S-23665

MAR 16 2001

Determination of Eligibility

for the

CONTRA COSTA POWER PLANT

DOCKET	
09-AFC-4	
DATE	SEP 08 2009
RECD.	DEC 15 2009

October 18, 2000

prepared by:

Fredric L. Quivik, Ph.D.
2830 Pearl Harbor Road
Alameda, CA 94501

under sub-contract to:

URS/Dames & Moore
221 Main Street, Suite 600
San Francisco, CA 94105

Table of Contents

Summary of Findings	1
Project Description	1
Methods Used In Completing This Report	2
Historical Overview	2
Description	5
Conclusions	9
Endnotes	12
Bibliography	14

Appendix A: Photographs of Contra Costa Power Plant
Appendix B: Form 523
Appendix C: Resume for Fredric L. Quivik

CONTRA COSTA POWER PLANT

Summary of Findings

The Contra Costa Power Plant is eligible for listing in the National Register of Historic Places under Criterion A at the "state" level of significance for its association with the postwar expansion of California's economy, which was a major factor in the new character of the nation's economy in the second half of the twentieth century. The Contra Costa Power Plant is also eligible for listing in the California Register of Historical Resources under Criterion 1 for that same association with California's postwar growth. California's population grew an estimated 43 percent during World War II as hundreds of thousands of people moved into the state to work in agriculture and manufacturing in support of the war effort. The population continued to grow in the late 1940s as much of the state's wartime industrial growth converted to a permanent economic footing based especially on the aeronautics and electronics industries. Increased population and industry and the absence of wartime restrictions yielded tremendous additional demand for energy, to which Pacific Gas & Electric (PG&E) responded by embarking on the largest program for constructing new electric generating capacity by a utility in the nation's history, spending more than a billion dollars between the end of the war and 1953. At the end the expansion, PG&E had made a transition from being a utility that depended primarily on hydropower sources for its electrical energy to being a utility that drew a large majority of its electricity from steam generating plants.

The Contra Costa Power Plant, with an initial capacity of 330 megawatts, represents this expansion of generating capacity. Although shortly after the war PG&E built two smaller new steam plants, the Contra Costa Power Plant, completed in 1951, and its twin at Monterey launched the utility's program of large steam plant construction. As California's economy continued to grow, PG&E made immediate plans to expand the Contra Costa plant, even as it was building other new power plants as well. The 240-megawatt addition went into service in 1953. Although PG&E again expanded the Contra Costa plant's capacity in 1964, the original 1951-1953 components were unchanged. Concentrated in the northwestern corner of the property, the original components retain excellent integrity, both in terms of architecture and plant layout and in terms of the boilers, turbines, generators, and other equipment housed in the original buildings.

Southern Energy California, the current owner of the Contra Costa Power Plant, plans to build an eighth unit at the northeast corner of the power plant property. The proposed new construction, as presently planned, will not have an adverse effect on the National Register or California Register qualities of the historic portions of the property, which are recommended here as comprising an eligible historic district.

Project Description

Southern Energy California, the current owner of the Contra Costa Power Plant, plans to build a new electrical generating unit on the site. As part of its application for a permit to do so under the California Environmental Quality Act (CEQA), Southern Energy must record all the buildings on the site older than 45 years of age and determine their eligibility for listing in the National Register of Historic Places and the California Register of Historical Resources. URS/Dames & Moore has the contract to prepare Southern Energy's permit application. URS/Dames & Moore has subcontracted with Fredric L. Quivik, Ph.D., to evaluate the historical significance of the buildings on the site. Dr. Quivik is a consulting historian of technology with many years of

experience documenting and evaluating historic resources of industrial or engineering character. His resume is appended to this report.

Methods Used in Completing This Report

Fred Quivik inspected the Contra Costa Power Plant on September 26, 2000. He was accompanied by David Frandsen, Plant Engineer for Southern Energy. During the site visit, Dr. Quivik inspected the interiors and exteriors of each of the primary structures and the exteriors of the secondary structures to determine the extent to which alterations had occurred over the history of the plant. He also inspected the equipment housed in the plant to determine how much of the original equipment was still in place. During the site visit, Dr. Quivik also investigated historic documents present on site. They include a 1951 site map drawn by Bechtel Corporation, showing the original buildings, and three albums of construction photographs, showing construction of each phase of expansion (Units 1-3, Units 4 and 5, and Units 6 and 7). These photographs helped in the assessment of how intact the original buildings and equipment are. Dr. Quivik returned to the site for additional photography and recording on October 3, 2000.

After the first site visit, Dr. Quivik researched the history of the Contra Costa Power Plant by investigating articles in technical journals describing construction of the plant in particular and postwar trends in generating plant design and construction in general, histories of PG&E and the Bechtel Corporation, and histories that analyze growth of California's economy during World War II and during the postwar period and that analyze the effects of those trends on the national economy. This research allowed him to document the history of the design and construction of the Contra Costa Power Plant and place those events in appropriate historical contexts for determining the plant's eligibility for listing in the National Register and the California Register. Results of that analysis are presented in this report.

Historical Overview

The Contra Costa Power Plant was built in the early 1950s as part of PG&E's monumental postwar construction program aimed at satisfying new demand for energy in the wake of California's industrial growth and accompanying increase in population stimulated first by the wartime economy and then by the successful transition of the economy to a permanent footing.

California's population had swelled during the war, as workers were attracted by jobs in agriculture, in shipyards, and in other industries supplying the nation's needs for the war. During the war years, California's population grew an estimated 40 percent. After a brief stall in 1946, California's growth continued in the late 1940s as the Cold War helped make California's aeronautics industry a permanent one and the agriculture sector continued to grow in response to demands for food by a nation no longer facing depression or wartime restrictions. Suburban expansion to provide permanent housing for California's newcomers also continued to stimulate the state's economic growth. The continuing rapid development of California's economy marked a profound westward shift in the nation's economy. In 1950, California's population of 10,586,000 was 53 percent higher than it had been in 1940. Even before the war ended, management at PG&E, the utility that served the San Francisco Bay Area and most of northern and central California from Redding to Bakersfield, recognized that the wartime population and industrial booms would be permanent and that the company would have to greatly expand its electrical generating capacity to meet demand. PG&E announced that it would embark on a ten-year program of construction costing $1.5 billion to supply California with its energy needs.[1]

The magnitude of PG&E's construction may be seen by comparing it to the nation's postwar utility growth. Between 1945 and 1951, electrical utilities in the United States spent $9 billion expanding their physical plant. During that period, PG&E spent $800 million, nearly a tenth of the national total. By the end of 1953, PG&E's expenditures on expansion exceeded a billion dollars. It was said to have been the largest program of construction undertaken in the United States to date by an energy utility company.[2] Commenting on the postwar expansion in capacity by PG&E and California's other utility companies, James C. Williams said in his 1997 history, "Through it all, California's energy regime confidently supplied all the fuel and electric power people wanted."[3]

Historically, PG&E had relied mainly on northern and central California's extensive hydropower potential for its electrical generation needs. Steam-powered electric generating plants in the PG&E system mainly had served as standby facilities, ready to generate electricity in periods of peak loads, low water, or emergencies. At mid-century, PG&E engineers and planners recognized that there were fewer available sites for hydroelectric plants. The engineering for steam power plants was also improving, so that they were becoming more efficient and the cost of operating them was declining. Therefore, PG&E decided to greatly expanded its reliance on fuel oil–fired steam plants in its system. Although the company built several new hydroelectric plants in the postwar period, steam plants commanded the larger portion of PG&E's investment in new generating capacity. In 1940, steam plants accounted for only 30 percent of PG&E's generating capacity. Ten years later, PG&E relied on steam for 42 percent of its electricity. When the first phase of PG&E's expansion program was completed in the early 1950s and the new plants (including Contra Costa) came on-line, the company drew 54 percent of its electricity from steam plants, and new construction continued to increase steam's share of the load.[4]

PG&E's first-phase expansion of steam-generating capacity consisted of the construction of four new plants: Kern near Bakersfield, rated at 175 megawatts; Hunters Point in San Francisco, 200 megawatts; Moss Landing near Monterey, 330 megawatts; and Contra Costa at East Antioch, 330 megawatts. PG&E selected the firm of Stone & Webster to design and build Kern, Hunters Point, and Moss Landing, and chose Bechtel Corporation to design and build the Contra Costa plant.[5]

The Bechtel Corporation is one of the twentieth century's largest engineering and construction companies. Headquartered in San Francisco, it now markets its services to the entire world, with an emphasis on large-scale energy projects. Bechtel Corporation's origins lay with W.A. Bechtel, a San Francisco-based contractor, who joined with Henry J. Kaiser and others to form the Six Companies consortium that in 1931 successfully bid on the construction of Hoover Dam for the U.S. Bureau of Reclamation. Kaiser and Bechtel also collaborated to build the San Francisco–Oakland Bay Bridge in the 1930s. During World War II, Bechtel had numerous large construction projects in support of the nation's war effort. His sons were also leading figures in the W.A. Bechtel Company. One son, Stephen, formed a partnership with John McCone in 1937 to design and build oil refineries and chemical plants.[6]

The W.A. Bechtel Company and Bechtel-McCone merged in 1945 to form the Bechtel Corporation, which continued to build large domestic energy projects and moved into the international realm as well, notably in the developing oil fields of Saudi Arabia. The contract Bechtel Corporation received from PG&E to build the Contra Costa Power Plant was Bechtel's largest power plant project to date. Shortly thereafter, PG&E contracted with Bechtel to design and build another power plant a few miles downstream at Pittsburg. When it opened in 1954, the Pittsburg plant was the largest steam plant west of the Mississippi. Bechtel has continued

to be a major factor in large-scale engineering and construction projects, noteworthy among them the Bay Area Rapid Transit system (BART), which Bechtel helped to engineer in a joint venture with two other large firms. Two of the Bechtel company's top managers, George Schultz and Caspar Weinberger, became cabinet officers in the Reagan Administration. Today, the Bechtel Corporation has evolved into the Bechtel Group, a holding company that owns six companies, each of which has its own specialty, including energy, chemicals, construction, and helping clients obtain project funding. One of those subsidiaries, Bechtel Civil, Inc., is currently in a joint venture with Parsons Brinkerhoff Quade & Douglas (one of its partners in the earlier BART joint venture) to engineer Boston's Central Artery/Tunnel Project, which is one of costliest and most complex public works projects ever undertaken.[7]

When PG&E awarded the contract for the Contra Costa project to Bechtel Corporation, James N. Landis, Bechtel's chief power engineer, was put in charge of design and engineering. Bechtel construction superintendent, Ed Garbarini, was placed in charge of work in the field.[8]

Bechtel's design for the Contra Costa Power Plant embodied numerous features that were coming to characterize power plants in the postwar period. One design feature entailed moving some components outdoors, rather than enclosing virtually all of the equipment within a costly permanent building. In the deep South, some power plants were designed so that virtually all components were outside. A more typical trend was toward the semi-outdoor design, such as that of the Contra Costa plant. Another such feature was the arrangement of components so that they could all be operated from one level. At the Contra Costa plant, both the firing aisle in the boiler house, and the turbines, generators, pumps, and other equipment in the turbine building are located at the third level. Yet another trend was to centralize the control room for ease in observing all operating areas and thereby reduce labor requirements. The control room at the Contra Costa plant gives a direct view both to the firing aisle and to the turbines and generators. Moreover, the boiler feed water pumps are of a then-new type with a low profile that would not obstruct the view from the control room toward the turbines and generators. Increasing numbers of power plants were being designed to use fuel oil or natural gas instead of coal. The Contra Costa plant boilers were designed to be fired by either fuel oil or gas. One deviation from a design trend was in the number of boilers for each turbine. In the postwar period, most power plants were designed with one boiler for each turbine, but Units 1-3 at the Contra Costa Power Plant have two boilers per turbine. Later additions to the Contra Costa plant embody the new trend. In the postwar period, boilers were being designed to operate at higher temperature and pressure, reaching 1,000° F and 2,000 psi. Contra Costa's Units 1-3 operated at 950° F and 1,550 psi.[9]

PG&E chose the Antioch location for the Contra Costa plant for a number of reasons, including ease of delivering fuel (the company could use pipeline, railroad, or ship), access to the San Joaquin River for supply and discharge of cooling water, and proximity to existing sub-stations in the PG&E grid. The elevation of the river fluctuates about 4 feet twice daily due to the effects of the tides in the San Francisco Bay. This movement of water up- and downstream insured that the power plant would have plenty of water to cool the recirculated boiler feed water. The 167-acre site also had ample space for fuel storage. Although the Contra Costa plant (along with the Moss Landing plant at Monterey) would be the largest in the PG&E system, it was designed to handle dramatic fluctuations in load on the PG&E system. The Contra Costa plant was designed to make the jump from standby duty to full load in a matter of seconds.[10]

In constructing previous plants, PG&E had been experimenting with finding the most effective location for its controls. Design of the Contra Costa plant reflected lessons of the utility's experience. The central control room served both the boilers and the turbine-generator units. It

housed instrumentation for the most important controls. The utility had found, however, that certain less-important controls could be clustered at other points at sub-control centers throughout the plant. Thus, for example, a sub-control board was located in an operating building near the high-voltage switchyard. This saved costs that would otherwise have been required to extend control circuits from the central control room to the switchyard. Likewise, sub-control boards were located near the boilers and the turbines. Those control boards are still in place.[11]

Construction of the Contra Costa plant began in February 1949. Initial construction included the boilers, turbines, and generators for Units 1-3 as well as four fuel-oil storage tanks, a 230-kilovolt switchyard to tie the power plant into the PG&E grid, and the necessary infrastructure to operate the plant, such as water-supply and water-discharge equipment. The plant went into service in August 1951 with the three generating units feeding 330 megawatts into the PG&E grid. Even before construction was complete, Bechtel began designing and building an expansion of the Contra Costa plant. Units 4 and 5 were built as an addition extending eastward from Units 1-3. Each of the new units had a capacity of 120 megawatts, giving the Contra Costa plant a total capacity of 570 megawatts when the new units went into service in October 1953. At about the time construction began on the Unit 4 and 5 expansion, PG&E announced that Bechtel would design and build a new 600 megawatt power plant at Pittsburg, a few miles downstream of the Contra Costa plant. When it went into service, the Pittsburg plant was the nation's largest west of the Mississippi River, reflecting the continuing expansion of the PG&E system to meet California's ongoing growth and corresponding increase in demand for electricity.[12]

In a 1958 pictorial review of many of its largest construction projects, the Bechtel Corporation called the Contra Costa plant the "Curtain raiser of the vast postwar steam, electric capacity of America's largest power utility."[13] Behind such corporate boosterism often lies a grain of historical truth. Such is the case with the Contra Costa Power Plant. The postwar economic expansion of California's economy helped restructure the nation's economy. Much of the energy that powered the industrial development driving California's economic expansion was in the form of electricity. PG&E, the utility that served northern and central California, had to mount an unprecedented construction program in order to satisfy California's rapidly swelling demand for electricity. The Contra Costa plant was an integral component of that construction program.

PG&E again expanded the capacity of the Contra Costa plant, adding Units 6 and 7 east of the existing units in 1964. Each of the new units has a capacity of 330 megawatts. During the 1970s, PG&E also built three new fuel-oil storage tanks.[14] PG&E ceased using Units 1-3 to generate electricity in about June 1994 and ceased using Units 4 and 5 to generate electricity in December 1994. PG&E sold the Contra Costa Power Plant to Southern Energy California in April 1999. Southern Energy does not keep Units 1-3 operational. Southern Energy uses Units 4 and 5 as synchronous condensers, which is to say that current generated in Units 6 and 7 is run through Unit 4 and/or 5, causing it to spin and thereby helping to maintain the phase and frequency of the alternating current running through the grid.[15]

Description

The potential Contra Costa Power Plant Historic District occupies a portion of the Contra Costa Power Plant site, a nearly rectangular parcel of land along the south bank of the San Joaquin River in East Antioch, Contra Costa County, California. The east, south, and west boundaries of power plant site are orthogonal to the cardinal directions, while the north boundary follows

the river bank and is irregular. The east boundary measures about 2,850 feet, the south boundary measures about 2,850 feet, and the west boundary measures about 2,300 feet. The site accommodates seven steam-powered electric generating units. The historic portion of the power plant site is in the northwestern corner of the parcel, where Units 1-5 are located. It includes the turbine building, boiler buildings, several water tanks and small ancillary buildings, and five fuel oil tanks. Descriptions of buildings and important features in the potential historic district are provided below.

Turbine Building: This is a flat-roof, steel-frame building on an elevated concrete base. It is about 160 feet wide and about 660 feet long. The turbine building has brick masonry curtain walls along the south side and west end and corrugated asbestos sheathing on the east end. The boiler buildings are along the north side. The brick curtain walls are pierced periodically with groups of narrow, vertical window bands. The turbine building was actually built in two stages. The west half houses the turbines and generators for Units 1-3 and was built in 1951. The east half houses the turbines and generators for Units 4 and 5 and was built in 1953. The brick curtain wall of the section housing Units 4 and 5 is identical to the original. A vertical construction joint just east of the service delivery entrance shows the dividing line between the two sections.

The major pieces of equipment are at the third-floor level of the turbine building, which is called the operating level. Three bays extend the length of the building from west to east. The turbine-generator units are located along the south-side bay, which is called the turbine bay. Unit 1 is at the west end and Unit 3 at the east end of the original segment. Each generator is rated at 110 megawatts. The center bay, called the auxiliary bay, contains boiler feed pumps and house turbines, which could generate electricity for the plant if it were ever "islanded," i.e., cut off from the rest of the grid. The main control room is located midway along the northern bay, which is called the control bay. It is situated between the turbine building and the boilers, which are located in the adjacent building to the north. The control room houses three sets of control panels and meter panels, one set for each unit. A slight westward projection of the facade at the northwestern corner of the building identifies the location of the main office for the power plant staff, located on the third floor in the control bay at that corner. A low cantilevered canopy along the projection identifies the entrance to the main office. Virtually all the equipment in the building is original to the beginning of the power plant's operation in 1951. A significant exception is turbine no. 1, which was replaced in the 1970s. It nevertheless appears nearly identical to the turbines for Units 2 and 3, built for PG&E by General Electric. One class of equipment that is no longer in place is the make-up evaporators that were located at the west end of the auxiliary bay. Their function is now handled by the new equipment located on the ground west of the boiler house. A room for storage of plans and other documents has been installed where the evaporators were located.[16]

Units 4 and 5 are located along the turbine bay of the addition. The boiler feed water pumps are located in the turbine bay between Unit 4 and Unit 5. The control room for Units 4 and 5 is located in the control bay of the addition and provides access to the boiler house for Units 4 and 5. The configuration of equipment in the addition is somewhat different than the configuration in the original section, but it is nevertheless consistent with design conventions of the early 1950s.[17] The turbine building, including both the 1951 and 1953 sections, is a primary contributing feature of the potential power plant district.

Boiler House for Units 1-3: The boiler house for Units 1-3 is of the semi-enclosed type. The steel-frame structure enclosing the boilers themselves is sheathed in corrugated Transite (a composite material of cement and asbestos) and has several horizontal bands of industrial steel

sash windows. There are six boilers, arranged with three on each side of a central firing aisle, which is on a north-south axis. The boilers were designed and constructed by Combustion Engineering Superheater, Inc. of New York. Each has a capacity to produce 550,000 pounds of steam per hour at a temperature of 950° F and a pressure of 1,550 pounds per square inch. They were designed to be fired either by fuel oil or natural gas.

All six boilers had to be fired when the three turbine-generator units were operating at full capacity. Piping from the boilers to the turbines is arranged so that each of the boilers could serve any of the three turbines during periods of less than full-capacity operation. Many of the ducts for delivering supply air to the boilers and conveying combustion gases to the stacks are exterior to the building. Each boiler has a fan for forcing draft to the boiler and another fan for inducing draft and drawing exhaust gases from the boiler to the stack. The fan housings are all exterior to the boiler house structure. There are six steel stacks, each standing adjacent to its respective boiler. Thus there are three stacks to the east of the structure and three to the west. The boiler house sits along the north side of the turbine house, and the firing aisle between the boilers leads directly into the control room in the turbine building. The Unit 1-3 boiler house is a primary contributing feature of the potential power plant district.

Stacks for Unit 1-3 Boilers: There are six steel stacks for Units 1-3, one for each boiler. There is a row of three stacks along the east side of the boiler house and a row of three along the west side. Each stack is 200 feet tall and 11 feet in diameter. The six stacks are primary contributing features of the potential power plant district.

