TABLE OF CONTENTS

TABLE OF CONTENTS

TABLE OF CONTENTS

Tables

Figures

TABLE OF CONTENTS

2.1 INTRODUCTION AND PROJECT OVERVIEW

Hydrogen Energy California LLC (HECA LLC) is proposing an Integrated Gasification Combined-Cycle (IGCC) polygeneration project (hereafter referred to as HECA or the Project). HECA LLC is owned by SCS Energy California LLC. The Project will gasify a 75 percent coal and 25 percent petroleum coke (petcoke) fuel blend to produce synthesis gas (syngas). Syngas produced via gasification will be purified to hydrogen-rich fuel, which will be used to generate low-carbon baseload electricity in a Combined Cycle Power Block, low-carbon nitrogen-based products in an integrated Manufacturing Complex, and carbon dioxide (CO_2) for use in enhanced oil recovery (EOR).

The products and power produced by the Project have a lower carbon footprint than similar products traditionally produced from fossil fuels. This low-carbon footprint is accomplished by capturing more than 90 percent of the CO_2 in the syngas and transporting CO_2 for use in EOR, which results in simultaneous sequestration (storage) of the CO_2 in a secure geologic formation. CO_2 will be transported for use in EOR in the adjacent Elk Hills Oil Field (EHOF), which is owned and operated by Occidental of Elk Hills, Inc. (OEHI). As discussed further below, the OEHI EOR Project will be separately permitted by OEHI through the Department of Conservation, Division of Oil, Gas, and Geothermal Resources (DOGGR). The EOR process results in sequestration (storage) of the CO_2.

The Project will be located near the unincorporated community of Tupman in western Kern County, California, as shown on Figure 2-1, Project Vicinity.

Highlights of the Project are as follows:

- The Project is designed to operate on a fuel blend consisting of 75 percent western sub-bituminous coal and 25 percent California petcoke based on thermal input to the gasifier higher heating value (HHV) basis for the life of the Project.
- The feedstocks will be gasified to produce syngas that will be further processed and cleaned in the Gasification Block to produce hydrogen-rich fuel.
- More than 90 percent of the carbon in the raw syngas will be captured in a high-purity CO_2 stream during steady-state operation.
- High purity CO_2 will be compressed and transported by pipeline to the EHOF for injection into deep underground hydrocarbon reservoirs for CO_2 EOR.
- The Combined Cycle Power Block will generate approximately 405 megawatts (MW) of gross power and will provide a nominal 300 MW of low-carbon baseload electricity to the grid during operations, feeding major load sources.
- An integrated Manufacturing Complex will produce approximately 1 million tons per year of low-carbon nitrogen-based products, including urea, urea ammonium nitrate (UAN), and anhydrous ammonia, to be used in agricultural, transportation, and industrial applications.

- The power and nitrogen-based products produced by the Project will have a significantly lower carbon emission profile relative to similar power and products traditionally generated from fossil fuels, such as natural gas or coal. Natural gas is the fuel source predominantly used for power generation in California.

- The Sulfur Recovery Unit (SRU) will convert sulfur compounds into a saleable sulfur product.

- The process water source for the Project will be brackish groundwater from the Buena Vista Water Storage District (BVWSD) Brackish Groundwater Remediation Project. The water will be supplied via an approximately 15-mile pipeline from northwest of the Project Site by BVWSD and will be treated on site to meet Project specifications. Potable water will be supplied by West Kern Water District (WKWD) for drinking and sanitary purposes.

- There will be no direct surface water discharge of industrial wastewater or storm water. Process wastewater will be treated on site and recycled for reuse within the Project. Other wastewaters (e.g., from cooling tower blowdown and the wastewater treatment unit) will be collected and directed to on-site zero liquid discharge (ZLD) unit. Water recovered by the ZLD unit is recycled for reuse within the facility.

- The Project is designed with state-of-the-art emission control technology to achieve minimal air emissions through the use of Best Available Control Technology (BACT). The Project is designed to avoid flaring during steady-state operation, and to minimize flaring during start-up and shut-down operations.

- Project greenhouse gas (GHG) emissions (e.g., CO_2) will be reduced through carbon capture and CO_2 EOR, resulting in simultaneous sequestration.

This Project Description section of this Application for Certification (AFC) Amendment describes the Project information summarized above in detail. A computer rendering of the Project is shown on Figure 2-2, Project Rendering Looking Northwest. A block flow diagram of the Project is shown on Figure 2-3, Overall Block Flow Diagram.

2.1.1 Project Background

SCS Energy California LLC acquired 100 percent ownership of HECA LLC in September 2011.

The previous owner of the Project submitted an AFC (08 AFC-8) to the California Energy Commission (CEC) on July 31, 2008, which proposed the Project on a different site. The previous owner subsequently decided to move the Project when it discovered the existence of sensitive biological resources at that site. A Revised AFC was submitted on May 28, 2009 for the current site, and deemed data adequate on August 26, 2009. An Informational Hearing and Site Visit were conducted on September 16, 2009. In addition, multiple staff workshops were held and responses to six sets of Data Requests were submitted between 2009 and 2011.

HECA LLC modified the Project design to ensure economic viability and better serve market needs, while continuing to adhere to the strictest environmental standards. HECA LLC respectfully submits this AFC Amendment for the modified Project design. This AFC Amendment supersedes previous application materials in their entirety, unless noted otherwise.

Several basic Project components remain unchanged, including the following:

- The Project Site location remains the same.
- The Project continues to use IGCC technology.
- More than 90 percent of the carbon in the syngas is captured during steady state operation.
- CO_2 is transported to the adjacent EHOF for use in EOR resulting in sequestration.
- State-of-the-art emission controls are included in the design.
- Process water consisting of brackish groundwater will be supplied by the BVWSD.
- ZLD technology is used in the Project design.

The following are some of the notable Project changes proposed in this AFC Amendment:

- The option to purchase an approximately 5-acre parcel adjacent to the Project Site was acquired subsequent to the 2009 Revised AFC. This parcel became part of the Controlled Area and increased its acreage from 628 to 633. Project Site boundaries have changed to include some areas previously within the Controlled Area and to exclude other areas that were previously part of the Project Site. The current Project Site and Controlled Area are now 453 acres and 653 acres, respectively, rather than the sizes of 473 and 628 acres that were presented in the 2009 Revised AFC.
- Mitsubishi Heavy Industries (MHI) oxygen-blown dry feed gasification technology has been selected.
- The gasifier preheaters are no longer needed, due to the change in design of the gasifier.
- A MHI 501GAC® CT has been selected.
- Tail gas from the SRU will be recycled back to the Gas Treating Area to minimize sulfur dioxide emissions.
- Coal transportation. HECA proposes two alternatives for transferring coal to the Project Site:
  - **Alternative 1, rail transportation.** An approximately 5-mile new industrial railroad spur that would connect the Project Site to the existing San Joaquin Valley Railroad (SJVRR) Buttonwillow railroad line, north of the Project Site. This railroad spur would also be used to transport some HECA products to customers.

- **Alternative 2, truck transportation.** Truck transport would be via existing roads from an existing coal transloading facility northeast of the Project Site. The truck route distance is approximately 27 miles. This alternative was presented in the 2009 Revised AFC.

- A new, integrated Manufacturing Complex will produce approximately 1 million tons per year of low-carbon nitrogen-based products, including urea, UAN and anhydrous ammonia, to be used in agricultural, transportation and industrial applications.

- The routes of the natural gas pipeline, potable water pipeline, and electrical transmission have been refined as follows:

  - An approximately 13-mile new natural gas pipeline will interconnect with an existing Pacific Gas and Electric Company (PG&E) natural gas pipeline located north of the Project Site.

  - Potable water will be delivered via an approximately 1-mile pipeline from a new WKWD potable water production site east of the Project Site.

  - An approximately 2-mile electrical transmission linear will interconnect with a future PG&E switching station east of the Project Site.

Details regarding these Project modifications are provided below.

2.1.2 Project Permitting

The CEC is responsible for reviewing and approving the HECA Project under the Warren–Alquist Act, Cal. Pub. Res. Code § 25500 *et seq*. The OEHI EOR Project will be separately permitted by DOGGR.

2.1.2.1 California Energy Commission Role

In addition to issuing a license for the HECA Project, the CEC will act as lead agency under the California Environmental Quality Act (CEQA) for the environmental review of the "whole of the Project," including the HECA Project and the OEHI EOR Project. The CEC conducts this review in accordance with the administrative adjudication provisions of the Administrative Procedure Act, Cal. Gov't Code § 11400 *et seq*., and its own regulations governing site certification proceedings, 20 California Code of Regulations § 1701, *et seq*. These provisions require the CEC staff to conduct an independent analysis of applications for certification and prepare an independent assessment of a project's potential environmental impacts, feasible mitigation measures, and alternatives as part of this process. In preparing this analysis, the staff consults with interested local, regional, state, and federal agencies and Native American tribes.

2.1.2.2 Division of Oil, Gas, and Geothermal Resources

DOGGR will separately permit the OEHI EOR Project. DOGGR has statutory responsibility under Division 3 of the Public Resources Code to regulate all oilfield operations in the State of California. DOGGR is authorized by law to approve the injection and extraction wells and associated well facilities, to regulate downhole operations, and to be responsible for appropriate regulation of surface activities relating to the OEHI CO_2 EOR. The wells to be used for injection of the CO_2 are Class II injection wells under the Underground Injection Control (UIC) program in the Federal Safe Drinking Water Act (SWDA), 42 United States Code § 300h-4. DOGGR has primacy to approve Class II injection wells in the state of California under Section 1425 of the SDWA, see U.S. Environmental Protection Agency (USEPA, 1983). The wells and associated well facilities for the OEHI CO_2 EOR will be approved pursuant to authority provided to DOGGR in the Public Resources Code and the SWDA and in accordance with applicable DOGGR regulations.

CO_2 from HECA will be compressed and transported via pipeline to the EHOF, where it will be injected for CO_2 EOR. The CO_2 EOR process involves the injection and reinjection of CO_2 to reduce the viscosity and enhance other properties of the trapped oil, thus allowing it to flow through the reservoir and improve extraction. The injection and re-injection of CO_2 is a closed-loop process that results in the additional oil recovery. Over time, virtually all of the injected CO_2 becomes trapped or sequestered underground (occupying the pore space left after the oil is produced), sequestered in a secure geologic formation.

OEHI will be installing the CO_2 pipeline from the Project Site to the EHOF, as well as the EOR processing facility and associated wells needed in the EHOF for CO_2 EOR. OEHI completed the following environmental evaluations and corresponding reports regarding the CO_2 line and CO_2 EOR facilities.

- Project Supplemental Environmental Information, Occidental of Elk Hills Inc., CO_2 Enhanced Oil Recovery Project, dated April 2012, prepared by Stantec

- Modified CO_2 Supply Line Alignment Data Gap Analysis, dated April 2012, prepared by Stantec

These documents are provided in Appendix A-1 and A-2 of this AFC Amendment. The environmental evaluation related to the OEHI CO_2 EOR facilities, including injection wells, is included entirely within the Supplemental Environmental Information document provided in Appendix A. The environmental evaluation related to the CO_2 pipeline is covered in Appendix A and this AFC Amendment. This information and analysis is based upon an average annual CO_2 output of 107 million standard cubic feet per day (mmscfd) and a maximum daily CO_2 output of 145 mmscfd. HECA LLC and OEHI are engaged in discussions regarding an increased average annual CO_2 output of 135 mmscfd and a maximum daily CO_2 output of 162 mmscfd. Such an increase in CO_2 would not be expected to materially alter the information and analysis contained herein and in Appendix A. In the event that HECA LLC and OEHI agree upon an increased CO_2 output, any required additional information and analysis will be provided to the CEC at that time.

This section provides Project description details regarding the HECA facility and the OEHI CO_2 pipeline. Appendix A provides Project Description details regarding the OEHI CO_2 EOR.

2.1.2.3 Department of Energy

The Department of Energy (DOE) is providing financial assistance to HECA LLC for the definition, design, construction, and demonstration of the HECA Project. DOE has selected the Project through a competitive process under the Clean Coal Power Initiative Round 3 (CCPI) program. Because the Project is receiving funding from a federal agency, it is subject to the National Environmental Policy Act (NEPA). NEPA's process consists of an evaluation of relevant environmental effects of a federal project or action undertaking, including a series of pertinent alternatives. NEPA's process begins when an agency develops a proposal to address a need to take an action. This AFC Amendment is intended to provide information to CEC and DOE for their use in preparing a joint CEQA/NEPA document.

The Purpose and Need statement prepared for the Project is provided in Appendix B, NEPA. Specific terms as they pertain to the Project are summarized below.

Proposed Action

The Proposed Action is the DOE award of financial assistance to HECA LLC for Project definition, design and construction, and demonstration of the following components of the Project:

- HECA Project Site, including the proposed Project and associated processes and equipment, except for the Air Separation Unit (ASU), which is a Connected Action
- Potable water linear
- Transmission linear
- Process water linear and well field
- Natural gas linear
- Railroad spur

Connected Actions

Elements that will not be part of the cost-sharing effort are referred to as Connected Actions. This AFC Amendment evaluates the potential impacts of Connected Actions in addition to those of the Proposed Action.

- CO_2 linear
- CO_2 EOR and sequestration
- ASU

2.1.3 Project Terminology

The following terminology will be used throughout this AFC:

- **Project or HECA.** The IGCC electrical generation, low-carbon nitrogen-based products manufacture, and associated equipment and processes, including its linear facilities

- **OEHI Project.** The use of the CO_2 for EOR at EHOF and resulting sequestration, including the CO_2 pipeline and associated EOR equipment
- **HECA and OEHI Project.** The IGCC electrical generation, low-carbon nitrogen-based products manufacture, and associated equipment and processes, including its linear facilities plus OEHI's CO_2 EOR, unless stated explicitly as the HECA Project or OEHI Project
- **Project Site or HECA Project Site.** The 453-acre parcel of land that would contain the HECA facility. HECA has the option to purchase the Project Site from the property owner.
- **Controlled Area.** HECA also has the option to purchase 653 acres adjacent to the Project Site over which HECA will control access and future land uses.
- **OEHI Project Site.** The portion of land within the EHOF in which the CO_2 produced by HECA will be used for EOR and resulting sequestration.
- **Proposed Action.** DOE financial assistance for the funded components of the Project.
- **Connected Actions.** Components of the Project that will not be funded by DOE (i.e., OEHI Project and HECA Project ASU).
- **Gasification Block.** Process units needed to produce hydrogen-rich fuel (i.e., Gasification, Shift, Low-Temperature Gas Cooling (LTGC), Mercury Removal, Acid Gas Removal (AGR), Sulfur Recovery, Tail Gas Treating, EOR CO_2 Compression Units and associated utilities).
- **Power Block.** Equipment associated with combined cycle power generation (i.e., combustion turbine (CT), steam turbine (ST), Generator, Heat Recovery Steam Generator (HRSG), Condenser, Switchyard, and associated support systems).
- **Manufacturing Complex.** Process units needed to produce low-carbon, nitrogen-based products (i.e., Pressure Swing Adsorption (PSA), CO_2 Purification and Compression, Ammonia Synthesis, Urea, Urea Pastillation and Storage, Nitric Acid, Ammonium Nitrate, Urea Ammonium Nitrate Units, and associated utilities).

2.1.4 Project Benefits

The Project will provide numerous benefits at the local, state, regional, national, and global levels. DOE describes the overall HECA benefits as

> "The Project will be among the cleanest of any commercial solid fuel power plant built or under construction and will significantly exceed the emission reduction targets for 2020 established under the Energy Policy Act of 2005. In addition, emissions from the Project plant will be well below the California regulation requiring baseload plants to emit less greenhouse gases than comparably-sized natural gas combined cycle power plants. The CO_2 captured by the Project will enable geologic storage at a rate of approximately 3 million tons of CO_2 per year and will increase domestic oil production (DOE, 2011)."

According to DOE,

> "A need exists to further develop carbon management technologies that capture and store or beneficially reuse CO_2 that would otherwise be emitted into the atmosphere from coal-based electric power generating facilities. Carbon capture and storage (CCS) technologies offer great potential for reducing CO_2 emissions and mitigating global climate change, while minimizing the economic impacts of the solution. Once demonstrated, the technologies can be readily considered in the commercial marketplace by the electric power industry (DOE, 2011)."

The Project's key technologies—integrated gasification combined cycle, carbon capture and storage, and enhanced oil recovery—have long been used separately and safely and will combine together in the HECA Project as a model for the future.

Additional specific benefits of the Project include:

- Achieving approximately 90 percent CO_2 capture efficiency and geologically storing approximately 3 million tons of CO_2 per year.
- Incorporating the beneficial use of CO_2 for EOR. EOR brings economic and energy security benefits.
- Converting coal to hydrogen, thus using an abundant cheap supply of the nation's fuel in a new and clean manner and increasing energy diversity in a time when California is largely dependent on natural gas for power generation.
- Meeting California's increasing power demands by generating low-carbon hydrogen power.
- Providing approximately 300 MW of new, low-carbon baseload electric-generating capacity during operations, supplying power for over 160,000 homes.
- Supporting a reliable power grid that is an essential component to meeting California's GHG-reduction goals for 2020 and beyond.
- Using hydrogen as a fuel source for electricity, thus providing a new alternative source of energy to California and the nation.
- Providing baseload dispatchable power to help back-up intermittent renewable power sources to benefit California's grid.
- Helping to restore a local aquifer by using brackish water that currently threatens local agriculture. HECA's use of brackish water from BVWSD is expected to improve local lands for agricultural use by physically lowering the brackish water table and allowing better water from the east to penetrate the area.
- Eliminating direct surface water discharge of industrial wastewater and storm water run-off through the use of ZLD technology.

- Providing a low carbon footprint for California's key agricultural market and substantially lowering foreign imports of fertilizer to the United States.

- Boosting the local and California economy with an estimated 2,500 jobs associated with peak construction and approximately 200 full-time positions associated with Project operations, plus ancillary jobs and businesses to support the Project.

- Eliminating 3 million tons per year of CO_2 (roughly equivalent to the GHG output of 650,000 automobiles) through carbon capture, utilization, and sequestration.

- Proving out CCS as a viable method for reducing the carbon footprint of power generation and manufacturing. Many scientists, academicians, and policy makers acknowledge that carbon capture and sequestration must play a large role in decarbonizing electricity and that CCS technology is critical for California to meet its 2050 GHG-reduction goals.

- Increasing California's production of oil when the state is currently importing approximately 50 percent of its oil and 90 percent of its natural gas needs each year. An estimated 2 barrels of oil can be recovered for every ton of CO_2 injected for EOR. According to this estimate, output from the HECA Project will help California extract an otherwise unrecoverable 5 million barrels of oil each year or 150 million barrels over the first 30 years of the Project.

- Reducing the carbon footprint of California's oil supply. The increased production of oil from EHOF provides an increased supply of domestic, in-state energy that is environmentally preferential to oil imports that are produced in foreign countries with a higher carbon footprint plus transported across the ocean.

- Increasing the supply of hydrogen available to support the state's goal of energy independence and diversity as expressed in California Executive Order S-7-04, which mandates the development of a hydrogen infrastructure and transportation system in California.

- Supplying an in-state source of lower-cost fertilizer products that will be manufactured with a low carbon footprint. Currently, the vast majority of all California nitrogen-based fertilizer feedstocks are imported into the state. Due to these transportation costs, California nitrogen-based fertilizers are priced 20 to 30 percent higher than in other United States regions. Therefore, the presence of a nitrogen-based fertilizer producer is likely to benefit local consumers through increased competition and the lowering of transportation costs.

In summary, HECA's polygeneration configuration provides the following:

- Low carbon footprint fertilizers commercially available for the first time.

- Low carbon footprint hydrogen commercially available for industrial use for the first time.

- A low carbon footprint supply of urea for NO_X control in diesel trucks mandated by USEPA beginning in 2010.

- A commercial-scale supply of captured CO_2 for use in EOR and simultaneous sequestration.

2.1.5 Project Objectives

Project objectives are summarized as follows:

- Provide dependable, low-carbon electricity to help meet future power needs, and to help back-up intermittent renewable power sources, to support a reliable power grid.

- Enhance the production and availability of in state nitrogen-based products for use in agricultural, transportation, and industrial applications by producing approximately 1 million tons per year of low-carbon products, including urea, UAN, and anhydrous ammonia.

- Conserve domestic energy supplies and enhance energy security by using abundant solid feedstocks, coal, and petroleum coke to generate electricity and manufacture low-carbon nitrogen based products.

- Mitigate impacts related to climate change by dramatically reducing average annual GHG emissions relative to those emitted from a conventional power plant and/or nitrogen-based product manufacturing facility by capturing, at a rate of at least 90%, and sequestering $CO_{2.}$.

- Use captured CO_2 for EOR to produce additional oil reserves.

- Demonstrate advanced solid fuel based technologies that can generate clean, reliable, and affordable electricity in the United States and prove out carbon capture and sequestration as a viable method for reducing the carbon footprint of power generation and manufacturing.

- Facilitate and support the development of hydrogen infrastructure in California by supplementing the quantities of hydrogen available for future energy and transportation technologies.

- Help restore local groundwater quality and enhance agricultural production by using brackish groundwater water that currently threatens local agriculture.

- Minimize environmental impacts associated with the construction and operation of the Project through technology selection, Project design, and implementation of feasible mitigation measures, where necessary.

- Site the Project at a location over which HECA LLC will have control, and which offers reasonable access to necessary infrastructure, including natural gas, process water supply, transmission and rail interconnection, and geologic formations appropriate for CO_2 EOR and sequestration.

- Ensure the economic viability of the Project by integrating electricity production with the manufacture of multiple products to meet market demand.

- Meet all requirements necessary to secure and retain U.S. Department of Energy funding for the Project.

2.1.6 Project Ownership

HECA LLC is owned by SCS Energy California LLC. HECA LLC proposes to be the owner and operator of the IGCC polygeneration facility and has the option to purchase the 453-acre Project Site, as defined above, from the site owner. HECA LLC also has the option to purchase 653 acres adjacent to the Project Site, herein referred to as the Controlled Area, in which HECA LLC will control access and future land uses.

The transmission line ownership, up to the point of interconnect at the future PG&E switching station, will be determined in the future based on input from PG&E and the California Independent System Operator (CAISO). The natural gas supply line will be owned by PG&E. The process water supply line and associated well field will be owned and operated by BVWSD. The potable water supply line will be owned by HECA LLC. The railroad spur will be owned by HECA LLC.

OEHI will own and operate the CO_2 pipeline as well as the EOR Processing Facility and associated infrastructure required for CO_2 EOR and sequestration.

2.1.7 Schedule

The construction milestones for the Project are anticipated to be as follows:

Commencement of pre-construction and construction activities	June 2013
Commencement of truck deliveries and ground disturbance	August 2013
Completion of construction	February 2017
Commencement of pre-commissioning and commissioning	March 2016
Commencement of commercial operation of the Project	September 2017

2.1.8 Location

The Project Site consists of approximately 453 acres in Kern County, California, as shown on Figure 2-1, Project Vicinity. The Project Site is located approximately 2 miles northwest of the unincorporated community of Tupman. The street address of the Project Site is 7361 Adohr Road, Buttonwillow, CA 93206. The Project Site is located within Section 10 of Township 30 South, Range 24 East in Kern County. The Project Site Assessor's Parcel Numbers (APNs) are as follows:

- Part of 159-040-02
- Part of 159-040-16

- Part of 159-040-18

The Controlled Area is shown on Figure 2-4, Site Plan. The APNs associated with the Controlled Area are as follows:

- All of 159-040-04
- All of 159-040-11
- All of 159-040-17
- All of 159-190-09
- Remnant part of 159-040-02
- Remnant part of 159-040-16
- Remnant part of 159-040-18

The Project Site is predominantly used for agricultural purposes, including cultivation of cotton, alfalfa and onions. Land use in the vicinity of the Project Site is primarily agricultural. Adjacent land uses include Adohr Road and agricultural uses to the north; Tupman Road and agricultural uses to the east; agricultural uses and an irrigation canal to the south; and Dairy Road right of way and agricultural uses to the west. The West Side Canal (and the Outlet Canal, Kern River Flood Control Channel (KRFCC), and the California Aqueduct (State Water Project) are approximately 500, 700, and 1,900 feet south of the Project Site, respectively.

2.1.9 Affected Study Areas

For purposes of environmental review, the affected study areas include the HECA Project Site, Controlled Area, the OEHI Project Site, and related linear facilities, all of which are entirely located in Kern County, California.

Major components located on the Project Site will include, as shown on Figure 2-5, Preliminary Plot Plan, and Figure 2-6, Project Elevations:

- Solids handling, gasification, and gas treatment:
  - Feedstock delivery, handling, and storage
  - Gasification Unit
  - Sour Shift/LTGC/Mercury Removal units
  - AGR Unit
  - SRU/Tail Gas Compression
  - CO_2 compression

- Power generation:
  - Combined Cycle Power Block equipment
  - Electrical equipment and systems

- Manufacturing Complex:
  - PSA Unit
  - Ammonia Synthesis Unit
  - CO_2 compression and purification (for urea production)
  - Urea Unit

  - Urea Pastillation Unit
  - UAN Complex (includes Nitric Acid Unit, Ammonium Nitrate Unit, and Urea Ammonium Nitrate Unit)

- Supporting process systems:
  - Natural gas fuel systems
  - ASU
  - Sour water treatment
  - Wastewater treatment for process and plant wastewater streams
  - Raw water treatment plant for process water
  - Other plant systems (i.e., heat rejection systems, auxiliary boiler, flares, emergency engines, fire protection, plant instrumentation, and air emission monitoring systems)

The affected study areas also include the following off-site linears, as shown on Figure 2-7, Project Location Map. Off-site linears are summarized below and described in more detail in Section 2.7.1.10, Linear Construction and Maintenance.

- **Electrical transmission line**. An approximately 2-mile electrical transmission line will interconnect the Project to the future PG&E switching station located east of the Project Site.

- **Natural gas supply pipeline.** An approximately 13-mile natural gas interconnection will be made with an existing PG&E natural gas pipeline located north of the Project Site.

- **Water supply pipelines**. The Project will use brackish groundwater supplied from the BVWSD located to the northwest for process water. The raw water supply pipeline will be approximately 15 miles in length and connect to five new groundwater wells. Potable water for drinking and sanitary use will be supplied by WKWD to the east. The potable water supply pipeline will be approximately 1 mile in length.

- **CO_2 pipeline**. An approximately 3-mile CO_2 pipeline will transfer the CO_2 captured from the Project Site south to the OEHI CO_2 processing facility.

- **Industrial railroad spur**. Alternative 1 for the transportation of coal to the Project Site is an approximately 5-mile new railroad spur that would connect the Project Site to the existing SJVRR Buttonwillow railroad line, located north of the Project Site. The railroad spur will deliver Coal Unit Trains, as well as export products during operations. If available, the railroad spur will also be used to deliver plant equipment during construction. Public and private at-grade crossings will be required

Finally, the affected study areas also include the following existing facilities:

- **Existing coal transloading facility**. Alternative 2 for the transportation of coal to the Project Site is truck transport via existing roads from an existing coal transloading facility located in Wasco northeast of the Project Site. The truck route distance is approximately 27 miles. Under this alternative, all products produced by HECA would be transported off the Project Site by truck.

- **OEHI Project Site**. This is the portion of land in the EHOF in which CO_2 produced by HECA will be used for EOR and resulting sequestration.

The components described above are shown on Figure 2-8, Project Location Details, which depicts the region, the vicinity, the Project Site, the OEHI Project Site, and their immediate surroundings.

Temporary construction equipment laydown and parking, including construction parking, offices, and construction laydown areas, will be located within the Project Site and the Controlled Area. Figure 2-9, Preliminary Temporary Construction Facilities Plan, illustrates the locations of these facilities.

The purpose of the Controlled Area is to ensure ownership and control by HECA LLC over public access and land use adjacent to the Project Site. With the exception of temporary construction impacts for linears and laydown, current plans are to continue to use the Controlled Area for agricultural purposes during construction and operations. As indicated on Figure 2-4, the transmission linear and potable water linear would cross the northeastern edge of the Controlled Area. The CO_2 pipeline linear would cross the southwest and southern portions of the Controlled Area. The process water line would cross the southwest portion of the Controlled Area. The railroad spur would enter the northwest corner of the Project Site without intersecting the Controlled Area. The natural gas supply would cross the west portion of the Controlled Area.

The Controlled Area is under Williamson Act contract, except for parcel 159-040-11-001, which is the 1.23-acre area including and surrounding an irrigation canal to the south of the Project Site. The Controlled Area will be fenced.

The disturbed acreage associated with the Project is summarized in Table 2-1, Project Disturbed Acreage.

Table 2-2, Site Characteristics, summarizes site meteorology and other characteristics upon which the Project design has been based.

2.1.10 Site Plan and Access

Figure 2-5, Preliminary Plot Plan, presents a scaled, overall plot plan for the Project. The Overall Plot Plan identifies the primary site access, which will be from Dairy Road on the western side of the Project Site for personnel access, and Station Road for feedstock and other deliveries. The Overall Plot Plan also identifies the railroad entrance, which is located at the northwest corner of the Project Site. Elevations are shown on Figure 2-6, Project Elevations.

Table 2-3, Project Linear Tie-In Location on Plot Plan, provides a list of the currently anticipated Project pipelines, communication, and electrical interfaces at the site boundaries.

2.1.11 Resource Inputs

The feedstocks for the Project include the following and are discussed below in more detail:

- California petroleum coke and western sub-bituminous coal
- Natural gas
- Water
- Oxygen
- Nitrogen

2.1.11.1 Petcoke and Western Sub-Bituminous Coal

Coal is an abundant, domestic feedstock exhibiting stable supply compared to oil and natural gas resources. Securing a domestically available long-term, stable feedstock will enable the Project to provide dependable low-carbon hydrogen-generated electricity and to assist in meeting future electrical power needs and supporting a reliable power grid.

The Project expects to obtain its western sub-bituminous coal from New Mexico. Based on the design plant production rate, the Project will consume 4,580 stpd of coal (nominally 1.6 million short tons per year [stpy]). Several western sub-bituminous coal mines that can supply coal meeting Project technology requirements in terms of ash composition and other characteristics have been identified. The Project is in the process of discussing contractual terms with relevant entities.

Petcoke most likely will be supplied from refineries in the Los Angeles or Santa Maria areas. The petcoke that will be used for the Project is a byproduct from the oil refining process. Currently, petcoke is trucked from California refineries to ports for export to other nations, where it is burned in conventional furnaces and boilers that release CO_2 and other air pollutants directly into the air. In contrast, HECA will capture more than 90 percent of the CO_2 and sell this commodity to OEHI where it will be used for EOR and effectively sequestered in a closed-loop process.

Transportation of coal to the Project Site will occur via one of two alternatives. Alternative 1 is the use of a new railroad spur that will deliver the coal to the Project Site. Alternative 2 involves the transfer of the coal onto trucks at the existing coal transloading facility in Wasco. Trucks would then transport the coal to the Project Site. Petcoke transportation to the Project Site will occur via truck. Coal and petcoke deliveries to the Project Site will be unloaded and stored at the Project Site in the coal/petcoke barn designed to contain feedstock sufficient for 30 days of operation (approximately 172,000 tons of coal and petcoke). The rail and truck unloading systems, feedstock reclaiming and blending system, and pre-crushing system will have dust collection systems to minimize particulate emissions. The grinding mill feed bins will be totally enclosed and will include baghouses. Petcoke and coal will be transported from the unloading systems to the enclosed barn, the pre-crushing system, and the grinding mill feed bins in enclosed conveyors with dust collection systems.

2.1.11.2 Western Sub-Bituminous Coal

HECA LLC expects to obtain its western sub-bituminous coal from New Mexico. Based on the design plant production rate, the Project will consume 4,580 stpd of coal (nominally 1.6 million short tons per year [stpy]). Several western sub-bituminous coal mines that can supply coal meeting Project technology requirements in terms of ash composition and other characteristics have been identified. The Project is in the process of discussing contractual terms with relevant entities. The coal hauls will require rail shipments. Railcars will either be delivered to the Project Site via the railroad spur per Alternative 1 or the coal will be transferred onto trucks at the existing coal transloading facility in Wasco, then transported to the Project Site per Alternative 2.

2.1.11.3 Petcoke

Petcoke is expected to be readily available to the Project. Approximately 16,000 stpd (6.0 million stpy) of fuel-grade petcoke are produced by major California refineries. Five of these refineries are located in the Los Angeles area, and one is in central California. At steady-state operation feeding 25 percent petcoke, the Project would consume about 7 percent of this total in-state production (around 1,140 stpd, or 400,000 stpy).

Hauling distances for petcoke are short enough to favor truck movements. These truck shipments can be delivered directly to the Project Site for unloading.

2.1.11.4 Feedstock Quality and Plant Operations

Feedstock Flexibility

The ability of the Project to accept a variety of petcoke and coal feedstocks will enable it to increase the number of potential fuel suppliers and to minimize fuel costs.

Sulfur Content

Potential sources of coal investigated for the Project have an average sulfur content of approximately 1 percent. Petcoke sulfur levels may be variable over time as heavier crudes are processed at a number of California refineries. However, the Project's sulfur recovery system is able to handle feedstock blends with variable sulfur levels and therefore will accommodate both current and expected future sulfur levels in California petcokes. Higher-sulfur petcoke generally costs less than lower-sulfur petcoke in the marketplace, and the ability to process higher-sulfur feedstocks will help minimize fuel costs.

2.1.11.5 Transportation and Logistics

Trucking

A number of trucking firms with petcoke-handling experience (and coal-handling experience for Alternative 2) have been identified and engaged in preliminary discussions. All have expressed interest in serving the Project. The use of Los Angeles and central California area petcoke would minimize truck shipments, thus minimizing emissions and transportation costs.

Rail Shipments

Because of the distances involved and desire to minimize truck traffic, western sub-bituminous coal procured for the Project will be transported by railroad to Kern County. Alternative 1 would further minimize truck traffic by delivering the coal to the Project Site via a new railroad spur. The railroad spur will also be used to transport products from the Project Site during operations. Under Alternative 2, the coal would be transferred to trucks at the existing coal transloading facility in Wasco, then delivered to the Project Site.

Storage

The Project will provide 30 days of feedstock storage (based on anticipated usage rates) on site, in an enclosed barn.

Feedstock Characteristics

A representative feedstock analysis is provided below for each feedstock. The representative feedstock analysis for petcoke is provided in Table 2-4, Typical Analysis for Petcoke. The representative feedstock analysis for western sub-bituminous coal is provided in Table 2-5, Typical Analysis of Sub-Bituminous Coal.

2.1.11.6 Natural Gas

Natural gas is required for operation during start-ups, shut-downs, and equipment outages. Natural gas is also used to fuel the auxiliary boiler, flare pilots, start-up the SRU, and as support fuel for the SRU tail gas thermal oxidizer. The natural gas supply metering station will be located within the Project Site, near the southwestern corner.

An interconnection with a PG&E pipeline is available to supply natural gas to the Project. The pipeline length will be approximately 13 miles. The interconnect will consist of one tap off the existing natural gas line and one metering station at the beginning of the natural gas linear adjacent to the PG&E Inlet. The metering station will be up to 100 feet by 100 feet and will be surrounded by a chain link fence. In addition, there will be a metering station at the end of the natural gas linear, located near the southwestern corner of the Project Site, and a pressure limiting station located on the Project Site.

The pipeline route is shown on Figure 2-7, Project Location Map. See Project location details on Figure 2-8 Project Location Details (sheets 4 through 7).

The estimated delivery pressure of the PG&E line is a minimum of 335 pounds per square inch gauge (psig). The Project includes a natural gas compressor to provide sufficient pressure for start-up and natural gas operation.

Typical yearly averages for the natural gas composition and physical properties are given in Table 2-6, Typical Natural Gas Composition.

2.1.11.7 Water

It is estimated that the Project will use approximately 4,600 gallons per minute (gpm) of brackish water on an average annual basis. This increases to approximately 5,150 gpm during average summer afternoon conditions. These raw water requirement rates are greater than those presented in the 2009 AFC because of the following two main factors:

- Project design changes resulted in an approximately 50 percent increase in syngas production. Increased syngas production drives a need for more water, which is consumed in the shift reaction to produce more hydrogen.
- Project design addition of the Manufacturing Complex, which increased the process cooling tower duty, thereby increasing its water evaporation rate.

The Project will use local brackish groundwater treated on site to meet Project requirements. The brackish groundwater will be supplied from the BVWSD, which is a local water district with impaired groundwater sources not suitable for agricultural or potable use. BVWSD has stated that it will be able to provide brackish groundwater with an average total dissolved solids concentration of approximately 2,000 milligrams per liter (mg/L), with an acceptable range from about 1,000 to 4,000 mg/L, to the Project for the estimated life of the Project. Potable water will be supplied by WKWD located east of the Project Site, along Morris Road north of Station Road.

Water usage in the Project can be divided into six categories: Power Block cooling tower, process cooling tower, ASU cooling tower, Manufacturing Complex, gasification solids, and HRSG stack. Figure 2-10, Water Usage, and Figure 2-11, Flow Diagram Raw Water/ Wastewater/Demin Water Treatment Plant, depict the water usage allocated by category.

Water is used for heat rejection in the form of evaporation from cooling towers. The process cooling tower and the ASU cooling tower are associated with the gasification process and syngas treatment. The other cooling tower (the Power Block cooling tower) serves the Combined Cycle Power Block, with the majority of the cooling duty consumed by the condenser.

Other major areas of water usage are associated with the production of hydrogen. Water is converted to hydrogen in the Gasification Unit and the Sour Shift Unit. The hydrogen is used as a fuel at the combustion turbine/HRSG and as a feedstock for the low-carbon nitrogen products. Water is also used in the processing of gasification solids.

The HECA Project has been designed to minimize wastewater. Water losses from the Plant Wastewater Treatment Unit are very small due to the incorporation of ZLD technology. Plant wastewater (including cooling tower blowdown, water treatment reject, evaporative cooler blowdown, and other miscellaneous drains) is evaporated and concentrated using a conventional mechanical vapor recompression brine concentrator followed by a brine crystallizer.

2.1.11.8 Oxygen and Nitrogen

The gasification process requires high-pressure, high-purity (99.5 volume percent) oxygen (O_2). The O_2 is supplied from the ASU, which separates and purifies O_2 and nitrogen from the ambient air. The ambient air is filtered, compressed, dried, and cooled to cryogenic temperatures. High-purity O_2 created in this process is pumped to the required pressure, vaporized, and sent to the Gasification Unit. In addition, low-pressure, high-purity O_2 is used in the SRU. The ASU also supplies high-purity, compressed nitrogen for use in the CT, the Ammonia Synthesis Unit, and various uses within the Gasification Unit. In the CT, nitrogen is used as a diluent to reduce the thermal nitrogen oxide (NO_X) produced when hydrogen-rich fuel is combusted. The ASU also provides high-purity nitrogen for purging equipment, piping, and instrumentation.

2.1.12 Product Output

As a polygeneration facility, the Project is designed to produce several types of products. These products include the following, which are discussed below in more detail:

- Electricity
- CO_2
- Degassed liquid sulfur
- Gasification solids
- Low-carbon nitrogen-based products

2.1.12.1 Electricity and Transmission Line

An approximately 2-mile electrical transmission line will interconnect the Project Site to the future PG&E switching station. The power generated by the Project will be connected to the PG&E system by a new single-tower, 230-kV transmission line. This single-circuit line will be connected to a new switchyard at the Project Site. The proposed transmission route exits the Project Site, crosses Tupman Road and runs in an easterly direction, crosses Morris Road and continues east to enter the PG&E switching station.

Table 2-7, Electrical Specification, describes the general specification for electricity delivery.

Figure 2-12, Overall Single-Line Diagram, presents the one-line diagram for the future PG&E switching station after the interconnection of the Project.

2.1.12.2 Carbon Dioxide

CO_2 will be compressed and transported by an approximately 3-mile pipeline to the OEHI CO_2 Processing Facility to be used for CO_2 EOR and sequestration in the EHOF. Appendix A of this AFC Amendment discusses CO_2 EOR and resulting sequestration.

2.1.12.3 Sulfur

The selection and integration of pre-combustion capture and sulfur recovery technologies allows the Project to minimize sulfur emissions. Sulfur found in feedstocks is removed from the syngas by the AGR and delivered to the Sulfur Recovery Unit where it is converted into a saleable product. Unconverted, residual sulfur compounds (SRU tail gas) are recycled back into the gas treatment section for subsequent capture. Most of the sulfur will be transported by truck to off-takers but some may also be transported by rail. It is estimated that sulfur product export would be approximately 75 percent by truck and 25 percent by rail. The planned production rate would be 100 stpd and Table 2-8, Sulfur Specification, describes the sulfur product specification.

2.1.12.4 Gasification Solids

Gasification solids are comprised of the silica, alumina, and other constituents found in coal and petcoke. The high temperature in the gasifier produces a glassy vitrified solid that is suitable for reuse. Most of the gasifier solids will be transported by rail for beneficial reuse by regional industries. A smaller portion can be transported to nearby industries by truck. It is estimated that gasification solids export would be approximately 75 percent by rail and 25 percent by truck. The planned production rate would be about 840 stpd on a dry basis. The composition of the gasification solids has been estimated based on the anticipated feedstock composition.
Table 2-9, Example Composition of Gasification Solids, represents a projected composition of the gasification solids.

Gasification solids are dewatered, and the solids are accumulated for shipment. Upon exiting the gasifier, the liquids are recovered and returned for reuse in the process. The dewatered gasification solids will be retained in on-site storage until sufficient quantities are accumulated to facilitate their economical transportation. On-site gasification solids storage has the capacity for seven days of production.

HECA has studied the beneficial reuse of gasification solids in a variety of industrial applications. Areas currently being evaluated include reuse for the production of cement, roofing granules and sandblast grit.

2.1.12.5 Low-Carbon Nitrogen-Based Products

The Project will produce low-carbon nitrogen-based products, including, but not necessarily limited to:

- **Ammonia.** The ammonia unit capacity is approximately 2,000 stpd, with a daily average production rate of 1,500 stpd. The ammonia is an intermediate for the on-site production of urea pastilles and UAN. The Project has been designed with flexibility to allow for the option of directly selling ammonia product, rather than using it for urea or UAN production, and it is estimated that this amount could be up to 500 tons/day. Estimated ammonia export is 25 percent by rail and 75 percent by truck (under Alternative 1).

- **Urea pastilles.** Urea pastilles are small solid pellets of urea. The urea pastilles unit capacity is 1,700 stpd, which is also the planned production rate. Estimated urea export is 75 percent by rail and 25 percent by truck (under Alternative 1).

- **UAN**. The UAN unit capacity is 1,500 stpd, with a planned production rate of 1,400 stpd. The estimated movements are 50 percent by rail and 50 percent by truck.

2.1.12.6 Wastewater Discharge

The Project has been designed for ZLD and therefore will not discharge storm water or wastewater off site. Project wastewater will primarily result from cooling tower blowdown, gasification solids removal and Shift/LTGC process condensate blowdown. The cooling tower circulation water and the process condensate from Shift/LTGC will be recycled to the maximum practical extent to minimize water usage and the size of the wastewater treatment equipment. Cooling tower blowdown and all process wastewater streams are treated with softening, reverse osmosis and evaporation/crystallization. All water is recovered for reuse within the plant. Solids from the softeners and evaporation/crystallization unit are composed almost entirely of the minerals concentrated from the plant's water supply. The solids from the softeners and evaporation/crystallization unit are not a hazardous waste. Solids will be tested and disposed of Sanitary wastewater from the Project restrooms, showers, and kitchens will be conveyed by an underground gravity collection system and discharged to a private on-site sewage disposal system consisting of a conventional septic tank and leach field**.** No municipal system is available in the immediate area to serve the Project.

2.1.13 Plant Performance Summary

Table 2-10, Representative Heat and Material Balances, presents typical heat and material balances. Figure 2-13, HECA Overall Component Balances, provides additional illustration of the carbon and sulfur material balances. Table 2-11, Maximum Feeds and Products, shows the maximum feed and product rates anticipated for the Project.

2.2 SOLIDS HANDLING, GASIFICATION, AND GAS TREATMENT

2.2.1 Overview of Gasification Technology

Gasification is a chemical conversion process that can be used to convert solid feedstocks into syngas (see Table 2-12, Primary Gasification Reactions). Figure 2-14, Flow Diagram Gasification Process provides an illustration. The primary components of syngas are CO and H_2, and syngas is further processed in a gas treatment unit to produce hydrogen-rich fuel. See Table 2-13, Components of Syngas from Oxygen-Blown Gasification. The treatment of syngas is classified as a pre-combustion treatment process and has advantages over a post combustion treatment process used for pulverized coal power plants. The treatment and removal of CO_2 and sulfur in syngas occurs at higher pressures and lower volumetric flowrates and this increases the capture efficiency in comparison to post combustion treatment of exhaust gas in a conventional power plant. The Project uses MHI oxygen-blown dry-feed gasification technology. The MHI gasifier incorporates a two-stage reaction that increases conversion of feedstocks to syngas and improves efficiency. MHI also uses a water wall to provide thermal protection for the vessel wall instead of a refractory lining. This increases the run length and availability of the equipment and reduces the amount of time required to start up the unit.

IGCC generally refers to the use of gasification technology to generate electricity in a combined cycle power block. Products other than power may be co-produced in an IGCC plant. This Project will use a blend of 75 percent coal and 25 percent petcoke on a thermal basis to produce electricity, low-carbon nitrogen-based products, and CO_2. The CO_2 will then be sold to OEHI where it will be used for EOR and be effectively sequestered in a closed-loop process.

The Project will achieve the strictest air emissions controls available for this type of equipment. In addition to providing a platform for efficient and cost-effective CO_2 removal, IGCC plants also minimize other air pollutants. Because the coal is not actually combusted, an IGCC plant can more effectively eliminate criteria air pollutants. In an IGCC plant, the air emissions controls remove pollutants from the syngas stream at a point in the process where the pollutants are dense and easily removed, instead of trying to eliminate them from the stack emissions where a much greater stream of dilute flue gas would need to be treated.

2.2.2 Feedstock Delivery, Handling and Storage

2.2.2.1 Rail Unloading and Transfer Systems

Under Alternative 1, the Project Site would be equipped with a rail unloading and transfer system to unload coal from unit trains and convey it to the storage barn. The system accomplishes the following objectives.

- Unloads coal from unit trains
- Conveys the coal to storage in the coal barn

The transfer conveyor is fully enclosed for weather protection and to control fugitive dust. The conveyor is provided with belt scales, magnetic separators, metal detectors, and safety switches, as required. Figure 2-15, Flow Diagram Feedstock Handling and Storage, presents an illustration of the process.

All related coal feedstock buildings are fully enclosed. Dust suppression spray systems, dust collection systems, and/or transfer design are used to control fugitive dust.

2.2.2.2 Truck Unloading and Transfer Systems

Petcoke will be delivered to the Project Site via over-the-road bottom dump haul trucks. At the Project Site, petcoke will be unloaded at the truck dump unloading station. The truck dump has a single hopper located below each unloading station. Petcoke from these hoppers is sent to the petcoke storage via belt feeders, unloading conveyor, and transfer conveyors. An as-received sample system is provided with the petcoke transfer conveyors. Under Alternative 2, the coal would also be delivered to the Project Site and unloaded as described above for petcoke**.**

The concrete floor under the truck unloading system slopes to a sump. This sump is equipped with an installed sump pump to recycle water back to the wash down system or to forward it to the IGCC water reclaim system.

Once trucks have unloaded the petcoke (or coal, under Alternative 2), each vehicle exits and passes through a truck wash system. This truck wash system sprays the entire truck with wash-down water (no soap added) and a specific spray system cleans the wheels. This is done to minimize or eliminate any dust and debris from being deposited on the roads both inside the

Project Site and on public roads. The wastewater collected under the truck wash is routed to a sump that sends the wastewater back to the IGCC water reclaim system.

2.2.2.3 Feedstock Blending and Handling

Coal and petcoke will be stored in a storage building with separate coal and petcoke storage piles. The coal and petcoke will be reclaimed at a set rate and blended as they are placed on conveyors for transfer from the storage building. This coal and petcoke blend will then flow to Gasification for further processing.

The transfer conveyor is fully enclosed for weather protection and to control fugitive dust. The conveyor is provided with belt scales, magnetic separators, metal detectors, and safety switches, as required.

2.2.3 Gasification

2.2.3.1 Feedstock Grinding and Drying

The MHI gasification system includes equipment to grind and dry the feedstock. The blended feedstock is stored in intermediate storage bins. The feedstock then flows to the grinding mills where the particle size is reduced to that required for transport into the gasifier and simultaneously dried. The heat source for feedstock drying is hot gas turbine exhaust gas from the heat recovery steam generator. After drying the feedstock, the drying gases flow through a dust collection system before being vented through the coal dryer stack.

2.2.3.2 Gasifier

The MHI oxygen-blown gasifier is a pressurized, upflow, entrained-flow slagging reactor with a two-stage operation. The MHI gasifier is a dry-feed system and the reactor internals are protected by a membrane wall.

The reactor consists of two sections (or stages): a first stage and a second stage. The coal/feed enters the gasifier at two separate points, with one portion being fed into the lower stage together with O_2 where it is gasified at high temperature to produce carbon monoxide and CO_2, in addition to water vapor. The temperature generated is sufficiently high to melt the coal ash. The molten coal ash flows down the membrane wall to the bottom of the gasifier, where it is quenched in a water bath and then removed using a lock hopper system.

The gas produced in the first stage rises to the second stage, where the remaining petcoke/feed is added without any additional O_2. In this fuel-rich reducing environment, the key reactions that take place are the gasification of char to CO and the shifting of CO and water to hydrogen and CO_2. In the second stage, heat provided by the hot gas from the first stage is used to drive these endothermic gasification reactions. As a result, the second stage operates at a lower temperature than the first stage. Completing the gasification reactions at a lower temperature reduces the O_2 required and improves the efficiency of the gasifier. The syngas produced exits the second stage through a syngas cooler, generating steam in the process. This steam is used for power generation. A cyclone and a filter are used downstream of the syngas cooler to collect the char and recycle it to the lower section to increase the overall carbon conversion efficiency. The raw syngas leaving the second stage of the gasifier is typically at a temperature of approximately 2,200°F, hot enough that negligible hydrocarbon gases and liquids are formed.

2.2.3.3 Gasification Solids and Water Handling

Gasification solids are comprised of vitrified (glass-like) material produced by melting the mineral matter in the coal and petcoke and small amounts of unconverted carbon.

In the collection sump, the gasification solids are separated from the water. The gasification solids are accumulated for off-site transportation by rail or truck.

2.2.4 Syngas Scrubbing, Sour Shift, Low-Temperature Gas Cooling, and Sour Water Treatment

Hot, raw syngas from the gasifier is treated in the syngas Scrubber to remove chlorides. Removal of chlorides in the syngas Scrubber minimizes the potential to precipitate ammonium chloride in downstream equipment as the syngas is further cooled. The bottoms stream from the syngas Scrubber along with sour water streams from the SRU is sent to a sour water stripper. The sour gas from the stripper overhead is sent as a feed to the SRU. The stripper bottoms stream is sent to the Wastewater Treatment Unit for additional processing. A simplified process flow sketch of the Sour Water Stripper is included on Figure 2-38, Flow Diagram: Scrubber Bottoms Sour Water Stripper.

Scrubbed syngas entering the Sour Shift Unit is rich in carbon monoxide and water. The Sour Shift Unit employs the water-gas shift (WGS) reaction to convert carbon monoxide and water to CO_2 and hydrogen. The WGS reaction proceeds as shown below:

$$CO + H_2O \leftrightarrow CO_2 + H_2$$

The heat from the exothermic shift reaction is used to generate steam or to heat other process streams via cross-exchange, thereby improving overall plant efficiency. A simplified process flow sketch of the Sour Shift unit is included on Figure 2-16, Flow Diagram: Sour Shift System.

The WGS reaction is carried out in a two-stage process. Each of the reactors has a sulfur-tolerant catalyst bed composed of cobalt and molybdenum oxides. This catalyst also promotes the hydrolysis of carbonyl sulfide (COS) to hydrogen sulfide (H_2S).

Hydrogenated tail gas from the SRU is recycled to the Sour Shift Unit. This configuration eliminates a need to remove H_2S from the hydrogenated tail gas and also eliminates the need for atmospheric tail gas emissions.

Hot syngas from the sour shift reaction section is cooled and sent to the ammonia wash column. In the ammonia wash column, the syngas is washed with clean boiler feed water to remove any ammonia present in the syngas. Cooled, shifted, ammonia-free syngas exits the wash column and is sent to the Mercury Removal Unit. The bottoms stream from the ammonia wash column is sent to a separate sour water stripper. Most of the ammonia is concentrated in the stripper overhead stream, which is sent as a feed to the SRU. The stripper bottoms stream is recycled back to the syngas Scrubber. A simplified process flow sketch of the LTGC unit is presented on Figure 2-17, Flow Diagram Low-Temperature Gas Cooling.

2.2.5 Mercury Removal

In order to minimize potential mercury emissions, the Project has incorporated mercury capture technology. Tests of petcoke sources show occasional trace levels of mercury in the elemental analyses. Western sub-bituminous coals typically contain trace levels of mercury as well. Mercury is removed downstream of the Sour Shift and LTGC units and at the coal dryer using activated carbon. After mercury removal, the product syngas is treated in the AGR Unit. A simplified sketch of the syngas-activated carbon bed is presented on Figure 2-18, Flow Diagram Wash Column and Mercury Removal. These controls will reduce mercury emissions to a level that will comply with the new National Emission Standards for Hazardous Air Pollutants (NESHAP) for IGCC Electric Generating Units.

2.2.6 Acid Gas Removal

The term “acid gas” refers to vapor containing significant concentrations of acidic gases such as H_2S and CO_2. This section describes how acid gases are removed from the shifted syngas to produce a hydrogen-rich fuel that feeds the Combined Cycle Power Block. A portion of the hydrogen-rich fuel is used to generate a high-purity hydrogen stream that serves as a feedstock to the Ammonia Synthesis Unit.

2.2.6.1 Rectisol® Process Description

The Rectisol® process is shown on Figure 2-19, Flow Diagram Rectisol® Acid Gas Removal. The shifted sour syngas feed is chilled prior to entering the pre-wash section, in which condensed or dissolved impurities are removed. The gas then flows to the absorber column, where it is contacted with methanol solvent for absorption of H_2S, other sulfur compounds, and CO_2.

Clean, hydrogen-rich fuel (very low in sulfur compounds and CO_2) exits the top of the absorber column. The clean, hydrogen-rich fuel is heated and sent to the Combined Cycle Power Block for use as fuel or to the PSA Unit for further purification.

The hydrogen-sulfide-laden solvent is withdrawn from the absorber column and flashed, with the flash gas being recycled to the absorber column and the separated liquid solvent sent to CO_2-separation columns. Carbon-dioxide-laden solvent from the absorber column is also sent to the CO_2-separation columns.

Separated CO_2 exits the top of the CO_2-separation columns and flows to CO_2 compression equipment. After compression, the CO_2 is transported to the OEHI CO_2 Processing Facility for CO_2 EOR.

CO_2-free solvent exiting the bottom of the CO_2-separation columns flows to the hot regenerator where H_2S and other sulfur compounds are released from the solvent by increasing the temperature and stripping with methanol vapor generated in a reboiler. The separated acid gas exiting the top of the hot regenerator undergoes further processing in the SRU to recover liquid sulfur as a product.

The regenerated methanol solvent exiting the bottom of the hot regenerator, now CO_2 and H_2S-free, is cooled and returned to the absorber column for reuse.

A small portion of the regenerated solvent is sent to the methanol-water column for separation of water and impurities from the methanol by distillation. The methanol-rich overhead stream from the methanol-water column is returned to the hot regenerator. The separated column bottoms water is cooled and sent to the Wastewater Treatment Unit.

2.3 POWER GENERATION

2.3.1 Summary

Combined cycle power generation is one of the most efficient commercial electricity generation technologies available. The power generation equipment used for the Project is similar to a conventional natural gas combined cycle plant, with the notable exception that substantial heat integration with the gasification process is included to maximize the recovery of useful energy both for internal and external process use and power generation. The Combined Cycle Power Block will include one single-shaft nominal 405 MW MHI 501GAC® G-class, air-cooled advanced CT/ST/generator configured to use hydrogen-rich fuel, one HRSG, and a water cooled surface condenser. The CT, HRSG, and ST will convert chemical energy contained in the syngas fuel to electricity through the shaft power developed by the CT/ST/generator and through the thermal energy recovered from the CT exhaust. This exhaust gas is converted to high-energy steam in the HRSG and combined with the high-energy steam recovered in the gasification process to generate additional electricity in the ST. The G-class machine is arranged in a single shaft configuration where the CT and ST share a common shaft/generator.

Electrical power generation is distributed in the switchyard for transmission to the grid and for satisfying the auxiliary loads within the facility.

2.3.2 Major Power Block Equipment Description

The major equipment is described in the following sections. An overall sketch of the Power Block system is shown on Figure 2-20, Flow Diagram Power Block Systems.

2.3.2.1 Combustion Turbine and Heat Recovery Steam Generator

The MHI 501GAC® CT and ST generator will produce 405 MW of gross output. Exhaust gas from the turbine section is ducted through the HRSG to generate high-energy steam which produces additional electricity in the ST. Some of the exhaust gas is also ducted from the HRSG to Gasification to dry the feed and will be discharged at the stack in that process block. Remaining exhaust gas at the HRSG is discharged through the HRSG stack. The combustion system is designed for operation on hydrogen-rich fuel. The combustion system is also equipped with separate fuel nozzles for natural gas-firing during start-up, shut-down and equipment outages. The combustion system is designed to achieve low-NO_X emissions while injecting nitrogen diluent and combusting hydrogen-rich fuels. When operating on natural gas, water is injected for NO_X control. Natural gas is used during start-up and , of the CT and during periods of unplanned equipment outages (up to 2 weeks per year), but not during operations. Table 2-14, Combustion Turbine Generator, presents additional information.

The CT exhaust gas, supplemental hydrogen-rich fuel and PSA off-gas for duct-firing are used as energy input into the HRSG.

2.3.2.2 Emissions Controls Systems

The Project is designed with state-of-the-art emission-control technology. HRSG emissions control systems are designed to meet BACT levels of NO_X, carbon monoxide, sulfur dioxide, and VOCs, based on the most current industry data and manufacturers' information. HRSG emission control systems are described in detail below.

A selective catalytic reduction (SCR) system is installed in the HRSG to reduce emissions of NO_X to meet BACT requirements. An oxidation catalyst is also installed in the HRSG to reduce CO and volatile organic compound (VOC) emissions to permit requirements**.** The HRSG stack is provided with a continuous emissions monitoring system (CEMS) to verify compliance with applicable air permit requirements.

The SCR system reduces NO_X emissions from the HRSG stack gases. Vaporized ammonia is mixed with dilution air and injected into the CT exhaust gas upstream of a catalytic system that converts NO_X and ammonia to nitrogen and water. This vaporized ammonia will come from the on-site ammonia plant storage tank.

