (G-1, L-1) | Multiple | 74 |
| C1 | Bus Section | Multiple | 83 |
| C2 | Breaker Failure | Multiple | 100 |
| C3 | Double Single-Element (N-1, N-1) | Multiple | 7 |
| C5 | Double-Circuit Towerline (N-2) | Multiple | 29 |
| C8 | Transformer plus Breaker Failure | Multiple | 7 |
| D10 | Power Plant (G-3) | Multiple | 1 |

The objective of the A2PP initial interconnection system impact study is to identify impacts on any downstream facilities, which directly result from interconnecting a generation project. Furthermore, the goal of the study is to demonstrate reliable power system operation when generation output within the local area is maximized.

A2PP power flow thermal analysis results indicate that the interconnection of the A2PP to the TID electric transmission system will not trigger any new (or exacerbate any existing) thermal overloads. No impacts to downstream facilities were observed/identified.

Under anticipated 2012 summer off-peak conditions, all TID generation was modeled on-line with the exception of the Walnut CTs (peaking units). For this scenario, new thermal overloads on the Grayson-Westport 69 kV line and Walnut-WEC 115 kV line were observed. The thermal overloads and initiating events are listed in **Table V-2**.

**Table V-2. 2012 Summer Off-Peak Thermal Results (Almond CT On)**

| Effected Power System Element | Pre-Project Loading (%) | Post-Project Loading (%) | Delta | Outage Description |
|---|---|---|---|---|
| Grayson-Westport 69 kV Line | <90.00 | 105.09 | >15.09 | Grayson-Taylor & Grayson-Hughson 115 kV Lines Out |
| Walnut-WEC 115 kV Line | <90.00 | 102.98 | >12.98 | Tuolumne 115 kV Bus Section Fault |
| Walnut-WEC 115 kV Line | <90.00 | 102.98 | >12.98 | Tuolumne 115 kV Breaker 710, 730, 750, 770, 780, or 790 Failure |
| Walnut-WEC 115 kV Line | <90.00 | 102.47 | >12.47 | Pioneer-Tuolumne & Grayson-Hughson 115 kV Lines Out |
| Walnut-WEC 115 kV Line | <90.00 | 101.04 | >11.04 | Hughson 115 kV Bus Section Fault |
| Walnut-WEC 115 kV Line | <90.00 | 101.04 | >11.04 | Hughson 115 kV Breaker 700 or 710 Failure |
| Walnut-WEC 115 kV Line | <90.00 | 100.68 | >10.68 | Grayson-Hughson 115 kV Line Out |
| Walnut-WEC 115 kV Line | <90.00 | 100.68 | >10.68 | Grayson 115 kV Bus Section between Breaker 1700 & 1710 |
| Walnut-WEC 115 kV Line | <90.00 | 100.68 | >10.68 | Grayson 115 kV Breaker 1700 Failure |
| Walnut-WEC 115 kV Line | <90.00 | 100.68 | >10.68 | Grayson 115 kV Breaker 1710 Failure |
| Walnut-WEC 115 kV Line | <90.00 | 100.05 | >10.05 | Pioneer-Tuolumne & Hughson-Tuolumne 115 kV Lines Out |

A power flow thermal 2012 summer off-peak sensitivity analysis was performed with the existing Almond CT taken off-line. Based on economics and historical operation, the Almond CT is operated as a 'pseudo-peaking unit'; it is run during peak and shoulder-peak periods, but typically shut off at night (off-peak). Turning off the existing Almond CT alleviated the previously identified thermal overloads. The revised thermal loadings and initiating events are listed in **Table V-3**.

**Table V-3. 2012 Summer Off-Peak Thermal Results (Almond CT Off)**

| Effected Power System Element | Pre-Project Loading (%) | Post-Project Loading (%) | Delta | Outage Description |
|---|---|---|---|---|
| Walnut-WEC 115 kV Line | <90.00 | 95.48 | >5.48 | Pioneer-Tuolumne & Grayson-Hughson 115 kV Lines Out |
| Walnut-WEC 115 kV Line | <90.00 | 95.05 | >5.05 | Tuolumne 115 kV Bus Section Fault |
| Walnut-WEC 115 kV Line | <90.00 | 95.05 | >5.05 | Tuolumne 115 kV Breaker 710, 730, 750, 770, 780, or 790 Failure |
| Walnut-WEC 115 kV Line | <90.00 | 94.38 | >4.38 | Hughson 115 kV Bus Section Fault |
| Walnut-WEC 115 kV Line | <90.00 | 94.38 | >4.38 | Hughson 115 kV Breaker 700 or 710 Failure |
| Walnut-WEC 115 kV Line | <90.00 | 94.01 | >4.01 | Grayson-Hughson 115 kV Line Out |
| Walnut-WEC 115 kV Line | <90.00 | 94.01 | >4.01 | Grayson 115 kV Bus Section between Breaker 1700 & 1710 |
| Walnut-WEC 115 kV Line | <90.00 | 94.01 | >4.01 | Grayson 115 kV Breaker 1700 Failure |
| Walnut-WEC 115 kV Line | <90.00 | 94.01 | >4.01 | Grayson 115 kV Breaker 1710 Failure |
| Walnut-WEC 115 kV Line | <90.00 | 93.05 | >3.05 | Pioneer-Tuolumne & Hughson-Tuolumne 115 kV Lines Out |
| Grayson-Westport 69 kV Line | <90.00 | <90.00 | NA | Grayson-Taylor & Grayson-Hughson 115 kV Lines Out |

The thermal overloads identified during anticipated 2012 summer off-peak periods are not only a function of system generation, but system load as well. As system load increases over time, the thermal overloads identified during 2012 summer off-peak studies will reduce (and likely disappear). Furthermore, TID, as owner of all generation within its Balancing Authority, can (and does) manage its generation portfolio to ensure reliable system operation during off-peak periods.

Under anticipated 2012 summer peak conditions, all MID generation was modeled on-line with the exception of McClure generation (per the A2PP Final Study Plan Outline). For this scenario,

thermal overloads on MID's 8th Street-12th Street, Rosemore-8th Street and Briggsmore-Enslen 69 kV lines were observed. The thermal overloads and initiating events are listed in **Table V-4**.

**Table V-4. Summer Peak Thermal Results (McClure Generation Off)**

| Effected Power System Element | Pre-Project Loading (%) | Post-Project Loading (%) | Delta | Outage Description |
|---|---|---|---|---|
| 8th Street-12th Street 69 kV Line | 111.58 | 112.50 | 0.92 | Parker-Westley & Parker-Walnut 230 kV Lines Out |
| Rosemore-8th Street 69 kV Line | 103.61 | 104.85 | 1.24 | Parker-Westley & Parker-Walnut 230 kV Lines Out |
| Briggsmore-Enslen 69 kV Line | 101.60 | 102.43 | 0.83 | Parker-Westley & Parker-Walnut 230 kV Lines Out |
| Enslen-Woodland 69 kV Line | 92.73 | 93.32 | 0.59 | Parker-Westley & Parker-Walnut 230 kV Lines Out |

In subsequent conversations with MID Transmission Planning and Operations engineers, it was determined that McClure generation would be running under summer peak load conditions. The dispatch of McClure generation alleviated the thermal overloads observed on MID's system. The revised thermal loadings and initiating events are listed in **Table V-5**.

**Table V-5. Summer Peak Thermal Results (McClure Generation On)**

| Effected Power System Element | Pre-Project Loading (%) | Post-Project Loading (%) | Delta | Outage Description |
|---|---|---|---|---|
| 8th Street-12th Street 69 kV Line | 99.25 | 99.98 | 0.73 | Parker-Westley & Parker-Walnut 230 kV Lines Out |
| Briggsmore-Enslen 69 kV Line | 92.52 | 93.25 | 0.73 | Parker-Westley & Parker-Walnut 230 kV Lines Out |
| Rosemore-8th Street 69 kV Line | 91.48 | 92.66 | 1.18 | Parker-Westley & Parker-Walnut 230 kV Lines Out |

A2PP power flow voltage analysis results indicate that the interconnection of the A2PP to the TID electric transmission system will not trigger any new (or exacerbate any existing) voltage criteria violations. TID electric transmission system voltage performance was so robust that it exceeded the A2PP Final Study Plan Outline reporting criteria. Therefore, there are no voltage results to present.

Detailed power flow thermal results for 2012 spring peak, summer off-peak and summer peak conditions (including sensitivity generation) are provided in **Appendix 8**.

Furthermore, power flow thermal and voltage analysis one-line diagrams (before and after interconnection of the A2PP) for 2012 spring peak, summer off-peak and summer peak conditions (including sensitivity generation) are provided in **Appendix 9**.

### *Transient Stability*

Transient stability analysis is a time-based simulation that assesses the performance of the power system during (and shortly following) a contingency. Transient stability studies were performed under anticipated 2012 summer peak conditions (with the A2PP) to ensure system stability following a critical fault on the system. Transient stability simulations were performed out to 20 seconds. A total of twenty-one (21) contingencies were evaluated for transient stability: Nine (9) TID local system outages, three (3) TID import path outages, and nine (9) 500 kV bulk transmission system outages.

A2PP transient stability analysis results indicate that the interconnection of the A2PP to the TID electric transmission system will not contribute to power system instability. All simulations performed exhibited positive damping and were well within WECC Disturbance-Performance criteria.

After a Category B disturbance:

- No transient voltage dips below 25 percent at load buses or 30 percent at non-load buses were observed.
- No durations of transient voltage dips greater than 20 percent, exceeding 20 cycles at load buses, were observed.
- No minimum transient frequencies below 59.6 Hz for more than 6 cycles at load buses were observed.

After a Category C (or D) disturbance:

- No transient voltage dips below 30 percent at any bus were observed.
- No durations of transient voltage dips greater than 20 percent, exceeding 40 cycles at load buses, were observed.
- No minimum transient frequencies below 59.0 Hz for more than 6 cycles at load buses were observed.

Transient stability plots, which include voltage, relative rotor angle and frequency plots for the outages outlined in **Table V-6**, **Table V-7** and **Table V-8**, are provided in **Appendix 14 (Vol. II)**.

**Table V-6. TID Local System Transient Stability**

| Outage Description | Voltage | Frequency | Damping |
|---|---|---|---|
| N-0 All Elements in Service | NA | NA | NA |
| Almond 2 Power Plant + Interconnection | No Violations | No Violations | Well Damped |
| Grayson-Almond #1 115 kV Line Out | No Violations | No Violations | Well Damped |
| Grayson-Hughson 115 kV Line Out | No Violations | No Violations | Well Damped |
| Grayson-Taylor 115 kV Line Out | No Violations | No Violations | Well Damped |
| Grayson-Taylor & Grayson-Hughson 115 kV Lines Out | No Violations | No Violations | Well Damped |
| Grayson 115/69 kV Transformer Out | No Violations | No Violations | Well Damped |
| Grayson-Almond 69 kV Line Out | No Violations | No Violations | Well Damped |
| Grayson-Gilstrap 69 kV Line Out | No Violations | No Violations | Well Damped |
| Grayson-Westport 69 kV Line Out | No Violations | No Violations | Well Damped |

**Table V-7. TID Import Path Transient Stability**

| Outage Description | Voltage | Frequency | Damping |
|---|---|---|---|
| Walnut-Westley & Walnut-Parker 230 kV Lines Out | No Violations | No Violations | Well Damped |
| Oakdale-Tuolumne #1 & #2 115 kV Lines Out | No Violations | No Violations | Well Damped |
| Westley-Marshall & Westley-Rogers 115 kV Lines Out | No Violations | No Violations | Well Damped |

**Table V-8. 500 kV Bulk Transmission System Transient Stability**

| Outage Description | Voltage | Frequency | Damping |
|---|---|---|---|
| Los Banos-Gates #3 500 kV Line Out | No Violations | No Violations | Well Damped |
| Los Banos-Midway 500 kV Line Out | No Violations | No Violations | Well Damped |
| Los Banos-Tesla 500 kV Line Out | No Violations | No Violations | Well Damped |
| Los Banos-Tracy 500 kV Line Out | No Violations | No Violations | Well Damped |
| Los Banos-Gates & Los Banos-Midway 500 kV Lines Out | No Violations | No Violations | Well Damped |
| Los Banos-Tesla & Los Banos-Tracy 500 kV Lines Out | No Violations | No Violations | Well Damped |
| Tesla-Table Mt & Tesla-Vaca-Dixon 500 kV Lines Out | No Violations | No Violations | Well Damped |
| Tracy-Tesla #1 500 kV Line Out | No Violations | No Violations | Well Damped |
| Tracy-Los Banos & Tracy-Tesla #1 500 kV Lines Out | No Violations | No Violations | Well Damped |

### *Voltage Stability*

Voltage stability analysis was conducted to determine how close the system is from collapse for each contingency based on a reactive limit. Voltage stability is an indicator that gives the relative strength of a system. This indicator is designed to cover for modeling discrepancies, operational differences, and equipment failures that fall outside of reliability criteria. The intent of reactive margin criteria application is to ensure reliable operation of the power system by bridging the gap between the studied system and real-world operation.

In previous years, TID has performed exhaustive post-transient voltage stability assessments of their system by the generation of Q-V curves. Assessment of reactive margin was employed in both Transmission Planning and Operations Engineering analysis. These studies verified that TID does not have a post-transient voltage stability concern. As such, the A2PP initial interconnection system impact study employed the 5.0% and 2.5% validation tests to confirm post-transient voltage stability with limited/select Q-V curve development. By increasing either system load or import by the appropriate percentage, only a valid power flow solution is needed to prove voltage stability for any contingency.

All contingencies (outages) simulated under anticipated 2012 spring peak, summer off-peak and summer peak conditions, with the 5.0% and 2.5% test applied, yielded a valid power flow solution. As such, post-transient voltage stability is verified/achieved. As referenced earlier, a complete list of the evaluated contingencies (outages) is provided in **Appendix 7**.

A2PP voltage stability (Q-V curve) analysis results indicate that the interconnection of the A2PP to the TID electric transmission system will not adversely impact TID local system voltage stability. The A2PP will improve TID local system voltage stability by increasing TID's reactive margin from 341 MVAr to 373 MVAr (an improvement of 32 MVAr).

**Table V-9** tabulates and compares TID local voltage stability (under anticipated 2012 summer peak conditions) before and after interconnection of the A2PP. The associated plotted Q-V curves are provided in **Appendix 10**.

**Table V-9. TID Local System Voltage Stability**

| Outage Description | Location | Pre-Project | | Post-Project | |
|---|---|---|---|---|---|
| | | Margin (MVAr) | Voltage (p.u.) | Margin (MVAr) | Voltage (p.u.) |
| N-0 All Elements in Service | August 115 | -390 | 0.64 | -425 | 0.61 |
| Walnut-Westley & Walnut-Parker 230 kV Lines Out | August 115 | -289 | 0.65 | -365 | 0.60 |
| Oakdale-Tuolumne #1 & #2 115 kV Lines Out | August 115 | -351 | 0.60 | -396 | 0.61 |
| Westley-Marshall & Westley-Rogers 115 kV Lines Out | August 115 | -341 | 0.60 | -373 | 0.61 |

A2PP voltage stability (Q-V curve) analysis results also indicate that the interconnection of the A2PP to the TID electric transmission system will not adversely impact 500 kV bulk transmission system voltage stability.

**Table V-10** tabulates and compares 500 kV bulk transmission system voltage stability (under anticipated 2012 summer peak conditions) before and after interconnection of the A2PP. The associated plotted Q-V curves are provided in **Appendix 11**.

**Table V-10. 500 kV Bulk Transmission System Voltage Stability**

| Outage Description | Location | Pre-Project | | Post-Project | |
|---|---|---|---|---|---|
| | | Margin (MVAr) | Voltage (p.u.) | Margin (MVAr) | Voltage (p.u.) |
| N-0 All Elements in Service | Gates 500 | -5,080 | 0.72 | -5,092 | 0.72 |
| | Los Banos 500 | -5,862 | 0.76 | -6,097 | 0.70 |
| | Tesla 500 | -4,831 | 0.84 | -4,890 | 0.83 |
| | Tracy 500 | -4,573 | 0.81 | -4,581 | 0.81 |
| Los Banos-Gates #3 500 kV Line Out | Gates 500 | -4,753 | 0.71 | -4,749 | 0.71 |
| | Los Banos 500 | -5,786 | 0.69 | -5,789 | 0.70 |
| | Tesla 500 | -4,733 | 0.84 | -4,810 | 0.83 |
| | Tracy 500 | -4,456 | 0.81 | -4,527 | 0.81 |
| Los Banos-Midway 500 kV Line Out | Gates 500 | -4,859 | 0.72 | -4,855 | 0.72 |
| | Los Banos 500 | -5,429 | 0.68 | -5,433 | 0.68 |
| | Tesla 500 | -4,656 | 0.84 | -4,690 | 0.84 |
| | Tracy 500 | -4,370 | 0.81 | -4,424 | 0.81 |
| Los Banos-Tesla 500 kV Line Out | Gates 500 | -4,811 | 0.73 | -4,826 | 0.72 |
| | Los Banos 500 | -5,471 | 0.68 | -5,489 | 0.68 |
| | Tesla 500 | -4,311 | 0.83 | -4,361 | 0.83 |
| | Tracy 500 | -4,170 | 0.82 | -4,247 | 0.81 |

| Outage Description | Location | Pre-Project | | Post-Project | |
|---|---|---|---|---|---|
| | | Margin (MVAr) | Voltage (p.u.) | Margin (MVAr) | Voltage (p.u.) |
| Los Banos-Tracy 500 kV Line Out | Gates 500 | -4,830 | 0.72 | -4,862 | 0.72 |
| | Los Banos 500 | -5,563 | 0.69 | -5,573 | 0.69 |
| | Tesla 500 | -4,439 | 0.84 | -4,476 | 0.84 |
| | Tracy 500 | -4,005 | 0.81 | -3,985 | 0.81 |
| Los Banos-Gates & Los Banos-Midway 500 kV Lines Out | Gates 500 | -4,196 | 0.72 | -4,209 | 0.72 |
| | Los Banos 500 | -3,946 | 0.74 | -3,778 | 0.77 |
| | Tesla 500 | -3,175 | 0.88 | -3,218 | 0.88 |
| | Tracy 500 | -2,990 | 0.87 | -3,017 | 0.87 |
| Los Banos-Tesla & Los Banos-Tracy 500 kV Lines Out | Gates 500 | -4,405 | 0.74 | -4,406 | 0.74 |
| | Los Banos 500 | -4,537 | 0.68 | -4,545 | 0.68 |
| | Tesla 500 | -3,663 | 0.84 | -3,683 | 0.83 |
| | Tracy 500 | -3,467 | 0.81 | -3,427 | 0.81 |
| Tesla-Table Mt & Tesla-Vaca-Dixon 500 kV Lines Out | Gates 500 | -5,359 | 0.72 | -5,506 | 0.71 |
| | Los Banos 500 | -6,491 | 0.70 | -6,574 | 0.68 |
| | Tesla 500 | -5,600 | 0.82 | -5,592 | 0.80 |
| | Tracy 500 | -5,496 | 0.80 | -5,312 | 0.79 |
| Tracy-Tesla #1 500 kV Line Out | Gates 500 | -5,077 | 0.72 | -5,075 | 0.72 |
| | Los Banos 500 | -6,048 | 0.70 | -6,023 | 0.70 |
| | Tesla 500 | -4,698 | 0.80 | -4,716 | 0.80 |
| | Tracy 500 | -3,560 | 0.68 | -3,587 | 0.68 |
| Tracy-Los Banos & Tracy-Tesla #1 500 kV Lines Out | Gates 500 | -4,867 | 0.72 | -4,888 | 0.72 |
| | Los Banos 500 | -5,524 | 0.68 | -5,536 | 0.68 |
| | Tesla 500 | -4,338 | 0.81 | -4,401 | 0.80 |
| | Tracy 500 | -2,104 | 0.64 | -2,118 | 0.65 |

Load handling capability (P-V curve) analysis is a compliment to Q-V analysis. P-V curves illustrate the voltage performance at a specific system location as a function of either increasing system load or increasing import. For the A2PP initial interconnection system impact study, the forecast modeled load was incremented in the development of limited/select P-V curves. Load handling capability is defined as the maximum load a system can support just prior to experiencing voltage collapse.

A2PP load handling capability (P-V curve) analysis results indicate that the interconnection of the A2PP to the TID electric transmission system will increase TID load handling capability from 1,094 MW to 1,308 MW (an improvement of 214 MW).

**Table V-11** tabulates and compares TID load handling capability before and after interconnection of the A2PP. The associated plotted P-V curves are provided in **Appendix 12**.

**Table V-11. TID Import Path Load Handling Capability**

| Outage Description | Pre-Project (MW) | Post-Project (MW) | Delta (MW) |
|---|---|---|---|
| N-0 All Elements in Service | 1,698 | 1,935 | +237 |
| Walnut-Westley & Walnut-Parker 230 kV Lines Out | 1,094 | 1,308 | +214 |
| Oakdale-Tuolumne #1 & #2 115 kV Lines Out | 1,438 | 1,704 | +265 |
| Westley-Marshall & Westley-Rogers 115 kV Lines Out | 1,514 | 1,732 | +218 |

### *Short-Circuit*

Short-circuit analysis was performed by TID using the ASPEN OneLiner software package. The purpose of the short-circuit analysis was to determine the impacts to fault duty by adding the A2PP to the TID electric transmission system. Three-phase faults and single line-to-ground faults were examined. Fault duties were calculated before and after the project. **Table V-12** documents the largest percent increases in fault currents.

A2PP short-circuit study results indicate that three (3) circuit breakers at the TID Walnut 69 kV station (CB 510, CB 530 and CB 550) may need an upgrade due to an increase in observed single line-to-ground fault current. The single line-to-ground fault current of 27,699 Amperes at

Walnut 69 kV station exceeds the three (3) breakers' existing 27,000 Ampere interrupting capability.

**Table V-12. Short-Circuit**

| Location | Voltage | 3-Phase Fault Currents | | | Single Line-to-Ground Fault Currents | | | Interrupting Capability (Amps) |
|---|---|---|---|---|---|---|---|---|
| | | Pre-Project (Amps) | Post-Project (Amps) | Delta (%) | Pre-Project (Amps) | Post-Project (Amps) | Delta (%) | |
| Almond | 69 | 12,912 | 14,900 | 15.4% | 11,774 | 14,018 | 19.1% | 31,500 |
| Almond 115 | 115 | NA | 11,821 | NA | NA | 12,428 | NA | 15,000 |
| Almond G1 | 13.8 | NA | 41,472 | NA | NA | 40,037 | NA | TBD |
| Almond G2 | 13.8 | NA | 41,472 | NA | NA | 40,037 | NA | TBD |
| Almond G3 | 13.8 | NA | 41,472 | NA | NA | 40,037 | NA | TBD |
| Ceres | 69 | 11,115 | 12,075 | 8.6% | 7,506 | 8,019 | 6.8% | 19,000 |
| Commons | 69 | 17,518 | 18,247 | 4.2% | 13,371 | 13,713 | 2.6% | 40,000 |
| Cortez | 115 | 7,780 | 8,697 | 11.8% | 4,962 | 5,423 | 9.3% | 40,000 |
| Crows Landing. | 69 | 10,979 | 12,092 | 10.1% | 7,694 | 8,367 | 8.8% | 31,500 |
| Gilstrap | 69 | 12,305 | 14,195 | 15.4% | 10,746 | 12,870 | 19.8% | 19,000 |
| Grayson | 115 | 8,101 | 12,102 | 49.4% | 6,706 | 12,279 | 83.1% | 15,000 |
| Grayson 69 | 69 | 13,434 | 15,847 | 18.0% | 12,697 | 16,264 | 28.1% | TBD |
| Hilmar | 115 | 8,862 | 9,420 | 6.3% | 5,817 | 6,059 | 4.2% | 40,000 |
| Hughson | 115 | 9,738 | 12,022 | 23.5% | 7,226 | 8,890 | 23.0% | 40,000 |
| Oakdale (TID) | 115 | 9,056 | 9,891 | 9.2% | 6,238 | 6,655 | 6.7% | 40,000 |
| Pioneer | 115 | 6,326 | 6,620 | 4.6% | 4,119 | 4,229 | 2.7% | 40,000 |
| Roeding | 69 | 9,391 | 10,011 | 6.6% | 5,894 | 6,174 | 4.8% | 19,000 |
| Taylor | 115 | 8,681 | 10,503 | 21.0% | 6,022 | 7,218 | 19.9% | 40,000 |
| Tuolumne | 69 | 15,381 | 16,692 | 8.5% | 12,893 | 13,889 | 7.7% | 19,000 |
| Tuolumne | 115 | 10,649 | 12,431 | 16.7% | 8,182 | 9,340 | 14.2% | 40,000 |
| Walnut | 69 | 24,286 | 25,260 | 4.0% | 26,871 | 27,699 | 3.1% | 27,000 |
| Walnut | 115 | 16,352 | 17,019 | 4.1% | 16,370 | 16,848 | 2.9% | 40,000 |
| WEC | 115 | 15,803 | 16,455 | 4.1% | 15,681 | 16,143 | 2.9% | 40,000 |
| Westport | 69 | 11,324 | 12,207 | 7.8% | 7,533 | 8,036 | 6.7% | 19,000 |

A2PP short-circuit study results have been provided to PG&E, MID and WAPA for their review. PG&E, MID and WAPA have committed to cross-check TID's study results against their circuit breakers' existing interrupting capability. The need for circuit breaker replacement outside of TID service territory, due to the interconnection of the A2PP, is not anticipated.

Complete short-circuit analysis output is provided in **Appendix 13**.

## VI. Mitigation (Alternatives)

As proposed, interconnection of the A2PP requires that the existing 2.9-mile-long Almond-Crows Landing 69 kV single-circuit transmission line be re-rated to prevent possible thermal overloads under certain contingencies. Aside from the aforementioned Almond-Crows Landing 69 kV re-rate, no additional mitigation measures were identified as part of the initial interconnection system impact study for the A2PP.

# Turlock Irrigation District
# Almond 2 Power Plant
# (09-AFC-2)

## Appendix 1

Final Study Plan Outline

**Almond 2 Power Plant Project**
**Final Study Plan Outline**

September 24, 2009

Prepared for the Turlock Irrigation District by:
Ron S. Daschmans
Vice President of Technical Services
Utility System Efficiencies, Inc.

## Introduction

On behalf of the Turlock Irrigation District (TID), Utility System Efficiencies, Inc. (USE) respectfully submits the following study plan outline for the Almond 2 Power Plant (A2PP) project. Per the California Energy Commission's request, the plan is outlined in bullet fashion.

The outline is a result of coordination and communication between TID, the Merced Irrigation District (MeID), the Modesto Irrigation District (MID), the Sacramento Municipal Utility District (SMUD), the California ISO (CAISO), the Pacific Gas & Electric Company (PG&E), and the California Energy Commission (CEC).

The study plan outline is broken into two (2) distinct sections: System Modeling & Technical Analysis. The Technical Analysis section is subdivided into three (3) sections: Evaluation, Criteria & Report/Deliverables.

## System Modeling Summarized

### General Modeling Assumptions

- Study Year
    - 2012
- Study Seasons:
    - Summer Peak
    - Summer Off-Peak
    - Spring Peak
- Study Base Cases
    - 2012 Summer Central Valley 1:10 Peak Load Case
        - PG&E Assessment Case Developed in 2009
        - Case is Truncated (must be merged into PG&E Assessment full-loop case)
    - 2012 Summer Off-Peak Case
        - Source 2010 PG&E Assessment Case Developed in 2009
        - Case is Truncated (must be merged into PG&E Assessment full-loop case)
        - Change File Updating Loads to 2012 Provided by CAISO
    - 2012 Spring Peak Case
        - Developed from 2010 Heavy Spring WECC base case
        - Change File Updating Loads to 2012 Provided by PG&E
        - Approved Transmission Projects to be Added Manually

### Local System Loads & Losses Modeling

***Table I. Local System Loads & Losses Summary***

| Area | Summer Peak (1:10) | Summer Off-Peak (50% of Peak) | Spring Peak (1:10) |
|---|---|---|---|
| TID | 617 MW | 308.5 MW | 489 MW |
| MeID | 113 MW | 56.5 MW | 90 MW |
| TID + MeID | 730 MW | 365 MW | 579 MW |

## Almond 2 Power Plant Generation Project Modeling

- Three (3) 58 MW General Electric LM6000PG Turbines
    - 58 MW/unit (174 MW Total Gross Output)
    - 71 MVAr/unit boosting capability
    - 0 MVAr/unit bucking capability (study purposes only)
- Three (3) 2 MW + 1 MVAr Station Aux Loads (6 MW + 3 MVAr Total)
- Three (3) 72.5 MVA Generator Step-Up (GSU) Transformers
- Two (2) 115 kV Lines to Grayson Substation

## CEC Generation (Queue) Modeling

- Total Generation: 3,606 MW + 600 MW (On-Hold) = 4,206 MW
- Includes Operational, Under Construction & Approved Projects

***Table II. CEC Generation Queue***

| Docket No. | Project Name | Status | Capacity (MW) | Location |
|---|---|---|---|---|
| 1997-AFC-02 | Sutter - Calpine | Operational | 525 | Sutter |
| 1998-AFC-01 | Los Medanos - Calpine | Operational | 564 | Contra Costa |
| 1998-AFC-03 | Delta - Calpine | Operational | 895 | Contra Costa |
| 2000-AFC-01 | Gateway - PG&E | Operational | 530 | Contra Costa |
| 2001-AFC-16 | Tracy Peaker - GWF | Operational | 169 | San Joaquin |
| 2001-AFC-19 | Cosumnes - SMUD | Operational | 500 | Sacramento |
| 2001-SPPE-01 | Woodland II - Modesto Irrigation District | Operational | 80 | Stanislaus |
| 2002-AFC-04 | Walnut - Turlock Irrigation District | Operational | 255 | Stanislaus |
| 2003-SPPE-01 | Ripon - Modesto Irrigation District | Operational | 95 | San Joaquin |
| 2001-AFC-07 | Russell City - Calpine & GE | On-Hold | 614 | Alameda |

## CAISO Generation (Queue) Modeling

- Total Generation: 1,102 MW (Within 40-Mile Radius of Walnut 230 kV Substation)
    - See Supplemental Map
- Transient Stability Data Not Available for CAISO Generation Queue
    - Use Typical Data

***Table III. CAISO Generation Queue (Transition Cluster)***

| Queue No. | Project Name | Application Status | Capacity (MW) | Location | Type | Distance (Miles) |
|---|---|---|---|---|---|---|
| 76 | Merced #1 Circuit (El Nido) | Complete | 13 | Merced | Steam | 30 |
| 268 | Tesla-Manteca Line (via Schulte Switchyard) | Active-Serial | 155 | San Joaquin | Steam | 30 |
| 172 & 248 | Tesla-Bellota Lines | Active-Serial | 589 | San Joaquin | Natural Gas | 40 |
| 269 | Tesla-Westley Lines | Transition-Serial | 371 | San Joaquin | Natural Gas | 40 |

## Existing TID Generation Modeling

***Table IV. TID Generation***

| Name | Unit ID | Capacity (MW) | Comment |
|---|---|---|---|
| Don Pedro | 1 | 55 | Due to Canal Limitations Don Pedro Normal Operating Maximum Dispatch Assumed to be 90 MW Total |
| Don Pedro | 2 | 55 | |
| Don Pedro | 4 | 38 | |
| Almond CT | 1 | 50 | |
| Walnut CT | 1 | 24 | Peaking Unit<br>Used in Emergency Situations & for Reserves<br>See Section Entitled Generation Sensitivity |
| Walnut CT | 2 | 24 | Peaking Unit<br>Used in Emergency Situations & for Reserves<br>See Section Entitled Generation Sensitivity |
| WEC | 1 | 82.3 | |
| WEC | 2 | 82.3 | |
| WEC | 3 | 93.6 | |
| La Grange | 1 | 5 | |
| Dawson | 1 | 5 | |

## Existing MID Generation Modeling

***Table V. MID Generation***

| Name | Unit ID | Capacity (MW) | Comment |
|---|---|---|---|
| Don Pedro | 3 | 55 | |
| Hershey | 1 | 5.7 | Normally Off-Line |
| McClure | 1 | 62 | Peaking Unit<br>See Section Entitled Generation Sensitivity |
| McClure | 2 | 62 | Peaking Unit<br>See Section Entitled Generation Sensitivity |
| New Hogan Dam | 1 | 2.2 | |
| New Hogan Dam | 2 | 2.2 | |
| Ripon | 1 | 50 | |
| Ripon | 2 | 50 | |
| Woodland | 1 | 49 | |
| Woodland II | 2 | 80 | |

## Other Planned Generation Modeling

- MID Woodland III
    - 49.2 MW (6 x 8.2 MW reciprocating engines)
    - Anticipated On-Line Date 2012

## Generation Sensitivity

- 2012 Summer Peak Sensitivity Case to Include Peaking Units & On-Hold Projects
- Total Sensitivity Generation: 2,428 MW

***Table VI. Sensitivity Generation***

| Name | Unit ID | Capacity (MW) | Comment |
|---|---|---|---|
| Walnut CT | 1 | 24 | Peaking Unit<br>Used in Emergency Situations & for Reserves |
| Walnut CT | 2 | 24 | Peaking Unit<br>Used in Emergency Situations & for Reserves |
| McClure | 1 | 62 | Peaking Unit |
| McClure | 2 | 62 | Peaking Unit |
| Tesla Substation 230 kV (Bus E) | - | 1,156 | 2001-AFC-21 Tesla – FPL<br>Alameda<br>CEC Status On Hold<br>CAISO Generation Queue No. 6 |
| East Altamont - Calpine | - | 1,100 | 2001-AFC-04<br>Alameda<br>CEC Status On Hold |

## Transmission Infrastructure Project Modeling

- PG&E Approved Projects
- CAISO Generation Queue Transmission Reinforcements
    - To be Posted Shortly on Secure CAISO Website
- Transmission Infrastructure Projects to be Tabulated in SIS

## Technical Analysis Summarized

## Power Flow (Thermal & Voltage) Analysis

- Power Flow Analysis to be Conducted
    - 2012 Summer Central Valley 1:10 Peak Load Case
    - 2012 Summer Off-Peak case
    - 2012 Spring Peak case
- Evaluate & Compare (Pre- & Post-Project) Power Flow Thermal & Voltage Performance
    - Category A – All Elements in Service
    - Category B – Approximately 100 Contingencies
    - Category C – Approximately 200 Contingencies
    - Category B – G-1, L-1
        - One (1) WEC GT Out & WEC Stream Unit Reduced to Half Output
        - Plus All Category B L-1 Outages
    - Path Flows within Limits
- Disturbance/Performance Criteria
    - Within Seasonal Normal Thermal Rating (Less than 100% for Category A)
    - Within Seasonal Emergency Thermal Rating (Less than 100% for Category B & C)
    - No more than 5% Voltage Deviation Allowed for Category B
    - No more than 10% Voltage Deviation Allowed for Category C
- Reporting/Deliverables (One-Line Diagrams & Tabular Output)
    - Mitigation Measures, if Needed, will be Included in SIS

- List of Contingencies Evaluated
- New Thermal Violations Triggered by the Project
  - Pre-Project Thermal Loading Less than or Equal 100% & Post-Project Thermal Loading Greater than 100%
- Thermal Violations Exacerbated by the Project
  - Pre-Project Thermal Loading Greater than 100% & Post-Project Thermal Loading Greater than 100%
- New Voltage Violations Triggered by the Project
  - Pre-Project Voltage Deviations Less than or Equal 5% & Post-Project Thermal Voltage Deviations Greater than 5% for Category B
  - Pre-Project Voltage Deviations Less than or Equal 10% & Post-Project Voltage Deviations Greater than 10% for Category C
- Voltage Violations Exacerbated by the Project
  - Pre-Project Voltage Deviations Greater than 5% & Post-Project Thermal Voltage Deviations Greater than 5% for Category B
  - Increases Greater Than or Equal to 0.02%
  - Pre-Project Voltage Deviations Greater than 10% & Post-Project Thermal Voltage Deviations Greater than 10% for Category C
  - Increases Greater Than or Equal to 0.02%
- Provide Power Flow diagrams (MW, % Loading & P. U. Voltage) for Base Cases with & without the Project
- Provide Power Flow diagrams (MW, % Loading & P. U. Voltage) for all N-0, N-1 & N-2 Results where Overloads or Voltage Violations Appear
  - Largest Violation Only
  - Tabular Output to Contain All Violations

## Transient Stability Analysis

- Transient Stability Analysis to be Conducted
  - 2012 Summer Central Valley 1:10 Peak Load Case
- Evaluate & Compare (Post-Project Only) Transient Stability Performance
  - Project-Related
    - A2PP Load Rejection (Three-Phase Fault on High-Side Bus)
  - Local Area
    - Grayson-Hughson 115 kV Single-Line Outage
    - Grayson-Taylor 115 kV Single-Line Outage
    - Grayson-Almond 69 kV Single-Line Outage
    - Grayson-Gilstrap 69 kV Single-Line Outage
    - Grayson-Westport 69 kV Single-Line Outage
  - Import Paths
    - Walnut-Parker / Walnut-Westley 230 kV Double-Line Outage
    - Oakdale-Tuolumne 115 kV Double-Line Outage
    - Westley-Marshall / Westley-Rogers 115 kV Double-Line Outage
  - 500 kV Bulk Transmission System
    - Select N-1 & N-2 Outages
- Disturbance/Performance Criteria

*Table VII. WECC/NERC Disturbance/Performance Criteria*

| NERC and WECC Categories | Transient Voltage Dip Standard | Minimum Transient Frequency Standard | Post Transient Voltage Deviation Standard (See Note 2) |
|---|---|---|---|
| A | Nothing in addition to NERC | | |
| B | Not to exceed 25% at load buses or 30% at non-load buses. Not to exceed 20% for more than 20 cycles at load buses. | Not below 59.6Hz for 6 cycles or more at a load bus. | Not to exceed 5% at any bus. |
| C | Not to exceed 30% at any bus. Not to exceed 20% for more than 40 cycles at load buses. | Not below 59.0Hz for 6 cycles or more at a load bus. | Not to exceed 10% at any bus. |
| D | Nothing in addition to NERC | | |

- Reporting/Deliverables
    - Mitigation Measures, if Needed, will be Included in SIS
    - List of Contingencies Evaluated
    - Transient Stability plots will be Provided in Adobe Acrobat pdf Format
    - Plots Illustrate Voltage, Frequency & Angle of the Almond 2 Power Plant Project along with up to five (5) other key locations
    - Plot Format will be One (1) Plot per Page (for Readability)
    - Each Plot will Overlay Pre- & Post-Project Performance for Easy Comparison

## Voltage Stability (Q-V/P-V) Analysis

- Voltage Stability Analysis to be Conducted
    - 2012 Summer Central Valley 1:10 Peak Load Case
- Evaluate & Compare (Pre- & Post-Project) Voltage Stability Performance
    - Develop Q-V/P-V Curves for Import Paths
        - All Elements in Service
        - Walnut-Parker / Walnut-Westley 230 kV Double-Line Outage
        - Oakdale-Tuolumne 115 kV Double-Line Outage
        - Westley-Rogers / Westley-Marshall 115 kV Double-Line Outage
        - Select N-1 & N-2 500 kV Bulk Transmission System Outages
    - 5.0% Test for Remaining Category B Outages
    - 2.5% Test for Remaining Category C Outages
- Disturbance/Performance Criteria
    - Positive Reactive Margin for Q-V Curves
    - Solved Cases for 5.0% & 2.5% Tests
    - No more than 5% Voltage Deviation allowed for Category B
    - No more than 10% Voltage Deviation allowed for Category C
- Reporting/Deliverables
    - Mitigation Measures, if Needed, will be Included in SIS
    - List of Contingencies Evaluated
    - Q-V/P-V Curves
    - Tabular Summary of 5.0% & 2.5% Tests
    - New Voltage Violations Triggered by the Project
        - Pre-Project Voltage Deviations Less than or Equal 5% & Post-Project Thermal Voltage Deviations Greater than 5% for Category B

        - Pre-Project Voltage Deviations Less than or Equal 10% & Post-Project Voltage Deviations Greater than 10% for Category C
    - Voltage Violations Exacerbated by the Project
        - Pre-Project Voltage Deviations Greater than 5% & Post-Project Thermal Voltage Deviations Greater than 5% for Category B
        - Increases Greater Than or Equal to 0.02%
        - Pre-Project Voltage Deviations Greater than 10% & Post-Project Thermal Voltage Deviations Greater than 10% for Category C
        - Increases Greater Than or Equal to 0.02%

### Short-Circuit Analysis

- Short-Circuit Analysis to be Conducted
    - 2012 Summer Central Valley 1:10 Peak Load Case
- Short-Circuit Duties Assessed by TID Engineers
    - Three-Phase & Single-Phase to Ground
    - Pre-Project & Post-Project
    - Results Folded into SIS
    - TID Possesses Circuit Breaker Data/Information
    - TID In-House Analysis Superior to Generic WECC Data Sets
    - Includes Current Contributions for Tie Lines

## Report Structure Summarized

### SIS Report Structure Overview

- Introduction
- Executive Summary
- Base Cases & Assumptions
- Study Criteria
- Study Results (Including Pertinent Tables & Figures)
    - Power Flow
    - Transient Stability
    - Voltage Stability
    - Short-Circuit
- Mitigation (Alternatives)
- Appendices

# Turlock Irrigation District
# Almond 2 Power Plant
# (09-AFC-2)

## Appendix 2

A2PP Power Flow Model
(GE PSLF Format)

## A2PP Power Flow Model (GE PSLF Format)

```
bus data  [    4]              ty  vsched   volt     angle    ar zone  vmax   vmin   date_in date_out pid L own st  latitude  longitude
   38493 "ALMND115" 115.00  :  1 1.00000 1.030898   2.01703  30  324 1.1000 0.9000   400101   391231   0 0 337 0    0.00000    0.00000
   38544 "ALMCT2  "  13.80  :  2 1.01500 1.015000  10.30500  30  324 1.1000 0.9000   400101   391231   0 0 337 0    0.00000    0.00000
   38545 "ALMCT3  "  13.80  :  2 1.01500 1.015000  10.30500  30  324 1.1000 0.9000   400101   391231   0 0 337 0    0.00000    0.00000
   38546 "ALMCT4  "  13.80  :  2 1.01500 1.015000  10.30500  30  324 1.1000 0.9000   400101   391231   0 0 337 0    0.00000    0.00000
#
branch data  [    2]                                ck  se  long_id_    st resist   react   charge   rate1  rate2  rate3  rate4 aloss
lngth
  38493 "ALMND115" 115.00   38534 "GRAY115 " 115.00 "2 "  1 "        " :  1 0.00755 0.04689  0.00753  162.7  187.2  197.8  217.7 0.000
1.0 /
  30  324 0.0000 0.000 0.000   400101   391231   0 0  0    0.0    0.0    0.0    0.0 337 1.000   0 0.000   0 0.000   0 0.000   0 0.000
0 0.000   0 0.000   0 0.000  0
  38493 "ALMND115" 115.00   38534 "GRAY115 " 115.00 "1 "  1 "        " :  1 0.00755 0.04689  0.00753  162.7  187.2  197.8  217.7 0.000
1.0 /
  30  324 0.0000 0.000 0.000   400101   391231   0 0  0    0.0    0.0    0.0    0.0 337 1.000   0 0.000   0 0.000   0 0.000   0 0.000
0 0.000   0 0.000   0 0.000  0
#
transformer data  [   3]                              ck   long_id_    st ty --no---    reg_name          zt         int
tert              ar zone  tbase   ps_r    ps_x    pt_r    pt_x    ts_r    ts_x
   38493 "ALMND115" 115.00    38544 "ALMCT2  "  13.80 "1 " "        " :  1  1     38544 "ALMCT2  "  13.80   0   -1      "        "
000.00   -1      "        " 000.00   30  324   43.5 0.00240 0.12000 0.00000 0.00000 0.00000 0.00000 /
 115.00  13.50   0.00 0.0000 0.00000 0.00000   72.5   72.5   72.5   72.5 0.000 1.5000 0.5000 1.0500 0.9500 0.00625 1.0000 1.0000
1.0000 0.0000   400101   391231   0 0     0.0    0.0    0.0    0.0 /
 337 1.000   0 0.000   0 0.000   0 0.000   0 0.000   0 0.000   0 0.000   0 0.000  0 /
    0.0    0.0 0.0000 0.0000     0.0    0.0    0.0     0.0    0.0    0.0 0.000 0.000  0  0  0 0.0000 0.0000
   38493 "ALMND115" 115.00    38545 "ALMCT3  "  13.80 "1 " "        " :  1  1     38545 "ALMCT3  "  13.80   0   -1      "        "
000.00   -1      "        " 000.00   30  324   43.5 0.00240 0.12000 0.00000 0.00000 0.00000 0.00000 /
 115.00  13.50   0.00 0.0000 0.00000 0.00000   72.5   72.5   72.5   72.5 0.000 1.5000 0.5000 1.0500 0.9500 0.00625 1.0000 1.0000
1.0000 0.0000   400101   391231   0 0     0.0    0.0    0.0    0.0 /
 337 1.000   0 0.000   0 0.000   0 0.000   0 0.000   0 0.000   0 0.000   0 0.000  0 /
    0.0    0.0 0.0000 0.0000     0.0    0.0    0.0     0.0    0.0    0.0 0.000 0.000  0  0  0 0.0000 0.0000
   38493 "ALMND115" 115.00    38546 "ALMCT4  "  13.80 "1 " "        " :  1  1     38546 "ALMCT4  "  13.80   0   -1      "        "
000.00   -1      "        " 000.00   30  324   43.5 0.00240 0.12000 0.00000 0.00000 0.00000 0.00000 /
 115.00  13.50   0.00 0.0000 0.00000 0.00000   72.5   72.5   72.5   72.5 0.000 1.5000 0.5000 1.0500 0.9500 0.00625 1.0000 1.0000
1.0000 0.0000   400101   391231   0 0     0.0    0.0    0.0    0.0 /
 337 1.000   0 0.000   0 0.000   0 0.000   0 0.000   0 0.000   0 0.000   0 0.000  0 /
    0.0    0.0 0.0000 0.0000     0.0    0.0    0.0     0.0    0.0    0.0 0.000 0.000  0  0  0 0.0000 0.0000
#
generator data  [   3]     id   long_id_    st ---no--     reg_name       prf  qrf  ar zone   pgen   pmax   pmin   qgen   qmax   qmin
mbase   cmp_r cmp_x gen_r gen_x           hbus                    tbus           date_in date_out pid N
  38546 "ALMCT4  "  13.80 "1 " "        " :  1   38546 "ALMCT4  "  13.80  1.00 1.00  30  324   58.00   58.0  10.0    6.4   71.0    0.0
100.0000 0.000 0.000 0.000 0.000  -1      "       " 0.0   -1      "       " 0.0    400101   391231   0 0 /
 0.0000 0.0000 1.0000 337 1.000   0 0.000   0 0.000   0 0.000   0 0.000   0 0.000   0 0.000   0 0.000    0   0   0   1   0   0   0
0.0
  38545 "ALMCT3  "  13.80 "1 " "        " :  1   38545 "ALMCT3  "  13.80  1.00 1.00  30  324   58.00   58.0  10.0    6.4   71.0    0.0
100.0000 0.000 0.000 0.000 0.000  -1      "       " 0.0   -1      "       " 0.0    400101   391231   0 0 /
```

```
 0.0000 0.0000 1.0000 337 1.000   0 0.000   0 0.000   0 0.000   0 0.000   0 0.000   0 0.000   0 0.000    0   0   0   1   0   0   0
0.0
  38544 "ALMCT2  "  13.80 "1 " "        " :  1   38544 "ALMCT2  "  13.80  1.00 1.00  30  324   58.00   58.0  10.0    6.4   71.0    0.0
100.0000 0.000 0.000 0.000 0.000  -1      "       " 0.0   -1      "       " 0.0    400101   391231   0 0 /
 0.0000 0.0000 1.0000 337 1.000   0 0.000   0 0.000   0 0.000   0 0.000   0 0.000   0 0.000   0 0.000    0   0   0   1   0   0   0
0.0
#
load data  [   3]           id   long_id_     st      mw      mvar    mw_i    mvar_i  mw_z      mvar_z  ar zone  date_in date_out pid
N own
   38546 "ALMCT4  "  13.80 "ss" "        "  :  1    2.000    1.000    0.000    0.000    0.000    0.000  30  324   400101   391231   0
0 337
   38545 "ALMCT3  "  13.80 "ss" "        "  :  1    2.000    1.000    0.000    0.000    0.000    0.000  30  324   400101   391231   0
0 337
   38544 "ALMCT2  "  13.80 "ss" "        "  :  1    2.000    1.000    0.000    0.000    0.000    0.000  30  324   400101   391231   0
0 337
```

# Turlock Irrigation District
# Almond 2 Power Plant
# (09-AFC-2)

## Appendix 3

A2PP Dynamic Model
(GE PSDS Format)

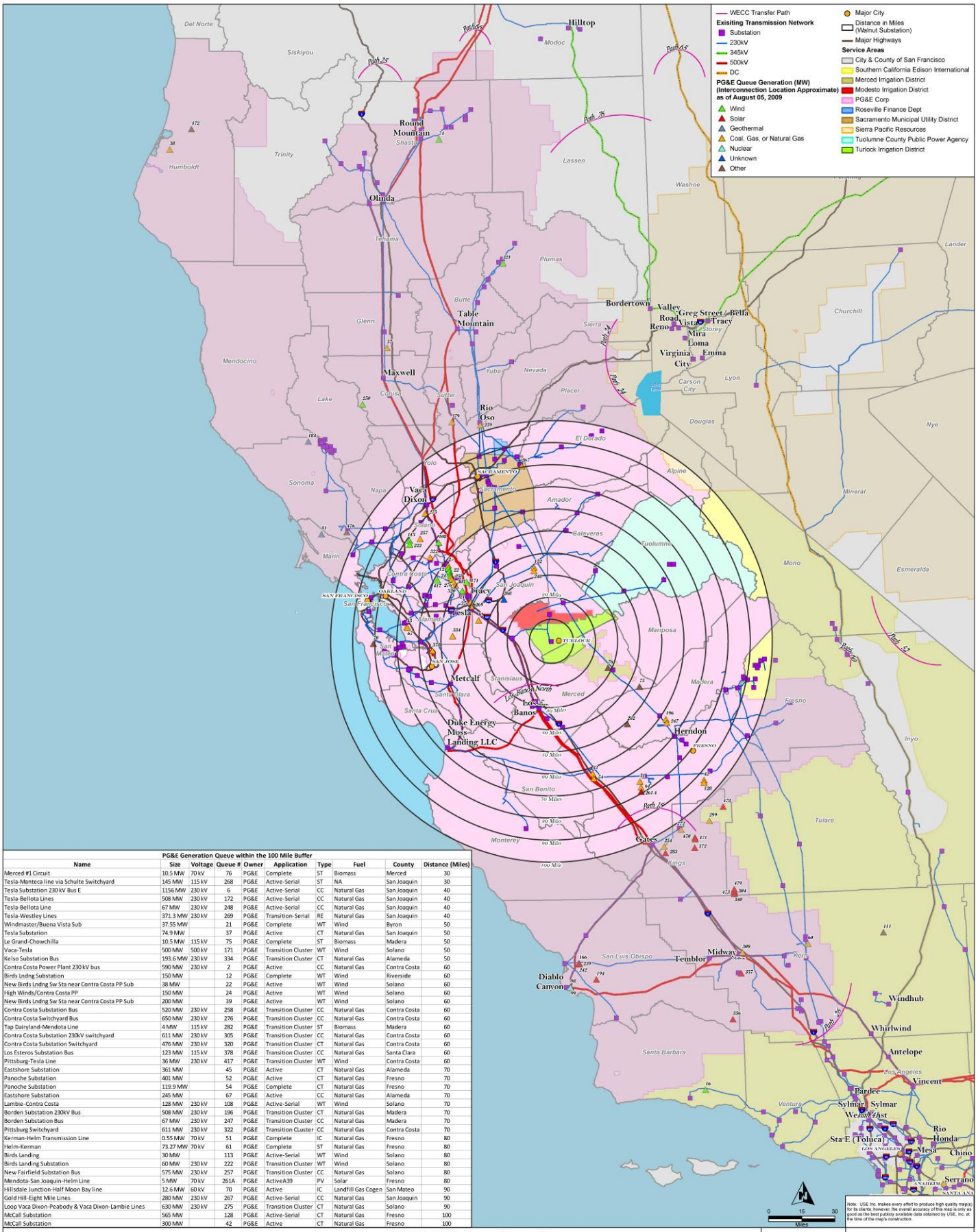
## A2PP Dynamic Model (GE PSDS Format)

```
genrou   38544 "ALMCT2  "  13.80 "1 " : #9 mva=60.000   7.00  0.03  0.75  0.05  2.40  0.00 2.10  2.00  0.20  0.50  0.18  0.15  0.05
0.30 0.00  0.0000 0.0000
exst4b   38544 "ALMCT2  "  13.80 "1 " : #9 0.02 3.15 3.15 0.02 1.00 -0.87 1.00 0.00 1.00 -0.87 0.0 6.50  0.0 0.0 0.08 0.0 8.00
ggov1    38544 "ALMCT2  "  13.80 "1 " : #9 0.0400 1.0 1.0 0.0500 -0.0500 10.0 2.0 0.0 1.0 1.0 0.1000 0.5000 1.5000 0.1500 0.5000 0.0
0.0 0.0 3.0 1.0 0.2 1.0 0.0 0.1 -0.1
pss2a    38544 "ALMCT2  "  13.80 "1 " : #9 1.0000 0.0000 3.0000 0.0000 2.0000 2.0000 2.0000 0.0000 0.0000 2.0000 0.41667 1.0000 1.0000
0.5000 0.1000 1.0000 5.0000 10.0000 0.2500 0.0400 0.2000 0.0300 0.1000 -0.1000
#
genrou   38545 "ALMCT3  "  13.80 "1 " : #9 mva=60.000   7.00  0.03  0.75  0.05  2.40  0.00 2.10  2.00  0.20  0.50  0.18  0.15  0.05
0.30 0.00  0.0000 0.0000
exst4b   38545 "ALMCT3  "  13.80 "1 " : #9 0.02 3.15 3.15 0.02 1.00 -0.87 1.00 0.00 1.00 -0.87 0.0 6.50  0.0 0.0 0.08 0.0 8.00
ggov1    38545 "ALMCT3  "  13.80 "1 " : #9 0.0400 1.0 1.0 0.0500 -0.0500 10.0 2.0 0.0 1.0 1.0 0.1000 0.5000 1.5000 0.1500 0.5000 0.0
0.0 0.0 3.0 1.0 0.2 1.0 0.0 0.1 -0.1
pss2a    38545 "ALMCT3  "  13.80 "1 " : #9 1.0000 0.0000 3.0000 0.0000 2.0000 2.0000 2.0000 0.0000 0.0000 2.0000 0.41667 1.0000 1.0000
0.5000 0.1000 1.0000 5.0000 10.0000 0.2500 0.0400 0.2000 0.0300 0.1000 -0.1000
#
genrou   38546 "ALMCT4  "  13.80 "1 " : #9 mva=60.000   7.00  0.03  0.75  0.05  2.40  0.00 2.10  2.00  0.20  0.50  0.18  0.15  0.05
0.30 0.00  0.0000 0.0000
exst4b   38546 "ALMCT4  "  13.80 "1 " : #9 0.02 3.15 3.15 0.02 1.00 -0.87 1.00 0.00 1.00 -0.87 0.0 6.50  0.0 0.0 0.08 0.0 8.00
ggov1    38546 "ALMCT4  "  13.80 "1 " : #9 0.0400 1.0 1.0 0.0500 -0.0500 10.0 2.0 0.0 1.0 1.0 0.1000 0.5000 1.5000 0.1500 0.5000 0.0
0.0 0.0 3.0 1.0 0.2 1.0 0.0 0.1 -0.1
pss2a    38546 "ALMCT4  "  13.80 "1 " : #9 1.0000 0.0000 3.0000 0.0000 2.0000 2.0000 2.0000 0.0000 0.0000 2.0000 0.41667 1.0000 1.0000
0.5000 0.1000 1.0000 5.0000 10.0000 0.2500 0.0400 0.2000 0.0300 0.1000 -0.1000
```

**Turlock Irrigation District**
**Almond 2 Power Plant**
**(09-AFC-2)**

# Appendix 4

CAISO Generation Queue
(PG&E Area Map)




**PG&E Generation Queue within the 100 Mile Buffer**

| Name | Size | Voltage | Queue # | Owner | Application | Type | Fuel | County | Distance (Miles) |
|---|---|---|---|---|---|---|---|---|---|
| Merced #1 Circuit | 10.5 MW | 70 kV | 76 | PG&E | Complete | ST | Biomass | Merced | 30 |
| Tesla-Manteca line via Schulte Switchyard | 145 MW | 115 kV | 268 | PG&E | Active-Serial | ST | NA | San Joaquin | 30 |
| Tesla Substation 230 kV Bus E | 1156 MW | 230 kV | 6 | PG&E | Active-Serial | CC | Natural Gas | San Joaquin | 40 |
| Tesla-Bellota Lines | 508 MW | 230 kV | 172 | PG&E | Active-Serial | CC | Natural Gas | San Joaquin | 40 |
| Tesla-Bellota Line | 67 MW | 230 kV | 248 | PG&E | Active-Serial | CC | Natural Gas | San Joaquin | 40 |
| Tesla-Westley Lines | 371.3 MW | 230 kV | 269 | PG&E | Transition-Serial | RE | Natural Gas | San Joaquin | 40 |
| Windmaster/Buena Vista Sub | 37.55 MW | | 21 | PG&E | Complete | WT | Wind | Byron | 50 |
| Tesla Substation | 74.9 MW | | 37 | PG&E | Active | CT | Natural Gas | San Joaquin | 50 |
| Le Grand-Chowchilla | 10.5 MW | 115 kV | 75 | PG&E | Complete | ST | Biomass | Madera | 50 |
| Vaca-Tesla | 500 MW | 500 kV | 171 | PG&E | Transition Cluster | WT | Wind | Solano | 50 |
| Kelso Substation Bus | 193.6 MW | 230 kV | 334 | PG&E | Transition Cluster | CT | Natural Gas | Alameda | 50 |
| Contra Costa Power Plant 230 kV bus | 590 MW | 230 kV | 2 | PG&E | Active | CC | Natural Gas | Contra Costa | 60 |
| Birds Lndng Substation | 150 MW | | 12 | PG&E | Complete | WT | Wind | Riverside | 60 |
| New Birds Lndng Sw Sta near Contra Costa PP Sub | 38 MW | | 22 | PG&E | Active | WT | Wind | Solano | 60 |
| High Winds/Contra Costa PP | 150 MW | | 24 | PG&E | Active | WT | Wind | Solano | 60 |
| New Birds Lndng Sw Sta near Contra Costa PP Sub | 200 MW | | 39 | PG&E | Active | WT | Wind | Solano | 60 |
| Contra Costa Substation Bus | 520 MW | 230 kV | 258 | PG&E | Transition Cluster | CC | Natural Gas | Contra Costa | 60 |
| Contra Costa Switchyard Bus | 650 MW | 230 kV | 276 | PG&E | Transition Cluster | CC | Natural Gas | Contra Costa | 60 |
| Tap Dairyland-Mendota Line | 4 MW | 115 kV | 282 | PG&E | Transition Cluster | ST | Biomass | Madera | 60 |
| Contra Costa Substation 230kV switchyard | 611 MW | 230 kV | 305 | PG&E | Transition Cluster | CC | Natural Gas | Contra Costa | 60 |
| Contra Costa Substation Switchyard | 476 MW | 230 kV | 320 | PG&E | Transition Cluster | CT | Natural Gas | Contra Costa | 60 |
| Los Esteros Substation Bus | 123 MW | 115 kV | 378 | PG&E | Transition Cluster | CC | Natural Gas | Santa Clara | 60 |
| Pittsburg-Tesla Line | 36 MW | 230 kV | 417 | PG&E | Transition Cluster | WT | Wind | Contra Costa | 60 |
| Eastshore Substation | 361 MW | | 45 | PG&E | Active | CT | Natural Gas | Alameda | 70 |
| Panoche Substation | 401 MW | | 52 | PG&E | Active | CT | Natural Gas | Fresno | 70 |
| Panoche Substation | 119.9 MW | | 54 | PG&E | Complete | CT | Natural Gas | Fresno | 70 |
| Eastshore Substation | 245 MW | | 67 | PG&E | Active | CC | Natural Gas | Alameda | 70 |
| Lambie-Contra Costa | 128 MW | 230 kV | 108 | PG&E | Active-Serial | WT | Wind | Solano | 70 |
| Borden Substation 230kV Bus | 508 MW | 230 kV | 196 | PG&E | Transition Cluster | CT | Natural Gas | Madera | 70 |
| Borden Substation Bus | 67 MW | 230 kV | 247 | PG&E | Transition Cluster | CC | Natural Gas | Madera | 70 |
| Pittsburg Switchyard | 611 MW | 230 kV | 322 | PG&E | Transition Cluster | CC | Natural Gas | Contra Costa | 70 |
| Kerman-Helm Transmission Line | 0.55 MW | 70 kV | 51 | PG&E | Complete | IC | Natural Gas | Fresno | 80 |
| Helm-Kerman | 73.27 MW | 70 kV | 61 | PG&E | Complete | ST | Natural Gas | Fresno | 80 |
| Birds Landing | 30 MW | | 113 | PG&E | Active-Serial | WT | Wind | Solano | 80 |
| Birds Landing Substation | 60 MW | 230 kV | 222 | PG&E | Transition Cluster | WT | Wind | Solano | 80 |
| New Fairfield Substation Bus | 575 MW | 230 kV | 257 | PG&E | Transition Cluster | CC | Natural Gas | Solano | 80 |
| Mendota-San Joaquin-Helm Line | 5 MW | 70 kV | 261A | PG&E | ActiveA39 | PV | Solar | Fresno | 80 |
| Hillsdale Junction-Half Moon Bay line | 12.6 MW | 60 kV | 70 | PG&E | Active | IC | Landfill Gas Cogen | San Mateo | 90 |
| Gold Hill-Eight Mile Lines | 280 MW | 230 kV | 267 | PG&E | Active-Serial | CC | Natural Gas | San Joaquin | 90 |
| Loop Vaca Dixon-Peabody & Vaca Dixon-Lambie Lines | 630 MW | 230 kV | 275 | PG&E | Transition Cluster | CT | Natural Gas | Solano | 90 |
| McCall Substation | 565 MW | | 128 | PG&E | Active-Serial | CT | Natural Gas | Fresno | 100 |
| McCall Substation | 300 MW | | 42 | PG&E | Active | CT | Natural Gas | Fresno | 100 |

# CAISO Generation Queue
# PG&E Area

# Turlock Irrigation District
# Almond 2 Power Plant
# (09-AFC-2)

## Appendix 5

Transmission Infrastructure Project Modeling
(CAISO/PG&E Approved Projects)

## Transmission Infrastructure Project Modeling (CAISO/PG&E Approved Projects)

| No. | Project Name | Date |
|---|---|---|
| 1 | Herndon-Bullard 115 kV Re-conductor | In-service |
| 2 | Kasson-Lammers 115 kV Re-conductor | In-service |
| 3 | Lone Tree Substation | In-service |
| 4 | McCall 230/115 kV Transformer Replacement | In-service |
| 5 | Metcalf - El Patio 115 kV Re-conductor | In-service |
| 6 | Monta Vista 115/60 kV Transformer | In-service |
| 7 | Newark - Fremont 115 kV Re-conductor | In-service |
| 8 | Palermo 230/115 kV Transformer | In-service |
| 9 | Stagg 230/60 kV Transformers | In-service |
| 10 | Templeton - Atascadero 70 kV Re-conductor | In-service |
| 11 | Weber #1 60 kV Line | In-service |
| 12 | Humboldt - Harris 60 kV Re-conductor | In-service |
| 13 | Martin 115/60 kV Transformer Replacement | In-service |
| 14 | Metcalf-Moss Landing 230 kV Re-conductor | In-service |
| 15 | Merced 115 kV Bus Re-conductor | In-service |
| 16 | Plainfield Substation Capacity Increase | In-service |
| 17 | Live Oak Substation Capacity Increase | In-service |
| 18 | Plumas Substation Capacity Increase | In-service |
| 19 | Davis 115 kV Circuit Breaker | In-service |
| 20 | Martin-Hunters Point 115 kV Cable | 2009 |
| 21 | Gold Hill - Clarksville 115 kV Line Re-conductor | 2009 |
| 22 | Lakeville 230/60 kV Transformer Capacity Increase | 2009 |
| 23 | Pease-Marysville 60 kV Line | 2009 |
| 24 | Potrero Bus Parallel Circuit Breaker Project | 2009 |
| 25 | Humboldt Reactive Support | 2009 |
| 26 | West Sacramento-Brighton 115 kV Re-conductor | 2009 |
| 27 | Brighton 230/115 kV Transformer Replacement | 2009 |
| 28 | Placer - Horseshoe 115 kV Reinforcement Project | 2009 |
| 29 | Brighton 230/115 kV Transformer Replacement | 2009 |
| 30 | Moss Landing - Salinas - Soledad 115 kV Re-conductor | 2009 |
| 31 | Larkin Circuit Breaker No. 192 | 2009 |
| 32 | Mesa (DCPP ) 230 kV Shunt Capacitors | 2010 |
| 33 | Glass - Madera 70 kV Reconfiguration (Borden - Madera 70 kV new line) | 2010 |
| 34 | Hollister 115 kV Re-conductor | 2010 |
| 35 | West Point - Valley Springs 60 kV Line | 2010 |
| 36 | Gregg 230 kV Reactor | 2010 |
| 37 | Mendocino Coast Reactive Support | 2010 |
| 38 | Oakland Underground Cable | 2010 |
| 39 | Pittsburg - Tesla 230 kV Re-conductor | 2010 |
| 40 | Menlo 60 kV Switch Upgrade (Menlo Area 60 kV System Upgrade) | 2010 |
| 41 | Stone Substation Capacity Increase | 2010 |
| 42 | 7th Standard Substation Capacity Increase | 2010 |
| 43 | Newark - Ravenswood 230 kV Line | 2010 |
| 44 | Contra Costa - Las Positas 230 kV Line | 2010 |
| 45 | Tesla 115 kV Capacity Increase | 2010 |
| 46 | Atlantic - Lincoln Transmission | 2010 |
| 47 | Crazy Horse Switching Station | 2010 |
| 48 | Palermo - Rio Oso 115 kV Line Re-conductor | 2010 |
| 49 | South of Birds Landing 230 kV Re-conductor | 2010 |
| 50 | Humboldt 115/60 kV Transformer Replacements | 2010 |
| 51 | Lakeville No. 2 60 kV Switch Upgrade | 2010 |
| 52 | Palermo 115 kV Circuit Breaker & Switch Replacement | 2010 |
| 53 | Carbona Reliability | 2010 |
| 54 | Kyoho Manufacturing California 115 kV Interconnection | 2010 |
| 55 | Lodi-industrial 60 kV Line Switch Upgrade Project | 2010 |
| 56 | Salado-Newman 60 kV Line #2 Re-conductor | 2010 |
| 57 | Country Club 60 kV Bus Upgrade | 2010 |
| 58 | Menlo Area 60 kV System Upgrade | 2010 |
| 59 | Daly City Bus Reconfiguration | 2010 |
| 60 | Tri-Valley Voltage Control | 2010 |
| 61 | San Mateo-Bair 60 kV Line Re-conductor | 2010 |
| 62 | Occidental of Elk Hills 230 kV Interconnection Project | 2010 |
| 63 | Del Monte - Fort Ord 60 kV Reinforcement Project | 2010 |
| 64 | Burns Reliability Project | 2010 |

| No. | Project Name | Date |
|---|---|---|
| 65 | Lakeville - Ignacio #2 230 kV Line Project | 2011 |
| 66 | Bay Meadows 115 kV Re-conductor | 2011 |
| 67 | Contra Costa - Moraga 230 kV Line Re-conductor | 2011 |
| 68 | Half Moon Bay Reactive Support | 2011 |
| 69 | Moraga Transformer Capacity Increase | 2011 |
| 70 | Cortina 60 kV Reliability | 2011 |
| 71 | Pittsburg 230/115 kV Transformer Capacity Increase | 2011 |
| 72 | Soledad 115/60 kV Transformer Capacity | 2011 |
| 73 | South of San Mateo Capacity Increase | 2011 |
| 74 | Tesla-Newark 230 kV Path Upgrade | 2011 |
| 75 | Cooley Landing 115/60 kV Transformer Capacity Upgrade | 2011 |
| 76 | Table Mountain - Rio Oso 230 kV Line Re-conductor and Tower Raises | 2011 |
| 77 | West Fresno Reactive  Support (Sanger - California Ave 70 kV to 115 kV Voltage Conversion) | 2011 |
| 78 | Wheeler Ridge 230/70 kV Transformer | 2011 |
| 79 | East Nicolaus 115 kV Area Reinforcement | 2011 |
| 80 | Missouri Flat - Gold Hill 115 kV Line | 2011 |
| 81 | Vaca Dixon - Birds Landing 230 kV Re-conductor | 2011 |
| 82 | Maple Creek Reactive Support | 2011 |
| 83 | Garberville Reactive Support | 2011 |
| 84 | Gold Hill-Horseshoe 115 kV Reinforcement | 2011 |
| 85 | San Justo Substation Interconnection | 2011 |
| 86 | Guernsey-Henrietta 70 kV Line Re-conductor Project | 2011 |
| 87 | Herndon 115 kV Circuit Breaker Replacement Project | 2011 |
| 88 | Herndon 230/115 kV Transformer Project | 2011 |
| 89 | Sanger-Reedley 70 kV to 115 kV Conversion Project | 2011 |
| 90 | Sanger-California Ave 70 kV to 115 kV Voltage Conversion Project | 2011 |
| 91 | Sheperd Substation | 2011 |
| 92 | Rio Oso 230/115 kV Transformer Upgrades | 2012 |
| 93 | Monta Vista - Los Altos 60 kV Re-conductor | 2012 |
| 94 | Metcalf-Evergreen 115 kV | 2012 |
| 95 | Metcalf-Piercy & Swift and Newark-Dixon Landing 115 kV Upgrade | 2012 |
| 96 | Clear Lake 60 kV System Reinforcement | 2012 |
| 97 | Valley Spring 230/60 kV Transmission Addition | 2012 |
| 98 | Evergreen-Mabury 60 kV to 115 kV conversion | 2012 |
| 99 | Ravenswood-Cooley Landing 115 kV line Re-conductor | 2012 |
| 100 | Midway-Renfro 115 kV Re-conductor | 2012 |
| 101 | Natividad Substation Interconnection | 2012 |
| 102 | Caruthers - Kingsburg 70kV | 2012 |

**Turlock Irrigation District**
**Almond 2 Power Plant**
**(09-AFC-2)**

# Appendix 6

NERC/WECC Transmission Systems Standards
Normal & Contingency Conditions

**Table I. NERC/WECC Transmission Systems Standards Normal & Contingency Conditions**

| Category | Contingencies | Elements Out of Service | System Limits or Impacts | | | | |
|---|---|---|---|---|---|---|---|
| | Initiating Event(s) and Contingency Element(s) | | Thermal Limits | Voltage Limits | System Stable | Loss of Demand or Curtailed Firm Transfers | Cascading [c] Outages |
| A – No Contingencies | All Facilities in Service | None | Applicable Rating [a] (A/R) | Applicable Rating [a] (A/R) | Yes | No | No |
| B – Event resulting in the loss of a single element. | Single Line Ground (SLG) or 3-Phase (3Ø) Fault, with Normal Clearing: | | | | | | |
| | 1. Generator | Single | A/R | A/R | Yes | No [b] | No |
| | 2. Transmission Circuit | Single | A/R | A/R | Yes | No [b] | No |
| | 3. Transformer | Single | A/R | A/R | Yes | No [b] | No |
| | 4. Loss of an Element without a Fault | Single | A/R | A/R | Yes | No [b] | No |
| | Single Pole Block, Normal Clearing [f]: | | | | | | |
| | 5. Single Pole (dc) Line | Single | A/R | A/R | Yes | No [b] | No |
| C – Event(s) resulting in the loss of two or more (multiple) elements. | SLG Fault, with Normal Clearing [f]: | | | | | | |
| | 1. Bus Section | Multiple | A/R | A/R | Yes | Planned/Controlled [d] | No |
| | 2. Breaker (failure or internal fault) | Multiple | A/R | A/R | Yes | Planned/Controlled [d] | No |
| | SLG or 3Ø Fault, with Normal Clearing [f], Manual System Adjustments, followed by another SLG or 3Ø Fault, with Normal Clearing [f]: 3. Category B (B1, B2, B3, or B4) contingency, manual system adjustments, followed by another Category B (B1, B2, B3, or B4) contingency | Multiple | A/R | A/R | Yes | Planned/Controlled [d] | No |
| | Bipolar Block, with Normal Clearing [f]: | | | | | | |
| | 4. Bipolar (dc) Line | Multiple | A/R | A/R | Yes | Planned/Controlled [d] | No |
| | Fault (non 3Ø), with Normal Clearing [f]: | | | | | | |
| | 5. Double Circuit Towerline [g] | Multiple | A/R | A/R | Yes | Planned/Controlled [d] | No |
| | SLG Fault, with Delayed Clearing [f] (stuck breaker or protection system failure): | | | | | | |
| | 6. Generator | Multiple | A/R | A/R | Yes | Planned/Controlled [d] | No |
| | 7. Transmission Circuit | Multiple | A/R | A/R | Yes | Planned/Controlled [d] | No |
| | 8. Transformer | Multiple | A/R | A/R | Yes | Planned/Controlled [d] | No |
| | 9. Bus Section | Multiple | A/R | A/R | Yes | Planned/Controlled [d] | No |

| Category | Contingencies | Elements Out of Service | System Limits or Impacts | | | | |
|---|---|---|---|---|---|---|---|
| | Initiating Event(s) and Contingency Element(s) | | Thermal Limits | Voltage Limits | System Stable | Loss of Demand or Curtailed Firm Transfers | Cascading [c] Outages |
| D [e] – Extreme event resulting in two or more (multiple) elements removed or cascading out of service | 3Ø Fault, with Delayed Clearing [f] (stuck breaker or protection system failure):<br>1. Generator<br>2. Transmission Circuit<br>3. Transformer<br>4. Bus Section<br>3Ø Fault, with Normal Clearing [f]:<br>5. Breaker (failure or internal fault) | Evaluate for risks and consequences.<br>• May involve substantial loss of customer demand and generation in a widespread area or areas.<br>• Portions or all of the interconnected systems may or may not achieve a new, stable operating point.<br>• Evaluation of these events may require joint studies with neighboring systems. | | | | | |
| | Other:<br>6. Loss of towerline with three or more circuits<br>7. All transmission lines on a common right-of way<br>8. Loss of a substation (one voltage level plus transformers)<br>9. Loss of a switching station (one voltage level plus transformers)<br>10. Loss of all generating units at a station<br>11. Loss of a large load or major load center<br>12. Failure of a fully redundant special protection system (or remedial action scheme) to operate when required<br>13. Operation, partial operation, or misoperation of a fully redundant special protection system (or remedial action scheme) for an event or condition for which it was not intended to operate<br>14. Impact of severe power swings or oscillations from disturbances in another Regional Council. | | | | | | |

***Footnotes to Table I.***[3]

*a) Applicable rating (A/R) refers to the applicable normal and emergency facility thermal rating or system voltage limit as determined and consistently applied by the system or facility owner. Applicable ratings may include emergency ratings applicable for short durations as required to permit operating steps necessary to maintain system control. All ratings must be established consistent with applicable NERC Planning Standards addressing facility ratings.*

[3] Table I taken from the NERC/WECC Planning Standards document approved by the Planning Coordination Committee (PCC) at its June 27-28, 2002 meeting. Approved by the Board of Directors at its August 8-9, 2002 meeting.

b) *Planned or controlled interruption of electric supply to radial customers or some local network customers, connected to or supplied by the faulted element or by the affected area, may occur in certain areas without impacting the overall security of the interconnected transmission systems. To prepare for the next contingency, system adjustments are permitted, including curtailments of contracted firm (non-recallable reserved) electric power transfers.*

c) *Cascading is the uncontrolled successive loss of system elements triggered by an incident at any location. Cascading results in widespread service interruption, which cannot be restrained from sequentially spreading beyond an area predetermined by appropriate studies.*

d) *Depending on system design and expected system impacts, the controlled interruption of electric supply to customers (load shedding), the planned removal from service of certain generators, and/or the curtailment of contracted firm (non-recallable reserved) electric power transfers may be necessary to maintain the overall security of the interconnected transmission systems.*

e) *A number of extreme contingencies that are listed under Category D and judged to be critical by the transmission planning entity (or entities) will be selected for evaluation. It is not expected that all possible facility outages under each listed contingency of Category D will be evaluated.*

f) *Normal clearing is when the protection system operates as designed and the fault is cleared in the time normally expected with proper functioning of the installed protection systems. Delayed clearing of a fault is due to failure of any protection system component such as a relay, circuit breaker, or current transformer (CT), and not because of an intentional design delay.*

g) *System assessments may exclude these events where multiple circuit towers are used over short distances (e.g., station entrance, river crossings) in accordance with Regional exemption criteria*

# Turlock Irrigation District
# Almond 2 Power Plant
# (09-AFC-2)

## Appendix 7

Contingency (Outage) List

## Contingency (Outage) List

| Outage Number | WECC/NERC Category | Outage Description |
|---|---|---|
| 10000 | A | N-0 All Elements in Service |
| 20000 | B1 | Almond CT Out |
| 20001 | B1 | Almond Unit #2 Out |
| 20002 | B1 | Almond Unit #3 Out |
| 20003 | B1 | Almond Unit #4 Out |
| 20004 | B1 | Don Pedro Unit #1 Out |
| 20005 | B1 | Don Pedro Unit #2 Out |
| 20006 | B1 | Don Pedro Unit #4 Out |
| 20007 | B1 | Walnut CT Unit #1 Out |
| 20008 | B1 | Walnut CT Unit #2 Out |
| 20009 | B1 | WEC Unit #1 Out |
| 20010 | B1 | WEC Unit #2 Out |
| 20011 | B1 | WEC Unit #3 Out |
| 20012 | B1 | Moccasin Unit #1 Out |
| 20013 | B1 | Moccasin Unit #2 Out |
| 20014 | B1 | Don Pedro Unit #3 Out |
| 20015 | B1 | McClure Unit #1 Out |
| 20016 | B1 | McClure Unit #2 Out |
| 20017 | B1 | New Hogan Dam Unit #1 Out |
| 20018 | B1 | New Hogan Dam Unit #2 Out |
| 20019 | B1 | Ripon Unit #1 Out |
| 20020 | B1 | Ripon Unit #2 Out |
| 20021 | B1 | Woodland MID Out |
| 20022 | B1 | Woodland MID II Out |
| 30000 | B2 | Westley-Walnut 230 kV Line Out |
| 30001 | B2 | Westley-Parker 230 kV Line Out |
| 30002 | B2 | Walnut-Parker 230 kV Line Out |
| 30003 | B2 | Westley-Tracy #1 230 kV Line Out |
| 30004 | B2 | Westley-Tracy #2 230 kV Line Out |
| 30005 | B2 | Tuolumne-Oakdale #1 115 kV Line Out |
| 30006 | B2 | Tuolumne-Oakdale #2 115 kV Line Out |
| 30007 | B2 | Tuolumne-Pioneer 115 kV Line Out |
| 30008 | B2 | Pioneer-Castle 115 kV Line Out |
| 30009 | B2 | Castle-Cooper 115 kV Line Out |
| 30010 | B2 | Cooper-Pioneer 115 kV Line Out |
| 30011 | B2 | Pioneer-August 115 kV Line Out |
| 30012 | B2 | August-Walnut 115 kV Line Out |
| 30013 | B2 | Walnut-WEC 115 kV Line Out |
| 30014 | B2 | WEC-Hilmar 115 kV Line Out |
| 30015 | B2 | Hilmar-Cortez 115 kV Line Out |
| 30016 | B2 | Cortez-Taylor 115 kV Line Out |
| 30017 | B2 | Hughson-Tuolumne 115 kV Line Out |
| 30018 | B2 | Westley-Marshall 115 kV Line Out |
| 30019 | B2 | Marshall-Walnut 115 kV Line Out |
| 30020 | B2 | Walnut-Rogers 115 kV Line Out |
| 30021 | B2 | Rogers-Westley 115 kV Line Out |
| 30022 | B2 | Grayson-Taylor 115 kV Line Out |
| 30023 | B2 | Grayson-Hughson 115 kV Line Out |
| 30024 | B2 | Grayson-Almond #1 115 kV Line Out |
| 30025 | B2 | Grayson-Almond #2 115 kV Line Out |
| 30026 | B2 | Newark-Moccasin #3 115 kV Line Out |
| 30027 | B2 | Newark-Moccasin #4 115 kV Line Out |
| 30028 | B2 | Westley-Rosemore #1 230 kV Line Out |
| 30029 | B2 | Westley-Rosemore #2 230 kV Line Out |
| 30030 | B2 | Claus-Huntwstp 115 kV Line Out |
| 30031 | B2 | Claus-McClure 115 kV Line Out |
| 30032 | B2 | Claus-Standiford 115 kV Line Out |
| 30033 | B2 | Huntwstp-Hershey 115 kV Line Out |
| 30034 | B2 | McClure-Santa Cruz 115 kV Line Out |
| 30035 | B2 | Santa Cruz-Standiford 115 kV Line Out |
| 30036 | B2 | Warnerville-Standiford #1 115 kV Line Out |
| 30037 | B2 | Warnerville-Standiford #2 115 kV Line Out |
| 30038 | B2 | Westley-Tesla 230 kV Line Out |

| Outage Number | WECC/NERC Category | Outage Description |
|---|---|---|
| 30039 | B2 | Westley-Los Banos 230 kV Line Out |
| 30040 | B2 | Tracy-Tesla #1 500 kV Line Out |
| 30041 | B2 | Los Banos-Gates #1 500 kV Line Out |
| 30042 | B2 | Los Banos-Gates #3 500 kV Line Out |
| 30043 | B2 | Los Banos-Tracy 500 kV Line Out |
| 30044 | B2 | Los Banos-Tesla 500 kV Line Out |
| 30045 | B2 | Los Banos-Moss Landing 500 kV Line Out |
| 30046 | B2 | Los Banos-Midway 500 kV Line Out |
| 30047 | B2 | Walnut-Commons 69 kV Line Out |
| 30048 | B2 | Commons-Westport 69 kV Line Out |
| 30049 | B2 | Gilstrap-Grayson 69 kV Line Out |
| 30050 | B2 | Grayson-Westport 69 kV Line Out |
| 30051 | B2 | Grayson-Almond 69 kV Line Out |
| 30052 | B2 | Gilstrap-Almond 69 kV Line Out |
| 30053 | B2 | Almond-Crows Landing 69 kV Line Out |
| 30054 | B2 | Crows Landing-Ceres 69 kV Line Out |
| 30055 | B2 | Ceres-Tuolumne 69 kV Line Out |
| 30056 | B2 | Ceres-Roeding 69 kV Line Out |
| 30057 | B2 | Roeding-Tuolumne 69 kV Line Out |
| 30058 | B2 | Walnut-Fairground 69 kV Line Out |
| 30059 | B2 | Fairground-College-Geer 69 kV Line Out |
| 30060 | B2 | Geer-Montpellier Tap 69 kV Line Out |
| 30061 | B2 | Geer-Tuolumne 69 kV Line Out |
| 30062 | B2 | Walnut-Industrial 69 kV Line Out |
| 30063 | B2 | Walnut-WEC 69 kV Line Out |
| 30064 | B2 | WEC-Industrial 69 kV Line Out |
| 30065 | B2 | Industrial-South Turlock 69 kV Line Out |
| 30066 | B2 | South Turlock-F Street 69 kV Line Out |
| 30067 | B2 | F Street-Montpellier Tap 69 kV Line Out |
| 30068 | B2 | Montpellier-Montpellier Tap 69 kV Line Out |
| 30069 | B2 | Montpellier-Tuolumne 69 kV Line Out |
| 30070 | B2 | Montpellier-Geer-F Street 3-Terminal 69 kV Line Out |
| 30071 | B2 | Don Pedro-Tuolumne #1 69 kV Line Out |
| 30072 | B2 | Don Pedro-Tuolumne #2 69 kV Line Out |
| 30073 | B2 | Don Pedro-Hawkins 69 kV Line Out |
| 30074 | B2 | Hawkins-Geer 69 kV Line Out |
| 40000 | B3 | Walnut 230/115 kV Transformer #1 Out |
| 40001 | B3 | Westley 230/115 kV Transformer #1 Out |
| 40002 | B3 | Westley 230/115 kV Transformer #2 Out |
| 40003 | B3 | Grayson 115/69 kV Transformer Out |
| 40004 | B3 | Warnerville 230/115 kV Transformer #1 Out |
| 40005 | B3 | Warnerville 230/115 kV Transformer #2 Out |
| 40006 | B3 | Warnerville 230/115 kV Transformer #3 Out |
| 40007 | B3 | Tesla 500/230 kV Transformer #2 Out |
| 40008 | B3 | Tesla 500/230 kV Transformer #4 Out |
| 40009 | B3 | Tesla 500/230 kV Transformer #6 Out |
| 40010 | B3 | Tracy 500/230 kV Transformer #1 Out |
| 40011 | B3 | Tracy 500/230 kV Transformer #2 Out |
| 40012 | B3 | Los Banos 500/230 kV Transformer #1 Out |
| 40013 | B3 | Walnut 230/69 kV Transformer #1 Out |
| 40014 | B3 | Walnut 230/69 kV Transformer #2 Out |
| 40015 | B3 | Tuolumne 115/69 kV Transformer #1 Out |
| 40016 | B3 | Tuolumne 115/69 kV Transformer #2 Out |
| 50000 | CAISO B | WEC Unit #2 Out & Westley-Walnut 230 kV Line Out |
| 50001 | CAISO B | WEC Unit #2 Out & Westley-Parker 230 kV Line Out |
| 50002 | CAISO B | WEC Unit #2 Out & Walnut-Parker 230 kV Line Out |
| 50003 | CAISO B | WEC Unit #2 Out & Westley-Tracy #1 230 kV Line Out |
| 50004 | CAISO B | WEC Unit #2 Out & Westley-Tracy #2 230 kV Line Out |
| 50005 | CAISO B | WEC Unit #2 Out & Tuolumne-Oakdale #1 115 kV Line Out |
| 50006 | CAISO B | WEC Unit #2 Out & Tuolumne-Oakdale #2 115 kV Line Out |
| 50007 | CAISO B | WEC Unit #2 Out & Tuolumne-Pioneer 115 kV Line Out |
| 50008 | CAISO B | WEC Unit #2 Out & Pioneer-Castle 115 kV Line Out |
| 50009 | CAISO B | WEC Unit #2 Out & Castle-Cooper 115 kV Line Out |
| 50010 | CAISO B | WEC Unit #2 Out & Cooper-Pioneer 115 kV Line Out |

| Outage Number | WECC/NERC Category | Outage Description |
|---|---|---|
| 50011 | CAISO B | WEC Unit #2 Out & Pioneer-August 115 kV Line Out |
| 50012 | CAISO B | WEC Unit #2 Out & August-Walnut 115 kV Line Out |
| 50013 | CAISO B | WEC Unit #2 Out & Walnut-WEC 115 kV Line Out |
| 50014 | CAISO B | WEC Unit #2 Out & WEC-Hilmar 115 kV Line Out |
| 50015 | CAISO B | WEC Unit #2 Out & Hilmar-Cortez 115 kV Line Out |
| 50016 | CAISO B | WEC Unit #2 Out & Cortez-Taylor 115 kV Line Out |
| 50017 | CAISO B | WEC Unit #2 Out & Hughson-Tuolumne 115 kV Line Out |
| 50018 | CAISO B | WEC Unit #2 Out & Westley-Marshall 115 kV Line Out |
| 50019 | CAISO B | WEC Unit #2 Out & Marshall-Walnut 115 kV Line Out |
| 50020 | CAISO B | WEC Unit #2 Out & Walnut-Rogers 115 kV Line Out |
| 50021 | CAISO B | WEC Unit #2 Out & Rogers-Westley 115 kV Line Out |
| 50022 | CAISO B | WEC Unit #2 Out & Grayson-Taylor 115 kV Line Out |
| 50023 | CAISO B | WEC Unit #2 Out & Grayson-Hughson 115 kV Line Out |
| 50024 | CAISO B | WEC Unit #2 Out & Grayson-Almond #1 115 kV Line Out |
| 50025 | CAISO B | WEC Unit #2 Out & Grayson-Almond #2 115 kV Line Out |
| 50026 | CAISO B | WEC Unit #2 Out & Newark-Moccasin #3 115 kV Line Out |
| 50027 | CAISO B | WEC Unit #2 Out & Newark-Moccasin #4 115 kV Line Out |
| 50028 | CAISO B | WEC Unit #2 Out & Westley-Rosemore #1 230 kV Line Out |
| 50029 | CAISO B | WEC Unit #2 Out & Westley-Rosemore #2 230 kV Line Out |
| 50030 | CAISO B | WEC Unit #2 Out & Claus-Huntwstp 115 kV Line Out |
| 50031 | CAISO B | WEC Unit #2 Out & Claus-McClure 115 kV Line Out |
| 50032 | CAISO B | WEC Unit #2 Out & Claus-Standiford 115 kV Line Out |
| 50033 | CAISO B | WEC Unit #2 Out & Huntwstp-Hershey 115 kV Line Out |
| 50034 | CAISO B | WEC Unit #2 Out & McClure-Santa Cruz 115 kV Line Out |
| 50035 | CAISO B | WEC Unit #2 Out & Santa Cruz-Standiford 115 kV Line Out |
| 50036 | CAISO B | WEC Unit #2 Out & Warnerville-Standiford #1 115 kV Line Out |
| 50037 | CAISO B | WEC Unit #2 Out & Warnerville-Standiford #2 115 kV Line Out |
| 50038 | CAISO B | WEC Unit #2 Out & Westley-Tesla 230 kV Line Out |
| 50039 | CAISO B | WEC Unit #2 Out & Westley-Los Banos 230 kV Line Out |
| 50040 | CAISO B | WEC Unit #2 Out & Tracy-Tesla #1 500 kV Line Out |
| 50041 | CAISO B | WEC Unit #2 Out & Los Banos-Gates #1 500 kV Line Out |
| 50042 | CAISO B | WEC Unit #2 Out & Los Banos-Gates #3 500 kV Line Out |
| 50043 | CAISO B | WEC Unit #2 Out & Los Banos-Tracy 500 kV Line Out |
| 50044 | CAISO B | WEC Unit #2 Out & Los Banos-Tesla 500 kV Line Out |
| 50045 | CAISO B | WEC Unit #2 Out & Los Banos-Moss Landing 500 kV Line Out |
| 50046 | CAISO B | WEC Unit #2 Out & Los Banos-Midway 500 kV Line Out |
| 50047 | CAISO B | WEC Unit #2 Out & Walnut-Commons 69 kV Line Out |
| 50048 | CAISO B | WEC Unit #2 Out & Commons-Westport 69 kV Line Out |
| 50049 | CAISO B | WEC Unit #2 Out & Gilstrap-Grayson 69 kV Line Out |
| 50050 | CAISO B | WEC Unit #2 Out & Grayson-Westport 69 kV Line Out |
| 50051 | CAISO B | WEC Unit #2 Out & Grayson-Almond 69 kV Line Out |
| 50052 | CAISO B | WEC Unit #2 Out & Gilstrap-Almond 69 kV Line Out |
| 50053 | CAISO B | WEC Unit #2 Out & Almond-Crows Landing 69 kV Line Out |
| 50054 | CAISO B | WEC Unit #2 Out & Crows Landing-Ceres 69 kV Line Out |
| 50055 | CAISO B | WEC Unit #2 Out & Ceres-Tuolumne 69 kV Line Out |
| 50056 | CAISO B | WEC Unit #2 Out & Ceres-Roeding 69 kV Line Out |
| 50057 | CAISO B | WEC Unit #2 Out & Roeding-Tuolumne 69 kV Line Out |
| 50058 | CAISO B | WEC Unit #2 Out & Walnut-Fairground 69 kV Line Out |
| 50059 | CAISO B | WEC Unit #2 Out & Fairground-College-Geer 69 kV Line Out |
| 50060 | CAISO B | WEC Unit #2 Out & Geer-Montpellier Tap 69 kV Line Out |
| 50061 | CAISO B | WEC Unit #2 Out & Geer-Tuolumne 69 kV Line Out |
| 50062 | CAISO B | WEC Unit #2 Out & Walnut-Industrial 69 kV Line Out |
| 50063 | CAISO B | WEC Unit #2 Out & Walnut-WEC 69 kV Line Out |
| 50064 | CAISO B | WEC Unit #2 Out & WEC-Industrial 69 kV Line Out |
| 50065 | CAISO B | WEC Unit #2 Out & Industrial-South Turlock 69 kV Line Out |
| 50066 | CAISO B | WEC Unit #2 Out & South Turlock-F Street 69 kV Line Out |
| 50067 | CAISO B | WEC Unit #2 Out & F Street-Montpellier Tap 69 kV Line Out |
| 50068 | CAISO B | WEC Unit #2 Out & Montpellier-Montpellier Tap 69 kV Line Out |
| 50069 | CAISO B | WEC Unit #2 Out & Montpellier-Tuolumne 69 kV Line Out |
| 50070 | CAISO B | WEC Unit #2 Out & Montpellier-Geer-F Street 3-Terminal 69 kV Line Out |
| 50071 | CAISO B | WEC Unit #2 Out & Don Pedro-Tuolumne #1 69 kV Line Out |
| 50072 | CAISO B | WEC Unit #2 Out & Don Pedro-Tuolumne #2 69 kV Line Out |
| 50073 | CAISO B | WEC Unit #2 Out & Don Pedro-Hawkins 69 kV Line Out |
| 50074 | CAISO B | WEC Unit #2 Out & Hawkins-Geer 69 kV Line Out |

| Outage Number | WECC/NERC Category | Outage Description |
|---|---|---|
| 60000 | C1 | Almond 115 kV Bus Section between Breaker 700 & 710 |
| 60001 | C1 | Almond 115 kV Bus Section between Breaker 710 & 720 |
| 60002 | C1 | Almond 115 kV Bus Section between Breaker 720 & 740 |
| 60003 | C1 | Almond 115 kV Bus Section between Breaker 730 & 740 |
| 60004 | C1 | Almond 115 kV Bus Section between Breaker 730 & 700 |
| 60005 | C1 | August 115 kV Bus Section Fault |
| 60006 | C1 | Castle 115 kV Bus Section Fault |
| 60007 | C1 | Cooper 115 kV Bus Section Fault |
| 60008 | C1 | Cortez 115 kV Bus Section Fault |
| 60009 | C1 | Grayson 115 kV Bus Section between Breaker 700 & 710 |
| 60010 | C1 | Grayson 115 kV Bus Section between Breaker 730 & 740 |
| 60011 | C1 | Grayson 115 kV Bus Section between Breaker 760 & 770 |
| 60012 | C1 | Grayson 115 kV Bus Section between Breaker 770 & 780 |
| 60013 | C1 | Grayson 115 kV Bus Section between Breaker 1700 & 1710 |
| 60014 | C1 | Hilmar 115 kV Bus Section #1 Fault |
| 60015 | C1 | Hilmar 115 kV Bus Section #2 Fault |
| 60016 | C1 | Hughson 115 kV Bus Section Fault |
| 60017 | C1 | Marshall 115 kV Bus Section #1 or #3 Fault |
| 60018 | C1 | Marshall 115 kV Bus Section #2 Fault |
| 60019 | C1 | Marshall 115 kV Bus Section #4 Fault |
| 60020 | C1 | Oakdale 115 kV Bus Section Fault |
| 60021 | C1 | Pioneer 115 kV Bus Section #1 Fault |
| 60022 | C1 | Pioneer 115 kV Bus Section #2 Fault |
| 60023 | C1 | Pioneer 115 kV Bus Section #3 or #5 Fault |
| 60024 | C1 | Pioneer 115 kV Bus Section #4 Fault |
| 60025 | C1 | Pioneer 115 kV Bus Section #6 Fault |
| 60026 | C1 | Rogers 115 kV Bus Section Fault |
| 60027 | C1 | Taylor 115 kV Bus Section Fault |
| 60028 | C1 | Tuolumne 115 kV Bus Section Fault |
| 60029 | C1 | Walnut 115 kV Bus Section #1 Fault |
| 60030 | C1 | Walnut 115 kV Bus Section #2 Fault |
| 60031 | C1 | Walnut 115 kV Bus Section #3 Fault |
| 60032 | C1 | Walnut 115 kV Bus Section #4 Fault |
| 60033 | C1 | Walnut 115 kV Bus Section #5 Fault |
| 60034 | C1 | Walnut 230 kV Bus Section #1 Fault |
| 60035 | C1 | Walnut 230 kV Bus Section #2 Fault |
| 60036 | C1 | Walnut 230 kV Bus Section #3 Fault |
| 60037 | C1 | Walnut 230 kV Bus Section #4 Fault |
| 60038 | C1 | Walnut 230 kV Bus Section #5 Fault |
| 60039 | C1 | WEC 115 kV Bus Section #1 Fault |
| 60040 | C1 | WEC 115 kV Bus Section #2 Fault |
| 60041 | C1 | WEC 115 kV Bus Section #3 Fault |
| 60042 | C1 | WEC 115 kV Bus Section #4 Fault |
| 60043 | C1 | Westley 115 kV Bus Section #1 Fault |
| 60044 | C1 | Westley 115 kV Bus Section #2 Fault |
| 60045 | C1 | Westley 115 kV Bus Section #3 Fault |
| 60046 | C1 | Westley 115 kV Bus Section #4 Fault |
| 60047 | C1 | Westley 230 kV Bus Section #2 Fault |
| 60048 | C1 | Westley 230 kV Bus Section #3 Fault |
| 60049 | C1 | Westley 230 kV Bus Section #5 Fault |
| 60050 | C1 | Westley 230 kV Bus Section #6 Fault |
| 60051 | C1 | Westley 230 kV Bus Section #7 Fault |
| 60052 | C1 | Westley 230 kV Bus Section #8 Fault |
| 60053 | C1 | Westley 230 kV Bus Section #9 Fault |
| 60054 | C1 | Westley 230 kV Bus Section #10 Fault |
| 60055 | C1 | Westley 230 kV Bus Section #11 Fault |
| 60056 | C1 | Westley 230 kV Bus Section #12 Fault |
| 60057 | C1 | Walnut 69 kV Bus Section Fault |
| 60058 | C1 | Commons 69 kV Bus Section #1 Fault |
| 60059 | C1 | Commons 69 kV Bus Section #2 or #4 Fault |
| 60060 | C1 | Commons 69 kV Bus Section #3 Fault |
| 60061 | C1 | Gilstrap 69 kV Bus Section Fault |
| 60062 | C1 | Almond 69 kV Bus Section Fault |
| 60063 | C1 | Crows Landing 69 kV Bus Section Fault |

| Outage Number | WECC/NERC Category | Outage Description |
|---|---|---|
| 60064 | C1 | Ceres Bus 69 kV Section Fault |
| 60065 | C1 | Roeding 69 kV Bus Section Fault |
| 60066 | C1 | Tuolumne 69 kV South Bus Section #1 Fault |
| 60067 | C1 | Tuolumne 69 kV South Bus Section #2 Fault |
| 60068 | C1 | Fairground 69 kV Bus Section Fault |
| 60069 | C1 | College 69 kV Bus Section Fault |
| 60070 | C1 | Geer Bus 69 kV Section Fault |
| 60071 | C1 | Montpellier 69 kV Bus Section Fault |
| 60072 | C1 | WEC 69 kV Bus Section #2 Fault |
| 60073 | C1 | WEC 69 kV Bus Section #3 Fault |
| 60074 | C1 | WEC 69 kV Bus Section #4 Fault |
| 60075 | C1 | Industrial 69 kV Bus Section Fault |
| 60076 | C1 | South Turlock 69 kV Bus Section Fault |
| 60077 | C1 | F Street 69 kV Bus Section Fault |
| 60078 | C1 | Don Pedro 69 kV Bus Section Fault |
| 60079 | C1 | Hawkins 69 kV Bus Section Fault |
| 60080 | C1 | Grayson 69 kV Bus Section between Breaker 500 & 540 |
| 60081 | C1 | Grayson 69 kV Bus Section between Breaker 500 & 510 |
| 60082 | C1 | Grayson 69 kV Bus Section between Breaker 510 & 520 |
| 60083 | C1 | Grayson 69 kV Bus Section between Breaker 520 & 540 |
| 70000 | C2 | Almond 115 kV Breaker 700 Failure |
| 70001 | C2 | Almond 115 kV Breaker 710 Failure |
| 70002 | C2 | Almond 115 kV Breaker 720 Failure |
| 70003 | C2 | Almond 115 kV Breaker 730 Failure |
| 70004 | C2 | Almond 115 kV Breaker 740 Failure |
| 70005 | C2 | August 115 kV Breaker 700, 708, 710, or 718 Failure |
| 70006 | C2 | Castle 115 kV Breaker 700, 708, 710, or 718 Failure |
| 70007 | C2 | Cooper 115 kV Breaker 700, 710, 720, 708, 718, 728 or 738 Failure |
| 70008 | C2 | Cortez 115 kV Breaker 700 or 710 Failure |
| 70009 | C2 | Grayson 115 kV Breaker 700 Failure |
| 70010 | C2 | Grayson 115 kV Breaker 710 Failure |
| 70011 | C2 | Grayson 115 kV Breaker 730 Failure |
| 70012 | C2 | Grayson 115 kV Breaker 740 Failure |
| 70013 | C2 | Grayson 115 kV Breaker 760 Failure |
| 70014 | C2 | Grayson 115 kV Breaker 770 Failure |
| 70015 | C2 | Grayson 115 kV Breaker 780 Failure |
| 70016 | C2 | Grayson 115 kV Breaker 1700 Failure |
| 70017 | C2 | Grayson 115 kV Breaker 1710 Failure |
| 70018 | C2 | Hilmar 115 kV Breaker 700 Failure |
| 70019 | C2 | Hilmar 115 kV Breaker 710 Failure |
| 70020 | C2 | Hilmar 115 kV Breaker 730 Failure |
| 70021 | C2 | Hughson 115 kV Breaker 700 or 710 Failure |
| 70022 | C2 | Marshall 115 kV Breaker 700 Failure |
| 70023 | C2 | Marshall 115 kV Breaker 710 Failure |
| 70024 | C2 | Marshall 115 kV Breaker 720 Failure |
| 70025 | C2 | Marshall 115 kV Breaker 740 Failure |
| 70026 | C2 | Pioneer 115 kV Breaker 1700 Failure |
| 70027 | C2 | Pioneer 115 kV Breaker 1710 Failure |
| 70028 | C2 | Pioneer 115 kV Breaker 1720 Failure |
| 70029 | C2 | Pioneer 115 kV Breaker 1800 Failure |
| 70030 | C2 | Pioneer 115 kV Breaker 1810 Failure |
| 70031 | C2 | Pioneer 115 kV Breaker 1820 Failure |
| 70032 | C2 | Rogers 115 kV Breaker 700, 708, 710 or 718 Failure |
| 70033 | C2 | Taylor 115 kV Breaker 700, 708, 710 or 718 Failure |
| 70034 | C2 | Tuolumne 115 kV Breaker 710, 730, 750, 770, 780, or 790 Failure |
| 70035 | C2 | Walnut 115 kV Breaker 700 Failure |
| 70036 | C2 | Walnut 115 kV Breaker 710 Failure |
| 70037 | C2 | Walnut 115 kV Breaker 720 Failure |
| 70038 | C2 | Walnut 115 kV Breaker 730 Failure |
| 70039 | C2 | Walnut 115 kV Breaker 740 Failure |
| 70040 | C2 | Walnut 230 kV Breaker 800 Failure |
| 70041 | C2 | Walnut 230 kV Breaker 810 Failure |
| 70042 | C2 | Walnut 230 kV Breaker 820 Failure |
| 70043 | C2 | Walnut 230 kV Breaker 830 Failure |

| Outage Number | WECC/NERC Category | Outage Description |
|---|---|---|
| 70044 | C2 | Walnut 230 kV Breaker 840 Failure |
| 70045 | C2 | WEC 115 kV Breaker 700 Failure |
| 70046 | C2 | WEC 115 kV Breaker 710 Failure |
| 70047 | C2 | WEC 115 kV Breaker 720 Failure |
| 70048 | C2 | WEC 115 kV Breaker 730 Failure |
| 70049 | C2 | Westley 115 kV Breaker 700 Failure |
| 70050 | C2 | Westley 115 kV Breaker 710 Failure |
| 70051 | C2 | Westley 115 kV Breaker 720 Failure |
| 70052 | C2 | Westley 115 kV Breaker 740 Failure |
| 70053 | C2 | Westley 230 kV Breaker 2345 Failure |
| 70054 | C2 | Westley 230 kV Breaker 2346 Failure |
| 70055 | C2 | Westley 230 kV Breaker 2347 Failure |
| 70056 | C2 | Westley 230 kV Breaker 2351 Failure |
| 70057 | C2 | Westley 230 kV Breaker 2352 Failure |
| 70058 | C2 | Westley 230 kV Breaker 2353 Failure |
| 70059 | C2 | Westley 230 kV Breaker 2354 Failure |
| 70060 | C2 | Westley 230 kV Breaker 2355 Failure |
| 70061 | C2 | Westley 230 kV Breaker 2356 Failure |
| 70062 | C2 | Westley 230 kV Breaker 2357 Failure |
| 70063 | C2 | Westley 230 kV Breaker 2358 Failure |
| 70064 | C2 | Westley 230 kV Breaker 2359 Failure |
| 70065 | C2 | Westley 230 kV Breaker 2360 Failure |
| 70066 | C2 | Westley 230 kV Breaker 2361 Failure |
| 70067 | C2 | Westley 230 kV Breaker 2362 Failure |
| 70068 | C2 | Oakdale 115 kV Breaker 750 Failure |
| 70069 | C2 | Oakdale 115 kV Breaker 770 Failure |
| 70070 | C2 | Oakdale 115 kV Breaker 760 or 780 Failure |
| 70071 | C2 | Walnut 69 kV Breaker Failure |
| 70072 | C2 | Commons 69 kV Breaker 500 or 540 Failure |
| 70073 | C2 | Commons 69 kV Breaker 510 or 520 Failure |
| 70074 | C2 | Westport 69 kV Breaker Failure |
| 70075 | C2 | Gilstrap 69 kV Breaker Failure |
| 70076 | C2 | Almond 69 kV Breaker Failure |
| 70077 | C2 | Crows Landing 69 kV Breaker Failure |
| 70078 | C2 | Ceres 69 kV Breaker Failure |
| 70079 | C2 | Roeding 69 kV Breaker Failure |
| 70080 | C2 | Tuolumne 69 kV Breaker 510, 530, or 550 Failure |
| 70081 | C2 | Tuolumne 69 kV Breaker 570, 590, 610, 630, 650, or 670 Failure |
| 70082 | C2 | Tuolumne 69 kV Breaker 560 Failure |
| 70083 | C2 | Fairground 69 kV Breaker Failure |
| 70084 | C2 | Geer 69 kV Breaker 500 Failure |
| 70085 | C2 | Geer 69 kV Breaker 510, 520, 550, or 560 Failure |
| 70086 | C2 | Grayson 69 kV Breaker 500 Failure |
| 70087 | C2 | Grayson 69 kV Breaker 510 Failure |
| 70088 | C2 | Grayson 69 kV Breaker 520 Failure |
| 70089 | C2 | Grayson 69 kV Breaker 540 Failure |
| 70090 | C2 | Montpellier 69 kV Breaker Failure |
| 70091 | C2 | WEC 69 kV Breaker 500 Failure |
| 70092 | C2 | WEC 69 kV Breaker 510 Failure |
| 70093 | C2 | WEC 69 kV Breaker 520 Failure |
| 70094 | C2 | WEC 69 kV Breaker 530 Failure |
| 70095 | C2 | Industrial 69 kV Breaker Failure |
| 70096 | C2 | South Turlock 69 kV Breaker Failure |
| 70097 | C2 | F Street 69 kV Breaker 500 Failure |
| 70098 | C2 | F Street 69 kV Breaker 510 Failure |
| 70099 | C2 | Don Pedro 69 kV Breaker Failure |
| 70100 | C2 | Hawkins 69 kV Breaker Failure |
| 80000 | C3 | Westley 230/115 kV #1 & #2 Transformer Outage |
| 80001 | C3 | Walnut 230/115 kV #1 & Westley 230/115 kV #1 Transformer Outage |
| 80002 | C3 | Oakdale-Tuolumne 115 kV #1 Line Out & Westley 230/115 kV #1 Transformer Outage |
| 80003 | C3 | Westley-Los Banos 230 kV & Westley-Tesla 230 kV Lines Out |
| 80004 | C3 | Los Banos-Westley & Walnut-Westley 230 kV Lines Out |
| 80005 | C3 | Tesla-Westley & Parker-Westley 230 kV Lines Out |

| Outage Number | WECC/NERC Category | Outage Description |
|---|---|---|
| 80006 | C3 | Tracy-Westley #1 & Westley-Rosemore #1 230 kV Lines Out |
| 80007 | C3 | Tracy-Westley #2 & Westley-Rosemore #2 230 kV Lines Out |
| 100000 | C5 | Westley-Walnut & Westley-Parker 230 kV Lines Out |
| 100001 | C5 | Walnut-Westley & Walnut-Parker 230 kV Lines Out |
| 100002 | C5 | Parker-Westley & Parker-Walnut 230 kV Lines Out |
| 100003 | C5 | Walnut-Marshall & Walnut-Rogers 115 kV Lines Out |
| 100004 | C5 | Westley-Marshall & Westley-Rogers 115 kV Lines Out |
| 100005 | C5 | Westley-Marshall & Rogers-Walnut 115 kV Lines Out |
| 100006 | C5 | Walnut-August & WEC-Hilmar 115 kV Lines Out |
| 100007 | C5 | Walnut-August & Hilmar-Cortez 115 kV Lines Out |
| 100008 | C5 | August-Pioneer & Hilmar-Cortez 115 kV Lines Out |
| 100009 | C5 | Grayson-Almond #1 115 kV line & Grayson-Almond 69 kV Line Out |
| 100010 | C5 | Grayson-Taylor & Grayson-Hughson 115 kV Lines Out |
| 100011 | C5 | Pioneer-August & Pioneer-Tuolumne 115 kV Lines Out |
| 100012 | C5 | Pioneer-Castle & Pioneer-Cooper 115 kV Lines Out |
| 100013 | C5 | Pioneer-Tuolumne & Cortez-Taylor 115 kV Lines Out |
| 100014 | C5 | Pioneer-Tuolumne & Grayson-Taylor 115 kV Lines Out |
| 100015 | C5 | Pioneer-Tuolumne & Grayson-Hughson 115 kV Lines Out |
| 100016 | C5 | Pioneer-Tuolumne & Hilmar-Cortez 115 kV Lines Out |
| 100017 | C5 | Pioneer-Tuolumne & Hughson-Tuolumne 115 kV Lines Out |
| 100018 | C5 | Oakdale-Tuolumne #1 & #2 115 kV Lines Out |
| 100019 | C5 | Newark-Moccasin #3 & #4 115 kV Lines Out |
| 100020 | C5 | Walnut-WEC & Walnut-August 115 kV Lines Out |
| 100021 | C5 | Warnerville-Standiford 115 kV Lines Out |
| 100022 | C5 | Westley-Tesla 230 kV & Westley-Tracy #1 230 kV Lines Out |
| 100023 | C5 | Tracy-Tesla 230 kV #1 & #2 Lines Out |
| 100024 | C5 | Westley-Tracy 230 kV #1 & #2 Lines Out |
| 100025 | C5 | Almond-Crows Landing & Almond-Gilstrap 69 kV Lines Out |
| 100026 | C5 | Crows Landing-Almond & Crows Landing-Ceres 69 kV Lines Out |
| 100027 | C5 | Ceres-Tuolumne & Ceres-Roeding 69 kV Lines Out |
| 100028 | C5 | Don Pedro-Tuolumne #1 & #2 69 kV Lines Out |
| 100029 | C5 | Hawkins-Geer & Hawkins-Don Pedro 69 kV Lines Out |
| 130000 | C8 | Walnut 230/115 kV Fault with Breaker 710 Failure |
| 130001 | C8 | Walnut 230/115 kV Fault with Breaker 720 Failure |
| 130002 | C8 | Walnut 230/115 kV Fault with Breaker 800 Failure |
| 130003 | C8 | Walnut 230/115 kV Fault with Breaker 830 Failure |
| 130004 | C8 | Westley 230/115 kV Transformer #1 Fault with Breaker 700 Failure |
| 130005 | C8 | Westley 230/115 kV Transformer #1 Fault with Breaker 710 Failure |
| 130006 | C8 | Westley 230/115 kV Transformer #2 Fault with Breaker 720 Failure |
| 130007 | C8 | Westley 230/115 kV Transformer #2 Fault with Breaker 740 Failure |
| 240000 | D10 | Almond 2 Power Plant |

# Turlock Irrigation District
# Almond 2 Power Plant
# (09-AFC-2)

## Appendix 8

Power Flow Thermal Analysis Output

## 2012 Spring Peak Power Flow Thermal Analysis Output

| Outage Number | WECC/NERC Category | Outage Description | Effected Power System Element | | | | ID | E Rate (Amps) | Pre-Project Loading (%) | Post-Project Loading (%) | Delta |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 100010 | C5 | Grayson-Taylor & Grayson-Hughson 115 kV Lines Out | CERES | 69 | CROWSLND | 69 | #1 | 730 | < 90.00 | 90.91 | > 0.91 |

## 2012 Summer Off-Peak Power Flow Thermal Analysis Output (Almond CT On)

| Outage Number | WECC/NERC Category | Outage Description | Effected Power System Element | | | | ID | N Rate (Amps) | Pre-Project Loading (%) | Post-Project Loading (%) | Delta |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 10000 | A | N-0 All Elements in Service | WALNT115 | 115 | WEC115 | 115 | #1 | 817 | 73.90 | 99.83 | 25.93 |
| 10000 | A | N-0 All Elements in Service | WARNERVL | 230 | WILSON | 230 | #1 | 911 | 90.28 | 90.97 | 0.69 |

| Outage Number | WECC/NERC Category | Outage Description | Effected Power System Element | | | | ID | E Rate (Amps) | Pre-Project Loading (%) | Post-Project Loading (%) | Delta |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 30007 | B2 | Tuolumne-Pioneer 115 kV Line Out | WALNT115 | 115 | WEC115 | 115 | #1 | 940 | < 90.00 | 93.25 | > 3.25 |
| 30013 | B2 | Walnut-WEC 115 kV Line Out | HUGHSON | 115 | GRAY115 | 115 | #1 | 940 | < 90.00 | 90.42 | > 0.42 |
| 30017 | B2 | Hughson-Tuolumne 115 kV Line Out | WALNT115 | 115 | WEC115 | 115 | #1 | 940 | < 90.00 | 97.82 | > 7.82 |
| 30023 | B2 | Grayson-Hughson 115 kV Line Out | WALNT115 | 115 | WEC115 | 115 | #1 | 940 | < 90.00 | 100.68 | > 10.68 |
| 30048 | B2 | Commons-Westport 69 kV Line Out | WALNT115 | 115 | WEC115 | 115 | #1 | 940 | < 90.00 | 90.42 | > 0.42 |
| 30050 | B2 | Grayson-Westport 69 kV Line Out | WALNT115 | 115 | WEC115 | 115 | #1 | 940 | < 90.00 | 91.28 | > 1.28 |
| 40003 | B3 | Grayson 115/69 kV Transformer Out | WALNT115 | 115 | WEC115 | 115 | #1 | 940 | < 90.00 | 92.07 | > 2.07 |
| 50007 | B4 | WEC Unit #2 Out & Tuolumne-Pioneer 115 kV Line Out | WALNT115 | 115 | WEC115 | 115 | #1 | 940 | < 90.00 | 90.48 | > 0.48 |
| 50013 | B4 | WEC Unit #2 Out & Walnut-WEC 115 kV Line Out | WESTPORT | 69 | GRAY69 | 69 | #1 | 730 | < 90.00 | 96.33 | > 6.33 |
| 50017 | B4 | WEC Unit #2 Out & Hughson-Tuolumne 115 kV Line Out | WALNT115 | 115 | WEC115 | 115 | #1 | 940 | < 90.00 | 95.04 | > 5.04 |
| 50023 | B4 | WEC Unit #2 Out & Grayson-Hughson 115 kV Line Out | WALNT115 | 115 | WEC115 | 115 | #1 | 940 | < 90.00 | 97.89 | > 7.89 |
| 60011 | C1 | Grayson 115 kV Bus Section between Breaker 760 & 770 | WALNT115 | 115 | WEC115 | 115 | #1 | 940 | < 90.00 | 92.07 | > 2.07 |
| 60013 | C1 | Grayson 115 kV Bus Section between Breaker 1700 & 1710 | WALNT115 | 115 | WEC115 | 115 | #1 | 940 | < 90.00 | 100.68 | > 10.68 |
| 60016 | C1 | Hughson 115 kV Bus Section Fault | WALNT115 | 115 | WEC115 | 115 | #1 | 940 | < 90.00 | 101.04 | > 11.04 |
| 60020 | C1 | Oakdale 115 kV Bus Section Fault | WALNT115 | 115 | WEC115 | 115 | #1 | 940 | < 90.00 | 90.06 | > 0.06 |
| 60022 | C1 | Pioneer 115 kV Bus Section #2 Fault | WALNT115 | 115 | WEC115 | 115 | #1 | 940 | < 90.00 | 93.25 | > 3.25 |
| 60028 | C1 | Tuolumne 115 kV Bus Section Fault | WALNT115 | 115 | WEC115 | 115 | #1 | 940 | < 90.00 | 102.98 | > 12.98 |
| 60032 | C1 | Walnut 115 kV Bus Section #4 Fault | HUGHSON | 115 | GRAY115 | 115 | #1 | 940 | < 90.00 | 90.42 | > 0.42 |
| 60039 | C1 | WEC 115 kV Bus Section #1 Fault | HUGHSON | 115 | GRAY115 | 115 | #1 | 940 | < 90.00 | 90.42 | > 0.42 |
| 60057 | C1 | Walnut 69 kV Bus Section Fault | WALNT115 | 115 | WEC115 | 115 | #1 | 940 | < 90.00 | 97.53 | > 7.53 |
| 60058 | C1 | Commons 69 kV Bus Section #1 Fault | WALNT115 | 115 | WEC115 | 115 | #1 | 940 | < 90.00 | 90.42 | > 0.42 |
| 60081 | C1 | Grayson 69 kV Bus Section between Breaker 500 & 510 | WALNT115 | 115 | WEC115 | 115 | #1 | 940 | < 90.00 | 91.28 | > 1.28 |
| 60083 | C1 | Grayson 69 kV Bus Section between Breaker 520 & 540 | WALNT115 | 115 | WEC115 | 115 | #1 | 940 | < 90.00 | 92.07 | > 2.07 |
| 70013 | C2 | Grayson 115 kV Breaker 760 Failure | WALNT115 | 115 | WEC115 | 115 | #1 | 940 | < 90.00 | 92.07 | > 2.07 |
| 70016 | C2 | Grayson 115 kV Breaker 1700 Failure | WALNT115 | 115 | WEC115 | 115 | #1 | 940 | < 90.00 | 100.68 | > 10.68 |
| 70017 | C2 | Grayson 115 kV Breaker 1710 Failure | WALNT115 | 115 | WEC115 | 115 | #1 | 940 | < 90.00 | 100.68 | > 10.68 |
| 70021 | C2 | Hughson 115 kV Breaker 700 or 710 Failure | WALNT115 | 115 | WEC115 | 115 | #1 | 940 | < 90.00 | 101.04 | > 11.04 |
| 70029 | C2 | Pioneer 115 kV Breaker 1800 Failure | WALNT115 | 115 | WEC115 | 115 | #1 | 940 | < 90.00 | 93.30 | > 3.30 |
| 70030 | C2 | Pioneer 115 kV Breaker 1810 Failure | WALNT115 | 115 | WEC115 | 115 | #1 | 940 | < 90.00 | 93.25 | > 3.25 |
| 70034 | C2 | Tuolumne 115 kV Breaker 710, 730, 750, 770, 780, or 790 Failure | WALNT115 | 115 | WEC115 | 115 | #1 | 940 | < 90.00 | 102.98 | > 12.98 |
| 70037 | C2 | Walnut 115 kV Breaker 720 Failure | HUGHSON | 115 | GRAY115 | 115 | #1 | 940 | < 90.00 | 90.66 | > 0.66 |
| 70039 | C2 | Walnut 115 kV Breaker 740 Failure | HUGHSON | 115 | GRAY115 | 115 | #1 | 940 | < 90.00 | 90.23 | > 0.23 |
| 70039 | C2 | Walnut 115 kV Breaker 740 Failure | WESTPORT | 69 | GRAY69 | 69 | #1 | 730 | < 90.00 | 90.20 | > 0.20 |
| 70068 | C2 | Oakdale 115 kV Breaker 750 Failure | WALNT115 | 115 | WEC115 | 115 | #1 | 940 | < 90.00 | 90.06 | > 0.06 |
| 70069 | C2 | Oakdale 115 kV Breaker 770 Failure | WALNT115 | 115 | WEC115 | 115 | #1 | 940 | < 90.00 | 90.06 | > 0.06 |
| 70070 | C2 | Oakdale 115 kV Breaker 760 or 780 Failure | WALNT115 | 115 | WEC115 | 115 | #1 | 940 | < 90.00 | 90.06 | > 0.06 |
| 70071 | C2 | Walnut 69 kV Breaker Failure | WALNT115 | 115 | WEC115 | 115 | #1 | 940 | < 90.00 | 97.53 | > 7.53 |

| Outage Number | WECC/NERC Category | Outage Description | Effected Power System Element | | | | ID | E Rate (Amps) | Pre-Project Loading (%) | Post-Project Loading (%) | Delta |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 70072 | C2 | Commons 69 kV Breaker 500 or 540 Failure | WALNT115 | 115 | WEC115 | 115 | #1 | 940 | < 90.00 | 90.42 | > 0.42 |
| 70074 | C2 | Westport 69 kV Breaker Failure | WALNT115 | 115 | WEC115 | 115 | #1 | 940 | < 90.00 | 91.39 | > 1.39 |
| 70081 | C2 | Tuolumne 69 kV Breaker 570, 590, 610, 630, 650, or 670 Failure | HAWKINS | 69 | GEER | 69 | #1 | 720 | 93.61 | 93.62 | 0.01 |
| 70081 | C2 | Tuolumne 69 kV Breaker 570, 590, 610, 630, 650, or 670 Failure | DONPEDRO | 69 | LA GTP2 | 69 | #1 | 799 | 90.21 | 90.22 | 0.01 |
| 70081 | C2 | Tuolumne 69 kV Breaker 570, 590, 610, 630, 650, or 670 Failure | HAWKINS | 69 | LA GTP2 | 69 | #1 | 799 | 90.21 | 90.22 | 0.01 |
| 70082 | C2 | Tuolumne 69 kV Breaker 560 Failure | HAWKINS | 69 | GEER | 69 | #1 | 720 | 93.62 | 93.64 | 0.02 |
| 70082 | C2 | Tuolumne 69 kV Breaker 560 Failure | DONPEDRO | 69 | LA GTP2 | 69 | #1 | 799 | 90.23 | 90.26 | 0.03 |
| 70082 | C2 | Tuolumne 69 kV Breaker 560 Failure | HAWKINS | 69 | LA GTP2 | 69 | #1 | 799 | 90.23 | 90.26 | 0.03 |
| 70084 | C2 | Geer 69 kV Breaker 500 Failure | WALNT115 | 115 | WEC115 | 115 | #1 | 940 | < 90.00 | 91.38 | > 1.38 |
| 70086 | C2 | Grayson 69 kV Breaker 500 Failure | WALNT115 | 115 | WEC115 | 115 | #1 | 940 | < 90.00 | 91.34 | > 1.34 |
| 70087 | C2 | Grayson 69 kV Breaker 510 Failure | WALNT115 | 115 | WEC115 | 115 | #1 | 940 | < 90.00 | 91.33 | > 1.33 |
| 70088 | C2 | Grayson 69 kV Breaker 520 Failure | WALNT115 | 115 | WEC115 | 115 | #1 | 940 | < 90.00 | 92.13 | > 2.13 |
| 70089 | C2 | Grayson 69 kV Breaker 540 Failure | WALNT115 | 115 | WEC115 | 115 | #1 | 940 | < 90.00 | 92.07 | > 2.07 |
| 100010 | C5 | Grayson-Taylor & Grayson-Hughson 115 kV Lines Out | WESTPORT | 69 | GRAY69 | 69 | #1 | 730 | < 90.00 | 105.09 | > 15.09 |
| 100010 | C5 | Grayson-Taylor & Grayson-Hughson 115 kV Lines Out | CERES | 69 | CROWSLND | 69 | #1 | 730 | < 90.00 | 93.14 | > 3.14 |
| 100011 | C5 | Pioneer-August & Pioneer-Tuolumne 115 kV Lines Out | WALNT115 | 115 | WEC115 | 115 | #1 | 940 | < 90.00 | 90.03 | > 0.03 |
| 100015 | C5 | Pioneer-Tuolumne & Grayson-Hughson 115 kV Lines Out | WALNT115 | 115 | WEC115 | 115 | #1 | 940 | < 90.00 | 102.47 | > 12.47 |
| 100017 | C5 | Pioneer-Tuolumne & Hughson-Tuolumne 115 kV Lines Out | WALNT115 | 115 | WEC115 | 115 | #1 | 940 | < 90.00 | 100.05 | > 10.05 |
| 100018 | C5 | Oakdale-Tuolumne #1 & #2 115 kV Lines Out | WALNT115 | 115 | WEC115 | 115 | #1 | 940 | < 90.00 | 90.06 | > 0.06 |
| 100019 | C5 | Newark-Moccasin #3 & #4 115 kV Lines Out | WALNT115 | 115 | WEC115 | 115 | #1 | 940 | < 90.00 | 90.05 | > 0.05 |
| 100020 | C5 | Walnut-WEC & Walnut-August 115 kV Lines Out | WESTPORT | 69 | GRAY69 | 69 | #1 | 730 | < 90.00 | 97.31 | > 7.31 |
| 100028 | C5 | Don Pedro-Tuolumne #1 & #2 69 kV Lines Out | HAWKINS | 69 | GEER | 69 | #1 | 720 | 93.59 | 93.60 | 0.01 |
| 100028 | C5 | Don Pedro-Tuolumne #1 & #2 69 kV Lines Out | DONPEDRO | 69 | LA GTP2 | 69 | #1 | 799 | 90.18 | 90.19 | 0.01 |
| 100028 | C5 | Don Pedro-Tuolumne #1 & #2 69 kV Lines Out | HAWKINS | 69 | LA GTP2 | 69 | #1 | 799 | 90.18 | 90.19 | 0.01 |
| 130001 | C8 | Walnut 230/115 kV Fault with Breaker 720 Failure | HUGHSON | 115 | GRAY115 | 115 | #1 | 940 | < 90.00 | 90.66 | > 0.66 |

## 2012 Summer Off-Peak Sensitivity Power Flow Thermal Analysis Output (Almond CT Off)

| Outage Number | WECC/NERC Category | Outage Description | Effected Power System Element | | | | ID | N Rate (Amps) | Pre-Project Loading (%) | Post-Project Loading (%) | Delta |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 10000 | A | N-0 All Elements in Service | WALNT115 | 115 | WEC115 | 115 | #1 | 817 | 68.50 | 94.47 | 25.97 |
| 10000 | A | N-0 All Elements in Service | WARNERVL | 230 | WILSON | 230 | #1 | 911 | 90.07 | 90.76 | 0.69 |

| Outage Number | WECC/NERC Category | Outage Description | Effected Power System Element | | | | ID | E Rate (Amps) | Pre-Project Loading (%) | Post-Project Loading (%) | Delta |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 30017 | B2 | Hughson-Tuolumne 115 kV Line Out | WALNT115 | 115 | WEC115 | 115 | #1 | 940 | < 90.00 | 91.14 | > 1.14 |
| 30023 | B2 | Grayson-Hughson 115 kV Line Out | WALNT115 | 115 | WEC115 | 115 | #1 | 940 | < 90.00 | 94.01 | > 4.01 |
| 40003 | B3 | Grayson 115/69 kV Transformer Out | WALNT115 | 115 | WEC115 | 115 | #1 | 940 | < 90.00 | 90.32 | > 0.32 |
| 50023 | B4 | WEC Unit #2 Out & Grayson-Hughson 115 kV Line Out | WALNT115 | 115 | WEC115 | 115 | #1 | 940 | < 90.00 | 91.24 | > 1.24 |
| 60011 | C1 | Grayson 115 kV Bus Section between Breaker 760 & 770 | WALNT115 | 115 | WEC115 | 115 | #1 | 940 | < 90.00 | 90.32 | > 0.32 |
| 60013 | C1 | Grayson 115 kV Bus Section between Breaker 1700 & 1710 | WALNT115 | 115 | WEC115 | 115 | #1 | 940 | < 90.00 | 94.01 | > 4.01 |
| 60016 | C1 | Hughson 115 kV Bus Section Fault | WALNT115 | 115 | WEC115 | 115 | #1 | 940 | < 90.00 | 94.38 | > 4.38 |
| 60028 | C1 | Tuolumne 115 kV Bus Section Fault | WALNT115 | 115 | WEC115 | 115 | #1 | 940 | < 90.00 | 95.05 | > 5.05 |
| 60083 | C1 | Grayson 69 kV Bus Section between Breaker 520 & 540 | WALNT115 | 115 | WEC115 | 115 | #1 | 940 | < 90.00 | 90.32 | > 0.32 |
| 70013 | C2 | Grayson 115 kV Breaker 760 Failure | WALNT115 | 115 | WEC115 | 115 | #1 | 940 | < 90.00 | 90.32 | > 0.32 |
| 70016 | C2 | Grayson 115 kV Breaker 1700 Failure | WALNT115 | 115 | WEC115 | 115 | #1 | 940 | < 90.00 | 94.01 | > 4.01 |
| 70017 | C2 | Grayson 115 kV Breaker 1710 Failure | WALNT115 | 115 | WEC115 | 115 | #1 | 940 | < 90.00 | 94.01 | > 4.01 |
| 70021 | C2 | Hughson 115 kV Breaker 700 or 710 Failure | WALNT115 | 115 | WEC115 | 115 | #1 | 940 | < 90.00 | 94.38 | > 4.38 |
| 70034 | C2 | Tuolumne 115 kV Breaker 710, 730, 750, 770, 780, or 790 Failure | WALNT115 | 115 | WEC115 | 115 | #1 | 940 | < 90.00 | 95.05 | > 5.05 |
| 70088 | C2 | Grayson 69 kV Breaker 520 Failure | WALNT115 | 115 | WEC115 | 115 | #1 | 940 | < 90.00 | 90.33 | > 0.33 |
| 70089 | C2 | Grayson 69 kV Breaker 540 Failure | WALNT115 | 115 | WEC115 | 115 | #1 | 940 | < 90.00 | 90.30 | > 0.30 |
| 100015 | C5 | Pioneer-Tuolumne & Grayson-Hughson 115 kV Lines Out | WALNT115 | 115 | WEC115 | 115 | #1 | 940 | < 90.00 | 95.48 | > 5.48 |
| 100017 | C5 | Pioneer-Tuolumne & Hughson-Tuolumne 115 kV Lines Out | WALNT115 | 115 | WEC115 | 115 | #1 | 940 | < 90.00 | 93.05 | > 3.05 |

## 2012 Summer Peak Power Flow Thermal Analysis Output (McClure Generation Off)

| Outage Number | WECC/NERC Category | Outage Description | Effected Power System Element | | | | ID | E Rate (Amps) | Pre-Project Loading (%) | Post-Project Loading (%) | Delta |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 100002 | C5 | Parker-Westley & Parker-Walnut 230 kV Lines Out | 8TH ST | 69 | 12TH ST | 69 | #1 | 939 | 111.58 | 112.50 | 0.92 |
| 100002 | C5 | Parker-Westley & Parker-Walnut 230 kV Lines Out | ROSEMORE | 69 | 8TH ST | 69 | #1 | 939 | 103.61 | 104.85 | 1.24 |
| 100002 | C5 | Parker-Westley & Parker-Walnut 230 kV Lines Out | BRGGSMRE | 69 | ENSLEN | 69 | #1 | 939 | 101.60 | 102.43 | 0.83 |
| 100002 | C5 | Parker-Westley & Parker-Walnut 230 kV Lines Out | ENSLEN | 69 | WOODLMID | 69 | #2 | 941 | 92.73 | 93.32 | 0.59 |

## 2012 Summer Peak Sensitivity Power Flow Thermal Analysis Output (McClure Generation On)

| Outage Number | WECC/NERC Category | Outage Description | Effected Power System Element | | | | Ckt | E Rate (Amps) | Pre-Project Loading (%) | Post-Project Loading (%) | Delta |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 100002 | C5 | Parker-Westley & Parker-Walnut 230 kV Lines Out | 8TH ST | 69 | 12TH ST | 69 | #1 | 939 | 99.25 | 99.98 | 0.73 |
| 100002 | C5 | Parker-Westley & Parker-Walnut 230 kV Lines Out | BRGGSMRE | 69 | ENSLEN | 69 | #1 | 939 | 92.52 | 93.25 | 0.73 |
| 100002 | C5 | Parker-Westley & Parker-Walnut 230 kV Lines Out | ROSEMORE | 69 | 8TH ST | 69 | #1 | 939 | 91.48 | 92.66 | 1.18 |

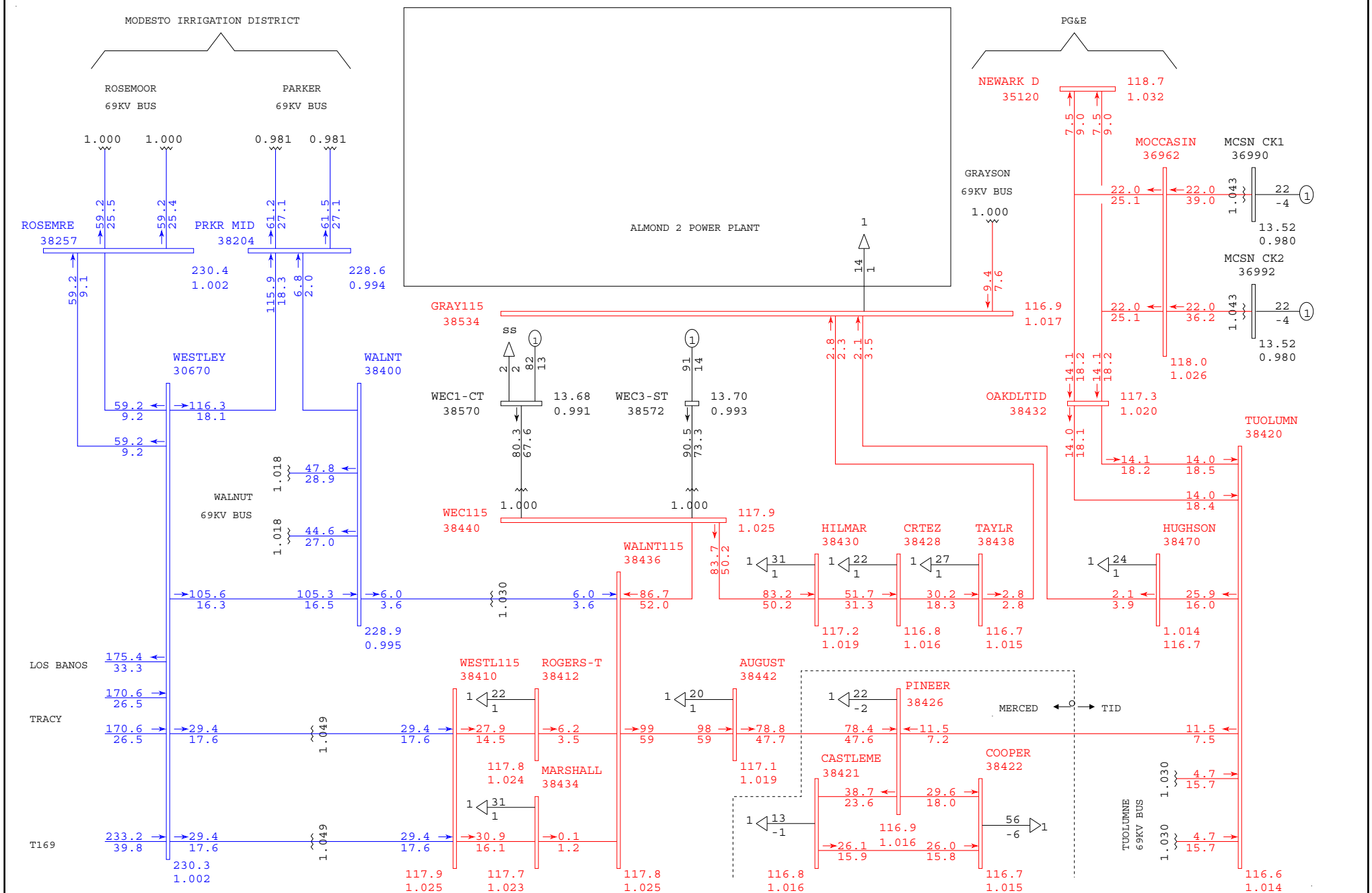
# Turlock Irrigation District
# Almond 2 Power Plant
# (09-AFC-2)

## Appendix 9

Power Flow Thermal Analysis One-Line Diagrams

# Power Flow Thermal Analysis One-Line Diagram

## 2012 Spring Peak
## (Pre-Project)



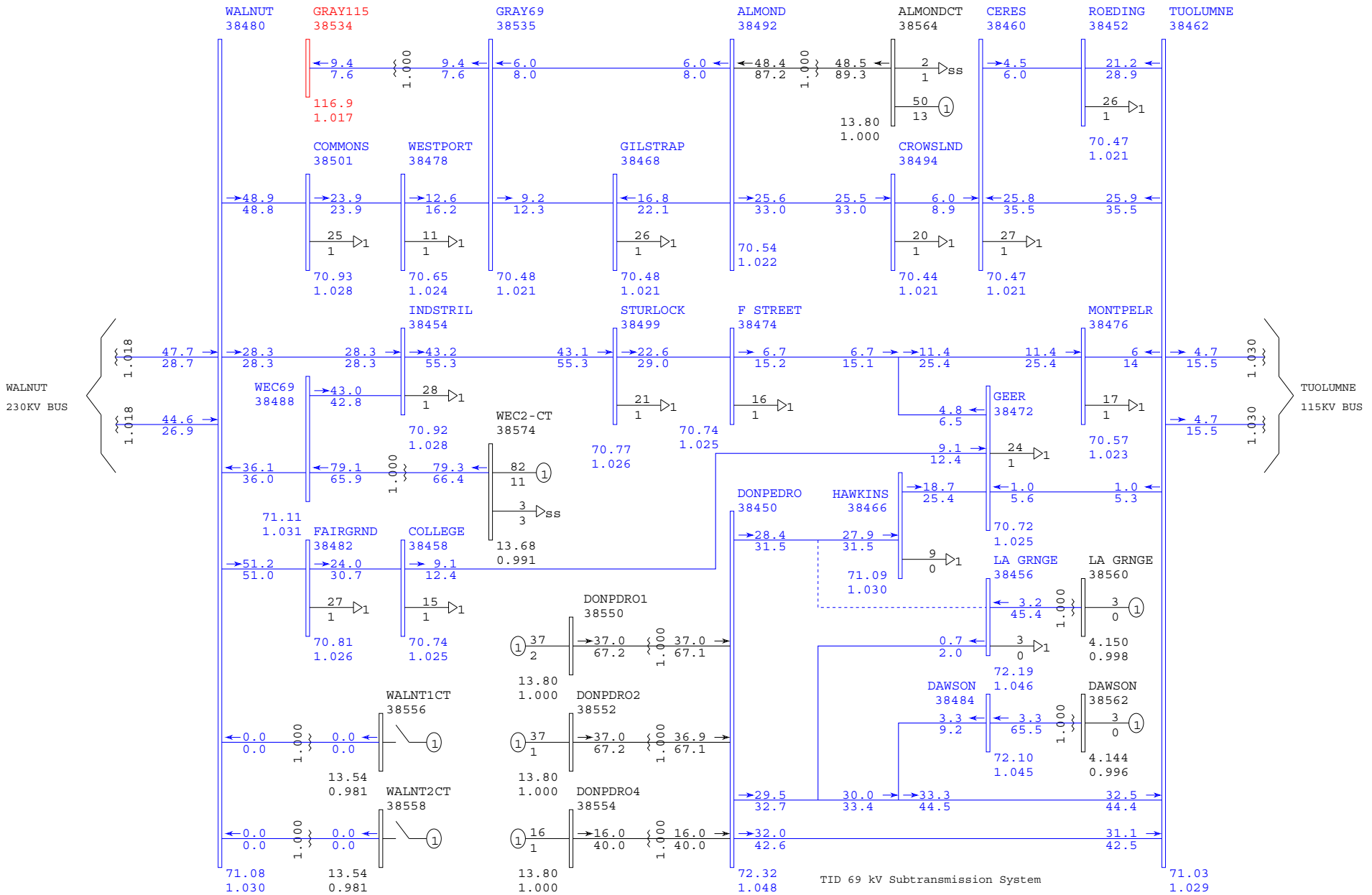

General Electric International, Inc. PSLF Program Mon Oct 19 23:53:23 2009 2012_spr_pk_pre.sav