Boiler House for Units 4 and 5: The boiler house for Units 4 and 5 is also of the semi-enclosed type. The steel-frame structure enclosing the boilers is also sheathed in corrugated Transite. It is located along the north side of the addition to the turbine building. Unlike the original boiler house, which houses two boilers for each turbine, this boiler house has only two boilers. Their orientation is 90° from that of the original six boilers. Thus the burner front of each boiler faces south toward the turbine building. The ducts for supply air and combustion gases are on the north side of the boiler house. Fan housings are outside the structure. The Unit 4 and 5 boiler house is a primary contributing feature of the potential power plant district.

Stacks for Units 4 and 5 Boilers: There are two steel stacks for Units 4 and 5, one for each boiler. They stand on the north side of the boiler house. Each stack is 200 feet tall and 16.5 feet in diameter. The stacks for Units 4 and 5 are primary contributing features of the potential power plant district.

Boiler Water Tank: This steel cylindrical tank sits just west of the stack for the middle boiler on the west side of the Unit 1-3 boiler house. It is original to the power plant and is a contributing feature of the potential power plant district.

Distilled Water Storage Tanks: There are three steel water tanks sitting in a row extending west of the stack for the southernmost boiler on the west side of the Unit 1-3 boiler house. The two nearest the boiler house are original to the power plant and are contributing features of the potential power plant district. The westernmost tank is a later addition and is a non-contributing feature in the potential district.

Water Treatment Apparatus: West of the stack for the northernmost boiler on the west side of the Unit 1-3 boiler house is a grouping of equipment used to treat river water before it was sent to the boilers. The equipment is a later addition to the power plant and is a non-contributing feature.

Water Tower: An elevated water tank stands at the northwestern corner of the site on the small peninsula created by the discharge channel. The water tower is original to the power plant and is a contributing feature of the potential power plant district.

Quonset Hut: Located at the east end of the row of service buildings along the north side of the site, the Quonset Hut (so named by a sign over its door) serves as a storage and shop building for the power plant. Unlike other buildings on the site, which typically have corrugated Transite sheathing, the Quonset Hut has corrugated steel sheathing. Although it does not appear on an original plot plan for the site, it does appear in a 1952 photo showing construction of Units 4 and 5. It is a contributing feature of the potential power plant district.[18]

Warehouse: The warehouse is due west of the Quonset Hut. It is a steel-framed building with gable roof and corrugated asbestos siding. It is original to the power plant and is a contributing feature of the potential power plant district.

Water Intake Works: Built on the same axis as the firing aisle of the Unit 1-3 boiler house, the cooling water intake tubes extend out into the San Joaquin River below the surface of the water and are therefore not visible. All that is visible above the surface is the walkway on timber piling that extends from the river bank east of the tubes and out to a platform directly over the intake end of the tubes and a wood pile barrier along the west side of the tubes. The landward end of the tubes couples to the screenwell structure, described below. The water intake works is original to the power plant and is a contributing feature of the potential power plant district.

Screenwell Structure: From the perspective of pavement between the Unit 1-3 boiler house and the river, this structure appears to be little more than a concrete slab-on-grade next to the water's edge. It houses the screens for cleaning cooling water drawn from the river through the intake tubes. Four steel housings sit atop the structure, enclosing the equipment used from raising the screens. When Units 4 and 5 were built, the screenwell structure was enlarged to the east. A construction joint in the concrete is visible, distinguishing the original screenwell structure from the addition. Because the addition was built more than 45 years ago, the entire screenwell structure contributes to the potential power plant district.

Units 4 and 5 Cooling Water Pump House: The pumps for delivering cooling water to the six boilers for Units 1-3 are located inside the plant, whereas the pumps for Units 4 and 5 were designed to be housed next to the screenwell structure. The pump house is a steel-framed building with a gable roof and corrugated Transite siding. It contributes to the potential power plant district.

Chlorinator House: Just south of the original section of the screenwell structure is the small house for the chlorination equipment. It is a steel-framed structure with a gable roof and corrugated Transite siding. It contributes to the potential power plant district.

Control House: Just west of the screenwell structure is the control house for the intake works. It is a steel-framed structure with a gable roof and corrugated Transite siding. It contributes to the potential power plant district.

Discharge Works: At the northwestern corner of the site, there is a short channel that conveys water back into the river after it has been used for cooling. The water is discharged through simple culvert openings into the channel. The discharge works is original to the power plant and contributes to the potential power plant district.

Fuel-Oil Tanks 1-5: The fuel-oil tanks are located along the west edge of the site. The four that are original to the power plant are west-southwest of Units 1-3 and are arranged in a quad pattern. The fifth tank, built shortly after the power plant went into service, is located just south of the westernmost pair of original tanks. Each of the five tanks is about 140 feet in diameter and is surrounded by an earthen embankment, rectangular in plan, meant to contain leaks. Three newer, larger tanks are located at the southwestern corner of the site. Tanks 1-5 are contributing features of the potential power plant district. The three newer tanks do not contribute to the potential district.

PG&E Switchyard: East of tank 5 and about 1,100 feet south of the turbine building is the PG&E switchyard. The original switchyard extended as far east as the east end of the Unit 1-3 turbine building. The switchyard now extends as far east as Units 6 and 7. Although much of the truss structure for the switchyard is original to the site, the insulators and transformers have been significantly altered in the intervening years. Although the switchyard is an essential part of the power plant complex, it has lost its historic integrity. It is therefore a non-contributing feature to the potential power plant district.

Units 6 and 7: Built in 1964, the boilers, turbines, and generators for Units 6 and 7 are set within an unenclosed structure, representing the evolution of design characteristics for power plants in the second half of the twentieth century. Each unit has a capacity of 330 megawatts, representing the trend toward ever-larger generating units. The boilers are on the south side of the structure and the turbines and generators are on the north side, which is opposite from the configuration of Units 1-5. A single stack, 450 feet tall, rises from the center of the south side of the structure, serving both boilers.[19] Units 6 and 7 are non-contributing features of the potential power plant district.

Transmission Towers: Several steel transmission towers carry wires between the generating units and the switchyard. The two towers south of the Unit 1-5 turbine building are likely original to the site and are contributing features. The towers south of Units 6 and 7 are of more recent construction and do not contribute.

Conclusions

Eligibility: Following are the "Criteria for Evaluation" by which resources may be determined eligible for listing in the National Register of Historic Places:

The quality of significance in American history, architecture, archaeology, engineering, and culture is present in districts, sites, buildings, structures, and objects that possess integrity of location, design, setting, materials, workmanship, feeling, and association, and:

A. that are associated with events that have made a significant contribution to the broad patterns of our history; or

B. that are associated with the lives of persons significant in our past; or

C. that embody the distinctive characteristics of a type, period, or method of construction, or that represent the work of a master, or that possess high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinction; or

D. have yielded, or may be likely to yield, information important in prehistory or history.

Criteria for listing in the California Register of Historical Resources are similar. A resource may be eligible if:

1. It is associated with events that have made a significant contribution to the broad patterns of local or regional history, or the cultural heritage of California or the United States;

2. It is associated with lives of persons important to local, California, or national history;

3. It embodies the distinctive characteristics of a type, period, region, or method of construction, or represents the work of a master or possesses high artistic values; or

4. It has yielded, or has the potential to yield, information important to the prehistory or history of the local area, California, or the nation.

A portion of the Contra Costa Power Plant is eligible as a historic district for listing in the National Register of Historic Places under Criterion A for its association with California's post-war economic boom, with the role of electricity in powering that boom, and with PG&E's notable expansion of its generating capacity to meet the demand for more electricity. The Contra Costa Power Plant retains excellent integrity. The major features from the period of significance — Units 1-3 and their original equipment, Units 4 and 5 and their original equipment, the original five fuel-oil storage tanks, and the ancillary structures clustered near Units 1-5 — reflect the way the power plant looked and operated in the early 1950s, when PG&E was employing state-of-the-art steam plant engineering to meet expanding demand for electricity. Expansion of the power plant, by the construction of Units 6 and 7, did not impinge on the industrial character of the original five units.

The Contra Costa Power Plant historic district does not appear to be eligible for the National Register under Criterion B for association with the lives of persons significant to our past.

The Contra Costa Power Plant historic district does not appear at this time to be eligible for the National Register under Criterion C. The power plant embodies most of the design features that characterized steam plants built during the postwar period. The power plant did not, however, pioneer those characteristics. Moreover, Units 1-3 are atypical in that there is more than one boiler per generating unit. Were a survey completed of postwar steam plants in California and the Contra Costa plant found to be the sole surviving example with such superb historical integrity, the plant would then likely be eligible as well under Criterion C for embodying the distinctive characteristics of a type, period, and method of construction. The power plant is also associated with Bechtel Corporation, one of the nation's leading engineering and construction companies to emerge from the Great Depression and World War II. It is not known without further study whether the power plant is eligible under Criterion C for its association with Bechtel Corporation. If not, then the Bechtel association adds to the power plant's significance under Criterion A for Bechtel's role in the postwar urban and industrial expansion of the region.

Preparation for this report did not include archeological survey. No conclusions have been drawn as to the site's eligibility under Criterion D.

The recommendation that the Contra Costa Power Plant historic district is eligible for the National Register is based solely on an assessment of the integrity of the historic resources and

an understanding of the historical context within which the plant was built. During the period of significance, PG&E also built several other power plants, both steam and hydroelectric. Other than checking with the California State Historic Preservation Office to determine whether any of the other steam plants have been previously evaluated for their eligibility (they have not), none of those plants have been evaluated as part of this project. It is not known how much integrity those other plants retain or how their historical significance relative to PG&E's postwar expansion compares with that of the Contra Costa plant. A better understanding of the Contra Costa plant's historical significance could be developed if a broader survey were to be completed.

The Contra Costa Power Plant is also eligible for listing in the California Register of Historical Resources under Criterion 1 for its association with the postwar expansion of California's economy. The state's growth in population and industrial activity during World War II and the years following ushered in changes that are still reverberating today, both within the state and nationally. PG&E's additions to its generating capacity, including the construction of the Contra Costa Power Plant, helped to supply the energy upon which much of California's growth was built.

Period of Significance: The Period of Significance for the Contra Costa Power Plant is 1945-1953, reflecting the period during which PG&E began planning its postwar construction program and during which the power plant was built in two phases. Although Units 1-3 were completed in 1951 and Units 4 and 5 were completed in 1953, and are therefore less than 50 years of age, their planning and construction took place more than 50 years ago and the postwar economic expansion of which they were a part began more than 50 years ago. Moreover, Units 1-3 will shortly be 50 years of age (in August 2001).

Proposed District Boundary: The boundary of the proposed Contra Costa Power Plant historic district begins at the northwest corner of the power plant property and extends along the bank of the San Joaquin River to a point just west of the intake structure for Units 6 and 7. From there it runs due south along the east side of the Quonset Hut and the west side of the Unit 6 and 7 structure to the north side of the east-west service road (about 880 feet). From there it runs west to the west side of the service road along the east side of the fuel-oil tanks (about 990 feet). From there it runs south to the north side of the service road along the fence around the PG&E switchyard (about 660 feet). From there it runs west to the bend in the road around the northwest corner of the switchyard (about 290 feet). From there it runs south along the west side of the service road to a line midway between the southernmost of the 1950s storage tanks and the northernmost of the 1970s tanks (about 330 feet). From there it runs due west to the west edge of the property (about 440 feet). From there it runs due north along the property line to the point of beginning (about 1,210 feet).

Effect: Southern Energy proposes to build a new Unit 8 at the northeast corner of the Contra Costa Power Plant property. Units 6 and 7 have already been built on the property without detracting from the cultural values of Units 1-5. The function and use of Units 6 and 7 are the same and therefore compatible with the former function and use of Units 1-5. The same will be true for the proposed Unit 8. Southern Energy plans to use open space south of Units 1-5 for construction parking and construction trailers. These temporary uses will also not have an adverse effect on the cultural values of Units 1-5 or the proposed historic district. All of the proposed construction for Unit 8 will be well to the east of the proposed Contra Costa Power Plant historic district and therefore will not have an adverse effect on the district.

Endnotes

1 James C. Williams, *Energy and the Making of Modern California* (Akron, OH: The University of Akron Press, 1997), 269-271, 280-284; Charles M. Coleman, *PG&E of California: The Centennial Story of Pacific Gas and Electric, 1852-1952* (New York: McGraw-Hill Book Company, Inc. 1952), 331-332; Mel Scott, *The San Francisco Bay Area: A Metropolis in Perspective* (Berkeley: University of California Press, 1959), 271-281; Charles Wollenberg, *Golden Gate Metropolis: Perspectives on Bay Area History* (Berkeley: Institute of Governmental Studies, University of California, 1985), 258-260; Richard White, *"It's Your Misfortune and None of My Own:" A New History of the American West* (Norman: University of Oklahoma Press, 1991), 513-517.

2 Coleman, *PG&E of California*, 331, 338; I.C. Steele, "Steam Power Gains on Hydro in California," *Civil Engineering* 20 (January 1950): 17.

3 Williams, *Energy and the Making of Modern California*, 11.

4 Coleman, *PG&E of California*, 333-334; Steele, "Steam Power Gains on Hydro," 18.

5 Steele, "Steam Power Gains on Hydro," 18, 21.

6 Mark S. Foster, *Henry J. Kaiser: Builder of the Modern American West* (Austin: University of Texas Press, 1989), 38-39, 46-48; Robert L. Ingram, *The Bechtel Story: Seventy Years of Accomplishment in Engineering and Construction* (San Francisco: n.p. 1968), 6, 9-12.

7 Ingram, *The Bechtel Story*, 18, 23-25, 99-100; Thomas P. Hughes, *Rescuing Prometheus* (New York: Pantheon Books, 1998), 197-200, 212-215.

8 "PG&E Contra Costa Steam Plant," *Bechtel Briefs* 4 (February 1949): 6-7.

9 "Distinctive Design Features of 81 Postwar Power Plants," *Electrical World* 133 (8 May 1950): 88-92; "Design Trends in 92 of the Newest Power Plants," *Electrical World* 137 (7 April 1952): 119-120; Mike Reilly, "Power Developments in the West," *California Engineer* 30 (December 1951): 27; J.B. McClure and A.G. Mellor, "Today's Trends in Steam Plant Design—I," *Electrical World* 138 (8 September 1952): 117-119; McClure and Mellor, "Today's Trends in Steam Plant Design—III," *Electrical World* 138 (3 November 1952): 96-99. Specifications for Contra Costa's boilers may be seen on the maker's plate mounted on each one.

10 "PG&E Contra Costa Steam Plant," 6; C.K. Lewis and L.T. Zbanek, "Cold Water-Hot Steam and High Voltage," *Bechtel Briefs* 5 (March 1950): 6; "Contra Costa Strategic Link in PG&E System," *Electric Light and Power* 29 (December 1951): 73; "*Power* Takes You Through New Contra Costa Plant," *Power* 96 (February 1952): 76-77.

11 "Contra Costa Is Highly Instrumented," *Electrical West* 107 (October 1951): 81-83.

12 Bechtel Corporation, "Plot Plan, Contra Costa Steam Plant Units 1, 2, & 3, Pacific Gas & Electric Company, San Francisco," drawing no. 53401 dated 21 May 1951 (and revised 16 September 1952), document storage room, Contra Costa Power Plant, Antioch, CA; "PG&E Contra Costa Steam Plant," 7; "Build-up Day at Contra Costa," *Bechtel Briefs* 6 (March 1951): 7; *Electrical West* 107 (October 1951): 73; Coleman, *PG&E of California*, 327.

13 Bechtel Corporation, *Engineers and Builders for Industry* (n.p. 1958), 40.

14 Construction of Units 6 and 7 may be seen in detail in an album of photographs titled, "Contra Costa Steam Plant - Pacific Gas and Electric Company, Units 6 and 7," and kept in the office of David Frandsen, Contra Costa Power Plant, Antioch, CA. The three newer tanks are not visible in a 1970 aerial photograph; see U.S. Geological Survey, "Antioch North, Calif." Orthophoto Quad (1970). The tanks are, however, depicted on the 1978 U.S.G.S. topographic map; see U.S. Geological Survey, "Antioch North, Calif." (1978).

15 Interview at Contra Costa Plant by author with David Frandsen, plant engineer, 9-26-00.

16 The original condition of the Contra Costa Power Plant and its equipment may be seen in detail in an album of photographs titled, "Contra Costa Steam Plant - Pacific Gas and Electric Company," and kept in the office of David Frandsen, Contra Costa Power Plant, Antioch, CA.

17 The original condition of the Units 4 and 5 addition and its equipment may be seen in detail in an album of photographs titled, "Contra Costa Steam Plant, Units 4 & 5 — Pacific Gas and Electric Company," and kept in the office of David Frandsen, Contra Costa Power Plant, Antioch, CA.

18 Bechtel Corporation, "Plot Plan, Contra Costa Steam Plant"; Coleman, *PG&E of California*, 327.

19 The original condition of the Units 6 and 7 structure and its equipment may be seen in detail in an album of photographs titled "Contra Costa Steam Plant, Units 6 & 7 — Pacific Gas and Electric Company," kept in the office of David Frandsen, Contra Costa Power Plant, Antioch, CA.

Bibliography

Bechtel Corporation. *Engineers and Builders for Industry*. n.p. 1958.

_____. "Plot Plan, Contra Costa Steam Plant Units 1, 2, & 3, Pacific Gas & Electric Company, San Francisco." Drawing no. 53401 dated 21 May 1951 (and revised 16 September 1952), document storage room, Contra Costa Power Plant, Antioch, CA.

"Build-up Day at Contra Costa." *Bechtel Briefs* 6 (March 1951): 6-7.

Coleman, Charles M. *PG&E of California: The Centennial Story of Pacific Gas and Electric, 1852-1952*. New York: McGraw-Hill Book Company, Inc., 1952.

"Contra Costa is Highly Instrumented." *Electrical West* 107 (October 1951): 81-83.

"Contra Costa Strategic Link in PG&E System." *Electric Light and Power* 29 (December 1951): 73-76.

"Design Trends in 92 of the Newest Power Plants." *Electrical World* 137 (7 April 1952): 119-120.

Electrical West. 107 (October 1951): 73.

"Distinctive Design Features of 81 Postwar Power Plants." *Electrical World* 133 (8 May 1950): 88-92.

Frandsen, David. Interview by author at Contra Costa Power Plant, 26 September 2000.

Foster, Mark S. *Henry J. Kaiser: Builder of the Modern American West*. Austin: University of Texas Press, 1989.

Hughes, Thomas P. *Rescuing Prometheus*. New York: Pantheon Books, 1998.

Ingram, Robert L. *The Bechtel Story: Seventy Years of Accomplishment in Engineering and Construction*. San Francisco: n.p., 1968.

Lewis, C.K., and L.T. Zbanek. "Cold Water-Hot Steam and High Voltage." *Bechtel Briefs* 5 (March 1950): 6-7.

McClure, J.B., and A.G. Mellor. "Today's Trends in Steam Plant Design — I." *Electrical World* 138 (8 September 1952): 117-119.

_____. "Today's Trends in Steam Plant Design — II: Machine Needs Pace Excitation Progress." *Electrical World* 138 (20 October 1952): 93-96.

_____. "Today's Trends in Steam Plant Design — III: Auxiliary System Loads Are Mounting." *Electrical World* 138 (3 November 1952): 96-99.

Pacific Gas & Electric. Photograph albums showing the construction of Units 1-3 (1951), Units 4 and 5 (1953), and Units 6 and 7 (1964), held in the office of David Frandsen, plant engineer, Contra Costa Power Plant, Antioch, CA.

"PG&E Contra Costa Steam Plant." *Bechtel Briefs* 4 (February 1949): 6-7.

"*Power* Takes You Through New Contra Costa Plant." *Power* 96 (February 1952): 75-79.

Reilly, Mike. "Power Developments in the West." *California Engineer* 30 (December 1951): 26-27.

Scott, Mel. *The San Francisco Bay Area: A Metropolis in Perspective.* Berkeley: University of California Press, 1959.

Steele, I.C. "Steam Power Gains on Hydro in California." *Civil Engineering* 20 (January 1950): 17-21.

U.S. Geological Survey. "Antioch North, Calif." Orthophoto Quad (Aerial Photograph). 1970.