The components in the SCR system are as follows:

- **Dilution air blower.** The blower delivers fresh air to be combined with the vaporized ammonia.

- **Ammonia injection grid**. The diluted ammonia is sent to an injection grid where the ammonia stream is divided into various injection points upstream of a catalyst. The flow of ammonia to each injection point can be balanced to provide optimum NO_X reduction.

- **SCR catalyst**. The SCR catalyst provides the surface area and the catalyst for ammonia and NO_X to react and form nitrogen and water. The SCR catalyst is installed in a reactor housing located within the HRSG at the proper flue gas temperature-point for good NO_X conversion.

2.3.2.3 Oxidation System

An oxidation catalyst is installed in the HRSG casing upstream of the SCR ammonia injection location to reduce carbon monoxide emissions. The carbon monoxide catalyst oxidizes the carbon monoxide and VOCs produced from the CT and duct burners.

2.3.2.4 Continuous Emissions Monitoring System

The CEMS records the emissions out of the HRSG stack to comply with local, state, and federal emission requirements. The CEMS typically monitors the NO_X, O_2, and CO levels. The monitored emissions will be determined by the San Joaquin Valley Air Pollution Control District. It uses control system signals for CT power output and fuel gas to the CT to calculate the total mass rate of emissions released, and may also be used as part of the ammonia injection controls for the SCR system. The CEMS is designed, installed, and certified in accordance with the applicable San Joaquin Valley Air Pollution Control District and U.S. Environmental Protection Agency standards for analyzer performance, data acquisition, and data reporting.

2.3.2.5 Steam Turbine

The ST for the Project is a MHI reheat turbine. The ST is coupled to the generator through a clutch along with the CT on a single shaft, and the ST exhaust steam is condensed in a water-cooled condenser.

2.3.2.6 Heat Rejection System

The excess thermal energy in the steam exhausted to the condenser is dissipated in the heat rejection system. This system is comprised of a condenser, a circulating water system, and a multi-cell cooling tower.

The condenser is a shell and tube heat exchanger with the steam condensing on the shell side under a vacuum and the cooling water flowing through the tubes in a single or double pass design. The condensate collects in the condenser hotwell, where it supplies the condensate pumps that feed the HRSG.

The heat in the condenser is picked up by the circulating water system and transferred to the cooling tower. The cooling water system also transfers heat to the cooling tower from the hydrogen-cooled generator and other power and gasification equipment.

During start-up, a separate set of auxiliary cooling pumps supply water from the cooling tower basin and pump it through plate type closed cooling water (CCW) exchangers and return the water to the cooling tower fill material. The CCW pumps circulate higher purity water through the CCW exchangers that cool the water before it removes heat from the closed-circuit cooling water users. The use of a separate closed cooling water system also reduces the electric power load by enabling the shut-down of the large, main circulating pumps when the Power Block is in standby mode, ready to start, or following a ST shut-down.

2.3.3 Major Electrical Equipment and Systems

The Project electrical distribution system configuration is shown on Figures 2-21 through 2-27, Electrical Overall One-Line Diagrams.

The Project will have a 230-kV air-insulated switchyard for interconnection to a future PG&E switching station. The 230-kV transmission line is sized for the total plant output. Revenue metering is provided in the Project Switchyard on the transmission line to PG&E.

Start-up power for the Project is obtained by back feeding from the 230-kV grid through the main transformer to the unit auxiliary transformers.

The Project's auxiliary loads are served by various Power Distribution Centers (PDCs). PDC-1 serves major 13.8-kV loads including downstream 4160-V and 480-V PDCs and large motor drivers. Each of the 4,160-volt (V) and 480-V PDCs have a double-ended substation configuration with two 100 percent sized transformers.

Dual 1.5-MW standby diesel generators provide emergency power to essential services in the event of a grid failure.

Medium-voltage (MV) and low-voltage (LV) switchgear, MV and LV motor control centers, 125 Vdc batteries, chargers, uninterruptable power supply, and Distributed Control System (DCS) I/O racks are located indoors in pre-fabricated electrical PDCs with redundant heating, ventilation, air conditioning units. The Major Electrical Equipment will be in accordance with American National Standards Institute/Institute of Electrical and Electronic Engineers (IEEE)/ National Electrical Manufacturers Association/American Society for Testing and Materials standards. The electrical system design and installation are in accordance with the National Electrical Code.

2.4 MANUFACTURING COMPLEX

2.4.1 Pressure Swing Adsorption Unit

A portion of clean hydrogen-rich fuel from the AGR Unit is sent to the PSA Unit to generate a high-purity hydrogen gas stream for use as a feedstock to the Ammonia Synthesis Unit. The off-gas from the PSA unit is compressed and sent to the HRSG for use as duct-burner fuel. Two PSA Units in series are used to maximize hydrogen recovery. Refer to Figure 2-28, Flow Diagram PSA and Off-Gas Compression Systems, for illustration.

2.4.2 Ammonia Synthesis Unit

The high-purity hydrogen stream from the PSA Unit and a nitrogen stream from the ASU are the two primary feedstocks for the Ammonia Synthesis Unit. Figure 2-29, Flow Diagram Ammonia Synthesis Unit, provides an illustration. The major steps in the process are described below.

The hydrogen and nitrogen feed streams are first compressed to a high pressure and then mixed with recycle gas in the syngas compressor. The combined mixture is then further compressed, heated, and fed to the ammonia (NH_3) synthesis converter where the exothermic conversion to ammonia takes place over an iron-based catalyst as follows:

$$3\ H_2 + N_2 \leftrightarrow 2\ NH_3$$

The hot ammonia synthesis converter effluent is first cooled by generating steam in the waste heat boiler. The converter effluent is then further cooled in a series of exchangers to condense the ammonia product and separate it from the vapor stream in the primary separator. The vapor stream from the primary separator is recycled to the syngas compressor while the liquid ammonia product is first processed for the removal of inert substances and then it is routed to storage.

The cold liquid ammonia storage system uses two vertical cylindrical steel tanks, each housed in its own unique second vessel with double integrity, elevated above ground on a concrete pedestal, surrounded by a concrete barrier. Additional details are provided in Section 5.12, Hazardous Materials. A vapor recovery system is included to prevent any product losses. The tanks have sufficient storage capacity to support a cold start-up of the Ammonia Synthesis Unit. Additionally, the capacity of the tanks enables the production rate of urea pastilles and UAN solution to remain relatively constant as the IGCC plant undergoes on-peak and off-peak operations. The liquid ammonia is pumped from the tanks to the various users within the facility.

Ammonia is intended to be used on site to produce urea pastilles and UAN solution. However, the plant has also been designed with facilities to load liquid ammonia onto railcars or into trucks for off-site shipment to allow for future operational flexibility**.**

A natural gas-fired start-up heater is provided in the Ammonia Synthesis Unit to raise the catalyst bed temperatures during initial plant commissioning or during start-up after plant maintenance outage.

The Ammonia Synthesis Unit also contains an ammonia refrigeration system to provide the chilling required for cooling the converter effluent stream and the ammonia product stream and to recover and condense ammonia vapor from the ammonia storage tanks.

2.4.3 Urea Unit

Figure 2-30, Flow Diagram Urea Unit Synthesis, provides a general illustration of the urea synthesis process.

CO_2 recovered in the AGR Unit is compressed and treated in the CO_2 Purification Unit to remove any trace sulfur compounds and produce very high purity CO_2 for urea synthesis. Liquid ammonia from the upstream Ammonia Synthesis Unit is pumped and combined with this CO_2 in the Urea Reactor. The following exothermic reaction proceeds quickly:

$2\ NH_3 + CO_2 \leftrightarrow NH_2\text{-}CO\text{-}ONH_4$ (ammonium carbamate)

Ammonium carbamate is then dissociated to urea and water through the application of heat. The reaction kinetics for urea production are slower than those for the ammonium carbamate reaction.

$NH_2\text{-}CO\text{-}ONH_4 \leftrightarrow NH_2\text{-}CO\text{-}NH_2$ (urea) + H_2O

Since the above reaction does not proceed to completion, additional steps are necessary to produce the desired urea product. Various combinations of dissociation, condensation, recycle of uncoverted reactants, and stripping are used to complete the conversion to urea.

Finally, the intermediate urea solution is concentrated to provide the required feeds to the UAN Complex and to the Urea Pastillation Unit. Vacuum evaporator/separator systems are used to produce the required urea solutions. A single stage unit can provide approximately 80 weight percent urea feed to the UAN complex, and a multistage system is required to provide the approximately 99 weight percent urea melt for the pastillation unit. These solutions are then pumped to the final stage in their respective production process. Vapors from the vacuum system are scrubbed in an absorber using process condensates. The treated vapors (inert substances) are vented. The process condensates are recycled within the Urea Unit. Figure 2-31, Flow Diagram Urea Unit Concentration, provides an illustration of the process.

The capacity of the Urea Unit is sufficient to provide the combined urea product for both downstream UAN and pastillation production requirements. An intermediate urea solution surge tank is provided to enable continuous production should operations of either the upstream or downstream systems be briefly interrupted**.**

2.4.4 Urea Pastillation Unit

Pastillation technology converts the urea melt into high-quality pastilles. Pastillation is selected due to its ability to minimize emissions of particulate matter and ammonia. A drop former deposits uniform droplets onto a moving belt. These droplets solidify on the belt to produce a uniform pastille product. The heat of crystallization is removed by spraying the underside of the belt with cooling water. At no point in the process does the cooling water contact the urea product. After they have cooled and solidified, the urea pastilles are removed from the belt by an oscillating scraper. The section above the moving steel belt is enclosed with a hood and vented.

2.4.4.1 Urea Pastille Handling

The urea pastille handling system collects urea pastilles from the Urea Pastillation Unit and conveys them to the bulk storage/rail and truck loadout facility.

The system accomplishes the following objectives:

- Receives urea pastilles from the Urea Pastillation Unit
- Conveys the urea pastilles to the urea storage domes
- Maintains a low-humidity atmosphere inside the storage domes to prevent the urea pastille, which is hygroscopic, from absorbing moisture
- Reclaims the urea pastilles
- Conveys the urea pastilles to the urea loadout system

All conveyors are fully enclosed in tubular galleries for weather protection and for control of fugitive dust. All urea handling buildings are fully enclosed with roofing and siding. Dust collection systems, and/or transfer system design, are used to control dusting and fugitive dust emissions.

2.4.5 Urea Ammonium Nitrate Complex

In order to produce UAN solution, it is necessary to produce several intermediate products. These include nitric acid (HNO_3), ammonium nitrate (NH_4NO_3), and urea (NH_2-CO-NH_2). The following sections provide a brief overview of each of these processes.

2.4.5.1 Nitric Acid Unit

Nitric acid production is a three-step process consisting of ammonia (NH_3) oxidation, nitric oxide (NO) oxidation, and absorption. Figure 2-32, Flow Diagram Nitric Acid Unit, provides an illustration of the process.

In the ammonia oxidation step, ammonia from the Ammonia Synthesis Unit is oxidized by air at high temperatures as it passes over a platinum-based catalyst. The exothermic oxidation reaction proceeds as shown below:

$$4\ NH_3 + 5\ O_2 \rightarrow 4\ NO + 6\ H_2O$$

The hot effluent from the reactor is cooled via steam generation or cross-exchange with another process stream. Nitric oxide formed during the ammonia oxidation step must also be oxidized. In order to accomplish this, the process stream is cooled. Nitric oxide reacts non-catalytically with O_2 to form nitrogen dioxide (NO_2):

$$2\ NO + O_2 \rightarrow 2\ NO_2$$

Next, the nitrogen dioxide is further cooled and introduced into an absorption tower along with water. Nitric acid is formed via the following reaction:

$$3\ NO_2 + H_2O \rightarrow 2\ HNO_3 + NO$$

An additional air stream is introduced to re-oxidize the nitric oxide formed in the above reaction. This air stream also helps to remove any dissolved nitrous oxide present from the acid product.

Tail gas from the absorber column is cleaned before being vented. Catalytic decomposition and reduction of both nitrous oxide (N_2O) and NO_X are used to control emissions. The tail gas abatement unit complies with the application of Best Available Control Technology (BACT).

2.4.5.2 Ammonium Nitrate Unit

Ammonium nitrate (NH_4NO_3) solution is produced via a neutralization reaction between gaseous ammonia (NH_3) and aqueous nitric acid (HNO_3). The exothermic reaction proceeds as follows:

$$NH_3 + HNO_3 \rightarrow NH_4NO_3$$

The water produced in the aqueous phase neutralization reaction is reused in the process.

Ammonium nitrate is produced and stored as a water solution (rather than in the solid form) to enhance process safety. Figure 2-33, Flow Diagram Ammonium Nitrate/UAN Units, provides an illustration of this process, as well as the process described in the section below.

2.4.5.3 Urea Ammonium Nitrate Unit

The ammonium nitrate solution and the urea solution are metered, mixed, and cooled. Depending upon the concentration of the feedstock solutions and the desired product specifications, water may be added in as well. The final product is UAN, an aqueous UAN solution.

2.4.6 UAN Solution Storage and Handling

The UAN solution is stored in tanks, and then loaded into railcars or tank trucks for shipment.

2.5 SUPPORTING PROCESS SYSTEMS

2.5.1 Natural Gas Fuel System

2.5.1.1 Natural Gas Metering Station

The natural gas fuel system provides natural gas to all the Project components at the required pressure, temperature, and flow rates. The natural gas system is shown on Figure 2-34, Flow Diagram Natural Gas System. The natural gas underground pipeline enters the Project Site at the Natural Gas Metering Station. The metering station is provided by the gas supplier and contains the gas revenue meters and gas analyzers. The gas metering station also contains a knock out (KO) drum and filter. The Project takes custody of the natural gas at the outlet of the metering station.

2.5.1.2 High-Pressure Natural Gas

High-pressure natural gas is provided to the gasifier for start-up and to the CT. If the natural gas pressure is below the minimum required then the natural gas compressor is placed in operation. The natural gas to the CT passes through a KO drum, is heated with an electrical heater, and is filtered before entering the CT fuel control skid.

2.5.1.3 Low-Pressure Natural Gas

Low-pressure reduction stations and a KO drum are provided to supply the Project's other low-pressure natural gas users (i.e., flares, Auxiliary Boiler, Tail Gas Thermal Oxidizer, and the Ammonia Plant Start-Up Heater).

2.5.2 Air Separation Unit

The ASU is a third-party design, build, own, and operate facility. It produces high-pressure, high-purity O_2 for use in the gasifier as well as low-pressure, high-purity O_2 for use in the SRU.

In addition to O_2, the ASU provides high-purity nitrogen for use in the ASU, the CT (diluent), and various users within the Gasification Unit.

The ambient air is filtered, compressed, dried, and cooled to cryogenic temperatures. The O_2 and nitrogen are then separated by cryogenic distillation within a heavily insulated cold box. Because operating temperatures for air separation are at cryogenic levels, distillation equipment is enclosed within cold boxes and insulated from heat leakage. A simple process flow diagram for the ASU is presented as Figure 2-35, Flow Diagram Air Separation Unit.

2.5.3 Sulfur Recovery and Tail Gas Compression Unit

Acid gas from the AGR unit, sour gas streams from the two sour water strippers, and various plant vents are fed to a SRU. Figure 2-36, Flow Diagram Sulfur Recovery Unit, presents a simplified process flow sketch of the SRU. A portion of the H_2S in the feed is oxidized to sulfur dioxide (SO_2) in a reaction furnace. The resulting SO_2 reacts with the remaining H_2S in the correct ratio to form elemental sulfur. These reactions proceed as shown below:

$$H_2S + 3/2\ O_2 \rightarrow SO_2 + H_2O$$

$$2\ H_2S + SO_2 \leftrightarrow 3\ S + 2\ H_2O$$

Hot effluent gases from the reaction furnace are cooled in the waste heat boiler by generation of 600 psig steam. The tempered effluent gas is sent to the first condenser where the temperature is decreased further to condense and recover elemental sulfur. Low-pressure steam is generated in the first condenser. Gas leaving the first condenser is then reheated before entering a catalytic reactor to further promote the H_2S and SO_2 reaction to elemental sulfur, followed by a condenser to recover additional sulfur. One additional reheater, reactor and condenser follow.

Sulfur recovered in the three condenser stages is sent to a Sulfur Degassing Unit to reduce the concentration of H_2S dissolved in the sulfur product. After degassing, the liquid sulfur product is sent to a storage tank and ultimately shipped from the facility via rail or truck.

SRU effluent gases exiting the final condenser are directed to the Tail Gas Treating Unit (TGTU) hydrogenation equipment, which converts the various sulfur compounds remaining in the gas, back to H_2S. Water is condensed out of the hydrogenated tail gas in a quench tower, after which it is compressed and recycled to the Sour Shift Unit. This configuration minimizes sulfur emissions from the facility and eliminates the need for a TGTU amine section. This configuration also recovers the CO_2 that would be emitted by a conventional TGTU. A process flow sketch for the TGTU is shown on Figure 2-37, Flow Diagram Tail Gas Treating Unit.

The SRU will include both ammonia-destruction and O_2-enrichment technology in the reaction furnace, in addition to the degassing technology used in treatment of the product sulfur. Oxygen enrichment technology uses high-purity O_2 rather than air in the combustion section of the SRU, thereby decreasing the volumetric flow of gas through the entire unit. The use of O_2 increases the temperature in the reaction furnace to a level that destroys the ammonia present in the feed gases. Ammonia destruction technology is a critical part of the SRU design. Complete destruction of ammonia in the reaction furnace helps to prevent the potential for ammonia salts to foul downstream equipment.

2.5.3.1 Sulfur Storage and Handling

As stated above, the degassed liquid sulfur product is stored in a tank for shipment via railcars or tank trucks.

2.5.4 Raw Water and Plant Wastewater Treatment Unit

The Raw Water and Plant Wastewater Treatment Unit is designed as a ZLD facility. Brackish groundwater from the BVWSD will be used to meet the Project's process and service water requirements. All wastewater streams generated from plant operation will be treated in this unit and reused within the plant.

As previously introduced in Section 2.1.11.7, Water, a process flow diagram for the Raw Water and Plant Wastewater Treatment Plant is shown on Figure 2-11, Flow Diagram Raw Water/ Wastewater/Demin Water Treatment Plant. The unit is designed to treat brackish water from the BVWSD water supply field as well as the wastewater generated in the various process units. These wastewater streams are listed below:

- Wastewater from the Gasification Unit.
- Wastewater from the syngas Scrubber sour water stripper.
- Wastewater from the AGR Unit.
- Recovered utility drain water from truck wash down area, wash water from the feedstock handling/slurry preparation area and other utility drains.

Wastewater from the AGR Unit and recovered utility drain water are treated in the wastewater purification unit making it suitable for recycling through the Raw Water Softeners.

These sources of water, either segregated or combined, are treated with a lime-soda softening process followed by pH adjustment before using the treated water as cooling tower makeup.

The softener sludge is pumped to the sludge thickener. It is then routed to a plate-and-frame filter press for dewatering. The dewatered sludge solids are discharged into the roll-on/off bins below the filter press for disposal off site.

2.5.5 Cooling Tower Blowdown and Demineralized Water Treatment Unit

The flow diagram for the cooling tower blowdown and demineralized water treatment unit is included on Figure 2-11, Flow Diagram Raw Water/Wastewater/Demin Treatment Plant. Cooling tower blowdown is first treated using lime-soda softening systems followed by ultra filtration. Filtered water is further treated using a two-pass Reverse Osmosis (RO). First pass RO permeate is degasified to remove CO_2. The first pass RO concentrate is directed to the ZLD crystallizer feed tank. The second pass RO further polishes the water as a feed to the electrodeionization system. Second pass RO reject is recycled back to the treated water tank.

The crystallizer system is a conventional mechanical vapor re-compressor brine concentrator followed by a brine crystallizer to recover water and produce ZLD solids. The crystallizer distillate is blended with first pass RO. The ZLD solids are discharged into the roll-on/off bins below the filter press for disposal off site.

The treatment in this unit will produce water for the plant's other water demands such as evaporative cooler make-up, ASU cooling tower make-up, plant utility water, and demineralized water used for boiler feed as well as makeup for the Acid Gas Removal Unit.

2.5.6 Carbon Dioxide Compression and Pipeline

More than 90 percent of the carbon in the raw syngas is captured in the form of a highly concentrated CO_2 stream.

2.5.6.1 Compression and Pipeline

CO_2 is transported by pipeline to EHOF for CO_2 EOR and resulting sequestration. In order for the CO_2 to be transported, it must first be compressed. The CO_2 Compression System is shown on Figure 2-39, Flow Diagram CO_2 Compression and Purification Systems. The CO_2 that will be compressed comes from the AGR Unit. After processing by the AGR unit, the CO_2 is very dry, which avoids pipeline and equipment corrosion.

The minimum pressure requirement for the CO_2 pipeline is 2,500 psig. Once the CO_2 pressure reaches approximately 1,200 psig it becomes super-critical. Super-critical refers to a material at a temperature and pressure above its critical point, where there is no defined phase difference between liquid and vapor. Under these conditions, heating or cooling the fluid changes its density, but it does not develop into a separate liquid phase. High-pressure compression is needed for CO_2 injection operations and to keep the CO_2 in a super-critical phase throughout the CO_2 pipeline. The stream of CO_2 in the pipeline is at least 97 percent pure CO_2.

The pipeline facilities consist of the pipeline, metering, one pig launcher, one pig receiver, cathodic protection system, two main block valves and two additional emergency shut-down valves, as specified by the California State Fire Marshal.

The CO_2 is delivered to the OEHI CO_2 Processing Facility for injection into deep underground hydrocarbon reservoirs for CO_2 EOR and resulting sequestration.

2.5.6.2 Carbon Dioxide Compression and Purification

A portion of the low-pressure CO_2 gas from the AGR Unit is compressed and purified to remove sulfur-bearing compounds. The purified CO_2 gas is sent to the Urea Unit for use as a feedstock.

2.5.7 Heat Rejection Systems

Mechanical draft cooling towers are used for indirect heat rejection where low process outlet temperatures are critical to overall plant efficiency. Mechanical draft cooling towers serve multiple heat loads in more than one process unit.

The Project has three mechanical draft cooling towers (one for the Combined Cycle Power Block, the second for the Gasification Block/Process Units and the third dedicated for the ASU) that are described below. Figure 2-40, Flow Diagram Power Block Cooling Water System, provides a process sketch of the Power Block Cooling Water System. The configuration shown in this figure is also representative of what is employed for the ASU and Process Cooling Water Systems. The cooling towers use treated water from the water treatment plant as makeup. Cooling tower blowdown from the cooling towers is directed to the water treatment plant.

The air coolers are dedicated to specific services primarily in the Sour Shift, LTGC, SRU/TGTU, and Sour Water Stripper (SWS) units for heat rejection.

2.5.7.1 Power Block Cooling Tower

The largest heat rejection load in the Project is the ST surface condenser in the Combined Cycle Power Block. The main cooling water pumps supply water from the cooling tower basin and pump it through the surface condenser tubes and back to the top of the cooling tower cells. The return water flows into distribution piping below high-efficiency drift eliminators and above the cooling tower fill material. Electric motor-driven induced-draft fans move air up through the tower fill material, contacting the cooling water with air and promoting evaporative cooling. A chemical feed system will supply water conditioning chemicals to the circulating water to minimize corrosion and control the formation of mineral scale and biofouling. Sulfuric acid will be fed into the circulating water system for alkalinity reduction to control the tendency for scaling. The acid feed system will consist of storage and two full-capacity metering pumps. A polyacrylate solution is also fed into the circulating water system to inhibit scale formation. This system also requires storage and two full-capacity metering pumps. Sodium hypochlorite is added to prevent biofouling in the circulating water system. The system requires storage and two full-capacity metering pumps.

The cooling tower is provided with high-efficiency drift eliminators designed to reduce drift to less than 0.0005 percent of the circulating water flow rate.

2.5.7.2 Process Cooling Tower

The design of the Process Cooling Water System is similar to that of the Power Block Cooling Water System described above. The major heat rejection duties are from the CO_2 compressor and the AGR refrigeration unit. Cooling water is also supplied to the Gasification, Shift, LTGC, SRU/TGTU, SWS, Manufacturing Complex , and other miscellaneous users. The process cooling tower has a cooling water basin, pumps, and piping system. The tower is supplied with high-efficiency drift eliminators designed to reduce drift to less than 0.0005 percent of circulation.

2.5.7.3 Air Separation Unit Cooling Tower

The ASU cooling tower will be owned and operated by a third party Industrial Gas Company (IGC). The Project will supply the IGC with treated makeup water, and will also treat the ASU cooling tower blowdown in the Project's water treatment plant. The following description reflects the IGC's cooling water system design.

The ASU Cooling Water System design is also similar to that of the Power Block Cooling Water System. The major heat rejection duties are from the main air compressor intercooler and aftercooler, the booster air compressor intercooler, and the nitrogen compressor intercooler. The ASU cooling tower is located in the ASU near the cooling loads. The ASU cooling tower has separate pumps and piping systems and is operated independently of the other cooling water systems. The ASU cooling tower is supplied with high-efficiency drift eliminators designed to reduce drift to less than 0.0005 percent of circulation.

2.5.8 Auxiliary Boiler

The auxiliary boiler is a pre-engineered shop fabricated package boiler that will provide steam for pre-start-up equipment warm-up and for other miscellaneous purposes when steam from the Gasification Block or HRSG is not available. During typical operation, the auxiliary boiler may be kept in warm standby (steam sparged, no firing) or cold standby (no sparging), and will not have emissions. The boiler will produce a maximum of about 150,000 pounds per hour of steam and will be fueled by natural gas. The boiler will be equipped with low-NO_X burners and SCR to minimize emissions.

2.5.9 Flares

Flaring will occur only during start-up of the plant, from outages or during emergencies. The previous design necessitated regular rotation of three gasifiers into and out of service to facilitate periodic maintenance of the gasifier refractory and other critical gasifier system components. The rotation of each gasifier into service after maintenance required flaring of syngas from the time of light-off until the syngas was up to pressure and within specification. The new design uses a single 100-percent capacity MHI gasifier with an internal membrane wall that requires significantly less maintenance, eliminates rotations, and requires less syngas flaring events than a refractory-lined gasifier.

Although the plant is designed to avoid flaring during steady-state operations, flares are needed to protect the plant operators and equipment. The plant employs three pressure relief systems and their corresponding flares (Gasification, Rectisol®, and SRU) for this purpose. All three flares are conventional elevated flares and will be provided with natural gas assist as required. Vessels, towers, heat exchangers, and other equipment are connected to piping systems that will discharge gases and vapors to a relief system in order to prevent excessive pressure from building up in the equipment during upsets and emergencies. The flares also allow safe venting of equipment during routine start-up and shut-down operations.

During non-start-up plant operation, the three flares will be operated in a standby mode with only minimal emissions from the natural gas pilot flames. As explained below, the Gasifier and SRU flares will be also be used to occasionally flare excess start-up gases in a safe manner.

2.5.9.1 Gasification Flare

The Gasification Unit is provided with an elevated flare to safely flare excess gas during gasifier start-up operations or during upset conditions. Syngas sent to the flare during planned flaring events is filtered, water-scrubbed and sulfur-free. Flaring of untreated syngas or other streams within the plant will only occur as an emergency safety measure during unplanned plant upsets or equipment failures. A simplified flow sketch is shown on Figure 2-41, Flow Diagram Gasification and Rectisol® Flare System.

2.5.9.2 Sulfur Recovery Unit Flare

An SRU Flare will be used to safely flare gas streams containing sulfur during start-up and shut-down (as described further in this section) and gas streams containing sulfur during unplanned upsets or emergency events. Acid gas derived from the AGR, and SWS overhead is routed to the SRU for recovery as elemental sulfur. During cold plant start-up of the Gasification, AGR, and Shift Units, these acid gas streams will be diverted to the SRU Flare header for a short time. To reduce the emissions of sulfur compounds during SRU or TGTU shut-down, the acid gas is routed to the emergency caustic scrubber, where the sulfur compounds are absorbed with caustic solution. After scrubbing, the gas is then routed to the elevated SRU Flare stack via the SRU Flare KO drum. Fresh and spent caustic tanks and pumps are provided to allow delivery of fresh caustic and disposal of spent caustic. A simplified process flow sketch of the SRU flare system is shown on Figure 2-42, Flow Diagram SRU Flare System.

2.5.9.3 Rectisol® Flare

Cold reliefs and vents from the AGR Unit and its associated Refrigeration Unit, and the Ammonia Synthesis Unit are collected in the Rectisol® Flare header. The Rectisol® Flare header is used only in start-up, shut-down, emergencies or plant upsets and contains gases that can be below the freezing point of water. For this reason, the Rectisol® Flare header gases are segregated from the wet gases in the Gasification Flare header. A simplified process flow sketch of the Rectisol® Flare system is shown on Figure 2-41, Flow Diagram of Gasification and Rectisol® Flare System.

2.5.9.4 Carbon Dioxide Vent

The CO_2 Venting System consists of a CO_2 vent header, vent KO drum and a CO_2 vent stack. The system is used to vent incombustible, high-purity CO_2. The vent gas is generated from reliefs, start-up/shut-down vents and venting when the CO2 compression, transportation, or injection system is unavailable.

2.5.10 Emergency Engines

The following is a description of the emergency engines required for the Project. These engines are fueled using ultra-low sulfur diesel fuel.

2.5.10.1 Emergency Diesel Generator

Two 2,000-kW standby diesel generators in an outdoor enclosure will be connected via stepdown transformers to supply emergency essential service power to critical lube oil and cooling pumps, gasification and auxiliary steam systems, station battery chargers, uninterruptible power supply, heat tracing, control room, emergency exit lighting, and other critical plant loads.

A Local Control Panel will be located on the diesel generator with standard microprocessor-based engine and generator controls, interlocks, metering, alarms, and synchronizing system. Remote control of the diesel generator shall be from DCS operators via a fiber optic cable to the control system.

2.5.10.2 Diesel Firewater Pump

One approximately 600-horsepower standby diesel-driven firewater pump will be located adjacent to the firewater tank.

2.5.11 Fire Protection

2.5.11.1 Fire Protection Program

The Project Fire Protection Program includes both fire prevention and protection measures. Fire prevention and suppression measures will include employment of conservative equipment layouts, segregation of critical components, and the remote location of non-essential resources as applicable.

Conservative equipment spacing and segregation of potentially hazardous activities from the balance of the Project will be employed as appropriate to protect personnel and property. Flammable gas monitors will be provided to detect and alarm hazardous levels. Oil containment sumps and firewalls, as appropriate, will be erected to isolate large transformers using combustible heat transfer fluids from adjacent facilities. Structural steel will be protected with fire-proofing materials in areas subject to direct fire exposure. Process liquid drains will be configured to contain liquid spills within the unit of origin. An extensive plant grounding system will be installed to dissipate static electrical charges. Emergency lighting is provided to illuminate egress lanes.

Fire suppression will be provided by various means. A dedicated firewater storage and site-wide loop distribution system will be provided to serve automatic fire suppression systems and manual firewater fighting equipment (monitors and hydrants). Inert gas or other special agents will be provided for the protection of equipment and structures where the use of water-based suppression systems is not appropriate. CO_2 fire-suppression systems will be provided in the CT enclosures. Provisions for the deployment of aqueous fire-fighting foam will be included with the methanol storage tanks. Steam may be used to smother fires originating in hot equipment that may otherwise be further damaged by the application of firewater.

The Project Site will be subdivided into discrete fire areas to identify potential hazards, protect personnel, control a fire incident within a defined area, limit the spread of fire to other areas, and minimize the possibility of consequential fire damage in other areas of the Project. Fire area boundaries will be based on:

- The type, quantity, density, and locations of each fire hazard (solid, liquid, and gas)
- Location and configuration of critical plant equipment
- Consequence of damage to plant equipment
- Location of fire detection alarm panels, firewater storage, and pumping systems

The capacity of the firewater storage, supply, and distribution system described below was sized based on the demand of the largest fire risk area.

The following overview describes the main features of the Project's fire detection and suppression plan.

2.5.11.2 Firewater Storage and Distribution System

The Firewater Distribution System is shown on Figure 2-43, Flow Diagram Firewater System. The Firewater Storage and Distribution System would provide firewater to all plant areas. The firewater source would be the service water/firewater storage tank. The tank nozzle drawoff point for the service water and firewater supply would provide a dedicated water supply for fire protection. A 100 percent capacity electric motor-driven fire pump and a 100 percent capacity diesel-driven fire pump would be provided to supply the required flow rate and pressure of firewater for the plant. An electric-motor-driven pressure maintenance (jockey) pump would maintain pressure in the firewater system. The fire pump enclosure would be protected by an automatic sprinkler system. The firewater pumps would be located inside a prefabricated enclosure that would have heating and lighting. A fire loop with hydrants spaced in accordance with National Fire Protection Association recommendations would be located about the Project Site.

2.5.11.3 Automatic Fire-Suppression System

The Automatic Fire-Suppression System would use firewater as the primary fire-fighting medium. The under-floor spaces in Control Room and Rack Room areas will be provided with inert gas suppression systems. The type of inert gas and deployment method would be selected to minimize personnel exposure and plant equipment damage. The CT enclosure would be flooded with CO_2 or some other suitable fire suppressant to suppress fires. Wherever an inert gas is used for fire suppression, a pre-release alarm annunciates to inform any personnel working in the area to leave immediately. Personnel will receive training on the meaning of these pre-alarms (tone, duration, etc.) and the time allotted for personnel to leave an area**.**

Automatic Fire-Sprinkler Systems, Pre-Action Fire-Sprinkler Systems, and Water-Spray Systems are planned to be used for the protection of structures and equipment, as appropriate.

2.5.12 Plant and Instrument Air

Utility and instrument air for the entire plant is supplied by the ASU. Backup air is provided by an air compressor/dryer skid.

Primary plant service and instrument air is extracted from the ASU air-compression equipment and cooled. This air is clean and dry and is fed directly to the plant and instrument air distribution system without further conditioning.

Secondary backup plant and instrument air is supplied from a stand-alone package air compressor/dryer/accumulator skid. The quality and quantity of air provided from this source is similar to that of the primary air system.

Both primary and secondary air sources are integrated and piped to the plant-wide distribution systems. The instrument air piping distribution system is sized to ensure that adequate quantities are supplied to the various instrument and control air consumers. Accumulators/volume bottles are installed near large intermittent air consumers (i.e., fast-acting control valves) to make certain that the required response times are attained.

Project service air system utility stations are positioned throughout the facility to provide plant air for maintenance activities. The source of the air to these utility air users is automatically shut off on low instrument air pressure. This feature ensures that priority is given to the instrument air system to make certain that adequate volumes are available to safely operate and control the facility.

2.5.13 Emissions Monitoring System

The CEMS will be installed to measure emissions from stacks as required by applicable regulations and permit conditions. These analyzers are designed, installed, certified, and calibrated. These systems sample, analyze, and record stack emission data for several specified pollutants. CEMS incorporates data handling and acquisition systems to automatically generate emissions data logs and compliance documentation. Alarms alert operators if stack emissions exceed specified limits. Each CEMS undergoes periodic calibration, audits, and testing to verify accuracy.

In addition to continuous monitoring, the Project performs periodic stack emission tests to verify compliance as required.

2.5.14 Hazardous Material Management

The Project will store and use hazardous materials in conjunction with construction and operation and maintenance (O&M) of the Project. In general, the type and character of these materials will be the same as those for other IGCC and polygeneration projects.

Hazardous materials used during the construction of the Project would mainly be limited to fuels and construction materials, including:

- Gasoline, diesel fuel, and motor oil for construction equipment
- Compressed gas cylinders containing O_2, acetylene, and argon for welding
- Paint and cleaning solvents
- Concrete form release
- Miscellaneous lubricants, adhesives, and sealants

Each construction contractor will be responsible for maintaining a set of Material Safety Data Sheets (MSDSs) for each on-site chemical it controls, and construction workers will be made aware of the location and content of these MSDSs. Similar information and training will be provided during operations.

Hazardous materials that may be routinely stored in bulk and used in conjunction with the Project operations include but are not limited to methanol, petroleum products, flammable and/or compressed gases, acids and caustics, ammonia, water treatment and cleaning chemicals, paints, and solvents. Table 2-15, Hazardous Materials Usage and Storage during Operations Based on Title 22 Hazardous Characterization, and Table 2-16, Hazardous Materials Usage and Storage during Operations Based on Material Properties, lists each material and describes the approximate annual quantity needed and use of the material during operations.

Figure 2-44, Preliminary Hazardous Material Location Plan, shows the location of major sources of hazardous materials on the Project Site.

Storage of hazardous materials will occur in appropriately designed storage areas. Bulk tanks will be provided with secondary containment to contain leaks or spills. Safety showers and eyewashes will be provided in appropriate chemical storage and use areas. Personnel who could potentially handle hazardous materials will be properly trained to perform their duties safely and to respond to emergency situations that may occur in the event of an accidental spill or release.

2.5.15 Hazardous Waste Management

Hazardous wastes will be generated in small quantities as a result of construction waste and operational waste.

Hazardous Construction Waste

The majority of hazardous waste generated during construction will consist of liquid waste such as waste oil from routine equipment maintenance, flushing and cleaning fluids, waste solvents, and waste paints or other material coatings. Additionally, some solid waste in the form of spent welding materials, oil filters, oily rags and absorbent, spent batteries, and empty hazardous material containers may also be generated.

Construction contractors will employ practices consistent with the proper handling of all hazardous wastes. This includes all licensing requirements, training of employees where required, accumulation limits and duration, and record keeping and reporting requirements. All hazardous wastes will be removed from the Project Site by a licensed hazardous waste management facility.

Table 2-17, Summary of Construction Waste Streams and Management Methods, lists the anticipated construction wastes, which include both hazardous and non-hazardous waste, and identifies the likely disposition of the waste.

Hazardous Operations Waste

Estimated operations waste streams are shown in Table 2-18, Summary of Operating Waste Streams and Management Methods. This table includes both hazardous and non-hazardous waste sources. Used catalysts, activated carbon filters, and ZLD solids will be characterized and disposed of. Spent caustic will be treated off site to oxidize sulfides to sulfates and will be disposed of as a non-hazardous material.

Chemical cleaning wastes may also be generated from the periodic cleaning of machinery and piping. Waste lubricants, such as waste oil, will be periodically generated during the operations and maintenance of the Project. Waste oil will be collected and stored in appropriate containers and recycled by an approved contractor.

As with hazardous construction waste described above, where appropriate, hazardous waste resulting from operation activities will also be collected in hazardous waste accumulation containers placed near the area of generation. All hazardous wastes will be properly removed from the Project Site.

2.5.16 Storm Water Management

Storm water management for the Project is designed to avoid direct discharge to surface waters.

Retention basins and storm water collection/conveyance systems will be designed in accordance with the Kern County Development Standards. The retention basin locations are shown on Figure 2-45, Preliminary Storm Water Drainage Plan.

Storm water generated at the Project Site will be managed as follows:

- Storm water from inside the process plant area will be routed to lined retention basins. After solids have settled and water is determined to be suitable for reuse, storm water will be pumped to the water treatment plant for further treatment and reuse. If this collected storm water is determined to be unsuitable for reuse, then it will be transferred and processed in the ZLD system at the wastewater treatment plant.

- Storm water that may be contaminated with oil will be separately collected and routed to an oil/separator. Recovered waste oil from the separator will be disposed off-site. The separated water will be transferred and processed at the wastewater treatment plant.

- Storm water in the AGR Unit will be collected in a separate lined, dedicated AGR storm water retention basin. The AGR Unit collection system is isolated to contain any potentially contaminated water that could result in the unlikely event of a methanol spill.

- Storm water from chemical and oil storage areas will be held in the associated secondary containment. Storm water held in these areas will first be tested. If it is acceptable for cooling water makeup, then it will be routed to the lined retention basin. Oily storm water will be routed through an oil/separator at the wastewater treatment plant.

- Storm water within the process plant area where solids are present (e.g., coal, petcoke, or gasification solids) will be collected and conveyed to the solids handling water collection facility. The collection facility will be constructed of concrete and will provide for mobile equipment access to remove accumulated solids. Water that accumulates within the solids handling collection facility will be processed in the ZLD system at the wastewater treatment plant.

- Storm water from remote solids handling areas such as feedstock unloading and the crusher station will be collected in lined retention basins for settlement, testing, reuse, and/or treatment as appropriate.

- Storm water from outside the process plant area but within the Project Site will be separately collected in retention basins located throughout the Project Site.

A Storm Water Pollution Prevention Plan will be developed prior to operations. The Project storm water will be managed in accordance with this plan, which will include the measures outlined above.

2.5.17 Control System

The Project Control System will require the integration of many available technologies related to sensors, control elements, and data acquisition and control (as shown on Figure 2-46, Control System Block Diagram). The system will be designed so that the plant operations personnel will have state-of-the-art control and monitoring capabilities. The Project will be designed around a DCS supported by auxiliary systems to allow personnel to analyze Project conditions and react in a timely way to upset conditions. Multi-level system architecture will be provided with security levels and firewalls between each level in order to prevent accidental manipulation of Project operations.

The overall design of the instrumentation and control systems will be in accordance with applicable national and local standards such as those from the IEEE, National Fire Protection Association, and Instrument Society of America. Electrical equipment and components will also be purchased requiring third-party approvals from Underwriters Laboratories, Factory Mutual Research Corporation, Canadian Standards Association, or others as required.

2.5.18 Project Buildings

Buildings and kiosks will be provided on-site to satisfy operating requirements. The buildings and kiosks located on the Project Site are likely to include:

- Feedstock barn
- Control rooms, administration, and laboratory structures
- Emergency response and medical center
- Power distribution centers
- Instrument and control structures
- Analyzer shelters
- Warehouse shop building
- Guard houses

2.5.19 Security Systems

Cameras in the plant will monitor for environmental issues, process safety, and security. A motorized actuator will control the access gates. Gate actuators will include inputs from control room and receptionist switches, the exit loop, and a local keypad or card reader station. Gate intercom stations will be near the local keypad or card reader.

2.6 PLANT OPERATING SCENARIOS AND EMISSIONS

2.6.1 Operations

The Project will operate as an IGCC facility that will produce low-carbon baseload power and low-carbon nitrogen-based products using hydrogen-rich fuel. The Gasification Unit consists of one Mitsubishi Heavy Industries (MHI) oxygen-blown gasifier that will provide hydrogen-rich fuel to the MHI 501GAC® CT. The heat recovery steam generator (HRSG) will duct fire PSA Unit off-gas. Depending on the operating mode, surplus hydrogen-rich fuel may also be available for duct firing in the HRSG. Natural gas is required for operation during start-ups, shut-downs, and as a short-term backup for equipment outages and/or to meet critical contractual obligations.

The gasifier syngas capacity is greater than the maximum fuel capacity of the combined cycle unit. The additional syngas is used for production of low-carbon nitrogen-based products.

Table 2-19, Maximum Fuel Energy, presents the maximum heat input to the gas turbine and the HRSG Duct Burner for hydrogen-rich fuel and natural gas.

Table 2-20, HECA Total Combined Annual Criteria Pollutant Emissions, presents a summary of the steady-state emissions and emission control devices associated with the operating modes discussed above. Figure 2-47, Preliminary Emissions Sources Plot Plan, identifies the emission sources on the Project Site plot plan. Figure 2-48, Overall Block Flow Diagram with Emission Sources, shows the process sequence and emission points for the Project.

2.6.2 Start-Up

This section describes a cold start-up, which assumes the plant had been shut down for a period of time and is at ambient temperature. This sequence assumes that all the necessary utility and support systems are already in service (DCS; fire protection and other safety systems; electrical switchyard and in-plant electrical distribution; water treatment; ZLD; natural gas, steam, instrument, and plant air; purge nitrogen, etc.).

Note that if the IGCC is being restarted after a short outage, when the equipment is still close to operating conditions, the durations of each step will be much shorter than indicated below.

The IGCC takes 4 to 6 days from cold start to export of low-carbon power. The following summarizes the start-up sequences.

Power Block Start-Up

The MHI 501GAC® and the MHI ST are on a common shaft, with the common generator located between the CT and ST. A clutch is provided between the ST and the generator to allow the CT to start-up independently of the ST. The clutch is disengaged during the following CT start-up sequence.

Once all the start-up permissives are met, the MHI 501GAC® CT start signal is given and the generator is used as a motor to rotate the CT and accelerate it until the operation is self-sustaining (static start). The CT compressor is first partially loaded to provide enough air flow and duration to purge the HRSG. Following the purge, natural gas is introduced into the CT combustors, resulting in the CT operation becoming self-sustaining and the discontinuation of the static start. Natural gas is required to start-up the CT. When the CT reaches 3,600 revolutions per minute (RPM), or "full speed, no load," it is synchronized with the electrical grid, and the main breaker is closed. Shortly after the CT is synchronized, it is loaded to a minimum or "spinning-reserve" load. All the preceding steps are executed automatically by the CT's control computer system. At this point the HRSG begins warming up and rapidly begins to produce steam. The steam is initially vented, and as pressure builds in the steam system, the atmospheric vents close and the steam flow is diverted to the surface condenser. Once dry superheated steam is available at the ST, the ST start-up sequence can be initiated. The ST can then be accelerated to 3,600 RPM to match speed with the generator shaft. Once the speeds are synchronized, the clutch can be engaged and both the CT and the ST will supply shaft work to the generator. The ST metal temperatures determine how quickly the ST can be loaded. The cold start sequence requires the CT to operate at reduced load (below the emission compliance level) for up to 4 hours. During this time, the CT load is slowly increased to match the steam temperature to the ST metal temperature to heat the ST while minimizing thermal stress. Once the CT reaches the required load, steam is introduced to control NO_X formation. Once the SCR catalyst reaches the required temperature, ammonia injection is initiated and the HRSG stack emissions will fall to the required compliance levels. The CT can then be loaded normally to base load, and the ST will reach a load based on the available steam.

ASU Start-Up

The ASU will require 3 to 4 days to start up and reach full capacity. Because the ASU operates at cryogenic conditions, the start-up sequence includes an extensive cool down and drying period. During this time, the main air compressor and booster air compressor will be operated to provide the auto refrigeration necessary to cool and dry the ASU. Near the end of the start-up sequence, the ASU will begin producing liquid oxygen (LOX) and liquid nitrogen. The LOX is stored to provide a backup O_2 supply to cover a compressor trip or other short ASU outage. The liquid nitrogen storage is provided as a backup supply for the purge nitrogen system. Once the ASU is producing enough O_2 to operate the gasifier, the LOX pumping and vaporization system can be started to make high-pressure O_2 vapor available to the Gasification Unit.

AGR Start-Up

The AGR Unit is assumed to be ready to start (purged with nitrogen and with start-up methanol levels established in the circulating system). Methanol circulation is started and the refrigeration system is started to begin cooling the methanol to normal operating temperature (approximately minus 40°F). This sequence is expected to take about 2 days and will complete at about the same time that sufficient O_2 is available to start the gasifier.

SRU Start-Up

The SRU is a single train with an O_2-enriched reaction furnace (thermal reactor) and two modified Claus reactor stages. The SRU reaction furnace is refractory lined. After an extended outage, both the refractory and the SRU catalyst require a gradual heating program that will take about 3 days for initial curing and dryout and 1 day on subsequent start-ups. The heating is provided by firing natural gas with air in the reaction furnace. The combustion products flow through the reaction furnace, catalyst beds, and boilers to the tail gas thermal oxidizer. During the refractory dryout/cure period, the hydrogenation reactor in the TGTU will also be preheated. The hydrogenation reactor catalyst requires pre-sulfiding prior to being put into operation, which will be timed to complete when the SRU and the gasifier are both feed-ready.

Gasification Block Start-Up

The MHI gasifier is a dry-feed system, and the gasification reaction zone is protected by a membrane wall. This design reduces the amount of time needed to warm the gasifier (as compared to a refractory lined vessel) when preparing the gasifier for start-up. Natural gas will be burned in air inside the gasifier to provide heat during initial warm-up.

The shift reactors require warm up and pre-sulfiding before sour syngas (containing H_2S) can be introduced. The shift reactor catalyst is heated by circulating hot nitrogen across the catalyst beds for about two days. The nitrogen is heated indirectly with a high-pressure steam heater. Once the catalyst is hot, a small amount of sulfur-containing compound is added to the circulating nitrogen. The pre-sulfiding is completed when traces of sulfur are detected in the effluent of the second shift reactor. The shift reactors are then placed in a hot standby condition and ready for feed.

The CO_2 compression system will be purged and ready to compress CO_2. The CO_2 compressor start-up sequence will be timed to coincide to when the AGR Unit is producing CO_2 in sufficient quantity to allow sustained operation of the CO_2 compressor.

When the gasifier reaches operating temperature, and the gasifier system has been purged with nitrogen, the gasifier can be started by introducing O_2 to gasify the natural gas, then switching to the coal/petcoke-blend feedstock. Produced raw syngas is sent to Gasification Flare until the system pressure and flow are stabilized. For start-up, the syngas sent to flare is either produced from natural gas or treated in the AGR Unit and will be essentially sulfur-free. Syngas is diverted through the shift reactors and LTGC sections and then to the AGR Unit. The circulating solution in the AGR Unit then begins absorbing the CO_2 in the syngas. Once the CO_2 concentration in the rich solution reaches the required level, the flash drums will begin separating CO_2 vapor. This CO_2 will be washed to remove any traces of methanol and vented to the atmosphere.

Once sufficient hydrogen-rich fuel production is available, the MHI 501GAC® CT can initiate a switch to 100 percent hydrogen-rich fuel. At this point, the start-up is complete and operation begins.

Also at this point, the start-up of the PSA Unit and Ammonia Synthesis Unit is initiated, a process that takes 1 to 2 days. Subsequently, the Urea Plant start-up is initiated over a second 24-hour process.

Ammonia Synthesis Unit Start-Up

The Ammonia Synthesis Unit will require about 2 days to start-up and reach full capacity for a cold start-up. First, the circulation of high-pressure boiler feedwater through the waste heat boiler, and that of cooling water through the appropriate heat exchangers is started. Then, the syngas compressor is started up and its speed slowly increased with hydrogen and nitrogen feeds. The initial period is used for purging the system and venting the gas (essentially hydrogen and nitrogen) via the flare system in the IGCC complex. The synthesis loop pressure is increased by increasing the compressor speed and syngas flowrate. The start-up heater is switched on to raise the converter catalyst bed temperatures. As the catalyst bed temperature is increased, the exothermic ammonia synthesis reaction starts taking place and ammonia is produced. As the synthesis loop pressure and the converter temperatures are increased, the ammonia refrigeration compressor is brought on line. The chilling provided by this system is used to separate the ammonia product from the main gas stream. The unconverted gas is recycled back to the syngas compressor.

The operating temperatures of the ammonia synthesis converter and the ammonia chillers are next optimized and the start-up heater is shut down. Then, the synthesis loop pressure is brought to design conditions by increasing the syngas compressor speed and feed rates. At this point, the Ammonia Synthesis Unit is operating at its design capacity and producing cold liquid, warm liquid and vapor ammonia product streams.

Urea Unit Start-Up

For a cold start-up, the Urea Unit will require about 18 hours to reach full capacity. First, the circulation of cooling water through the appropriate heat exchangers is started. The CO_2 Compressor and the Air Blower are then brought on line at low speed, and the CO_2 and air are circulated through the following high-pressure vessels:

- High-Pressure (HP) Stripper
- Urea Reactor
- HP Carbamate Condenser
- HP Scrubber

The initial period is used for purging the system and venting the gas, which is essentially CO_2. Then, the CO_2 compressor speed is increased and the above-mentioned vessels are pressurized with CO_2. Medium pressure (385 psig) steam is then introduced in the HP Stripper to raise the temperature of the system. Steam condensate from the HP Stripper is flashed at low pressure (60 psig) to provide steam for users at this level.

Pressurized liquid ammonia stream is introduced into the Urea Reactor to react with the CO_2 stream. The liquid product stream from the Urea Reactor consists of urea, carbamate, water, and excess ammonia. This liquid stream is routed to the HP Stripper where carbamate and excess ammonia are separated and recycled to the Urea Reactor with the incoming CO_2 feed stream. The bottoms product from the HP Stripper is a urea solution containing over 50 weight percent urea. The urea solution is routed to downstream units for further concentration. A 70 weight percent urea solution is first produced in the LP Rectifier and the Flash Vessel. This solution is stored in the intermediate solution tank. From this tank it is pumped to the vacuum separators/ evaporators to produce either the 80 weight percent urea stream for use in the UAN complex, or a greater than 99 weight percent urea melt stream for use in the Pastillation Unit.

UAN Unit Start-Up

From a typical cold start-up, the UAN Unit will require about 12 hours to reach full capacity. The UAN Unit consists of a Nitric Acid Unit, Ammonium Nitrate Unit, and a UAN blending unit. It is assumed that both the upstream Ammonia Unit and the Urea Unit are operating normally before the UAN Unit is started-up. The start-up sequence will consist of the following:

- Start-up of the Nitric Acid Unit
- Start-up of the Ammonium Nitrate Unit
- Start-up of the Urea Ammonium Nitrate Blending Unit

Start-Up of the Nitric Acid Unit

Circulation of boiler feed water is first started through the Waste Heat Boiler. Then, the air compressor is started up and air is used to pressurize the system consisting of the Ammonia Converter, Tail Gas Heater, Absorber, and all associated heat exchangers. The ammonia vapor stream from the battery limits is then slowly introduced and fed to the Ammonia Converter. A highly exothermic reaction of ammonia with air takes place over a platinum catalyst to produce a mixture of nitric oxide and water vapor. The resulting high-temperature gas from the Ammonia Converter then flows through a heat recovery system consisting of Expander Gas Heater, Waste Heat Boiler, Tail Gas Heater, and Air Heater. The cooled gas is then routed to the Absorber where it is mixed with air to reoxidize the nitric oxide to nitrogen dioxide. The vapor stream is contacted with feed water in the Absorber column to produce nitric acid of the desired strength. The overhead from the Absorber is tail gas, which is heated in a series of exchangers before being routed to the Tail Gas Expander for power recovery. The tail gas is treated in a catalytic system for NO_X emission control before being released to the atmosphere. The nitric acid product is routed to the Nitric Acid Surge tank for use as feed to the Ammonium Nitrate Unit.

Start-Up of the Ammonium Nitrate Unit

The feeds for the Ammonium Nitrate Unit are nitric acid and ammonia vapor. Ammonium Nitrate (75 to 83 weight percent) is produced in the Neutralizer by the reaction between ammonia vapor and nitric acid. The ammonia vapor is mixed with the nitric acid with a sparger system in the bottom of the Neutralizer.

The heat of reaction in the Neutralizer boils off steam, which passes overhead in the Scrubber. The function of the Scrubber is to condense the right amount of steam to control the concentration of the product ammonium nitrate solution from the Neutralizer. The overhead vapors from the Neutralizer/Scrubber are further cooled and scrubbed of residual ammonia in the vent scrubber before being released to the atmosphere. The collected condensate is returned to the Absorber. The resultant ammonium nitrate solution is routed to the UAN Blending facility.

Start-Up of the UAN Blending Unit

The feeds to this unit are 80 weight percent urea solution from the Urea Unit and the ammonium nitrate solution from the Ammonium Nitrate Unit. These two streams are blended in the UAN Mix Tank to produce the UAN solution.

2.6.3 Transient Operations

During peak electrical demand periods, the Project operates with the Power Block operating at maximum capacity on hydrogen-rich fuel. Transient operations associated with combined cycle load following are limited to the transition periods required to move from one operating mode to another. The following subsections describe the primary operating modes and the transient operations associated with them, as well as outage scenarios during annual operation.

For planning purposes, the Project expects two gasifier shut-downs and start-ups per year. These gasifier shut-downs are expected to be planned, based on on-line diagnostics and maintenance history. The MHI 501GAC® will automatically switch from hydrogen-rich fuel to natural gas on loss of hydrogen-rich fuel pressure. During operation there is a small excess of hydrogen-rich fuel production that is fired in the HRSG duct burners. This allows the amount of duct firing to vary with the normal variations in gasifier operation. When the gasifier is shut down, the duct firing will stop and the MHI 501GAC® CT will switch to the natural gas firing mode. The CT will continue to operate firing natural gas fuel until the gasifier is brought back on-line. When sufficient hydrogen-rich fuel is available, the CT will switch to 100 percent hydrogen-rich fuel, and hydrogen-rich duct firing can be restored. During gasifier operation, additional power can be generated by duct-firing PSA Unit off-gas.

The Project will typically be operated at base load during peak electrical demand periods. During base load operation hydrogen-rich fuel will be used in both the gas turbine and HRSG duct burners. During off peak electrical demand periods the gasifier, Shift, LTGC, Mercury Removal and AGR units will continue to operate at their design capacity. The gas turbine will be turned down to about 80 percent load. During off-peak operation the surplus hydrogen rich fuel production will be purified and used to make additional low-carbon nitrogen-based products.

The Power Block can also operate at up to 80 percent load on natural gas to support start-up or shut-down of the Gasification Block.

Power Block outages can either be planned or unplanned. Planned outages will be timed to occur with scheduled maintenance outages of the rest of the Project. Unplanned Power Block outages can occur for a variety of reasons. A CT shut-down will result in an immediate surplus of hydrogen-rich fuel. To accommodate this scenario, the gasifier will be turned down to the point at which the syngas generated in the gasifier will fully load the Manufacturing Complex. If the Power Block can be brought back online in a relatively short time, the Gasification Block will continue to operate feeding the Manufacturing Complex until the Power Block is back online. If the Power Block outage is expected to be long in duration, then a decision to shut down the Gasification Block may be made.

The Gasification Block can operate for limited periods without the Combined Cycle Power Block operating. The Gasification Block auxiliary loads will be supplied initially from the grid following a MHI 501GAC® trip.

The Project will have one gasifier operating continuously at full load during operation. The gasifier is designed to operate at a minimum load of 70 percent, and will be able to reduce to this level in approximately one half hour.

Several events including the loss of CO_2 compression, or a loss or reduction in one of the units in the Manufacturing Complex, could make it desirable to operate the gasifier at reduced capacity to minimize flaring hydrogen-rich fuel and/or venting CO_2. The anticipated time to repair and restore operation will determine whether it is desirable to turn down the gasifier for a limited time or shut it down.

2.6.4 Commissioning

Construction is initially scheduled by area and major equipment erection. Later construction transitions to completion by system in order to support turnover to the commissioning team. Commissioning is completed by system, with the utilities (fire protection, power, water, natural gas, steam, etc.) completed first. Commissioning the utility and support systems includes electric power, water treating, natural gas, and cooling tower, as well as the safety systems that will be needed to support initial operations of the equipment. Commissioning the Diesel Firewater Pump and the Emergency Diesel Generators will produce air emissions during initial operation and testing.

The major process units will be commissioned in a sequence that begins with the feed-producing units and ends with the product-producing units and systems.

The major Gasification Block units consume electrical power. The Power Block also must be reliable before commissioning on hydrogen-rich fuel begins. For these reasons, the Power Block will be commissioned ahead of the Gasification Block. The commissioning for the Project will require four distinct phases, which are described in sections 2.6.4.1 through 2.6.4.4.