2012 Spring Peak Base Case

MW/% rate

TID_230_115_V1.drw

Rating = 1




General Electric International, Inc. PSLF Program Mon Oct 19 23:53:25 2009 2012_spr_pk_pre.sav

2012 Spring Peak Base Case

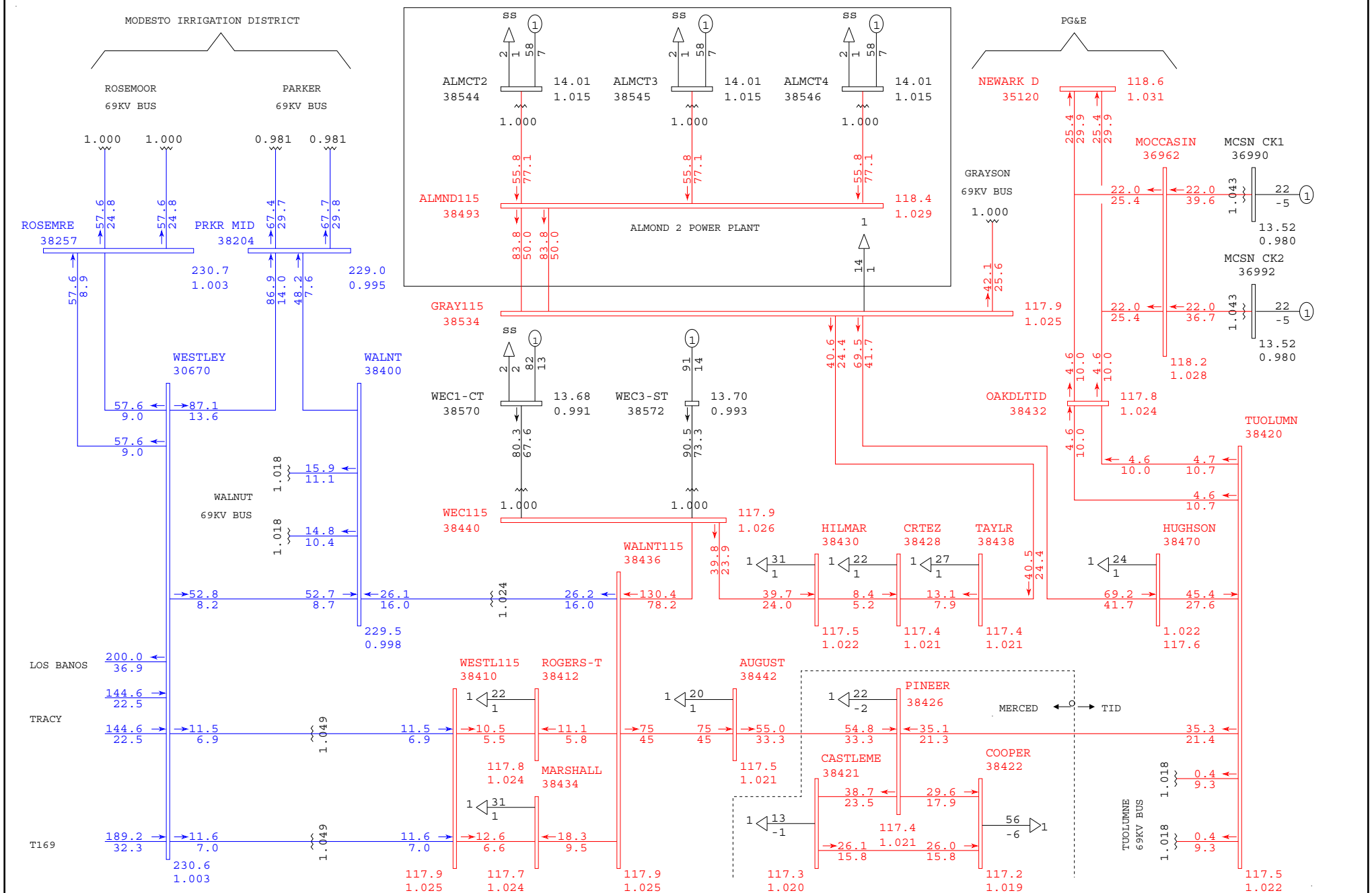
MW/% rate

TID_69_V1.drw

Rating = 1

# Power Flow Thermal Analysis One-Line Diagram

## 2012 Spring Peak
## (Post-Project)



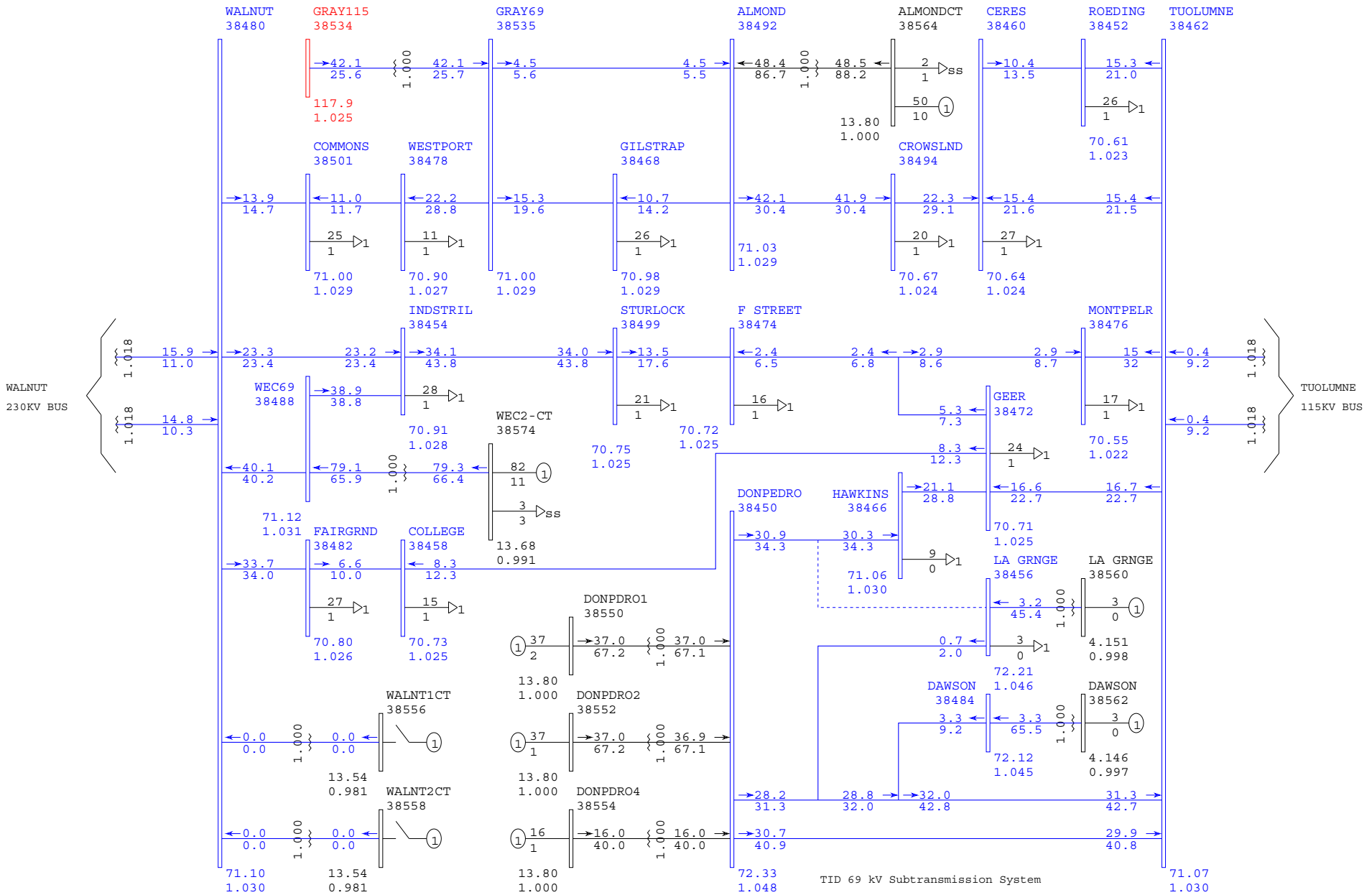

General Electric International, Inc. PSLF Program Mon Oct 19 23:53:23 2009 2012_spr_pk_pst.sav

2012 Spring Peak Base Case

MW/% rate

TID_230_115_V1.drw

Rating = 1




General Electric International, Inc. PSLF Program Mon Oct 19 23:53:26 2009 2012_spr_pk_pst.sav

2012 Spring Peak Base Case

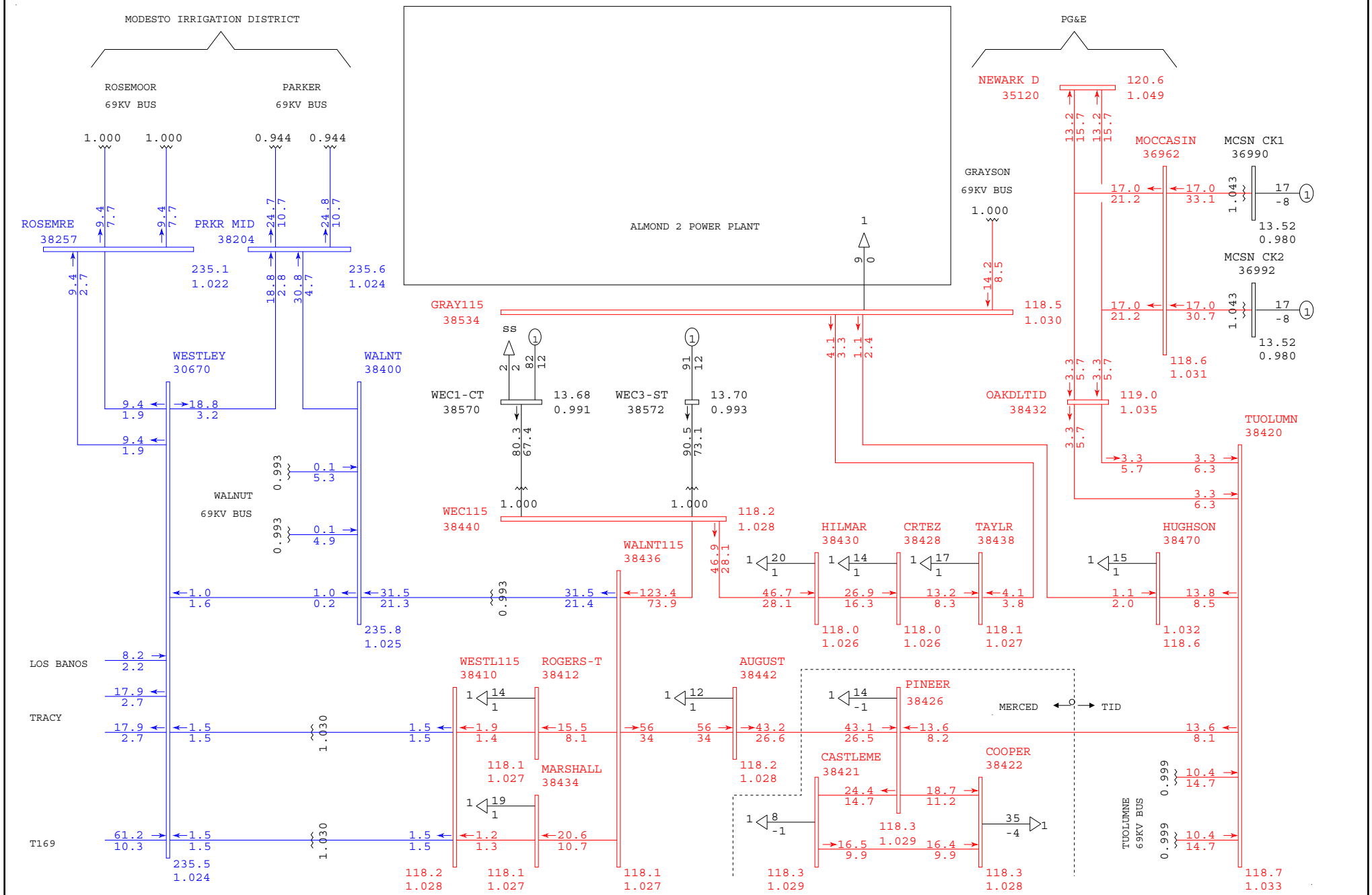
MW/% rate

TID_69_V1.drw

Rating = 1

# Power Flow Thermal Analysis One-Line Diagram

## 2012 Summer Off-Peak
## (Pre-Project)



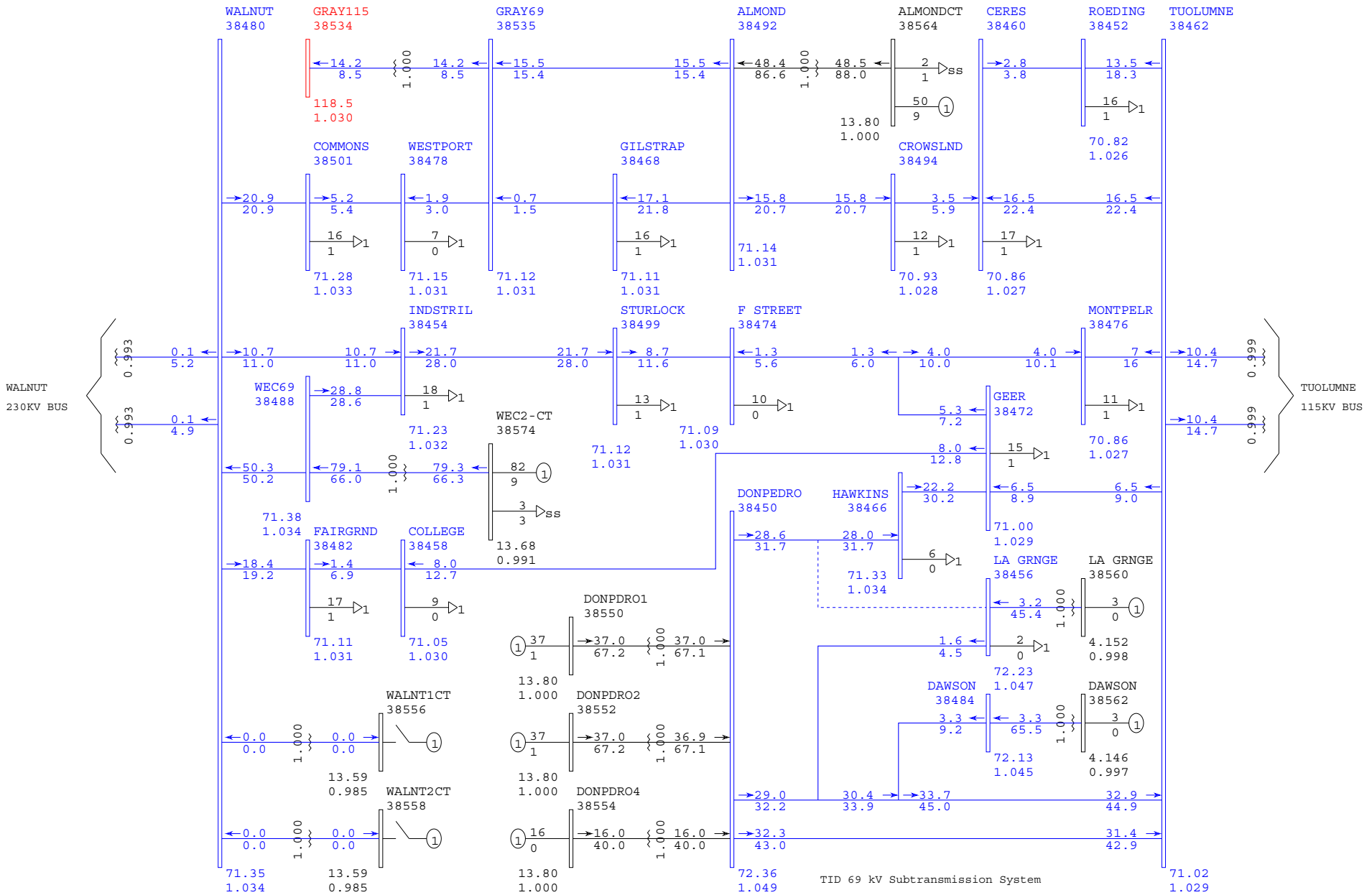

General Electric International, Inc. PSLF Program Mon Oct 19 23:53:24 2009 2012_sum_opk_pre.sav

2012 Summer Off-Peak Base Case

MW/% rate

TID_230_115_V1.drw

Rating = 1




General Electric International, Inc. PSLF Program Mon Oct 19 23:53:26 2009 2012_sum_opk_pre.sav

2012 Summer Off-Peak Base Case

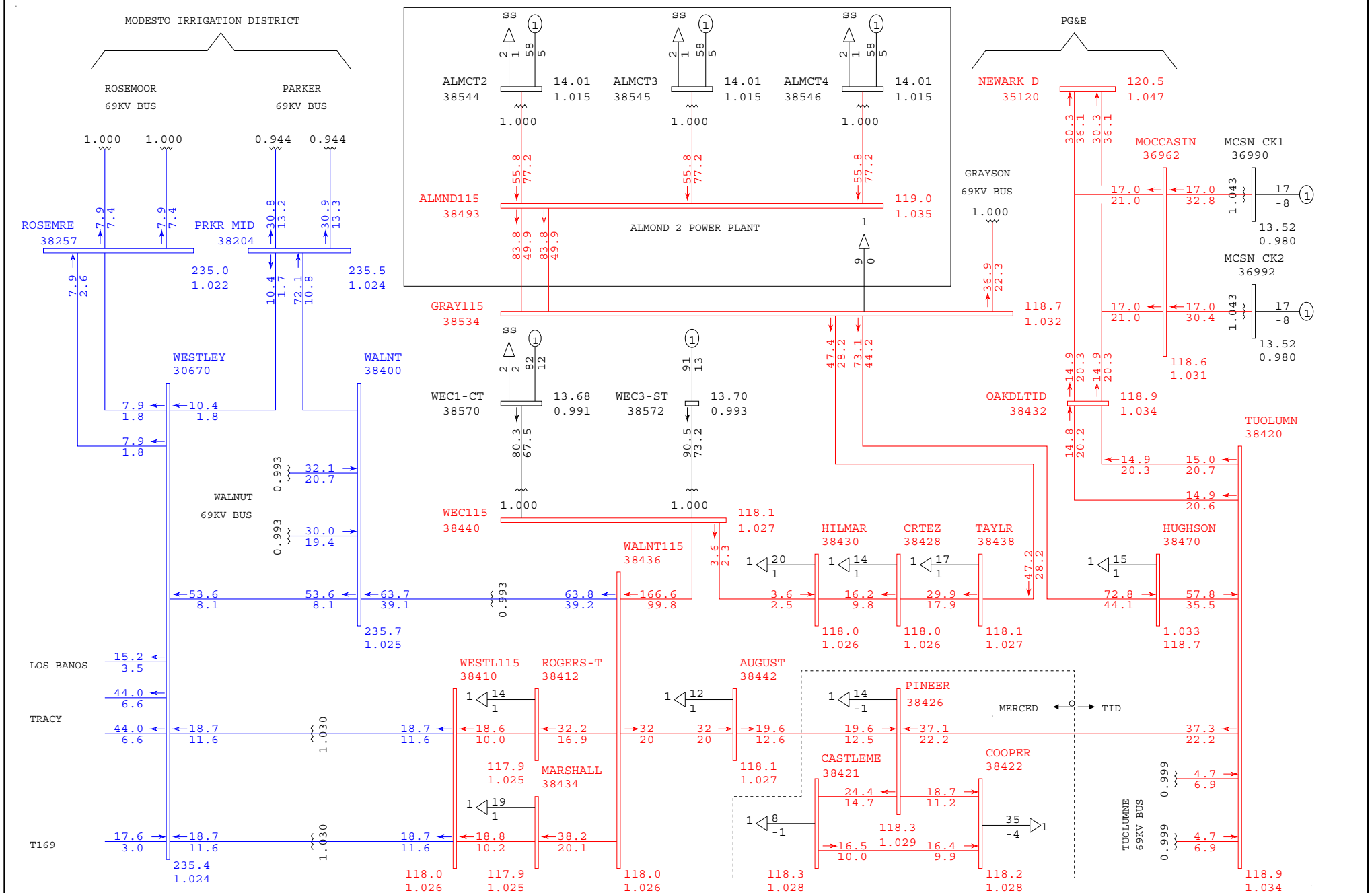
MW/% rate

TID_69_V1.drw

Rating = 1

# Power Flow Thermal Analysis One-Line Diagram

## 2012 Summer Off-Peak
## (Post-Project)

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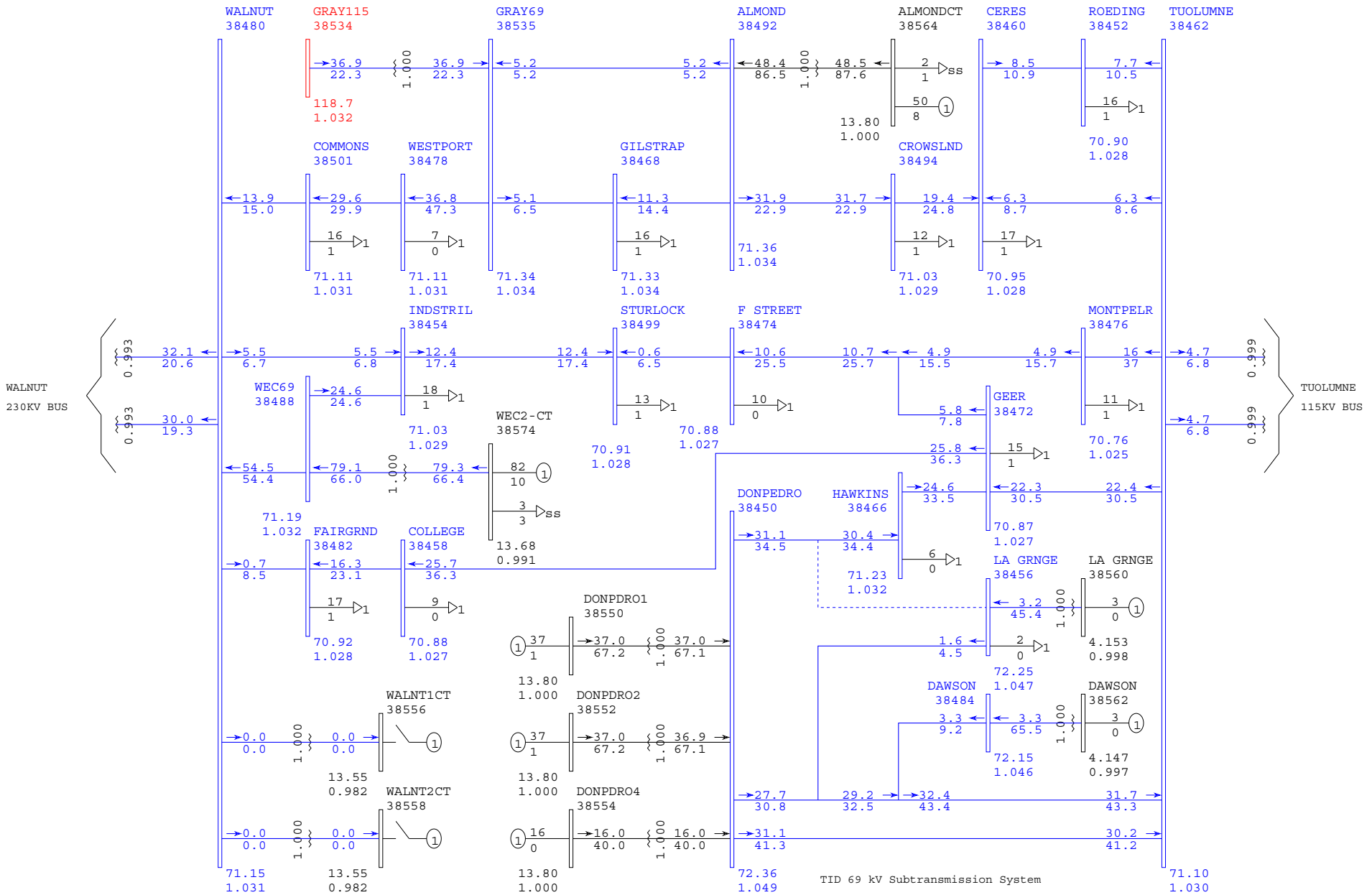
2012 Summer Off-Peak Base Case

MW/% rate

TID_230_115_V1.drw

Rating = 1




General Electric International, Inc. PSLF Program Mon Oct 19 23:53:26 2009 2012_sum_opk_pst.sav

2012 Summer Off-Peak Base Case

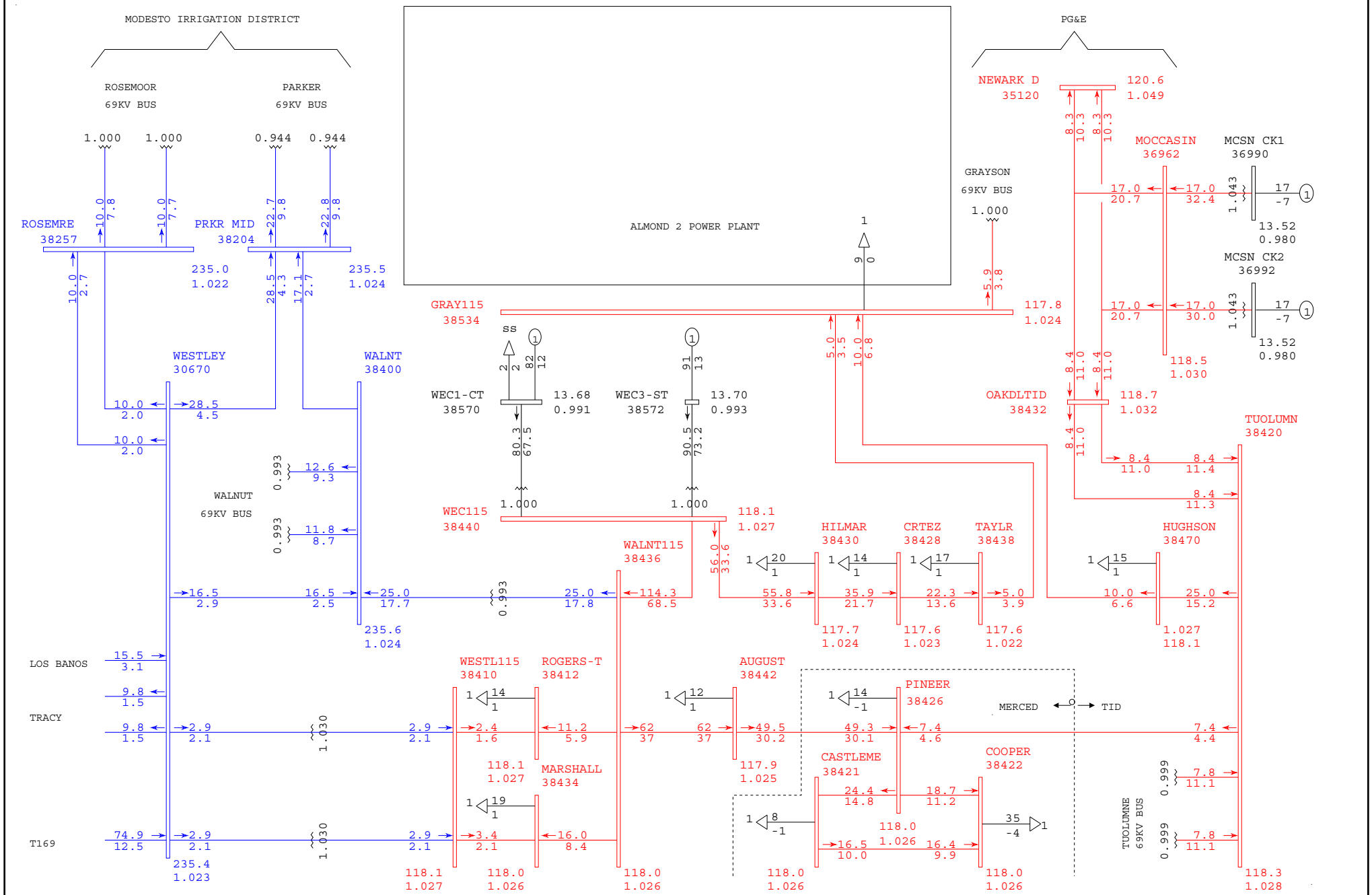
MW/% rate

TID_69_V1.drw

Rating = 1

# Power Flow Thermal Analysis One-Line Diagram

## 2012 Summer Off-Peak Sensitivity Case
## (Pre-Project)

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2012 Summer Off-Peak Base Case

MW/% rate

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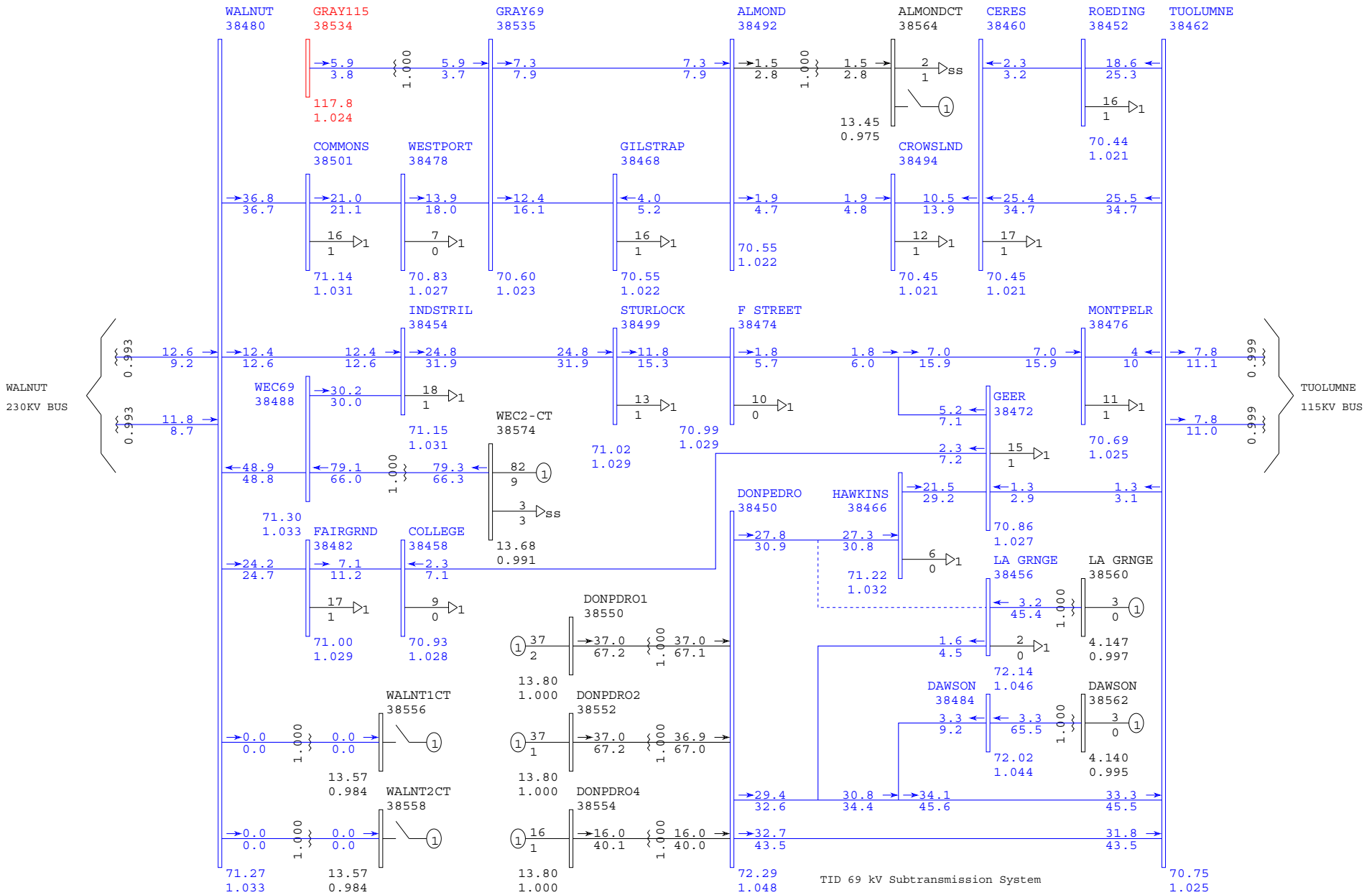
Rating = 1




General Electric International, Inc. PSLF Program Wed Oct 21 13:51:52 2009 2012_sum_mit_pre.sav

2012 Summer Off-Peak Base Case

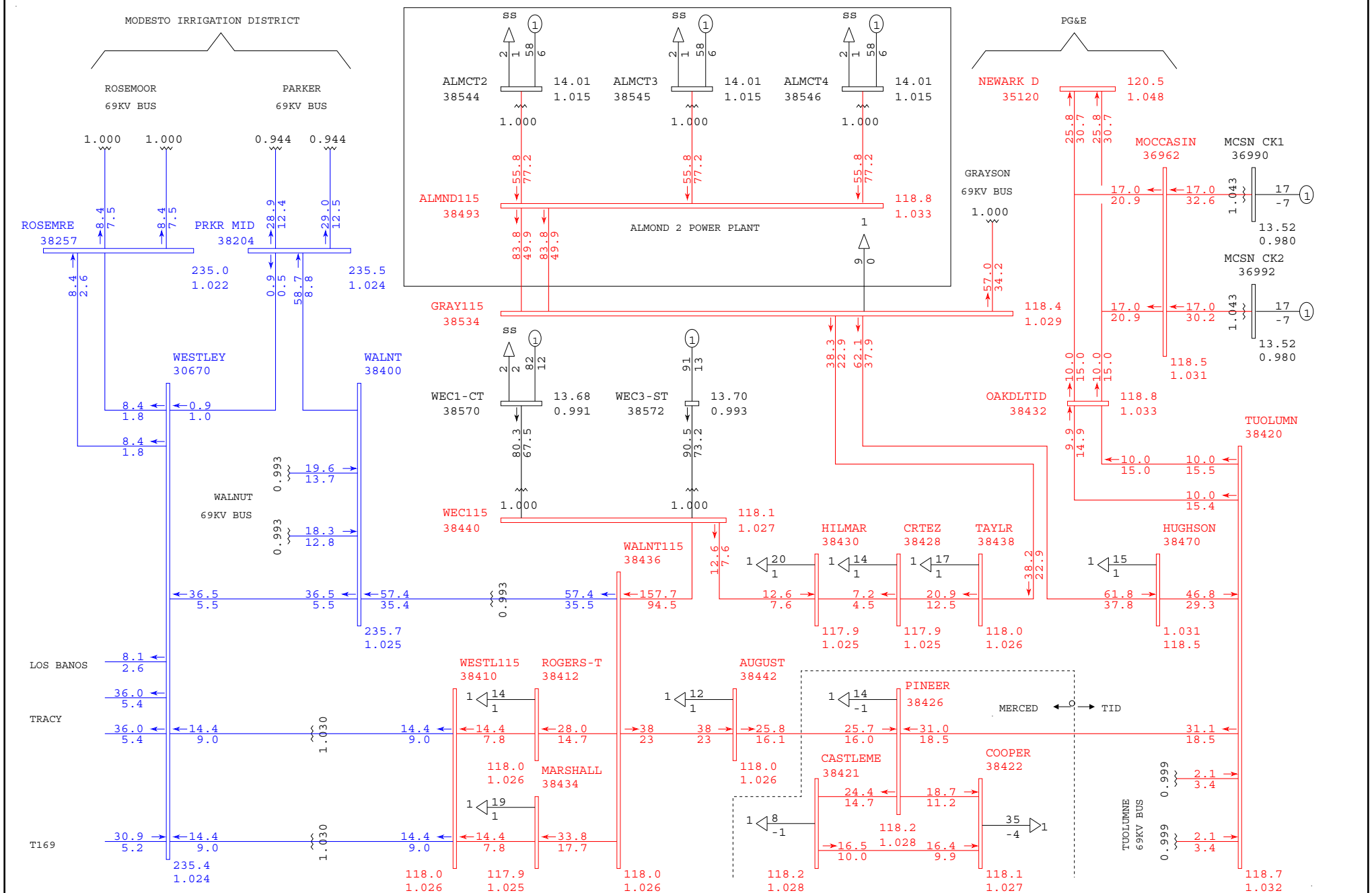
MW/% rate

TID_69_V1.drw

Rating = 1

# Power Flow Thermal Analysis One-Line Diagram

## 2012 Summer Off-Peak Sensitivity Case
## (Post-Project)

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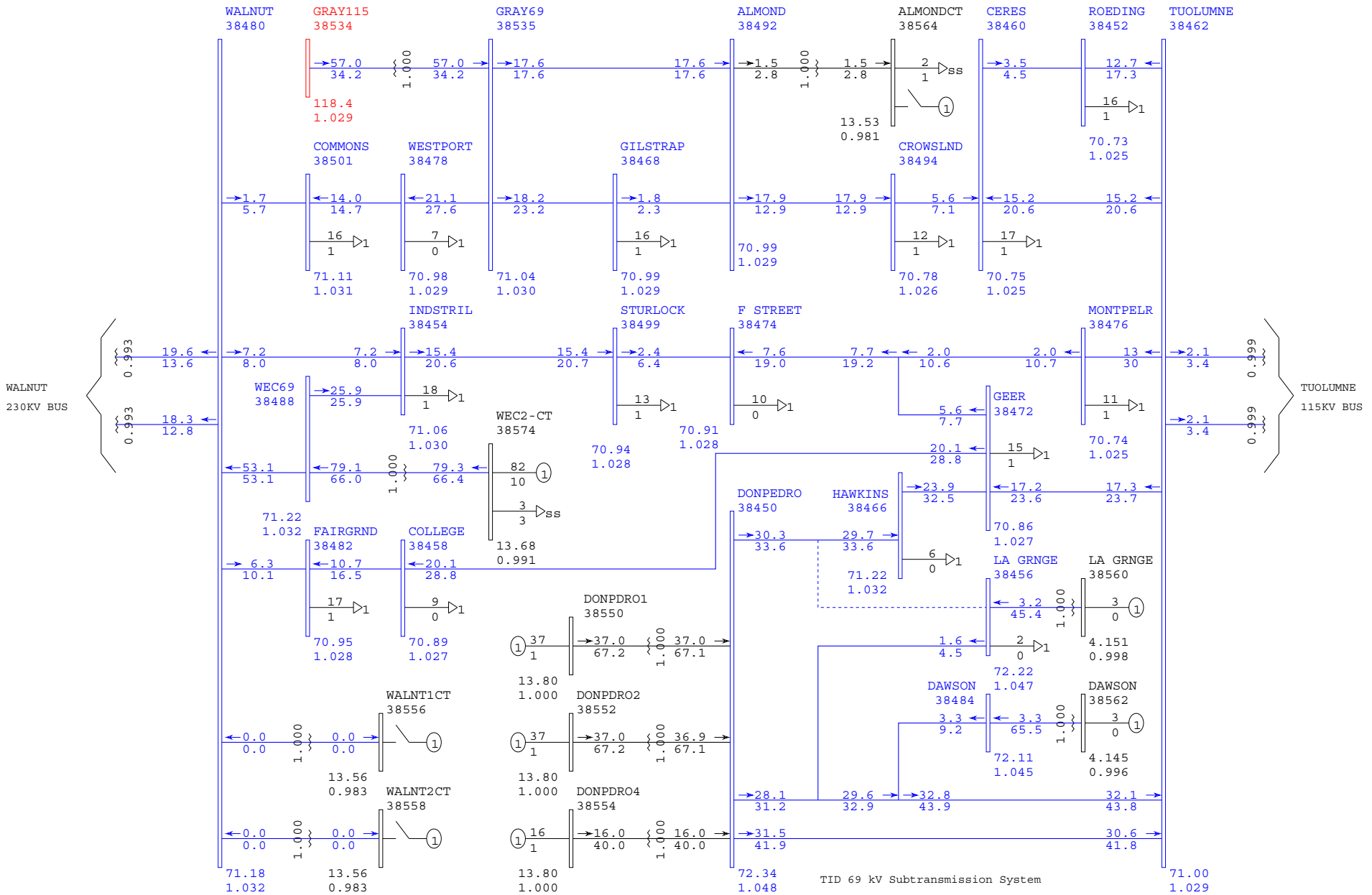
2012 Summer Off-Peak Base Case

MW/% rate

TID_230_115_V1.drw

Rating = 1




General Electric International, Inc. PSLF Program Wed Oct 21 13:51:52 2009 2012_sum_mit_pst.sav

2012 Summer Off-Peak Base Case

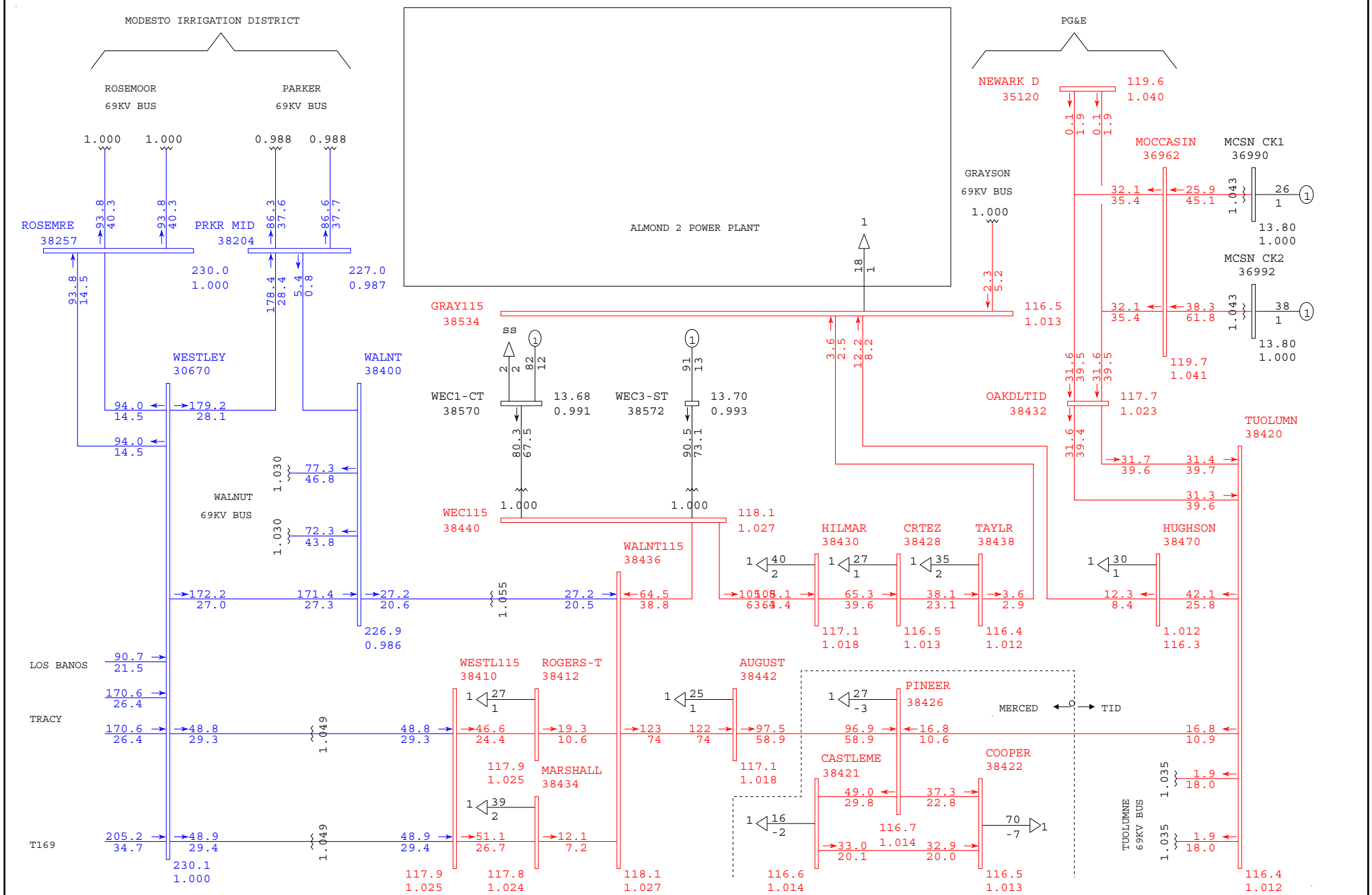
MW/% rate

TID_69_V1.drw

Rating = 1

# Power Flow Thermal Analysis One-Line Diagram

## 2012 Summer Peak
## (Pre-Project)

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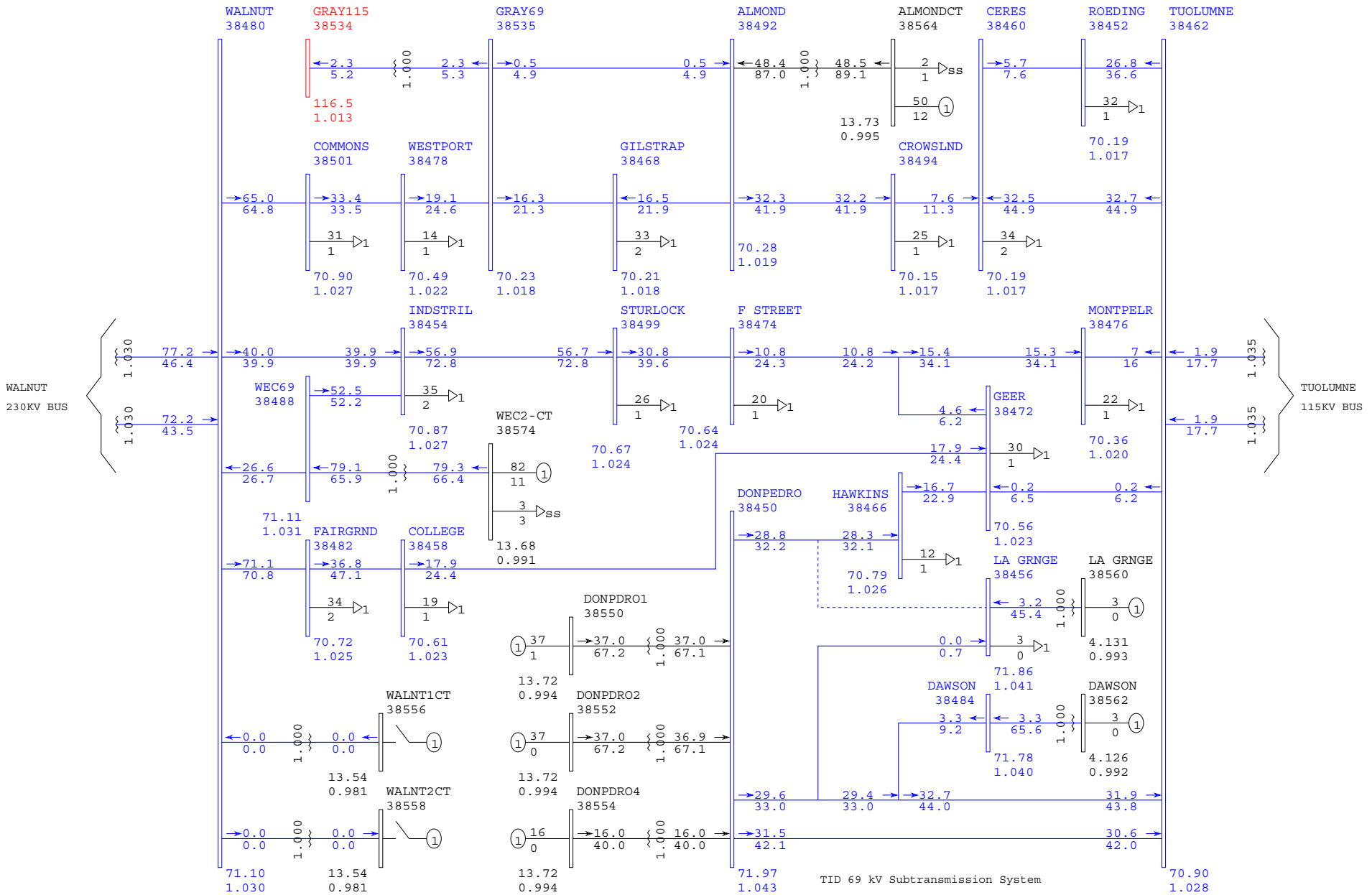
2012 Summer Peak Base Case

MW/% rate

TID_230_115_V1.drw

Rating = 1




General Electric International, Inc. PSLF Program Mon Oct 19 23:53:27 2009 2012_sum_pk_pre.sav

2012 Summer Peak Base Case

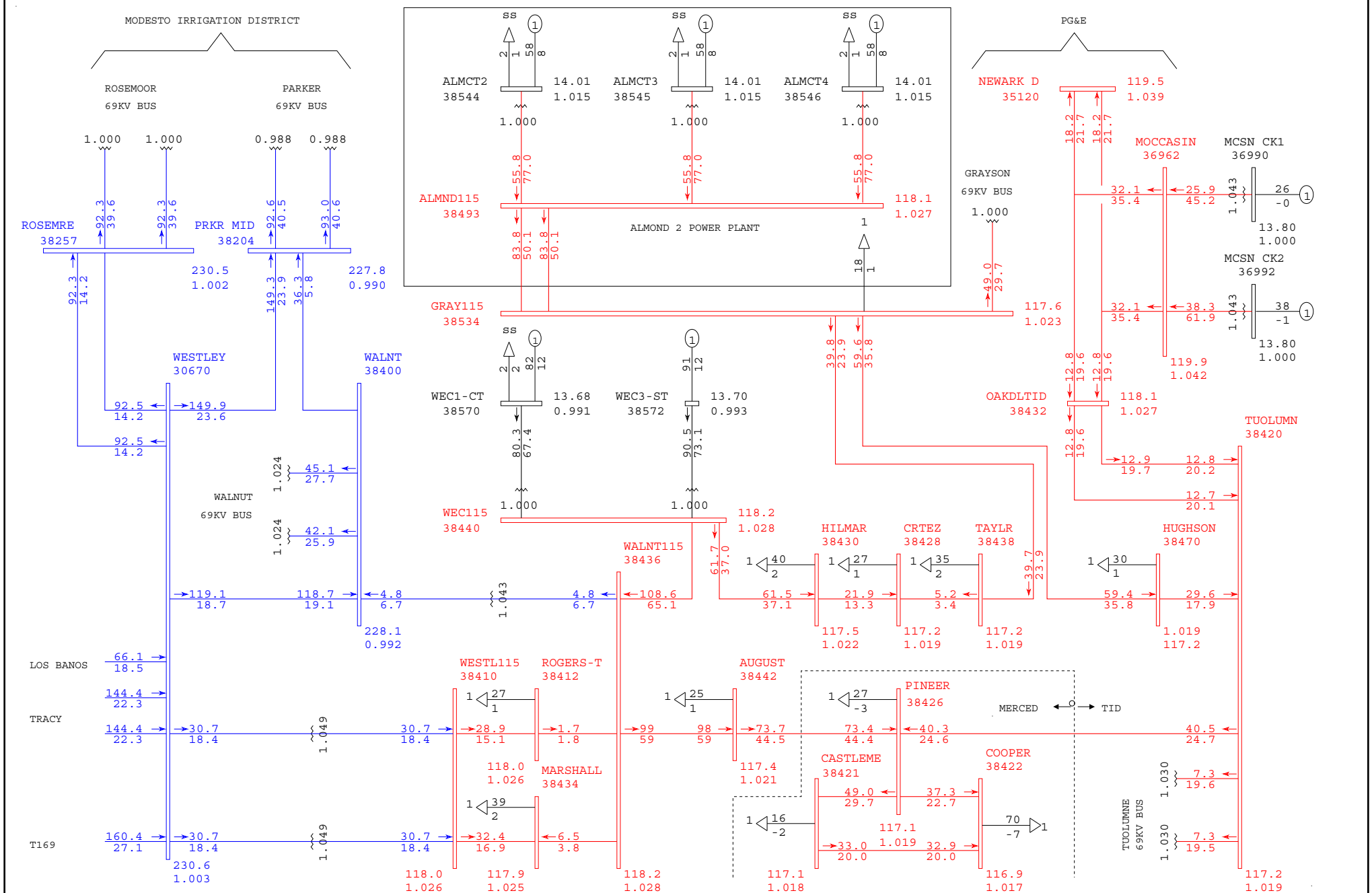
MW/% rate

TID_69_V1.drw

Rating = 1

# Power Flow Thermal Analysis One-Line Diagram

## 2012 Summer Peak
## (Post-Project)



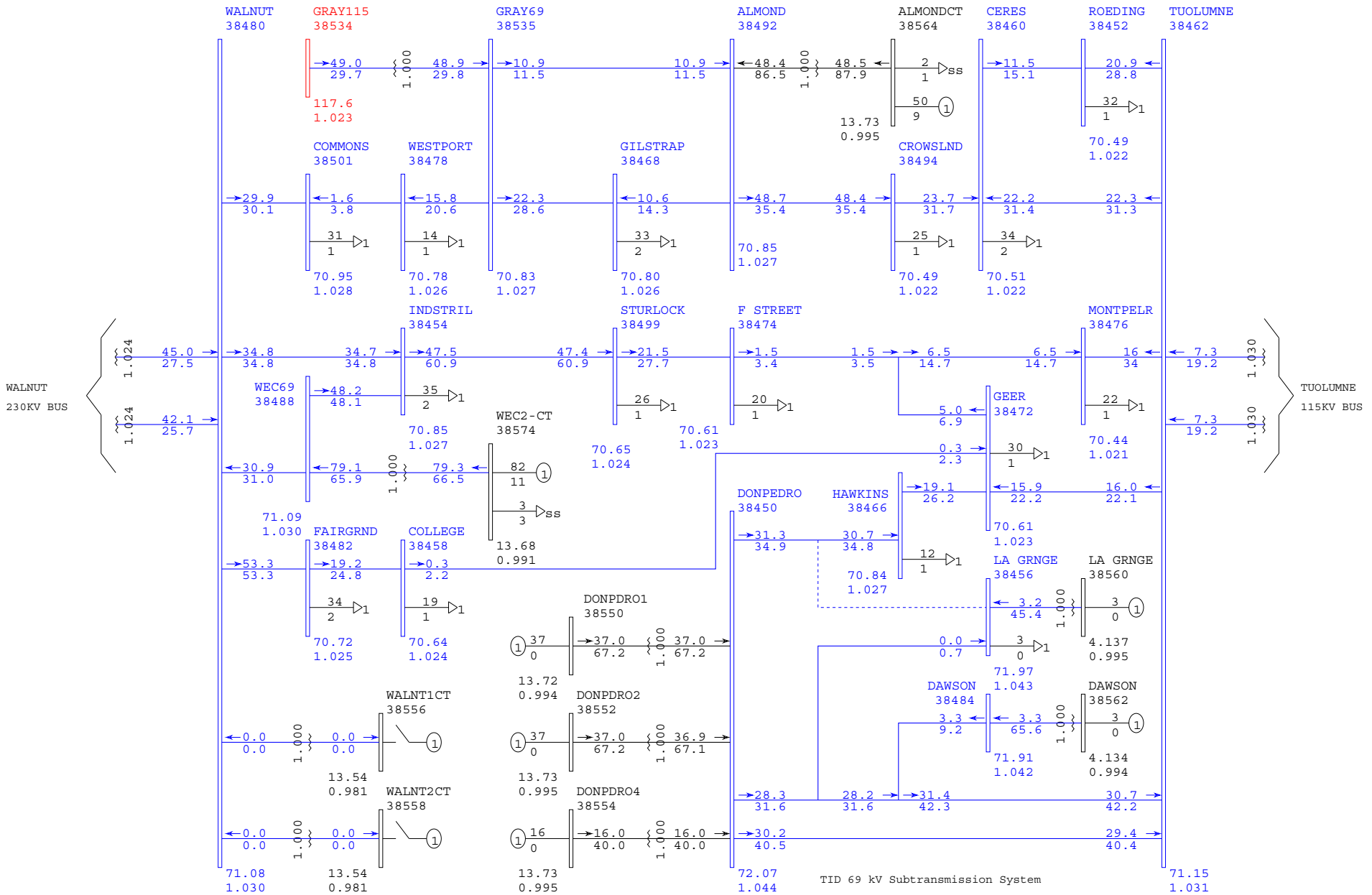

General Electric International, Inc. PSLF Program Mon Oct 19 23:53:25 2009 2012_sum_pk_pst.sav

2012 Summer Peak Base Case

MW/% rate

TID_230_115_V1.drw

Rating = 1




General Electric International, Inc. PSLF Program Mon Oct 19 23:53:27 2009 2012_sum_pk_pst.sav

2012 Summer Peak Base Case

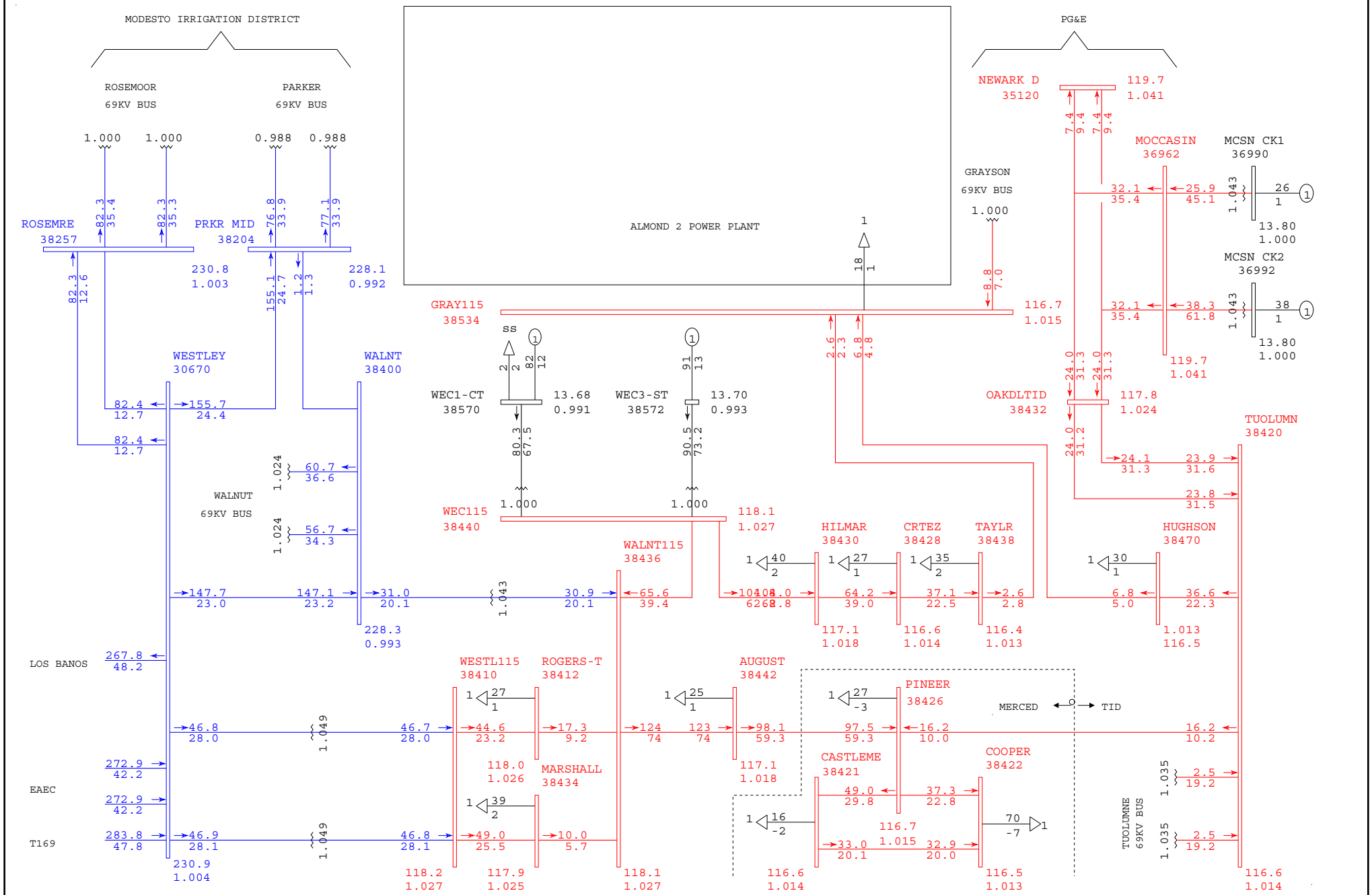
MW/% rate

TID_69_V1.drw

Rating = 1

# Power Flow Thermal Analysis One-Line Diagram

## 2012 Summer Peak Sensitivity Case
## (Pre-Project)



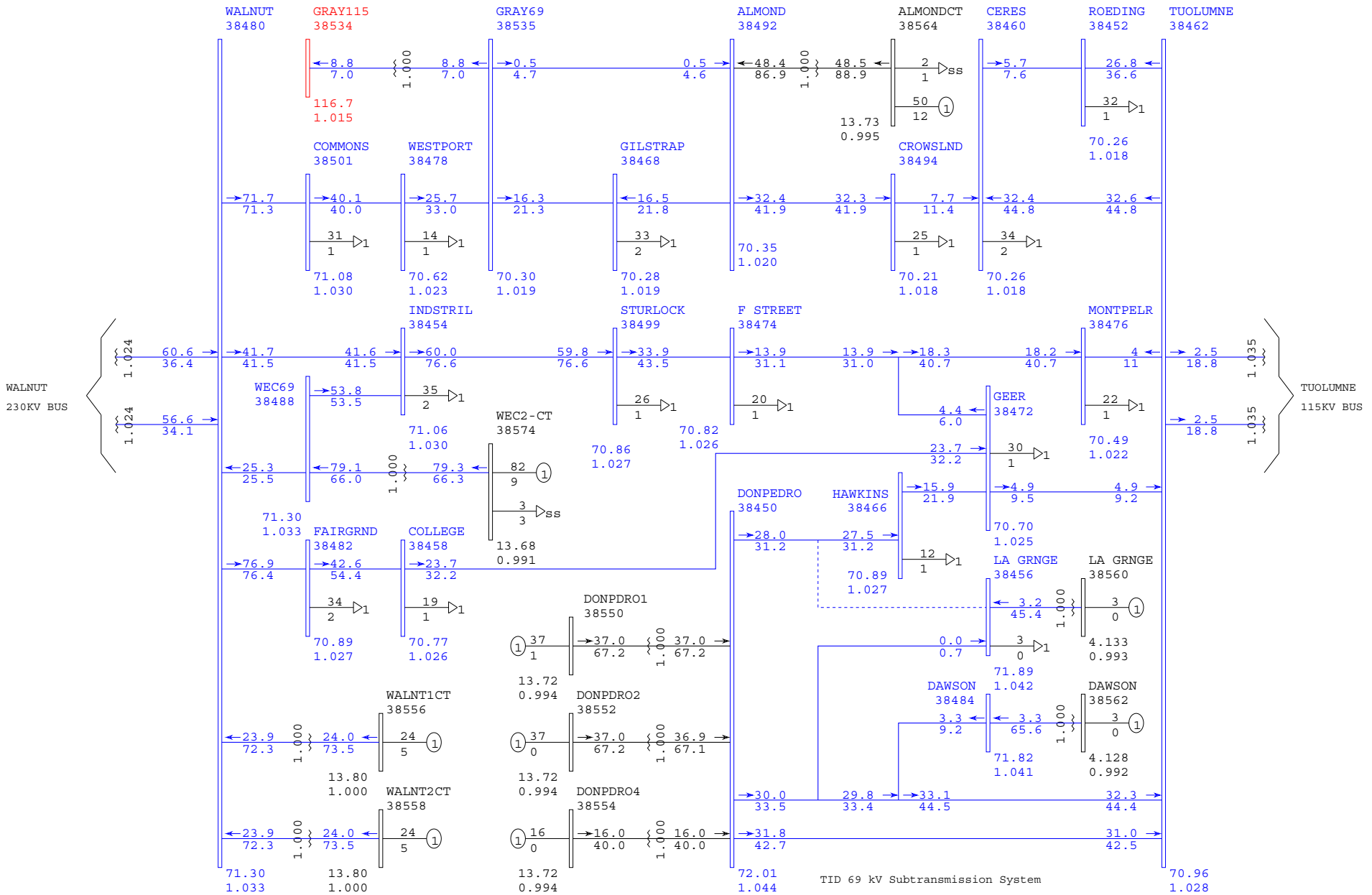

General Electric International, Inc. PSLF Program Mon Oct 19 23:53:28 2009 2012_sum_sen_pre.sav

2012 Summer Peak Base Case (Sensitivity)

MW/% rate

TID_230_115_V2.drw

Rating = 1

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2012 Summer Peak Base Case (Sensitivity)

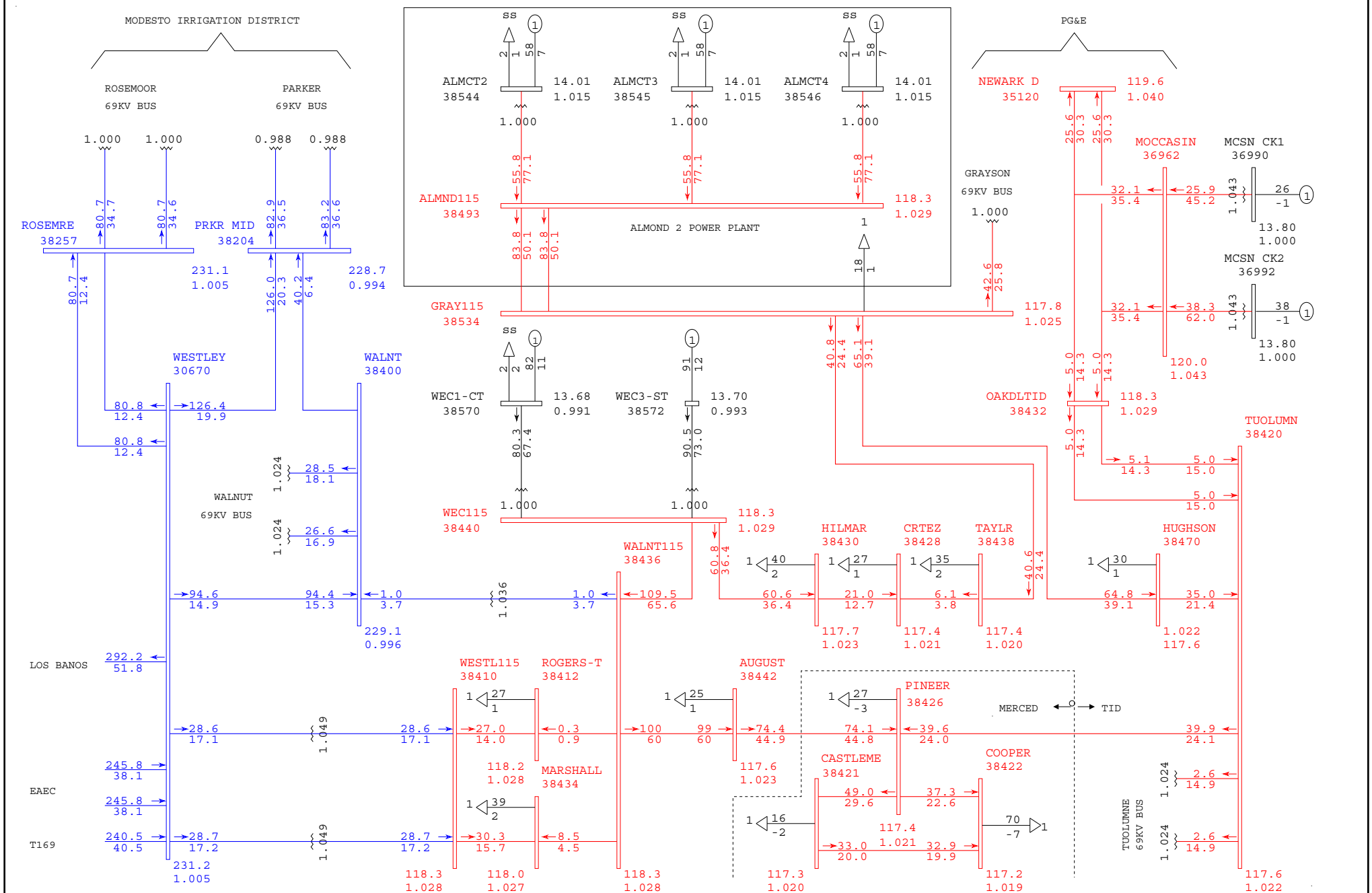
MW/% rate

TID_69_V1.drw

Rating = 1

# Power Flow Thermal Analysis One-Line Diagram

## 2012 Summer Peak Sensitivity Case
## (Post-Project)



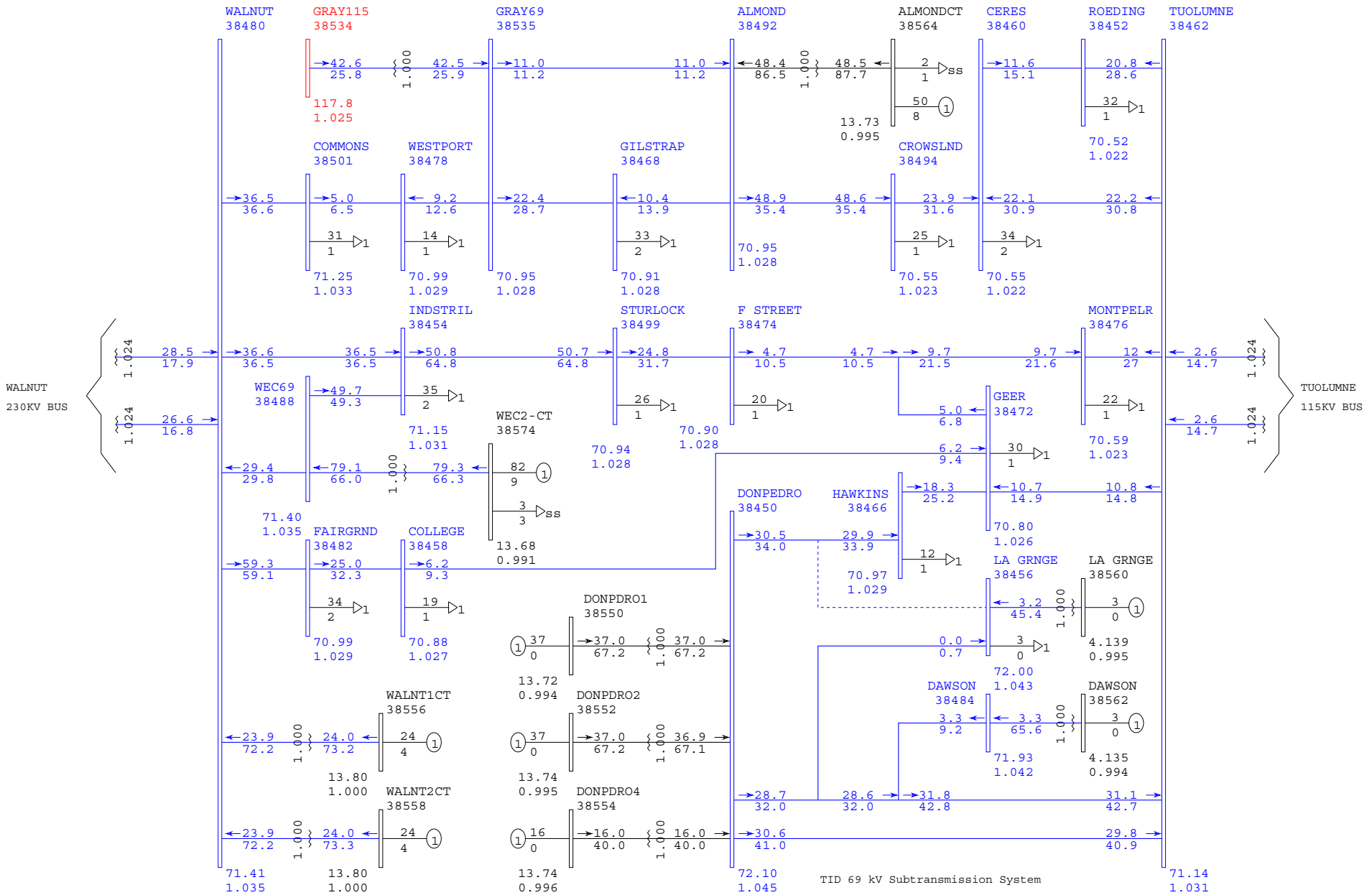

General Electric International, Inc. PSLF Program Mon Oct 19 23:53:28 2009 2012_sum_sen_pst.sav

2012 Summer Peak Base Case (Sensitivity)

MW/% rate

TID_230_115_V2.drw

Rating = 1




General Electric International, Inc. PSLF Program Mon Oct 19 23:53:29 2009 2012_sum_sen_pst.sav

2012 Summer Peak Base Case (Sensitivity)

MW/% rate

TID_69_V1.drw

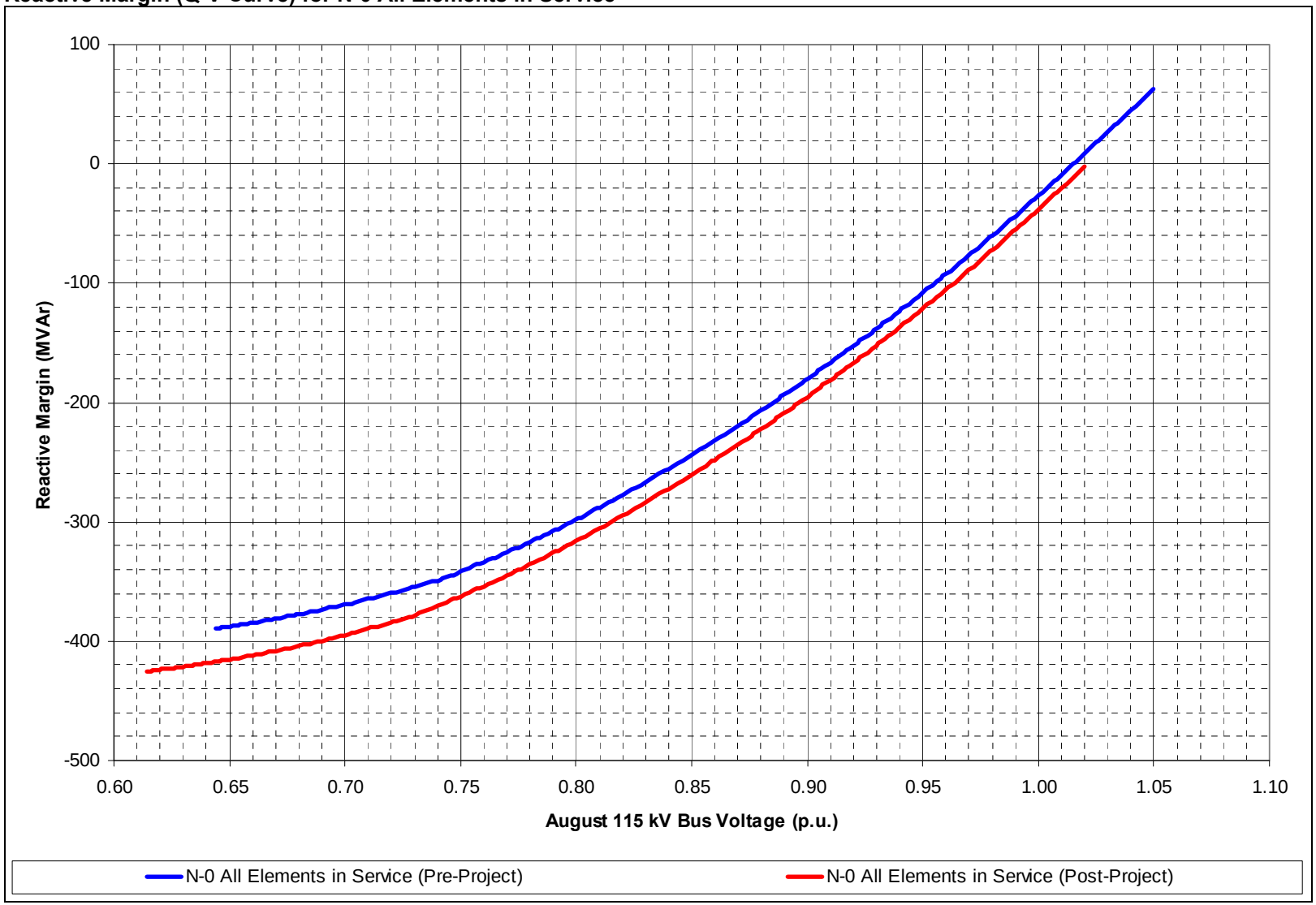
Rating = 1

# Turlock Irrigation District
# Almond 2 Power Plant
# (09-AFC-2)

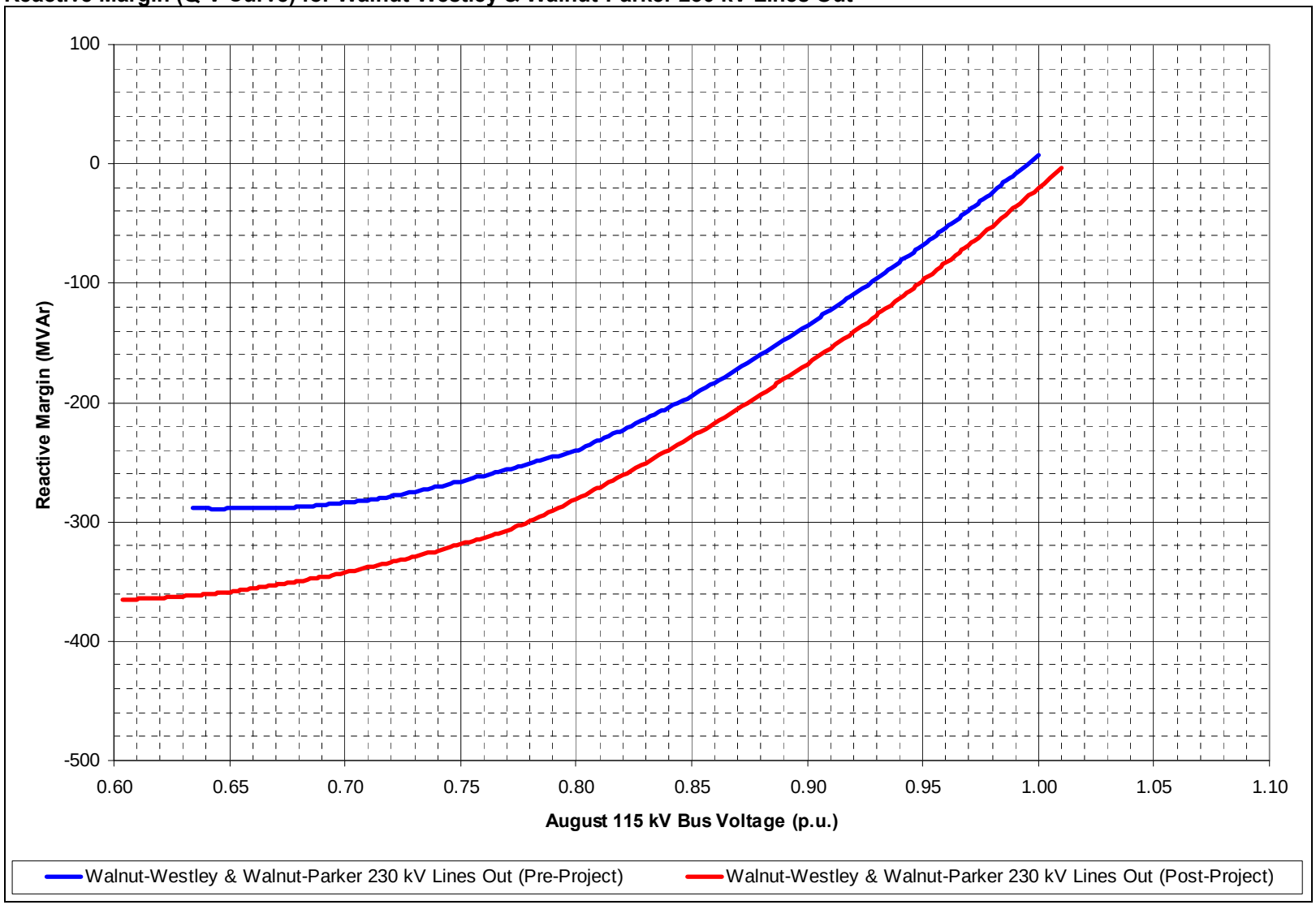
## Appendix 10

TID Local System Voltage Stability
Reactive Margin (Q-V Curves)

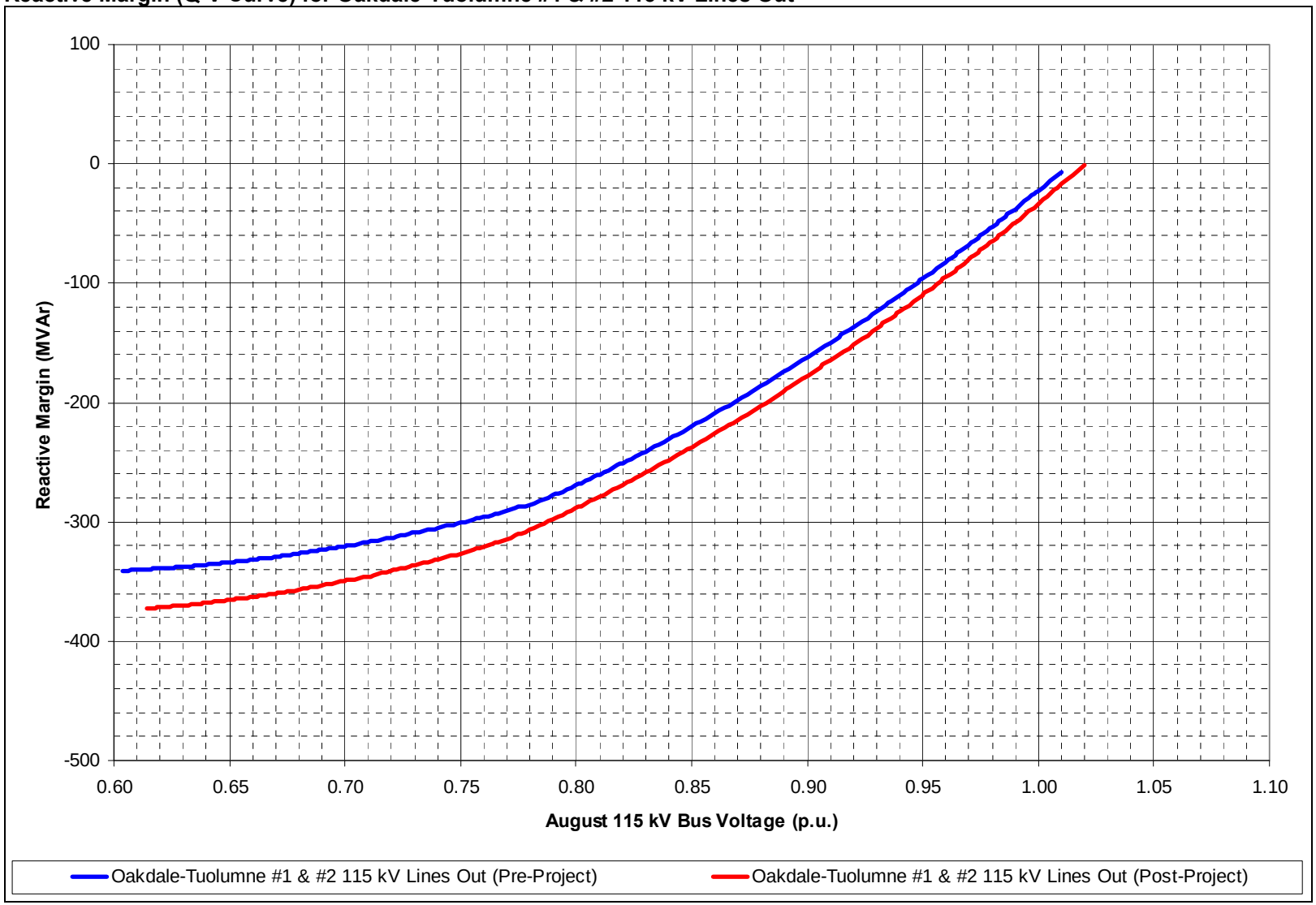
**Reactive Margin (Q-V Curve) for N-0 All Elements in Service**



**Reactive Margin (Q-V Curve) for Walnut-Westley & Walnut-Parker 230 kV Lines Out**



**Reactive Margin (Q-V Curve) for Oakdale-Tuolumne #1 & #2 115 kV Lines Out**



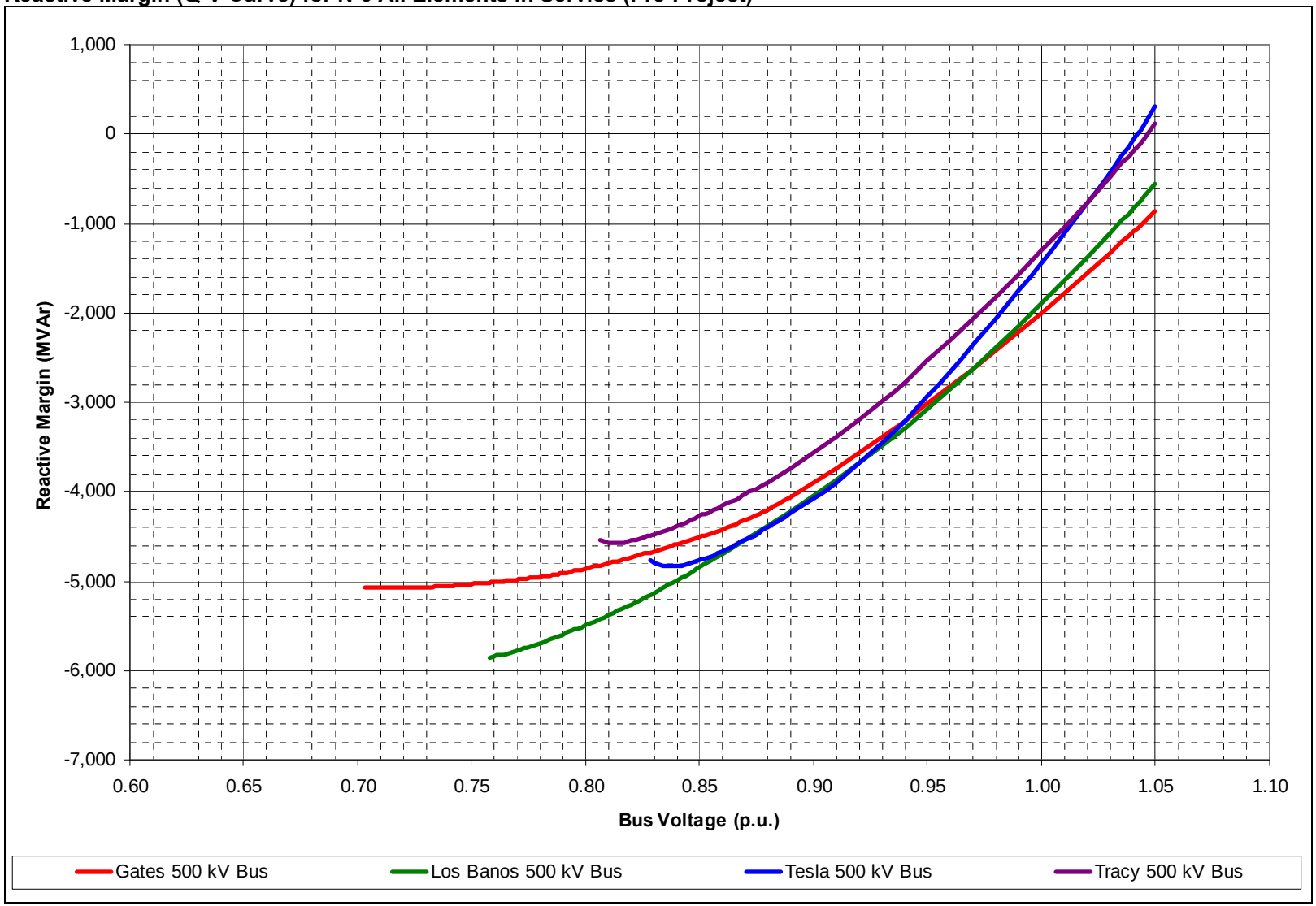
**Reactive Margin (Q-V Curve) for Westley-Marshall & Westley-Rogers 115 kV Lines Out**

# Turlock Irrigation District
# Almond 2 Power Plant
# (09-AFC-2)

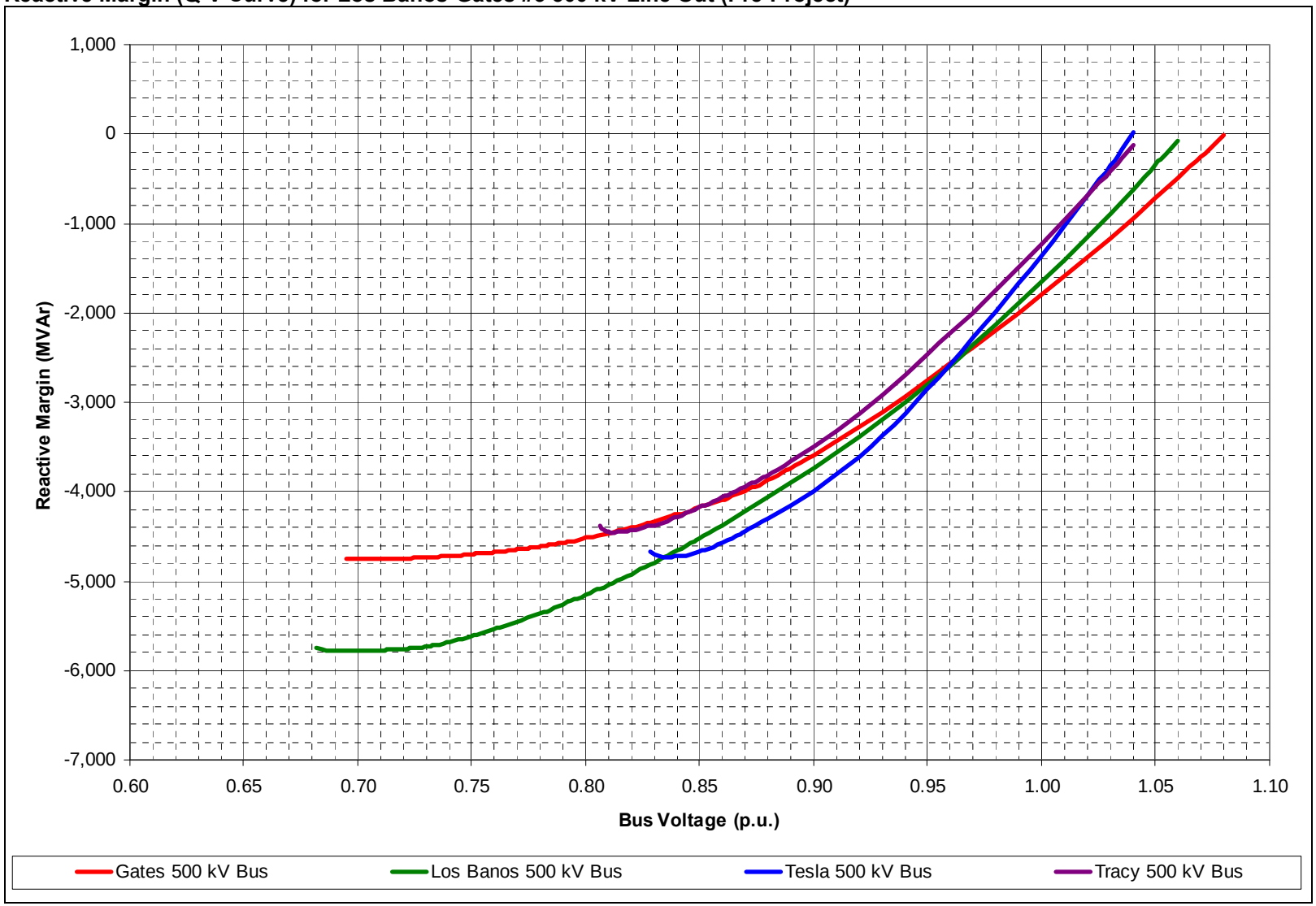
## Appendix 11

500 kV Bulk Transmission System Voltage Stability
Reactive Margin (Q-V Curves)

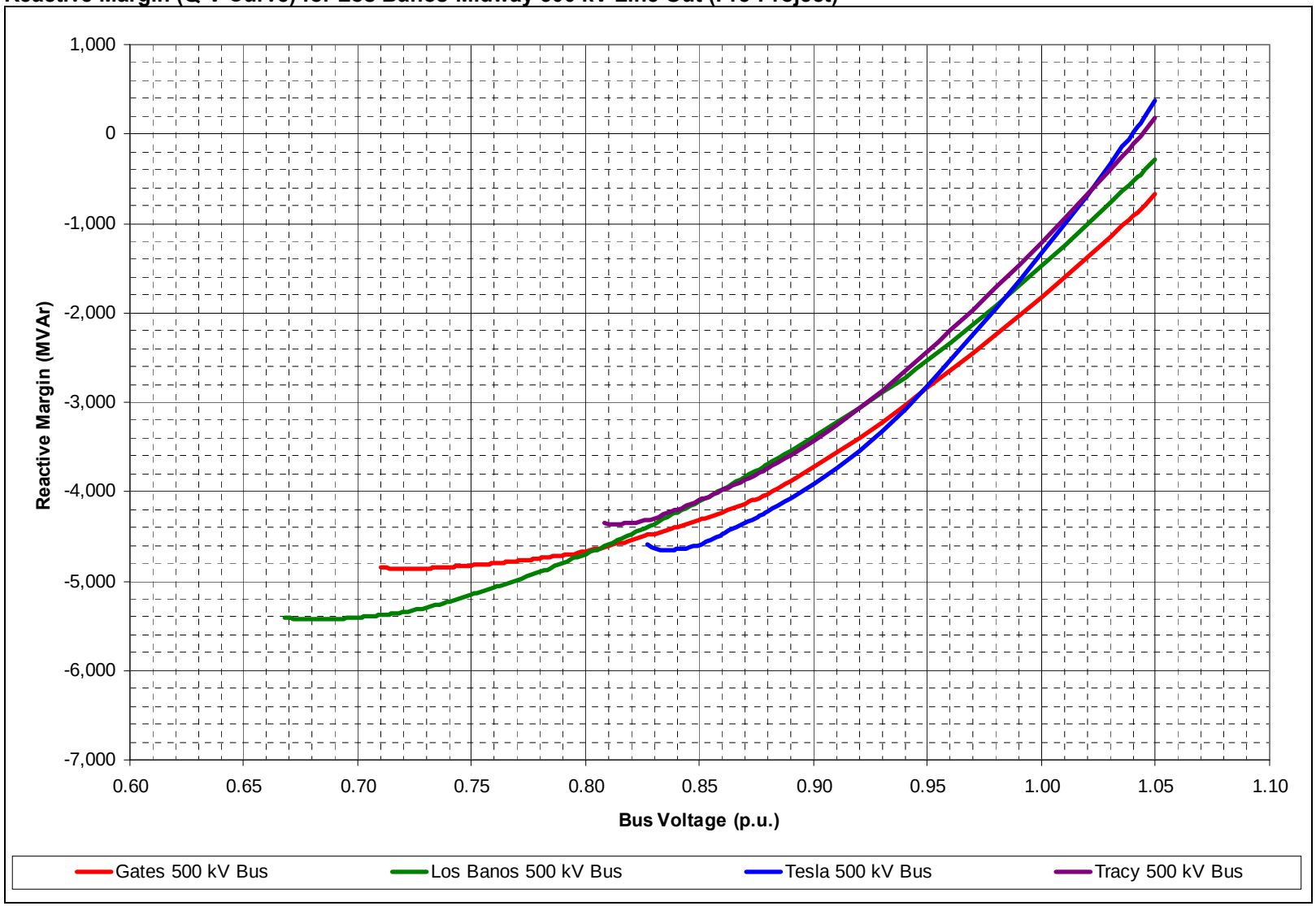
**Reactive Margin (Q-V Curve) for N-0 All Elements in Service (Pre-Project)**



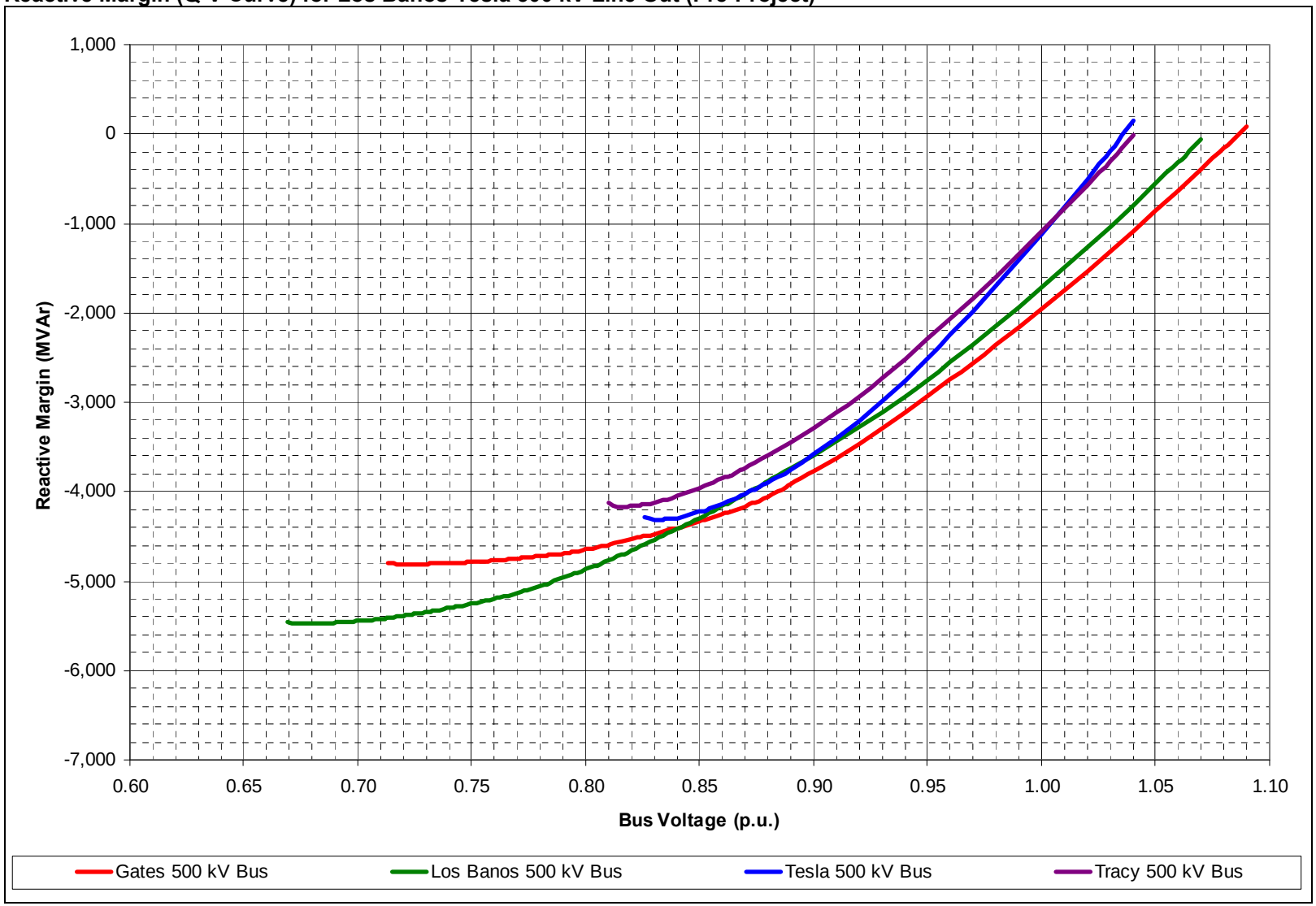
**Reactive Margin (Q-V Curve) for Los Banos-Gates #3 500 kV Line Out (Pre-Project)**



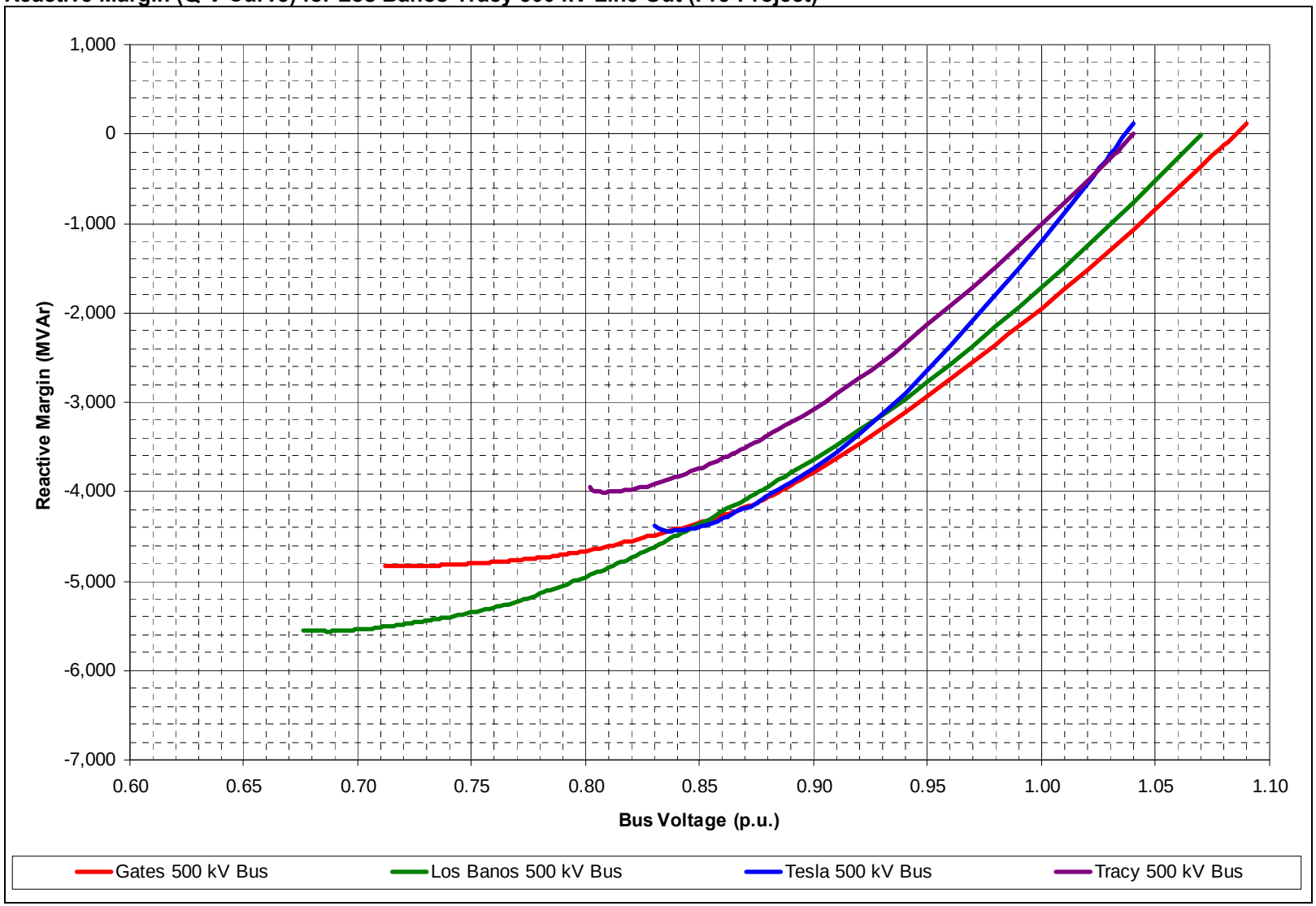
**Reactive Margin (Q-V Curve) for Los Banos-Midway 500 kV Line Out (Pre-Project)**



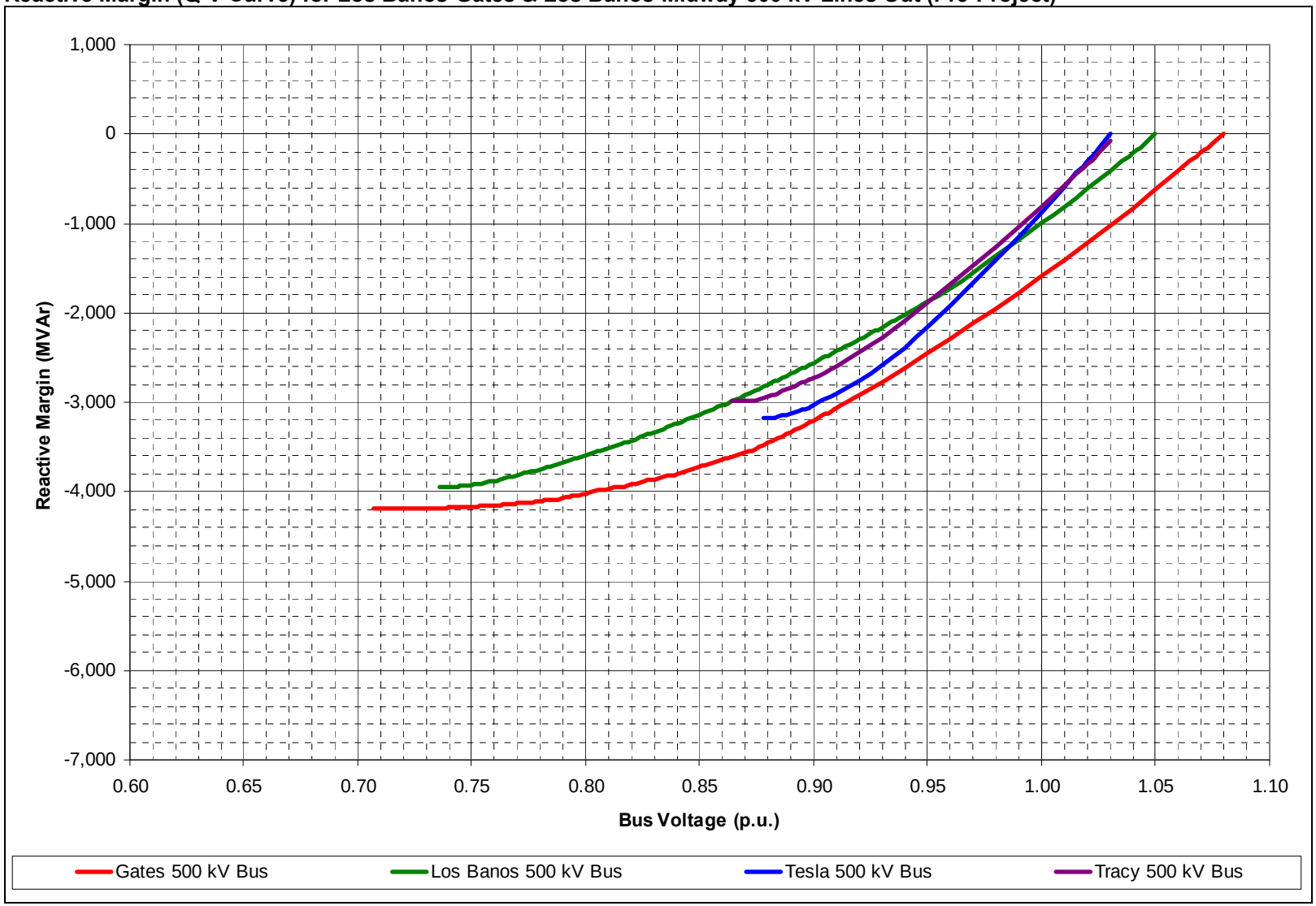
**Reactive Margin (Q-V Curve) for Los Banos-Tesla 500 kV Line Out (Pre-Project)**



**Reactive Margin (Q-V Curve) for Los Banos-Tracy 500 kV Line Out (Pre-Project)**

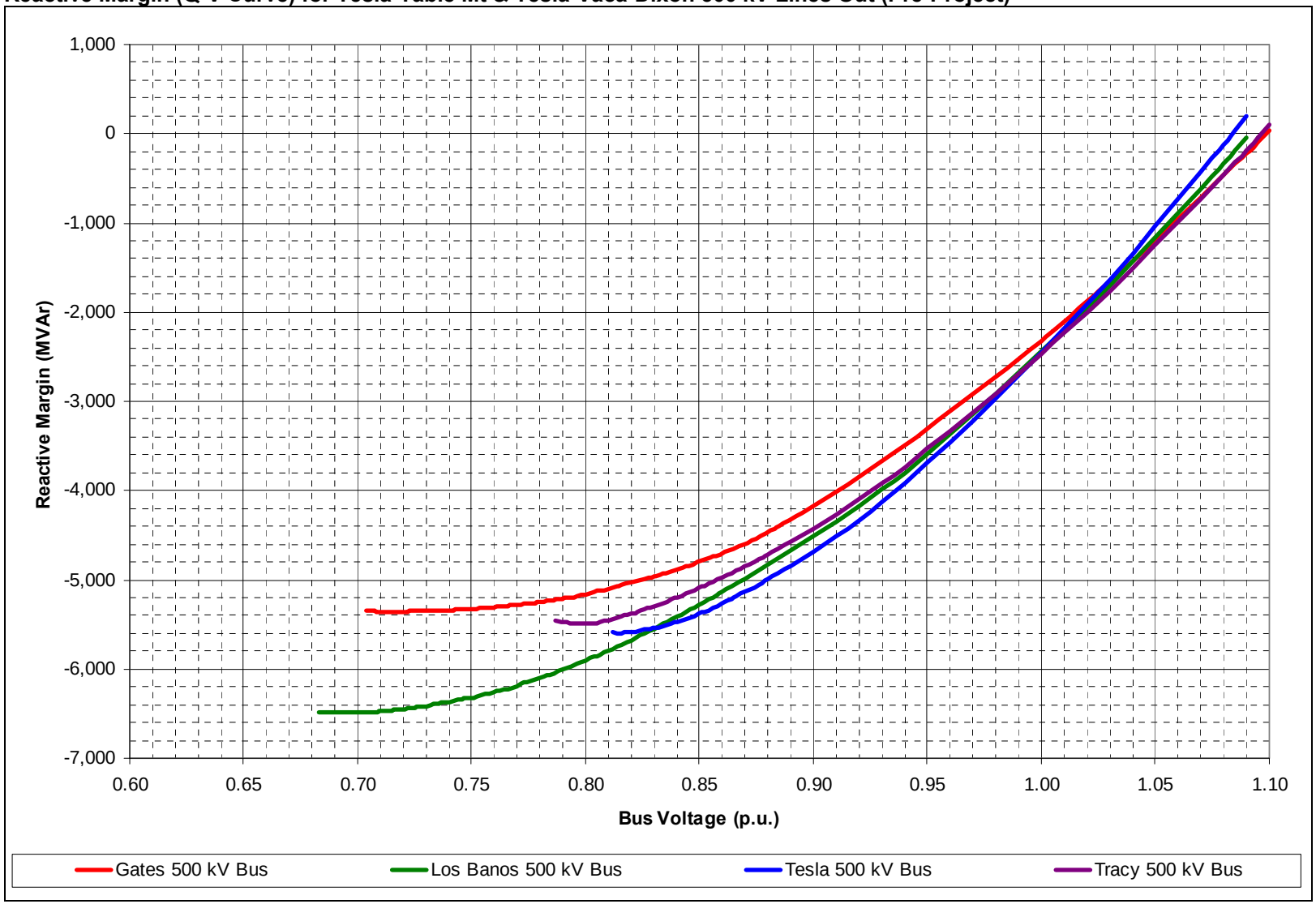


**Reactive Margin (Q-V Curve) for Los Banos-Gates & Los Banos-Midway 500 kV Lines Out (Pre-Project)**

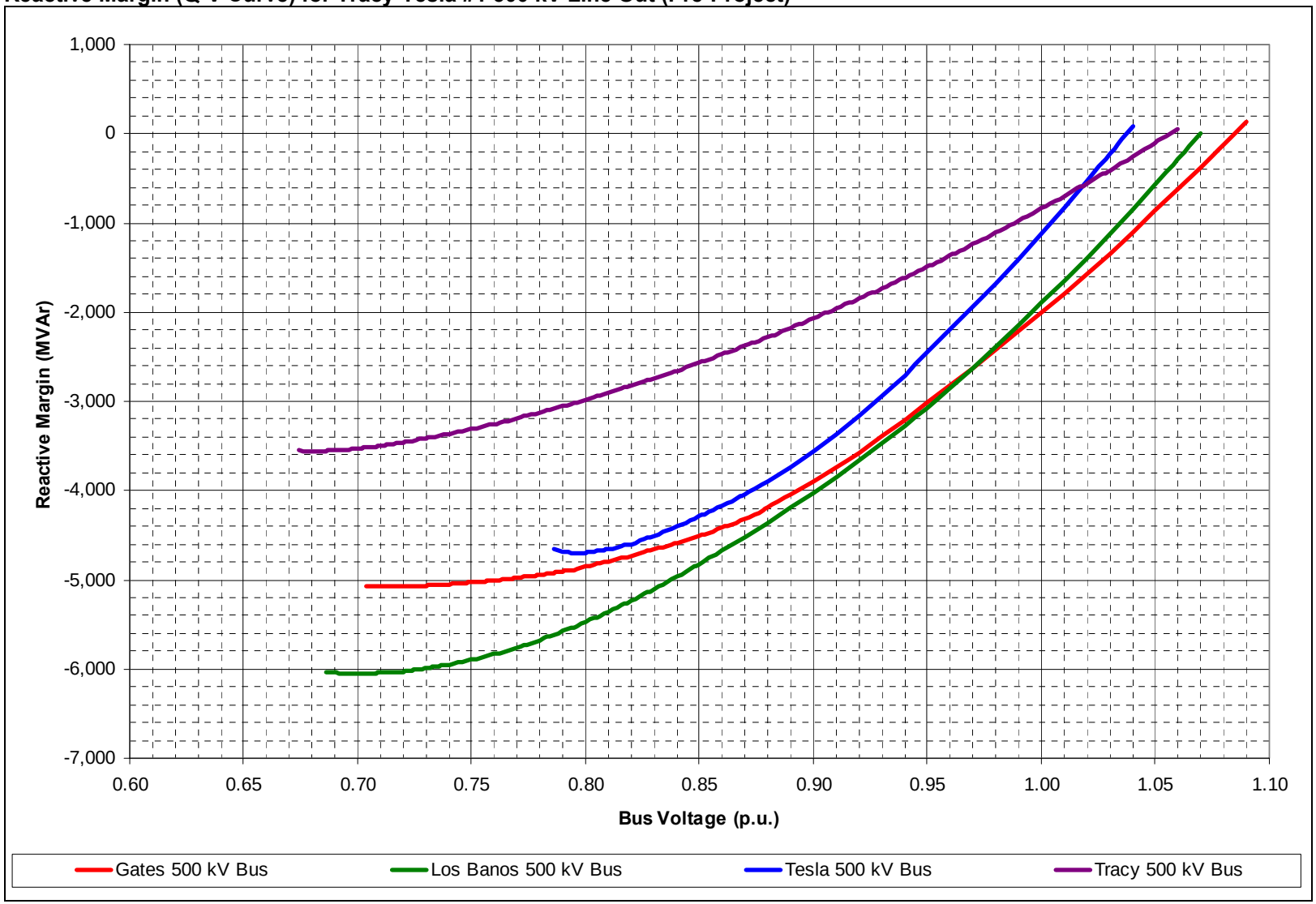


**Reactive Margin (Q-V Curve) for Los Banos-Tesla & Los Banos-Tracy 500 kV Lines Out (Pre-Project)**

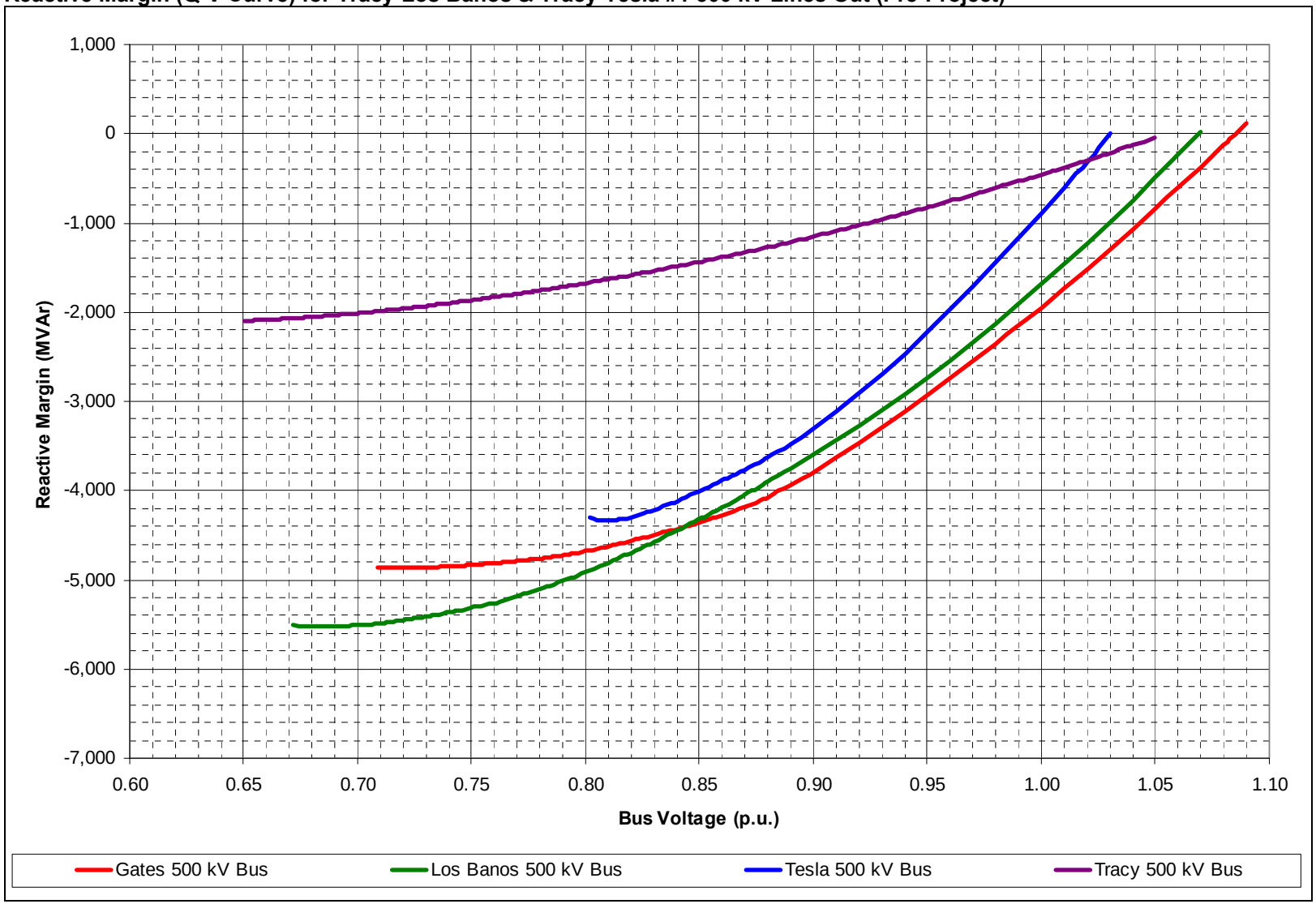
**Reactive Margin (Q-V Curve) for Tesla-Table Mt & Tesla-Vaca-Dixon 500 kV Lines Out (Pre-Project)**



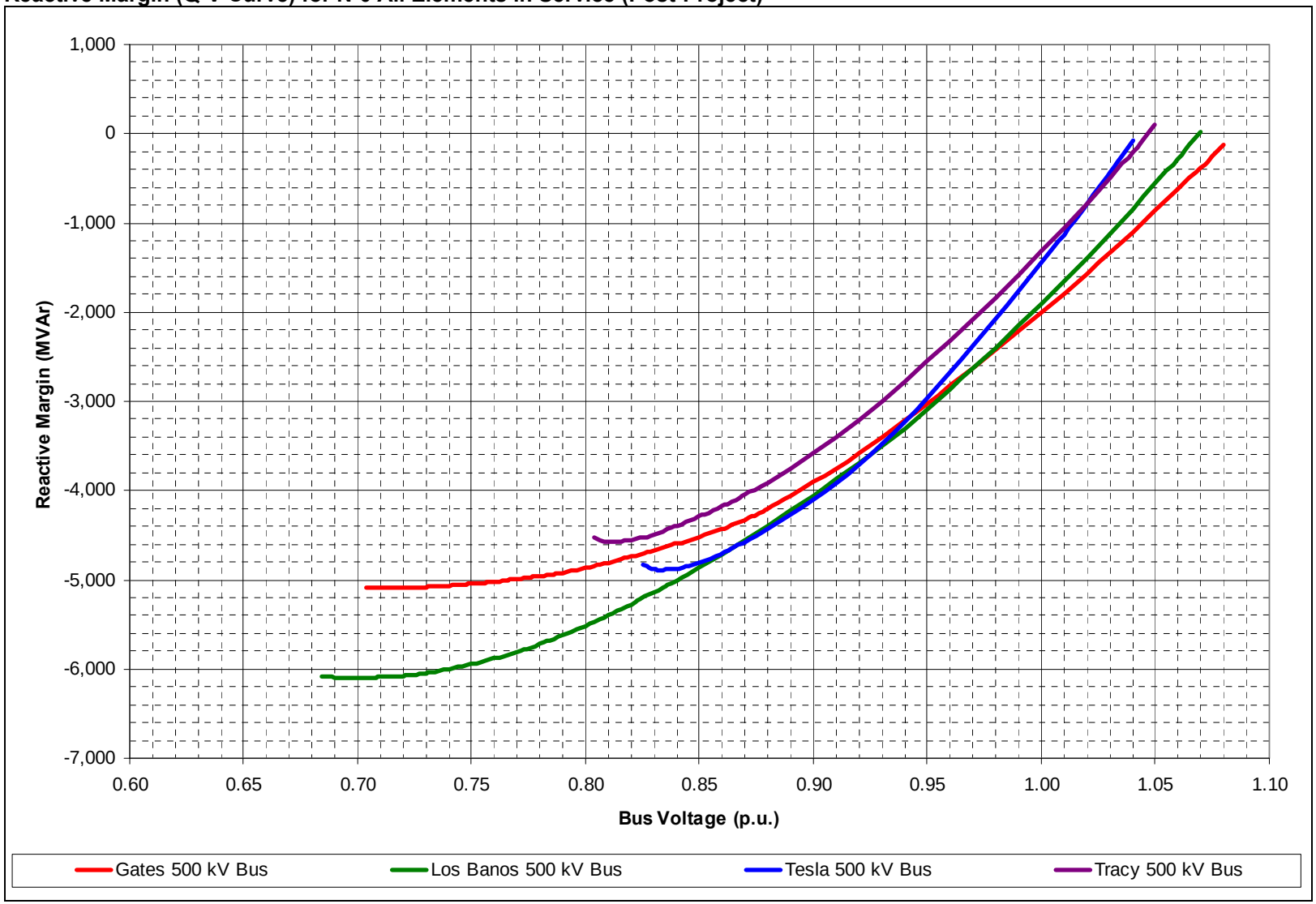
**Reactive Margin (Q-V Curve) for Tracy-Tesla #1 500 kV Line Out (Pre-Project)**



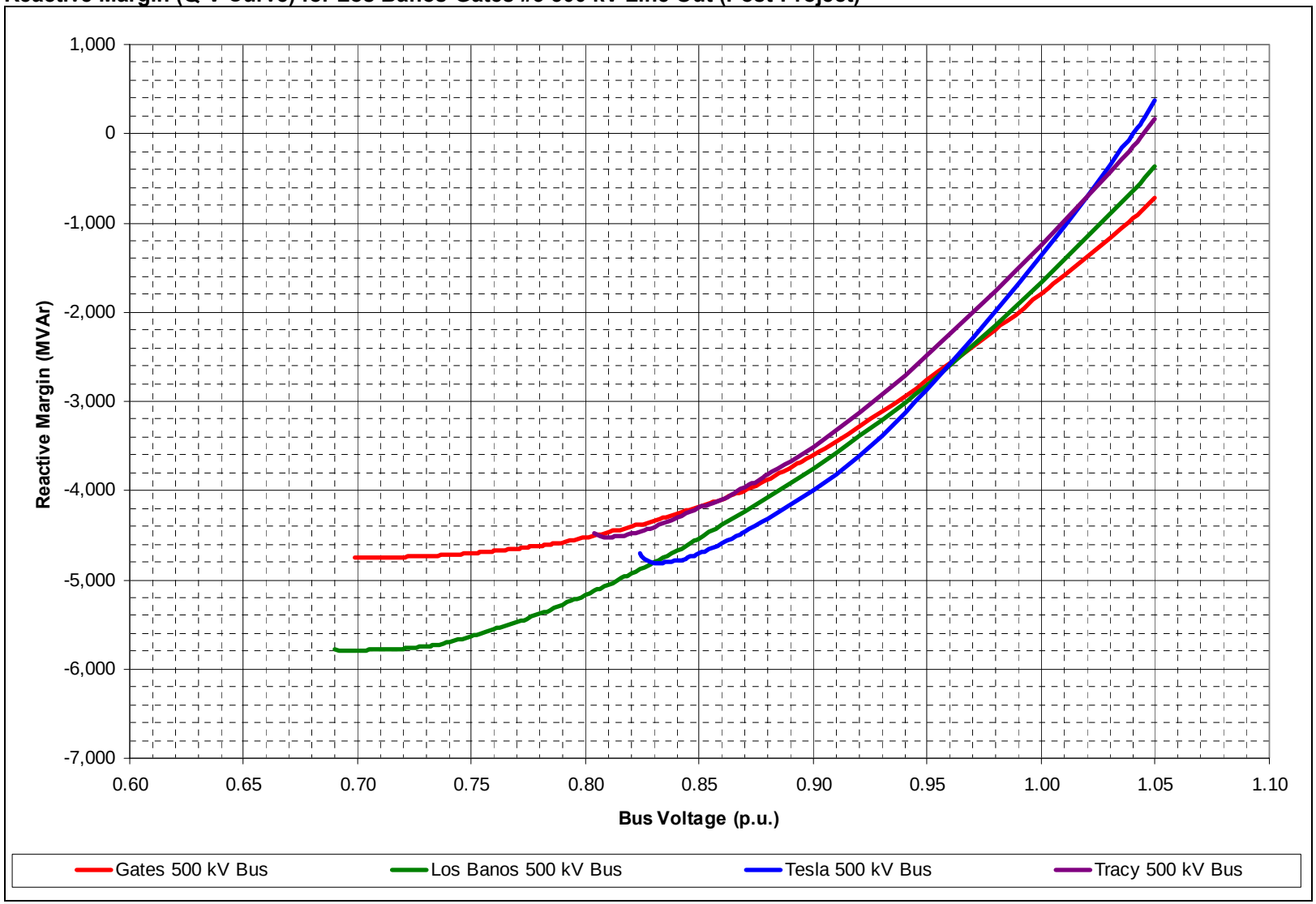
**Reactive Margin (Q-V Curve) for Tracy-Los Banos & Tracy-Tesla #1 500 kV Lines Out (Pre-Project)**



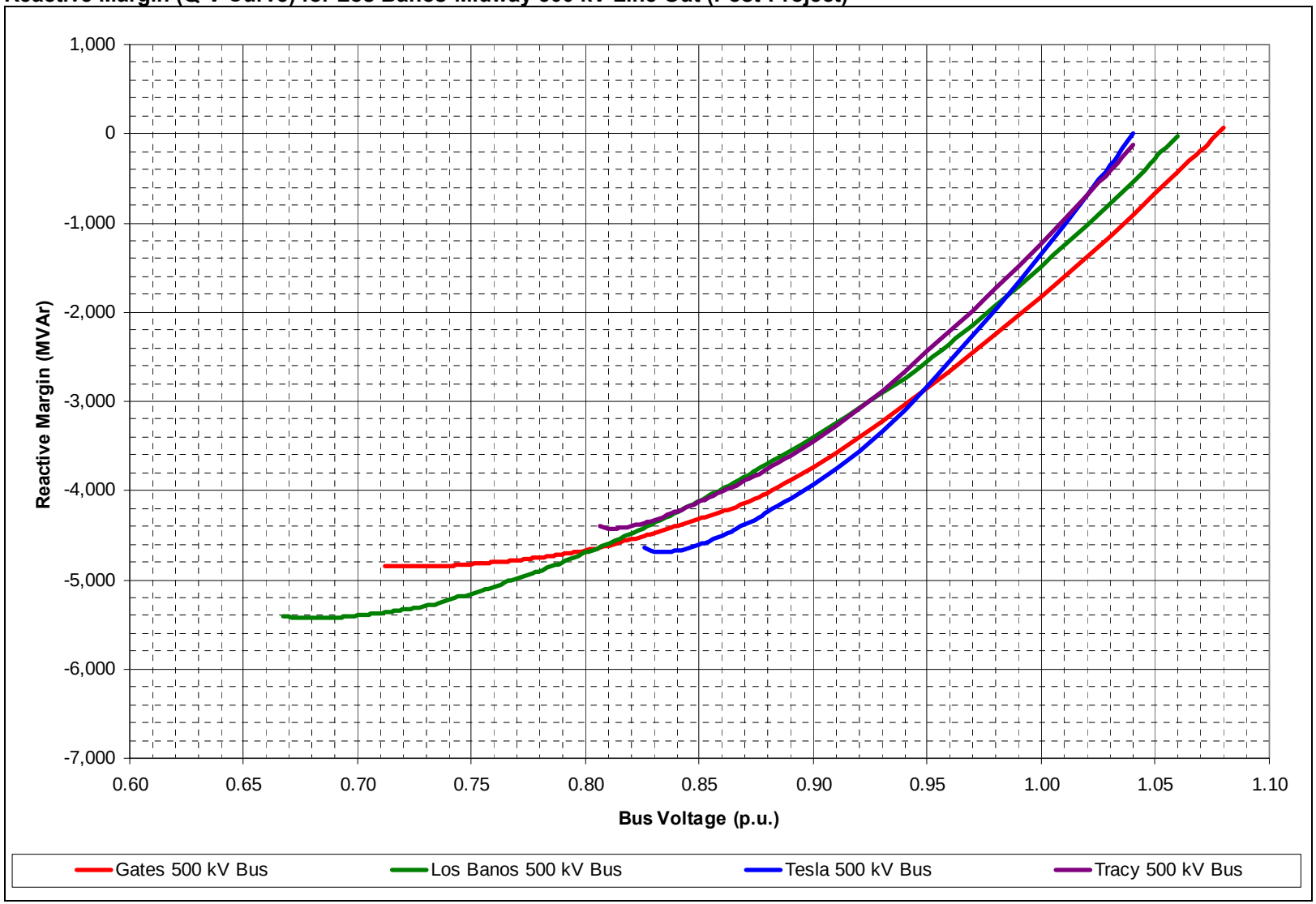
**Reactive Margin (Q-V Curve) for N-0 All Elements in Service (Post-Project)**



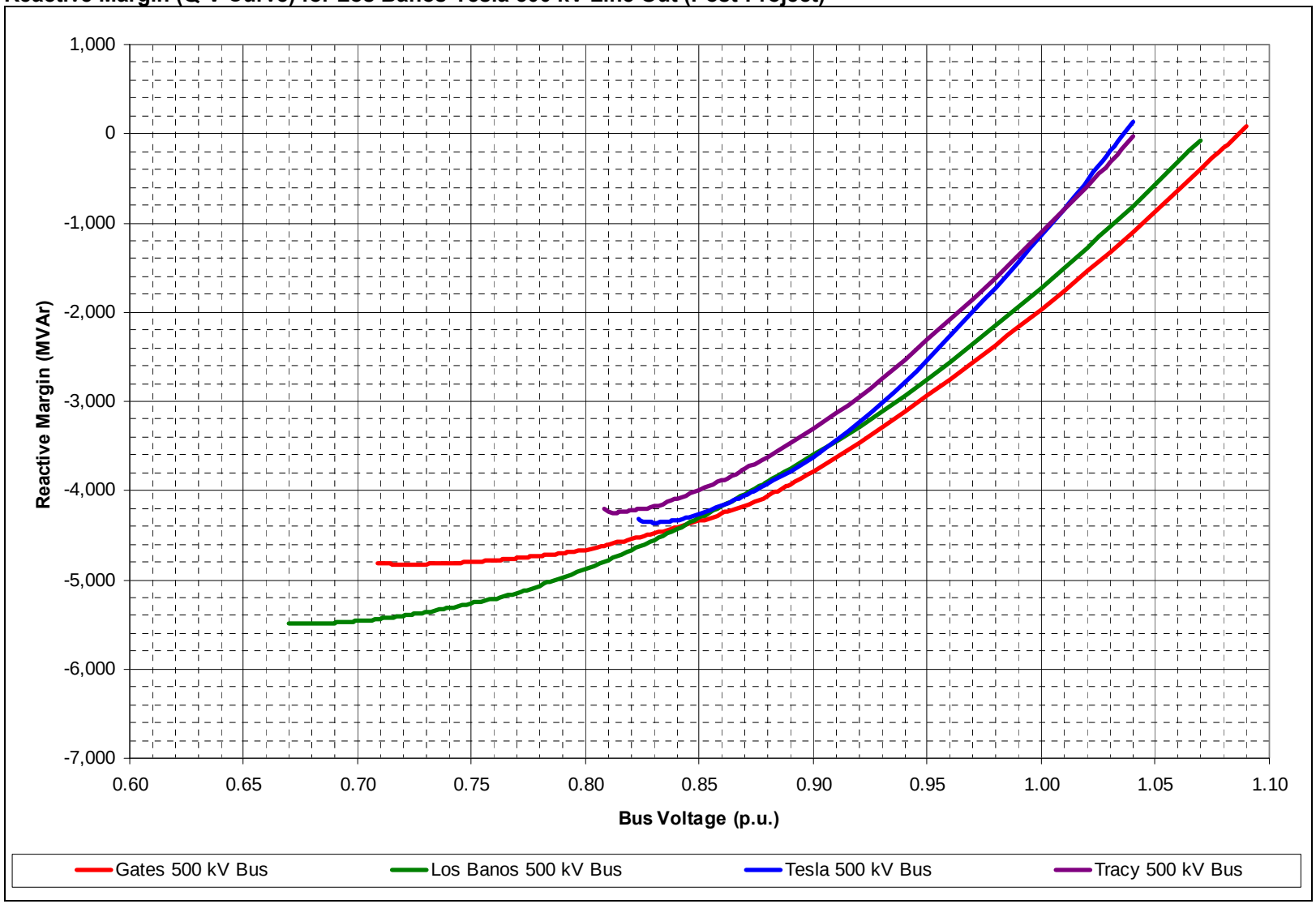
**Reactive Margin (Q-V Curve) for Los Banos-Gates #3 500 kV Line Out (Post-Project)**



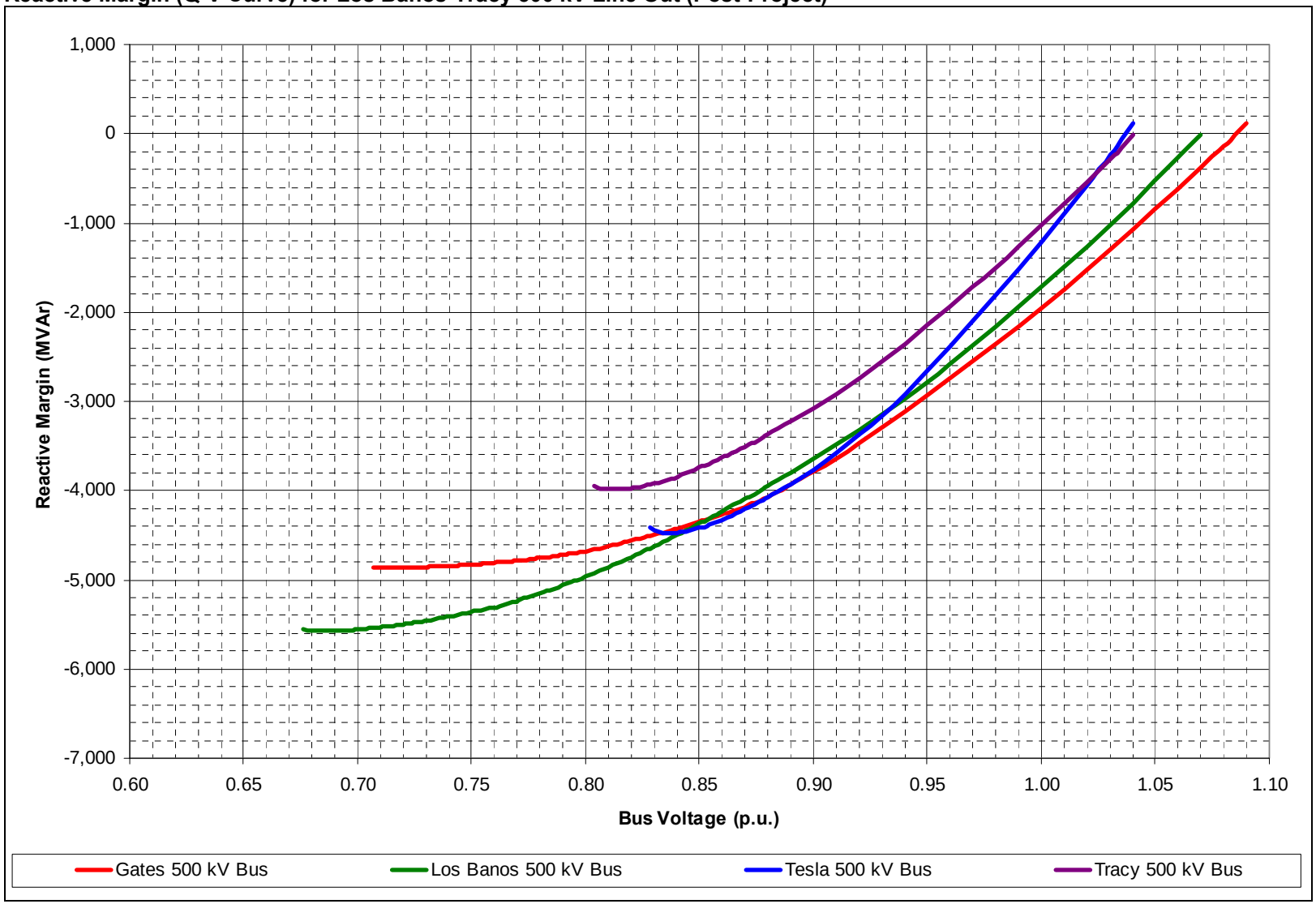
**Reactive Margin (Q-V Curve) for Los Banos-Midway 500 kV Line Out (Post-Project)**