_____. "Antioch North, Calif." Topographic Map. 1978.

White, Richard. *"It's Your Misfortune and None of My Own:" A New History of the American West.* Norman: University of Oklahoma Press, 1991.

Williams, James C. *Energy and the Making of Modern California.* Akron, OH: The University of Akron Press, 1997.

Wollenberg, Charles. *Golden Gate Metropolis: Perspectives on Bay Area History.* Berkeley: Institute of Governmental Studies, University of California, 1985.

Determination of Eligibility
for the
CONTRA COSTA POWER PLANT

Appendix A

Photographs of Contra Costa Power Plant

APPENDIX A: Photographs

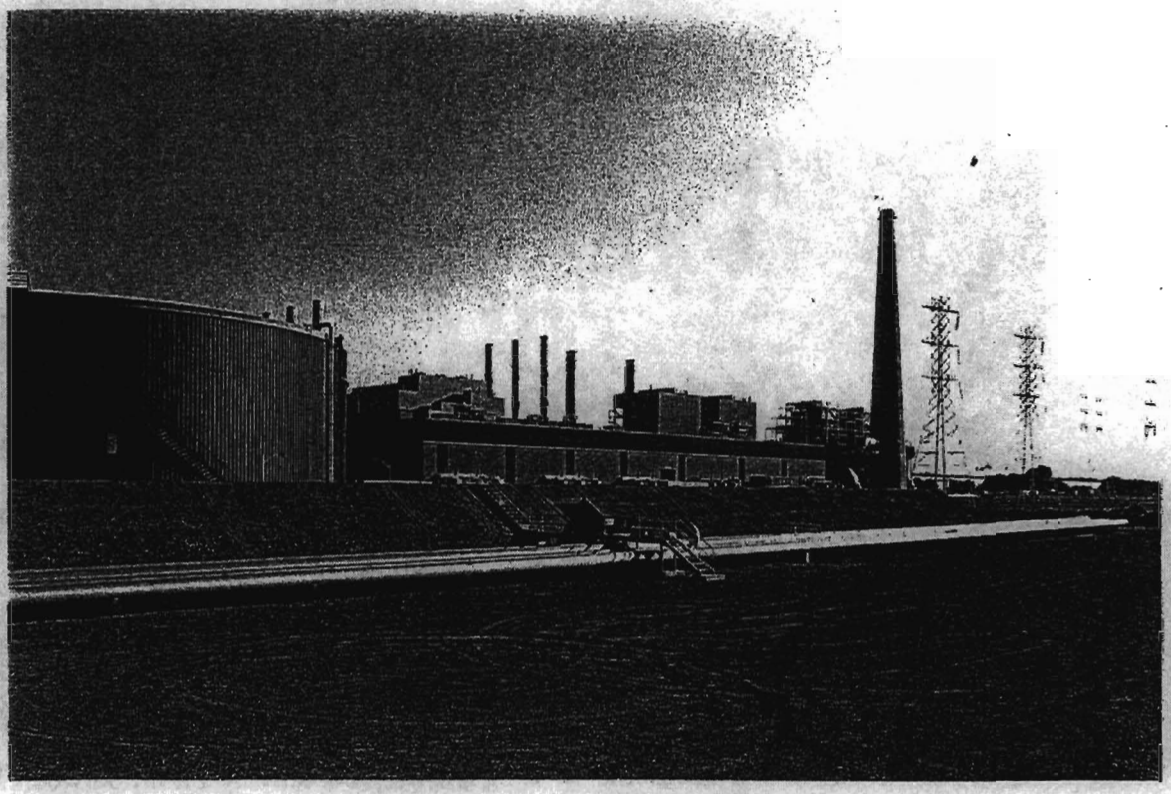


Fig. 1: view toward turbine building, showing fuel tank on left, view to NE

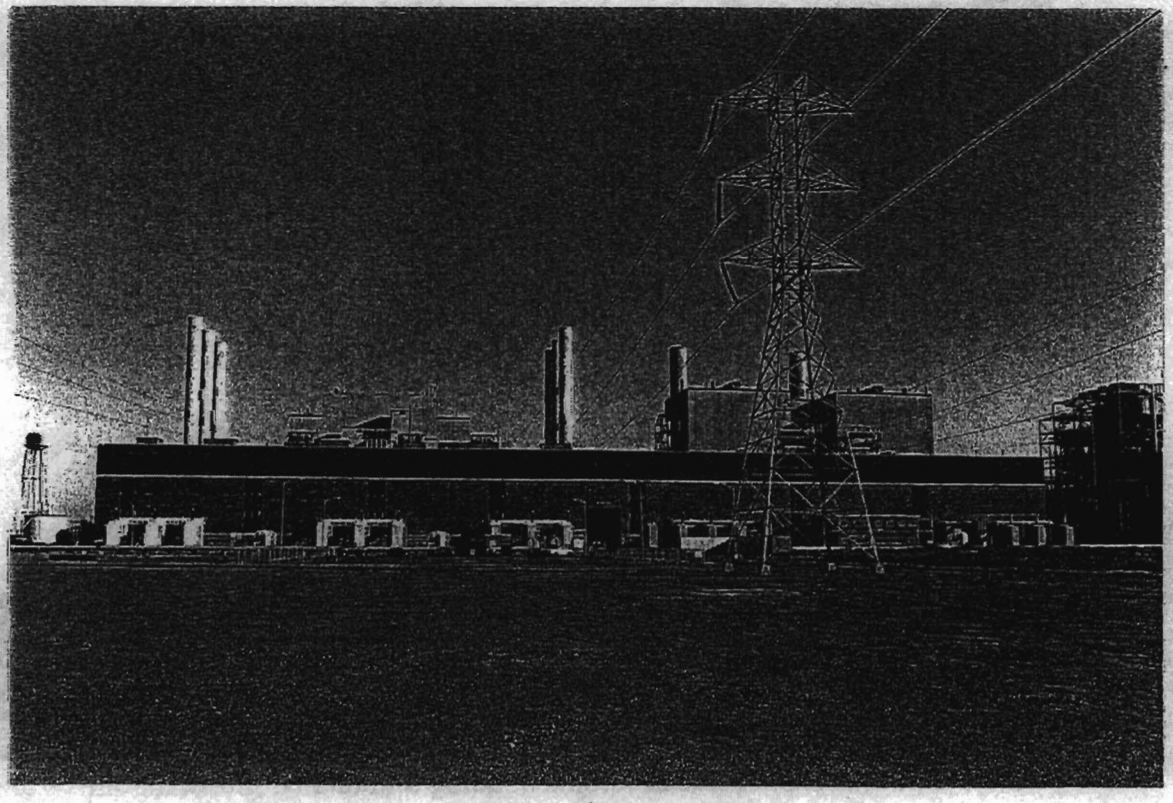


Fig. 2: south elevation of turbine bldg. for units 1-5, view to north

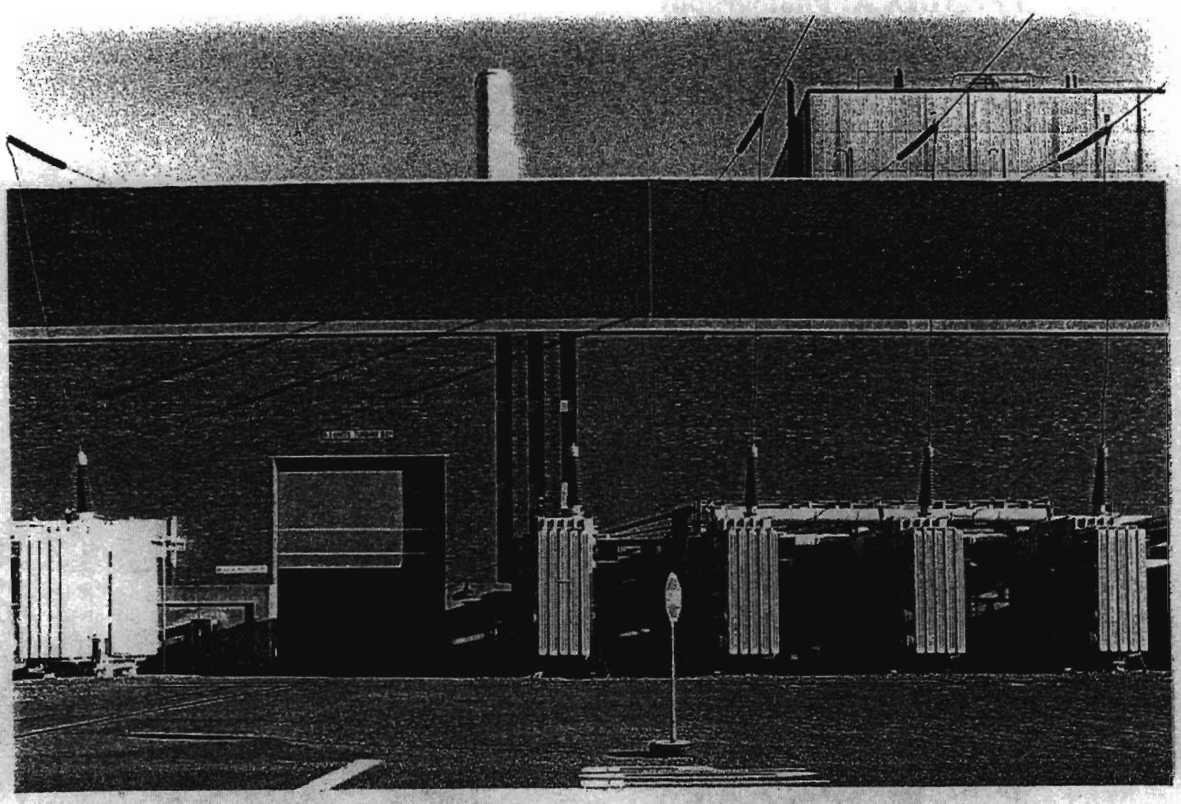


Fig 3: view of south side of turbine building showing construction joint between 1951 & 1953 buildings, view to north.

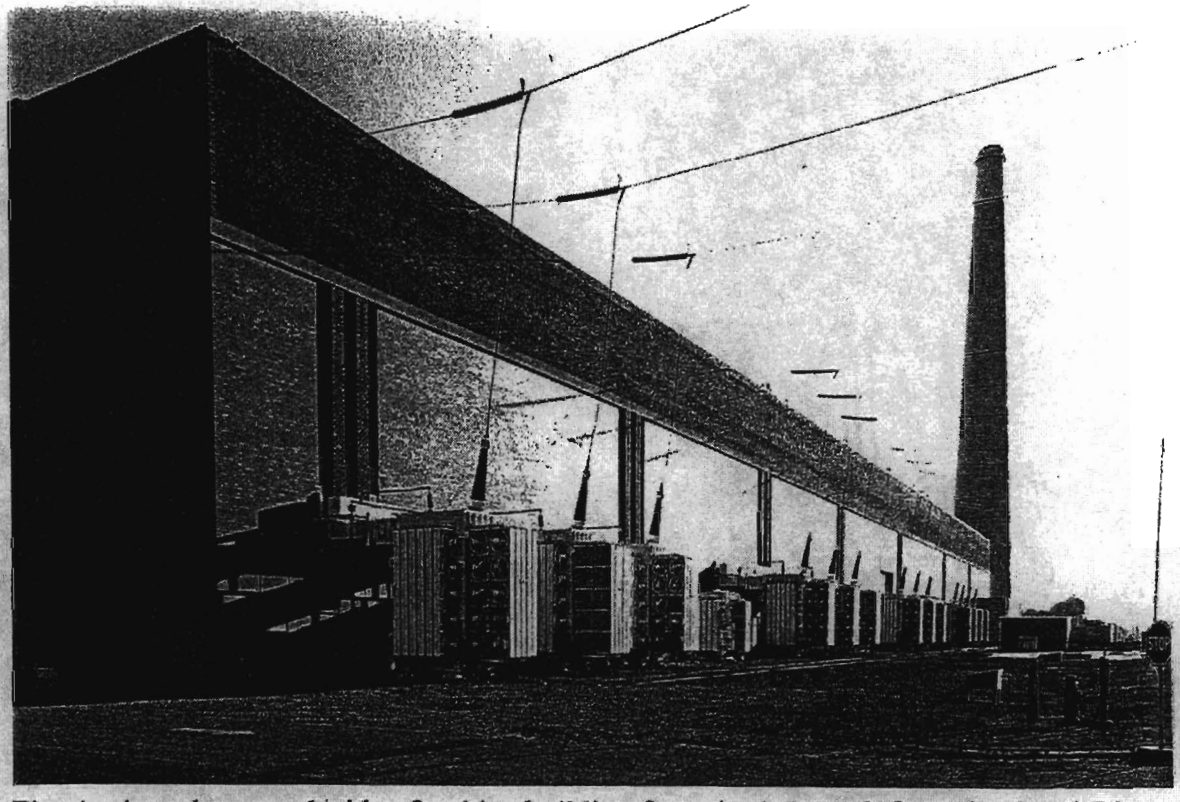


Fig. 4: view along south side of turbine building for units 1-5, stack for units 6 and 7 in background, view to NE.

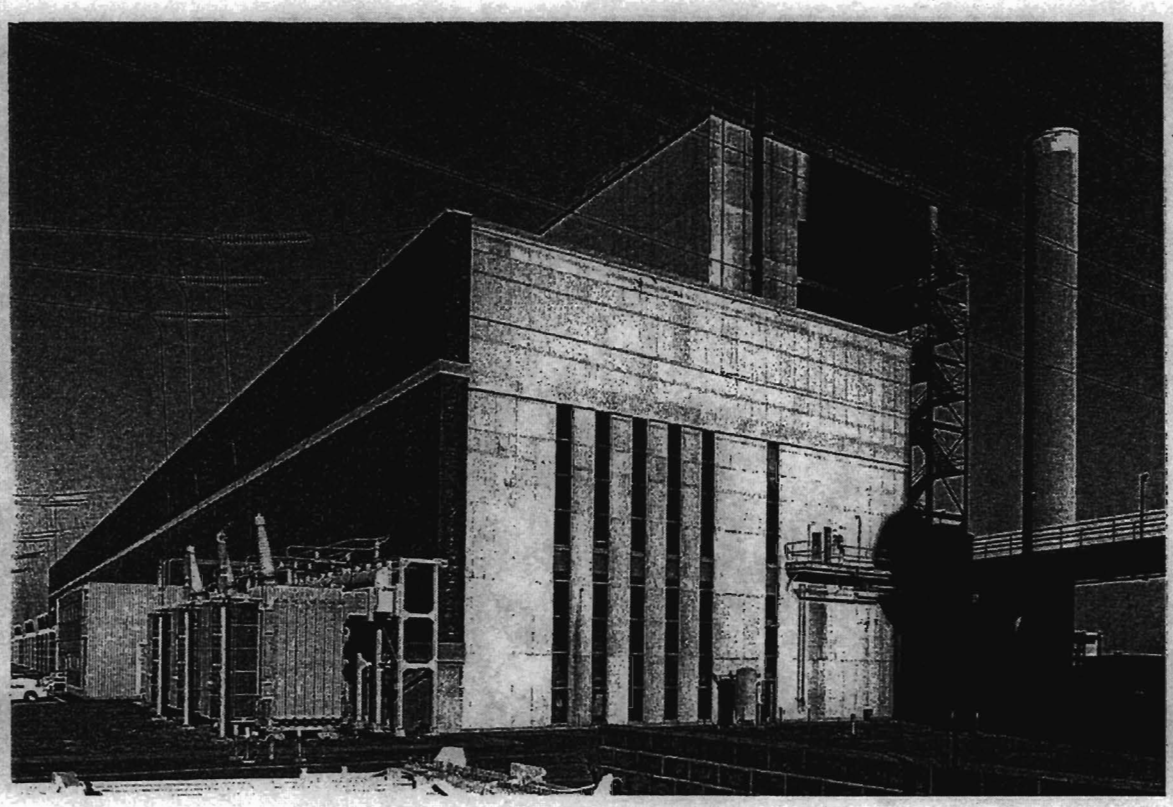


Fig. 5: view of east end of turbine building, view to NW.

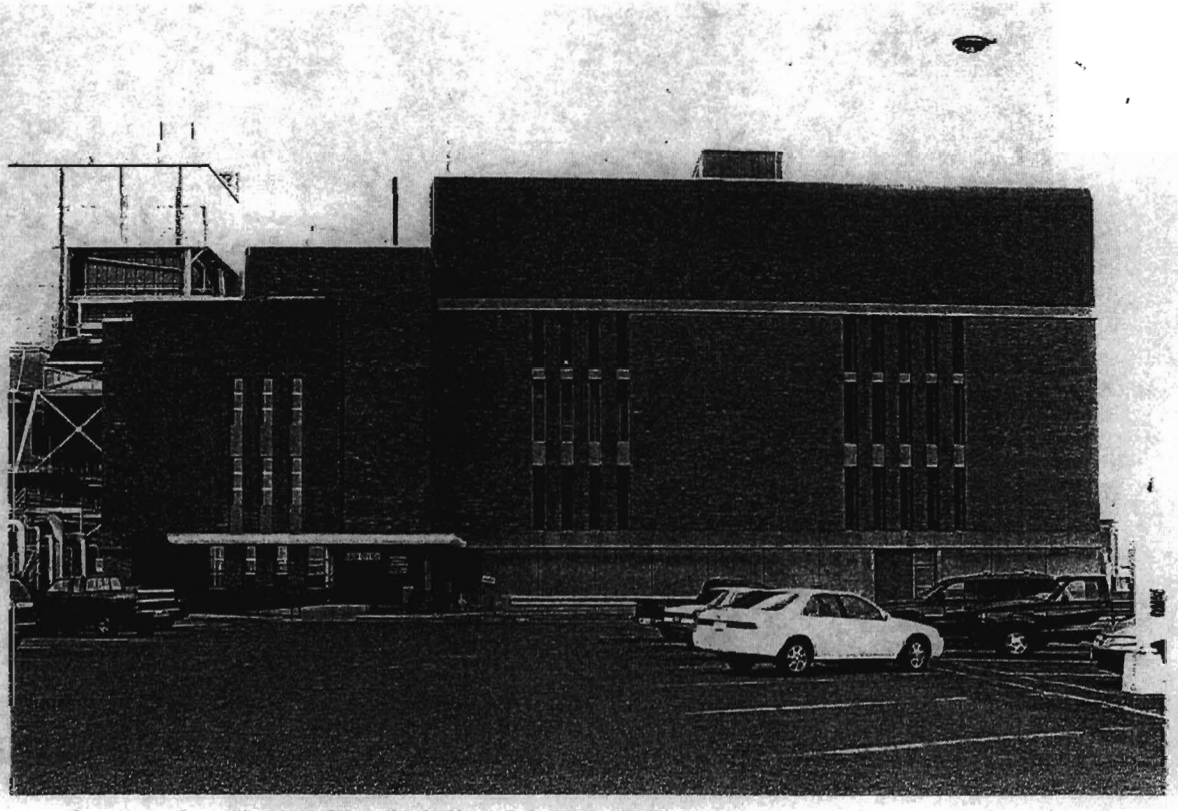


Fig. 6: west elevation turbine building, view to east.