2.6.4.1 Power Block Commissioning on Natural Gas

The Power Block will be initially commissioned on natural gas. The MHI 501GAC® uses diffusion combustors with water injection, rather than dry-low NO_X combustors. The following list briefly describes the steps for commissioning on natural gas:

- First fire
- Initial CT run-in
- Support of steam blows
- Initial ST roll
- NO_X tuning with steam injection

- Installation of SCR and oxidation catalyst
- CEMS drift test and source testing
- Power Block functional testing
- Water wash and Power Block performance testing and continuous operation test

2.6.4.2 Gasification Block and Balance of Plant Commissioning

The following description includes the commissioning activities that are expected to have air emissions. The description assumes that the major utility support systems are already operational (power distribution, firewater, power plant and instrument air, water treatment, steam, boiler feedwater, etc.). The key activities and events are listed below:

- Testing Diesel Generators
- Testing Diesel Firewater Pump
- Auxiliary boiler initial firing and burner tuning
- Auxiliary boiler source testing
- Auxiliary boiler operation to support gasification commissioning (typically when the Power Block is not operating)
- Operation of the Power Block in support of Gasification Block commissioning
- Cooling tower operation supporting the ASU, Combined Cycle Power Block, and Gasification Block (process cooling tower)
- Gasification Flare testing and operation in support of Gasification Block commissioning
- Rectisol® Flare testing and operation in support of AGR Unit commissioning
- SRU Flare testing and operation in support of Gasification Block commissioning
- Gasifier testing and operation
- Testing and operation of the AGR, SRU, and Tail Gas Compression Unit
- Testing the SRU Thermal Oxidation
- Venting CO_2 to support the testing and operation of the AGR and CO_2 compression system

2.6.4.3 Power Block Commissioning on Hydrogen-Rich Fuel

The Power Block will require additional testing and NO_X tuning with hydrogen-rich fuel. The testing will cover the range of allowable load ranges. The Power Block will be commissioned first on natural gas. The oxidation catalyst is assumed to be in service and active when the HRSG operating temperature is sufficient. The SCR catalyst and ammonia injection system are assumed to be operating whenever the SCR catalyst temperature is in the required range and operation is sufficiently stable. Ammonia injection may be off-line during the initial phases of NO_X tuning. The key activities and events that are expected to produce air emissions are listed below:

- Start-up, shut-down, and standby operation of MHI 501GAC® on natural gas
- CT NO_X tuning on 100 percent hydrogen-rich fuel
- CT NO_X tuning on part load
- Water wash and performance testing on hydrogen-rich fuel
- Duct burner testing on hydrogen-rich fuel

- Duct burner testing on PSA Unit off-gas (if available)
- Source testing on hydrogen-rich fuel across the load range
- Functional testing including fuel transfers and load changes
- IGCC performance test
- IGCC operational reliability test

2.6.4.4 Manufacturing Complex Commissioning

The Manufacturing Complex is comprised of several plants and support systems that together produce low-carbon nitrogen-based products including urea, UAN, and anhydrous ammonia. High-purity hydrogen and high-purity nitrogen are feedstocks to the Ammonia Synthesis Unit, which produces anhydrous ammonia. Anhydrous ammonia and high-purity CO_2 are feedstocks to the Urea Unit. The Urea Unit produces approximately 99 weight percent urea solution that feeds the Urea Pastillation Unit, as well as 80 weight percent urea solution that feeds the UAN Unit. Anhydrous ammonia is the feedstock for the Nitric Acid Unit and the Ammonium Nitrate Unit. The 80 weight percent urea solution and ammonium nitrate solution are feedstocks to the UAN Unit. The key commissioning activities and events that are expected to produce air emissions through the use of fired heaters or flare systems are listed below:

- PSA Units 1 and 2 including PSA Unit off-gas compression (brief flaring of hydrogen and PSA Unit off-gas)
- High-purity hydrogen compression and nitrogen compression (brief flaring of hydrogen)
- Test HRSG PSA Unit off-gas duct burner system (if not already completed)
- Ammonia Synthesis Unit (use of start-up heater, brief flaring during catalyst reduction, and recycle compressor testing)
- Build ammonia storage inventory
- CO_2 purification and purified CO_2 compression (brief venting of CO_2)
- Urea Unit (HP loop passivation and heating)
- Urea Pastillation Unit (functional testing including particulate control systems)
- Nitric Acid Unit (tail gas nitrous oxide abator)
- Ammonium Nitrate Unit (ammonium nitrate vent scrubber)
- UAN Unit (neutralizer overhead cleanup scrubber)
- Manufacturing Complex performance testing
- IGCC and Manufacturing Complex functional dispatch testing
- Plant-wide performance test
- Plant-wide reliability demonstration

2.6.5 Plant Staffing

The operating staff will consist of management and engineers, shift supervision, and shift operating personnel. It is expected that there will be four operating shifts with a shift supervisor and an operating/maintenance crew of approximately 22 people on each shift on a rotation basis. In addition to operation and management personnel, the Project will require qualified staffing in areas such as: production planning; equipment maintenance; instrument, electrical, and control support; material coordinating/inventory/procurement; health/safety/security/environmental protection; administrative support; benefits/human relations; training; laboratory; and in other necessary functions. It is estimated that the Project will employ approximately 200 full-time workers; of these, about 80 to 90 would be shift workers, and the rest would be day workers.

In addition to the permanent staff, there will be ongoing contract maintenance work for scheduled and unscheduled outages. The Gasification Block will follow the CT scheduled inspection maintenance cycle, typically on an annual basis. The contract maintenance will typically include inspections and overhauls for the large compressors and rotating machinery, the combustion/ST generator, electrical transmission equipment, the ST and other steam generating boilers and heat exchangers, catalyst and sorbent change out, tower and vessel inspection, and repair/replacement of internals, as well as other non-routine maintenance.

2.6.6 Materials and Equipment Delivery during Operations

Table 2-21, Material Delivery, describes the delivery schedule and general, origination location of each product for the Project. To the extent practical, the incoming railcars and trucks would be used to transport outgoing products. Refer to Section 5.10, Traffic and Transportation, for additional details.

The following are the anticipated feedstock delivery routes during operations:

- **Petcoke route.** From I-5 to westbound Stockdale Highway, left turn on southbound Morris Road (local road), right turn onto Station Road (local road), across Tupman Road (local road) into the Project Site through the Tupman Road entrance and vice versa.

- **Coal route.** Alternative 1: From the SJVRR via a new railroad spur connecting the existing SJVRR to the Project Site. Alternative 2: From the existing coal transloading facility in Wasco at the intersection of State Route (SR) 43 and J Street, south on SR 43, right turn onto Stockdale highway, left turn onto Morris Road, right turn onto Station Road, cross Tupman Road into the Project Site through the Tupman Road entrance,

Personnel will enter the Project Site through one of the Dairy Road entrances.

Information regarding the make, model, fuel type, and annual use of on-site vehicles is under development and currently not available. However, the fleet is estimated to be 10 light heavy-duty gasoline trucks and 10 light heavy-duty diesel trucks and an on-site average annual usage of 10,000 miles for each truck.

During operations, all routine on-site vehicular traffic is anticipated to travel almost exclusively on paved roads to minimize soil disturbance and fugitive dust emissions. Figure 2-49, Preliminary Paving Plan, shows the proposed paving at the Project Site.

There will be no on-site gasoline or diesel vehicle refueling storage. The on-road, non-road, and stationary engines will be refueled on an as-needed basis by a commercial fueling contractor licensed to do business in the State of California. Facility vehicles licensed for travel on public roads will either be refueled on-site by the service trucks or driven to one of several nearby commercial filling stations or truck stops.

2.7 PROJECT CONSTRUCTION

The following section describes the construction process for the Project Site and linear facilities.

2.7.1 Project Site Construction

Construction activities for the Project will occur throughout the 42-month construction period. As previously presented in Section 2.1.9, Affected Project Study Areas, Figure 2-9, Preliminary Temporary Construction Facilities Plan, shows the on-site construction areas, including laydown and parking. All construction laydown and parking areas will be located within the Project Site and the Controlled Area as shown on Figure 2-9, Preliminary Temporary Construction Facilities Plan. On-site construction activities include clearing and grubbing, grading, hauling, layout of equipment, delivery and handling of materials and supplies, and Project construction and testing operations. The Project Site occurs in an area of relatively flat topography. Site grading will occur as necessary to form level building pads for major process units.

Construction site access will be via Dairy Road for truck deliveries and Adohr Road for construction craft vehicles arriving and departing the site. Dairy Road currently ends at Adohr Road, but will be extended during Project construction. This extension will be permanent and will also be used for personnel access during operations. Initial site preparation operations will include construction of temporary access roads, craft parking, laydown areas, office and warehouse facilities, installation of erosion control measures, and other improvements necessary for construction. Erosion control measures will include construction of storm water retention basins and related site drainage facilities to control runoff within the site boundary. Existing drainage patterns outside the site boundary will remain undisturbed. No runoff from outside the site boundary will flow onto the Project Site.

Figure 2-50, Preliminary Grading Plan, shows the proposed grading at the Project Site.

2.7.1.1 Construction Planning

The Engineering, Procurement, and Construction (EPC) contractor will be responsible for the engineering, procurement, and construction of the Project. The EPC contractor will select subcontractors for certain specialty work as required.

2.7.1.2 Mobilization

The EPC contractor is expected to commence truck deliveries and ground disturbance in the third quarter of 2013. Project Site preparation work will include site grading and storm water/erosion control. Gravel and road base material will be used for temporary roads, laydown, parking, and work areas. Construction planning will include the evaluation of existing county roads. The roads will be upgraded as necessary to handle the increased loads and traffic.

2.7.1.3 Construction Offices, Parking, Warehouse, and Laydown Areas

Mobile trailers or similar suitable facilities (e.g., modular offices) will be used as construction offices for owner, contractor, and subcontractor personnel. All construction laydown and parking areas will be as shown on Figure 2-9, Preliminary Temporary Construction Facilities Plan.

Site access will be controlled for personnel and vehicles. A security fence will be installed around the Project Site boundary.

2.7.1.4 Emergency Facilities

Emergency services will be coordinated with the local fire department and hospital. First-aid kits will be provided around the Project Site and regularly maintained. The appropriate number of personnel trained in first aid and first response will be part of the construction staff upon mobilization. Additional personnel will be added as crew size increases in order to address environmental, health, and safety training; site security; and to provide appropriate levels of on-site first aid. Fire extinguishers will be located throughout the site at strategic locations at all times during construction.

2.7.1.5 Construction Utilities and Site Services

During construction, temporary utilities will be provided for the construction offices, the laydown area, and the Project Site. Temporary construction power will be initially generator-powered and will transition to utility-furnished power. Area lighting will be strategically located for safety and security. Potable water for personnel during construction will delivered by truck. Construction water will be delivered via pipe from West Kern Water District's facility, located approximately a mile to the east of the Project Site. Water sources for dust control and other construction activities will come from on-site irrigation wells and/or WKWD's potable water line.

For construction activities, including hydrotesting of the process equipment and piping, average daily use is projected to be 11,800 gallons per day over the Project construction period and 2,000 gallons per day over the linear construction period, as presented in Table 2-22, Estimated Construction Water Use. The hydrotesting of the process equipment and other piping is normally done toward the end of Project construction after the mechanical construction is complete. The hydrotest water will be sampled and tested and disposed of in compliance with permit(s). Clean water with suitable chemistry will be routed to the storm water retention basin. Water that is not suitable for routing to the retention basin will be transported by truck to an appropriately licensed off-site treatment or disposal facility.

The EPC contractor will provide the following site services:

- Environmental health and safety training
- Site security
- Site first aid
- Construction testing (Non-Destructive Examination [NDE], hydrotesting, positive material identification [PMI], etc.)
- Site fire protection and fire extinguisher maintenance
- Furnishing and servicing of sanitary facilities

- Trash collection and disposal
- Disposal of hazardous materials and waste
- Erosion and dust control during construction activities
- Warehousing, mitigation management and logistics

2.7.1.6 Construction Materials and Heavy Equipment Deliveries

Both rail and major freeway access are available in the vicinity of the Project Site. Construction materials such as concrete, structural steel, pipe, wire and cable, fuels, reinforcing steel, and small tools as well as consumables will be delivered to the Project Site by truck.

Major equipment such as the gasifier vessel, absorber vessels, shift converters, CT, ST, transformers, elements of the HRSG, and other equipment will be delivered to the Project Site by rail, truck, or by special conveyance.

Most equipment will be transported to the area via Interstate 5 (I-5) or by rail. Rail deliveries will either be delivered directly to the Project Site via a railroad spur or be off-loaded and transported by a specialized heavy-haul contractor near Buttonwillow to the Project Site. Large pieces of apparatus will be brought by barge to the Port of Stockton and delivered to the Project Site by a specialized heavy haul contractor.

2.7.1.7 Hazardous Materials Storage

Table 2-23, Hazardous Materials Usage and Storage during Construction Based on Title 22 Hazardous Characterization, and Table 2-24, Hazardous Materials Usage and Storage during Construction Based on Material Properties, list each material and describe the approximate annual quantity needed and use of the material during construction. Hazardous materials generated during the construction period will be placed in properly identified and approved storage bins until they are recycled or disposed of off-site. Hazardous materials and commodities for use on-site will be inventoried and appropriately stored. Warehouse personnel will maintain the records for these materials.

Non-hazardous refuse and construction rubbish will be sorted and stored in containers until removed from the Project Site for recycling or disposal.

2.7.1.8 Construction Disturbance Area

The majority of the Project Site is currently used for agricultural purposes. Figure 2-9, Preliminary Construction Facilities Plan identifies areas of on-site construction disturbance. These areas include temporary construction laydown facilities, construction roads, and Project facilities. Construction also consists of installation of off-site linear facilities, including process and potable water lines, a natural gas pipeline, a railroad spur, a CO_2 pipeline, and a transmission line. Linear facilities are described in more detail in Section 2.7.1.10, below. The estimated acreages of land that will be used for construction of the Project are presented in Table 2-1, Project Disturbed Acreage.

2.7.1.9 Storm Water Runoff Prevention Plan

Project Site erosion control will be accomplished during construction through the use of strategically placed berms, swales, and culverts to redirect runoff toward the storm water retention basins. Sandbags, filter bales, silt fences, and/or temporary dams will be installed, as needed, to minimize the volume of sediment carried by storm runoff and to prevent the erosion of slopes and temporary drainage facilities. Grades will be designed to prevent the effects of ruts and ponding. Following each significant precipitation event, a site review of the effectiveness of the erosion control plan will take place. Storm water will be retained on site for impoundment in the storm water retention basins located as shown on Figure 2-9, Preliminary Temporary Construction Facilities Plan.

2.7.1.10 Linear Construction and Maintenance

The following linear facilities will extend off the Project Site, as shown on Figure 2-7, Project Location Map:

- Railroad spur
- Electrical transmission line
- Natural gas supply pipeline
- Water supply pipelines
- CO_2 pipeline

The section, township, and ranges intersected by the linears are shown on Figure 2-8, Project Location Details. Construction of the linear facilities is expected to span approximately 12 months. The following provides details regarding the construction of the linear facilities.

Alternative 1, Rail Transportation

Construction

Under Alternative 1, construction of the railroad spur will occur early in the Project construction timeline so that the railroad spur could be used to deliver additional equipment. Construction of the railroad spur is expected to span approximately 5 months. Construction of the railroad spur will use earthwork and track construction equipment typically used on similar rail projects throughout California and the United States. The following is a summary of the construction sequence and methods anticipated to be used for the railroad spur. Under Alternative 2, no additional construction would be necessary because the Project would use existing roads and the existing coal transloading facility in Wasco.

Earthwork, Utilities, and Drainage

Since the majority of the alignment is traversing previously disturbed agricultural areas, minimal clearing and grubbing of the proposed right-of-way will be required to remove vegetation. Once the right-of-way is cleared, rough grading work will begin. Earth moving equipment will create a track embankment section and drainage ditches using standard equipment consisting of bulldozers, scrapers, dump trucks, roadway graders, and vibratory compactors. Utility relocation work will also be performed as part of this initial grading work. Existing local service power lines and underground irrigation piping will be relocated or protected in place. The natural gas linear will follow the railroad spur linear from the Project Site to its interconnection with the existing SJVRR line. The natural gas linear will be installed 25 feet from the centerline of the track.

Major Drainage Structures

The proposed route crosses one irrigation canal (East Side Canal) managed by BVWSD. HECA will work with BVWSD and secure the appropriate approvals. Potential impacts to non-wetland waters of the U.S. would qualify for authorization under Nationwide Permit (NWP) 12 for Utility Line Activities and NWP 33 for Temporary Construction Access. The Project is expected to affect less than 0.1 acre of permanent impact to waters of the U.S.

Laydown Area and Construction Access

A laydown area for track construction materials will be located near the proposed interconnection to the existing SJVRR track totaling approximately three acres of temporary disturbance. Along the new rail spur, truck turnaround points will be required about every 0.25 mile. These truck turn around points will be typical hammerhead design of about 30 feet by 75 feet. All work will be performed within the proposed 75-foot railway construction ROW**.**

Maintenance

HECA currently anticipates that it will own, operate, and maintain the approximately 5-mile railroad spur. Regardless of final ownership of the spur, maintenance activities will consist of routine annual maintenance activities and programmed maintenance conducted on a periodic basis. Annual maintenance activities consist of visual inspections, vegetation control, spot surfacing and lining of rough spots in the track, and adjusting/lubrication of turnouts. In addition, any warning devices at road crossings will be inspected as frequently as monthly.

Programmed major maintenance consists of surfacing and lining the rail line, typically every three to five years; and replacing the rail, potentially once during the life of the plant. If timber ties are used rather than concrete ties 15 percent of the timber ties would need to be replaced on a 10-year cycle. Major maintenance activities will be conducted using on-track equipment. Replaced materials will be removed from the right-of-way (ROW) and recycled. Timber ties will be disposed of by incineration, landfill disposal or other approved disposal options.

Electrical Transmission Line

Construction

A new 230-kV electrical transmission line will interconnect the Project to a future PG&E switching station. A 230-kV transmission line will be connected to a new 230-kV switchyard at the HECA Combined Cycle Power Block for power generated by the Project. A 230-kV transmission line will be connected to a new 230-kV switchyard at the ASU for power from PG&E.

Approximately 15 steel poles are expected to be required outside of the Project Site for the electrical transmission line interconnection. Construction of the interconnection lines will consist of installing footings, poles, insulators and hardware, and pulling conductors and shield wires. The new transmission line interconnection will be placed in an approximate 100-foot-wide permanent ROW.

Construction of the new 230-kV transmission line interconnection will require approximately 3 months. It is scheduled for completion and be operational in time for generation testing of the Project. Construction of the new PG&E switching station will be performed by PG&E as required to accommodate the interconnection of the new transmission line to the Project Site.

Maintenance

It is anticipated that annual maintenance of the electrical transmission line will be provided for under an agreement between PG&E and the Project. The electrical transmission line is located entirely within areas that are actively farmed or are developed. Most of the maintenance will be routine and can be scheduled during periods when damage to the crops and land can be minimized. Maintenance activities will be conducted by personnel trained to be aware of the presence of sensitive wildlife.

Natural Gas Supply Pipeline

Construction

A new natural gas pipeline will interconnect with the existing PG&E natural gas pipeline located north of the Project Site. The interconnect will consist of one tap off the existing natural gas line and one metering station at the beginning of the natural gas pipeline adjacent to the PG&E Inlet. The metering station will be up to 100 feet by 100 feet, surrounded by a chain link fence. In addition, there will be a metering station at the end of the natural gas pipeline, located on the southwest side of the Project Site, and a pressure limiting station located on the Project Site. HECA or PG&E will construct the natural gas pipeline. PG&E will own the natural gas pipeline.

The natural gas line is approximately 13 miles in length.

Construction of the natural gas pipeline interconnection will involve a variety of crews performing the following industry standard pipeline construction activities: hauling and stringing of the pipe along the route; welding, radiographic inspection, and coating of the pipe welds; trenching; lowering of the pipe into the trench; backfill of the trench; hydrostatic testing of the pipeline; tie-in to the existing pipeline; purging the pipeline; and cleanup and restoration of construction areas. Roads and rights-of-way will be restored to specifications of the Project and affected agencies.

Construction of the natural gas pipeline interconnection will take approximately 6 months. It is scheduled to be finished and operational in time to provide test gas to the Project. Construction will occur in accordance with a traffic management plan to minimize impacts to traffic.

Grade cuts will be restored to their original contours, and affected areas will be restored to their original state in order to minimize erosion.

Maintenance

PG&E will own, operate and maintain the natural gas pipeline. Maintenance of the natural gas pipeline would follow PG&E corporate policies and protocols.

Long-term maintenance needs of the natural gas pipeline would be minimal during the 25-year lifespan of the Project.

Water Supply Pipelines

Construction

For process water, the Project will use brackish groundwater supplied from the BVWSD. BVWSD will construct and own the process water pipeline. The process water pipeline route runs from Seventh Standard Road to the Project Site, along the existing BVWSD road on the northwest side of the West Side Canal. The process water supply pipeline will be approximately 15 miles in length.

BVWSD will construct and own a well field for the Project process water supply that will be located in the western portion of BVWSD's service area near the West Side Canal in the vicinity of Seventh Standard Road, at the north end of the 15-mile-long process water line. It is currently anticipated that there will be up to five groundwater extraction wells. Two of these wells will provide operational redundancy. The maximum depth of the wells will be approximately 300 feet below ground surface. The brackish water will be treated on the Project Site to meet all process and utility water requirements.

The process water well field and pipeline are fully addressed in this AFC Amendment. It should be noted, however, that these Project elements were also previously reviewed under CEQA in connection with the BVWSD Groundwater Management Plan (GMP) for which an Environmental Impact Report was prepared and certified in December 2009 (Krieger and Stewart, Incorporated, 2009).

The process water well field and pipeline were previously reviewed and cleared under CEQA.

For drinking and sanitary use, the Project will use potable water supplied by WKWD. The potable water line will be constructed and owned by HECA LLC.

The potable water supply pipeline route begins approximately 1 mile east of the northeast corner of the Project. The potable water line is approximately 1 mile in length. This pipeline will be placed within the electrical transmission corridor ROW.

Installation of the water supply pipelines will involve industry standard construction activities for pipelines, including trenching; hauling and stringing of pipe along the routes; welding; radiographic inspection and coating of pipe welds; lowering welded pipe into the trench; hydrostatic testing; and backfilling and restoring the approximate surface grade. Construction of the process water pipeline is expected to take approximately 6 months to complete. The source of the water to be used for hydrostatic testing of the pipelines will be an on-site irrigation well, supplemented by potable water from WKWD. The hydrotest water will be sampled, tested, and disposed of in compliance with National Pollutant Discharge Elimination System permit(s). Clean water with suitable chemistry will be routed to the storm water retention basin. Water that is not suitable for routing to the retention basin will be transported by truck to an appropriately licensed off-site treatment or disposal facility.

Maintenance

BVWSD will own, operate, and maintain the approximate 15-mile process water pipeline and associated wells. Annual maintenance of the process water pipeline and associated groundwater wells would be conducted by BVWSD. Maintenance activities of the wells and the pipeline would follow BVWSD corporate policies and protocols.

Long-term maintenance needs of the process water pipeline would be minimal during the 25-year lifespan of the Project.

HECA will own, operate and maintain the approximate 1-mile potable water pipeline. Maintenance activities of the pipeline would include:

- Annual reconnaissance of the pipeline ROW
- Annual inspection and exercising (opening and closing for one cycle) of valves, as necessary
- Annual vegetation removal, re-grading, and application of dirt for the access road after wet periods and pipe work, as necessary
- As determined necessary by routine inspection, replacement of pipeline components (lining and coating, valves, and joints)

Long-term maintenance needs of the potable water pipeline would be minimal during the 25-year lifespan of the Project; therefore, they are not quantified in this document.

Carbon Dioxide Pipeline

Construction

A CO_2 pipeline will be constructed to transfer the CO_2 produced by the HECA Project to the OEHI CO_2 Processing Facility used by OEHI for injection into deep underground hydrocarbon reservoirs for CO_2 EOR. The CO_2 pipeline route will leave the southwestern portion of the HECA Project Site and will use Horizontal Directional Drilling (HDD) to pass under the Outlet Canal, the KRFCC, and the California Aqueduct. The number of HDD entry and exit pits will be determined based on field conditions. HDD would also be used to avoid disturbance of archaeological sites. On the south side of the aqueduct, the route extends southeast and south to the OEHI CO_2 Processing Facility and parallels existing private roads. The route is approximately 3 miles in length. OEHI will construct and own the CO_2 pipeline.

With the exception of these HDD crossings where the depth of the CO_2 pipeline may reach 100 feet below grade, the pipeline will be buried approximately 5 feet below grade, and will be protected by cathodic protection and monitored by independent leak-detection systems. Construction of the CO_2 pipeline interconnection will involve a variety of crews performing the following industry standard pipeline construction activities: hauling and stringing of the pipe along the route; welding; radiographic inspection; coating of the pipe welds; trenching; lowering of the pipe into the trench; backfill of the trench; hydrostatic testing of the pipeline; purging the pipeline; and cleanup and restoration of construction areas. Grade cuts will be restored to their original contours, and affected areas will be restored to their original state so as to minimize erosion.

Construction of the CO_2 pipeline will take approximately 6 months.

Maintenance

OEHI will own, operate, and maintain the CO_2 pipeline. Maintenance of the CO_2 linear will follow OEHI corporate policies and protocols. Long-term maintenance needs of the CO_2 pipeline would be minimal during the 25-year lifespan of the Project.

Pipeline Crossings and Horizontal Directional Drilling

Horizontal Directional Drilling (HDD) will be used in areas where open cutting or non-invasive waterbody or sensitive area crossing is not feasible, such as the CO_2 pipeline crossings. HDD will be used to install the CO_2 pipeline under the Outlet Canal, the KRFCC, and the California Aqueduct. The depth of HDD under water bodies will comply with all applicable federal and state regulations.

The California Department of Water Resources, Encroachment Permit Guidelines—June 2005, identifies specific requirements regarding the use of HDD for the crossing of water bodies. The principal requirements include but are not limited to the following:

- A site-specific geotechnical report must be submitted to the California Department of Water Resources with the Encroachment Permit application.
- Pipe sleeves are required with any pipeline carrying hazardous materials or pollutants.
- The minimum separation between the bottom of the aqueduct channel and the top of pipe is 25 feet; further separation may be required depending on the actual pipe diameter.
- Drawings submitted with the Encroachment Permit Application must include the following information for buried pipelines (as a minimum):
  - Aqueduct mileposts at each crossing, pipe size, location, and type of material transported
  - Maximum operating pressure, type of pipe and pipe joints, pipe wall thickness, maximum test pressure, and description of test procedures
  - Type of sleeve/casing including diameter, joints, and wall thickness
  - Protection coatings and a description of control measures
  - Method employed to accommodate pipeline expansion and contraction

- Thrust block location and details
- Pipeline coatings and corrosion control measures
- Location of shutoff valves on each side of the crossing
- List of applicable design codes
- Location, including depth of the buried aqueduct communication and control cables
- Identification of existing utility easements or encroachments in the immediate vicinity of the proposed crossing

The HDD method includes a drilling rig that will bore a horizontal hole under the water crossings. At each of these crossings, a 100-foot by 200-foot laydown area (or entry/exit pit) has been identified on either side of the water course to accommodate the HDD installation (see Figure 2-8, Project Location Details).

Best management practices for HDD will include installing silt fencing around the drill sites, using energy dissipation devices for discharging water from hydrostatic testing of the pipeline, selecting drilling fluids for environmental compatibility, and removing spent fluids from the areas immediately adjacent to the water bodies for safe disposal and to prevent contamination. In addition, soil erosion control measures will be implemented to prevent runoff and impacts to water quality.

2.7.2 Combined Construction Workforce

Construction is expected to begin in the third quarter of 2013 and continue for 42 months. Commissioning and Start-Up is expected to continue for an additional 7 months (total 49 months). The schedule has been estimated on a single-shift, 5-day basis, beginning at 6 a.m., Monday through Friday. Additional hours and/or a second shift may be necessary to make up weather delays, schedule deficiencies or to complete critical construction activities. During Project start-up and testing, some activities may continue up to 24 hours per day, 7 days per week.

Most construction workers traveling to the Project Site from the south and east (e.g., Arvin, Taft, south Bakersfield) will reach Tupman Road from SR 119. Construction workers traveling either from the south along I-5 will reach the Project Site entrance at Dairy and Adohr Roads via Stockdale Highway. Construction workers traveling to the Project Site from the north (e.g., Buttonwillow, Shafter, north Bakersfield) will reach the Project Site entrance at Dairy and Adohr Roads via Stockdale Highway and I-5. Traffic management plans will be implemented for construction workers, shift changes, and hauling of oversize loads to the Project Site. Estimates of average and peak construction traffic during the on-site construction period, and traffic management for construction, are described in Section 5.10.4, Traffic and Transportation.

Table 2-25, Preliminary Estimate of Monthly Construction Labor Power by Craft, shows the estimated construction labor by craft.

2.7.3 Combined Construction Equipment Requirements

Table 2-26, Construction Equipment Estimate, shows an estimate of construction equipment by type and by days of use per month.

2.7.4 Combined Construction Traffic

During the construction phase, there will be vehicular traffic both on and off of the Project Site. This includes traffic generated from the following activities:

- Delivering heavy equipment to the Project Site, such as bulldozers and cranes
- Importing construction fill material
- Delivering structures, construction material, and equipment to the Project Site
- Daily commuting of construction workforce and managers
- Access by other miscellaneous site visitors

There will be seven entrances to the Project Site during construction:

- **Controlled Area on Adohr Road.** This entrance will provide access to the construction laydown area, as well as access to the Project Site. Workers, materials and equipment will have access through this entrance;

- **Dairy Road.** Six entrances along Dairy Road will provide access to the Project Site. Workers, materials and equipment, and shipments of imported construction fill will have access through these entrances.

General and heavy haul loads access to the Project Site will be from Stockdale Highway to Dairy Road to the Project Site (or Dairy Road to Adohr Road to the Project Site). Regional access to the Project Site will be via I-5, which runs north–south to the east of the Project Site, and SR 58, which runs east-west and is about 4 miles north of the Project Site. Direct access to the Project Site is provided by the following routes:

- **Construction Worker Route 1.** Locally sourced or temporary workers lodging in Metropolitan Bakersfield and nearby communities may arrive via westbound Stockdale Highway, turn left on southbound Dairy Road (local road), which will be extended into the Project Site. Alternatively, workers can turn left on Adohr Road to access the Controlled Area from the Adohr Road entrance, then gain access to the Project Site from the Controlled Area.

- **Construction Worker Route 2.** Locally sourced or temporary workers lodging in Metropolitan Bakersfield and nearby communities may arrive via westbound Stockdale Highway, turn left on southbound Morris Road (local road), right on westbound Station Road, right on northbound Tupman Road, left on westbound Adohr Road, then either into the Adohr Road entrance, or left on Dairy Road to one of six Dairy Road entrances.

- **Construction Worker Route 3.** Locally sourced or temporary workers lodging in metropolitan Bakersfield and nearby communities may arrive via Taft Highway (SR 119) to northbound Tupman Road, then turn left onto Adohr Road, then either into the Adohr Road entrance, or left on Dairy Road to one of six Dairy Road entrances.

- **Material Delivery and Construction Haul Route 1.** On westbound Stockdale Highway, turn left on southbound Dairy Road (local road), continuing south and into the Project Site via one of six entrances on Dairy Road. Alternatively, trucks can turn left on Adohr Road to access the laydown area in the Controlled Area from the Adohr Road entrance, then gain access to the Project Site from the Controlled Area.

- **Material Delivery and Construction Haul Route 2.** On westbound Stockdale Highway, turn left on southbound Morris Road (local road), right on westbound Station Road, right on northbound Tupman Road, left on westbound Adohr Road, then either into the Adohr Road entrance, or left on Dairy Road to one of six Dairy Road entrances.

Some of the heavy equipment is expected to be delivered via rail due to its weight and size. Rail deliveries will either be delivered directly to the Project Site via the industrial railroad spur or be off-loaded and transported by a specialized heavy-haul contractor near Buttonwillow to the Project Site. These deliveries will comply with Caltrans regulations and weight restrictions for state highways.

As shown in Table 2-25, Preliminary Estimate of Monthly Construction Labor by Craft, based on a peak month workforce requirement of approximately 2,500 employees per month and an average vehicle occupancy rate of 2.0 people per vehicle, it is estimated that an average of about approximately 2,500 total vehicle trips (1,250 round trips) per day will result from construction worker traffic. In addition to the workforce traffic, it is anticipated that an average of 100 total truck trips (50 truck round trips) per day will be required for construction equipment and material deliveries during the construction period, and an average of 320 total truck trips (160 truck round trips) per day will be required for import fill deliveries during the construction period.

Security measures will be incorporated at the access gates to control construction traffic.

Table 2-26, Construction Equipment Estimate, shows the type of construction equipment that will be used during construction of the Project, including early construction, commissioning and start-up. This equipment list includes trucks, cranes, bulldozers, excavators, rollers, forklifts, and concrete pumpers.

2.7.4.1 Traffic Control Plan during Construction

An On-Site Traffic Control Plan will be developed prior to construction. This plan will assist in the development of roads on-site, parking areas, security issues, and site access. Additionally, the plan will be used to develop protocol for the movement of heavy-haul equipment on site. Additional features of the plan may include the following:

- Using proper signs and traffic control measures in accordance with Caltrans, particularly pertaining to nearby roads under their jurisdiction
- Coordinating construction activities with the appropriate jurisdiction, such as the County, if closures of major roads are necessary during transmission line or pipeline construction
- Scheduling traffic lane or road closures during off-peak hours whenever possible
- Limiting vehicle traffic to approved access roads, construction yards, and construction sites
- Constructing off-site pipelines in accordance with applicable state and local encroachment permit requirements and covering trenches in roadways during non-work hours

The Project will obtain the appropriate transportation-related permits prior to construction.

2.8 FACILITY SAFETY DESIGN

Process Safety Design

Appropriate process safety design measures will be implemented to deliver a practical, intrinsically safe design for the Project. These measures will include the following process safety principles as applicable throughout the work process:

- Mitigate risks associated with inherent hazards:
  - Inherent hazards are identified, assessed, understood, documented, and mitigated.

- Minimize potential causes and reduce severity:
  - Opportunities to minimize risks at the source will be evaluated. This process includes identifying the actual risks and considering what is to be done to mitigate them. At the conclusion of this activity, a decision is made to implement those measures that are feasible and practicable and that are likely to reduce the potential severity of identified potential risks. This includes substituting hazardous materials if feasible or reducing on-site inventory of hazardous materials to the amount necessary to support operations.

- Manage the process to:
  - Increase equipment integrity, equipment reliability, and longevity to minimize the probability of an unwanted event occurring.
  - Minimize potential risks throughout the design life of the Project.
  - Make certain that the risk management strategy has been accepted by those who will implement the strategy.
  - Ensure timely implementation of effective and reliable combinations of the identified mitigation measures to achieve desired goals.

Health, Safety, and Environmental Focus Areas

HECA will develop procedures to protect human health (employees, contractors, and the general public), the environment, and property against possible accidents resulting from the failures of facilities or components on the Project Site.

The main focus is to ensure that adequate measures are used to minimize the risks and to mitigate the consequences of, fire, explosion, or accidental hazardous material release. While the probability of these incidents occurring may be low, selected potentially significant risks will be addressed, and methods identified to reduce them will be established.

During the course of detailed engineering, the following areas will be evaluated:

- Unit and component location, access, and spacing for personnel/protection and O&M
- Internal Project road layout and operating unit setbacks
- Firewater storage and distribution system
- Deluge fire protection system(s)

- Area/unit fire and gas detection systems
- Identification of materials requiring MSDS documents

2.8.1 Natural Hazards

The Project will be planned, engineered, designed, constructed, and operated to meet the requirements of applicable LORS as described in detail in Appendix D, Design Criteria. The detailed engineering will evaluate and address the following natural hazards.

Earthquake

The Project Site, like most of California, is within a seismically active region. A review of geologic literature did not identify the presence of any known active or potentially active faults at the Project Site or crossing the Project Site. Section 5.15, Geological Hazards and Resources, provides details on the potential geological hazards associated with the Project. Figure 5.15-1, Regional Geologic Map, does not show any faults mapped within the Project.

The closest known faults classified as active by the State of California Geologic Survey are the San Andreas Fault, which is, according to Blake (2000), approximately 21 miles to the west of the Project Site; the White Wolf Fault, located approximately 23 miles to the southeast; and the Pleito Thrust, located approximately 27 miles south. These faults are shown on Figure 5.15-3, Regional Fault Map.

Based upon findings of the Geotechnical Investigation (filed as Appendix P in the 2009 Revised AFC), the potential for liquefaction is low to nil and seismic-induced dry sand settlement is on the order of 0.25 inch, which is low.

The Project Site is located in a high-earthquake zone, and the mapped maximum credible accelerations and design response spectrum will be determined from Section 1613A, California Building Code (CBC, 2010).

Structures, their foundations, and equipment anchors will be designed in accordance with the CBC (2010) and ASCE 7-05.

When there is conflict in code requirements, the most conservative requirements will govern. Also, the substation equipment will meet requirements of IEEE 693-2005, Recommended Practice for Seismic Design of Substations.

Floods

As discussed more fully in Section 5.15, Geological Hazards and Resources, the Project Site is not located within an area identified as having flood hazards or shallow groundwater. The Project linears extending to the west and south of the Project Site will cross a flood hazard zone on the northeastern side of the California State Water Project.

Based on Federal Emergency Management Agency Flood Insurance Rate Map "Kern County, California, and Incorporated Areas" (Map 06029C2225E), dated 2008, the Project Site is not in the 100-year flood zone.

Due to the proper site drainage and storm water retention basins design, the Project Site is not likely to experience flooding.

Wind Loads

The basic design wind speed (3-second gust) is 85 miles per hour as per CBC 2010. Wind loads on structures, systems, and components will be determined from ASCE 7-05 and CBC 2010.

2.8.2 Emergency Systems and Safety Precautions

2.8.2.1 Community and Stakeholder Awareness

HECA LLC values the importance of community awareness in the Kern County area and will actively engage in dialogue with the community and various stakeholders to maintain public confidence in the integrity of Project's operations, products and HECA LLC's commitment to HSE performance.

HSE issues will be identified by listening and consulting with concerned employees, contractors, regulatory agencies, public organizations, and communities. All communications will be responded to in a timely manner.

The Project will establish and maintain open and proactive communications with employees, contractors, regulatory agencies, public organizations, and communities regarding the HSSE aspects of the Project.

2.8.2.2 Emergency Preparedness

The Project will develop and use communications and response plans for emergency situations. The response plan will be reviewed by the appropriate manager, who will take necessary actions to prepare to respond to an emergency event. Plans will be coordinated with the designated local emergency response organizations within Kern County, and the Bakersfield area in particular. Area hospitals clinical medical services and fire protection resources have been identified and will be detailed in communications and response plans.

2.8.2.3 Specific Project Emergency Systems

The Project's auxiliary systems described below support, protect, and control the Project.

Fire Protection

See Section 2.5.11, Fire Protection, for details on the fire protection system for the Project.

Lighting System

The lighting system provides plant personnel with illumination in both normal and emergency conditions. The system consists primarily of alternating current (AC) lighting, and includes direct current (DC) lighting for activities or emergency egress required during an outage of the Project's AC electrical system. Lighting fixtures will be directionally oriented, shielded, and hooded to minimize off-site migration of light. The electrical distribution system also provides AC convenience outlets for portable lamps and tools.

Grounding System

The Project's electrical systems and equipment are susceptible to ground faults, switching surges, and lightning, which can impose hazardous voltage and current on Project equipment and structures. To protect against personnel injury and equipment damage, the grounding system provides a path to dissipate hazardous voltage and current under the most severe conditions. Bare conductor is installed below grade in a grid pattern, and each junction of the grid is bonded together by welding or mechanical clamps. The grid spacing is designed to maintain safe voltage gradients. Ground resistivity readings and the identified available ground fault currents are used to determine the necessary grid spacing and numbers of ground rods. Steel structures and non-energized parts of Project electrical equipment are connected to the grounding grid. Protective relays and system design elements, such as resistance grounding of transformers and generators, assist in limiting the amount of ground current.

Distributed Control System

The DCS provides control, monitoring, alarm, and data storage functions for Project systems.

The following functions will be provided:

- Controlling the CT, ST, HRSG, Gasification and other process units, and balance-of-plant systems in a coordinated manner
- Monitoring operating parameters from Project systems and equipment and visual display of the associated operating data to control operators and technicians
- Detecting abnormal operating parameters and parameter trends and providing visual and audible alarms to apprise control operators of such conditions
- Storing and retrieving historical operating data

The DCS is a microprocessor-based system. Redundant capability is provided for critical DCS components such that no single component failure will cause an outage. The DCS consists of the following major components:

- Visual display-based control operator interface (redundant)
- Visual display-based control technician workstation
- Multi-function processors (redundant)
- Input/output processors (redundant for critical control parameters)
- Field sensors and distributed processors (redundant for critical control parameters)

- Historical data archive
- Printers, data highways, data links, control cabling, and cable trays

The DCS is linked to local control systems furnished by packaged equipment vendors.

Emergency Relief System

The Project is furnished with pressure relief devices and three flares to protect equipment from overpressure. Any excess gas or liquid accumulated in equipment will be routed to the flares for safe disposal in the event of an emergency or upset condition.

Cathodic and Lightning Protection System

Cathodic protection may be provided using an impressed current or buried anode system to prevent corrosion of buried carbon steel piping and structures. Protective coatings are applied as primary protection and to minimize cathodic protection current requirements. The requirement for a cathodic protection system will be determined during detailed design. Lightning protection will be furnished for buildings and structures. Lightning protection for the switchyard will be installed in accordance with industry practice.

Personnel Protection Insulation

Though not required for process, insulation will be provided on equipment and piping that operates above 140°F to avoid burn injuries.

Instrument Air System

The instrument air system provides dry, filtered air to pneumatic operators and devices throughout the Project. Air from the service air system is dried, filtered, and pressure-regulated prior to delivery to the instrument air piping network. This supports continual safe operation of the instruments controlling Project operation.

Emergency Facilities

Emergency services will be coordinated with the local fire department and hospital. First-aid kits will be provided around the Project Site and regularly maintained. Construction staff will include the appropriate number of personnel trained in first aid and first response. Fire extinguishers will be located throughout the Project Site at strategic locations at all times during construction.

Fire Safety Program

Prior to the beginning of construction, the construction management contractor will develop a site-specific fire safety program. The program will include, among other things, safety procedures that address welding, thermal cutting, and gas cylinders; fire protection; and refueling emergency response.

The developed program will be reviewed with local government emergency response organizations.

Emergency Response Procedures

Prior to commencement of construction activities, the construction contractor will develop a site-specific construction emergency response program. The developed programs will be reviewed with local government emergency response organizations.

2.9 TECHNOLOGY SELECTION AND FACILITY RELIABILITY

2.9.1 Technology Selection

This section explains how the technology being used within the Project is demonstrated within other industrial commercial scale applications, and how this relates to the actions taken to maximize the reliability of the Project.

It is now widely recognized that carbon capture and sequestration has a central role to play in GHG emissions reduction. Numerous studies, including by the Electric Power Research Institute, (EPRI, 2007) Massachusetts Institute of Technology (MIT, 2007), Princeton (Pacala and Socolow, 2004) and others have stressed the major role carbon capture and sequestration must play in meeting targets for GHG emissions reduction in California, the United States, and the world.

HECA studied the technological, commercial, permitting and all other aspects of feasibility to potentially build and operate an IGCC facility capable of providing approximately 300 MW of low-carbon baseload power and approximately 1 million tons per year of low-carbon nitrogen-based products from solid fuel in Kern County, California.

HECA LLC was formed to develop a business consisting of the production of hydrogen fuel for the generation of low-carbon power and low-carbon nitrogen-based products. The feasibility review for the technology selection has two key objectives:

- Proving commercial scale IGCC with carbon capture operability at high capture rates and low emissions
- Proving associated economic viability, with delivering a highly reliable operating plant within a minimum period after initial start-up as a key aspect

To deliver these objectives and reduce overall Project risk, the Project has a preference to select, where available, standard and proven technology and equipment that is operating within the industry at equivalent capacities and design criteria.

Both gasification and gas purification with carbon capture are proven technologies, operating at commercial scale within the United States and around the world. The integration of these technologies with sequestration has not yet been performed on a commercial scale.

The following sections of this document contain information regarding the demonstrated feasibility of the technologies to be used in the Project:

- Section 6.5.1, Mitsubishi Heavy Industries Gasification Technology
- Section 6.5.2, Acid Gas Removal System
- Section 6.5.3, MHI 501GAC® CT

In addition, other process units selected for the Project are proven technologies that operate at commercial scale facilities throughout the developed world. The downstream unit technologies (including sour gas shift reactors, AGR technology, and Claus sulfur removal technology) have been demonstrated in commercial applications in the United States (including Eastman Chemical Plant in Tennessee) and many chemical plants in China (mostly ammonia and methanol plants).

For example, domestic CO_2 compression is practiced at a North Dakota SNG plant at similar production pressures and rates for pipeline transportation to EOR facilities, and is also practiced at slightly different flowrates/pressures in the Four Corners area of the United States where naturally occurring CO_2 is compressed for pipeline transportation. CO_2 compression is also used at numerous facilities around the world. The ZLD system in the Wastewater Treatment Unit takes process wastewater and treats it using industry standard technology to produce a purified water stream that is recycled for reuse within the Project and a solid waste for off-site disposal in accordance with applicable LORS. The Tampa Electric IGCC plant in Polk County, Florida, treats process water in a similar ZLD system to produce a recycled water stream and a solid waste for off-site disposal. The remaining systems within the Project are commercially proven technologies operating at facilities in the United States and around the world: water treatment plant, heat rejection cooling system, solids handling system with particulate abatement systems, sour shift- temperature gas cooling, mercury removal, flares, ASU, SRU, auxiliary boiler, and resource linear pipelines.

MHI gasification technology for solid fuels has been demonstrated at commercial scale in the Nakoso 250 MW IGCC Facility in Nakoso, Japan, which has been in operation since 2008. The MHI gasification technology has been demonstrated on a variety of coal and other feedstocks in pilot facilities, demonstration plants and the commercial facility at Nakoso, Japan.

2.9.2 Facility Reliability

In addition to the above approach of selecting proven technologies where available, the Project critically analyzed each unit within the Project to determine its reliability and impact on the reliability of the whole Project based on historic reliability data from actual operating plants. As an example, this analysis enabled engineers to make informed decisions when deciding between installing a pump or adopting enhanced preventative maintenance procedures.

The Project is designed for an operating life of a minimum of 25 years. The O&M procedures will be consistent with industry standard practices to maintain the equipment in good operating condition over the useful life of the Project. The primary fuel to the CT is hydrogen-rich fuel, with natural gas as a backup fuel for up to two weeks per year when hydrogen-rich fuel is not available due to, for example, maintenance of the Gasifier unit. The commissioning and start-up period of the Project is expected to be completed within approximately 1 year from mechanical completion. Commercial operation will start when the commissioning and start-up activities are completed and the licensor/contractor guarantees and milestones have been achieved.

Because of the scheduled maintenance of the MHI 501GAC® CT, the entire IGCC complex will be shut down when the Combined Cycle Power Block is out of service. The remaining process blocks (AGR, Sour Shift, LTGC units, etc.) have demonstrated high reliability in historical industry practice. However, in order to match the CT outage schedule, the process blocks will also be shut down during the CT scheduled maintenance period. This offers an opportunity to perform much of the maintenance for the AGR and Shift Units in a manner that can further enhance the reliability of the Project.

HECA LLC requires high standards of engineering and safety design criteria. The EPC contractor will be a reputable company, with experience in handling large capital projects. Comprehensive training and simulation programs will be established to ensure the integrity of the design and safety awareness of all O&M personnel.

2.10 REFERENCES

CBC (California Building Code), 2010.

DOE (U.S. Department of Energy), 2011. National Energy Technology Laboratory. Project Facts, Clean Coal Power Initiative (CCPI 3). Hydrogen Energy California Project: Commercial Demonstration of Advanced IGCC with Full Carbon Capture. November.

EPRI (Electric Power Research Institute), 2007. The Power to Reduce CO_2 Emissions: The Full Portfolio. Available from http://mydocs.epri.com/docs/public/DiscussionPaper2007.pdf

MIT Joint Program on the Science and Policy of Global Change, April 2007. Assessment of U.S. Cap-and-Trade Proposals. Report No. 146.

Pacala, S. and R. Socolow, 2004. "Stabilization Wedges: Solving the Climate Problem for the Next 50 Years with Current Technologies," Science, 13 August 2004, 968–72.

USEPA (U.S. Environmental Protection Agency), 1983. Safe Water Drinking Act, 48 Fed. Reg. 6336, February 11.

Table 2-1
Disturbed Acreage

Project Component	Size	Approx. Linear Length (miles)	ROW Construction	ROW Permanent	Temporary Disturbance (acres)	Permanent Disturbance (acres)
Project Site	453 acres	N/A	N/A	N/A	453	453
Electrical transmission line	Temporary disturbance: 25-foot wide road throughout linear length, plus up to 25-foot-diameter structural base for each of 15 poles. Permanent disturbance: Only the up to 25-foot diameter structural base for each of 15 poles.	2.1	100 feet	100 feet	7	0.17
Natural gas linear	Temporary disturbance: 50 feet wide along linear length, plus 100-foot by 100-foot metering station at the inlet. Permanent disturbance: Only the metering station at the inlet.	13	50 feet	25 feet	79	0.23
BVWSD well field and process water pipeline	Temporary disturbance: 50 feet wide along linear length, plus 50-foot by 50-foot area of disturbance around each of 5 wells. Permanent disturbance: Only the areas around each well.	15	50 feet	25 feet	91.2	0.29
Potable water pipeline	Temporary disturbance: 10 feet wide along linear length. Permanent disturbance: None.	1	10 feet	N/A	1.25	N/A
Railroad spur	Single track railroad. Temporary disturbance: 75 feet wide along linear length, plus 3 acres of laydown area. Permanent disturbance: 60 feet wide along linear length.	5.3	75 feet	60 feet	51.2	38.6

Table 2-1
Disturbed Acreage

Project Component	Size	Approx. Linear Length (miles)	ROW Construction	ROW Permanent	Temporary Disturbance (acres)	Permanent Disturbance (acres)
Temporary Construction Areas	Temporary disturbance: 91 acres in the Controlled Area. Permanent disturbance: None.	N/A	N/A	N/A	91	None
OEHI CO_2 pipeline	Temporary disturbance: 50 feet along linear length, plus 4 entry/exit pits (100-foot by 150-foot each) for HDD, plus two 50-foot by 50-foot valve box areas. Permanent disturbance: Only the two 50-foot by 50-foot valve box areas.	3.4	50 feet	25 feet	22.1	0.11
Total Disturbance					**795.5**	**492.3**

Source: HECA, 2012.

Notes:

BVWSD = Buena Vista Water Storage District

CO_2 = carbon dioxide

N/A = not applicable

ROW = right-of-way

Table 2-2
Site Characteristics

Elevation	Existing site elevation varies slightly from the high point grade elevation of 288 feet above mean sea level.	
Design Ambient Temperature and Humidity	**Dry Bulb (°F)**	**Relative Humidity (percent)**
Average ambient	65	55
Summer design	97	20
Winter	39	82
Extreme minimum ambient	20	85
Extreme maximum ambient	115	15
Design Ambient Barometric Pressure		14.54 psia
Rainfall		
Average Precipitation per year		6.5 inches (avg. 1981–2010)
24-hour Max Precipitation (50-year storm)		2.7 inches
Prevailing Wind Direction and Average Speed		Wind rose

Source: Computed from Annual and Monthly Summaries (year span) of Bakersfield, CA Meteorological Data, NOAA, National Climate Data Center, Asheville, NC.

Notes:

The 25-year, 24-hour maximum precipitation is 2.3 inches

ºF = degrees Fahrenheit

psia = pounds per square inch absolute

Table 2-3
Project Linear Tie-in Location on Plot Plan

Interface Description	Tie-In Location
Communications Conduit	Within other linear facility easements
Process Water Supply	Southwest side of Plot
Potable Water Supply	Northeast side of Plot
Plant Wastewater Discharge	None (ZLDs)
Natural Gas Supply	Southwest side of Plot
Carbon Dioxide Export	Southwest side of Plot
Transmission Line	Northeast side of Plot
Railroad Spur	Northwest corner of Plot

Source: HECA, 2012.

Table 2-4
Typical Analysis for Petcoke

Ultimate Analysis, wt% (dry)	
Carbon	84.4
Hydrogen	4.0
Nitrogen	4.0
Sulfur	6.0
Oxygen	0.6
Ash	1.0
Moisture, wt% (AR)	15.0
Chloride Content, ppmw (dry)	250
Gross Heating Value, Btu/lb (dry)	14,579
Bulk Density, lb/ft^3 (AR)	50
Ash Analysis, ppmw (dry)	
Vanadium	1,200
Nickel	1,200
Iron	1,000
Chromium	10
Sodium	400
Calcium	400

Source: HECA, 2012.

Notes:

% = percent
< = less than
> = greater than
AR = as received
Btu/lb = British thermal units per pound
lb/ft^3 = pounds per cubic feet
ppmw = parts per million by weight
wt% = weight percent

Table 2-5
Typical Analysis of Sub-Bituminous Coal

Ultimate Analysis, wt% (dry)	
Carbon	60.4
Hydrogen	4.5
Nitrogen	1.0
Sulfur	1.09
Oxygen	11.7
Ash	21.3
Moisture, wt% (AR)	14.8
Gross Heating Value, Btu/lb (dry)	10,860
Mercury Content, ppmw (dry whole coal basis)	0.09
Ash Mineral Analysis, wt% (ignited basis)	
Silicon Oxide	59.3
Aluminum Oxide	22.9
Titanium Dioxide	1.0
Sulfur Trioxide	3.4
Calcium Oxide	4.8
Potassium Oxide	1.1
Magnesium Oxide	1.0
Sodium Oxide	0.4
Iron Oxide	5.7
Phosphorous Oxide	0.1
Strontium Oxide	0.1
Barium Oxide	0.2
Manganese Dioxide	< 0.1

Source: HECA, 2012.

Notes:
< = less than
AR = as received (with delivered free moisture)
Btu/lb = British thermal units per pound
ppmw = parts per million by weight
wt% = weight percent

Table 2-6
Typical Natural Gas Composition

Pressure, psig	> 600
Specific Gravity	0.58
Higher Heating Value, Btu/scf	1,022
Composition, mol%	
Methane (CH_4 or C_1)	96.07
Ethane (C_2)	1.9
Propane (C_3)	0.3
iso-Butane (i-C_4)	0.05
normal Butane (n-C_4)	0.05
iso-Pentane (i-C_5)	0.02
normal Pentane (n-C_5)	0.01
Hexanes plus higher carbon compounds (C_6+)	0.03
Carbon Dioxide (CO_2)	1.08
Nitrogen (N_2)	0.46
Total Sulfur	< 0.75 grain/100 scf

Source: HECA, 2012.
Notes:
< = less than
> = greater than
Btu = British thermal units
I = iso
n = normal
psig = pounds per square inch gauge
grains/scf = grains per standard cubic foot

Table 2-7
Electrical Specification

Terminal Point	230-kV Plant Switchyard
Utility Interconnection Location	PG&E 230-kV Switching Station
Line Voltage	230 kV
Frequency	60 Hz
Switchyard	Outdoor Switchyard

Source: HECA.
Notes:
Hz = Hertz
kV = kilovolts

Table 2-8
Sulfur Specifications

Nominal Quantity	100 stpd
Maximum Degassing Capacity	150 stpd
Quality	Commercial Grade Degassed Liquid Sulfur
Degassed H_2S Content	<10 ppmw

Source: HECA, 2012.
Notes:
< = less than
H2S = hydrogen sulfide
ppmw = parts per million by weight
stpd = short tons per day

Table 2-9
Example Composition of Gasification Solids

Determination	Results %
Silicon (SiO_2)	49.43
Aluminum (Al_2O_3)	16.65
Iron (Fe_2O_3)	10.71
Calcium (CaO)	17.43
Magnesium (MgO)	1.50
Sulfur (SO_3)	0.20
Sodium (Na_2O)	0.98
Potassium (K_2O)	1.80
Titanium (TiO_2)	0.78
Phosphorus (P_2O_5)	0.32
Manganese (MnO)	0.20
Carbon (C)	0.00 (below detectable)
Mercury (Hg)	0.00 (below detectable)

Source: HECA, 2012.

Table 2-10
Representative Heat and Material Balances

Operating Case:	Hydrogen-Rich fuel: Maximum Power	Hydrogen-Rich fuel: Maximum Ammonia Production	Natural Gas
Ambient Temperature, °F	97	65 [1]	97
Feeds:			
Feedstock, stpd (AR)	5,800	5,800	0
Feedstock, MMBtu/hr [HHV]	4,710	4,710	0
Natural Gas, MMBtu/hr [HHV]	0	0	2,400
Water, gpm	5,150	4,610	1,450
Products:			
Hydrogen, mmscfd [2]	273	273	0
Ammonia, stpd	1,240	2,000	0
Urea Pastilles, stpd	1,700	1,700	0
Urea Ammonium Nitrate (UAN-32) Solution, stpd	1,400	1,400	0
Carbon Dioxide, stpd	9,200	9,200	0
Sulfur, stpd	100	100	0
Gasification Solids, stpd	850	850	0
Power Balance:			
Combustion Turbine/Steam Turbine, MW	405	295	320
Total Auxiliary Load, MW	138	150	20
CO_2 Compression, MW	40	40	0
AGR with Refrigeration, MW	23	23	0
NH_3 Unit Compression, MW	15	24	0
Other Internal Users, MW	60	63	20
Net Power, MW	267[3]	145	300

Source: HECA, 2012.

Notes:

1 Ambient temperature variations have minimal effect on hydrogen-rich fuel fueled combustion turbine generator output and gasification operation. Results are nearly constant for plant output across the ambient temperature range.

2 Hydrogen contained in the hydrogen-rich fuel used to fuel power generation equipment and production of nitrogen-based products.

3 Based on preliminary net output. Further optimization may result in an output of up to 300 MW.

AGR = Acid Gas Removal
AR = as received
°F = degrees Fahrenheit
gpm = gallons per minute
HHV = higher heating value
IGCC = integrated gasification combined cycle
MMBtu/hr = million British thermal units per hour
mmscfd = million standard cubic feet per day
MW = megawatt
NH_3 = Ammonia
stpd = short tons per day

Table 2-11
Maximum Feeds and Products

Feeds	Maximum Amounts
Feedstock (AR)	5,800 stpd
Water (high ambient)	5,200 gpm
Products	**Maximum Amounts**
Maximum: Normal Low-Carbon Power Maximum Power Capability[1]	 265 MW 300 MW
Carbon Dioxide for EOR	9,200 stpd
Sulfur	150 stpd
Gasification Solids	850 stpd
Ammonia (planned export)	500 stpd
Urea Pastilles	1,700 stpd
Urea Ammonium Nitrate (UAN) Solution	1,500 stpd

Source: HECA, 2012.