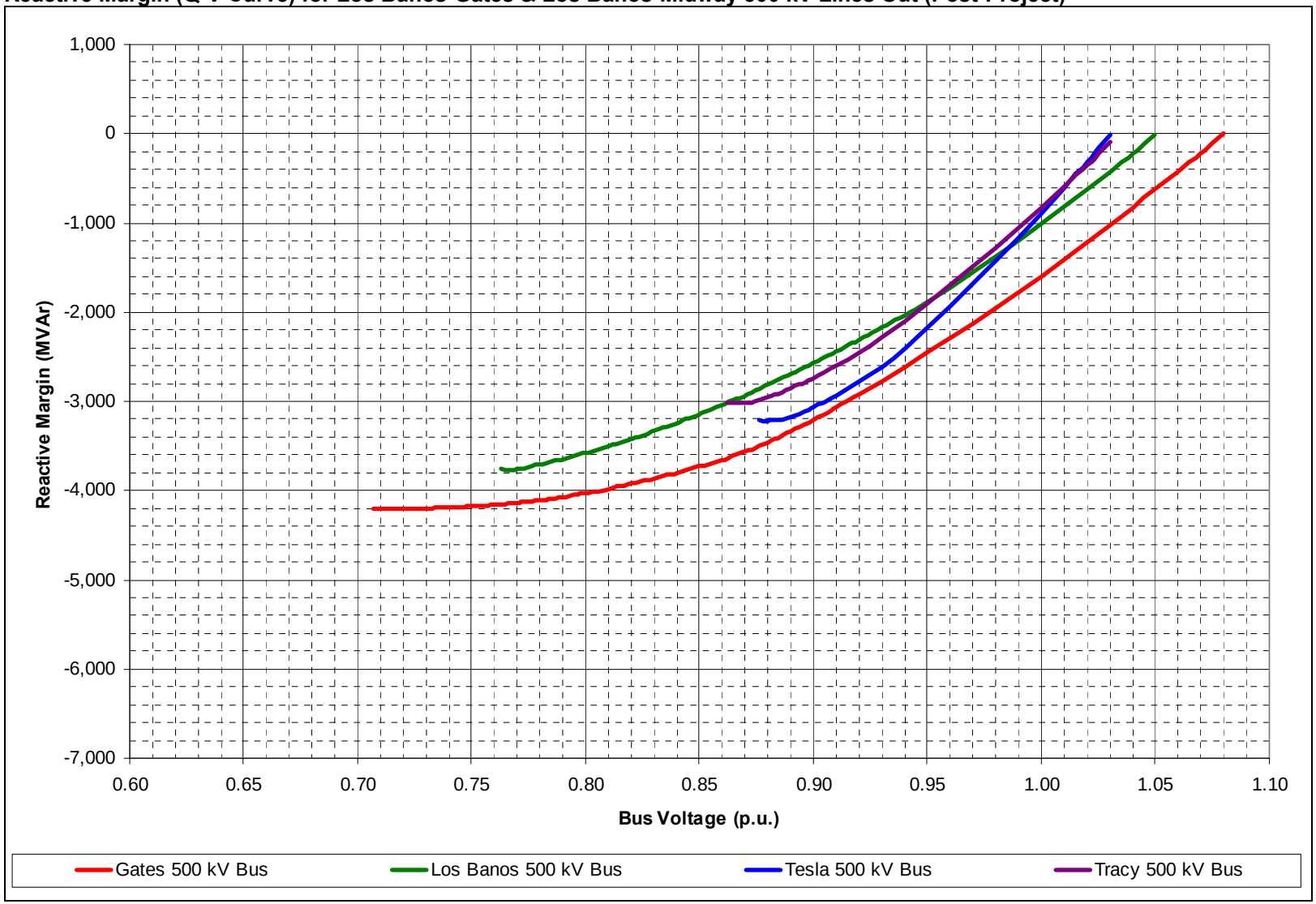
**Reactive Margin (Q-V Curve) for Los Banos-Tesla 500 kV Line Out (Post-Project)**



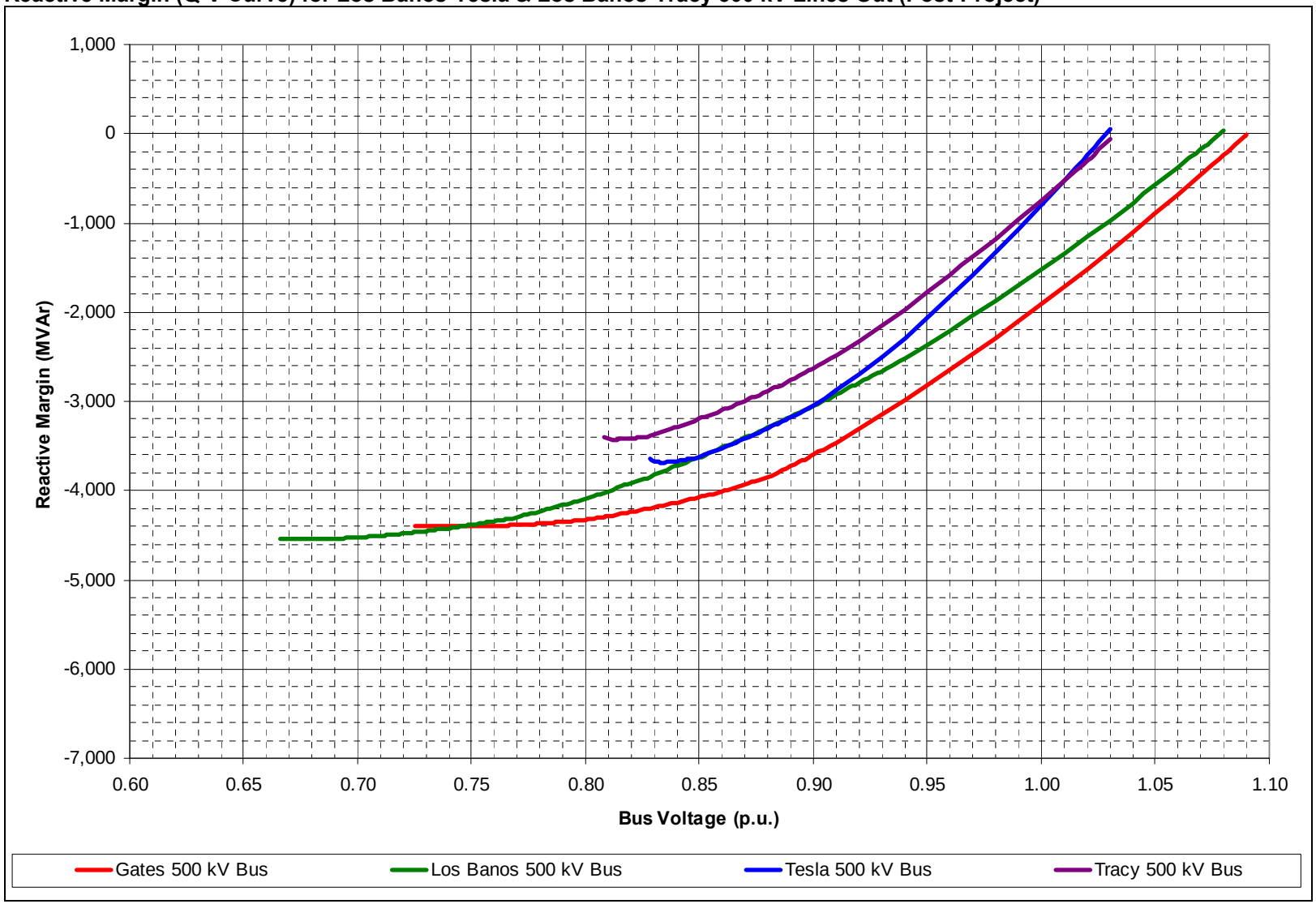
**Reactive Margin (Q-V Curve) for Los Banos-Tracy 500 kV Line Out (Post-Project)**



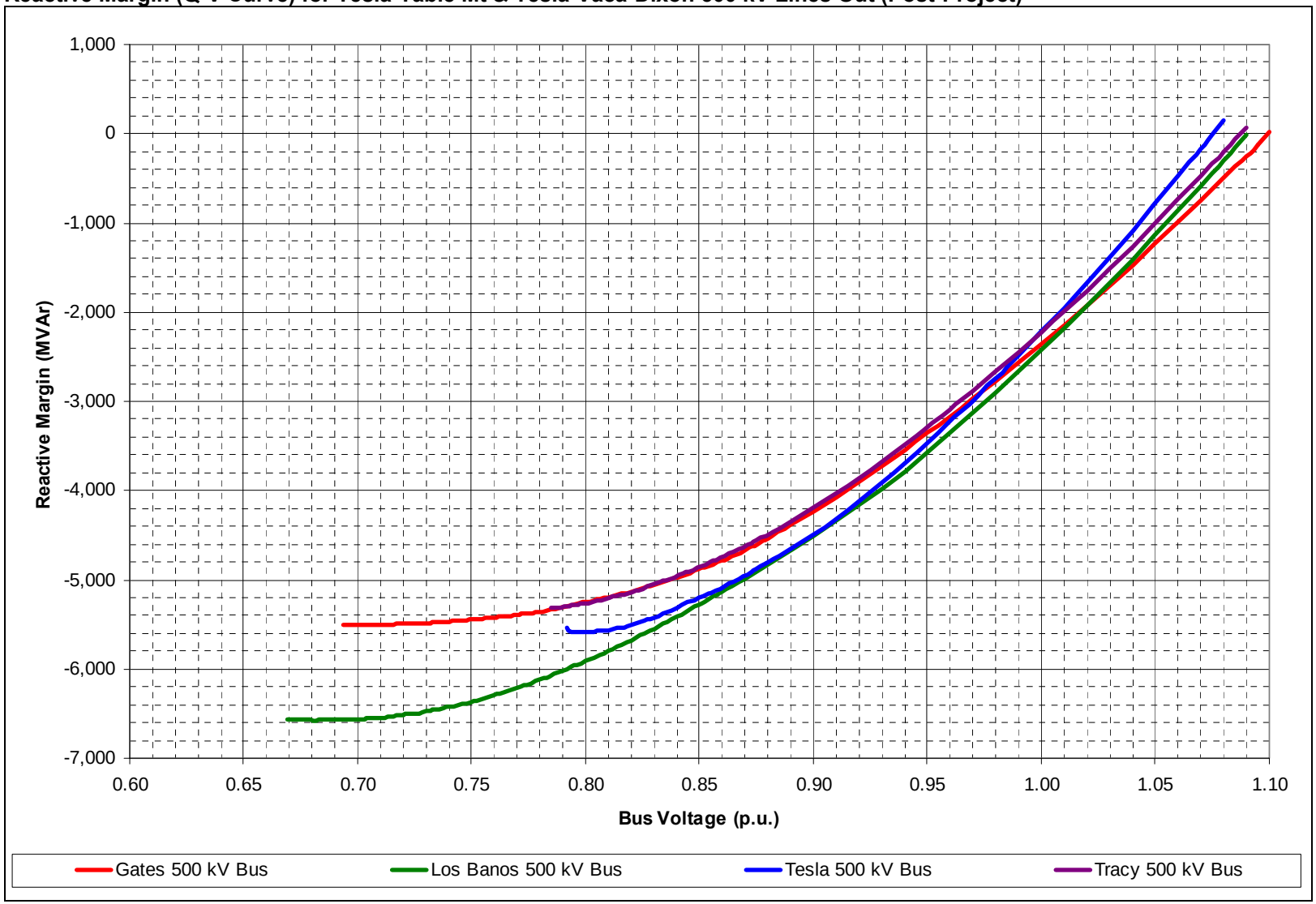
**Reactive Margin (Q-V Curve) for Los Banos-Gates & Los Banos-Midway 500 kV Lines Out (Post-Project)**



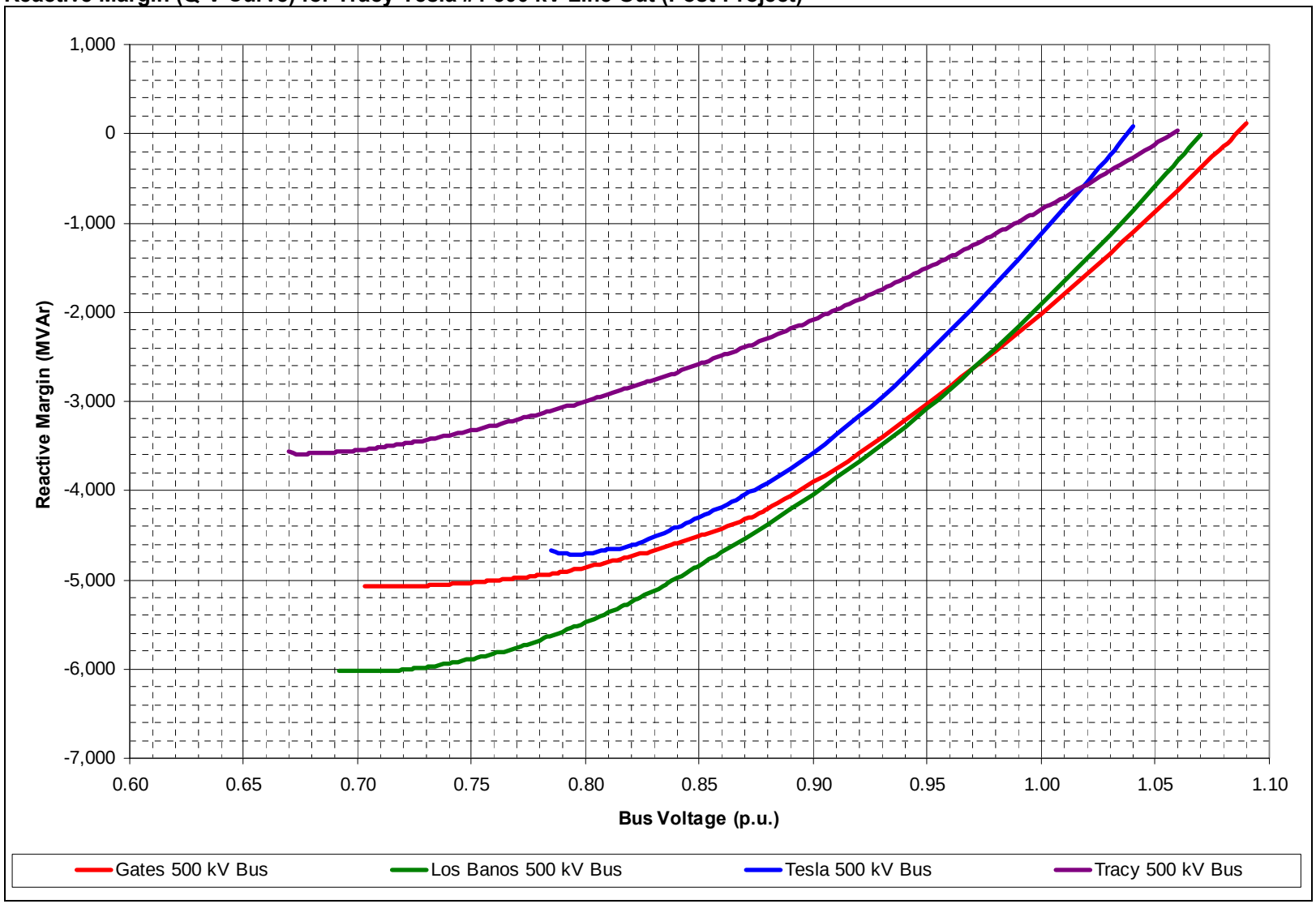
**Reactive Margin (Q-V Curve) for Los Banos-Tesla & Los Banos-Tracy 500 kV Lines Out (Post-Project)**



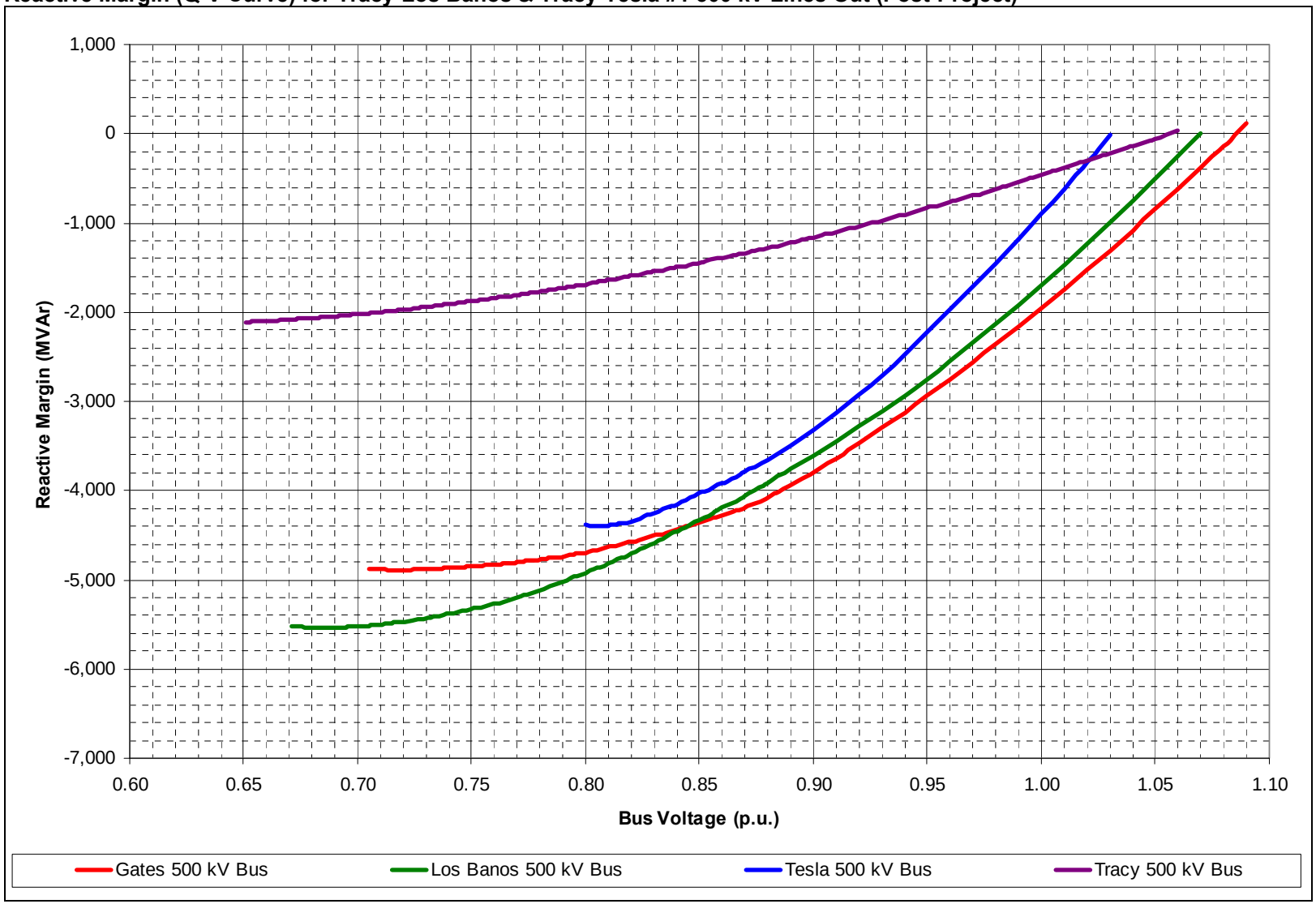
**Reactive Margin (Q-V Curve) for Tesla-Table Mt & Tesla-Vaca-Dixon 500 kV Lines Out (Post-Project)**



**Reactive Margin (Q-V Curve) for Tracy-Tesla #1 500 kV Line Out (Post-Project)**



**Reactive Margin (Q-V Curve) for Tracy-Los Banos & Tracy-Tesla #1 500 kV Lines Out (Post-Project)**

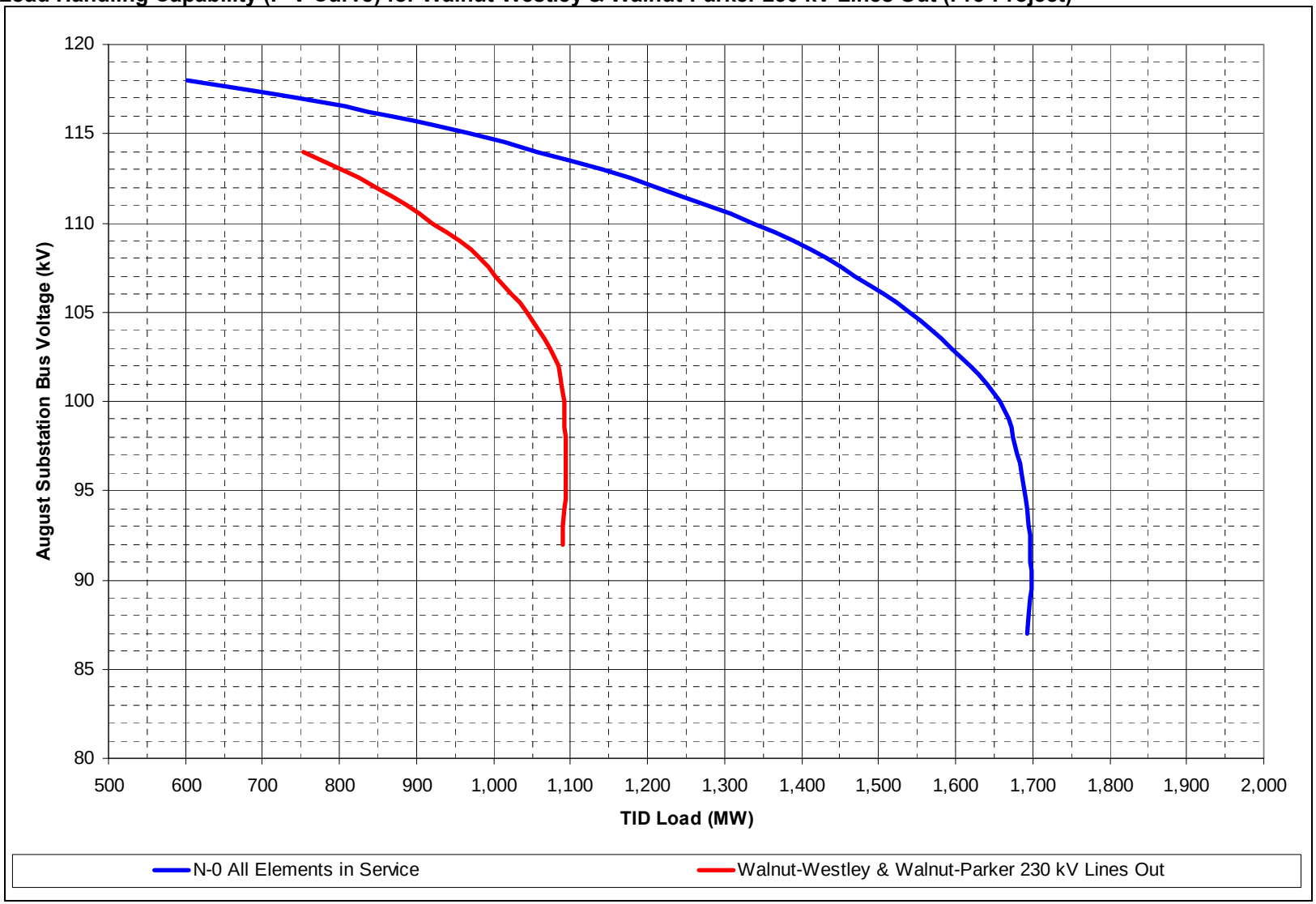


# Turlock Irrigation District
# Almond 2 Power Plant
# (09-AFC-2)

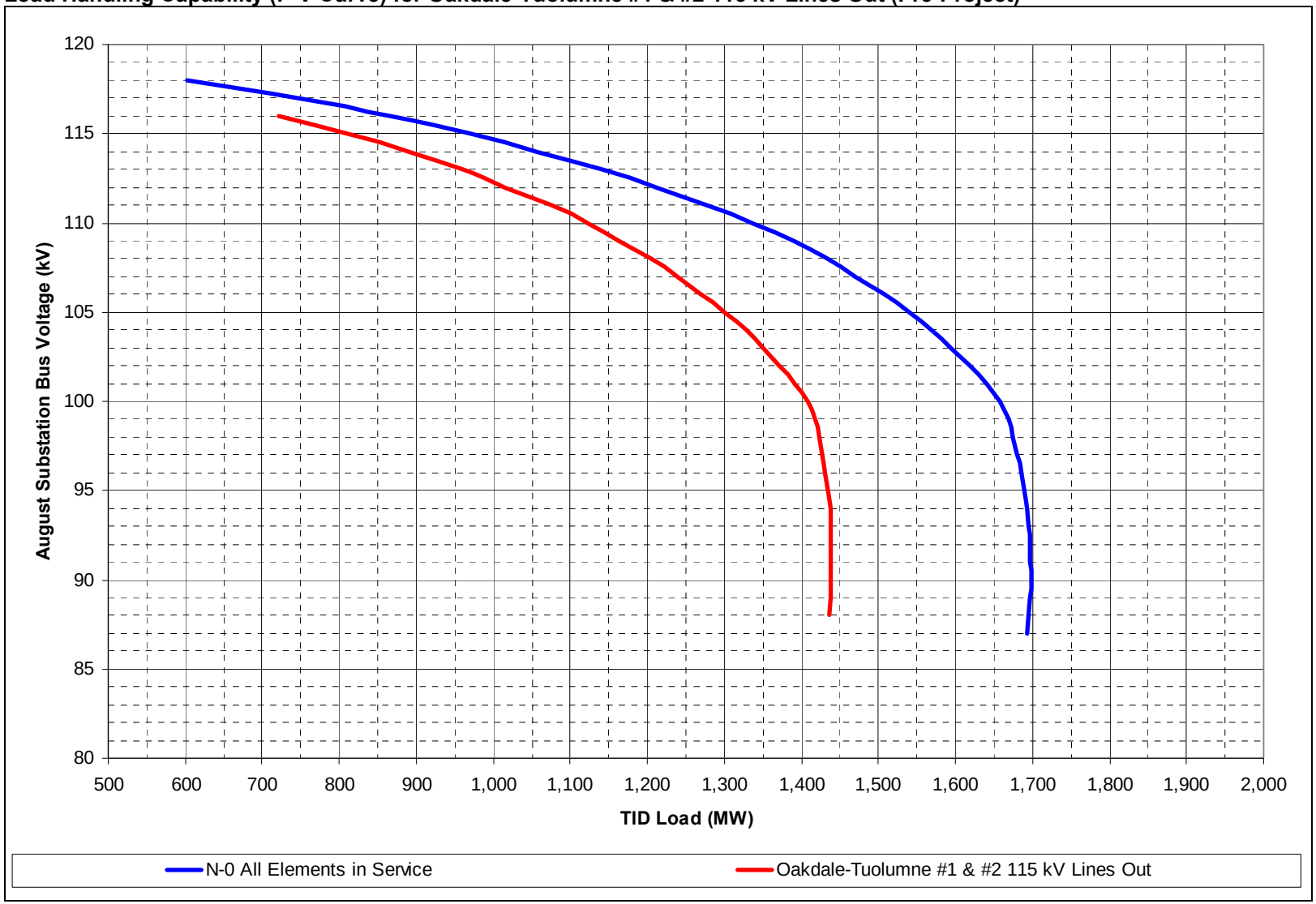
## Appendix 12

TID Local System Voltage Stability
Load Handling Capability (P-V Curves)

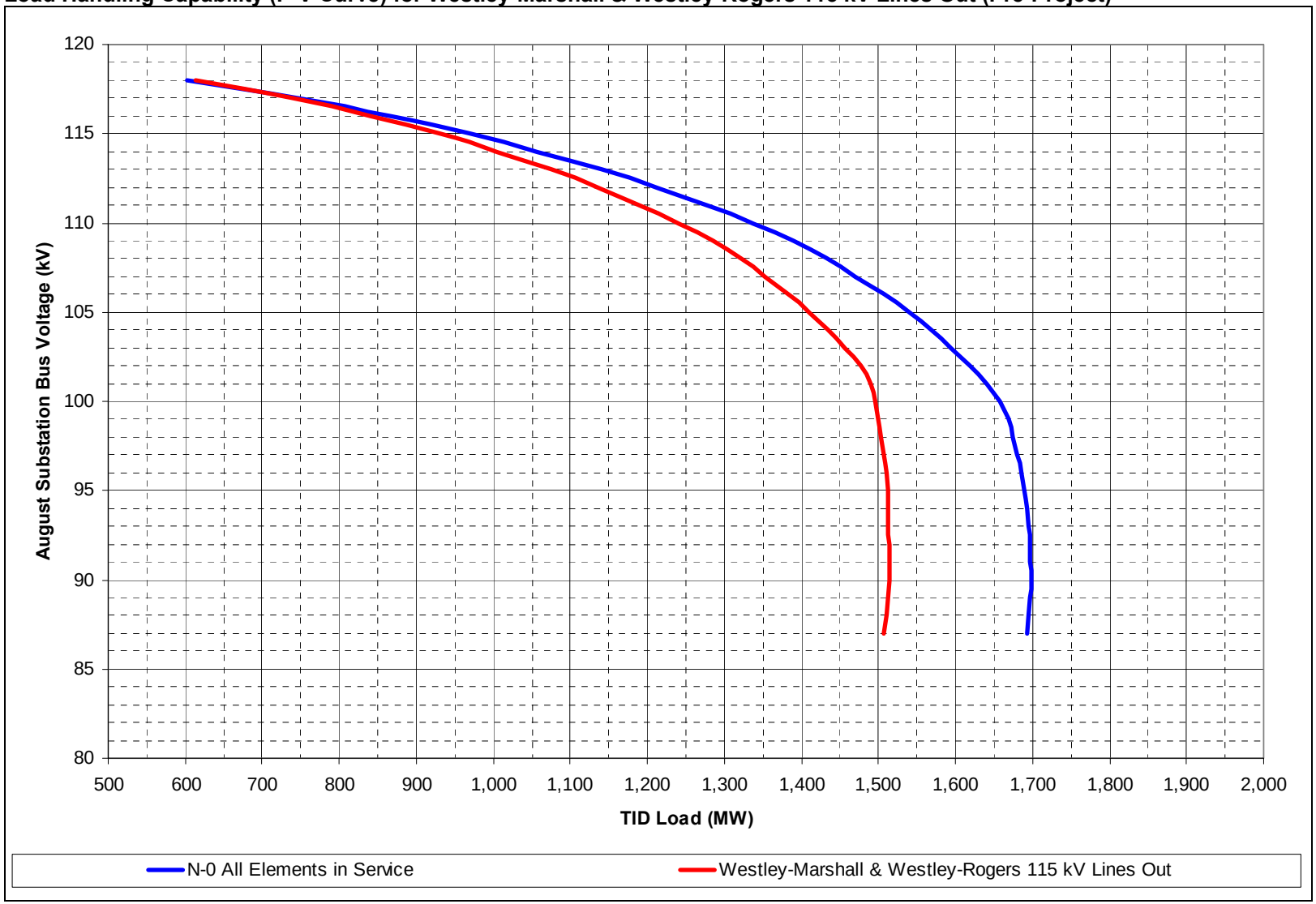
**Load Handling Capability (P-V Curve) for Walnut-Westley & Walnut-Parker 230 kV Lines Out (Pre-Project)**



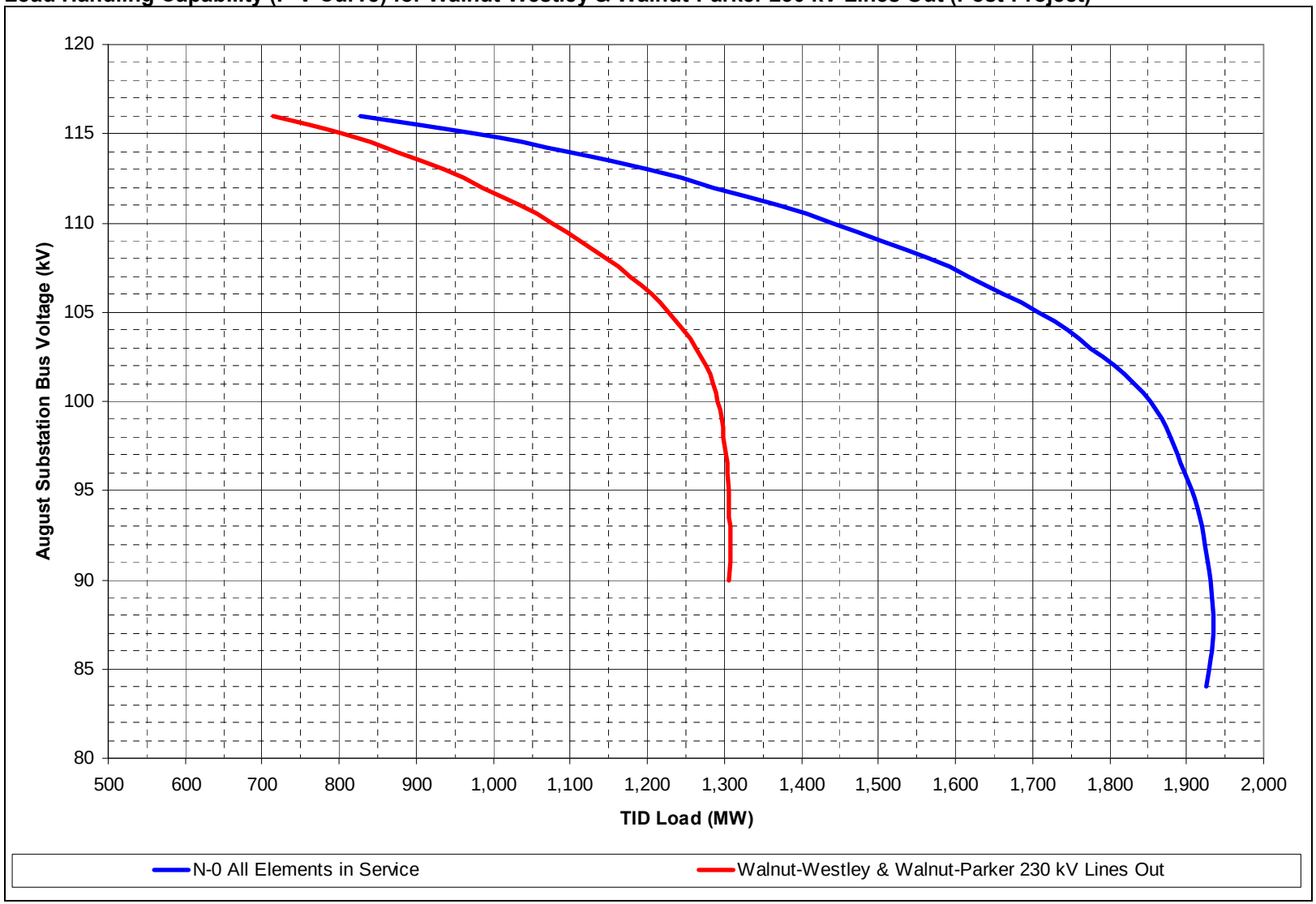
**Load Handling Capability (P-V Curve) for Oakdale-Tuolumne #1 & #2 115 kV Lines Out (Pre-Project)**



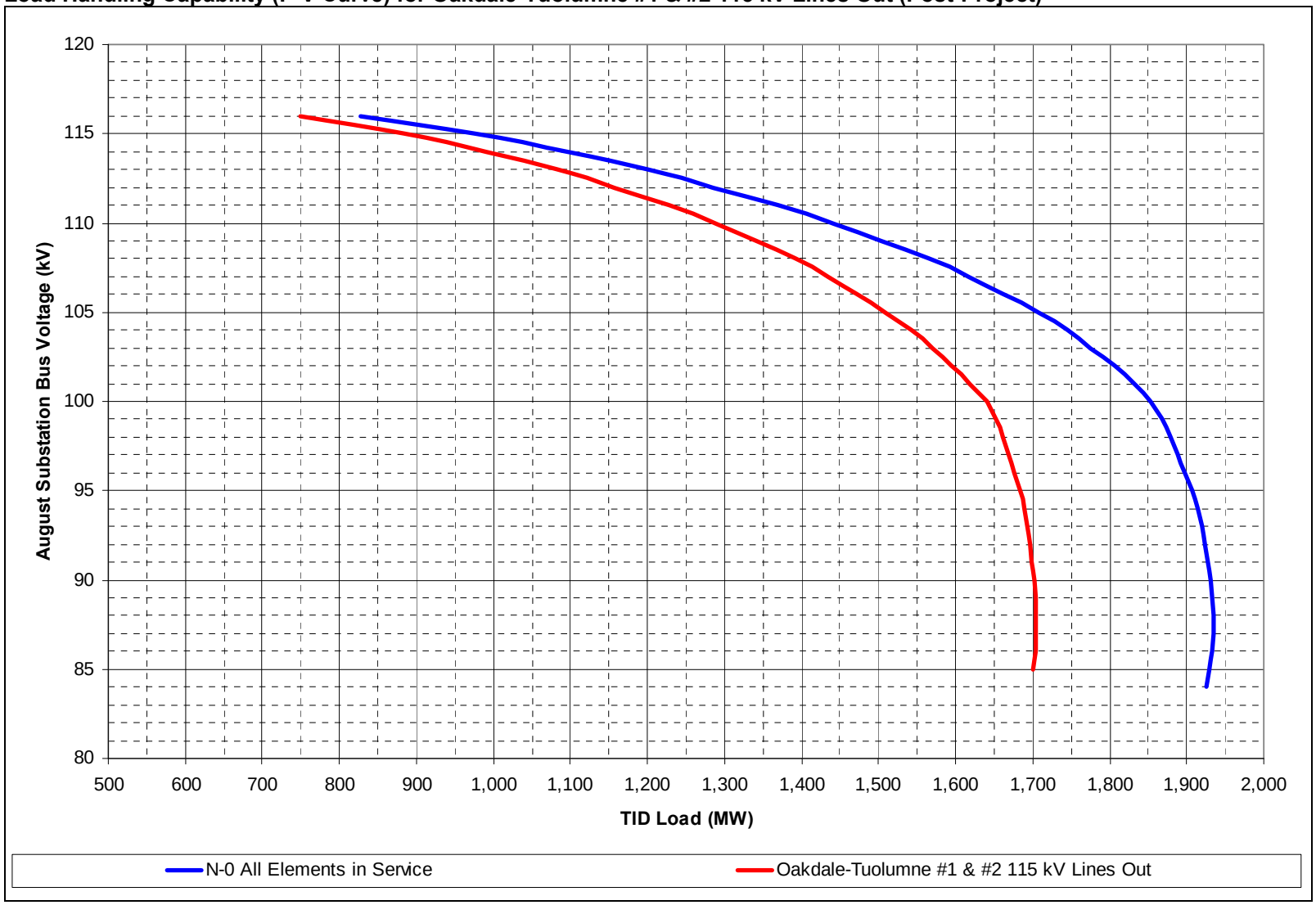
**Load Handling Capability (P-V Curve) for Westley-Marshall & Westley-Rogers 115 kV Lines Out (Pre-Project)**



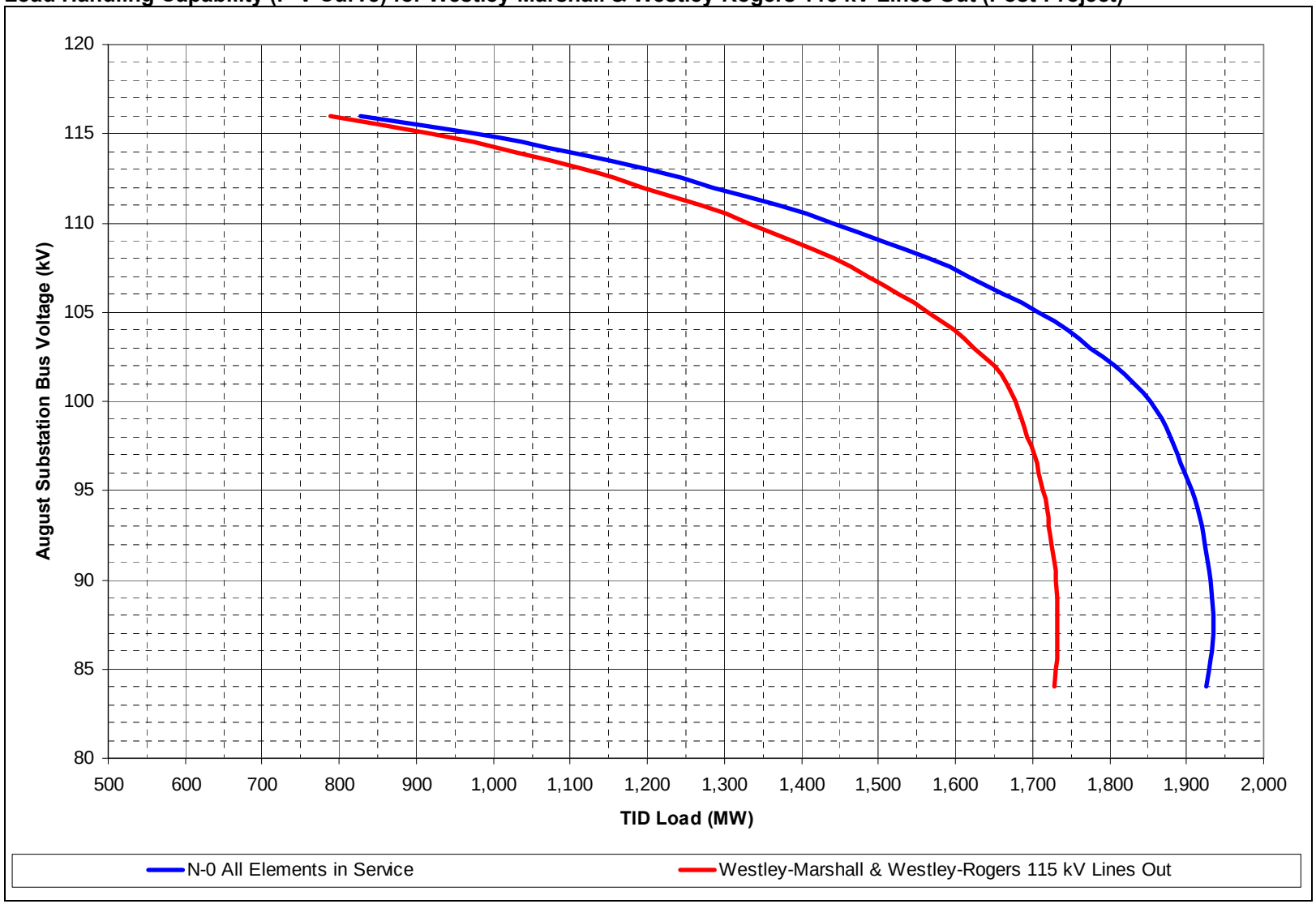
**Load Handling Capability (P-V Curve) for Walnut-Westley & Walnut-Parker 230 kV Lines Out (Post-Project)**



**Load Handling Capability (P-V Curve) for Oakdale-Tuolumne #1 & #2 115 kV Lines Out (Post-Project)**



**Load Handling Capability (P-V Curve) for Westley-Marshall & Westley-Rogers 115 kV Lines Out (Post-Project)**



# Turlock Irrigation District
# Almond 2 Power Plant
# (09-AFC-2)

## Appendix 13

Short-Circuit Analysis Output

## Short-Circuit Analysis Output 3-Phase Faults

| Location | Voltage | 3-Phase Fault Currents | | | | Interrupting Capability (Amps) | Owner |
|---|---|---|---|---|---|---|---|
| | | Pre-Project (Amps) | Post-Project (Amps) | Delta (Amps) | Delta (%) | | |
| 12TH STREET | 69 | 24,311 | 24,373 | 62 | 0.3% | | |
| 8TH STREET | 69 | 28,699 | 28,775 | 77 | 0.3% | | |
| ALMOND | 13.8 | 34,009 | 34,471 | 462 | 1.4% | | TID |
| ALMOND | 69 | 12,912 | 14,900 | 1,989 | 15.4% | 31,500 | TID |
| ALMOND 115 | 115 | NA | 11,821 | NA | NA | 15,000 | TID |
| ALMOND G1 | 13.8 | NA | 41,472 | NA | NA | TBD | TID |
| ALMOND G2 | 13.8 | NA | 41,472 | NA | NA | TBD | TID |
| ALMOND G3 | 13.8 | NA | 41,472 | NA | NA | TBD | TID |
| AUGUST | 115 | 6,654 | 6,892 | 238 | 3.6% | 40,000 | TID |
| BONDS FLAT | 69 | 9,578 | 9,667 | 89 | 0.9% | | |
| BRIGGSMORE | 69 | 28,954 | 29,048 | 94 | 0.3% | | |
| CALAV TB#1 | 21.6 | 2,011 | 2,011 | 0 | 0.0% | | |
| CALAVERAS | 115 | 8,463 | 8,488 | 24 | 0.3% | | |
| CALAVERAS 3 | 115 | 8,465 | 8,489 | 24 | 0.3% | | |
| CALAVERAS 4 | 115 | 8,465 | 8,489 | 24 | 0.3% | | |
| CASTLE | 115 | 4,326 | 4,460 | 133 | 3.1% | | |
| CERES | 69 | 11,115 | 12,075 | 959 | 8.6% | 19,000 | TID |
| CLAUS | 69 | 29,971 | 30,089 | 118 | 0.4% | | |
| CLAUS | 115 | 14,826 | 14,846 | 19 | 0.1% | | |
| Clough 17.2k | 17.2 | 4,153 | 4,152 | 0 | 0.0% | | |
| Clough 69kv | 69 | 9,249 | 9,253 | 4 | 0.0% | | |
| COMMONS | 69 | 17,518 | 18,247 | 729 | 4.2% | 40,000 | TID |
| COOPER | 115 | 4,219 | 4,345 | 126 | 3.0% | | |
| CORTEZ | 115 | 7,780 | 8,697 | 918 | 11.8% | 40,000 | TID |
| CROWS LNDG. | 69 | 10,979 | 12,092 | 1,114 | 10.1% | 31,500 | TID |
| DAWSON | 69 | 6,744 | 6,808 | 64 | 1.0% | 40,000 | TID |
| DON PEDRO | 69 | 11,359 | 11,486 | 127 | 1.1% | 21,000 | TID |
| DP UNIT 1 | 13.8 | 24,983 | 25,039 | 56 | 0.2% | | TID |
| DP UNIT 2 | 13.8 | 25,132 | 25,190 | 57 | 0.2% | | TID |
| DP UNIT 4 | 13.8 | 22,703 | 22,742 | 39 | 0.2% | | TID |
| ENSLEN | 69 | 30,999 | 31,083 | 85 | 0.3% | | |
| F STREET | 69 | 12,332 | 12,628 | 297 | 2.4% | 31,500 | TID |
| FAIRGROUND | 69 | 15,012 | 15,498 | 486 | 3.2% | 21,000 | TID |
| FINNEY | 69 | 16,015 | 16,032 | 17 | 0.1% | | |
| Fox River Pa | 70 | 12,050 | 12,056 | 6 | 0.0% | | |
| GEER | 69 | 14,143 | 14,701 | 558 | 3.9% | 19,000 | TID |
| GILSTRAP | 69 | 12,305 | 14,195 | 1,890 | 15.4% | 19,000 | TID |
| GRAYSON | 115 | 8,101 | 12,102 | 4,000 | 49.4% | 15,000 | TID |
| GRAYSON 69 | 69 | 13,434 | 15,847 | 2,414 | 18.0% | TBD | TID |
| HAWKINS | 69 | 5,219 | 5,267 | 48 | 0.9% | 19,000 | TID |
| HERSHEY | 115 | 13,028 | 13,033 | 6 | 0.0% | | |
| HILMAR | 115 | 8,862 | 9,420 | 557 | 6.3% | 40,000 | TID |
| HOLM 1 | 13.8 | 34,274 | 34,274 | 0 | 0.0% | | |
| HOLM 2 | 13.8 | 34,274 | 34,274 | 0 | 0.0% | | |
| HOLM1 | 230 | 5,881 | 5,882 | 0 | 0.0% | | |
| HOLM2 | 230 | 5,881 | 5,882 | 0 | 0.0% | | |
| HUGHSON | 115 | 9,738 | 12,022 | 2,285 | 23.5% | 40,000 | TID |
| HUNT 115KV | 115 | 12,312 | 12,317 | 5 | 0.0% | | |
| INDUSTRIAL | 69 | 16,426 | 16,893 | 468 | 2.8% | 19,000 | TID |
| ING CRK JT | 115 | 6,981 | 6,981 | 0 | 0.0% | | |
| INGRAM CRK | 115 | 6,588 | 6,589 | 0 | 0.0% | | |
| INTAKE | 230 | 6,156 | 6,156 | 1 | 0.0% | | |
| KANSAS | 69 | 21,563 | 21,599 | 36 | 0.2% | | |
| Kiernan 69 | 69 | 16,996 | 17,015 | 18 | 0.1% | | |
| KIRKWOOD 1 | 13.8 | 18,982 | 18,982 | 0 | 0.0% | | |
| KIRKWOOD 1 | 230 | 6,013 | 6,014 | 1 | 0.0% | | |
| KIRKWOOD 2 | 13.8 | 18,982 | 18,982 | 0 | 0.0% | | |
| KIRKWOOD 2 | 230 | 6,013 | 6,014 | 1 | 0.0% | | |
| KIRKWOOD 3 | 13.8 | 18,982 | 18,982 | 0 | 0.0% | | |
| KIRKWOOD 3 | 230 | 6,013 | 6,014 | 1 | 0.0% | | |
| LA GRANGE A | 69 | 8,200 | 8,270 | 70 | 0.9% | 40,000 | TID |
| LA GRANGE B | 69 | 7,934 | 8,011 | 77 | 1.0% | 40,000 | TID |

| Location | Voltage | 3-Phase Fault Currents | | | | Interrupting Capability (Amps) | Owner |
|---|---|---|---|---|---|---|---|
| | | Pre-Project (Amps) | Post-Project (Amps) | Delta (Amps) | Delta (%) | | |
| LADD | 69 | 13,174 | 13,184 | 10 | 0.1% | | |
| LAPHAM | 69 | 22,411 | 22,470 | 59 | 0.3% | | |
| LB-W1 T 8/40 | 230 | 22,516 | 22,557 | 41 | 0.2% | | |
| LB-W1 TR 0/2 | 230 | 28,915 | 28,949 | 33 | 0.1% | | |
| LB-W1T22/100 | 230 | 30,779 | 31,076 | 297 | 1.0% | | |
| LB-W1T30/134 | 230 | 25,415 | 25,583 | 168 | 0.7% | | |
| LB-W2 T 8/40 | 230 | 22,516 | 22,557 | 41 | 0.2% | | |
| LB-W2 TR 0/2 | 230 | 28,890 | 28,923 | 33 | 0.1% | | |
| LB-W2T22/100 | 230 | 30,808 | 31,106 | 298 | 1.0% | | |
| LB-W2T30/134 | 230 | 25,415 | 25,583 | 168 | 0.7% | | |
| LINCOLN | 69 | 19,510 | 19,556 | 46 | 0.2% | | |
| LOS BANOS | 230 | 29,131 | 29,164 | 33 | 0.1% | | |
| LOS BANOS | 525 | 29,913 | 29,933 | 20 | 0.1% | | |
| LOSBANOS DE1 | 525 | 29,862 | 29,881 | 20 | 0.1% | | |
| LOSBANOS DE4 | 525 | 29,858 | 29,877 | 20 | 0.1% | | |
| MANTECA | 115 | 10,815 | 10,815 | 1 | 0.0% | | |
| MARIPOSA | 69 | 19,134 | 19,177 | 44 | 0.2% | | |
| MARSHALL | 115 | 10,217 | 10,326 | 109 | 1.1% | 40,000 | TID |
| MCCLURE | 115 | 14,516 | 14,532 | 17 | 0.1% | | |
| McCLURE GEN1 | 13.8 | 53,641 | 53,650 | 8 | 0.0% | | |
| McClure GEN2 | 13.8 | 53,641 | 53,650 | 8 | 0.0% | | |
| MINNIEAR | 69 | 17,739 | 17,781 | 42 | 0.2% | | |
| MOCCASIN | 115 | 5,131 | 5,259 | 129 | 2.5% | | |
| MOCCASIN | 230 | 1,179 | 1,188 | 9 | 0.8% | | |
| MOCCASIN 1 | 13.8 | 28,617 | 28,836 | 219 | 0.8% | | |
| MOCCASIN 2 | 13.8 | 28,617 | 28,836 | 219 | 0.8% | | |
| MODST TIRE | 13.8 | 5,305 | 5,305 | 0 | 0.0% | | |
| MODST TIRE | 115 | 5,427 | 5,427 | 0 | 0.0% | | |
| MONTPELLIER | 69 | 9,584 | 9,884 | 300 | 3.1% | 19,000 | TID |
| NEWARK D | 115 | 37,665 | 37,744 | 79 | 0.2% | | |
| NEWARK F | 115 | 54,861 | 54,921 | 60 | 0.1% | | |
| OAKDALE (MID) | 69 | 24,621 | 24,694 | 73 | 0.3% | | |
| OAKDALE (TID) | 115 | 9,056 | 9,891 | 835 | 9.2% | 40,000 | TID |
| PARADISE | 69 | 17,965 | 17,990 | 25 | 0.1% | | |
| PARKER MID | 230 | 14,531 | 14,709 | 178 | 1.2% | 50,000 | MID |
| PARKER-69 | 69 | 34,386 | 34,561 | 175 | 0.5% | | |
| PIONEER | 115 | 6,326 | 6,620 | 294 | 4.6% | 40,000 | |
| POUST | 69 | 19,629 | 19,659 | 30 | 0.2% | | |
| PRESCOTT | 69 | 20,275 | 20,305 | 30 | 0.1% | | |
| Prescott Tap | 69 | 19,689 | 19,716 | 27 | 0.1% | | |
| REINWAY | 69 | 13,230 | 13,281 | 51 | 0.4% | | |
| Ripon GEN 1 | 13.8 | 30,471 | 30,472 | 1 | 0.0% | | |
| Ripon GEN 2 | 13.8 | 30,471 | 30,472 | 1 | 0.0% | | |
| Ripon69 (1) | 69 | 12,138 | 12,143 | 6 | 0.0% | | |
| Ripon69 (2) | 69 | 12,138 | 12,143 | 6 | 0.0% | | |
| RIVERBK CCSF | 115 | 13,025 | 13,033 | 8 | 0.1% | | |
| RIVERBK LV | 13.8 | 10,437 | 10,437 | 0 | 0.0% | | |
| ROEDING | 69 | 9,391 | 10,011 | 621 | 6.6% | 19,000 | TID |
| ROGERS | 115 | 11,662 | 11,770 | 108 | 0.9% | 40,000 | TID |
| ROSELLE | 69 | 23,155 | 23,225 | 70 | 0.3% | | |
| ROSEMORE | 69 | 28,427 | 28,494 | 68 | 0.2% | | |
| ROSEMORE | 230 | 16,740 | 16,829 | 89 | 0.5% | 50,000 | MID |
| SALADO | 115 | 5,263 | 5,263 | 0 | 0.0% | | |
| SALADO JCT1 | 115 | 5,181 | 5,181 | 0 | 0.0% | | |
| SANTA CRUZ | 115 | 12,373 | 12,385 | 12 | 0.1% | | |
| SANTA ROSA | 69 | 22,579 | 22,635 | 56 | 0.2% | | |
| SISK | 69 | 20,600 | 20,630 | 30 | 0.1% | | |
| SO. TURLOCK | 69 | 13,192 | 13,519 | 327 | 2.5% | 31,500 | TID |
| STANDIFORD | 69 | 31,637 | 31,707 | 71 | 0.2% | | |
| STANDIFORD | 115 | 18,366 | 18,392 | 26 | 0.1% | | |
| Stockton 17k | 17.2 | 4,558 | 4,558 | 0 | 0.0% | | |
| STOCKTON MID | 70 | 12,375 | 12,381 | 6 | 0.0% | | |
| STODDARD | 69 | 18,617 | 18,638 | 21 | 0.1% | | |

| Location | Voltage | 3-Phase Fault Currents | | | | Interrupting Capability (Amps) | Owner |
|---|---|---|---|---|---|---|---|
| | | Pre-Project (Amps) | Post-Project (Amps) | Delta (Amps) | Delta (%) | | |
| SYLVAN | 69 | 25,759 | 25,828 | 69 | 0.3% | | |
| T-LB T 7/36S | 525 | 24,336 | 24,360 | 24 | 0.1% | | |
| T-LB T35/165 | 525 | 17,998 | 18,008 | 10 | 0.1% | | |
| T-LB1 T 1/6 | 525 | 35,646 | 35,695 | 49 | 0.1% | | |
| T-LB1T29/133 | 525 | 19,637 | 19,648 | 11 | 0.1% | | |
| TAYLOR | 115 | 8,681 | 10,503 | 1,822 | 21.0% | 40,000 | TID |
| TE W1T22/100 | 230 | 31,362 | 31,666 | 303 | 1.0% | | |
| TE-TR D.E. | 525 | 31,424 | 31,466 | 42 | 0.1% | | |
| TE-W1 T 6/28 | 230 | 33,168 | 33,275 | 107 | 0.3% | | |
| TE-W1 T18/80 | 230 | 28,478 | 28,669 | 191 | 0.7% | | |
| TE-W1 TR 0/1 | 230 | 49,805 | 49,926 | 122 | 0.2% | | |
| TE-W2 T 6/28 | 230 | 33,168 | 33,275 | 107 | 0.3% | | |
| TE-W2 T18/80 | 230 | 28,478 | 28,669 | 191 | 0.7% | | |
| TE-W2 TR 0/1 | 230 | 49,720 | 49,842 | 122 | 0.2% | | |
| TE-W2T22/100 | 230 | 31,389 | 31,693 | 304 | 1.0% | | |
| TESLA | 115 | 28,326 | 28,336 | 9 | 0.0% | | |
| TESLA | 525 | 38,047 | 38,104 | 57 | 0.1% | | |
| TESLA BUS C | 230 | 39,991 | 40,022 | 31 | 0.1% | | |
| TESLA BUS D | 230 | 59,419 | 59,531 | 112 | 0.2% | | |
| TESLA BUS E | 230 | 52,708 | 52,835 | 127 | 0.2% | | |
| TESLA D.E.#3 | 525 | 37,947 | 38,003 | 56 | 0.1% | | |
| TESLA D.E.#4 | 525 | 37,976 | 38,033 | 57 | 0.1% | | |
| TIECHE 20T | 115 | 5,655 | 5,655 | 0 | 0.0% | | |
| TR-LB D.E. | 525 | 31,132 | 31,173 | 41 | 0.1% | | |
| TR-W#1 T100 | 230 | 24,670 | 24,726 | 56 | 0.2% | | |
| TR-W#1 T4 | 230 | 30,692 | 30,990 | 298 | 1.0% | | |
| TR-W#2 T100 | 230 | 24,670 | 24,726 | 56 | 0.2% | | |
| TR-W#2 T4 | 230 | 30,692 | 30,990 | 298 | 1.0% | | |
| TRACY | 230 | 52,222 | 52,345 | 123 | 0.2% | | |
| TRACY | 525 | 31,386 | 31,428 | 42 | 0.1% | | |
| TUOLUMNE | 69 | 15,381 | 16,692 | 1,311 | 8.5% | 19,000 | TID |
| TUOLUMNE | 115 | 10,649 | 12,431 | 1,782 | 16.7% | 40,000 | TID |
| TWR 77/336 | 115 | 2,694 | 2,694 | 0 | 0.0% | | |
| WALNUT | 69 | 24,286 | 25,260 | 973 | 4.0% | 27,000 | TID |
| WALNUT | 115 | 16,352 | 17,019 | 667 | 4.1% | 40,000 | TID |
| WALNUT (TID) | 230 | 14,828 | 15,165 | 338 | 2.3% | 40,000 | TID |
| WALNUT U1 | 13.8 | 17,722 | 17,756 | 34 | 0.2% | 61,000 | TID |
| WALNUT U2 | 13.8 | 17,812 | 17,846 | 34 | 0.2% | 61,000 | TID |
| WARNER EQUIV | 230 | 12,713 | 12,717 | 4 | 0.0% | | |
| WARNERVILLE | 115 | 18,098 | 18,107 | 10 | 0.1% | | |
| WARNERVILLE | 230 | 12,710 | 12,715 | 4 | 0.0% | | |
| WEC | 69 | 19,260 | 19,842 | 582 | 3.0% | 40,000 | TID |
| WEC | 115 | 15,803 | 16,455 | 652 | 4.1% | 40,000 | TID |
| WEC CT1 | 13.8 | 43,173 | 43,335 | 161 | 0.4% | | TID |
| WEC CT2 | 13.8 | 41,732 | 41,885 | 153 | 0.4% | | TID |
| WEC STG | 13.8 | 53,057 | 53,219 | 162 | 0.3% | | TID |
| WESTLEY | 115 | 17,882 | 18,061 | 180 | 1.0% | 40,000 | TID |
| WESTLEY | 230 | 32,457 | 32,799 | 343 | 1.1% | | MID |
| WESTPORT | 69 | 11,324 | 12,207 | 883 | 7.8% | 19,000 | TID |
| Wood- Gen2 | 13.8 | 57,642 | 57,653 | 12 | 0.0% | | |
| WOODLAND GEN | 13.8 | 36,737 | 36,743 | 6 | 0.0% | | |
| WOODLAND-MID | 69 | 28,343 | 28,406 | 63 | 0.2% | | |
| WOODROW | 69 | 24,295 | 24,338 | 43 | 0.2% | | |

## Short-Circuit Analysis Output Single Line-to-Ground Faults

| Location | Voltage | Single Line-to-Ground Fault Currents | | | | Interrupting Capability (Amps) | Owner |
|---|---|---|---|---|---|---|---|
| | | Pre-Project (Amps) | Post-Project (Amps) | Delta (Amps) | Delta (%) | | |
| 12TH STREET | 69 | 16,950 | 16,969 | 20 | 0.1% | | |
| 8TH STREET | 69 | 21,250 | 21,278 | 27 | 0.1% | | |
| ALMOND | 13.8 | 27,874 | 28,073 | 199 | 0.7% | | TID |
| ALMOND | 69 | 11,774 | 14,018 | 2,244 | 19.1% | 31,500 | TID |
| ALMOND 115 | 115 | NA | 12,428 | NA | NA | 15,000 | TID |
| ALMOND G1 | 13.8 | NA | 40,037 | NA | NA | TBD | TID |
| ALMOND G2 | 13.8 | NA | 40,037 | NA | NA | TBD | TID |
| ALMOND G3 | 13.8 | NA | 40,037 | NA | NA | TBD | TID |
| AUGUST | 115 | 4,901 | 5,002 | 101 | 2.1% | 40,000 | TID |
| BONDS FLAT | 69 | 8,925 | 8,976 | 51 | 0.6% | | |
| BRIGGSMORE | 69 | 21,394 | 21,427 | 34 | 0.2% | | |
| CALAV TB#1 | 21.6 | 2,040 | 2,040 | 0 | 0.0% | | |
| CALAVERAS | 115 | 5,475 | 5,483 | 9 | 0.2% | | |
| CALAVERAS 3 | 115 | 5,475 | 5,484 | 9 | 0.2% | | |
| CALAVERAS 4 | 115 | 5,478 | 5,487 | 9 | 0.2% | | |
| CASTLE | 115 | 2,531 | 2,571 | 40 | 1.6% | | |
| CERES | 69 | 7,506 | 8,019 | 513 | 6.8% | 19,000 | TID |
| CLAUS | 69 | 27,742 | 27,809 | 68 | 0.2% | | |
| CLAUS | 115 | 14,155 | 14,167 | 11 | 0.1% | | |
| Clough 17.2k | 17.2 | 3,806 | 3,806 | 0 | 0.0% | | |
| Clough 69kv | 69 | 5,093 | 5,093 | 1 | 0.0% | | |
| COMMONS | 69 | 13,371 | 13,713 | 341 | 2.6% | 40,000 | TID |
| COOPER | 115 | 2,455 | 2,493 | 38 | 1.5% | | |
| CORTEZ | 115 | 4,962 | 5,423 | 461 | 9.3% | 40,000 | TID |
| CROWS LNDG. | 69 | 7,694 | 8,367 | 673 | 8.8% | 31,500 | TID |
| DAWSON | 69 | 4,952 | 4,976 | 24 | 0.5% | 40,000 | TID |
| DON PEDRO | 69 | 12,462 | 12,565 | 103 | 0.8% | 21,000 | TID |
| DP UNIT 1 | 13.8 | 15,285 | 15,296 | 11 | 0.1% | | TID |
| DP UNIT 2 | 13.8 | 15,323 | 15,334 | 11 | 0.1% | | TID |
| DP UNIT 4 | 13.8 | 14,849 | 14,858 | 9 | 0.1% | | TID |
| ENSLEN | 69 | 24,792 | 24,828 | 36 | 0.1% | | |
| F STREET | 69 | 7,924 | 8,012 | 88 | 1.1% | 31,500 | TID |
| FAIRGROUND | 69 | 10,189 | 10,357 | 168 | 1.7% | 21,000 | TID |
| FINNEY | 69 | 9,505 | 9,508 | 3 | 0.0% | | |
| Fox River Pa | 70 | 10,055 | 10,057 | 2 | 0.0% | | |
| GEER | 69 | 9,215 | 9,413 | 198 | 2.1% | 19,000 | TID |
| GILSTRAP | 69 | 10,746 | 12,870 | 2,124 | 19.8% | 19,000 | TID |
| GRAYSON | 115 | 6,706 | 12,279 | 5,573 | 83.1% | 15,000 | TID |
| GRAYSON 69 | 69 | 12,697 | 16,264 | 3,566 | 28.1% | TBD | TID |
| HAWKINS | 69 | 2,834 | 2,844 | 10 | 0.4% | 19,000 | TID |
| HERSHEY | 115 | 9,894 | 9,896 | 3 | 0.0% | | |
| HILMAR | 115 | 5,817 | 6,059 | 242 | 4.2% | 40,000 | TID |
| HOLM 1 | 13.8 | 19,532 | 19,531 | 0 | 0.0% | | |
| HOLM 2 | 13.8 | 19,532 | 19,531 | 0 | 0.0% | | |
| HOLM1 | 230 | 6,213 | 6,213 | 0 | 0.0% | | |
| HOLM2 | 230 | 6,213 | 6,213 | 0 | 0.0% | | |
| HUGHSON | 115 | 7,226 | 8,890 | 1,665 | 23.0% | 40,000 | TID |
| HUNT 115KV | 115 | 9,054 | 9,056 | 2 | 0.0% | | |
| INDUSTRIAL | 69 | 12,218 | 12,398 | 180 | 1.5% | 19,000 | TID |
| ING CRK JT | 115 | 5,558 | 5,559 | 0 | 0.0% | | |
| INGRAM CRK | 115 | 5,179 | 5,179 | 0 | 0.0% | | |
| INTAKE | 230 | 6,614 | 6,614 | 0 | 0.0% | | |
| KANSAS | 69 | 14,392 | 14,402 | 10 | 0.1% | | |
| Kiernan 69 | 69 | 10,791 | 10,795 | 4 | 0.0% | | |
| KIRKWOOD 1 | 13.8 | 12,236 | 12,236 | 0 | 0.0% | | |
| KIRKWOOD 1 | 230 | 6,356 | 6,356 | 0 | 0.0% | | |
| KIRKWOOD 2 | 13.8 | 12,236 | 12,236 | 0 | 0.0% | | |
| KIRKWOOD 2 | 230 | 6,356 | 6,356 | 0 | 0.0% | | |
| KIRKWOOD 3 | 13.8 | 12,236 | 12,236 | 0 | 0.0% | | |
| KIRKWOOD 3 | 230 | 6,356 | 6,356 | 0 | 0.0% | | |
| LA GRANGE A | 69 | 6,634 | 6,664 | 30 | 0.5% | 40,000 | TID |
| LA GRANGE B | 69 | 6,198 | 6,230 | 32 | 0.5% | 40,000 | TID |

| Location | Voltage | Single Line-to-Ground Fault Currents | | | | Interrupting Capability (Amps) | Owner |
|---|---|---|---|---|---|---|---|
| | | Pre-Project (Amps) | Post-Project (Amps) | Delta (Amps) | Delta (%) | | |
| LADD | 69 | 7,728 | 7,729 | 2 | 0.0% | | |
| LAPHAM | 69 | 15,585 | 15,603 | 18 | 0.1% | | |
| LB-W1 T 8/40 | 230 | 14,444 | 14,455 | 11 | 0.1% | | |
| LB-W1 TR 0/2 | 230 | 28,581 | 28,602 | 21 | 0.1% | | |
| LB-W1T22/100 | 230 | 19,172 | 19,251 | 79 | 0.4% | | |
| LB-W1T30/134 | 230 | 14,719 | 14,757 | 38 | 0.3% | | |
| LB-W2 T 8/40 | 230 | 14,444 | 14,455 | 11 | 0.1% | | |
| LB-W2 TR 0/2 | 230 | 28,554 | 28,575 | 21 | 0.1% | | |
| LB-W2T22/100 | 230 | 19,184 | 19,262 | 79 | 0.4% | | |
| LB-W2T30/134 | 230 | 14,719 | 14,757 | 38 | 0.3% | | |
| LINCOLN | 69 | 12,773 | 12,786 | 12 | 0.1% | | |
| LOS BANOS | 230 | 29,236 | 29,258 | 22 | 0.1% | | |
| LOS BANOS | 525 | 20,260 | 20,266 | 6 | 0.0% | | |
| LOSBANOS DE1 | 525 | 20,209 | 20,215 | 6 | 0.0% | | |
| LOSBANOS DE4 | 525 | 20,208 | 20,214 | 6 | 0.0% | | |
| MANTECA | 115 | 9,664 | 9,664 | 0 | 0.0% | | |
| MARIPOSA | 69 | 12,417 | 12,429 | 12 | 0.1% | | |
| MARSHALL | 115 | 6,663 | 6,694 | 31 | 0.5% | 40,000 | TID |
| MCCLURE | 115 | 14,902 | 14,914 | 12 | 0.1% | | |
| McCLURE GEN1 | 13.8 | 0 | 0 | 0 | | | |
| McClure GEN2 | 13.8 | 0 | 0 | 0 | | | |
| MINNIEAR | 69 | 10,690 | 10,699 | 10 | 0.1% | | |
| MOCCASIN | 115 | 5,736 | 5,845 | 109 | 1.9% | | |
| MOCCASIN | 230 | 1,315 | 1,322 | 8 | 0.6% | | |
| MOCCASIN 1 | 13.8 | 19,995 | 20,060 | 66 | 0.3% | | |
| MOCCASIN 2 | 13.8 | 19,995 | 20,060 | 66 | 0.3% | | |
| MODST TIRE | 13.8 | 0 | 0 | 0 | | | |
| MODST TIRE | 115 | 4,491 | 4,491 | 0 | 0.0% | | |
| MONTPELLIER | 69 | 5,899 | 6,001 | 102 | 1.7% | 19,000 | TID |
| NEWARK D | 115 | 39,596 | 39,654 | 58 | 0.1% | | |
| NEWARK F | 115 | 54,409 | 54,448 | 39 | 0.1% | | |
| OAKDALE (MID) | 69 | 17,041 | 17,064 | 23 | 0.1% | | |
| OAKDALE (TID) | 115 | 6,238 | 6,655 | 417 | 6.7% | 40,000 | TID |
| PARADISE | 69 | 10,991 | 10,996 | 6 | 0.1% | | |
| PARKER MID | 230 | 11,086 | 11,158 | 71 | 0.6% | 50,000 | MID |
| PARKER-69 | 69 | 32,851 | 32,959 | 109 | 0.3% | | |
| PIONEER | 115 | 4,119 | 4,229 | 110 | 2.7% | 40,000 | |
| POUST | 69 | 12,756 | 12,763 | 8 | 0.1% | | |
| PRESCOTT | 69 | 13,689 | 13,697 | 8 | 0.1% | | |
| Prescott Tap | 69 | 13,283 | 13,290 | 8 | 0.1% | | |
| REINWAY | 69 | 7,468 | 7,478 | 10 | 0.1% | | |
| Ripon GEN 1 | 13.8 | 30,663 | 30,663 | 0 | 0.0% | | |
| Ripon GEN 2 | 13.8 | 30,663 | 30,663 | 0 | 0.0% | | |
| Ripon69 (1) | 69 | 11,148 | 11,150 | 3 | 0.0% | | |
| Ripon69 (2) | 69 | 11,148 | 11,150 | 3 | 0.0% | | |
| RIVERBK CCSF | 115 | 10,645 | 10,648 | 4 | 0.0% | | |
| RIVERBK LV | 13.8 | 0 | 0 | 0 | | | |
| ROEDING | 69 | 5,894 | 6,174 | 280 | 4.8% | 19,000 | TID |
| ROGERS | 115 | 8,128 | 8,163 | 35 | 0.4% | 40,000 | TID |
| ROSELLE | 69 | 15,489 | 15,509 | 20 | 0.1% | | |
| ROSEMORE | 69 | 24,399 | 24,432 | 33 | 0.1% | | |
| ROSEMORE | 230 | 10,044 | 10,065 | 21 | 0.2% | 50,000 | MID |
| SALADO | 115 | 4,883 | 4,883 | 0 | 0.0% | | |
| SALADO JCT1 | 115 | 4,601 | 4,601 | 0 | 0.0% | | |
| SANTA CRUZ | 115 | 9,482 | 9,486 | 4 | 0.0% | | |
| SANTA ROSA | 69 | 15,402 | 15,419 | 17 | 0.1% | | |
| SISK | 69 | 13,719 | 13,727 | 8 | 0.1% | | |
| SO. TURLOCK | 69 | 8,723 | 8,825 | 102 | 1.2% | 31,500 | TID |
| STANDIFORD | 69 | 30,333 | 30,376 | 43 | 0.1% | | |
| STANDIFORD | 115 | 16,719 | 16,734 | 14 | 0.1% | | |
| Stockton 17k | 17.2 | 4,523 | 4,523 | 0 | 0.0% | | |
| STOCKTON MID | 70 | 11,422 | 11,425 | 3 | 0.0% | | |
| STODDARD | 69 | 12,200 | 12,206 | 5 | 0.0% | | |

| Location | Voltage | Single Line-to-Ground Fault Currents | | | | Interrupting Capability (Amps) | Owner |
|---|---|---|---|---|---|---|---|
| | | Pre-Project (Amps) | Post-Project (Amps) | Delta (Amps) | Delta (%) | | |
| SYLVAN | 69 | 17,813 | 17,834 | 21 | 0.1% | | |
| T-LB T 7/36S | 525 | 20,322 | 20,333 | 11 | 0.1% | | |
| T-LB T35/165 | 525 | 12,937 | 12,940 | 3 | 0.0% | | |
| T-LB1 T 1/6 | 525 | 29,017 | 29,039 | 22 | 0.1% | | |
| T-LB1T29/133 | 525 | 13,563 | 13,567 | 4 | 0.0% | | |
| TAYLOR | 115 | 6,022 | 7,218 | 1,196 | 19.9% | 40,000 | TID |
| TE W1T22/100 | 230 | 19,536 | 19,617 | 80 | 0.4% | | |
| TE-TR D.E. | 525 | 23,825 | 23,841 | 16 | 0.1% | | |
| TE-W1 T 6/28 | 230 | 21,069 | 21,097 | 28 | 0.1% | | |
| TE-W1 T18/80 | 230 | 17,329 | 17,377 | 48 | 0.3% | | |
| TE-W1 TR 0/1 | 230 | 45,620 | 45,688 | 68 | 0.1% | | |
| TE-W2 T 6/28 | 230 | 21,069 | 21,097 | 28 | 0.1% | | |
| TE-W2 T18/80 | 230 | 17,329 | 17,377 | 48 | 0.3% | | |
| TE-W2 TR 0/1 | 230 | 45,547 | 45,615 | 68 | 0.1% | | |
| TE-W2T22/100 | 230 | 19,547 | 19,627 | 81 | 0.4% | | |
| TESLA | 115 | 31,174 | 31,181 | 7 | 0.0% | | |
| TESLA | 525 | 31,568 | 31,594 | 26 | 0.1% | | |
| TESLA BUS C | 230 | 39,130 | 39,149 | 20 | 0.0% | | |
| TESLA BUS D | 230 | 58,047 | 58,118 | 71 | 0.1% | | |
| TESLA BUS E | 230 | 50,896 | 50,975 | 79 | 0.2% | | |
| TESLA D.E.#3 | 525 | 31,417 | 31,443 | 26 | 0.1% | | |
| TESLA D.E.#4 | 525 | 31,462 | 31,488 | 26 | 0.1% | | |
| TIECHE 20T | 115 | 4,236 | 4,236 | 0 | 0.0% | | |
| TR-LB D.E. | 525 | 23,527 | 23,542 | 16 | 0.1% | | |
| TR-W#1 T100 | 230 | 17,015 | 17,032 | 17 | 0.1% | | |
| TR-W#1 T4 | 230 | 19,140 | 19,219 | 79 | 0.4% | | |
| TR-W#2 T100 | 230 | 16,776 | 16,792 | 17 | 0.1% | | |
| TR-W#2 T4 | 230 | 19,151 | 19,230 | 79 | 0.4% | | |
| TRACY | 230 | 43,587 | 43,643 | 57 | 0.1% | | |
| TRACY | 525 | 23,791 | 23,807 | 16 | 0.1% | | |
| TUOLUMNE | 69 | 12,893 | 13,889 | 996 | 7.7% | 19,000 | TID |
| TUOLUMNE | 115 | 8,182 | 9,340 | 1,159 | 14.2% | 40,000 | TID |
| TWR 77/336 | 115 | 2,044 | 2,044 | 0 | 0.0% | | |
| WALNUT | 69 | 26,871 | 27,699 | 827 | 3.1% | 27,000 | TID |
| WALNUT | 115 | 16,370 | 16,848 | 478 | 2.9% | 40,000 | TID |
| WALNUT (TID) | 230 | 12,261 | 12,433 | 172 | 1.4% | 40,000 | TID |
| WALNUT U1 | 13.8 | 11,376 | 11,383 | 7 | 0.1% | 61,000 | TID |
| WALNUT U2 | 13.8 | 11,400 | 11,407 | 7 | 0.1% | 61,000 | TID |
| WARNER EQUIV | 230 | 11,481 | 11,483 | 2 | 0.0% | | |
| WARNERVILLE | 115 | 18,185 | 18,191 | 6 | 0.0% | | |
| WARNERVILLE | 230 | 11,480 | 11,482 | 2 | 0.0% | | |
| WEC | 69 | 17,777 | 18,113 | 336 | 1.9% | 40,000 | TID |
| WEC | 115 | 15,681 | 16,143 | 462 | 2.9% | 40,000 | TID |
| WEC CT1 | 13.8 | 40,989 | 41,080 | 91 | 0.2% | | TID |
| WEC CT2 | 13.8 | 40,197 | 40,286 | 89 | 0.2% | | TID |
| WEC STG | 13.8 | 54,145 | 54,261 | 115 | 0.2% | | TID |
| WESTLEY | 115 | 17,380 | 17,494 | 114 | 0.7% | 40,000 | TID |
| WESTLEY | 230 | 20,562 | 20,656 | 94 | 0.5% | | MID |
| WESTPORT | 69 | 7,533 | 8,036 | 503 | 6.7% | 19,000 | TID |
| Wood- Gen2 | 13.8 | 49,389 | 49,395 | 6 | 0.0% | | |
| WOODLAND GEN | 13.8 | 28,644 | 28,646 | 2 | 0.0% | | |
| WOODLAND-MID | 69 | 23,480 | 23,509 | 29 | 0.1% | | |
| WOODROW | 69 | 17,695 | 17,710 | 15 | 0.1% | | |

# Turlock Irrigation District
# Almond 2 Power Plant
# (09-AFC-2)

# System Impact Study
# Volume II

October 22, 2009

Prepared by
Ron S. Daschmans
Vice President, Technical Services
Utility System Efficiencies, Inc.

# Turlock Irrigation District
# Almond 2 Power Plant
# (09-AFC-2)

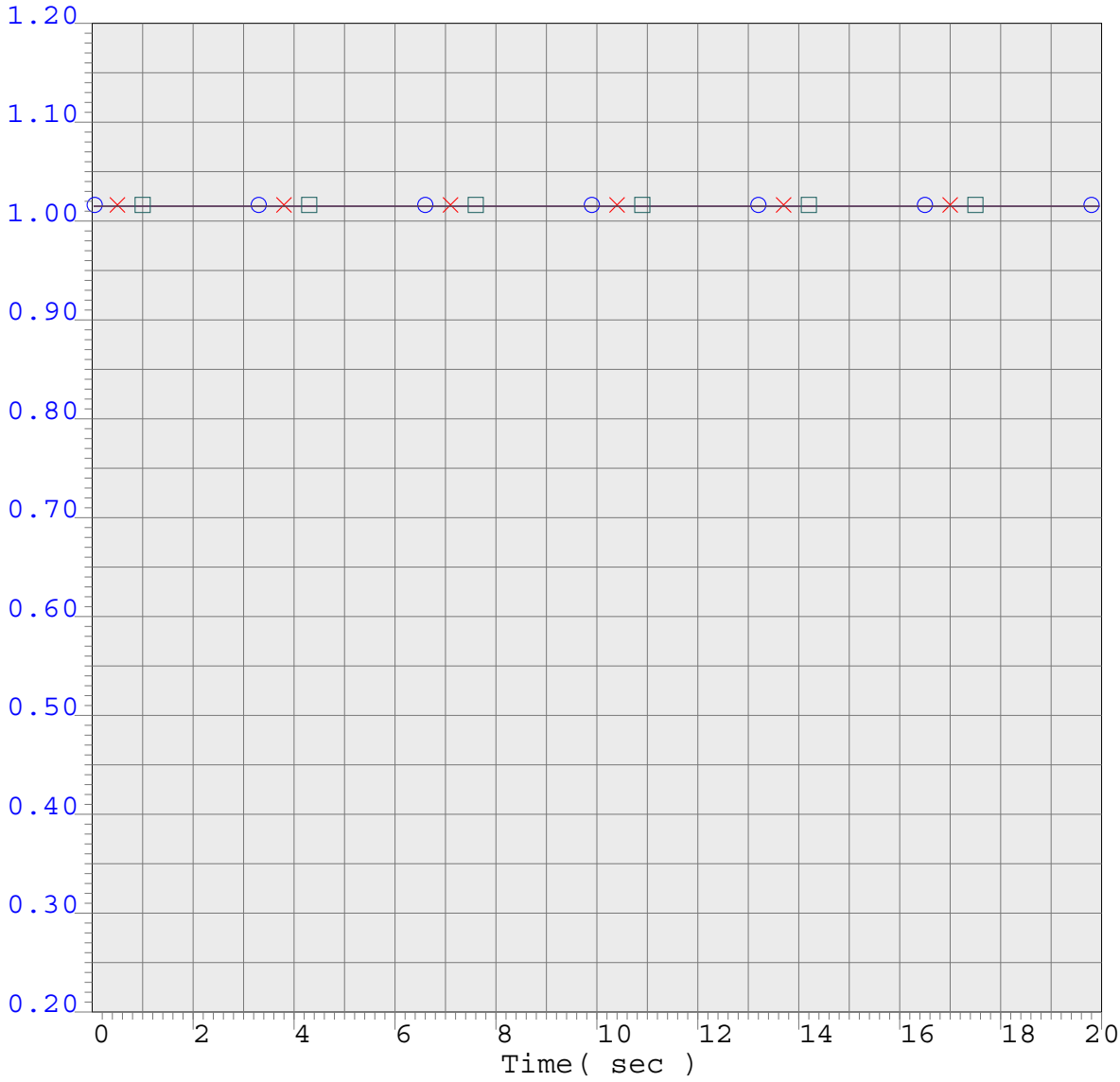
## Appendix 14

Transient Stability Plots

# Transient Stability Plots

## N-0 All Elements in Service
## (Flat Run)

# Almond 2 Power Plant
# Terminal Voltage (p.u.)




| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| ○ | 0.2000 vt | 38544 | ALMCT2 | 13.8 | 0 | 0.0 | 1 | 1 | 1.2000 |
| × | 0.2000 vt | 38545 | ALMCT3 | 13.8 | 0 | 0.0 | 1 | 1 | 1.2000 |
| □ | 0.2000 vt | 38546 | ALMCT4 | 13.8 | 0 | 0.0 | 1 | 1 | 1.2000 |

2012 Summer Peak Base Case



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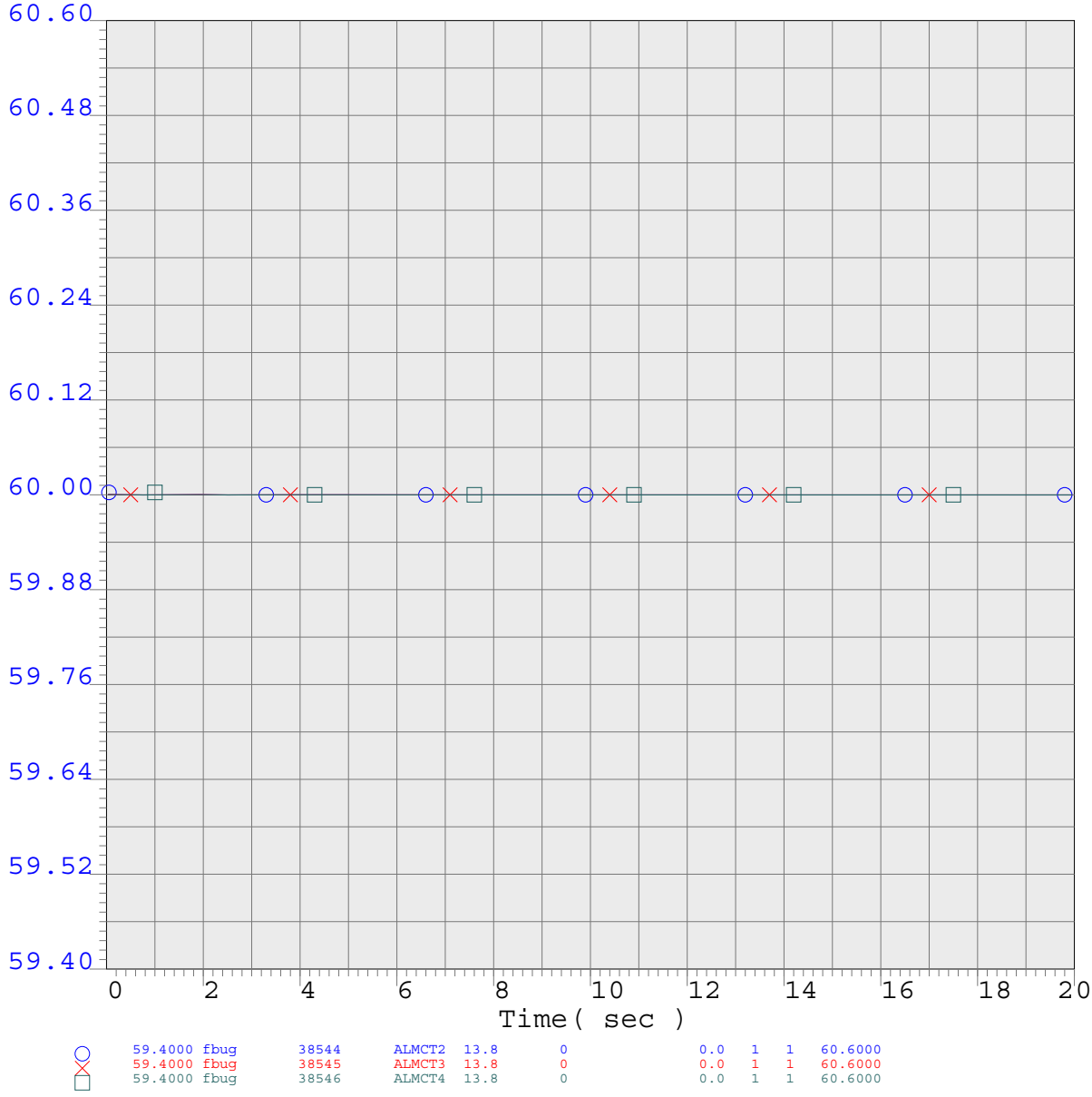
Almond 2 Power Plant
Frequency (Hz)

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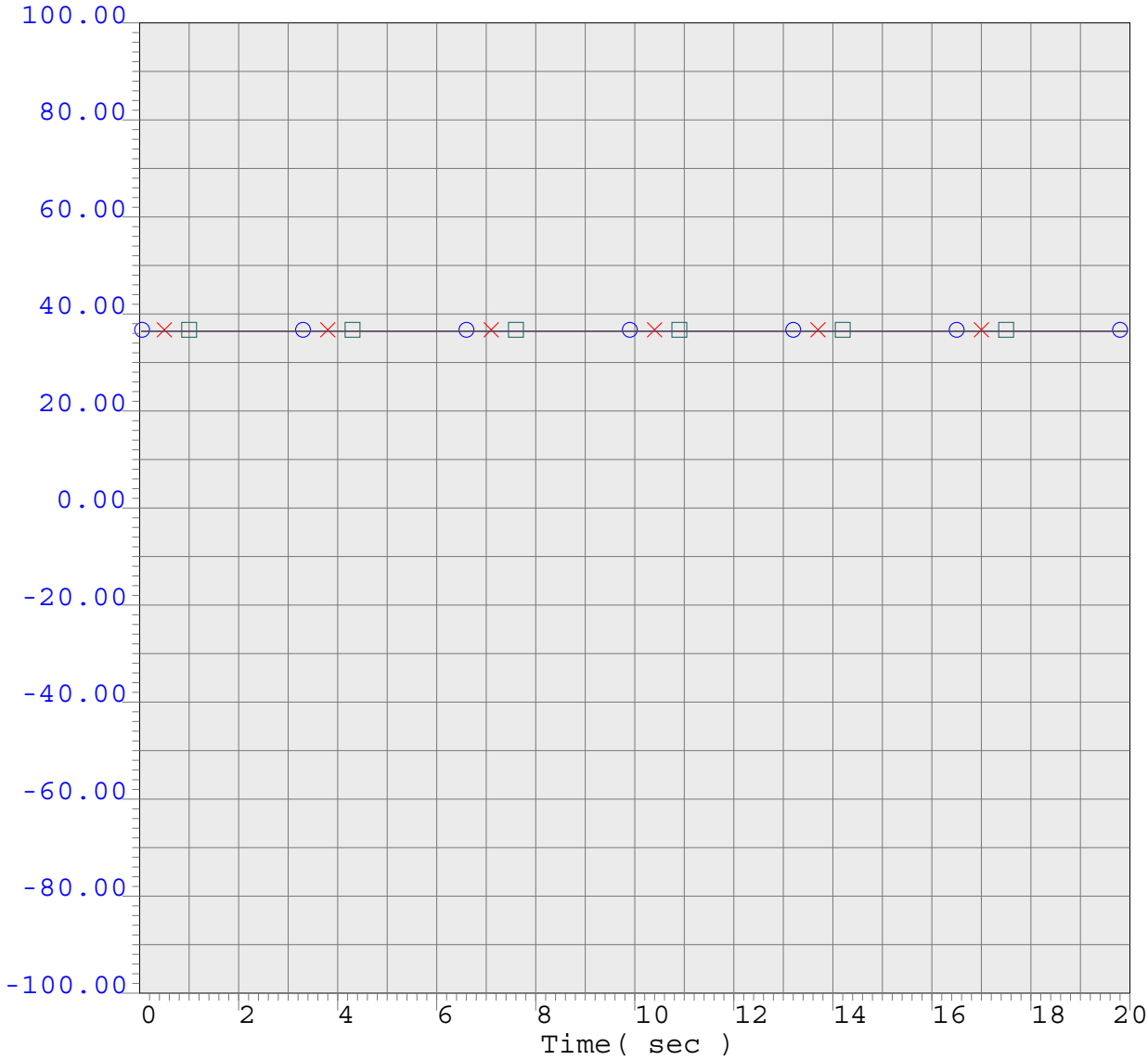
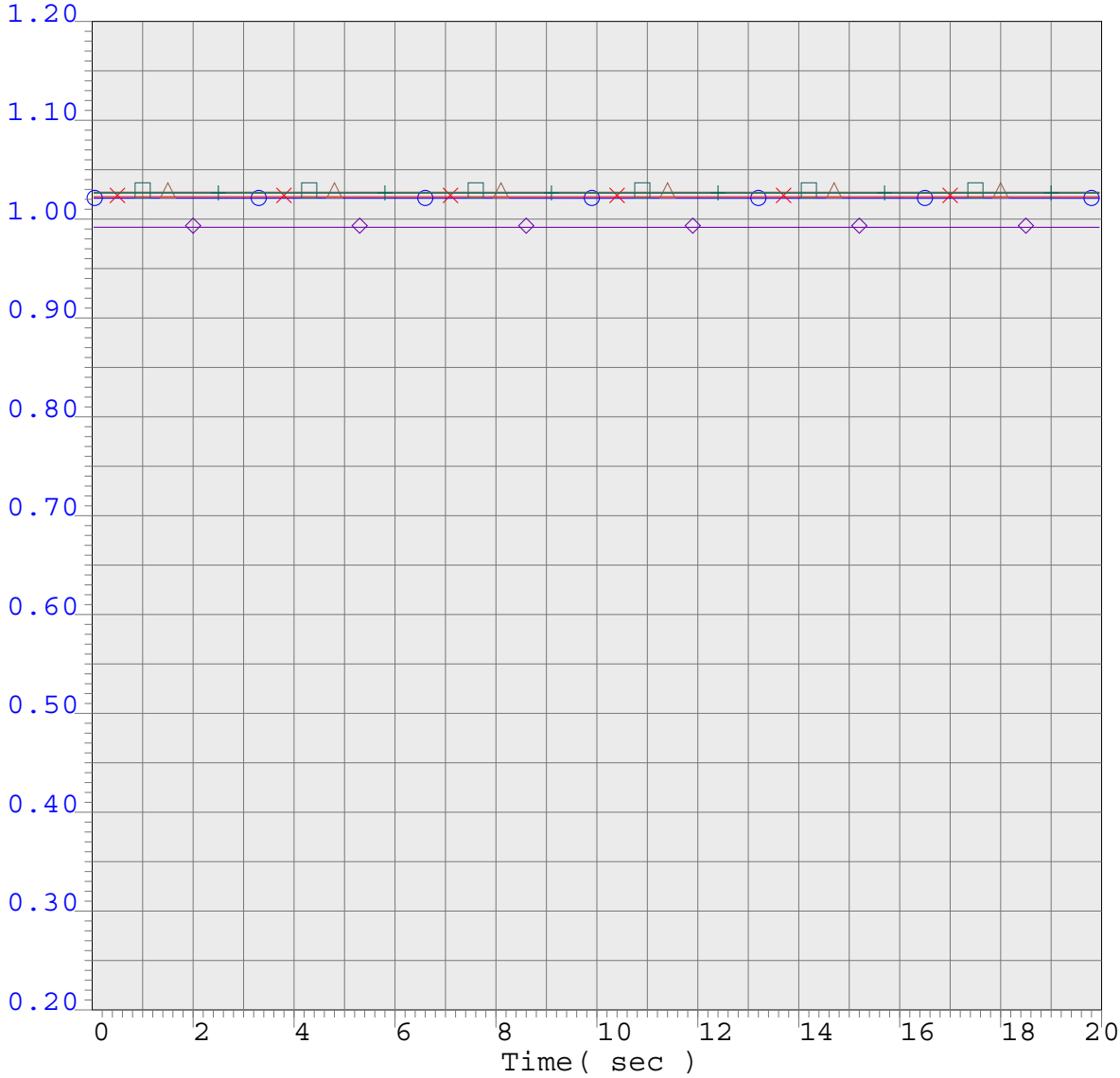
# Almond 2 Power Plant
## Relative Rotor Angle (degrees)



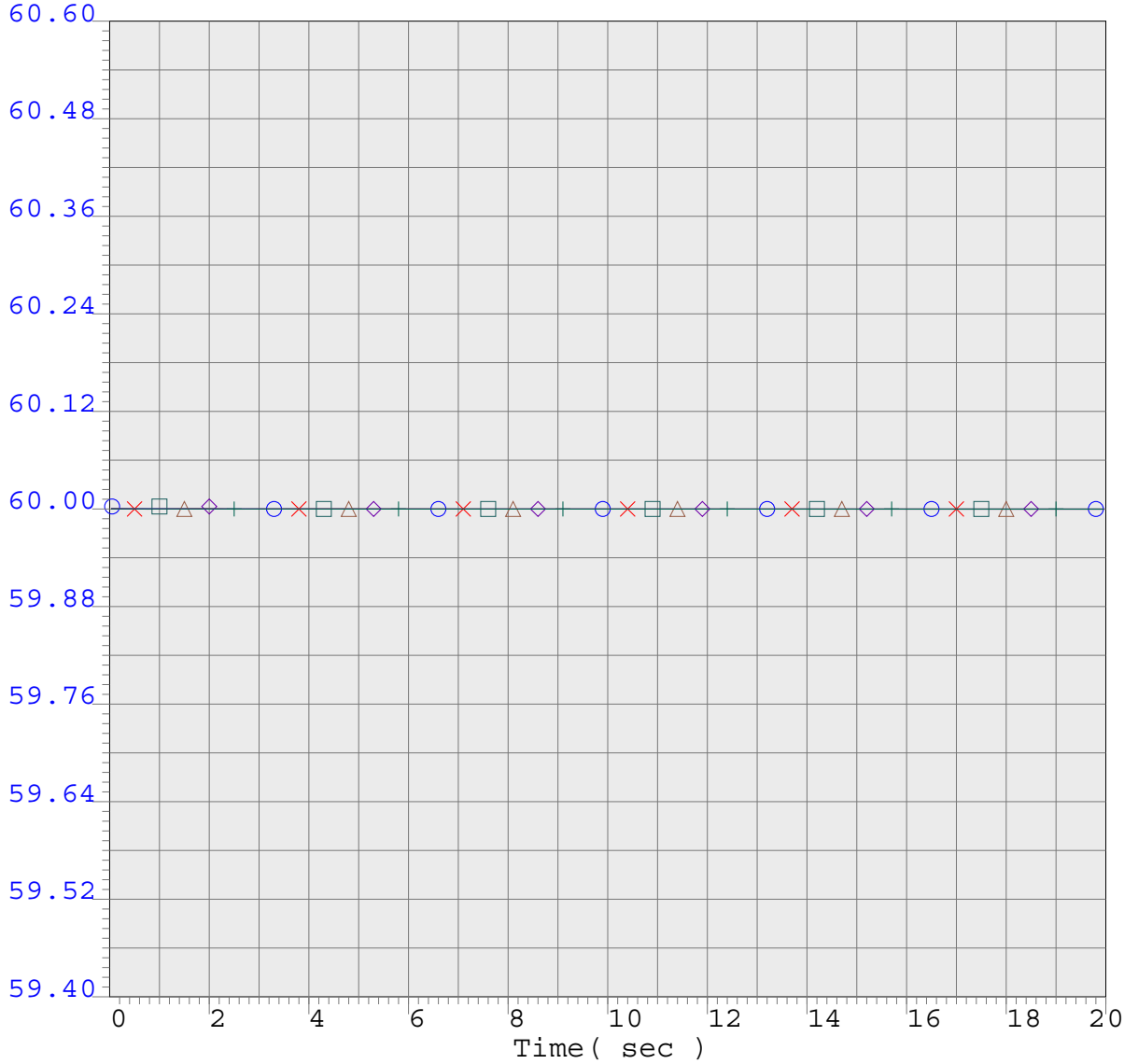

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| ○ | -100.0000 ang | 38544 | ALMCT2 | 13.8 | 0 | 0.0 | 1 | 1 | 100.0000 |
| × | -100.0000 ang | 38545 | ALMCT3 | 13.8 | 0 | 0.0 | 1 | 1 | 100.0000 |
| □ | -100.0000 ang | 38546 | ALMCT4 | 13.8 | 0 | 0.0 | 1 | 1 | 100.0000 |

Select TID System Parameters
Voltage (p.u.)



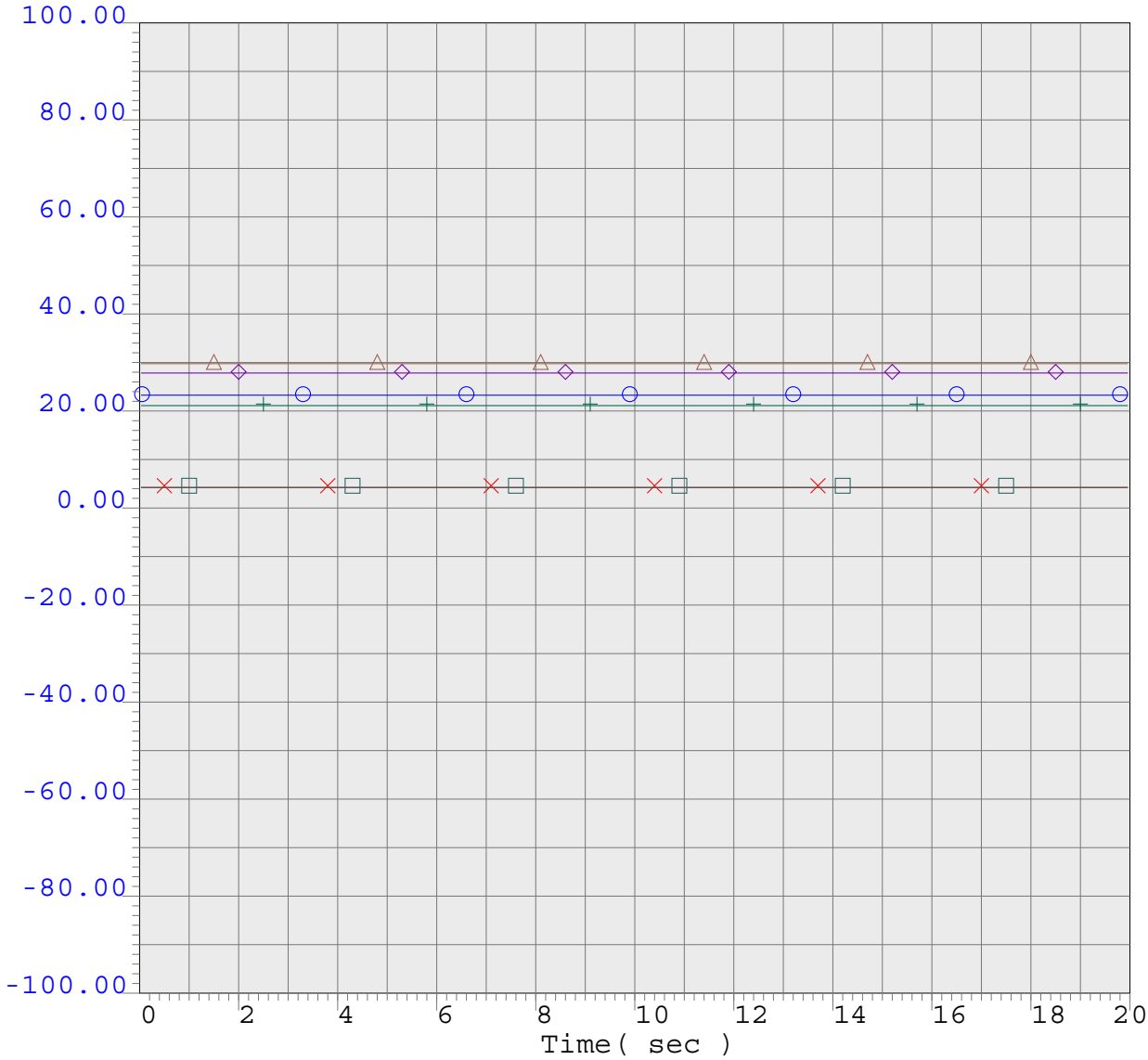

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 0.2000 | vbul | 38442 | AUGUST | 115.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbul | 38534 | GRAY115 | 115.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 38535 | GRAY69 | 69.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 38432 | OAKDLTID | 115.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 38400 | WALNT | 230.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 38410 | WESTL115 | 115.0 | 0 | 0.0 | 1 | 1 | 1.2000 |

Select TID System Parameters
Frequency (Hz)



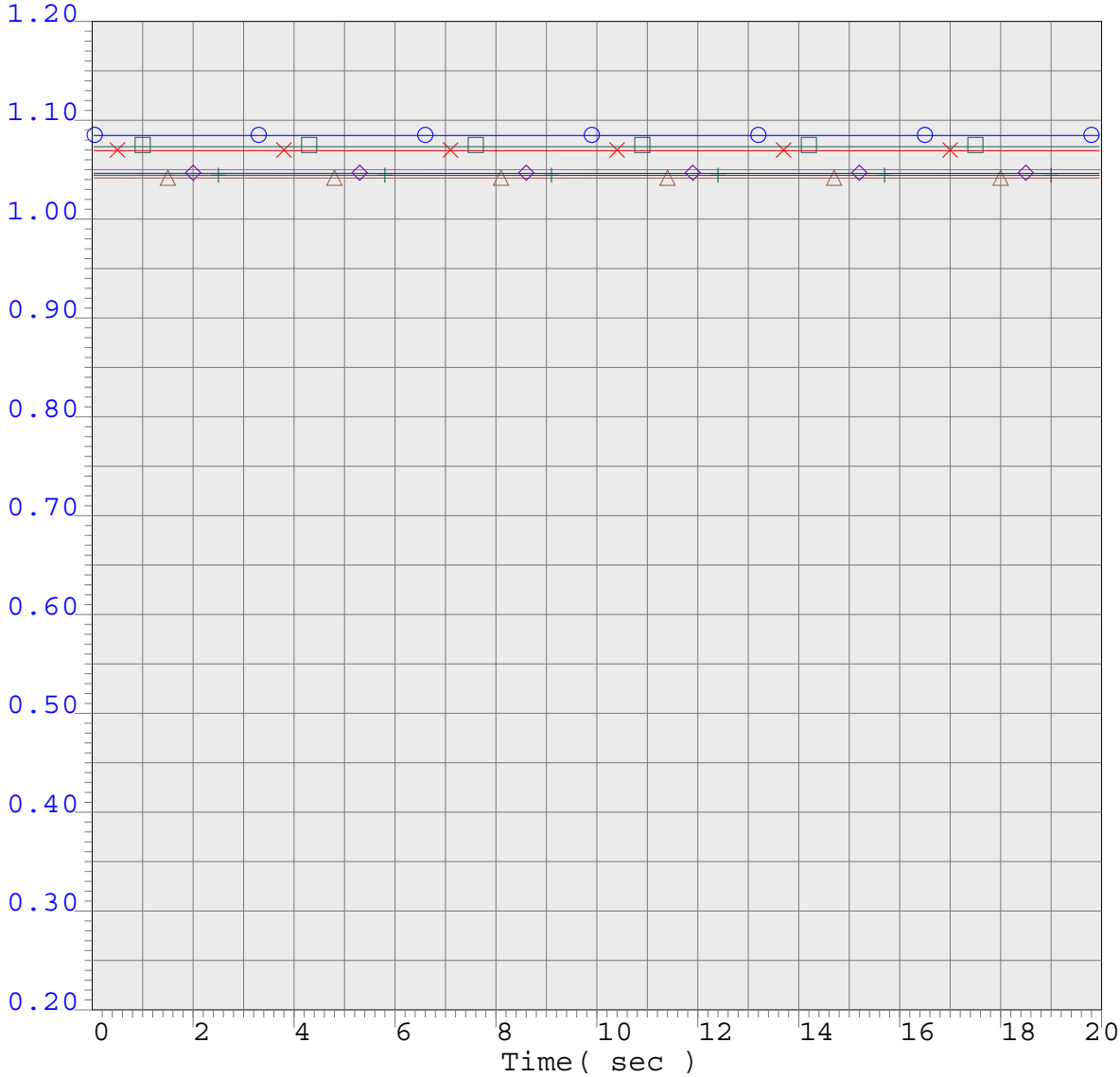

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 59.4000 | fbul | 38442 | AUGUST | 115.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbul | 38534 | GRAY115 | 115.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 38535 | GRAY69 | 69.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 38432 | OAKDLTID | 115.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 38400 | WALNT | 230.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 38410 | WESTL115 | 115.0 | 0 | 0.0 | 1 | 1 | 60.6000 |

Select TID System Parameters
Relative Rotor Angle (degrees)




| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| -100.0000 ang | 38564 | ALMONDCT | 13.8 | 0 | 0.0 | 1 | 1 | 100.0000 |
| -100.0000 ang | 38550 | DONPDRO1 | 13.8 | 0 | 0.0 | 1 | 1 | 100.0000 |
| -100.0000 ang | 38552 | DONPDRO2 | 13.8 | 0 | 0.0 | 1 | 1 | 100.0000 |
| -100.0000 ang | 38570 | WEC1-CT | 13.8 | 0 | 0.0 | 1 | 1 | 100.0000 |
| -100.0000 ang | 38574 | WEC2-CT | 13.8 | 0 | 0.0 | 1 | 1 | 100.0000 |
| -100.0000 ang | 38572 | WEC3-ST | 13.8 | 0 | 0.0 | 1 | 1 | 100.0000 |

# 500 kV Bulk System Parameters
Voltage (p.u.)




| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 0.2000 | vbus | 30055 | GATES | 500.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 30050 | LOSBANOS | 500.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 30060 | MIDWAY | 500.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 30040 | TESLA | 500.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 30035 | TRACY | 500.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 30030 | VACA-DIX | 500.0 | 0 | 0.0 | 1 | 1 | 1.2000 |

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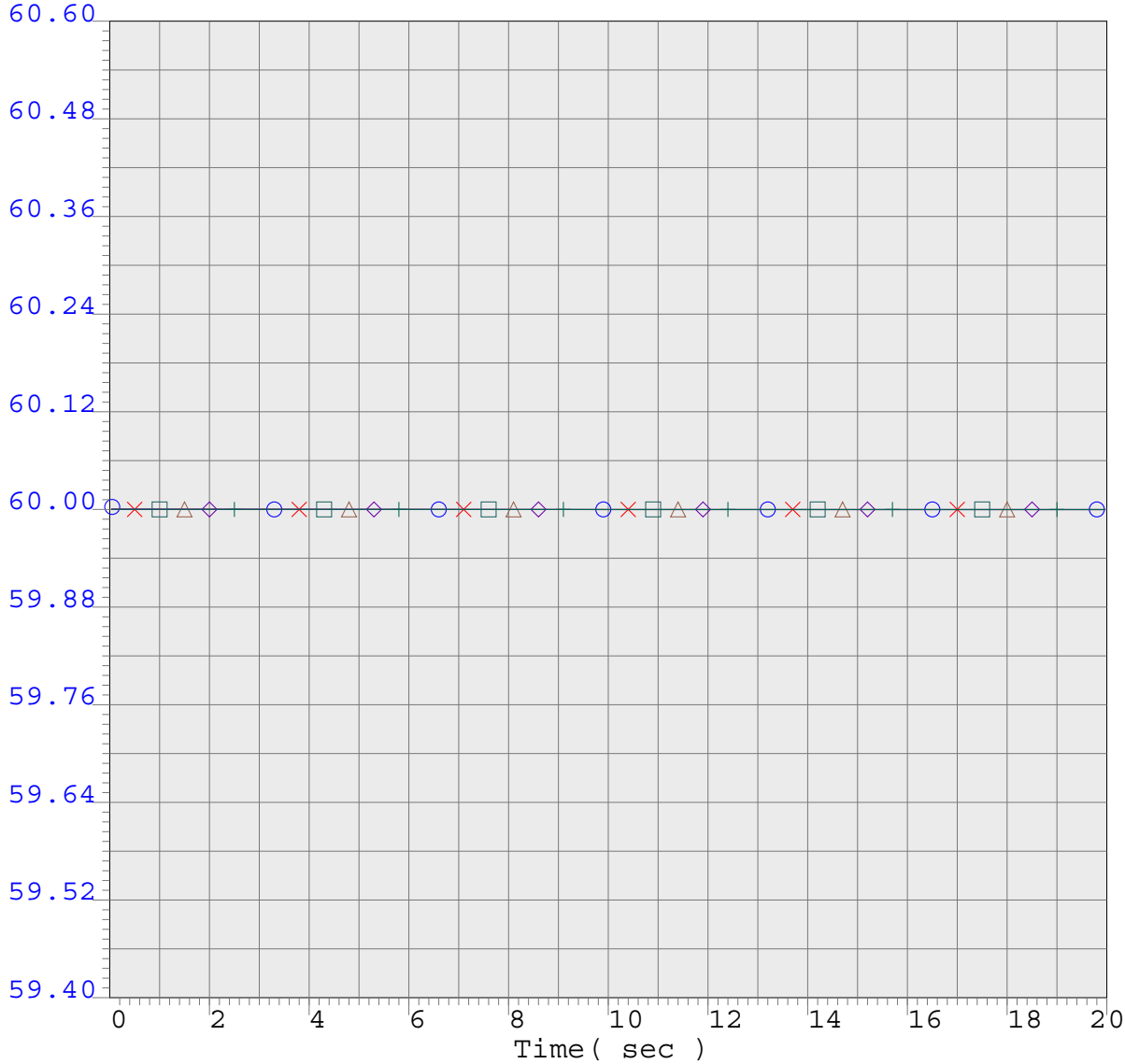
# 500 kV Bulk System Parameters
Frequency (Hz)




| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 59.4000 | fbus | 30055 | GATES | 500.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 30050 | LOSBANOS | 500.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 30060 | MIDWAY | 500.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 30040 | TESLA | 500.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 30035 | TRACY | 500.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 30030 | VACA-DIX | 500.0 | 0 | 0.0 | 1 | 1 | 60.6000 |

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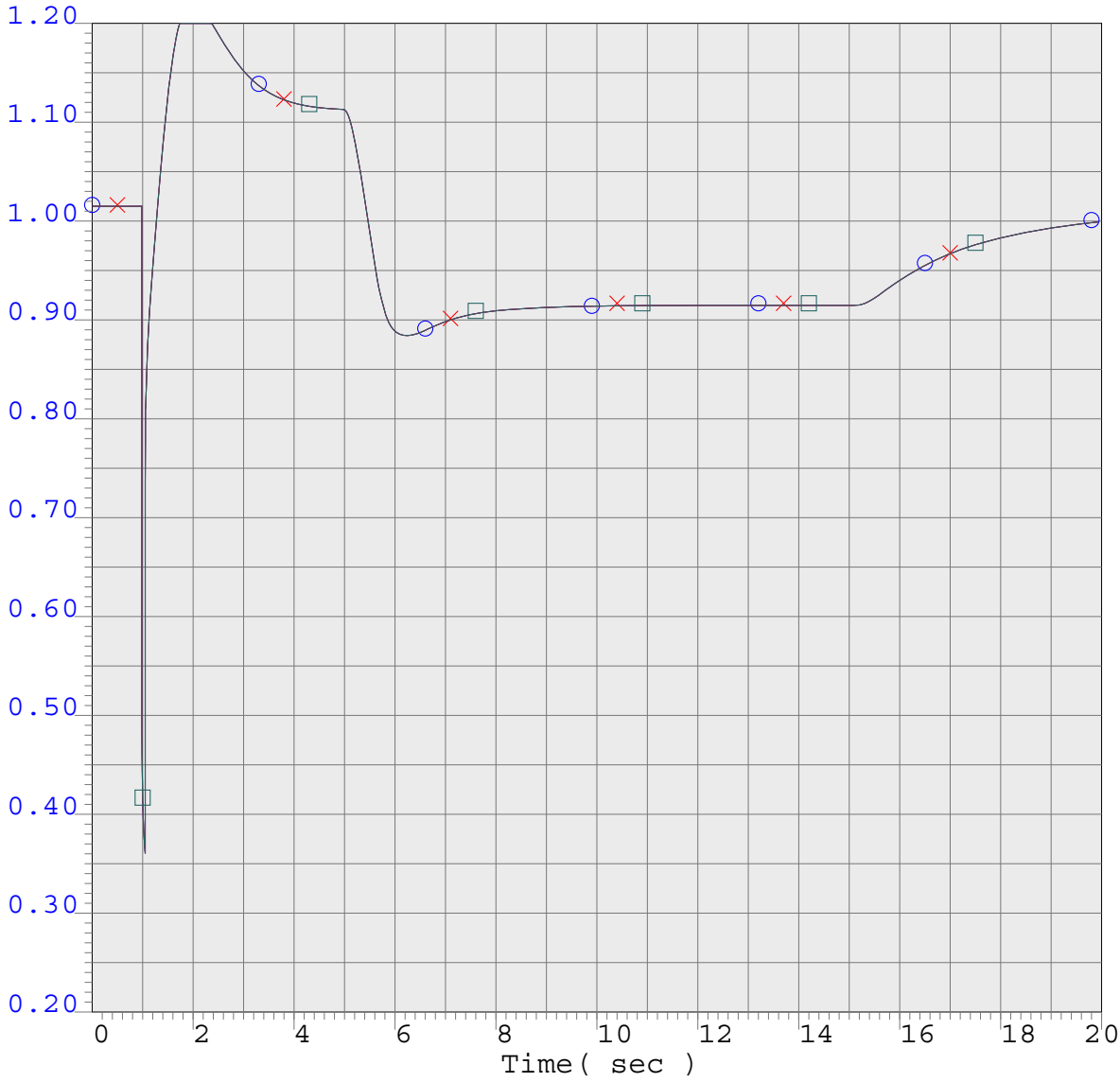
# Transient Stability Plots

# Almond 2 Power Plant + Interconnection

# Almond 2 Power Plant
# Terminal Voltage (p.u.)




| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| ○ | 0.2000 vt | 38544 | ALMCT2 | 13.8 | 0 | 0.0 | 1 | 1 | 1.2000 |
| × | 0.2000 vt | 38545 | ALMCT3 | 13.8 | 0 | 0.0 | 1 | 1 | 1.2000 |
| □ | 0.2000 vt | 38546 | ALMCT4 | 13.8 | 0 | 0.0 | 1 | 1 | 1.2000 |

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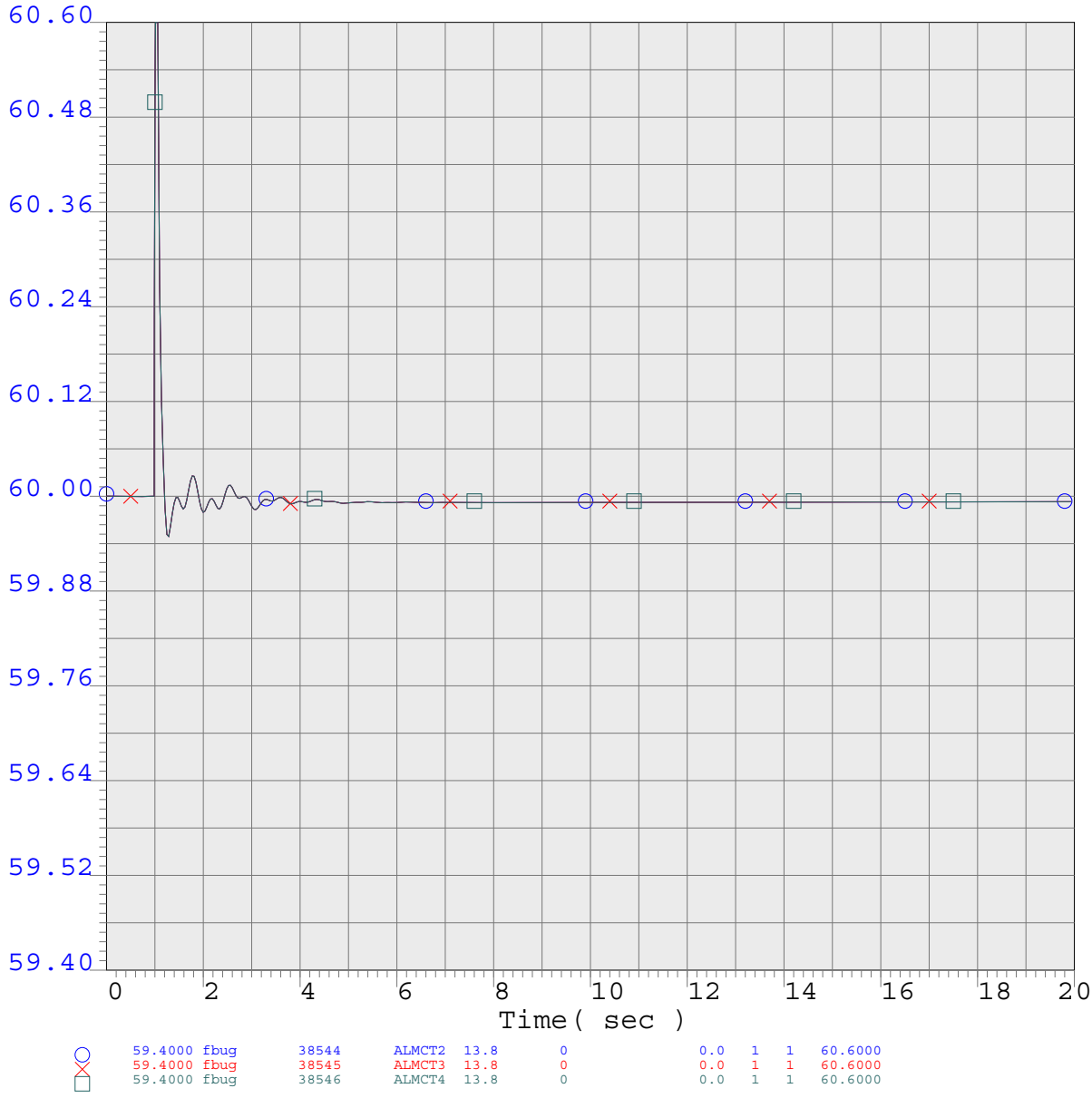
Almond 2 Power Plant
Frequency (Hz)

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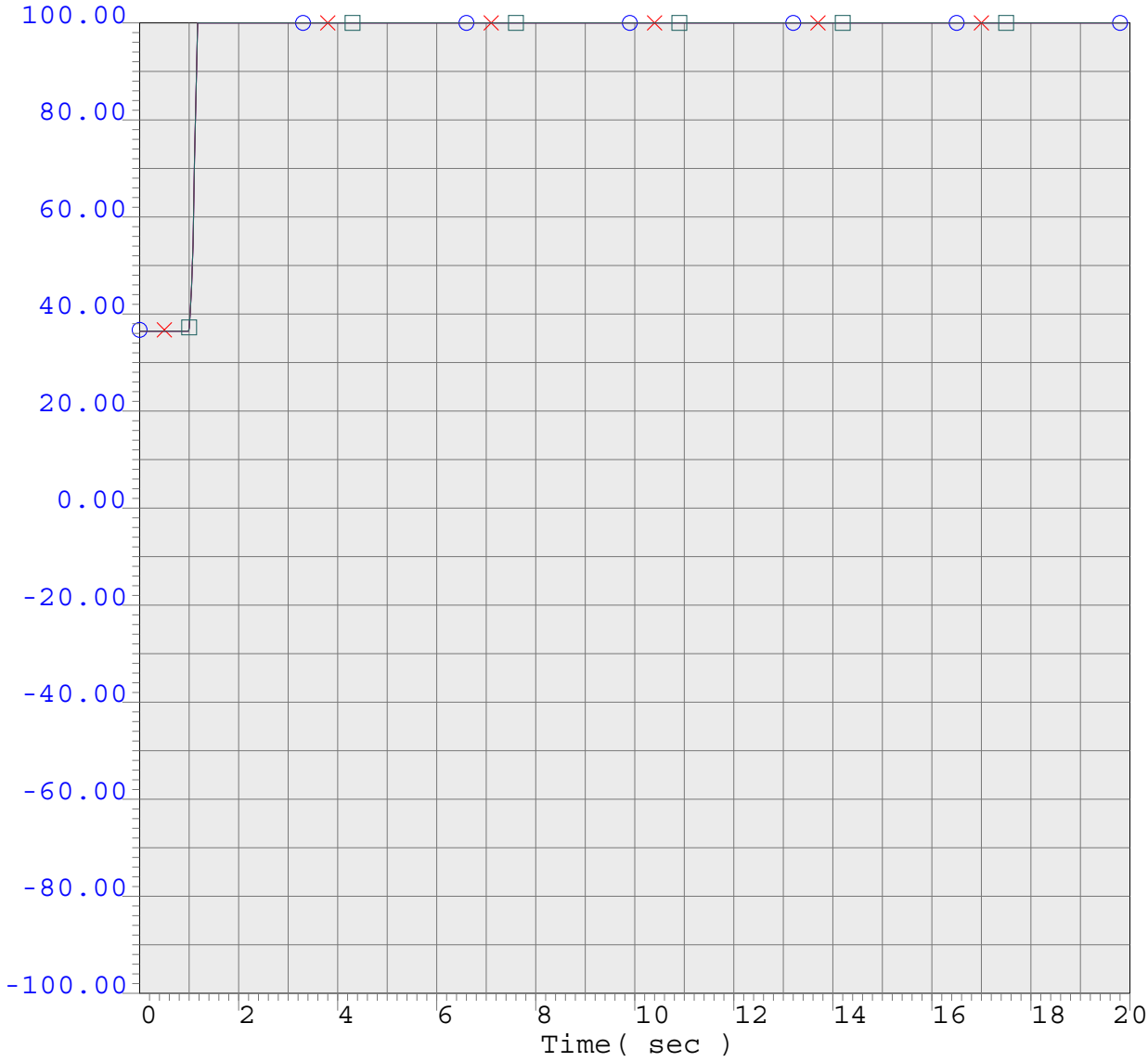
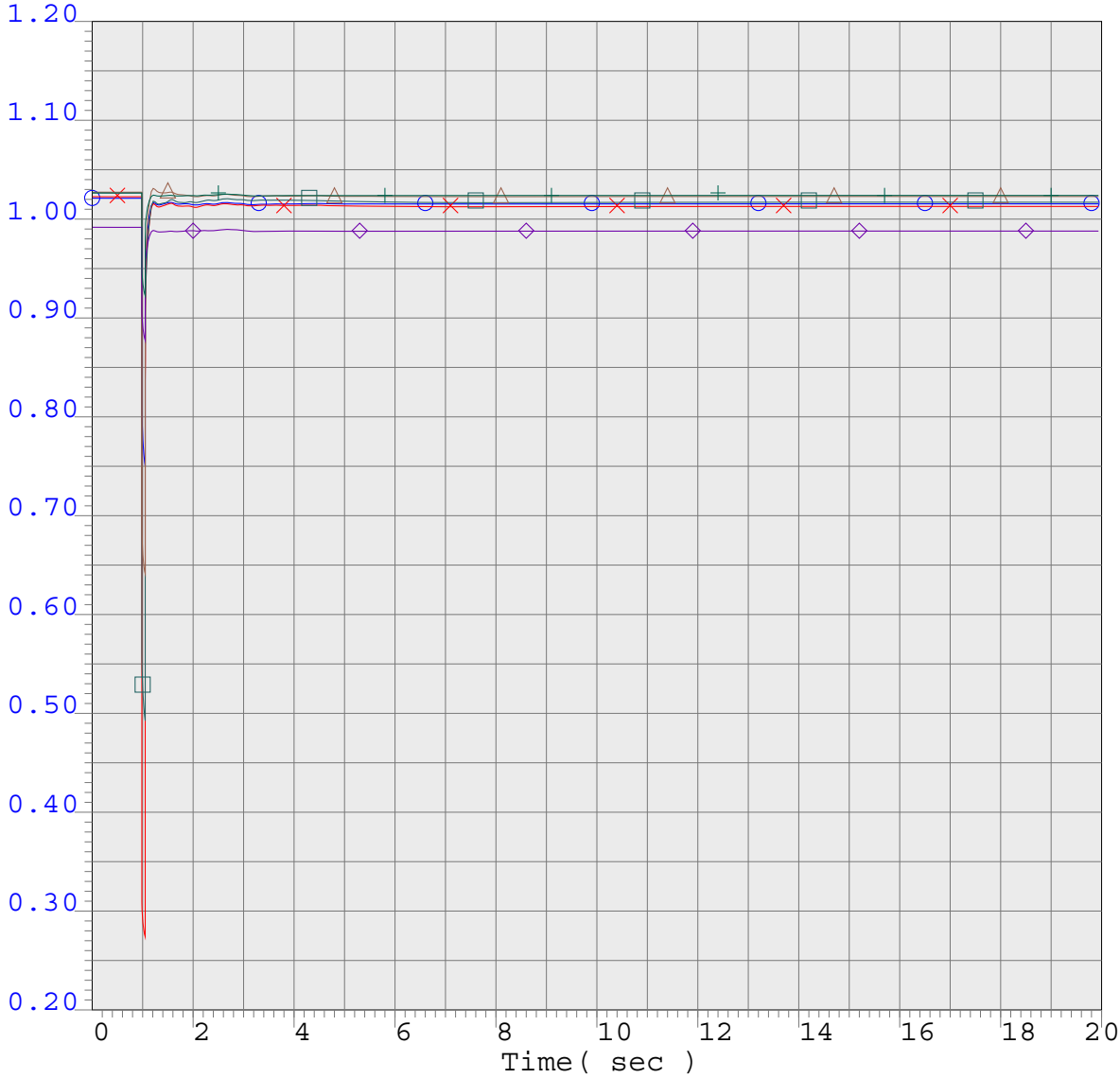
# Almond 2 Power Plant
## Relative Rotor Angle (degrees)




| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| -100.0000 ang | 38544 | ALMCT2 | 13.8 | 0 | 0.0 | 1 | 1 | 100.0000 |
| -100.0000 ang | 38545 | ALMCT3 | 13.8 | 0 | 0.0 | 1 | 1 | 100.0000 |
| -100.0000 ang | 38546 | ALMCT4 | 13.8 | 0 | 0.0 | 1 | 1 | 100.0000 |

Select TID System Parameters
Voltage (p.u.)




| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 0.2000 | vbul | 38442 | AUGUST | 115.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbul | 38534 | GRAY115 | 115.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 38535 | GRAY69 | 69.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 38432 | OAKDLTID | 115.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 38400 | WALNT | 230.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 38410 | WESTL115 | 115.0 | 0 | 0.0 | 1 | 1 | 1.2000 |

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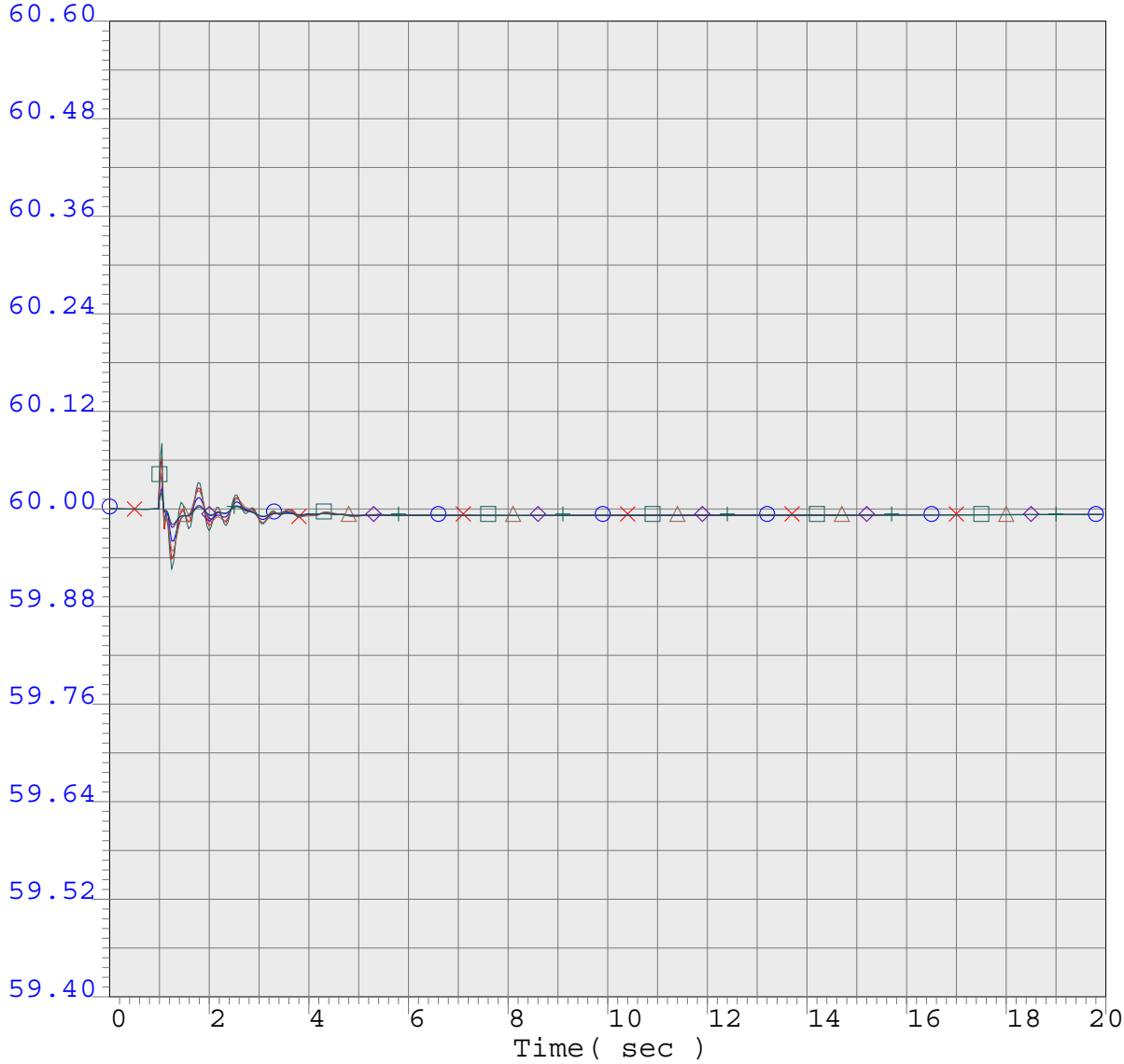
Select TID System Parameters
Frequency (Hz)




| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 59.4000 | fbul | 38442 | AUGUST | 115.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbul | 38534 | GRAY115 | 115.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 38535 | GRAY69 | 69.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 38432 | OAKDLTID | 115.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 38400 | WALNT | 230.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 38410 | WESTL115 | 115.0 | 0 | 0.0 | 1 | 1 | 60.6000 |

2012 Summer Peak Base Case



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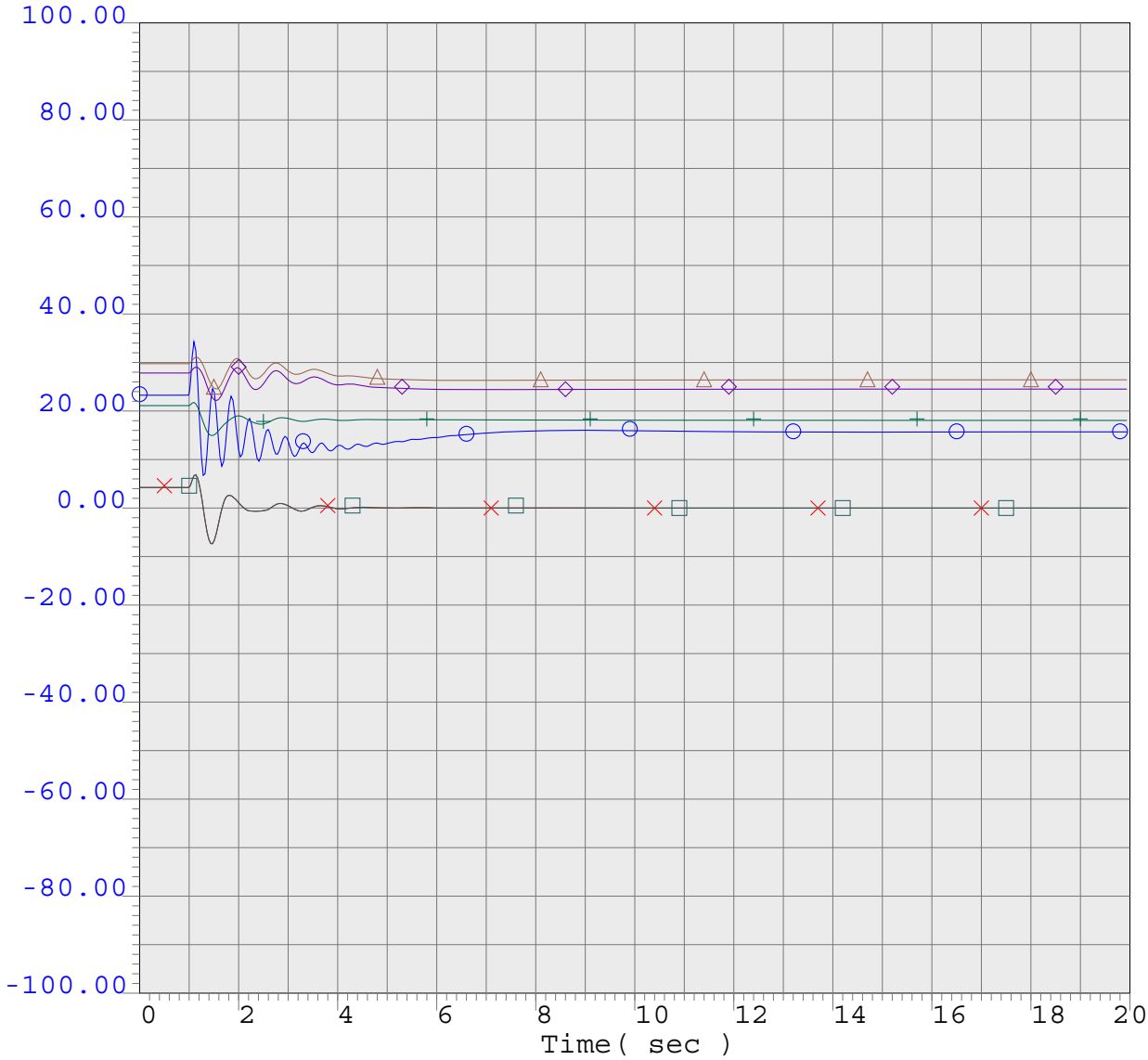
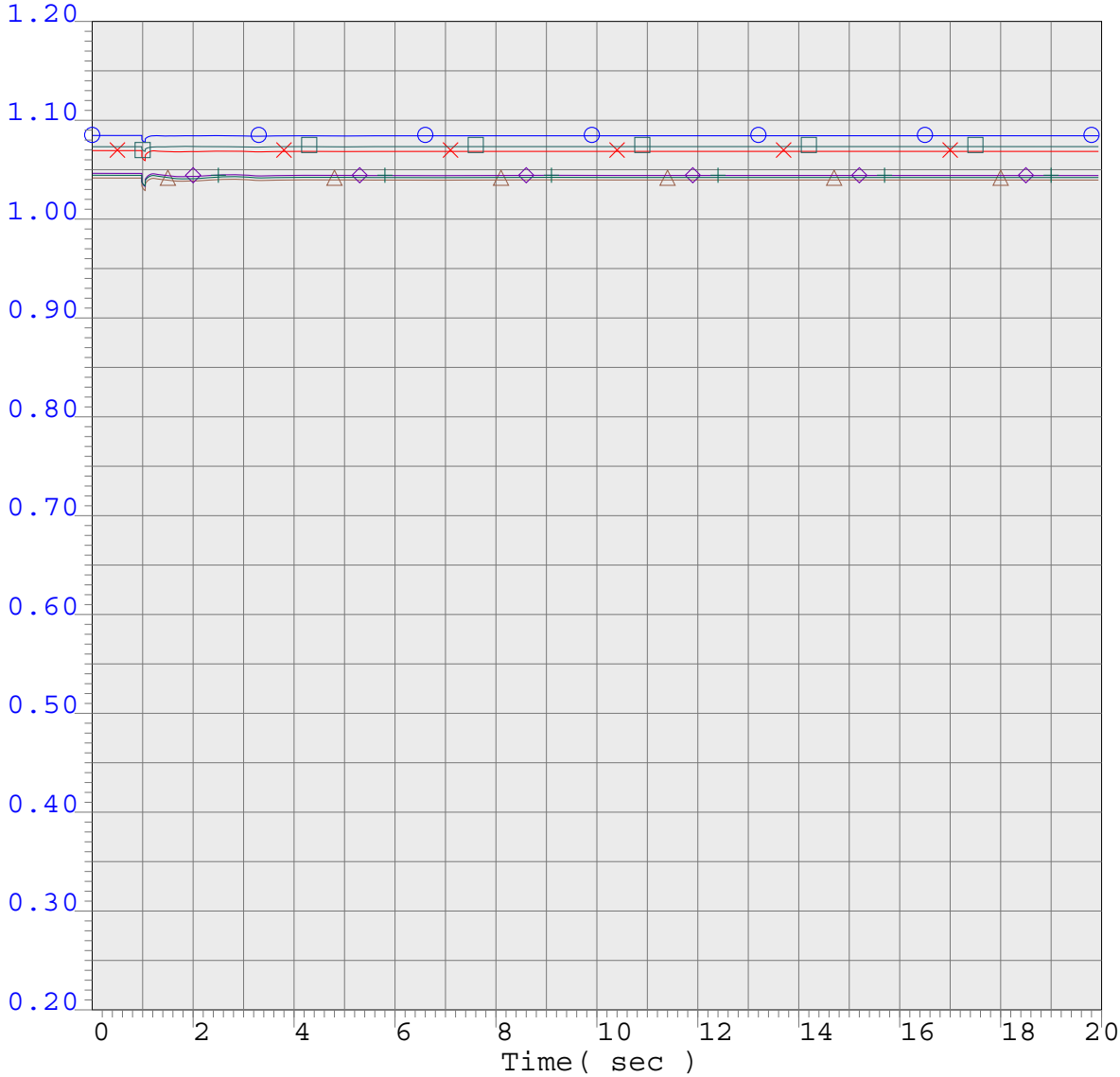
Select TID System Parameters
Relative Rotor Angle (degrees)