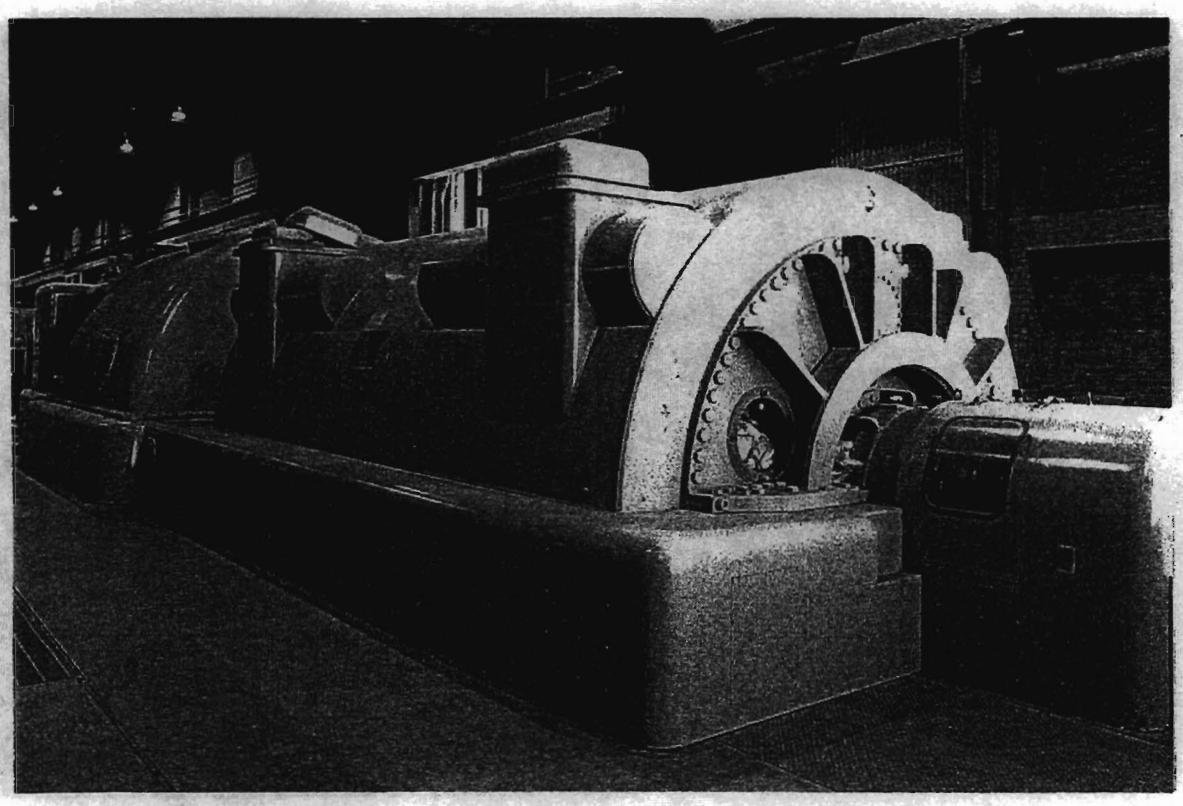


Fig. 7: turbine/generator unit no. 1, view to SE.

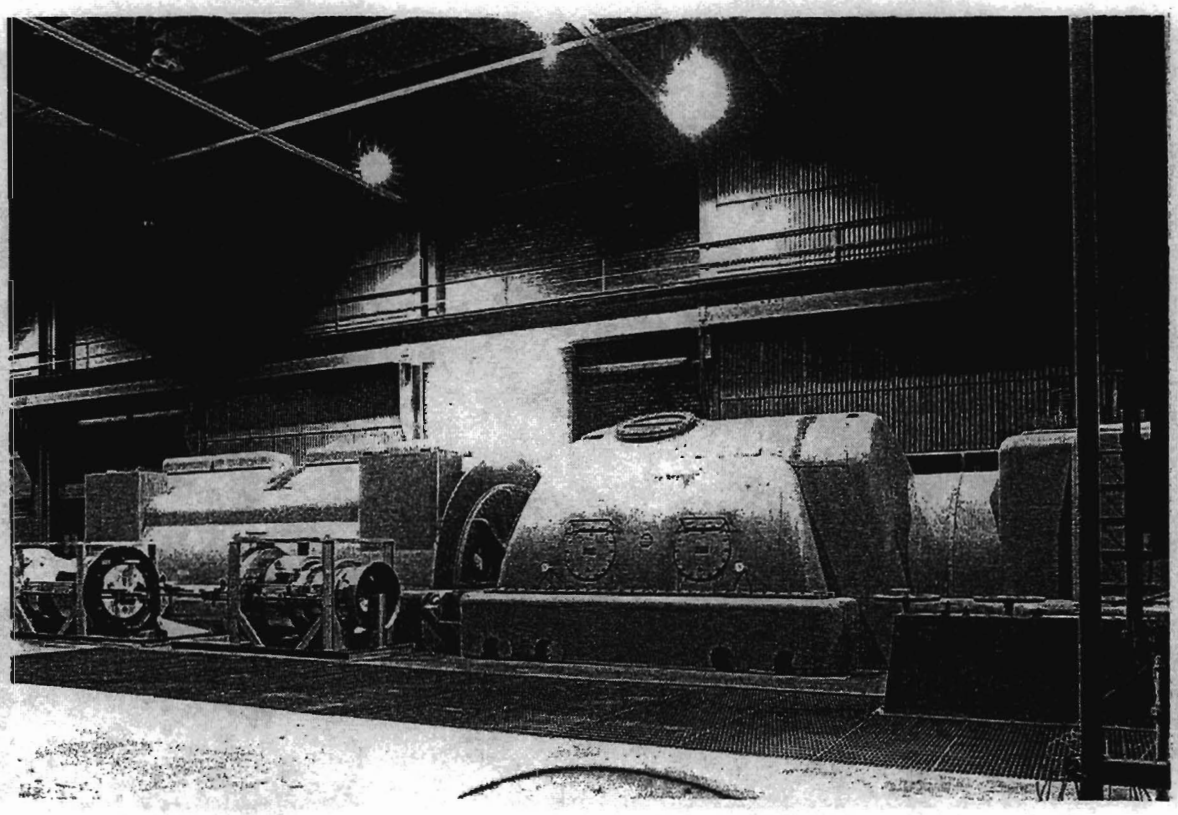


Fig. 8: turbine/generator unit no. 3, view to SE.

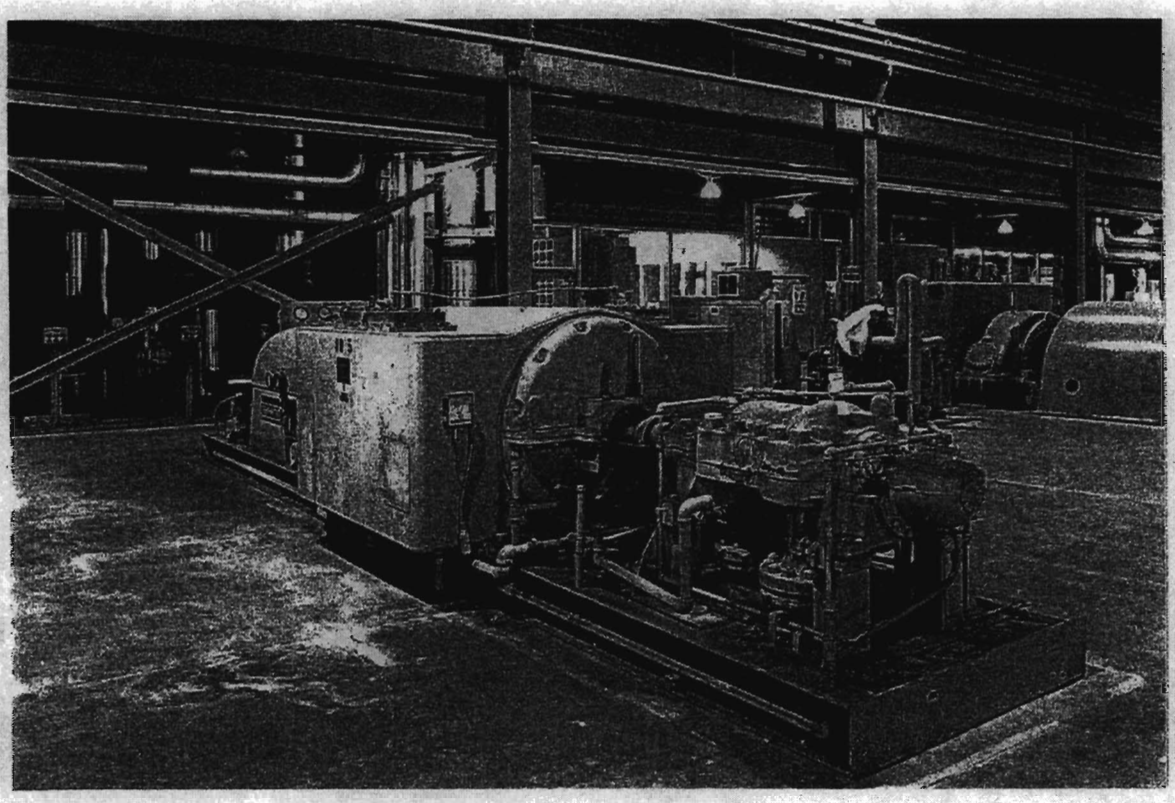


Fig. 9: boiler feed water pump for units 1-3, view to NE.

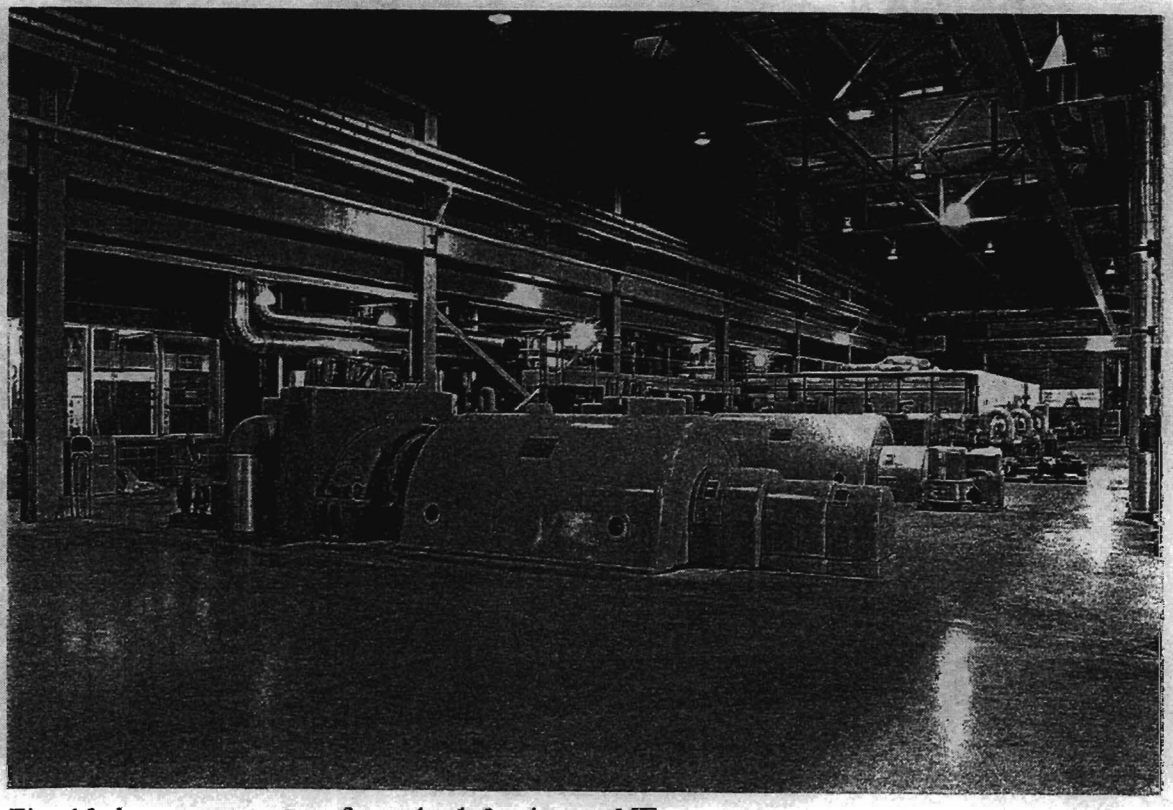


Fig. 10: house generators for units 1-3, view to NE.

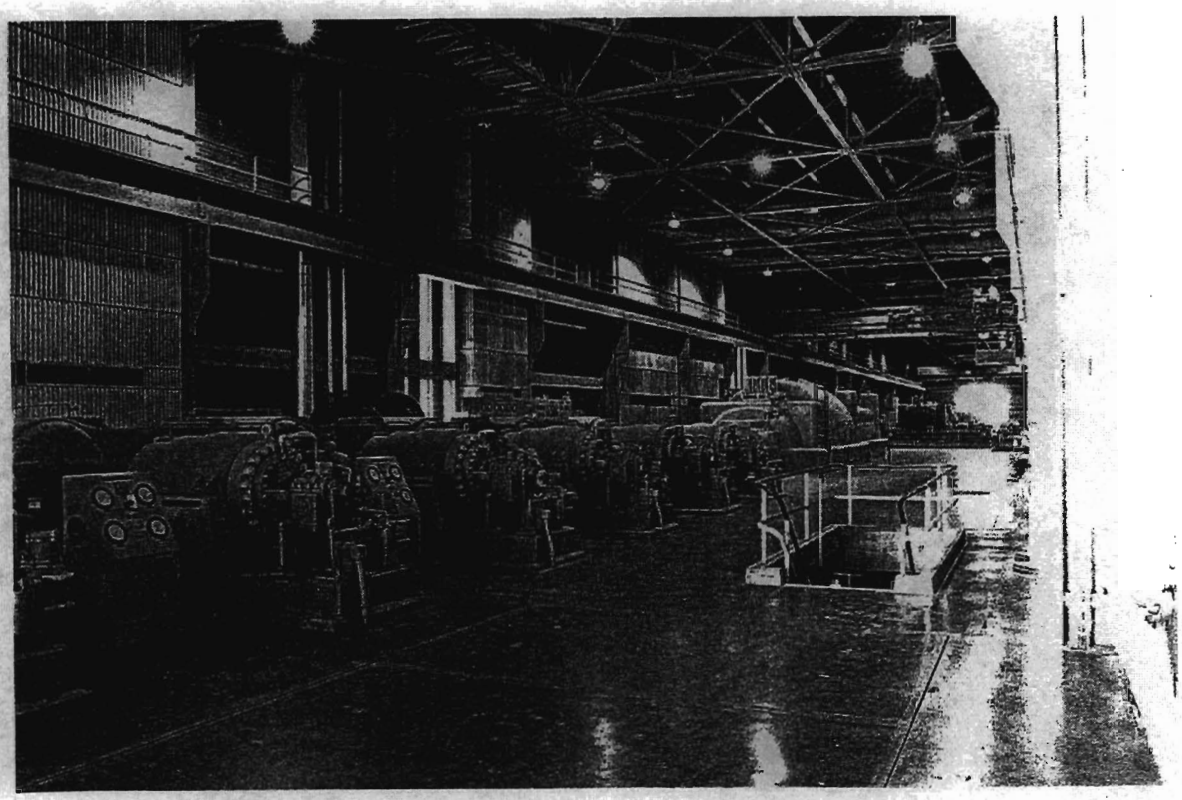


Fig. 11: boiler feed water pumps for units 4 and 5, unit 4 in background, view to SW.

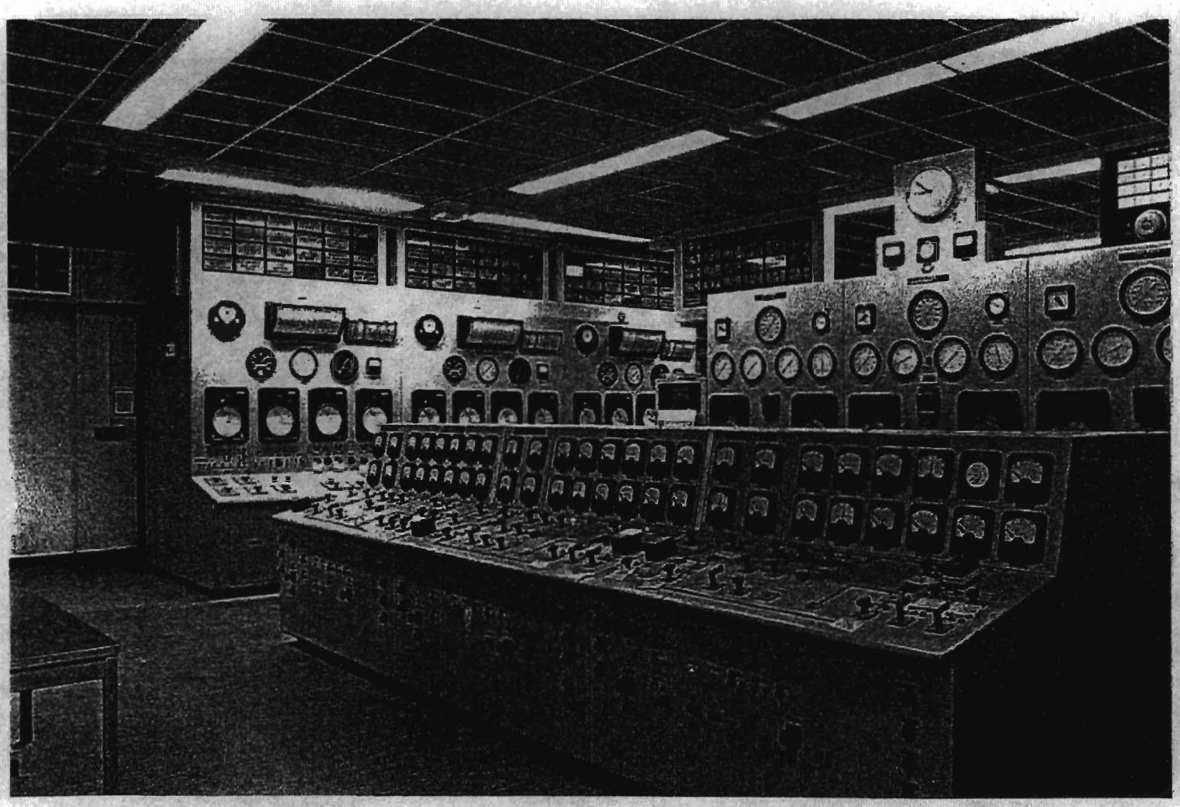


Fig. 12: control room for units 1-3, view to NE.

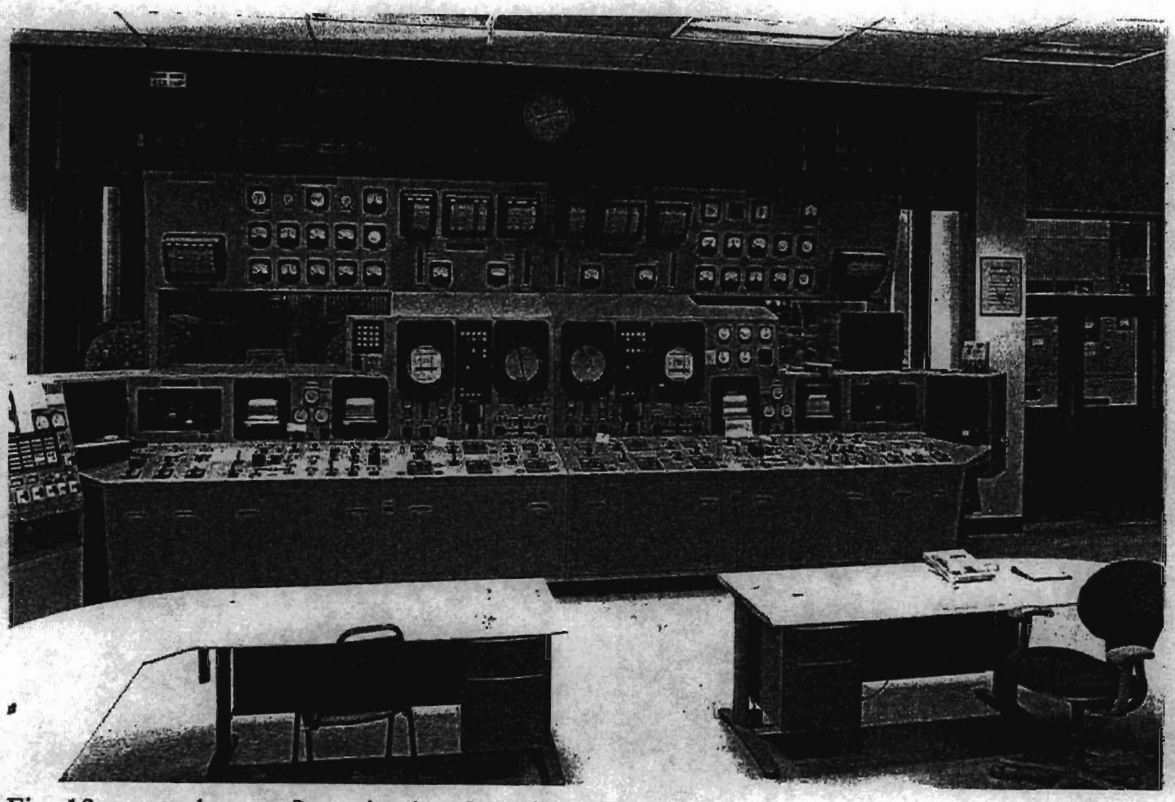


Fig. 13: control room for units 4 and 5, view to south.