Notes:
[1] Maximum power capacity as submitted in the CAISO Interconnection Request
AR = as received
ASU = Air Separation Unit
CAISO = California Independent System Operator
gpm = gallons per minute
MW = megawatt
stpd = short tons per day

Table 2-12
Primary Gasification Reactions

Devolatilization/Pyrolysis = CH_4 + CO + Oils + Tars + C (char)	
$C + O_2 \rightarrow CO_2$	Oxidation – exothermic – rapid
$C + ½ O_2 \rightarrow CO$	Partial oxidation – exothermic – rapid
$C + H_2O \rightarrow CO + H_2$	Water/gas reaction – endothermic – slower than oxidation
$C + CO_2 \rightarrow 2CO$	Boudouard reaction – endothermic – slower than oxidation
$CO + H_2O \rightarrow CO_2 + H_2$	Water gas shift reaction – exothermic – rapid
$CO + H_2 \rightarrow CH_4 + H_2O$	Methanation – exothermic
$C + 2H_2 \rightarrow CH_4$	Direct methanation – exothermic

Source: Multiple publicly available sources.

Notes:
C = carbon
CH_4 = methane
CO = carbon monoxide
CO_2 = carbon dioxide
H_2 = hydrogen
H_2O = water
O_2 = oxygen

Table 2-13
Components of Syngas from Oxygen-Blown Gasification

Constituent	Percent by Volume
Hydrogen	16–33
Carbon monoxide	33–55
Carbon dioxide	1–8
Water	0.1–9
Methane	0–1.5
Hydrogen sulfide	0.3–0.8
Carbonyl sulfide	0–0.1
Nitrogen + Argon	0.3–13
Ammonia + Hydrogen cyanide	0–0.3
Higher Heating Value	~200-300 Btu/scf

Source: HECA, 2012.
Notes:
Btu = British thermal unit
scf = standard cubic foot

Table 2-14
Combustion Turbine Generator

Model	MHI 501GAC®
Fuels	H_2-rich fuel, natural gas (co-firing during transition between natural gas and H_2-rich fuel)
Inlet Air Cooling	Evaporative coolers, 85% effectiveness
Emissions Control Diluent	Nitrogen for H_2-rich fuel, water injection for natural gas
Ambient Temperature Range	20°F to 115°F, average 65°F
Ambient Pressure/Elevation/Elevation	14.54 psia/288’ above msl
Exhaust Pressure Loss at 97ºF	18.0″ H_2O
Air Extraction	Not included
H_2 and Diluent Temperature	302°F at the MHI interface
Base Load Generator Output	282 MW
Exhaust Flow and Temperature	5,315 kpph, 950°F at average ambient
Minimum Output in Emissions Compliance	60 percent of base load on syngas

Source: HECA, 2012.
Notes:
‘ = feet
“ = inches
% = percent
°F = degrees Fahrenheit
H_2 = Hydrogen
H_2O = water
IGV = inlet guide vane
ISO = International Standards Organization standard conditions of 1 atmosphere 59 ºF, and 60 percent relative humidity
kpph = kilopounds per hour (thousands of pounds per hour)
MHI = Mitsubishi Heavy Industries
psia = pounds per square inch absolute
msl = mean sea level

Table 2-15
Hazardous Materials Usage and Storage during Operations
Based on Title 22 Hazardous Characterization[1]

Material	Hazardous Characteristics[2]	Purpose	Storage Location	Maximum Stored	Storage Type
Sodium Hydroxide (Caustic Solution)	Corrosivity Toxicity	Plant Wastewater ZLD, Sour Water Treatment, Demineralizers, Caustic Scrubber, Desuperheater Contact Condenser	Outdoor	150,000 gallons (5 to 50 wt% NaOH)	Carbon steel AST with secondary containment
Spent Caustic	Corrosivity Toxicity	Intermediate storage pending treatment off site	Outdoor	150,000 gal	Carbon steel AST with secondary containment
Degassed Liquid Sulfur	Ignitability, Reactivity	Product	Outdoor	700 tons	One sulfur pit and one AST
Methanol	Ignitability Toxicity	AGR solvent make-up	Outdoor	300,000 gallons	1 × 300,000 gal AST with secondary containment + 250,000 gal contained in process vessels of AGR
Compressed Gases (Ar, He, H_2)	Ignitability	Laboratory Services	Indoor	Minimal	Cylinders of various volumes
Chemical Reagents (acids/bases)	Corrosivity, Reactivity	Laboratory Services	Indoor chemical storage	<5 gallons	Small original containers
Flammable/ Hazardous Gases (H_2, CO, H_2S), Syngas and Hydrogen-Rich Fuel	Ignitability, Toxicity	Intermediate product used for power generation and nitrogen-based product generation	Process piping	In process quantities only, no storage on site	None
Miscellaneous Industrial Gases (Acetylene, Oxygen, Other Welding Gases, Analyzer Calibration Gases)	Ignitability, Toxicity	Maintenance Welding/ Instrumentation Calibration	Gas cylinder Storage in Shop/ shelters	Minimal	Cylinders of various volumes
Natural Gas	Ignitability	Provides fuel service to consumers	Supply piping only	Utility supply on demand via pipeline	None
Diesel Fuel	Ignitability	Emergency generator/ firewater pump fuel	Outdoor	2,000 gallons	ASTs with secondary containment
Sulfuric Acid	Corrosivity, Reactivity, Toxicity	Plant waste water treating, cooling Water, BFW pH control. Demineralizers	Outdoor	14,000 gallons	AST with secondary containment
Paint, Thinners Solvents, Adhesives, etc.	Ignitability, Toxicity	Shop/Warehouse	Indoor chemical storage area	<20 gallons	Small original containers
Boiler Feedwater Chemicals (e.g., Morpholine, Cyclohexamine, Sodium Sulfite)	Corrosivity	Boiler feedwater pH/ corrosion/dissolved oxygen/biocide control	Outdoor chemical storage area	<500 gallons	Small original containers

Table 2-15
Hazardous Materials Usage and Storage during Operations
Based on Title 22 Hazardous Characterization[1]

Material	Hazardous Characteristics[2]	Purpose	Storage Location	Maximum Stored	Storage Type
Hydrogen	Ignitability	STG & CTG generator cooling	Outdoor	30,000 standard cubic feet	Pressurized multi-tube trailer
CTG and HRSG Cleaning Chemicals (e.g., HCl, Citric Acid, EDTA Chelant, Sodium Nitrate)	Toxic, Reactive	HRSG Chemical Cleaning	Stored off site or temporarily on site	Intermittent cleaning requirement Temp storage only	Small original containers
Anhydrous Ammonia (Liquid)	Irritant, Corrosive to skin, eyes, respiratory tract, and mucus membranes	Intermediate, produced in and used in Manufacturing Complex	Outdoor	~10,800 tons (~7 day usage)	Double integrity tanks
Ammonium Nitrate Solution (75-85wt %)	Irritant	Intermediate, produced/used in UAN Plant	Outdoor	54 tons	Contained in process vessels
Nitric Acid (~60wt %)	Corrosivity, Reactivity, Toxicity	Intermediate, produced/used in UAN Plant	Outdoor	2,600 tons (3 days)	AST
UAN Solution	Corrosivity	Plant Product	Outdoor	63,000 tons (45 days of production)	AST

Source: HECA, 2012

Notes:

[1] All numbers are approximate.

[2] Hazardous characteristics identified per California Code of Regulations Title 22 §§66261.20 *et seq*., for hazardous wastes.

% = percent
< = less than
~ = approximately
AGR = acid gas removal
Ar = argon
AST = above-ground storage tank
BFW = boiler feed water
CO = carbon monoxide
CO_2 = carbon dioxide
CTG = combustion turbine generator
EDTA = ethylene diamine tetra-acetic acid
gal = gallons
H_2 = hydrogen
H_2S = hydrogen sulfide
HCl = hydrochloric acid
He = helium
HRSG = heat recovery steam generator
HDPE = high-density polyethylene
SCR = selective catalytic reduction
NaOH = sodium hydroxide
NO_X = nitrogen oxide
STG = steam turbine generator
UAN = urea ammonium nitrate
wt% = percent by weight
ZLD = zero liquid discharge

Table 2-16
Hazardous Materials Usage and Storage during Operations
Based on Material Properties[1]

Material	Potential Hazardous Characteristics[2]	Purpose	Storage Location	Maximum Stored	Storage Type
Sodium Hypochlorite	Corrosivity, Reactivity	Raw Water Treatment and Cooling Tower biological control	Outdoor	7,000 gallons	Polyethylene ASTs with secondary containment
Combustion Turbine Wash Chemicals (specialty detergents and surfactants)	Toxic, Irritants	Combustion Turbine Cleaning	Chemicals are contractor provided and are either not stored on site or are stored only temporarily in a chemical storage area.	Intermittent use/cleaning by contractor	Small original containers
Water Treatment Chemicals	Irritant, Mildly Toxic	Raw water, demineralized water, and cooling water treatment	Indoor chemical storage area	<500 gallons	Drums or ASTs
Oxygen (99.5 %), liquid	Oxidizer	Gasification, SRU	Outdoor	1,200 tons	AST within the ASU
Nitrogen[3]	Asphyxiant	Syngas fuel diluent for NO_X control, Purge gas, Ammonia plant feed, Gasification	Outdoor	100 tons based on 2.5 hr of feed	AST within the ASU
Cooling Water Chemical Additives (e.g., Magnesium Nitrate, Magnesium Chloride)	Mild Irritant, Mildly Toxic	Corrosion Inhibitor/Biocides	Outdoor chemical storage area near each cooling tower	<500 gallons	Small quantities in original containers
Diethylene glycol monobutyl ether (industrial cleaner)	Basic Compound, Toxic, Mild Irritant	Routine cleaning, degreasing, oxygen pipeline cleaning	Indoor	None	Temporary storage as needed provided by contractor
Compressed Carbon Dioxide Gas[3]	Asphyxiant	Generator purging and fire protection	Outdoor	50,000 standard cubic feet for purging	Carbon dioxide, for fire suppression, stored in pressurized cylinders or tank

Table 2-16
Hazardous Materials Usage and Storage during Operations
Based on Material Properties[1]

Material	Potential Hazardous Characteristics[2]	Purpose	Storage Location	Maximum Stored	Storage Type
Propylene Glycol	Mild Irritant	Heat Transfer Fluid		<300 gallons (100 vol. % solution)	4 × ~55 gallon drum or ASTs
Propylene Glycol	Mild Irritant	Heat Transfer Fluid	Closed Loop Cooling System -In process inventory	25,000 gallons (45 vol. % solution)	Contained in process equipment
Sodium Bisulfite	Irritant, Mildly Toxic	Raw Water Treatment	Indoor chemical storage area	<500 gallons	Drums or ASTs
Sodium Phosphate	Irritant, Mildly Toxic	Raw Water Treatment, Plant Wastewater ZLD	Indoor chemical storage area	1,500 gallons	AST with secondary containment
UAN Solution	Corrosivity	Plant Product	Outdoor	63,000 tons (45 day production)	AST

Notes:
[1] All numbers are approximate.
[2] Potential hazardous characteristics based on material properties and potential health hazards associated with those properties.
[3] Nitrogen and carbon dioxide are not hazardous materials but may be asphyxiants under some circumstances.

< = less than
AGR = acid gas removal
Ar = argon
AST = aboveground storage tank
BFW = boiler feed water
CO = carbon monoxide
CTG = combustion turbine generator
CCW = closed cooling water system
EDTA = ethylene diamine tetra-acetic acid
H_2 = hydrogen
H_2S = hydrogen sulfide
HCl = hydrochloric acid
He = helium
HRSG = heat recovery steam generator
HDPE = high density polyethylene
SCR = selective catalytic reduction
NaOH = sodium hydroxide
NO_X = nitrogen oxide
SO_2 = sulfur dioxide
SRU = sulfur recovery unit
STG = steam turbine generator
TGTU = tail gas treating unit
wt% = percent by weight
ZLD = zero liquid discharge

Table 2-17
Summary of Construction Waste Streams and Management Methods[1]

Waste Stream	Waste Classification	Anticipated Maximum Amount	Units	Disposal Method	Estimated Density (lb/CF)	Estimated Density (short tons/CY)	Volume (CY/year)[2]
Used Lube Oils, Flushing Oils	Hazardous	7	55-gallon drums per month	Recycle	N/A	N/A	N/A
Hydrotest Water (One time per commissioning, reuse as practical, test for hazardous characteristics)	Hazardous or Nonhazardous	2,800,000	gallons total	Characterize. Drain nonhazardous to the Retention Basin. Dispose of hazardous at a hazardous waste treatment and disposal facility.	N/A	N/A	N/A
Chemical Cleaning Wastes (Chelates, Mild Acids, TSP, and/or EDTA – During Commissioning)	Hazardous or Nonhazardous Recyclable	525,000	gallons total	Hazardous or nonhazardous waste treatment and disposal facility.	N/A	N/A	N/A
Solvents, Used Oils, Paint, Adhesives, Oily Rags	Cal-Hazardous Recyclable	160	gallons per month	Recycle or hazardous waste treatment and disposal facility.	N/A	N/A	N/A
Spent Welding Materials	Hazardous	300	pounds per month	Dispose at a hazardous waste landfill.	200	3.1	0.69
Used Oil Filters	Hazardous	100	pounds per month	Dispose at a hazardous waste landfill.	50	0.68	0.9
Fluorescent/Mercury Vapor Lamps	Hazardous Recyclable	50	units per year	Recycle	N/A	N/A	N/A
Misc. Oily Rags, Oil Absorbent	Nonhazardous or Hazardous Recyclable	1	55-gallon drum per month	Recycle or dispose at a hazardous waste landfill.	N/A	N/A	3.3
Empty Hazardous Material Containers	Hazardous Recyclable	1	cubic yard per week	Recondition, recycle, or dispose at a hazardous waste landfill.	N/A	N/A	52

Table 2-17
Summary of Construction Waste Streams and Management Methods[1]

Waste Stream	Waste Classification	Anticipated Maximum Amount	Units	Disposal Method	Estimated Density (lb/CF)	Estimated Density (short tons/CY)	Volume (CY/year)[2]
Used Lead/Acid and Alkaline Batteries	Hazardous Recyclable	1.2	ton per year	Recycle	N/A	N/A	N/A
Sanitary Waste from Workforce (Portable Chemical Toilets)	Nonhazardous	450	gallons per day	Pump and dispose by sanitary waste contractor.	N/A	N/A	N/A
Site Clearing – Grubbing, Excavation of Non-Suitable Soils, Misc. Debris	Nonhazardous	Minimal	N/A	Reuse Soils or dispose at a nonhazardous waste landfill (see Section 2.7.1 — Project Site Construction — of this AFC Amendment).	N/A	N/A	N/A
Scrap Materials, Debris, Trash (Wood, Metal, Plastic, Paper, Packing, Office Waste, etc.)	Nonhazardous	60	cubic yards per week	Recycle or dispose at a nonhazardous waste landfill.	N/A	N/A	3,120
					Total Annual Cubic Yards:		**3,177**

Source: HECA, 2012.
Notes:
[1] All Numbers are estimates.
[2] Volumetric quantities shown for wastes expected to be disposed in nonhazardous or hazardous waste landfills. Volumetric quantities are not shown for wastes that are expected to be recycled or treated and disposed by means other than landfill.
CF = cubic feet
CTG = combustion turbine generator
CY = cubic yards
EDTA = ethylene diamine tetra-acetic acid
lb = pounds
N/A = not applicable (due to waste not being landfilled)
STG = steam turbine generator
TSP = trisodium phosphate

Table 2-18
Summary of Operating Waste Streams and Management Methods[1]

Waste Stream	Waste Classification	Anticipated Maximum Amount/year	Units	Disposal Method	Density (lb/CF)	Density (short tons/CY)	Volume (CY/year)[2]
Spent Claus Sulfur Recovery Catalyst (Activated Alumina)	Nonhazardous	7	tons	Dispose at a nonhazardous waste landfill.	40	0.54	4
Claus Catalyst Support Balls (Activated Alumina)	Nonhazardous	1	ton	Recycle or Dispose at a nonhazardous waste landfill.	40	0.54	1
Spent Sour Shift Catalyst (Cobalt Molybdenum)	California Hazardous	30	tons	Send to reclaimer for metals recovery.	40.6	0.548	56
Spent Titania (TiO_2)	Nonhazardous	10	tons	Dispose at a nonhazardous waste landfill.	57.0	.77	4
Spent Hydrogenation Catalyst (Cobalt Molybdenum)	California Hazardous	10	tons	Send to reclaimer for metals recovery.	41	0.55	3
Hydrogenation Catalyst Support Balls (Alumina Silicate)	Nonhazardous	1	ton	Recycle or Dispose at a nonhazardous waste landfill.	81.0	1.09	1
Spent SCR Catalyst (Titanium, vanadium, tungsten, combustion contaminants, and inert ceramics)	Hazardous	1,600	cu ft	Return to supplier to reclaim/dispose.	N/A	N/A	N/A
Spent CO/VOC oxidation catalyst (Noble metals, other inerts, and combustion contaminants)	Nonhazardous	600	cu ft	Send to reclaimer for noble metals recovery.	N/A	N/A	N/A
Spent Mercury Removal Carbon Beds (Impregnated activated carbon)	Hazardous	3	tons	Stabilize and dispose at a hazardous waste landfill.	35.6	0.481	6

Table 2-18
Summary of Operating Waste Streams and Management Methods[1]

Waste Stream	Waste Classification	Anticipated Maximum Amount/year	Units	Disposal Method	Density (lb/CF)	Density (short tons/CY)	Volume (CY/year)[2]
Plant Wastewater ZLD Solids (Inorganic and organic salts)	Anticipated Nonhazardous	15,000	tons	Stabilize and Characterize for landfill disposal.	78.2	1.056	14,209
CO2 Purification Catalyst for COS Removal (activated Alumina)	Hazardous	300	cu ft	Stabilize and dispose at a hazardous waste landfill.	46	0.62	11.1
CO2 Purification Catalyst for H2S Removal (Zinc Oxide)	Hazardous	1200	cu ft	Stabilize and dispose at a hazardous waste landfill.	76.8	1.04	44.4
Ammonia Synthesis Catalyst iron-oxide based	Non-Hazardous	2500	cu ft	Dispose at a nonhazardous waste landfill.	170	23	92.6
Spent Urea Unit platinum-based catalyst for CO_2 Dehydrogeneration	Non-Hazardous	10	cu ft	Send to reclaimer for metals recovery.	N/A	N/A	N/A
Spent Nitric Acid Plant platinum-based catalyst	Non-Hazardous	250	lbs	Send to reclaimer for metals recovery.	N/A	N/A	N/A
Spent N_2O and NO_X decomposition catalyst SCR-type	Hazardous	150	cu ft	Return to supplier to reclaim/dispose.	N/A	N/A	N/A
Spent PSA Adsorbent	Hazardous	50	tons	Stabilize and dispose at a hazardous waste landfill.	18.2	0.25	204
Sour Water System Solids	Hazardous	30	tons	Dispose at an incinerator or hazardous waste landfill.	125	1.7	17.8

Table 2-18
Summary of Operating Waste Streams and Management Methods[1]

Waste Stream	Waste Classification	Anticipated Maximum Amount/year	Units	Disposal Method	Density (lb/CF)	Density (short tons/CY)	Volume (CY/year)[2]
Spent Caustic	Hazardous	400,000	gal	Off-site treatment to oxidize sulfides to sulfates. Adjust pH and dispose as nonhazardous.	N/A	N/A	N/A
Off-Line Combustion Turbine Wash Wastes (Detergents and residues)	Hazardous or Nonhazardous	15,000	gal	Characterize and dispose as nonhazardous or treat and dispose as hazardous waste.	N/A	N/A	N/A
HRSG Wash Water (Infrequent) (Detergent, residues, neutralized acids)	Hazardous or Nonhazardous	100,000	gal	Characterize and dispose as nonhazardous or treat and dispose as hazardous waste	N/A	N/A	N/A
Water Softener Solids and Used Water Filter Media	Nonhazardous	90	ton	Characterize and dispose as nonhazardous or hazardous waste.	40.0	0.540	167
Used Oil	Hazardous	8,000	gal	Recycle.	N/A	N/A	N/A
Spent Grease	Hazardous	20	55-gallon drums	Characterize and dispose as hazardous waste.	N/A	N/A	N/A
Miscellaneous Filters and Cartridges	Hazardous or Nonhazardous	150	cu yd	Characterize and dispose as nonhazardous or hazardous waste.	N/A	N/A	150
Miscellaneous Solvents	Hazardous	2	55-gallon drums	Recycle or treatment and disposal as hazardous waste.	N/A	N/A	N/A
Flammable Lab Waste	Hazardous	2	55-gallon drums	Characterize and recycle or treat and dispose as hazardous waste.	N/A	N/A	N/A

Table 2-18
Summary of Operating Waste Streams and Management Methods[1]

Waste Stream	Waste Classification	Anticipated Maximum Amount/year	Units	Disposal Method	Density (lb/CF)	Density (short tons/CY)	Volume (CY/year)[2]
Waste Paper and Cardboard	Nonhazardous	300	cu ft	Recycle	N/A	N/A	N/A
Combined Industrial Waste (Used PPE, materials, small amounts of refractory, slurry debris, etc.)	Nonhazardous	300	cu yd	Dispose at a nonhazardous waste landfill.	N/A	N/A	12
Gasification solids (Vitrified Ash) Dry Basis	Anticipated to be Nonhazardous or covered by regulatory exclusion	277,000	tons	Reuse, reclaim sellable metals, or characterize for landfill disposal.	82.5	1.114	246,016
				Total Cubic Yards w/o Gasifier Solids			**14,983**

Source: HECA, 2012.

Notes:

[1] All numbers are estimates.

[2] Volumetric quantities shown for wastes expected to be disposed in nonhazardous or hazardous waste landfills. Volumetric quantities are not shown for wastes that are expected to be recycled or treated and disposed by means other than landfill.

CF = cubic feet
CO = carbon monoxide
COS = carbonyl sulfide
cu ft = cubic feet
CY = cubic yards
HRSG = heat recovery steam generator
lb = pound
LORS = laws, ordinances, regulations, and standards
N/A = not applicable
PPE = personal protective equipment
PSA = Pressure Swing Adsorption
SCR = selective catalytic reduction
TiO2 = Titania
TGTU = tail gas treating unit
VOC = volatile organic compounds
ZLD = zero liquid discharge

Table 2-19
Maximum Fuel Energy

Maximum Heat Input	Units	Hydrogen-Rich Fuel	Natural Gas
Combustion Turbine	MMBtu/hr (HHV)	2,583	2,401
Duct Burner	MMBtu/hr (HHV)	360	0

Source: HECA, 2012.
Notes:
The maximum hydrogen-rich fuel input values for the CTG fuel and the HRSG duct burner do not occur at the same ambient temperature.
HHV = higher heating value
MMBtu/hr = million British thermal units per hour

Table 2-20
HECA Total Combined Annual Criteria Pollutant Emissions[1]

Equipment \ Pollutant	NO_X	CO	VOC	SO_2	PM_{10}	$PM_{2.5}$
	tons/year					
HRSG/CTG	109.7	92.9	15.3	17.1	54.6	54.6
Coal Dryer	17.4	13.3	2.4	2.8	5.6	5.6
Auxiliary Boiler	1.4	8.6	0.9	0.5	1.2	1.2
Tail Gas Thermal Oxidizer	13.4	11.2	0.3	8.3	0.4	0.4
CO_2 Vent	—	124.1	2.8	—	—	—
Gasification Flare	3.2	18.5	0.01	0.02	0.03	0.03
Rectisol® Flare	1.2	0.8	0.01	0.3	0.03	0.03
SRU Flare	0.2	0.2	0.003	0.4	0.006	0.006
Cooling Towers[2]	—	—	—	—	25.5	15.3
Emergency Generators[3]	0.2	0.8	0.1	0.001	0.02	0.02
Firewater Pump	0.09	0.2	0.01	0.0003	0.001	0.001
Nitric Acid Unit	17	—	—	—	—	—
Urea Pastillation Unit	—	—	—	—	0.2	0.2
Ammonium Nitrate Unit	—	—	—	—	0.8	0.8
Ammonia Start-Up Heater	0.04	0.1	0.02	0.01	0.02	0.02
Material Handling[4]	—	—	—	—	1.9	1.9
Fugitives	—	4.6	13.4	—	—	—
Total Annual	**163.7**	**275.2**	**35.4**	**29.4**	**90.3**	**80.2**

Source: HECA, 2012.
Notes:
1 The emissions represent the maximum annual emissions during operations plus start-up and shut-down emissions
2 Includes contributions from all three cooling towers
3 Includes contributions from both emergency generators
4 Material handling emissions are shown as the contribution of all dust collection points.
— = not applicable
HRSG = Heat Recovery Steam Generator
CTG = combustion turbine generator
CO = carbon monoxide
NO_X = nitrogen oxides
PM_{10}= particulate matter less than 10 microns in diameter
$PM_{2.5}$ =particulate matter less than 2.5 microns in diameter ($PM_{2.5}$ is assumed to equal PM_{10})
SO_2 = sulfur dioxide
VOC = volatile organic compound

Table 2-21
Material Delivery

Material	Mode	Distribution Point	Maximum Delivery Rate
Petcoke	Truck	Santa Barbara County/Los Angeles County	55/day
Coal	Rail[1]	Various Western mines	2 unit trains/day[3]
	Truck[2]	Transloading terminal in Wasco	244/day[4]
Miscellaneous (e.g., chemicals, equipment maintenance, etc.)	Truck	Various[5]	5/day

Source: HECA 2012.
Notes:
[1] Only rail delivery of coal occurs during Alternative 1.
[2] Only truck delivery of coal occurs during Alternative 2.
[3] Average delivery rate is 2.1 unit trains per week.
[4] Average delivery rate is 183 trucks per day.
[5] Materials will be purchased in Kern County, as practical.
The same number of petcoke and miscellaneous trucks are expected during either Alternative 1 or 2.

Table 2-22
Estimated Construction Water Use

Activity	Estimated Daily Average Use by Construction Phase (gpd)	Estimated Construction Phase Duration (months)	Daily Average Over Construction Period (gpd)	Estimated Water Use (acre-feet)	
				12-Month Period Maximum Use	Monthly Average Over Construction Period
Project Site (453 acres)					
Early Works • Initial Grading of Entire Site • Dust Control	24,000	2	11,800[1]	12	10
Site Preparation • Underground • Excavation/Backfill/Compaction • Dust Control	14,000	5			
Ongoing Day-to-Day Construction • Foundations • Backfill • Compaction • Dust Control • Road Cleaning	12,000	26			
Finishing Stage • Finish Grading and Paving • Landscaping • Construction Cleanup • Demobilization Dust Control	8,000	4			
Hydrotest – Plant Equipment and Piping	5,600	5			
Linear Construction					
Trenching	900	6	2,000	1.5	N/A
Horizontal Directional Drilling	2,300	3			
Hydrotest – Linears	2,000	6			

Notes:
[1] Daily average use after the first 12 months of construction, including construction of linears is estimated at 10,000 gpd.
gpd = gallons per day
N/A = not applicable

Table 2-23
Hazardous Materials Usage and Storage during Construction
Based on Title 22 Hazardous Characterization[1]

Material	Hazardous Characteristics[2]	Purpose	Storage Location	Maximum Stored	Storage Type
Diesel Fuel	Ignitability, Toxicity	Refueling Construction Vehicles and Equipment	Laydown Area	4,000 gallons	Tank
Acetylene, Oxygen, Other Welding Gases	Ignitability	Maintenance Welding	Temporary Gas Cylinder Storage Area	2,000 standard cubic feet	Cylinders of various volumes
Lead/Acid and Alkaline batteries	Corrosivity, Toxicity	Power for Equipment	Warehouse/ shop area	<50 units	Unit
Paints, Solvents, Adhesives, etc.	Toxicity, Ignitability	Painting and Paint Removal, general construction activities	Temporary Chemical Storage Area	300 gallons/ week	Drum
Gasoline	Ignitability, Toxicity	Refueling Construction Vehicles and Equipment	Warehouse/ Shop Area	4,000 gallons/week	Tank

Source: HECA, 2012.
Notes:
< = less than
[1] All numbers are approximate.
[2] Hazardous characteristics identified per California Code of Regulations Title 22 § 66261.20 *et seq*., for hazardous wastes.

Table 2-24
Hazardous Materials Usage and Storage during Construction
Based on Material Properties[1]

Material	Potential Hazardous Characteristics[2]	Purpose	Storage Location	Maximum Stored	Storage Type
Lubricating Oil	Mildly Toxic	Lubricating Equipment Parts	Laydown area	400 gallons	Tanks/ Drums
Cleaning Chemicals/ Detergents	Toxic, Irritant	Periodic Cleaning	Contained in storage tanks on equipment skids	1,000 pounds	Tanks and containers or equipment

Source: HECA, 2012.
Notes:
[1] All numbers are approximate.
[2] Potential hazardous characteristics based on material properties.

Rev. 5

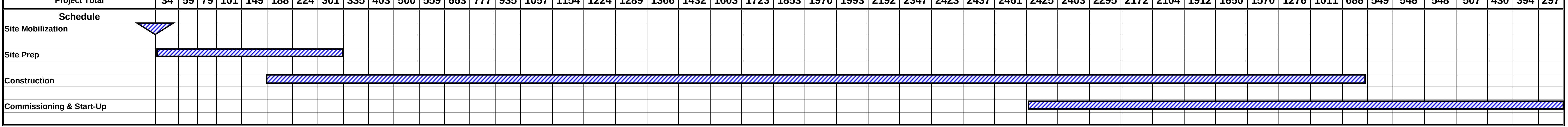
4/11/2012

Table 2-25
Preliminary Estimate of Monthly Construction Labor Power By Craft

FLUOR®

	Months after Construction Mobilization																							
Job Category	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**
CRAFT																								
Boilermakers													6	6	6	14	14	20	20	30	30	40	60	80
Carpenters		4	4	8	10	14	18	24	30	50	50	60	70	90	100	120	140	140	140	150	150	160	160	180
Cement Finishers								6	6	6	6	6	20	20	20	20	20	20	20	15	15	15	15	15
Electricians		4	4	8	8	10	12	16	18	20	20	30	40	60	60	80	90	90	100	100	120	120	140	140
Insulation Workers									10	10	10	10	10	10	10	10	20	20	20	30	30	30	40	40
Iron Workers		2	2	4	6	10	10	20	20	30	30	40	40	40	60	60	80	100	120	140	160	180	200	220
Laborers		11	13	22	45	54	60	71	68	60	61	66	83	133	149	138	138	143	143	131	131	155	155	155
Millwrights						2	2	2	2	2	4	4	6	6	6	10	10	14	20	26	40	60	80	80
Operators	16	16	20	20	30	30	30	40	40	50	50	50	60	60	60	70	70	80	80	90	90	110	120	140
Painters			2	2	2	2	2	4	4	4	4	4	4	6	6	6	8	8	8	10	10	16	16	16
Pipefitters		2	2	4	10	20	30	40	50	70	90	110	120	120	200	240	260	280	300	320	340	380	420	460
Sheet Metal Workers														4	4	6	6	8	8	10	10	10	10	10
Teamsters																								
Off plot Construction craft [2]											26	26	44	44	44	54	54	39	39	40	26	26		
Craft Subtotal	**16**	**39**	**47**	**68**	**111**	**142**	**164**	**223**	**248**	**302**	**351**	**406**	**503**	**599**	**725**	**828**	**910**	**962**	**1018**	**1092**	**1152**	**1302**	**1416**	**1536**
STAFF																								
Management	10	10	20	20	20	20	30	40	40	50	90	90	90	100	110	120	127	139	140	140	140	140	140	140
Engineering	2	2	2	2	2	4	4	6	10	10	10	10	10	12	14	15	15	15	15	15	15	15	15	15
Document Control	2	2	2	2	2	2	4	4	5	5	5	5	6	6	6	6	6	6	6	6	6	6	6	6
Subcontractors Staff	4	6	8	10	14	20	22	28	32	36	40	44	48	54	74	82	90	96	104	108	116	136	146	156
Off plot construction staf [f 2]											4	4	6	6	6	6	6	6	6	5	4	4		
Commissioning (by Owner)																								
Admin / Operating Staff (Owner)																								
Staff Subtotal	**18**	**20**	**32**	**34**	**38**	**46**	**60**	**78**	**87**	**101**	**149**	**153**	**160**	**178**	**210**	**229**	**244**	**262**	**271**	**274**	**281**	**301**	**307**	**317**
Project Total	**34**	**59**	**79**	**101**	**149**	**188**	**224**	**301**	**335**	**403**	**500**	**559**	**663**	**777**	**935**	**1057**	**1154**	**1224**	**1289**	**1366**	**1432**	**1603**	**1723**	**1853**

	Months after Construction Mobilization																								
Job Category	**25**	**26**	**27**	**28**	**29**	**30**	**31**	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**	**41**	**42**	**43**	**44**	**45**	**46**	**47**	**48**	**49**
CRAFT																									
Boilermakers	100	120	120	140	140	140	140	120	120	100	80	80	60	60	40	40	20	20	10	10	10	10	10	6	6
Carpenters	180	180	200	200	210	210	220	220	200	200	200	180	160	140	100	100	50	50	50	50	50	50	40	40	20
Cement Finishers	15	15	15	10	10	10	10	10	10	10	8	8	8	8	8	4	4	4							
Electricians	160	160	180	220	240	280	300	340	360	400	400	400	400	350	300	250	200	100	100	100	100	50	50	50	20
Insulation Workers	40	40	40	40	50	50	60	60	80	80	100	120	140	160	180	220	220	150	50	50	50	50	50	30	20
Iron Workers	240	260	260	280	280	260	240	200	180	140	100	80	60	40	30	20	20	10	10	10	10	6	6	4	4
Laborers	138	115	115	115	104	76	76	54	54	54	52	49	40	40	30	30	20	20	20	20	20	20	20	10	10
Millwrights	100	40	120	120	100	80	80	80	80	80	80	60	60	60	60	40	30	20	20	20	20	20	20	10	10
Operators	140	160	160	180	200	200	200	160	160	140	120	100	100	100	80	60	40	40	20	20	20	20	10	10	5
Painters	20	20	20	26	26	26	30	30	40	40	50	50	40	40	30	30	20	10	10	10	10	10	5	5	3
Pipefitters	500	540	600	640	680	720	720	720	700	660	600	600	500	500	400	200	150	50	50	50	50	50	30	20	10
Sheet Metal Workers	10	12	12	12	12	14	14	14	14	14	12	12	12	8	8	6	4	4	4	4	4	4	2	2	2
Teamsters																									
Off plot Construction craft [2]																									
Craft Subtotal	**1643**	**1662**	**1842**	**1983**	**2052**	**2066**	**2090**	**2008**	**1998**	**1918**	**1802**	**1739**	**1580**	**1506**	**1266**	**1000**	**778**	**478**	**344**	**344**	**344**	**290**	**243**	**187**	**110**
STAFF																									
Management	140	140	140	140	140	140	140	140	130	100	95	90	80	80	60	60	50	30	30	30	30	30	20	20	10
Engineering	15	15	15	15	15	15	15	15	15	15	15	15	10	10	10	10	5	5	5	5	5	5	5	5	5
Document Control	6	6	6	6	6	6	6	6	6	6	6	6	6	5	5	5	5	4	3	2	2	2	2	2	2
Subcontractors Staff	166	170	188	202	210	210	210	206	204	196	184	174	156	144	124	96	68	44	40	40	40	40	20	20	10
Off plot construction staf [f 2]																									
Commissioning (by Owner)								10	10	20	20	30	30	30	30	30	30	40	40	40	40	30	20	20	20
Admin / Operating Staff (Owner)								40	40	40	50	50	50	75	75	75	75	87	87	87	87	110	120	140	140
Staff Subtotal	**327**	**331**	**349**	**363**	**371**	**371**	**371**	**417**	**405**	**377**	**370**	**365**	**332**	**344**	**304**	**276**	**233**	**210**	**205**	**204**	**204**	**217**	**187**	**207**	**187**
Project Total	**1970**	**1993**	**2192**	**2347**	**2423**	**2437**	**2461**	**2425**	**2403**	**2295**	**2172**	**2104**	**1912**	**1850**	**1570**	**1276**	**1011**	**688**	**549**	**548**	**548**	**507**	**430**	**394**	**297**



Notes:

(1) These are approximate values

(2) Off plot includes preliminary estimates for work that may be performed outside of the plot (plot linears, facility upgrades, site interfaces, rail spur, etc.)

4/11/2012

Rev. 3

Table 2-26
Construction Equipment Estimate

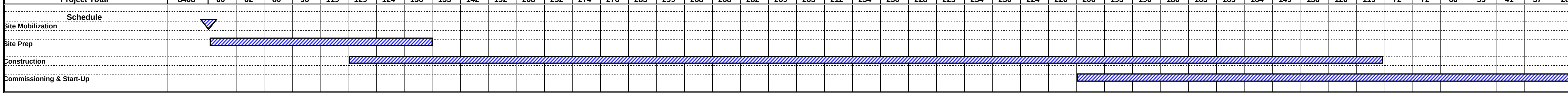
Units Use Per Month (months 1–25)

Equipment	Number of Units	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Truck Crane - Greater than 300 ton	34															1	1	1	1	1	2	2	2	3	3	3
Truck Crane - Greater than 200 ton	68												1	1	1	1	1	2	2	3	3	4	4	4	4	4
Heavy Haul / 600 tn Crane	9																		1	1	1	1	1	1	1	1
Heavy Haul / 1,000 tn Crane	6																				1	1	1	1	1	1
Cranes 100 / 150 ton cap	70											1	1	2	2	3	3	4	4	4	4	4	4	4	4	4
Crane - Mobile 65 ton	126												1	1	2	4	5	5	5	6	6	6	6	6	6	6
Cranes - Mobile 45 ton	84											2	2	2	2	2	2	2	2	4	4	4	4	4	4	4
Cranes - Mobile 35 ton	176							1	1	1	4	4	4	4	7	7	7	7	7	7	7	7	7	7	7	7
Bulldozer D10R	23	3	3	3	2	2	2	2	2	2	1	1														
Bulldozer D6C	33	3	3	3	3	2	2	2	2	2	2	1	1	1	1	1										
Excavator - Trencher (CAT320)	22						2	2	2	2	2	2	2	2	2	2	2									
Excavator - Earth Scraper 637	38	7	7	7	7	4	4	2																		
Excavator - Motor Grader (CAT140H)	24		1	1	1	3	3																			
Excavator - Backhoe/loader	68	2	2	3	4	4	4	4	4	4	4	4	2	2	2	2	2	1	1	1	1	1	1	1	1	
Excavator - loader	33	2	2	2	2	2	2	2	2	2	2	2	2	1	1											
Bob cat loader	62			1	1	1	1	1	4	4	4	4	4	3	3	3	3	3	3	2	2	2	2	2	2	
Vibratory Roller Ingersol-Rand 20 ton	53	3	3	3	3	3	3	3	3	3	2	2	2	2	2	1	1	1	1							
Portable Compaction Roller	82			5	5	5	5	5	5	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	
Truck - Water	127	5	5	5	5	5	5	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	2	3
Forklift	285	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	8	8	8	8	8	8	8	8	8
Dump Truck	76	3	4	4	3	3	3	3	3	3	3	2	2	2	2	2										
Service Truck - 1 ton	99	2	2	2	4	4	4	4	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Truck - Fuel/Lube	85	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Concrete Pumper Truck	39						2	2	2	2	2	2	2	2	3	3	3	2	2	2	2	2				
18 cy fill mat'l haul truck	185			10	10	20	20	20	20	10	10	10	10	5	5	5	5	5	5							
Trucks - Pickup 3/4 ton	931	5	5	5	5	5	6	7	8	15	15	15	15	25	25	25	25	25	25	25	25	25	25	25	25	25
Trucks - 3 ton	185	1	1	1	1	1	2	2	2	4	4	4	4	6	6	6	6	6	6	6	6	6	6	6	6	6
Diesel Tractor (Yard Dog)	236						2	2	2	2	2	2	4	4	4	4	4	8	8	8	8	8	8	8	10	10
Bus	365	2	2	2	2	3	3	3	3	3	3	5	5	5	5	5	5	7	7	7	10	10	10	10	14	14
Diesel Powered Welder	643				10	10	10	10	10	10	10	10	10	10	10	10	10	15	15	15	20	20	20	20	25	25
Light Plants	433	1	1	2	4	8	8	8	8	4	4	6	6	8	8	10	10	14	14	14	14	14	14	14	14	14
Portable Compaction - Vibratory Plate	126								6	6	6	6	6	6	6	6	6	6	6	6	6	6	6			
Man lifts - telescoping	506									5	5	5	10	10	10	10	10	10	10	15	15	15	15	15	20	20
Man lift - scissor	540								5	5	5	5	10	10	10	10	10	10	10	15	15	15	15	15	20	20
Pumps	182	3	3	3	6	6	6	6	6	6	6	6	6	6	6	6	6	6	3	3	3	3	3	3	3	3
Air Compressor 185 CFM	327	2	2	2	2	3	3	3	3	3	3	3	3	3	6	6	6	8	8	8	10	10	10	10	12	12
Air Compressor 750 CFM	98					1	1	1	1	2	2	2	2	2	2	2	4	4	4	4	4	4	4	4	4	4
Concrete Vibrators	140	4	4	4	4	4	4	4	4	4	8	8	8	8	8	8	8	8	4	4	4	2	2	2	2	2
Concrete Trowel Machine	58						2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Fusion Welder	83					2	2	2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Portable Power Generators	608	4	4	4	4	6	6	6	6	6	10	10	10	10	10	10	15	15	15	15	15	15	15	20	20	20
Fired Heaters (2,000 BTU)	166					4	4	4	4	3	3	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
Misc equip for off plot construction (2)	874											43	48	84	98	96	93	97	72	70	67	55	51			
Project Total	**8408**	**60**	**62**	**80**	**96**	**119**	**129**	**124**	**136**	**133**	**142**	**192**	**208**	**252**	**274**	**276**	**283**	**299**	**268**	**268**	**282**	**269**	**263**	**212**	**234**	**230**

Units Use Per Month (months 26–49)

Equipment	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49
Truck Crane - Greater than 300 ton	3	3	3	3	2																			
Truck Crane - Greater than 200 ton	4	4	4	4	3	3	2	2	2	1	1	1	1	1										
Heavy Haul / 600 tn Crane	1																							
Heavy Haul / 1,000 tn Crane																								
Cranes 100 / 150 ton cap	4	4	4	2	2	1	1	1	1	1	1													
Crane - Mobile 65 ton	6	6	6	6	6	5	5	4	2	2	2	2	2	1	1	1	1	1	1	1				
Cranes - Mobile 45 ton	4	4	4	4	2	2	2	2	2	2	2	2	2	2	2	1	1							
Cranes - Mobile 35 ton	7	5	5	5	5	5	5	5	5	2	2	2	2	2	2	2	2	2	2	2	1	1	1	1
Bulldozer D10R																								
Bulldozer D6C			1	1	1	1																		
Excavator - Trencher (CAT320)																								
Excavator - Earth Scraper 637																								
Excavator - Motor Grader (CAT140H)			1	1	1	1					2	2	2	2	1	1	1							
Excavator - Backhoe/loader											2	2	2	2	1	1	1							
Excavator - loader			1	1	1	1							1	1	1									
Bob cat loader											1	1	1	1	1	1	1							
Vibratory Roller Ingersol-Rand 20 ton			2	2	2	2							1	1	1	1								
Portable Compaction Roller				2	2	2	2	2	2				2	2	2	1	1							
Truck - Water	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	1	1	1	1	1	1	1
Forklift	8	8	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	2	2	2	2	1	1	1
Dump Truck			2	2	2	2	2	2	2	2	2	3	3	3	2	1	1	1	1	1				
Service Truck - 1 ton	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	1	1	1	1	1	1	1
Truck - Fuel/Lube	2	2	2	2	2	2	2	2	2	2	2	2	2	2	1	1	1	1	1	1	1			
Concrete Pumper Truck			1	1	1	1																		
18 cy fill mat'l haul truck											3	3	3	3	1	1	1							
Trucks - Pickup 3/4 ton	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	15	15	10	10	10	10	5
Trucks - 3 ton	6	6	6	6	6	6	6	6	6	4	3	3	3	3	2	2	2	1	1	1	1			
Diesel Tractor (Yard Dog)	10	10	10	10	10	10	10	10	10	10	4	4	4	4	4	4	4							
Bus	14	14	14	14	14	14	14	14	14	14	12	12	12	10	10	5	5	3	3	2	2	2	1	1
Diesel Powered Welder	25	25	25	25	25	25	15	15	15	15	15	15	10	10	10	10	10	5	5	5	5	3	3	2
Light Plants	14	14	14	14	14	14	10	10	10	10	10	10	10	10	10	5	5	5	5	5	4	4	2	2
Portable Compaction - Vibratory Plate			3	3	3	3					4	4	4	4	4	2	2							
Man lifts - telescoping	20	20	20	20	20	20	20	20	20	20	15	15	15	10	10	10	10	5	5	5	5	2	2	2
Man lift - scissor	20	20	20	20	20	20	20	20	20	20	15	15	15	10	10	10	10	10	10	10	10	5	5	5
Pumps	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	2	2	2	2	2	2	2
Air Compressor 185 CFM	12	12	12	12	12	12	12	12	12	12	8	8	8	6	6	6	6	4	4	4	2	2	1	1
Air Compressor 750 CFM	4	4	4	4	4	2	2	2	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Concrete Vibrators	2	2	2	2	2	2	2	2	2															
Concrete Trowel Machine	2	2	2	2								2	2	2	2	2	2							
Fusion Welder	3	3	3	1	1	1	1	1	1	1	1	1	1	1	1	1	1							
Portable Power Generators	20	20	20	20	20	20	20	20	20	20	15	15	15	15	10	10	10	10	10	10	5	5	5	2
Fired Heaters (2,000 BTU)	5	5	5	5	5	5	5	3	3	3	2	2	2	2	2	2	2	2	2	2	2	1	1	1
Misc equip for off plot construction (2)																								
Project Total	**228**	**225**	**234**	**230**	**224**	**220**	**206**	**193**	**190**	**180**	**163**	**165**	**164**	**149**	**136**	**120**	**119**	**72**	**72**	**66**	**55**	**41**	**37**	**28**

Schedule



Notes:

1 These are approximate values

2 Misc. equip for off plot include preliminary estimates for work performed outside of the plot (pipe and transmission lines, and rail road spur).

- Major Cities
- Major Highways
- State Boundaries
- County Boundaries

N

0 20 40 MILES

PROJECT VICINITY

April 2012
28068052

Hydrogen Energy California (HECA)
Kern County, California

URS

FIGURE 2-1

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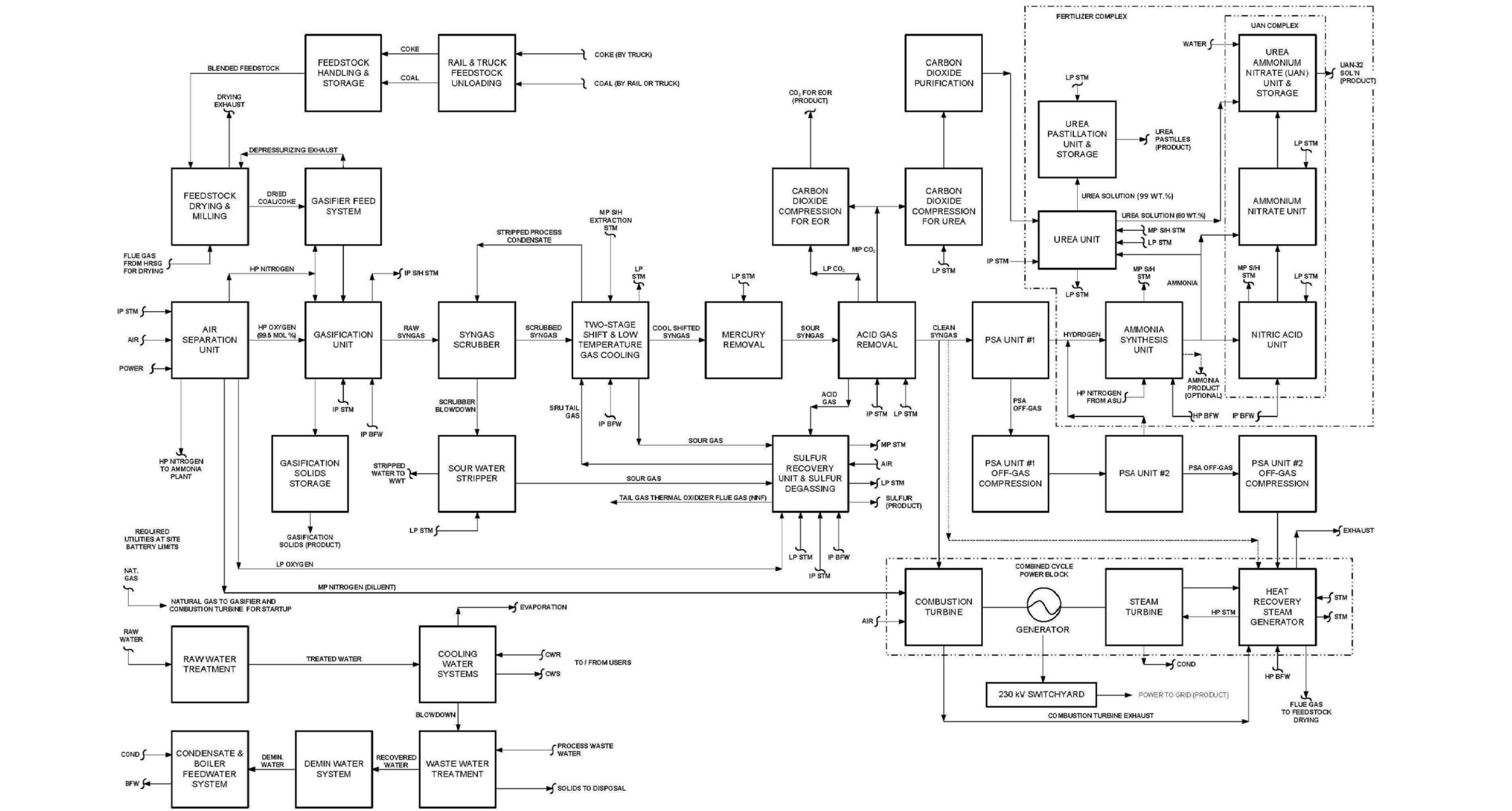
PROJECT SITE: PROJECT RENDERING

April 2012
28068052

Hydrogen Energy California (HECA)
Kern County, California

URS

FIGURE 2-2



OVERALL BLOCK FLOW DIAGRAM

April 2012
28068052

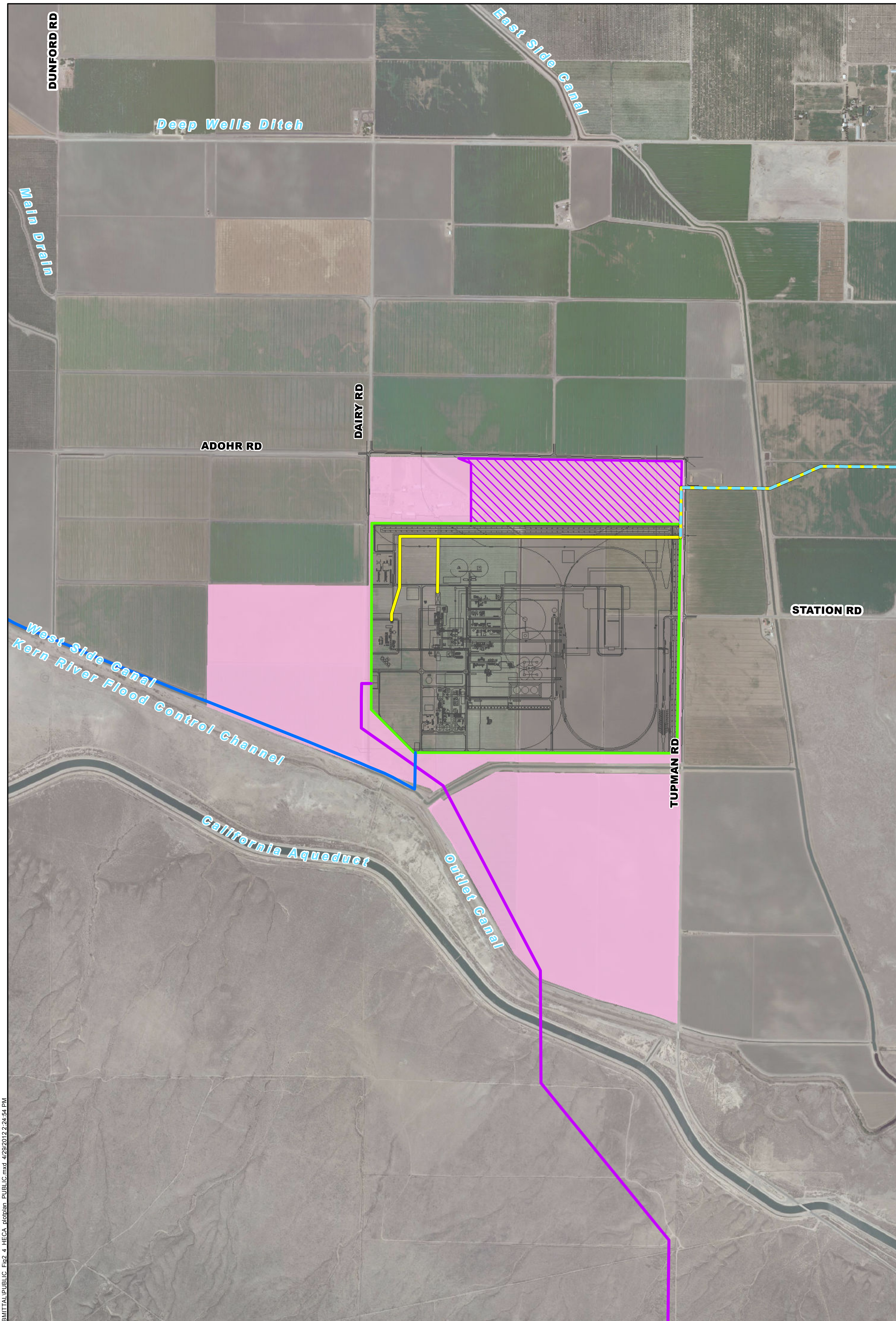
Hydrogen Energy California (HECA)
Kern County, California

URS

FIGURE 2-3

Source:
Fluor; HECA-SCS, 2012 AFC Update; Overall Block Flow Diagram;
Drawing No: A4UV-000-25-BFD-0001, Rev. 1 (3/29/12)

4/17/12 vsa..T:\HECA-SCS 2012\GRAPHICS 2012\2.0_Proj Description\2-3_overall_block_flow.ai



Project Site
Construction Staging Area
Controlled Area
Truck Turnaround[1]
Carbon Dioxide
Natural Gas[1]
Potable Water
Process Water
Railroad[1]
Transmission

Note:
1. Feature temporarily designated as confidential

N

0 750 1,500 FEET

SITE PLAN

April 2012
28068052

Hydrogen Energy California (HECA)
Kern County, California

URS

FIGURE 2-4

Source: Aerial Photo, Digital Globe, 2008.

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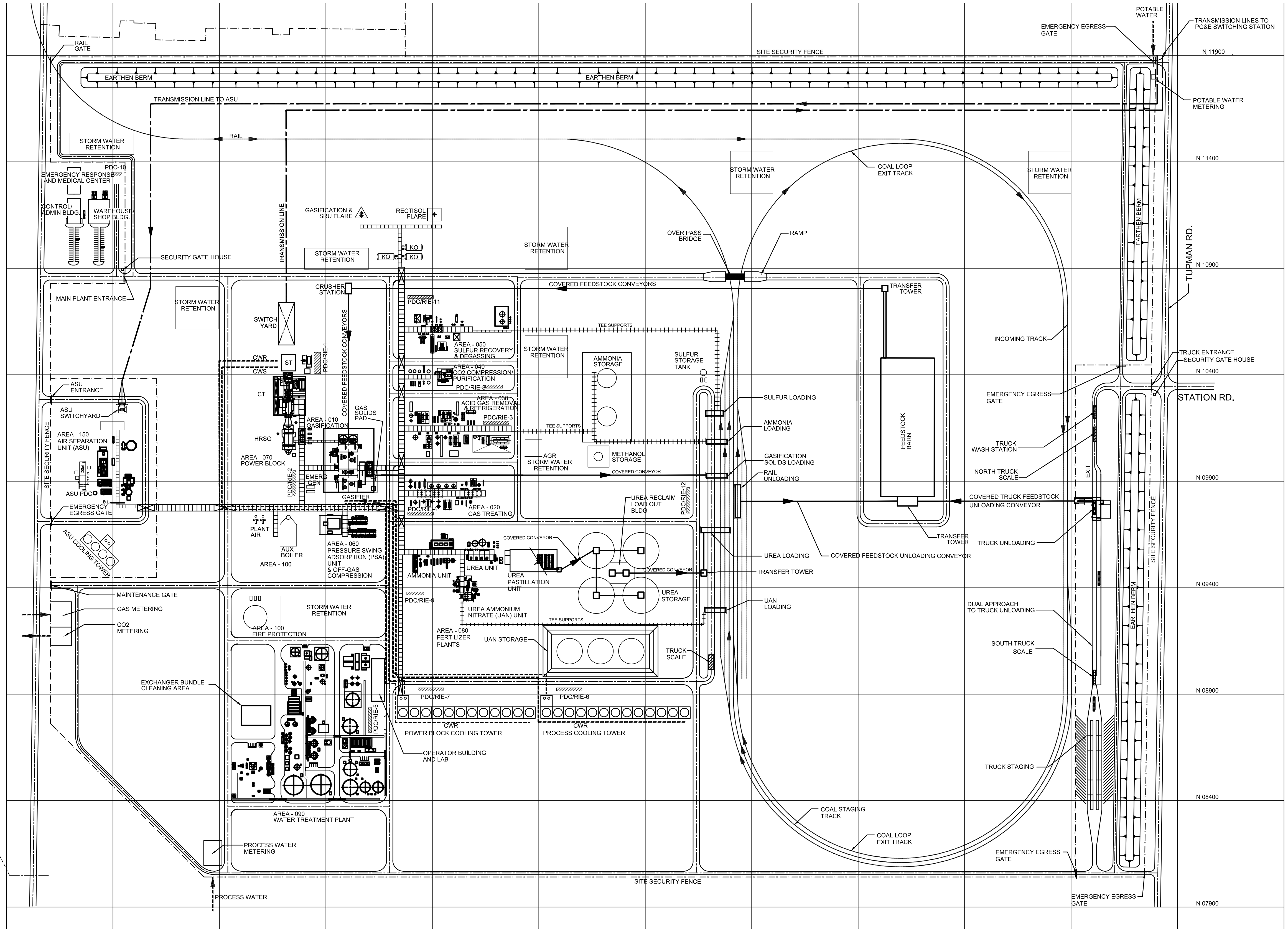
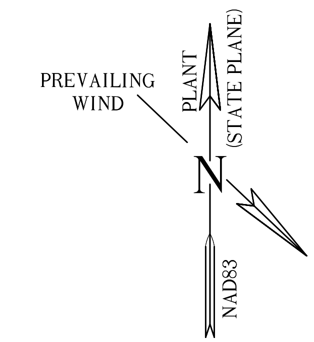




PLANT COORDINATE AND DATUM NOTES

1. PLANT COORDINATES IN FEET EQUATE TO E. 61XXXXX AND N. 23YYYYY OF CALIFORNIA STATE PLANE COORDINATE SYSTEM (NAD 83 ZONE V.)
2. PLANT ELEVATION 100.00' EQUATE TO 288.50' ABOVE MSL (NAVD88.)