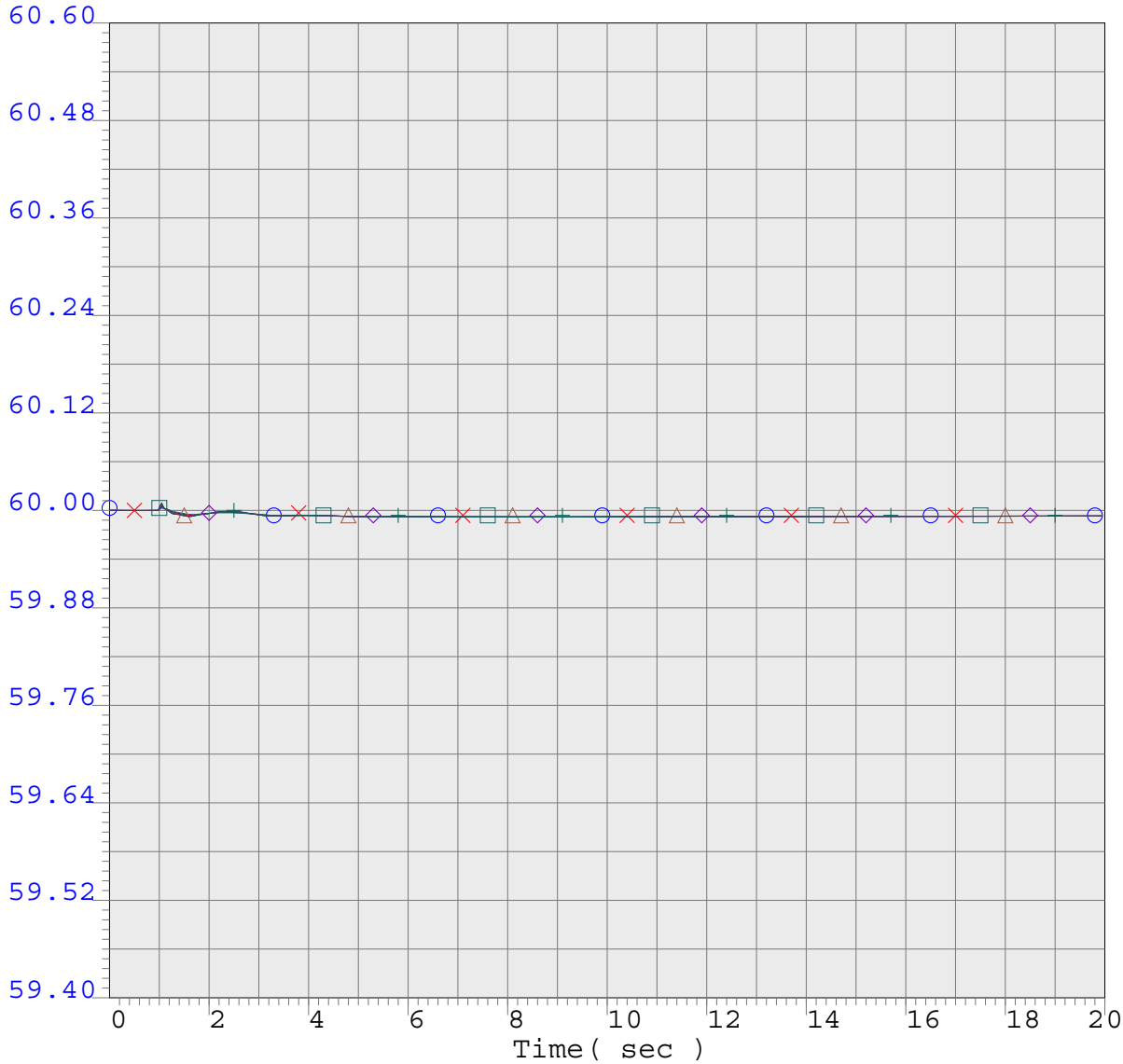

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| -100.0000 ang | 38564 | ALMONDCT | 13.8 | 0 | 0.0 | 1 | 1 | 100.0000 |
| -100.0000 ang | 38550 | DONPDRO1 | 13.8 | 0 | 0.0 | 1 | 1 | 100.0000 |
| -100.0000 ang | 38552 | DONPDRO2 | 13.8 | 0 | 0.0 | 1 | 1 | 100.0000 |
| -100.0000 ang | 38570 | WEC1-CT | 13.8 | 0 | 0.0 | 1 | 1 | 100.0000 |
| -100.0000 ang | 38574 | WEC2-CT | 13.8 | 0 | 0.0 | 1 | 1 | 100.0000 |
| -100.0000 ang | 38572 | WEC3-ST | 13.8 | 0 | 0.0 | 1 | 1 | 100.0000 |

# 500 kV Bulk System Parameters
Voltage (p.u.)




| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 0.2000 | vbus | 30055 | GATES | 500.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 30050 | LOSBANOS | 500.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 30060 | MIDWAY | 500.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 30040 | TESLA | 500.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 30035 | TRACY | 500.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 30030 | VACA-DIX | 500.0 | 0 | 0.0 | 1 | 1 | 1.2000 |

# 500 kV Bulk System Parameters
Frequency (Hz)




| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 59.4000 | fbus | 30055 | GATES | 500.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 30050 | LOSBANOS | 500.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 30060 | MIDWAY | 500.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 30040 | TESLA | 500.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 30035 | TRACY | 500.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 30030 | VACA-DIX | 500.0 | 0 | 0.0 | 1 | 1 | 60.6000 |

2012 Summer Peak Base Case



2012_sum_pk_pst_001_ALMOND_2_PP.chf

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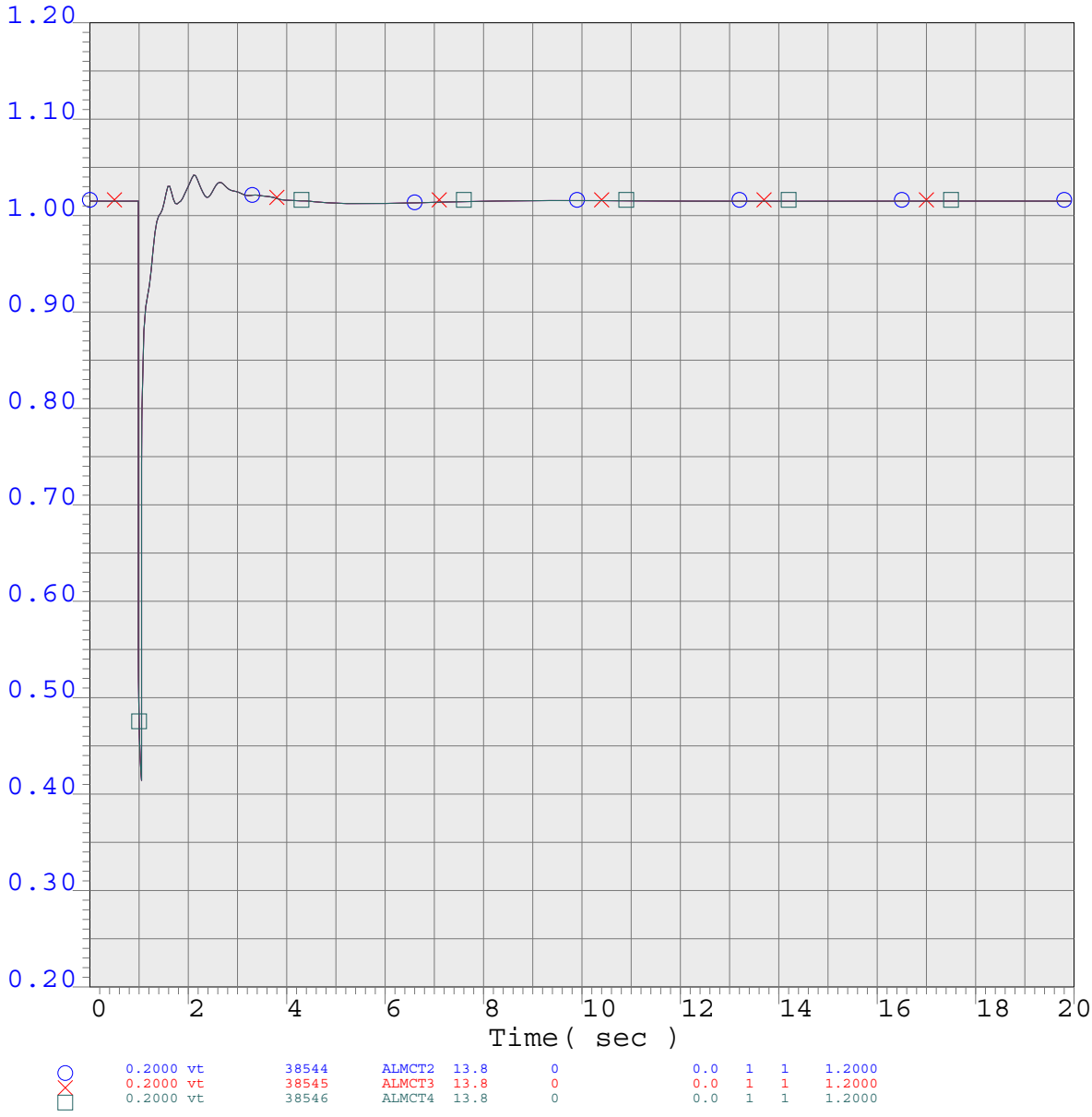
Mon Oct 19 00:51:29 2009

# Transient Stability Plots

# Grayson-Almond #1 115 kV Line Out

# Almond 2 Power Plant
# Terminal Voltage (p.u.)




2012 Summer Peak Base Case



2012_sum_pk_pst_002_GRAYSON-ALMOND_115.chf

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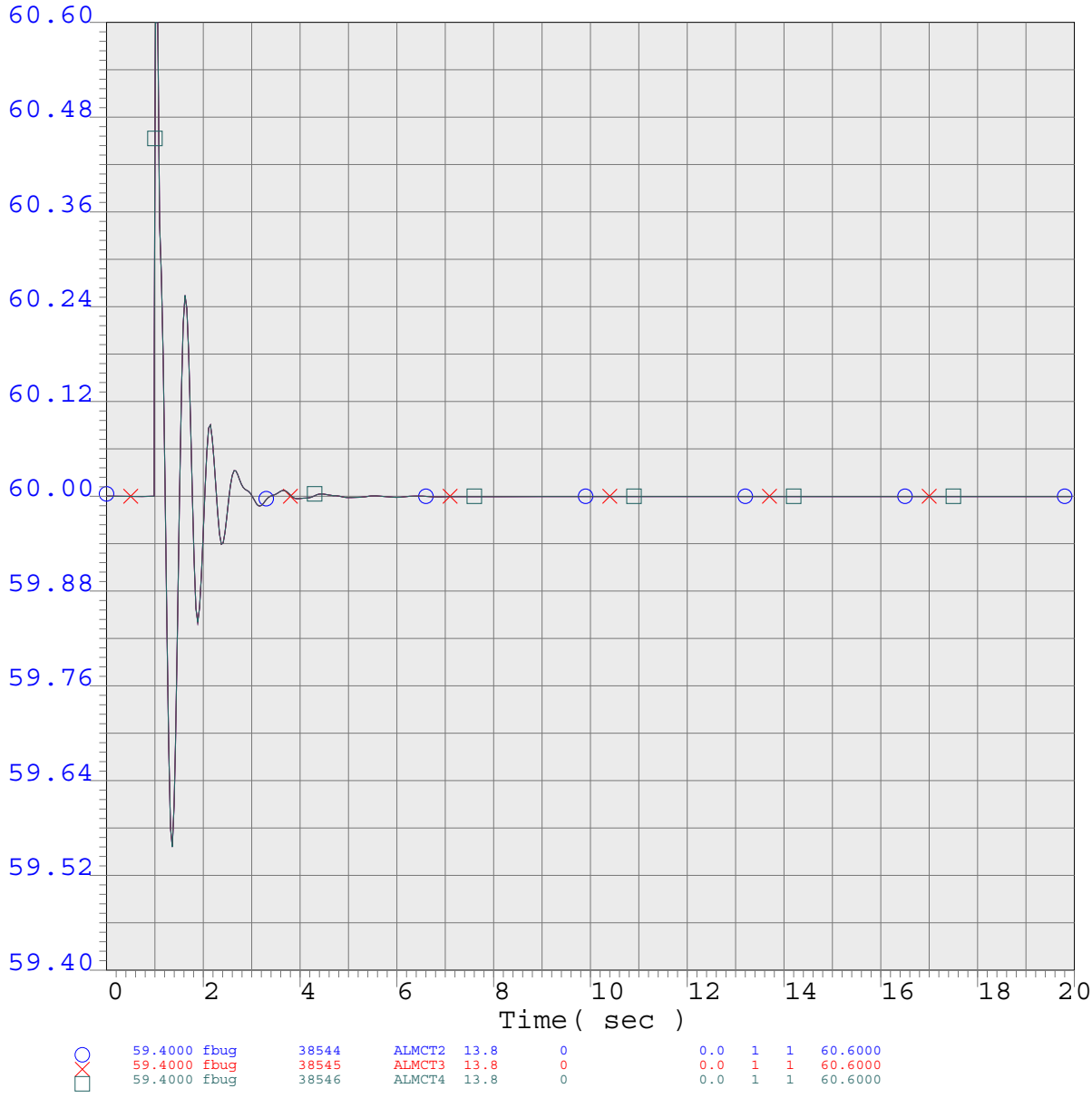
Mon Oct 19 00:51:34 2009

Almond 2 Power Plant
Frequency (Hz)




2012 Summer Peak Base Case



2012_sum_pk_pst_002_GRAYSON-ALMOND_115.chf

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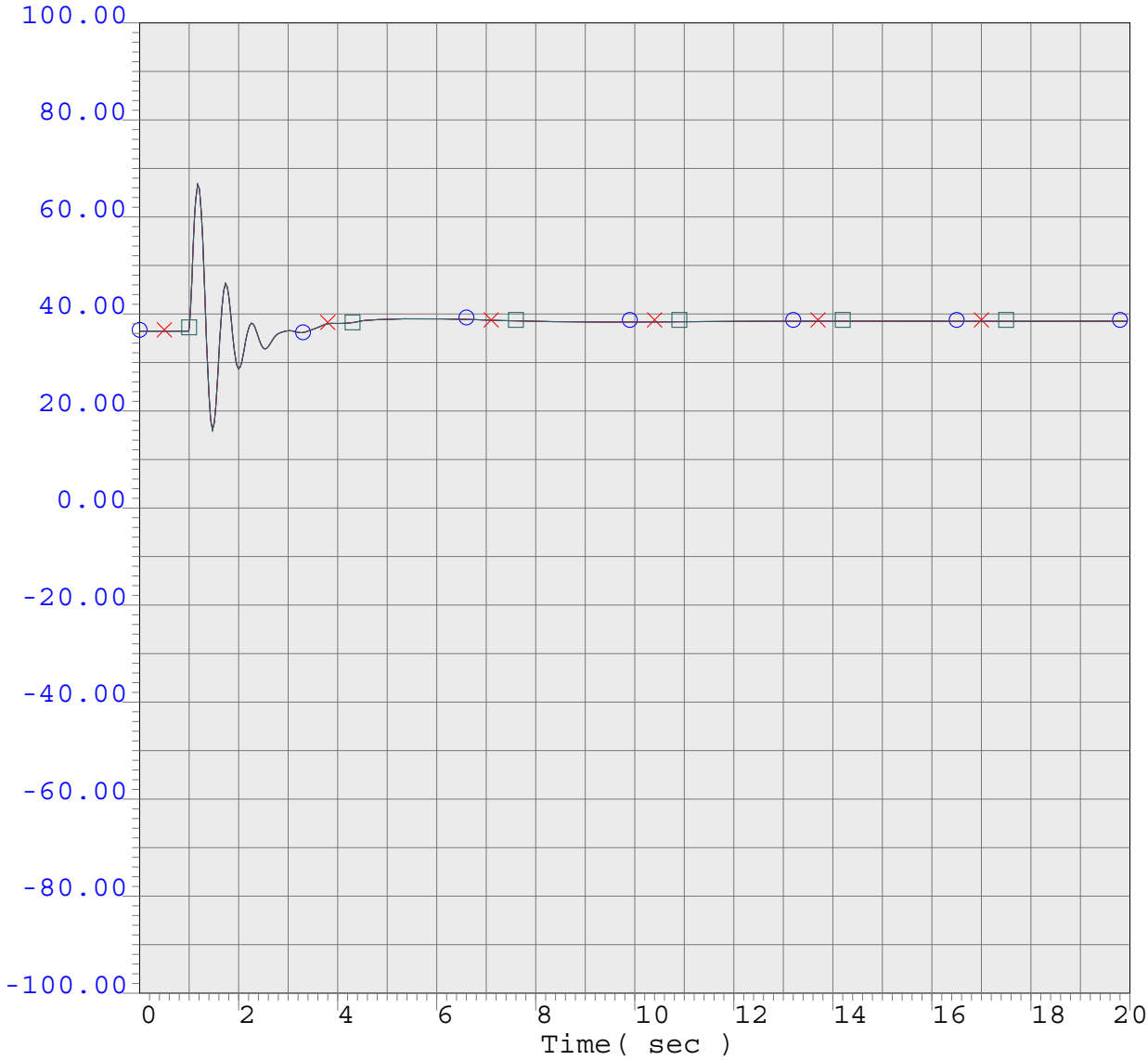
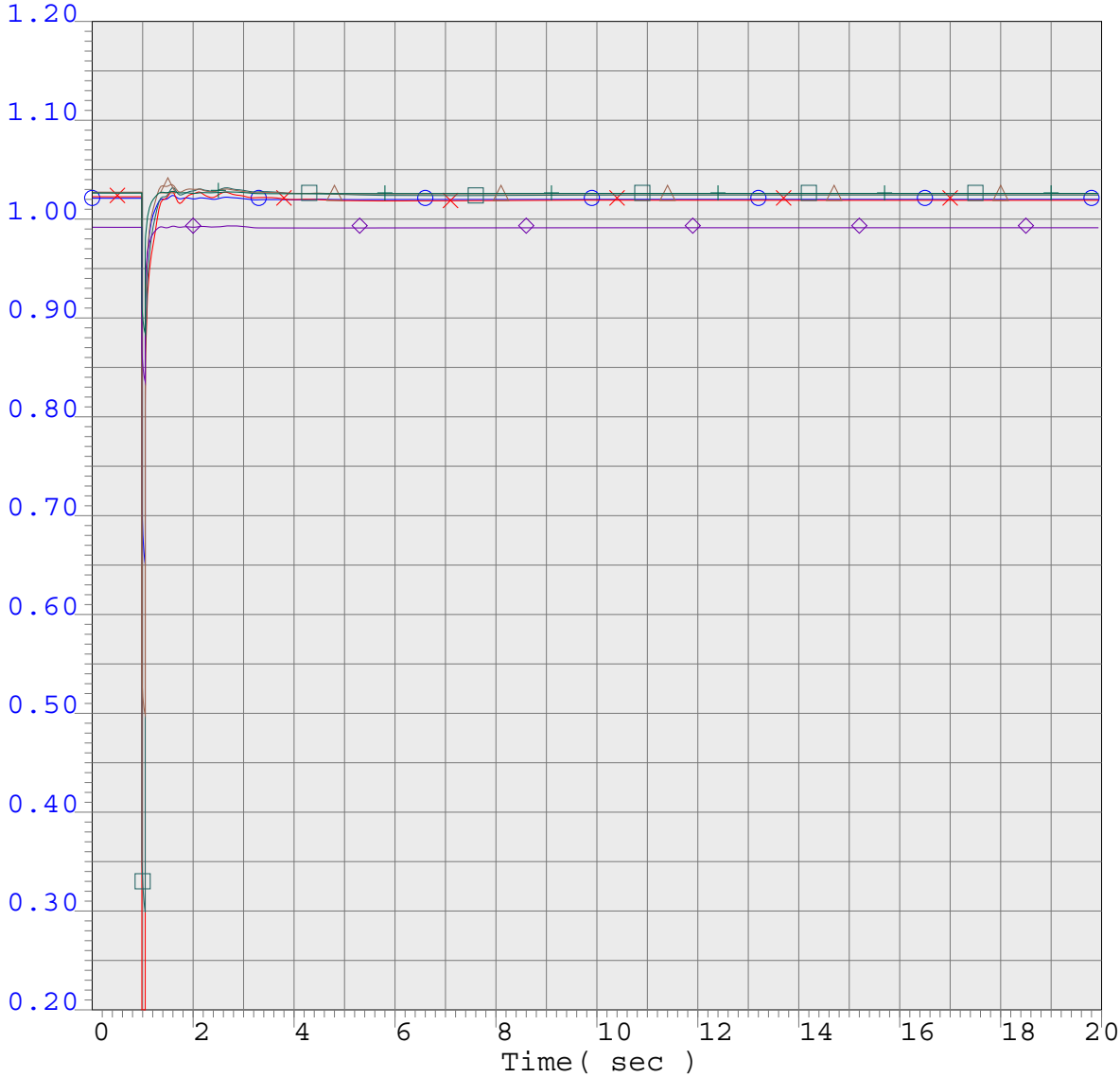
Mon Oct 19 00:51:34 2009

Almond 2 Power Plant
Relative Rotor Angle (degrees)




| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| -100.0000 ang | 38544 | ALMCT2 | 13.8 | 0 | 0.0 | 1 | 1 | 100.0000 |
| -100.0000 ang | 38545 | ALMCT3 | 13.8 | 0 | 0.0 | 1 | 1 | 100.0000 |
| -100.0000 ang | 38546 | ALMCT4 | 13.8 | 0 | 0.0 | 1 | 1 | 100.0000 |

Select TID System Parameters
Voltage (p.u.)




| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 0.2000 | vbul | 38442 | AUGUST | 115.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbul | 38534 | GRAY115 | 115.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 38535 | GRAY69 | 69.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 38432 | OAKDLTID | 115.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 38400 | WALNT | 230.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 38410 | WESTL115 | 115.0 | 0 | 0.0 | 1 | 1 | 1.2000 |

2012 Summer Peak Base Case



2012_sum_pk_pst_002_GRAYSON-ALMOND_115.chf

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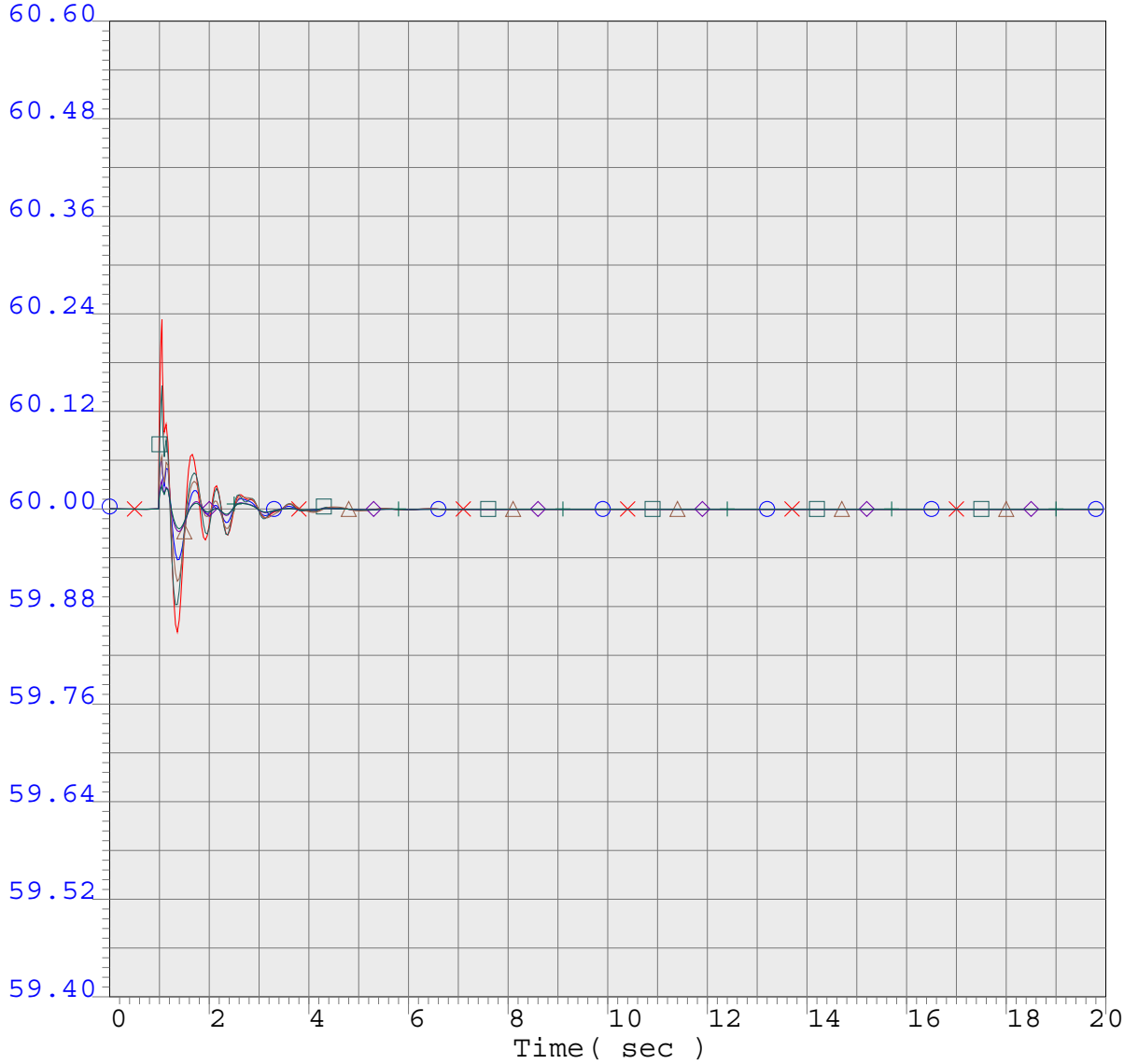
Select TID System Parameters
Frequency (Hz)




| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 59.4000 | fbul | 38442 | AUGUST | 115.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbul | 38534 | GRAY115 | 115.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 38535 | GRAY69 | 69.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 38432 | OAKDLTID | 115.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 38400 | WALNT | 230.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 38410 | WESTL115 | 115.0 | 0 | 0.0 | 1 | 1 | 60.6000 |

2012 Summer Peak Base Case



2012_sum_pk_pst_002_GRAYSON-ALMOND_115.chf

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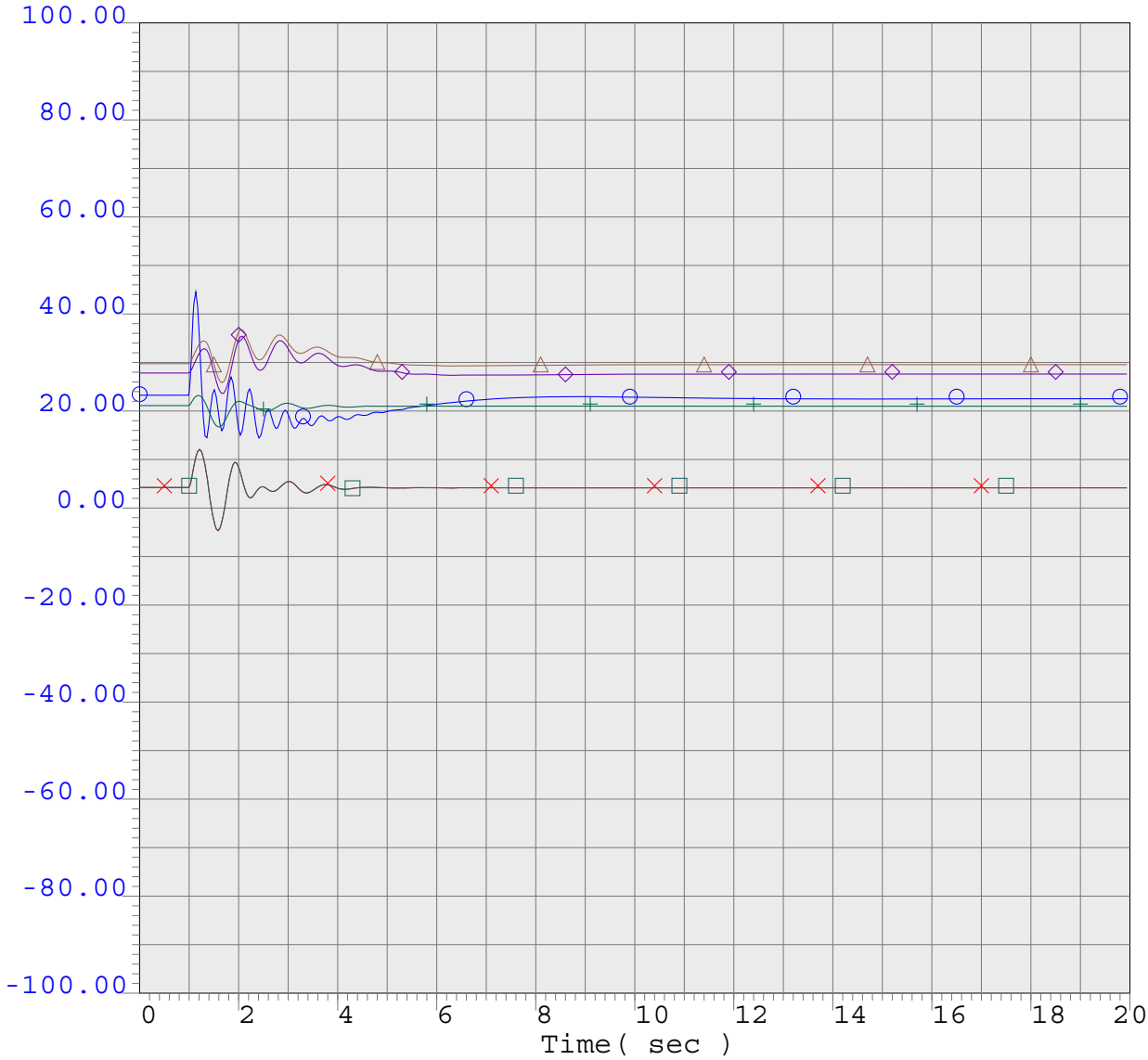
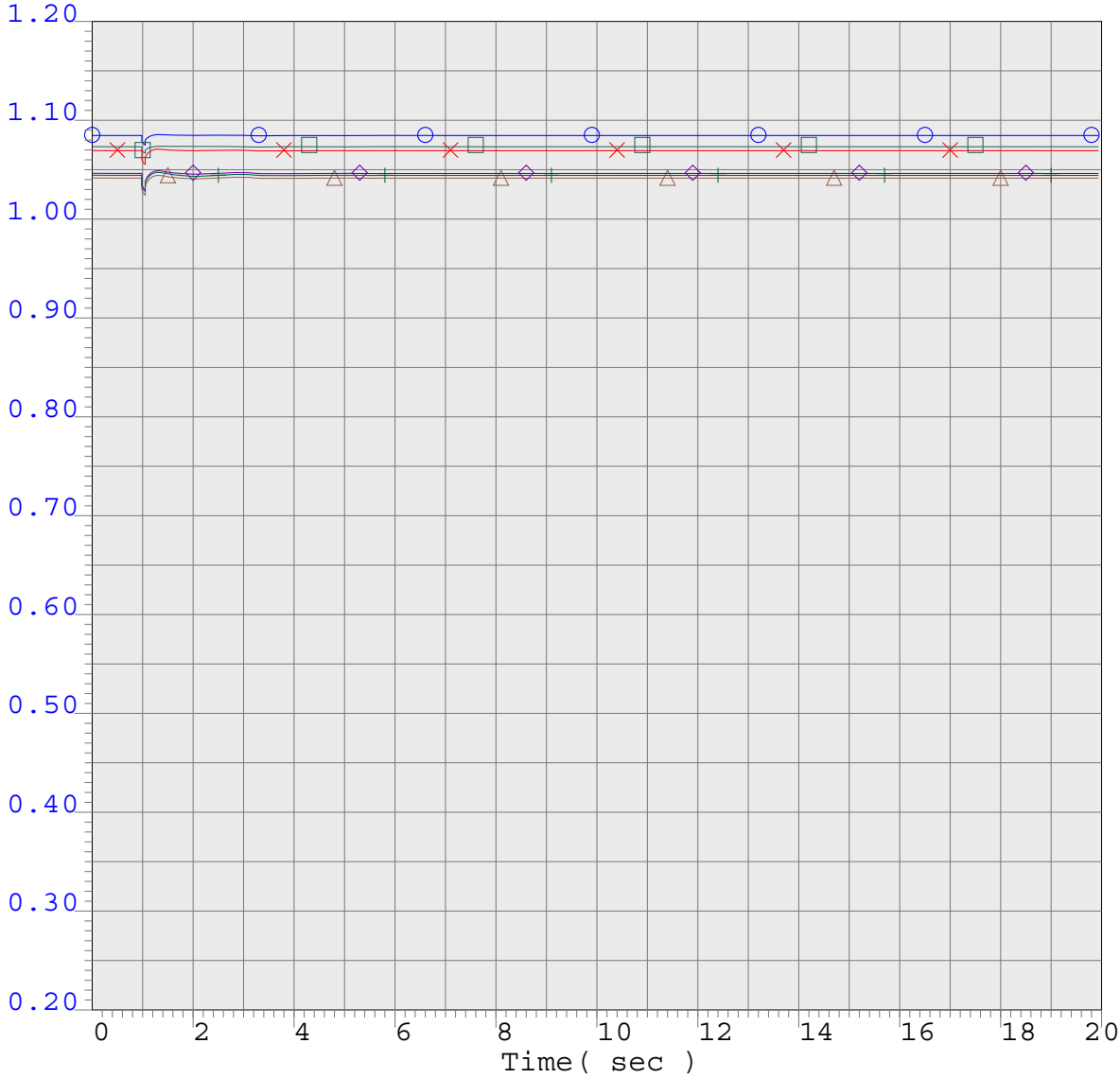
Select TID System Parameters
Relative Rotor Angle (degrees)



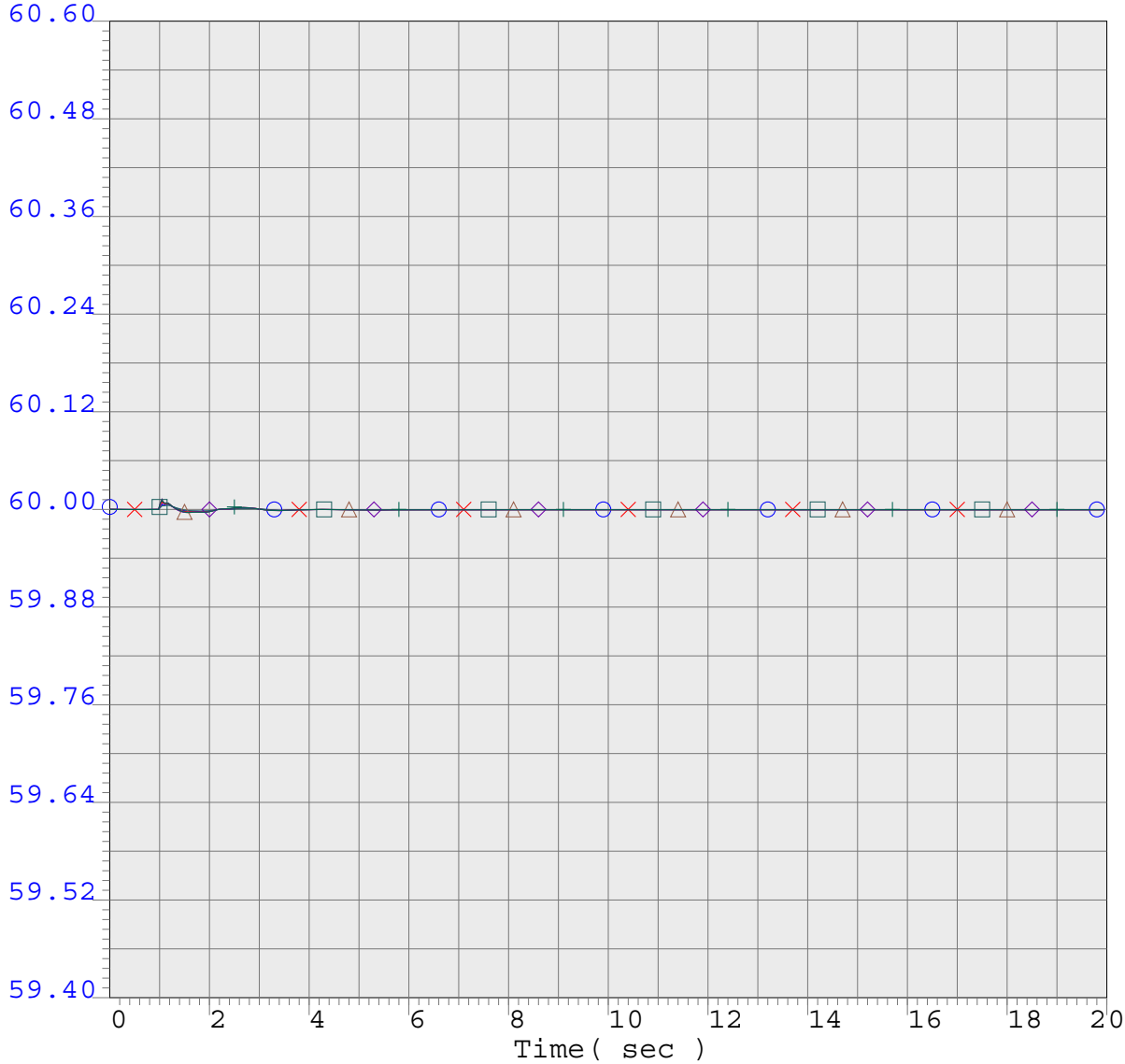

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| -100.0000 ang | 38564 | ALMONDCT | 13.8 | 0 | 0.0 | 1 | 1 | 100.0000 |
| -100.0000 ang | 38550 | DONPDRO1 | 13.8 | 0 | 0.0 | 1 | 1 | 100.0000 |
| -100.0000 ang | 38552 | DONPDRO2 | 13.8 | 0 | 0.0 | 1 | 1 | 100.0000 |
| -100.0000 ang | 38570 | WEC1-CT | 13.8 | 0 | 0.0 | 1 | 1 | 100.0000 |
| -100.0000 ang | 38574 | WEC2-CT | 13.8 | 0 | 0.0 | 1 | 1 | 100.0000 |
| -100.0000 ang | 38572 | WEC3-ST | 13.8 | 0 | 0.0 | 1 | 1 | 100.0000 |

# 500 kV Bulk System Parameters
Voltage (p.u.)




| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 0.2000 | vbus | 30055 | GATES | 500.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 30050 | LOSBANOS | 500.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 30060 | MIDWAY | 500.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 30040 | TESLA | 500.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 30035 | TRACY | 500.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 30030 | VACA-DIX | 500.0 | 0 | 0.0 | 1 | 1 | 1.2000 |

# 500 kV Bulk System Parameters
Frequency (Hz)




| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 59.4000 | fbus | 30055 | GATES | 500.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 30050 | LOSBANOS | 500.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 30060 | MIDWAY | 500.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 30040 | TESLA | 500.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 30035 | TRACY | 500.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 30030 | VACA-DIX | 500.0 | 0 | 0.0 | 1 | 1 | 60.6000 |

2012 Summer Peak Base Case



2012_sum_pk_pst_002_GRAYSON-ALMOND_115.chf

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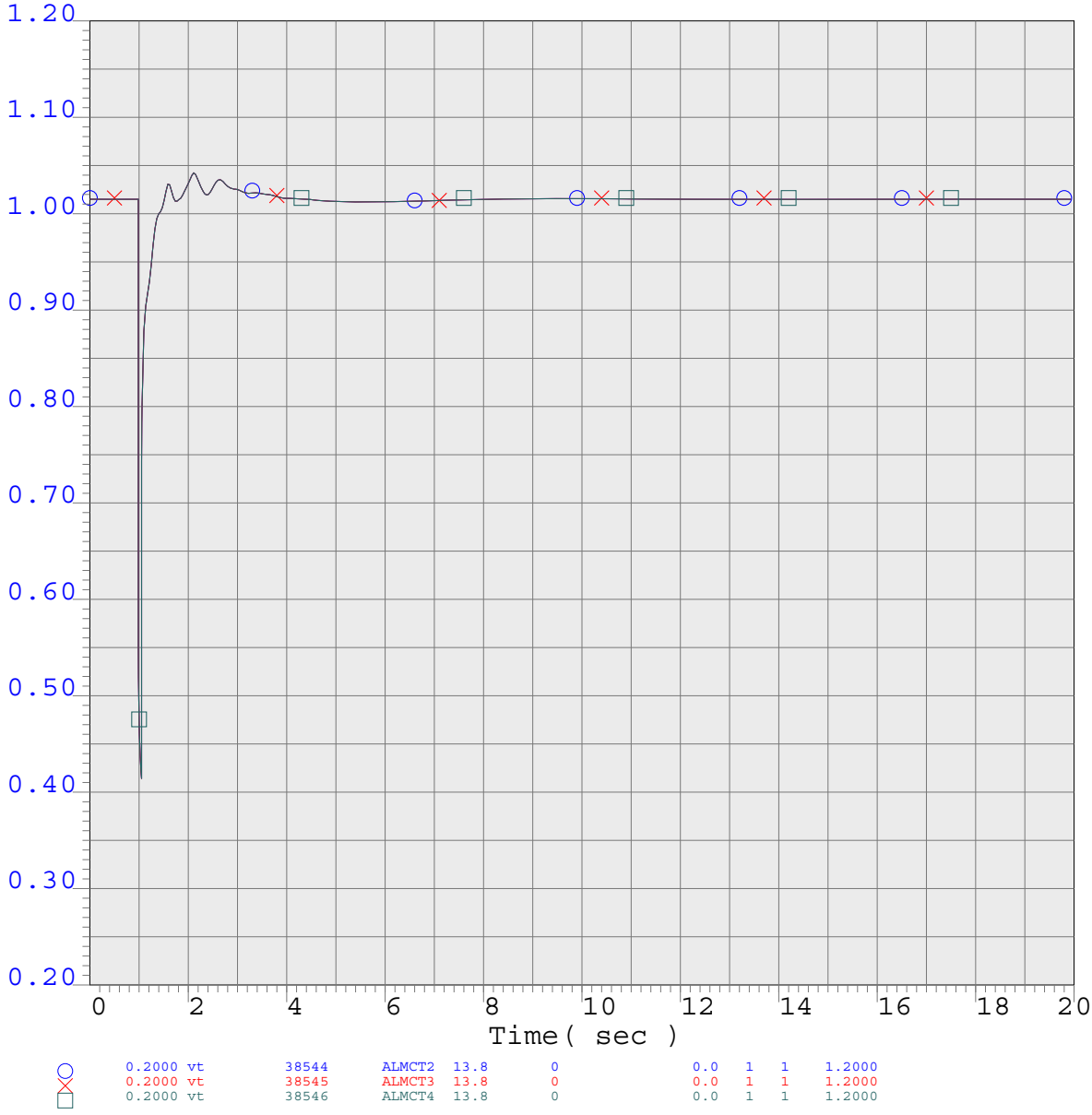
Mon Oct 19 00:51:34 2009

# Transient Stability Plots

# Grayson-Hughson 115 kV Line Out

# Almond 2 Power Plant
# Terminal Voltage (p.u.)




2012 Summer Peak Base Case



2012_sum_pk_pst_003_GRAYSON-HUGHSON_115.chf

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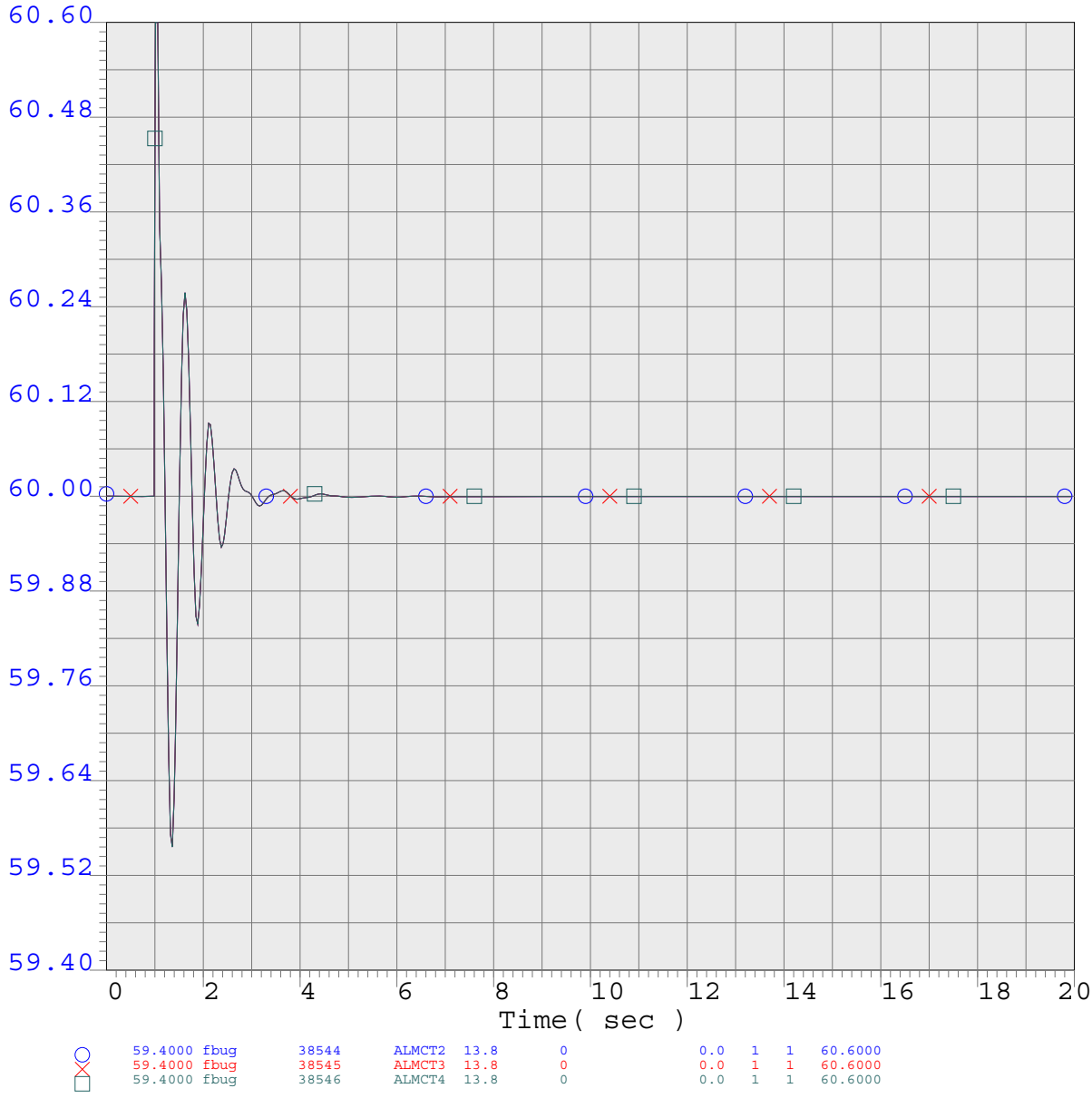
Mon Oct 19 00:51:38 2009

Almond 2 Power Plant
Frequency (Hz)




2012 Summer Peak Base Case



2012_sum_pk_pst_003_GRAYSON-HUGHSON_115.chf

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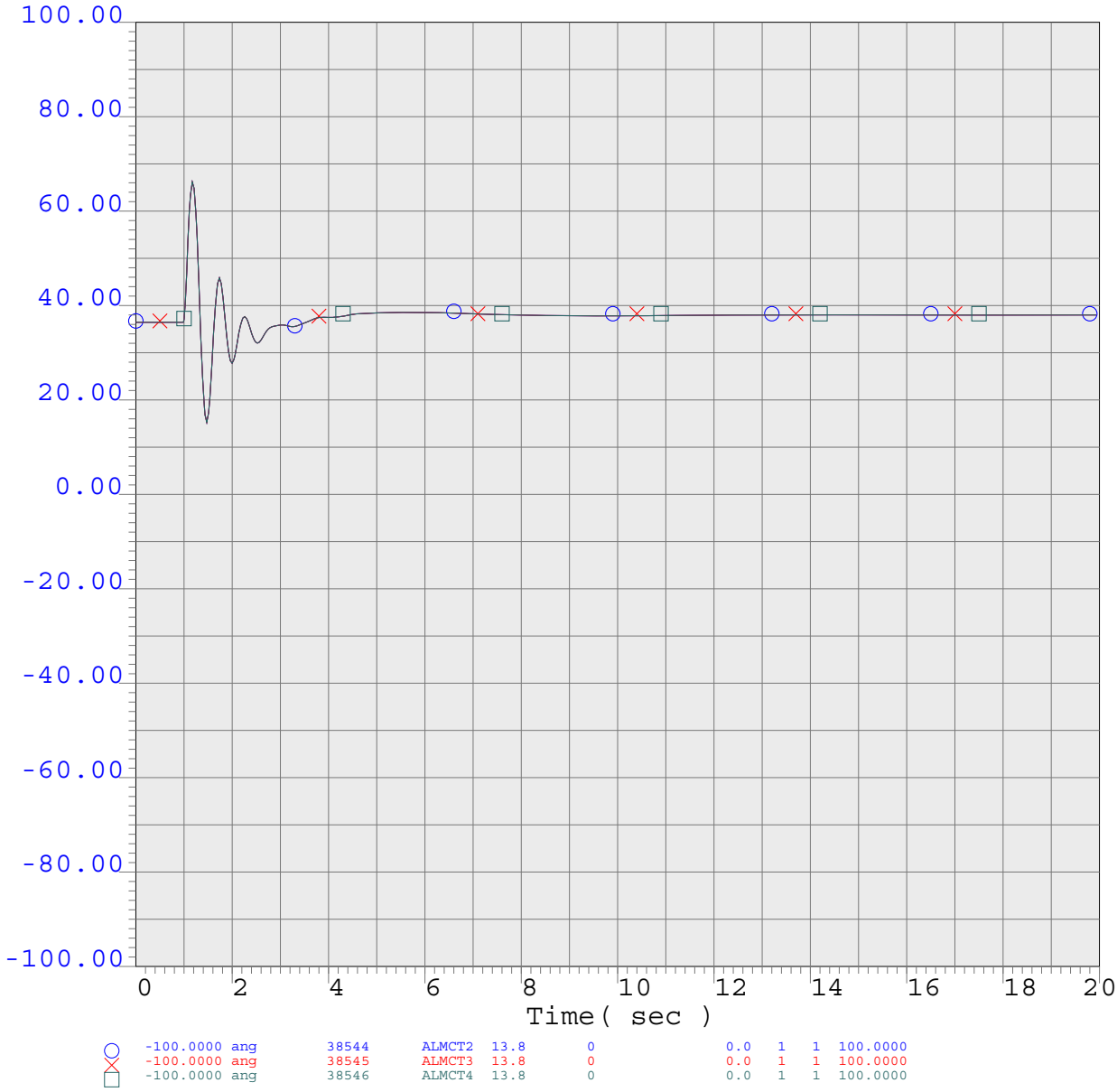
Mon Oct 19 00:51:38 2009

# Almond 2 Power Plant
## Relative Rotor Angle (degrees)




2012 Summer Peak Base Case



2012_sum_pk_pst_003_GRAYSON-HUGHSON_115.chf

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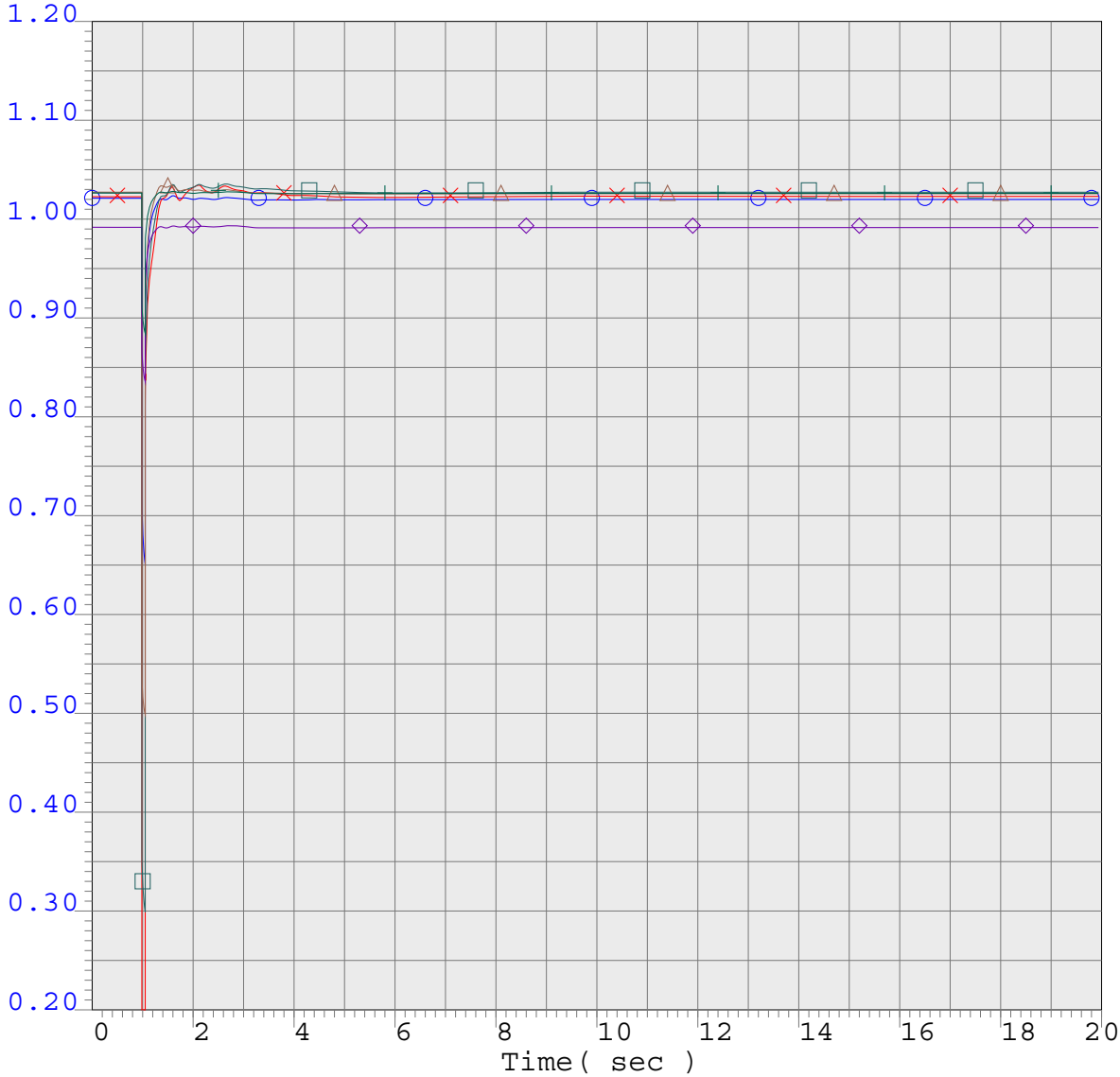
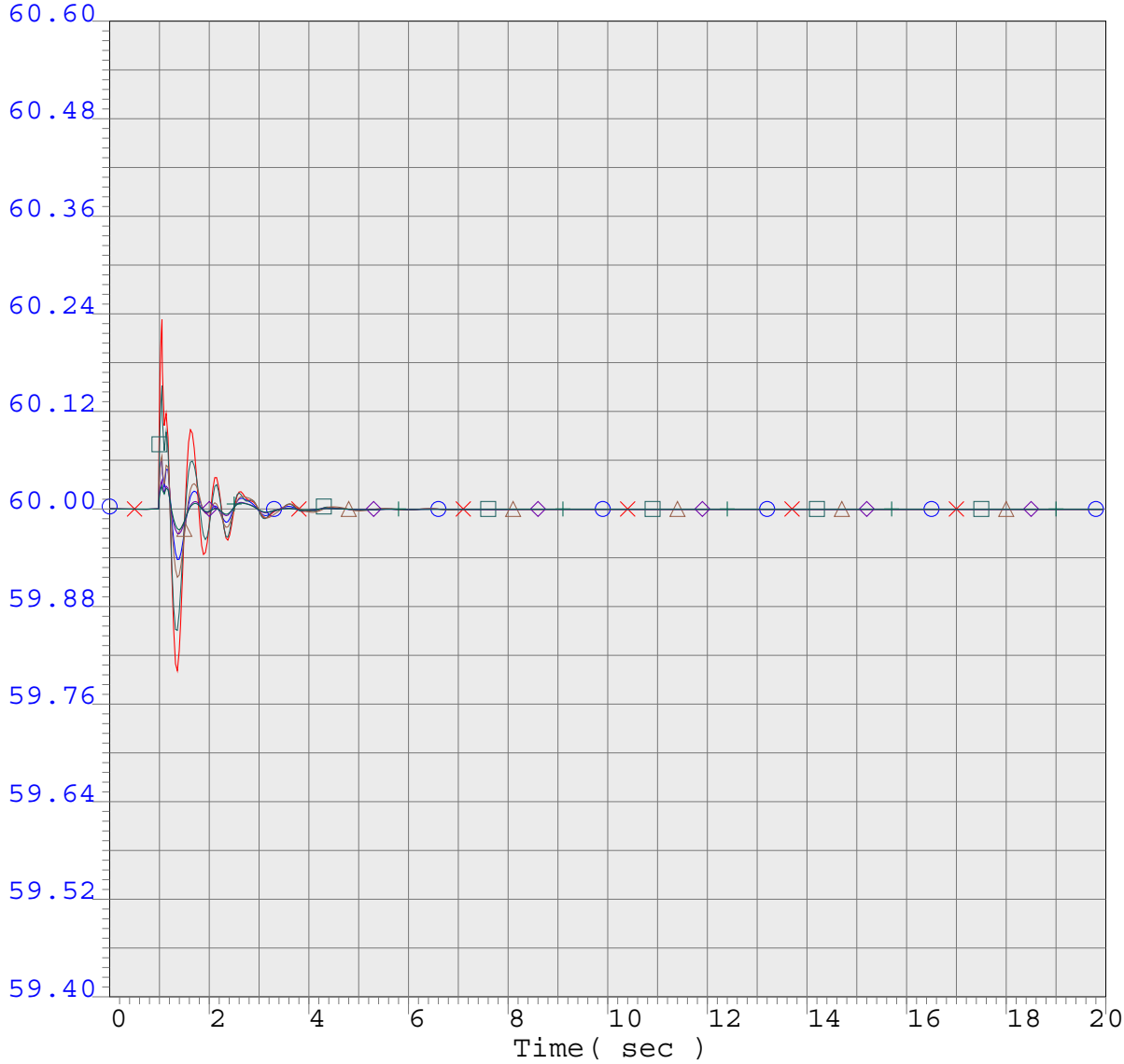
Mon Oct 19 00:51:38 2009

Select TID System Parameters
Voltage (p.u.)



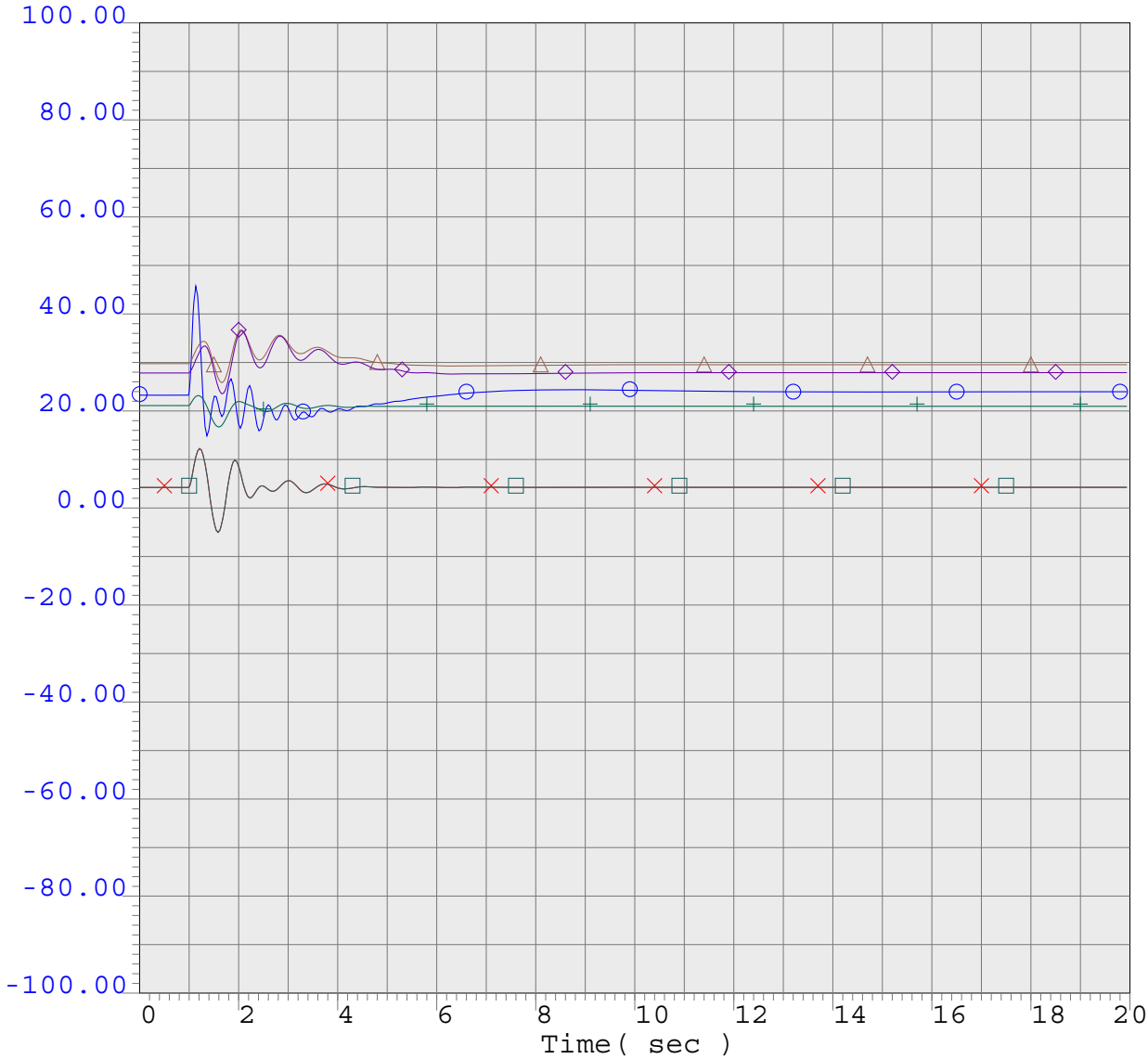

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 0.2000 | vbul | 38442 | AUGUST | 115.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbul | 38534 | GRAY115 | 115.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 38535 | GRAY69 | 69.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 38432 | OAKDLTID | 115.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 38400 | WALNT | 230.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 38410 | WESTL115 | 115.0 | 0 | 0.0 | 1 | 1 | 1.2000 |

Select TID System Parameters
Frequency (Hz)



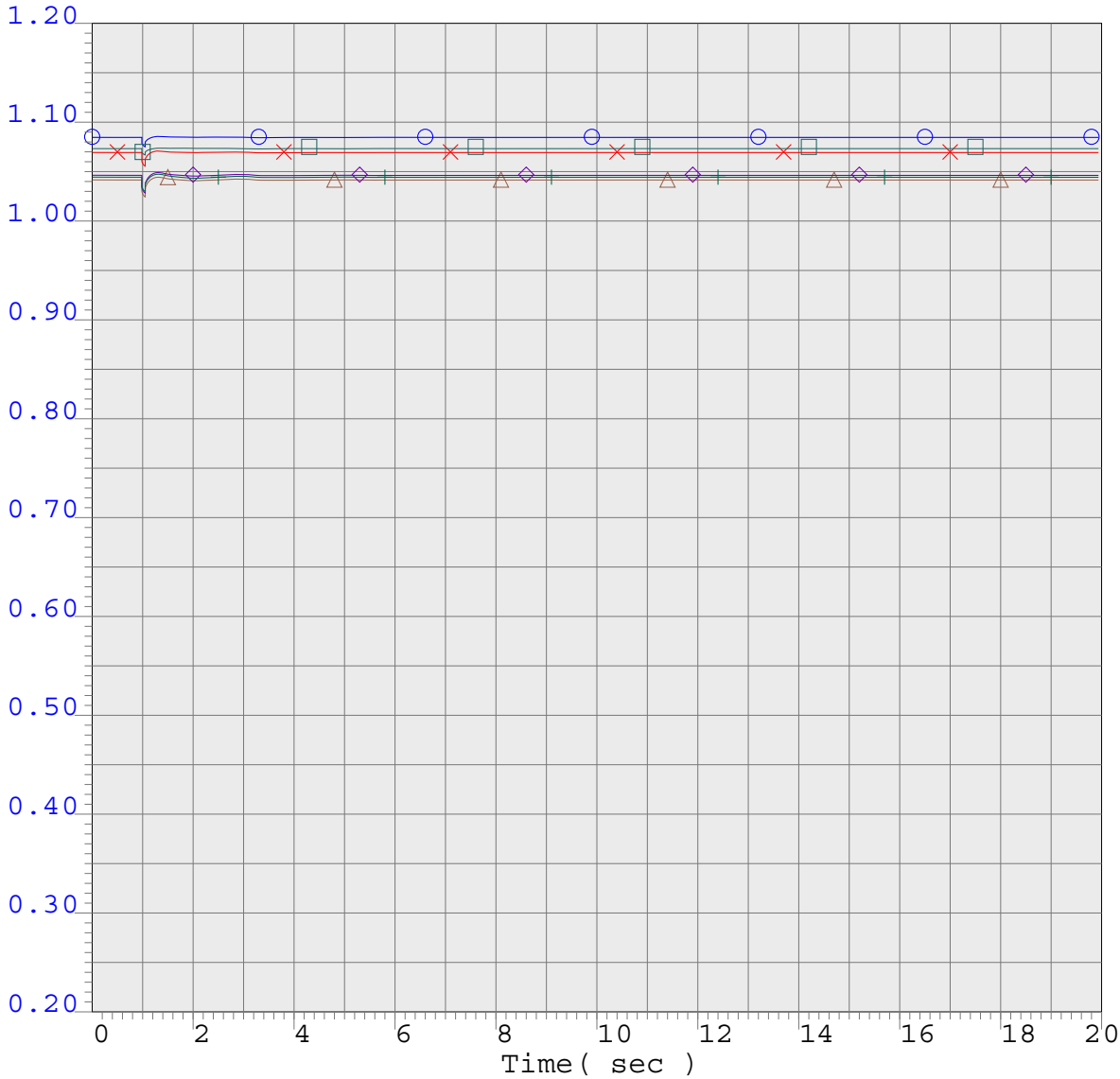

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 59.4000 | fbul | 38442 | AUGUST | 115.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbul | 38534 | GRAY115 | 115.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 38535 | GRAY69 | 69.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 38432 | OAKDLTID | 115.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 38400 | WALNT | 230.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 38410 | WESTL115 | 115.0 | 0 | 0.0 | 1 | 1 | 60.6000 |

Select TID System Parameters
Relative Rotor Angle (degrees)



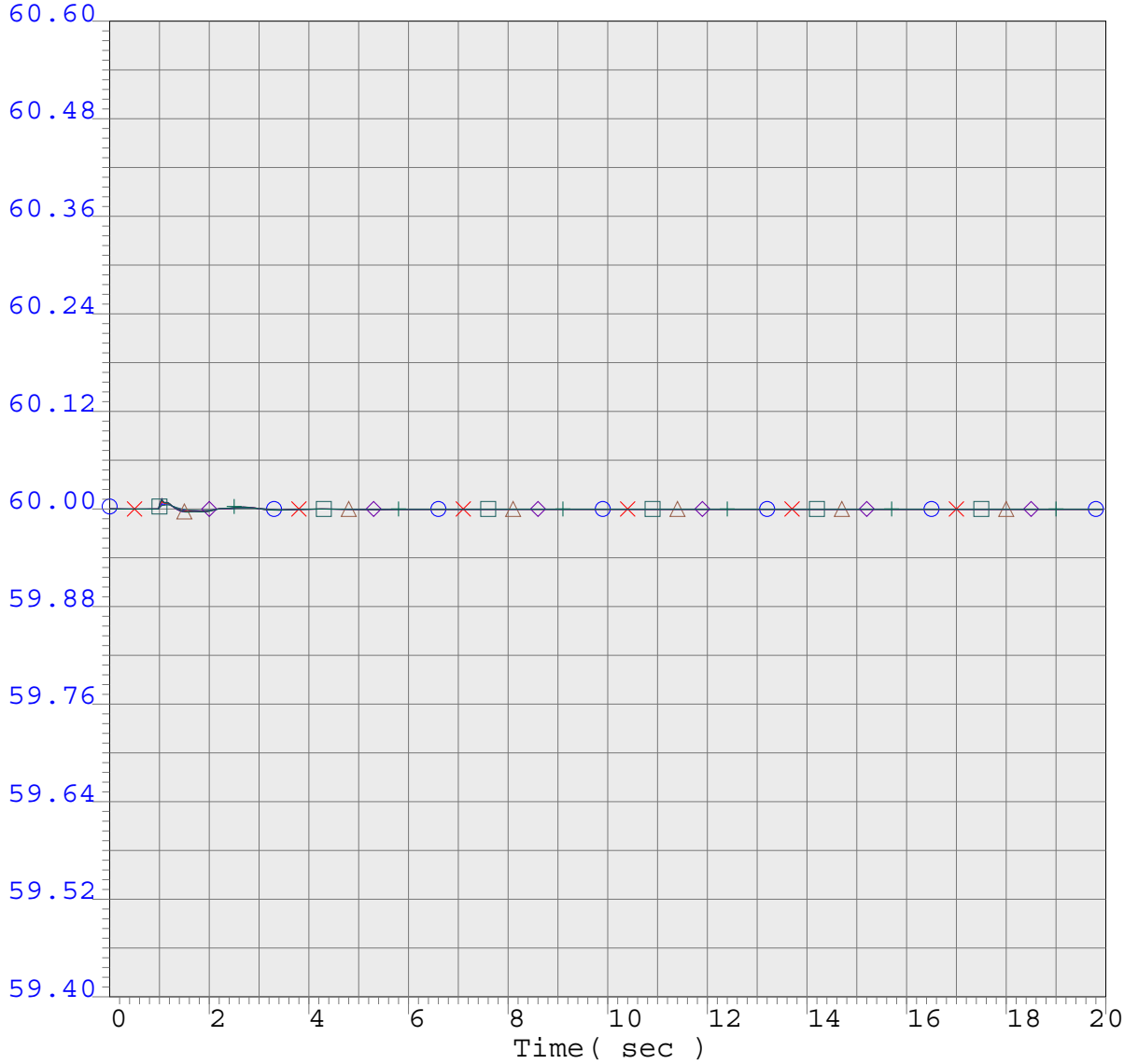

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| -100.0000 ang | 38564 | ALMONDCT | 13.8 | 0 | 0.0 | 1 | 1 | 100.0000 |
| -100.0000 ang | 38550 | DONPDRO1 | 13.8 | 0 | 0.0 | 1 | 1 | 100.0000 |
| -100.0000 ang | 38552 | DONPDRO2 | 13.8 | 0 | 0.0 | 1 | 1 | 100.0000 |
| -100.0000 ang | 38570 | WEC1-CT | 13.8 | 0 | 0.0 | 1 | 1 | 100.0000 |
| -100.0000 ang | 38574 | WEC2-CT | 13.8 | 0 | 0.0 | 1 | 1 | 100.0000 |
| -100.0000 ang | 38572 | WEC3-ST | 13.8 | 0 | 0.0 | 1 | 1 | 100.0000 |

# 500 kV Bulk System Parameters
Voltage (p.u.)




| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 0.2000 | vbus | 30055 | GATES | 500.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 30050 | LOSBANOS | 500.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 30060 | MIDWAY | 500.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 30040 | TESLA | 500.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 30035 | TRACY | 500.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 30030 | VACA-DIX | 500.0 | 0 | 0.0 | 1 | 1 | 1.2000 |

# 500 kV Bulk System Parameters
Frequency (Hz)




| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 59.4000 | fbus | 30055 | GATES | 500.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 30050 | LOSBANOS | 500.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 30060 | MIDWAY | 500.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 30040 | TESLA | 500.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 30035 | TRACY | 500.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 30030 | VACA-DIX | 500.0 | 0 | 0.0 | 1 | 1 | 60.6000 |

2012 Summer Peak Base Case



2012_sum_pk_pst_003_GRAYSON-HUGHSON_115.chf

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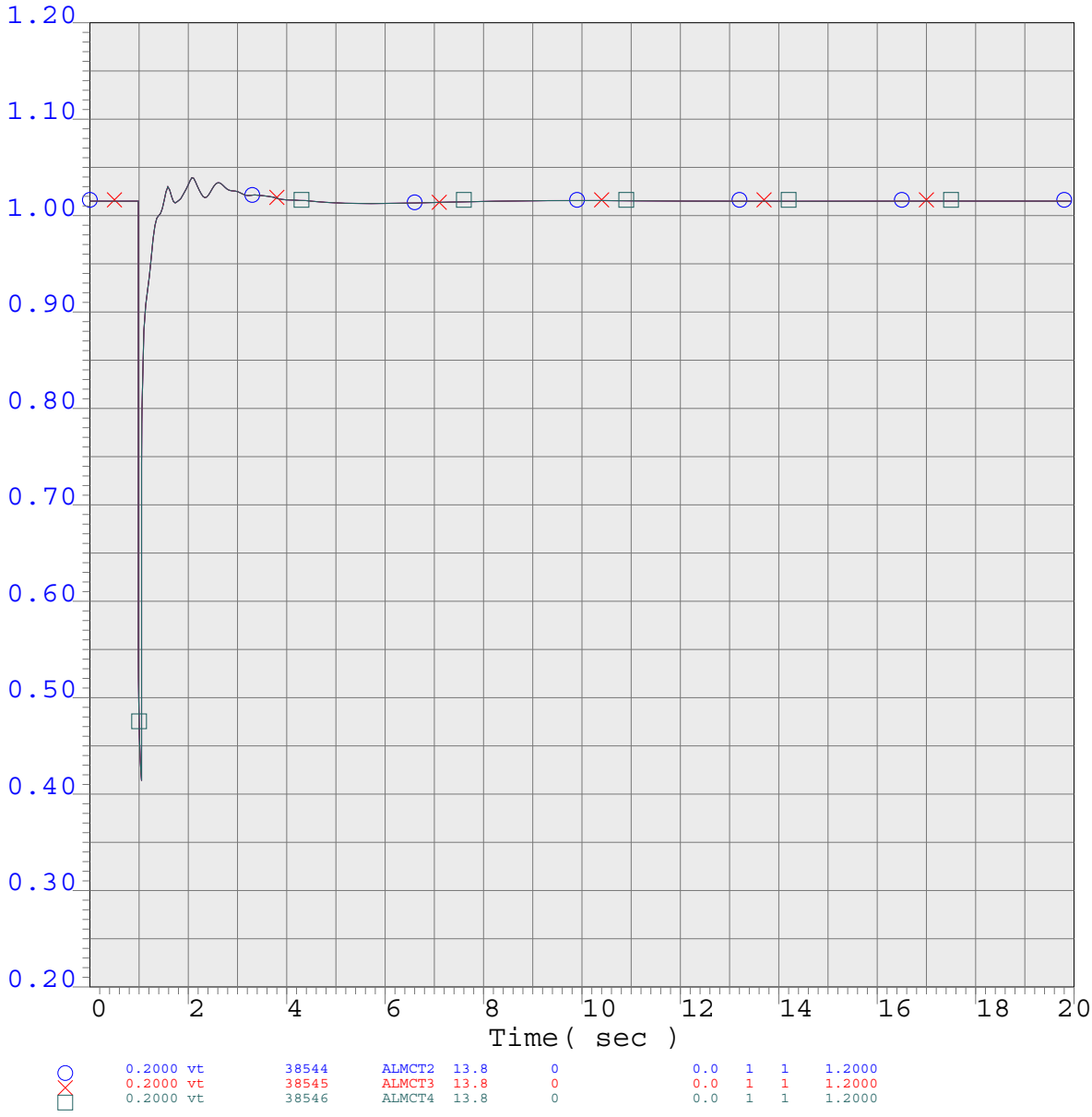
Mon Oct 19 00:51:38 2009

# Transient Stability Plots

# Grayson-Taylor 115 kV Line Out

# Almond 2 Power Plant
# Terminal Voltage (p.u.)




2012 Summer Peak Base Case



2012_sum_pk_pst_004_GRAYSON-TAYLOR_115.chf

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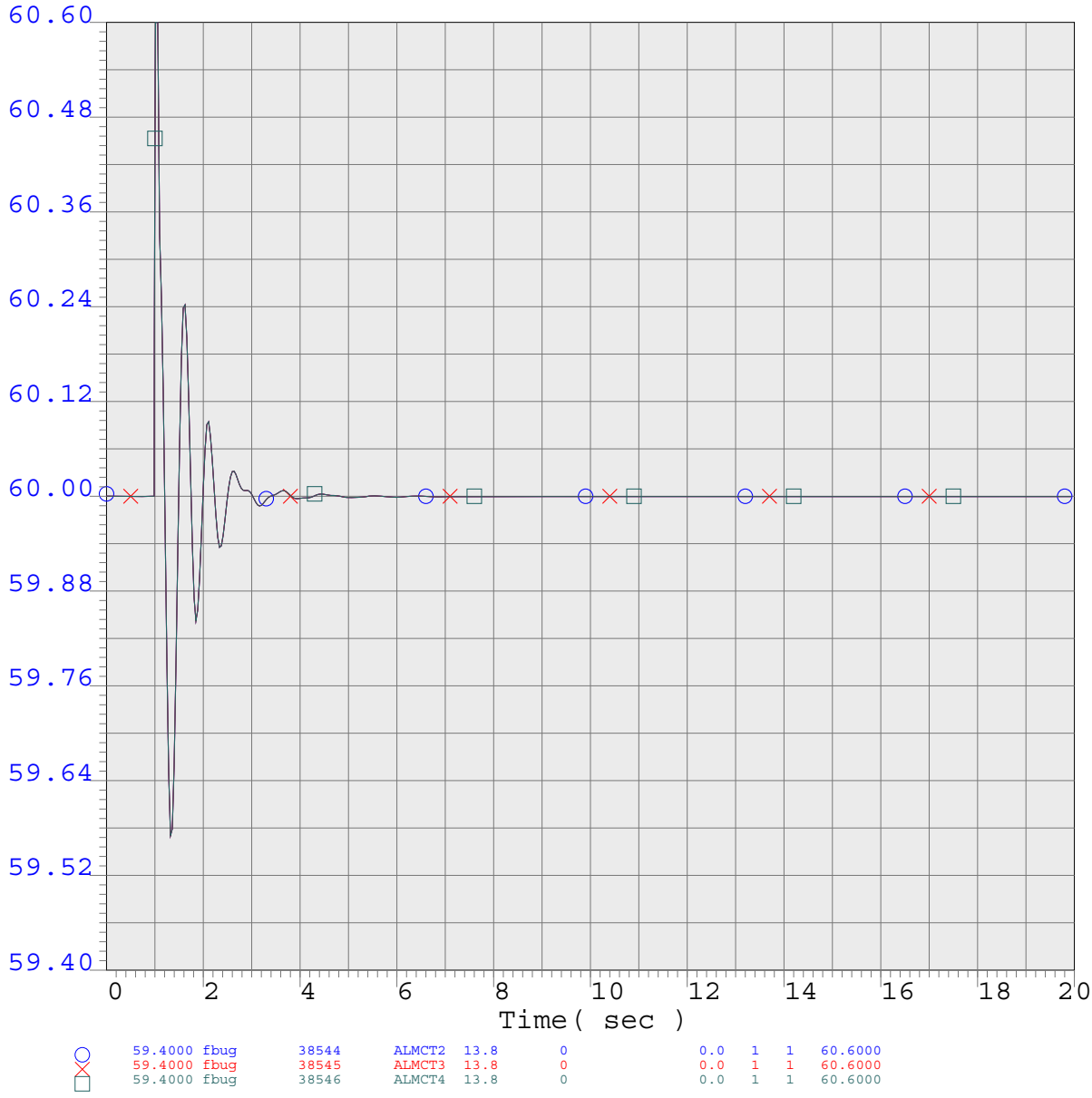
Mon Oct 19 00:51:42 2009

Almond 2 Power Plant
Frequency (Hz)




2012 Summer Peak Base Case



2012_sum_pk_pst_004_GRAYSON-TAYLOR_115.chf

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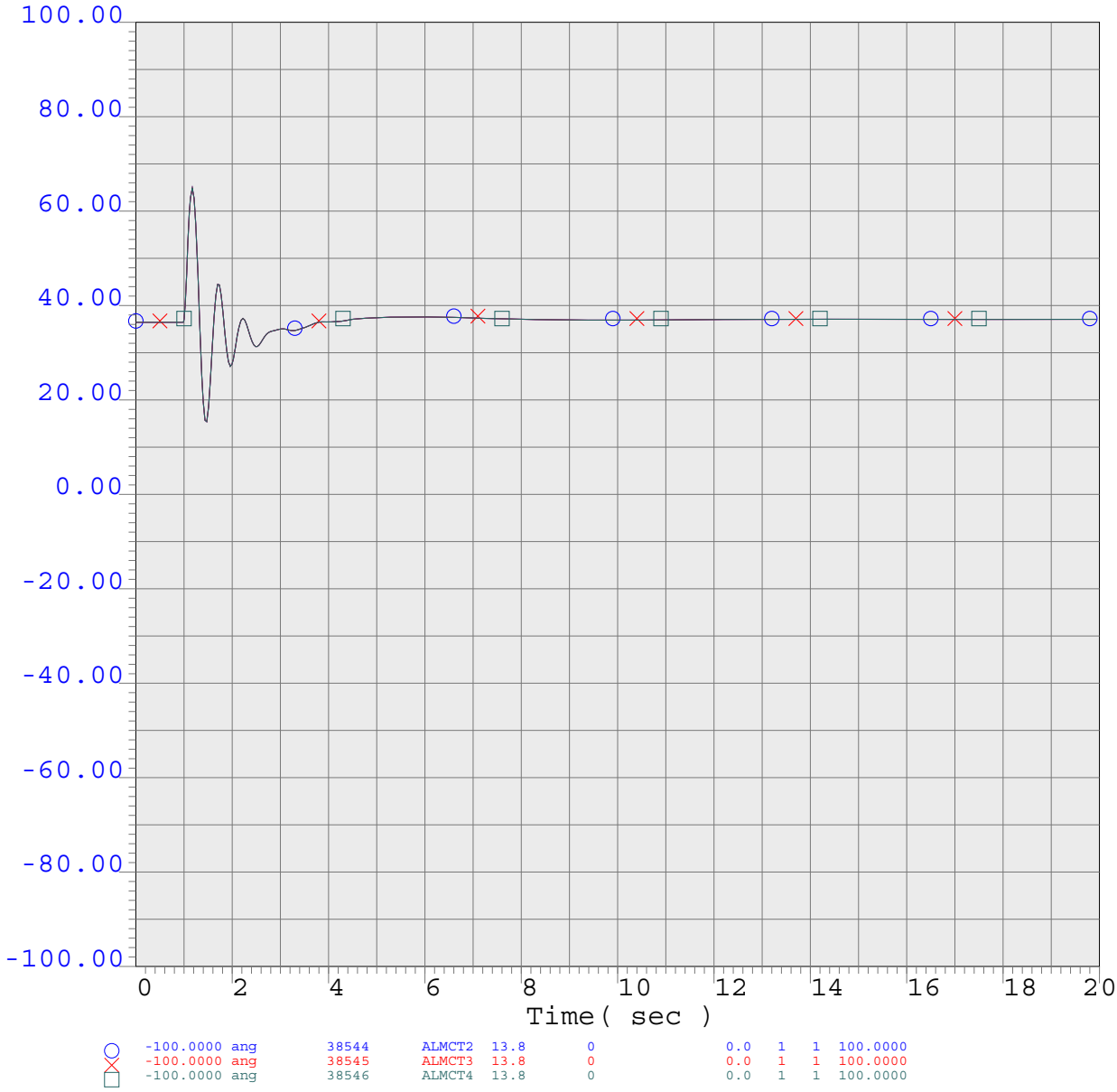
Mon Oct 19 00:51:42 2009

# Almond 2 Power Plant
## Relative Rotor Angle (degrees)




2012 Summer Peak Base Case



2012_sum_pk_pst_004_GRAYSON-TAYLOR_115.chf

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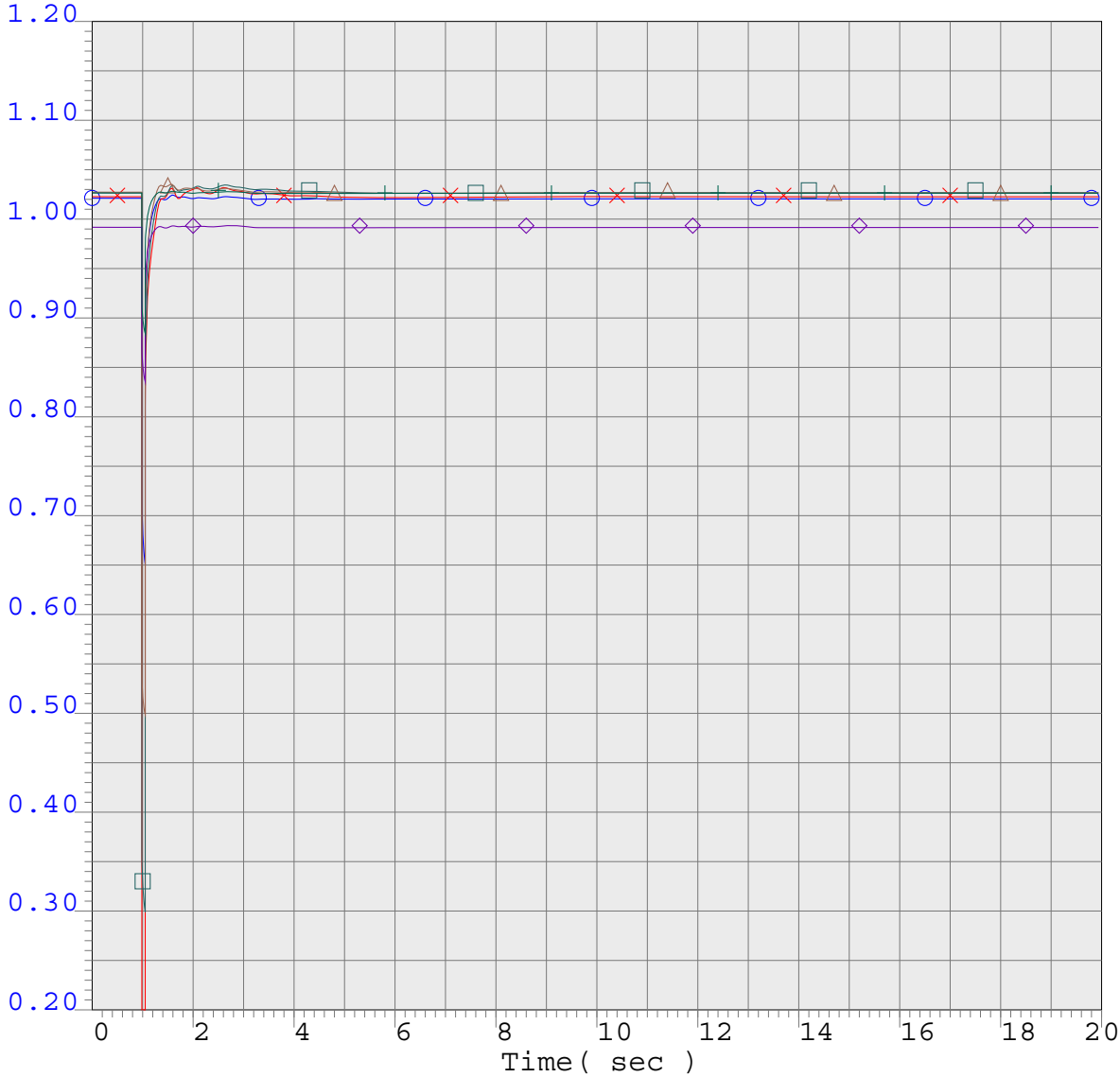
Mon Oct 19 00:51:42 2009

Select TID System Parameters
Voltage (p.u.)




| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 0.2000 | vbul | 38442 | AUGUST | 115.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbul | 38534 | GRAY115 | 115.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 38535 | GRAY69 | 69.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 38432 | OAKDLTID | 115.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 38400 | WALNT | 230.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 38410 | WESTL115 | 115.0 | 0 | 0.0 | 1 | 1 | 1.2000 |

2012 Summer Peak Base Case



2012_sum_pk_pst_004_GRAYSON-TAYLOR_115.chf

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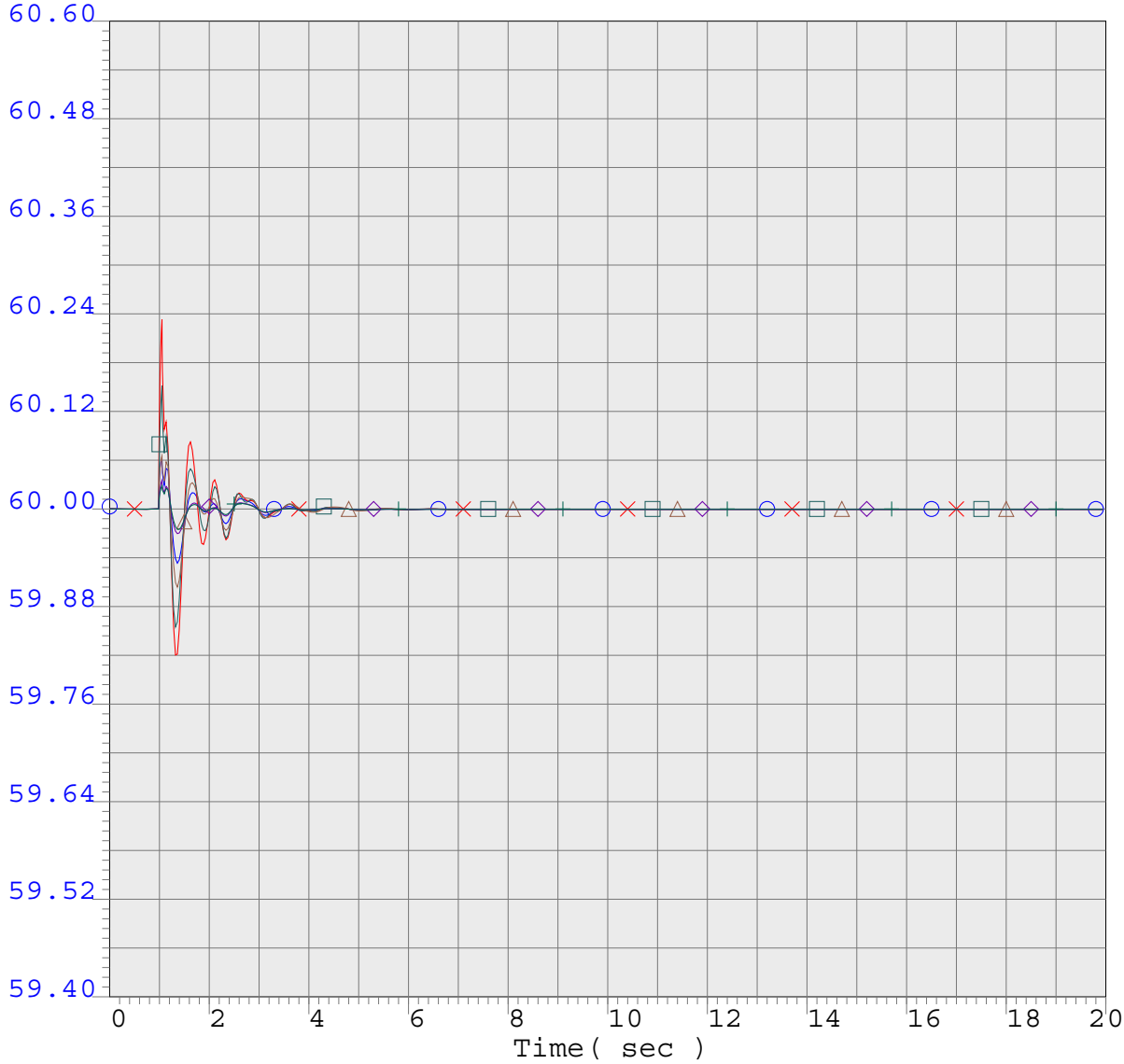
Mon Oct 19 00:51:42 2009

Select TID System Parameters
Frequency (Hz)




| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 59.4000 | fbul | 38442 | AUGUST | 115.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbul | 38534 | GRAY115 | 115.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 38535 | GRAY69 | 69.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 38432 | OAKDLTID | 115.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 38400 | WALNT | 230.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 38410 | WESTL115 | 115.0 | 0 | 0.0 | 1 | 1 | 60.6000 |

2012 Summer Peak Base Case



2012_sum_pk_pst_004_GRAYSON-TAYLOR_115.chf

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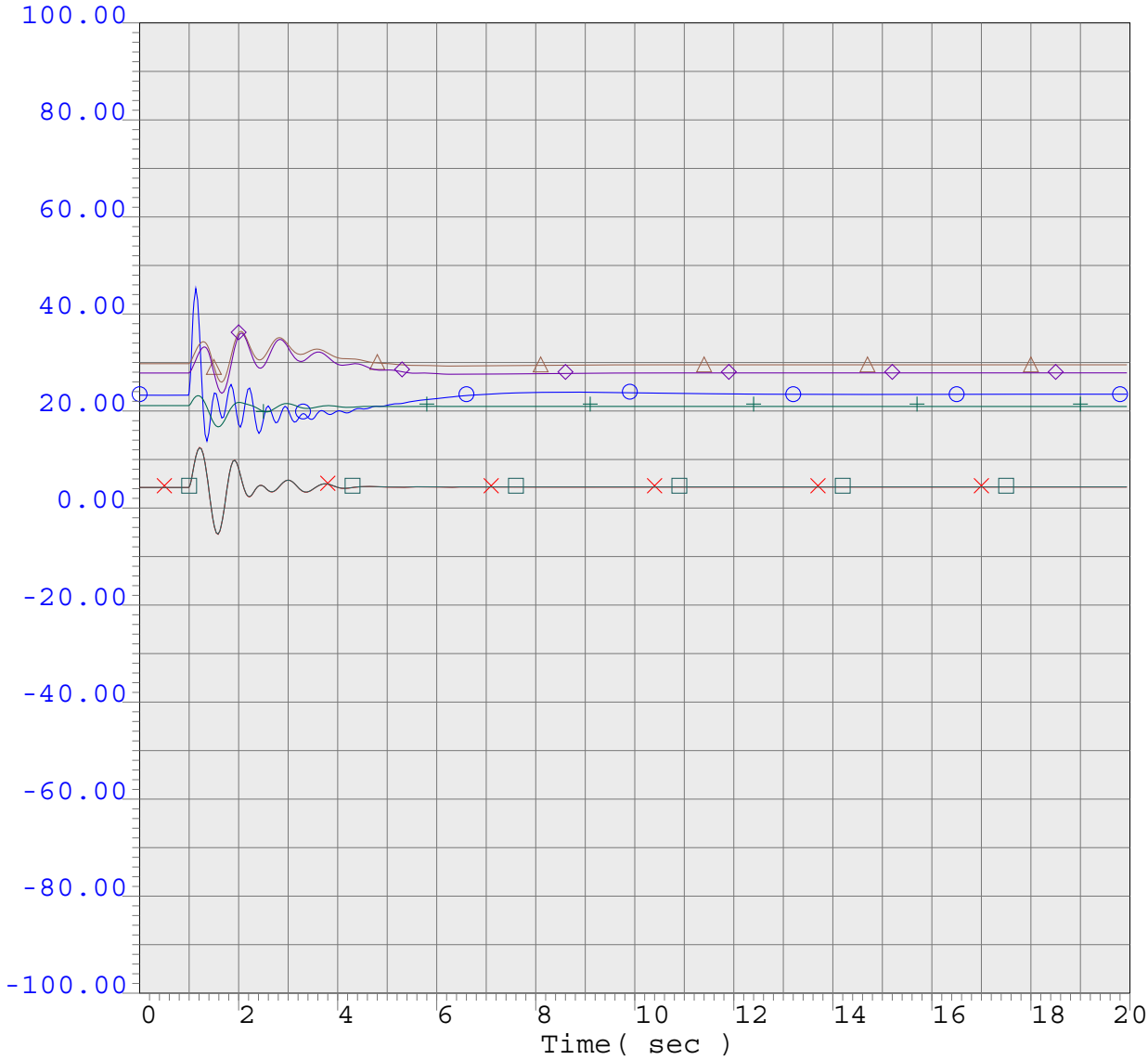
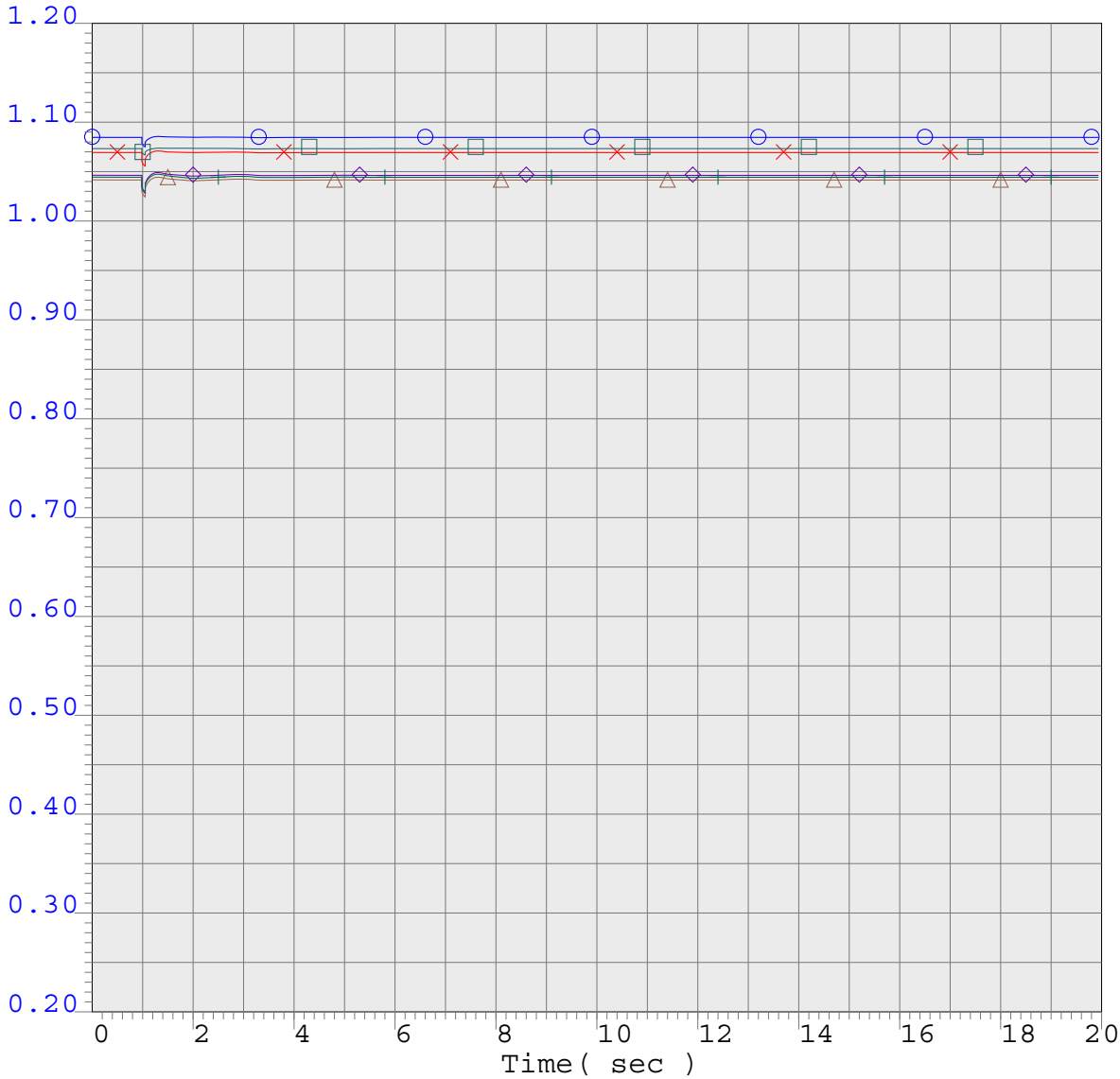
Mon Oct 19 00:51:42 2009

Select TID System Parameters
Relative Rotor Angle (degrees)




| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| -100.0000 ang | 38564 | ALMONDCT | 13.8 | 0 | 0.0 | 1 | 1 | 100.0000 |
| -100.0000 ang | 38550 | DONPDRO1 | 13.8 | 0 | 0.0 | 1 | 1 | 100.0000 |
| -100.0000 ang | 38552 | DONPDRO2 | 13.8 | 0 | 0.0 | 1 | 1 | 100.0000 |
| -100.0000 ang | 38570 | WEC1-CT | 13.8 | 0 | 0.0 | 1 | 1 | 100.0000 |
| -100.0000 ang | 38574 | WEC2-CT | 13.8 | 0 | 0.0 | 1 | 1 | 100.0000 |
| -100.0000 ang | 38572 | WEC3-ST | 13.8 | 0 | 0.0 | 1 | 1 | 100.0000 |

# 500 kV Bulk System Parameters
Voltage (p.u.)




| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 0.2000 | vbus | 30055 | GATES | 500.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 30050 | LOSBANOS | 500.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 30060 | MIDWAY | 500.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 30040 | TESLA | 500.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 30035 | TRACY | 500.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 30030 | VACA-DIX | 500.0 | 0 | 0.0 | 1 | 1 | 1.2000 |

2012 Summer Peak Base Case

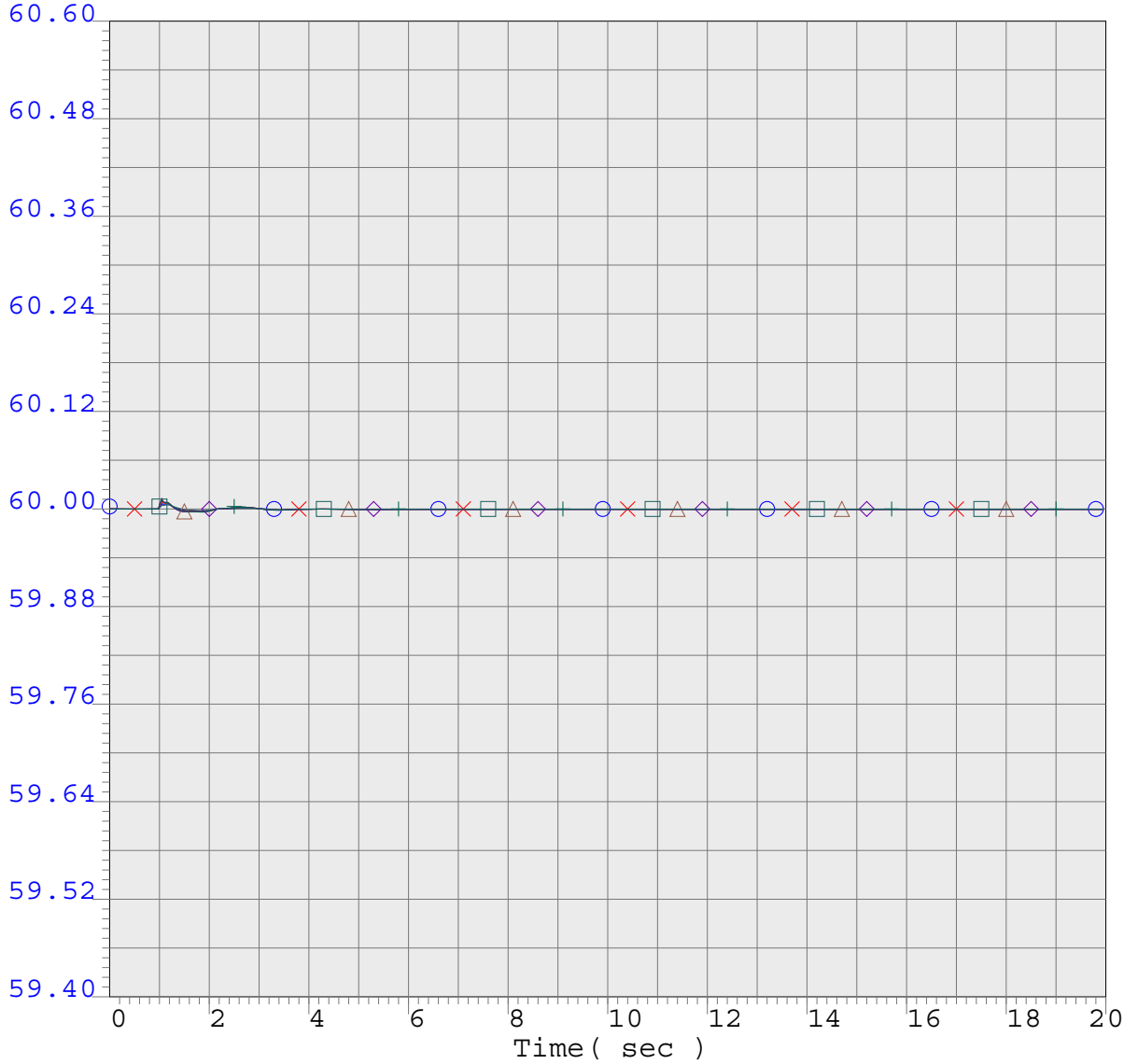


2012_sum_pk_pst_004_GRAYSON-TAYLOR_115.chf

.

Mon Oct 19 00:51:42 2009

# 500 kV Bulk System Parameters
Frequency (Hz)




| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 59.4000 | fbus | 30055 | GATES | 500.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 30050 | LOSBANOS | 500.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 30060 | MIDWAY | 500.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 30040 | TESLA | 500.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 30035 | TRACY | 500.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 30030 | VACA-DIX | 500.0 | 0 | 0.0 | 1 | 1 | 60.6000 |

2012 Summer Peak Base Case



2012_sum_pk_pst_004_GRAYSON-TAYLOR_115.chf

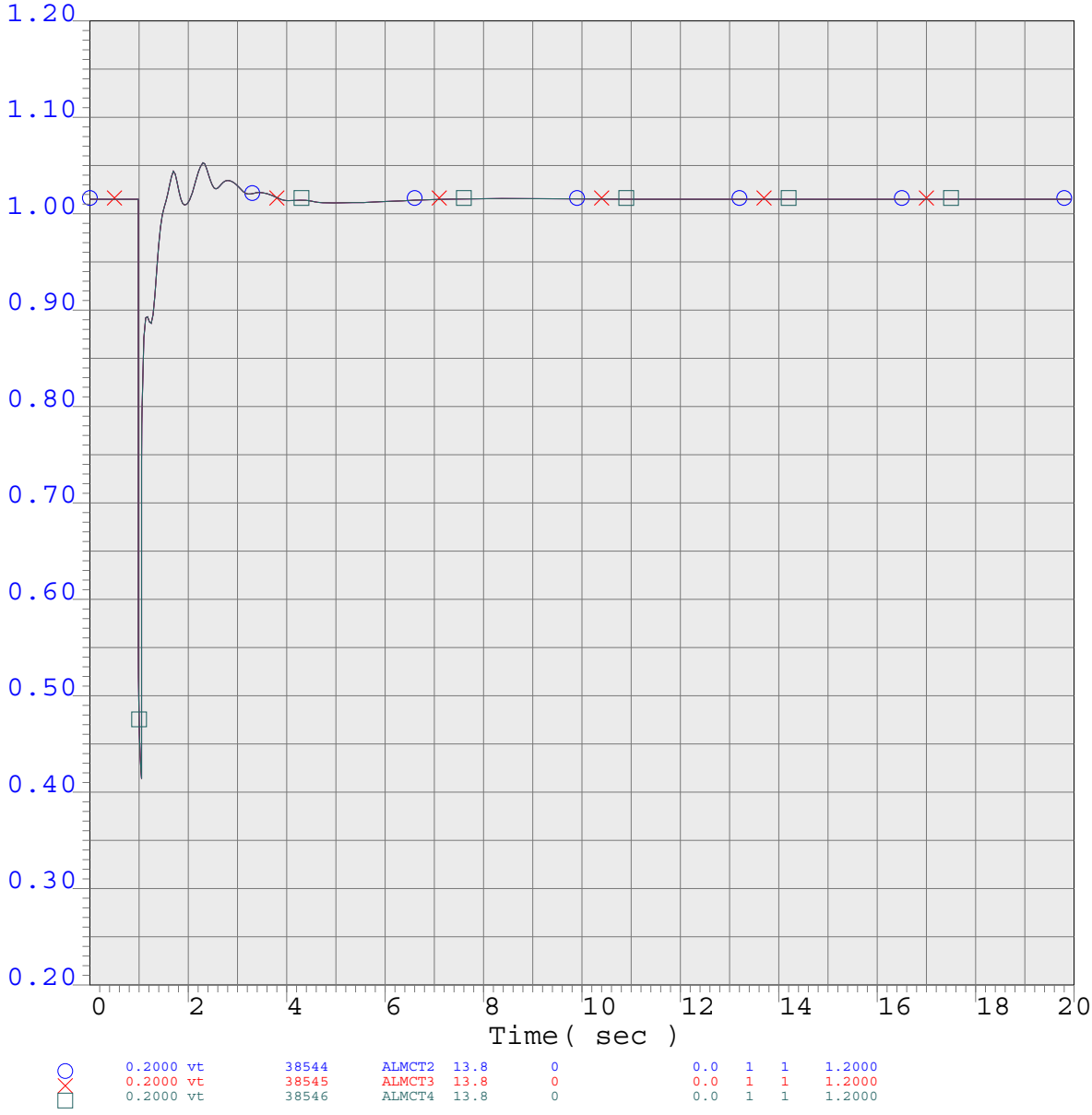
.

Mon Oct 19 00:51:43 2009

# Transient Stability Plots

# Grayson-Taylor & Grayson-Hughson 115 kV Lines Out

Almond 2 Power Plant
Terminal Voltage (p.u.)




2012 Summer Peak Base Case



2012_sum_pk_pst_005_GRAYSON-HUGHSON-TAYLOR_115_DLO.chf

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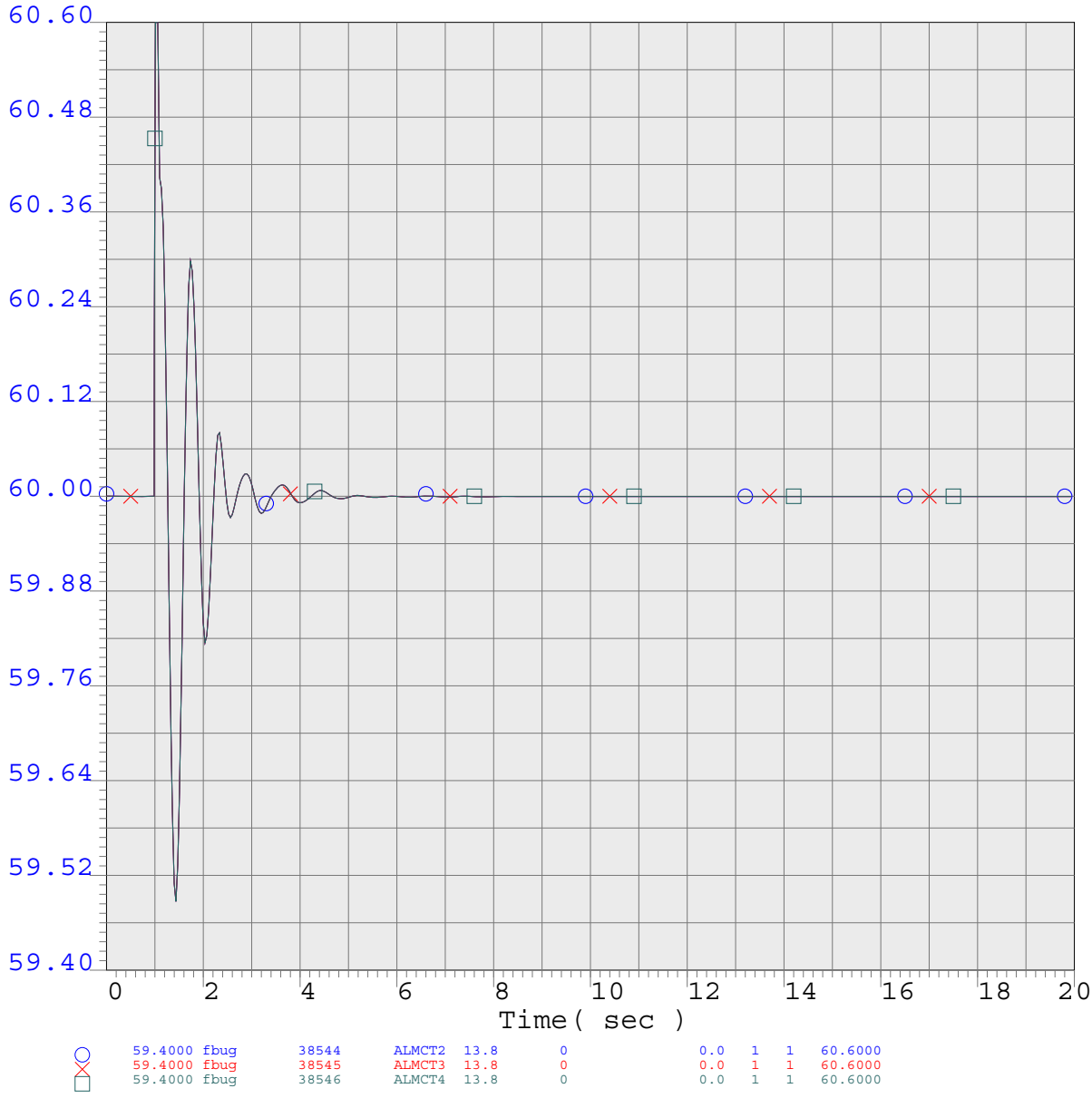
Mon Oct 19 00:51:46 2009

Almond 2 Power Plant
Frequency (Hz)




2012 Summer Peak Base Case

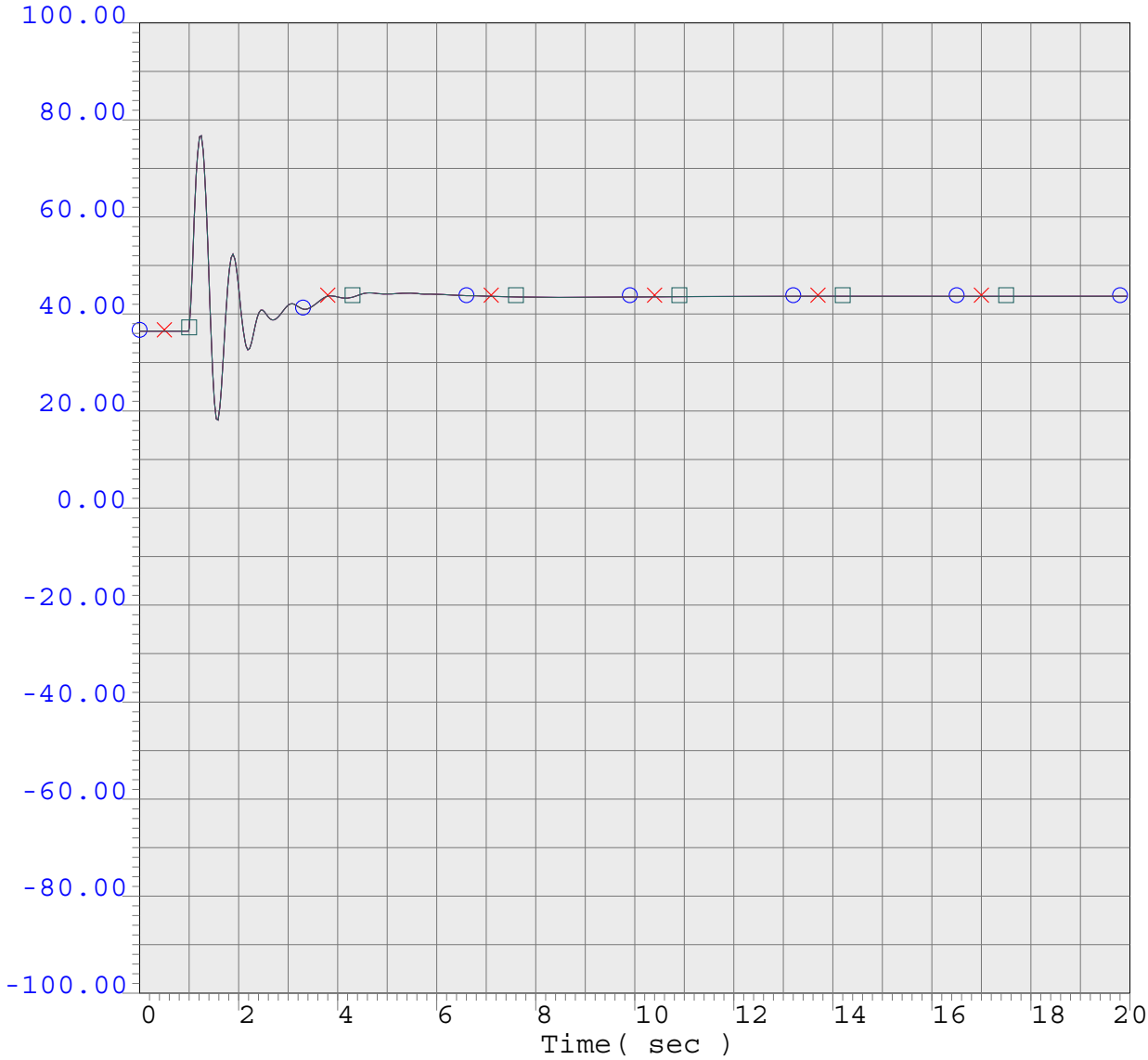


2012_sum_pk_pst_005_GRAYSON-HUGHSON-TAYLOR_115_DLO.chf

.

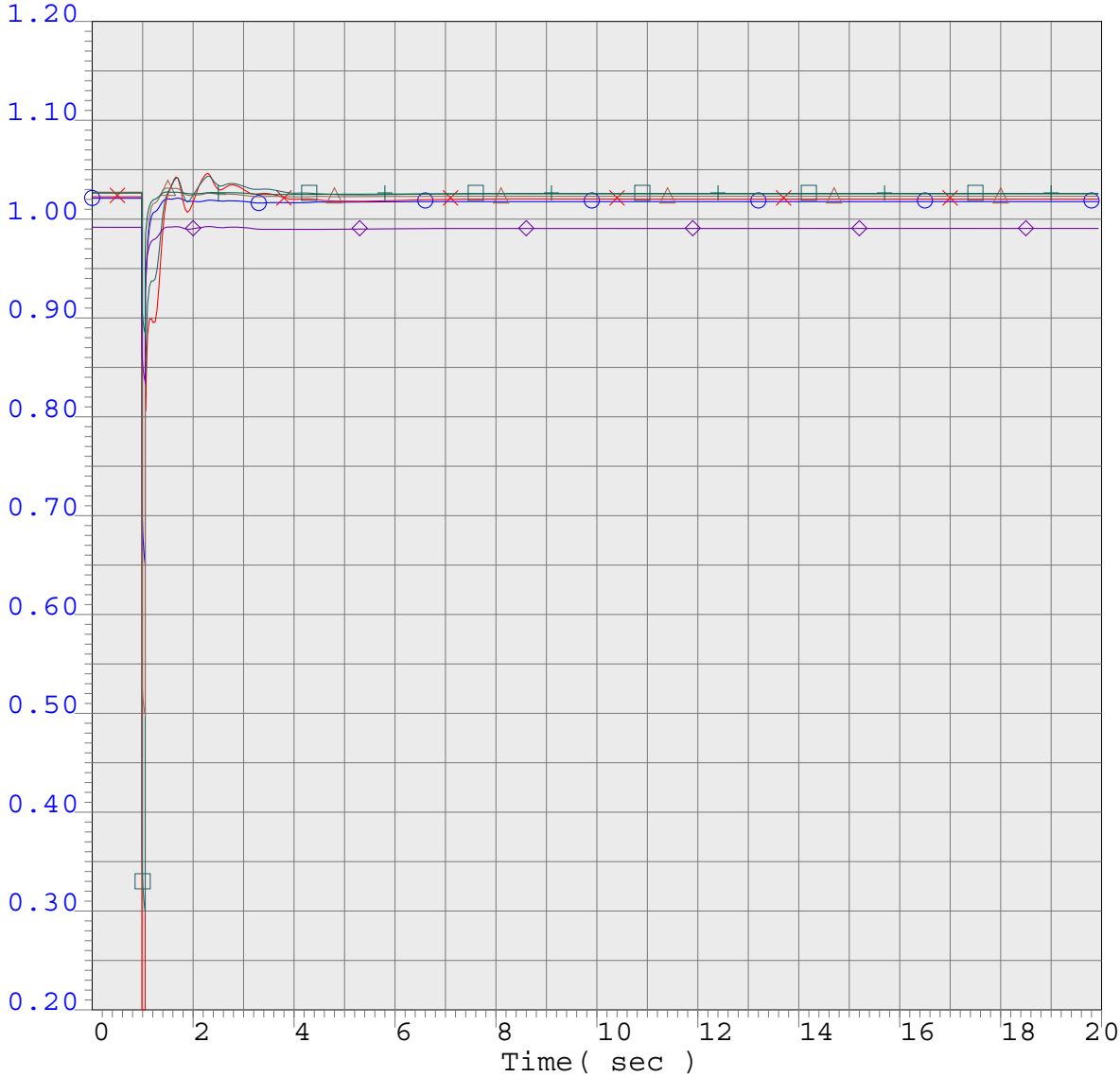
Mon Oct 19 00:51:46 2009

Almond 2 Power Plant
Relative Rotor Angle (degrees)




| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| -100.0000 ang | 38544 | ALMCT2 | 13.8 | 0 | 0.0 | 1 | 1 | 100.0000 |
| -100.0000 ang | 38545 | ALMCT3 | 13.8 | 0 | 0.0 | 1 | 1 | 100.0000 |
| -100.0000 ang | 38546 | ALMCT4 | 13.8 | 0 | 0.0 | 1 | 1 | 100.0000 |

Select TID System Parameters
Voltage (p.u.)




| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 0.2000 | vbul | 38442 | AUGUST | 115.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbul | 38534 | GRAY115 | 115.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 38535 | GRAY69 | 69.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 38432 | OAKDLTID | 115.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 38400 | WALNT | 230.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 38410 | WESTL115 | 115.0 | 0 | 0.0 | 1 | 1 | 1.2000 |

2012 Summer Peak Base Case

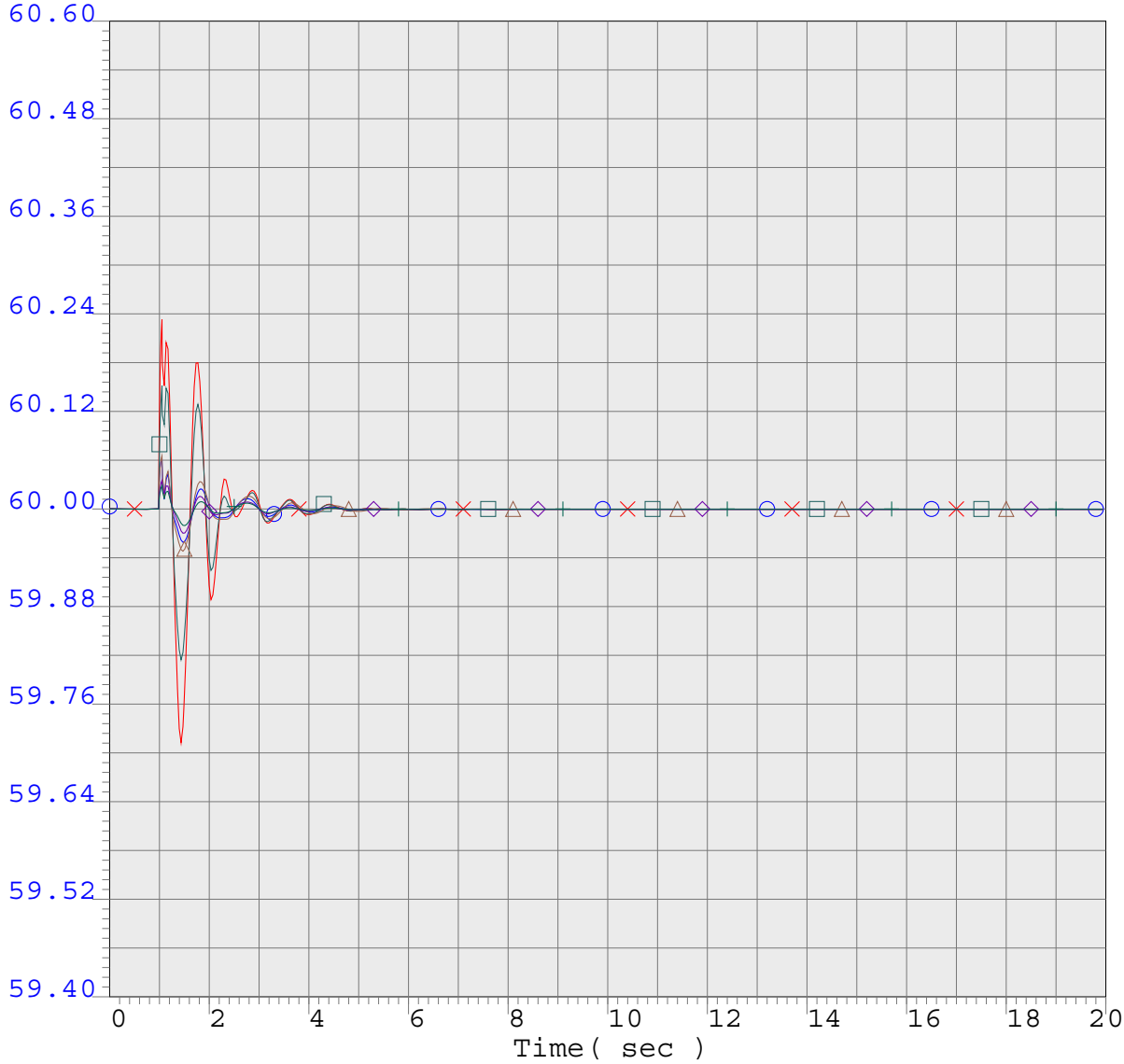


2012_sum_pk_pst_005_GRAYSON-HUGHSON-TAYLOR_115_DLO.chf

.