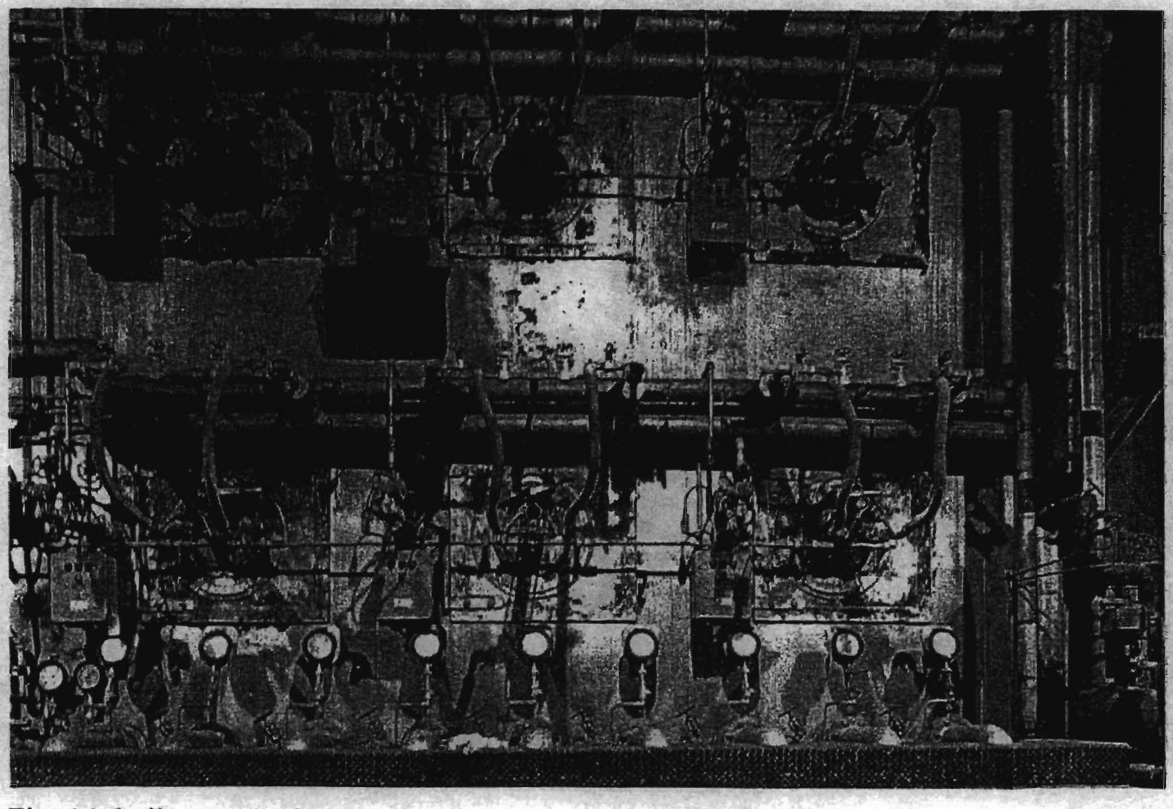


Fig. 14: boiler no. 4, view to east.

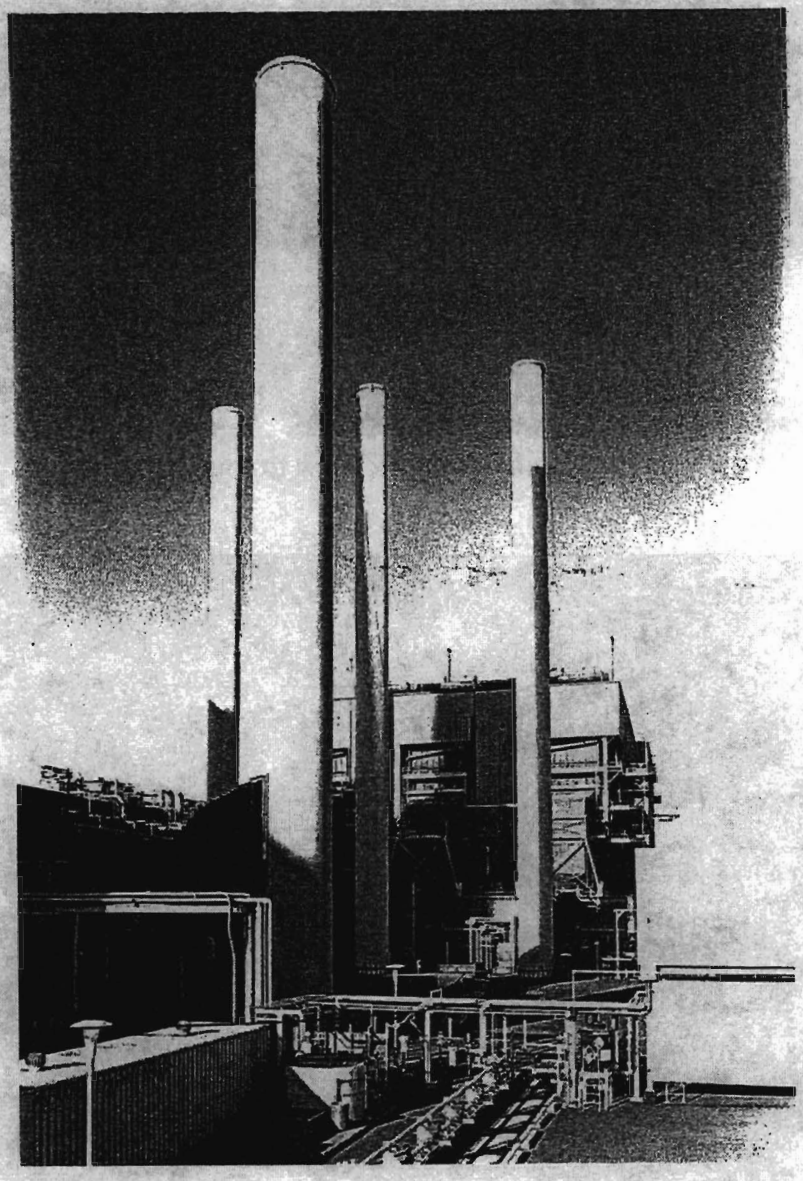


Fig 15: stack for boiler no. 7 (for units 4 and 5) foreground, three stacks for boilers 4-6 (for units 1-3) in background, and boiler house for units 1-3 behind those three stacks, view to WSW.

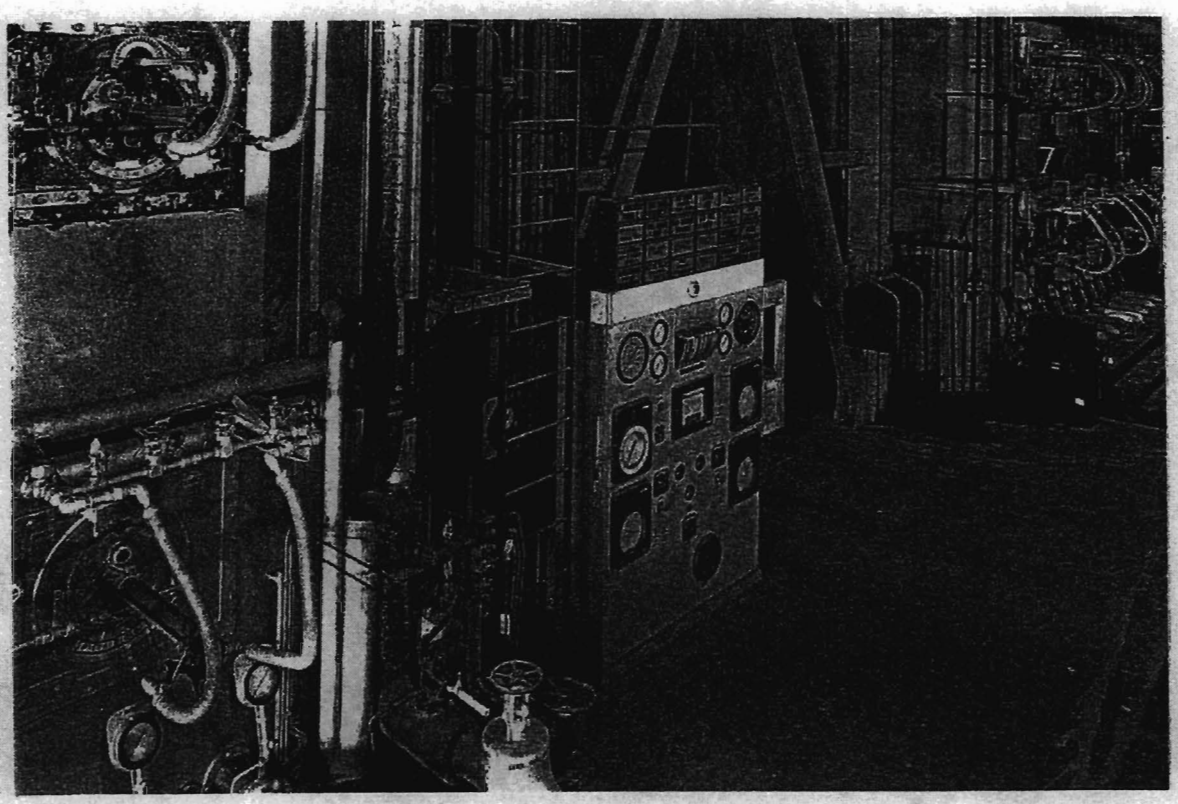


Fig. 16: boiler no. 6 (left), its control panel (center), and boiler no. 5 (right), view to SE.

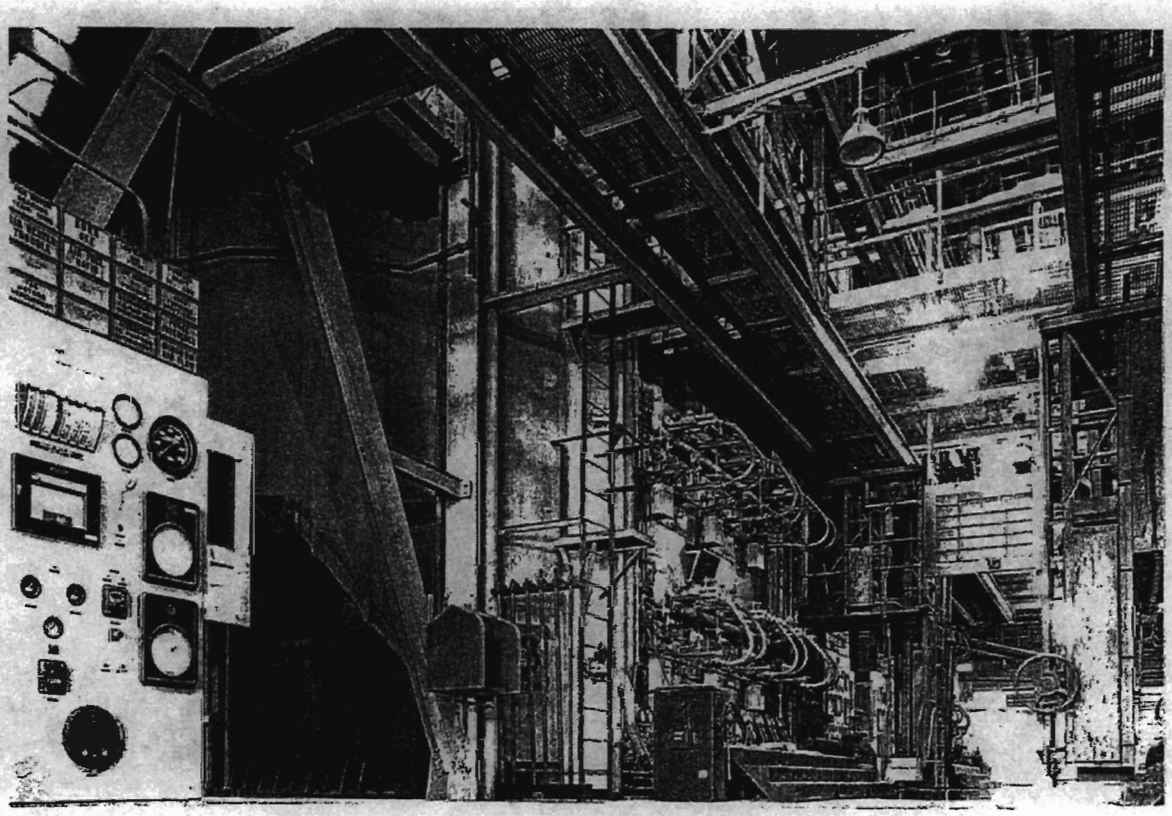


Fig. 17: boiler control panel (left) and boiler no. 5 (center), view to SW.

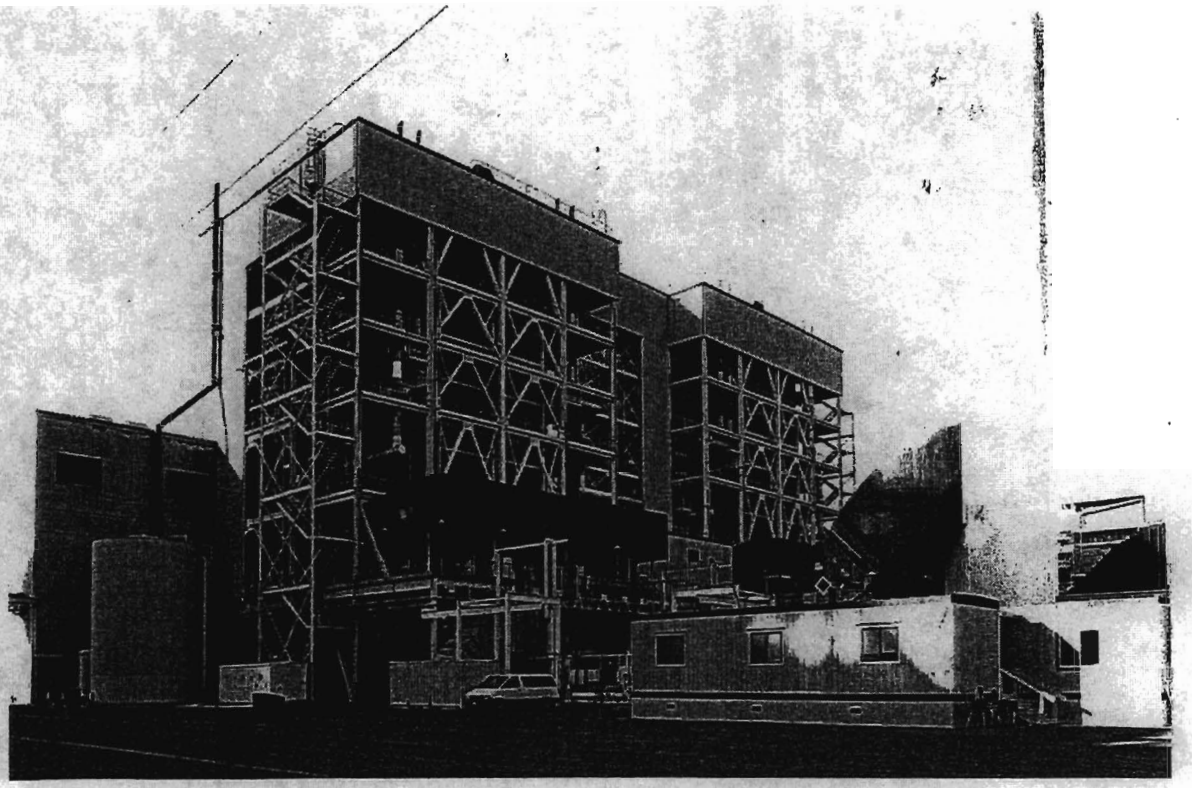


Fig. 18: boiler house for units 4 and 5 with the base of one of its stacks on the right, view to SW.

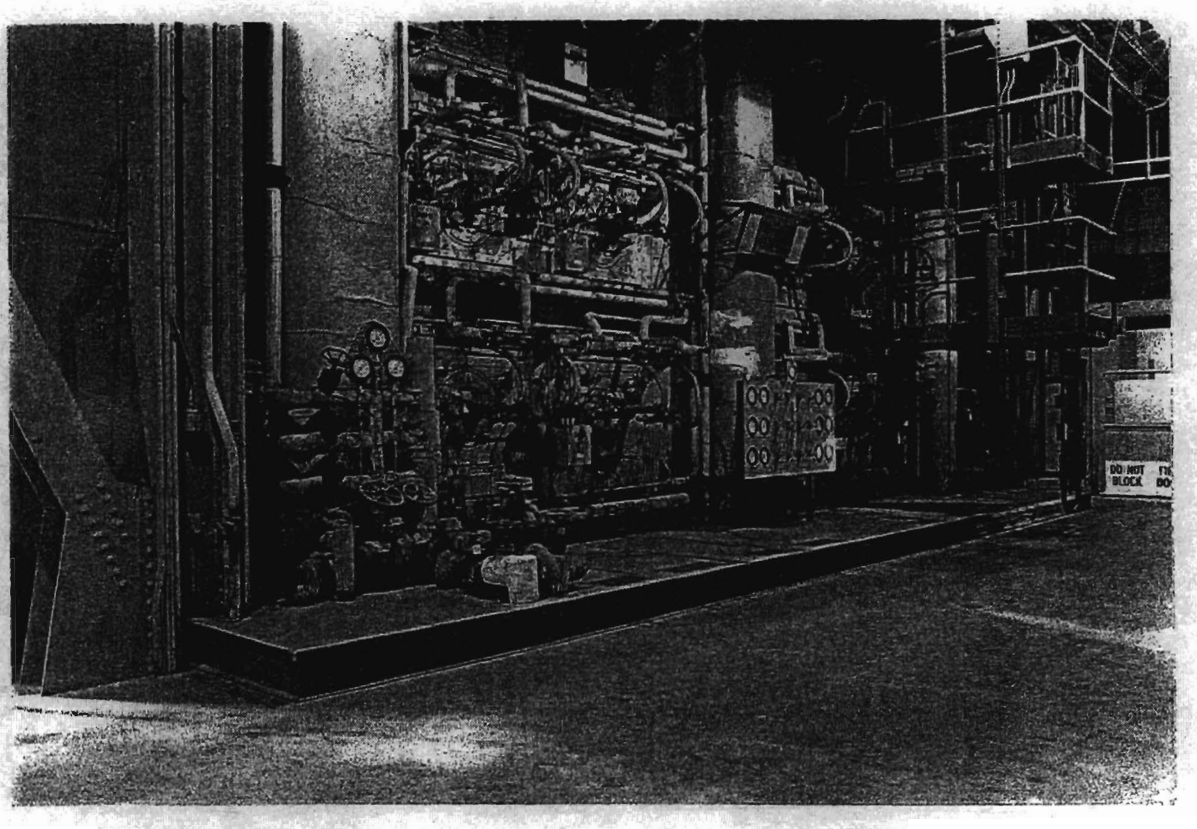


Fig. 19: boiler no. 7 for turbine/generator units 4 and 5, view to NE.