AREA / UNIT INDEX

AREA	UNIT	DESCRIPTION
000	000	COMMON
010	010	GASIFICATION
020	020	GAS TREATING
030	030	ACID GAS REMOVAL & REFRIGERATION
040	040	CO2 COMPRESSION / PURIFICATION
050	050	SULFUR RECOVERY & DEGASSING
060	060	PSA & OFF-GAS COMPRESSION
070	070	POWER BLOCK
080	080	FERTILIZER COMPLEX
090	090	WATER TREATMENT PLANT
100	100	OSBL (UTILITIES & OFF-SITES)
150	150	INTERFACES TO SITE

0 100' 200' 400' 600' 800' 1000'

Source:
Fluor; HECA-SCS, 2012 AFC Update; Preliminary Plot Plan;
Drawing No: A4UV-000-50-SK-0001, Rev. C (4/06/12)

vsa_4/16/12...U:\GIS\HECA\Projects\HECA_2012\Illustrator_Files\2-5_preliminary_plotplan_C.ai

PRELIMINARY PLOT PLAN

April 2012
28068052

Hydrogen Energy California (HECA)
Kern County, California

URS

FIGURE 2-5

Notes:
1) Identifiers are same as shown in Figure 2-36, Preliminary Emissions Sources Plot Plan

COORDINATE AND DATUM NOTES

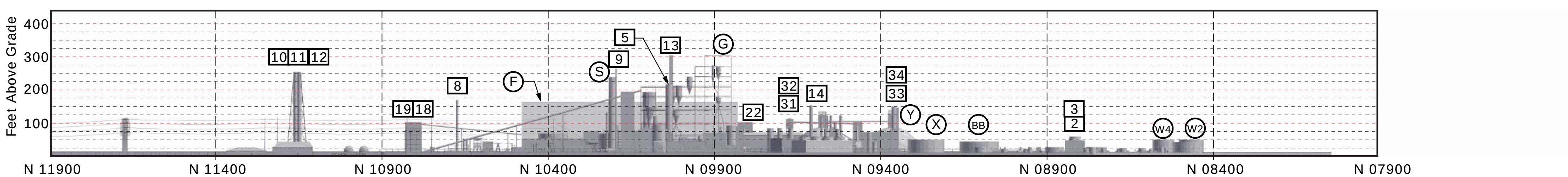
1. COORDINATES IN FEET EQUATE TO PLANT CORDINATES SHOWN ON FIGURE 2-36 PRELIMINARY EMMISIONS SOURCES PLOT PLAN
2. PLANT ELEVATION 100.00' EQUATE TO 288.50' ABOVE MSL (NAVD88.)
3. ACCURACY/TOLERANCE OF EMISSION POINT(S) COORDINATES ARE WITHIN A 50 FOOT RADIUS OF SOURCE POINT NOTED.
4. LOCATION OF EMISSION POINTS ARE SUBJECT TO COMPLETION OF DETAILED DESIGN BY LICENSORS AND EQUIPMENT SUPPLIERS.
5. SEE SHEETS 2 THROUGH 9 FOR INFORMATION ON COMPOSITION AND FLOW RATE FROM EACH SOURCE.
6. EMISSION POINT IS SHOWN FOR INFORMATION ONLY. ZERO EMISSIONS ARE EXPECTED DURING STEADY STATE OPERATION.

EMISSIONS SOURCES

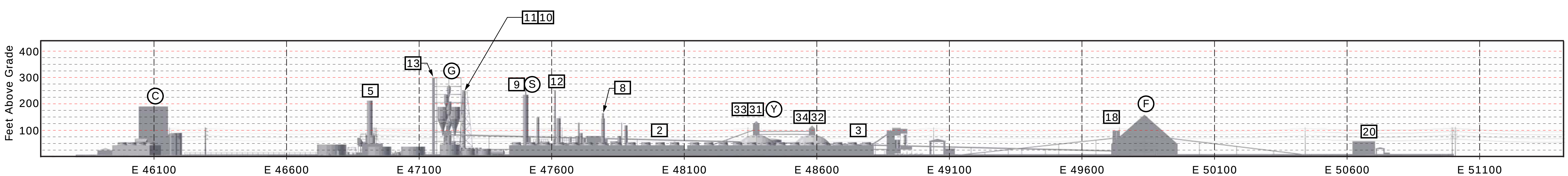
ID	SOURCE	STATE PLANE COOR. (ROUNDED) EAST	NORTH	APPX. ELEVATIONS FROM GRADE (FT)
1	ASU COOLING TOWER	46053'-0"	9557'-8"	55'
2	POWER BLOCK COOLING TOWER	47732'-0"	8813'-0"	55'
3	PROCESS COOLING TOWER	48460'-0"	8813'-0"	55'
4	EMERGENCY ENGINES (GENERATORS)	47067'-5"	9864'-0"	20'
5	HRSG STACK	46924'-0"	10035'-0"	213'
6	EMERGENCY ENGINE (FIRE WATER PUMP)	46789'-0"	9348'-0"	20'
7	AUXILIARY BOILER (NOTE 6)	46924'-0"	9730'-0"	80'
8	TAIL GAS THERMAL OXIDIZER	47713'-7"	10681'-0"	165'
9	CO2 VENT (NOTE 6)	47501'-0"	10208'-0"	260'
10	SRU FLARE	47267'-0"	11147'-0"	250'
11	GASIFICATION FLARE	47267'-0"	11159'-0"	250'
12	RECTISOL FLARE	47610'-0"	11153'-0"	250'
13	FEEDSTOCK DRYER	47140'-3"	10013'-3"	305'
14	UREA PLANT HP ABSORBER	47850'-0"	9591'-0"	130'
15	UREA PLANT LP ABSORBER	47802'-0"	9575'-0"	50'
16	UREA PASTILLATION VENT	48075'-0"	9527'-0"	50'
17	FEEDSTOCK RAIL UNLOADING VENT	49035'-0"	9804'-0"	30'
18	FEEDSTOCK TRANSFER TOWER	49726'-0"	10805'-0"	100'
19	FEEDSTOCK CRUSHER VENT	47206'-0"	10805'-0"	100'
20	FEEDSTOCK TRUCK UNLOADING VENT	50631'-0"	9810'-0"	60'
22	FEEDSTOCK TRANSFER TOWER B	49833'-0"	9806'-0"	100'
23	UREA LOADING VENT 1	48902'-0"	9667'-0"	30'
24	UREA LOADING VENT 2	48942'-0"	9667'-0"	30'
25	GASIFICATION SOLIDS PAD	47323'-7"	9868'-7"	N/A
27	NITRIC ACID ABSORBER VENT	47797'-0"	9373'-0"	145'
27A	AMMONIUM NITRATE SCRUBBER VENT	47767'-0"	9392'-0"	40'
28	GASIFICATION SOLIDS TRANSFER TOWER	47322'-2"	9928'-4"	30'
29	GASIFICATION SOLIDS LOADING VENT	48932'-8"	9928'-6"	30'
30	UREA BUCKET ELEVATOR	48196'-0"	9485'-0"	50'
31	UREA TRANSFER TOWER 1	48370'-0"	9574'-0"	100'
32	UREA TRANSFER TOWER 2	48580'-0"	9574'-0"	100'
33	UREA TRANSFER TOWER 3	48370'-0"	9364'-0"	100'
34	UREA TRANSFER TOWER 4	48580'-0"	9364'-0"	100'
35	UREA TRANSFER TOWER 5	48875'-0"	9469'-0"	100'
36	AMMONIA UNIT STARTUP HEATER	47495'-0"	9500'-0"	80'

MAJOR STRUCTURES/ EQUIPMENT AND TANKS

ID	DESCRIPTION	APPX. ELEVATIONS FROM GRADE (FT)	
A	ASU MAIN AIR COMPRESSOR ENCLOSURE	40	
B	LIQUID OXYGEN STORAGE (LOX) TANK	90	
C	AIR SEPARATION COLUMN CAN	200	
F	FEEDSTOCK BARN	160	
G	GASIFICATION STRUCTURE	305	
O	COMBUSTION TURBINE GENERATOR STRUCTURE	50	
P	HEAT RECOVERY STEAM GENERATOR STRUCTURE	90	
Q	FLARE K.O. DRUMS (QTY 3)	35	
R	POWER DISTRIBUTION CENTERS	25	
S	AGR METHANOL WASH COLUMN	235	
T	AGR REFRIGERATION COMPRESSOR STRUCTURE	40	
W1	RAW WATER TANK	100'DIA X 48'H	TANKS SET AT GRADE ELEVATION
W2	TREATED WATER TANK	95'DIA X 40'H	
W3	PURIFIED WATER TANK	75'DIA X 48'H	
W4	BACKWASH TANK	65'DIA X 48'H	
W5	UTILITY WATER TANK	50'DIA X 32'H	
W6	DEMINERALIZED WATER STORAGE TANK	52'DIA X 40'H	
X	FIREWATER STORAGE TANK	110'DIA X 48'H	
Y	UREA STORAGE (4 DOMES)	162'DIA X 70'H	
Z	METHANOL STORAGE TANK	40'DIA X 40'H	
AA	AMMONIA STORAGE (2 TANKS)	90'DIA X 70'H	
BB	UAN STORAGE (3 TANKS)	120'DIA X 48'H	
CC	UREA RECLAIM LOADOUT BUILDING	70	
DD	SULFUR STORAGE TANK	30'DIA X 24'H	



VIEWING EAST



VIEWING NORTH

Notes:
1) Identifiers are same as shown in Figure 2-36, Preliminary Emissions Sources Plot Plan

PROJECT ELEVATIONS

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Hydrogen Energy California (HECA)
Kern County, California

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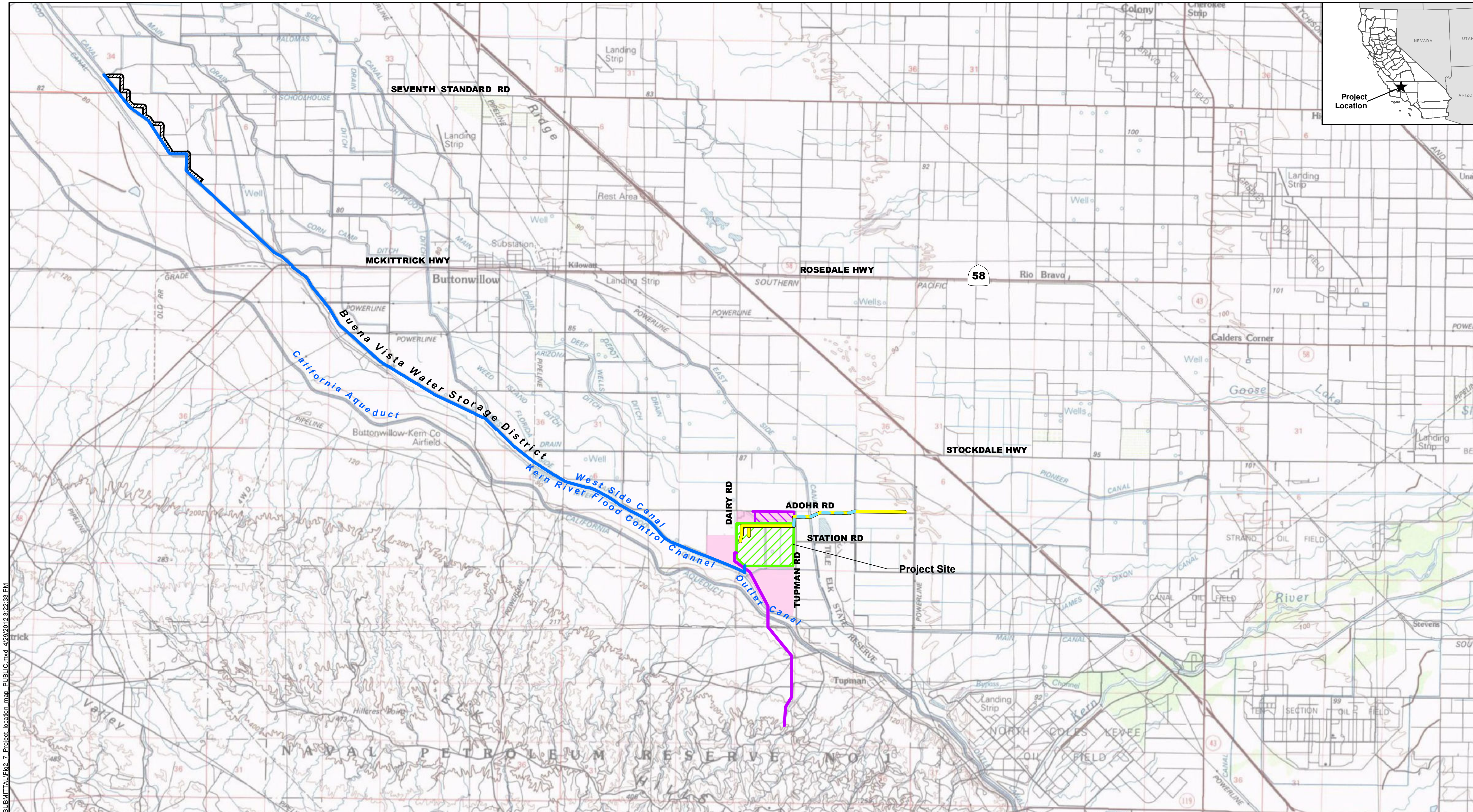
FIGURE 2-6

4/27/12 vsa..T:\HECA-SCS 2012\GRAPHICS 2012\2.0_Proj Description\2-6_proj_elevations_Rev5.ai



Project Site	Carbon Dioxide
Construction Staging Area	Natural Gas[1]
Controlled Area	Potable Water
BVWSD Well Field	Process Water
	Railroad[1]
	Transmission

Note:
1. Feature temporarily designated as confidential

0 1 2 MILES

N

PROJECT LOCATION MAP

April 2012
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Hydrogen Energy California (HECA)
Kern County, California

URS

FIGURE 2-7

Source: USGS (30'x60' quads: Taft 1982, Delano 1982). Created using TOPO!, ©2006 National Geographic Maps, All Rights Reserved. Kern County and State of California (proposed and approved projects).

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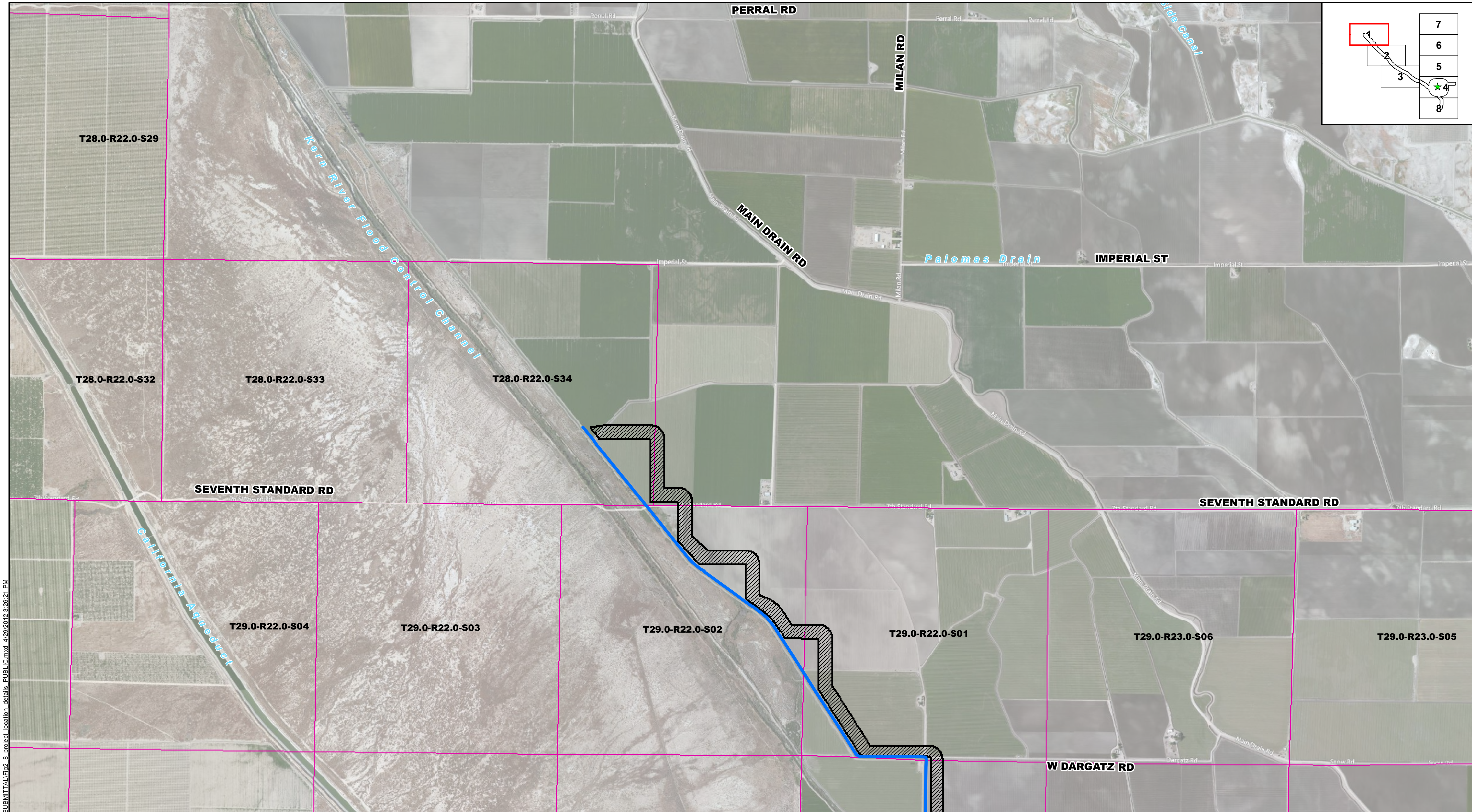

Project Site
Controlled Area
Construction Staging Area
BVWSD Well Field
Carbon Dioxide
Natural Gas[1]
Potable Water
Process Water
Railroad[1]
Transmission
Proposed Natural Gas Valve Station[1]
Rail Laydown Yard[1]
HDD Entry/Exit Pits
Section

Notes:
1. Feature temporarily designated as confidential
HDD = Horizontal Directional Drilling

N

0 1,000 2,000 FEET

PROJECT LOCATION DETAILS

April 2012
28068052

Hydrogen Energy California (HECA)
Kern County, California

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FIGURE 2-8 (1)

Source: Aerial Imagery, Bing Maps, 2009.

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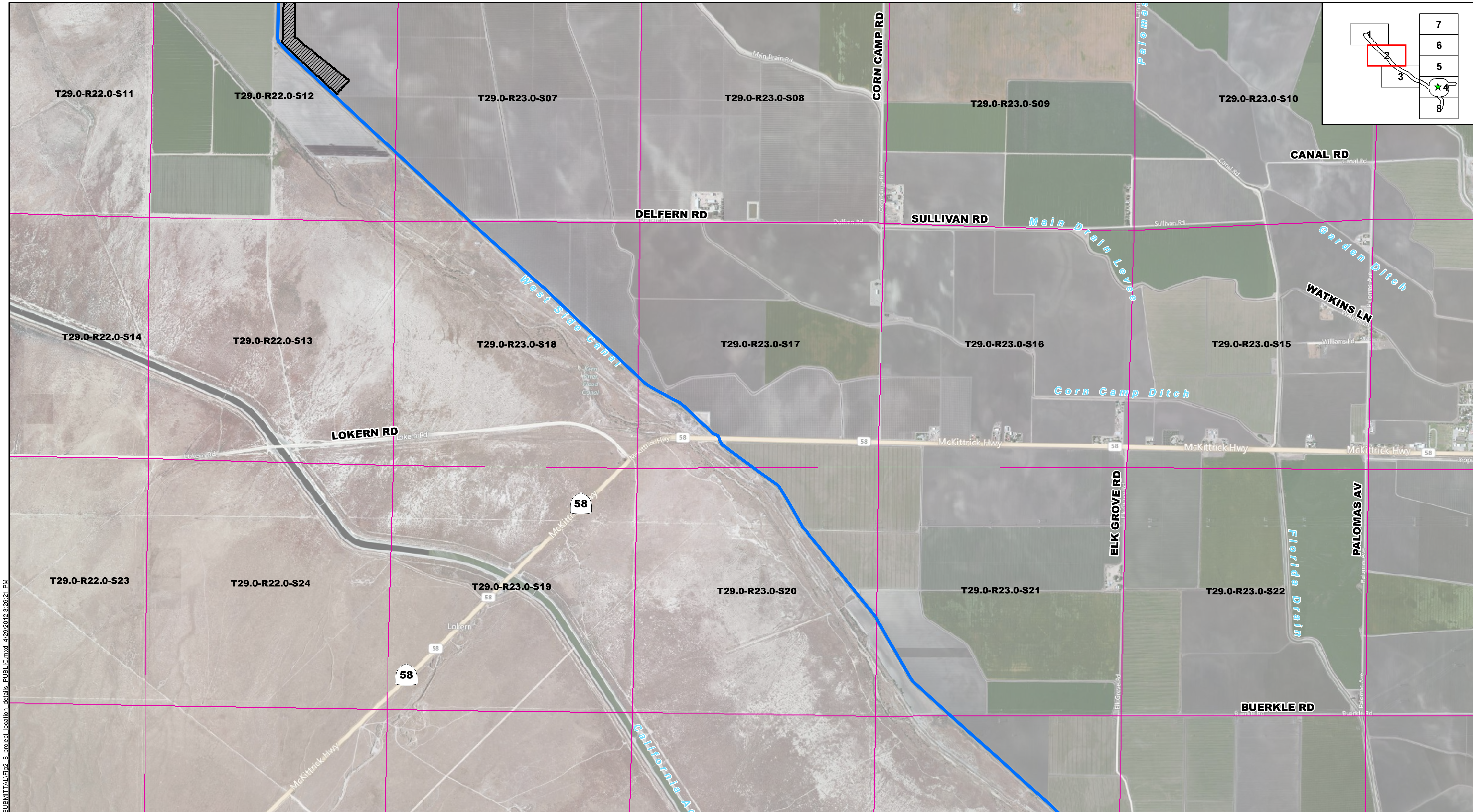

Project Site
Controlled Area
Construction Staging Area
BVWSD Well Field
Carbon Dioxide
Natural Gas[1]
Potable Water
Process Water
Railroad[1]
Transmission
Proposed Natural Gas Valve Station[1]
Rail Laydown Yard[1]
HDD Entry/Exit Pits
Section

Notes:
1. Feature temporarily designated as confidential
HDD = Horizontal Directional Drilling

N

0 1,000 2,000 FEET

PROJECT LOCATION DETAILS

April 2012
28068052

Hydrogen Energy California (HECA)
Kern County, California

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FIGURE 2-8 (2)

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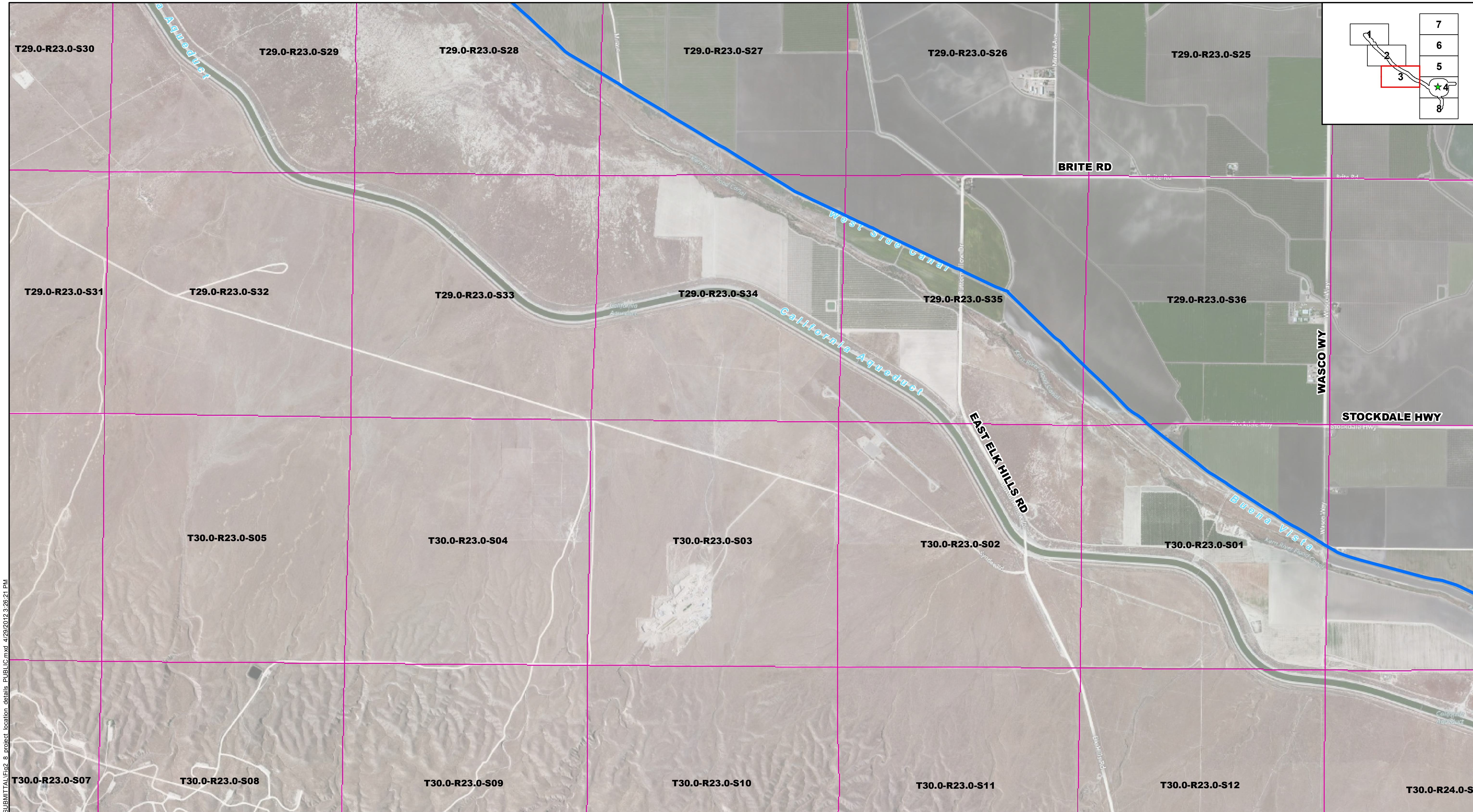
Source: Aerial Imagery, Bing Maps, 2009.



Project Site
Controlled Area
Construction Staging Area
BVWSD Well Field
Carbon Dioxide
Natural Gas[1]
Potable Water
Process Water
Railroad[1]
Transmission
Proposed Natural Gas Valve Station[1]
Rail Laydown Yard[1]
HDD Entry/Exit Pits
Section

Notes:
1. Feature temporarily designated as confidential
HDD = Horizontal Directional Drilling

N

0 1,000 2,000 FEET

PROJECT LOCATION DETAILS

April 2012
28068052

Hydrogen Energy California (HECA)
Kern County, California

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FIGURE 2-8 (3)

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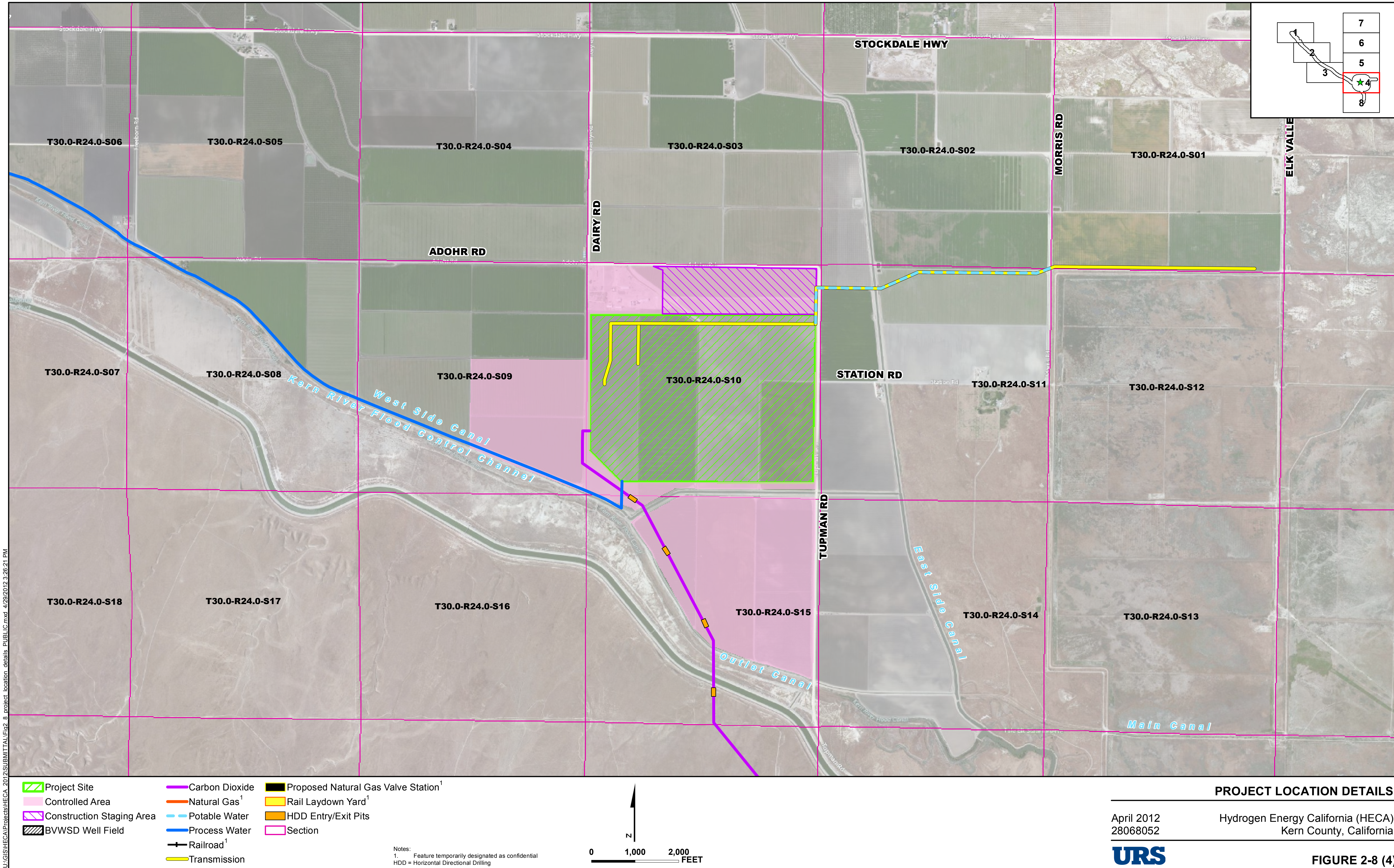
Source: Aerial Imagery, Bing Maps, 2009.



Notes:
1. Feature temporarily designated as confidential
HDD = Horizontal Directional Drilling

Source: Aerial Imagery, Bing Maps, 2009.

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PROJECT LOCATION DETAILS

April 2012
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Hydrogen Energy California (HECA)
Kern County, California

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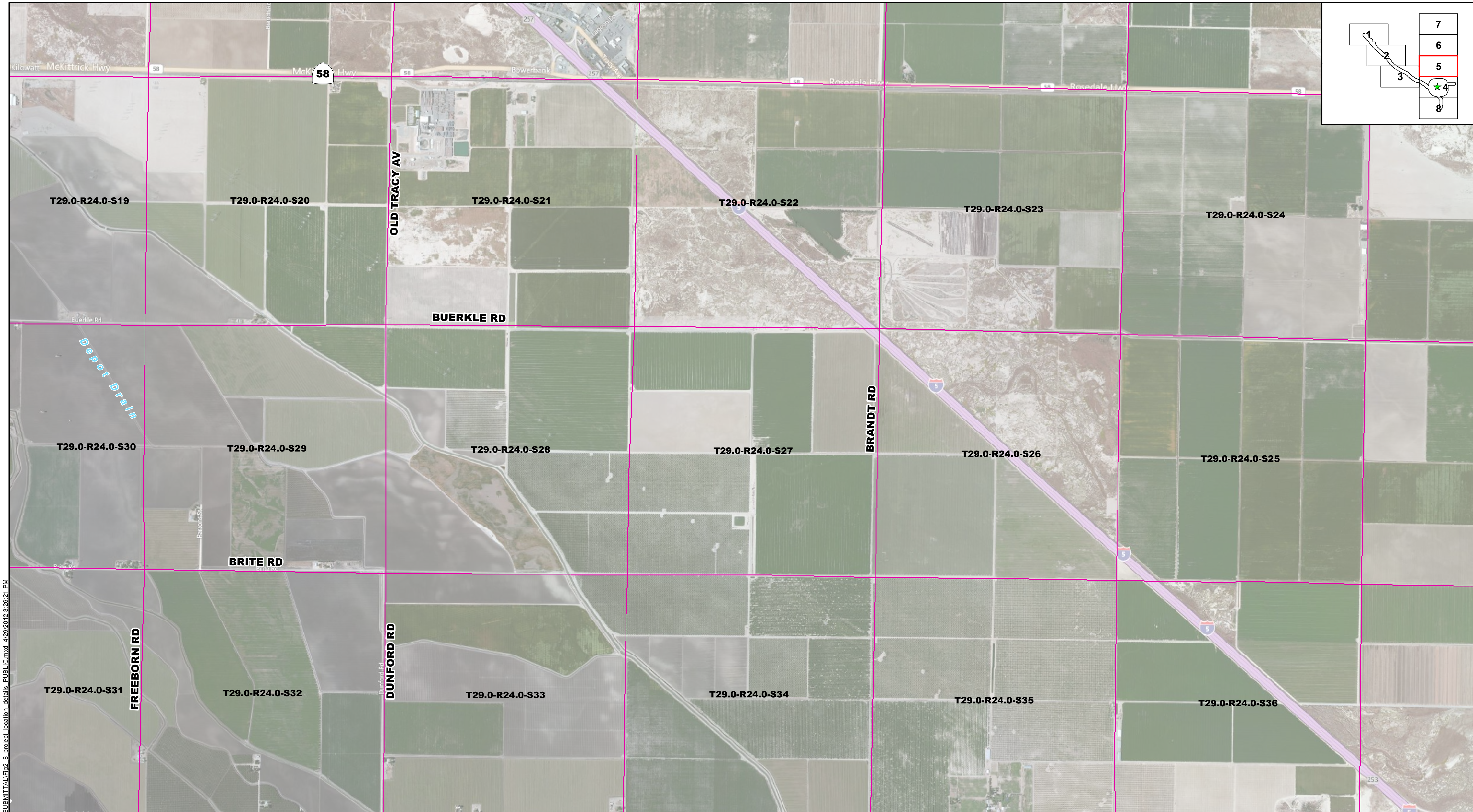
FIGURE 2-8 (4)



- Project Site
- Controlled Area
- Construction Staging Area
- BVWSD Well Field
- Carbon Dioxide
- Natural Gas[1]
- Potable Water
- Process Water
- Railroad[1]
- Transmission
- Proposed Natural Gas Valve Station[1]
- Rail Laydown Yard[1]
- HDD Entry/Exit Pits
- Section

Notes:
1. Feature temporarily designated as confidential
HDD = Horizontal Directional Drilling

N

0 1,000 2,000 FEET

PROJECT LOCATION DETAILS

April 2012
28068052

Hydrogen Energy California (HECA)
Kern County, California

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FIGURE 2-8 (5)

Source: Aerial Imagery, Bing Maps, 2009.

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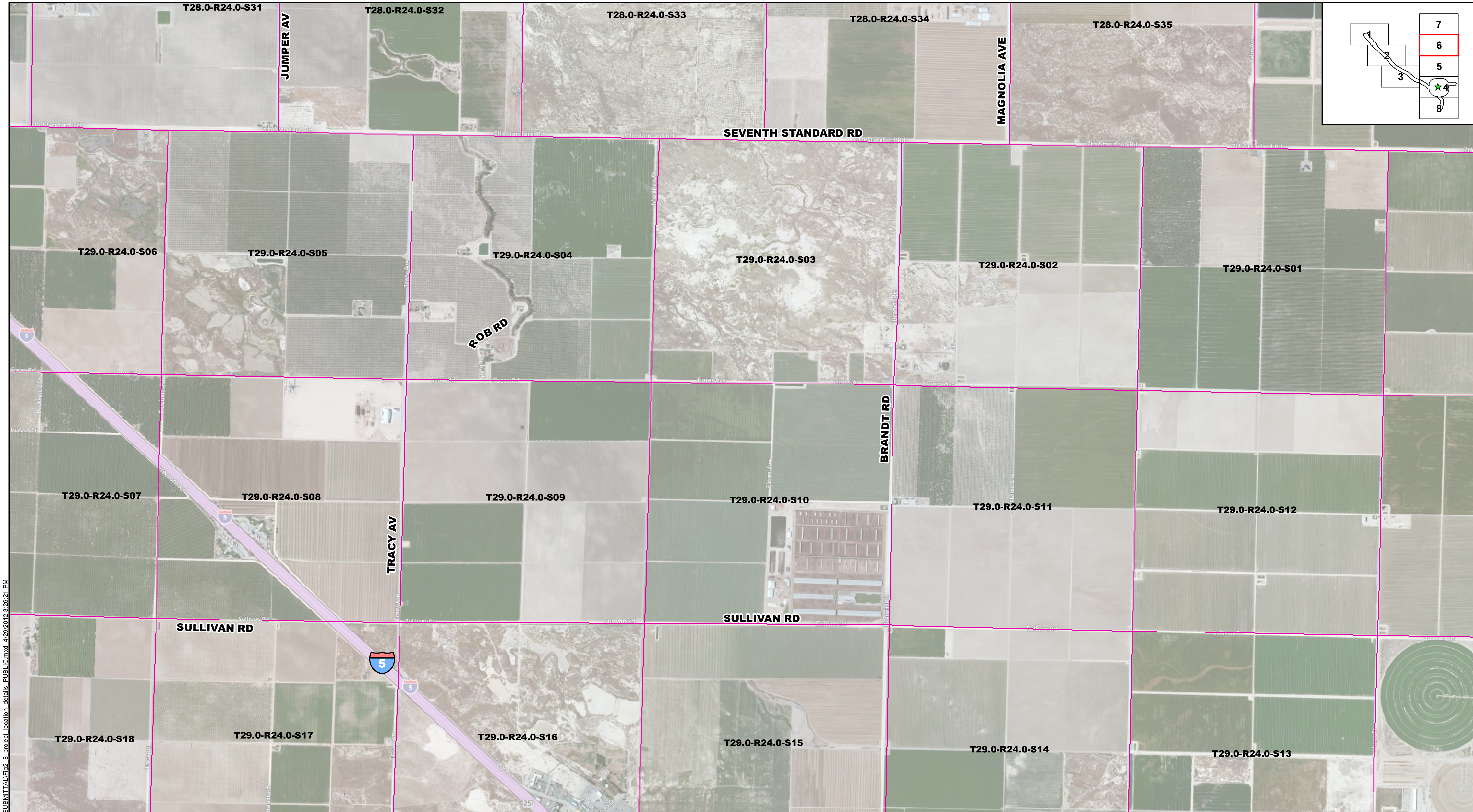

Project Site
Controlled Area
Construction Staging Area
BVWSD Well Field
Carbon Dioxide
Natural Gas[1]
Potable Water
Process Water
Railroad[1]
Transmission
Proposed Natural Gas Valve Station[1]
Rail Laydown Yard[1]
HDD Entry/Exit Pits
Section

Notes:
1. Feature temporarily designated as confidential
HDD = Horizontal Directional Drilling

N

0 1,000 2,000 FEET

PROJECT LOCATION DETAILS

April 2012
28068052

Hydrogen Energy California (HECA)
Kern County, California

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FIGURE 2-8 (6)

Source: Aerial Imagery, Bing Maps, 2009.

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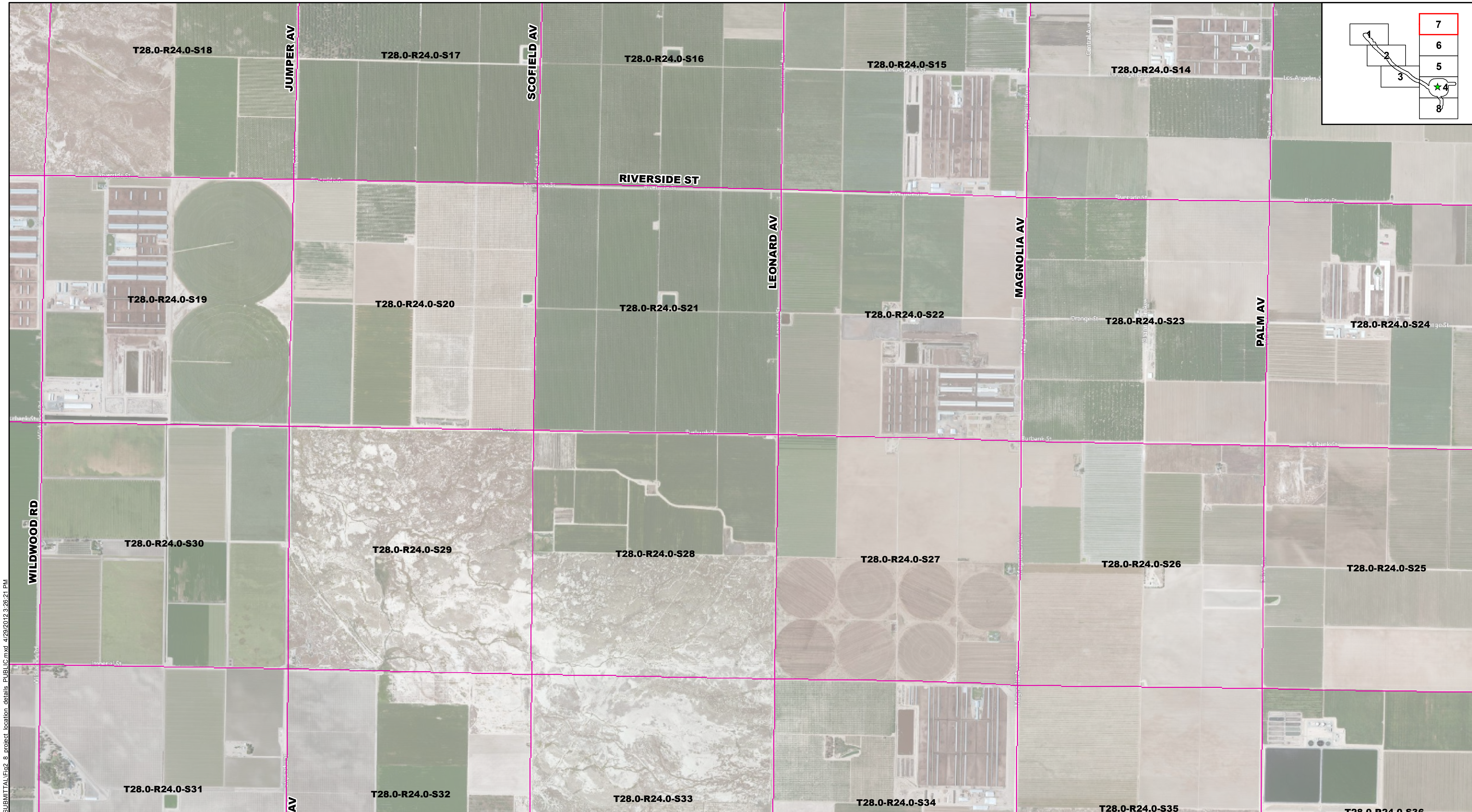

Project Site
Controlled Area
Construction Staging Area
BVWSD Well Field
Carbon Dioxide
Natural Gas[1]
Potable Water
Process Water
Railroad[1]
Transmission
Proposed Natural Gas Valve Station[1]
Rail Laydown Yard[1]
HDD Entry/Exit Pits
Section

Notes:
1. Feature temporarily designated as confidential
HDD = Horizontal Directional Drilling

PROJECT LOCATION DETAILS

April 2012
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Hydrogen Energy California (HECA)
Kern County, California

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FIGURE 2-8 (7)

Source: Aerial Imagery, Bing Maps, 2009.

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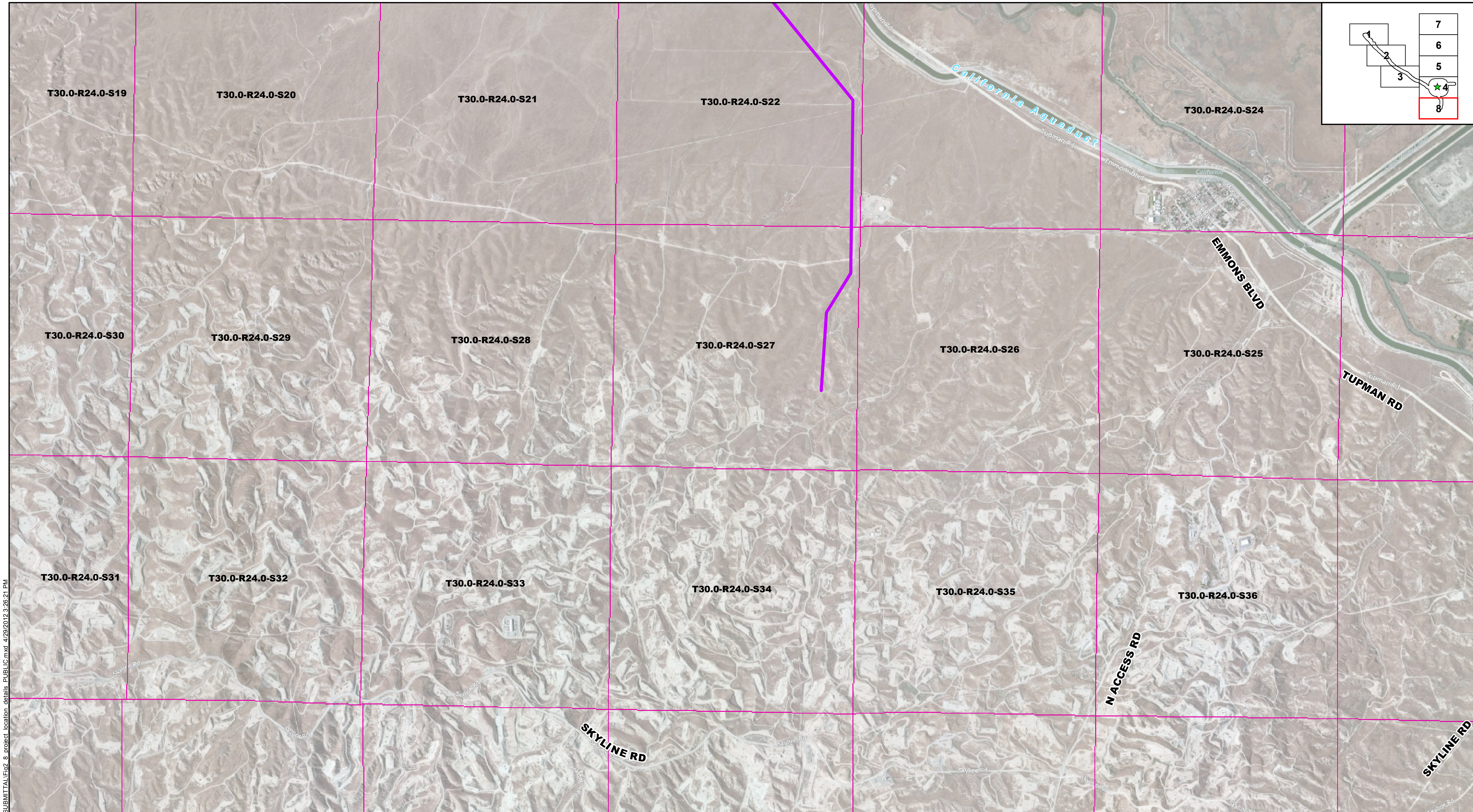

Project Site
Controlled Area
Construction Staging Area
BVWSD Well Field
Carbon Dioxide
Natural Gas[1]
Potable Water
Process Water
Railroad[1]
Transmission
Proposed Natural Gas Valve Station[1]
Rail Laydown Yard[1]
HDD Entry/Exit Pits
Section

Notes:
1. Feature temporarily designated as confidential
HDD = Horizontal Directional Drilling

N

0 1,000 2,000 FEET

PROJECT LOCATION DETAILS

April 2012
28068052

Hydrogen Energy California (HECA)
Kern County, California

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FIGURE 2-8 (8)

Source: Aerial Imagery, Bing Maps, 2009.

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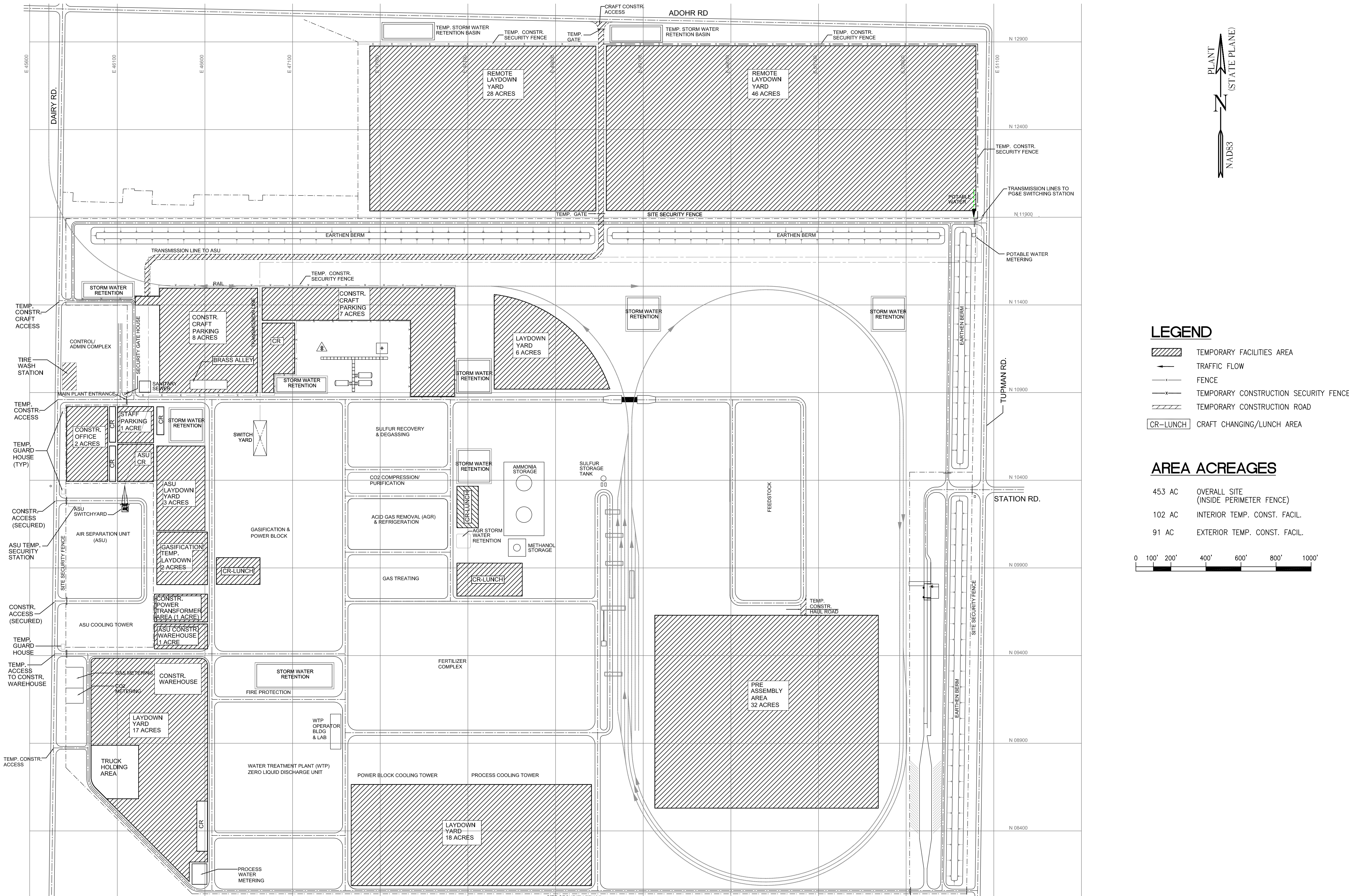

PRELIMINARY
TEMPORARY CONSTRUCTION FACILITIES PLAN

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28068052

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Kern County, California

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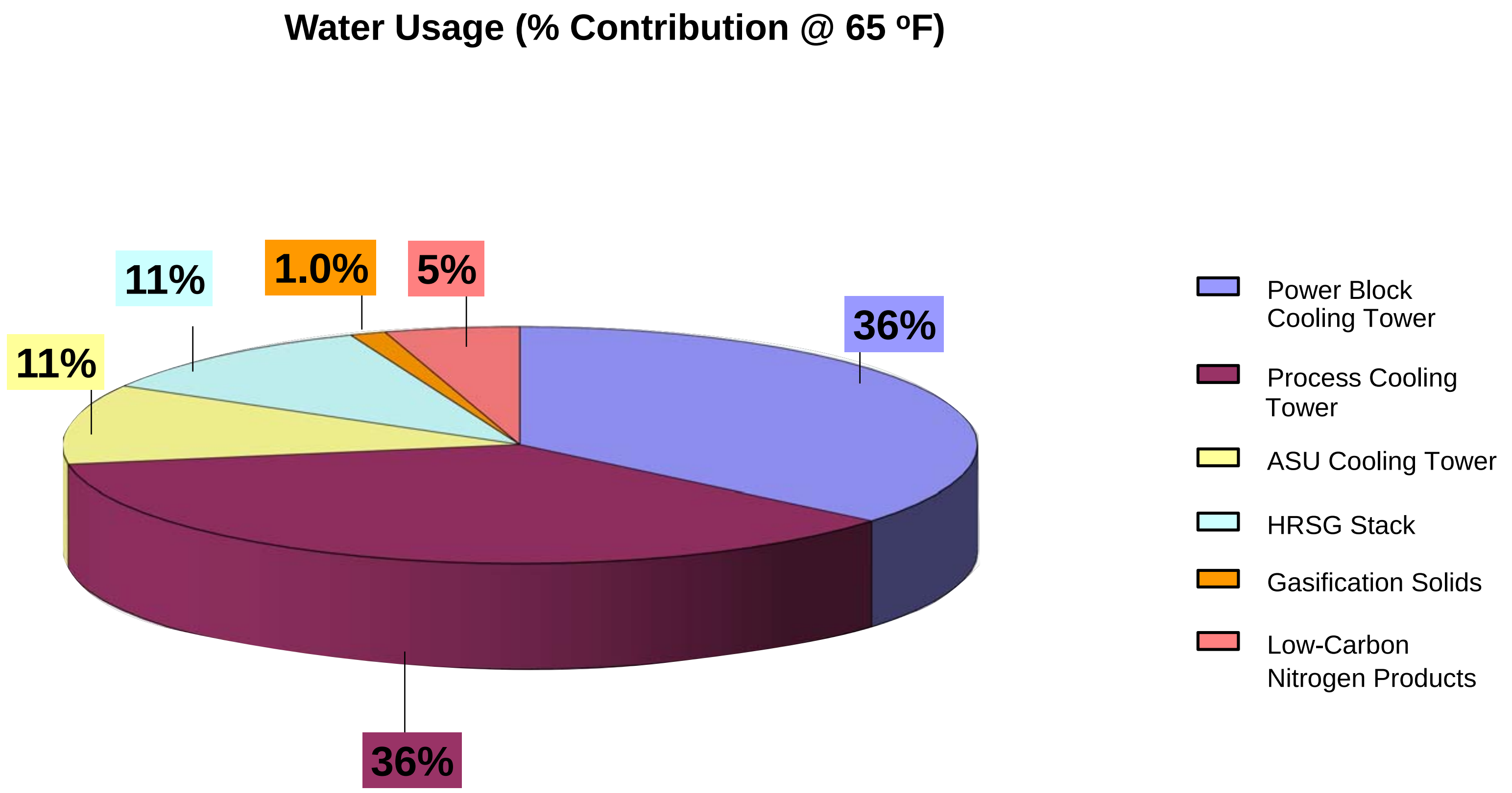
FIGURE 2-9

Source:
Fluor; HECA-SCS, 2012 AFC Update; Preliminary Temporary Construction Facilities Plan;
Drawing No: A4UV-000-10-SK-0004, Rev. D (4/11/12)



vsa_4/11/12...U:\GIS\HECA\Projects\HECA_2012\Illustrator_Files\2-10_water_usage.ai