Mon Oct 19 00:51:46 2009

Select TID System Parameters
Frequency (Hz)




| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 59.4000 | fbul | 38442 | AUGUST | 115.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbul | 38534 | GRAY115 | 115.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 38535 | GRAY69 | 69.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 38432 | OAKDLTID | 115.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 38400 | WALNT | 230.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 38410 | WESTL115 | 115.0 | 0 | 0.0 | 1 | 1 | 60.6000 |

2012 Summer Peak Base Case



2012_sum_pk_pst_005_GRAYSON-HUGHSON-TAYLOR_115_DLO.chf

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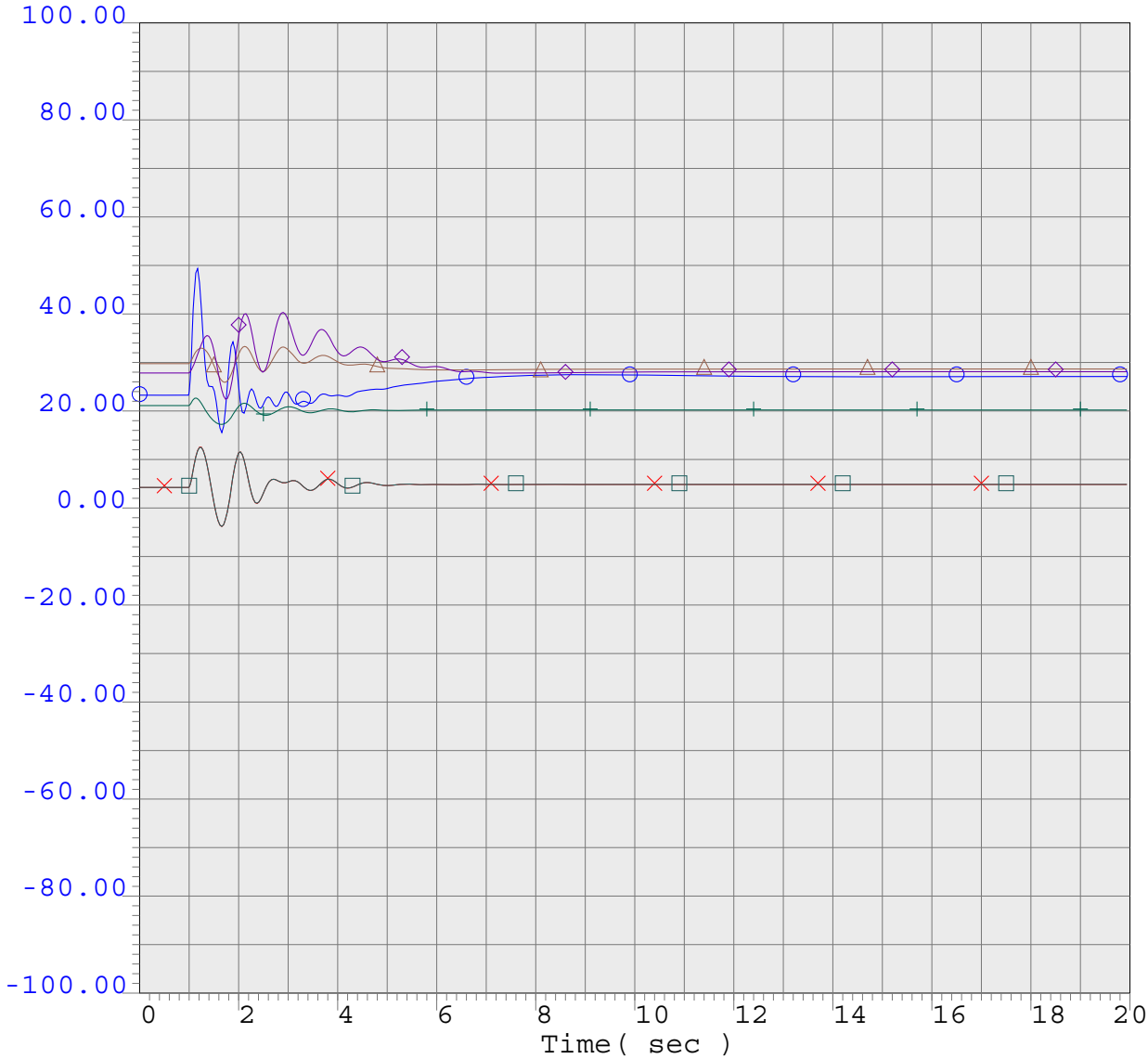
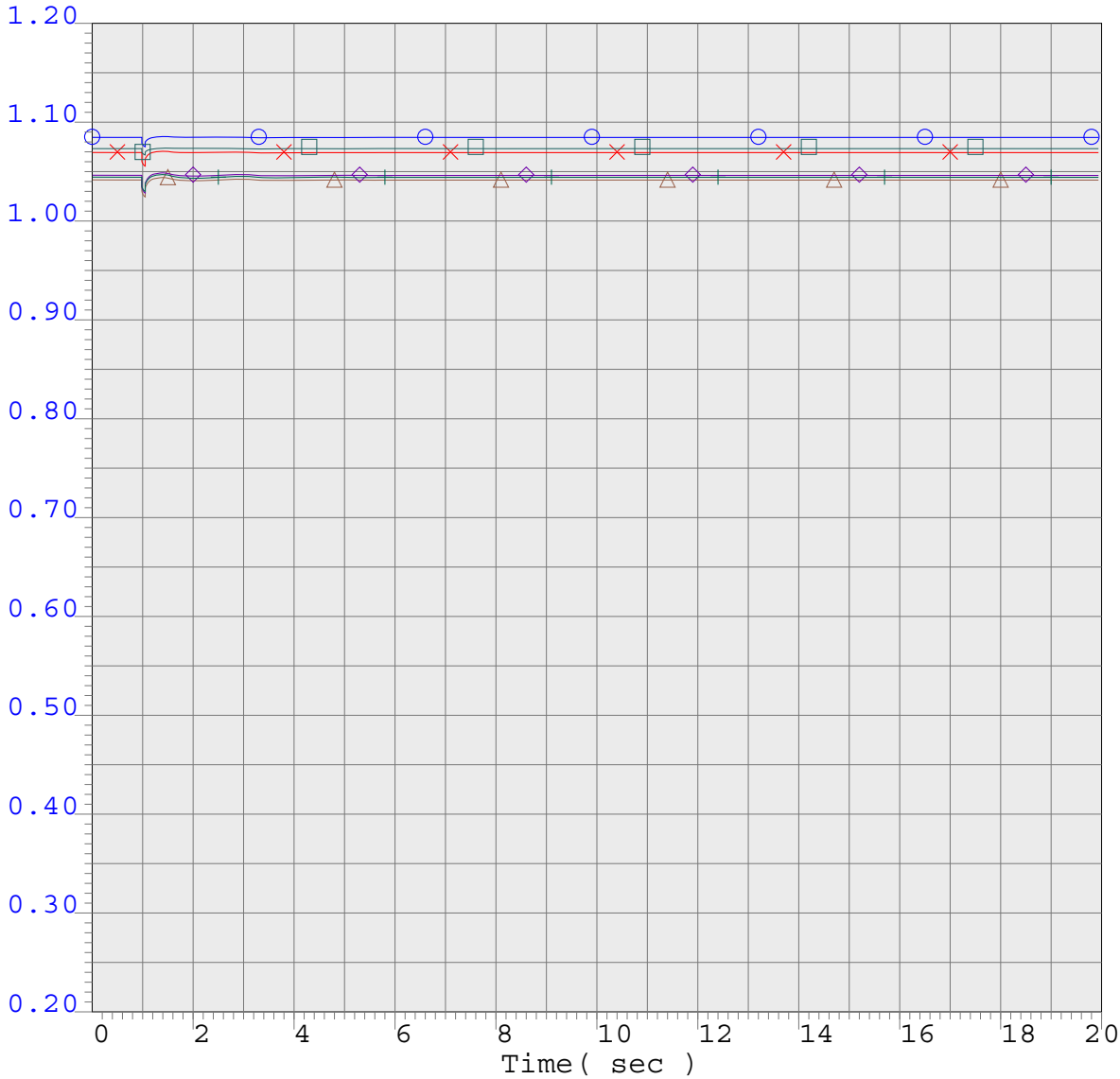
Mon Oct 19 00:51:46 2009

Select TID System Parameters
Relative Rotor Angle (degrees)




| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| -100.0000 ang | 38564 | ALMONDCT | 13.8 | 0 | 0.0 | 1 | 1 | 100.0000 |
| -100.0000 ang | 38550 | DONPDRO1 | 13.8 | 0 | 0.0 | 1 | 1 | 100.0000 |
| -100.0000 ang | 38552 | DONPDRO2 | 13.8 | 0 | 0.0 | 1 | 1 | 100.0000 |
| -100.0000 ang | 38570 | WEC1-CT | 13.8 | 0 | 0.0 | 1 | 1 | 100.0000 |
| -100.0000 ang | 38574 | WEC2-CT | 13.8 | 0 | 0.0 | 1 | 1 | 100.0000 |
| -100.0000 ang | 38572 | WEC3-ST | 13.8 | 0 | 0.0 | 1 | 1 | 100.0000 |

# 500 kV Bulk System Parameters
Voltage (p.u.)




| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 0.2000 | vbus | 30055 | GATES | 500.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 30050 | LOSBANOS | 500.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 30060 | MIDWAY | 500.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 30040 | TESLA | 500.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 30035 | TRACY | 500.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 30030 | VACA-DIX | 500.0 | 0 | 0.0 | 1 | 1 | 1.2000 |

2012 Summer Peak Base Case



2012_sum_pk_pst_005_GRAYSON-HUGHSON-TAYLOR_115_DLO.chf

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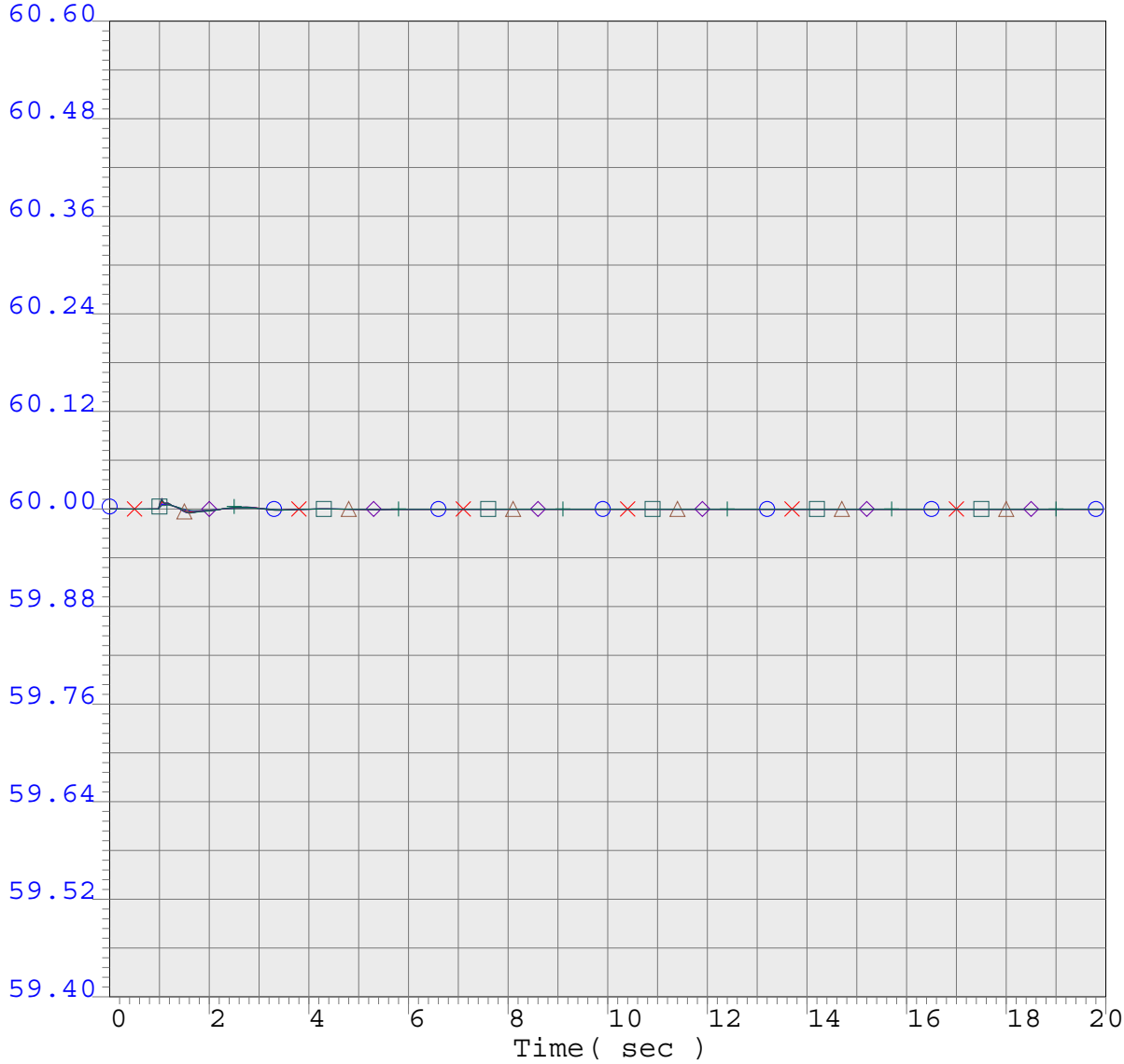
Mon Oct 19 00:51:46 2009

# 500 kV Bulk System Parameters
Frequency (Hz)




| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 59.4000 | fbus | 30055 | GATES | 500.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 30050 | LOSBANOS | 500.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 30060 | MIDWAY | 500.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 30040 | TESLA | 500.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 30035 | TRACY | 500.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 30030 | VACA-DIX | 500.0 | 0 | 0.0 | 1 | 1 | 60.6000 |

2012 Summer Peak Base Case



2012_sum_pk_pst_005_GRAYSON-HUGHSON-TAYLOR_115_DLO.chf

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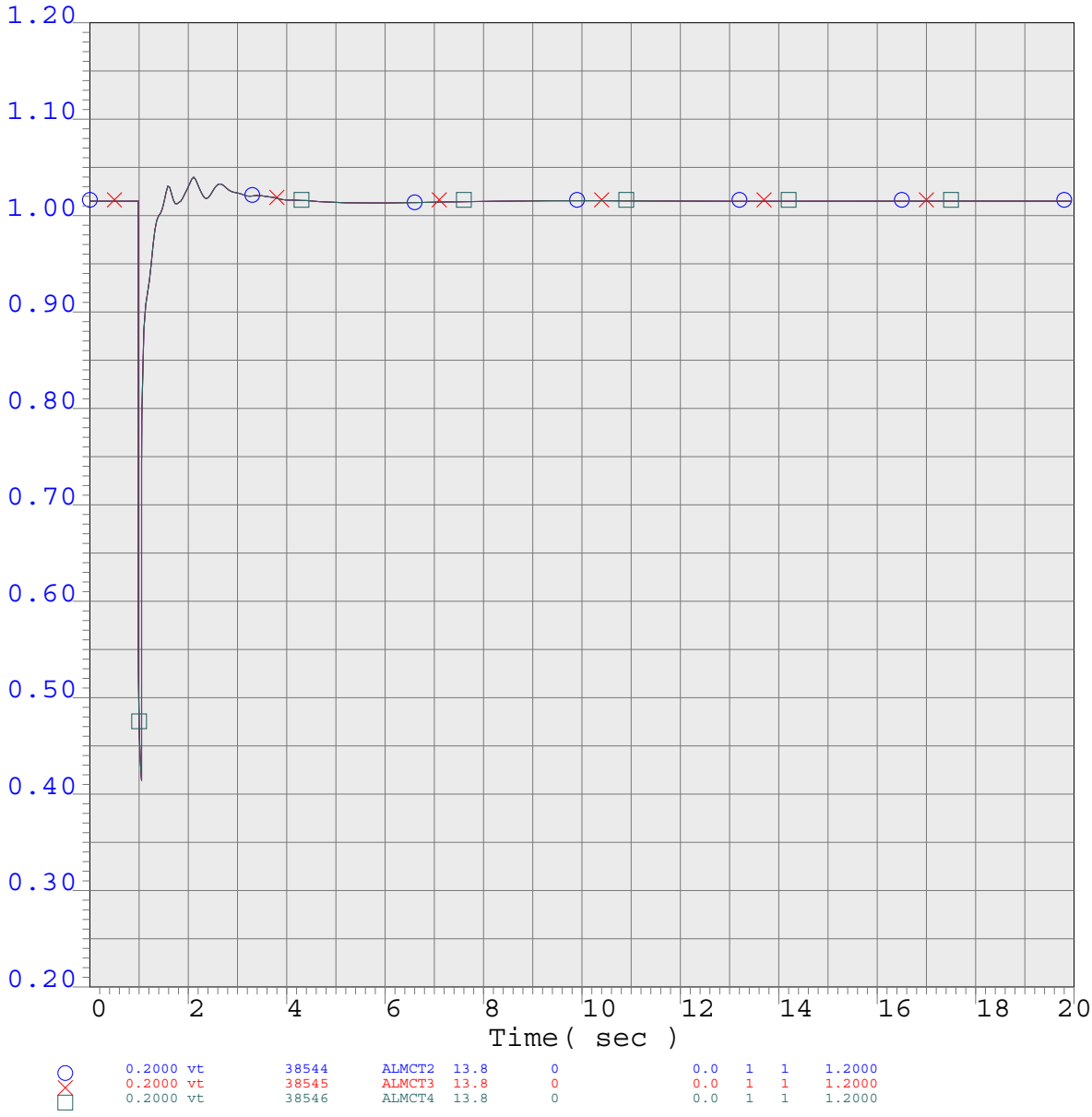
Mon Oct 19 00:51:46 2009

# Transient Stability Plots

# Grayson 115/69 kV Transformer Out

# Almond 2 Power Plant
# Terminal Voltage (p.u.)




2012 Summer Peak Base Case



2012_sum_pk_pst_006_GRAYSON_115-69_XFMR.chf

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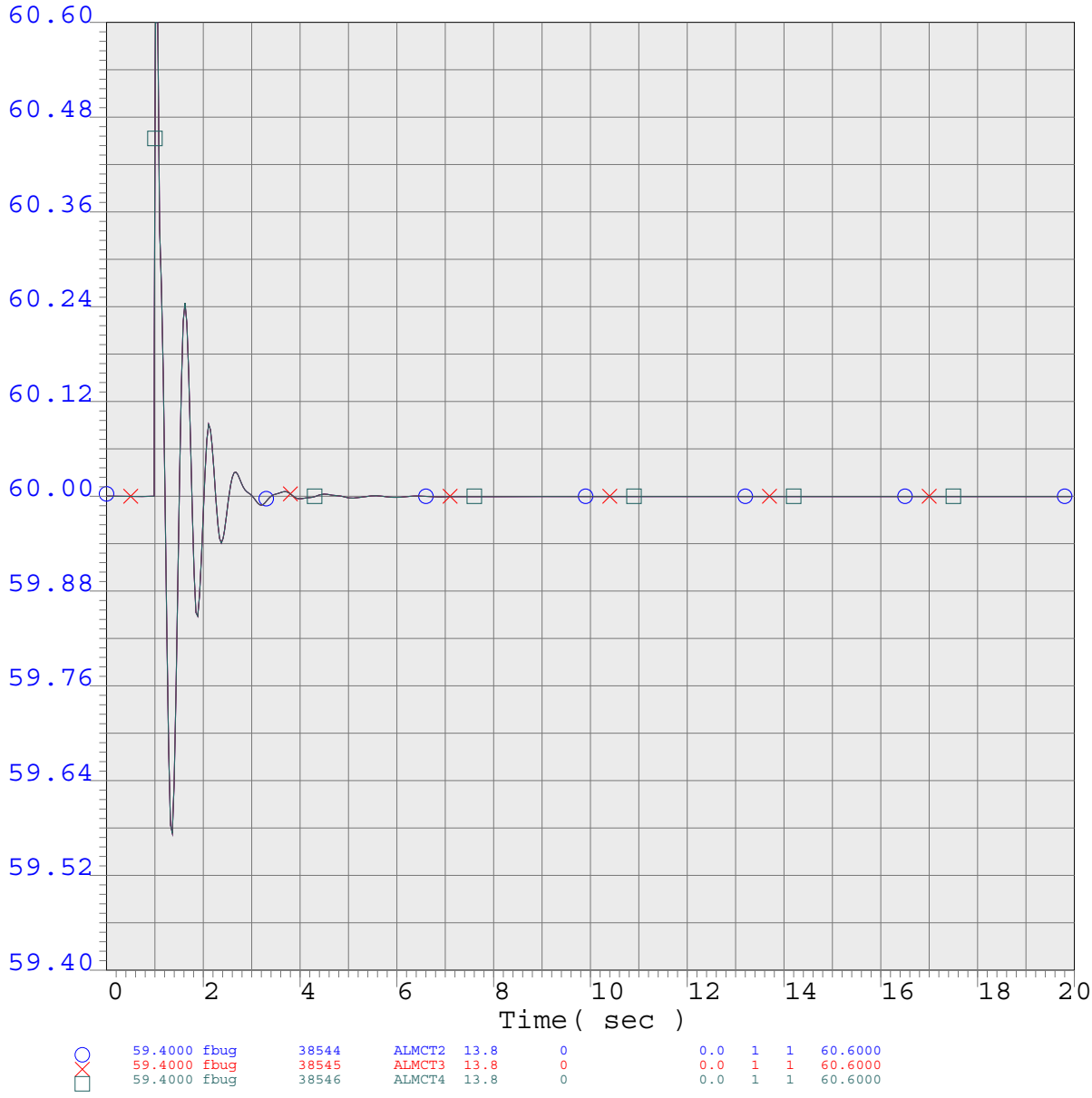
Mon Oct 19 00:51:51 2009

Almond 2 Power Plant
Frequency (Hz)




2012 Summer Peak Base Case



2012_sum_pk_pst_006_GRAYSON_115-69_XFMR.chf

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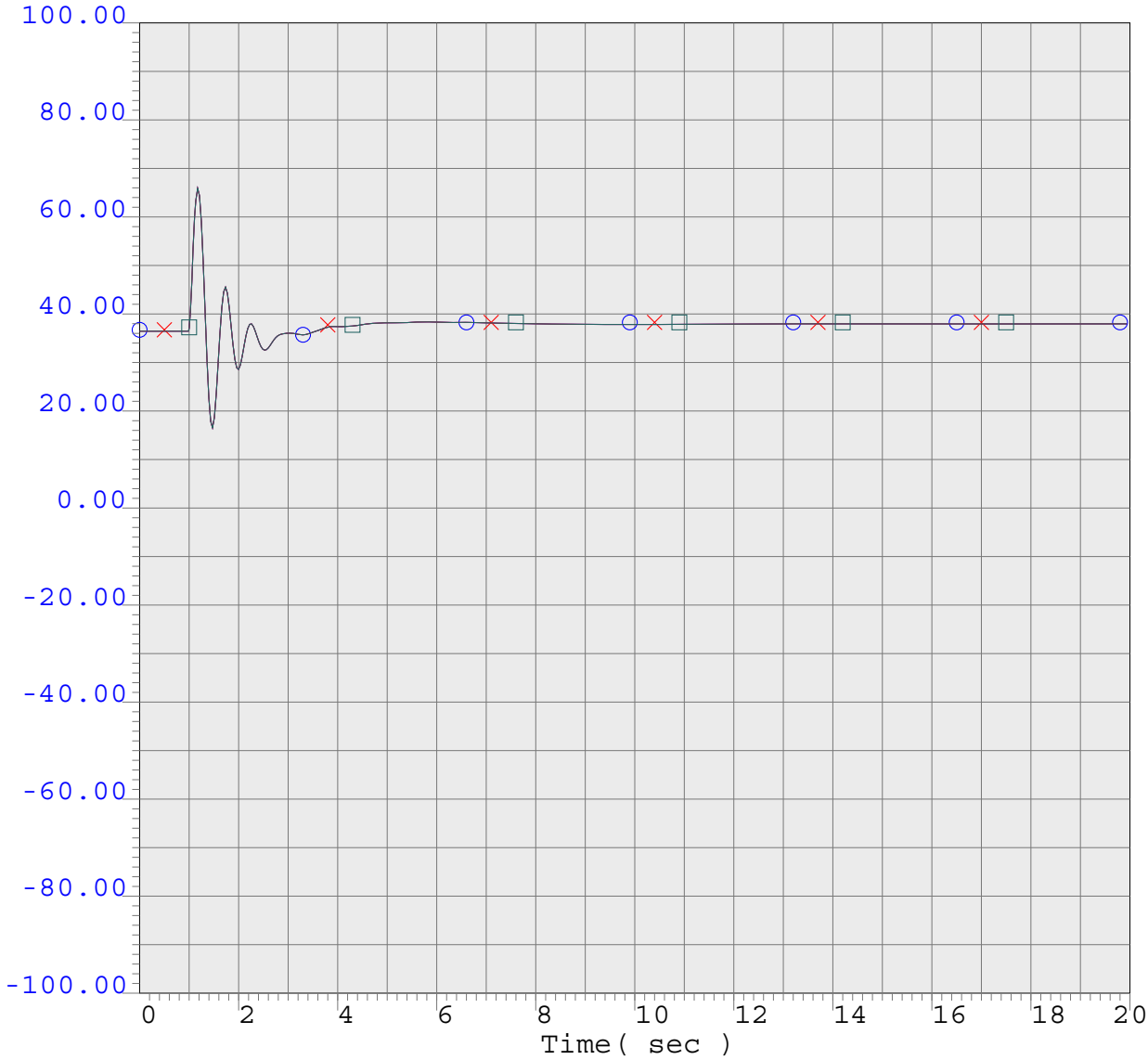
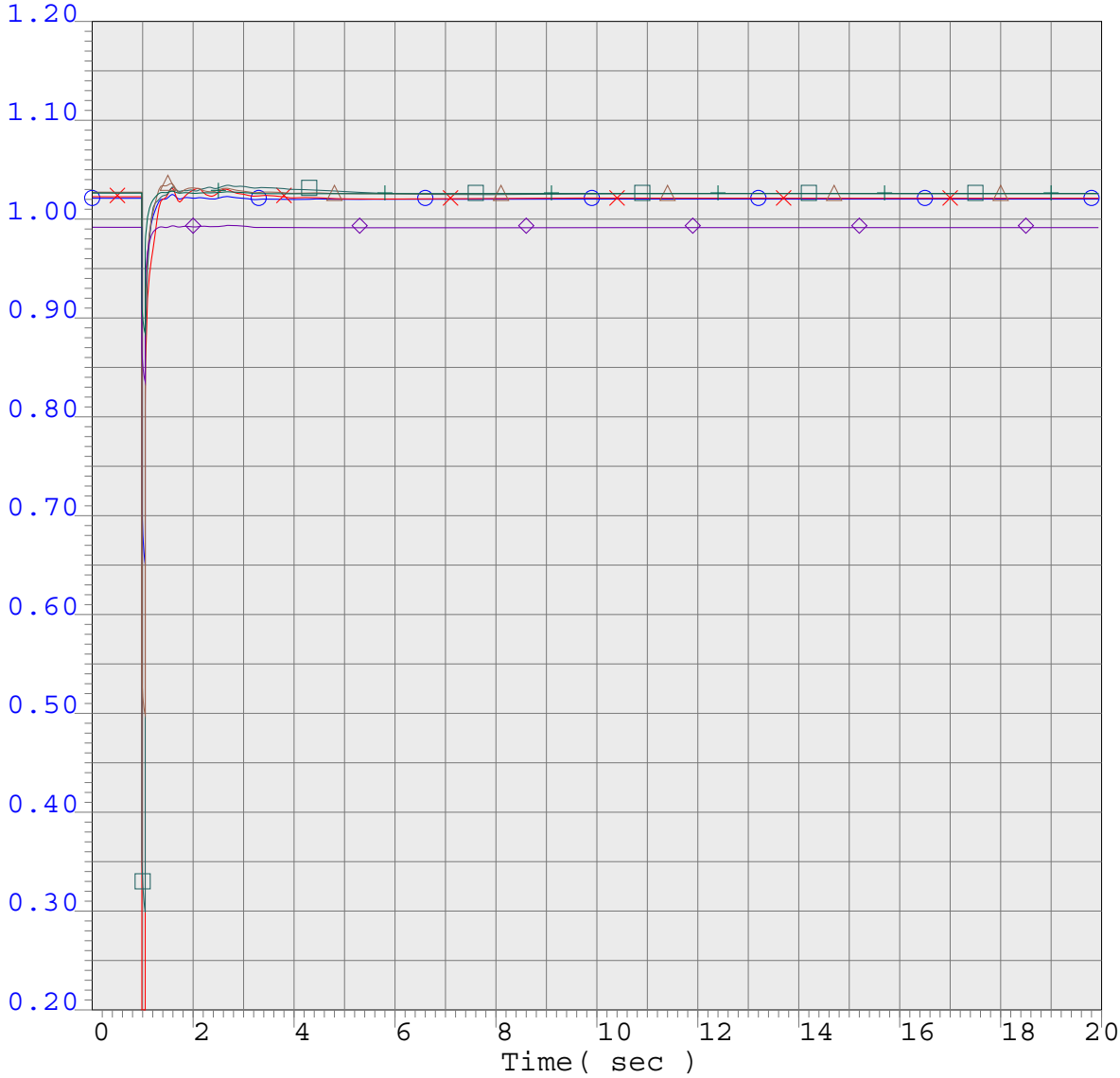
Mon Oct 19 00:51:51 2009

Almond 2 Power Plant
Relative Rotor Angle (degrees)




| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| -100.0000 ang | 38544 | ALMCT2 | 13.8 | 0 | 0.0 | 1 | 1 | 100.0000 |
| -100.0000 ang | 38545 | ALMCT3 | 13.8 | 0 | 0.0 | 1 | 1 | 100.0000 |
| -100.0000 ang | 38546 | ALMCT4 | 13.8 | 0 | 0.0 | 1 | 1 | 100.0000 |

Select TID System Parameters
Voltage (p.u.)




| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 0.2000 | vbul | 38442 | AUGUST | 115.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbul | 38534 | GRAY115 | 115.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 38535 | GRAY69 | 69.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 38432 | OAKDLTID | 115.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 38400 | WALNT | 230.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 38410 | WESTL115 | 115.0 | 0 | 0.0 | 1 | 1 | 1.2000 |

2012 Summer Peak Base Case



2012_sum_pk_pst_006_GRAYSON_115-69_XFMR.chf

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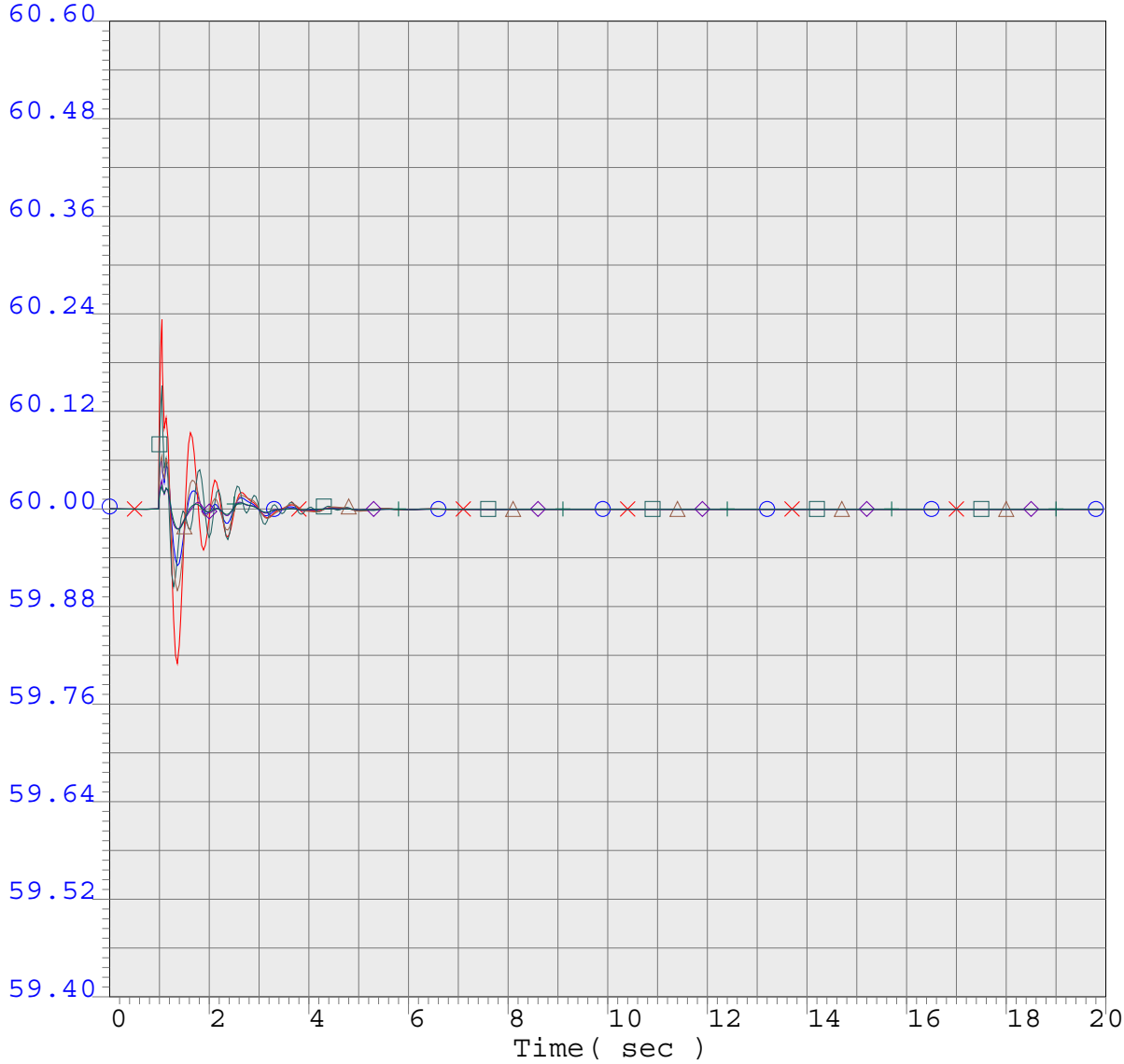
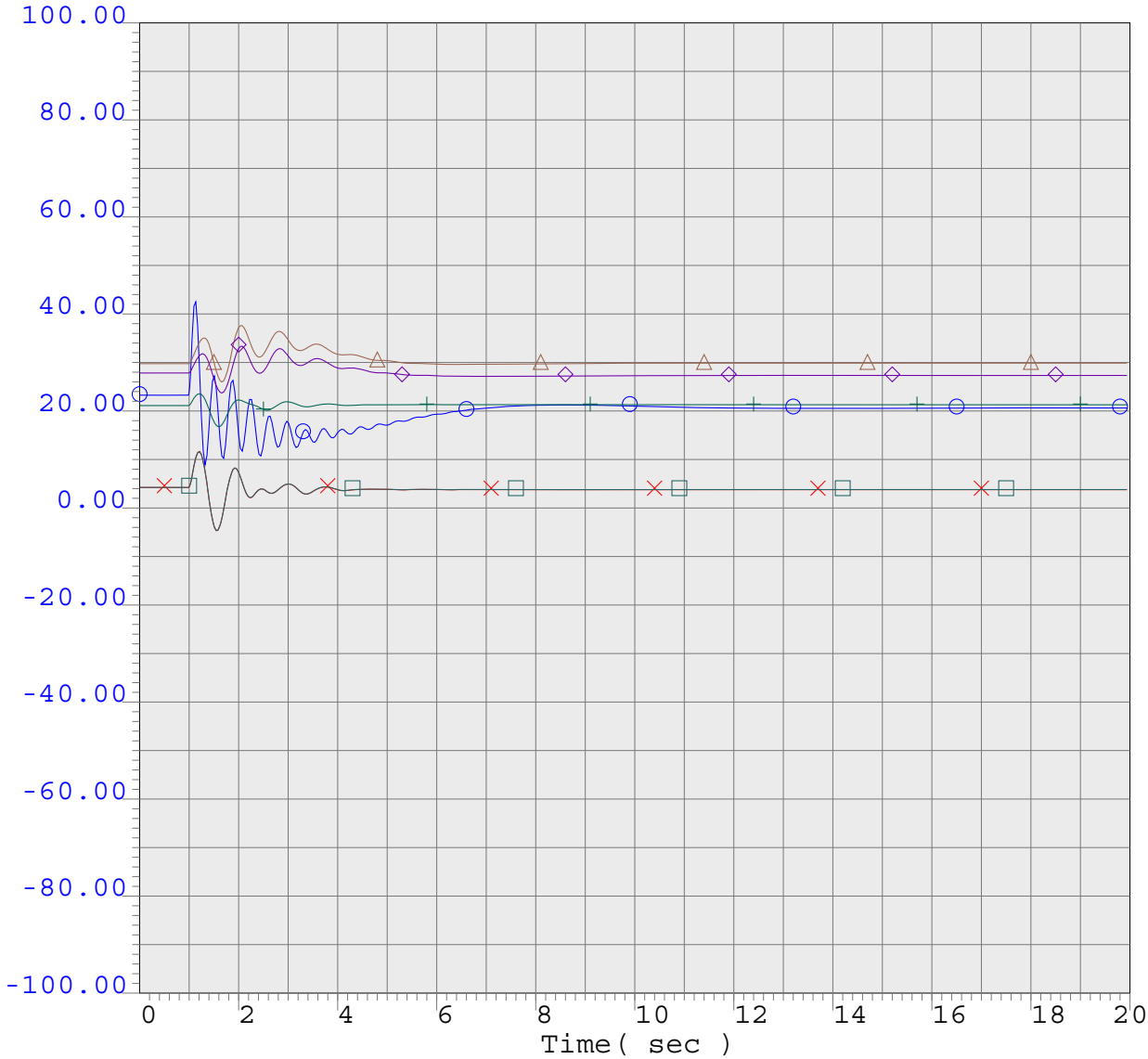
Mon Oct 19 00:51:51 2009

Select TID System Parameters
Frequency (Hz)



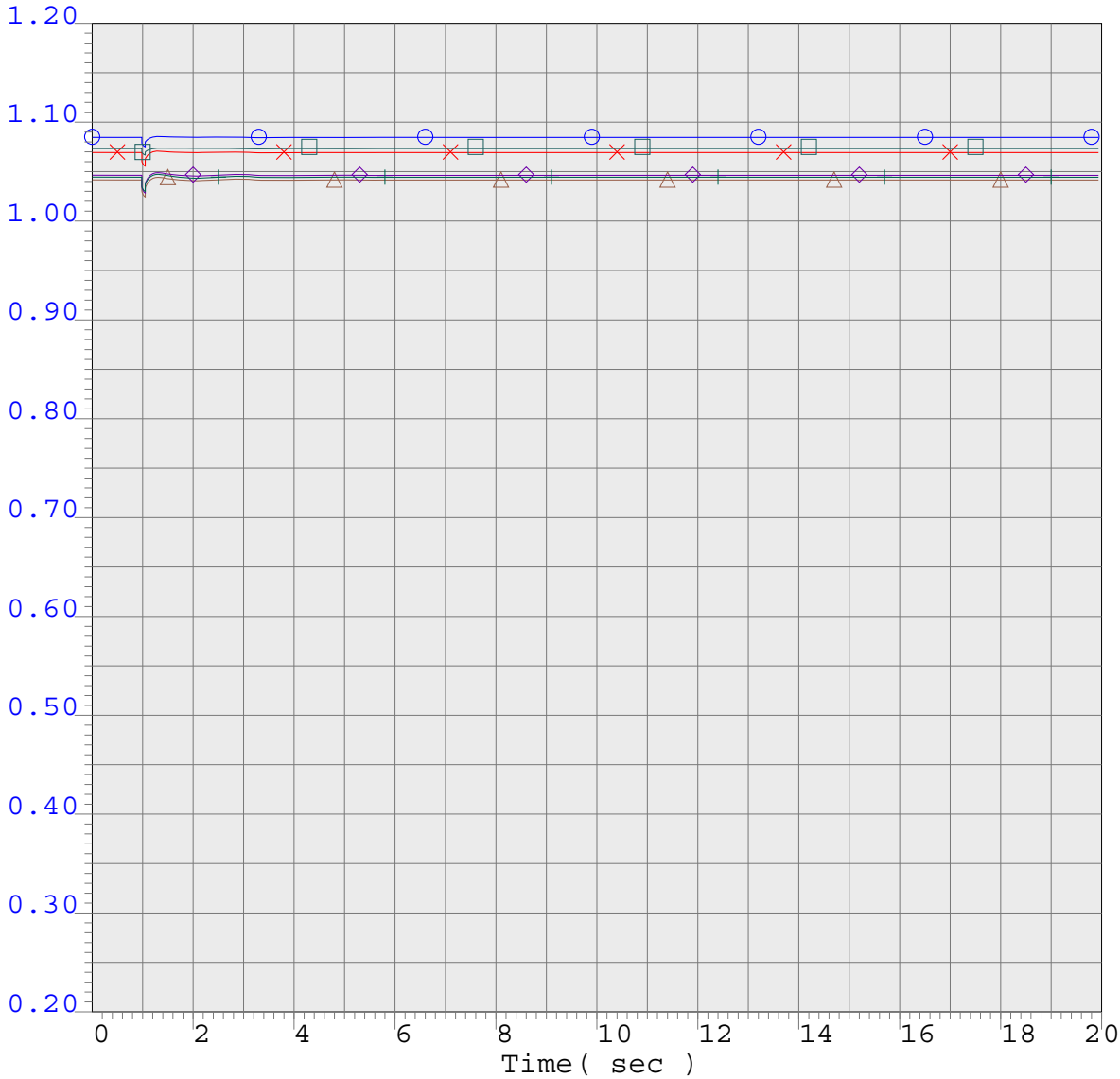

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 59.4000 | fbul | 38442 | AUGUST | 115.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbul | 38534 | GRAY115 | 115.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 38535 | GRAY69 | 69.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 38432 | OAKDLTID | 115.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 38400 | WALNT | 230.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 38410 | WESTL115 | 115.0 | 0 | 0.0 | 1 | 1 | 60.6000 |

Select TID System Parameters
Relative Rotor Angle (degrees)




| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| -100.0000 ang | 38564 | ALMONDCT | 13.8 | 0 | 0.0 | 1 | 1 | 100.0000 |
| -100.0000 ang | 38550 | DONPDRO1 | 13.8 | 0 | 0.0 | 1 | 1 | 100.0000 |
| -100.0000 ang | 38552 | DONPDRO2 | 13.8 | 0 | 0.0 | 1 | 1 | 100.0000 |
| -100.0000 ang | 38570 | WEC1-CT | 13.8 | 0 | 0.0 | 1 | 1 | 100.0000 |
| -100.0000 ang | 38574 | WEC2-CT | 13.8 | 0 | 0.0 | 1 | 1 | 100.0000 |
| -100.0000 ang | 38572 | WEC3-ST | 13.8 | 0 | 0.0 | 1 | 1 | 100.0000 |

# 500 kV Bulk System Parameters
Voltage (p.u.)




| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 0.2000 | vbus | 30055 | GATES | 500.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 30050 | LOSBANOS | 500.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 30060 | MIDWAY | 500.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 30040 | TESLA | 500.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 30035 | TRACY | 500.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 30030 | VACA-DIX | 500.0 | 0 | 0.0 | 1 | 1 | 1.2000 |

2012 Summer Peak Base Case

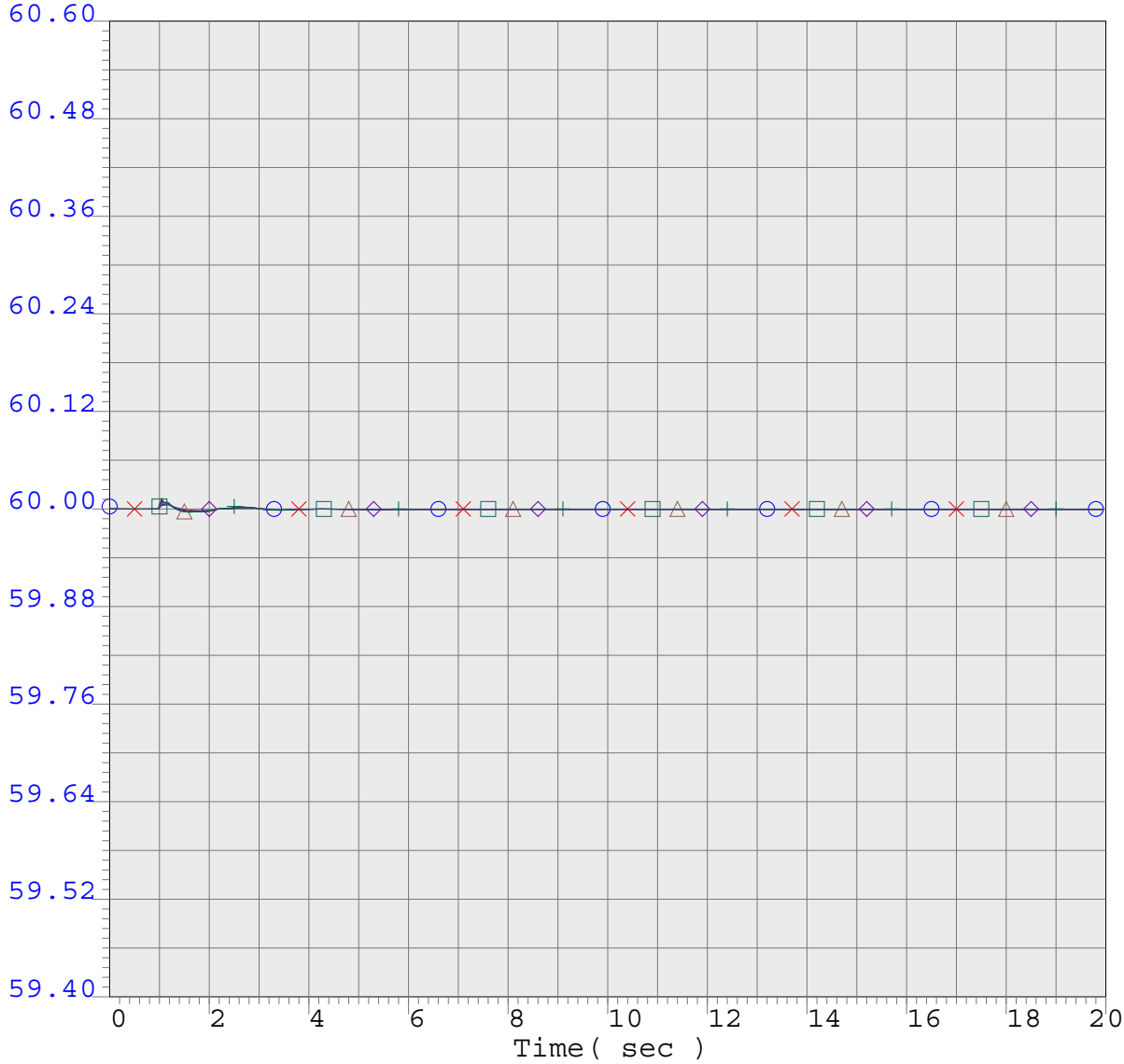


2012_sum_pk_pst_006_GRAYSON_115-69_XFMR.chf

.

Mon Oct 19 00:51:51 2009

# 500 kV Bulk System Parameters
Frequency (Hz)




| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 59.4000 | fbus | 30055 | GATES | 500.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 30050 | LOSBANOS | 500.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 30060 | MIDWAY | 500.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 30040 | TESLA | 500.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 30035 | TRACY | 500.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 30030 | VACA-DIX | 500.0 | 0 | 0.0 | 1 | 1 | 60.6000 |

2012 Summer Peak Base Case



2012_sum_pk_pst_006_GRAYSON_115-69_XFMR.chf

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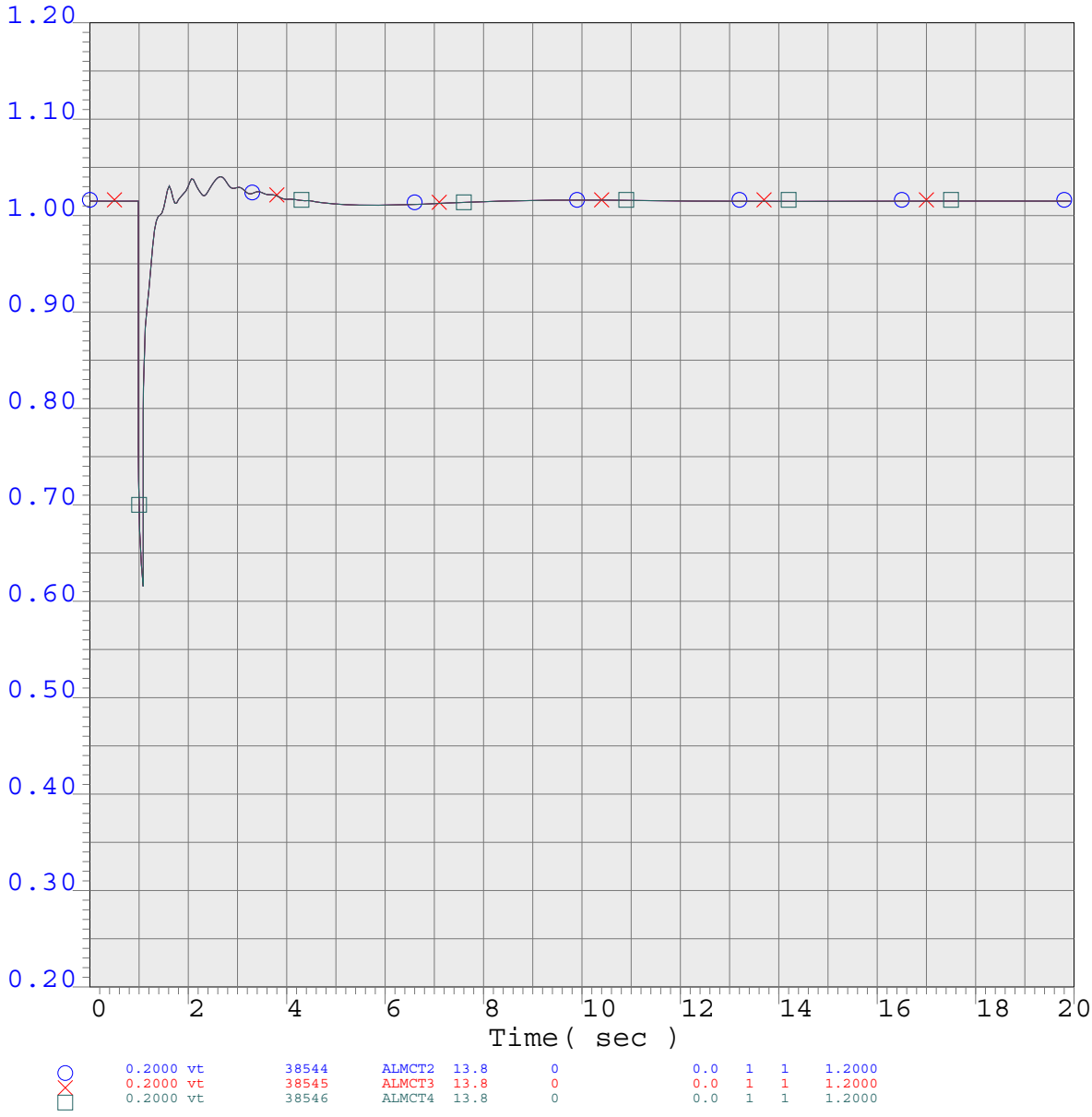
Mon Oct 19 00:51:51 2009

# Transient Stability Plots

# Grayson-Almond 69 kV Line Out

# Almond 2 Power Plant
# Terminal Voltage (p.u.)




2012 Summer Peak Base Case



2012_sum_pk_pst_007_GRAYSON-ALMOND_69.chf

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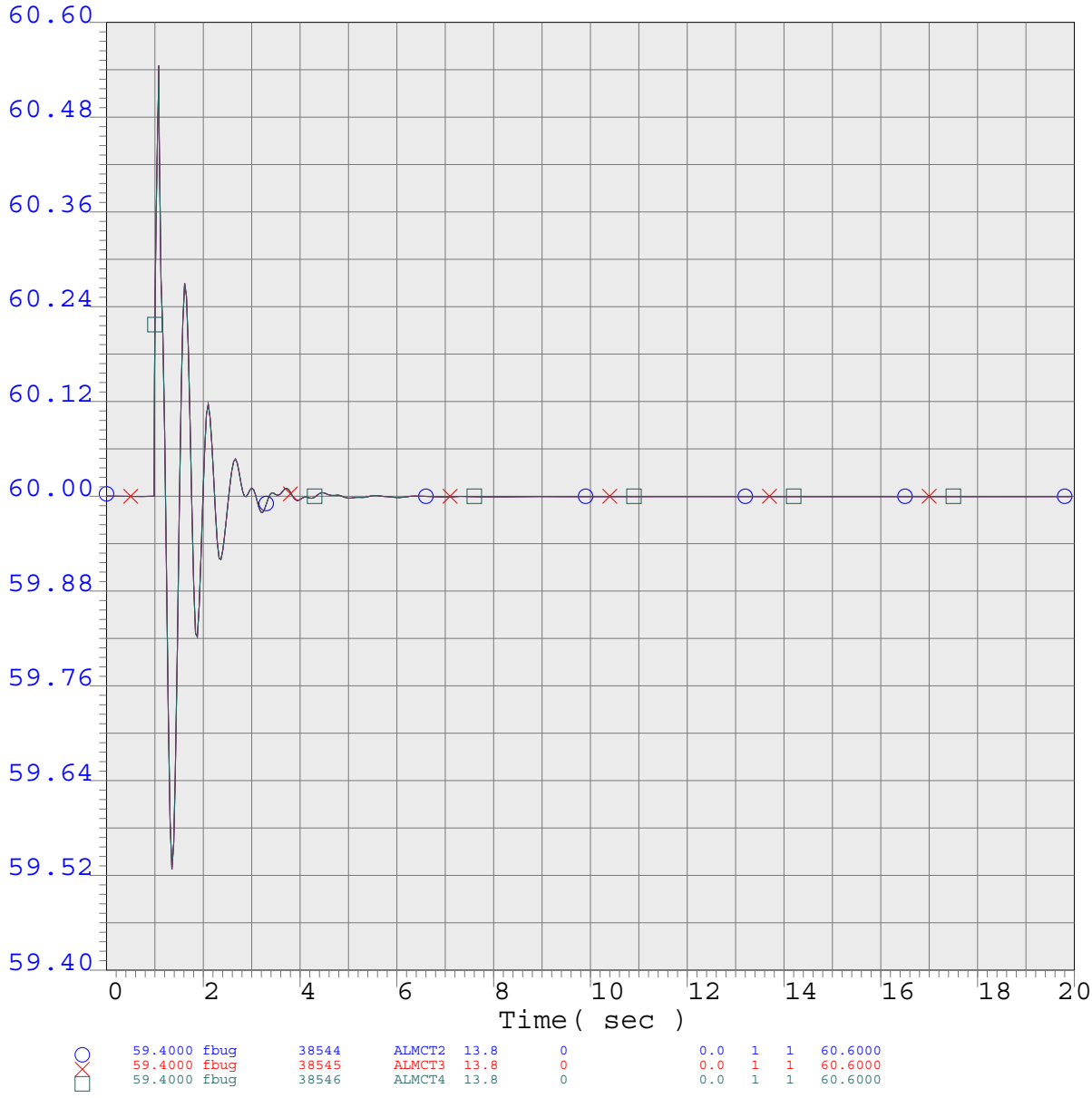
Mon Oct 19 00:51:56 2009

Almond 2 Power Plant
Frequency (Hz)




2012 Summer Peak Base Case



2012_sum_pk_pst_007_GRAYSON-ALMOND_69.chf

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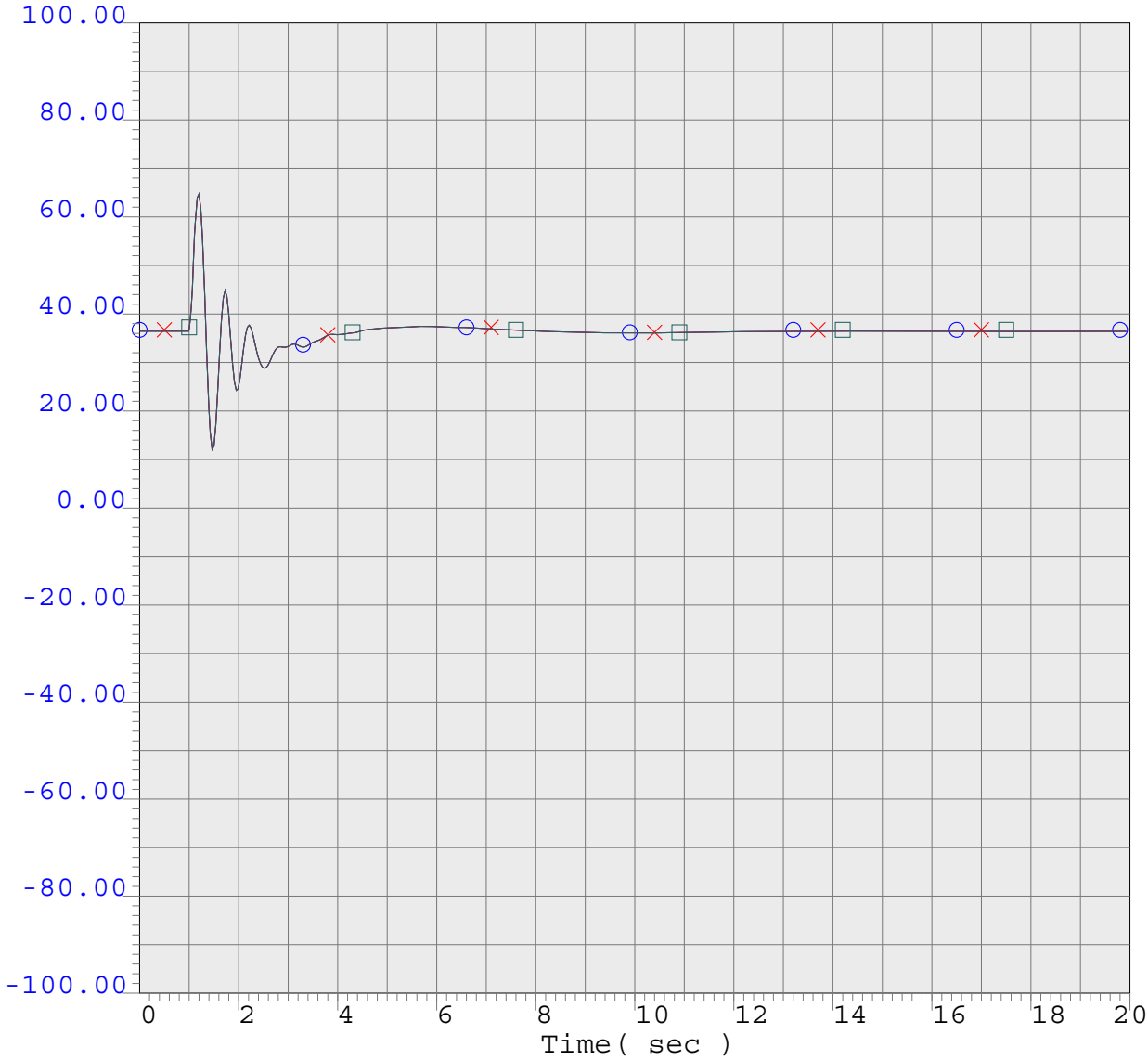
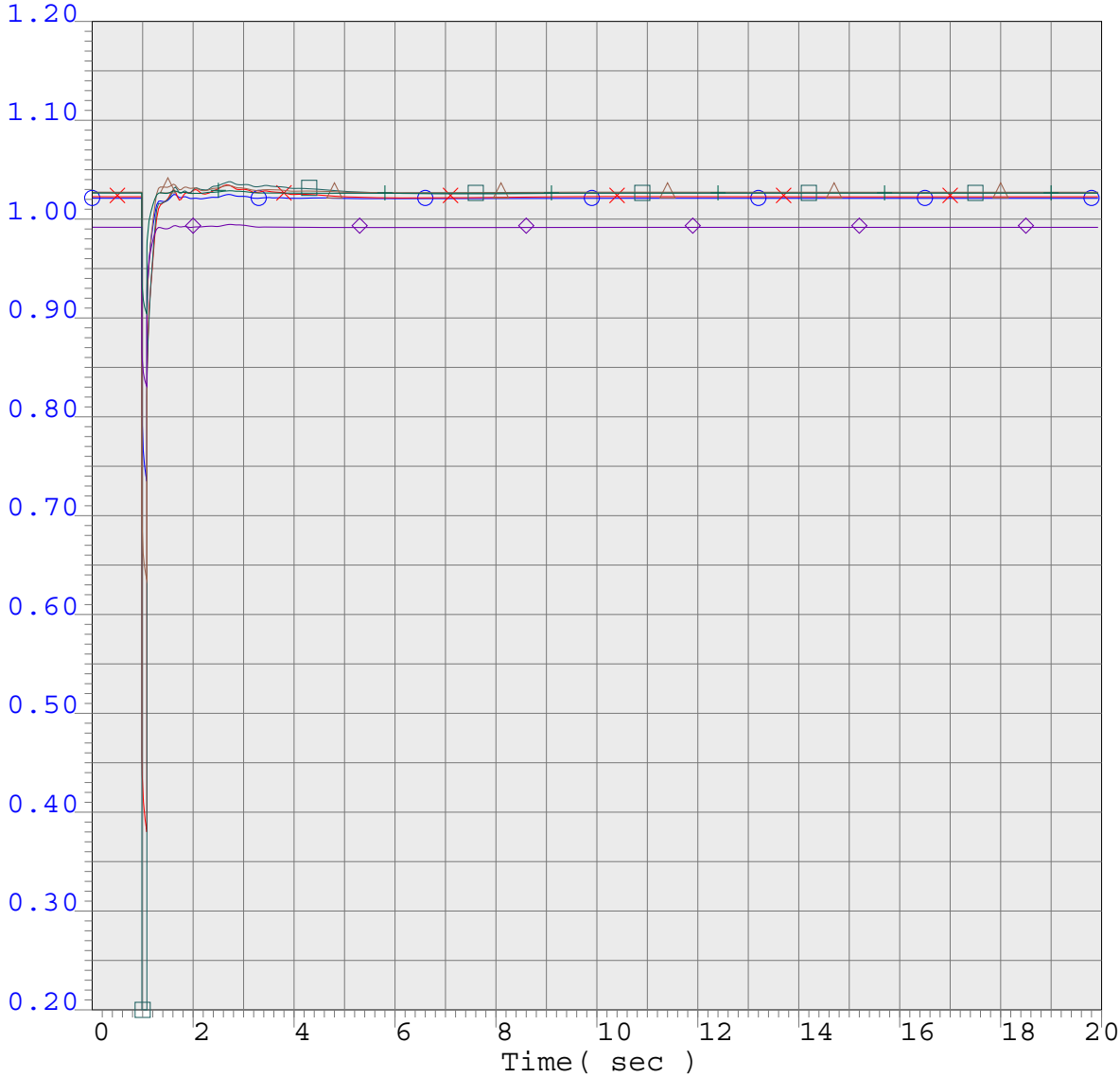
Mon Oct 19 00:51:56 2009

Almond 2 Power Plant
Relative Rotor Angle (degrees)




| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| -100.0000 ang | 38544 | ALMCT2 | 13.8 | 0 | 0.0 | 1 | 1 | 100.0000 |
| -100.0000 ang | 38545 | ALMCT3 | 13.8 | 0 | 0.0 | 1 | 1 | 100.0000 |
| -100.0000 ang | 38546 | ALMCT4 | 13.8 | 0 | 0.0 | 1 | 1 | 100.0000 |

Select TID System Parameters
Voltage (p.u.)




| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 0.2000 | vbul | 38442 | AUGUST | 115.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbul | 38534 | GRAY115 | 115.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 38535 | GRAY69 | 69.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 38432 | OAKDLTID | 115.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 38400 | WALNT | 230.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 38410 | WESTL115 | 115.0 | 0 | 0.0 | 1 | 1 | 1.2000 |

2012 Summer Peak Base Case



2012_sum_pk_pst_007_GRAYSON-ALMOND_69.chf

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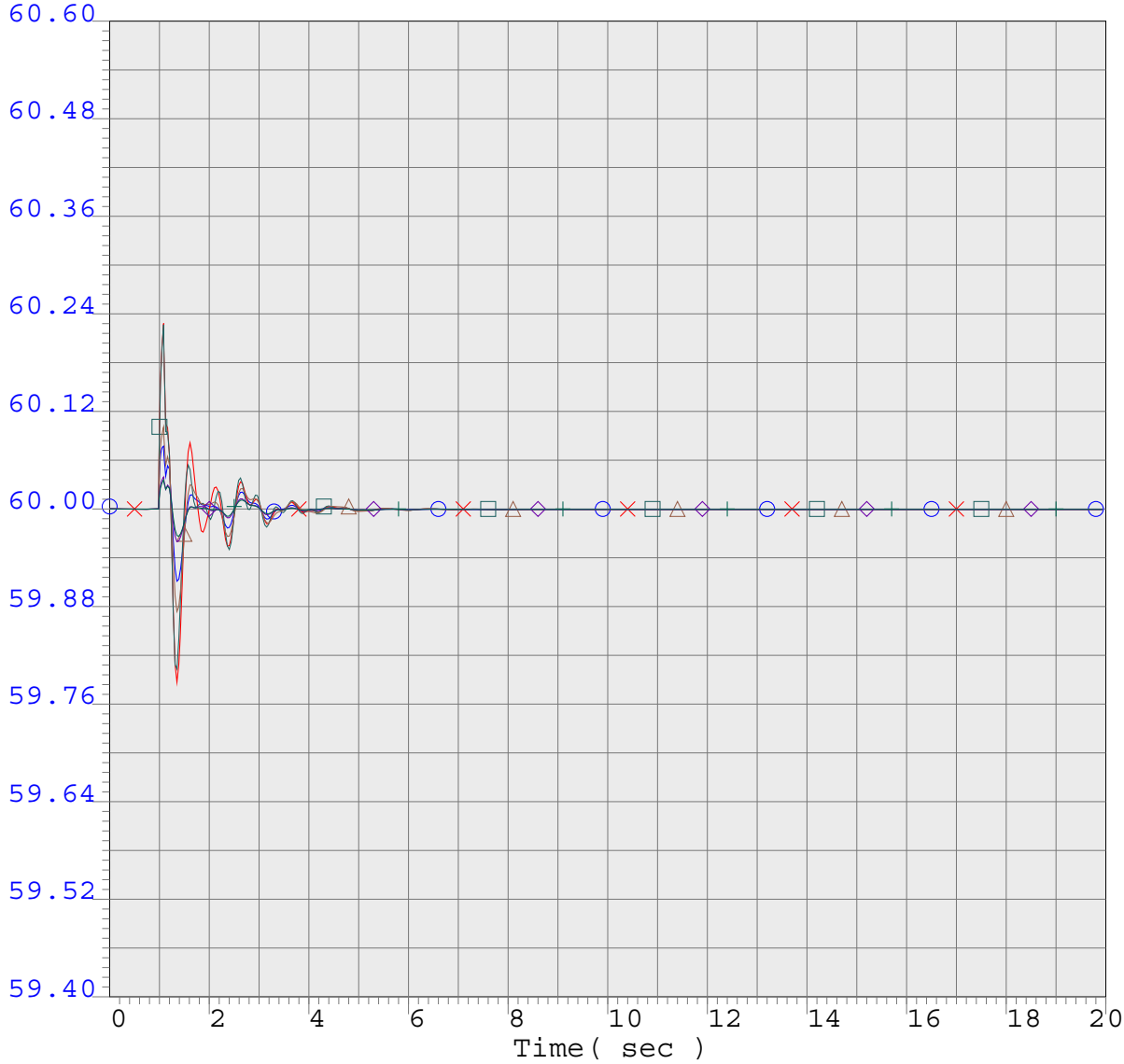
Mon Oct 19 00:51:56 2009

Select TID System Parameters
Frequency (Hz)




| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 59.4000 | fbul | 38442 | AUGUST | 115.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbul | 38534 | GRAY115 | 115.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 38535 | GRAY69 | 69.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 38432 | OAKDLTID | 115.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 38400 | WALNT | 230.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 38410 | WESTL115 | 115.0 | 0 | 0.0 | 1 | 1 | 60.6000 |

2012 Summer Peak Base Case



2012_sum_pk_pst_007_GRAYSON-ALMOND_69.chf

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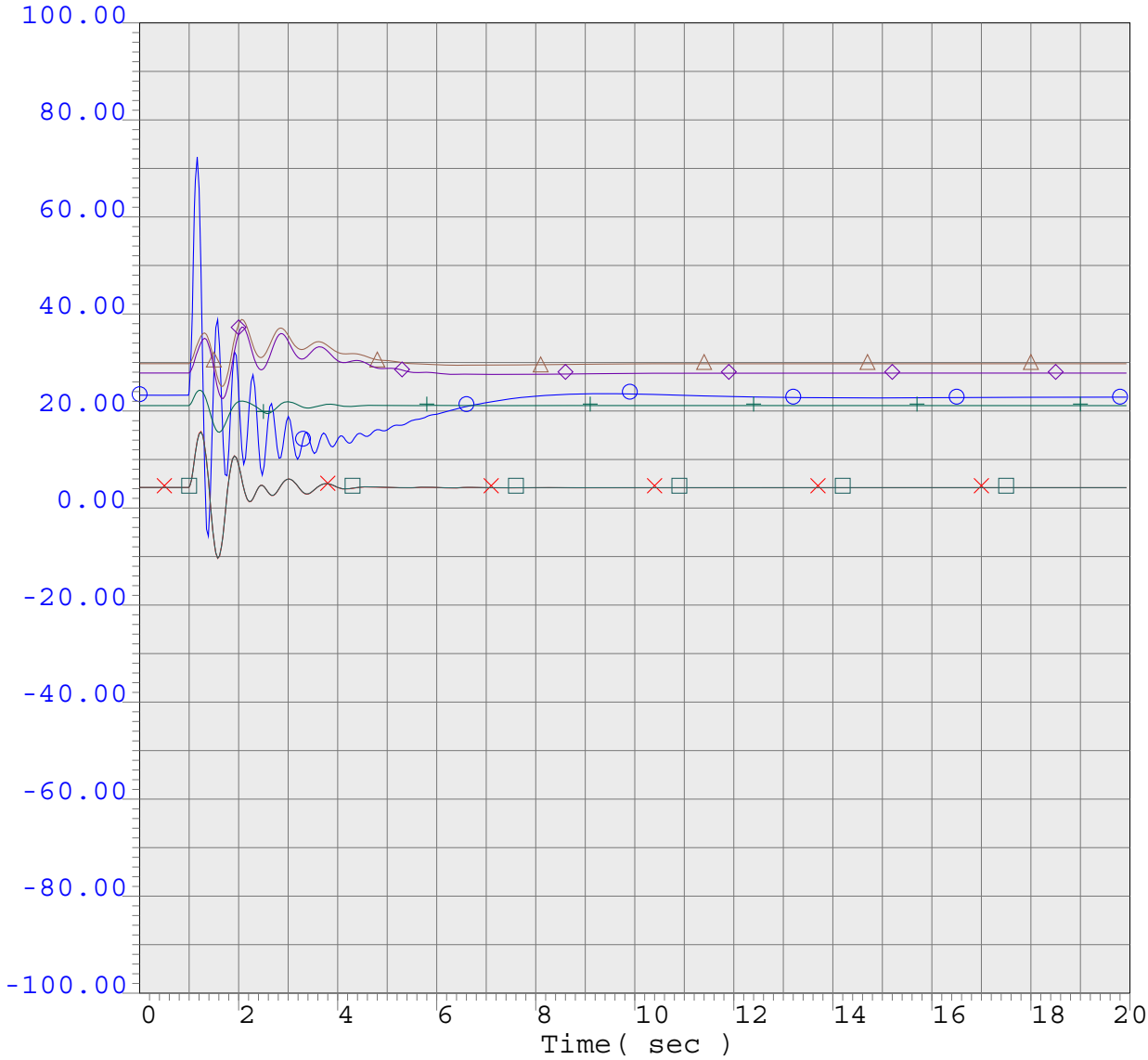
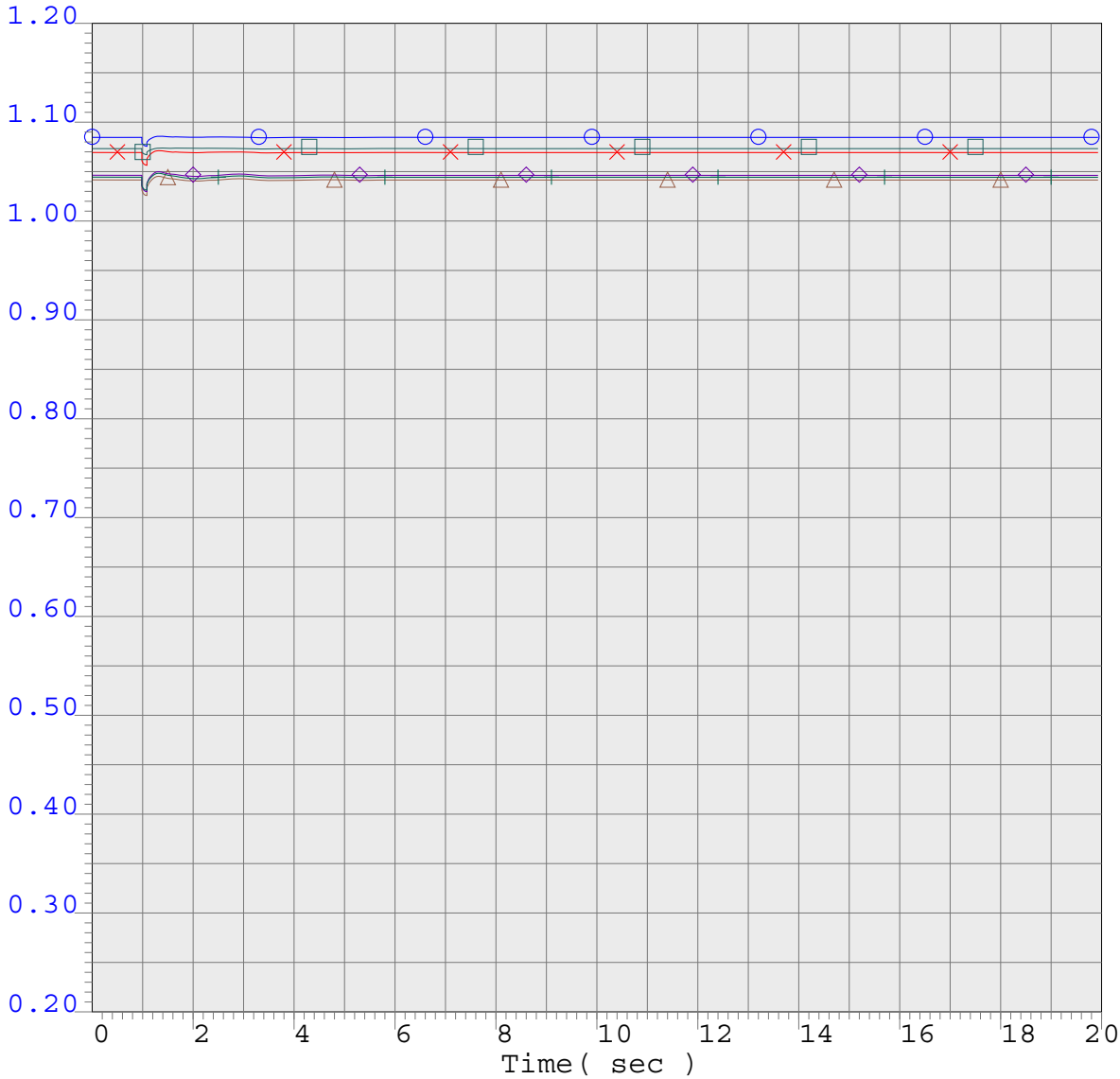
Mon Oct 19 00:51:56 2009

Select TID System Parameters
Relative Rotor Angle (degrees)



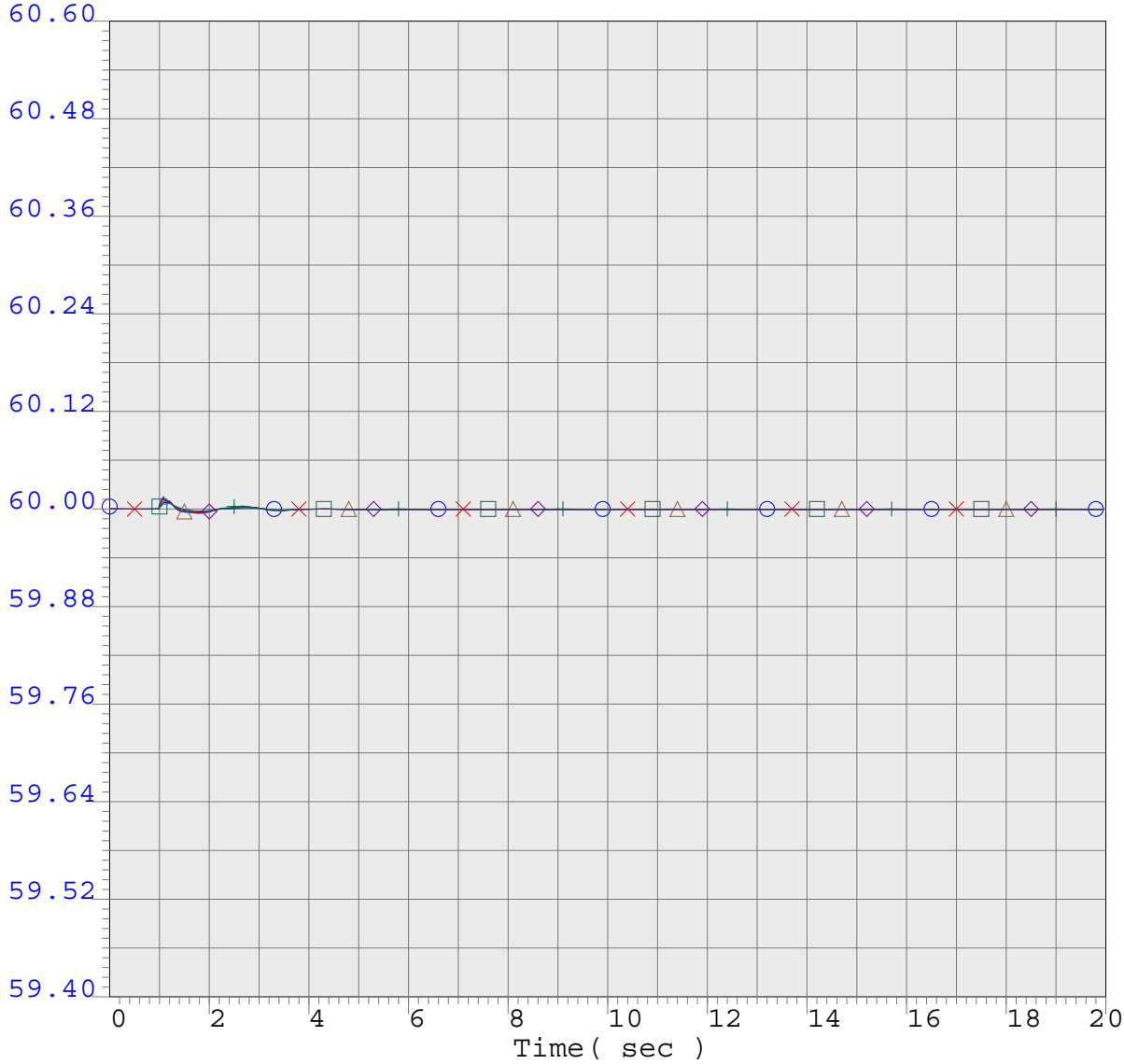

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| -100.0000 ang | 38564 | ALMONDCT | 13.8 | 0 | 0.0 | 1 | 1 | 100.0000 |
| -100.0000 ang | 38550 | DONPDRO1 | 13.8 | 0 | 0.0 | 1 | 1 | 100.0000 |
| -100.0000 ang | 38552 | DONPDRO2 | 13.8 | 0 | 0.0 | 1 | 1 | 100.0000 |
| -100.0000 ang | 38570 | WEC1-CT | 13.8 | 0 | 0.0 | 1 | 1 | 100.0000 |
| -100.0000 ang | 38574 | WEC2-CT | 13.8 | 0 | 0.0 | 1 | 1 | 100.0000 |
| -100.0000 ang | 38572 | WEC3-ST | 13.8 | 0 | 0.0 | 1 | 1 | 100.0000 |

# 500 kV Bulk System Parameters
Voltage (p.u.)




| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 0.2000 | vbus | 30055 | GATES | 500.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 30050 | LOSBANOS | 500.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 30060 | MIDWAY | 500.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 30040 | TESLA | 500.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 30035 | TRACY | 500.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 30030 | VACA-DIX | 500.0 | 0 | 0.0 | 1 | 1 | 1.2000 |

# 500 kV Bulk System Parameters
Frequency (Hz)




| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 59.4000 | fbus | 30055 | GATES | 500.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 30050 | LOSBANOS | 500.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 30060 | MIDWAY | 500.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 30040 | TESLA | 500.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 30035 | TRACY | 500.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 30030 | VACA-DIX | 500.0 | 0 | 0.0 | 1 | 1 | 60.6000 |

2012 Summer Peak Base Case



2012_sum_pk_pst_007_GRAYSON-ALMOND_69.chf

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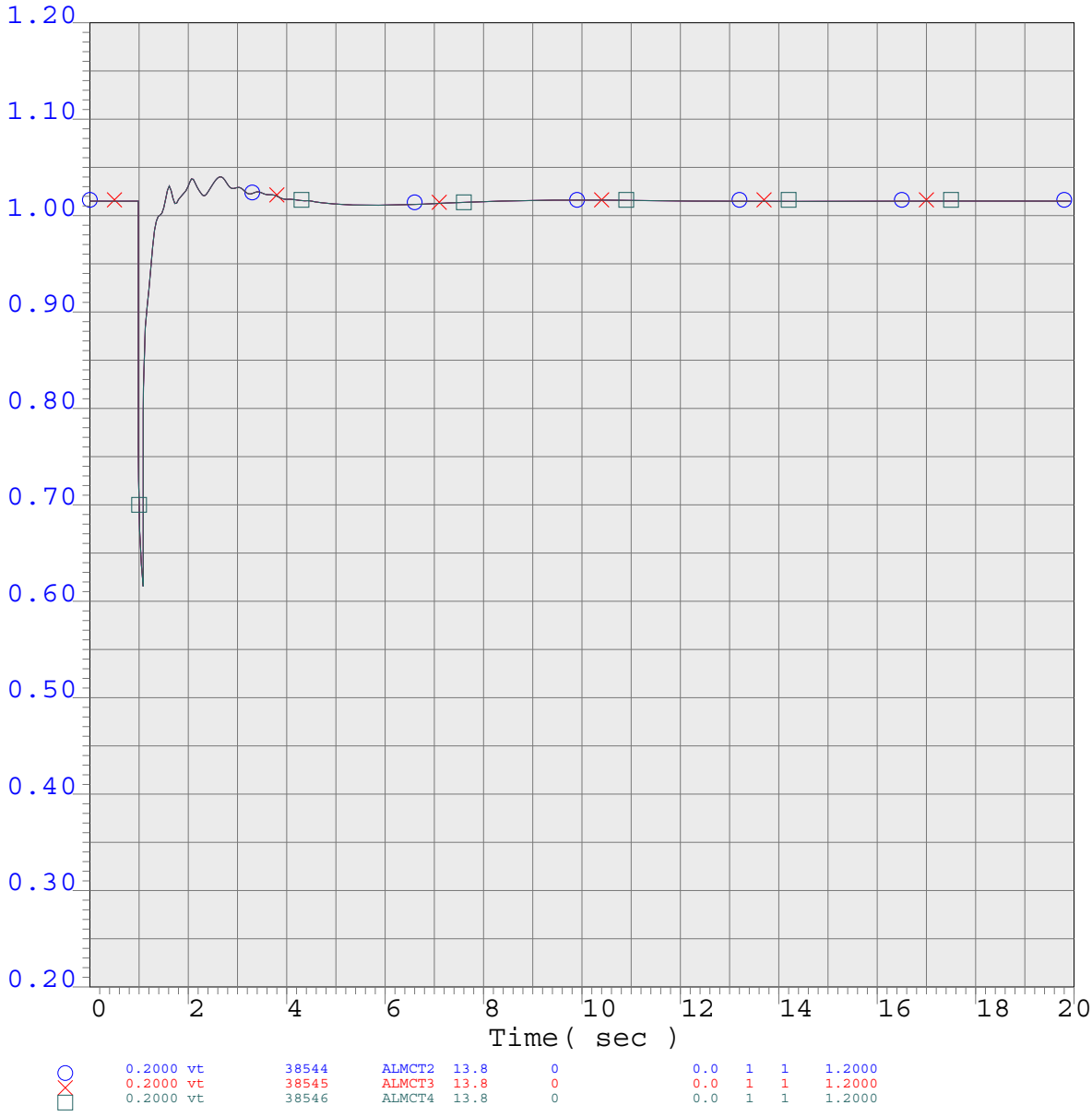
Mon Oct 19 00:51:56 2009

# Transient Stability Plots

# Grayson-Gilstrap 69 kV Line Out

# Almond 2 Power Plant
# Terminal Voltage (p.u.)




2012 Summer Peak Base Case



2012_sum_pk_pst_008_GRAYSON-GILSTRAP_69.chf

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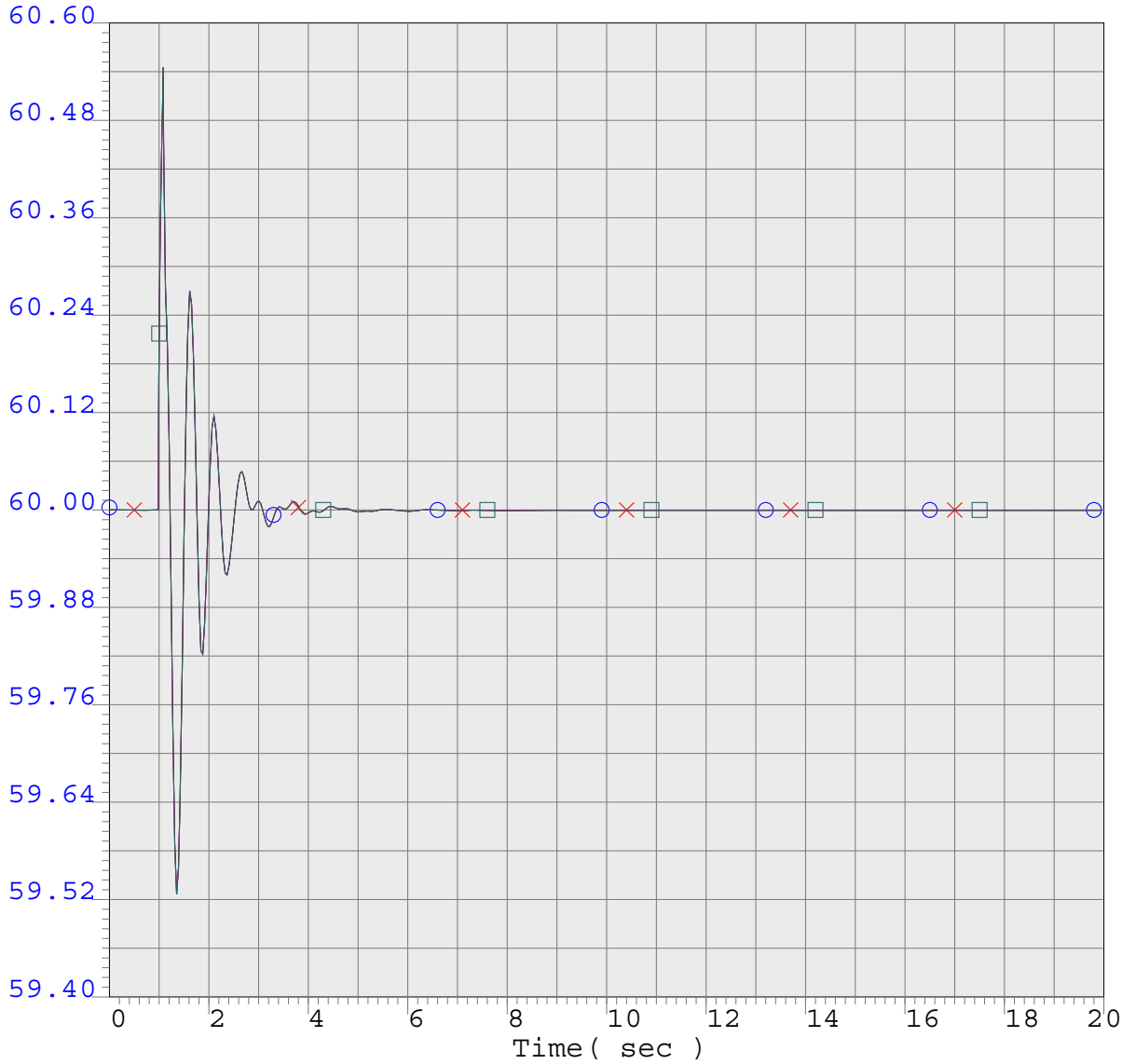
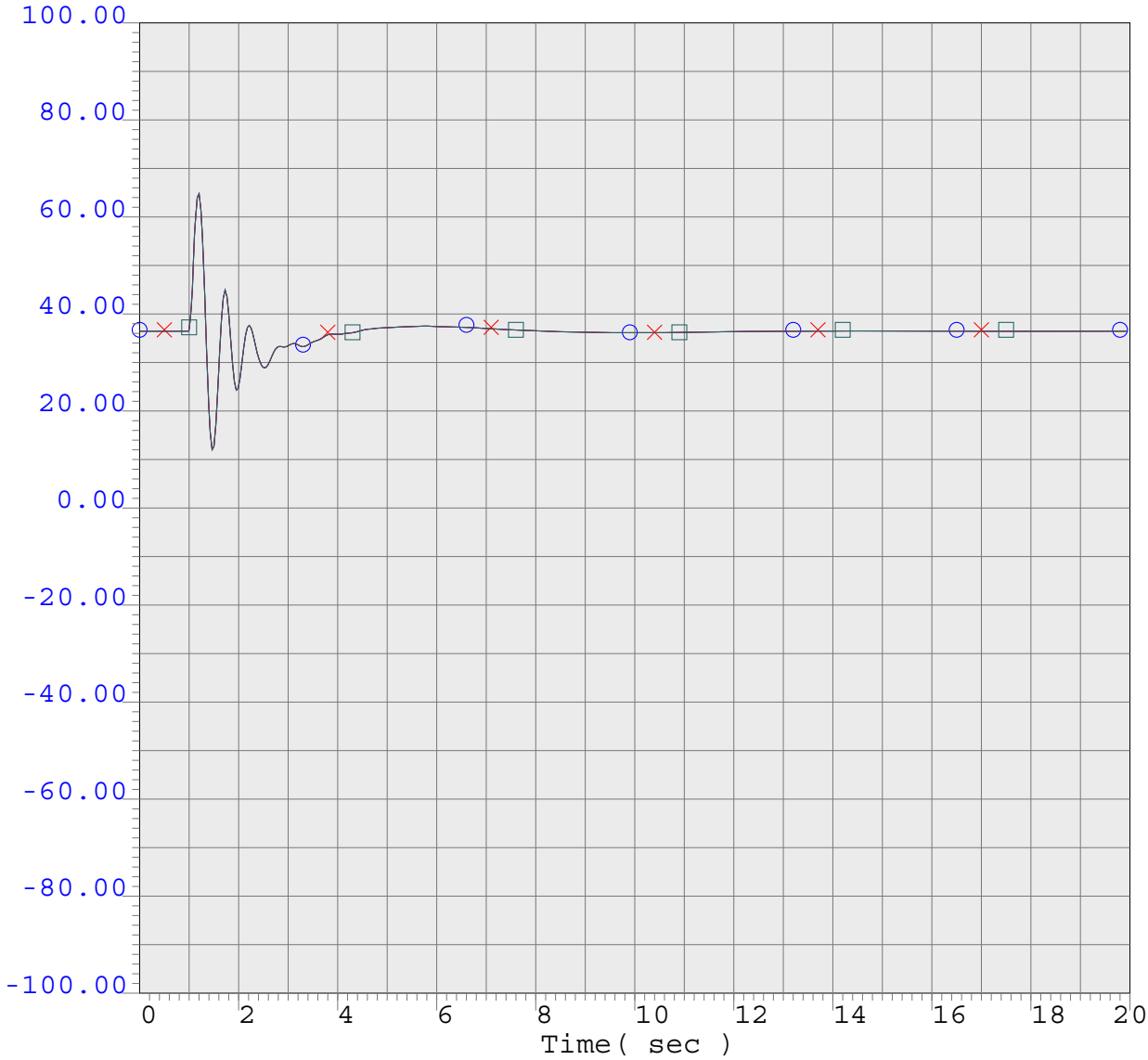
Mon Oct 19 00:52:01 2009

Almond 2 Power Plant
Frequency (Hz)



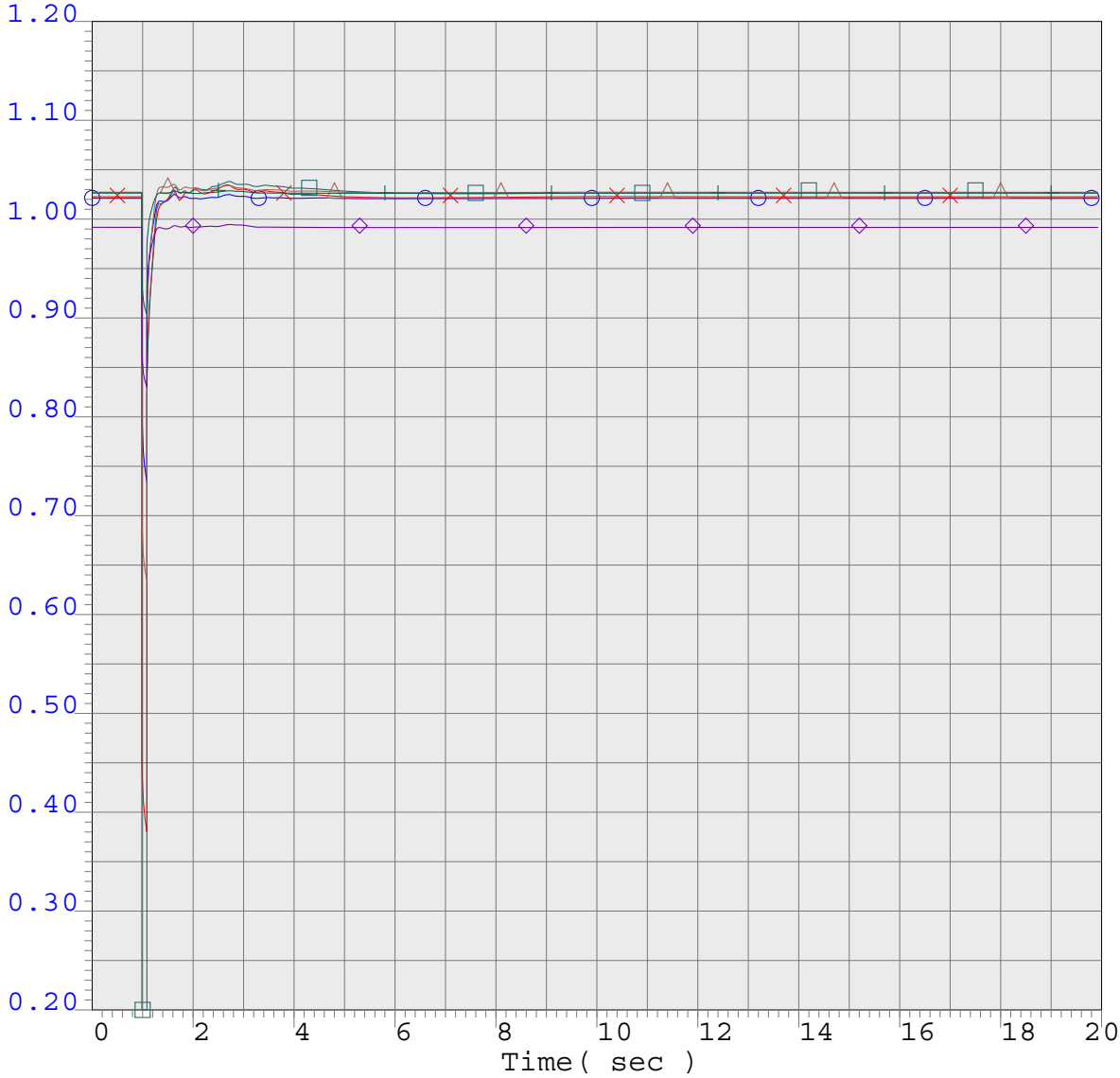

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| ○ | 59.4000 | fbug | 38544 | ALMCT2 | 13.8 | 0 | 0.0 | 1 | 1 | 60.6000 |
| × | 59.4000 | fbug | 38545 | ALMCT3 | 13.8 | 0 | 0.0 | 1 | 1 | 60.6000 |
| □ | 59.4000 | fbug | 38546 | ALMCT4 | 13.8 | 0 | 0.0 | 1 | 1 | 60.6000 |

Almond 2 Power Plant
Relative Rotor Angle (degrees)




| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| -100.0000 ang | 38544 | ALMCT2 | 13.8 | 0 | 0.0 | 1 | 1 | 100.0000 |
| -100.0000 ang | 38545 | ALMCT3 | 13.8 | 0 | 0.0 | 1 | 1 | 100.0000 |
| -100.0000 ang | 38546 | ALMCT4 | 13.8 | 0 | 0.0 | 1 | 1 | 100.0000 |

Select TID System Parameters
Voltage (p.u.)




| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 0.2000 | vbul | 38442 | AUGUST | 115.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbul | 38534 | GRAY115 | 115.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 38535 | GRAY69 | 69.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 38432 | OAKDLTID | 115.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 38400 | WALNT | 230.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 38410 | WESTL115 | 115.0 | 0 | 0.0 | 1 | 1 | 1.2000 |

2012 Summer Peak Base Case



2012_sum_pk_pst_008_GRAYSON-GILSTRAP_69.chf

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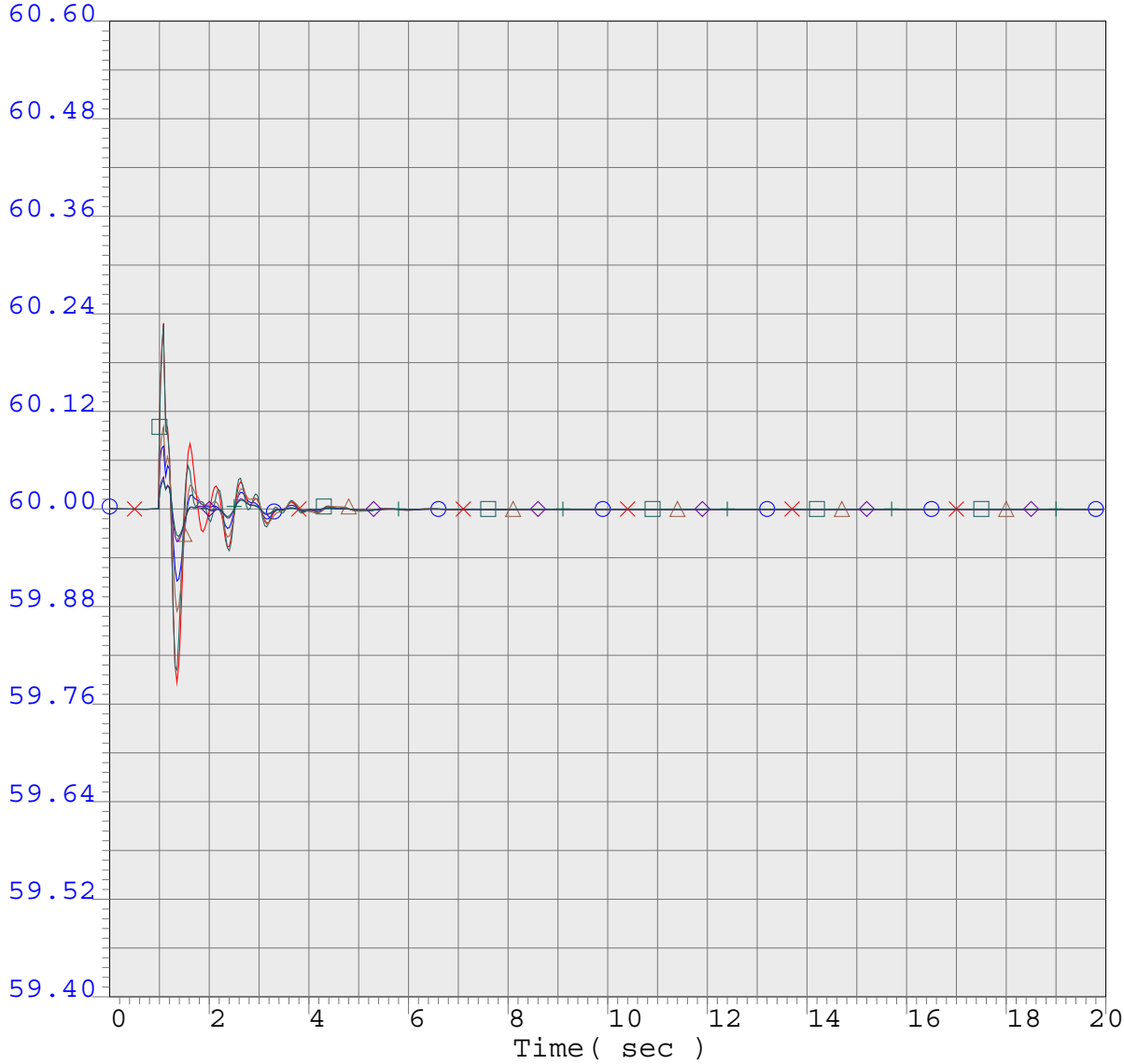
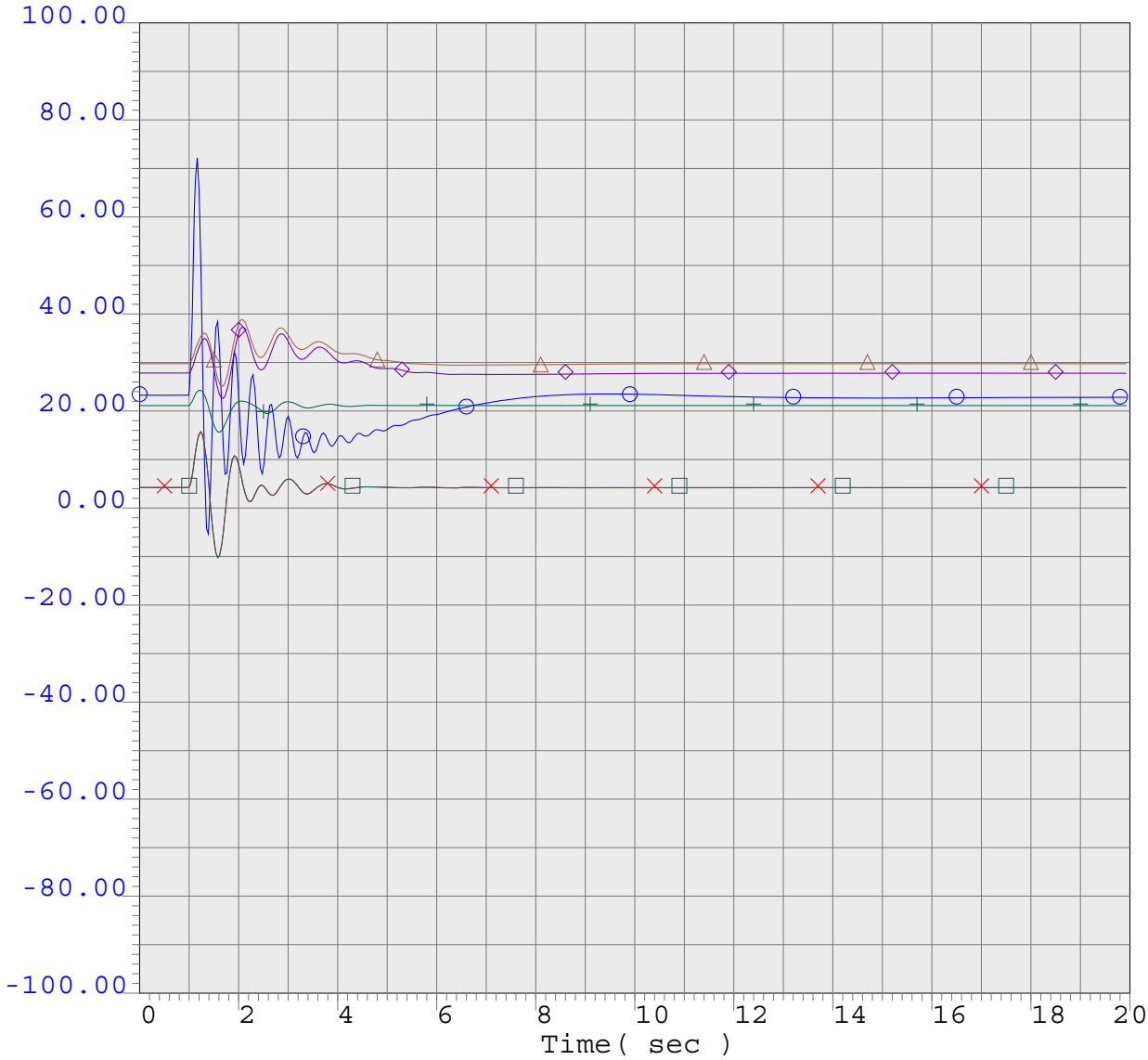
Select TID System Parameters
Frequency (Hz)



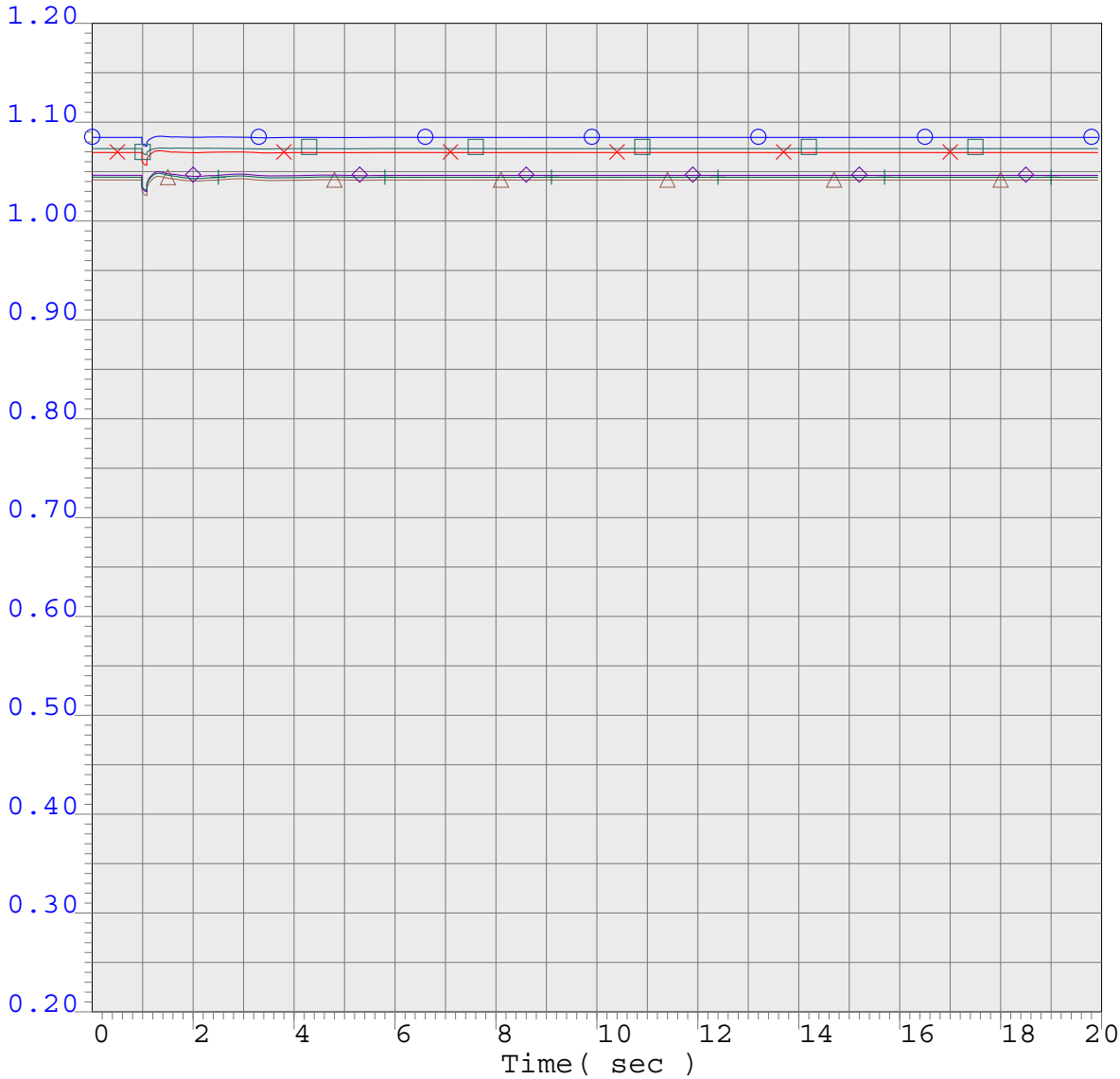

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 59.4000 | fbul | 38442 | AUGUST | 115.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbul | 38534 | GRAY115 | 115.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 38535 | GRAY69 | 69.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 38432 | OAKDLTID | 115.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 38400 | WALNT | 230.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 38410 | WESTL115 | 115.0 | 0 | 0.0 | 1 | 1 | 60.6000 |

Select TID System Parameters
Relative Rotor Angle (degrees)




| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| -100.0000 ang | 38564 | ALMONDCT | 13.8 | 0 | 0.0 | 1 | 1 | 100.0000 |
| -100.0000 ang | 38550 | DONPDRO1 | 13.8 | 0 | 0.0 | 1 | 1 | 100.0000 |
| -100.0000 ang | 38552 | DONPDRO2 | 13.8 | 0 | 0.0 | 1 | 1 | 100.0000 |
| -100.0000 ang | 38570 | WEC1-CT | 13.8 | 0 | 0.0 | 1 | 1 | 100.0000 |
| -100.0000 ang | 38574 | WEC2-CT | 13.8 | 0 | 0.0 | 1 | 1 | 100.0000 |
| -100.0000 ang | 38572 | WEC3-ST | 13.8 | 0 | 0.0 | 1 | 1 | 100.0000 |

# 500 kV Bulk System Parameters
Voltage (p.u.)




| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 0.2000 | vbus | 30055 | GATES | 500.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 30050 | LOSBANOS | 500.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 30060 | MIDWAY | 500.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 30040 | TESLA | 500.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 30035 | TRACY | 500.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 30030 | VACA-DIX | 500.0 | 0 | 0.0 | 1 | 1 | 1.2000 |

2012 Summer Peak Base Case



2012_sum_pk_pst_008_GRAYSON-GILSTRAP_69.chf

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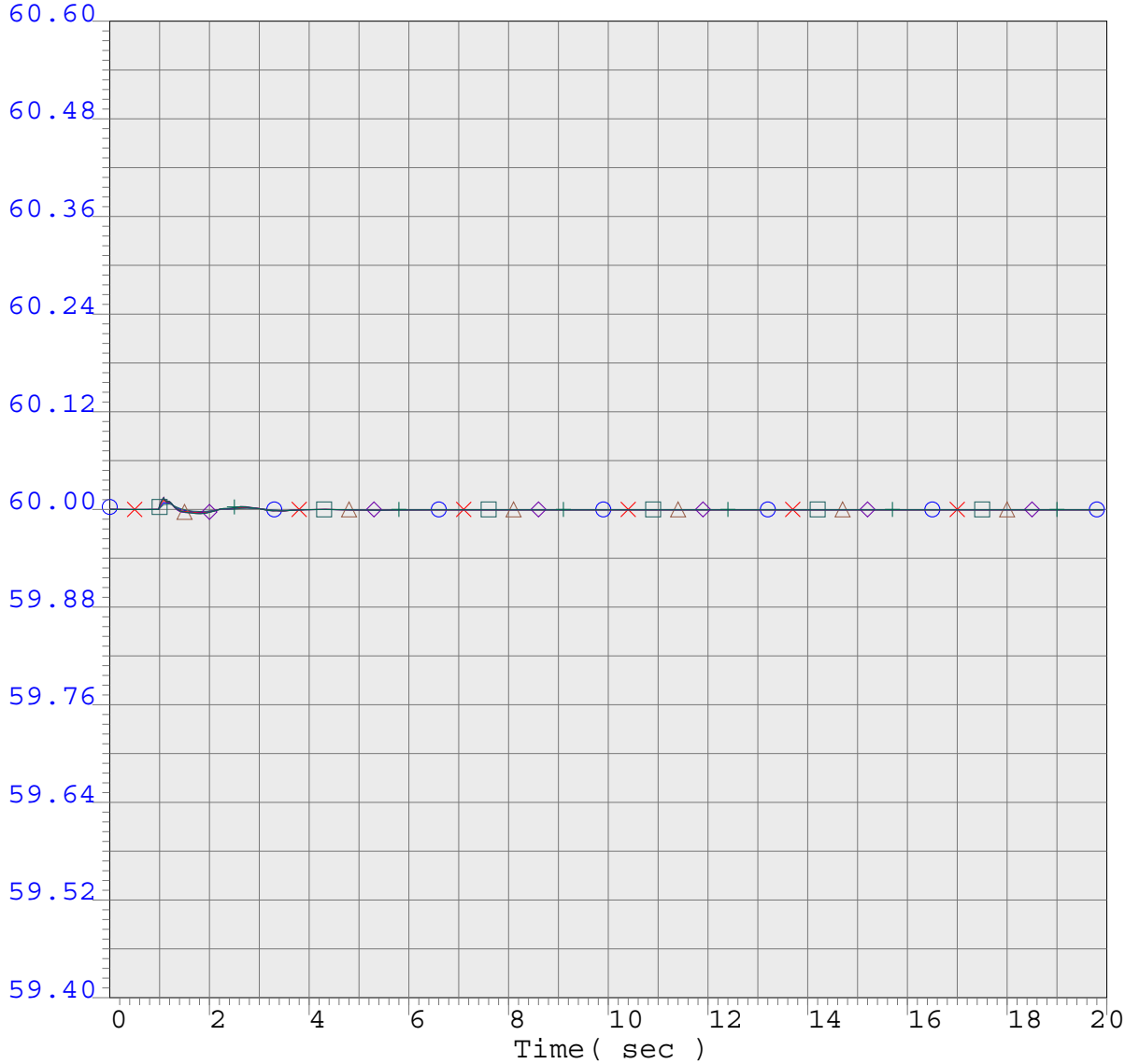
Mon Oct 19 00:52:01 2009

# 500 kV Bulk System Parameters
Frequency (Hz)




| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 59.4000 | fbus | 30055 | GATES | 500.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 30050 | LOSBANOS | 500.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 30060 | MIDWAY | 500.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 30040 | TESLA | 500.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 30035 | TRACY | 500.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 30030 | VACA-DIX | 500.0 | 0 | 0.0 | 1 | 1 | 60.6000 |

2012 Summer Peak Base Case



2012_sum_pk_pst_008_GRAYSON-GILSTRAP_69.chf

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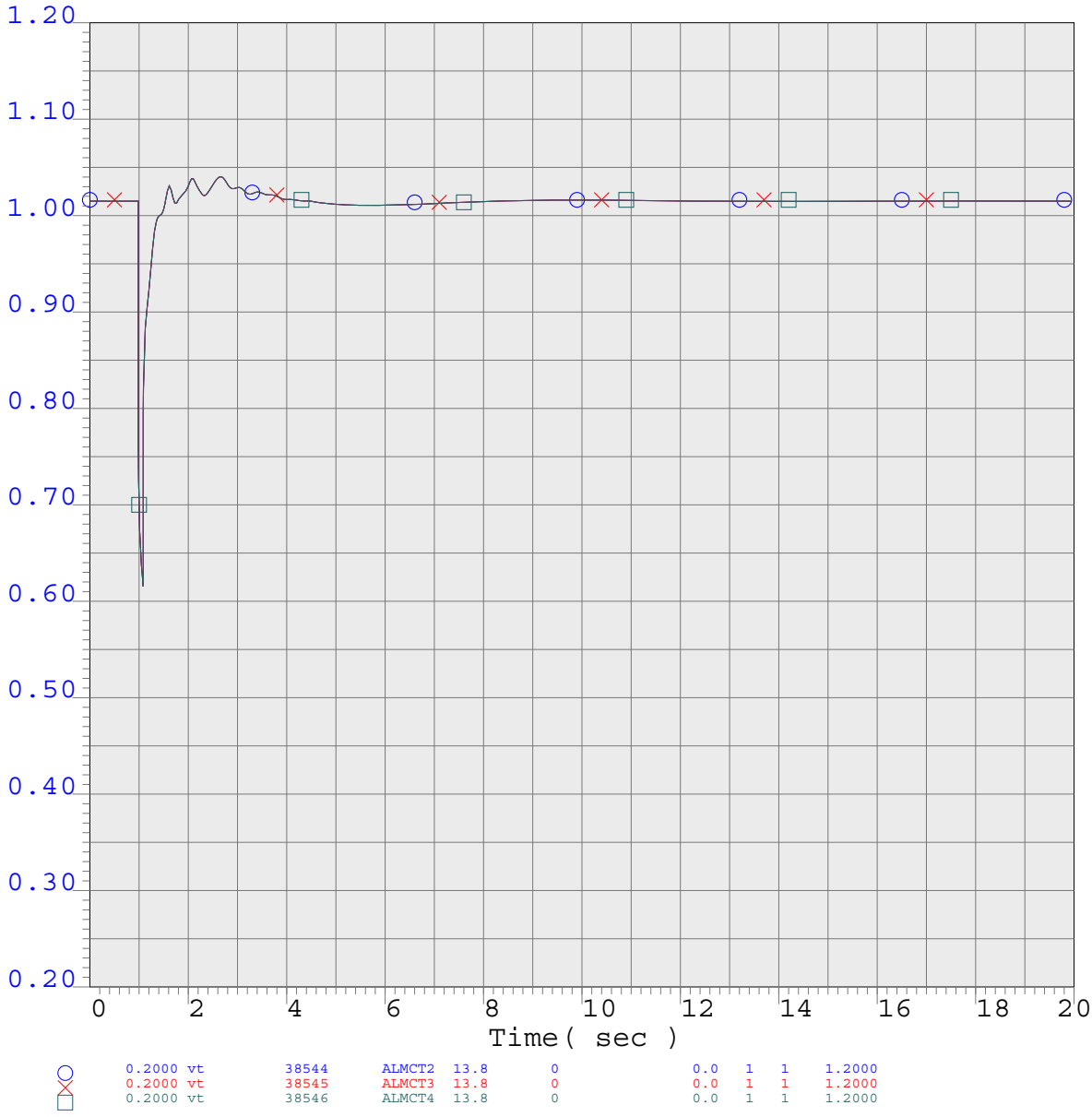
# Transient Stability Plots

# Grayson-Westport 69 kV Line Out

# Almond 2 Power Plant
# Terminal Voltage (p.u.)




2012 Summer Peak Base Case



2012_sum_pk_pst_009_GRAYSON-WESTPORT_69.chf

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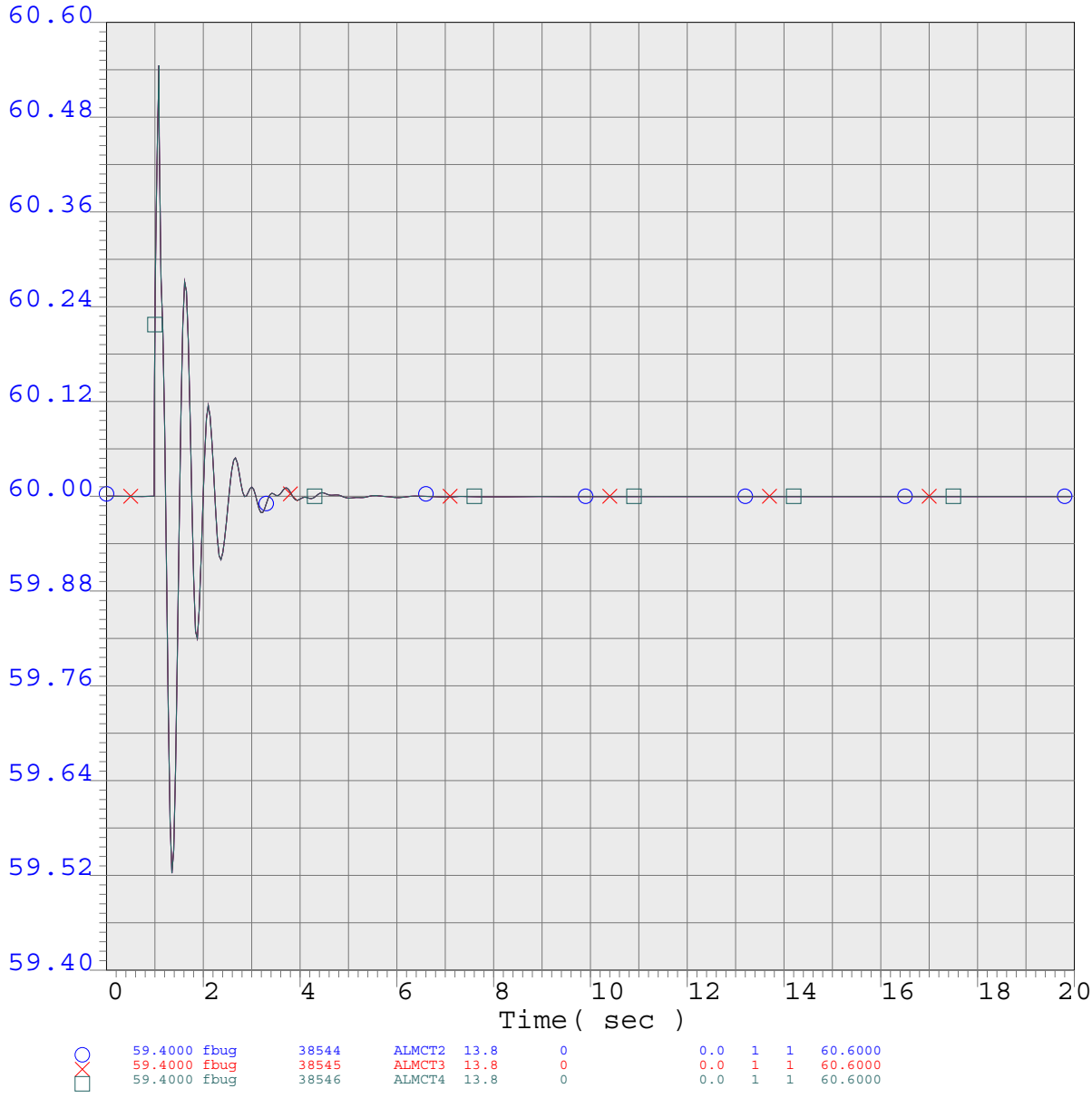
Mon Oct 19 00:52:06 2009

Almond 2 Power Plant
Frequency (Hz)




2012 Summer Peak Base Case



2012_sum_pk_pst_009_GRAYSON-WESTPORT_69.chf

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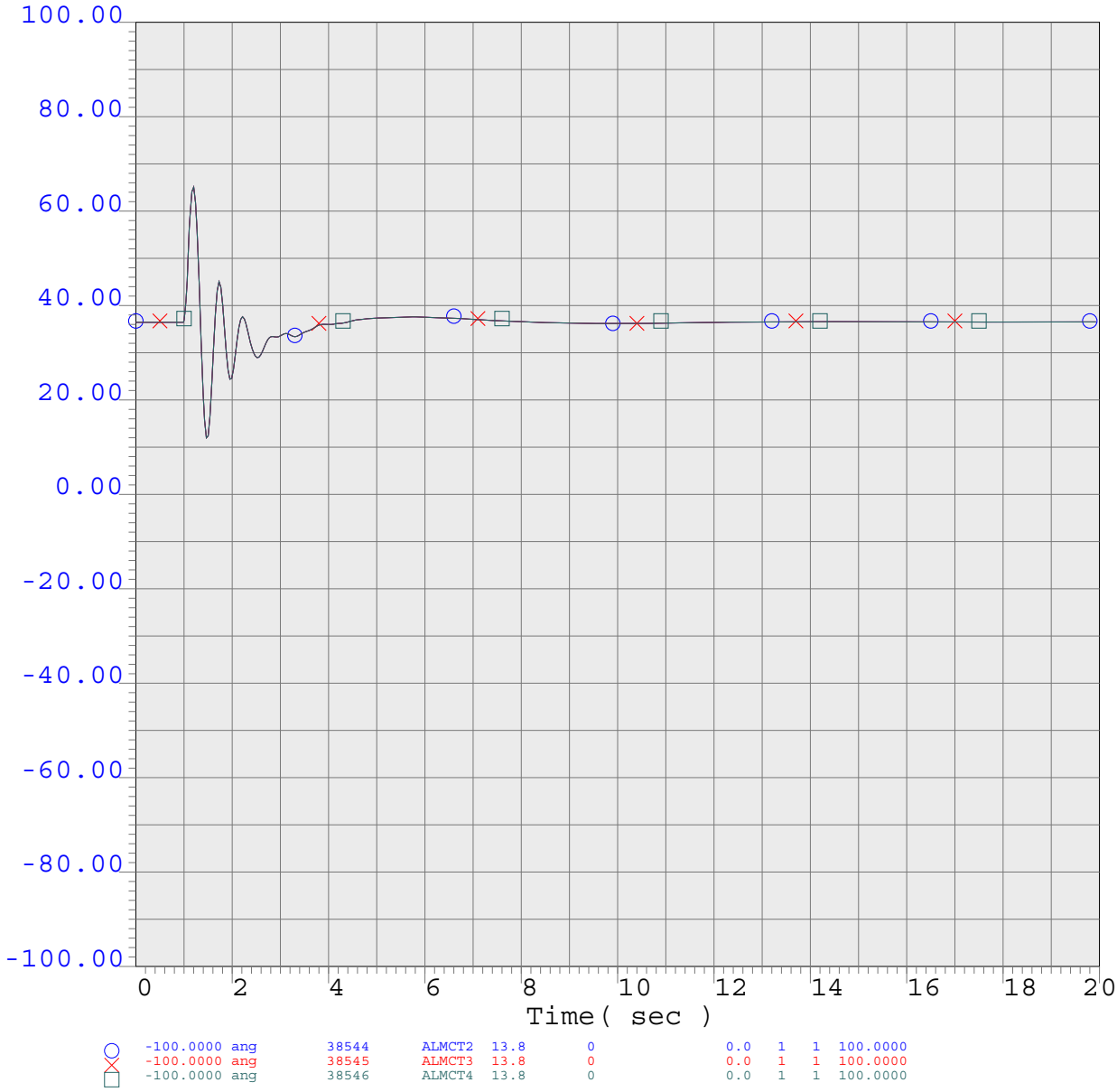
Mon Oct 19 00:52:06 2009

# Almond 2 Power Plant
## Relative Rotor Angle (degrees)




2012 Summer Peak Base Case



2012_sum_pk_pst_009_GRAYSON-WESTPORT_69.chf

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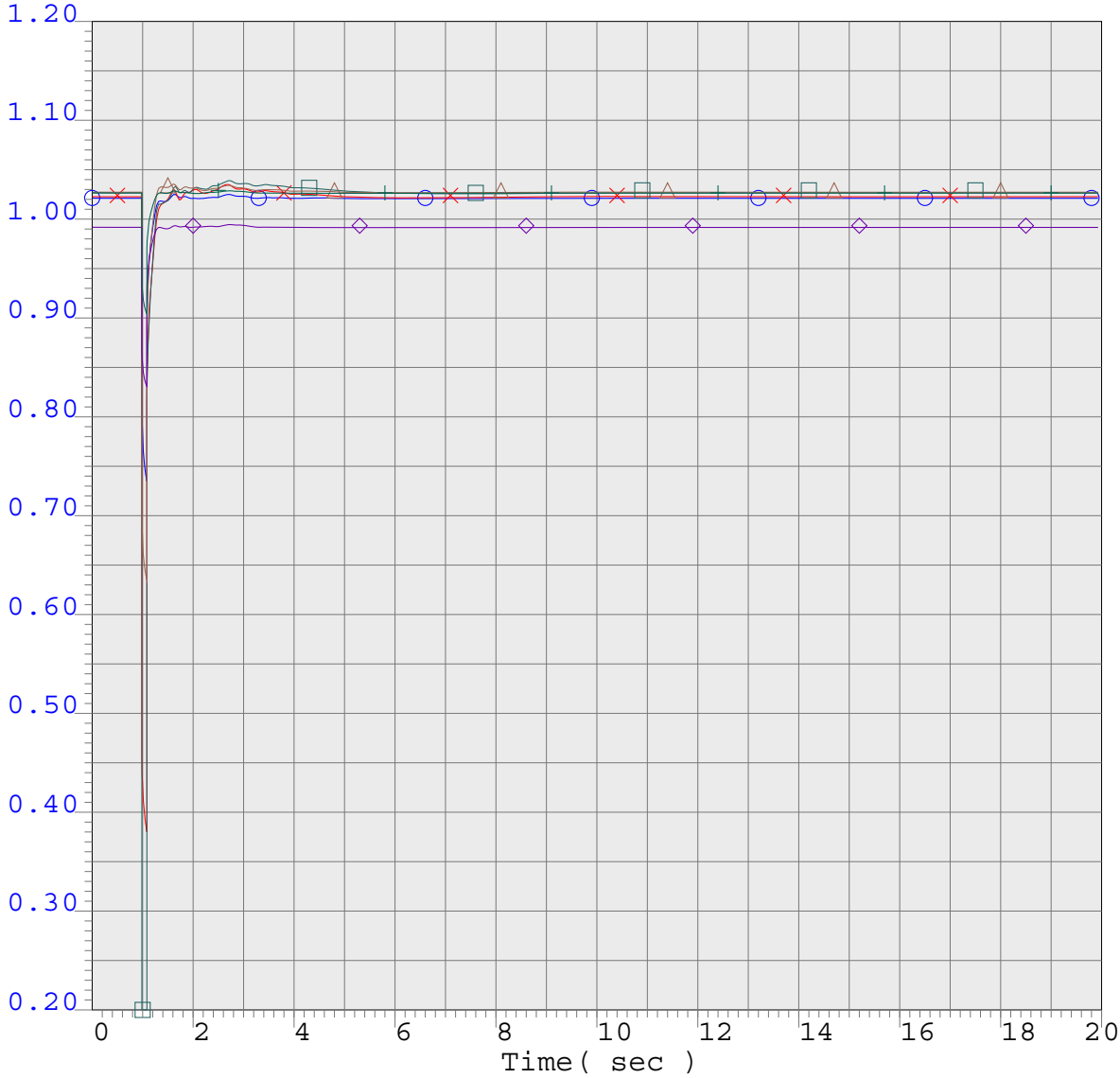
Mon Oct 19 00:52:06 2009

Select TID System Parameters
Voltage (p.u.)




| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 0.2000 | vbul | 38442 | AUGUST | 115.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbul | 38534 | GRAY115 | 115.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 38535 | GRAY69 | 69.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 38432 | OAKDLTID | 115.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 38400 | WALNT | 230.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 38410 | WESTL115 | 115.0 | 0 | 0.0 | 1 | 1 | 1.2000 |

2012 Summer Peak Base Case



2012_sum_pk_pst_009_GRAYSON-WESTPORT_69.chf

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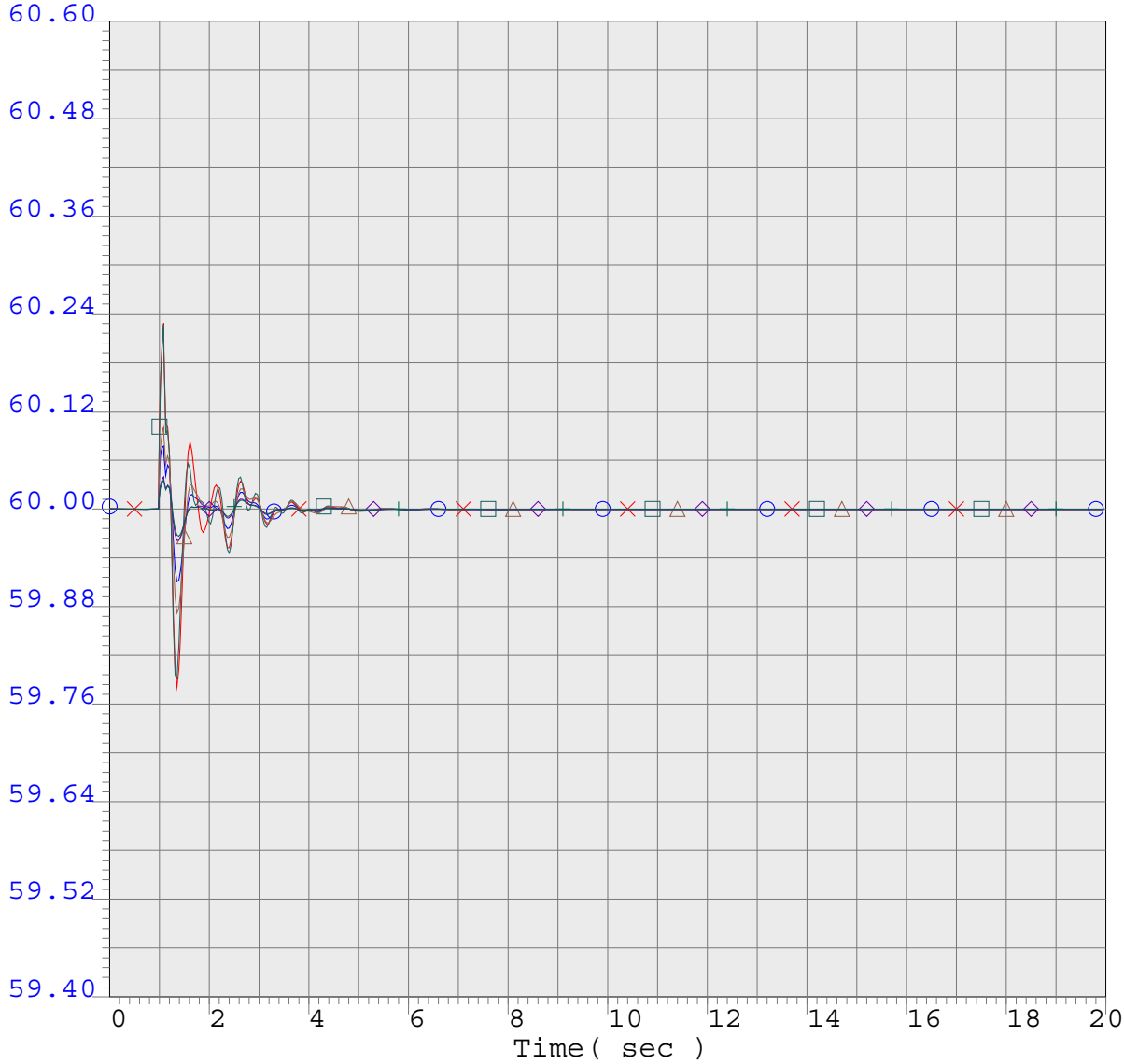
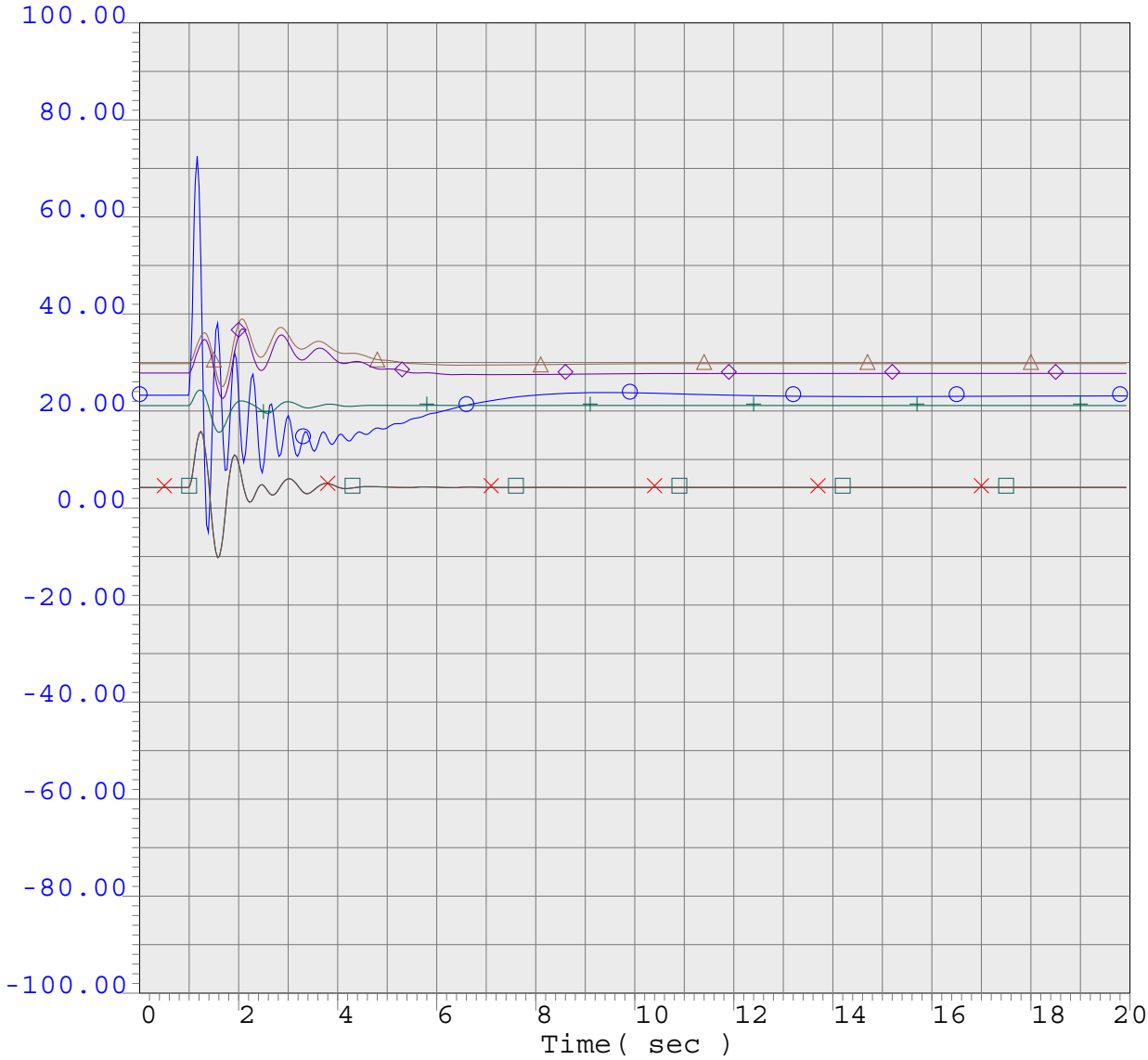
Mon Oct 19 00:52:06 2009

Select TID System Parameters
Frequency (Hz)



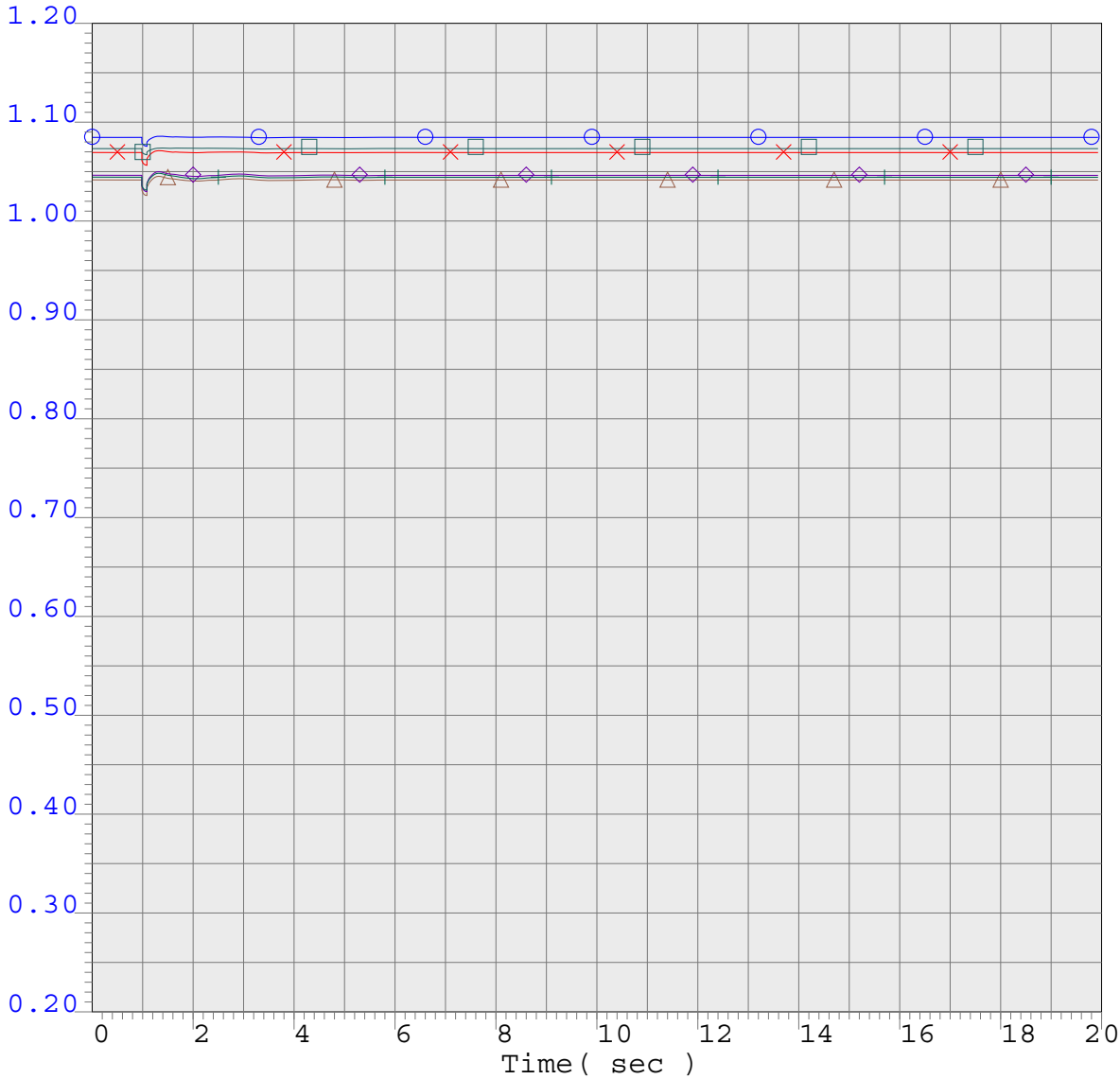

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 59.4000 | fbul | 38442 | AUGUST | 115.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbul | 38534 | GRAY115 | 115.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 38535 | GRAY69 | 69.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 38432 | OAKDLTID | 115.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 38400 | WALNT | 230.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 38410 | WESTL115 | 115.0 | 0 | 0.0 | 1 | 1 | 60.6000 |

Select TID System Parameters
Relative Rotor Angle (degrees)




| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| -100.0000 ang | 38564 | ALMONDCT | 13.8 | 0 | 0.0 | 1 | 1 | 100.0000 |
| -100.0000 ang | 38550 | DONPDRO1 | 13.8 | 0 | 0.0 | 1 | 1 | 100.0000 |
| -100.0000 ang | 38552 | DONPDRO2 | 13.8 | 0 | 0.0 | 1 | 1 | 100.0000 |
| -100.0000 ang | 38570 | WEC1-CT | 13.8 | 0 | 0.0 | 1 | 1 | 100.0000 |
| -100.0000 ang | 38574 | WEC2-CT | 13.8 | 0 | 0.0 | 1 | 1 | 100.0000 |
| -100.0000 ang | 38572 | WEC3-ST | 13.8 | 0 | 0.0 | 1 | 1 | 100.0000 |

# 500 kV Bulk System Parameters
Voltage (p.u.)




| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 0.2000 | vbus | 30055 | GATES | 500.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 30050 | LOSBANOS | 500.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 30060 | MIDWAY | 500.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 30040 | TESLA | 500.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 30035 | TRACY | 500.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 30030 | VACA-DIX | 500.0 | 0 | 0.0 | 1 | 1 | 1.2000 |

2012 Summer Peak Base Case



2012_sum_pk_pst_009_GRAYSON-WESTPORT_69.chf

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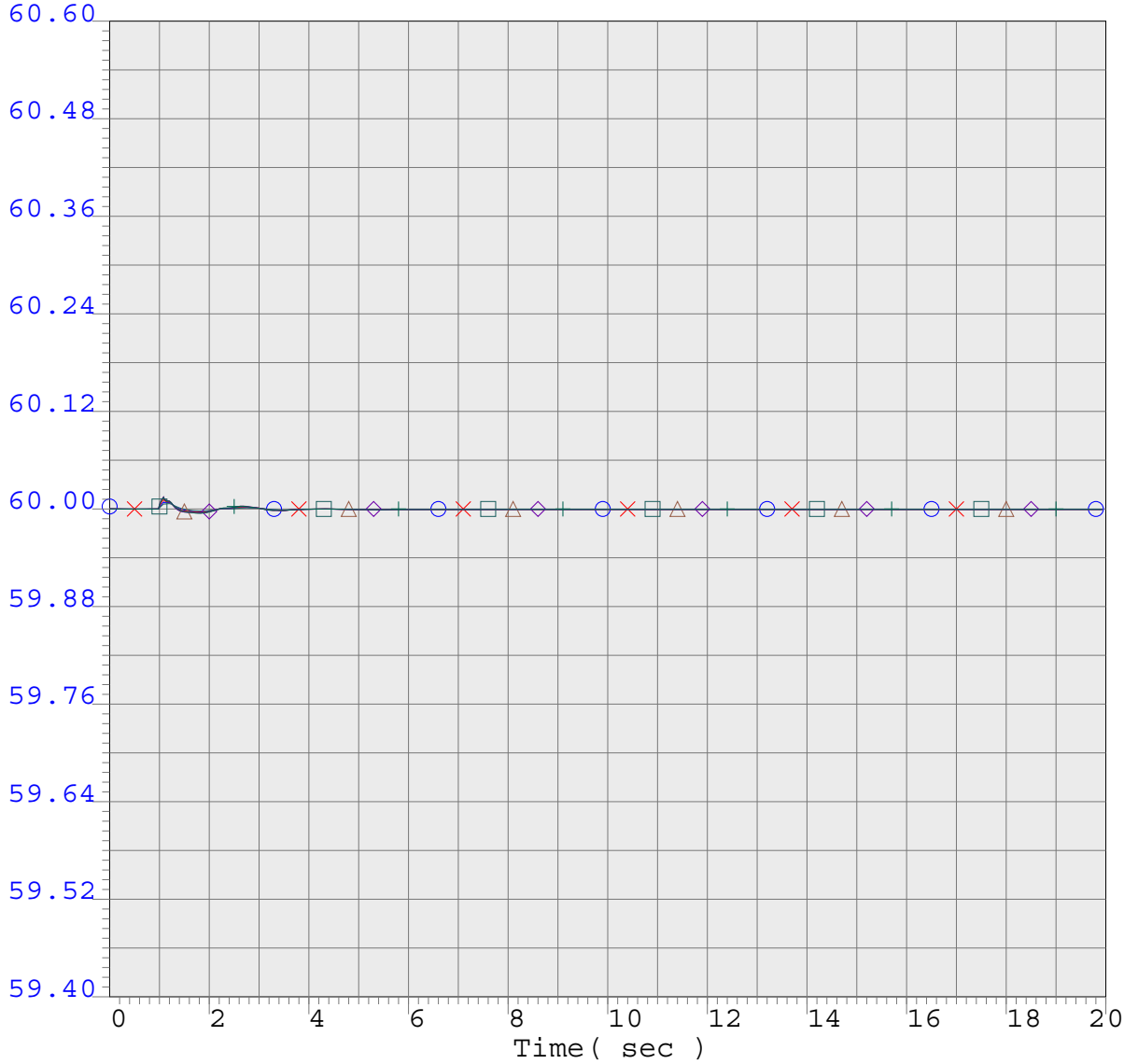
Mon Oct 19 00:52:06 2009

# 500 kV Bulk System Parameters
Frequency (Hz)




| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 59.4000 | fbus | 30055 | GATES | 500.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 30050 | LOSBANOS | 500.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 30060 | MIDWAY | 500.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 30040 | TESLA | 500.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 30035 | TRACY | 500.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 30030 | VACA-DIX | 500.0 | 0 | 0.0 | 1 | 1 | 60.6000 |

2012 Summer Peak Base Case



2012_sum_pk_pst_009_GRAYSON-WESTPORT_69.chf

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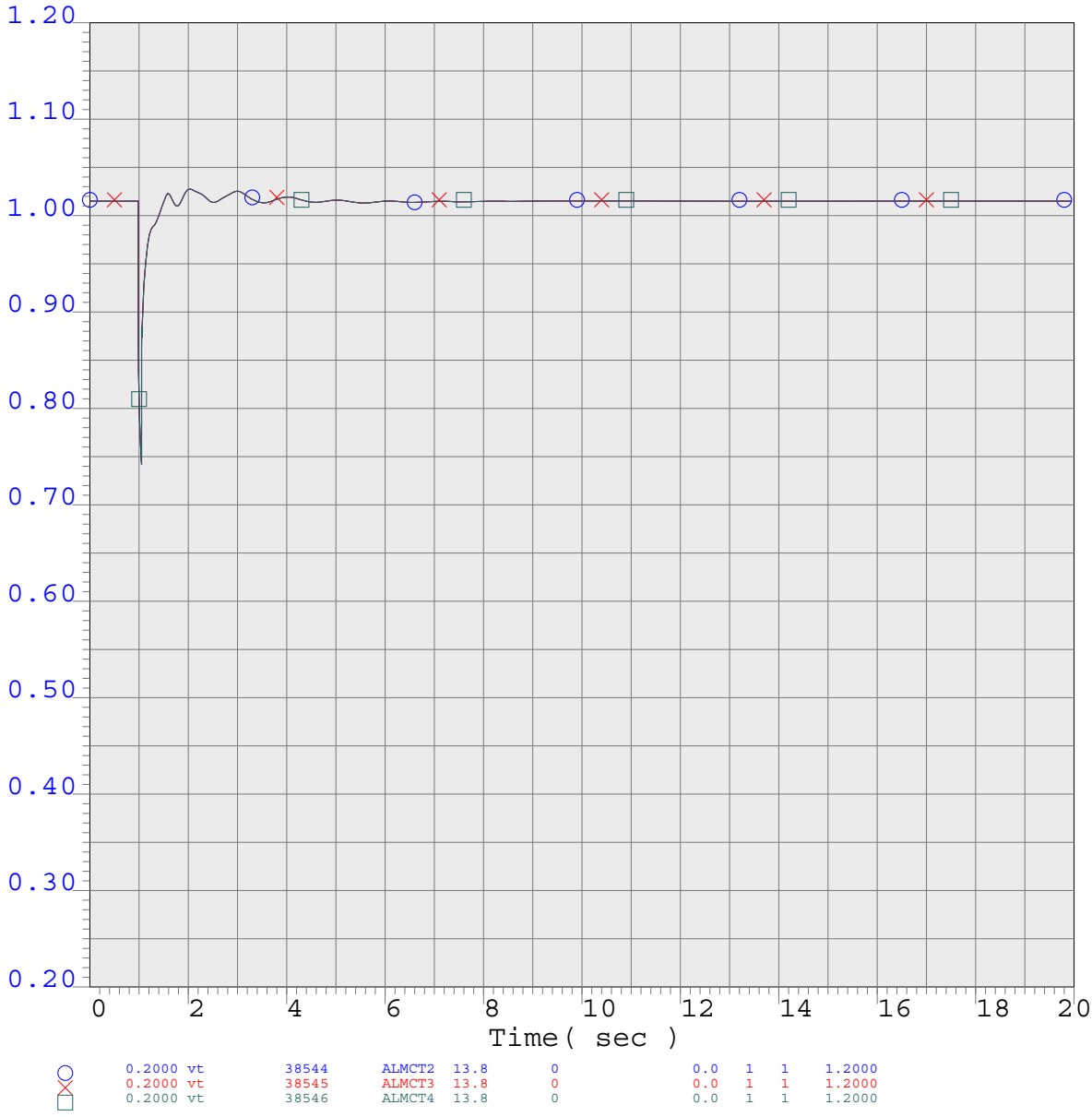
Mon Oct 19 00:52:06 2009