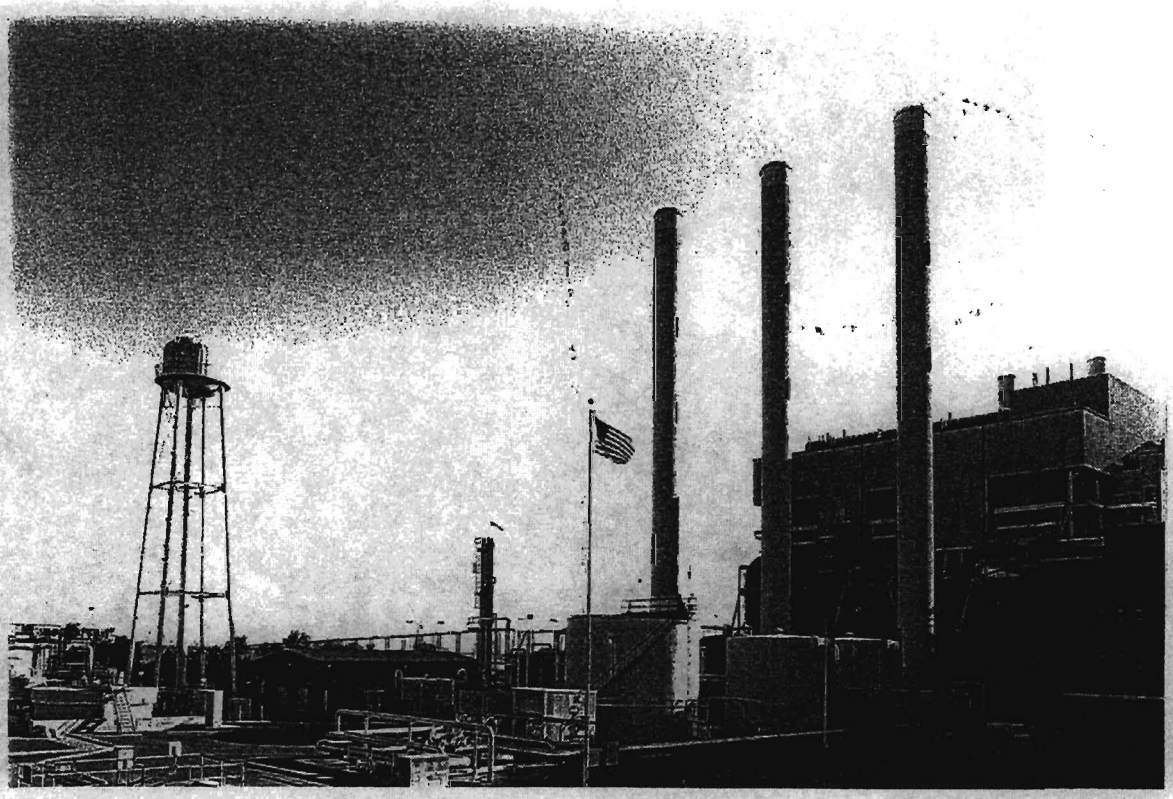


Fig. 20: water tower, water tanks, water treatment works, & stacks for boilers 1-3 with boiler house for units 1-3 in background, view to NE.

Fig. 21: water discharge works (foreground) and water tower (right), view to north.

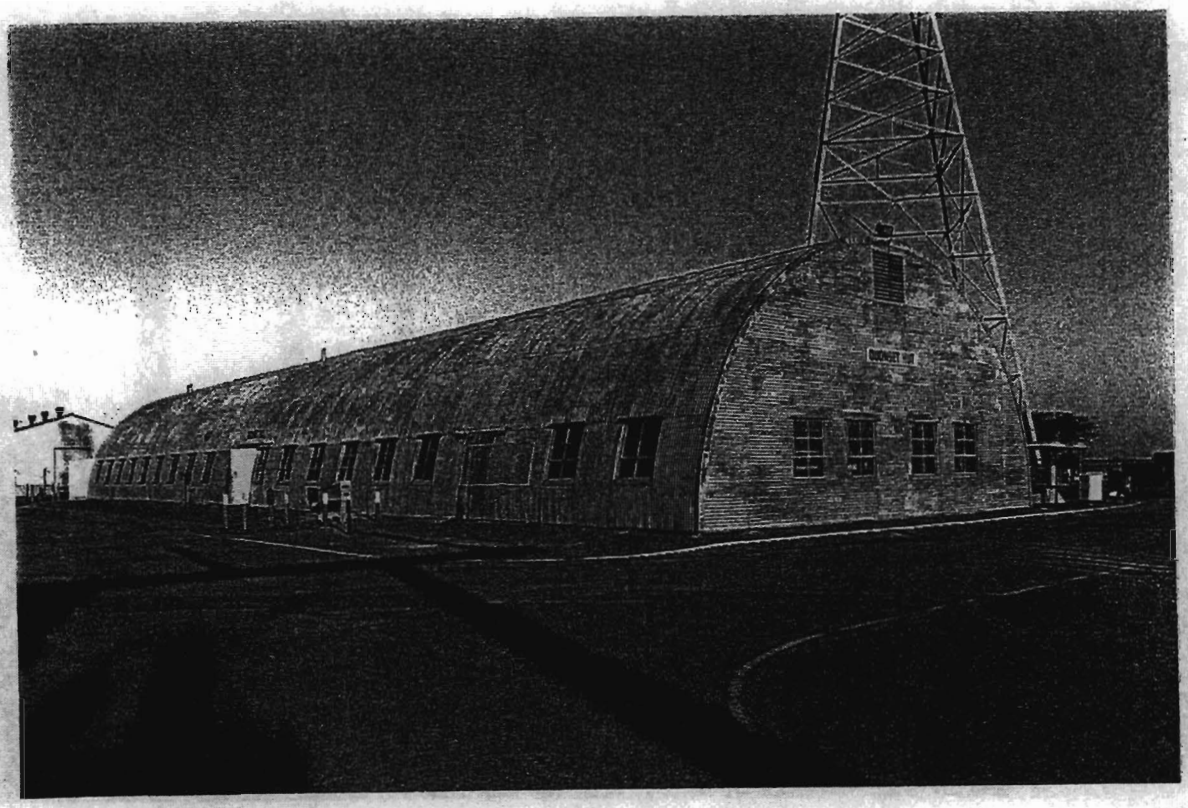


Fig. 22: Quonset Hut, view to NW.

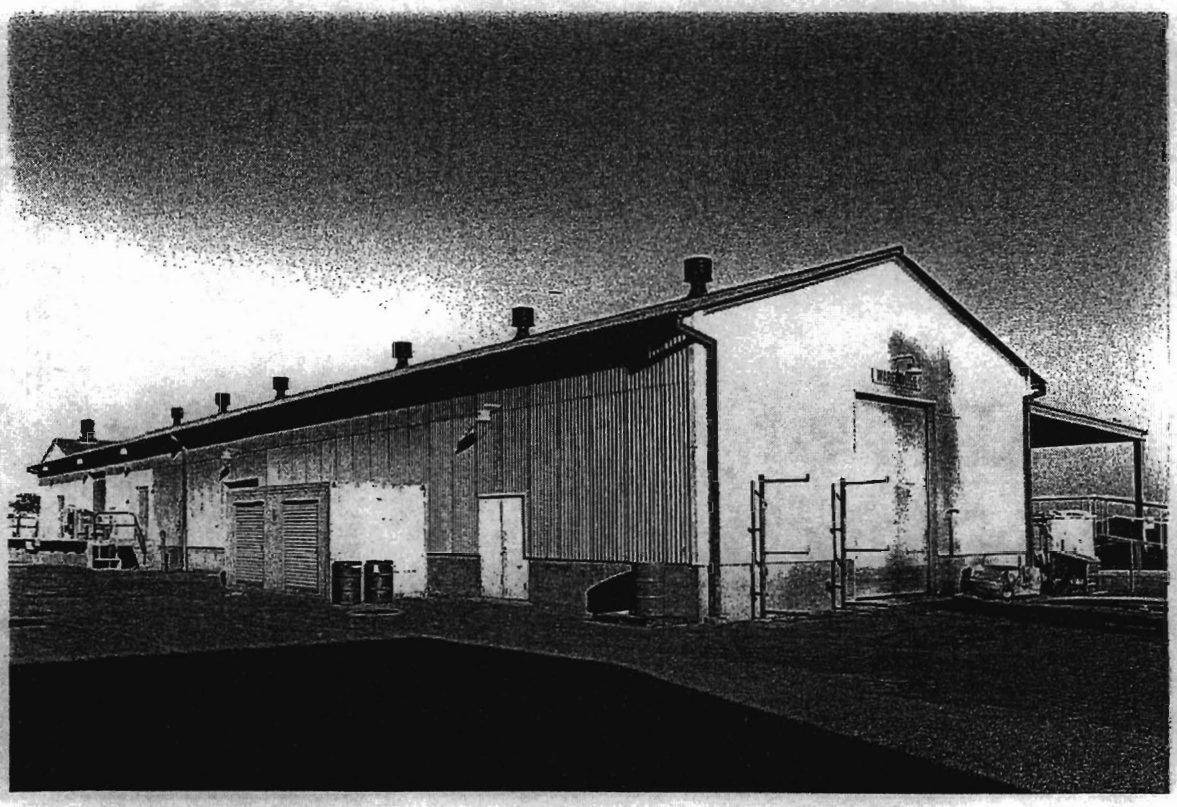


Fig. 23: warehouse, view to NW.

Fig. 24: water supply works in San Joaquin River, view to north.

Fig. 25: housings for moveable screen on screenwell structure, view to NNW.

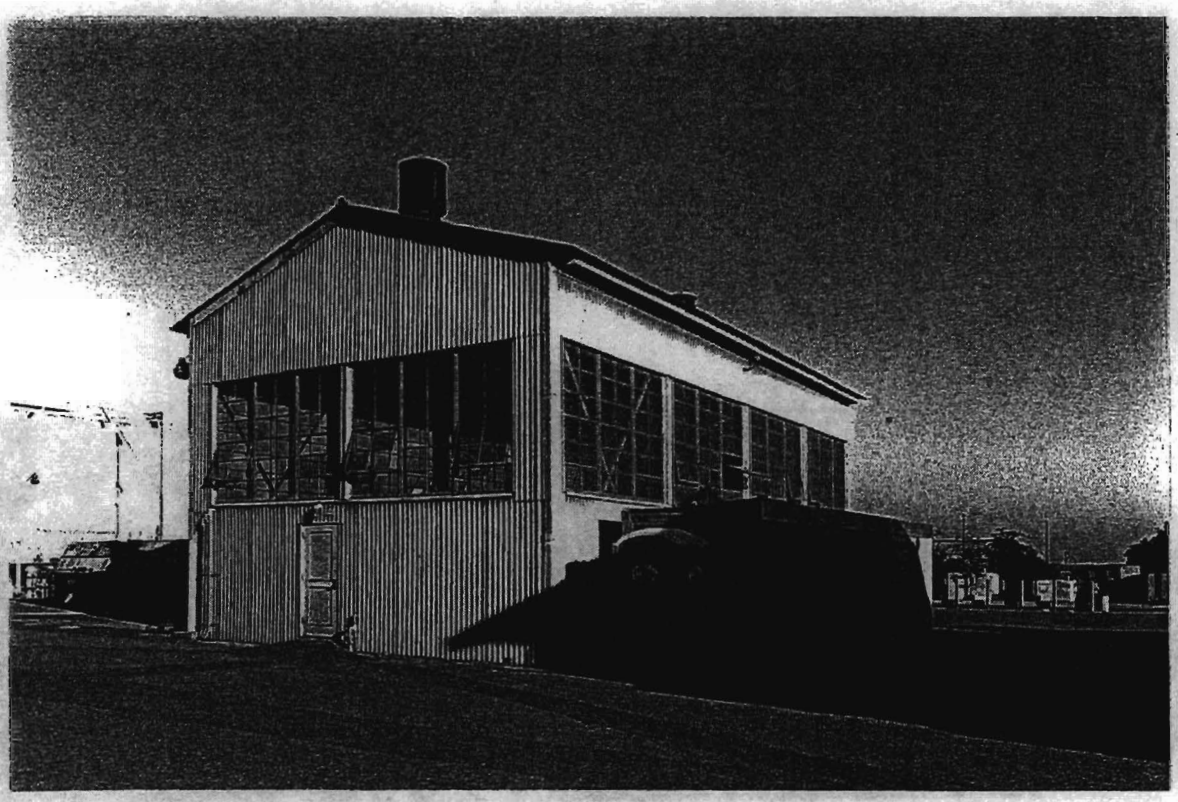


Fig. 26: pump house for units 4 and 5, view to NW.

Fig. 27: chlorination house, view to NW.

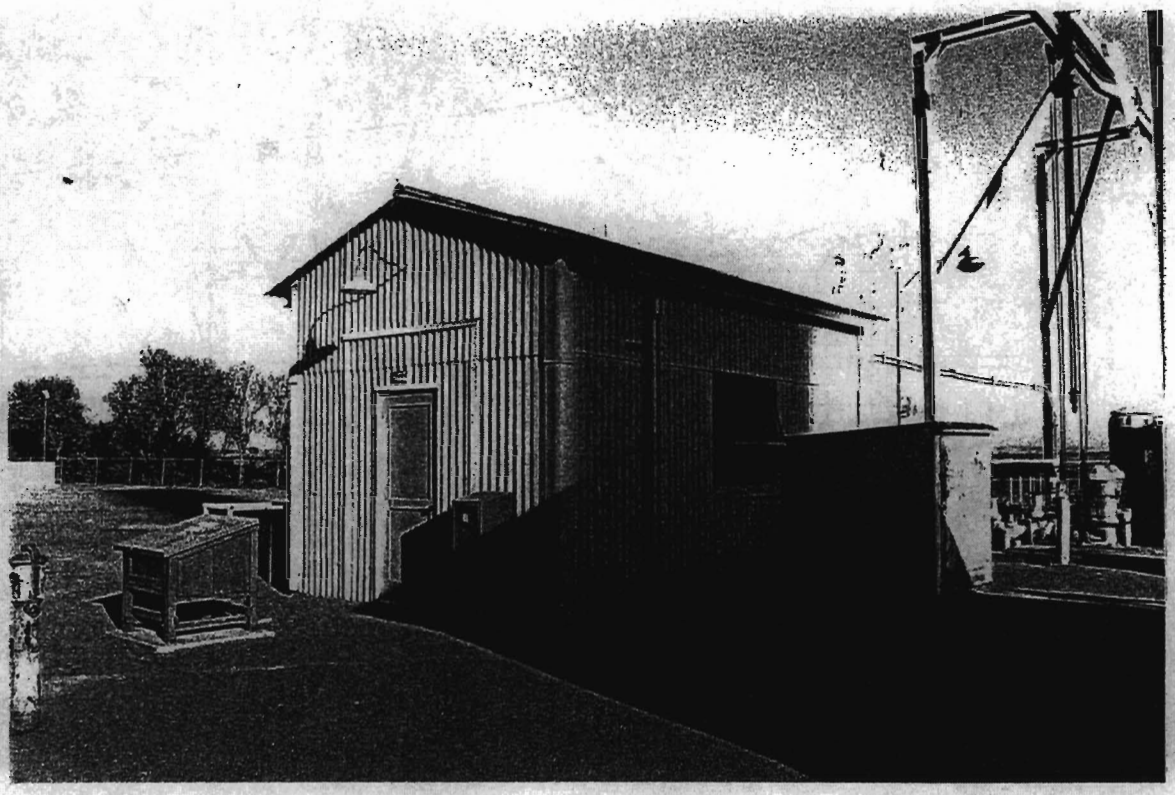


Fig. 28: control house, view to NW.

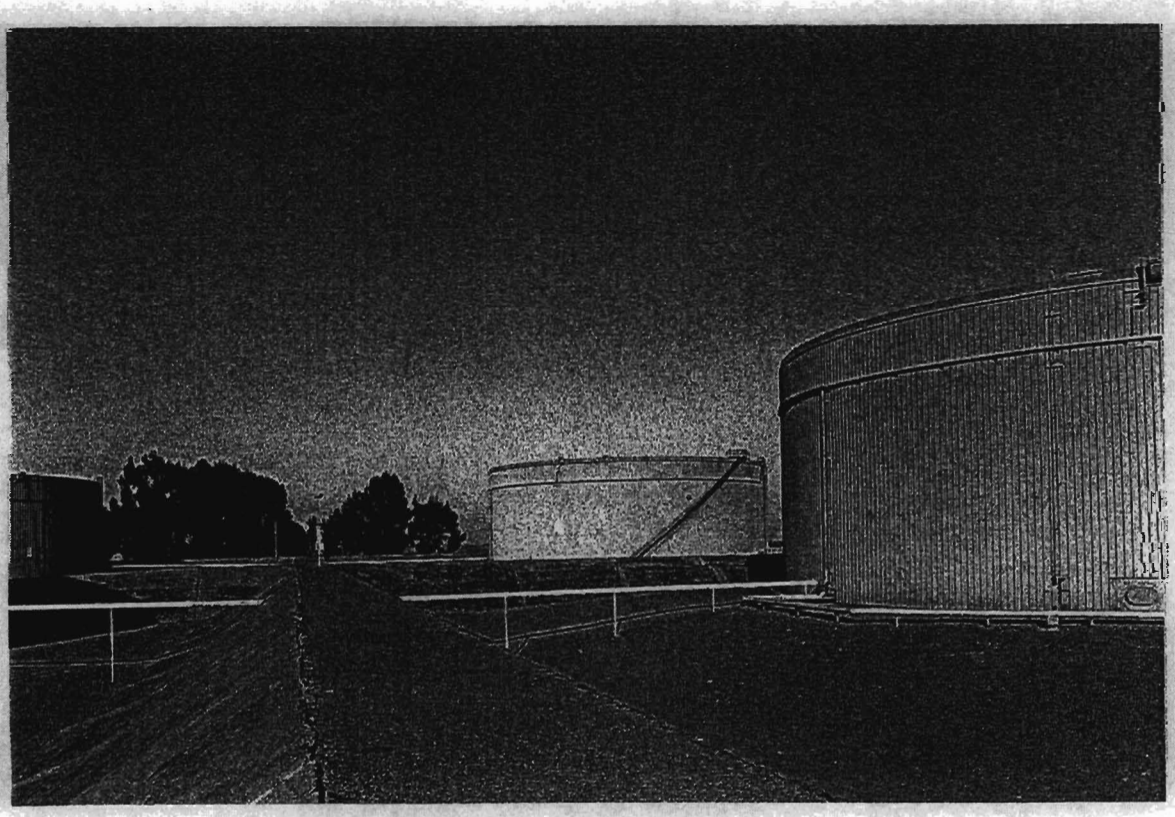


Fig. 29: three of the original fuel-oil tanks, view to west.

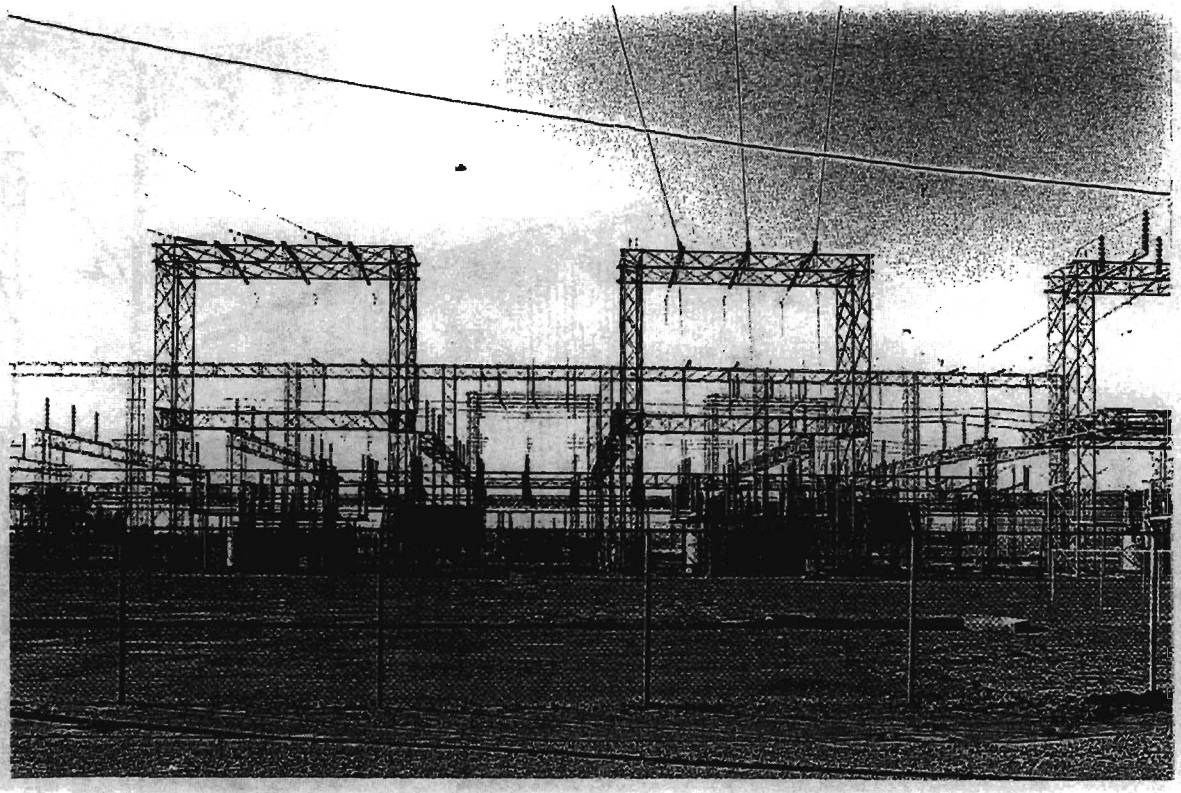


Fig. 30: PG&E switchyard, view to south.