Source:
Fluor; April 2, 2012

WATER USAGE

April 2012
28068052

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Kern County, California

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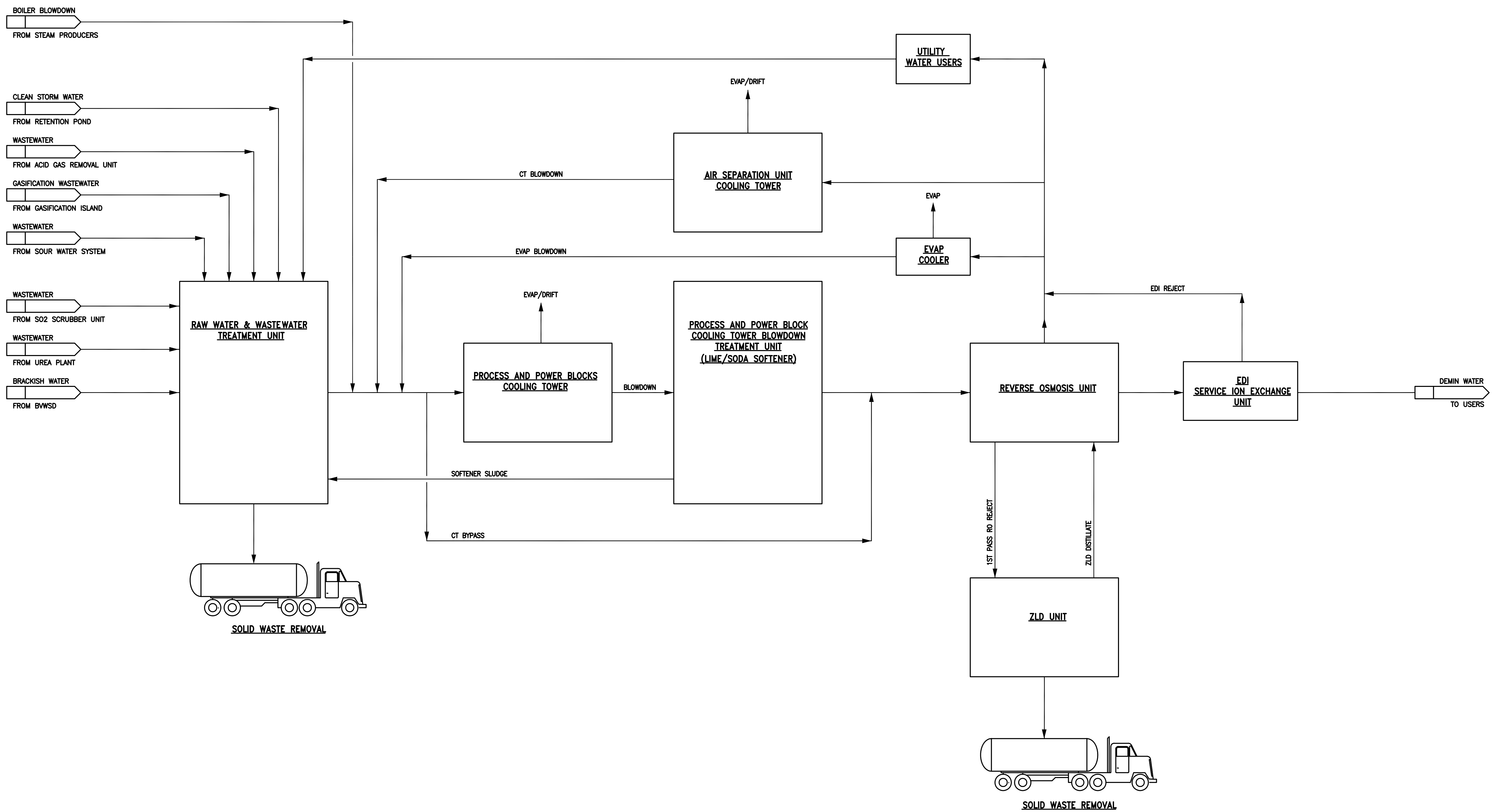
FIGURE 2-10



FLOW DIAGRAM: RAW WATER/WASTEWATER/ DEMIN WATER TREATMENT PLANT

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28068052

Hydrogen Energy California (HECA)
Kern County, California

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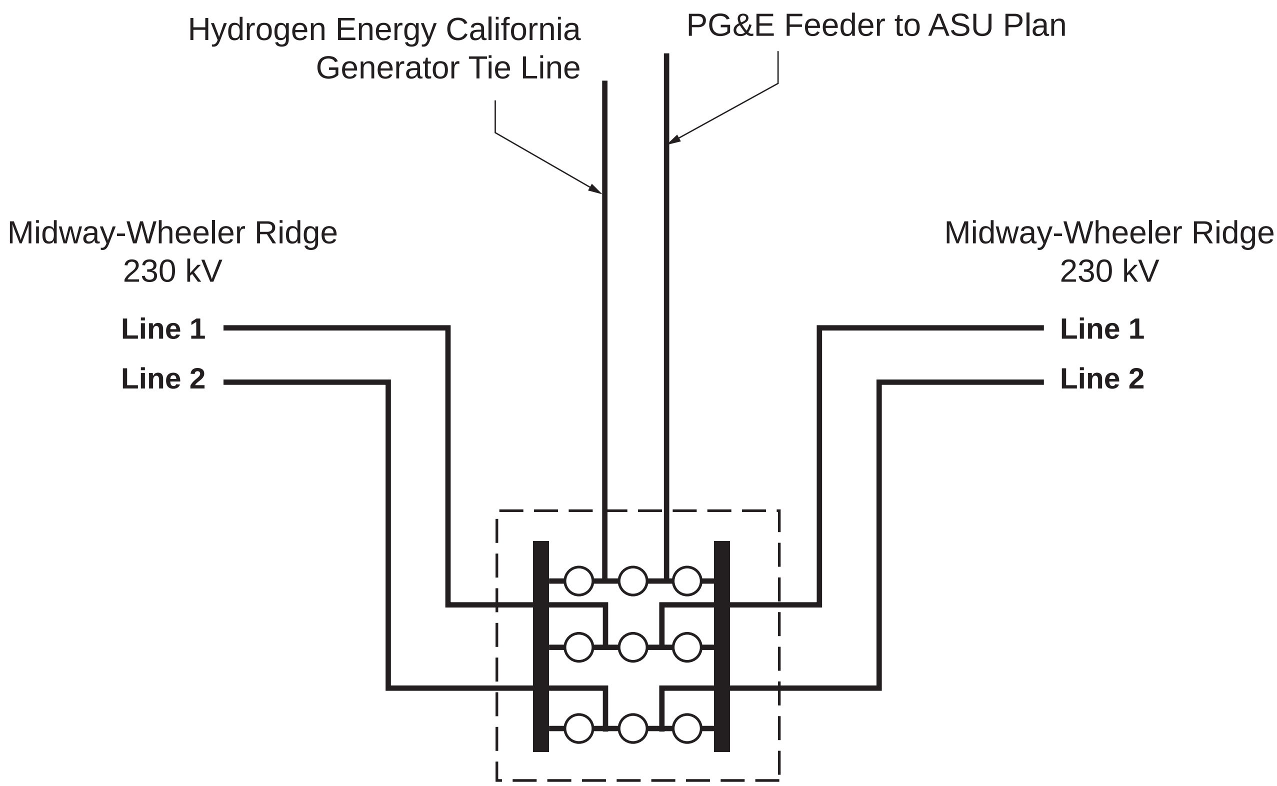
FIGURE 2-11

Source:
Fluor; HECA-SCS, 2012 AFC Update; Flow Diagram Raw Water/Wastewater/Demin Water Treatment Plant;
Drawing No: A4UV-090-25-SK-0001, Rev. 0 (2/27/12)

vsa_2/19/12...U:\GIS\HECA\Projects\HECA_2012\Illustrator_Files\2-11_flow_dia_water_treatment.ai



Proposed 230 kV Switching Station
(at Olean Avenue and Elk Valley Road)

Schematic: No Scale

OVERALL SINGLE-LINE DIAGRAM

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28068052

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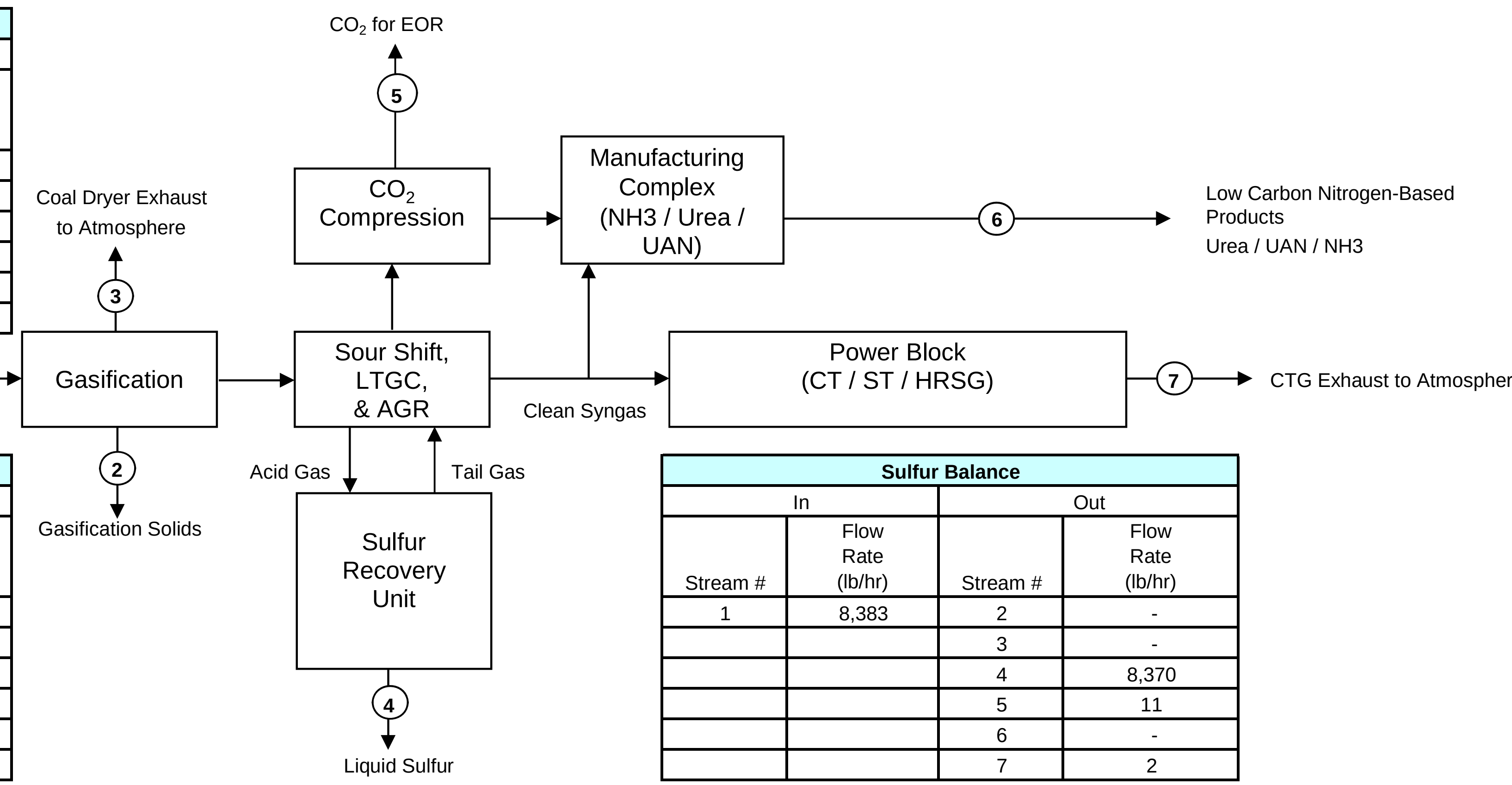
FIGURE 2-12

4/26/12 vsa..T:\HECA-SCS 2012\GRAPHICS 2012\2.0_Proj Description\2-12_overall_single_line.ai



Carbon Balance

In		Out	
Stream #	Flow Rate (lb/hr)	Stream #	Flow Rate (lb/hr)
1	264,544	2	265
		3	3,041
		4	-
		5	207,655
		6	36,350
		7	17,233

Inert Solids Balance

In		Out	
Stream #	Flow Rate (lb/hr)	Stream #	Flow Rate (lb/hr)
1	69,925	2	69,925
		3	-
		4	-
		5	-
		6	-
		7	-

Sulfur Balance

In		Out	
Stream #	Flow Rate (lb/hr)	Stream #	Flow Rate (lb/hr)
1	8,383	2	-
		3	-
		4	8,370
		5	11
		6	-
		7	2

Notes:
1. Only inert solids contained in the Feedstock is shown in the solids balance. All other feedstock components are excluded.
2. A water balance is provided in drawing A4UV-090-25-SK-0001.

Source: Fluor, 2012

HECA OVERALL COMPONENT BALANCES

April 2012
28068052

Hydrogen Energy California (HECA)
Kern County, California

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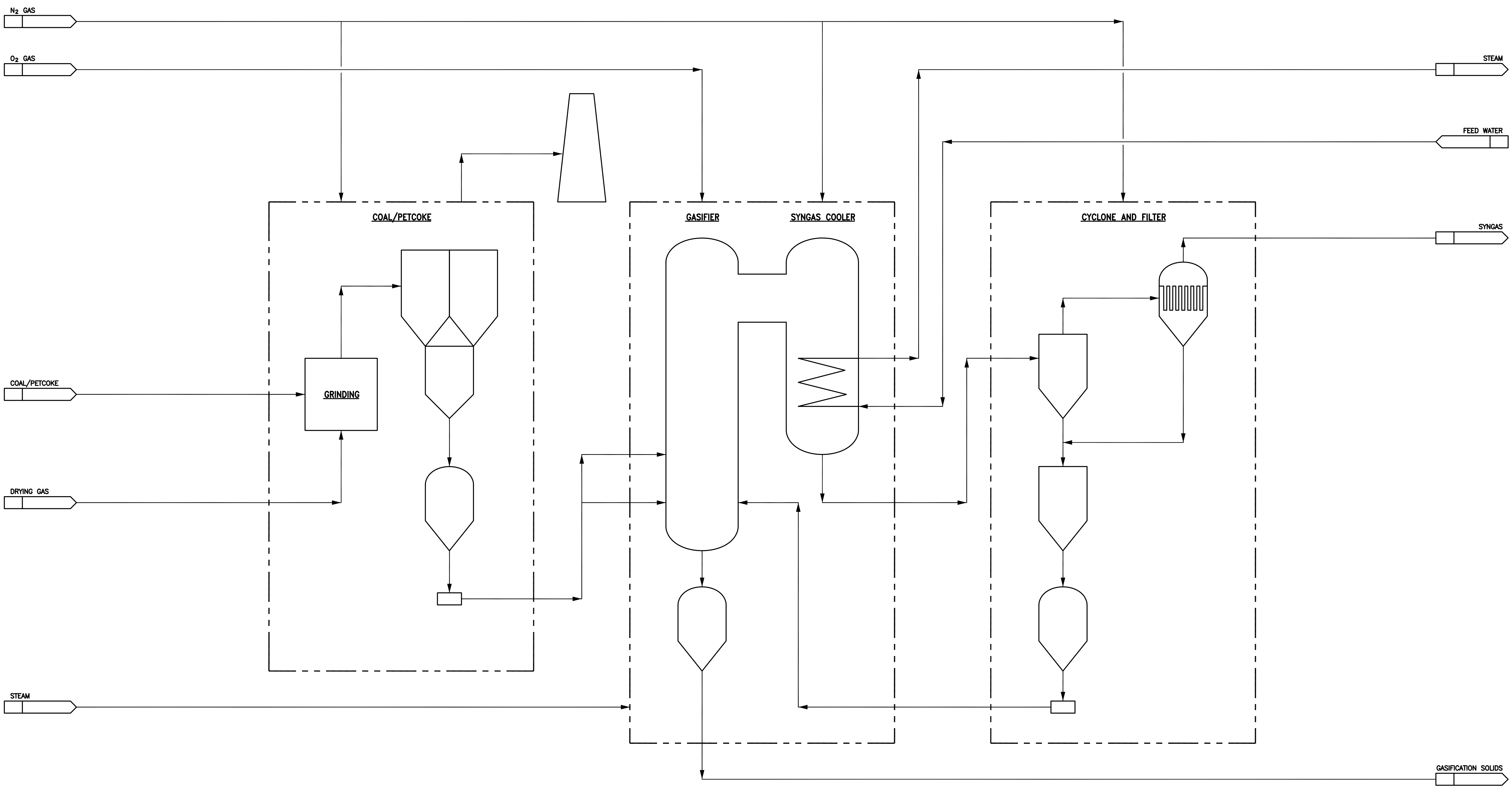
FIGURE 2-13



Sources:
Fluor; HECA-SCS, 2012 AFC Update; Flow Diagram Gasification Process;
Drawing No: A4UV-010-25-SK-0002, Rev. 0 (2/14/12)
Mitsubishi Heavy Industries, Ltd.

FLOW DIAGRAM
GASIFICATION PROCESS

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Hydrogen Energy California (HECA)
Kern County, California

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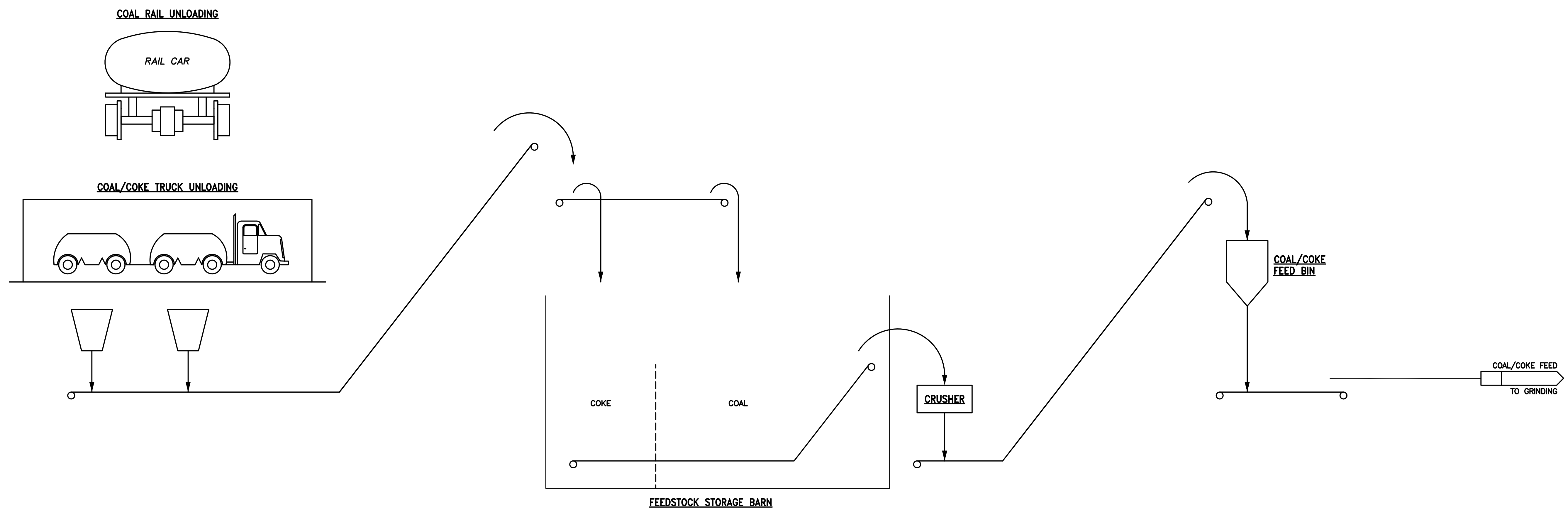
FIGURE 2-14

4/02/12 vsa..T:\HECA-SCS 2012\GRAPHICS 2012\2.0_Proj Description\2-14_flow_dia_gasification.ai



Source:
Fluor; HECA-SCS, 2012 AFC Update; Flow Diagram Feedstock Handling and Storage;
Drawing No: A4UV-010-25-SK-0001, Rev. 0 (2/14/12)

FLOW DIAGRAM
FEEDSTOCK HANDLING AND STORAGE

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Hydrogen Energy California (HECA)
Kern County, California

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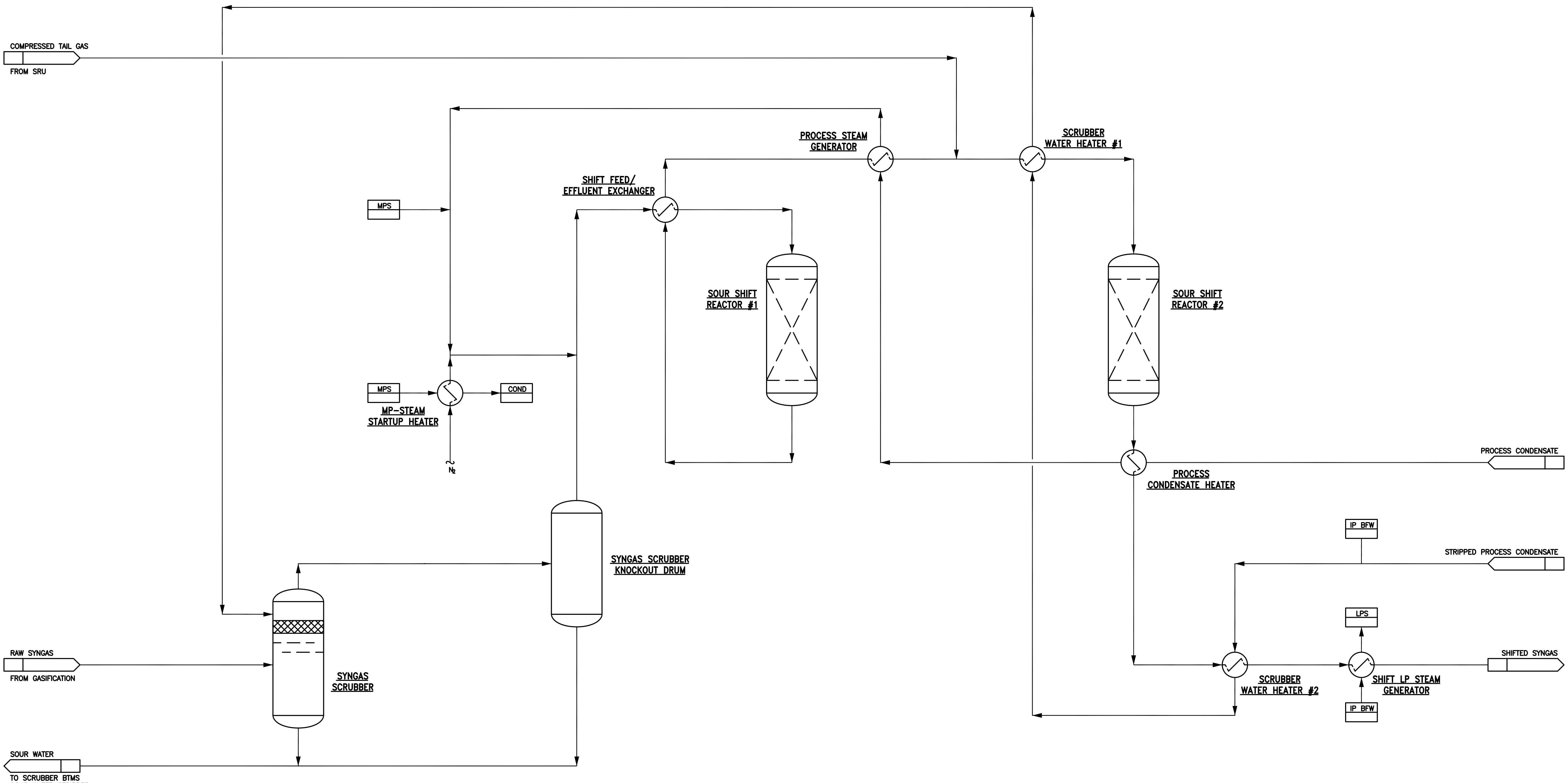
FIGURE 2-15



4/02/12 vsa..T:\HECA-SCS 2012\GRAPHICS 2012\2.0_Proj Description\2-16_flow_dia_sour_shift.ai

Source:
Fluor; HECA-SCS, 2012 AFC Update; Flow Diagram Sour Shift System;
Drawing No: A4UV-020-25-SK-0001, Rev. 0 (2/14/12)

FLOW DIAGRAM
SOUR SHIFT SYSTEM

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Hydrogen Energy California (HECA)
Kern County, California

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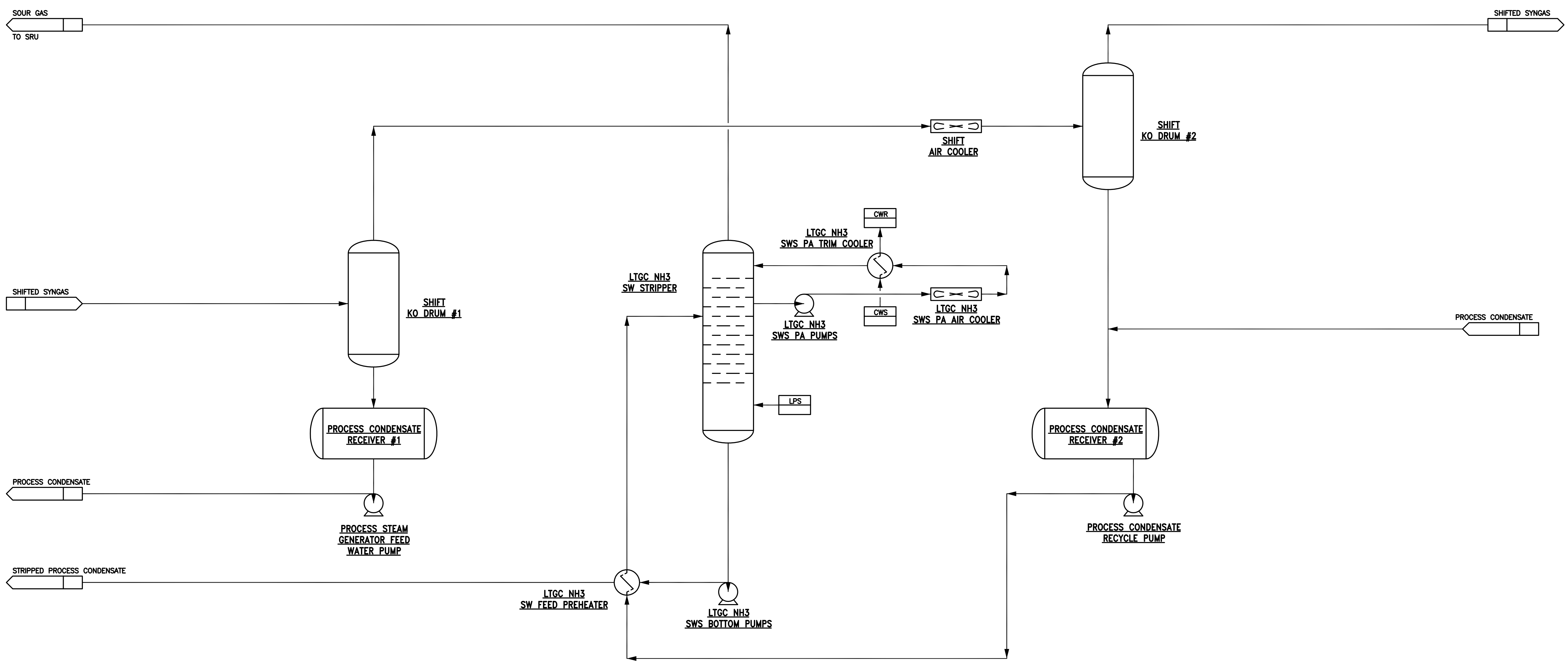
FIGURE 2-16



Source:
Fluor; HECA-SCS, 2012 AFC Update; Flow Diagram Low Temperature Gas Cooling;
Drawing No: A4UV-020-25-SK-0002, Rev. 0 (2/14/12)

FLOW DIAGRAM
LOW TEMPERATURE GAS COOLING (LTGC)

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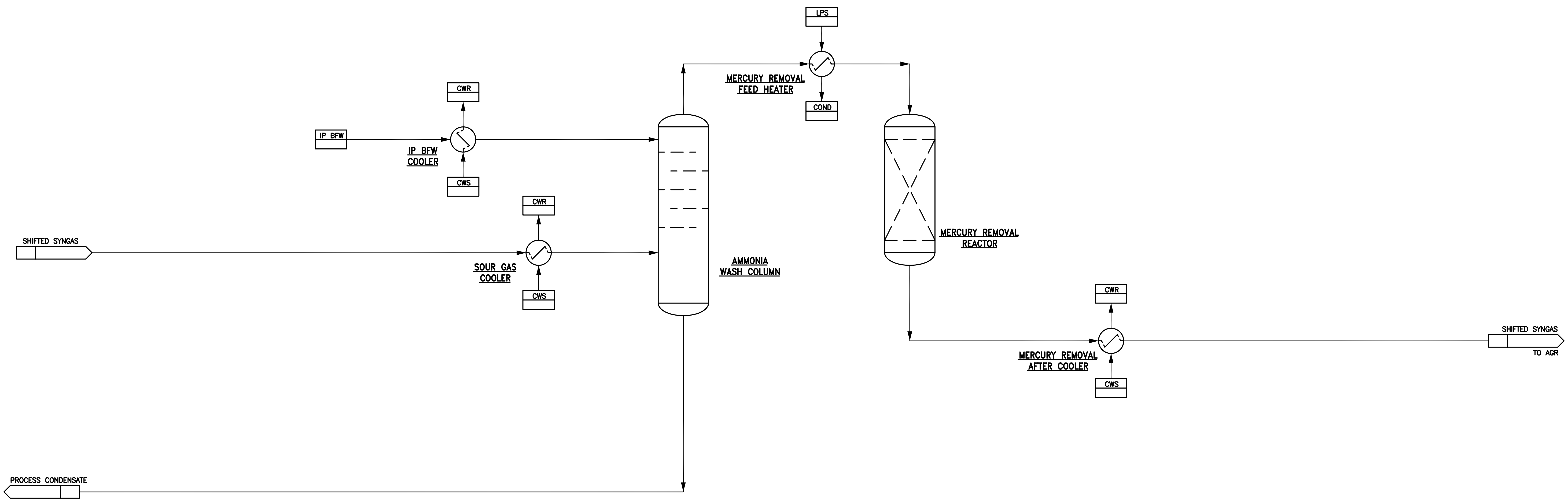
Hydrogen Energy California (HECA)
Kern County, California

FIGURE 2-17



Source:
Fluor; HECA-SCS, 2012 AFC Update; Flow Diagram Wash Column and Mercury Removal;
Drawing No: A4UV-020-25-SK-0003, Rev. 0 (2/14/12)

FLOW DIAGRAM
WASH COLUMN AND MERCURY REMOVAL

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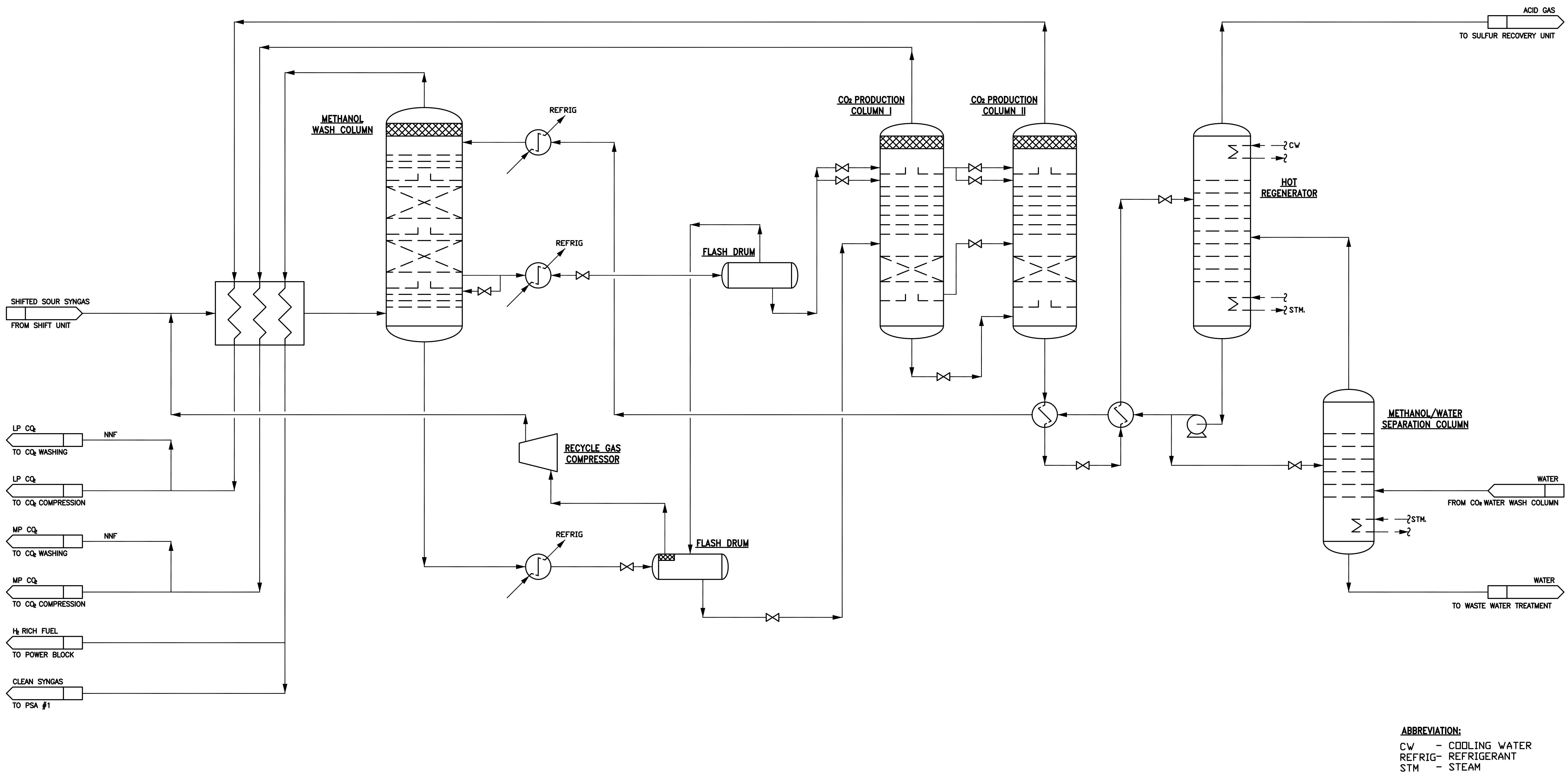
Hydrogen Energy California (HECA)
Kern County, California

FIGURE 2-18

4/02/12 vsa..T:\HECA-SCS 2012\GRAPHICS 2012\2.0_Proj Description\2-18_flow_dia_wash_mercury.ai



FLOW DIAGRAM
RECTISOL ACID GAS REMOVAL

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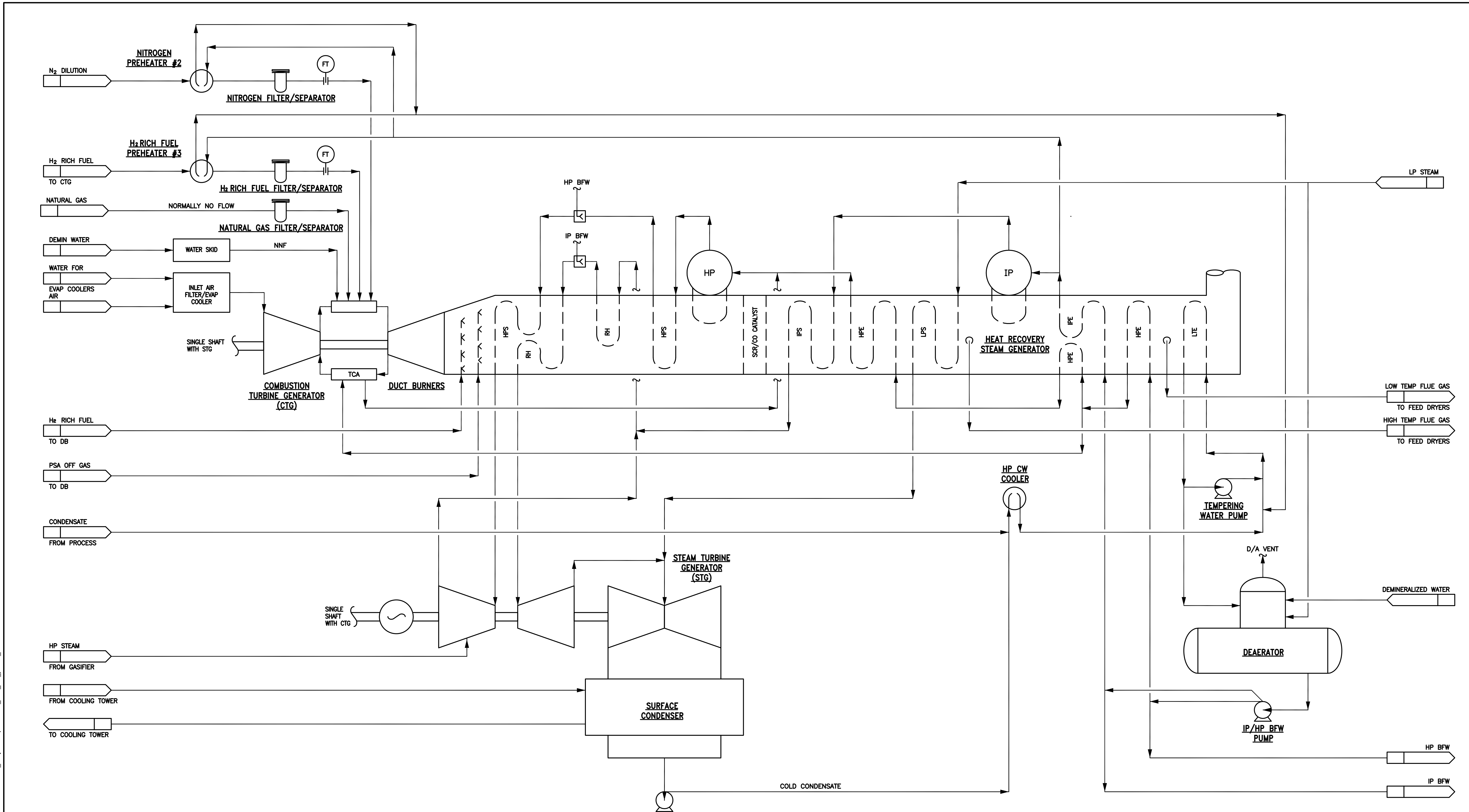
Hydrogen Energy California (HECA)
Kern County, California

URS

FIGURE 2-19

Source:
Fluor; HECA-SCS, 2012 AFC Update; Flow Diagram Rectisol Acid Gas Removal;
Drawing No: A4UV-030-25-SK-0001, Rev. 0 (2/14/12)

4/02/12 vsa..T:\HECA-SCS 2012\GRAPHICS 2012\2.0_Proj Description\2-19_flow_dia_rectisol.ai



FLOW DIAGRAM
POWER BLOCK SYSTEMS

April 2012
28068052

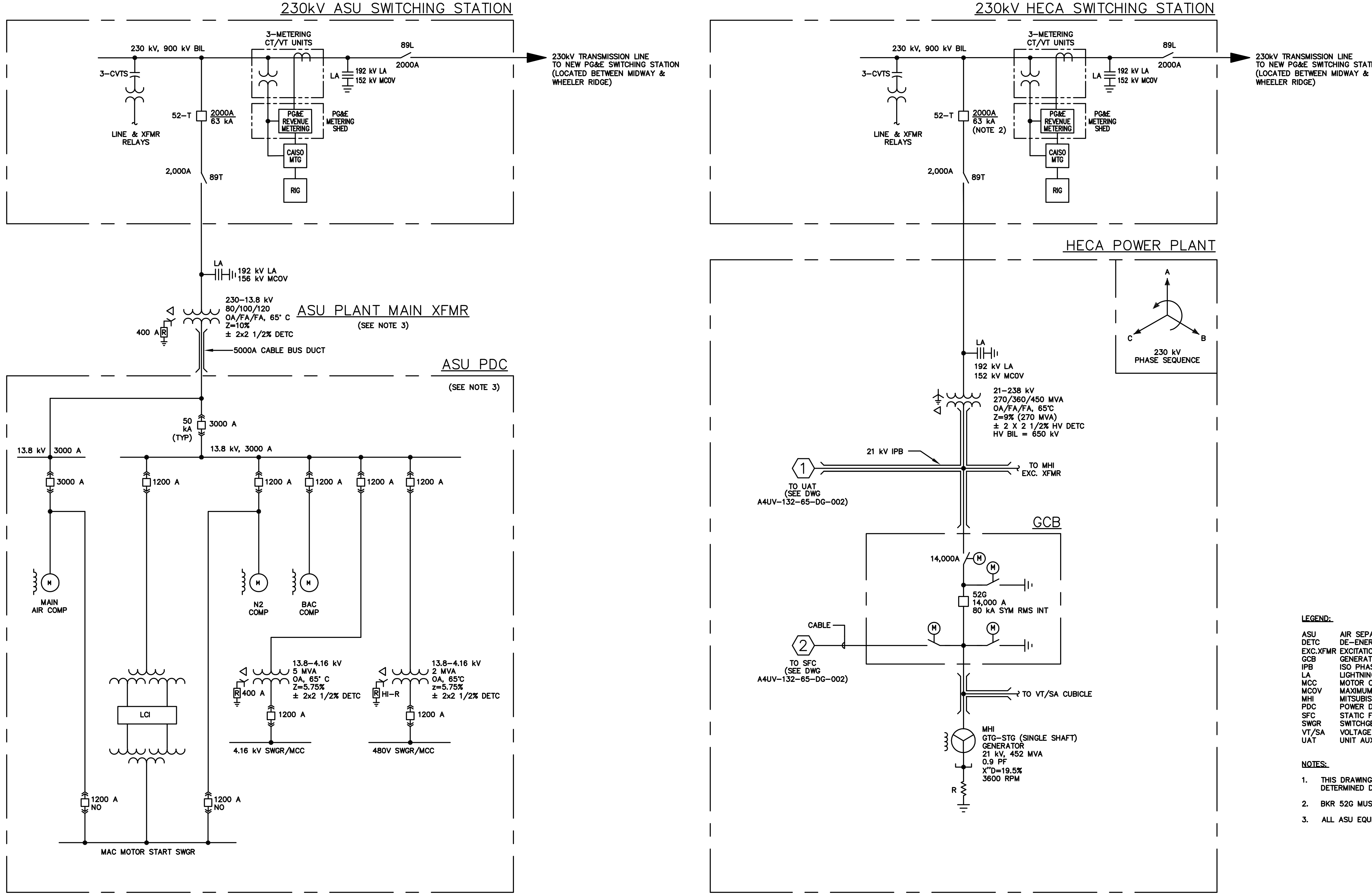
Hydrogen Energy California (HECA)
Kern County, California

URS

FIGURE 2-20

Source:
Fluor; HECA-SCS, 2012 AFC Update; Flow Diagram Power Block Systems;
Drawing No: A4UV-070-25-SK-0001, Rev. 0 (2/14/12)

4/02/12 vsa..T:\HECA-SCS 2012\GRAPHICS 2012\2.0_Proj Description\2-20_flow_dia_power_block.ai



LEGEND:

ASU	AIR SEPARATION UNIT
DETC	DE-ENERGIZED TAP CHANGER
EXC.XFMR	EXCITATION TRANSFORMER (BY MHI)
GCB	GENERATOR CIRCUIT BREAKER
IPB	ISO PHASE BUS
LA	LIGHTNING ARRESTOR
MCC	MOTOR CONTROL CENTER
MCOV	MAXIMUM CONTINUOUS OVERVOLTAGE
MHI	MITSUBISHI HEVAY INDUSTRIES
PDC	POWER DISTRIBUTION CENTER
SFC	STATIC FREQUENCY CONVERTER (BY MHI)
SWGR	SWITCHGEAR
VT/SA	VOLTAGE TRANSFORMER / SURGE ARRESTOR
UAT	UNIT AUXILIARY TRANSFORMER

NOTES:

1. THIS DRAWING IS CONCEPTUAL. EQUIPMENT RATINGS WILL BE DETERMINED DURING PROJECT DESIGN.
2. BKR 52G MUST BE OPEN TO ALLOW 52T TO CLOSE.
3. ALL ASU EQUIPMENT, SIZING AND RATINGS BY ASU PROVIDER.

Source:
Fluor; HECA-SCS, 2012 AFC Update; Electrical Overall One Line Diagram;
Drawing No: A4UV-132-65-DG-0001, Rev. A (2/08/12)

ELECTRICAL
OVERALL ONE-LINE DIAGRAM (1)

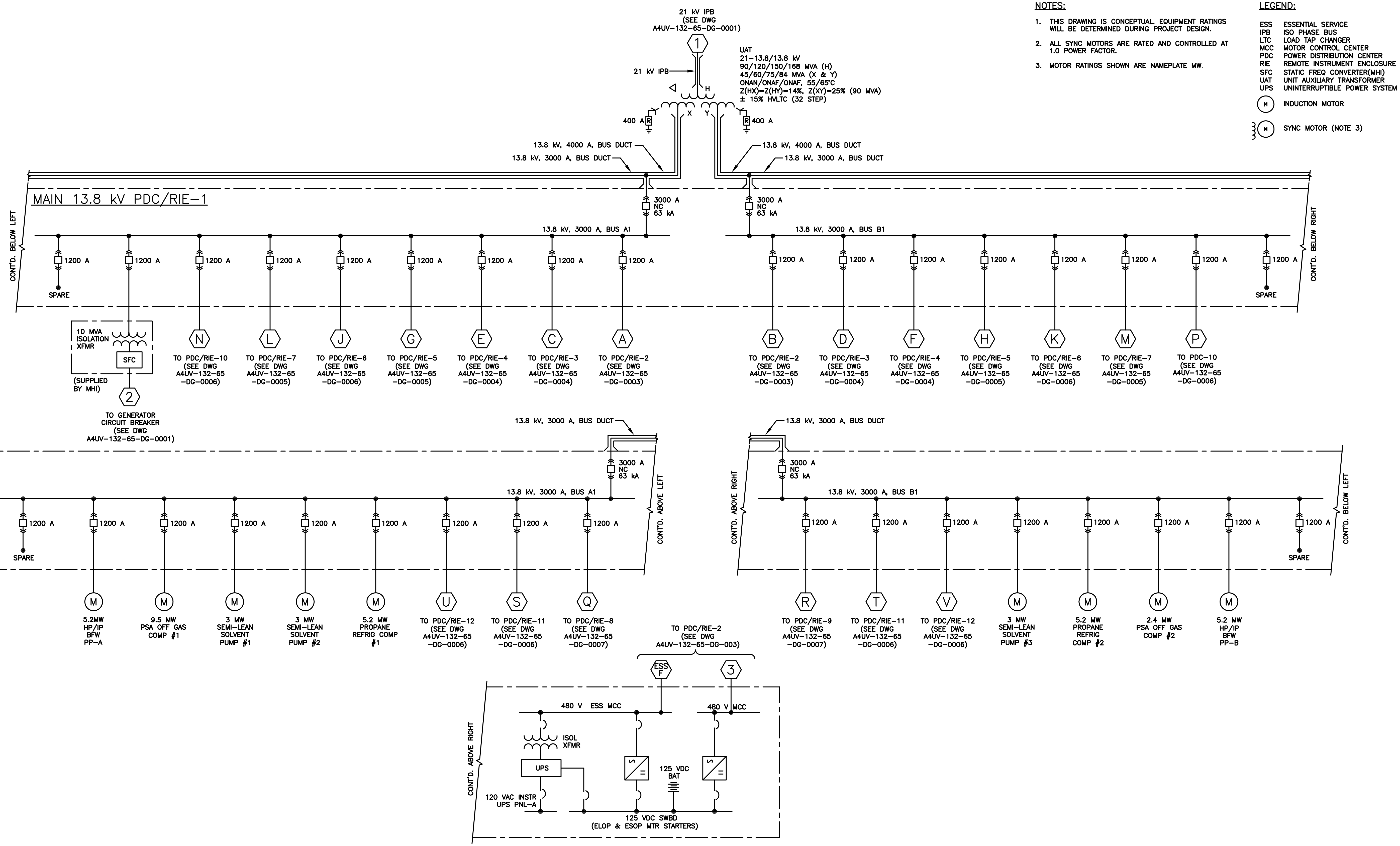
April 2012
28068052

Hydrogen Energy California (HECA)
Kern County, California

URS

FIGURE 2-21

vsa_4/17/12...U:\GIS\HECA\Projects\HECA_2012\Illustrator_Files\2-21_elect_overall_one-line_1.ai



NOTES:

1. THIS DRAWING IS CONCEPTUAL. EQUIPMENT RATINGS WILL BE DETERMINED DURING PROJECT DESIGN.
2. ALL SYNC MOTORS ARE RATED AND CONTROLLED AT 1.0 POWER FACTOR.
3. MOTOR RATINGS SHOWN ARE NAMEPLATE MW.

LEGEND:

ESS ESSENTIAL SERVICE
IPB ISO PHASE BUS
LTC LOAD TAP CHANGER
MCC MOTOR CONTROL CENTER
PDC POWER DISTRIBUTION CENTER
RIE REMOTE INSTRUMENT ENCLOSURE
SFC STATIC FREQ CONVERTER(MHI)
UAT UNIT AUXILIARY TRANSFORMER
UPS UNINTERRUPTIBLE POWER SYSTEM
(M) INDUCTION MOTOR
(M) SYNC MOTOR (NOTE 3)

Source:
Fluor; HECA-SCS, 2012 AFC Update; Electrical Overall One Line Diagram;
Drawing No: A4UV-132-65-DG-0002, Rev. A (2/08/12)

ELECTRICAL
OVERALL ONE-LINE DIAGRAM (2)

April 2012
28068052

Hydrogen Energy California (HECA)
Kern County, California

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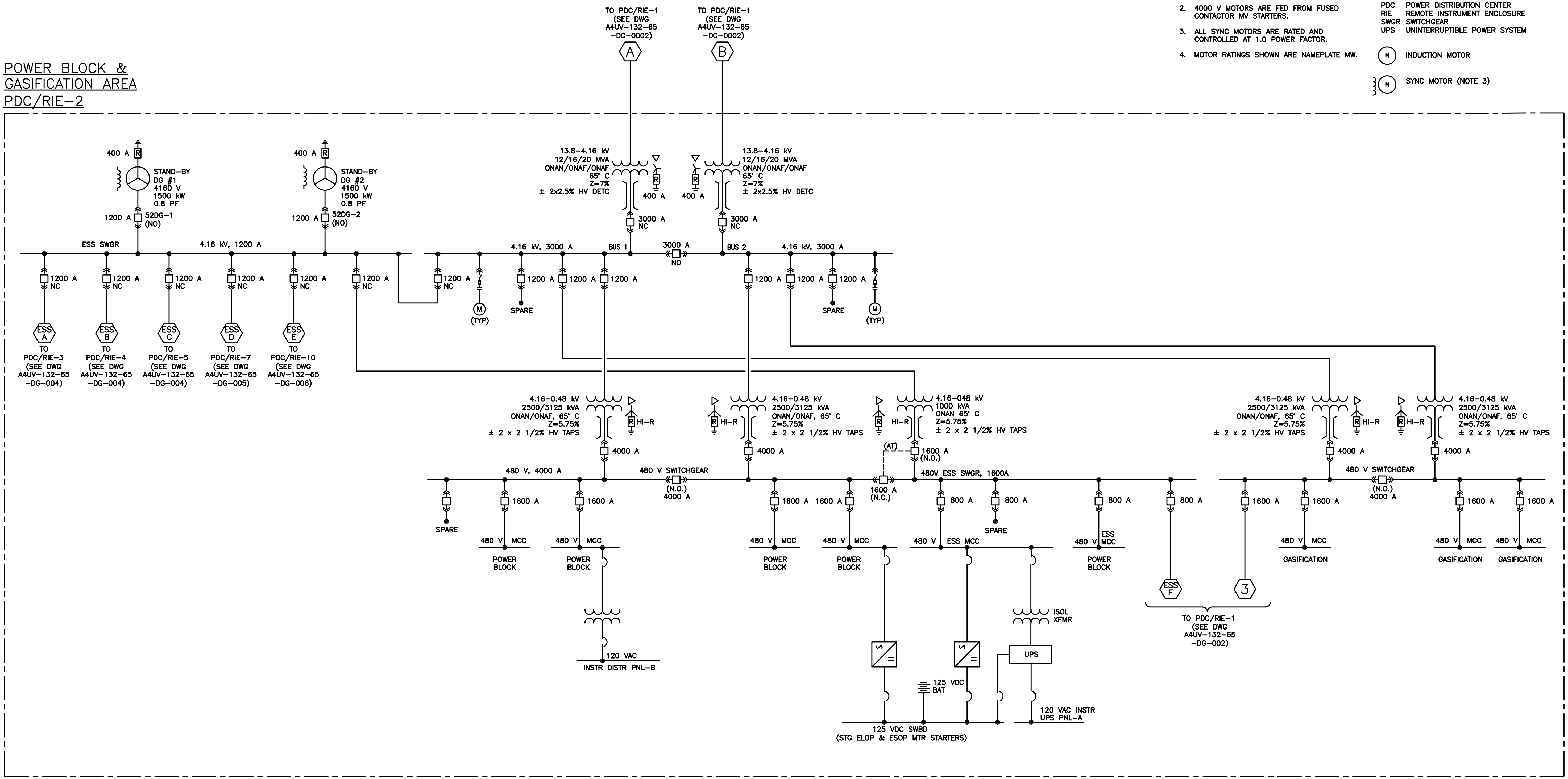
FIGURE 2-22

NOTES:

1. THIS DRAWING IS CONCEPTUAL. EQUIPMENT RATINGS WILL BE DETERMINED DURING PROJECT DESIGN.
2. 4000 V MOTORS ARE FED FROM FUSED CONTACTOR MV STARTERS.
3. ALL SYNC MOTORS ARE RATED AND CONTROLLED AT 1.0 POWER FACTOR.
4. MOTOR RATINGS SHOWN ARE NAMEPLATE MW.

LEGEND:

DETC	DEENERGISED TAP CHANGER
ESS	ESSENTIAL SERVICE
MCC	MOTOR CONTROL CENTER
PDC	POWER DISTRIBUTION CENTER
RIE	REMOTE INSTRUMENT ENCLOSURE
SWGR	SWITCHGEAR
UPS	UNINTERRUPTIBLE POWER SYSTEM
(M)	INDUCTION MOTOR
(M)	SYNC MOTOR (NOTE 3)



Source:
Fluor; HECA-SCS, 2012 AFC Update; Electrical Overall One Line Diagram;
Drawing No: A4UV-132-65-DG-0003, Rev. A (2/08/12)

ELECTRICAL
OVERALL ONE-LINE DIAGRAM (3)

April 2012
28068052

Hydrogen Energy California (HECA)
Kern County, California

URS

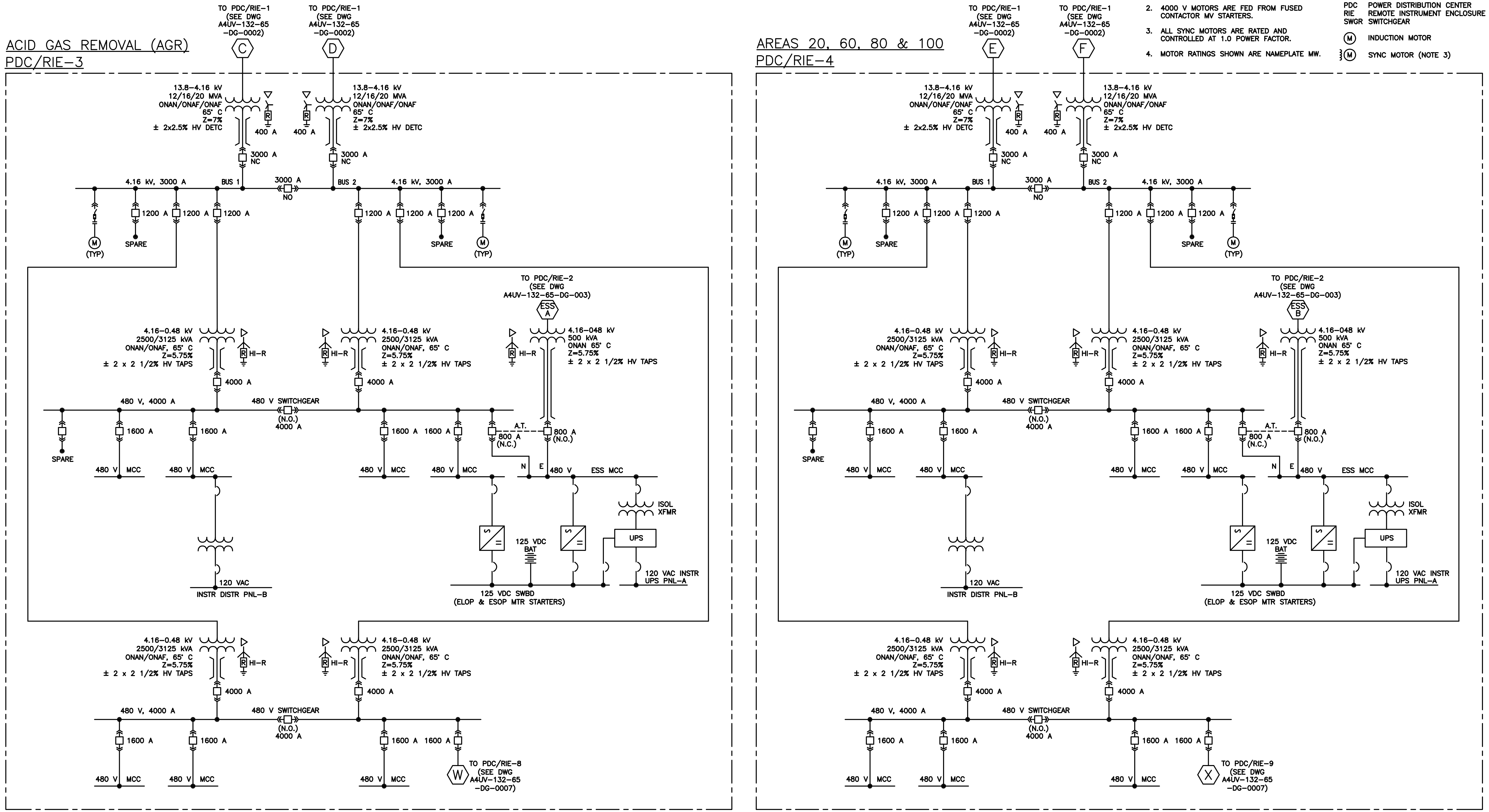
FIGURE 2-23

NOTES:

1. THIS DRAWING IS CONCEPTUAL. EQUIPMENT RATINGS WILL BE DETERMINED DURING PROJECT DESIGN.
2. 4000 V MOTORS ARE FED FROM FUSED CONTACTOR MV STARTERS.
3. ALL SYNC MOTORS ARE RATED AND CONTROLLED AT 1.0 POWER FACTOR.
4. MOTOR RATINGS SHOWN ARE NAMEPLATE MW.