# Transient Stability Plots

# Walnut-Westley & Walnut-Parker 230 kV Lines Out

# Almond 2 Power Plant
# Terminal Voltage (p.u.)




2012 Summer Peak Base Case



2012_sum_pk_pst_101_WALNUT-PARKER-WESTLEY_230_DLO.chf

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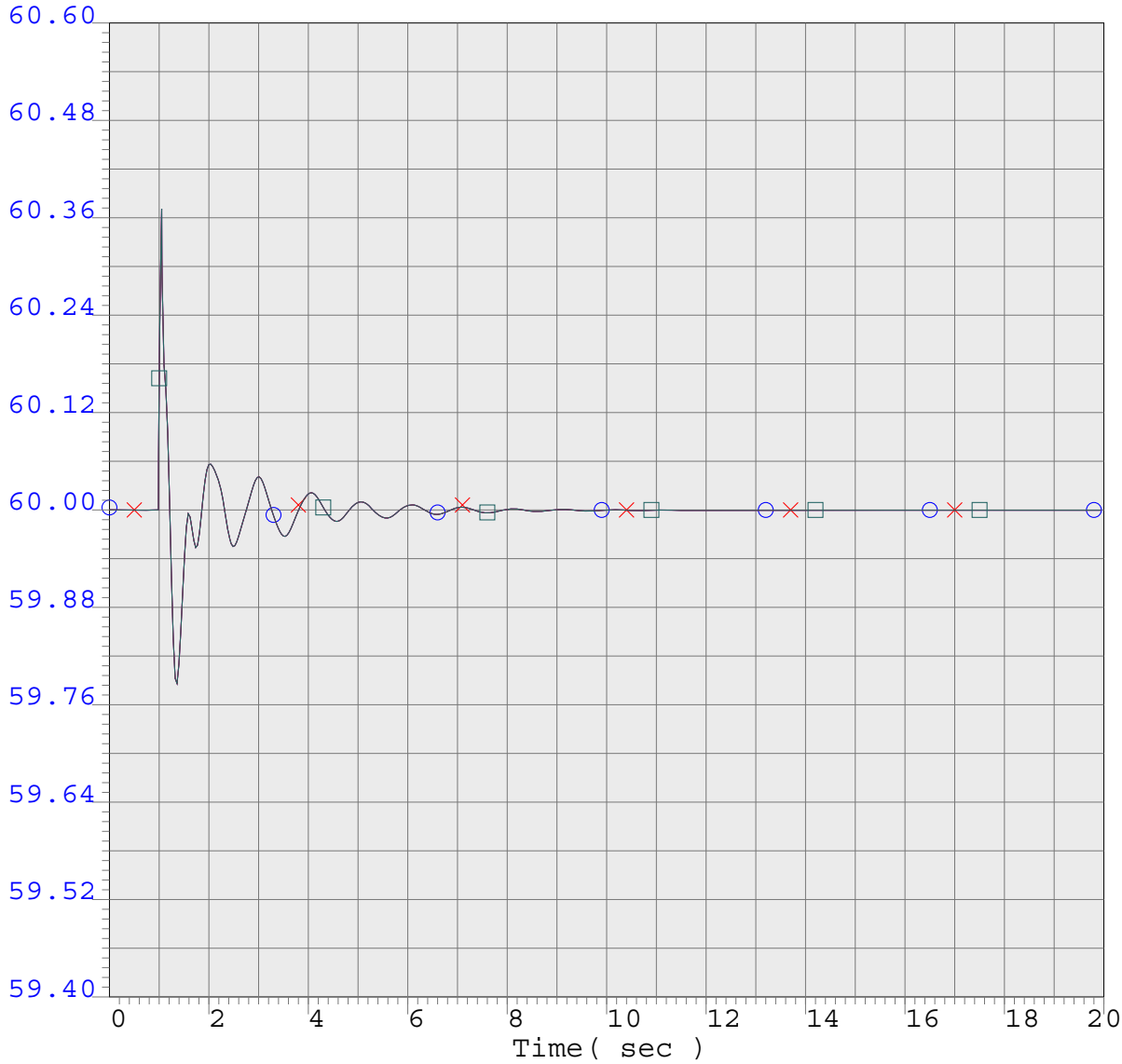
Mon Oct 19 00:52:11 2009

Almond 2 Power Plant
Frequency (Hz)




| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| ○ | 59.4000 fbug | 38544 | ALMCT2 | 13.8 | 0 | 0.0 | 1 | 1 | 60.6000 |
| × | 59.4000 fbug | 38545 | ALMCT3 | 13.8 | 0 | 0.0 | 1 | 1 | 60.6000 |
| □ | 59.4000 fbug | 38546 | ALMCT4 | 13.8 | 0 | 0.0 | 1 | 1 | 60.6000 |

2012 Summer Peak Base Case



2012_sum_pk_pst_101_WALNUT-PARKER-WESTLEY_230_DLO.chf

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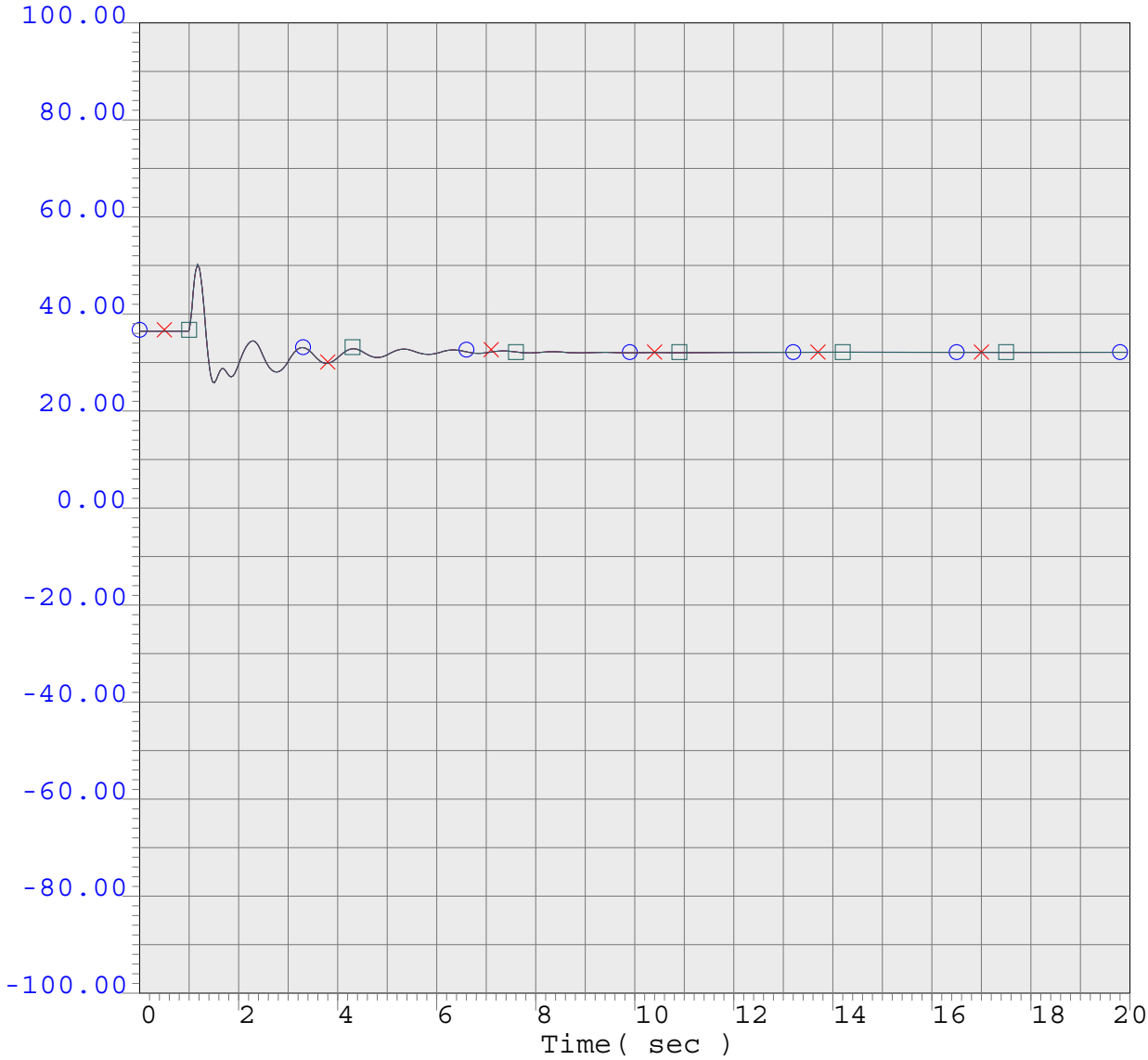
Mon Oct 19 00:52:11 2009

Almond 2 Power Plant
Relative Rotor Angle (degrees)




| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| -100.0000 ang | 38544 | ALMCT2 | 13.8 | 0 | 0.0 | 1 | 1 | 100.0000 |
| -100.0000 ang | 38545 | ALMCT3 | 13.8 | 0 | 0.0 | 1 | 1 | 100.0000 |
| -100.0000 ang | 38546 | ALMCT4 | 13.8 | 0 | 0.0 | 1 | 1 | 100.0000 |

2012 Summer Peak Base Case



2012_sum_pk_pst_101_WALNUT-PARKER-WESTLEY_230_DLO.chf

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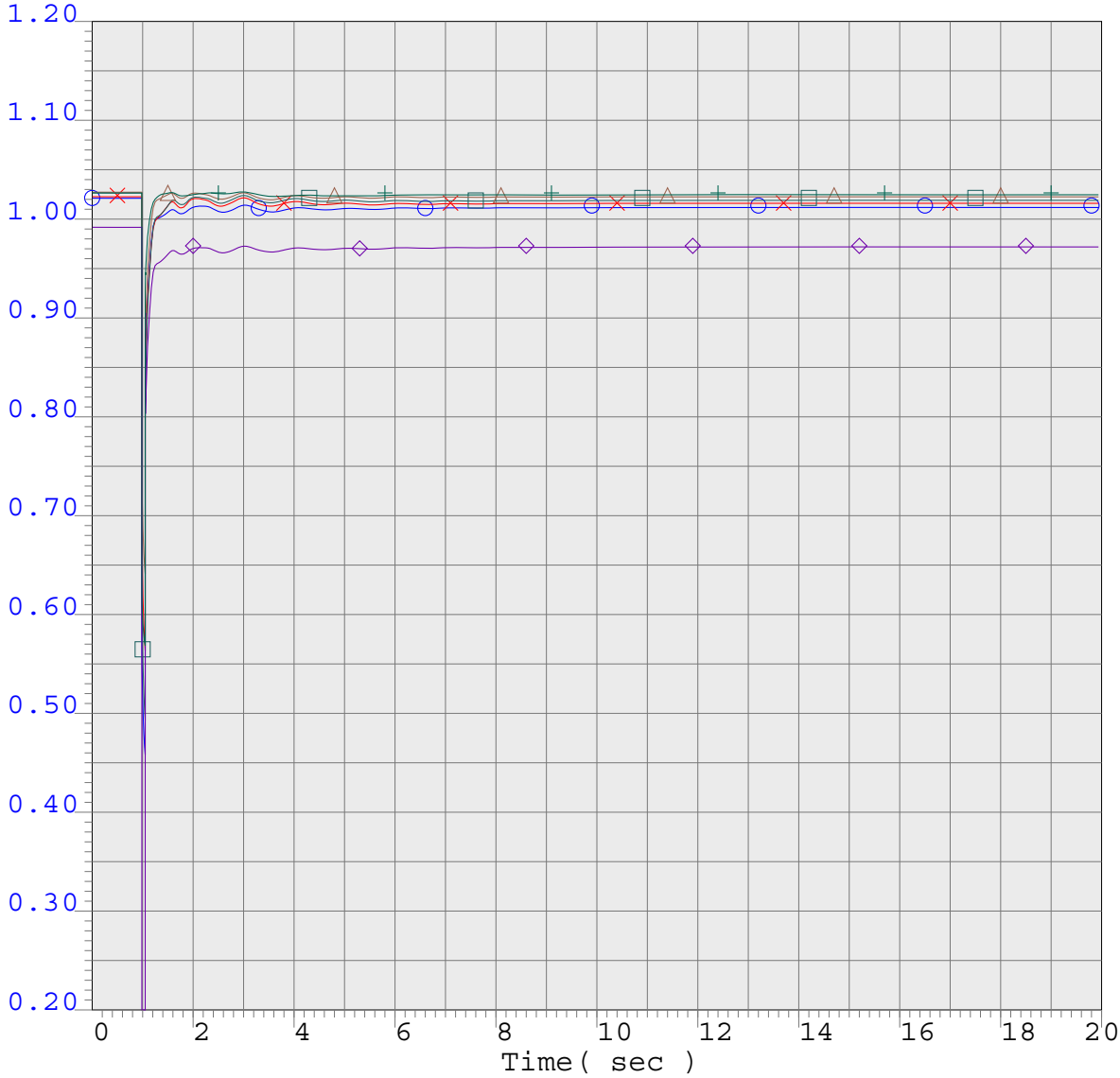
Mon Oct 19 00:52:11 2009

Select TID System Parameters
Voltage (p.u.)




| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 0.2000 | vbul | 38442 | AUGUST | 115.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbul | 38534 | GRAY115 | 115.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 38535 | GRAY69 | 69.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 38432 | OAKDLTID | 115.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 38400 | WALNT | 230.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 38410 | WESTL115 | 115.0 | 0 | 0.0 | 1 | 1 | 1.2000 |

2012 Summer Peak Base Case



2012_sum_pk_pst_101_WALNUT-PARKER-WESTLEY_230_DLO.chf

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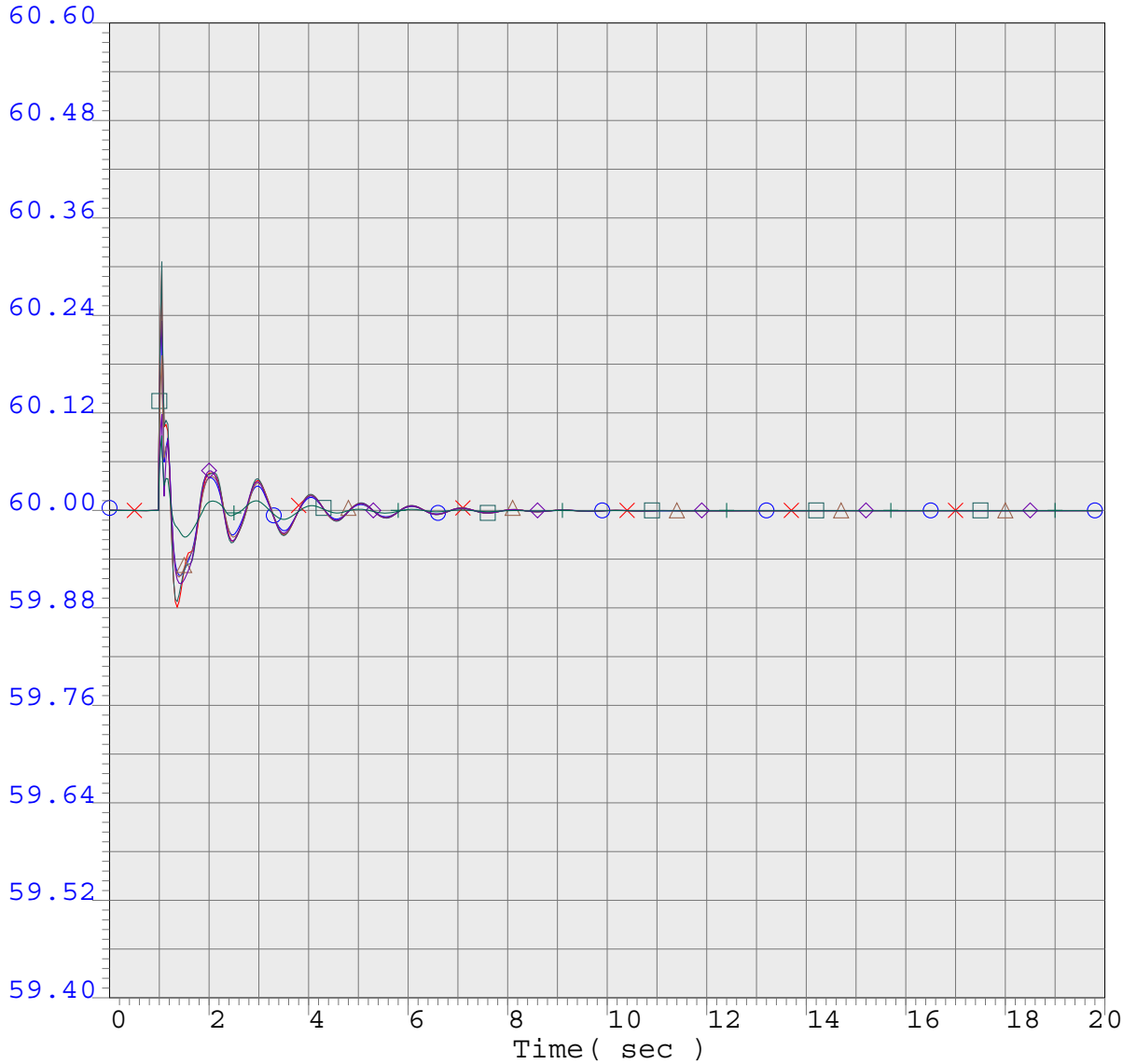
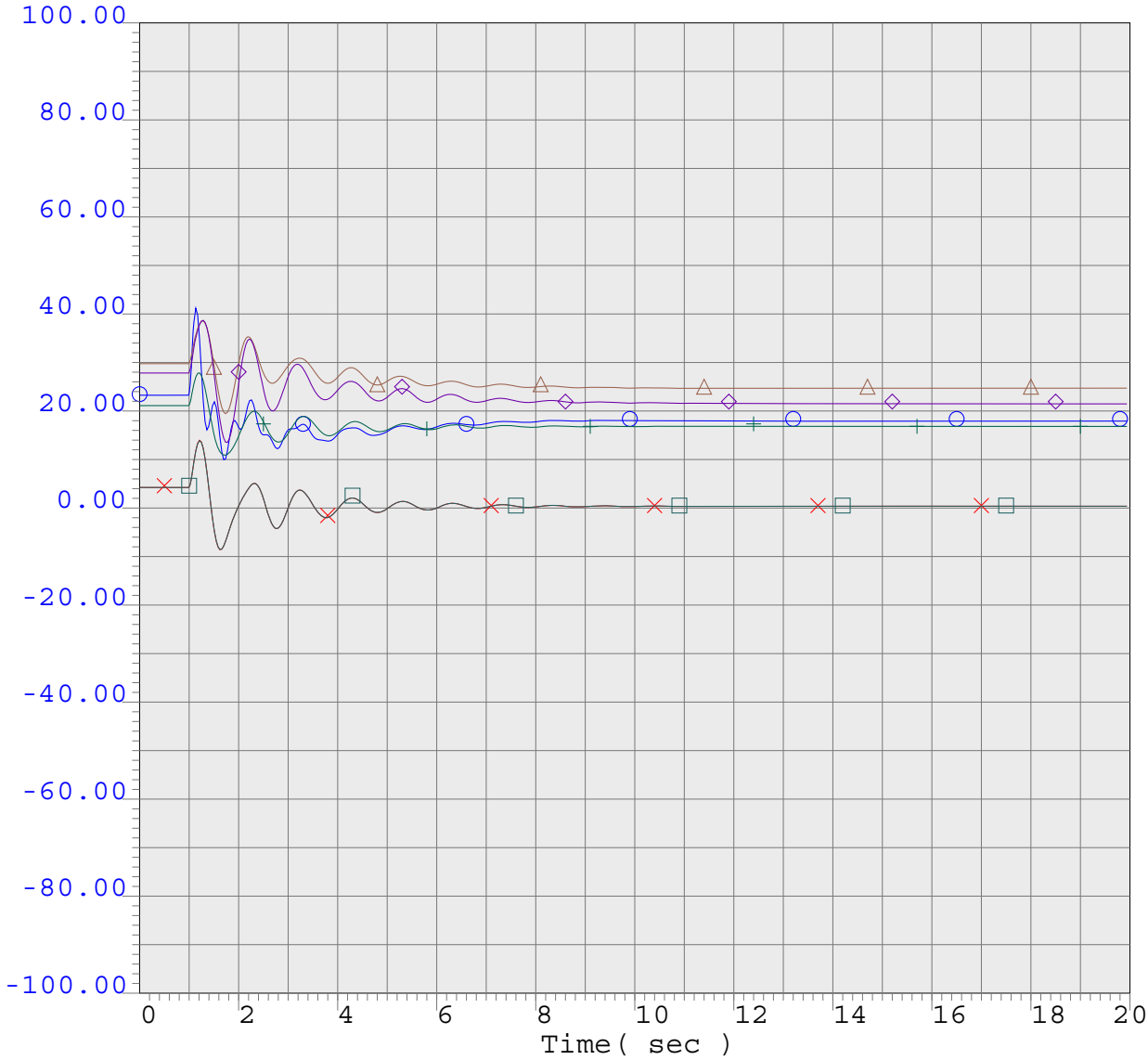
Mon Oct 19 00:52:11 2009

Select TID System Parameters
Frequency (Hz)



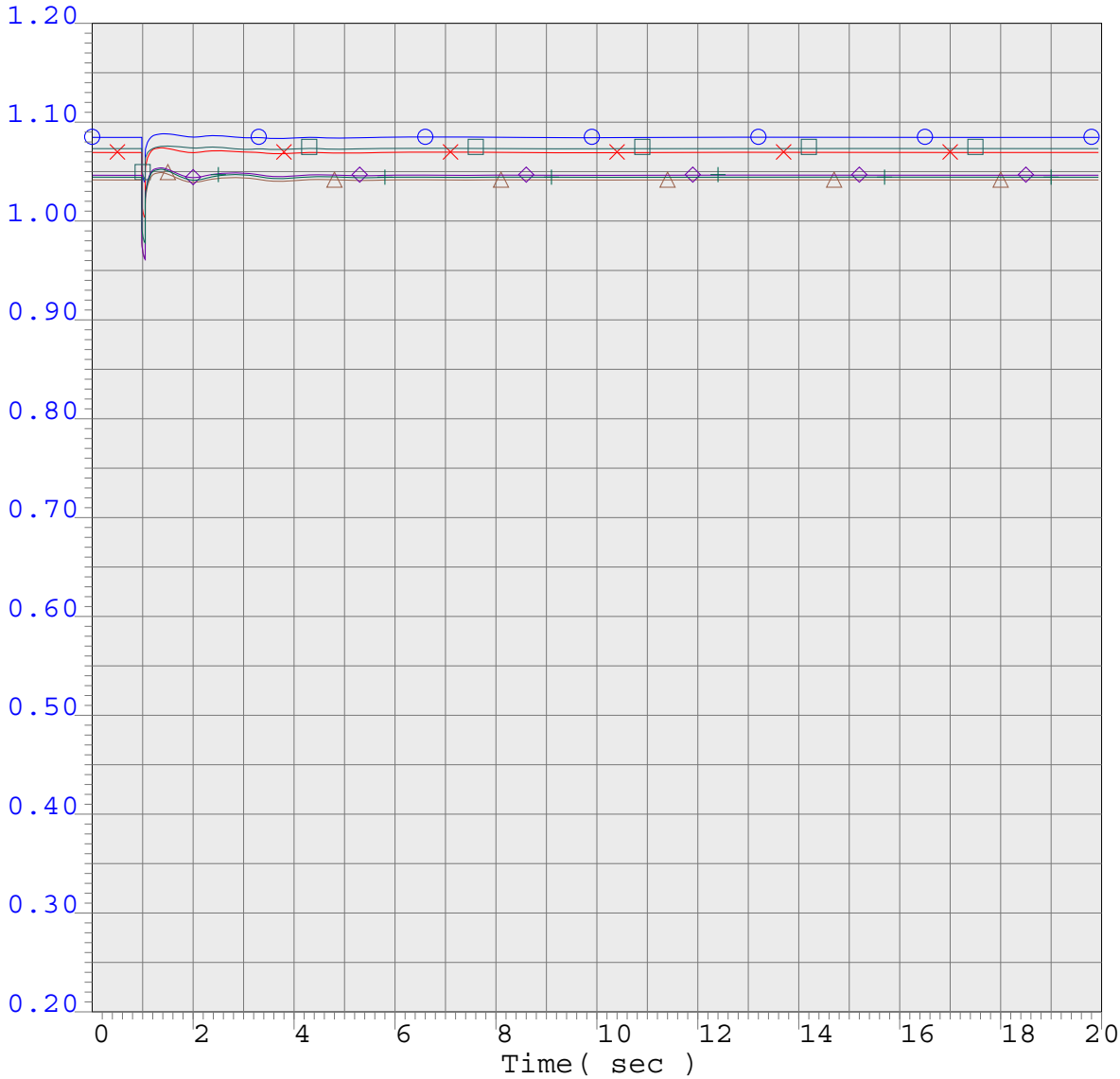

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 59.4000 | fbul | 38442 | AUGUST | 115.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbul | 38534 | GRAY115 | 115.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 38535 | GRAY69 | 69.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 38432 | OAKDLTID | 115.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 38400 | WALNT | 230.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 38410 | WESTL115 | 115.0 | 0 | 0.0 | 1 | 1 | 60.6000 |

Select TID System Parameters
Relative Rotor Angle (degrees)




| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| -100.0000 ang | 38564 | ALMONDCT | 13.8 | 0 | 0.0 | 1 | 1 | 100.0000 |
| -100.0000 ang | 38550 | DONPDRO1 | 13.8 | 0 | 0.0 | 1 | 1 | 100.0000 |
| -100.0000 ang | 38552 | DONPDRO2 | 13.8 | 0 | 0.0 | 1 | 1 | 100.0000 |
| -100.0000 ang | 38570 | WEC1-CT | 13.8 | 0 | 0.0 | 1 | 1 | 100.0000 |
| -100.0000 ang | 38574 | WEC2-CT | 13.8 | 0 | 0.0 | 1 | 1 | 100.0000 |
| -100.0000 ang | 38572 | WEC3-ST | 13.8 | 0 | 0.0 | 1 | 1 | 100.0000 |

# 500 kV Bulk System Parameters
Voltage (p.u.)




| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 0.2000 | vbus | 30055 | GATES | 500.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 30050 | LOSBANOS | 500.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 30060 | MIDWAY | 500.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 30040 | TESLA | 500.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 30035 | TRACY | 500.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 30030 | VACA-DIX | 500.0 | 0 | 0.0 | 1 | 1 | 1.2000 |

2012 Summer Peak Base Case



2012_sum_pk_pst_101_WALNUT-PARKER-WESTLEY_230_DLO.chf

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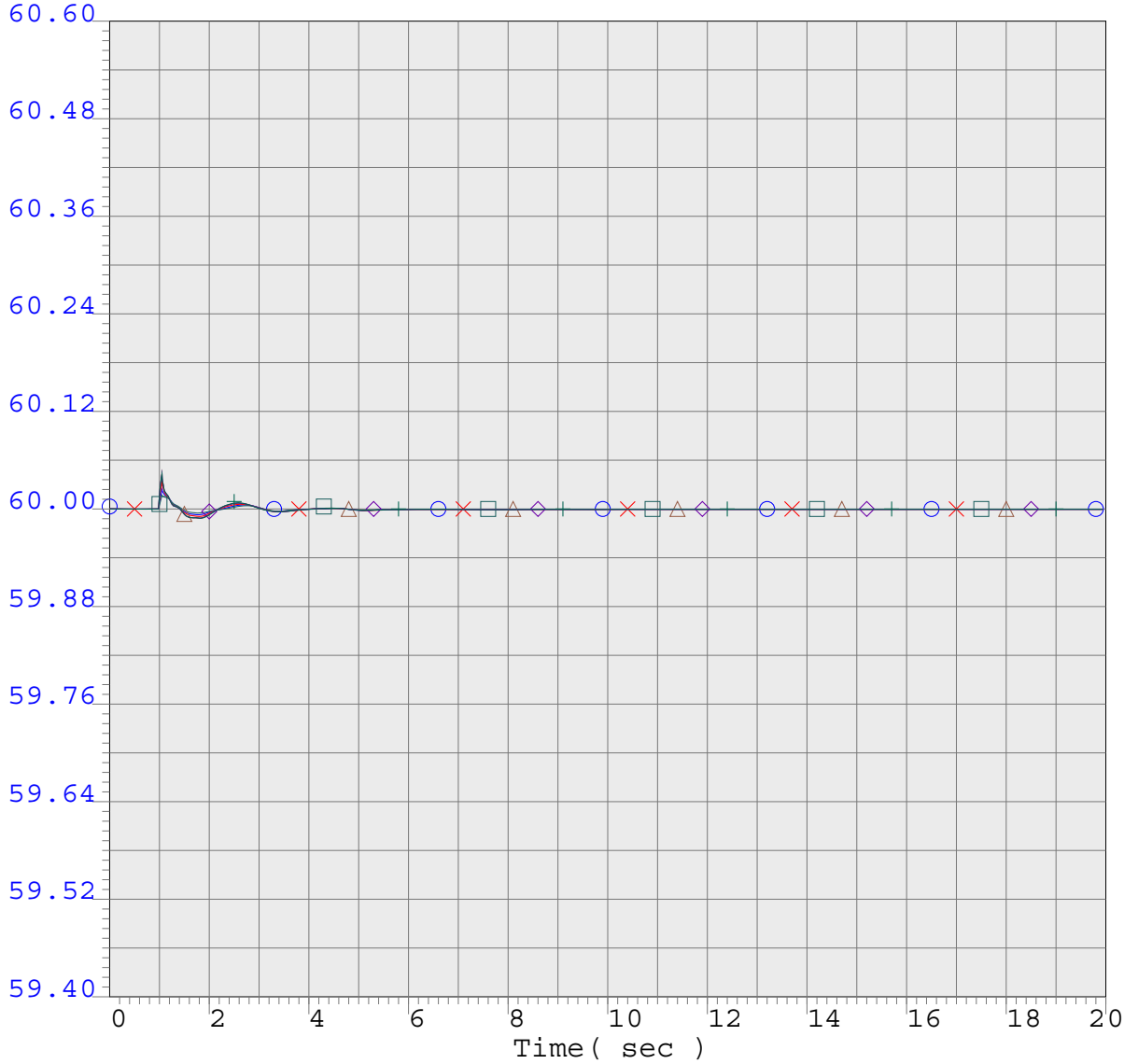
# 500 kV Bulk System Parameters
Frequency (Hz)




| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 59.4000 | fbus | 30055 | GATES | 500.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 30050 | LOSBANOS | 500.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 30060 | MIDWAY | 500.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 30040 | TESLA | 500.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 30035 | TRACY | 500.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 30030 | VACA-DIX | 500.0 | 0 | 0.0 | 1 | 1 | 60.6000 |

2012 Summer Peak Base Case



2012_sum_pk_pst_101_WALNUT-PARKER-WESTLEY_230_DLO.chf

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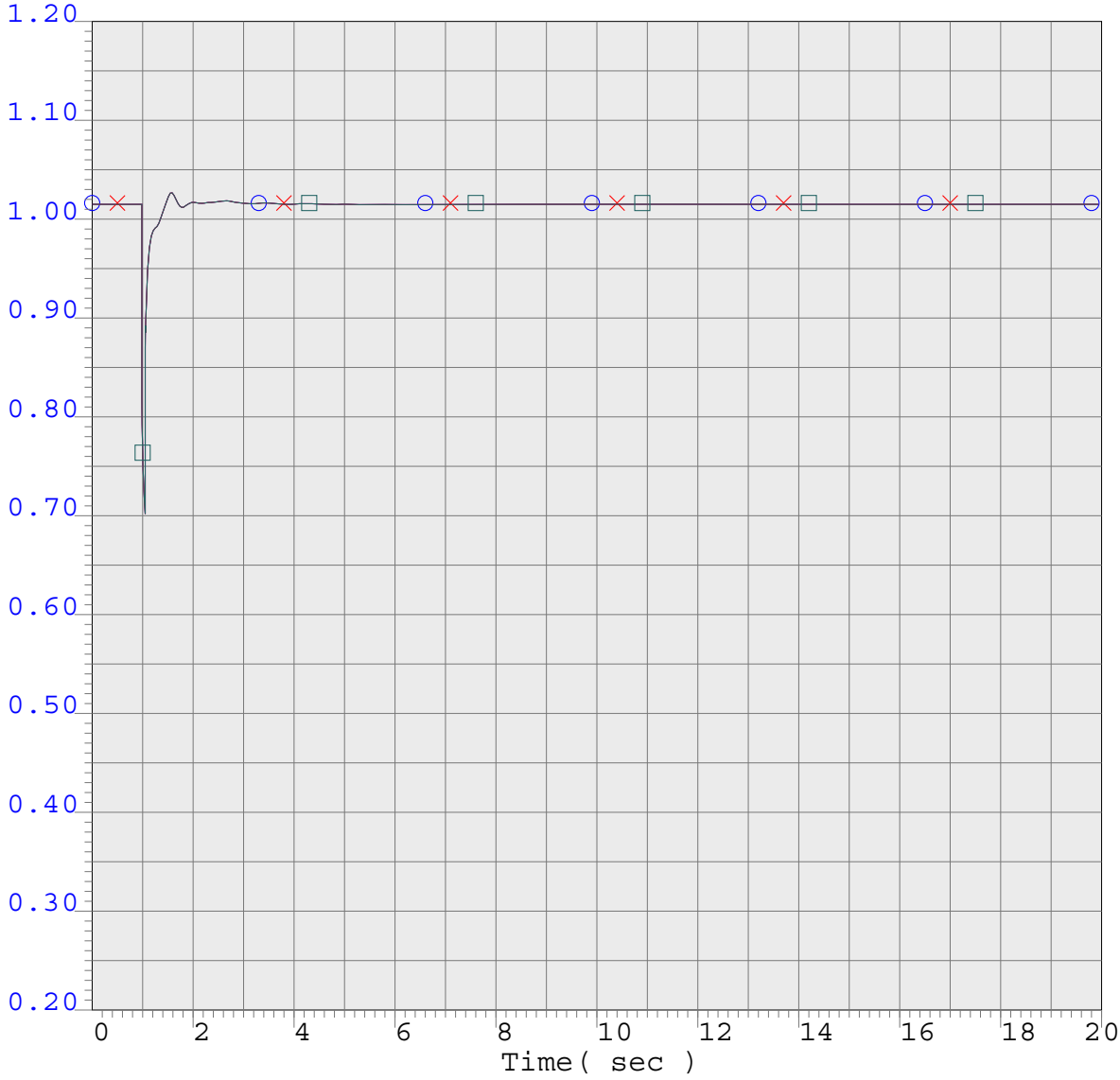
# Transient Stability Plots

# Oakdale-Tuolumne #1 & #2 115 kV Lines Out

# Almond 2 Power Plant
# Terminal Voltage (p.u.)




| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| ○ | 0.2000 vt | 38544 | ALMCT2 | 13.8 | 0 | 0.0 | 1 | 1 | 1.2000 |
| × | 0.2000 vt | 38545 | ALMCT3 | 13.8 | 0 | 0.0 | 1 | 1 | 1.2000 |
| □ | 0.2000 vt | 38546 | ALMCT4 | 13.8 | 0 | 0.0 | 1 | 1 | 1.2000 |

2012 Summer Peak Base Case



2012_sum_pk_pst_102_OAKDALE-TUOLUMNE_115_DLO.chf

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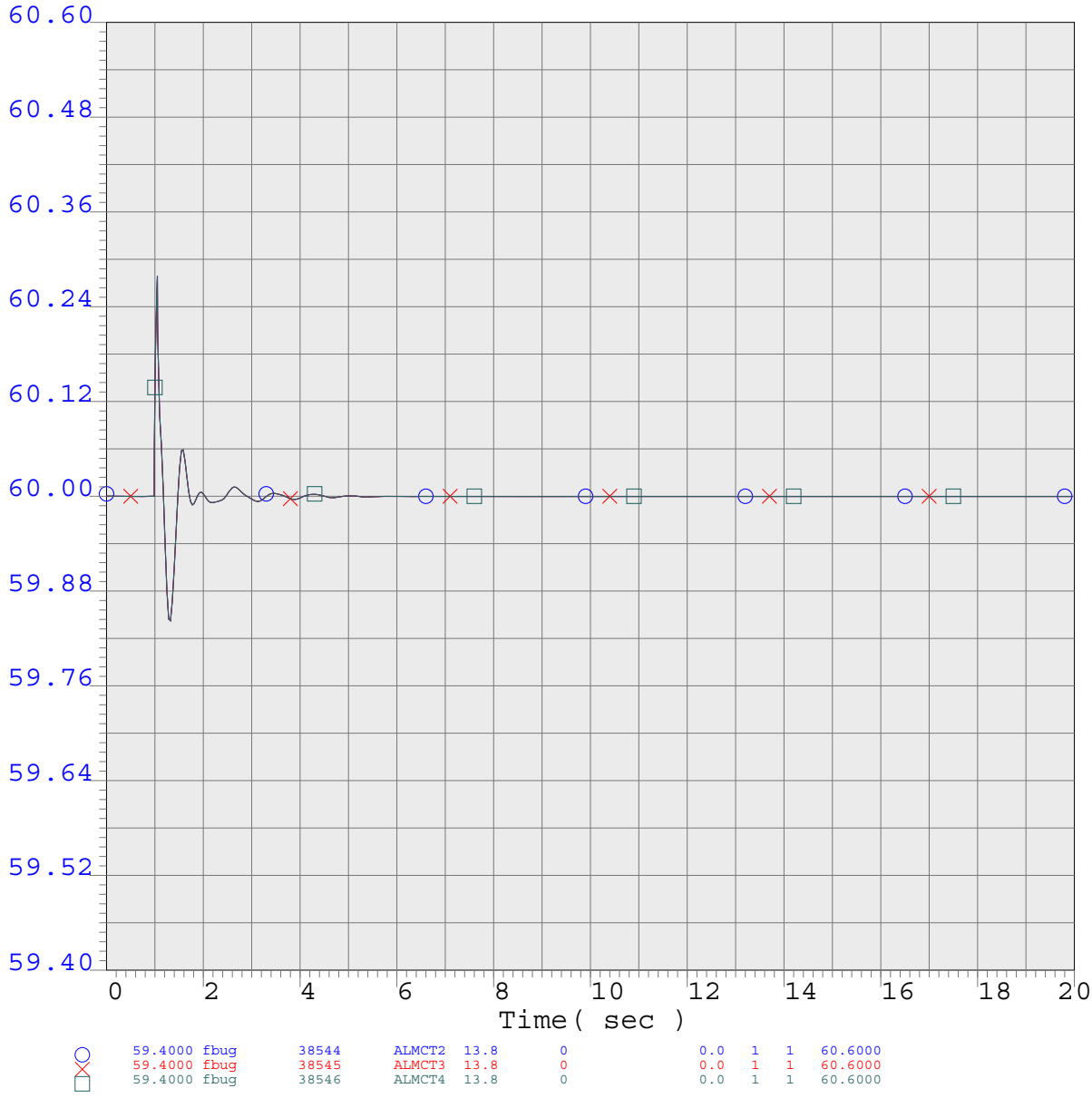
Almond 2 Power Plant
Frequency (Hz)




2012 Summer Peak Base Case



2012_sum_pk_pst_102_OAKDALE-TUOLUMNE_115_DLO.chf

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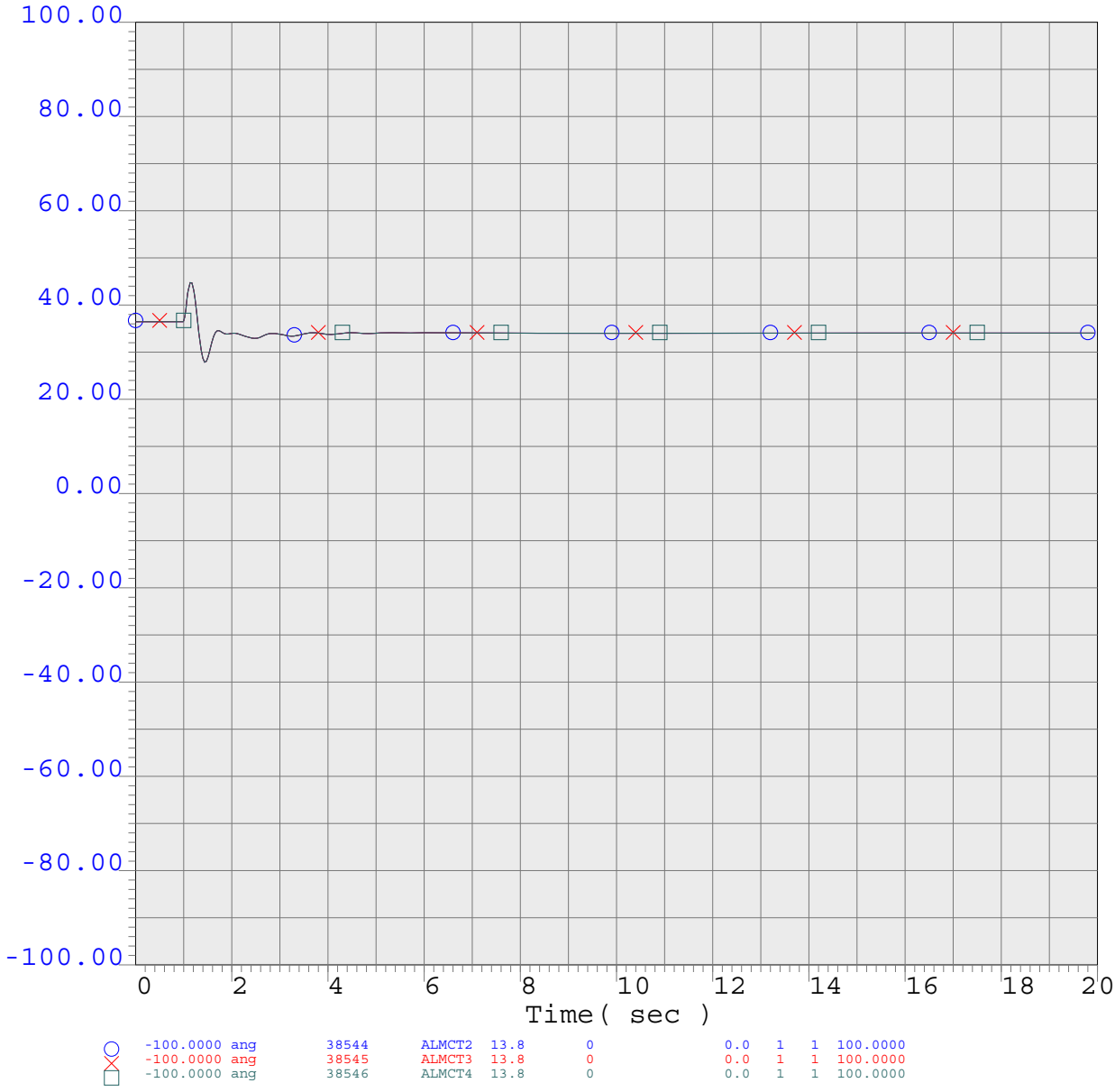
Almond 2 Power Plant
Relative Rotor Angle (degrees)




2012 Summer Peak Base Case



2012_sum_pk_pst_102_OAKDALE-TUOLUMNE_115_DLO.chf

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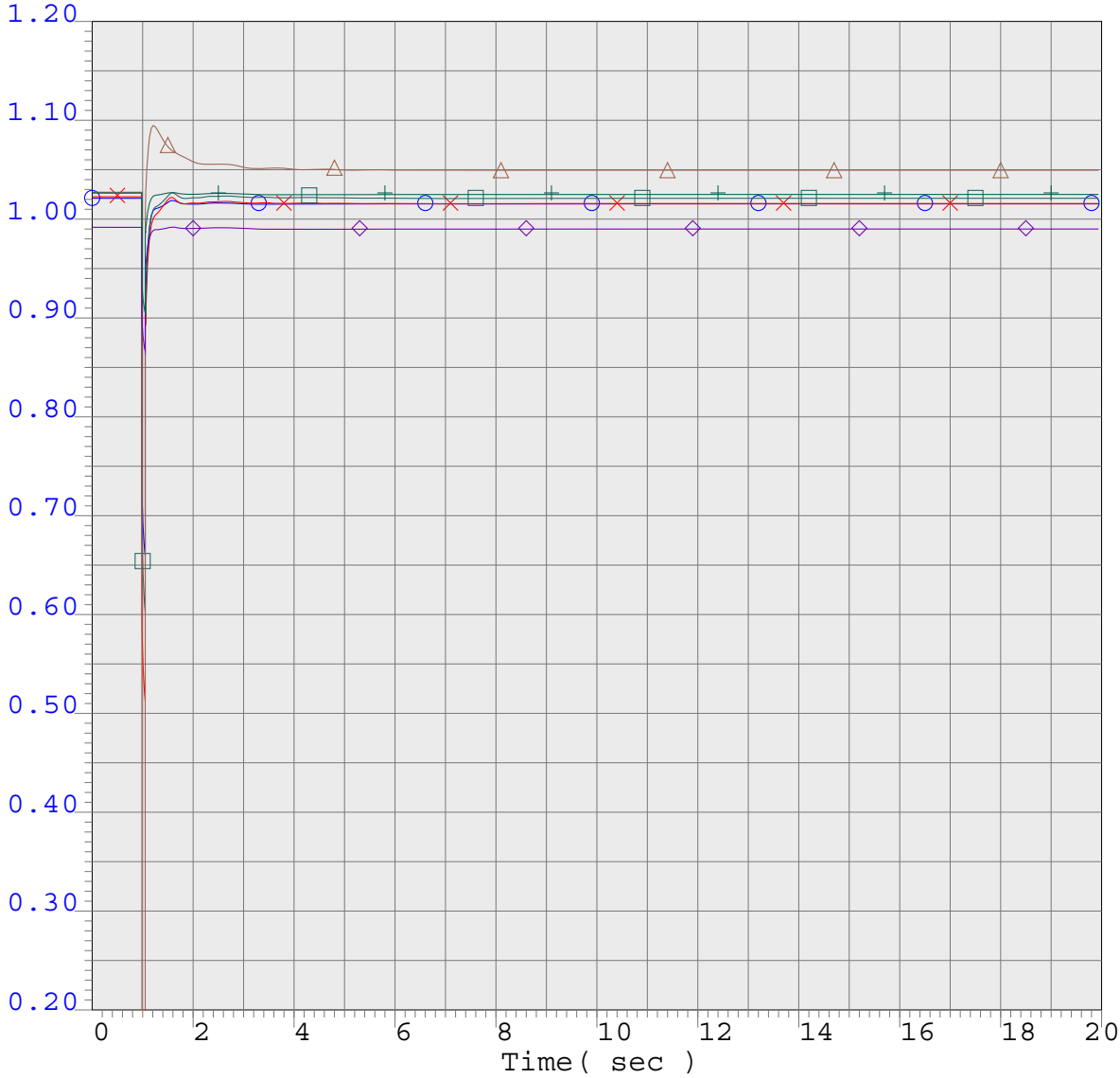
Select TID System Parameters
Voltage (p.u.)




| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 0.2000 | vbul | 38442 | AUGUST | 115.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbul | 38534 | GRAY115 | 115.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 38535 | GRAY69 | 69.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 38432 | OAKDLTID | 115.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 38400 | WALNT | 230.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 38410 | WESTL115 | 115.0 | 0 | 0.0 | 1 | 1 | 1.2000 |

2012 Summer Peak Base Case



2012_sum_pk_pst_102_OAKDALE-TUOLUMNE_115_DLO.chf

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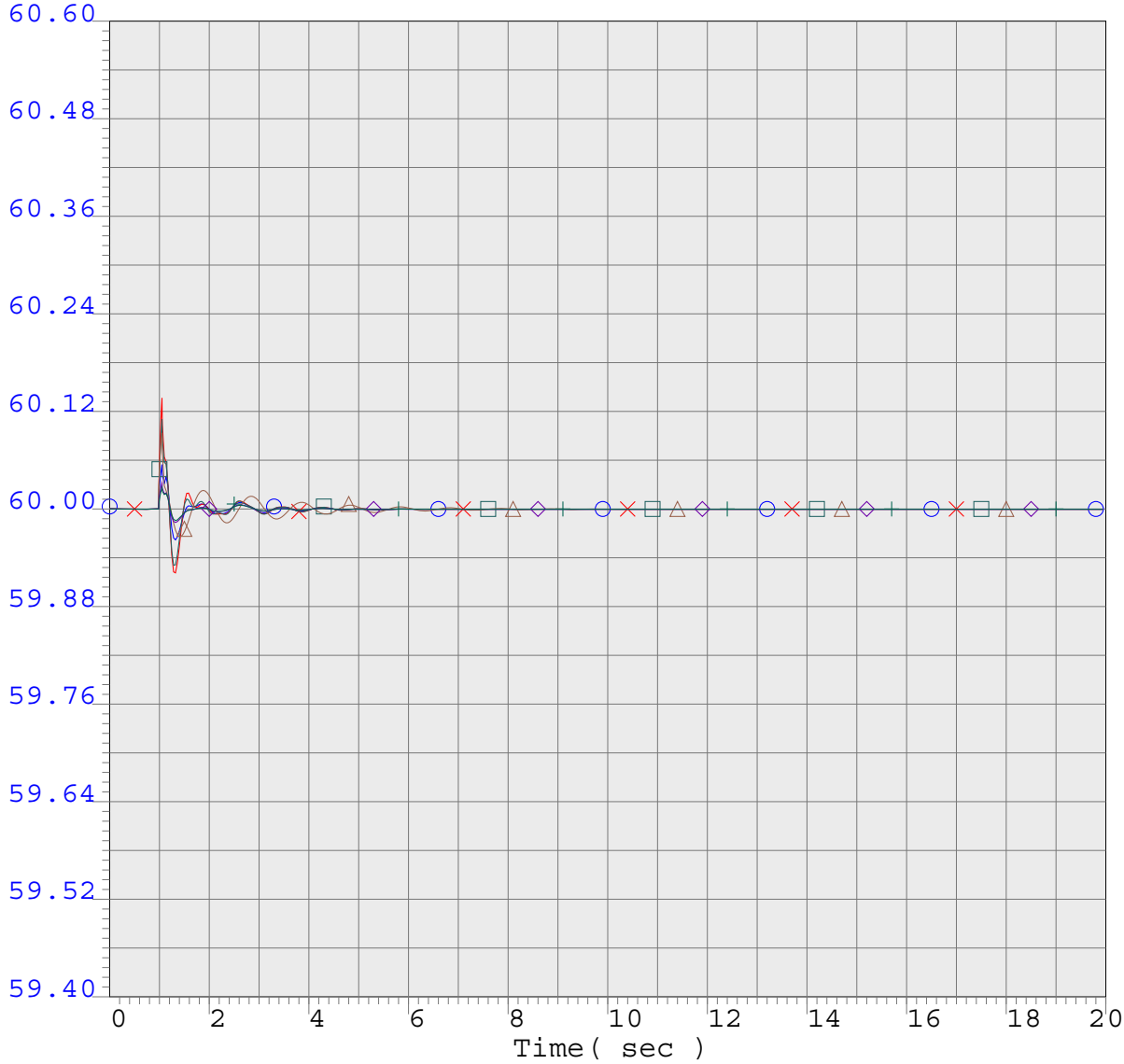
Select TID System Parameters
Frequency (Hz)




| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| ○ | 59.4000 | fbul | 38442 | AUGUST | 115.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| × | 59.4000 | fbul | 38534 | GRAY115 | 115.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| □ | 59.4000 | fbus | 38535 | GRAY69 | 69.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| △ | 59.4000 | fbus | 38432 | OAKDLTID | 115.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| ◇ | 59.4000 | fbus | 38400 | WALNT | 230.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| + | 59.4000 | fbus | 38410 | WESTL115 | 115.0 | 0 | 0.0 | 1 | 1 | 60.6000 |

2012 Summer Peak Base Case



2012_sum_pk_pst_102_OAKDALE-TUOLUMNE_115_DLO.chf

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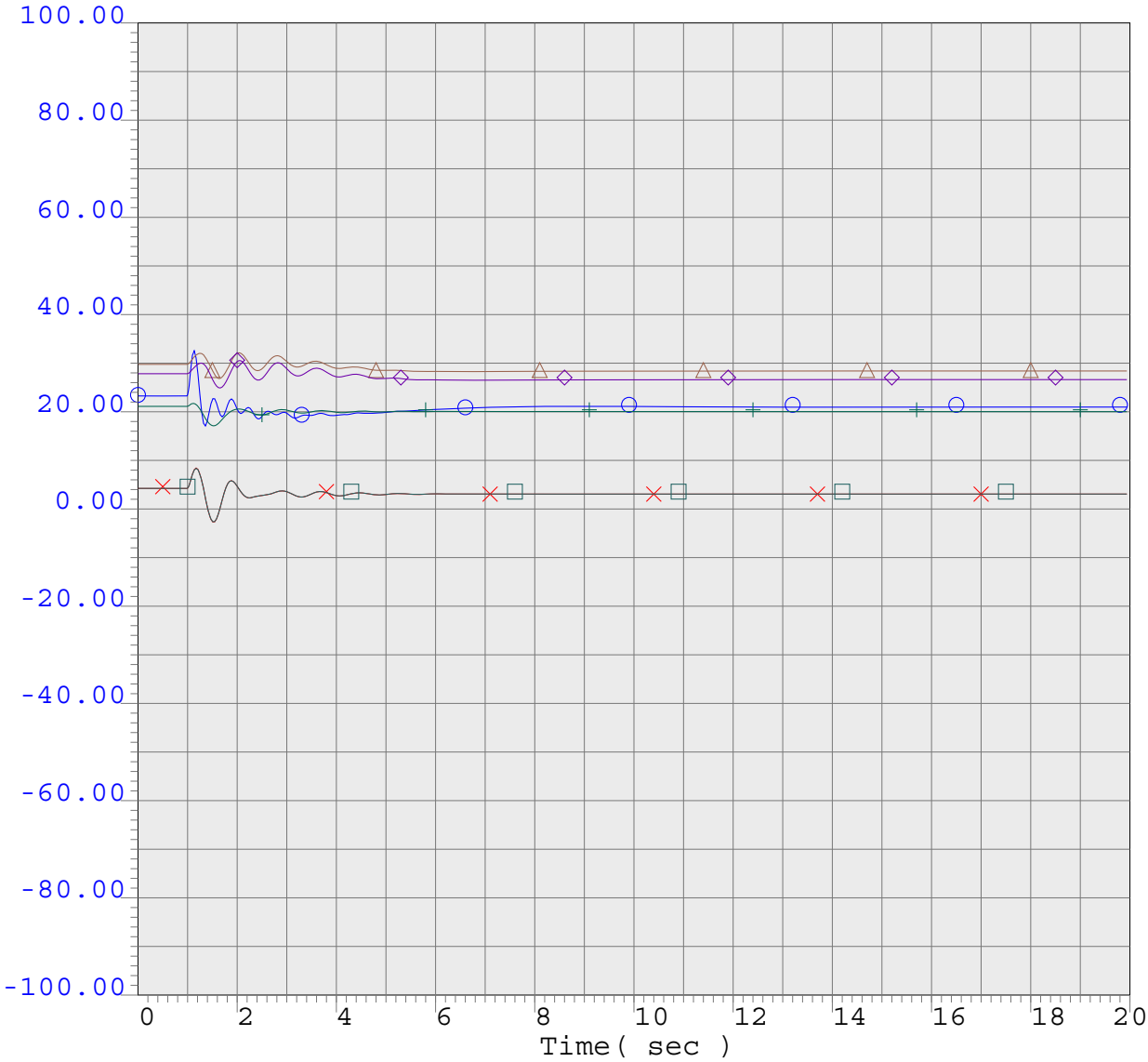
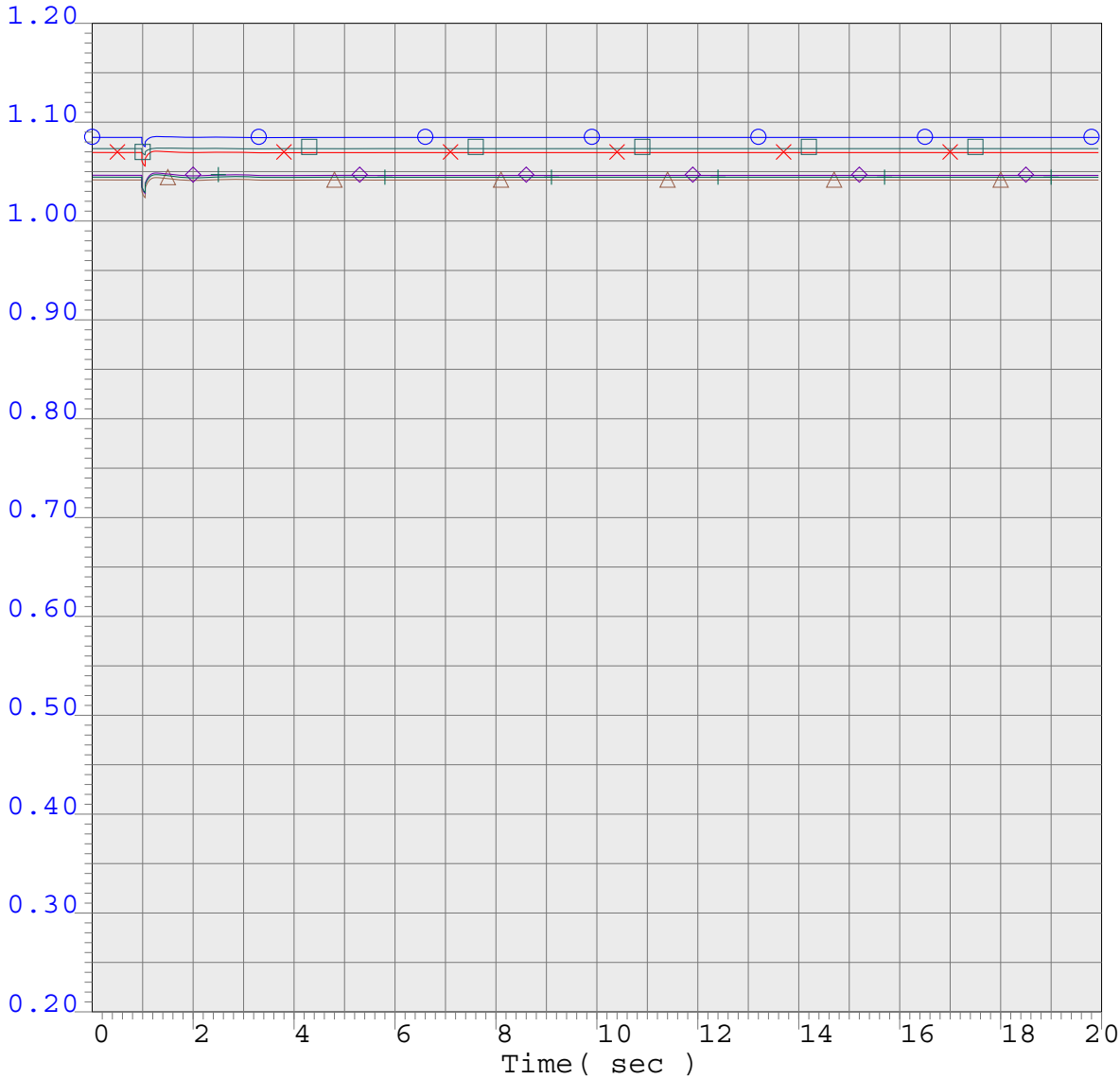
Select TID System Parameters
Relative Rotor Angle (degrees)




| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| -100.0000 ang | 38564 | ALMONDCT | 13.8 | 0 | 0.0 | 1 | 1 | 100.0000 |
| -100.0000 ang | 38550 | DONPDRO1 | 13.8 | 0 | 0.0 | 1 | 1 | 100.0000 |
| -100.0000 ang | 38552 | DONPDRO2 | 13.8 | 0 | 0.0 | 1 | 1 | 100.0000 |
| -100.0000 ang | 38570 | WEC1-CT | 13.8 | 0 | 0.0 | 1 | 1 | 100.0000 |
| -100.0000 ang | 38574 | WEC2-CT | 13.8 | 0 | 0.0 | 1 | 1 | 100.0000 |
| -100.0000 ang | 38572 | WEC3-ST | 13.8 | 0 | 0.0 | 1 | 1 | 100.0000 |

# 500 kV Bulk System Parameters
Voltage (p.u.)




| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 0.2000 | vbus | 30055 | GATES | 500.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 30050 | LOSBANOS | 500.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 30060 | MIDWAY | 500.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 30040 | TESLA | 500.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 30035 | TRACY | 500.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 30030 | VACA-DIX | 500.0 | 0 | 0.0 | 1 | 1 | 1.2000 |

2012 Summer Peak Base Case



2012_sum_pk_pst_102_OAKDALE-TUOLUMNE_115_DLO.chf

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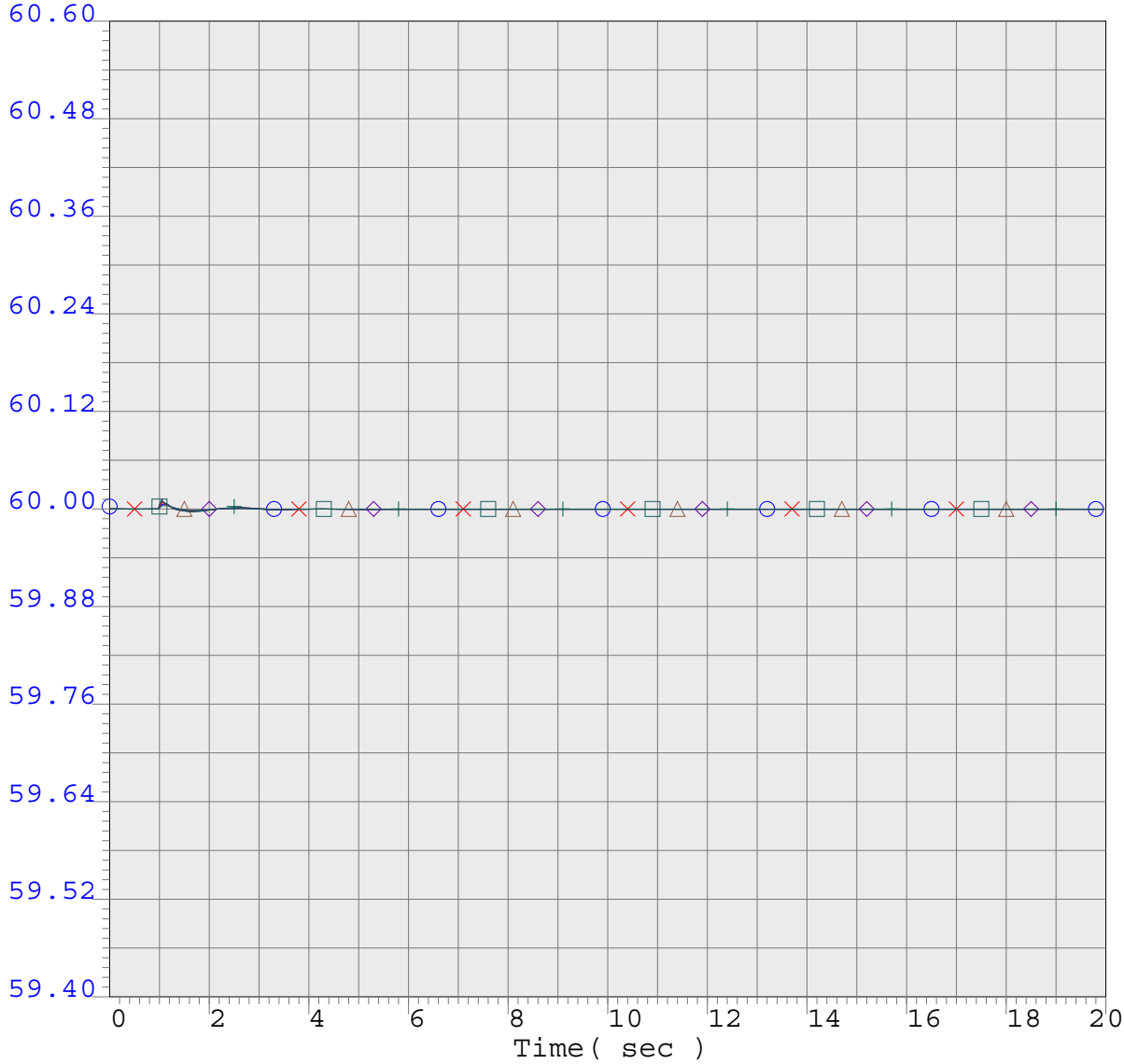
# 500 kV Bulk System Parameters
Frequency (Hz)




| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 59.4000 | fbus | 30055 | GATES | 500.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 30050 | LOSBANOS | 500.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 30060 | MIDWAY | 500.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 30040 | TESLA | 500.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 30035 | TRACY | 500.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 30030 | VACA-DIX | 500.0 | 0 | 0.0 | 1 | 1 | 60.6000 |

2012 Summer Peak Base Case



2012_sum_pk_pst_102_OAKDALE-TUOLUMNE_115_DLO.chf

.

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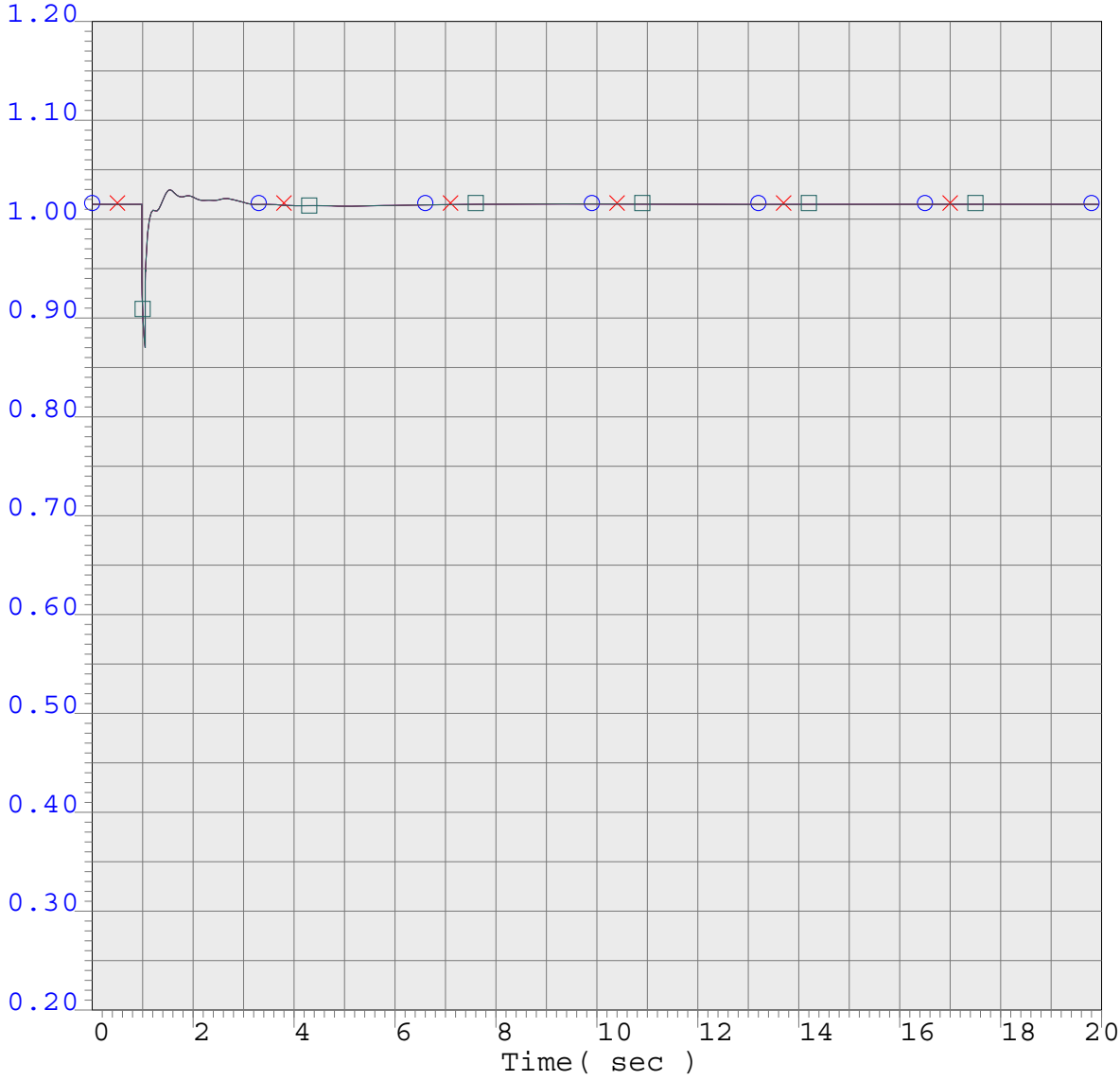
# Transient Stability Plots

# Westley-Marshall & Westley-Rogers 115 kV Lines Out

# Almond 2 Power Plant
# Terminal Voltage (p.u.)




| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| ○ | 0.2000 vt | 38544 | ALMCT2 | 13.8 | 0 | 0.0 | 1 | 1 | 1.2000 |
| × | 0.2000 vt | 38545 | ALMCT3 | 13.8 | 0 | 0.0 | 1 | 1 | 1.2000 |
| □ | 0.2000 vt | 38546 | ALMCT4 | 13.8 | 0 | 0.0 | 1 | 1 | 1.2000 |

2012 Summer Peak Base Case



2012_sum_pk_pst_103_WESTLEY-MARSHALL-ROGERS_115_DLO.chf

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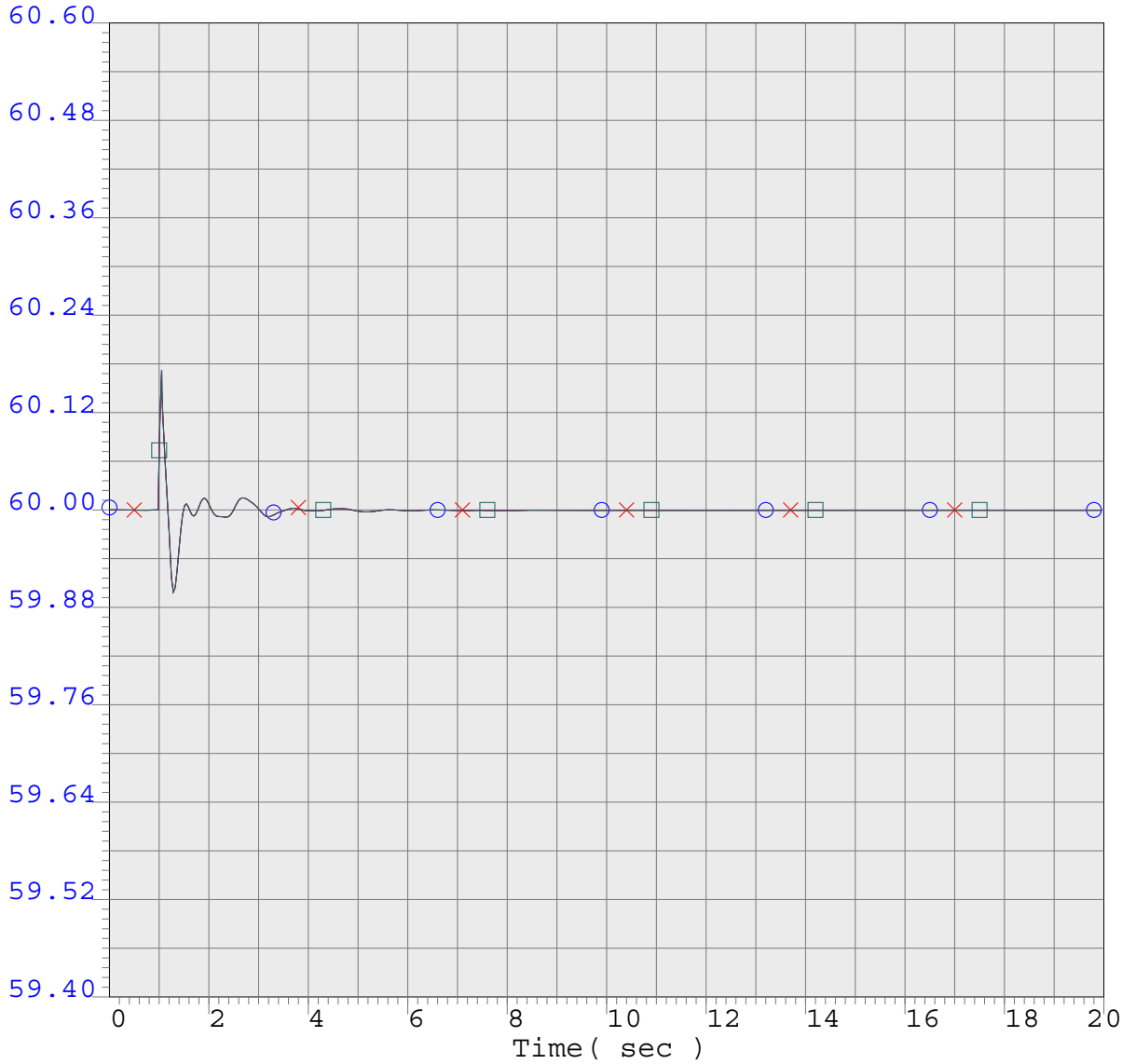
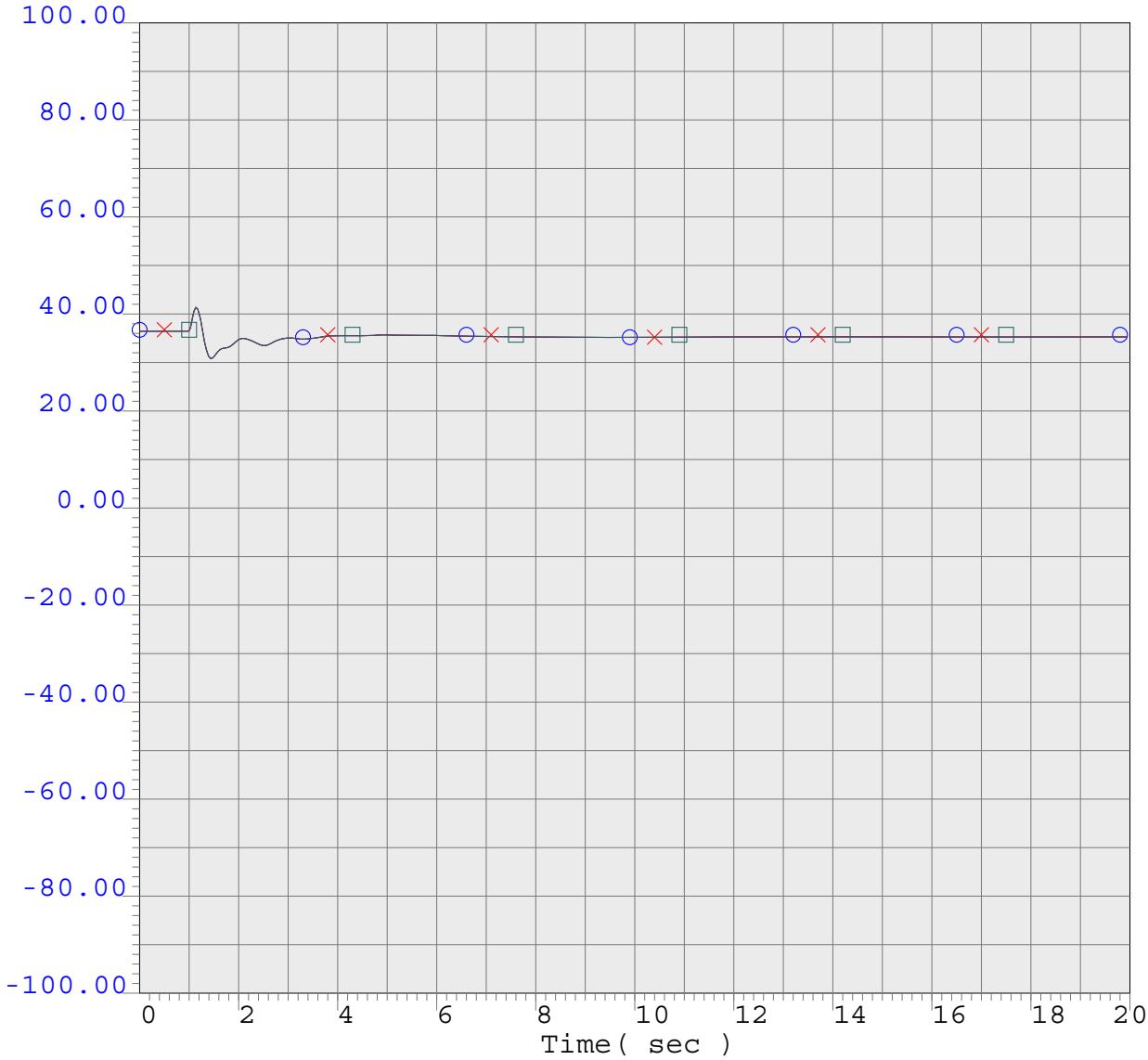
Almond 2 Power Plant
Frequency (Hz)




| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| ○ | 59.4000 | fbug | 38544 | ALMCT2 | 13.8 | 0 | 0.0 | 1 | 1 | 60.6000 |
| × | 59.4000 | fbug | 38545 | ALMCT3 | 13.8 | 0 | 0.0 | 1 | 1 | 60.6000 |
| □ | 59.4000 | fbug | 38546 | ALMCT4 | 13.8 | 0 | 0.0 | 1 | 1 | 60.6000 |

# Almond 2 Power Plant
## Relative Rotor Angle (degrees)




| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| -100.0000 ang | 38544 | ALMCT2 | 13.8 | 0 | 0.0 | 1 | 1 | 100.0000 |
| -100.0000 ang | 38545 | ALMCT3 | 13.8 | 0 | 0.0 | 1 | 1 | 100.0000 |
| -100.0000 ang | 38546 | ALMCT4 | 13.8 | 0 | 0.0 | 1 | 1 | 100.0000 |

2012 Summer Peak Base Case



2012_sum_pk_pst_103_WESTLEY-MARSHALL-ROGERS_115_DLO.chf

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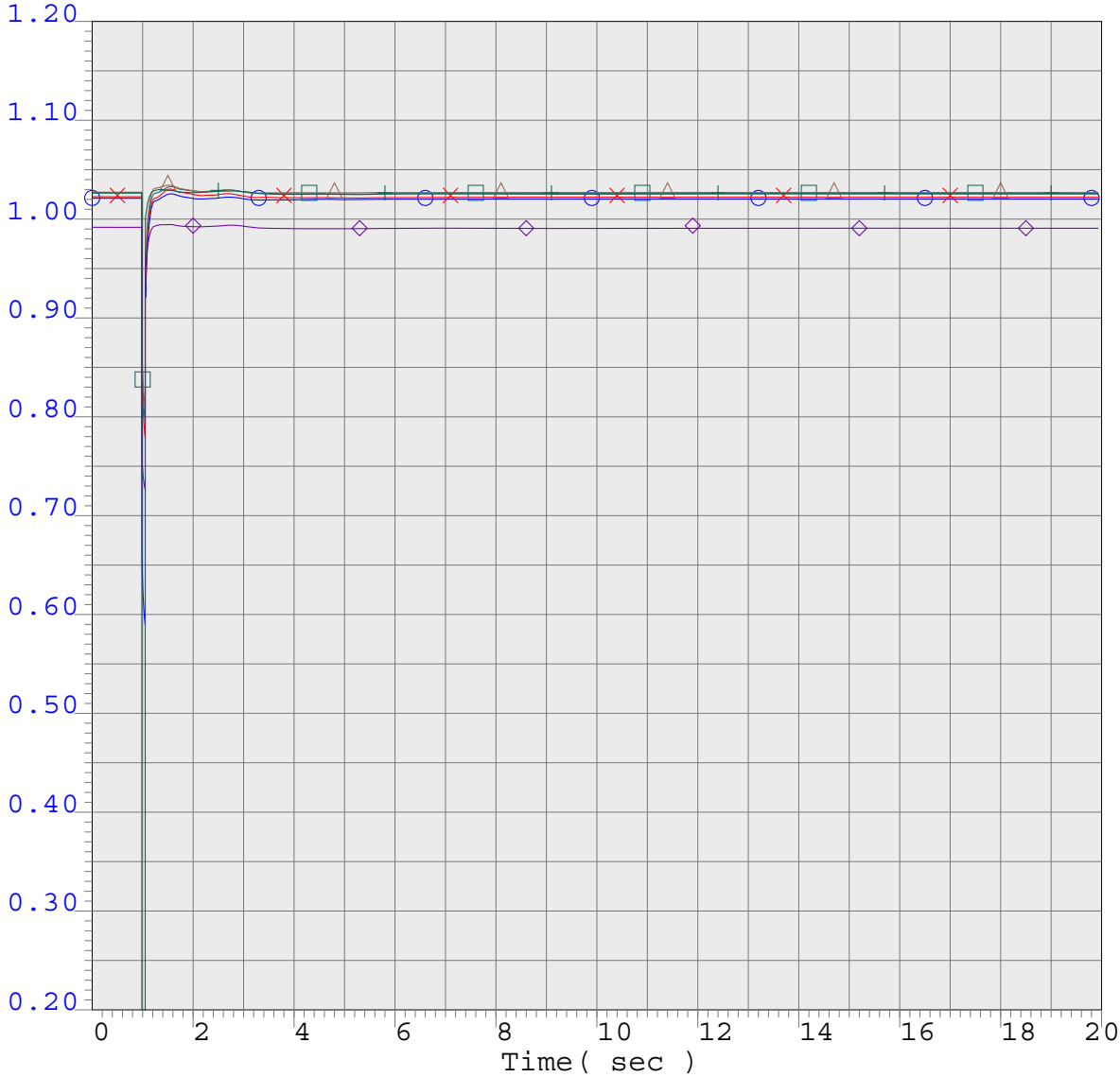
Select TID System Parameters
Voltage (p.u.)




| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 0.2000 | vbul | 38442 | AUGUST | 115.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbul | 38534 | GRAY115 | 115.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 38535 | GRAY69 | 69.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 38432 | OAKDLTID | 115.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 38400 | WALNT | 230.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 38410 | WESTL115 | 115.0 | 0 | 0.0 | 1 | 1 | 1.2000 |

2012 Summer Peak Base Case



2012_sum_pk_pst_103_WESTLEY-MARSHALL-ROGERS_115_DLO.chf

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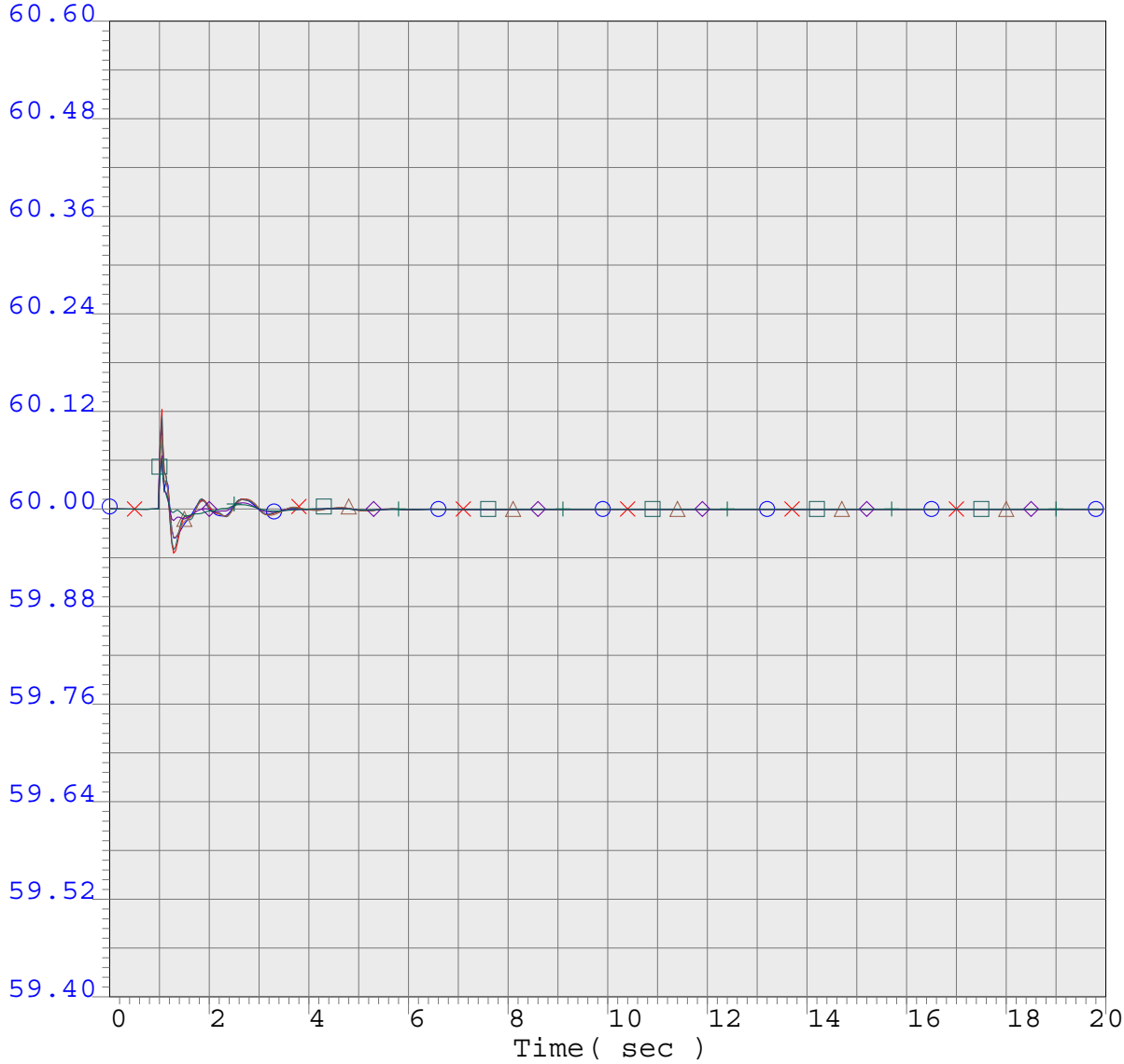
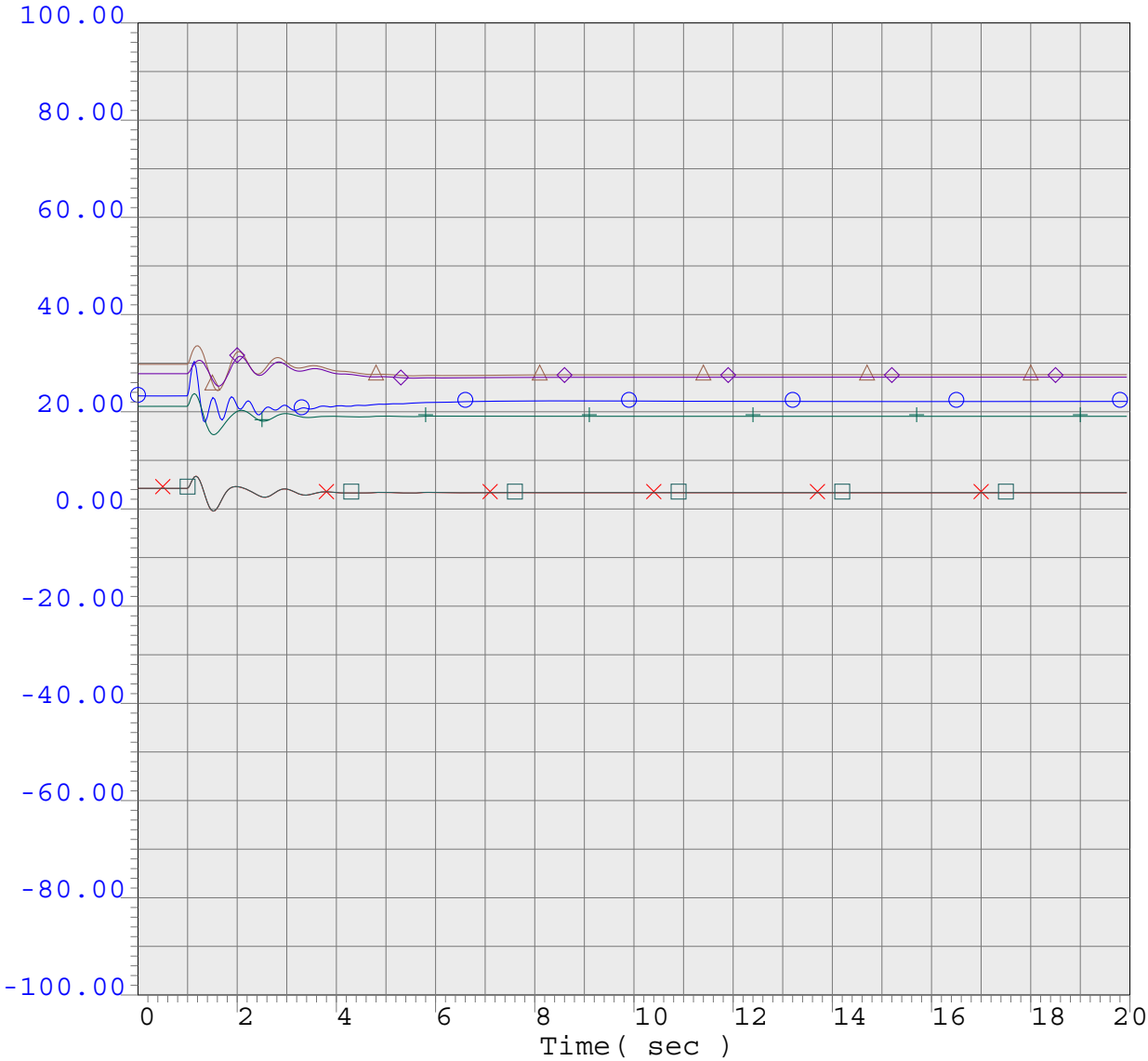
Select TID System Parameters
Frequency (Hz)



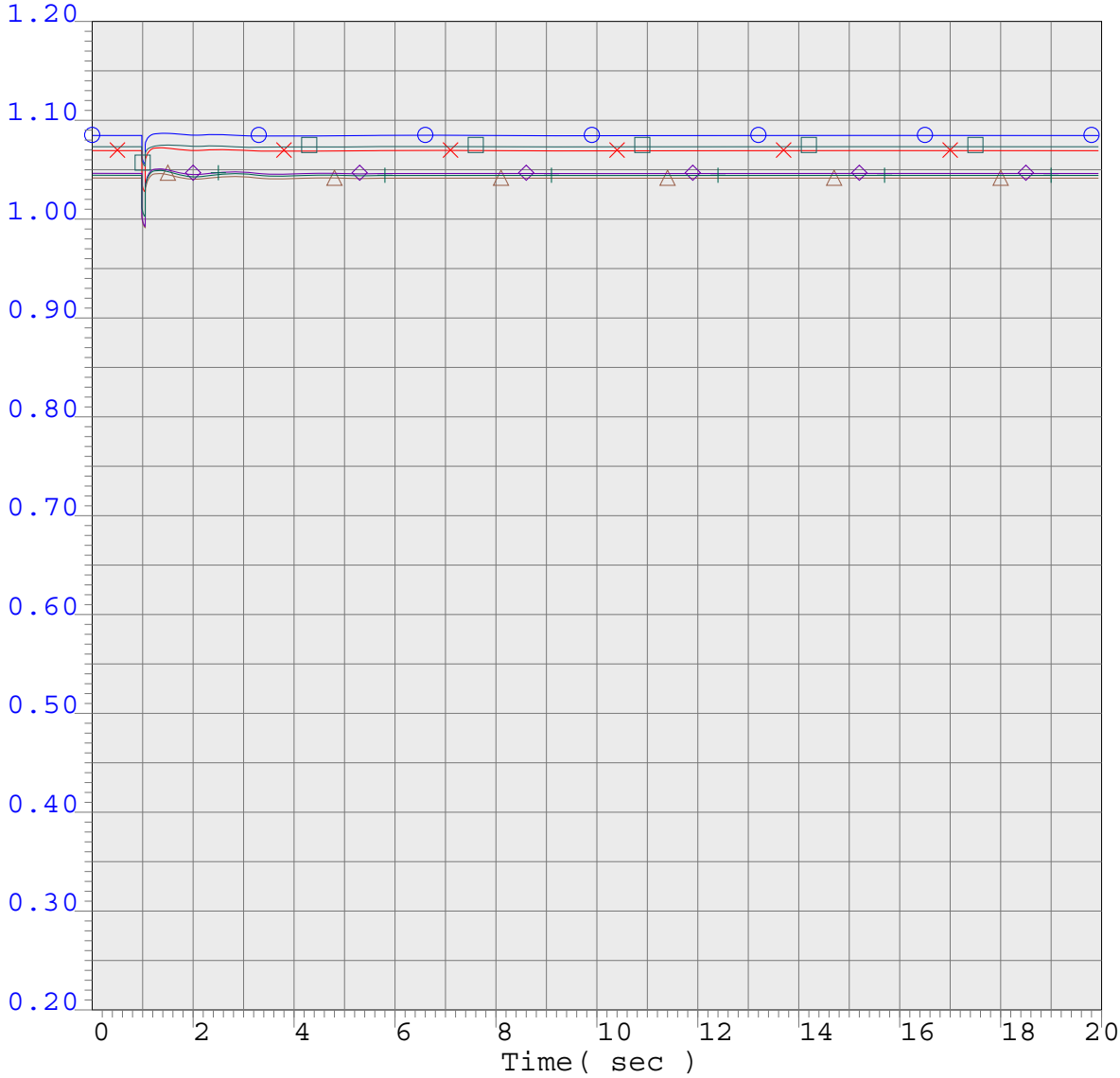

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 59.4000 | fbul | 38442 | AUGUST | 115.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbul | 38534 | GRAY115 | 115.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 38535 | GRAY69 | 69.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 38432 | OAKDLTID | 115.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 38400 | WALNT | 230.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 38410 | WESTL115 | 115.0 | 0 | 0.0 | 1 | 1 | 60.6000 |

Select TID System Parameters
Relative Rotor Angle (degrees)




| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| -100.0000 ang | 38564 | ALMONDCT | 13.8 | 0 | 0.0 | 1 | 1 | 100.0000 |
| -100.0000 ang | 38550 | DONPDRO1 | 13.8 | 0 | 0.0 | 1 | 1 | 100.0000 |
| -100.0000 ang | 38552 | DONPDRO2 | 13.8 | 0 | 0.0 | 1 | 1 | 100.0000 |
| -100.0000 ang | 38570 | WEC1-CT | 13.8 | 0 | 0.0 | 1 | 1 | 100.0000 |
| -100.0000 ang | 38574 | WEC2-CT | 13.8 | 0 | 0.0 | 1 | 1 | 100.0000 |
| -100.0000 ang | 38572 | WEC3-ST | 13.8 | 0 | 0.0 | 1 | 1 | 100.0000 |

# 500 kV Bulk System Parameters
Voltage (p.u.)




| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 0.2000 | vbus | 30055 | GATES | 500.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 30050 | LOSBANOS | 500.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 30060 | MIDWAY | 500.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 30040 | TESLA | 500.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 30035 | TRACY | 500.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 30030 | VACA-DIX | 500.0 | 0 | 0.0 | 1 | 1 | 1.2000 |

2012 Summer Peak Base Case



2012_sum_pk_pst_103_WESTLEY-MARSHALL-ROGERS_115_DLO.chf

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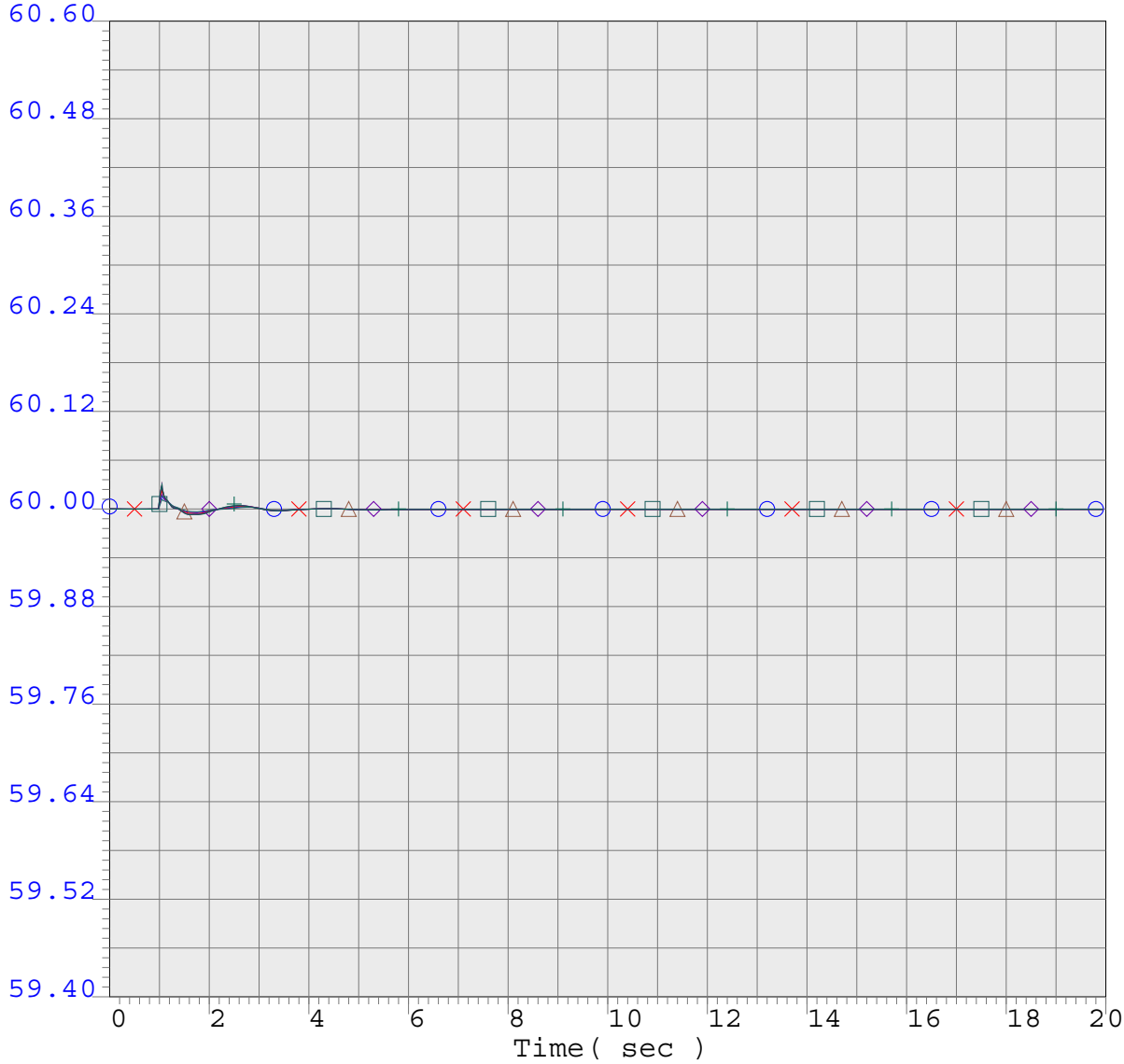
# 500 kV Bulk System Parameters
Frequency (Hz)




| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 59.4000 | fbus | 30055 | GATES | 500.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 30050 | LOSBANOS | 500.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 30060 | MIDWAY | 500.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 30040 | TESLA | 500.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 30035 | TRACY | 500.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 30030 | VACA-DIX | 500.0 | 0 | 0.0 | 1 | 1 | 60.6000 |

2012 Summer Peak Base Case



2012_sum_pk_pst_103_WESTLEY-MARSHALL-ROGERS_115_DLO.chf

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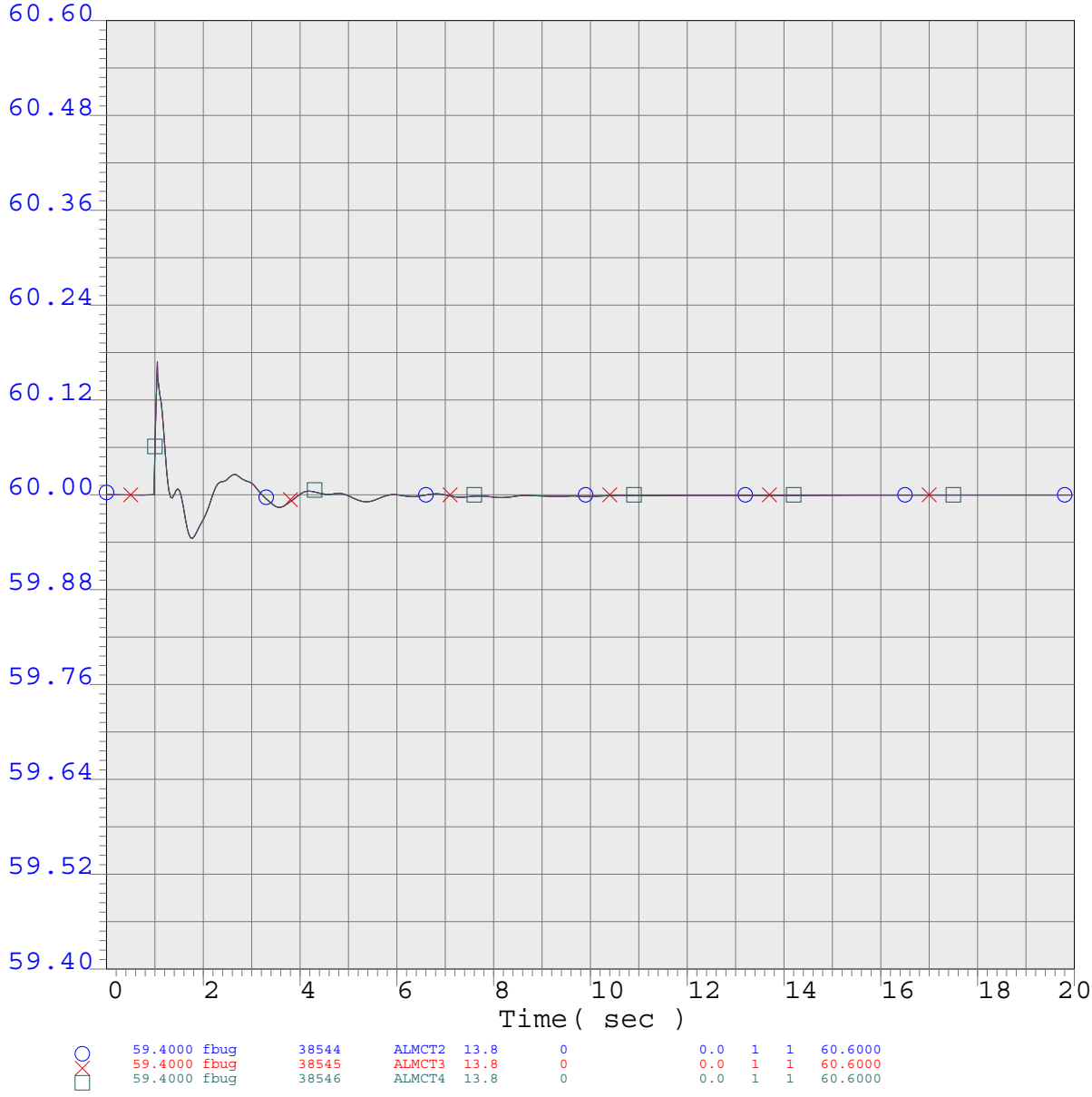
Mon Oct 19 00:52:20 2009

# Transient Stability Plots

# Los Banos-Gates #3 500 kV Line Out

# Almond 2 Power Plant
## Frequency (Hz)




2012 Summer Peak Base Case



2012_sum_pk_pst_201_LOSBANOS-GATES_500.chf

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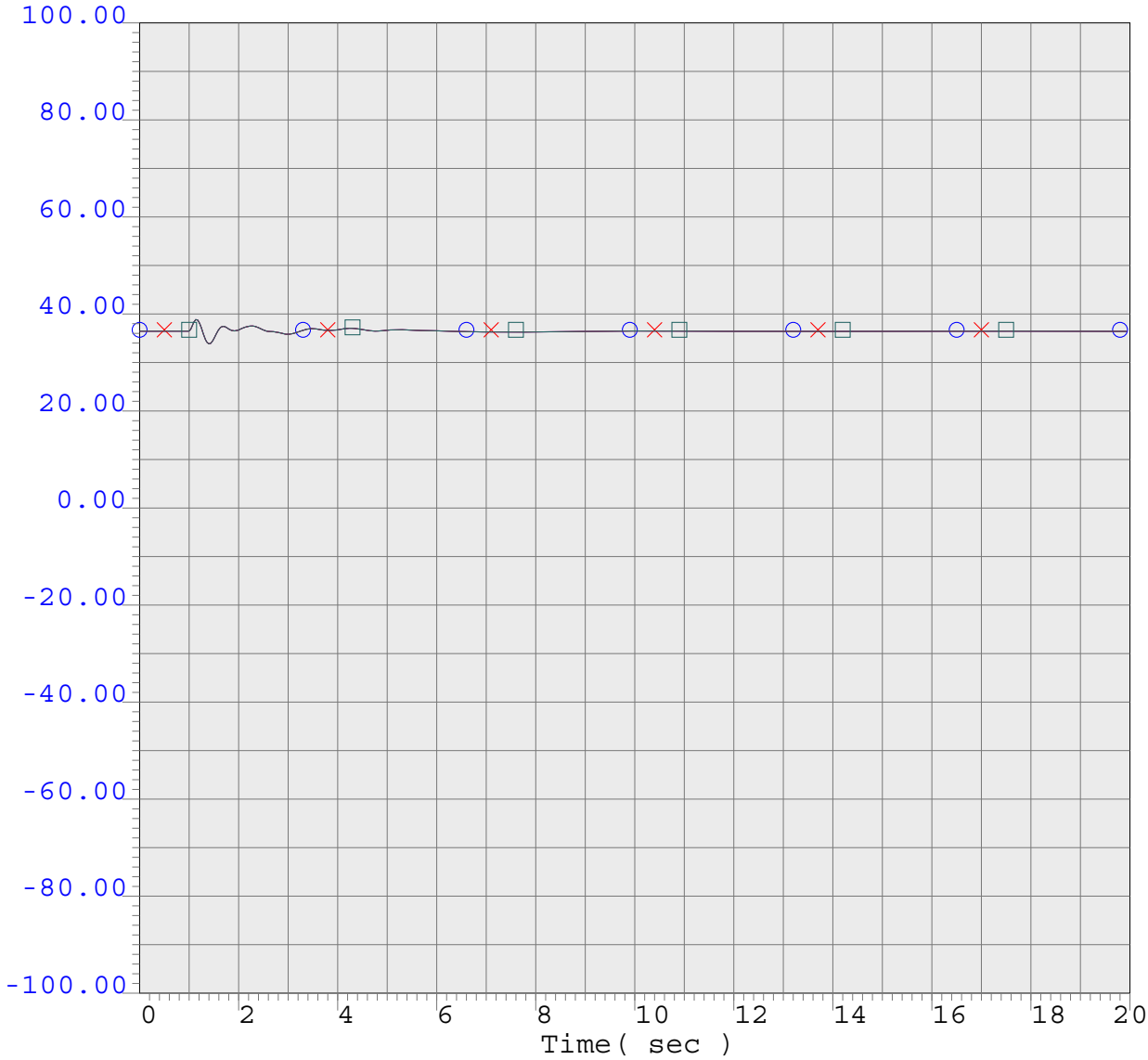
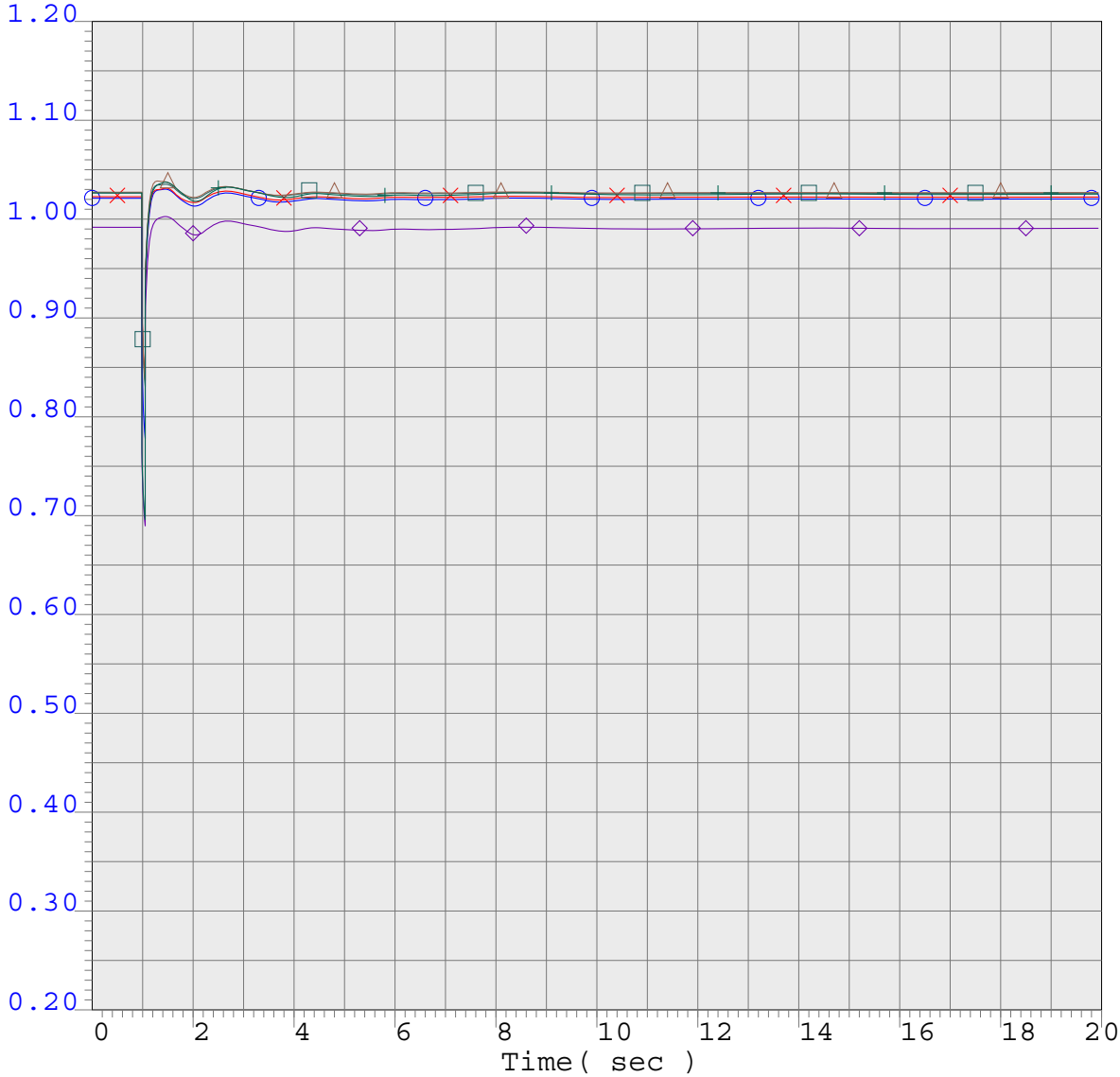
# Almond 2 Power Plant
## Relative Rotor Angle (degrees)




| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| -100.0000 ang | 38544 | ALMCT2 | 13.8 | 0 | 0.0 | 1 | 1 | 100.0000 |
| -100.0000 ang | 38545 | ALMCT3 | 13.8 | 0 | 0.0 | 1 | 1 | 100.0000 |
| -100.0000 ang | 38546 | ALMCT4 | 13.8 | 0 | 0.0 | 1 | 1 | 100.0000 |

Select TID System Parameters
Voltage (p.u.)




| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 0.2000 | vbul | 38442 | AUGUST | 115.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbul | 38534 | GRAY115 | 115.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 38535 | GRAY69 | 69.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 38432 | OAKDLTID | 115.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 38400 | WALNT | 230.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 38410 | WESTL115 | 115.0 | 0 | 0.0 | 1 | 1 | 1.2000 |

2012 Summer Peak Base Case



2012_sum_pk_pst_201_LOSBANOS-GATES_500.chf

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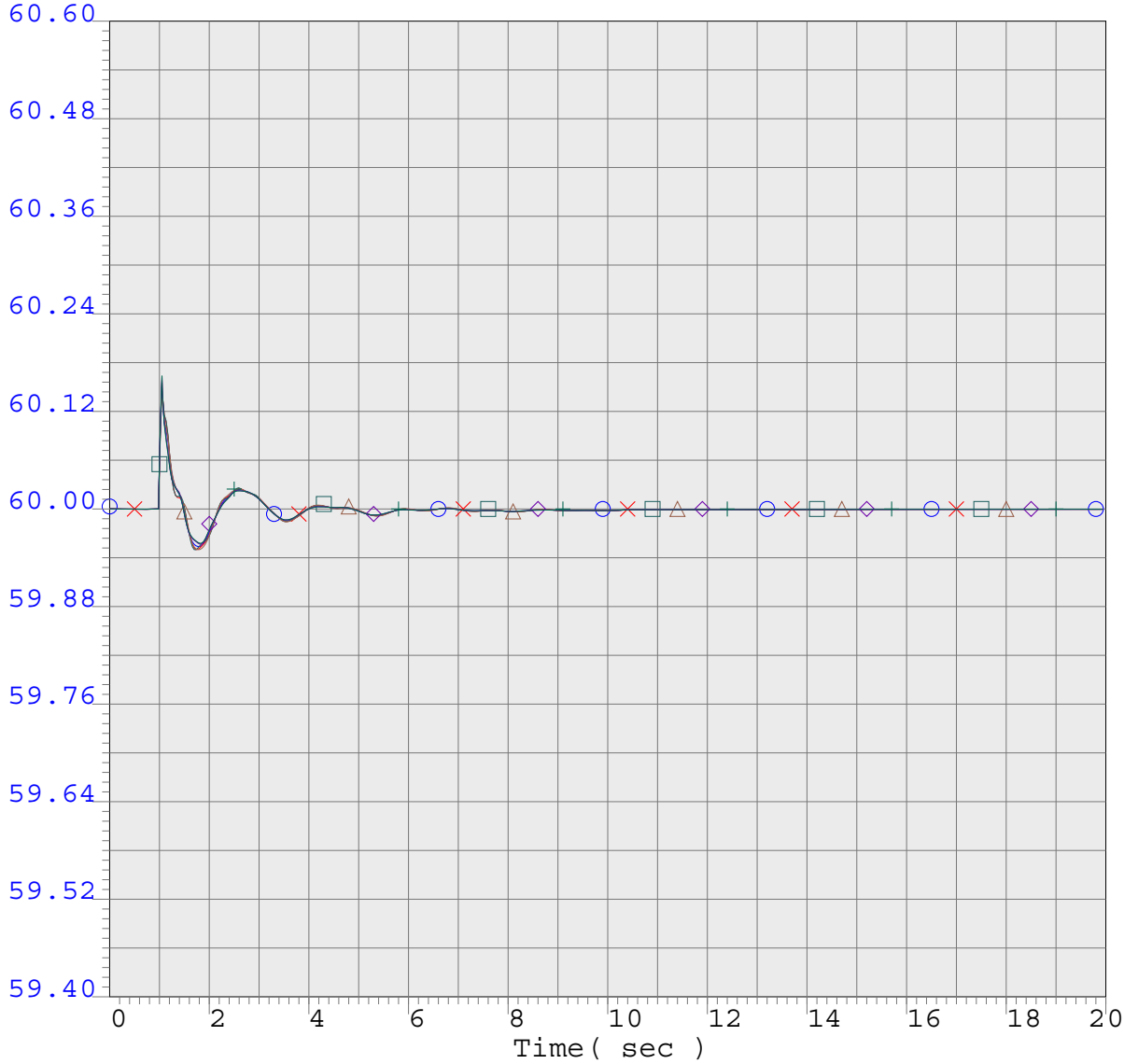
Select TID System Parameters
Frequency (Hz)




| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 59.4000 | fbul | 38442 | AUGUST | 115.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbul | 38534 | GRAY115 | 115.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 38535 | GRAY69 | 69.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 38432 | OAKDLTID | 115.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 38400 | WALNT | 230.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 38410 | WESTL115 | 115.0 | 0 | 0.0 | 1 | 1 | 60.6000 |

2012 Summer Peak Base Case



2012_sum_pk_pst_201_LOSBANOS-GATES_500.chf

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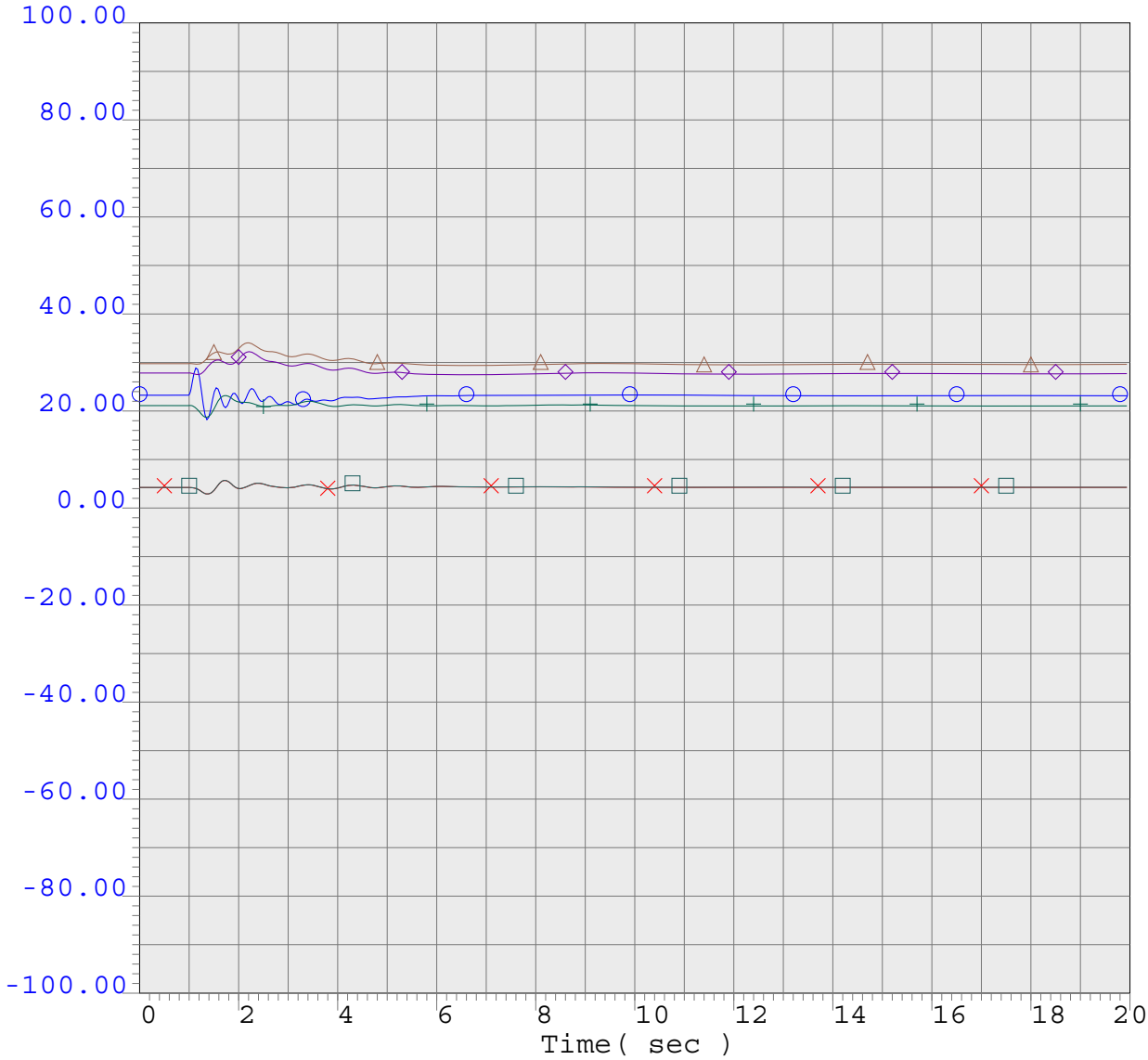
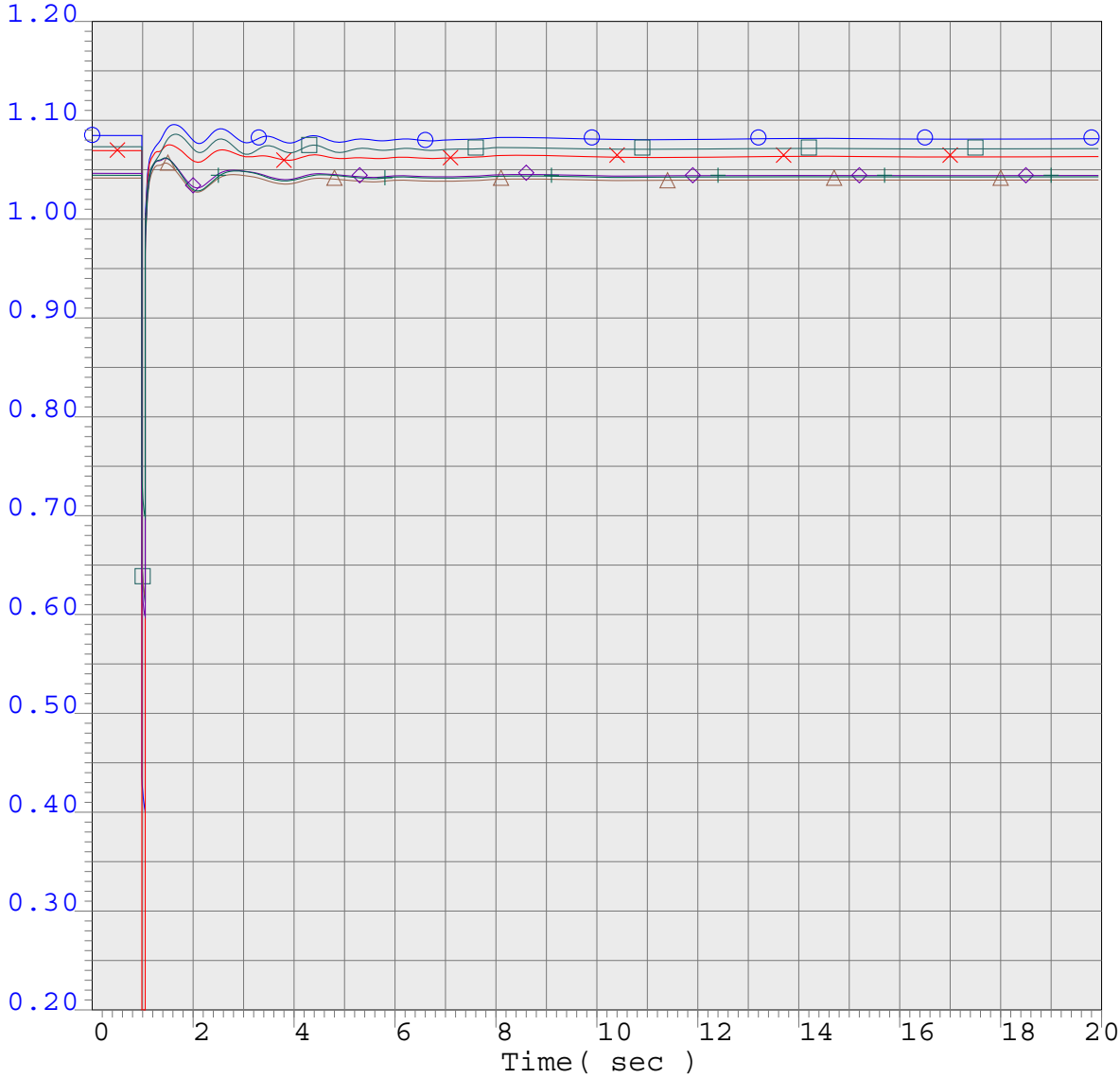
Mon Oct 19 00:52:26 2009

Select TID System Parameters
Relative Rotor Angle (degrees)




| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| -100.0000 ang | 38564 | ALMONDCT | 13.8 | 0 | 0.0 | 1 | 1 | 100.0000 |
| -100.0000 ang | 38550 | DONPDRO1 | 13.8 | 0 | 0.0 | 1 | 1 | 100.0000 |
| -100.0000 ang | 38552 | DONPDRO2 | 13.8 | 0 | 0.0 | 1 | 1 | 100.0000 |
| -100.0000 ang | 38570 | WEC1-CT | 13.8 | 0 | 0.0 | 1 | 1 | 100.0000 |
| -100.0000 ang | 38574 | WEC2-CT | 13.8 | 0 | 0.0 | 1 | 1 | 100.0000 |
| -100.0000 ang | 38572 | WEC3-ST | 13.8 | 0 | 0.0 | 1 | 1 | 100.0000 |

# 500 kV Bulk System Parameters
Voltage (p.u.)




| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 0.2000 | vbus | 30055 | GATES | 500.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 30050 | LOSBANOS | 500.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 30060 | MIDWAY | 500.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 30040 | TESLA | 500.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 30035 | TRACY | 500.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 30030 | VACA-DIX | 500.0 | 0 | 0.0 | 1 | 1 | 1.2000 |

2012 Summer Peak Base Case



2012_sum_pk_pst_201_LOSBANOS-GATES_500.chf

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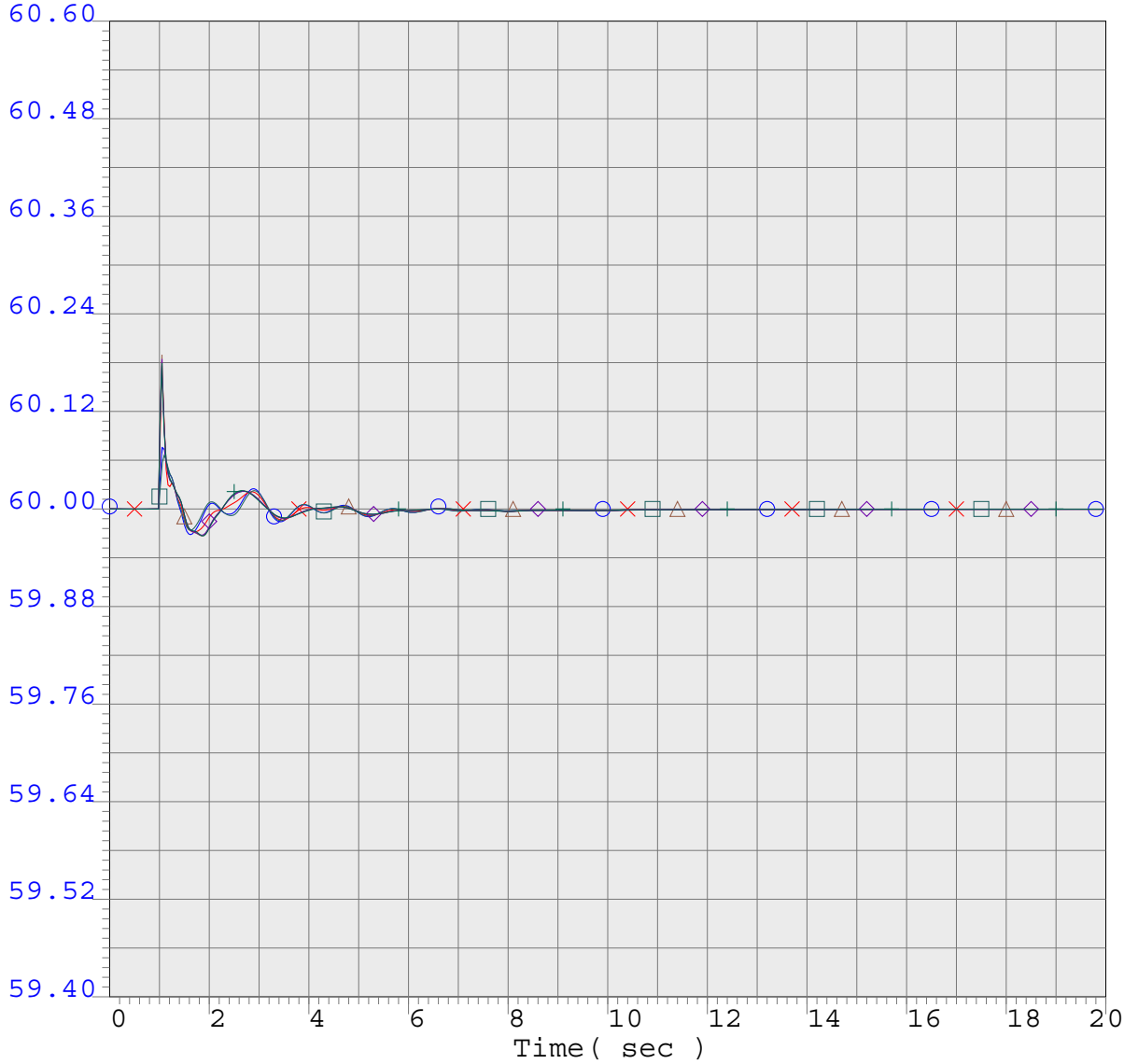
# 500 kV Bulk System Parameters
Frequency (Hz)




| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 59.4000 | fbus | 30055 | GATES | 500.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 30050 | LOSBANOS | 500.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 30060 | MIDWAY | 500.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 30040 | TESLA | 500.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 30035 | TRACY | 500.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 30030 | VACA-DIX | 500.0 | 0 | 0.0 | 1 | 1 | 60.6000 |

2012 Summer Peak Base Case



2012_sum_pk_pst_201_LOSBANOS-GATES_500.chf

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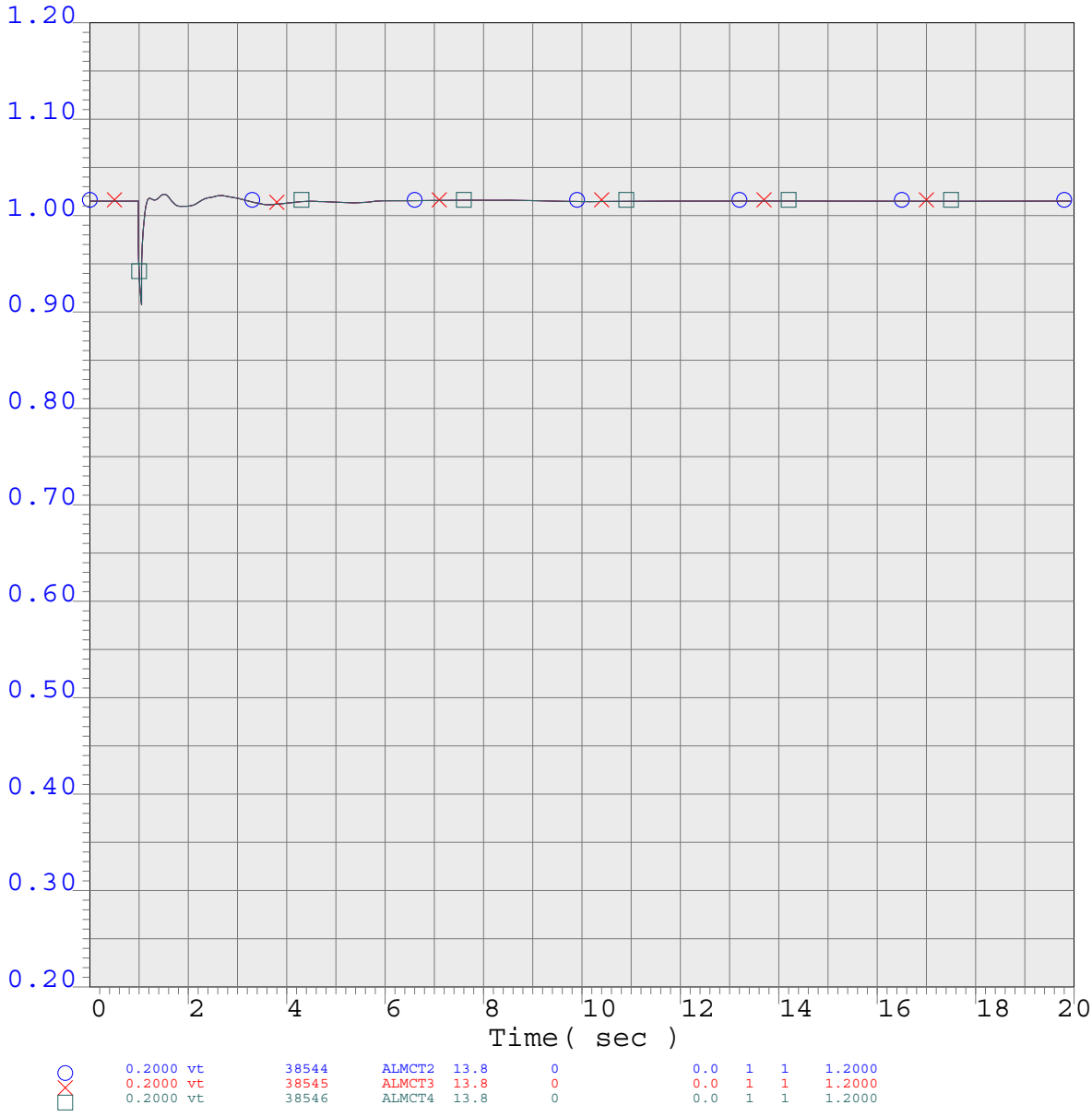
# Almond 2 Power Plant
# Terminal Voltage (p.u.)