Fig. 31: units 1-5 (left) and units 6 and 7 (right), view to NW.

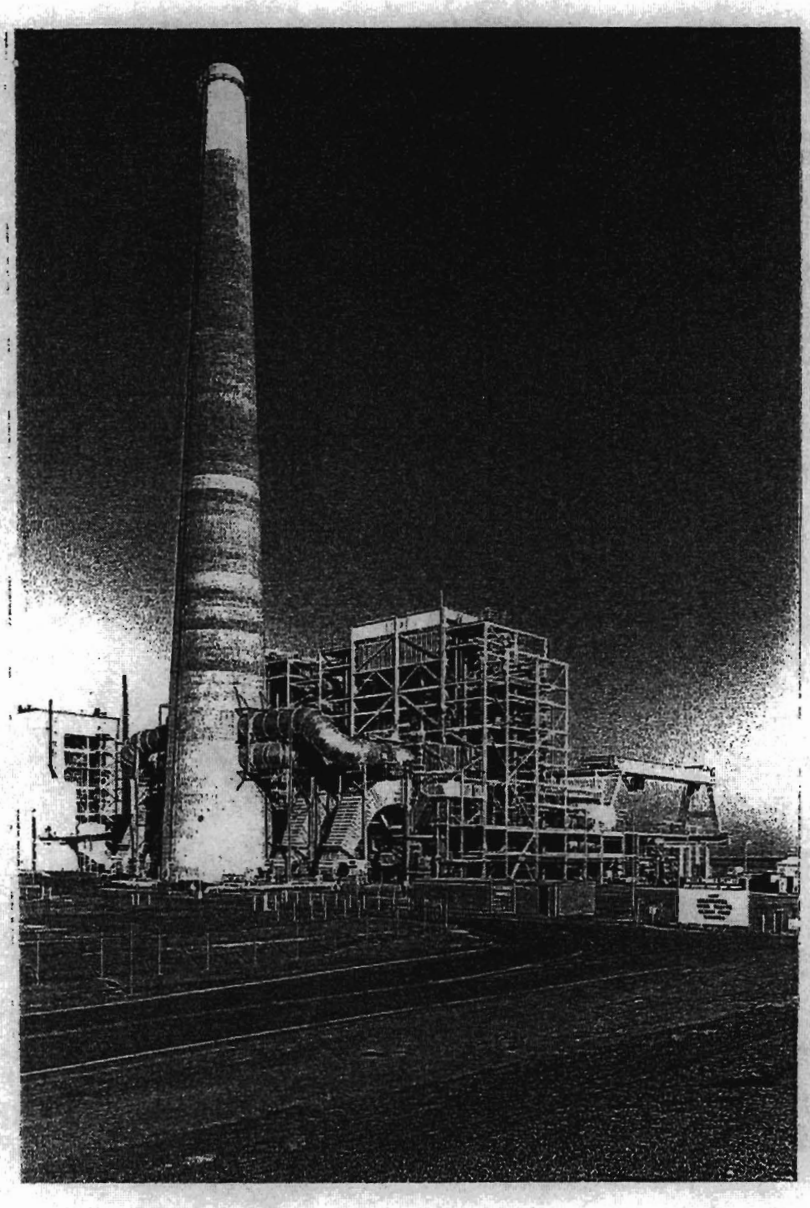


Fig. 32: units 6 and 7, view to NW.

Determination of Eligibility for the CONTRA COSTA POWER PLANT

Appendix B

Form 523

P-07-853

State of California — The Resources Agency
DEPARTMENT OF PARKS AND RECREATION
PRIMARY RECORD

Primary #
HRI #
Trinomial
NRHP Status Code
Other Listings
Review Code Reviewer Date

Page 1 of 11 *Resource Name or #: (Assigned by recorder) Contra Costa Power Plant

P1. Other Identifier:
P2. Location: ☐ Not for Publication ☒ Unrestricted
*a: County Contra Costa and (P2c,P2e, and P2b or P2d. Attach Location Map as necessary.)
*b. USGS 7.5' Quad Antioch North Date 1978 T 2N; R 2E; 5 ½ of Sec 16 ; B.M.
c. Address 3201 Wilbur Ave. City Antioch Zip 94509
d. UTM: (Give more than one for large and/or linear resources) Zone 2 ; 4,207,710 mE/ mN See cont. sheet
e. Other Locational Data: (e.g., parcel #, directions to resource, elevation, etc., as appropriate)

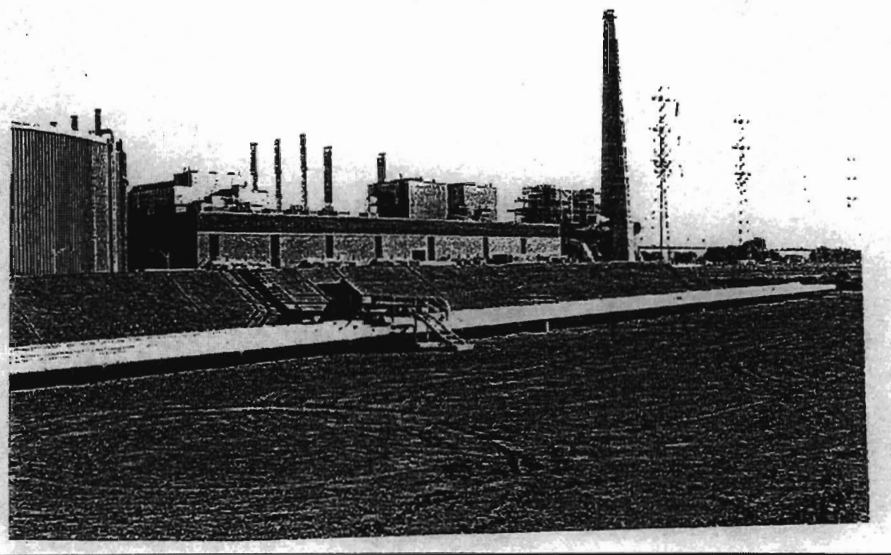
*P3a. Description: (Describe resource and its major elements. Include design, materials, condition, alterations, size, setting, and boundaries)

The Contra Costa Power Plant is a district located along the south bank of the San Joaquin River just east of Antioch, California. The entire site is flat, open terrain with little vegetation. There are industrial facilities of comparable scale neighboring the site both up- and downstream. The boilers, turbines, generators associated with the generation of electrical power are located in a row along the north end of the site. The original power plant structure, housing units 1-3 and built in 1951, is at the west end of the row. Units 4 and 5 were under construction even before units 1-3 went into service. They comprise an eastern extension to units 1-3 and went into service in 1953. Each of units 1-5 has its own 200-foot steel stack. Adjacent to the north side and the west end of units 1-5 are several small structures associated with the operation of the power plant that date from 1951. Units 6 and 7 are housed in a distinct structure at the east end of the row and went into service in 1964. The 450-foot concrete stack serving both units 6 and 7 is the most visible feature on the site. An entrance road runs near the east boundary from Wilbur Avenue on the south boundary to the generating units at the north. There is a security gate about 1,000 feet north

See continuation sheet

*P3b Resource Attributes: (List attributes and codes) (HP9) Public Utility Buildings
*P4. Resources Present: ☒ Building ☒ Structure ☐ Object ☐ Site ☒ District ☐ Element of District ☐ Other (isolates, etc.)

P5a



P5b. Description of Photo: (view, date, accession #) south elevation of units 1-5, view to north, 3 October 2000, roll #1, frame 33

*P6. Date Constructed/Age and Source:
☒ Historic ☐ Prehistoric
☐ Both
1951, units 1-3 complete
1953, units 4 & 5 complete

*P7. Owner and Address:
Southern Energy California,
1350 Treat Blvd., Suite 500,
Walnut Creek, CA 94596

*P8. Recorded by:
(Name, affiliation, and address)
Fredric L. Quivik
2830 Pearl Harbor Road
Alameda, CA 94501
sub-contractor to URS Dames & Moore

*P9. Date Recorded: 6 October 2000

*P10. Survey Type: (Describe) Intensive Survey, completed as part of Southern Energy's permitting process prior to building proposed unit 8

P11. Report Citation*: (Cite survey report and other sources, or enter "none".) Fredric L. Quivik, PhD, "Determination of Eligibility for the Contra Costa Power Plant," October 2000, prepared for URS Dames & Moore

*Attachments: ☐ NONE ☒ Location Map ☒ Continuation Sheet ☐ Building, Structure and Object Record
☐ Archaeological Record ☒ District Record ☐ Linear Feature Record ☐ Milling Station Record ☐ Rock Art Record
☐ Artifact Record ☒ Photograph Record ☒ Other (List) Report

P2.d. UTM (continued)

UTMs for the entire Contra Costa Power Plant:

A.	609,990 E	4,207,710 N
B.	608,360 E	4,207,710 N
C.	608,360 E	4,208,400 N
D.	609,990 E	4,208,530 N

UTMs for the proposed Contra Costa Power Plant historic district (see location and sketch maps):

C.	609,360 E	4,208,400 N
E.	609,850 E	4,208,570 N
F.	609,850 E	4,208,330 N
G.	609,580 E	4,208,330 N
H.	609,580 E	4,208,120 N
I.	609,470 E	4,208,120 N
J.	609,470 E	4,208,040 N
K.	609,360 E	4,208,040 N

P3.a. Description (continued)

of Wilbur Avenue. Large fuel-oil tanks are located along the entire west side of the site. The five northern-most tanks date fro the early 1950s, and the three souther tanks were built after 1970. A large electrical switchyard is located near the center of the site, extending from the tanks east almost to the entry road. Large steel transmission towers carry wires from the generating units to the switchyard. Units 1-5, the small buildings clustered around the units, and the five older fuel-oil tanks comprise a distinct cluster of historic buildings with excellent integrity. They contribute to the significance of the Contra Costa Power Plant district. Units 6 and 7, the larger tanks, and the switchyard are non-contributing elements.

D1. Historic Name: Contra Costa Power Plant D2. Common Name: Contra Costa Power Plant

***D3. Detailed Description** (Discuss overall coherence of the district, its setting, visual characteristics, and minor features. List all elements of district):

The potential Contra Costa Power Plant Historic District occupies a portion of the Contra Costa Power Plant site, a nearly rectangular parcel of land along the south bank of the San Joaquin River in East Antioch, Contra Costa County, California. The east, south, and west boundaries of power plant site are orthogonal to the cardinal directions, while the north boundary follows the river bank and is irregular. The east boundary measures about 2,850 feet, the south boundary measures about 2,850 feet, and the west boundary measures about 2,300 feet. The site accommodates seven steam-powered electric generating units. The historic portion of the power plant site is in the northwest corner of the parcel, where units 1-5 are located. It includes the turbine building, boiler buildings, several water tanks and small ancillary buildings, and five fuel oil tanks. Following descriptions of buildings and important features in the potential historic district:

See continuation sheet

***D4. Boundary Description** (Describe limits of district and attach map showing boundary and district elements.):

The proposed historic district boundary embraces the buildings from the period of significance, which are located at the northwest corner of the property. See location and sketch maps for details.

***D5. Boundary Justification:**

The district boundary encompasses those elements at the Power Plant that date from the period of signif.

D6. Significance: Theme Post-WW II Economic Development **Area** California
Period of Significance 1945-1953 **Applicable Criteria** A
(Discuss district's importance in terms of its historical context as defined by theme, period of significance, and geographic scope. Also address the integrity of the district as a whole.)

The Contra Costa Power Plant is eligible listing in for the National Register of Historic Places and the California Register of Historic Resources for its association with the postwar expansion of California's economy, which was a major factor in the new character of the nation's economy in the second half of the twentieth century. California's population grew an estimated 43% during World War II as hundreds of thousands of people moved to the state to work in agriculture and manufacturing in support of the war effort. The population continued to grow in the late 1940s and much of the state's wartime industrial growth converted to a permanent economic footing based especially on the aeronautics and electronics industries. Increased population and industry and the absence of wartime restrictions yielded tremendous additional demand for energy, to which Pacific Gas & Electric (PG&E) responded by embarking on the largest program for constructing new electrical generating capacity of any utility in the nation's history, spending more

See continuation sheet

***D7. References** (Give full citations including the names and addresses of any informants, where possible):

See continuation sheet

***D8. Evaluator:** Fredric L. Quivik, PhD **Date:** 6 October 2000
Affiliation and Address: 2830 Pearl Harbor Road, Alameda, CA 94501, working under subcontract to URS Dames & Moore for Southern Energy Company

D3. Description (continued)

Turbine Building: This is a flat-roof, steel-frame building on an elevated concrete base. It is about 160 feet wide and about 660 feet long. The turbine building has brick masonry curtain walls along the south side and west end and corrugated asbestos sheathing on the east end. The boiler buildings are along the north side. The brick curtain walls are pierced periodically with groups of narrow, vertical window bands. The turbine building was actually built in two stages. The west half houses the turbines and generators for units 1-3 and was built in 1951. The east half houses the turbines and generators for units 4 and 5 and was built in 1953. The brick curtain wall of the section housing units 4 and 5 is identical to the original. A vertical construction joint just east of the service delivery entrance shows the dividing line between the two sections.

The major pieces of equipment are at the third-floor level of the turbine building, which is called the operating level. Three bays extend the length of the building from west to east. The turbine-generator units are located along the south-side bay, which is called the turbine bay. Unit 1 is at the west end and unit 3 at the east end of the original segment. Each generator is rated at 110 megawatts. They are each rated at 120 megawatts. The center bay, called the auxiliary bay, houses boiler feed pumps and house turbines, which could generate electricity for the plant if it were ever "islanded," i.e. cut off from the rest of the grid. The main control room is located midway along the northern bay, which is called the control bay. It is situated between the turbine building and the boilers, which are located in the adjacent building to the north. The control room houses three sets of control panels and meter panels, one set for each unit. A slight westward projection of the facade at the northwest corner of the building identifies the location of the main office for the power plant staff, located on third floor in the control bay at that comer. A low cantilevered canopy along the projection identifies the entrance to the main office. Virtually all the equipment in the building is original to beginning of the power plant's operation in 1951. A significant exception is turbine no. 1, which was replaced in the 1970s. It appears nearly identical to the turbines for units 2 and 3.

Units 4 and 5 are located along the turbine bay of the addition. The boiler feed water pumps are located in the turbine b between unit 4 and unit 5. The control room for units 4 and 5 is located in the control bay of the addition and provides access to the boiler house for units 4 and 5. The configuration of equipment in the addition is somewhat different that the configuration in the original section, but it is nevertheless consistent with design conventions of the early 1950s. The turbine building, including both the 1951 and 1953 sections, is a primary contributing feature of the power plant district.

Boiler House for Units 1-3: The boiler house for units 1-3 is of the semi-enclosed type. The steel-frame structure enclosing the boilers themselves is sheathed in corrugated Transite (a composite material of cement and asbestos) and has several horizontal bands of industrial steel sash windows. There are six boilers, arranged with three on each side of a central firing aisle on a north-south axis. The boilers were designed and constructed by the Combustion Engineering Superheater, Inc. of New York. Each has a capacity to produce 550,000 pounds of steam per hour at a temperature of 950° F and a pressure of 1550 lb./sq. in. They were designed to be fired either by fuel oil or natural gas.

All six boilers were fired when the three turbine-generator units were operating at full capacity. Piping from the boilers to the turbines is arranged so that each of the boilers could serve any of the three turbines. Many of ducts for delivering supply air to the boilers and conveying combustion gases to the stacks are exterior to the building. Each boiler has a fan for forcing draft to the boiler and another fan for inducing draft and drawing exhaust gases from the boiler to the stack. The fan housings are all exterior to the boiler house structure. There are six steel stacks, each standing adjacent to its boiler. Thus there are three stacks to the east of the structure and three to the west. The boiler house sits along the north side of the turbine house, and the firing aisle between the boilers leads directly into the control room in the turbine building. The units 1-3 boiler house is a primary contributing feature of the power plant district.

Stacks for Unit 1-3 Boilers: There are six steel stacks for units 1-3, one for each boiler. There is a row of three stacks along the east side of the boiler house and a row of three along the west side. Each stack is about 200 feet tall. The six stacks are primary contributing features of the power plant district.

D3. Description (continued)

Boiler House for Units 4 and 5: The boiler house for units 4 and 5 is also of the semi-enclosed type. The steel-frame structure enclosing the boilers is also sheathed in corrugated Transite. It is located along the north side of the addition to the turbine building. Unlike the original boiler house, which houses two boilers for each turbine, this boiler house has only two boilers. Their orientation is 90° from that of the original six boilers. Thus the burner front of each boiler faces south toward the turbine building. The ducts for supply air and combustion gases are on the north side of the boiler house. Fan housings are outside the structure. The units 4 and 5 boiler house is a primary contributing feature of the power plant district.

Stacks for Units 4 and 5 Boilers: There are two steel stacks for units 4 and 5, one for each boiler. They stand on the north side of the boiler house. Each stack is about 200 feet tall. The stacks for units 4 and 5 are primary contributing features of the power plant district.

Boiler Water Tank: This steel cylindrical tank sits just west of stack for the middle boiler on the west side of the units 1-3 boiler house. It is original to the power plant and is a contributing feature of the power plant district.

Distilled Water Storage Tanks: There are three steel water tanks sitting in a row extending west of the stack for the southern-most boiler on the west side of the units 1-3 boiler house. The two nearest the boiler house are original to the power plant and are contributing features of the power plant district. The western-most tank is a later addition and is a non-contributing feature in the district.

Water Treatment Apparatus: West of the stack for the northern-most boiler on the west side of the units 1-3 boiler house is a grouping of equipment used to treat river water before it was sent to the boilers. The equipment is a later addition o the power plant and is a non-contributing feature.

Water Tower: An elevated water tank stands at the northwest corner of the site on the small peninsula created by the discharge channel. The water tower is original to the power plant and is a contributing feature of the power plant district.

Quonset Hut: Located at the east end of the row of service buildings along the north side of the site, the Quonset Hut (so named by a signed over its door) serves as a storage and shop building for the power plant. Although it does not appear on an original plot plan for the site, it does appear in a 1952 photo showing construction of units 4 and 5.

Warehouse: The warehouse is due west of the Quonset Hut. It is a steel-framed building with gable roof and corrugated asbestos siding. It is original to the power plant and is a contributing feature of the power plant district.

Water Intake Works: Built on the same axis as the firing aisle of the units 1-3 boiler house, the cooling water intake tubes extend out into the San Joaquin River below the surface of the water and are therefore not visible. All that is visible above the surface is the walkway on timber piling that extends from the river bank out to a platform directly over the intake end of the tubes. The landward end of the tubes couples to the screenwell structure, described below. The water intake works is original to the power plant and is a contributing feature of the power plant district.

Screenwell Structure: From the perspective of pavement between the unit 1-3 boiler house and the river, this structure appears to be little more than a concrete slab-on-grade next to water's edge. It houses the screens for cleaning cooling water drawn from the river through the intake tubes. Four steel housings sit atop the structure, enclosing the equipment used from raising the screens. When units 4 and 5 were built, the screenwell structure was enlarged to the east. A construction joint in the concrete is visible distinguishing the original screenwell structure from the addition. Because the addition is was built than 45 years ago, the entire screenwell structure contributes to the power plant district.

Units 4 and 5 Cooling Water Pump House: The pumps for delivering cooling water to the six boilers for units 1-3 are located inside the plant, whereas the pumps for units 4 and 5 were designed to be housed next to the screenwell structure. The pump house is a steel-framed building with a gable roof and corrugated siding. It contributes to the power plant district.

D3. Description (continued)

Chlorinator House: Just south of the original section of the screenwell structure is the small house for the chlorination equipment. It is a steel-framed structure with a gable roof and corrugated siding.

Control House: Just west of the screenwell structure is the control house for the intake works. It is a steel-framed structure with a gable roof and corrugated siding.

Discharge Works: At the northwest corner of the site, there is a short channel the conveys water--after it has been converted to steam, run through the turbines, and condensed to water--back into the river. The water is discharged through simple culvert openings into the channel. The discharge works is original to the power plant and contributes to the power plant district.

Fuel-Oil Tanks 1-5: The fuel-oil tanks are located along the west edge of the site. The four that are original to the power plant are west-southwest of units 1-3 are arranged in a quad pattern. The fifth tank, built shortly after the power plant went into service, is located just south of the western-most pair of original tanks. Each of the five tanks is about 140 feet diameter and is surrounded by an earthen embankment, rectangular in plan, meant contain leaks. Three newer, larger tanks are located at the southwest corner of the site. Tanks 1-5 are contributing features of the power plant district.