LEGEND:

DETC	DEENERGIZED TAP CHANGER
ESS	ESSENTIAL SERVICE
MCC	MOTOR CONTROL CENTER
PDC	POWER DISTRIBUTION CENTER
RIE	REMOTE INSTRUMENT ENCLOSURE
SWGR	SWITCHGEAR
(M)	INDUCTION MOTOR
(M)	SYNC MOTOR (NOTE 3)



Source:
Fluor; HECA-SCS, 2012 AFC Update; Electrical Overall One Line Diagram;
Drawing No: A4UV-132-65-DG-0004, Rev. A (2/08/12)

ELECTRICAL
OVERALL ONE-LINE DIAGRAM (4)

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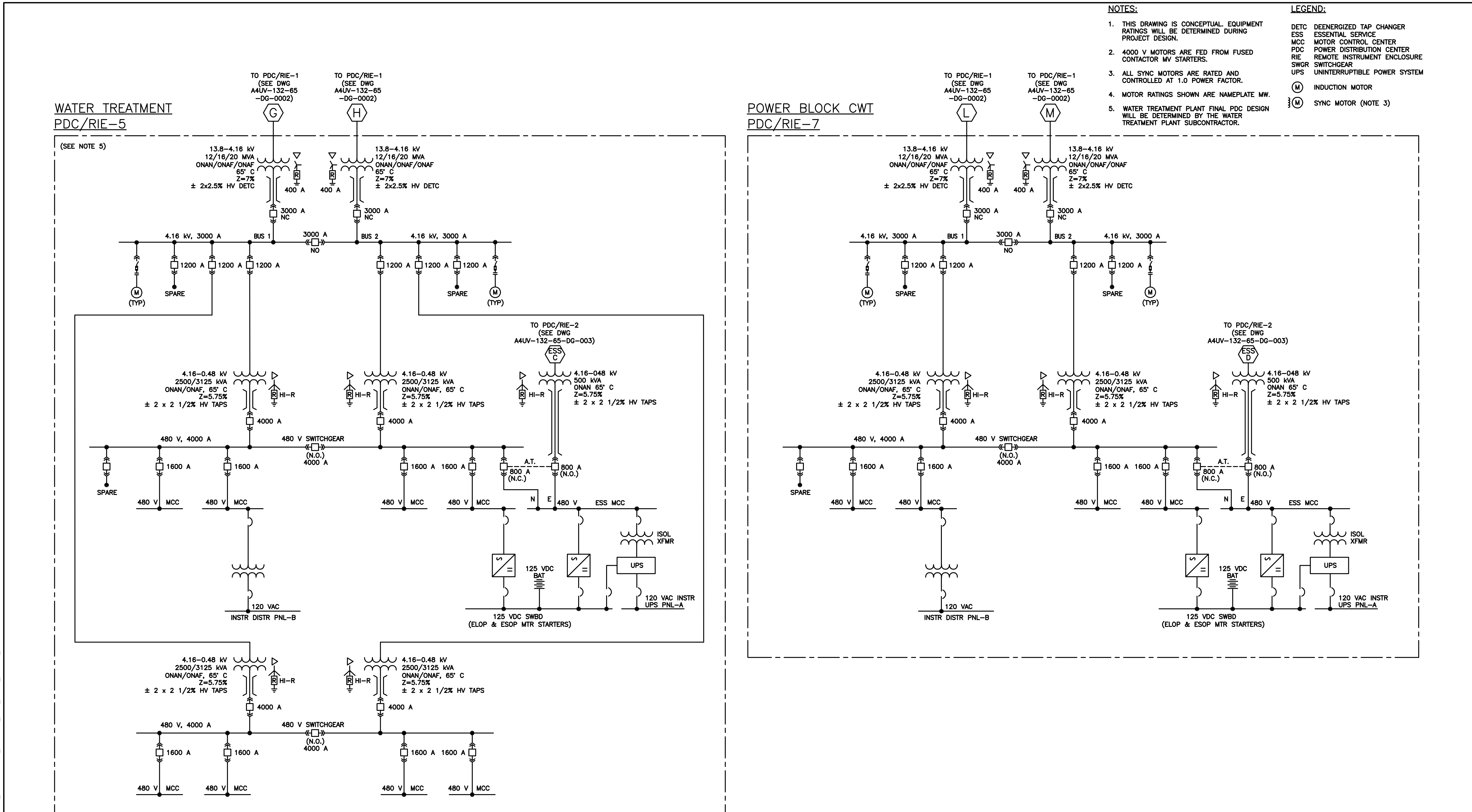
28068052

Hydrogen Energy California (HECA)
Kern County, California

URS

FIGURE 2-24

vsa_4/02/12..U:\GIS\HECA\Projects\HECA_2012\Illustrator_Files\2-24_elect_overall_one-line_4.ai



ELECTRICAL
OVERALL ONE-LINE DIAGRAM (5)

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Kern County, California

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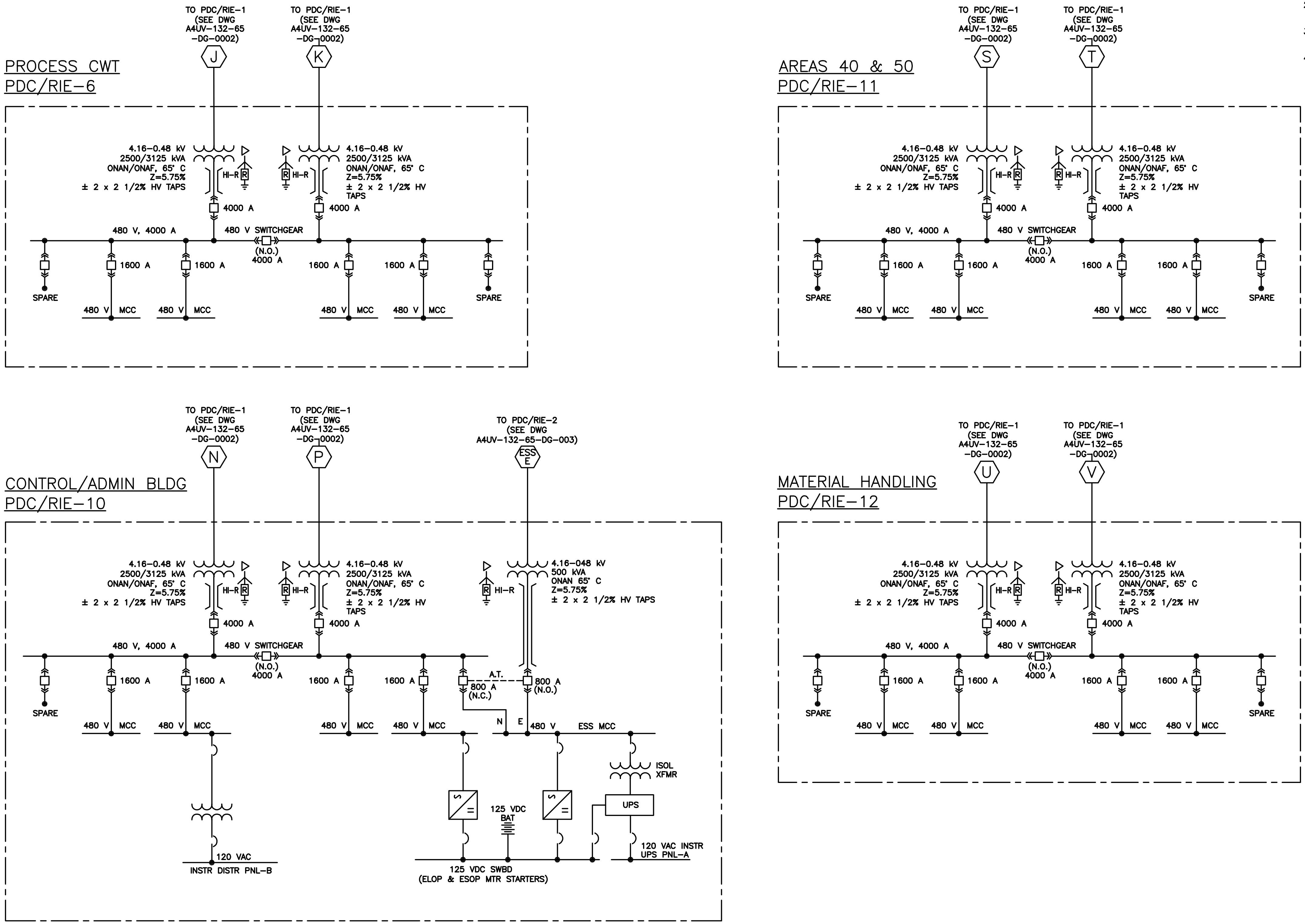
FIGURE 2-25

Source:
Fluor; HECA-SCS, 2012 AFC Update; Electrical Overall One Line Diagram;
Drawing No: A4UV-132-65-DG-0005, Rev. A (2/08/12)

vsa_4/02/12...U:\GIS\HECA\Projects\HECA_2012\Illustrator_Files\2-25_elect_overall_one-line_5.ai



NOTES:

1. THIS DRAWING IS CONCEPTUAL. EQUIPMENT RATINGS WILL BE DETERMINED DURING PROJECT DESIGN.
2. 4000 V MOTORS ARE FED FROM FUSED CONTACTOR MV STARTERS.
3. ALL SYNC MOTORS ARE RATED AND CONTROLLED AT 1.0 POWER FACTOR.
4. MOTOR RATINGS SHOWN ARE NAMEPLATE MW.

LEGEND:

DETC	DEENERGIZED TAP CHANGER
ESS	ESSENTIAL SERVICE
MCC	MOTOR CONTROL CENTER
PDC	POWER DISTRIBUTION CENTER
RIE	REMOTE INSTRUMENT ENCLOSURE
SWGR	SWITCHGEAR
UPS	UNINTERRUPTIBLE POWER SYSTEM
(M)	INDUCTION MOTOR
(M)	SYNC MOTOR (NOTE 3)

Source:
Fluor; HECA-SCS, 2012 AFC Update; Electrical Overall One Line Diagram;
Drawing No: A4UV-132-65-DG-0006, Rev. A (2/08/12)

ELECTRICAL
OVERALL ONE-LINE DIAGRAM (6)

April 2012
28068052

Hydrogen Energy California (HECA)
Kern County, California

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FIGURE 2-26

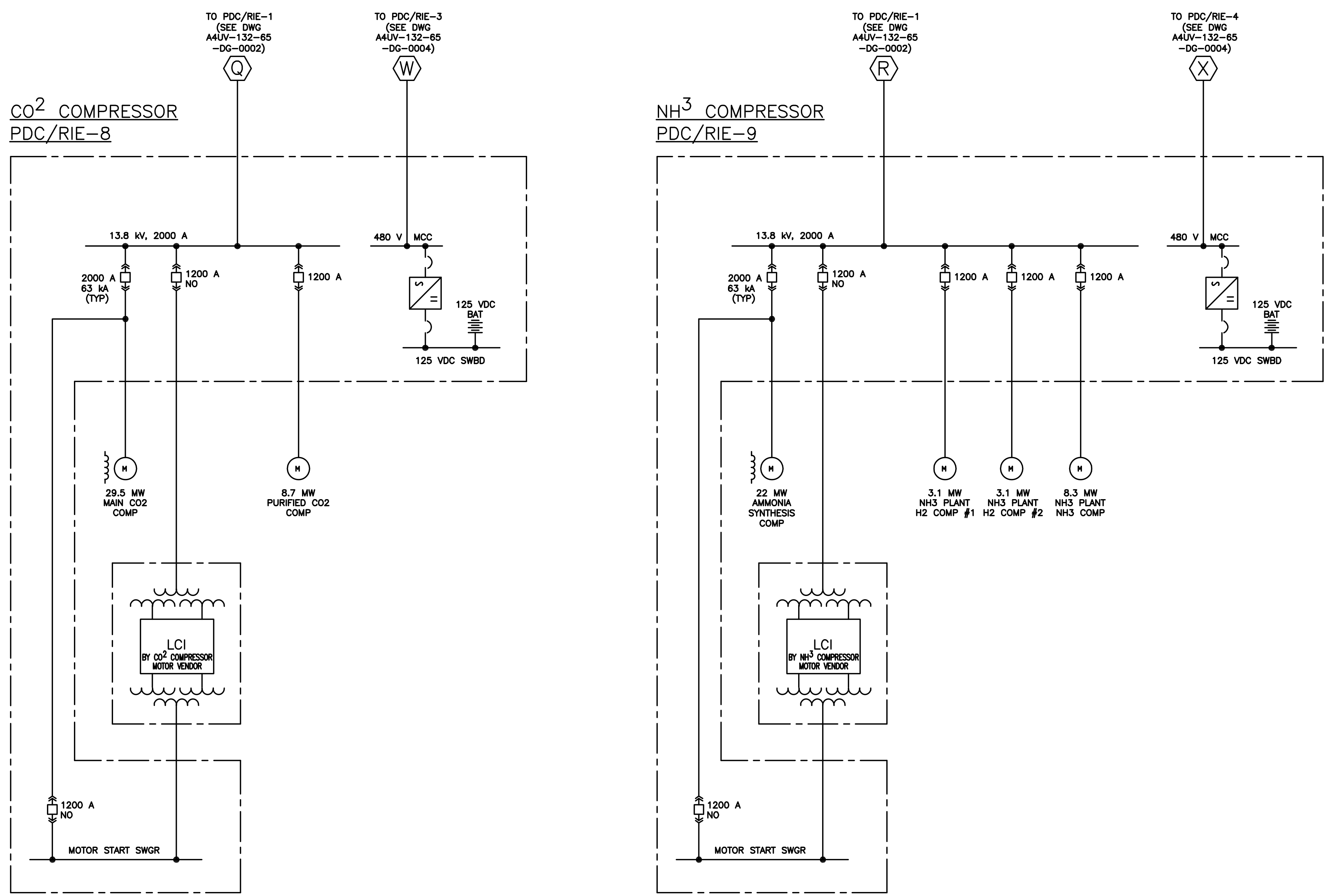
vsa_4/02/12...U:\GIS\HECA\Projects\HECA_2012\Illustrator_Files\2-26_elect_overall_one-line_6.ai

NOTES:

1. THIS DRAWING IS CONCEPTUAL. EQUIPMENT RATINGS WILL BE DETERMINED DURING PROJECT DESIGN.
2. ALL SYNC MOTORS ARE RATED AND CONTROLLED AT 1.0 POWER FACTOR.
3. MOTOR RATINGS SHOWN ARE NAMEPLATE MW.

LEGEND:

ESS ESSENTIAL SERVICE
LCI LOAD COMMUTATED INVERTER
MCC MOTOR CONTROL CENTER
PDC POWER DISTRIBUTION CENTER
RIE REMOTE INSTRUMENT ENCLOSURE
SWGR SWITCHGEAR
(M) INDUCTION MOTOR
(M) SYNC MOTOR (NOTE 3)



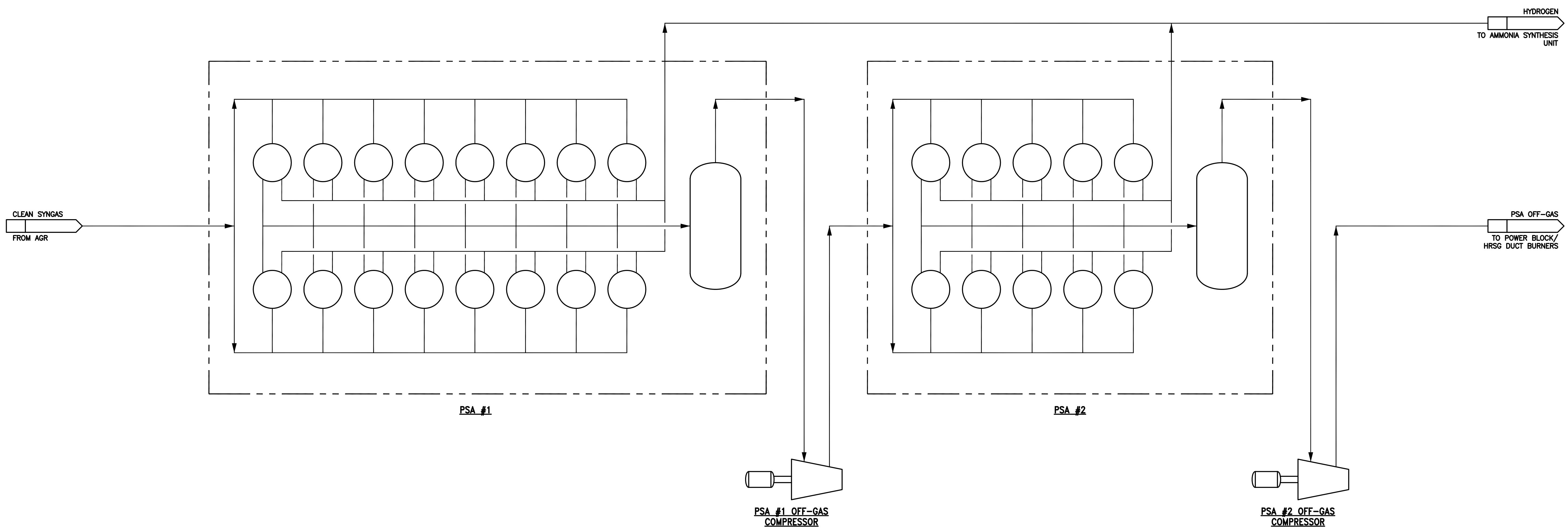
Source:
Fluor; HECA-SCS, 2012 AFC Update; Electrical Overall One Line Diagram;
Drawing No: A4UV-132-65-DG-0007, Rev. A (2/08/12)

ELECTRICAL
OVERALL ONE-LINE DIAGRAM (7)

April 2012
28068052

Hydrogen Energy California (HECA)
Kern County, California

FIGURE 2-27



Source:
Fluor; HECA-SCS, 2012 AFC Update; Flow Diagram PSA and Off-Gas Compression Systems;
Drawing No: A4UV-060-25-SK-0001, Rev. 0 (2/14/12)

FLOW DIAGRAM
PSA AND OFF-GAS COMPRESSION SYSTEMS

April 2012
28068052

Hydrogen Energy California (HECA)
Kern County, California

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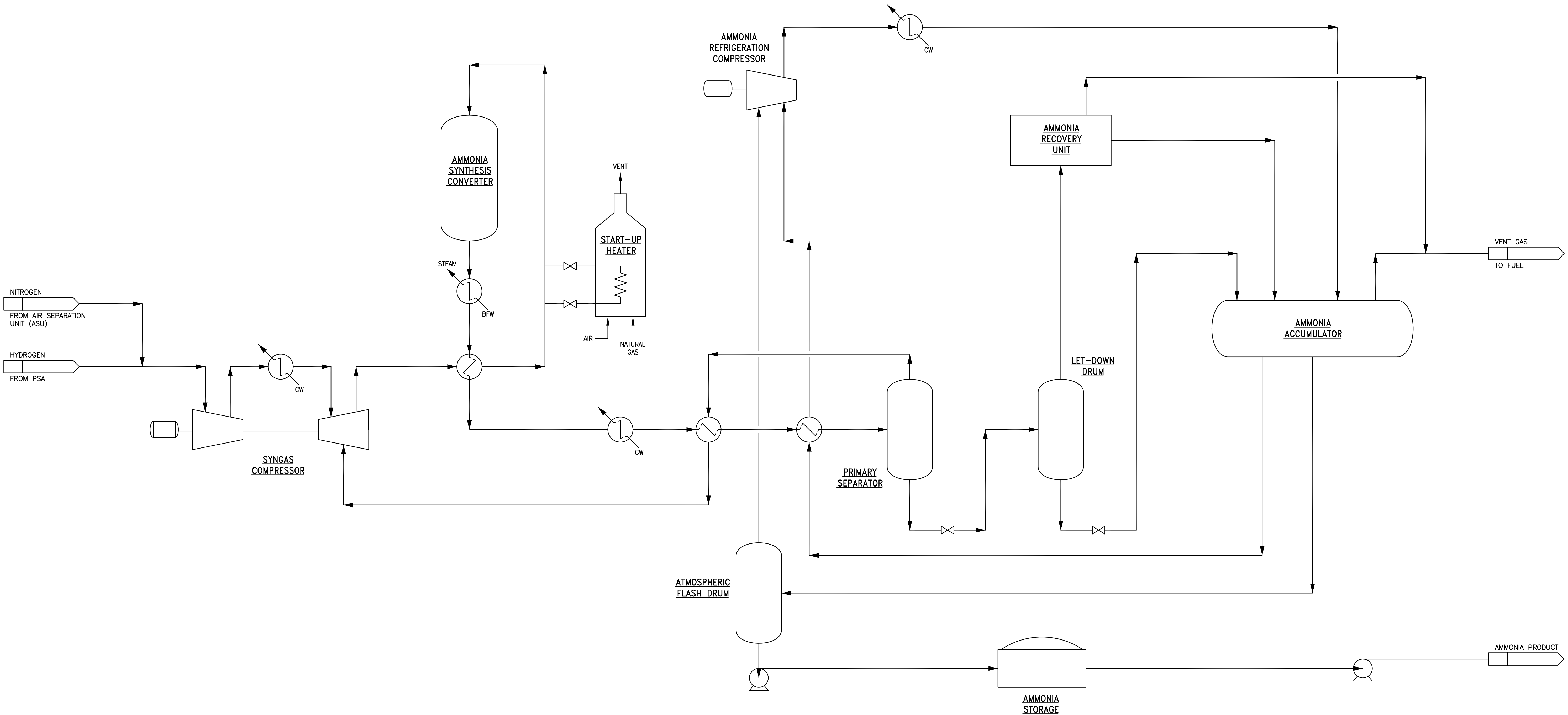
FIGURE 2-28

vsa_4/02/12...U:\GIS\HECA\Projects\HECA_2012\Illustrator_Files\2-28_flow_dia_PSA.ai



Source:
Fluor; HECA-SCS, 2012 AFC Update; Flow Diagram Ammonia Synthesis Unit;
Drawing No: A4UV-080-25-SK-0001, Rev. 1 (3/29/12)

FLOW DIAGRAM
AMMONIA SYNTHESIS UNIT

April 2012
28068052

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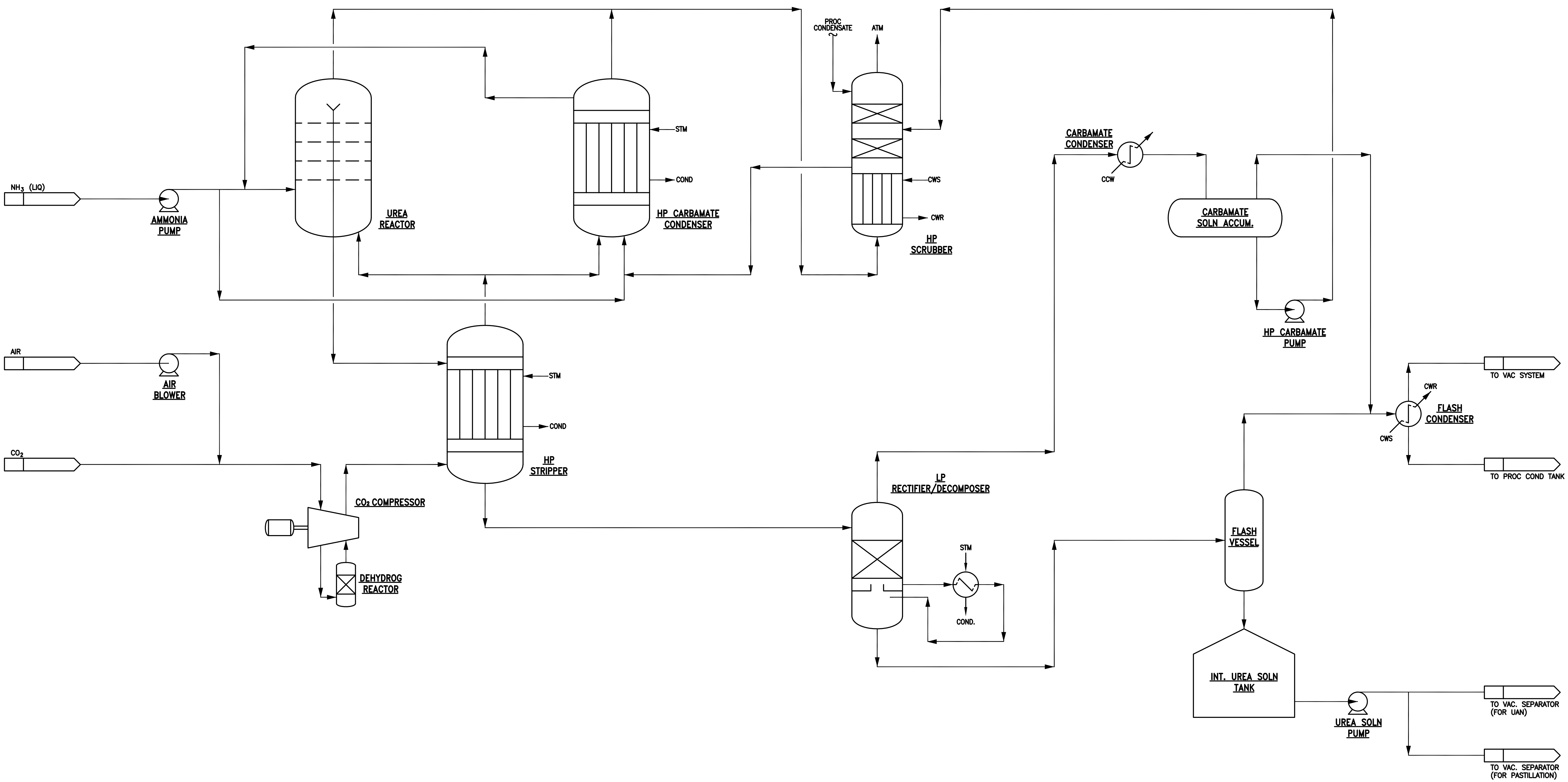
Kern County, California

URS

FIGURE 2-29

vsa_4/11/12...U:\GIS\HECA\Projects\HECA_2012\Illustrator_Files\2-29_flow_dia_ammonia_syn.ai



FLOW DIAGRAM
UREA UNIT - SYNTHESIS

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Kern County, California

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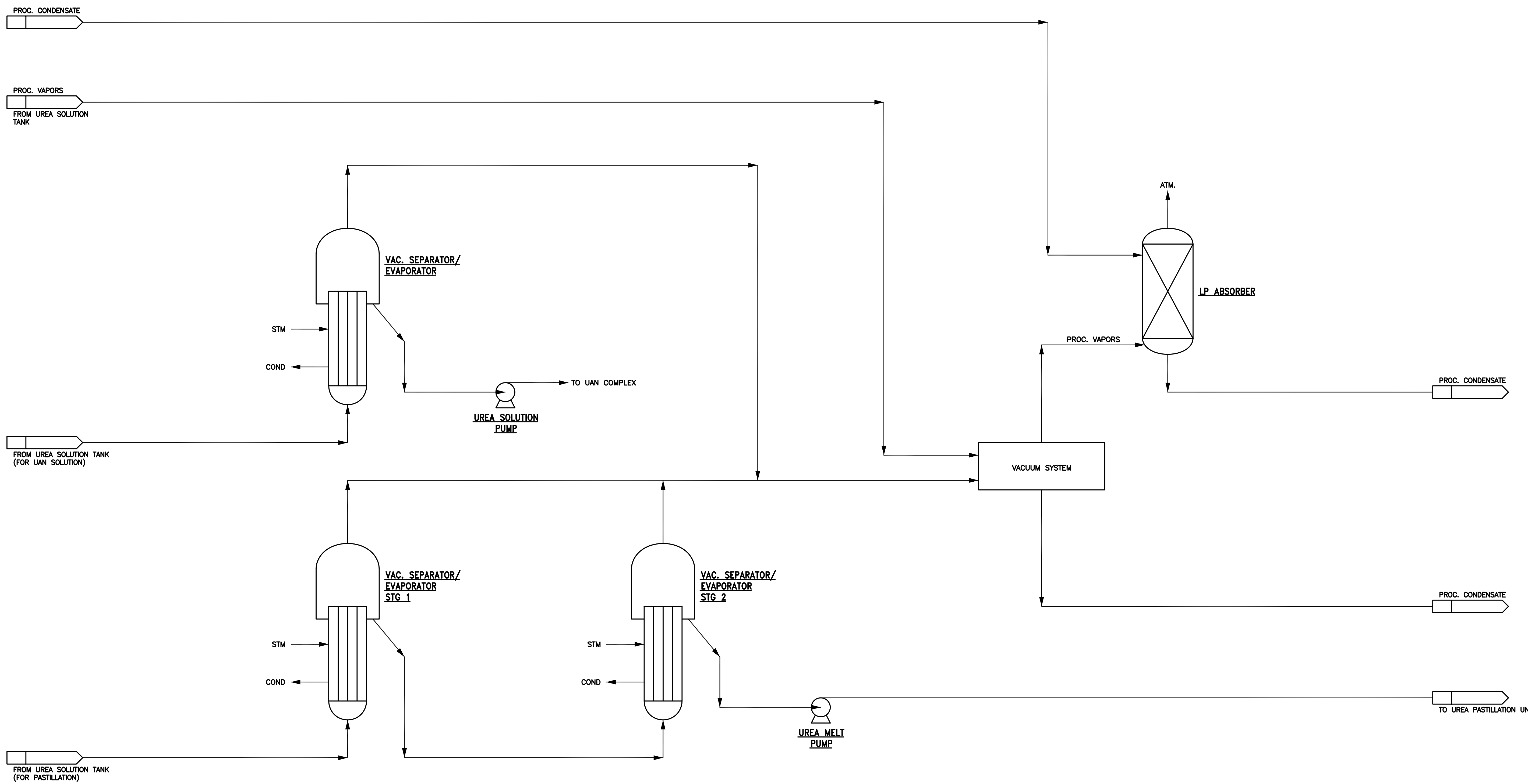
FIGURE 2-30

Source:
Fluor; HECA-SCS, 2012 AFC Update; Flow Diagram Urea Unit - Synthesis;
Drawing No: A4UV-080-25-SK-0002, Rev. 0 (2/14/12)

vsa_4/02/12...vsa_3/21/12...U:\GIS\HECA\Projects\HECA_2012\Illustrator_Files\2-30_flow_dia_urea_syn.ai



Source:
Fluor; HECA-SCS, 2012 AFC Update; Flow Diagram Urea Unit - Concentration;
Drawing No: A4UV-080-25-SK-0003, Rev. 0 (2/14/12)

FLOW DIAGRAM
UREA UNIT - CONCENTRATION

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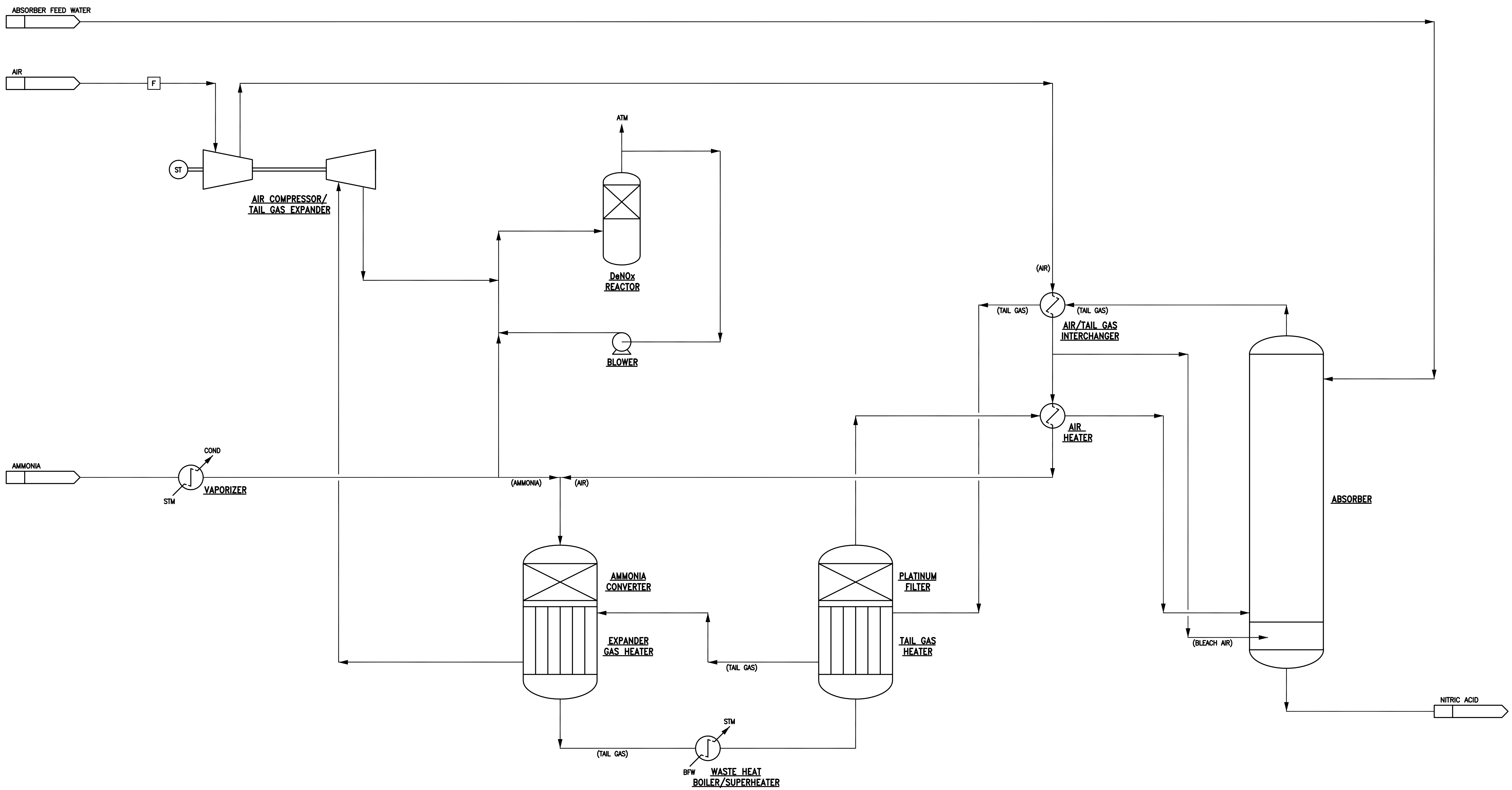
28068052

Hydrogen Energy California (HECA)
Kern County, California

URS

FIGURE 2-31

vsa_4/02/12...U:\GIS\HECA\Projects\HECA_2012\Illustrator_Files\2-31_flow_dia_urea_conc.ai



vsa_4/11/12...U:\GIS\HECA\Projects\HECA_2012\Illustrator_Files\2-32_flow_dia_nitric.ai

Source:
Fluor; HECA-SCS, 2012 AFC Update; Flow Diagram Nitric Acid Unit;
Drawing No: A4UV-080-25-SK-0004, Rev. 0 (2/14/12)

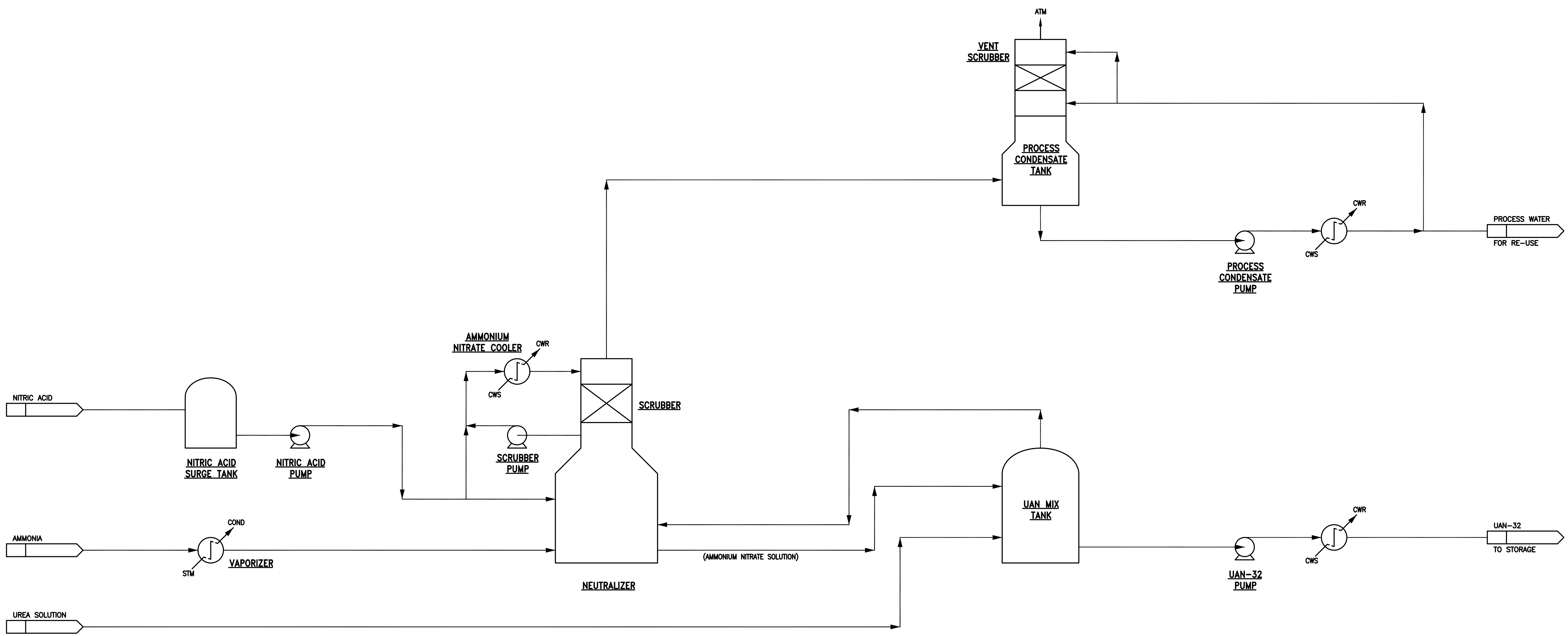
FLOW DIAGRAM
NITRIC ACID UNIT

April 2012
28068052

Hydrogen Energy California (HECA)
Kern County, California

URS

FIGURE 2-32



Source:
Fluor; HECA-SCS, 2012 AFC Update; Flow Diagram Ammonium Nitrate/UAN Units;
Drawing No: A4UV-080-25-SK-0005, Rev. 0 (2/14/12)

FLOW DIAGRAM
AMMONIUM NITRATE/UAN UNITS

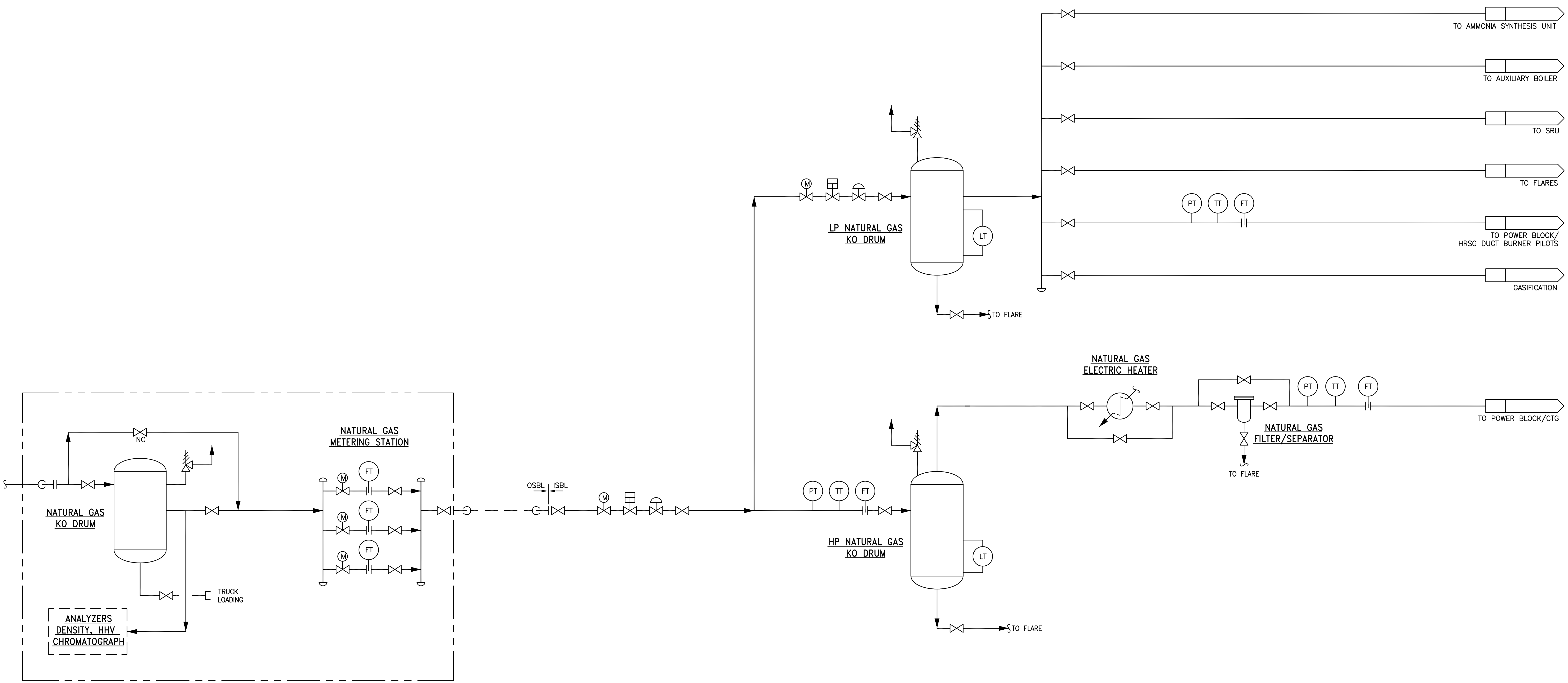
April 2012
28068052

Hydrogen Energy California (HECA)
Kern County, California

URS

FIGURE 2-33

vsa_4/02/12...U:\GIS\HECA\Projects\HECA_2012\Illustrator_Files\2-33_flow_dia_ammon_nitrate_UAN.ai



Source:
Fluor; HECA-SCS, 2012 AFC Update; Flow Diagram Natural Gas System;
Drawing No: A4UV-100-25-SK-0004, Rev. 1 (3/29/12)

FLOW DIAGRAM
NATURAL GAS SYSTEM

April 2012
28068052

Hydrogen Energy California (HECA)
Kern County, California

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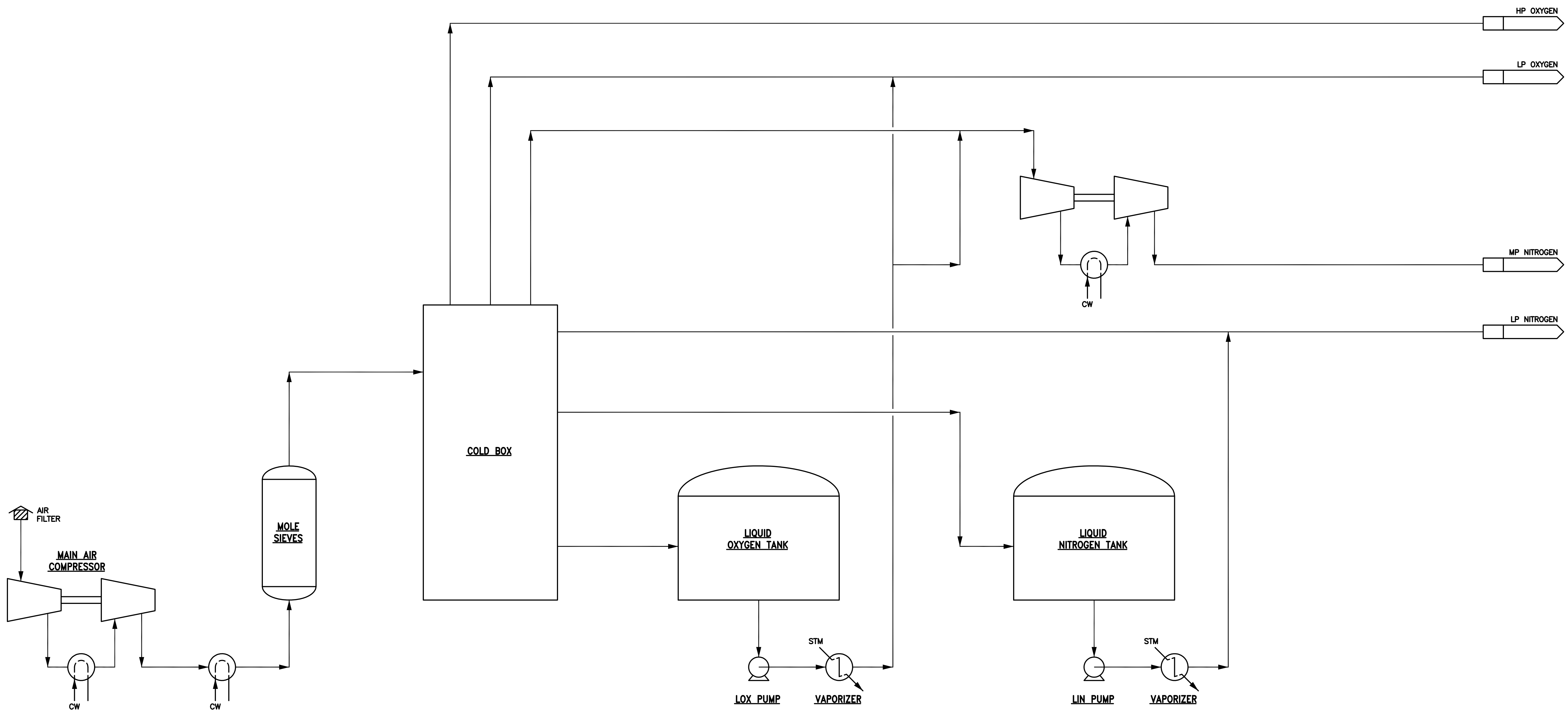
FIGURE 2-34



Source:
Fluor; HECA-SCS, 2012 AFC Update; Flow Diagram Air Separation Unit;
Drawing No: A4UV-150-25-SK-0001, Rev. 0 (2/14/12)

FLOW DIAGRAM
AIR SEPARATION UNIT

April 2012
28068052

Hydrogen Energy California (HECA)
Kern County, California

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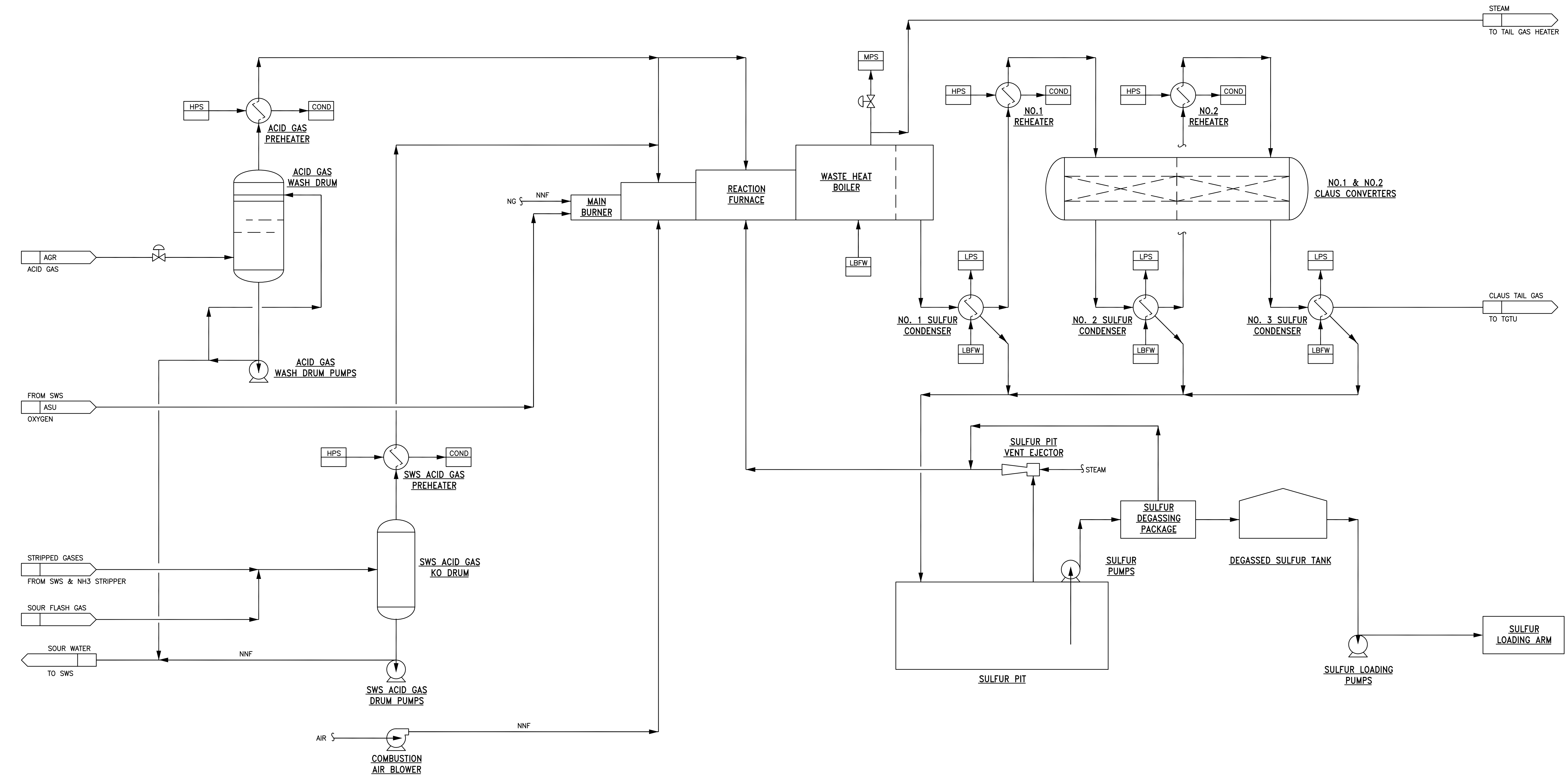
FIGURE 2-35

vsa_4/02/12...U:\GIS\HECA\Projects\HECA_2012\Illustrator_Files\2-35_flow_dia_air_separation.ai



FLOW DIAGRAM
SULFUR RECOVERY UNIT

April 2012
28068052

Hydrogen Energy California (HECA)
Kern County, California

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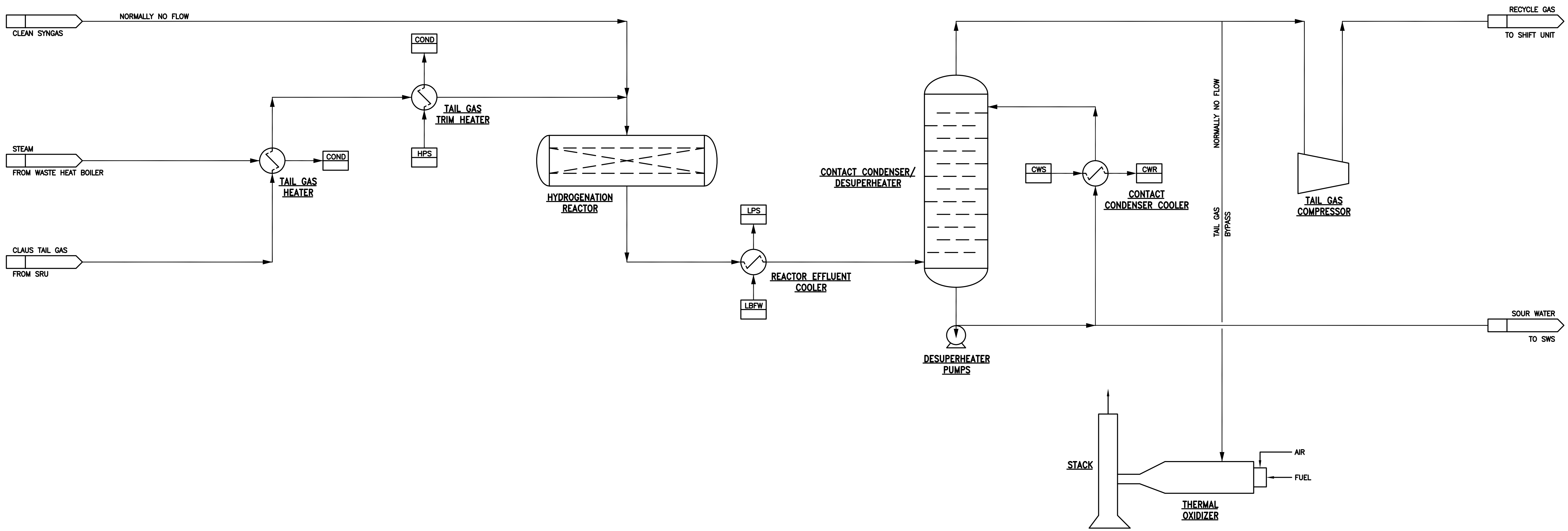
FIGURE 2-36

Source:
Fluor; HECA-SCS, 2012 AFC Update; Flow Diagram Sulfur Recovery Unit;
Drawing No: A4UV-050-25-SK-0001, Rev. 1 (3/29/12)



Source:
Fluor; HECA-SCS, 2012 AFC Update; Flow Diagram Tail Gas Treating Unit;
Drawing No: A4UV-050-25-SK-0002, Rev. 0 (2/14/12)

FLOW DIAGRAM
TAIL GAS TREATING UNIT

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28068052

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Kern County, California

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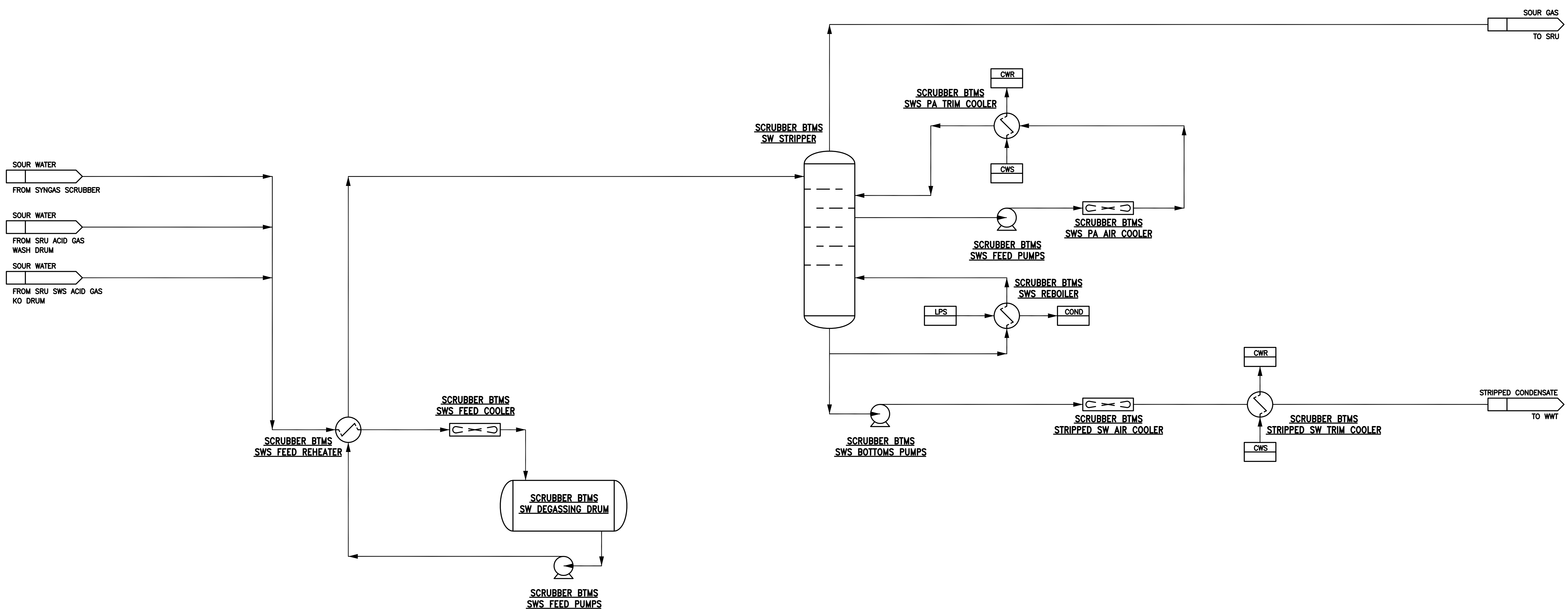
FIGURE 2-37



Source:
Fluor; HECA-SCS, 2012 AFC Update; Flow Diagram Scrubber Bottoms Sour Water Stripper;
Drawing No: A4UV-020-25-SK-0004, Rev. 0 (2/14/12)

FLOW DIAGRAM
SCRUBBER BOTTOMS SOUR WATER STRIPPER

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28068052

Hydrogen Energy California (HECA)
Kern County, California

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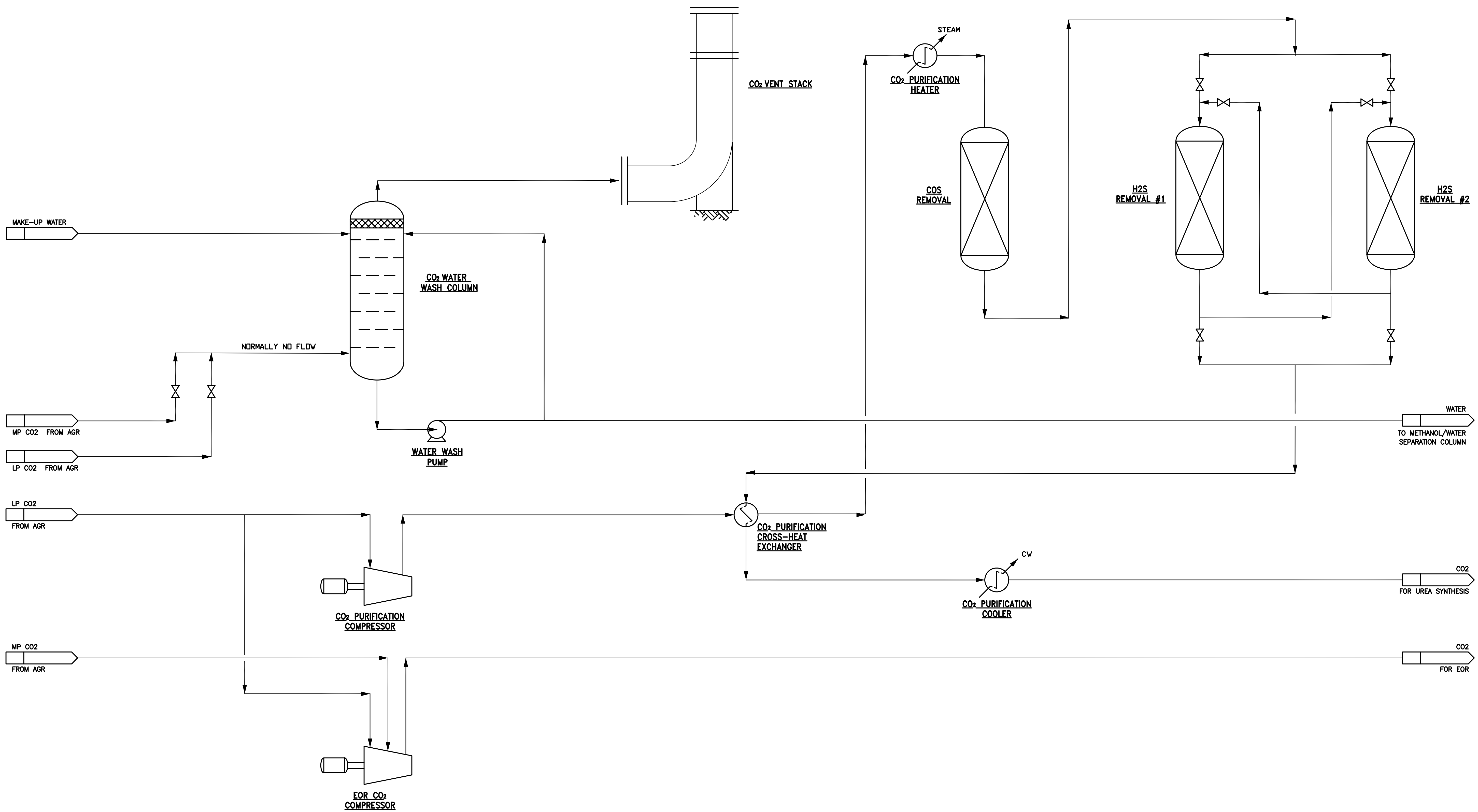
FIGURE 2-38

vsa_4/02/12...U:\GIS\HECA\Projects\HECA_2012\Illustrator_Files\2-38_flow_dia_scrubber_stripper.ai