2012 Summer Peak Base Case



2012_sum_pk_pst_201_LOSBANOS-GATES_500.chf

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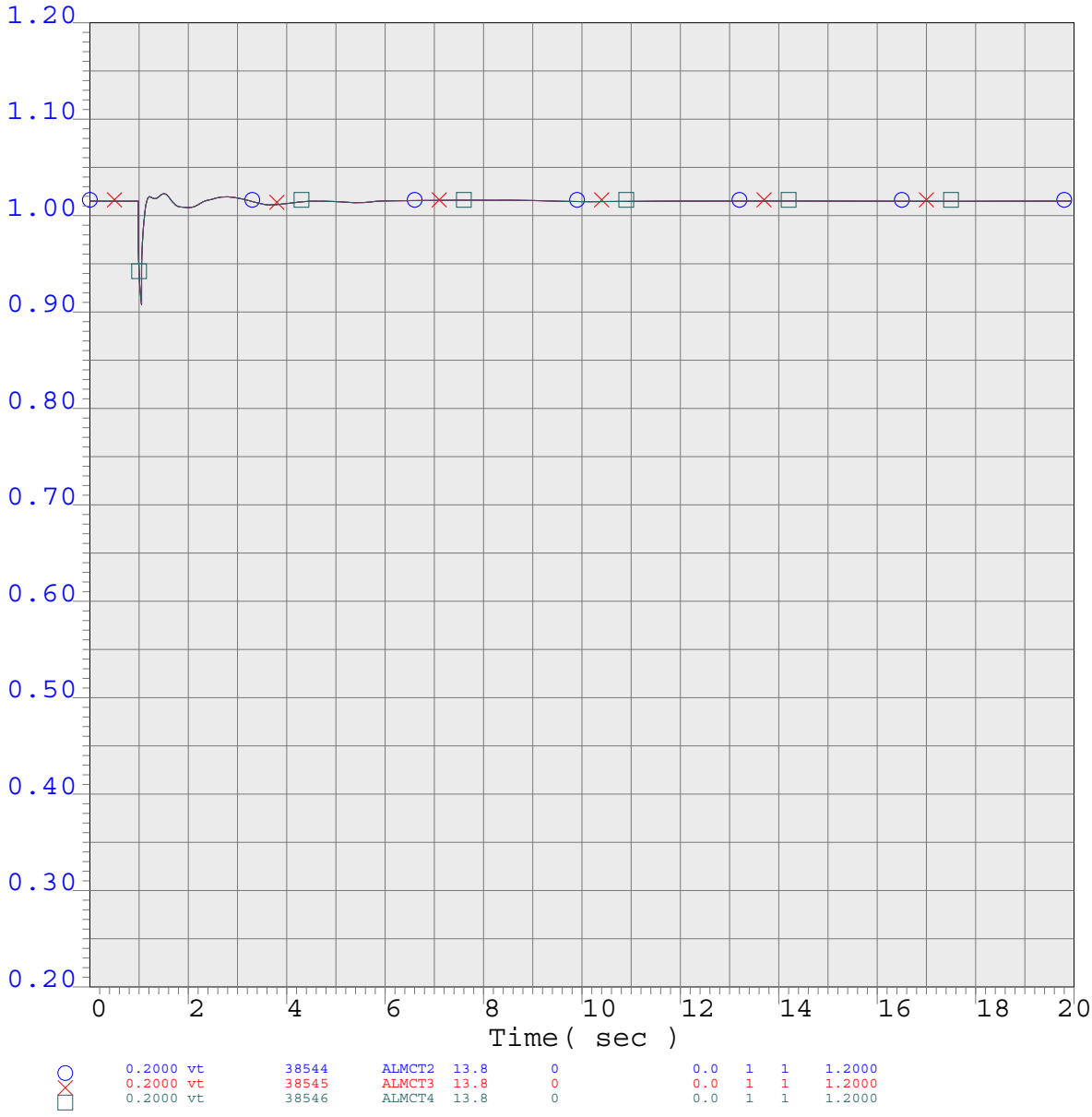
# Transient Stability Plots

# Los Banos-Midway 500 kV Line Out

# Almond 2 Power Plant
# Terminal Voltage (p.u.)




2012 Summer Peak Base Case



2012_sum_pk_pst_202_LOSBANOS-MIDWAY_500.chf

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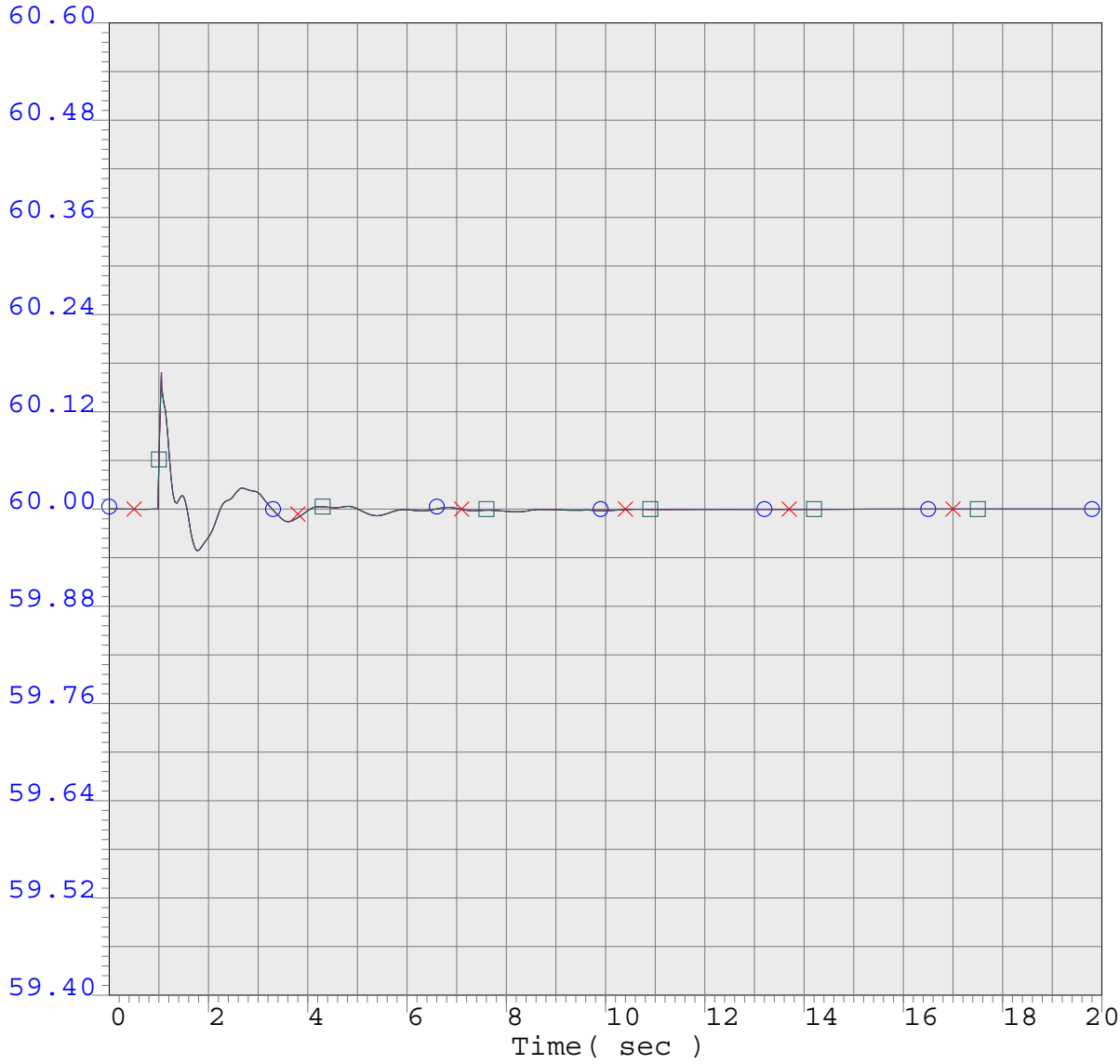
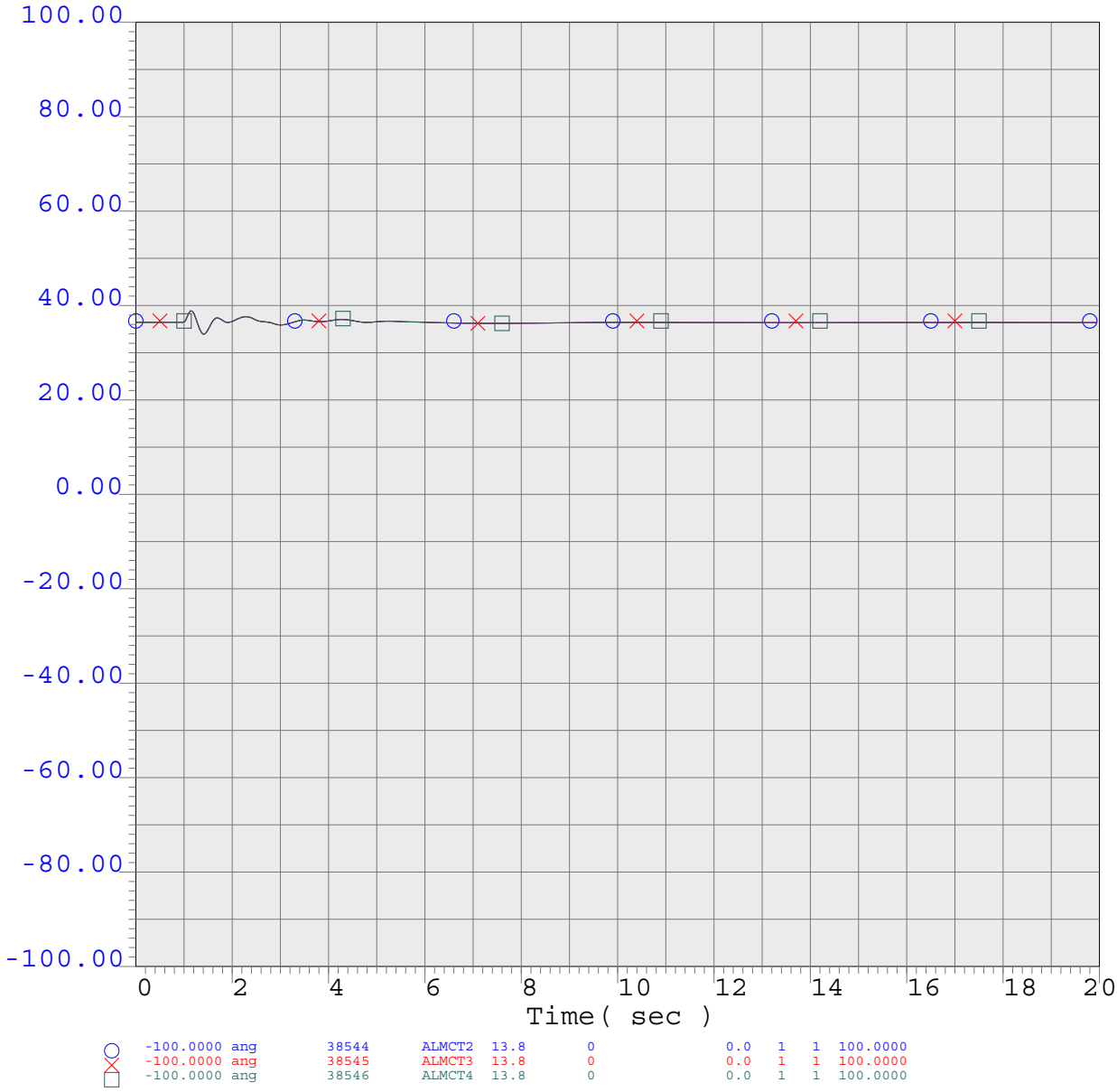
Mon Oct 19 00:52:32 2009

# Almond 2 Power Plant
## Frequency (Hz)




| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| ○ | 59.4000 | fbug | 38544 | ALMCT2 | 13.8 | 0 | 0.0 | 1 | 1 | 60.6000 |
| × | 59.4000 | fbug | 38545 | ALMCT3 | 13.8 | 0 | 0.0 | 1 | 1 | 60.6000 |
| □ | 59.4000 | fbug | 38546 | ALMCT4 | 13.8 | 0 | 0.0 | 1 | 1 | 60.6000 |

# Almond 2 Power Plant
## Relative Rotor Angle (degrees)




2012 Summer Peak Base Case



2012_sum_pk_pst_202_LOSBANOS-MIDWAY_500.chf

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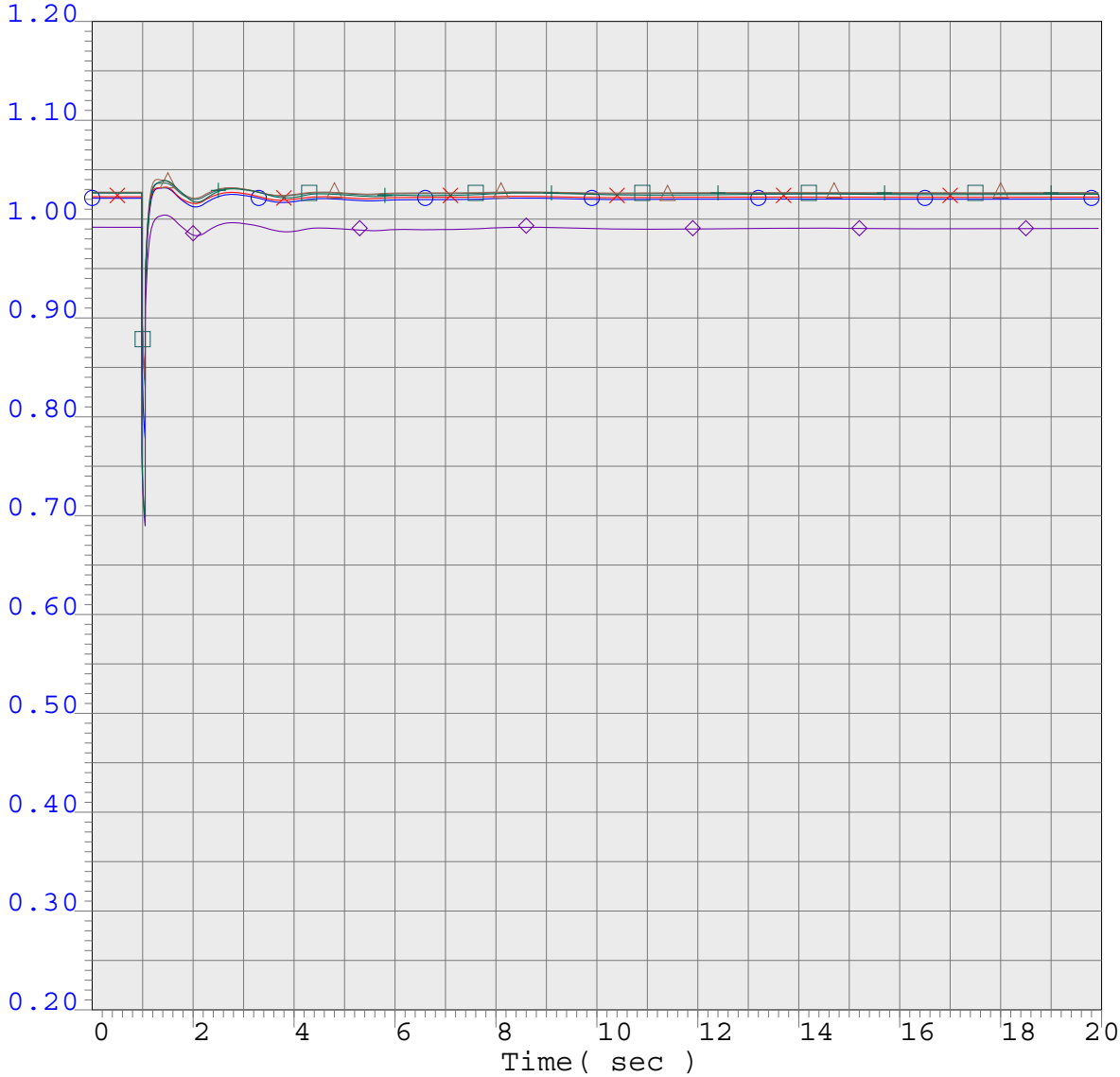
Select TID System Parameters
Voltage (p.u.)




| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 0.2000 | vbul | 38442 | AUGUST | 115.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbul | 38534 | GRAY115 | 115.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 38535 | GRAY69 | 69.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 38432 | OAKDLTID | 115.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 38400 | WALNT | 230.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 38410 | WESTL115 | 115.0 | 0 | 0.0 | 1 | 1 | 1.2000 |

2012 Summer Peak Base Case



2012_sum_pk_pst_202_LOSBANOS-MIDWAY_500.chf

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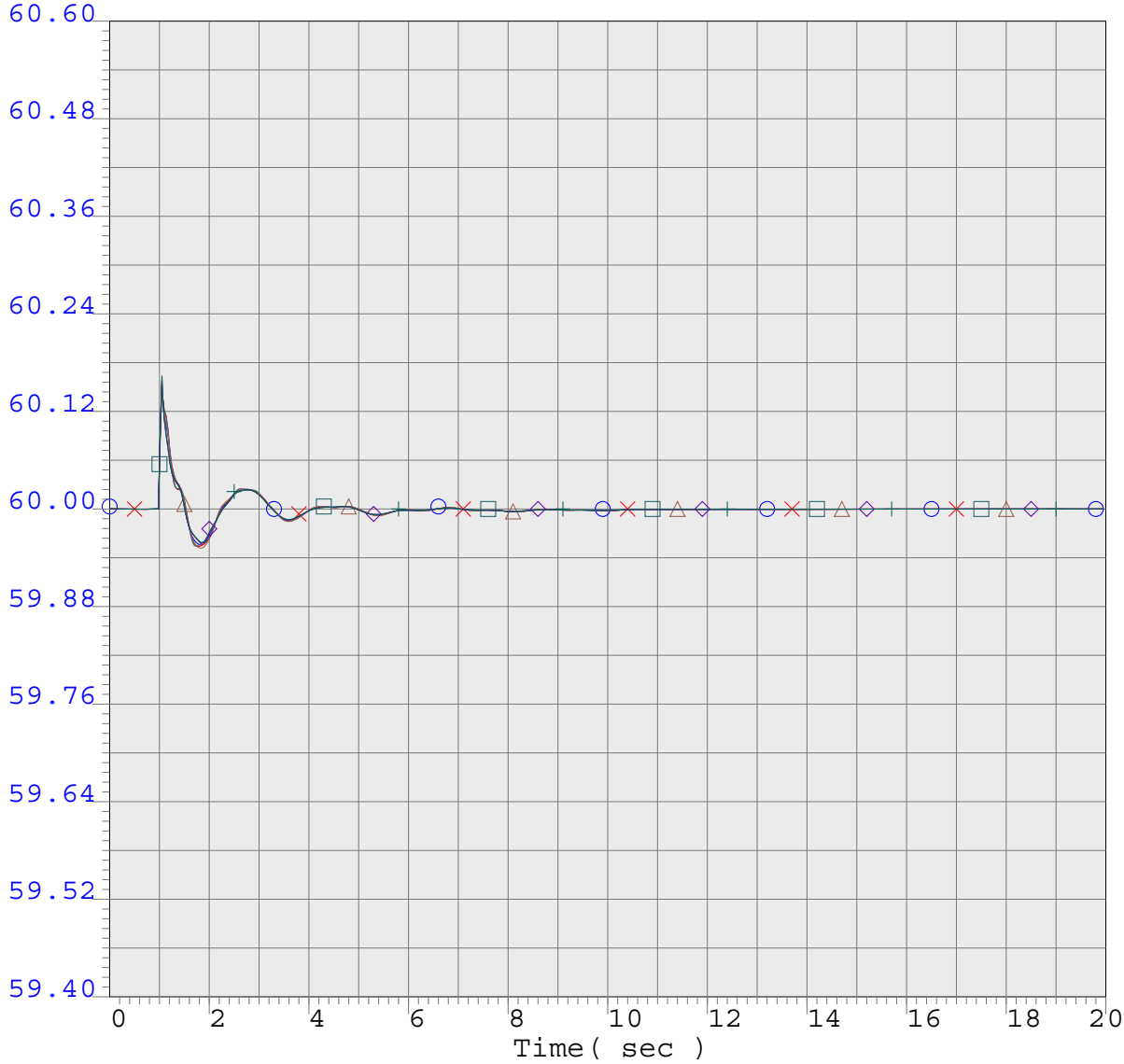
Mon Oct 19 00:52:32 2009

Select TID System Parameters
Frequency (Hz)




| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 59.4000 | fbul | 38442 | AUGUST | 115.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbul | 38534 | GRAY115 | 115.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 38535 | GRAY69 | 69.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 38432 | OAKDLTID | 115.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 38400 | WALNT | 230.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 38410 | WESTL115 | 115.0 | 0 | 0.0 | 1 | 1 | 60.6000 |

2012 Summer Peak Base Case



2012_sum_pk_pst_202_LOSBANOS-MIDWAY_500.chf

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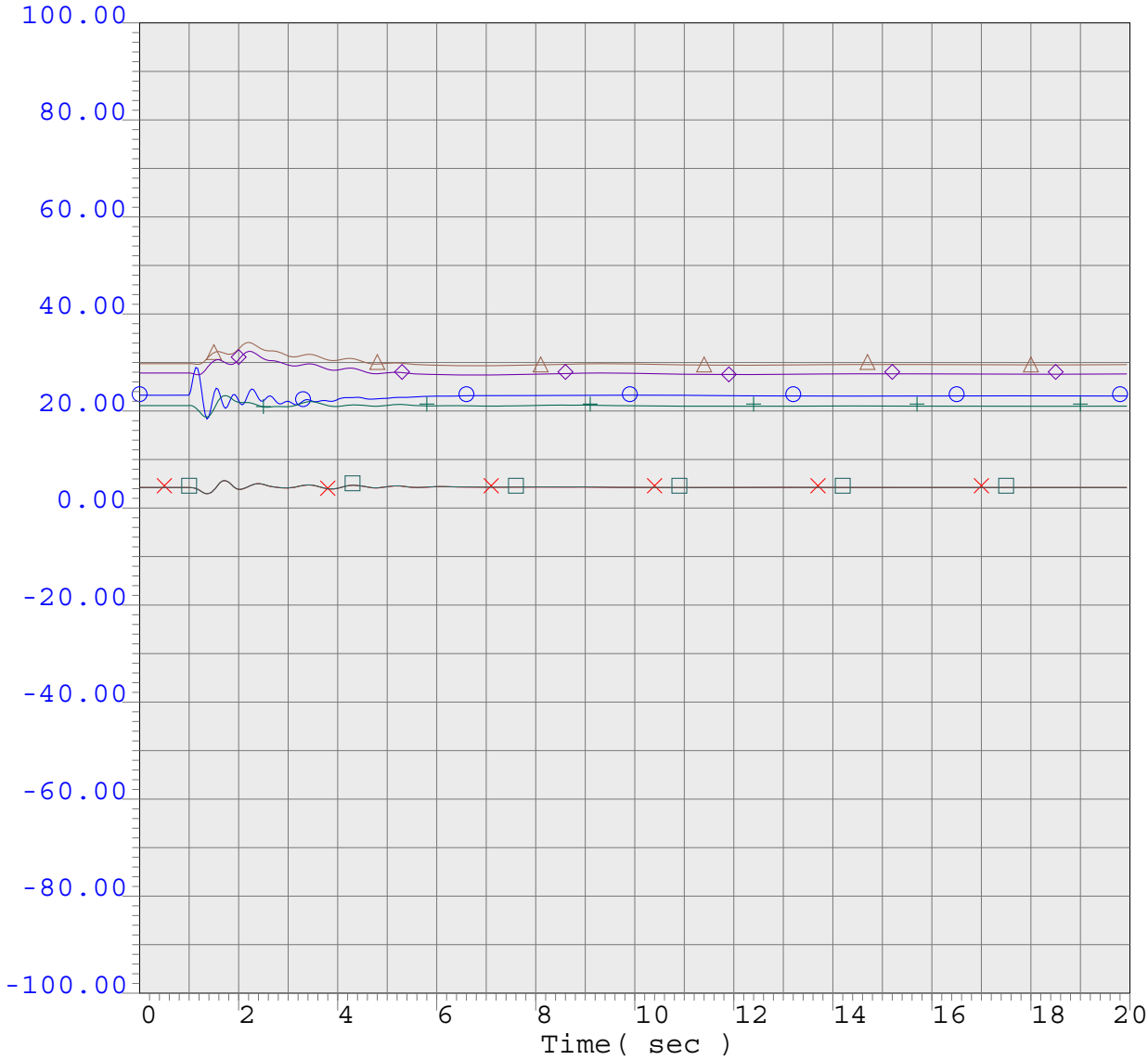
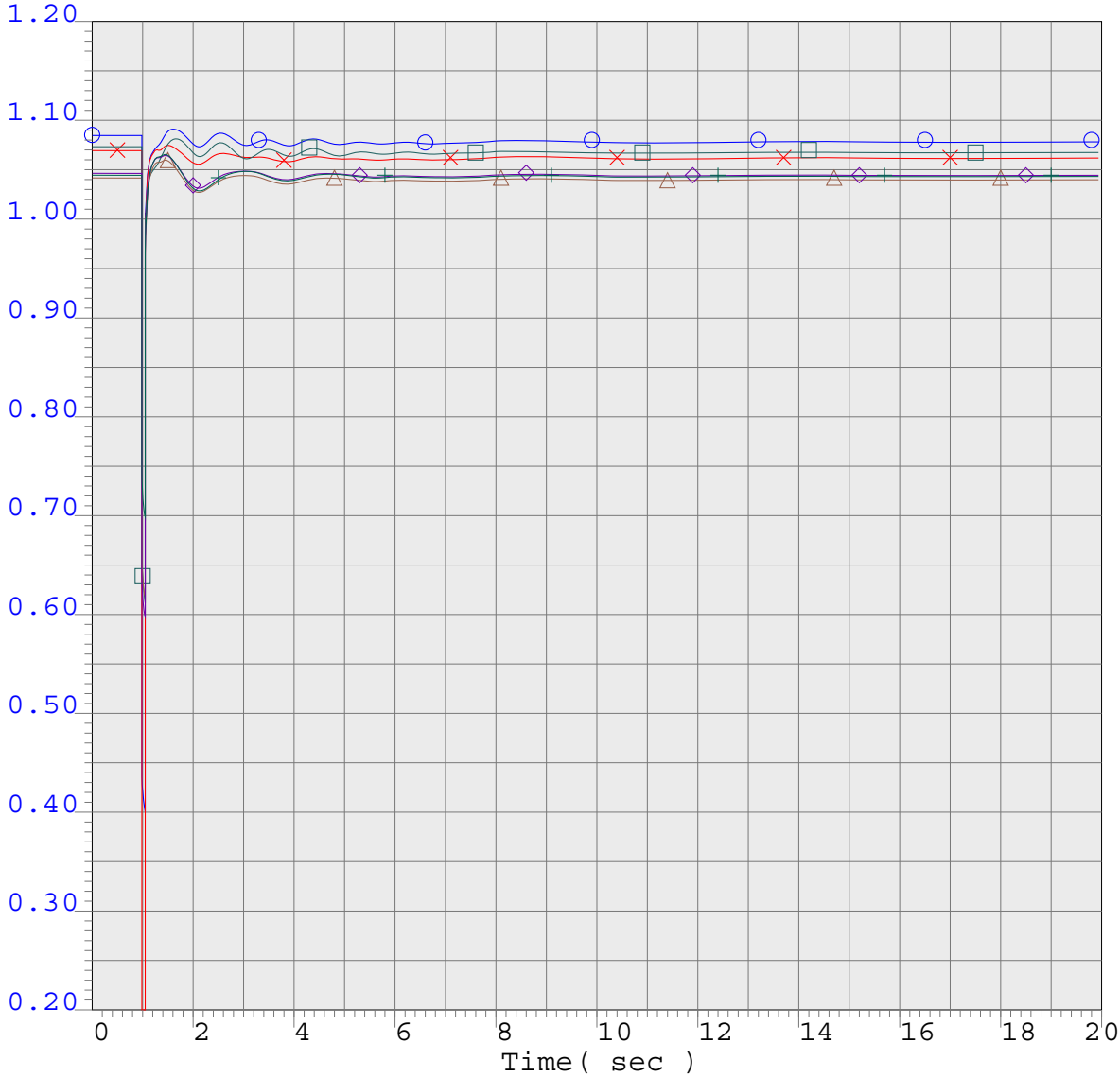
Select TID System Parameters
Relative Rotor Angle (degrees)




| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| -100.0000 ang | 38564 | ALMONDCT | 13.8 | 0 | 0.0 | 1 | 1 | 100.0000 |
| -100.0000 ang | 38550 | DONPDRO1 | 13.8 | 0 | 0.0 | 1 | 1 | 100.0000 |
| -100.0000 ang | 38552 | DONPDRO2 | 13.8 | 0 | 0.0 | 1 | 1 | 100.0000 |
| -100.0000 ang | 38570 | WEC1-CT | 13.8 | 0 | 0.0 | 1 | 1 | 100.0000 |
| -100.0000 ang | 38574 | WEC2-CT | 13.8 | 0 | 0.0 | 1 | 1 | 100.0000 |
| -100.0000 ang | 38572 | WEC3-ST | 13.8 | 0 | 0.0 | 1 | 1 | 100.0000 |

# 500 kV Bulk System Parameters
Voltage (p.u.)




| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 0.2000 | vbus | 30055 | GATES | 500.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 30050 | LOSBANOS | 500.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 30060 | MIDWAY | 500.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 30040 | TESLA | 500.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 30035 | TRACY | 500.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 30030 | VACA-DIX | 500.0 | 0 | 0.0 | 1 | 1 | 1.2000 |

2012 Summer Peak Base Case



2012_sum_pk_pst_202_LOSBANOS-MIDWAY_500.chf

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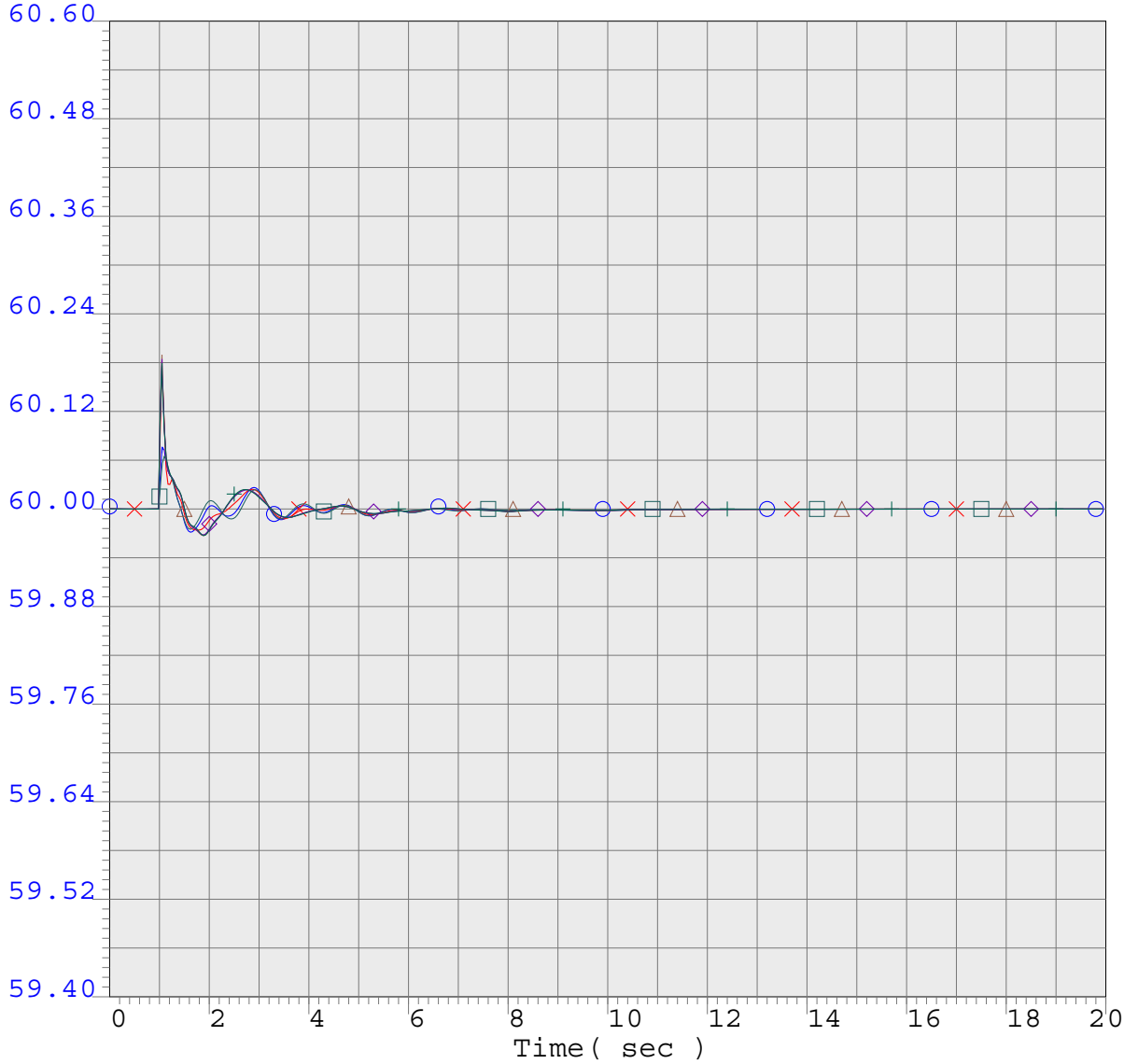
# 500 kV Bulk System Parameters
Frequency (Hz)




| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 59.4000 | fbus | 30055 | GATES | 500.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 30050 | LOSBANOS | 500.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 30060 | MIDWAY | 500.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 30040 | TESLA | 500.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 30035 | TRACY | 500.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 30030 | VACA-DIX | 500.0 | 0 | 0.0 | 1 | 1 | 60.6000 |

2012 Summer Peak Base Case



2012_sum_pk_pst_202_LOSBANOS-MIDWAY_500.chf

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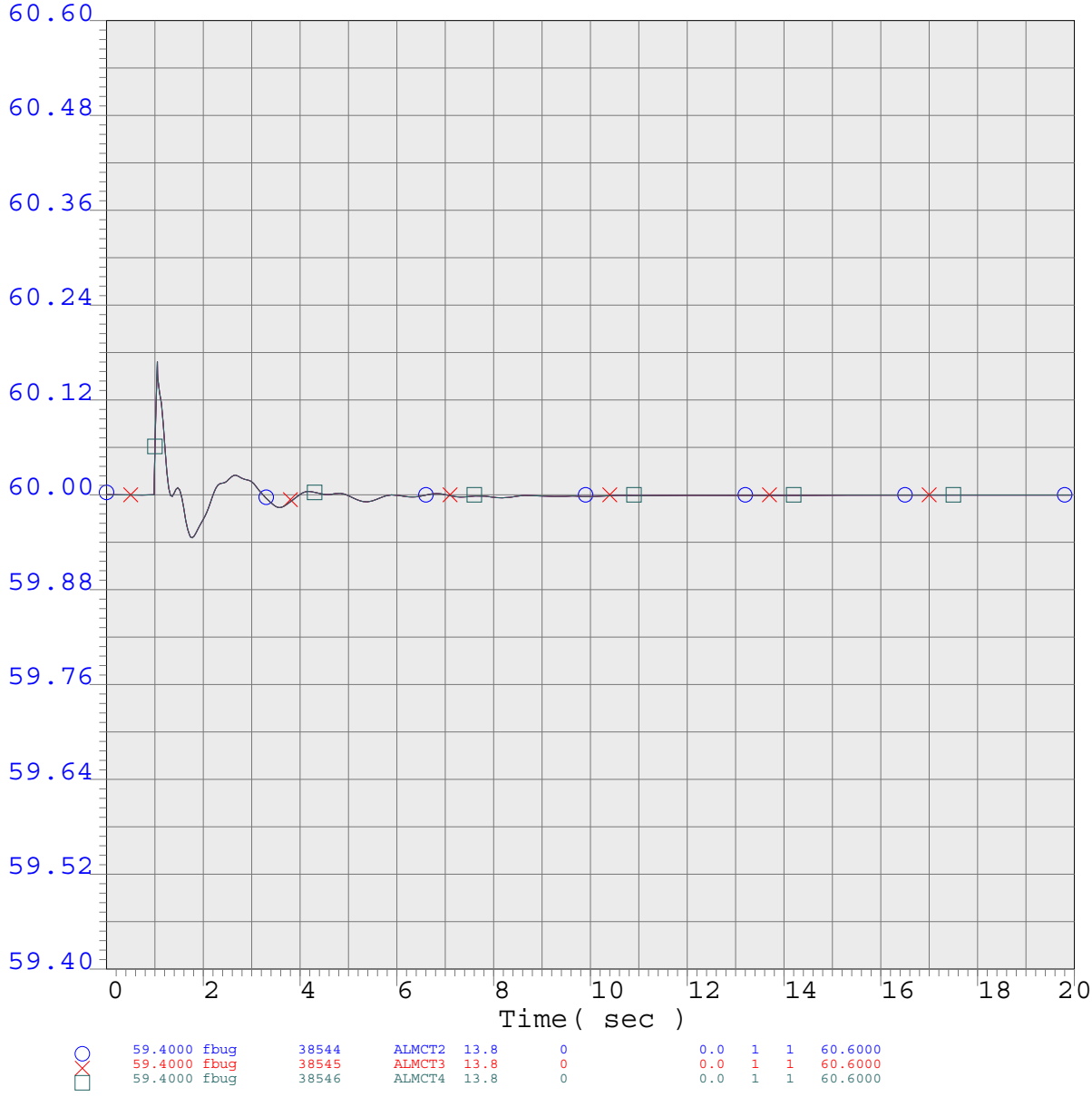
# Transient Stability Plots

# Los Banos-Tesla 500 kV Line Out

# Almond 2 Power Plant
## Frequency (Hz)




2012 Summer Peak Base Case



2012_sum_pk_pst_203_LOSBANOS-TESLA_500.chf

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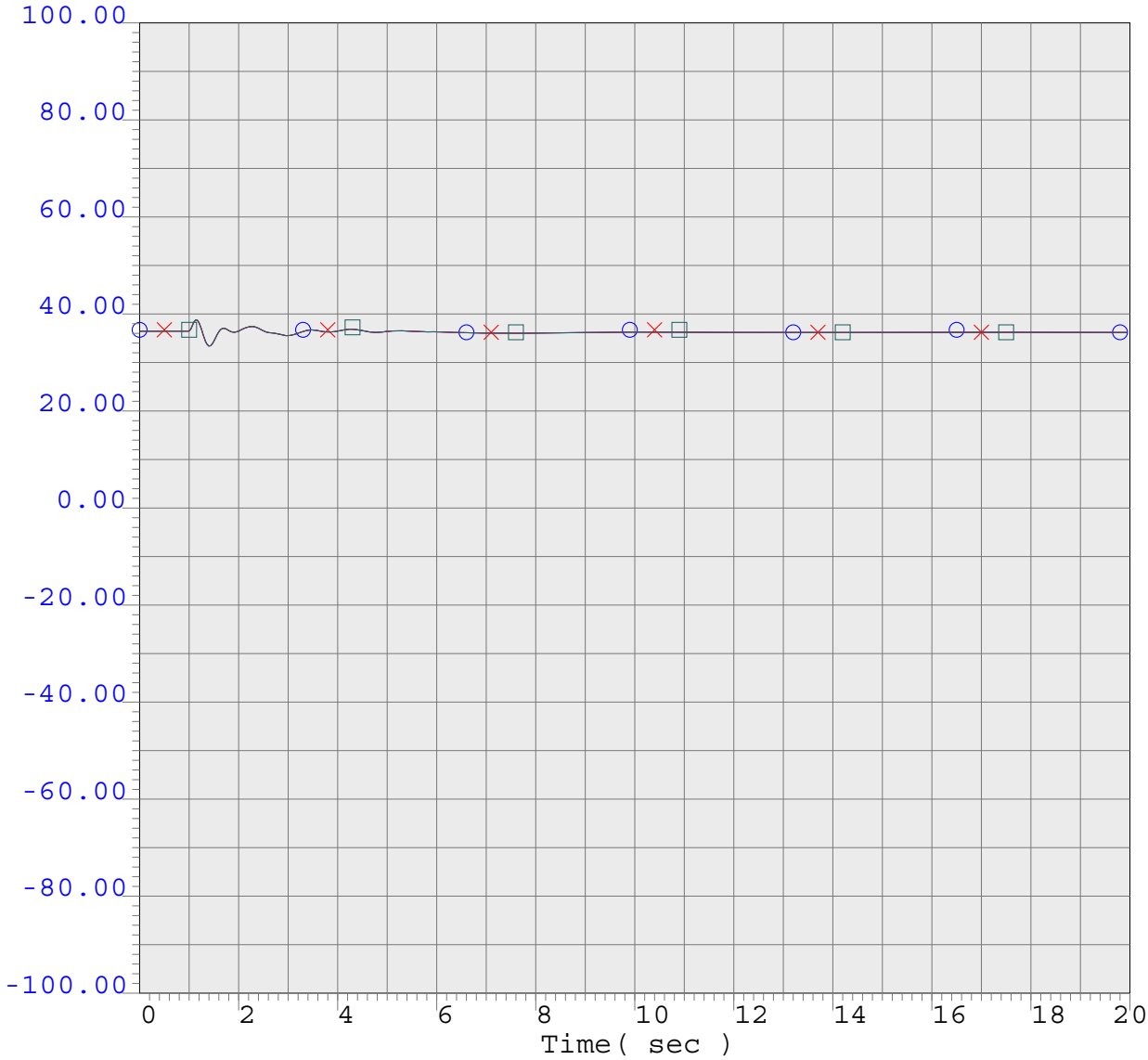
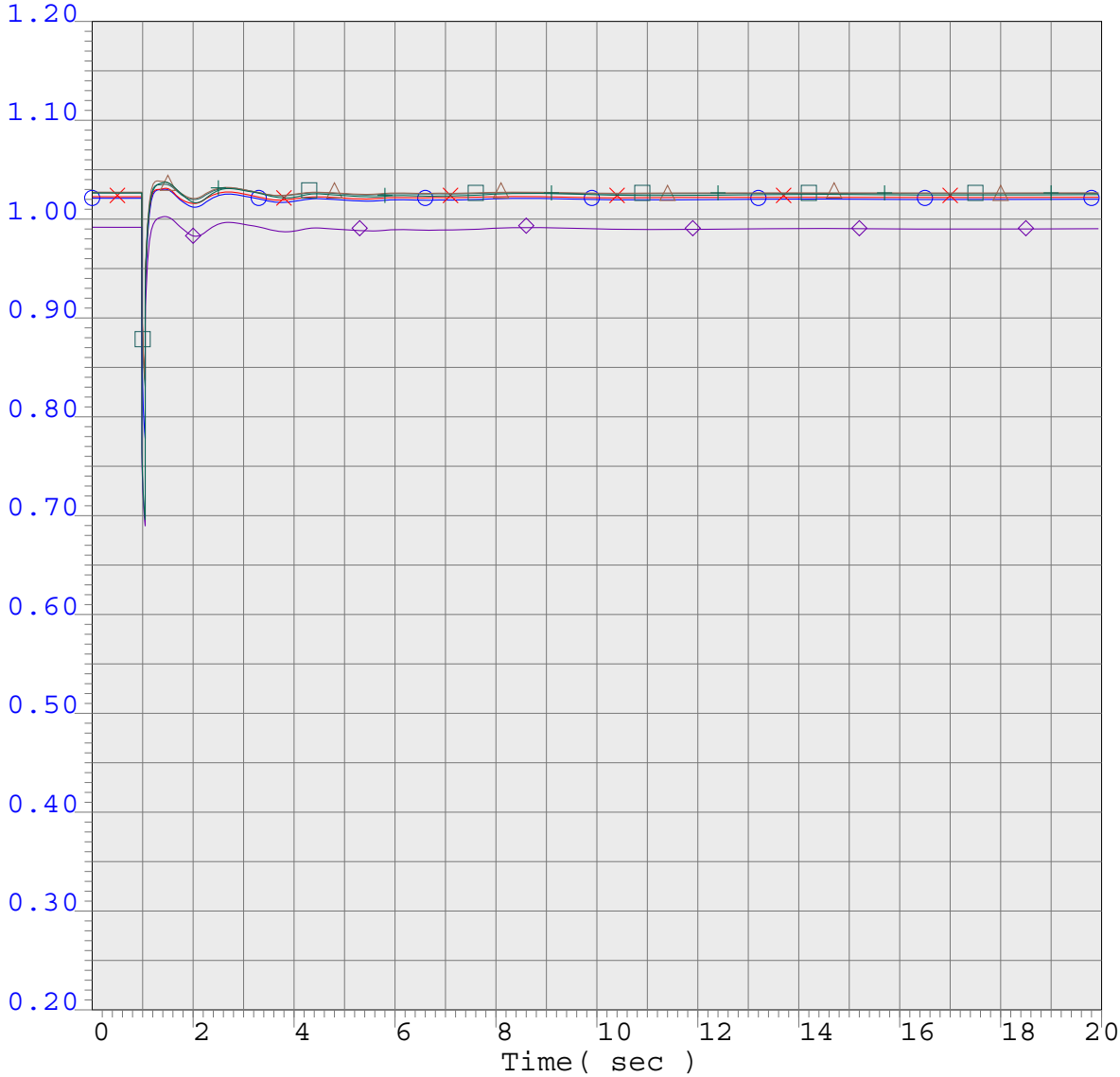
Mon Oct 19 00:52:37 2009

Almond 2 Power Plant
Relative Rotor Angle (degrees)




| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| -100.0000 ang | 38544 | ALMCT2 | 13.8 | 0 | 0.0 | 1 | 1 | 100.0000 |
| -100.0000 ang | 38545 | ALMCT3 | 13.8 | 0 | 0.0 | 1 | 1 | 100.0000 |
| -100.0000 ang | 38546 | ALMCT4 | 13.8 | 0 | 0.0 | 1 | 1 | 100.0000 |

Select TID System Parameters
Voltage (p.u.)




| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 0.2000 | vbul | 38442 | AUGUST | 115.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbul | 38534 | GRAY115 | 115.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 38535 | GRAY69 | 69.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 38432 | OAKDLTID | 115.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 38400 | WALNT | 230.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 38410 | WESTL115 | 115.0 | 0 | 0.0 | 1 | 1 | 1.2000 |

2012 Summer Peak Base Case



2012_sum_pk_pst_203_LOSBANOS-TESLA_500.chf

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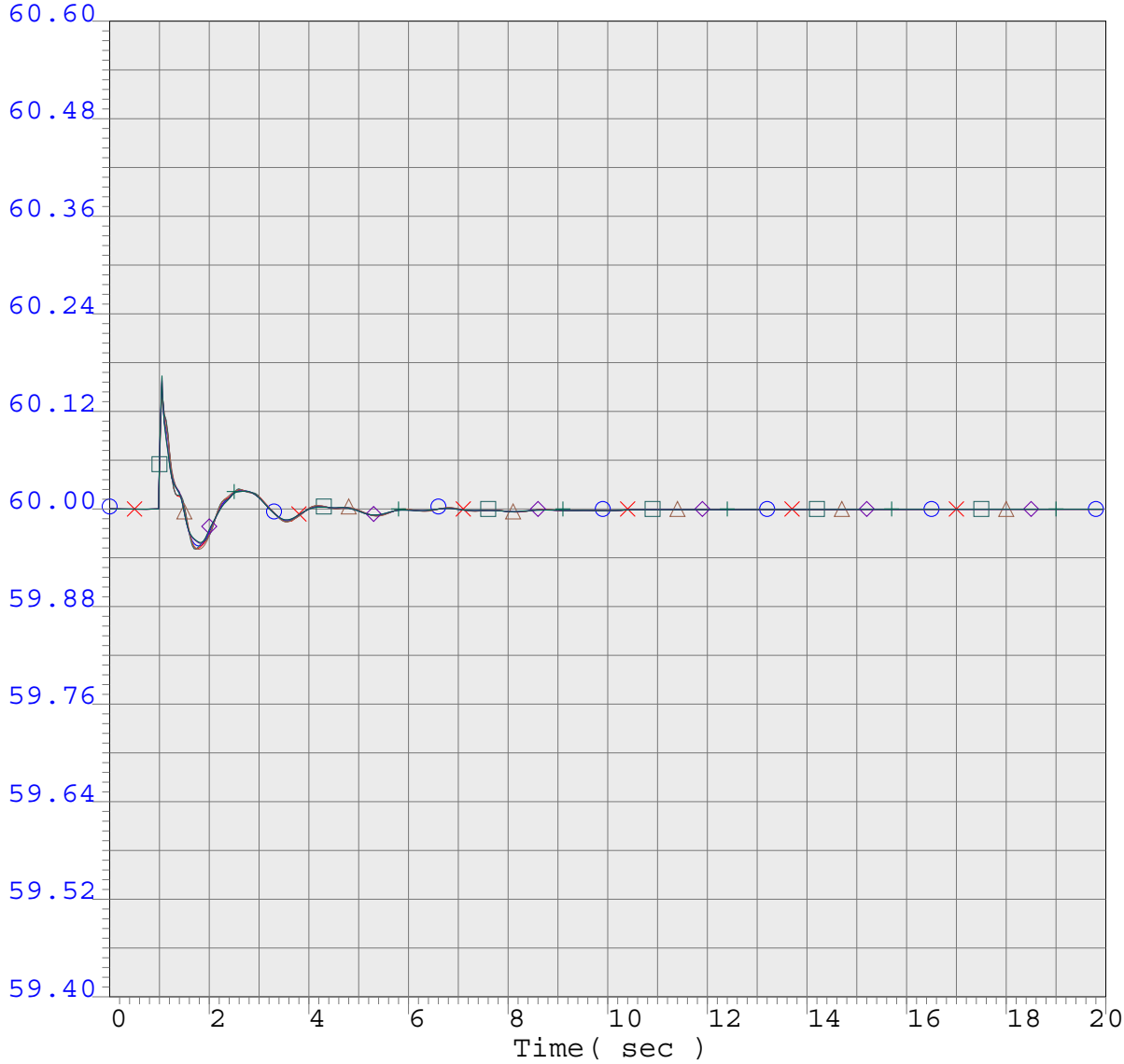
Select TID System Parameters
Frequency (Hz)




| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 59.4000 | fbul | 38442 | AUGUST | 115.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbul | 38534 | GRAY115 | 115.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 38535 | GRAY69 | 69.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 38432 | OAKDLTID | 115.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 38400 | WALNT | 230.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 38410 | WESTL115 | 115.0 | 0 | 0.0 | 1 | 1 | 60.6000 |

2012 Summer Peak Base Case



2012_sum_pk_pst_203_LOSBANOS-TESLA_500.chf

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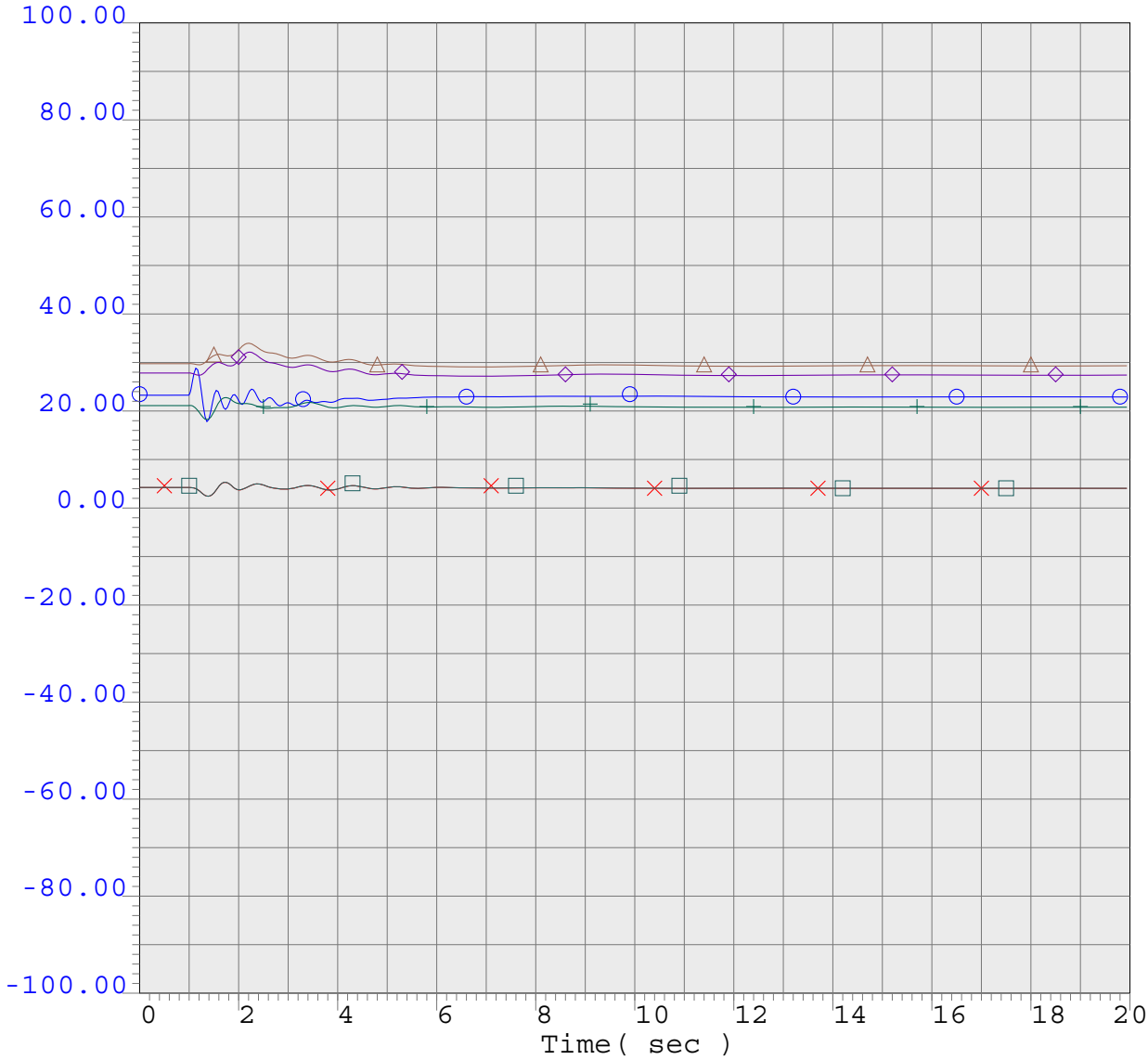
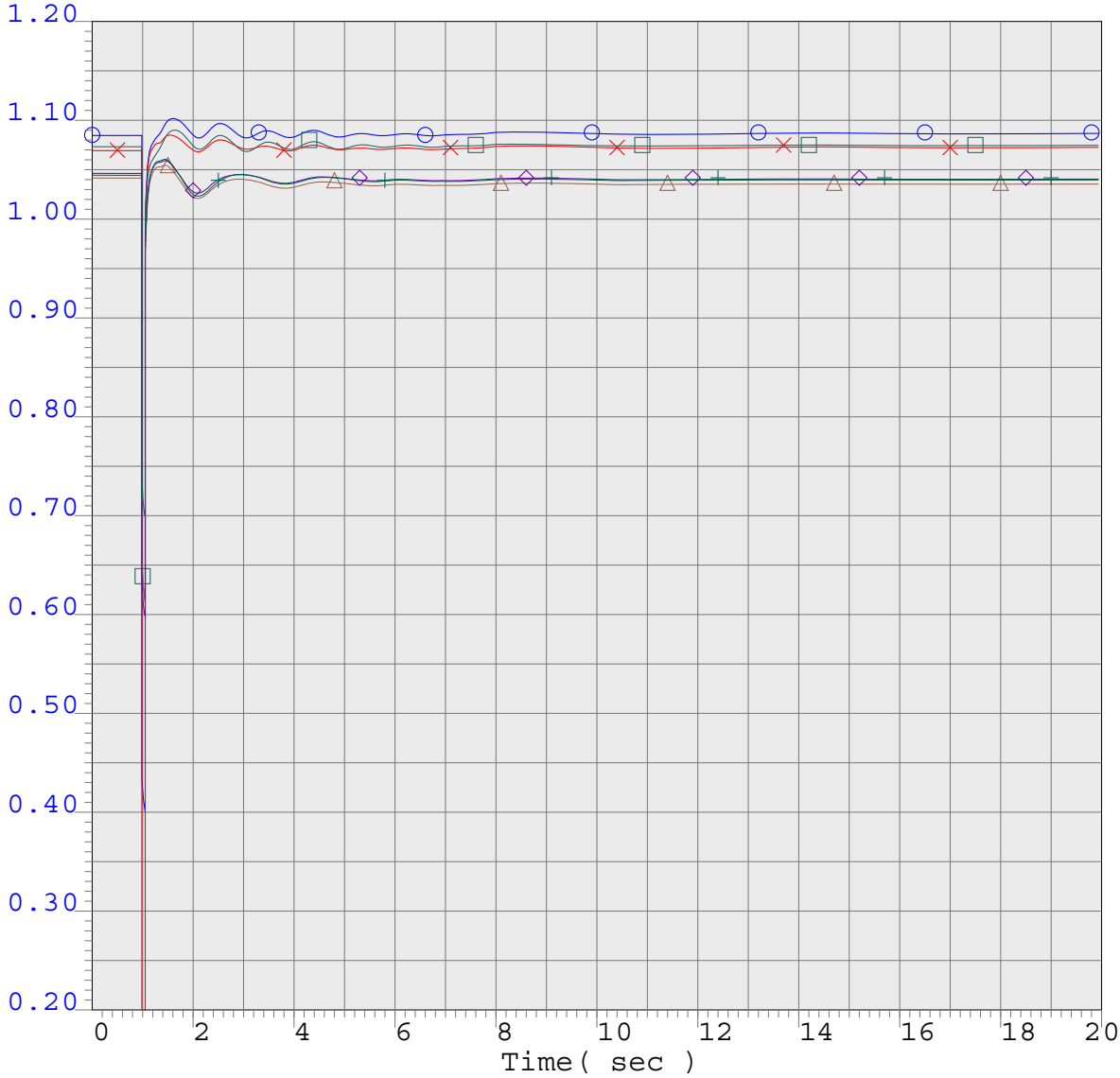
Mon Oct 19 00:52:37 2009

Select TID System Parameters
Relative Rotor Angle (degrees)




| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| -100.0000 ang | 38564 | ALMONDCT | 13.8 | 0 | 0.0 | 1 | 1 | 100.0000 |
| -100.0000 ang | 38550 | DONPDRO1 | 13.8 | 0 | 0.0 | 1 | 1 | 100.0000 |
| -100.0000 ang | 38552 | DONPDRO2 | 13.8 | 0 | 0.0 | 1 | 1 | 100.0000 |
| -100.0000 ang | 38570 | WEC1-CT | 13.8 | 0 | 0.0 | 1 | 1 | 100.0000 |
| -100.0000 ang | 38574 | WEC2-CT | 13.8 | 0 | 0.0 | 1 | 1 | 100.0000 |
| -100.0000 ang | 38572 | WEC3-ST | 13.8 | 0 | 0.0 | 1 | 1 | 100.0000 |

# 500 kV Bulk System Parameters
Voltage (p.u.)




| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 0.2000 | vbus | 30055 | GATES | 500.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 30050 | LOSBANOS | 500.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 30060 | MIDWAY | 500.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 30040 | TESLA | 500.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 30035 | TRACY | 500.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 30030 | VACA-DIX | 500.0 | 0 | 0.0 | 1 | 1 | 1.2000 |

2012 Summer Peak Base Case



2012_sum_pk_pst_203_LOSBANOS-TESLA_500.chf

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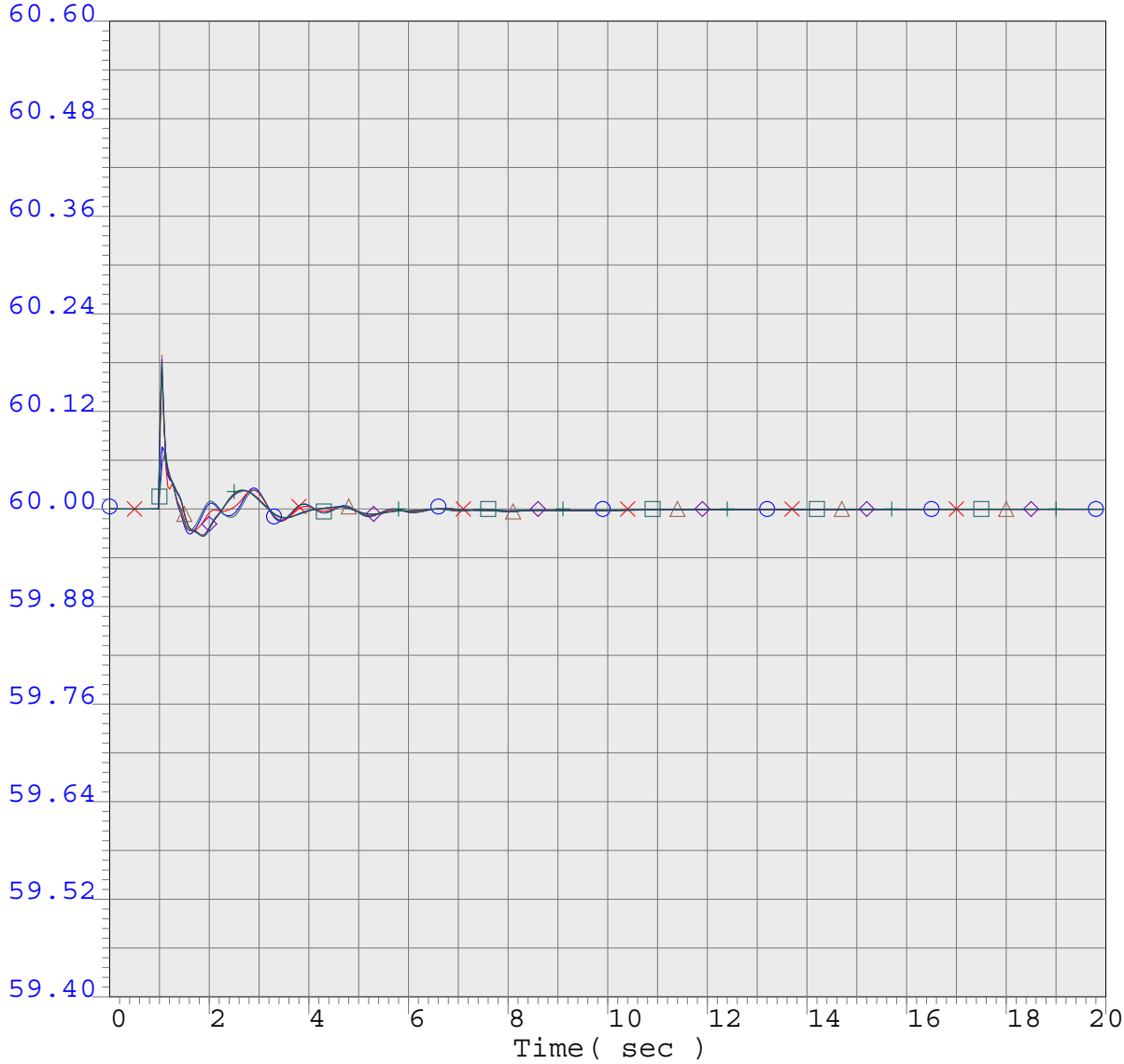
# 500 kV Bulk System Parameters
Frequency (Hz)




| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 59.4000 | fbus | 30055 | GATES | 500.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 30050 | LOSBANOS | 500.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 30060 | MIDWAY | 500.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 30040 | TESLA | 500.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 30035 | TRACY | 500.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 30030 | VACA-DIX | 500.0 | 0 | 0.0 | 1 | 1 | 60.6000 |

2012 Summer Peak Base Case



2012_sum_pk_pst_203_LOSBANOS-TESLA_500.chf

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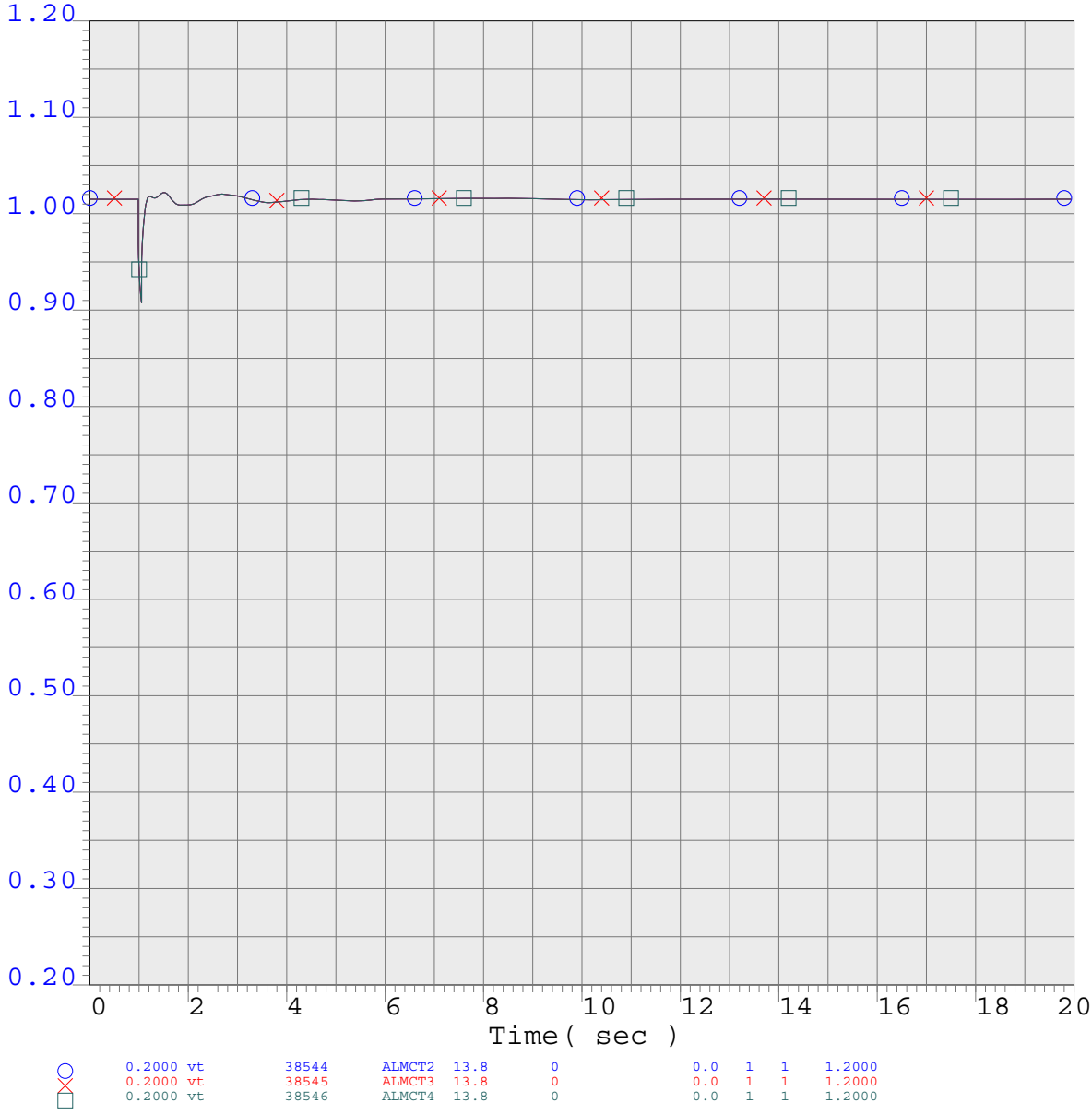
# Almond 2 Power Plant
# Terminal Voltage (p.u.)




2012 Summer Peak Base Case



2012_sum_pk_pst_203_LOSBANOS-TESLA_500.chf

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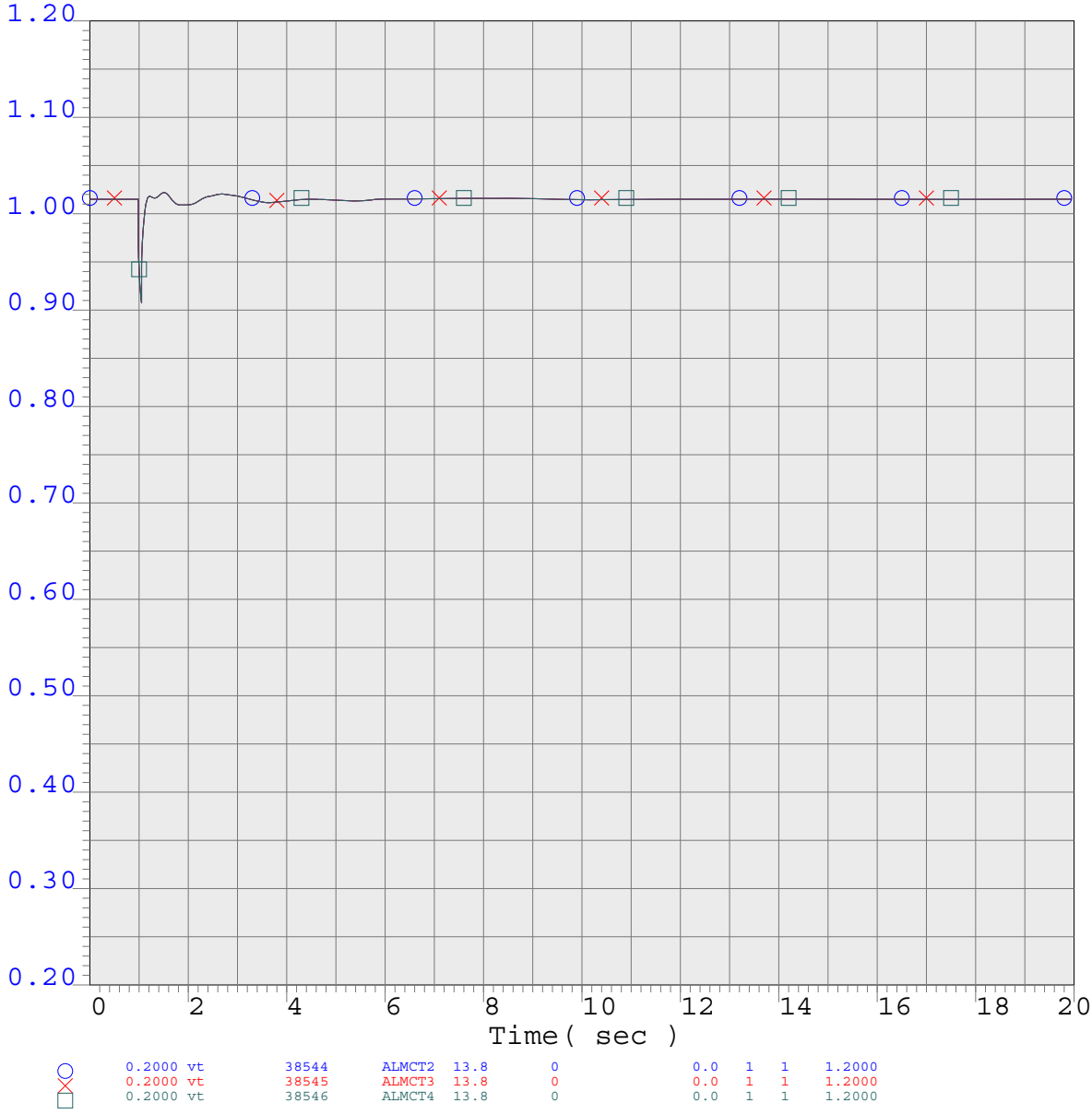
Mon Oct 19 00:52:37 2009

# Transient Stability Plots

# Los Banos-Tracy 500 kV Line Out

# Almond 2 Power Plant
# Terminal Voltage (p.u.)




2012 Summer Peak Base Case



2012_sum_pk_pst_204_LOSBANOS-TRACY_500.chf

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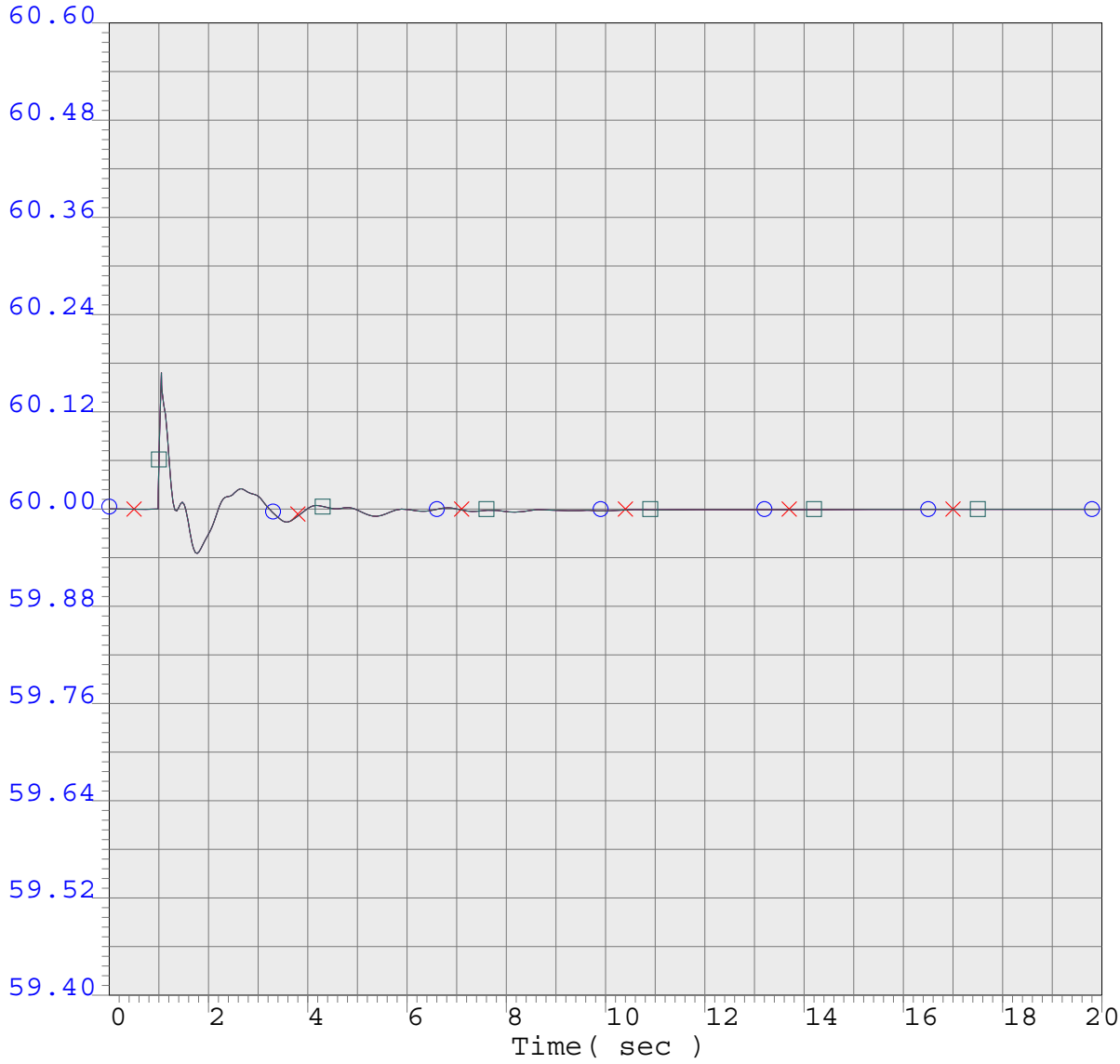
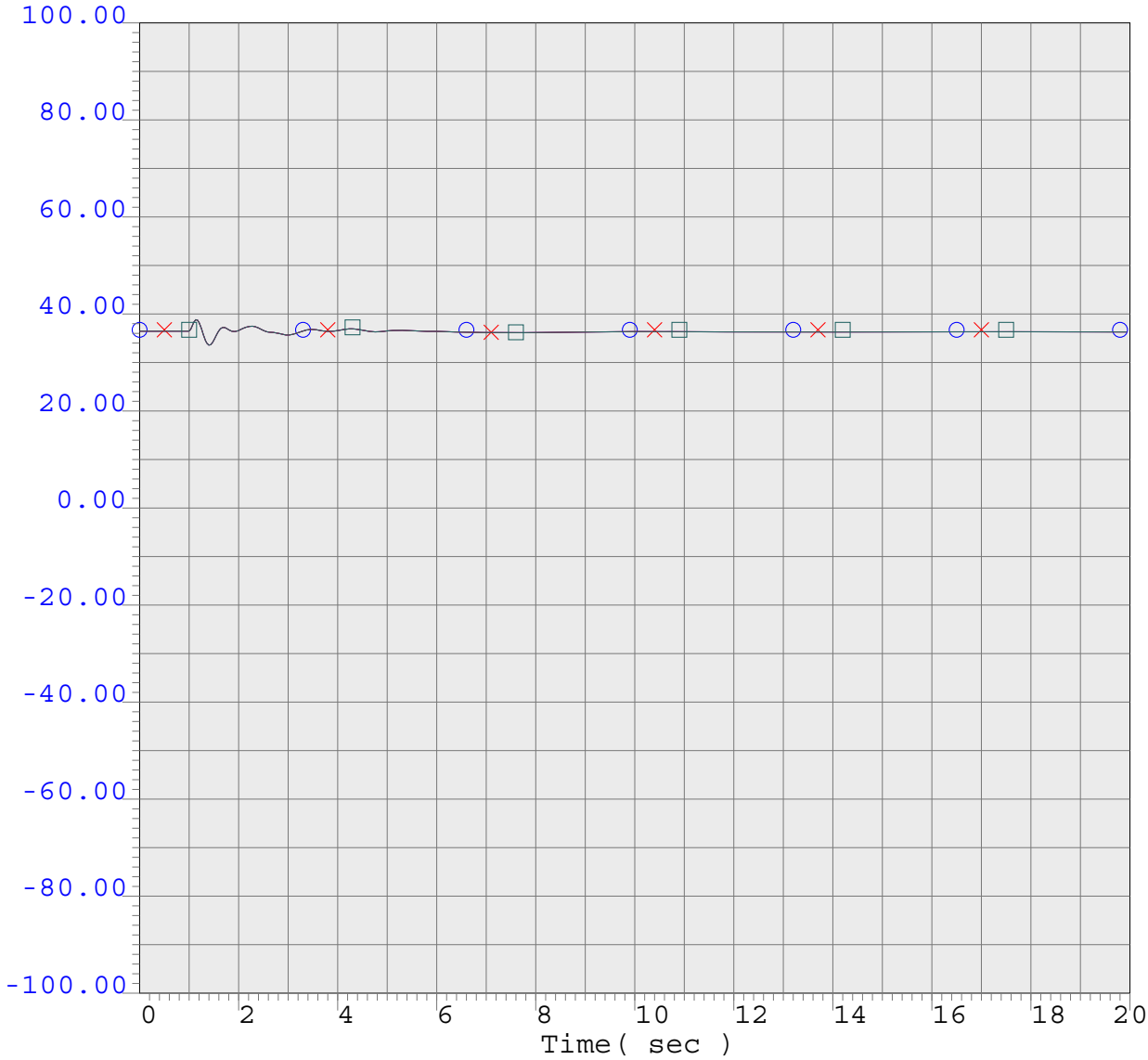
Mon Oct 19 00:52:45 2009

Almond 2 Power Plant
Frequency (Hz)



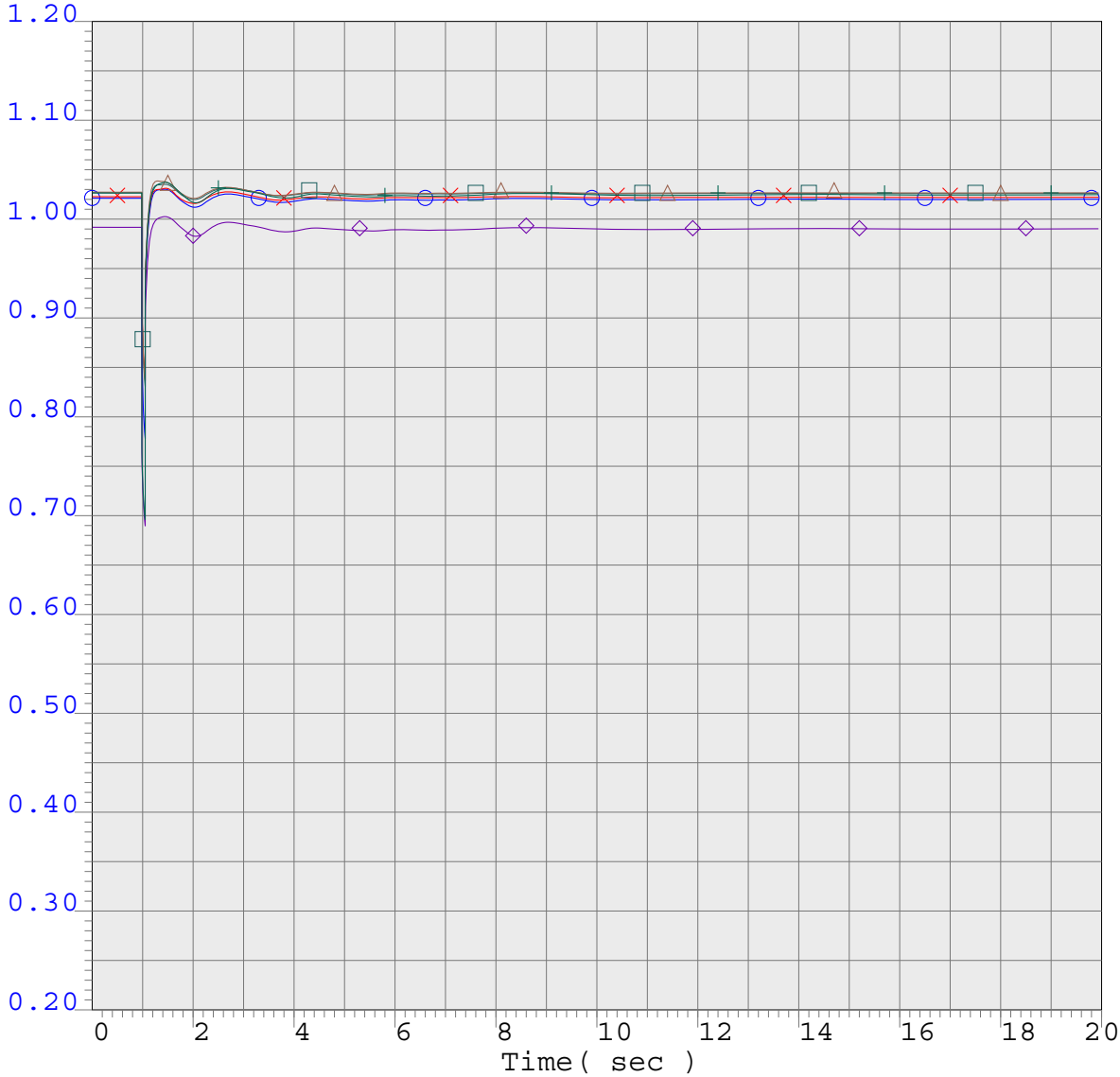

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| ○ | 59.4000 | fbug | 38544 | ALMCT2 | 13.8 | 0 | 0.0 | 1 | 1 | 60.6000 |
| × | 59.4000 | fbug | 38545 | ALMCT3 | 13.8 | 0 | 0.0 | 1 | 1 | 60.6000 |
| □ | 59.4000 | fbug | 38546 | ALMCT4 | 13.8 | 0 | 0.0 | 1 | 1 | 60.6000 |

# Almond 2 Power Plant
## Relative Rotor Angle (degrees)




| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| -100.0000 ang | 38544 | ALMCT2 | 13.8 | 0 | 0.0 | 1 | 1 | 100.0000 |
| -100.0000 ang | 38545 | ALMCT3 | 13.8 | 0 | 0.0 | 1 | 1 | 100.0000 |
| -100.0000 ang | 38546 | ALMCT4 | 13.8 | 0 | 0.0 | 1 | 1 | 100.0000 |

Select TID System Parameters
Voltage (p.u.)




| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 0.2000 | vbul | 38442 | AUGUST | 115.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbul | 38534 | GRAY115 | 115.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 38535 | GRAY69 | 69.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 38432 | OAKDLTID | 115.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 38400 | WALNT | 230.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 38410 | WESTL115 | 115.0 | 0 | 0.0 | 1 | 1 | 1.2000 |

2012 Summer Peak Base Case



2012_sum_pk_pst_204_LOSBANOS-TRACY_500.chf

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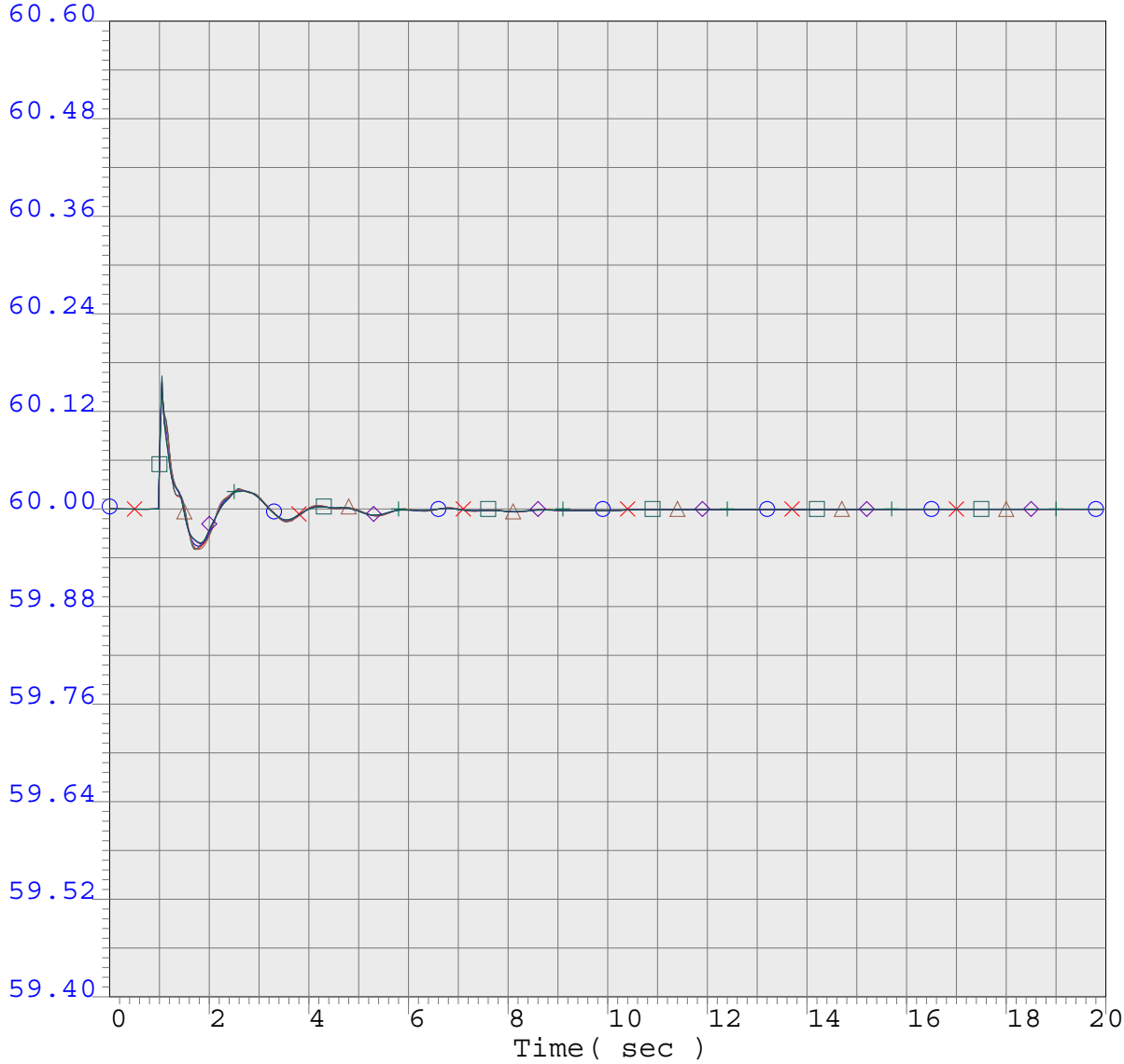
Select TID System Parameters
Frequency (Hz)




| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 59.4000 | fbul | 38442 | AUGUST | 115.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbul | 38534 | GRAY115 | 115.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 38535 | GRAY69 | 69.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 38432 | OAKDLTID | 115.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 38400 | WALNT | 230.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 38410 | WESTL115 | 115.0 | 0 | 0.0 | 1 | 1 | 60.6000 |

2012 Summer Peak Base Case



2012_sum_pk_pst_204_LOSBANOS-TRACY_500.chf

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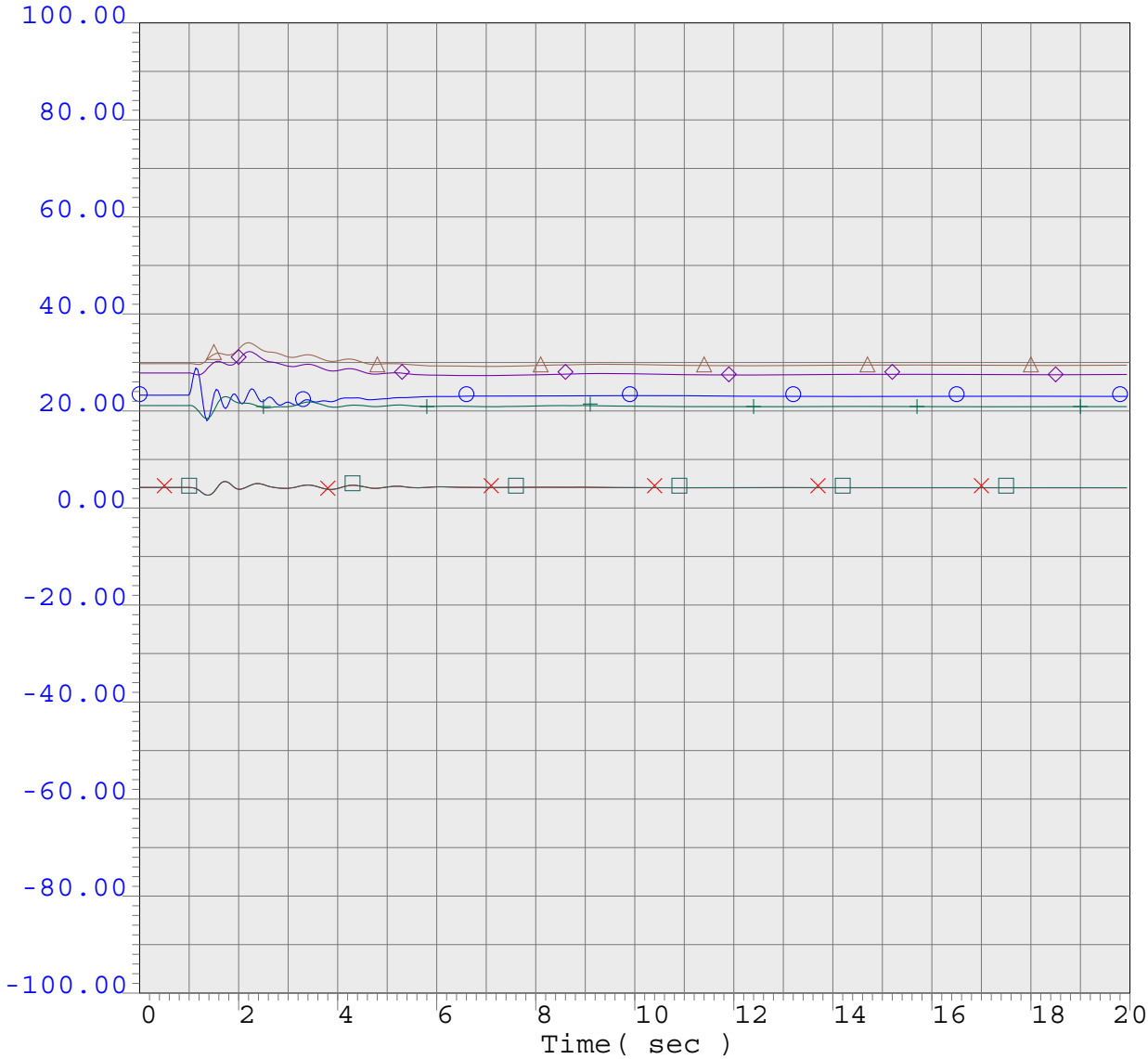
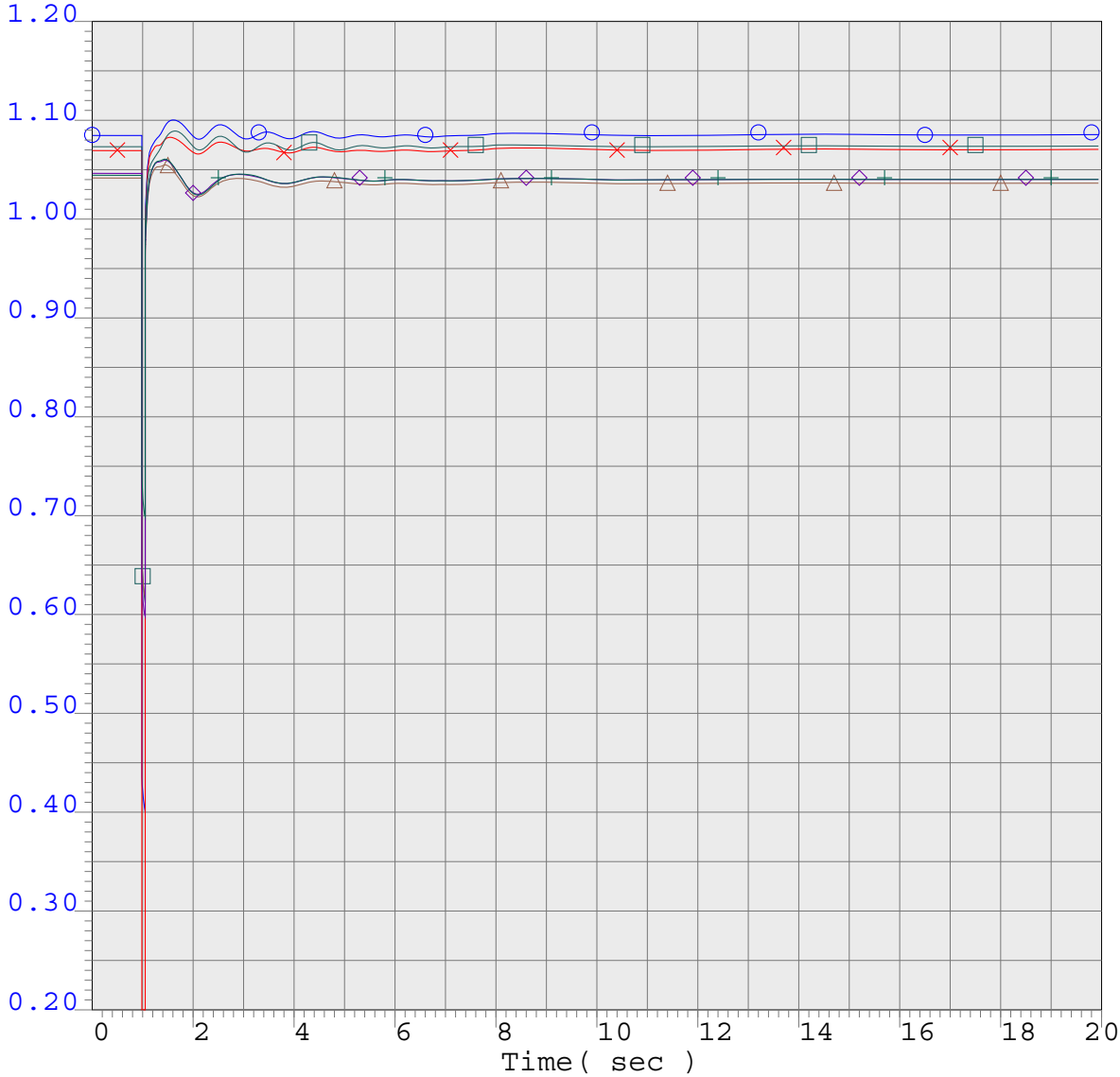
Select TID System Parameters
Relative Rotor Angle (degrees)




| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| -100.0000 ang | 38564 | ALMONDCT | 13.8 | 0 | 0.0 | 1 | 1 | 100.0000 |
| -100.0000 ang | 38550 | DONPDRO1 | 13.8 | 0 | 0.0 | 1 | 1 | 100.0000 |
| -100.0000 ang | 38552 | DONPDRO2 | 13.8 | 0 | 0.0 | 1 | 1 | 100.0000 |
| -100.0000 ang | 38570 | WEC1-CT | 13.8 | 0 | 0.0 | 1 | 1 | 100.0000 |
| -100.0000 ang | 38574 | WEC2-CT | 13.8 | 0 | 0.0 | 1 | 1 | 100.0000 |
| -100.0000 ang | 38572 | WEC3-ST | 13.8 | 0 | 0.0 | 1 | 1 | 100.0000 |

# 500 kV Bulk System Parameters
Voltage (p.u.)




| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 0.2000 | vbus | 30055 | GATES | 500.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 30050 | LOSBANOS | 500.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 30060 | MIDWAY | 500.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 30040 | TESLA | 500.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 30035 | TRACY | 500.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 30030 | VACA-DIX | 500.0 | 0 | 0.0 | 1 | 1 | 1.2000 |

2012 Summer Peak Base Case



2012_sum_pk_pst_204_LOSBANOS-TRACY_500.chf

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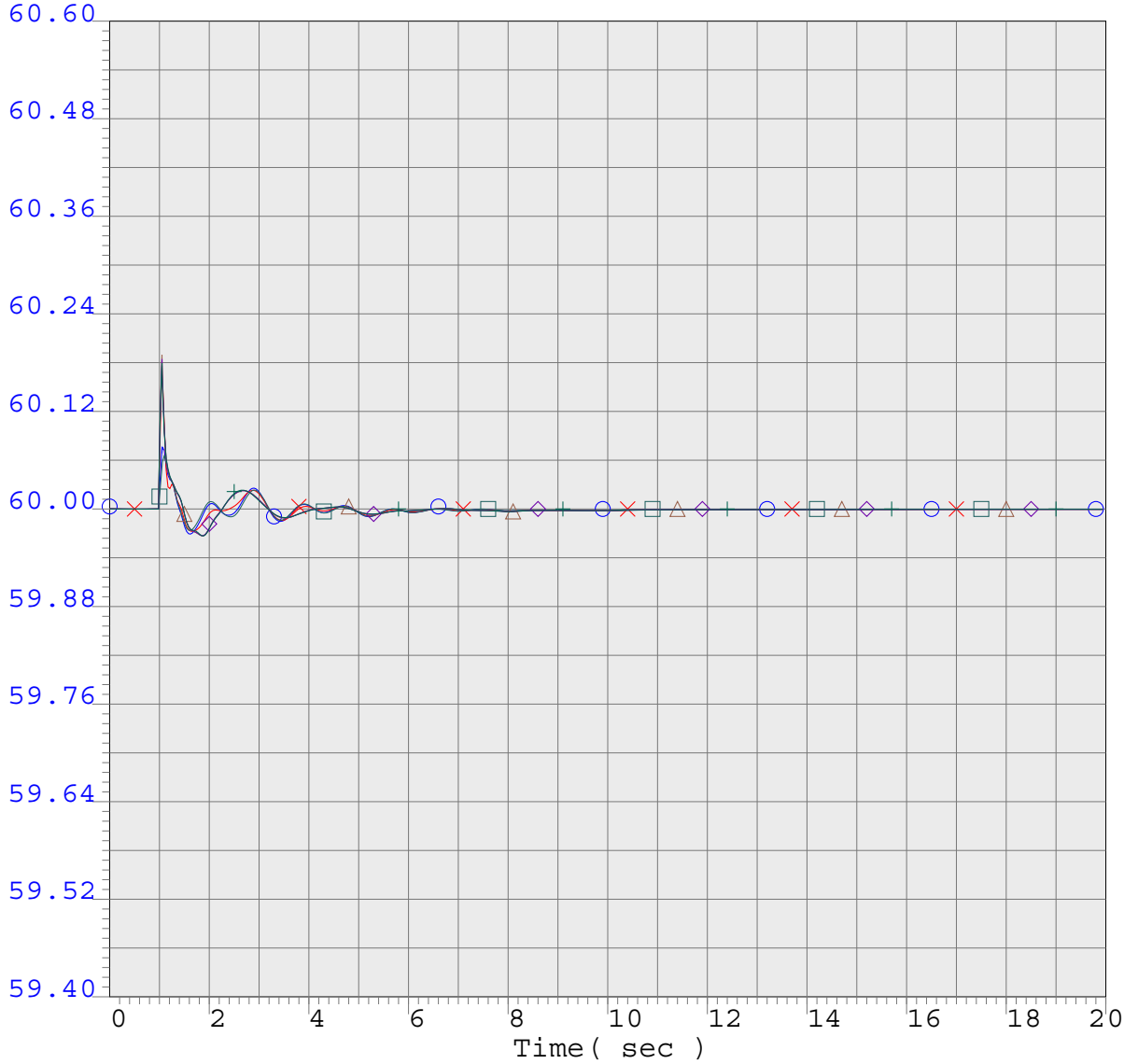
# 500 kV Bulk System Parameters
Frequency (Hz)




| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 59.4000 | fbus | 30055 | GATES | 500.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 30050 | LOSBANOS | 500.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 30060 | MIDWAY | 500.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 30040 | TESLA | 500.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 30035 | TRACY | 500.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 30030 | VACA-DIX | 500.0 | 0 | 0.0 | 1 | 1 | 60.6000 |

2012 Summer Peak Base Case



2012_sum_pk_pst_204_LOSBANOS-TRACY_500.chf

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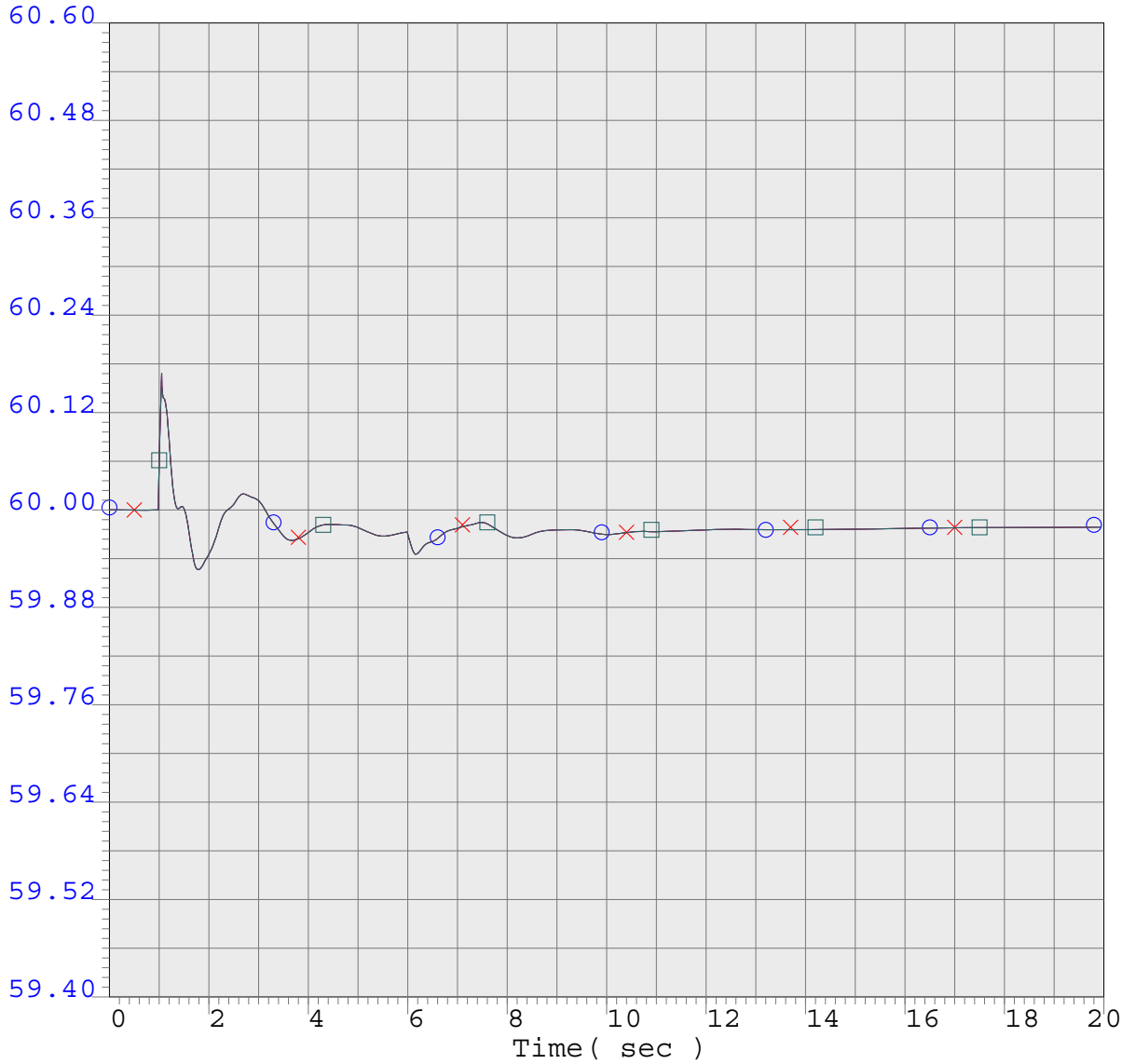
# Transient Stability Plots

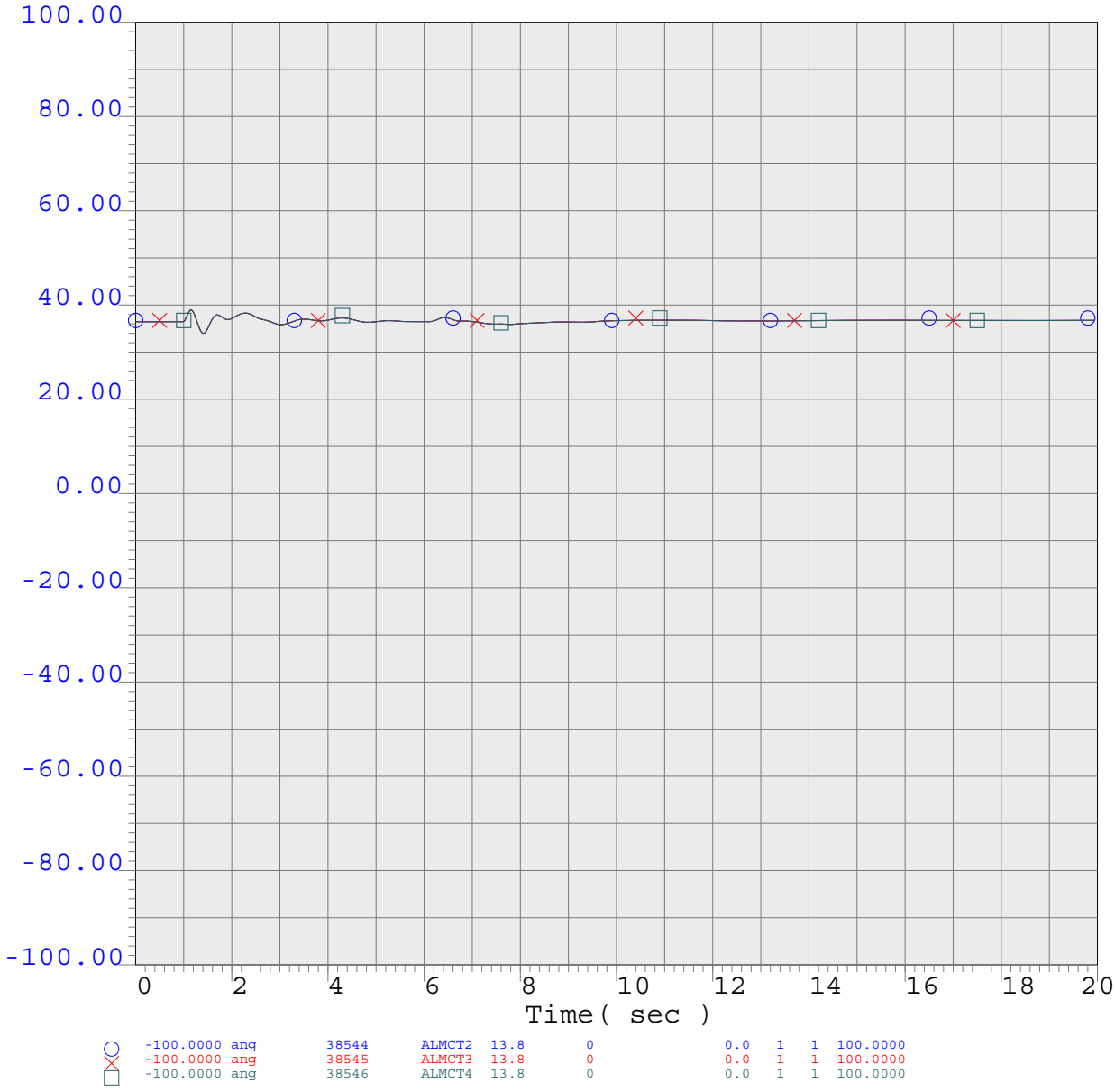
# Los Banos-Gates & Los Banos-Midway 500 kV Lines Out

Almond 2 Power Plant
Frequency (Hz)




| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| ○ | 59.4000 fbug | 38544 | ALMCT2 | 13.8 | 0 | 0.0 | 1 | 1 | 60.6000 |
| × | 59.4000 fbug | 38545 | ALMCT3 | 13.8 | 0 | 0.0 | 1 | 1 | 60.6000 |
| □ | 59.4000 fbug | 38546 | ALMCT4 | 13.8 | 0 | 0.0 | 1 | 1 | 60.6000 |

# Almond 2 Power Plant
## Relative Rotor Angle (degrees)




2012 Summer Peak Base Case



2012_sum_pk_pst_205_LOSBANOS-GATES-MIDWAY_500_DLO.chf

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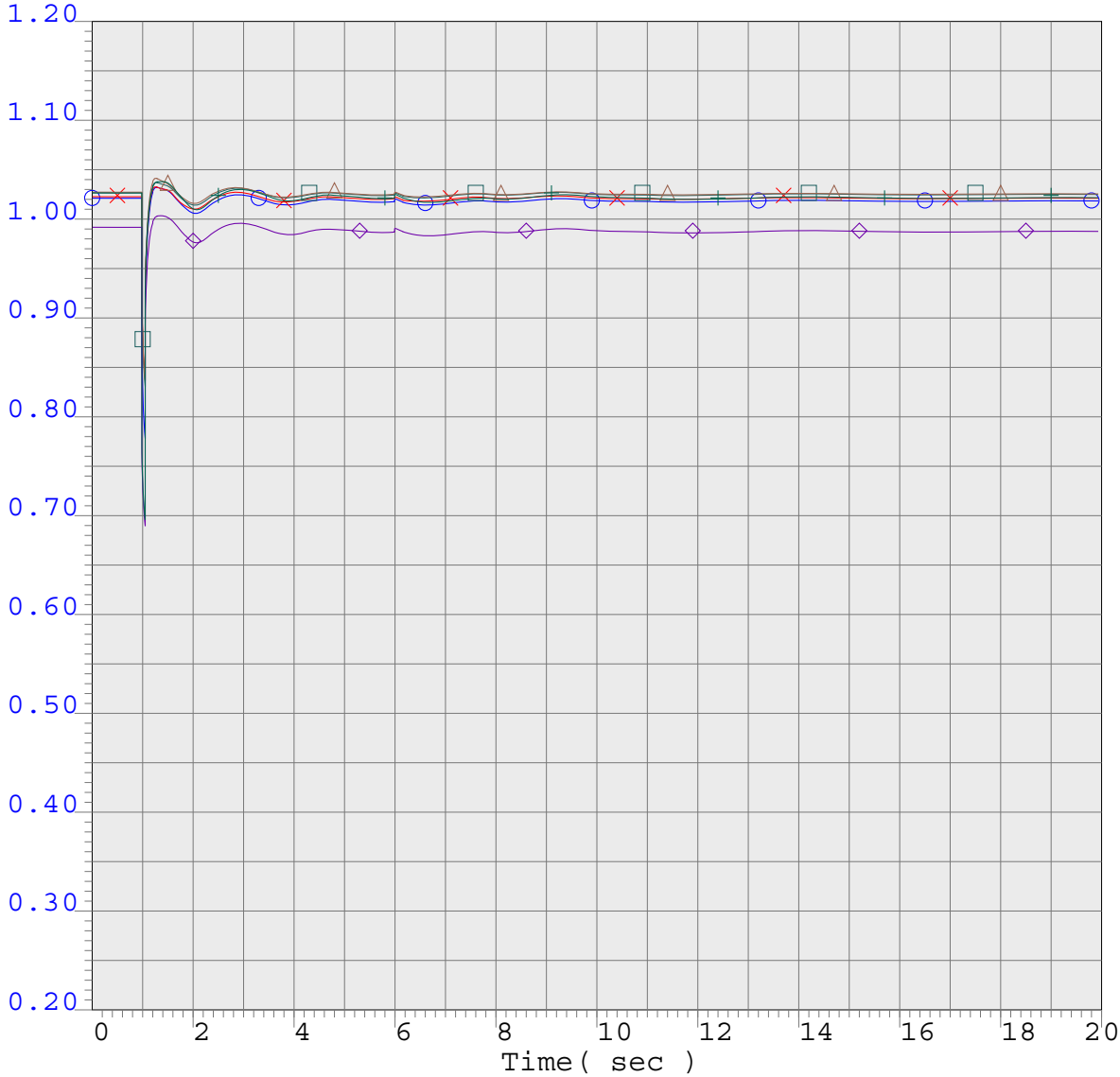
Select TID System Parameters
Voltage (p.u.)




| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 0.2000 | vbul | 38442 | AUGUST | 115.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbul | 38534 | GRAY115 | 115.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 38535 | GRAY69 | 69.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 38432 | OAKDLTID | 115.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 38400 | WALNT | 230.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 38410 | WESTL115 | 115.0 | 0 | 0.0 | 1 | 1 | 1.2000 |

2012 Summer Peak Base Case



2012_sum_pk_pst_205_LOSBANOS-GATES-MIDWAY_500_DLO.chf

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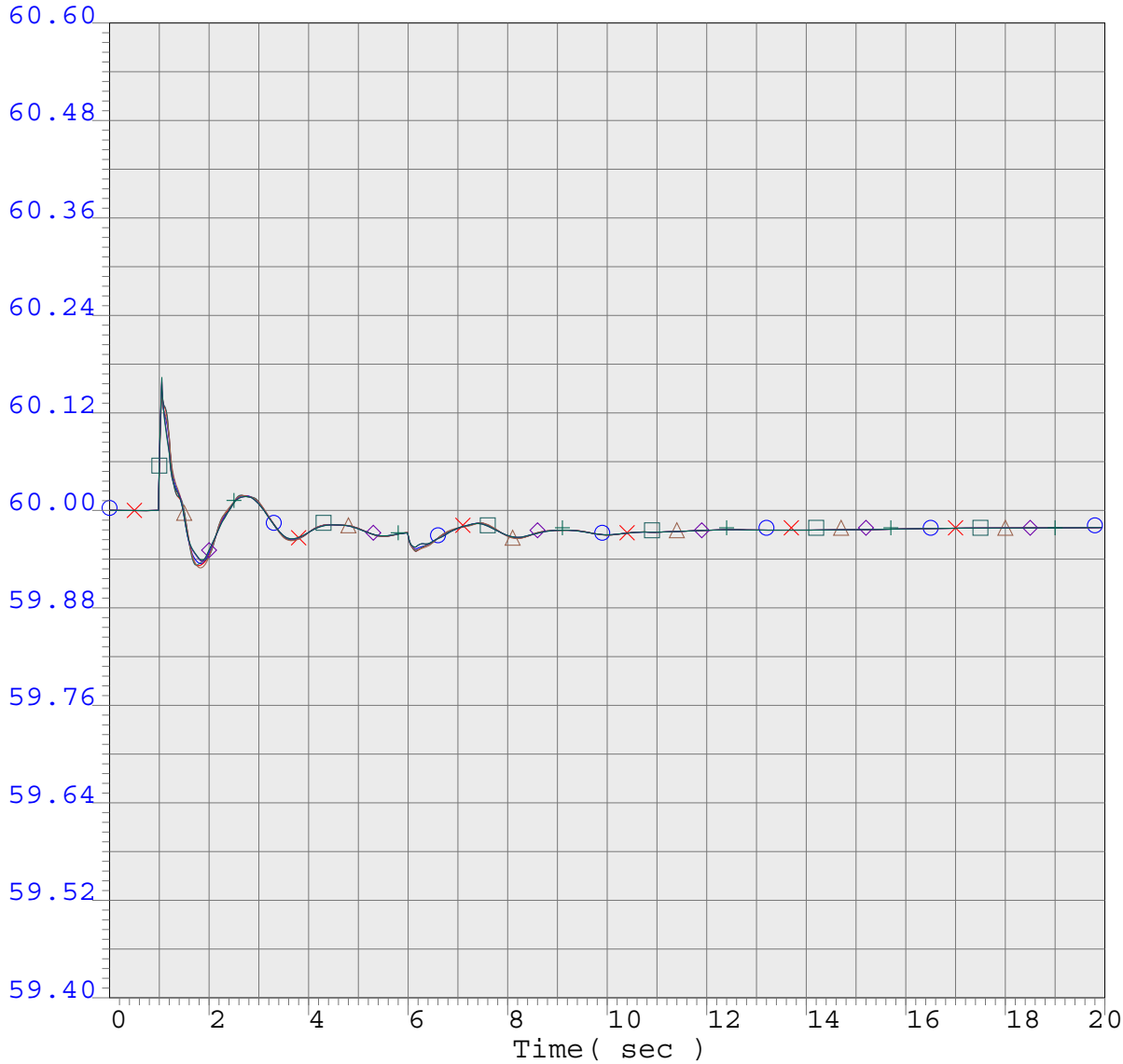
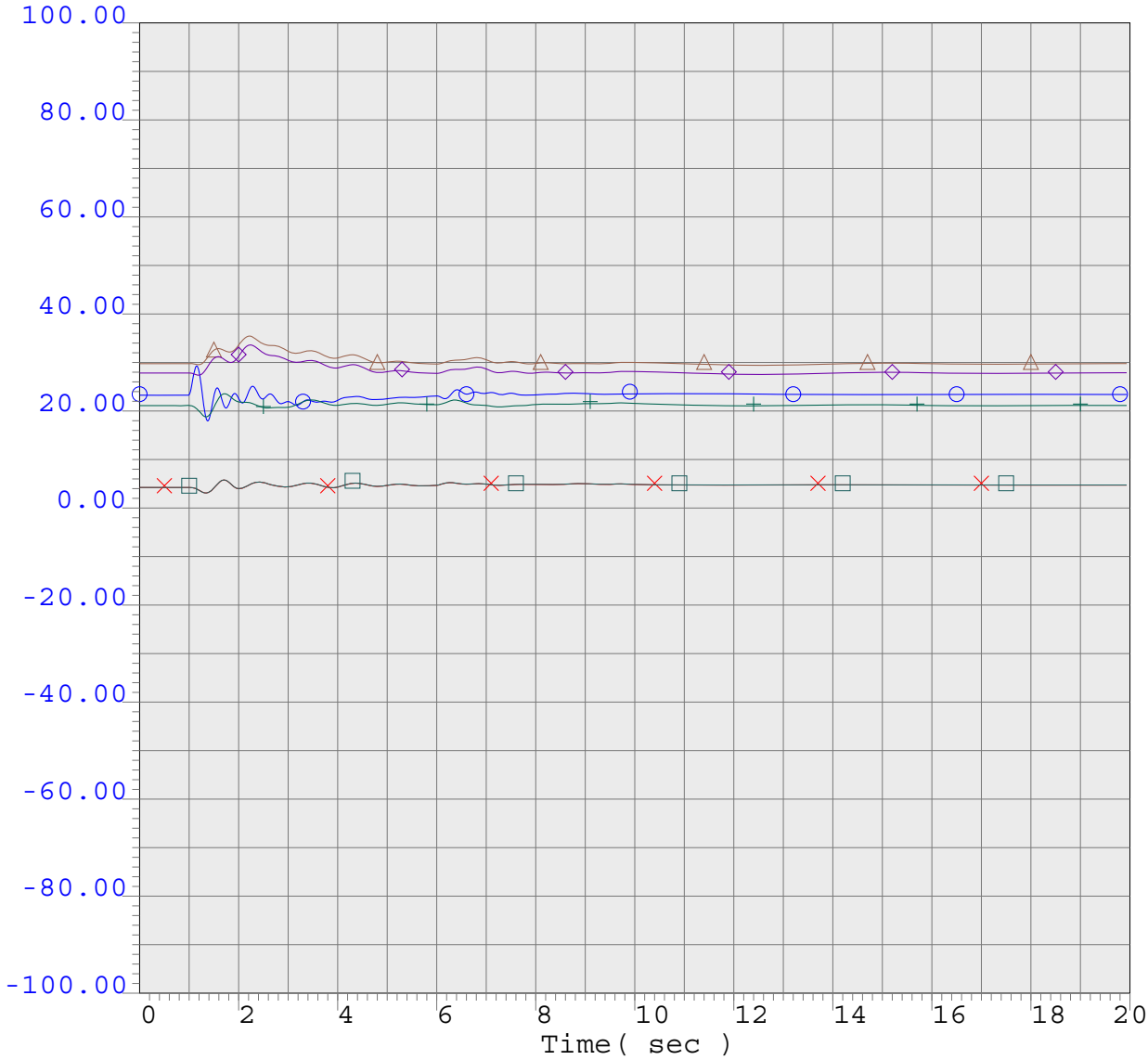
Mon Oct 19 00:52:52 2009

Select TID System Parameters
Frequency (Hz)



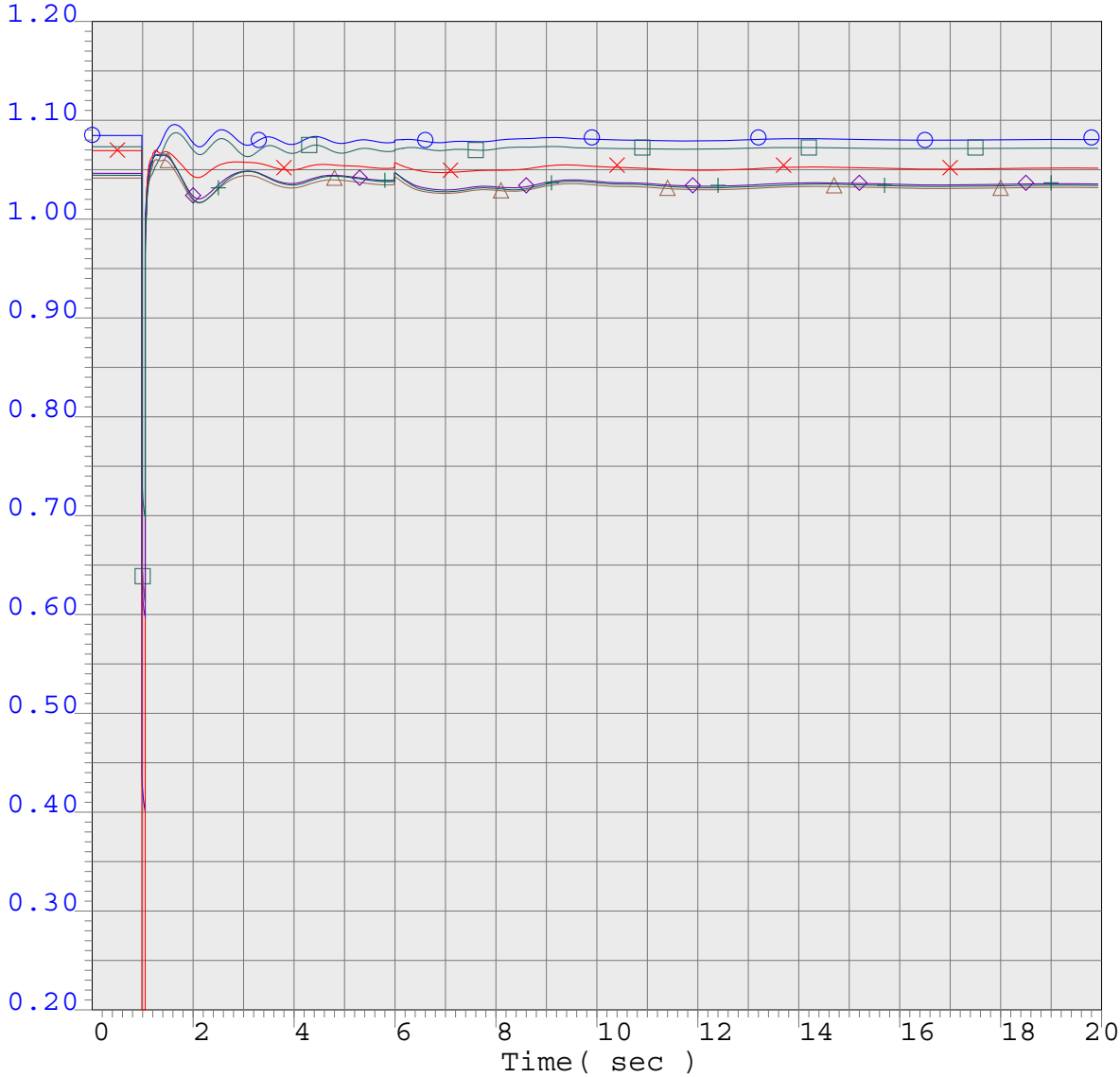

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 59.4000 | fbul | 38442 | AUGUST | 115.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbul | 38534 | GRAY115 | 115.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 38535 | GRAY69 | 69.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 38432 | OAKDLTID | 115.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 38400 | WALNT | 230.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 38410 | WESTL115 | 115.0 | 0 | 0.0 | 1 | 1 | 60.6000 |

Select TID System Parameters
Relative Rotor Angle (degrees)




| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| -100.0000 ang | 38564 | ALMONDCT | 13.8 | 0 | 0.0 | 1 | 1 | 100.0000 |
| -100.0000 ang | 38550 | DONPDRO1 | 13.8 | 0 | 0.0 | 1 | 1 | 100.0000 |
| -100.0000 ang | 38552 | DONPDRO2 | 13.8 | 0 | 0.0 | 1 | 1 | 100.0000 |
| -100.0000 ang | 38570 | WEC1-CT | 13.8 | 0 | 0.0 | 1 | 1 | 100.0000 |
| -100.0000 ang | 38574 | WEC2-CT | 13.8 | 0 | 0.0 | 1 | 1 | 100.0000 |
| -100.0000 ang | 38572 | WEC3-ST | 13.8 | 0 | 0.0 | 1 | 1 | 100.0000 |

# 500 kV Bulk System Parameters
Voltage (p.u.)




| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 0.2000 | vbus | 30055 | GATES | 500.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 30050 | LOSBANOS | 500.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 30060 | MIDWAY | 500.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 30040 | TESLA | 500.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 30035 | TRACY | 500.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 30030 | VACA-DIX | 500.0 | 0 | 0.0 | 1 | 1 | 1.2000 |

2012 Summer Peak Base Case



2012_sum_pk_pst_205_LOSBANOS-GATES-MIDWAY_500_DLO.chf

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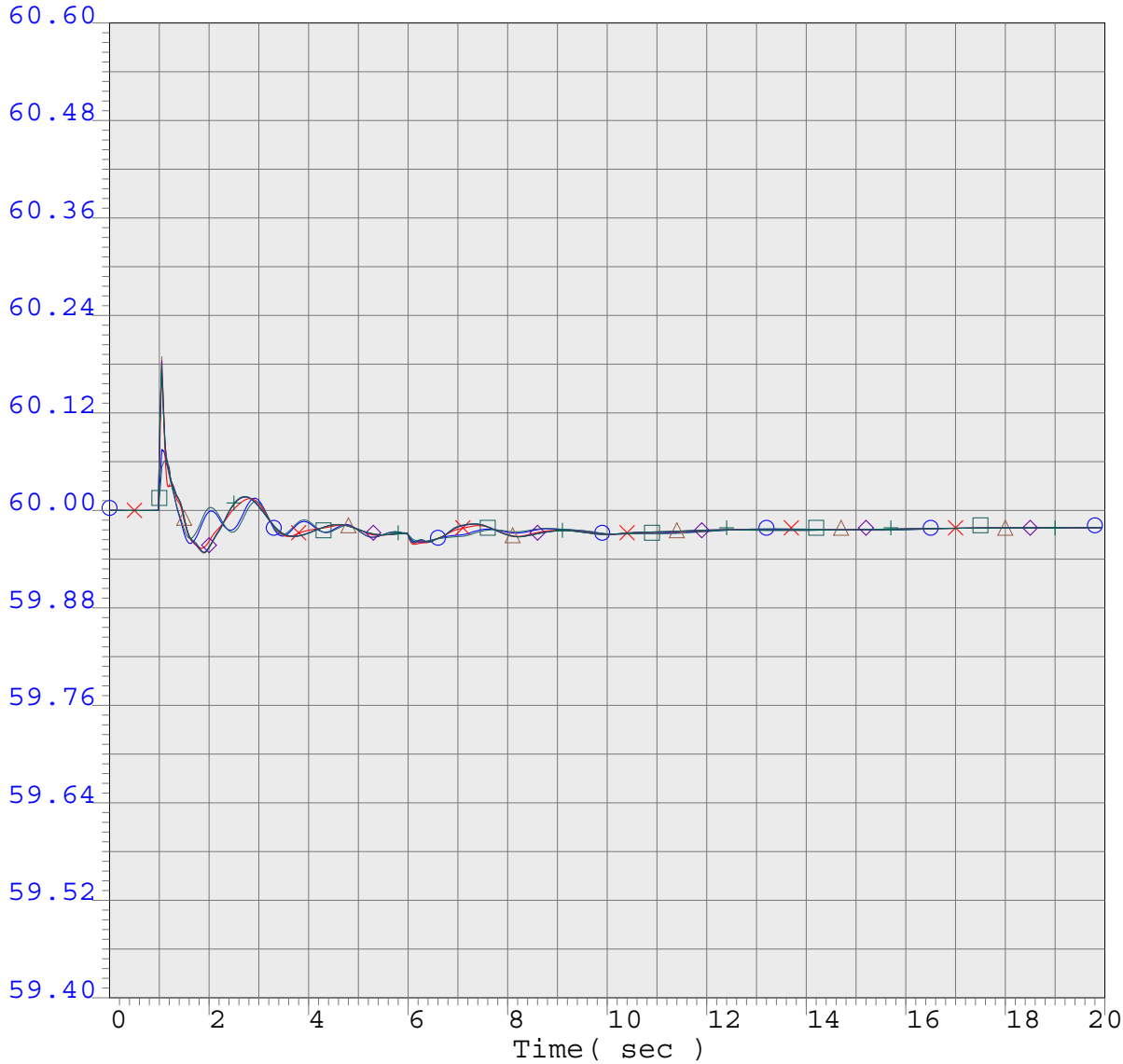
# 500 kV Bulk System Parameters
Frequency (Hz)




| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 59.4000 | fbus | 30055 | GATES | 500.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 30050 | LOSBANOS | 500.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 30060 | MIDWAY | 500.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 30040 | TESLA | 500.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 30035 | TRACY | 500.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 30030 | VACA-DIX | 500.0 | 0 | 0.0 | 1 | 1 | 60.6000 |

2012 Summer Peak Base Case



2012_sum_pk_pst_205_LOSBANOS-GATES-MIDWAY_500_DLO.chf

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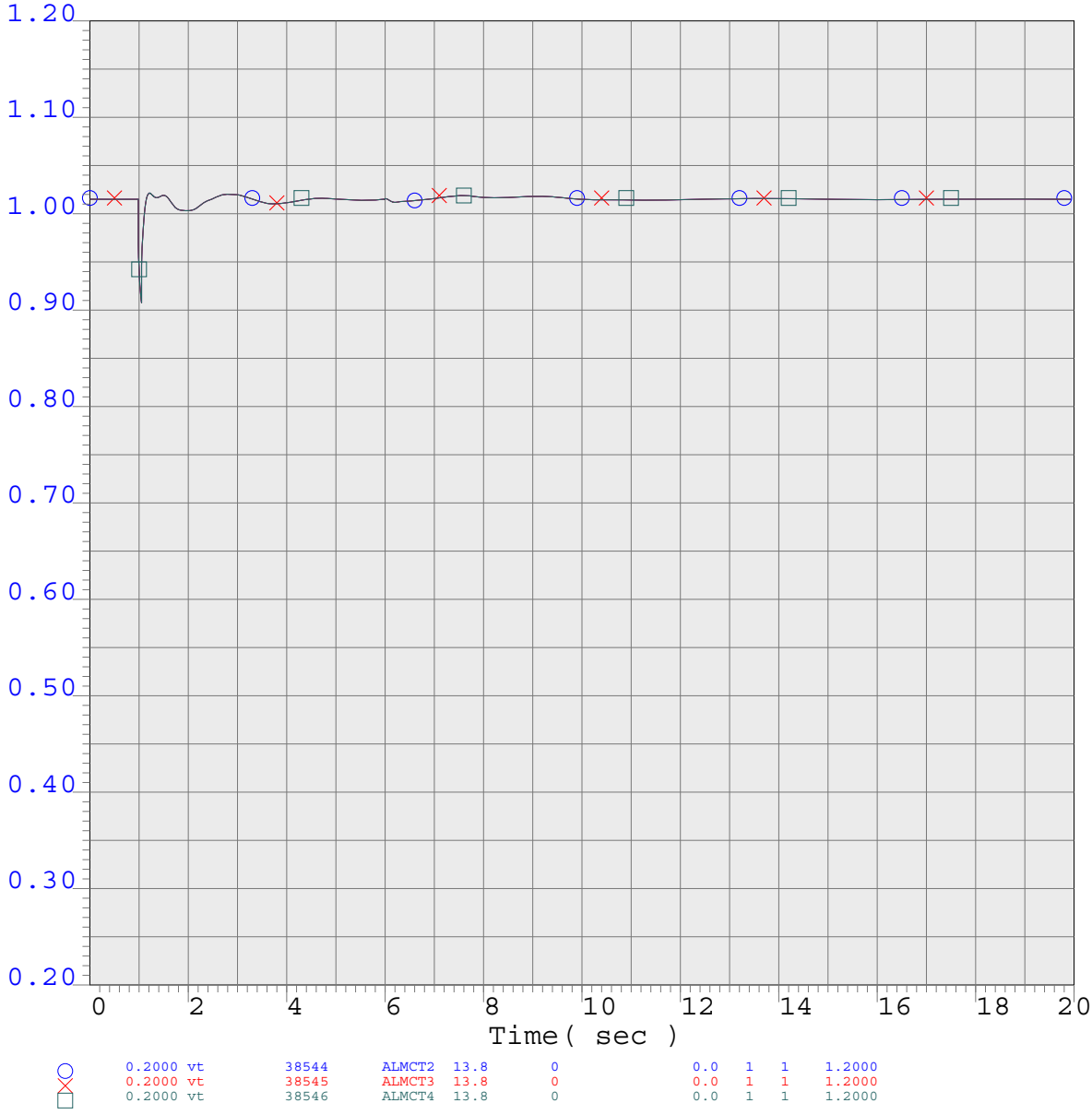
# Almond 2 Power Plant
# Terminal Voltage (p.u.)