Source:
Fluor; HECA-SCS, 2012 AFC Update; Flow Diagram CO2 Compression and Purification Systems;
Drawing No: A4UV-040-25-SK-0001, Rev. 0 (2/14/12)

FLOW DIAGRAM
CO_2 COMPRESSION AND PURIFICATION SYSTEMS

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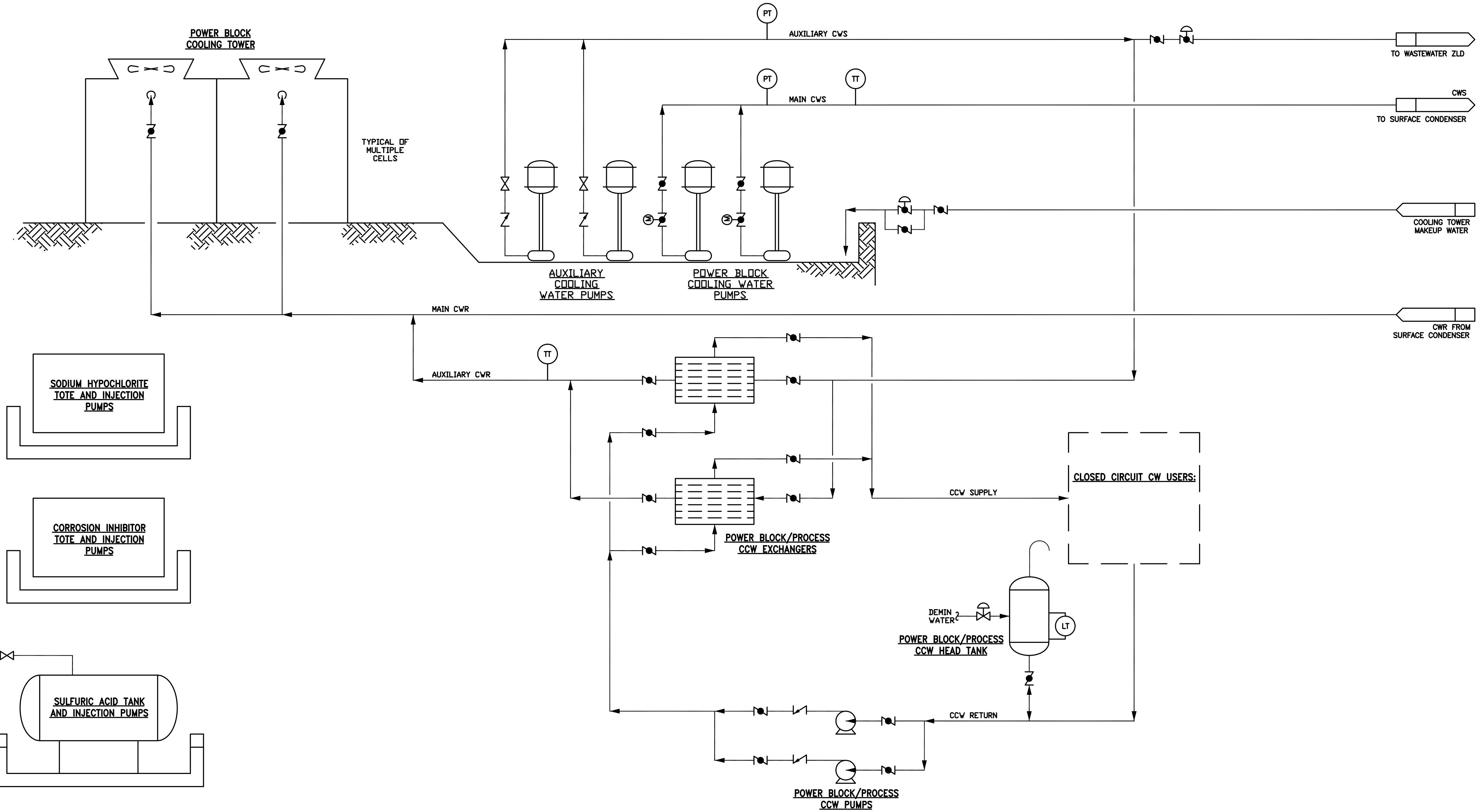
28068052

Hydrogen Energy California (HECA)
Kern County, California

URS

FIGURE 2-39

vsa_4/02/12...U:\GIS\HECA\Projects\HECA_2012\Illustrator_Files\2-39_flow_dia_CO2_compression.ai



Source:
Fluor; HECA-SCS, 2012 AFC Update; Flow Diagram Power Block Cooling Water System;
Drawing No: A4UV-100-25-SK-0005, Rev. 0 (2/14/12)

FLOW DIAGRAM
POWER BLOCK COOLING WATER SYSTEM

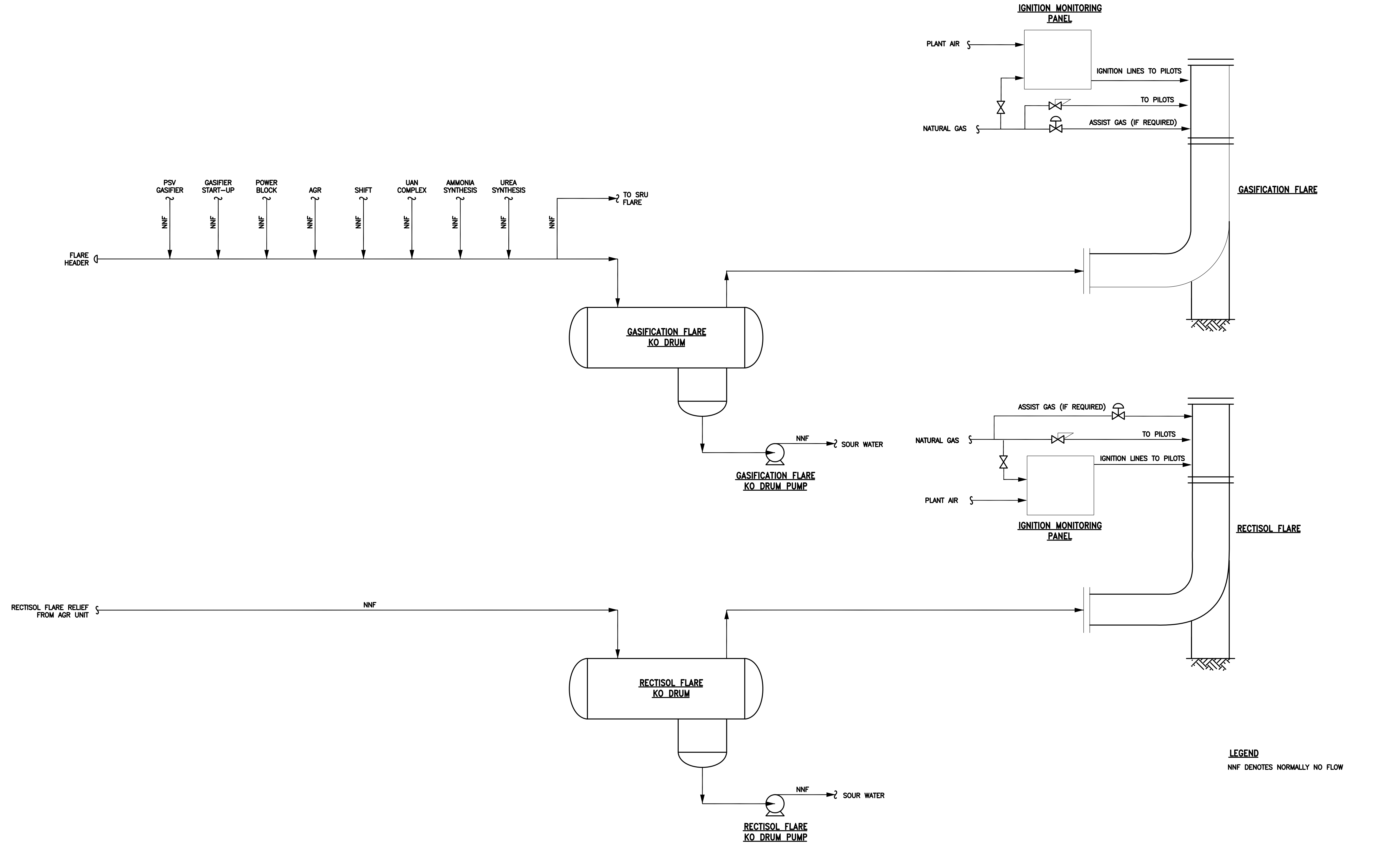
April 2012
28068052

Hydrogen Energy California (HECA)
Kern County, California

URS

FIGURE 2-40

vsa_4/02/12...U:\GIS\HECA\Projects\HECA_2012\Illustrator_Files\2-40_flow_dia_pb_cooling_water.ai



FLOW DIAGRAM
GASIFICATION AND RECTISOL FLARE SYSTEMS

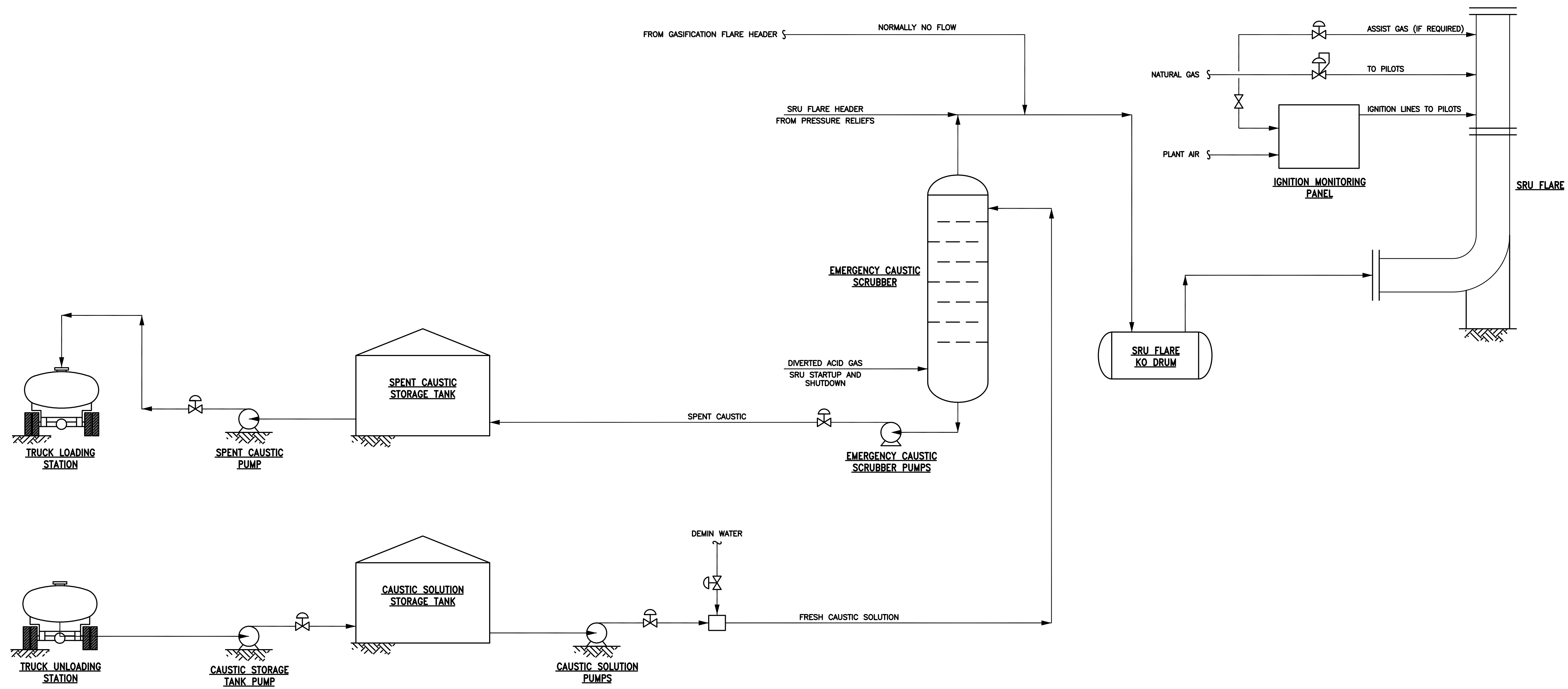
April 2012
28068052

Hydrogen Energy California (HECA)
Kern County, California

URS

FIGURE 2-41

Source:
Fluor; HECA-SCS, 2012 AFC Update; Flow Diagram Gasification and Rectisol Flare Systems;
Drawing No: A4UV-100-25-SK-0001, Rev. 0 (2/14/12)



FLOW DIAGRAM
SRU FLARE SYSTEM

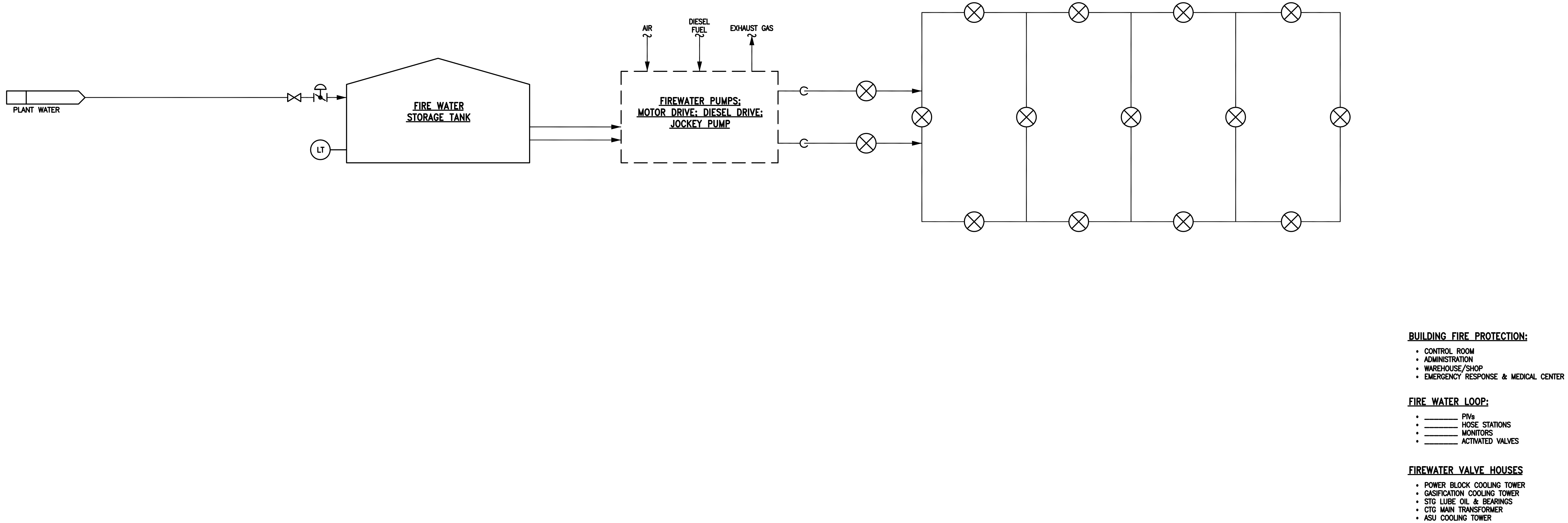
April 2012
28068052

Hydrogen Energy California (HECA)
Kern County, California

URS

FIGURE 2-42

Source:
Fluor; HECA-SCS, 2012 AFC Update; Flow Diagram SRU Flare System;
Drawing No: A4UV-100-25-SK-0002, Rev. 0 (2/14/12)



Source:
Fluor; HECA-SCS, 2012 AFC Update; Flow Diagram Fire Water System;
Drawing No: A4UV-100-25-SK-0003, Rev. 0 (2/14/12)

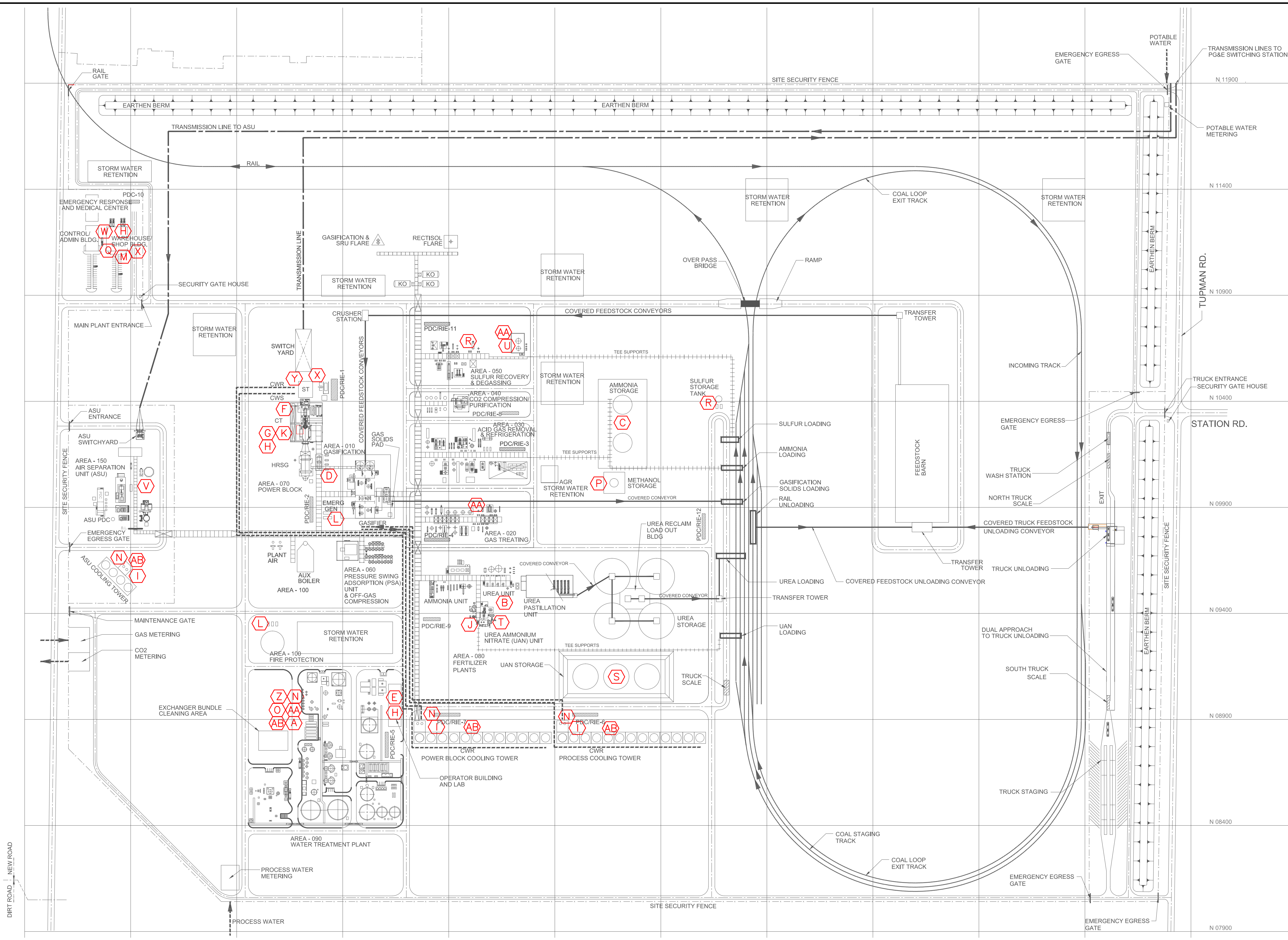
FLOW DIAGRAM
FIRE WATER SYSTEM

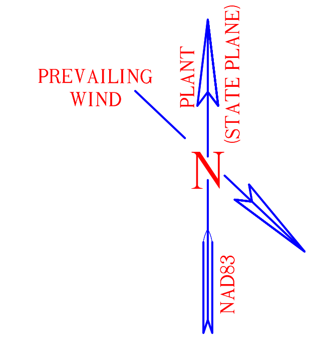
April 2012
28068052

Hydrogen Energy California (HECA)
Kern County, California

URS

FIGURE 2-43





PLANT COORDINATE AND DATUM NOTES

1. PLANT COORDINATES IN FEET EQUATE TO E. 61XXXXX AND N. 23YYYYY OF CALIFORNIA STATE PLANE COORDINATE SYSTEM (NAD 83 ZONE V.)
2. PLANT ELEVATION 100.00' EQUATE TO 288.50' ABOVE MSL (NAVD88.)

⬡ STORED HAZARDOUS MATERIAL

ID	DESCRIPTION
A	WATER TREATMENT CHEMICALS
B	AMMONIUM NITRATE SOLN
C	AMMONIA
D	BOILER FEEDWATER CHEMICALS
E	CHEMICAL REAGENTS (ACIDS/BASES/STANDARDS)
F	COMBUSTION TURBINE WASH CHEMICALS
G	COMPRESSED CARBON DIOXIDE GAS
H	COMPRESSED GASES
I	COOLING WATER CHEMICAL ADDITIVES
J	CORROSION INHIBITOR
K	CTG AND HRSG CLEANING CHEMICALS
L	DIESEL FUEL
M	DIETHYLENE GLYCOL MONOBUTYL ETHER
N	SULFURIC ACID
O	SODIUM PHOSPHATE
P	METHANOL
Q	MISCELLANEOUS INDUSTRIAL GASES
R	MOLTEN SULFUR
S	UAN SOLUTION
T	NITRIC ACID
U	SPENT CAUSTIC
V	OXYGEN, LIQUID
W	PAINT, THINNERS SOLVENTS, ADHESIVES, ETC.
X	PROPYLENE GLYCOL
Y	PROPYLENE GLYCOL SOLUTION
Z	SODIUM BISULFITE
AA	SODIUM HYDROXIDE
AB	SODIUM HYPOCHLORITE

0 100' 200' 400' 600' 800' 1000'

SCALE: 1"=200'

vsa_4/16/12...U:\GIS\HECA\Projects\HECA_2012\Illustrator_Files\2-44_prelim_hazmat_loc_plan_C.ai

Source:
Fluor; HECA-SCS, 2012 AFC Update; Preliminary Hazardous Material Location Plan; Drawing No: A4UV-000-50-SK-0003, Rev. C (4/11/12)

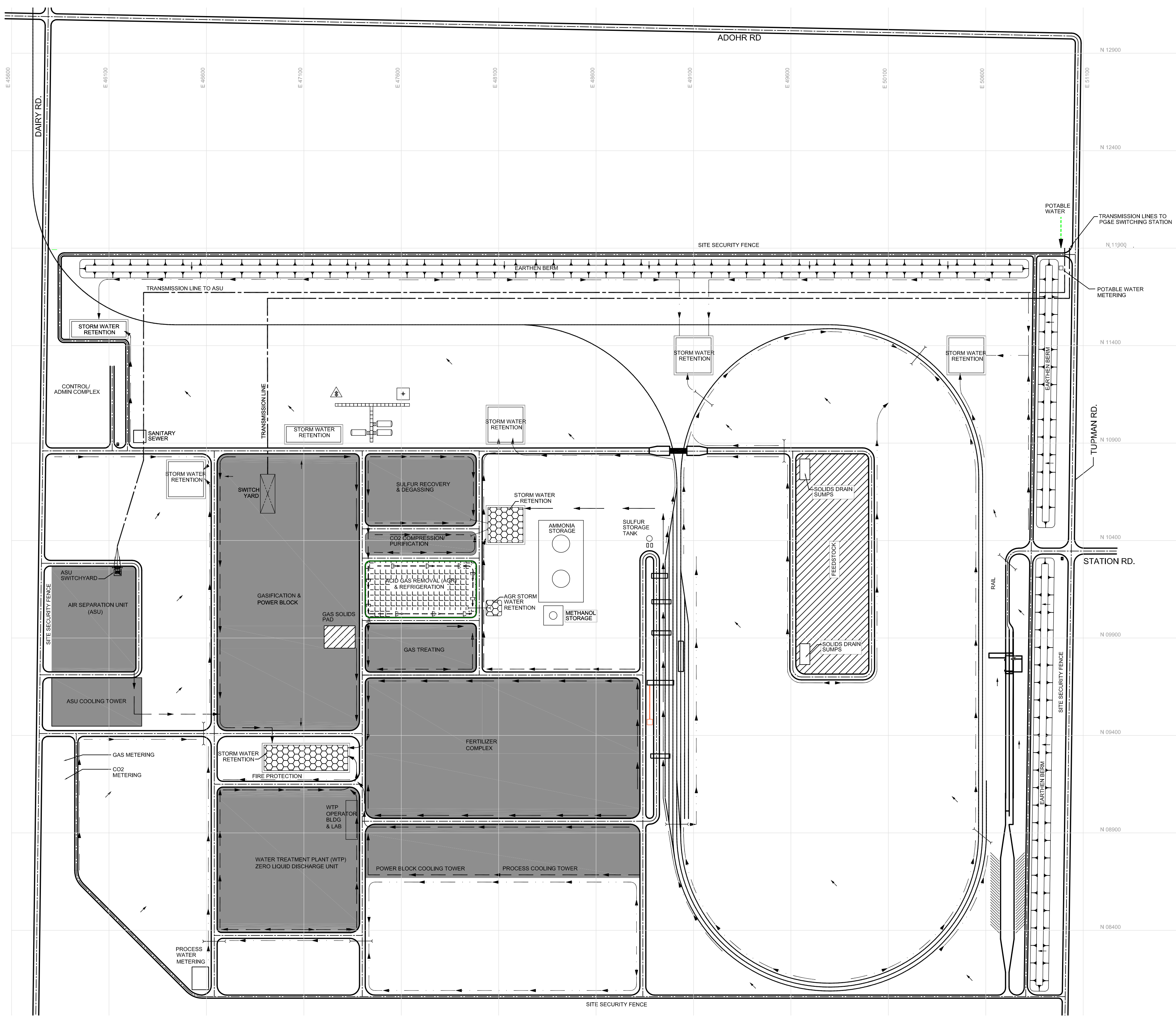
PRELIMINARY HAZARDOUS MATERIAL LOCATION PLAN

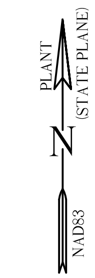
April 2012
28068052

Hydrogen Energy California (HECA)
Kern County, California

URS

FIGURE 2-44





LEGEND

- MAIN PLANT PROCESS AREAS
- SOLIDS HANDLING AREAS
- IMPERMEABLE LINER
- AGR AREA
- STORM WATER DRAINAGE SWALES AND DITCHES FROM NON-PROCESS AREAS
- STORM WATER SYSTEM FROM PROCESS AREAS WHERE SOLIDS ARE NOT PRESENT
- STORM WATER SYSTEM FROM SOLIDS HANDLING AREAS
- STORM WATER SYSTEM FROM AGR PROCESS AREA
- SURFACE RUNOFF
- CULVERT

NOTE:

1. WHERE DISTANCES ARE PROHIBITIVE FOR GRAVITY FLOW, SUMPS AND PUMPS WILL BE USED TO CONVEY RUNOFF TO THE APPROPRIATE DRAINAGE FACILITY FOR WATER TREATMENT OR RETENTION.
2. COLLECTION SUMPS FOR SETTLEMENT OF SOLIDS AND REUSE OF CLARIFIED WATER WILL BE PROVIDED AT SOLIDS HANDLING FACILITIES AT VARIOUS LOCATIONS.
3. UNCONTAMINATED RUN-OFF FROM UNDEVELOPED AREAS WITHIN THE PROJECT SITE AND OUTSIDE THE MAIN PLANT AREA AS WELL AS TEMPORARY USE AREAS WILL DRAIN BY SHEET FLOW TO DITCHES LOCATED ALONG AREA BOUNDARIES AND PLANT ROADS. CULVERTS WILL CONVEY FLOW UNDERNEATH PLANT ROADS AT CROSSING POINTS. RUNOFF COLLECTED IN THIS SYSTEM WILL DISCHARGE TO CLEAN STORM WATER RETENTION BASINS.

   EXISTING DRAINAGE PATTERNS OUTSIDE THE PROJECT SITE WILL REMAIN UNDISTURBED. EXCESS OFFSITE RUNOFF WILL FOLLOW EXISTING DRAINAGE PATTERNS TO CONVEY FLOW AROUND THE SITE. EXISTING DRAINAGE DITCHES LOCATED AT THE SITE PROPERY BOUNDARY WILL BE IMPROVED WHERE NECESSARY.

0 100' 200' 400' 600' 800' 1000'

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Source:
Fluor; HECA-SCS, 2012 AFC Update; Preliminary Storm Water Drainage Plan;
Drawing No: A4UV-000-10-SK-0002, Rev. D (4/11/12)

PRELIMINARY STORM WATER DRAINAGE PLAN

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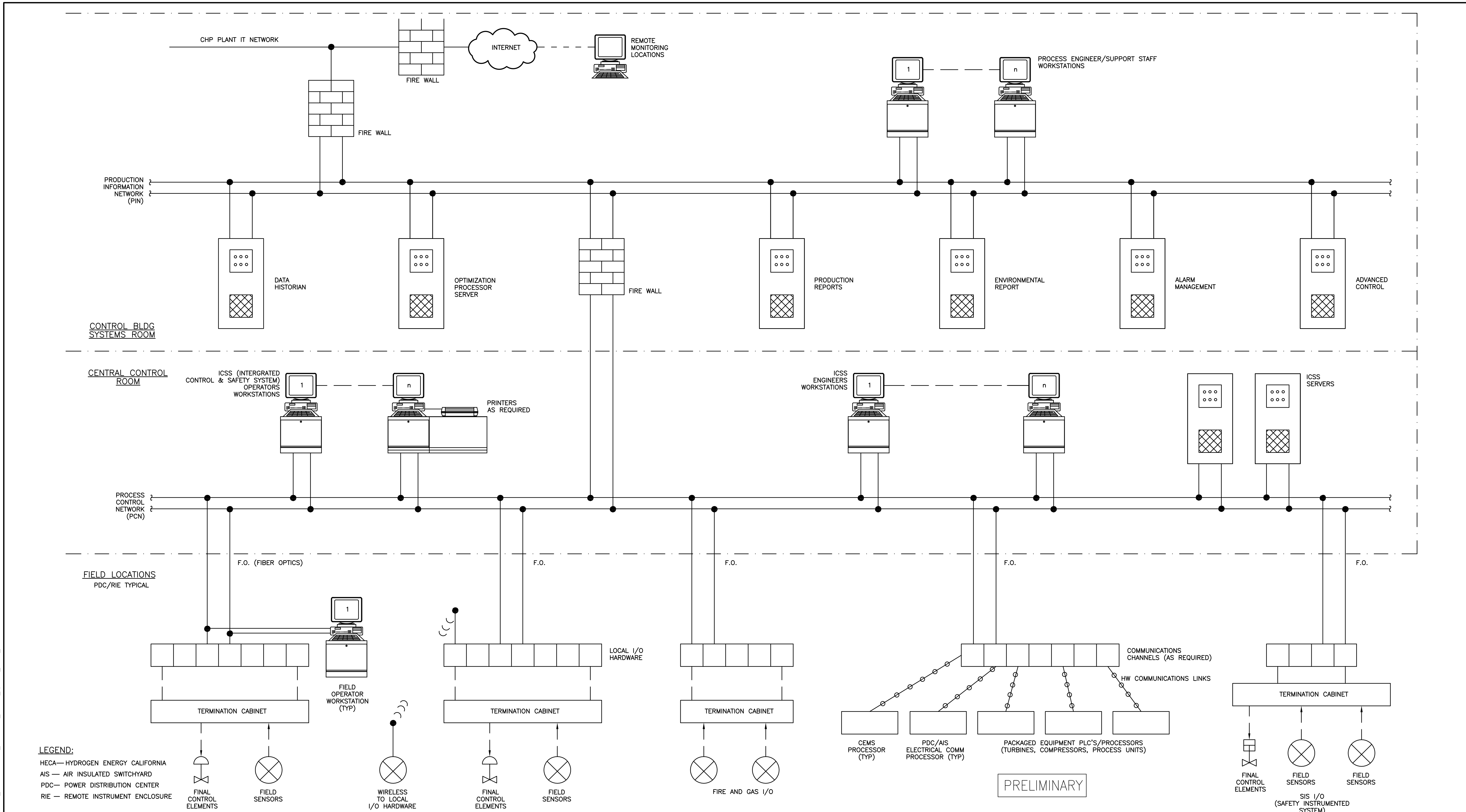
FIGURE 2-45



CONTROL SYSTEM BLOCK DIAGRAM

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FIGURE 2-46

Source:
Fluor; HECA-SCS, 2012 AFC Update; Control System Block Diagram;
Drawing No: A4UV-000-70-DG-0001, Rev. 0 (2/14/12)

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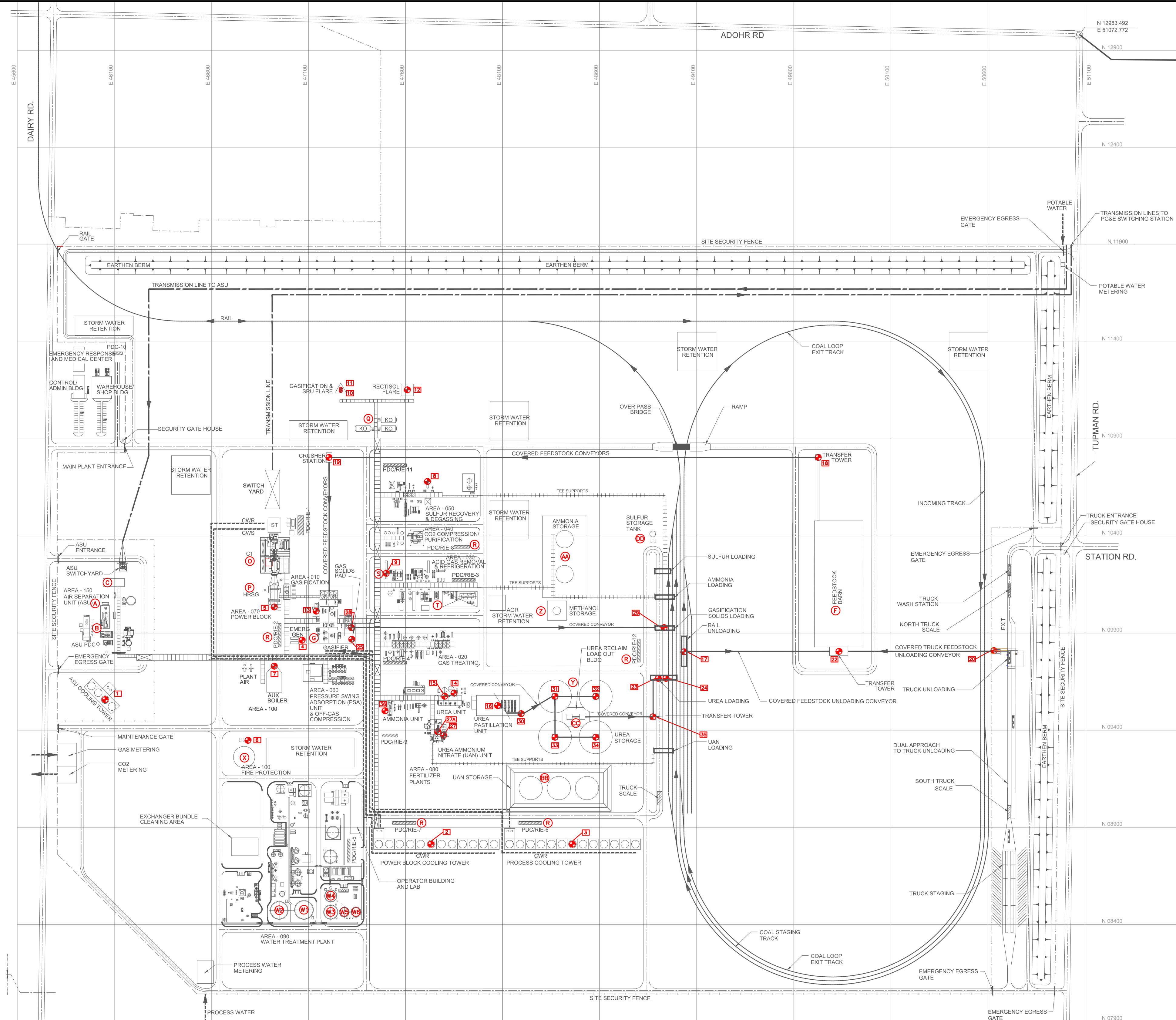

DWA #20001: (CALCULATED)	NORTHING	EASTING
STATE PLANE COORD.	2312983.492	6151072.772
NAD83 ZONE V (U.S. FEET)		
LATITUDE: 35°20'25.11200"	LONGITUDE: 119°22'36.21665"	
LATITUDE: 35.340309°	LONGITUDE: 119.37672°	

PREVAILING WIND
N
PLANT (STATE PLANE)
NAD83

PLANT COORDINATE AND DATUM NOTES

1. PLANT COORDINATES IN FEET EQUATE TO E. 61XXXXX AND N. 23YYYYY OF CALIFORNIA STATE PLANE COORDINATE SYSTEM (NAD 83 ZONE V.)
2. PLANT ELEVATION 100.00' EQUATE TO 288.50' ABOVE MSL (NAVD88.)
3. ACCURACY/TOLERANCE OF EMISSION POINT(S) COORDINATES ARE WITHIN A 50 FOOT RADIUS OF SOURCE POINT NOTED.
4. LOCATION OF EMISSION POINTS ARE SUBJECT TO COMPLETION OF DETAILED DESIGN BY LICENSORS AND EQUIPMENT SUPPLIERS.
5. SEE SHEETS 2 THROUGH 9 FOR INFORMATION ON COMPOSITION AND FLOW RATE FROM EACH SOURCE.
6. EMISSION POINT IS SHOWN FOR INFORMATION ONLY. ZERO EMISSIONS ARE EXPECTED DURING STEADY STATE OPERATION.

EMISSIONS SOURCES

ID	SOURCE	STATE PLANE COOR. (ROUNDED) EAST	NORTH	APPX. ELEVATIONS FROM GRADE (FT)
1	ASU COOLING TOWER	46053'–0"	9557'–8"	55'
2	POWER BLOCK COOLING TOWER	47732'–0"	8813'–0"	55'
3	PROCESS COOLING TOWER	48460'–0"	8813'–0"	55'
4	EMERGENCY ENGINES (GENERATORS)	47067'–5"	9864'–0"	20'
5	HRSG STACK	46924'–0"	10035'–0"	213'
6	EMERGENCY ENGINE (FIRE WATER PUMP)	46789'–0"	9348'–0"	20'
7	AUXILIARY BOILER (NOTE 6)	46924'–0"	9730'–0"	80'
8	TAIL GAS THERMAL OXIDIZER	47713'–7"	10681'–0"	165'
9	CO2 VENT (NOTE 6)	47501'–0"	10208'–0"	260'
10	SRU FLARE	47267'–0"	11147'–0"	250'
11	GASIFICATION FLARE	47267'–0"	11159'–0"	250'
12	RECTISOL FLARE	47610'–0"	11153'–0"	250'
13	FEEDSTOCK DRYER	47140'–3"	10013'–3"	305'
14	UREA PLANT HP ABSORBER	47850'–0"	9591'–0"	130'
15	UREA PLANT LP ABSORBER	47802'–0"	9575'–0"	50'
16	UREA PASTILLATION VENT	48075'–0"	9527'–0"	50'
17	FEEDSTOCK RAIL UNLOADING VENT	49035'–0"	9804'–0"	30'
18	FEEDSTOCK TRANSFER TOWER	49726'–0"	10805'–0"	100'
19	FEEDSTOCK CRUSHER VENT	47206'–0"	10805'–0"	100'
20	FEEDSTOCK TRUCK UNLOADING VENT	50631'–0"	9810'–0"	60'
22	FEEDSTOCK TRANSFER TOWER B	49833'–0"	9806'–0"	100'
23	UREA LOADING VENT 1	48902'–0"	9667'–0"	30'
24	UREA LOADING VENT 2	48942'–0"	9667'–0"	30'
25	GASIFICATION SOLIDS PAD	47323'–7"	9868'–7"	N/A
27	NITRIC ACID ABSORBER VENT	47797'–0"	9373'–0"	145'
27A	AMMONIUM NITRATE SCRUBBER VENT	47767'–0"	9392'–0"	40'
28	GASIFICATION SOLIDS TRANSFER TOWER	47322'–2"	9928'–4"	30'
29	GASIFICATION SOLIDS LOADING VENT	48932'–8"	9928'–6"	30'
30	UREA BUCKET ELEVATOR	48196'–0"	9485'–0"	50'
31	UREA TRANSFER TOWER 1	48370'–0"	9574'–0"	100'
32	UREA TRANSFER TOWER 2	48580'–0"	9574'–0"	100'
33	UREA TRANSFER TOWER 3	48370'–0"	9364'–0"	100'
34	UREA TRANSFER TOWER 4	48580'–0"	9364'–0"	100'
35	UREA TRANSFER TOWER 5	48875'–0"	9469'–0"	100'
36	AMMONIA UNIT STARTUP HEATER	47495'–0"	9500'–0"	80'

MAJOR STRUCTURES/ EQUIPMENT AND TANKS

ID	DESCRIPTION	APPX. ELEVATIONS FROM GRADE (FT)	
A	ASU MAIN AIR COMPRESSOR ENCLOSURE	40	
B	LIQUID OXYGEN STORAGE (LOX) TANK	90	
C	AIR SEPARATION COLUMN CAN	200	
F	FEEDSTOCK BARN	160	
G	GASIFICATION STRUCTURE	305	
O	COMBUSTION TURBINE GENERATOR STRUCTURE	50	
P	HEAT RECOVERY STEAM GENERATOR STRUCTURE	90	
Q	FLARE K.O. DRUMS (QTY 3)	35	
R	POWER DISTRIBUTION CENTERS	25	
S	AGR METHANOL WASH COLUMN	235	
T	AGR REFRIGERATION COMPRESSOR STRUCTURE	40	
W1	RAW WATER TANK	100'DIA X 48'H	TANKS SET AT GRADE ELEVATION
W2	TREATED WATER TANK	95'DIA X 40'H	
W3	PURIFIED WATER TANK	75'DIA X 48'H	
W4	BACKWASH TANK	65'DIA X 48'H	
W5	UTILITY WATER TANK	50'DIA X 32'H	
W6	DEMINERALIZED WATER STORAGE TANK	52'DIA X 40'H	
X	FIREWATER STORAGE TANK	110'DIA X 48'H	
Y	UREA STORAGE (4 DOMES)	162'DIA X 70'H	
Z	METHANOL STORAGE TANK	40'DIA X 40'H	
AA	AMMONIA STORAGE (2 TANKS)	90'DIA X 70'H	
BB	UAN STORAGE (3 TANKS)	120'DIA X 48'H	
CC	UREA RECLAIM LOADOUT BUILDING	70	
DD	SULFUR STORAGE TANK	30'DIA X 24'H	

0 100' 200' 400' 600' 800' 1000'

Source:
Fluor; HECA-SCS, 2012 AFC Update; Preliminary Emissions Sources Plot Plan;
Drawing No: A4UV-000-50-SK-0002, Rev. E (4/04/12)

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PRELIMINARY EMISSIONS SOURCES PLOT PLAN

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Kern County, California

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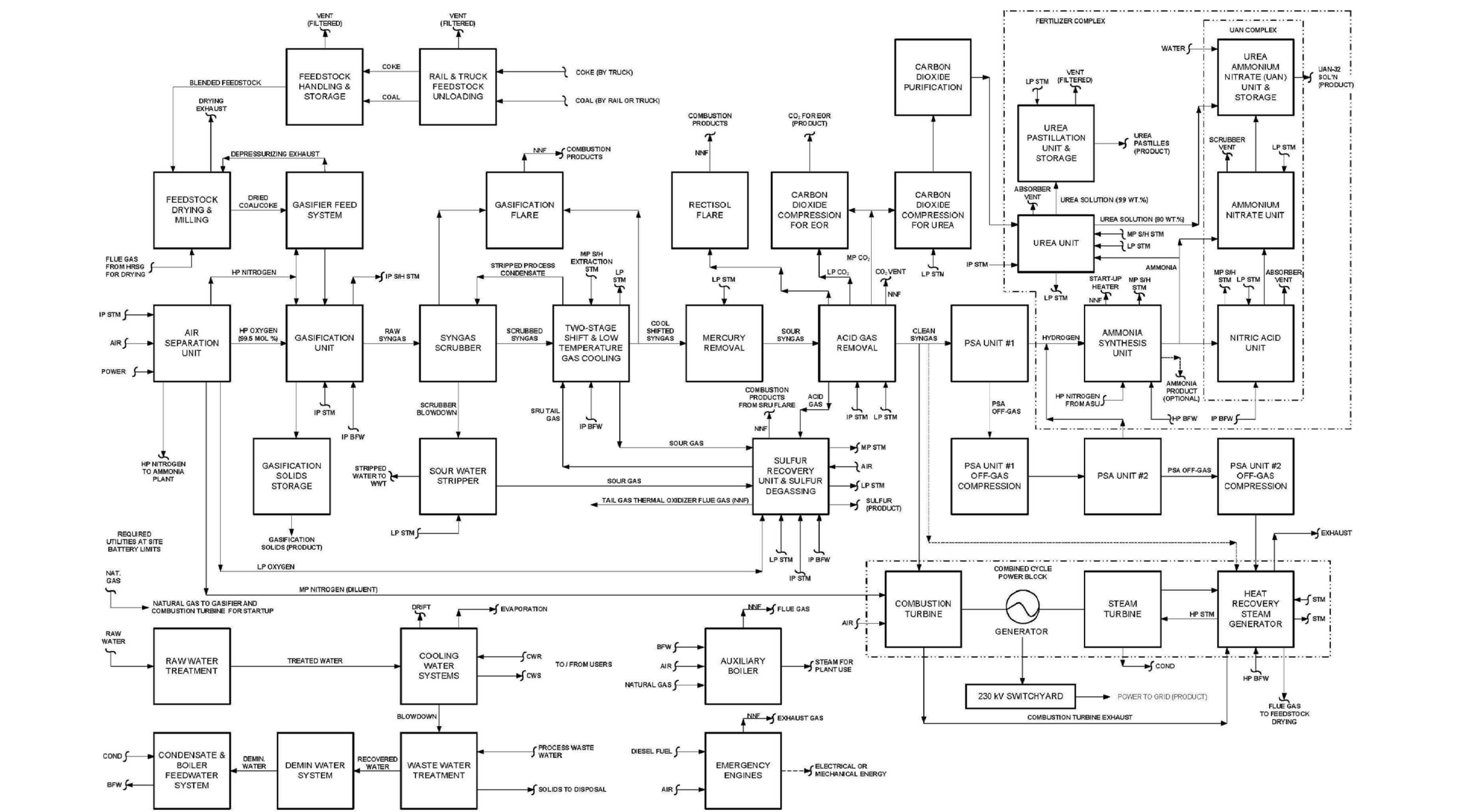
FIGURE 2-47



Source:
Fluor; HECA-SCS, 2012 AFC Update; Overall Block Flow Diagram With Emission Sources; Drawing No: A4UV-000-25-BFD-0002, Rev. 1 (3/29/12)

OVERALL BLOCK FLOW DIAGRAM WITH EMISSION SOURCES

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FIGURE 2-48

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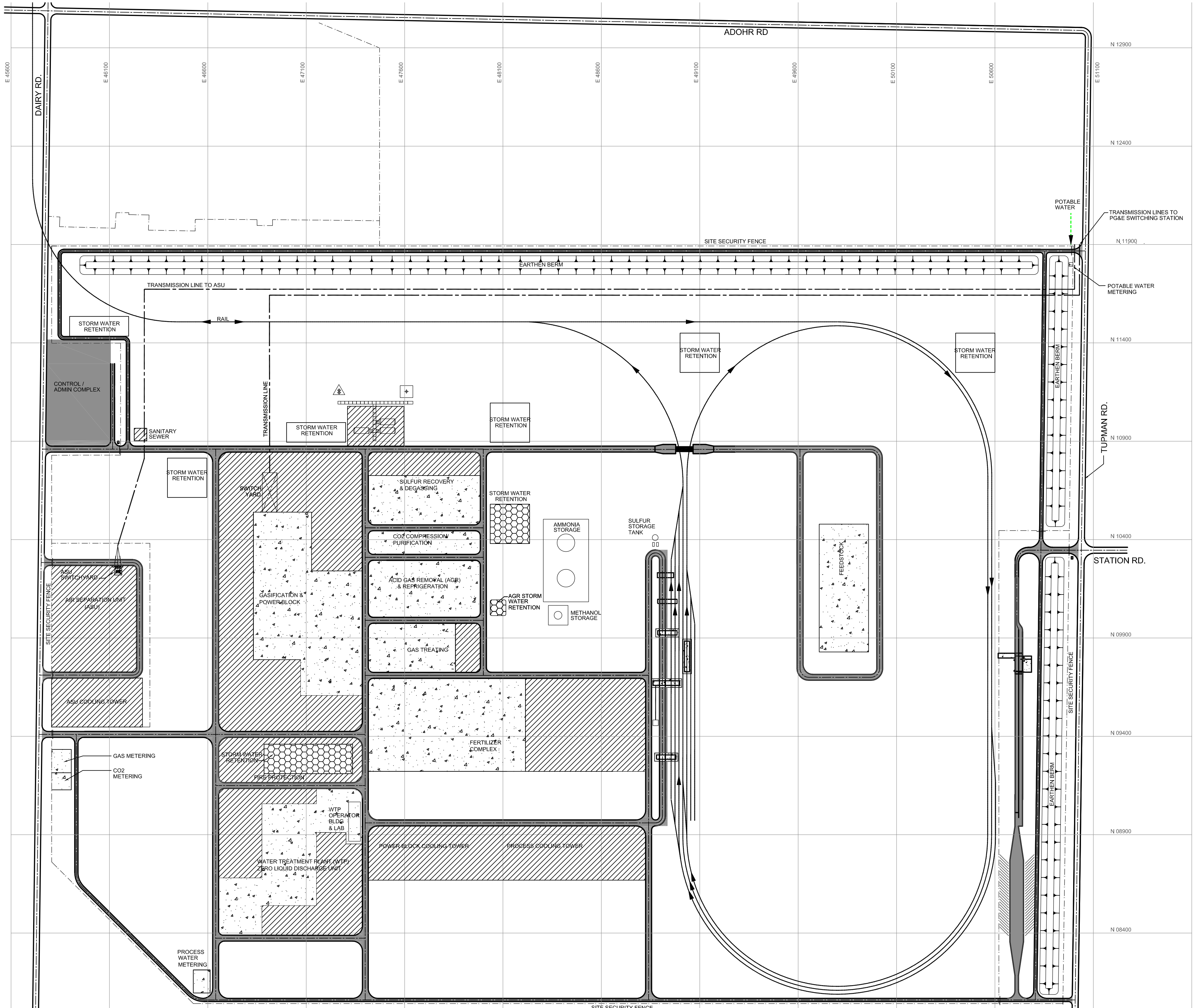

LEGEND

- ASPHALT CONCRETE PAVEMENT
- CONCRETE PAVEMENT
- CRUSHED ROCK SURFACING
- IMPERMEABLE LINER
- TOP / BOTTOM — EARTHEN BERM

NOTE:

1. PAVING SYMBOLOGY SHOWN DEPICTS PROPOSED SURFACE TREATMENT FOR DELINEATED AREA.
2. PAVED DRIVEWAYS, WALKWAYS AND CRANE ACCESS LOCATIONS WILL BE PROVIDED TO SUPPORT PLANT OPERATIONS AND MAINTENANCE. THESE FEATURES WILL BE IDENTIFIED AND SIZED DURING SUBSEQUENT DESIGN AND WILL BE DETAILED ON THE APPROPRIATE CIVIL/STRUCTURAL ENGINEERING DRAWINGS.

0 100' 200' 400' 600' 800' 1000'

Source:
Fluor; HECA-SCS, 2012 AFC Update; Preliminary Paving Plan;
Drawing No: A4UV-000-10-SK-0003, Rev. C (4/11/12)

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PRELIMINARY PAVING PLAN

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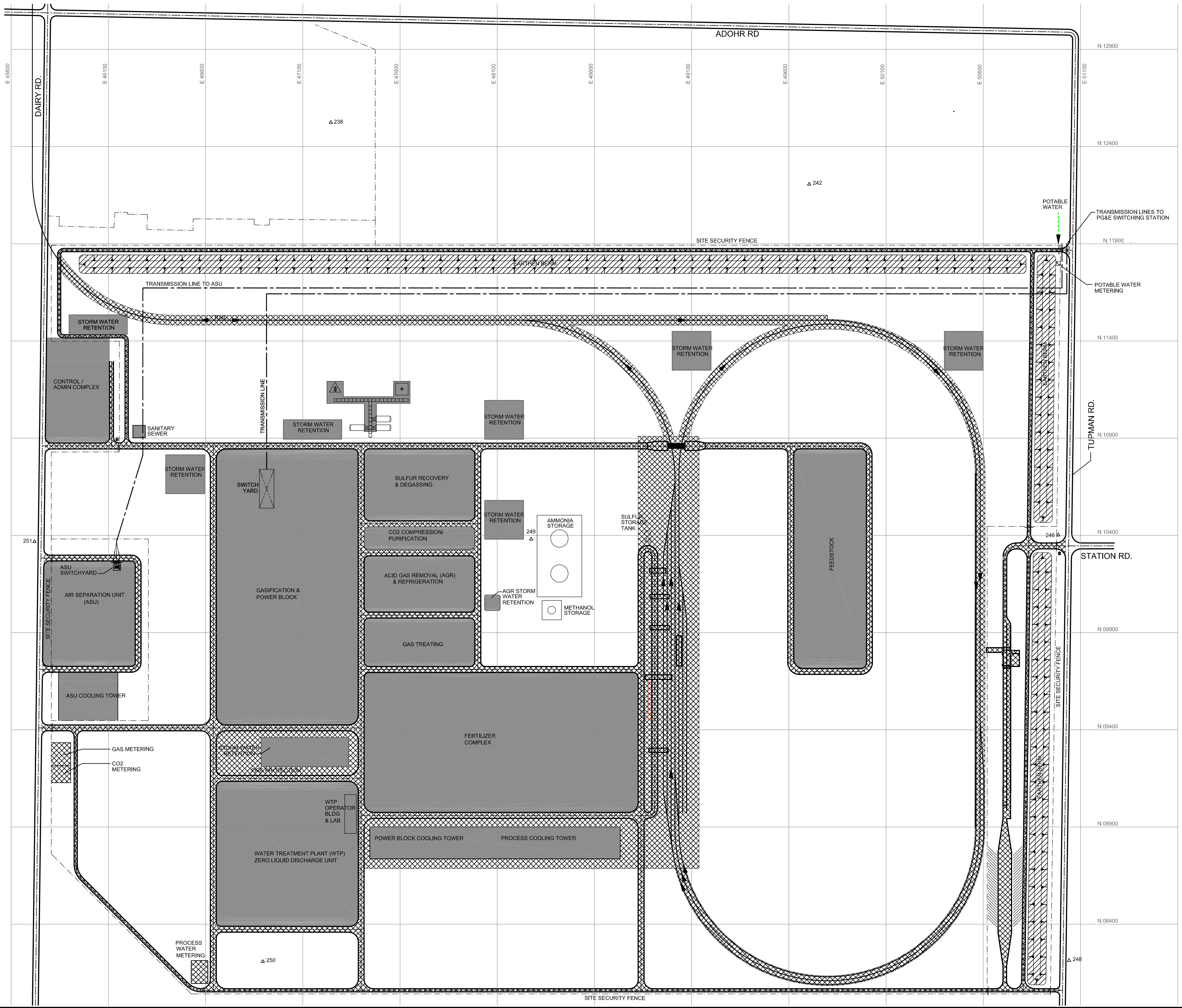
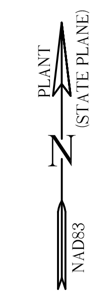
FIGURE 2-49





LEGEND:

- EL 288.5 — H.P. GRADE ELEVATION
- TOP / BOTTOM — EARTHEN BERM
- PAD AREA
- UNSUITABLE MATERIAL FROM CLEAR & GRUB
- EXCAVATED FILL MATERIAL
- 249 — SURVEY MONUMENT POINT NUMBER

EARTHWORK VOLUME	
EXCAVATION *	IMPORT *
850,000 CY	500,000 CY
* SEE NOTES	

NOTE:

1. EARTHWORK QUANTITIES ARE APPROXIMATE AND ARE BASED ON THE PRELIMINARY GEOTECHNICAL INVESTIGATION RECOMMENDATIONS PERTAINING TO THE REMOVAL OF UNSUITABLE SOILS.
2. UNSUITABLE SOIL MATERIAL WILL BE EXCAVATED, AND USED TO CONSTRUCT THE EARTHEN BERMS AND TO LEVEL THE OPEN AREAS AS SHOWN ON THE PLAN.
3. IMPORT MATERIAL WILL BE USED TO FILL THE VOID REMAINING FROM THE REMOVAL OF UNSUITABLE MATERIAL AND TO RAISE GRADE TO THE ELEVATIONS INDICATED.
4. PRELIMINARY EARTHWORK QUANTITIES AND FINAL GRADES WILL VARY DEPENDING ON FINAL GEOTECHNICAL RECOMMENDATIONS AND PLOT PLAN.
5. COORDINATE LOCATIONS SHOWN ARE BASED ON THE CALIFORNIA COORDINATE SYSTEM (CCS 83), ZONE V, 2007.0 EPOCH, RELATIVE TO THE NORTH AMERICAN DATUM OF 1983 (NAD 83). ELEVATIONS ARE BASED ON THE NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88).
6. PIPING AND FOUNDATIONS NOT SHOWN IN PROCESS AREAS FOR CLARITY.
7. GRADING SYMBOLOGY SHOWN DEPICTS PROPOSED ELEVATIONS FOR DELINEATED AREA.

SURVEY MONUMENT DATA

CALIFORNIA STATE PLANE COORDINATES			
POINT NO.	NORTHING	EASTING	ELEVATION
238	2,312,523.86	6,147,244.89	286.72
242	2,312,206.46	6,149,704.56	286.79
246	2,310,401.98	6,150,985.50	288.23
248	2,308,213.18	6,151,041.09	287.33
249	2,310,380.25	6,148,274.74	287.69
250	2,308,207.70	6,146,894.35	287.45
251	2,310,368.06	6,145,720.47	286.12

0 100' 200' 400' 600' 800' 1000'
SCALE: 1"=200'

Source:
Fluor; HECA-SCS, 2012 AFC Update; Preliminary Grading Plan;
Drawing No: A4UV-000-10-SK-0001, Rev. C (4/11/12)

PRELIMINARY GRADING PLAN

April 2012
28068052

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Kern County, California

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FIGURE 2-50

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