2012 Summer Peak Base Case



2012_sum_pk_pst_205_LOSBANOS-GATES-MIDWAY_500_DLO.chf

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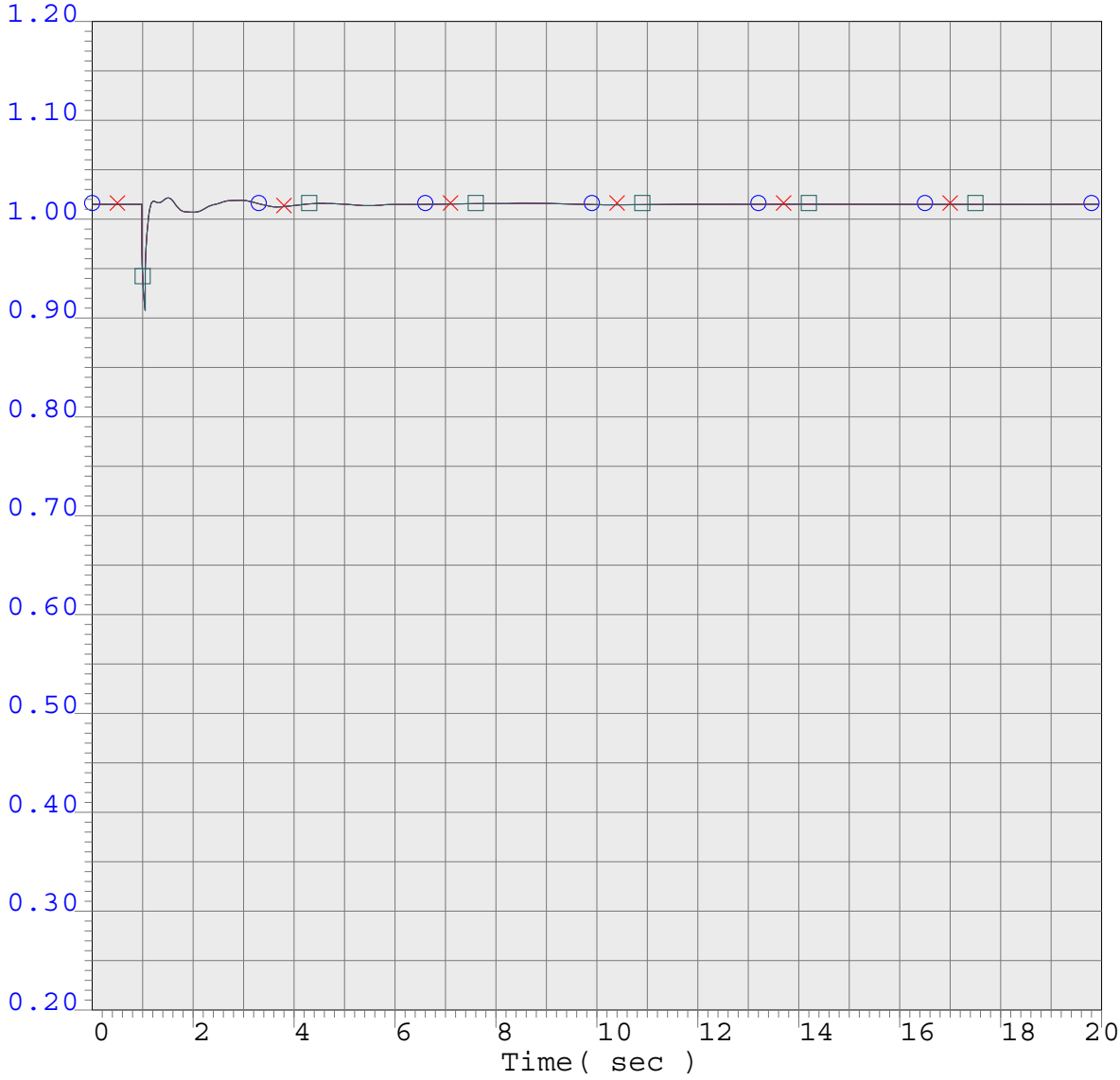
# Transient Stability Plots

# Los Banos-Tesla & Los Banos-Tracy 500 kV Lines Out

# Almond 2 Power Plant
# Terminal Voltage (p.u.)




| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| ○ | 0.2000 vt | 38544 | ALMCT2 | 13.8 | 0 | 0.0 | 1 | 1 | 1.2000 |
| × | 0.2000 vt | 38545 | ALMCT3 | 13.8 | 0 | 0.0 | 1 | 1 | 1.2000 |
| □ | 0.2000 vt | 38546 | ALMCT4 | 13.8 | 0 | 0.0 | 1 | 1 | 1.2000 |

2012 Summer Peak Base Case



2012_sum_pk_pst_206_LOSBANOS-TESLA-TRACY_500_DLO.chf

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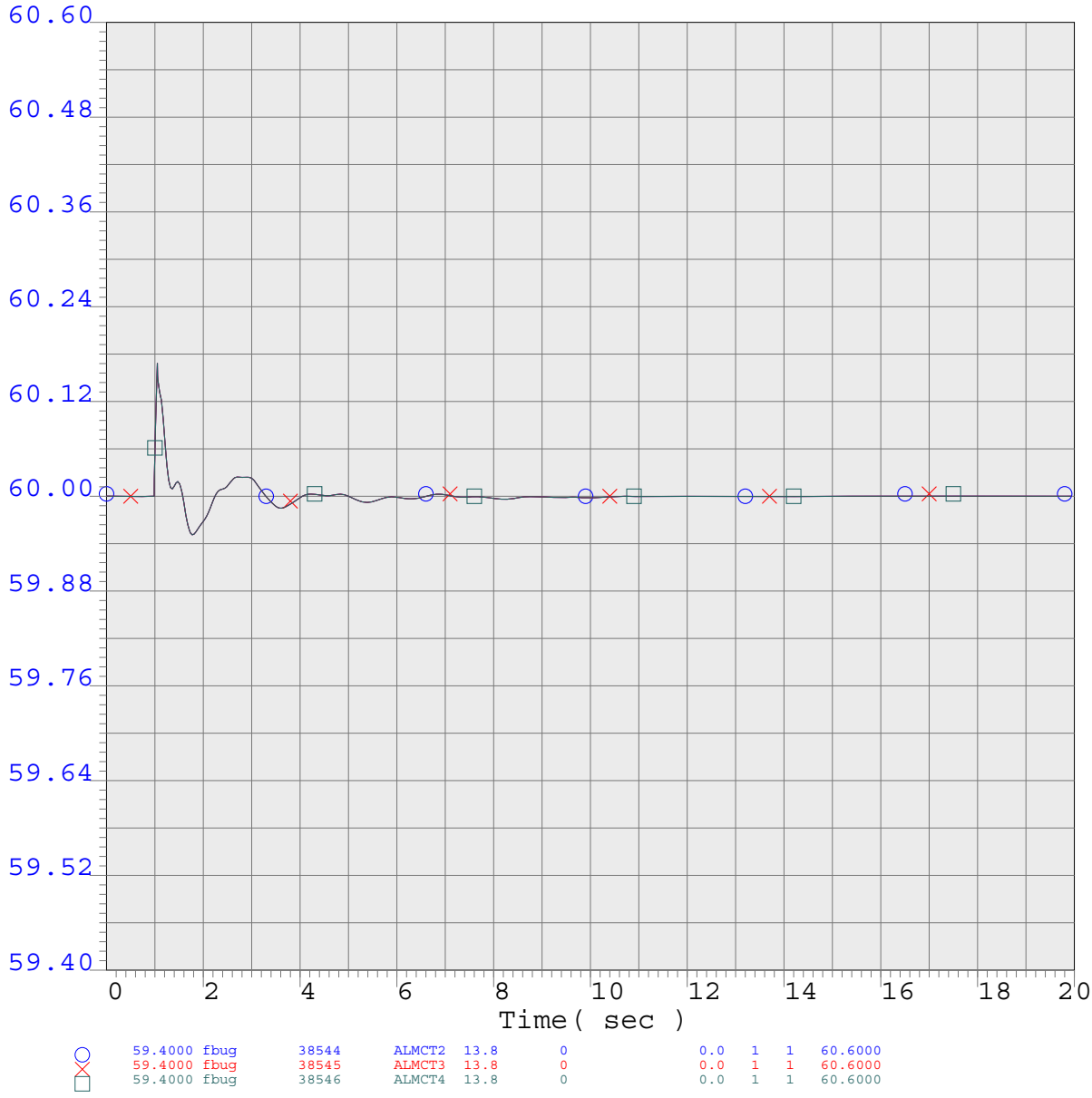
Almond 2 Power Plant
Frequency (Hz)




2012 Summer Peak Base Case



2012_sum_pk_pst_206_LOSBANOS-TESLA-TRACY_500_DLO.chf

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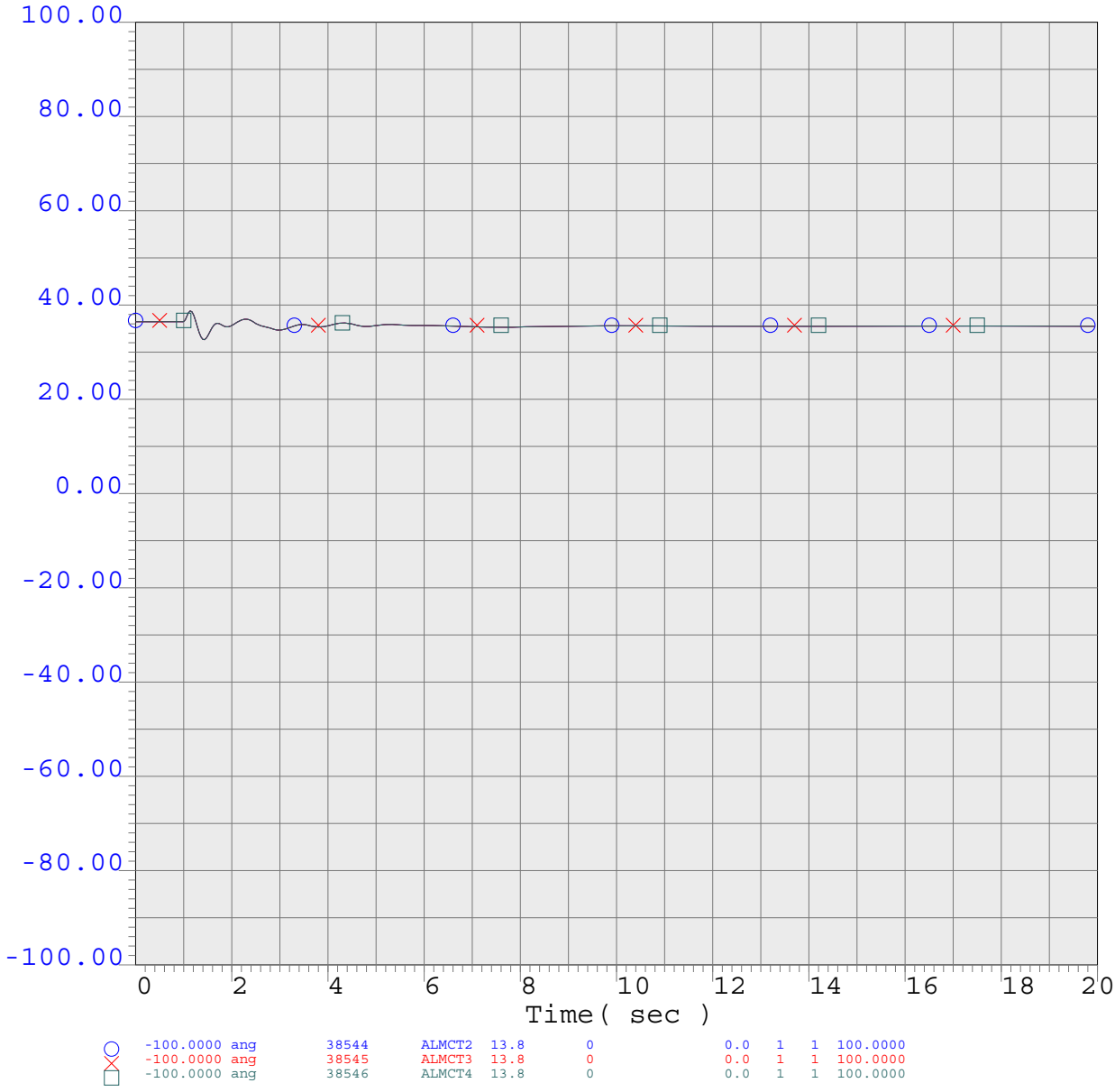
Almond 2 Power Plant
Relative Rotor Angle (degrees)




2012 Summer Peak Base Case



2012_sum_pk_pst_206_LOSBANOS-TESLA-TRACY_500_DLO.chf

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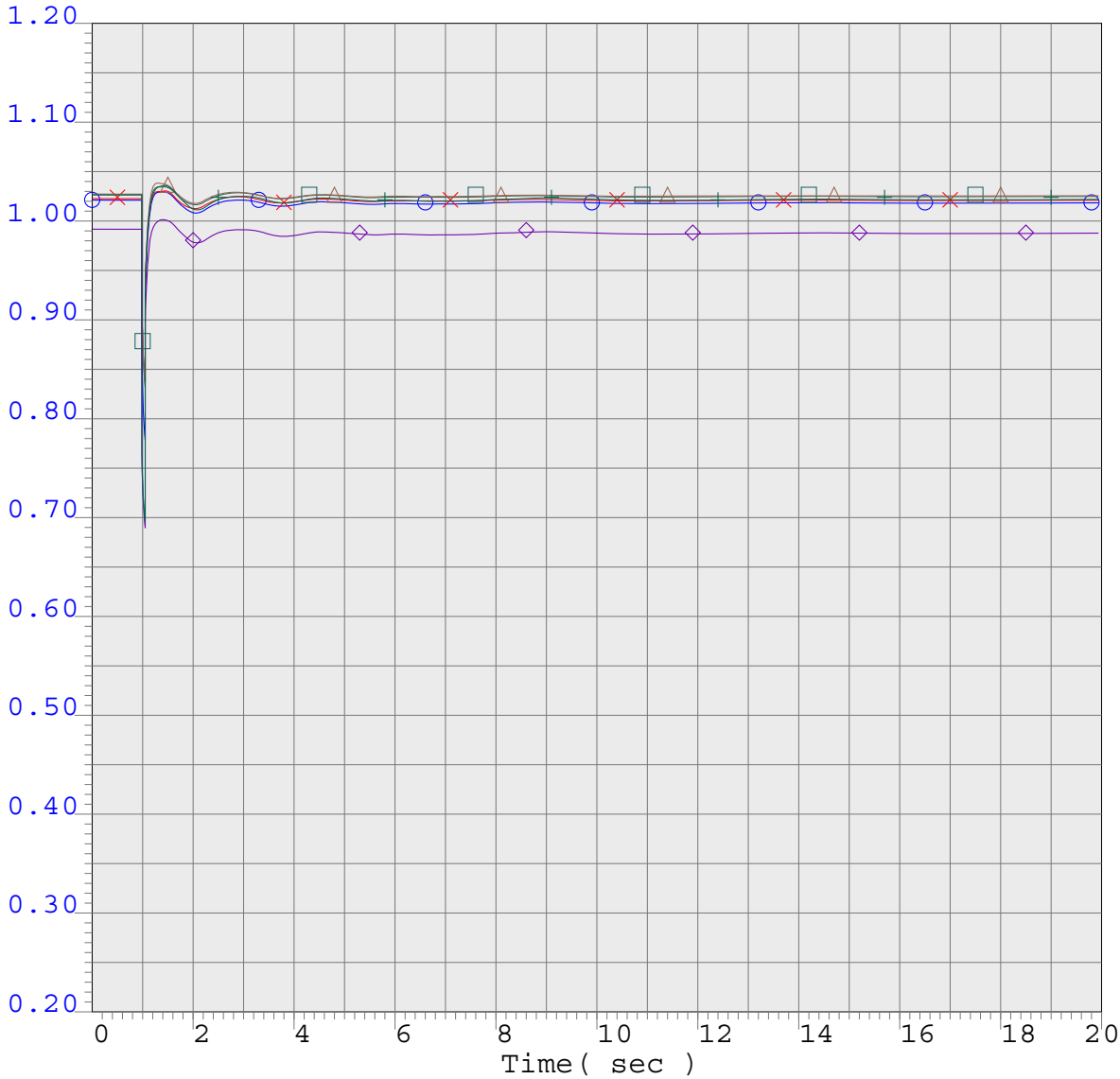
Mon Oct 19 00:52:58 2009

Select TID System Parameters
Voltage (p.u.)




| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 0.2000 | vbul | 38442 | AUGUST | 115.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbul | 38534 | GRAY115 | 115.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 38535 | GRAY69 | 69.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 38432 | OAKDLTID | 115.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 38400 | WALNT | 230.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 38410 | WESTL115 | 115.0 | 0 | 0.0 | 1 | 1 | 1.2000 |

2012 Summer Peak Base Case



2012_sum_pk_pst_206_LOSBANOS-TESLA-TRACY_500_DLO.chf

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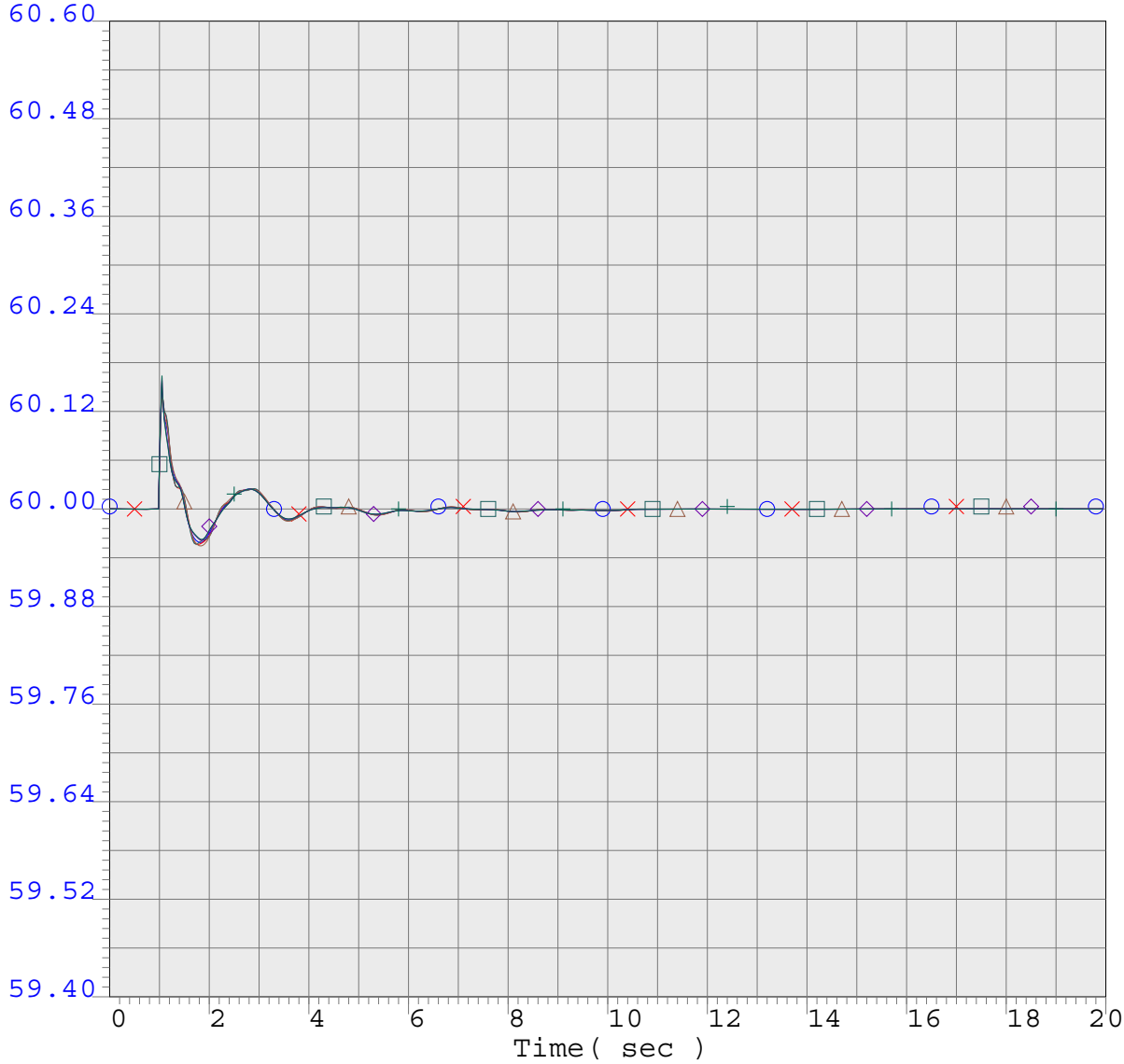
Select TID System Parameters
Frequency (Hz)




| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 59.4000 | fbul | 38442 | AUGUST | 115.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbul | 38534 | GRAY115 | 115.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 38535 | GRAY69 | 69.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 38432 | OAKDLTID | 115.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 38400 | WALNT | 230.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 38410 | WESTL115 | 115.0 | 0 | 0.0 | 1 | 1 | 60.6000 |

2012 Summer Peak Base Case



2012_sum_pk_pst_206_LOSBANOS-TESLA-TRACY_500_DLO.chf

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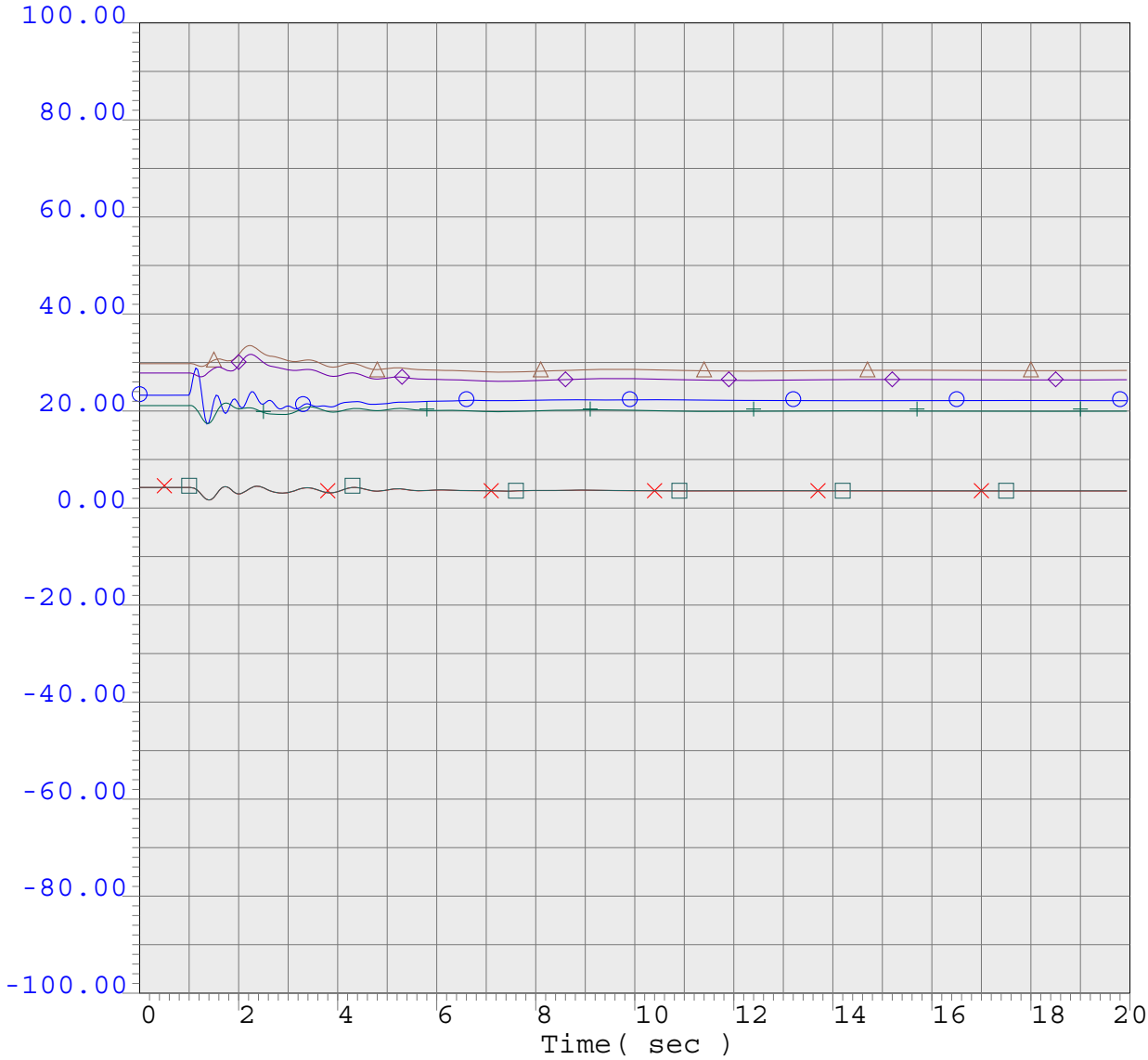
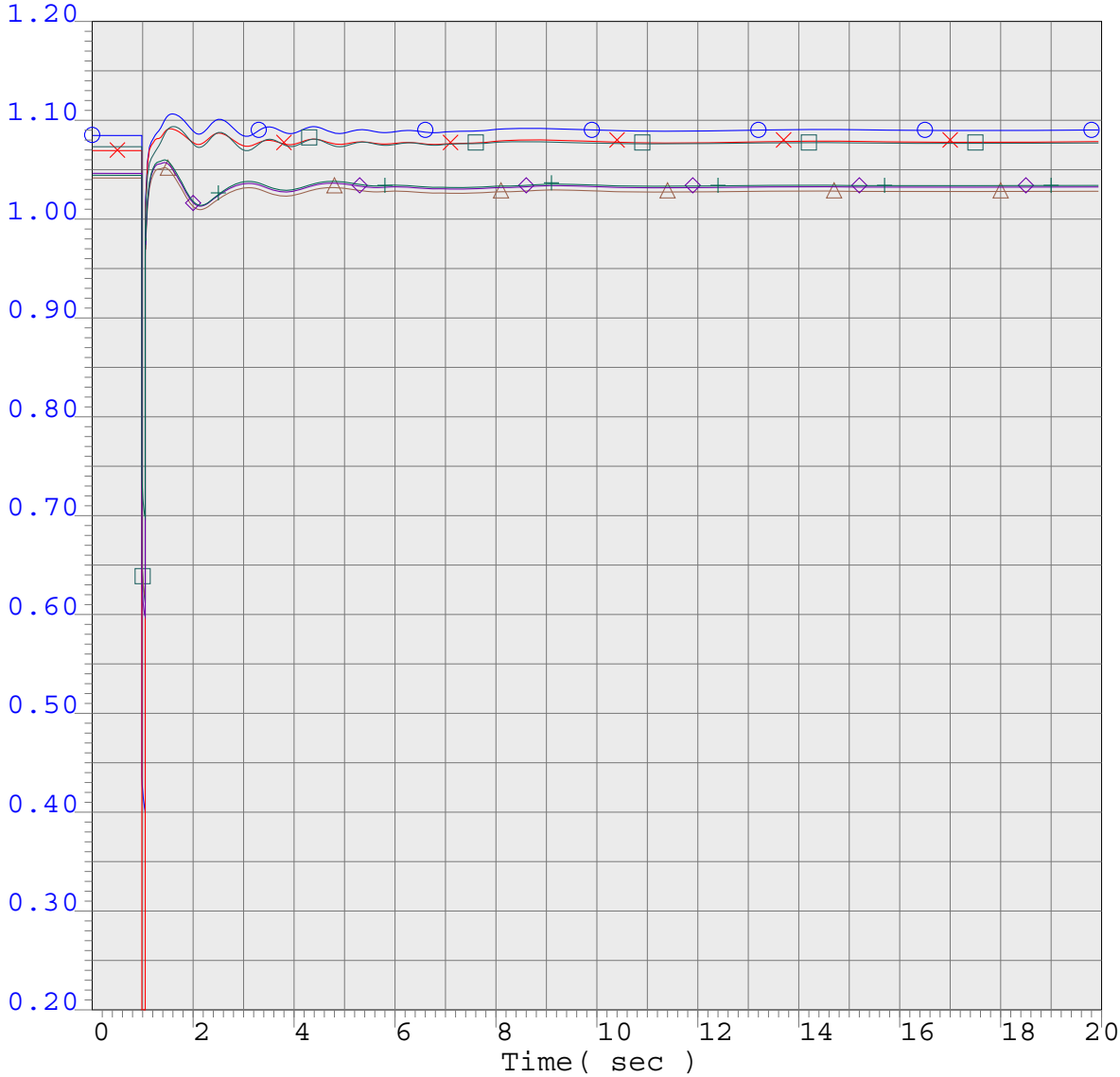
Select TID System Parameters
Relative Rotor Angle (degrees)




| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| -100.0000 ang | 38564 | ALMONDCT | 13.8 | 0 | 0.0 | 1 | 1 | 100.0000 |
| -100.0000 ang | 38550 | DONPDRO1 | 13.8 | 0 | 0.0 | 1 | 1 | 100.0000 |
| -100.0000 ang | 38552 | DONPDRO2 | 13.8 | 0 | 0.0 | 1 | 1 | 100.0000 |
| -100.0000 ang | 38570 | WEC1-CT | 13.8 | 0 | 0.0 | 1 | 1 | 100.0000 |
| -100.0000 ang | 38574 | WEC2-CT | 13.8 | 0 | 0.0 | 1 | 1 | 100.0000 |
| -100.0000 ang | 38572 | WEC3-ST | 13.8 | 0 | 0.0 | 1 | 1 | 100.0000 |

# 500 kV Bulk System Parameters
Voltage (p.u.)




| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 0.2000 | vbus | 30055 | GATES | 500.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 30050 | LOSBANOS | 500.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 30060 | MIDWAY | 500.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 30040 | TESLA | 500.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 30035 | TRACY | 500.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 30030 | VACA-DIX | 500.0 | 0 | 0.0 | 1 | 1 | 1.2000 |

2012 Summer Peak Base Case



2012_sum_pk_pst_206_LOSBANOS-TESLA-TRACY_500_DLO.chf

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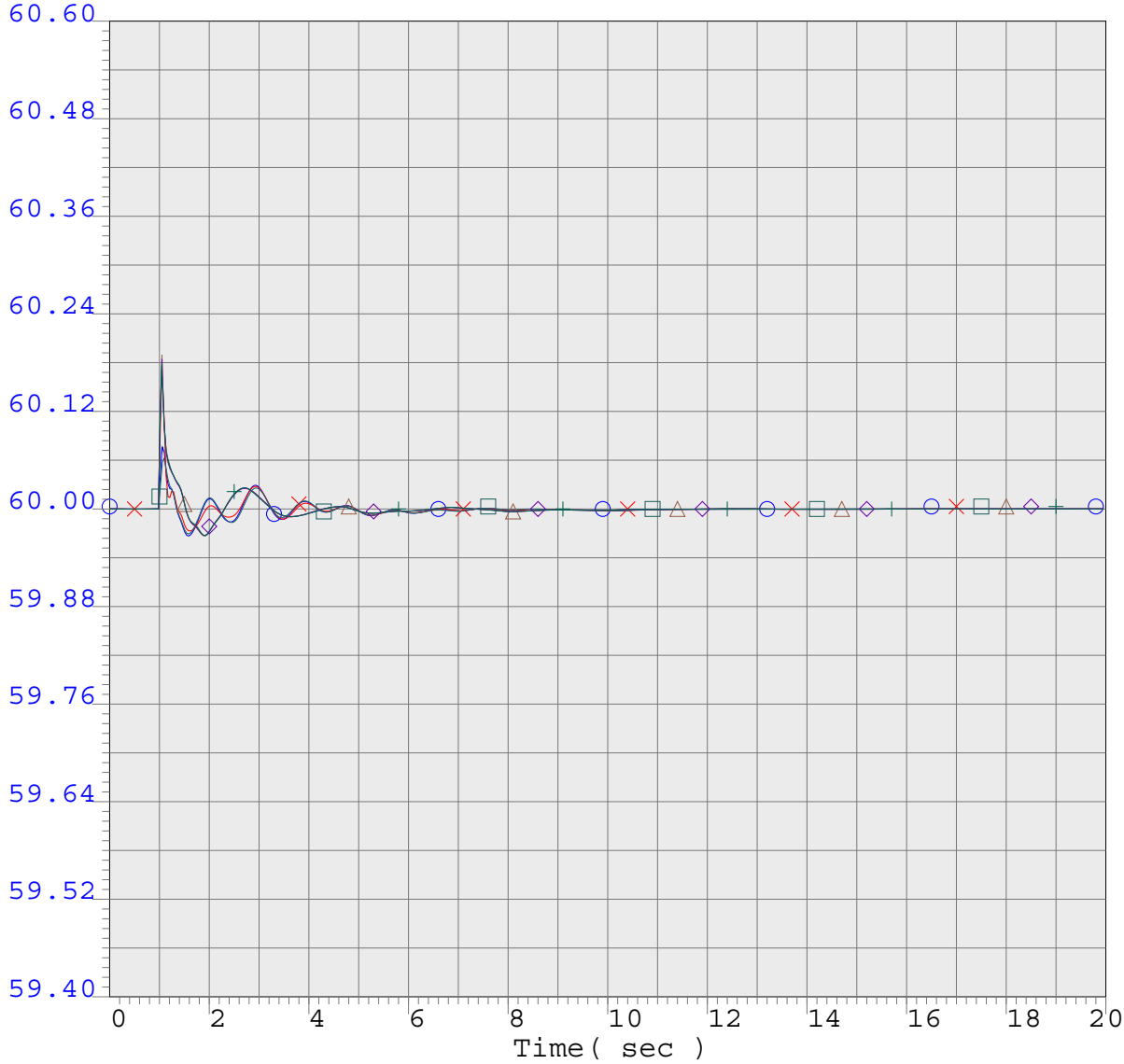
# 500 kV Bulk System Parameters
Frequency (Hz)




| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 59.4000 | fbus | 30055 | GATES | 500.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 30050 | LOSBANOS | 500.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 30060 | MIDWAY | 500.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 30040 | TESLA | 500.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 30035 | TRACY | 500.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 30030 | VACA-DIX | 500.0 | 0 | 0.0 | 1 | 1 | 60.6000 |

2012 Summer Peak Base Case



2012_sum_pk_pst_206_LOSBANOS-TESLA-TRACY_500_DLO.chf

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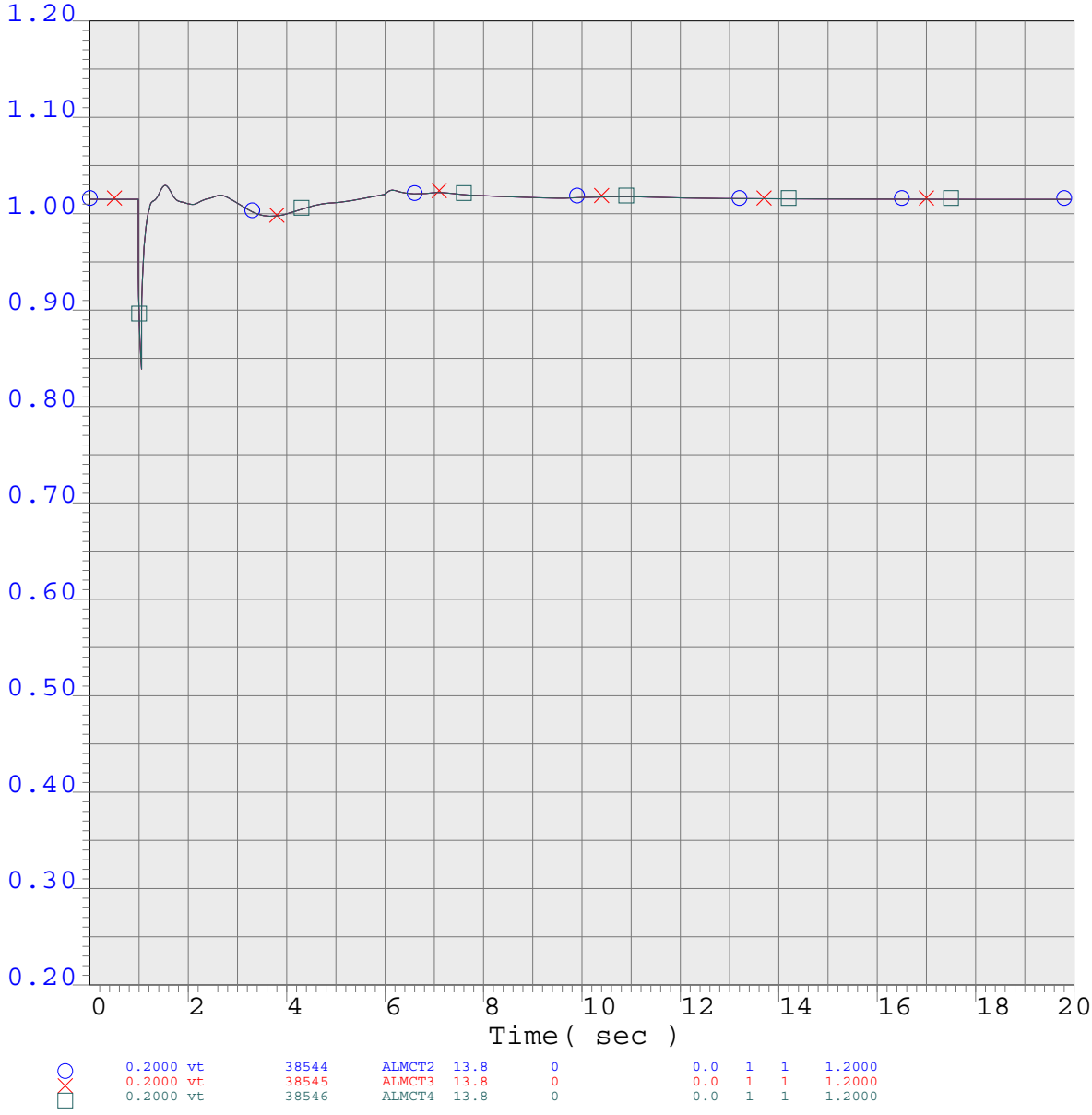
# Transient Stability Plots

# Tesla-Table Mt & Tesla-Vaca-Dixon 500 kV Lines Out

# Almond 2 Power Plant
# Terminal Voltage (p.u.)




2012 Summer Peak Base Case



2012_sum_pk_pst_207_TESLA-TABLE_MT-VACA_DIX_500_DLO.chf

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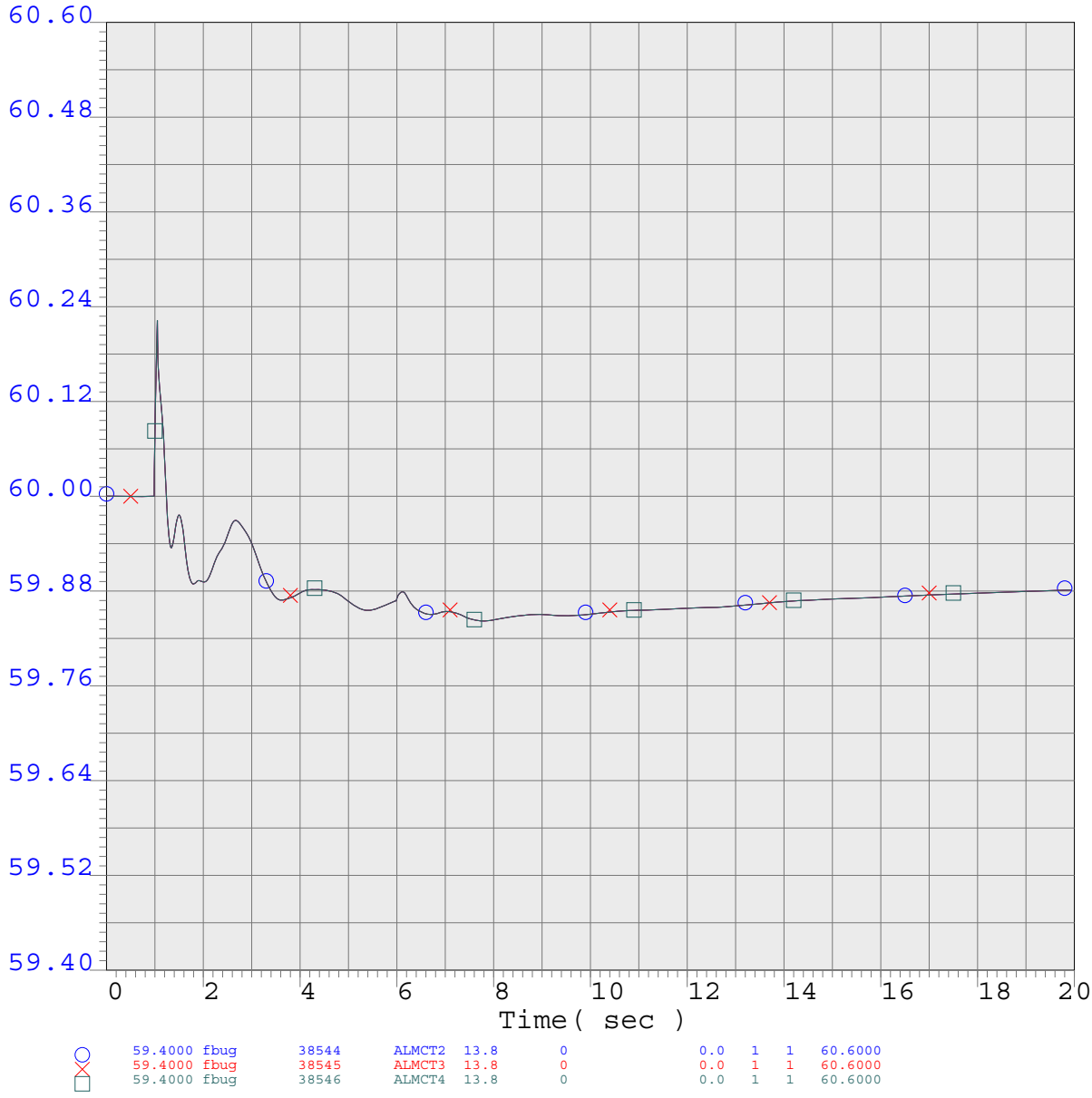
Mon Oct 19 00:53:04 2009

Almond 2 Power Plant
Frequency (Hz)




2012 Summer Peak Base Case



2012_sum_pk_pst_207_TESLA-TABLE_MT-VACA_DIX_500_DLO.chf

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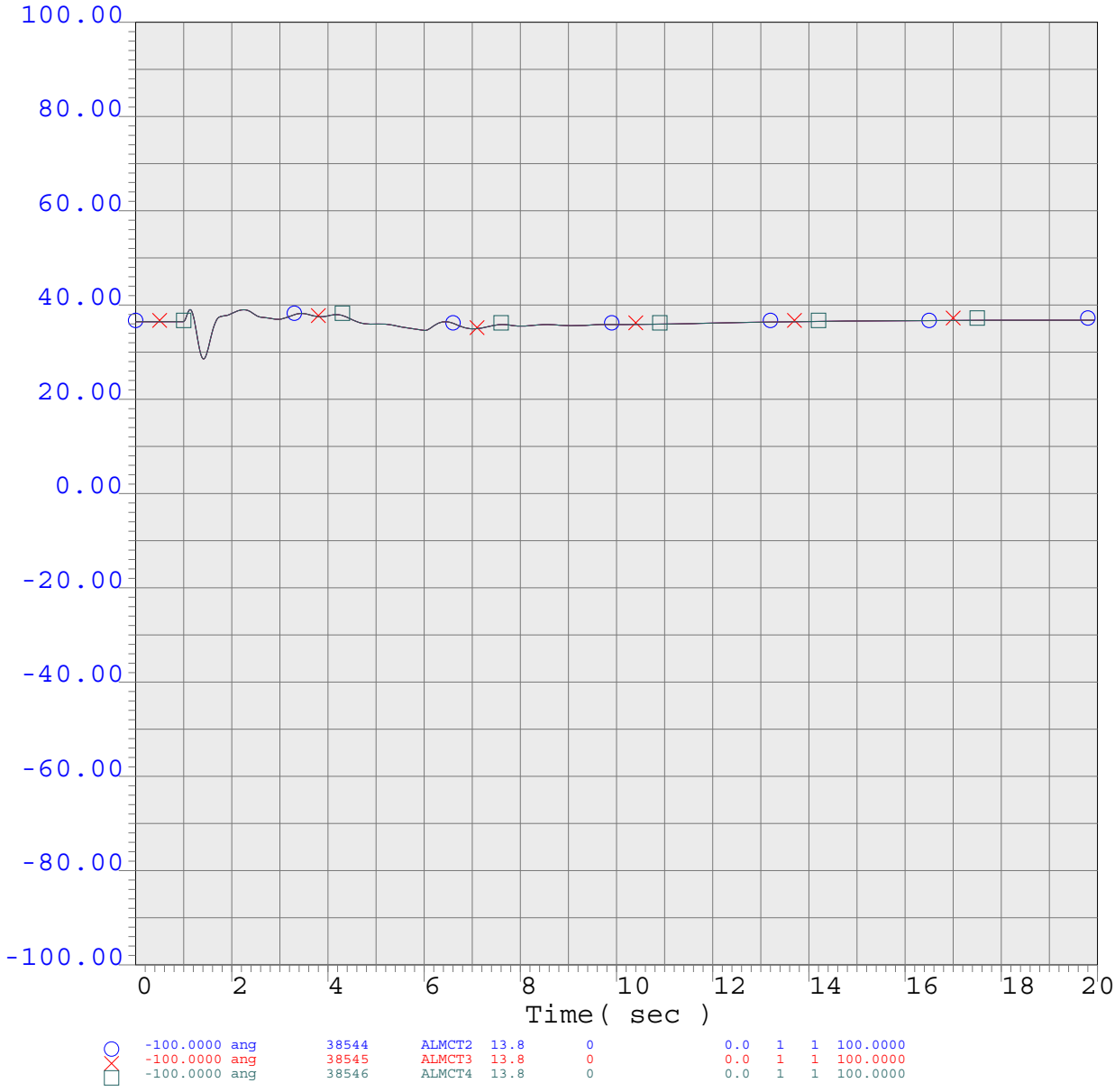
Mon Oct 19 00:53:04 2009

# Almond 2 Power Plant
## Relative Rotor Angle (degrees)




2012 Summer Peak Base Case



2012_sum_pk_pst_207_TESLA-TABLE_MT-VACA_DIX_500_DLO.chf

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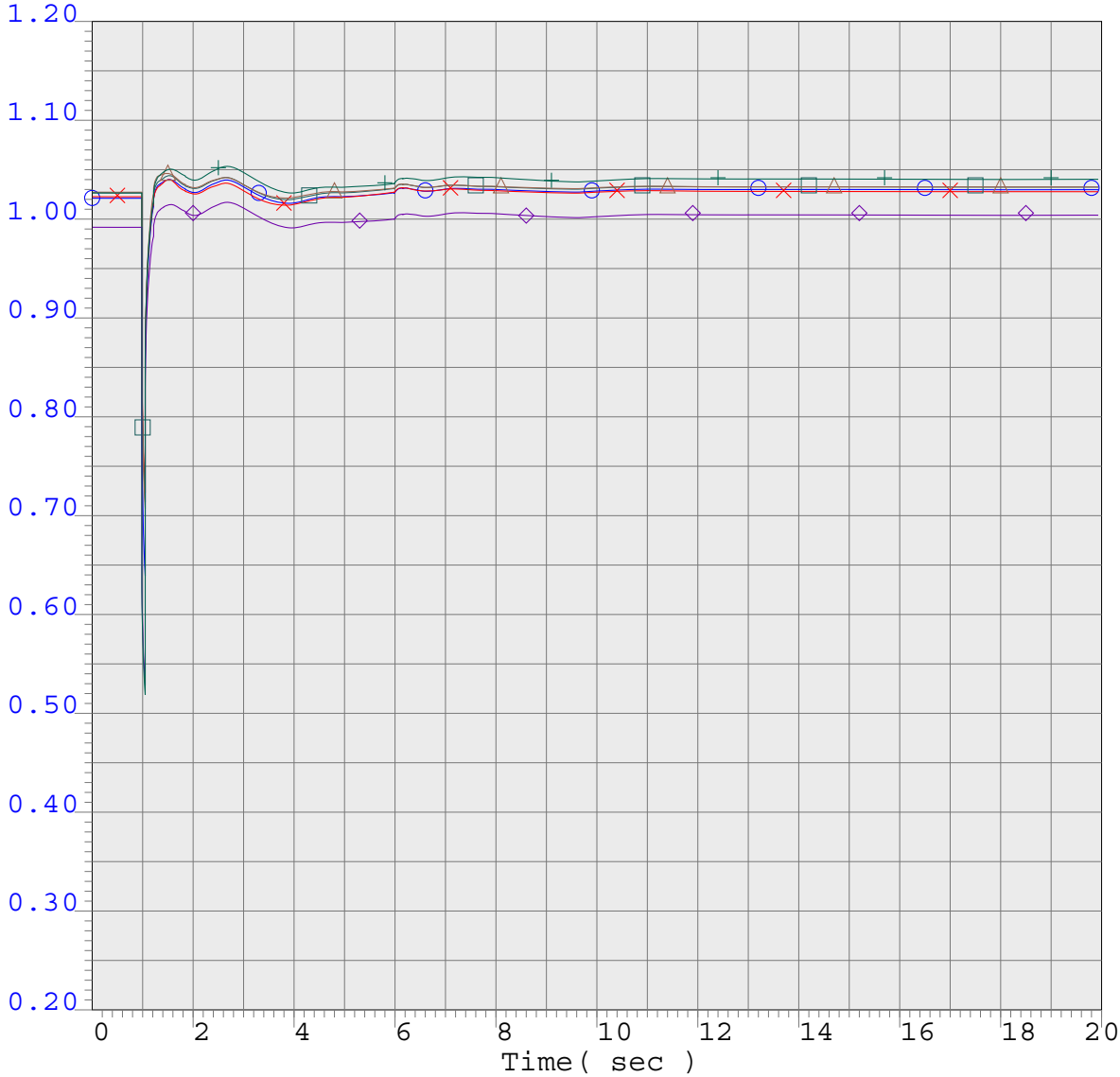
Select TID System Parameters
Voltage (p.u.)




| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 0.2000 | vbul | 38442 | AUGUST | 115.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbul | 38534 | GRAY115 | 115.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 38535 | GRAY69 | 69.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 38432 | OAKDLTID | 115.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 38400 | WALNT | 230.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 38410 | WESTL115 | 115.0 | 0 | 0.0 | 1 | 1 | 1.2000 |

2012 Summer Peak Base Case

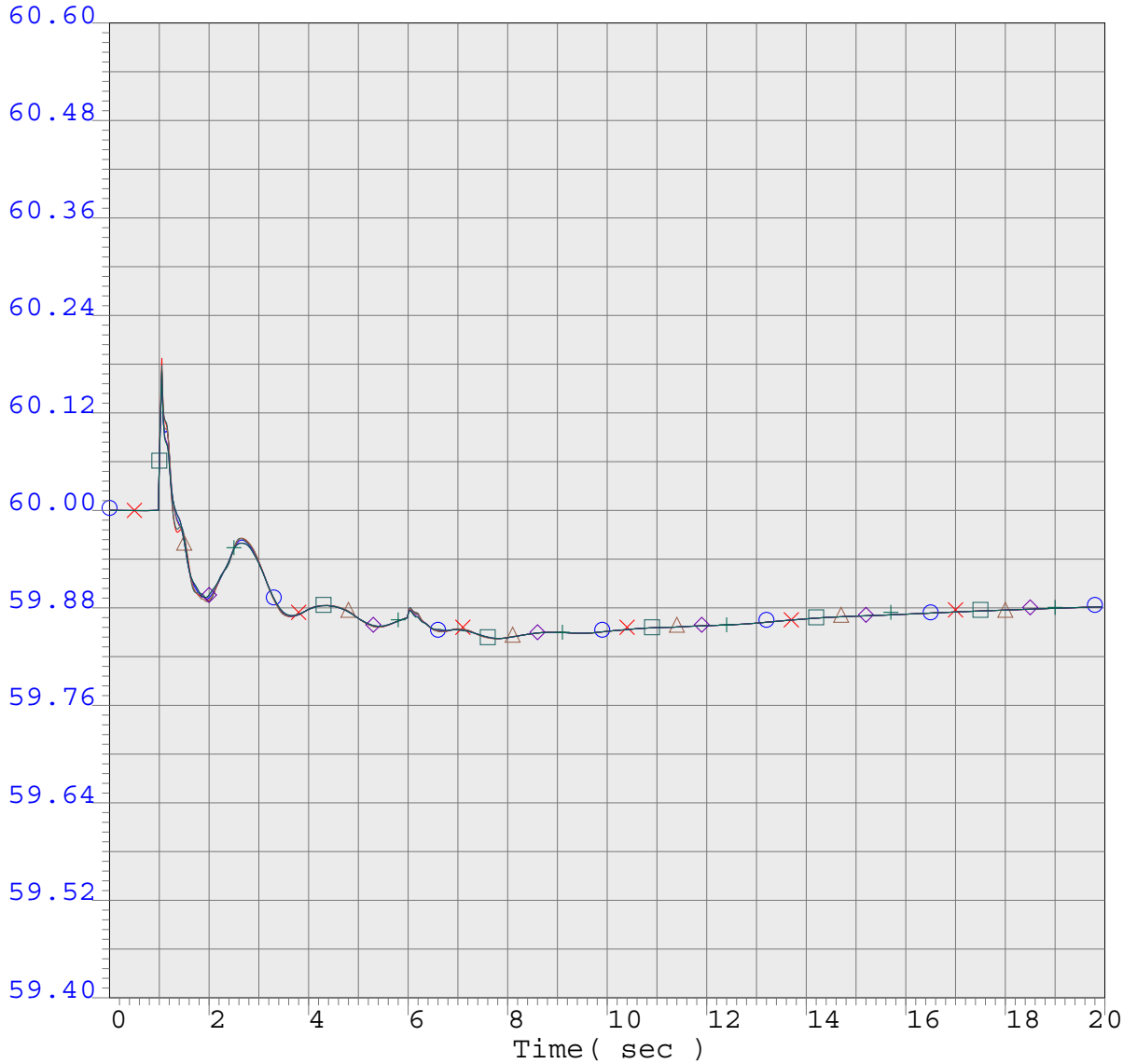


2012_sum_pk_pst_207_TESLA-TABLE_MT-VACA_DIX_500_DLO.chf

.

Mon Oct 19 00:53:04 2009

Select TID System Parameters
Frequency (Hz)




| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 59.4000 | fbul | 38442 | AUGUST | 115.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbul | 38534 | GRAY115 | 115.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 38535 | GRAY69 | 69.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 38432 | OAKDLTID | 115.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 38400 | WALNT | 230.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 38410 | WESTL115 | 115.0 | 0 | 0.0 | 1 | 1 | 60.6000 |

2012 Summer Peak Base Case



2012_sum_pk_pst_207_TESLA-TABLE_MT-VACA_DIX_500_DLO.chf

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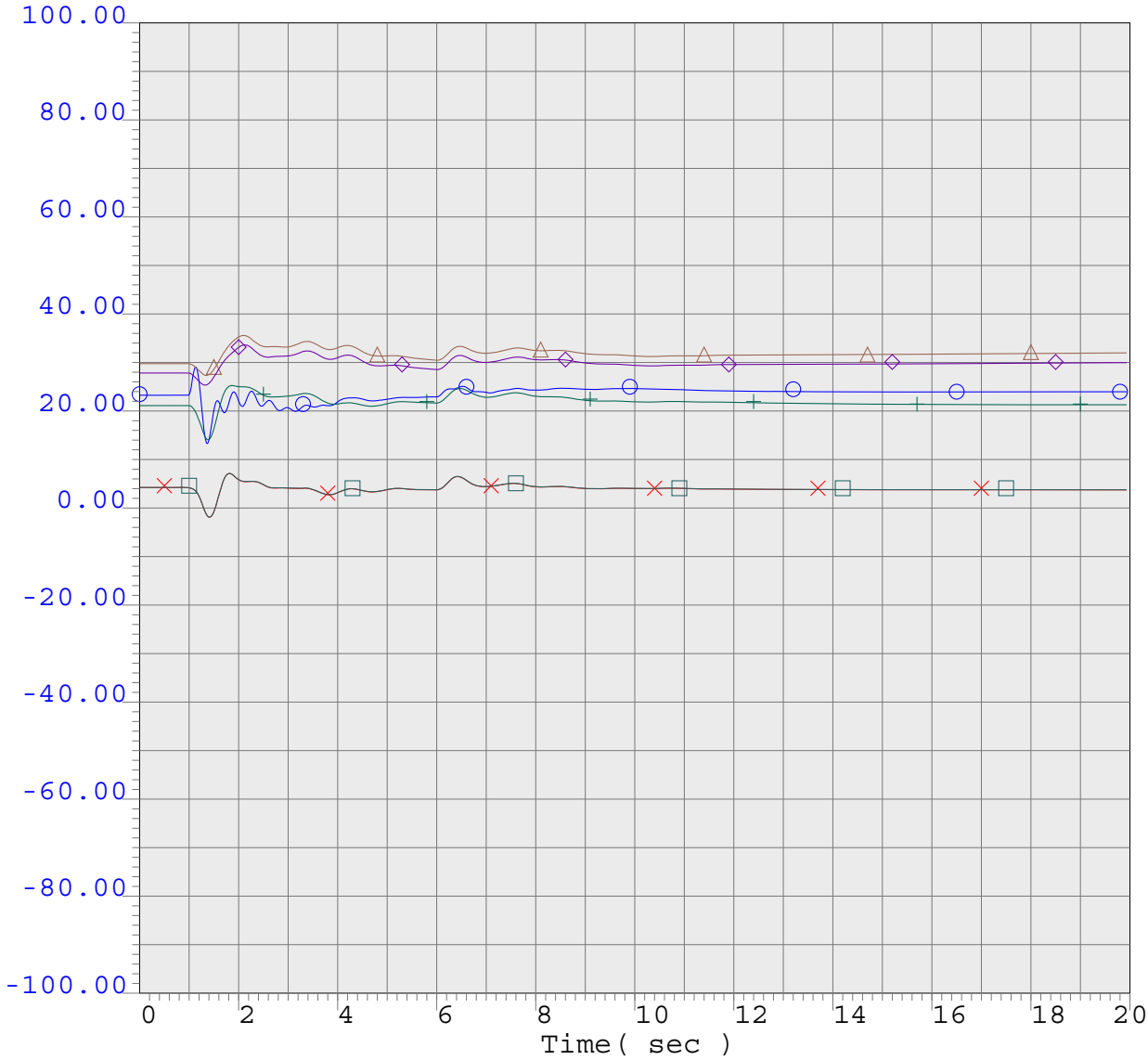
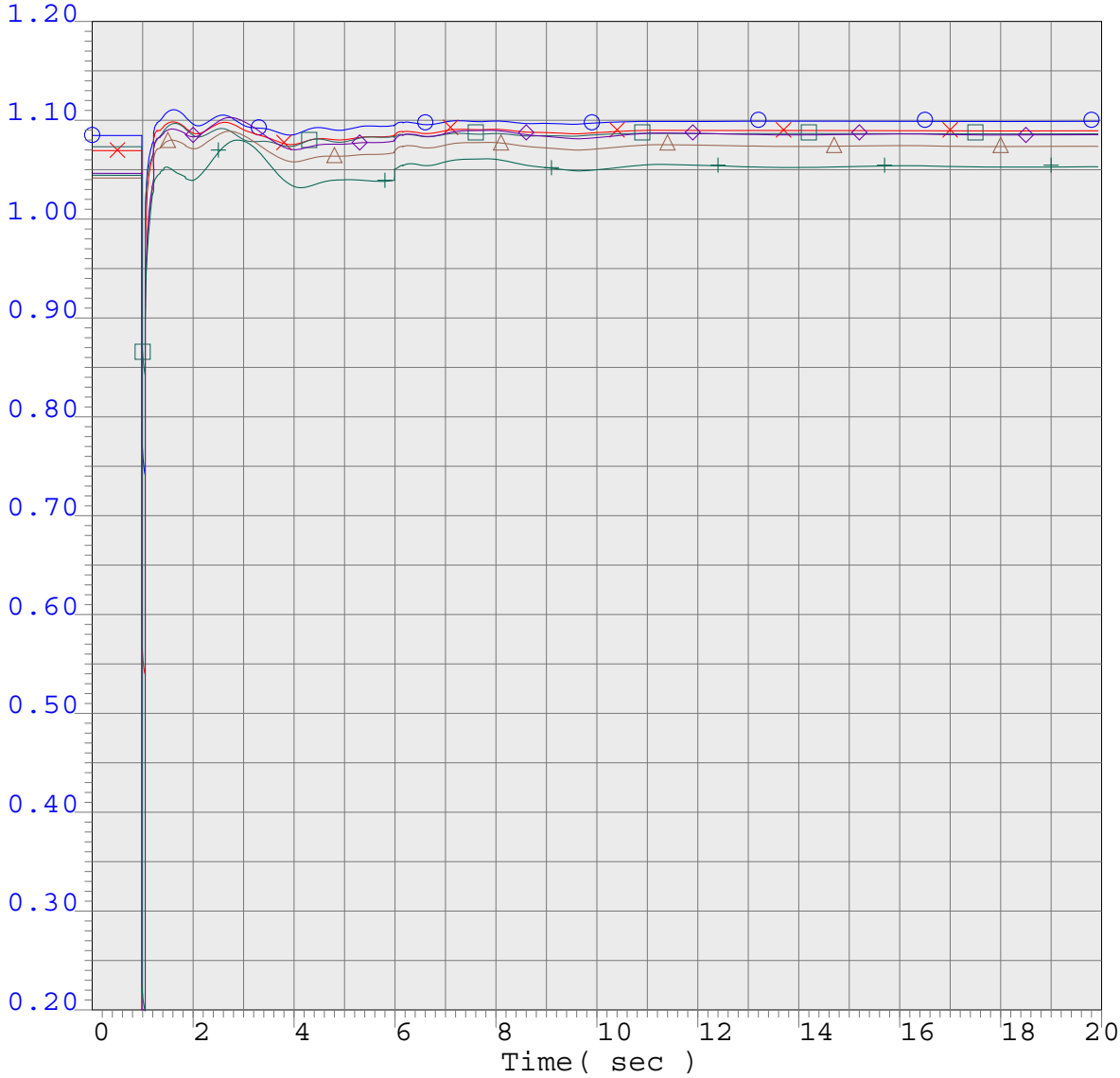
Select TID System Parameters
Relative Rotor Angle (degrees)




| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| -100.0000 ang | 38564 | ALMONDCT | 13.8 | 0 | 0.0 | 1 | 1 | 100.0000 |
| -100.0000 ang | 38550 | DONPDRO1 | 13.8 | 0 | 0.0 | 1 | 1 | 100.0000 |
| -100.0000 ang | 38552 | DONPDRO2 | 13.8 | 0 | 0.0 | 1 | 1 | 100.0000 |
| -100.0000 ang | 38570 | WEC1-CT | 13.8 | 0 | 0.0 | 1 | 1 | 100.0000 |
| -100.0000 ang | 38574 | WEC2-CT | 13.8 | 0 | 0.0 | 1 | 1 | 100.0000 |
| -100.0000 ang | 38572 | WEC3-ST | 13.8 | 0 | 0.0 | 1 | 1 | 100.0000 |

# 500 kV Bulk System Parameters
Voltage (p.u.)




| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 0.2000 | vbus | 30055 | GATES | 500.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 30050 | LOSBANOS | 500.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 30060 | MIDWAY | 500.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 30040 | TESLA | 500.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 30035 | TRACY | 500.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 30030 | VACA-DIX | 500.0 | 0 | 0.0 | 1 | 1 | 1.2000 |

2012 Summer Peak Base Case



2012_sum_pk_pst_207_TESLA-TABLE_MT-VACA_DIX_500_DLO.chf

.

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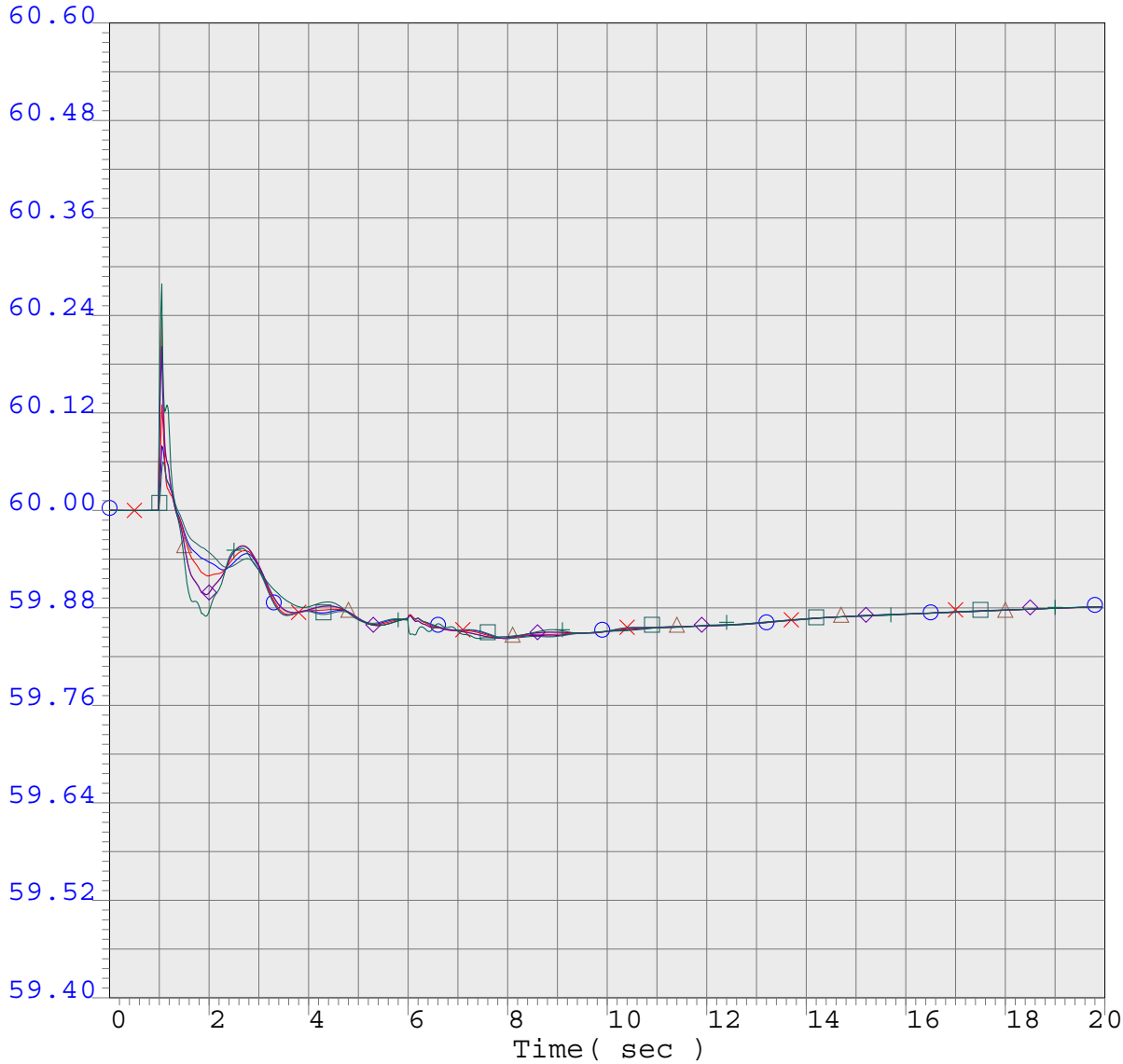
# 500 kV Bulk System Parameters
Frequency (Hz)




| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 59.4000 | fbus | 30055 | GATES | 500.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 30050 | LOSBANOS | 500.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 30060 | MIDWAY | 500.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 30040 | TESLA | 500.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 30035 | TRACY | 500.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 30030 | VACA-DIX | 500.0 | 0 | 0.0 | 1 | 1 | 60.6000 |

2012 Summer Peak Base Case



2012_sum_pk_pst_207_TESLA-TABLE_MT-VACA_DIX_500_DLO.chf

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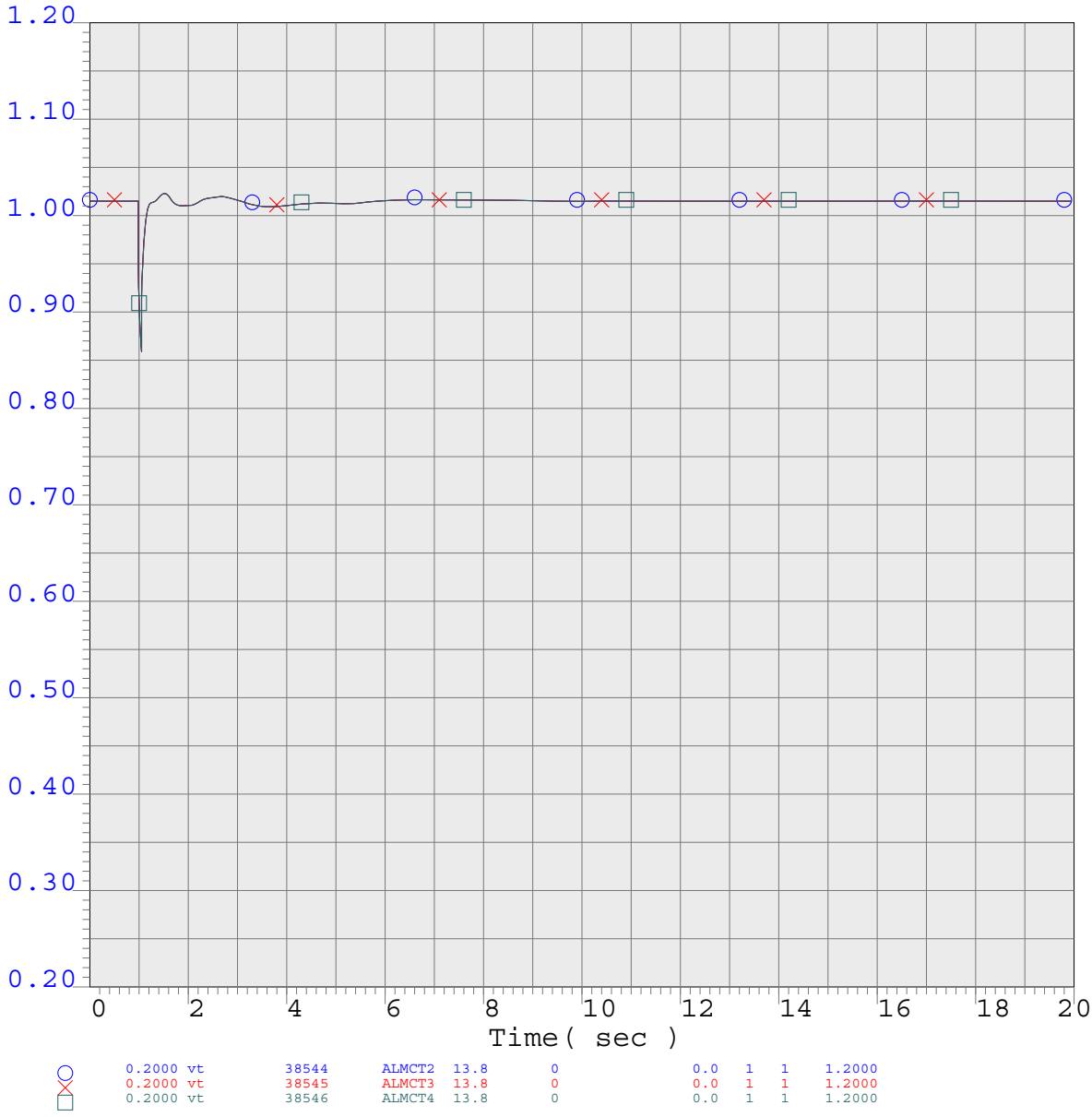
# Transient Stability Plots

# Tracy-Tesla #1 500 kV Line Out

# Almond 2 Power Plant
# Terminal Voltage (p.u.)




2012 Summer Peak Base Case



2012_sum_pk_pst_208_TRACY-TESLA_500.chf

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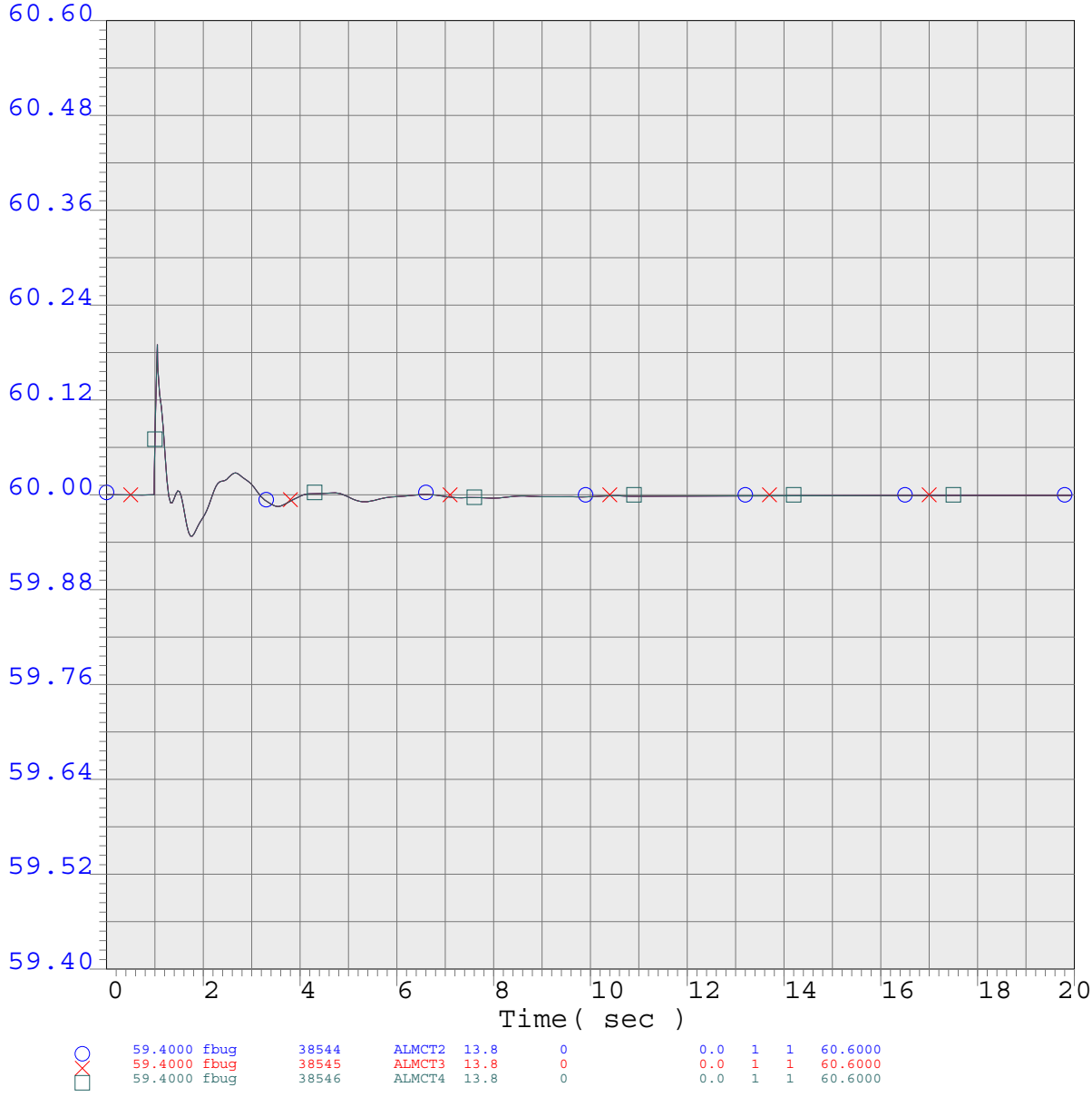
Almond 2 Power Plant
Frequency (Hz)




2012 Summer Peak Base Case



2012_sum_pk_pst_208_TRACY-TESLA_500.chf

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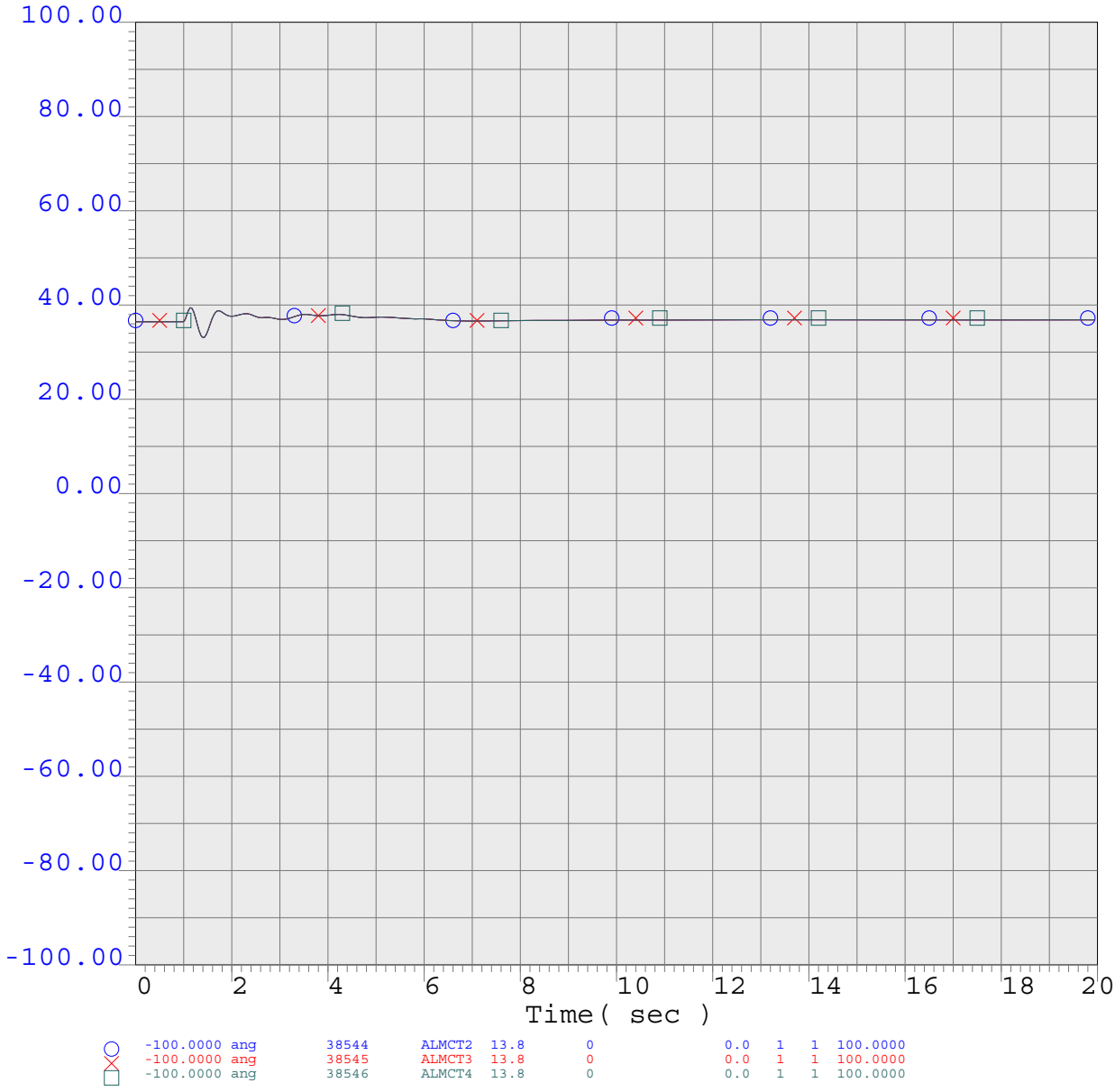
Mon Oct 19 00:53:10 2009

# Almond 2 Power Plant
## Relative Rotor Angle (degrees)




2012 Summer Peak Base Case



2012_sum_pk_pst_208_TRACY-TESLA_500.chf

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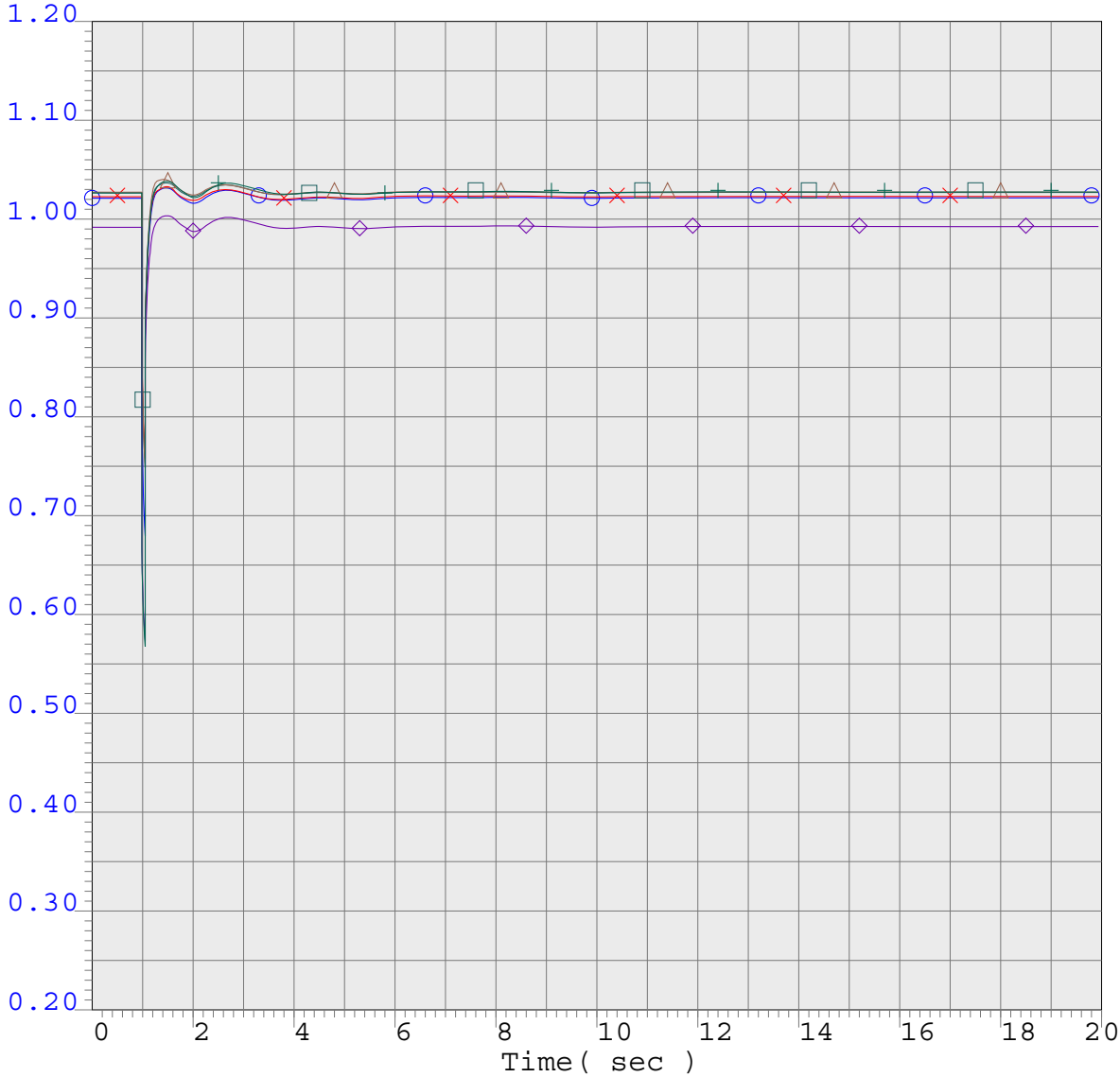
Select TID System Parameters
Voltage (p.u.)




| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 0.2000 | vbul | 38442 | AUGUST | 115.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbul | 38534 | GRAY115 | 115.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 38535 | GRAY69 | 69.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 38432 | OAKDLTID | 115.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 38400 | WALNT | 230.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 38410 | WESTL115 | 115.0 | 0 | 0.0 | 1 | 1 | 1.2000 |

2012 Summer Peak Base Case



2012_sum_pk_pst_208_TRACY-TESLA_500.chf

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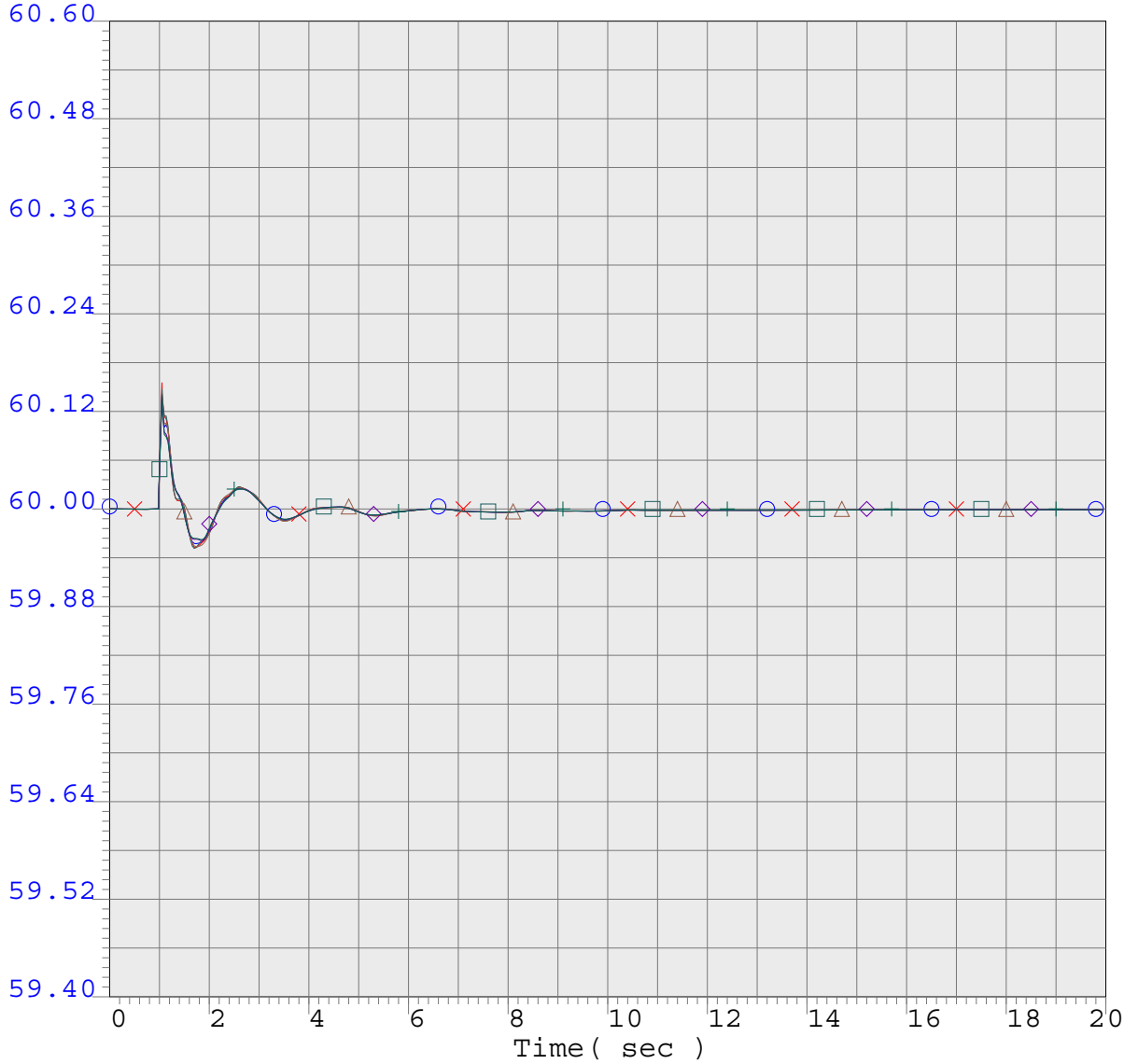
Mon Oct 19 00:53:10 2009

Select TID System Parameters
Frequency (Hz)




| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 59.4000 | fbul | 38442 | AUGUST | 115.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbul | 38534 | GRAY115 | 115.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 38535 | GRAY69 | 69.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 38432 | OAKDLTID | 115.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 38400 | WALNT | 230.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 38410 | WESTL115 | 115.0 | 0 | 0.0 | 1 | 1 | 60.6000 |

2012 Summer Peak Base Case



2012_sum_pk_pst_208_TRACY-TESLA_500.chf

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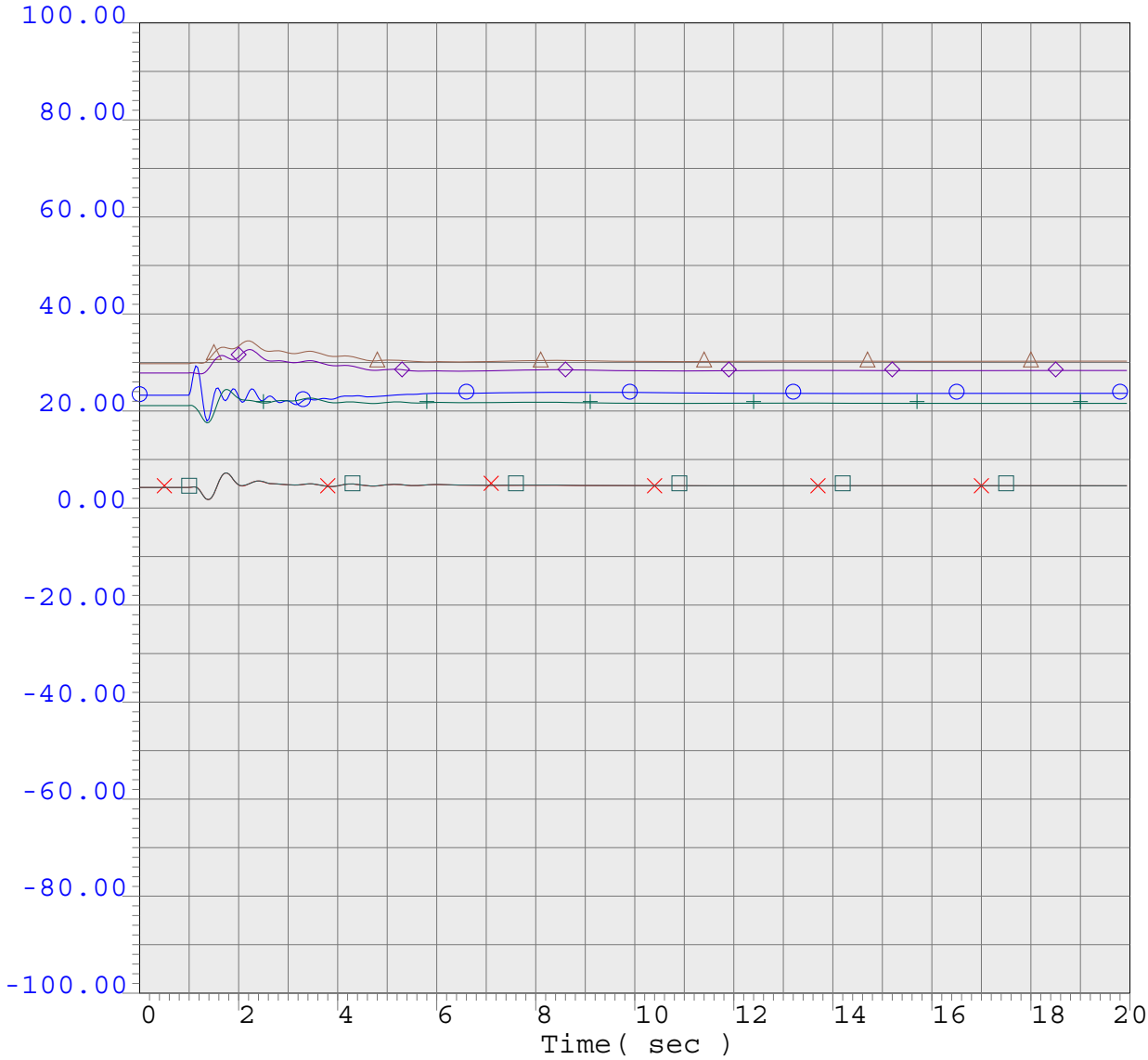
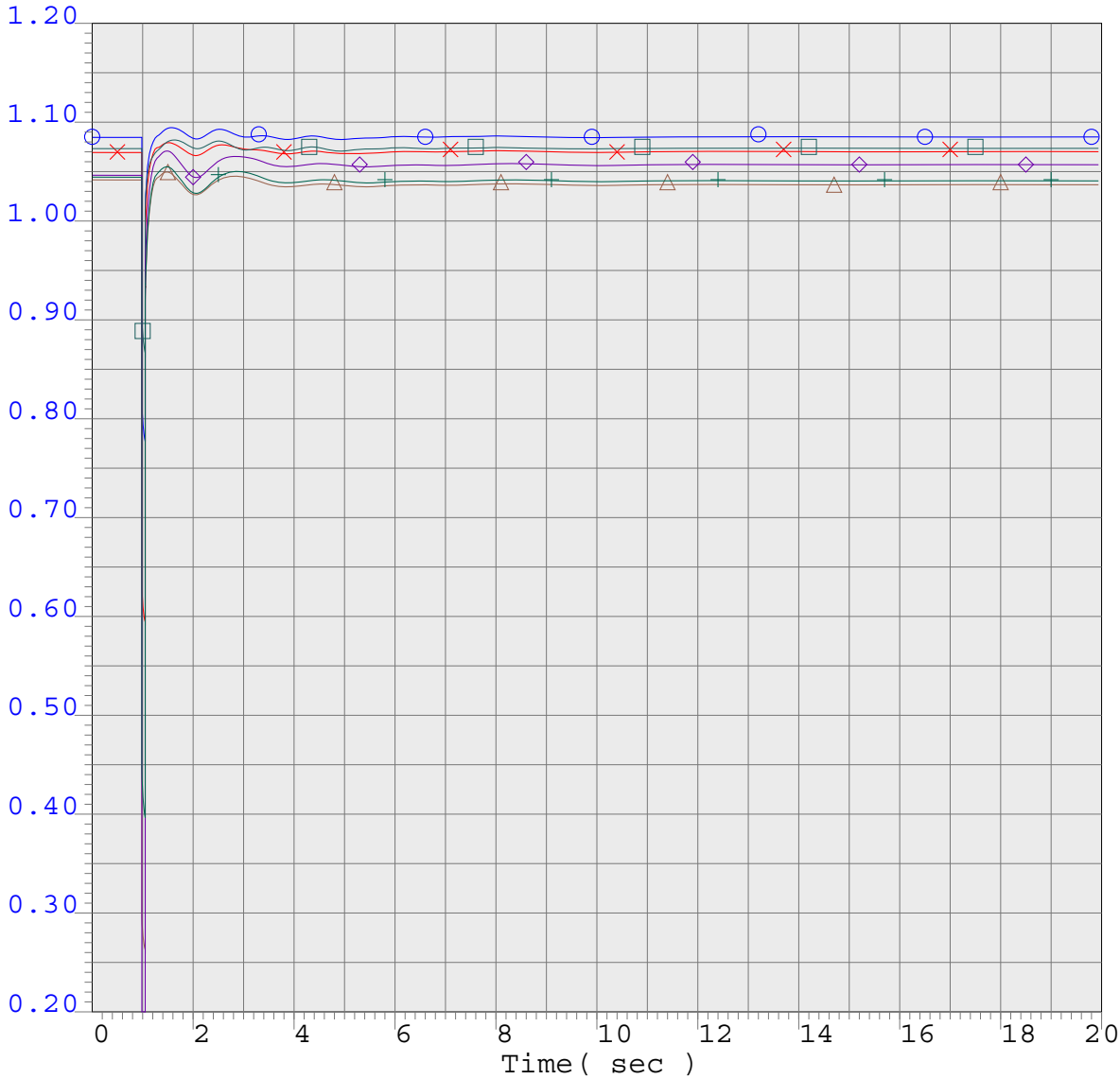
Select TID System Parameters
Relative Rotor Angle (degrees)




| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| -100.0000 ang | 38564 | ALMONDCT | 13.8 | 0 | 0.0 | 1 | 1 | 100.0000 |
| -100.0000 ang | 38550 | DONPDRO1 | 13.8 | 0 | 0.0 | 1 | 1 | 100.0000 |
| -100.0000 ang | 38552 | DONPDRO2 | 13.8 | 0 | 0.0 | 1 | 1 | 100.0000 |
| -100.0000 ang | 38570 | WEC1-CT | 13.8 | 0 | 0.0 | 1 | 1 | 100.0000 |
| -100.0000 ang | 38574 | WEC2-CT | 13.8 | 0 | 0.0 | 1 | 1 | 100.0000 |
| -100.0000 ang | 38572 | WEC3-ST | 13.8 | 0 | 0.0 | 1 | 1 | 100.0000 |

# 500 kV Bulk System Parameters
Voltage (p.u.)




| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 0.2000 | vbus | 30055 | GATES | 500.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 30050 | LOSBANOS | 500.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 30060 | MIDWAY | 500.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 30040 | TESLA | 500.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 30035 | TRACY | 500.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 30030 | VACA-DIX | 500.0 | 0 | 0.0 | 1 | 1 | 1.2000 |

2012 Summer Peak Base Case



2012_sum_pk_pst_208_TRACY-TESLA_500.chf

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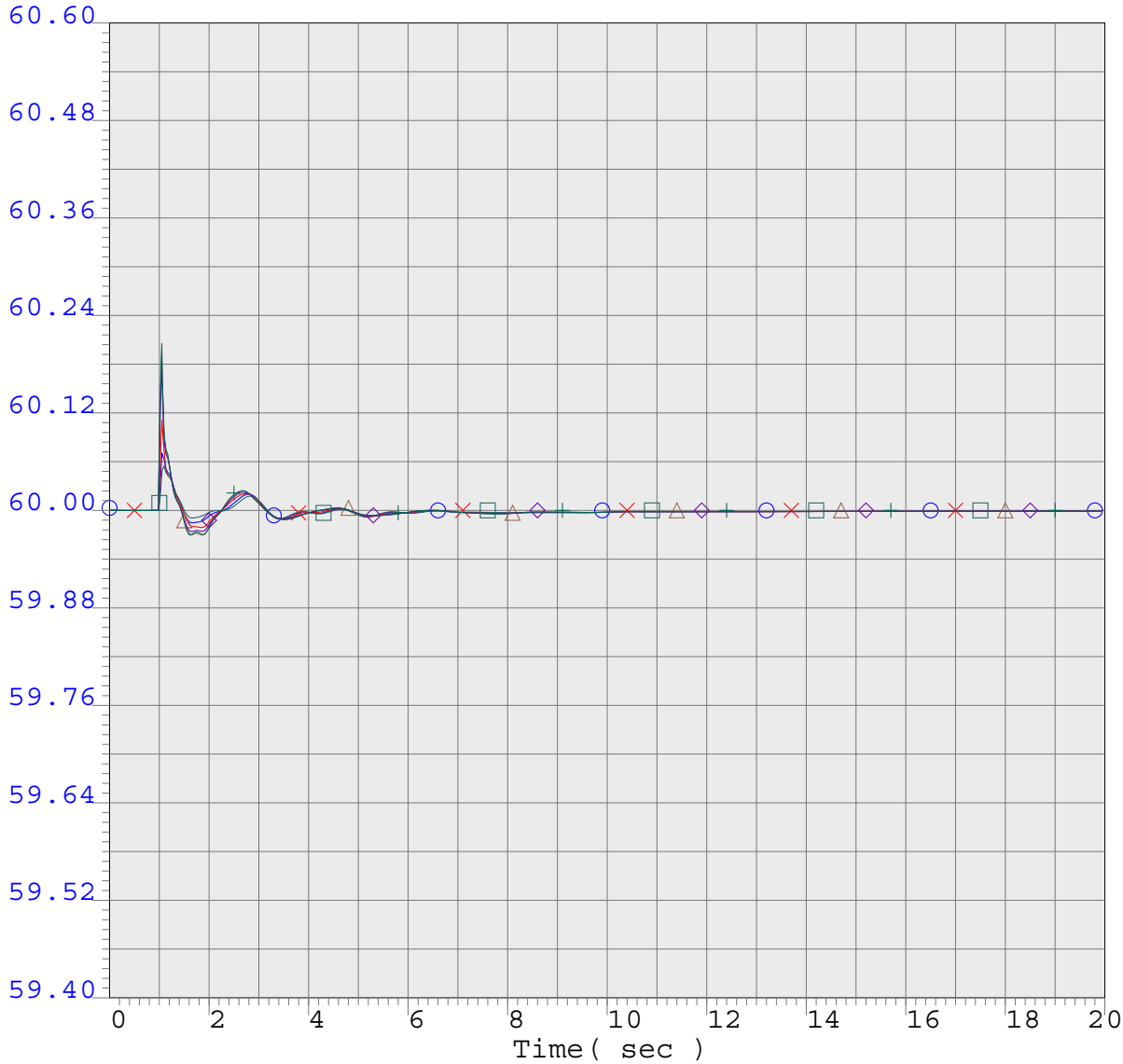
# 500 kV Bulk System Parameters
Frequency (Hz)




| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 59.4000 | fbus | 30055 | GATES | 500.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 30050 | LOSBANOS | 500.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 30060 | MIDWAY | 500.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 30040 | TESLA | 500.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 30035 | TRACY | 500.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 30030 | VACA-DIX | 500.0 | 0 | 0.0 | 1 | 1 | 60.6000 |

2012 Summer Peak Base Case



2012_sum_pk_pst_208_TRACY-TESLA_500.chf

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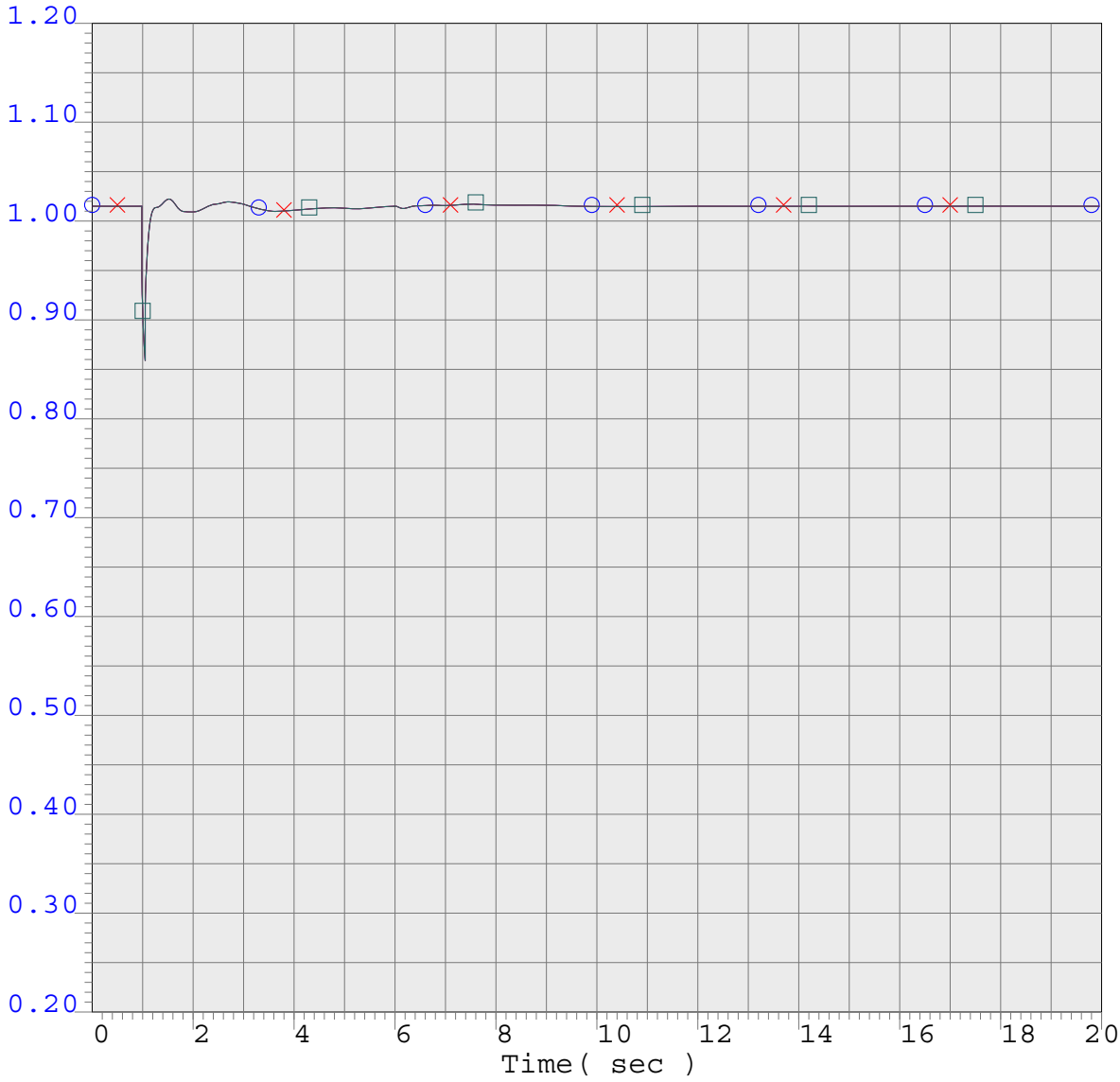
# Transient Stability Plots

# Tracy-Los Banos & Tracy-Tesla #1 500 kV Lines Out

# Almond 2 Power Plant
# Terminal Voltage (p.u.)




| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| ○ | 0.2000 vt | 38544 | ALMCT2 | 13.8 | 0 | 0.0 | 1 | 1 | 1.2000 |
| × | 0.2000 vt | 38545 | ALMCT3 | 13.8 | 0 | 0.0 | 1 | 1 | 1.2000 |
| □ | 0.2000 vt | 38546 | ALMCT4 | 13.8 | 0 | 0.0 | 1 | 1 | 1.2000 |

2012 Summer Peak Base Case



2012_sum_pk_pst_209_TRACY-LOSBANOS-TESLA_500_DLO.chf

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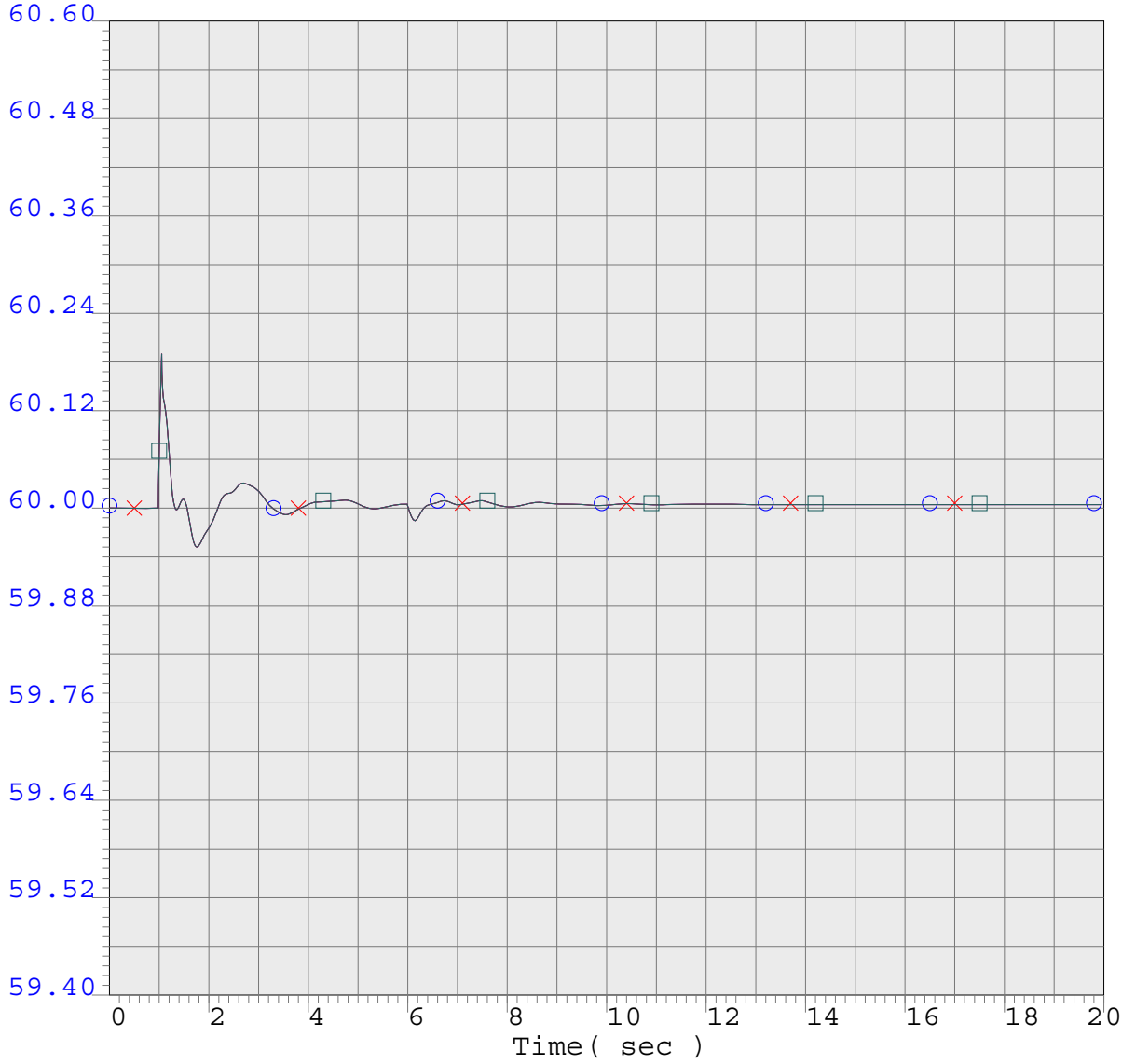
Almond 2 Power Plant
Frequency (Hz)




| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| ○ | 59.4000 fbug | 38544 | ALMCT2 | 13.8 | 0 | 0.0 | 1 | 1 | 60.6000 |
| × | 59.4000 fbug | 38545 | ALMCT3 | 13.8 | 0 | 0.0 | 1 | 1 | 60.6000 |
| □ | 59.4000 fbug | 38546 | ALMCT4 | 13.8 | 0 | 0.0 | 1 | 1 | 60.6000 |

2012 Summer Peak Base Case



2012_sum_pk_pst_209_TRACY-LOSBANOS-TESLA_500_DLO.chf

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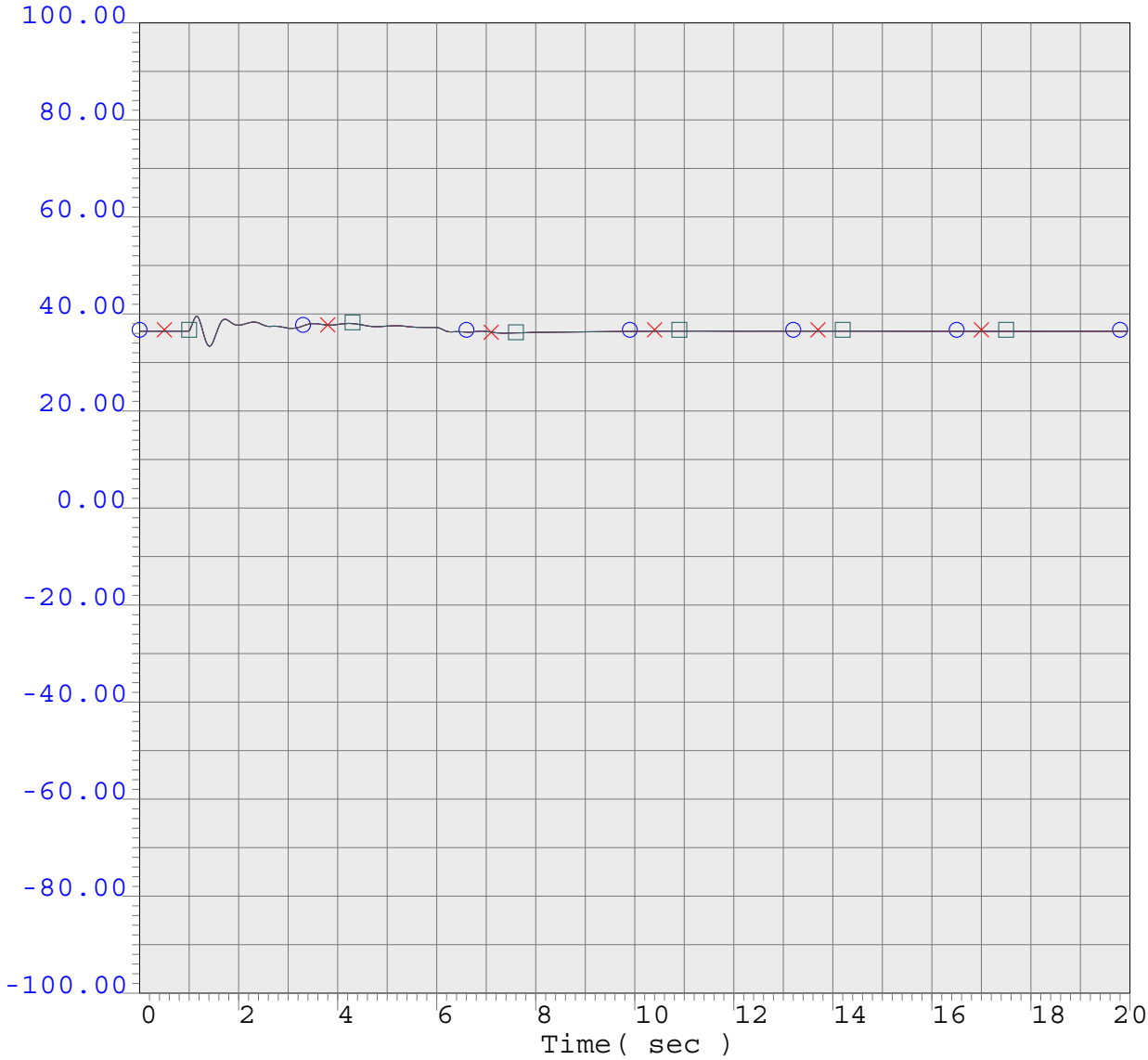
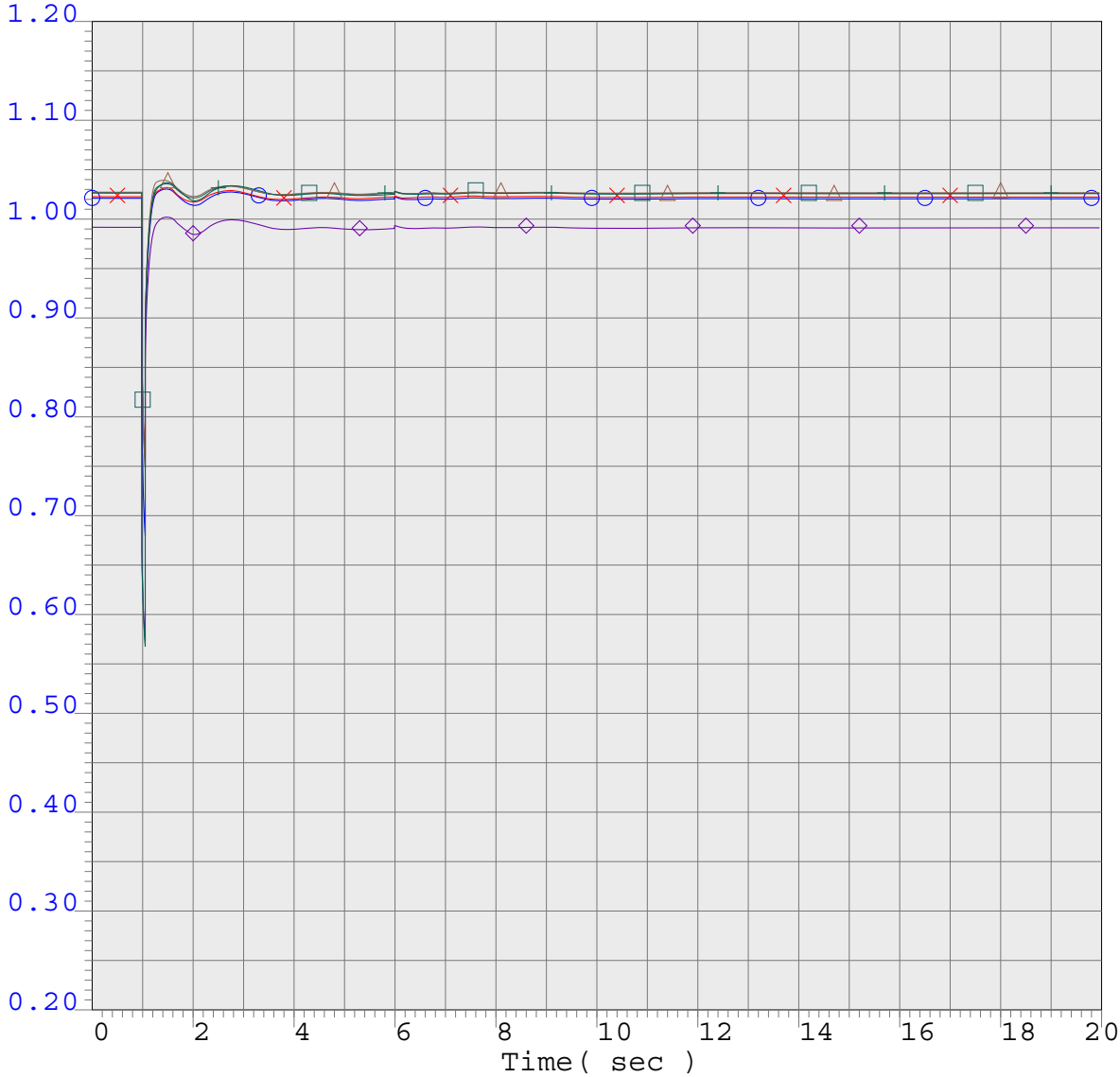
Almond 2 Power Plant
Relative Rotor Angle (degrees)




| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| -100.0000 ang | 38544 | ALMCT2 | 13.8 | 0 | 0.0 | 1 | 1 | 100.0000 |
| -100.0000 ang | 38545 | ALMCT3 | 13.8 | 0 | 0.0 | 1 | 1 | 100.0000 |
| -100.0000 ang | 38546 | ALMCT4 | 13.8 | 0 | 0.0 | 1 | 1 | 100.0000 |

Select TID System Parameters
Voltage (p.u.)




| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 0.2000 | vbul | 38442 | AUGUST | 115.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbul | 38534 | GRAY115 | 115.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 38535 | GRAY69 | 69.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 38432 | OAKDLTID | 115.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 38400 | WALNT | 230.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 38410 | WESTL115 | 115.0 | 0 | 0.0 | 1 | 1 | 1.2000 |

2012 Summer Peak Base Case



2012_sum_pk_pst_209_TRACY-LOSBANOS-TESLA_500_DLO.chf

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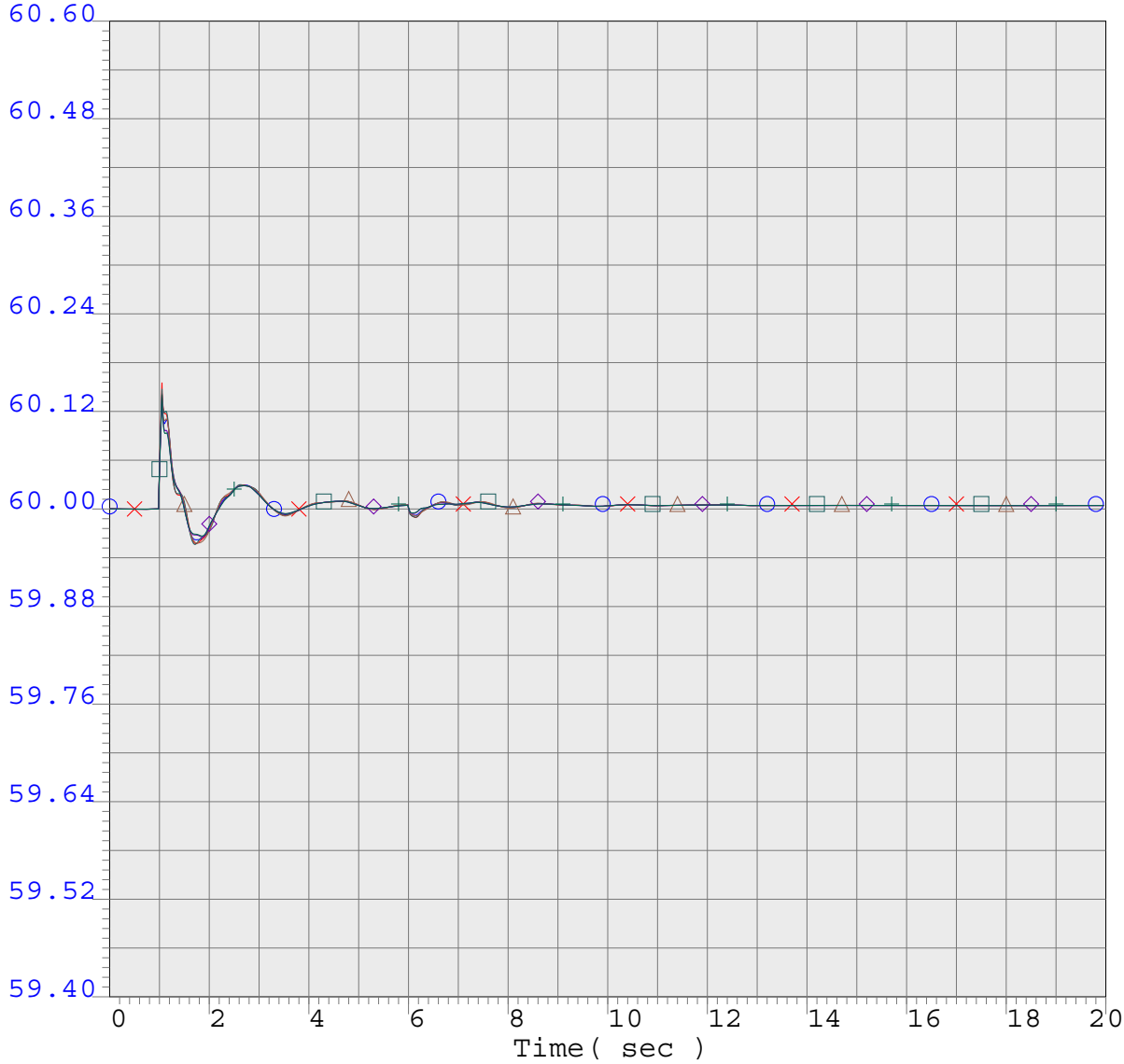
Select TID System Parameters
Frequency (Hz)




| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 59.4000 | fbul | 38442 | AUGUST | 115.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbul | 38534 | GRAY115 | 115.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 38535 | GRAY69 | 69.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 38432 | OAKDLTID | 115.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 38400 | WALNT | 230.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 38410 | WESTL115 | 115.0 | 0 | 0.0 | 1 | 1 | 60.6000 |

2012 Summer Peak Base Case



2012_sum_pk_pst_209_TRACY-LOSBANOS-TESLA_500_DLO.chf

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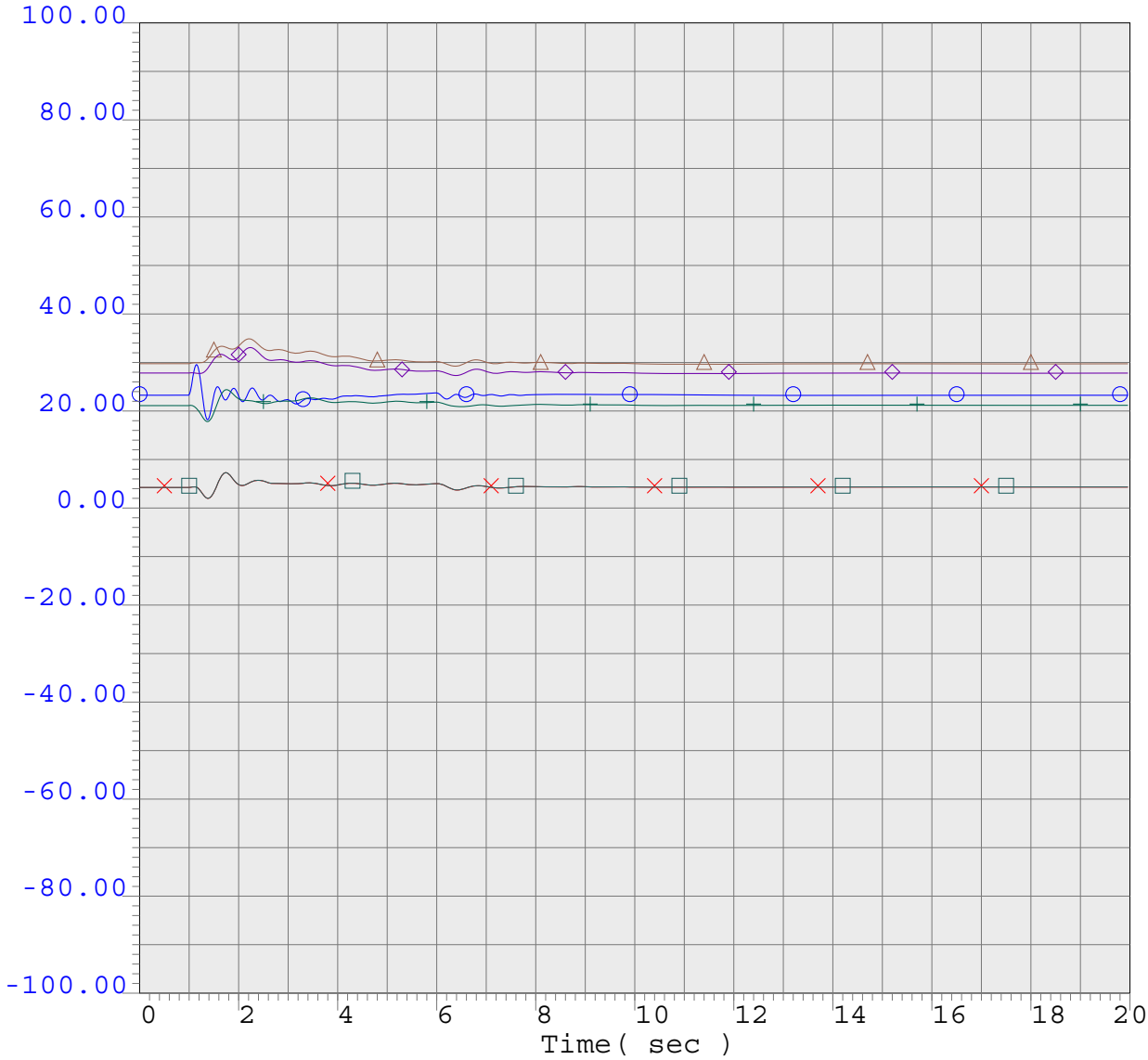
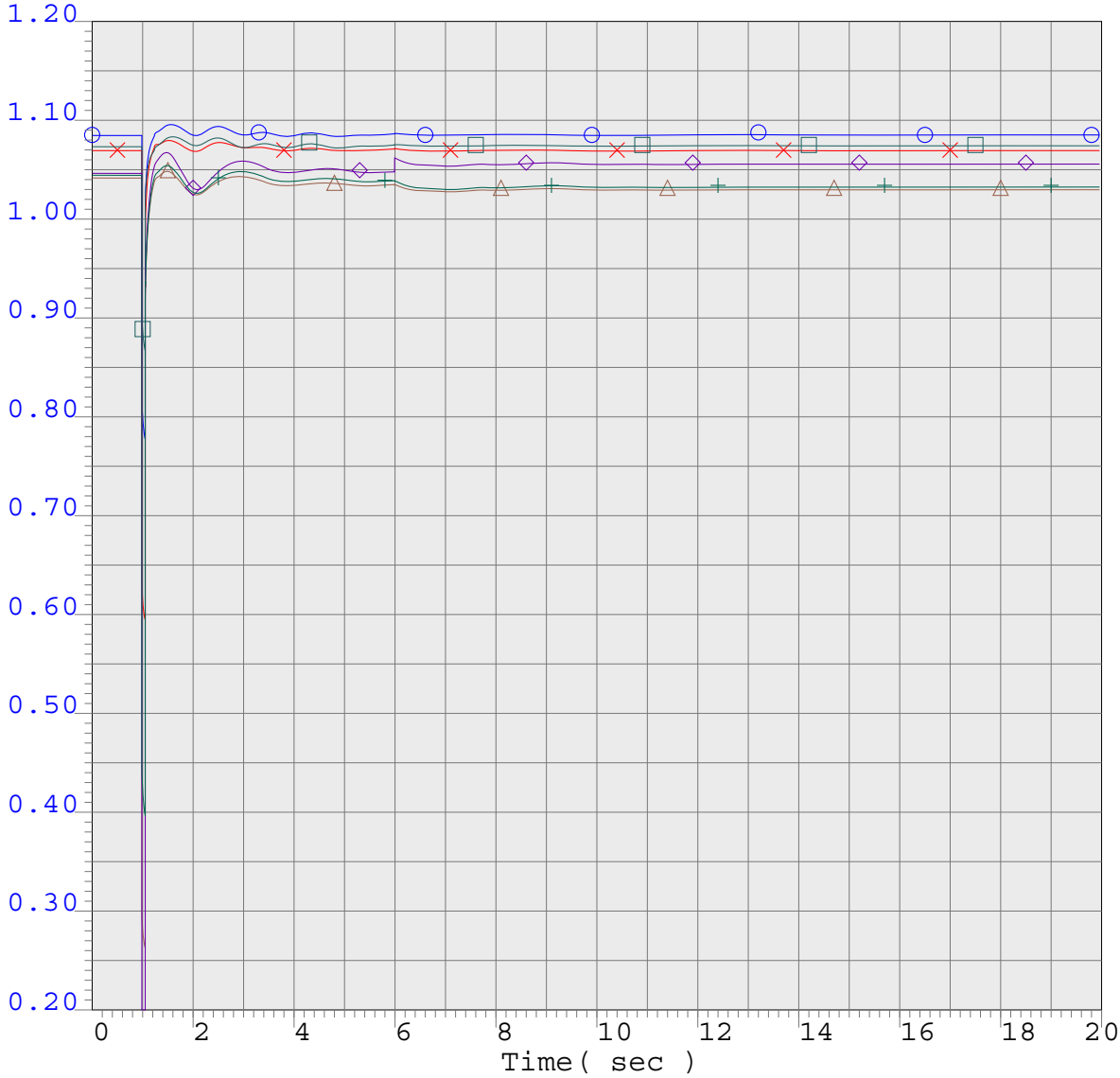
Mon Oct 19 00:53:17 2009

Select TID System Parameters
Relative Rotor Angle (degrees)




| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| -100.0000 ang | 38564 | ALMONDCT | 13.8 | 0 | 0.0 | 1 | 1 | 100.0000 |
| -100.0000 ang | 38550 | DONPDRO1 | 13.8 | 0 | 0.0 | 1 | 1 | 100.0000 |
| -100.0000 ang | 38552 | DONPDRO2 | 13.8 | 0 | 0.0 | 1 | 1 | 100.0000 |
| -100.0000 ang | 38570 | WEC1-CT | 13.8 | 0 | 0.0 | 1 | 1 | 100.0000 |
| -100.0000 ang | 38574 | WEC2-CT | 13.8 | 0 | 0.0 | 1 | 1 | 100.0000 |
| -100.0000 ang | 38572 | WEC3-ST | 13.8 | 0 | 0.0 | 1 | 1 | 100.0000 |

# 500 kV Bulk System Parameters
Voltage (p.u.)




| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 0.2000 | vbus | 30055 | GATES | 500.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 30050 | LOSBANOS | 500.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 30060 | MIDWAY | 500.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 30040 | TESLA | 500.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 30035 | TRACY | 500.0 | 0 | 0.0 | 1 | 1 | 1.2000 |
| 0.2000 | vbus | 30030 | VACA-DIX | 500.0 | 0 | 0.0 | 1 | 1 | 1.2000 |

2012 Summer Peak Base Case



2012_sum_pk_pst_209_TRACY-LOSBANOS-TESLA_500_DLO.chf

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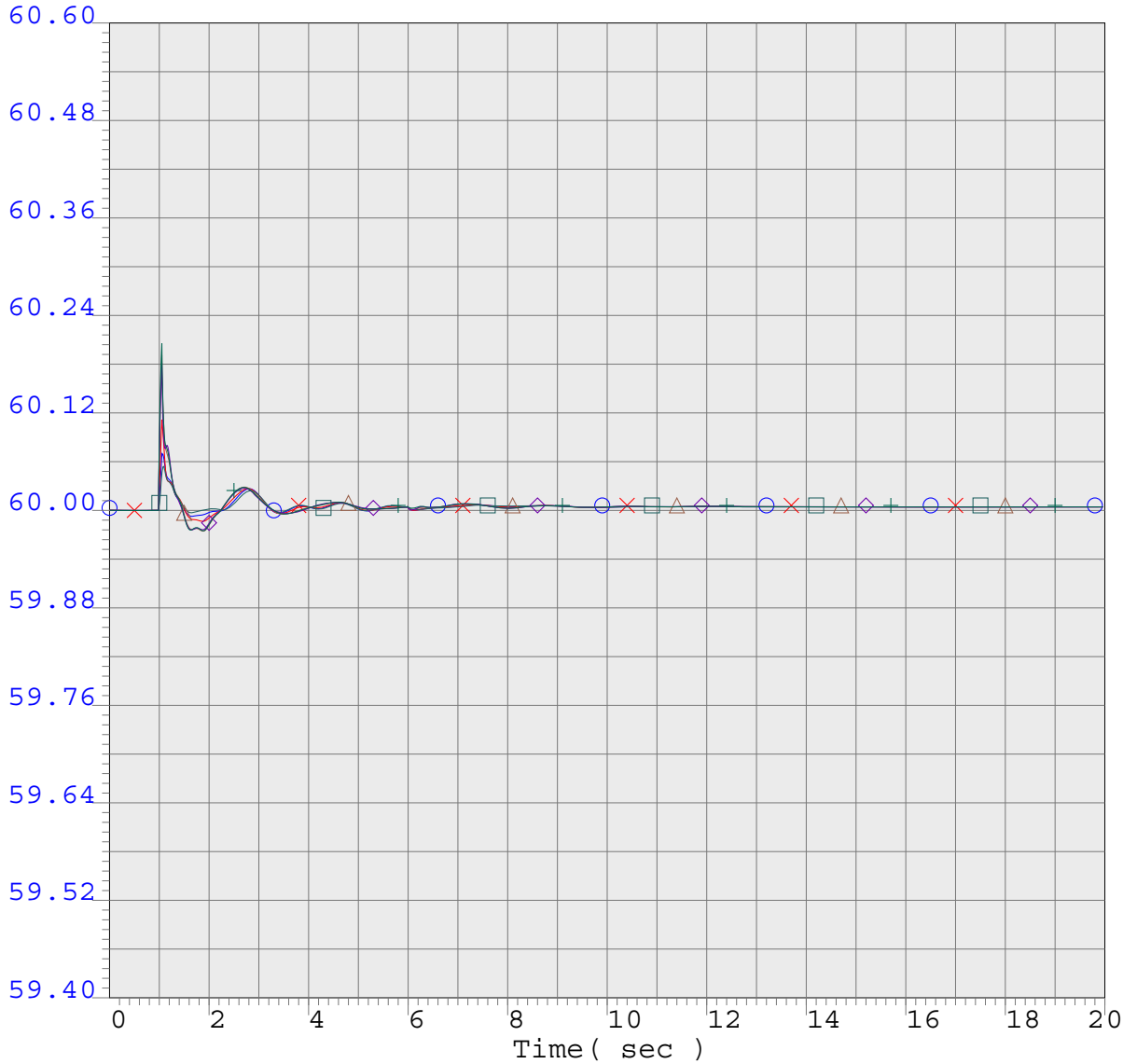
Mon Oct 19 00:53:17 2009

# 500 kV Bulk System Parameters
Frequency (Hz)




| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 59.4000 | fbus | 30055 | GATES | 500.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 30050 | LOSBANOS | 500.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 30060 | MIDWAY | 500.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 30040 | TESLA | 500.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 30035 | TRACY | 500.0 | 0 | 0.0 | 1 | 1 | 60.6000 |
| 59.4000 | fbus | 30030 | VACA-DIX | 500.0 | 0 | 0.0 | 1 | 1 | 60.6000 |

2012 Summer Peak Base Case



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Mon Oct 19 00:53:17 2009

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# RON S. DASCHMANS

Vice President, Technical Services

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## ACADEMIC BACKGROUND

B.S. Electrical & Electronic Engineering, with a specialty in Power Systems Engineering
California State University, Sacramento, 1987

## PROFESSIONAL EXPERIENCE

Ron S. Daschmans has over twenty-two (22) years of electric system utility experience - specializing in both transmission system planning & operations engineering. He possesses extensive experience and a strong working knowledge of the analytic tools that support the system performance evaluation and capital planning processes used by electric utilities. In recent years, he has also shared his expertise as a trainer and mentor. Ron joined Utility System Efficiencies, Inc. (USE) in September of 2001. His employment resumes spans over several sectors of the electric utility industry, including LADWP, SMUD and the CAISO.

As an Assistant Transmission Planning Engineer with LADWP, Ron was primarily involved in WSCC bulk-system activities. As a member of both the WSCC Pacific And Southwest Transfer (PAST) Technical Studies Work Group and serving as Vice-Chairman of the WSCC PAST Coordination Subcommittee, Ron garnered extensive experience in the evaluation of the WSCC interconnected system. During his tenure at LADWP, Ron also worked closely with SRP to evaluate the technical feasibility of the Westwing-Mead-Adelanto 500 kV transmission project.

While employed as a Senior Transmission Planning Engineer at SMUD, Ron assumed a local-system transmission-planning role, which included technical assessments of new transmission and generation interconnections. Ron was responsible for providing expert witness testimony and testifying on behalf of SMUD at CEC Evidentiary Hearings for the Sacramento Ethanol and Power Cogeneration Project. At the time of Ron's employment with SMUD, it was determined that the Sacramento area was prone to voltage collapse. Ron developed specialized software tools to assess both the reactive margin (Q-V) and load handling capability (P-V) of the Sacramento area. He was involved in the development and determination of the local area reactive margin criteria.

In addition to local system transmission planning responsibilities, Ron maintained a visible presence in the WSCC arena. He performed Operations System Studies (OSS) for summer 1995 & 1996, and developed the OSS Handbook – a training reference still widely used today. He was also a member of the System Review Work Group (SRWG), the Operating Capability Study Group (OCSG), and served as Chairman of the July 2 & August 10 Disturbance Validation Work Group. During his tenure as Chairman of the Disturbance Validation Work Group, Ron developed & benchmarked the original post-transient & reactive margin bulk-system assessment tools for the GE PSLF software, which are still being used, in various incarnations, today. At the time of Ron's employment with SMUD, he also conducted transient stability assessments for the proposed Central California-Desert Southwest 500 kV Transmission Project, and participated in the West-of-the-River (WOR) Rating Increase WSCC Review Group.

Ron's career at the CAISO was split between both Grid Planning & Operations Engineering disciplines. As a Grid Planning Engineer, Ron was responsible for the first Reliability Must-Run (RMR) assessment of the Southern California Edison system, coordination of the San Francisco-Peninsula Planning Study Group to assess the long-term transmission/generation needs of the

San Francisco Peninsula, and technical review & coordination of new generation projects interconnecting to the ISO-Controlled Grid. Before changing disciplines from planning to operations, Ron was responsible for providing expert witness testimony and/or testifying on behalf of the CAISO at CEC Hearings for La Paloma, Sunrise, and Elk Hills generation projects.

As a Senior Operations Engineer with the CAISO, Ron was assigned to both Northern California & Greater Bay Area regions. In order to ensure reliable system operation of these regions, Ron was responsible for the development, review & revision of operating procedures, and the engineering evaluation of system clearances and outages. Ron also provided GE PSLF/PSDS/SCSC power flow & transient stability training to members of California utilities, mentored new Operations Engineers, and provided OSAT Training "Summer Seminars" on Sacramento Valley voltage collapse with an emphasis on causes and solutions.

Ron obtained his Bachelors of Science degree in Electrical & Electronic Engineering with a Utility Power Engineering specialization from California State University, Sacramento. References from any existing or previous client of USE may be made available upon request.

## Utility System Efficiencies, Inc. 2001-Present

- **Turlock Irrigation District (TID).** Primary client over the last 8 years. Performed numerous Transmission Planning and Operations Engineering studies. Conducted the Walnut Energy Center (WEC) system impact study (2002-AFC-04). Performed annual Five & Ten Year Electric Transmission System Assessments. Developed seasonal operating Nomograms. Evaluated transmission system clearances (scheduled and forced outages). Provided power flow base case submittals for WECC case development.

- **Generation Interconnection Evaluations.** Performed numerous generation system impact studies for power plants ranging in size from 45 to 1,500 MW. Breadth of technical investigations performed included traditional power flow analysis (under normal and/or emergency system conditions), post-transient analysis, and transient stability evaluations. System impact studies also include the development and evaluation of transmission system mitigation alternatives that can range from capital additions to the implementation of special protection schemes (SPS). In addition to technical feasibility assessments, financial and risk assessments were also provided.

- **River City Transmission Group (RCTG).** Conducted a technical assessment to determine the cumulative impacts of the following generation projects on the Sacramento Area: East Altamont Energy Center (01-AFC-4), Rio Linda/Elverta Power Plant Project (01-AFC-1), Roseville Energy Facility (01-AFC-14), and SMUD Cosumnes Power Plant Project (01-AFC-21). The purpose of the evaluation was to benchmark and compare the electric system performance of the Sacramento Area under anticipated 2003-04 Light Winter operating conditions for various generation project dispatch scenarios. In all, nine (9) generation permutations were evaluated. Studies were limited to N-1 and select N-2 contingency thermal analysis for the PG&E Sacramento Division, PG&E Stockton Division, SMUD, Western Area Power Administration (WAPA), and NCPA areas.

- **TransCanada Northern Lights ±500 kV DC Transmission Project.** Served as the Project Manager for an initial feasibility study of TransCanada Energy Ltd. (TransCanada) project proposal to construct, interconnect and energize a ±500 kV (bi-pole) DC transmission line within the WECC (Western Electricity Coordinating Council) power system grid. Utility System Efficiencies, Inc. (USE) performed two preliminary transmission system impact evaluations, which were limited to the Pacific Northwest region of the United States. The scope of services was to evaluate and compare two potential interconnection alternatives. The components of the preliminary transmission system impact evaluation included: full-representation model development of the DC project, power flow (thermal overload and voltage deviation), post-transient (thermal overload, voltage deviation, reactive margin), and transient stability

assessments. The analysis determined if any transmission system expansion would be required to integrate the project under the most critical operating season, outlined preliminary system expansion alternatives, and identified system conditions that the project can be integrated without significant system expansion.

- **Bonneville Power Administration EPCL Tool Development.** Developed GE PSLF tools in EPCL to assist the Bonneville Power Administration (BPA) in meeting their WECC base case submittal requirements. Programs were written, tested and documented which expand aggregated generator units, detect unexpected shunt cap/reactor modeling, detect and correct unexpected transformer modeling, evaluate VAr flows on selected groups of transformers to identify VAr circulation, and look at generator/SVD/LTC voltage target conflicts at buses.

## California ISO Operations Engineering 2000-2001

- **Alerts Warning Emergency (AWE) Analysis.** Resolved how much generation capacity was available to the CAISO during AWE conditions. Examined each Stage 2 Emergency day for 2000, Developed a report (and tools) that itemized the amount of internal generation by technology and zone, the amount of generation curtailed and/or out of service, imports (with and without dynamics), actual operating reserves, and ACE during Stage 2 Emergency time periods.

- **Operation Engineering Tools.** Developed sophisticated tools in EPCL and Visual Basic, which completely automated the development of the T-126 Nomogram. The tools were tested, benchmarked, and utilized to handle San Francisco/Peninsula clearances and evaluate the Hunters Point 2 & 3 re-power and synchronous condenser proposals. These tools allowed Operations Engineers to analyze the San Francisco area in a way not previously possible. During the course of the year, additional tools were developed for use by Operations Engineering and Grid Planning. These included Unit Effectiveness, Split Bus, 25:1 Watt/VAr Ratio, and Monitoring applications.

- **WSCC / NERC Summer Preparedness.** Served as the Operations Engineering liaison to WSCC for the summer of 2000. Provided the CAISO's response to the WSCC Summer Adequacy Assessment and weekly updates to WSCC. Authored the NERC Summer 2000 Pre-Seasonal and Post-Seasonal Narratives for the CAISO. In addition, participated in the CMOPS Audit, and developed documents for the NERC Reliability Assessment Subcommittee Interview. Also, drafted detailed June 14 & 15 Stage 1 Emergency Reports and created various presentations and graphics for the ISO Board and CEO.

- **Operations Engineering & On-Call Duties.** As a core responsibility of an Operations Engineer, evaluated, suggested modification to, recommended re-schedule of, and approved clearances for both Northern California and Greater Bay Areas. Assessed approximately 200 complex clearances, which required engineering analysis. During one specific on-call rotation, Ron was dealt the challenge of maintaining the system reliability of the CAISO grid during a fire that took out a major 500/230/70 kV substation (Mira Loma). Developed a computer model reflecting the system conditions witnessed in Southern California and determined transmission line re-routing alternatives and minimum generation requirements for the Los Angeles basin due to the loss of the facility.

- **Training.** Conducted two three-day GE PSLF/PSDS training courses for CAISO, CEC, and PTO planning and operations staff. The course covered load flow mechanics, transient stability analysis, and EPCL programming. Responsible for the mentoring and training of new CAISO Operations Engineers. Provided Operations Support and Training (OSAT) Department training "Summer Seminars" on Sacramento Valley voltage collapse with an emphasis on causes and solutions.

- **CAISO Working Groups.** Participated in the CAISO New Generation Connection Working Group. Reviewed, commented on, and provided write-ups for the Action Plan for summer 2001 system operations. Provided comment and feasibility rankings for the Summer Reliability Generation (SRG) review.

- **Hardware/Software/Web Support.** Worked closely with IT, IBM, and MCI to properly configure the new hardware and coordinated with Grid Planning and Operations Engineering to minimize the transitional woes associated with the deployment of the new hardware. These included customized setups, restoration of individualized software, and secure data file backups during the transition. Provided PSLF/PSDS and PTI Software and Hardware Support throughout 2000 to Grid Planning, Operations Engineering, Market Operations and Outage Coordination. Also maintained the CAISO Grid Planning Web Site and Planning Discussion Groups. This included web redesign, layout and expansion. Coordinated all web site postings requested by internal and external entities and served as a single-point-of-contact to answer all Grid Planning related questions received via the web. 99% of all Grid Planning web site inquiries received were handled to the customer's satisfaction they day they were received, which well exceeded the Corporate Goal of three-day turn around.

## California ISO Grid Planning 1997-2000

- **CEC AFC Generation Projects.** Provided technical review and coordination of the interconnection of new generation projects to the CAISO-Controlled Grid. Responsible for La Paloma, Sunrise, Elk Hills, Midway Sunset, and Morro Bay projects. Ron was responsible for providing expert witness testimony and/or testifying on behalf of the CAISO at CEC Hearings for La Paloma, Sunrise, and Elk Hills generation projects.

- **Reliability Must-Run (RMR) Analysis.** Conducted technical analysis for the determination of the 1999-2003 Reliability Must-Run (RMR) generation requirements for the Southern California Edison (SCE) system and evaluation of Local Area Reliability Service (LARS) proposals. Also worked with SCE to reduce RMR generation requirements for the LA Basin with the implementation of an SCE Capacitor Project (1,450 MVAr of shunt capacitors installed in various locations).

- **Dual-Fuel Generation Requirements.** Provided a technical determination of the 1999 Dual-Fuel generation requirement for PG&E, SCE and SDG&E service territories. This study analyzed CAISO-Controlled Grid performance under extreme natural gas curtailment scenarios in an open stakeholder process.

- **San Francisco - Peninsula Long-Term Planning Study Group.** Served as Coordinator of the San Francisco - Peninsula Long-Term Planning Study Group from 1998 to 2000. Developed and evaluated numerous potential transmission and/or generation solutions intended ensure the reliable operation of the San Francisco Peninsula over a ten-year period.

## Sacramento Municipal Utility District 1990-1997

- **CEC AFC Generation Projects.** Ron was the Transmission Planning engineer responsible for the evaluation of the Sacramento Ethanol and Power Cogeneration (SEPCO) Project. Also conducted Transmission Interconnection Study & Assessment for Alternative Project Locations for the aforementioned project. Ron was responsible for providing expert witness testimony and/ testifying on behalf of SMUD at CEC Hearings for SEPCO.

- **Deregulation.** Provided a technical determination of facilities which should be included as part of the PX Grid. Developed SMUD Criteria for determining transmission facilities for which an ISO must have physical control.

- **Operations System Studies (OSS/OSCTG).** Conducted 1994 Spring & Summer Post-Transient Nomogram Studies for the California-Oregon Border Operations Study Coordination Group (OSCTG). Conducted COI & PDCI Nomogram studies for 1995 summer, 1996 summer. Authored the OSS Handbook reference.

- **SMUD Transmission Project Evaluation.** Responsible of the development of the SMUD Ten-Year 230/115 kV Transmission Plan with Provision for SP Shops & Richards Boulevard Development Plans. Also conducted Central California-Desert Southwest (CCDS) 500 kV Transmission Project Transient Stability Study for Transmission Agency of Northern California (TANC).

- **WSCC Committees.** Served as Chairman on July 2 and August 10 Disturbance Validation Work Group. Member of the Operating Capability Study Group (OCSG) from 1996 through 1997. Served as Vice-Chairman of the WSCC Pacific And Southwest Transfer (PAST) Coordination Subcommittee from 1992 through 1994. Member of the System Review Work Group (SRWG) Representation and Implementation Subgroups from 1995 through 1997.

- **Hardware/Software/Web Support.** Served as Systems & Network Administrator for SMUD Transmission Planning / Energy Operations RISC System/6000 AIX Computer Workstations & Networks.

## Los Angeles Department of Water & Power 1987-1990

- **Pacific and Southwest Transfer (PAST).** Served as a member on both the WSCC PAST Coordination Subcommittee and the Technical Studies Work Group. Responsible for the 1990 Summer Nomogram Study (PACI & PDCI), and the 1989 Winter PDCI Nomogram Study. Participated in all seasonal study activities between 1987 and 1990.

- **Mead-Adelanto 500 kV Transmission Project.** Worked closely with Salt River Project (SRP) to evaluate the technical feasibility of the Westwing-Mead-Adelanto 500 kV transmission project. Technical assessment included transient stability studies to determine the optimal sizing of SVCs at both Adelanto and Marketplace substations.

## Power Systems Analysis Tools

- General Electric PSLF/PSDS - *18 Years*
- WSCC Interactive Power Flow System (IPS) and WSCC Stability - *7 Years*
- Power Technologies, Inc. PSS/E - *3 Years*

## Relevant Course Work & Training

- PI-Systems Training - OSI Software, Inc., 1999
- Electronic Data Management Systems - Documentum, 1998
- Mechanics of Using EPCL (PSLF Version 10.1) - General Electric, 1998
- Power Transmission: Access, Pricing & Policy - Infocast, 1996
- Machine Parameter Measurements for Improved Modeling - Power Technologies, Inc., 1994
- Mechanics of Running PSLF Dynamics - General Electric, 1992
- C-Language Computer Programming - Sacramento City College, 1992 Fall Semester
- AIX & RISC System/6000 Systems Administration - IBM, 1991
- Static Compensators in Electric Utilities & Large Industries - University of Wisconsin, 1991
- Voltage Control & Reactive Power - Power Technologies, Inc., 1990
- Power System Dynamics - Power Technologies, Inc., 1990
- Advanced PSS/E - Power Technologies, Inc., 1988

## Extracurricular Activities

- California ISO Y2K Project Team
- California ISO Business Champions Team
- California ISO Volleyball Team
- California ISO Web Site Development
- Contributor to California ISO Newsletter
- Contributor to IBM Newsletter
- SMUD Employee Volunteer Program
- SMUD United Way Key Campaigner
- Team Leader, SMUD Safety Improvement Employee Action Team

## Awards

- 4-Time Recipient of California ISO Spot-Bonus Award Program, 1999-2001
- Recipient of SMUD District Excellence Award, 1997
- Life-Time Member Tau Beta Pi
- Member Golden Key Honor Society