PG&E Switchyard: East of tank no. 5 and about 1100 feet south of the turbine building is the PG&E switchyard. The original switchyard extended as far east as east end of the units 1-3 turbine building. The switchyard now extends as far east as units 6 and 7. Although much of the truss structure for the switchyard is original to the site, the insulators and transformers have been significantly altered in the intervening years. Although the switchyard is an essential part of the power plant complex, it has lo its historic integrity. It is therefore a non-contributing feature in the power plant district.

Units 6 and 7: Built in 1964, the boilers, turbines, and generators for units 6 and 7 are set within an unenclosed structure, representing the evolution of design characteristics for power plants in the second half of the twentieth century. Each unit has a capacity of 330 megawatts, representing the trend toward ever larger generating units. The boilers are on the south side of the structure and the turbines and generators are on the north side, which is the opposite as the configuration of units 1-5. A single stack, 450 feet tall, rises from the center of the south side of the structure, serving both boilers. Units 6 and 7 are non-contributing features of the power plant district.

Transmission Towers: There are several steel transmission towers that carry wires between the generating units and the switchyard. The two towers south of the units 1-5 turbine building are likely original to the site and are contributing features. The towers south of units 6 and 7 are of more recent construction and do not contribute.

D6. Significance (continued)

than a billion dollars between the end of the war and 1953. At the end the expansion, PG&E had made a transition from being a utility that depended primarily on hydropower sources for its electrical energy to being a utility that drew a large majority of its electricity from steam generating plants.

The Contra Costa Power Plant, with an initial capacity of 330 megawatts, represents this expansion of generating capacity. Although shortly after the war PG&E built two smaller new steam plants, the Contra Costa Power Plant, completed in 1951, launched the utility's program of large steam plant construction. As California's economy continued to grow, PG&E made immediate plans to expand the Contra Costa plant, even as it was building other new power plants as well. The 240,000 megawatt addition went into service in 1953. Although PG&E again expanded the Contra Costa plant's capacity in 1964, the original 1951-1953 components were unchanged. Concentrated in the northwest corner of the property, the original components retain excellent integrity, both in terms of architecture and in terms of the boilers, turbines, generators, and oth equipment housed in the original buildings.

D7. References (continued)

Coleman, Charles M. *PG&E of California: The Centennial Story of Pacific Gas and Electric, 1852-1952*. New York: McGraw-Hill Book Company, Inc. 1952.

Scott, Mel. *The San Francisco Bay Area: A Metropolis in Perspective*. Berkeley: University of California Press, 1959.

Steele, I.C. "Steam Power Gains on Hydro in California." *Civil Engineering* 20 (January 1950): 17-21.

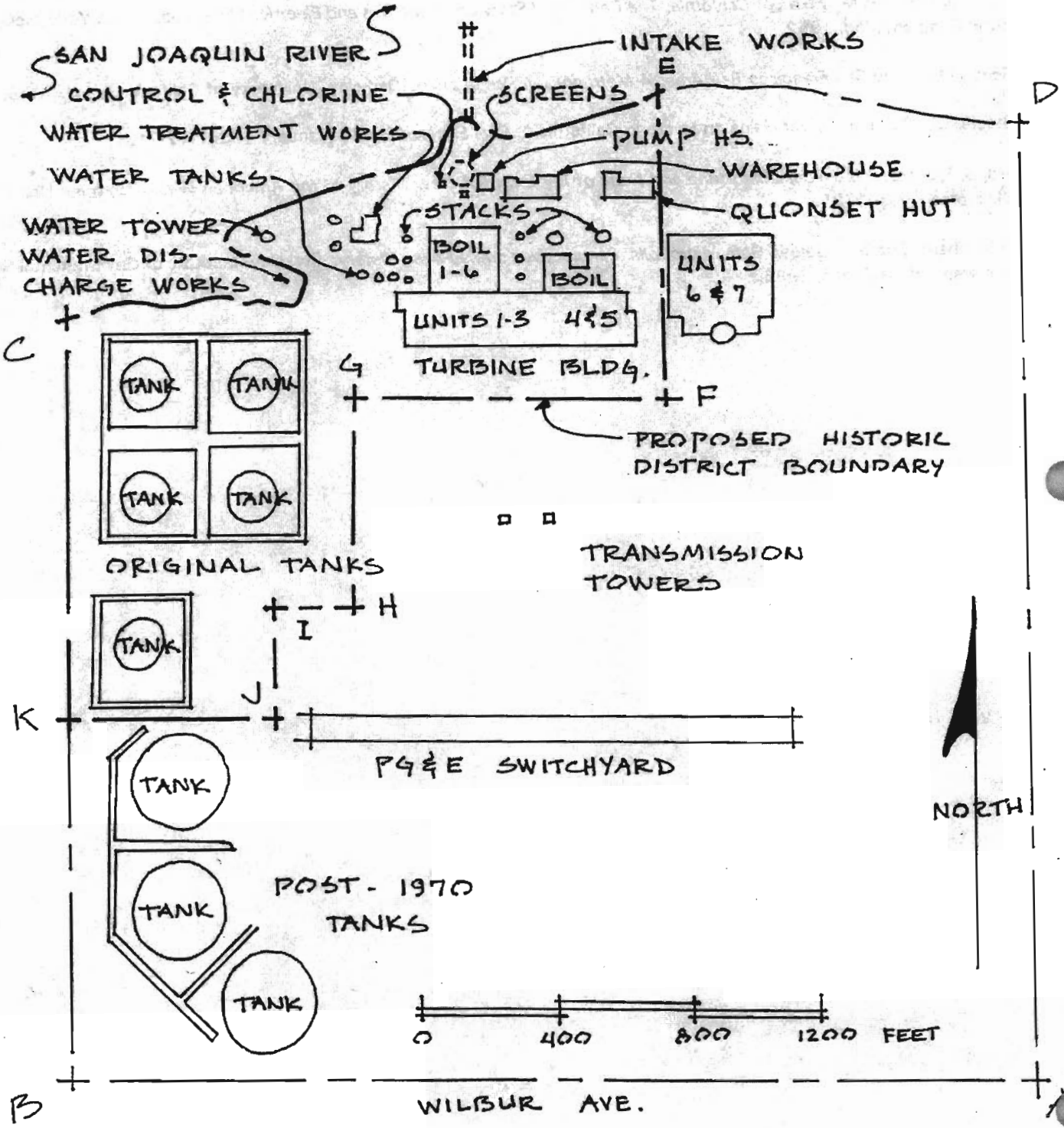
White, Richard. *"It's Your Misfortune and None of My Own:" A New History of the American West*. Norman: University of Oklahoma Press, 1991.

Wollenberg, Charles. *Golden Gate Metropolis: Perspectives on Bay Area History*. Berkeley: Institute of Governmental Studies, University of California, 1985.

State of California -- The Resources Agency
DEPARTMENT OF PARKS AND RECREATION
SKETCH MAP

Primary # _____
HRI# _____
Trinomial _____

Page 9 of 11 *Resource Name or # (Assigned by recorder) CONTRA COSTA POWER PLANT
*Drawn by: FREDRIC L. QUIVIK *Date of map: 10-6-00



NOTE: Include bar scale and north arrow.

State of California -- The Resources Agency
DEPARTMENT OF PARKS AND RECREATION

PHOTOGRAPHIC RECORD

Primary # _____
HRI# _____
Trinomial _____

Page 10 of 11 Project Name: CONTRA COSTA POWER PLANT Year 2000
Camera Format: 35 mm Lens Size: 28 mm p.c.
Film Type and Speed: KODAK T-MAX 400 Negatives Kept at: URS DAMES & MOORE

Mo.	Day	Time	Exp./Frame	Subject/Description	View Toward	Accession #
10	3	07:35	1	boiler no. 6 (left) and its control panel	SE	
10	3	07:35	2	boiler no. 6 (left) and its control panel	SE	
10	3	07:37	3	boiler control panel (left) and boiler no. 5	SE	
10	3	07:39	4	boiler no. 4	E	
10	3	07:39	5	boiler no. 4	E	
10	3	07:42	6	control room for units 1-3	NE	
10	3	07:50	7	house generator for units 1-3	NE	
10	3	07:51	8	boiler water feed pump for units 1-3	NE	
10	3	07:55	9	turbine/generator unit no. 1	SE	
10	3	08:02	10	boiler water feed pumps for units 4 and 5	SW	
10	3	08:05	11	control room for units 4 and 5	S	
10	3	08:09	12	boiler no. 7 for turbine/ generator units 4 and 5	NE	
10	3	08:19	13	view along south side of turbine bldg. for units 1-5, stack for units 6 and 7 in background	NE	
10	3	08:19	14	ditto	NE	
10	3	08:19	15	ditto	NE	
10	3	08:25	16	view of south side of turbine bldg. showing constr. joint betw. 1951 & 1953 bldgs.	N	
10	3	08:29	17	view of E. end of turbine bldg.	NW	
10	3	08:34	18	boiler house for units 4 and 5	SW	
10	3	08:36	19	Quonset Hut	NW	
10	3	08:38	20	stack for boiler no. 7 (for units 4 and 5) foreground & stacks for boilers 4-6 (for units 1-3) in background	WSW	
10	3	08:42	21	warehouse	NW	
10	3	08:44	22	pump house for units 4 and 5	NW	
10	3	08:47	23	water supply works in San Joaquin River	N	
10	3	08:51	24	moveable screen housings on screenwell structure	NNW	
10	3	08:53	25	chlorination house	NW	
10	3	08:54	26	control house	NW	
10	3	09:03	27	west elevation turbine bldg.	E	
10	3	09:12	28	water discharge works (foregr.) and water tower	N	

State of California -- The Resources Agency
DEPARTMENT OF PARKS AND RECREATION

PHOTOGRAPHIC RECORD

Primary # _____
HRI# _____
Trinomial _____

Page 11 of 11 Project Name: CONTRA COSTA POWER PLANT Year 2000
Camera Format: 35 MM Lens Size: 28 MM p.c.
Film Type and Speed: KODAK T-MAX 400 Negatives Kept at: URS DAMES & MOORE

Mo.	Day	Time	Exp./Frame	Subject/Description	View Toward	Accession #
10	3	09:13	29	water tanks, water treatment works, & stacks for boilers 1-3 west of boiler house	NE	
10	3	09:17	30	three of the original fuel-oil tanks	W	
10	3	09:26	31	PG&E switchyard	S	
10	3	09:31	32	view toward turbine building, showing fuel tank on left	NE	
10	3	09:35	33	so. elevation of turbine bldg.	N	
10	3	09:42	34	units 6 and 7	NW	
10	3	09:44	35	units 1-5 (left) and units 6 and 7 (right)	NW	
10	3	09:55	36	turbine/generator unit no. 3	SE	

Determination of Eligibility
for the
CONTRA COSTA POWER PLANT

Appendix C

Resume for Fredric L. Quivik

Fredric L. Quivik, PhD. **2830 Pearl Harbor Road**
September 2000 **Alameda, CA 94501**

home phone: 510-337-0339
office phone & fax: 510-769-7855
e-mail: fquivik@lmi.net

RESUME

SUMMARY OF EXPERIENCE

Since 1976, Dr. Quivik has been professionally active in the fields of history of technology, industrial archeology, and cultural resource management. He makes that experience available to clients as the principal in the firm Quivik Consulting Historian, Inc., which he incorporated in 1998. His main work in recent years has been as an expert witness (historian of technology) in Superfund litigation concerning the remediation of mining and metallurgical wastes in Montana (the Clark Fork Superfund project embracing Butte and Anaconda), Idaho (the Bunker Hill Superfund project in the Coeur d'Alene mining district), and Arizona (the Pinal Creek project, embracing the Globe/Miami mining district).

In 1982, Dr. Quivik founded Renewable Technologies, Inc. (RTI), an historic preservation consulting firm in Butte, Montana, that is still a thriving business. In 1990, Dr. Quivik left RTI to attend the University of Pennsylvania, were he was a William Penn Fellow. He received the PhD in History and Sociology of Science from Penn in 1998. The title of his dissertation is "Smoke & Tailings: An Environmental History of Copper Smelting Technologies in Montana, 1880-1930." While writing his dissertation, he continued to work as a consultant.

As an expert witness for the U.S. Dept. of Justice, providing litigation support in Superfund litigation, Dr. Quivik's specialty has been the history of the metallurgical technologies used at Butte and Anaconda and in the Coeur d'Alene district, with special attention to the discharge of byproducts. He has extensive knowledge of the role of industrialization in the development of the American West. At RTI, he completed surveys and HAER documentation of dams and hydroelectric generating plants of the Montana Power Company, of the Corps of Engineers' Fort Peck Dam, and of Bureau of Reclamation dams and irrigation infrastructure in Idaho, New Mexico, Oregon, and Wyoming. He conducted statewide historic bridge inventories in Minnesota, Montana, Nebraska, and North and South Dakota. He has also prepared a business and technological history of the Connellsville Coke Region in southwestern Pennsylvania for the Historic American Engineering Record/America's Industrial Heritage Project.

Dr. Quivik's experience in cultural resource management includes conducting surveys of rural, urban, and industrial historic sites and districts, preparing National Register nominations, performing determinations of eligibility and impact assessments according to federal guidelines, preparing photo-documentation and measured drawings of historic sites, and developing planning documents for the preservation of historic districts. Dr. Quivik is particularly skilled at researching and developing historical contexts within which to assess the significance of cultural resources. He is also skilled at large-format (4 x 5) photographic documentation of buildings and structures meeting HABS/HAER standards. He served for ten years on the Montana State Historic Preservation Review Board.

Dr. Quivik is a lecturer in the history of science and technology in the Interdisciplinary Studies Program, College of Engineering, University of California at Berkeley. He has also taught at Montana Tech in Butte and at Montana State University in Bozeman. As a research assistant at Penn, he examined the history of large-scale technological systems in the post-World War II period for Prof. Thomas Parke Hughes.

EDUCATION

PhD, History and Sociology of Science, University of Pennsylvania, Philadelphia, 1998. Dissertation title: "Smoke and Tailings: An Environmental History of Copper Smelting Technologies in Montana, 1880-1930." M.A., 1992. .

Master of Science in Historic Preservation, Graduate School of Architecture and Planning, Columbia University, New York City, 1977.

Bachelor of Environmental Design, School of Architecture, University of Minnesota, Minneapolis, MN, 1975.

Bachelor of Arts in Art, St. Olaf College, Northfield, MN, 1971.

EMPLOYMENT HISTORY

Consulting Historian of Technology, principally working in litigation support as an expert witness under contract to the U.S. Dept. of Justice, March 1994 to present.

Lecturer, history of science and engineering, Interdisciplinary Studies Program, College of Engineering, University of California at Berkeley, January 1999 to present; history of science and technology, Dept. of History, U.C. Berkeley, January to May 2000.

Research Assistant for Thomas Parke Hughes, Mellon Professor of the History and Sociology of Science, University of Pennsylvania, Philadelphia, September 1992 to May 1993.

Historian, Historic American Engineering Record, U.S. Dept. of the Interior, Jeannette, PA, June to August 1991, June to September 1992.

Architectural Historian (and founder), Renewable Technologies, Inc., Butte, MT, May 1982 to August 1990.

Adjunct Assistant Professor, School of Architecture, Montana State University, Bozeman, MT, winter quarter 1983.

Instructor, Historic Preservation, Montana State Univ., Bozeman, winter quarter 1982); Montana College of Mineral Science & Technology, Butte, MT, fall semester 1979.

Building Recycling Spec., Nat'l. Center for Appropriate Technology, Butte, MT, April 1977 to September 1981.

Instructor, Engineering Graphics, Montana College of Mineral Science and Technology, Butte, MT, 1/81-5/81 (spring semester).

Historian, Historic American Engineering Record, U.S. Dept. of Interior, Butte, October 1979 to April 1981.

PROFESSIONAL AFFILIATIONS

Society for Industrial Archeology: past-president 6/98 to 6/00; president 6/96 to 6/98; vice president 6/94-6/96; national Board of Directors 6/90-6/93.
Capitol Advisory Council (Montana), appointed by Gov. Racicot 1/96 to 8/98.
Klepetko (Montana) Chapter, Society for Industrial Archeology, president 9/87-8/90.
Committee on Historic and Archeological Preservation in Transportation, Transportation Research Board of the Nat'l Research Council, 1/91 to 6/93.
Board of Directors, Butte-Anaconda Historical Park and Railroad Corporation, 1986-1990.
Montana Historic Preservation Review Board, 1981-1990: appointed by Governor Schwinden, 10/81; reappointed 10/85; elected chairperson, 12/87.
Montana State Capitol Restoration Advisory Panel, appointed by House Speaker John Vincent, 5/85-4/89.
Board of Directors, Butte-Silver Bow Public Archives, 1979-1986.
Society of Architectural Historians.
Society for the History of Technology.
American Society for Environmental History
History of Science Society
Western History Association
Organization of American Historians
Norwegian-American Historical Association

SCHOLARLY and OTHER PUBLICATIONS

"The Historic Industrial Landscape of Butte and Anaconda," in Images of an American Land: Vernacular Architecture Studies in the Western United States, Thomas Carter, ed. (Albuquerque: University of New Mexico Press, 1997).

Butte & Anaconda Revisited: An Overview of Early-Day Mining and Smelting in Montana, with Brian Shovers, Dale Martin, and Mark Fiege, Special Publication 99 (Butte: Montana Bureau of Mines, 1991). This is a reprint of "Guidebook to Historic Industrial Resources of Butte and Anaconda," October 1989, prepared by the same authors for the Annual Fall Tour of the Society for Industrial Archeology.

"Steel Transmission Towers & Energy for Montana's Copper Industry," Historic Landscapes feature in Montana: The Magazine of Western History, 38 (Fall 1988): 67-69.

"The Anaconda Company Smelters at Great Falls and Anaconda," in The Speculator: The Journal of Butte and Southwest Montana History, 1 (Summer 1984), based on a paper given at the Annual Meeting of the Society for Industrial Archeology, St. Paul, MN, May 1983.

"Montana's Minneapolis Bridge Buildings," in IA: The Journal of the Society for Industrial Archeology, 10 (1984), no. 1, based on a paper given at the Annual Meeting of the Society for Industrial Archeology, St. Paul, MN, May 1983.

Historic Bridges in Montana, (Washington, DC: U.S. Department of the Interior, National Park Service, Historic American Engineering Record, 1982).

"A Comparison Between Passive Solar and Superinsulated Retrofits," paper given at the Sixth National Passive Solar Conference, Portland, OR, September 1981. Published in the Conference Proceedings, AS/ISES, 1981.

"Retrofitting with Passive Solar," paper published in New Energy From Old Buildings (Washington, D.C: The Preservation Press, 1981), and presented at the Smithsonian Institution, Washington, D.C., during National Historic Preservation Week, May 1980.

SCHOLARLY REVIEWS

Served as peer reviewer for articles submitted to the following scholarly journals: *BC Studies; Environmental History; IA: the Journal of the Society for Industrial Archeology; Montana: the Magazine of Western History; Technology & Culture.*

Review of *Smelter Smoke in North America: The Politics of Transborder Pollution*, by John D. Wirth, forthcoming in *Technology & Culture*.

Review of *True Gardens of the Gods: Californian-Australian Environmental Reform, 1860-1930*, by Ian Tyrrell, in *Environmental History* 5 (April 2000): 254-255.

Review of *Common Fields: An Environmental History of St. Louis*, edited by Andrew Hurley, in *American Studies Journal* 40 (Fall 1999): 187-188.

Review of *Managing the Industrial Heritage*, edited by Marilyn Palmer and Peter Neaverson, in *IA: The Journal of the Society for Industrial Archeology* 24 (no. 2, 1998): 53-54.

Review of *The Search for the Ultimate Sink: Urban Pollution in Historical Perspective*, by Joel Tarr, in *Historical Geography* 26 (1988): 228-230.

Review of *Race and Labor in Western Copper*, by Philip J. Mellinger, in *Montana: The Magazine of Western History* 47 (Autumn 1997): 84-85.

Review of *Environmental History Review*, Spring 1994, special issue on "Technology, Pollution, and the Environment," Joel A. Tarr and Jeffrey K. Stine, eds., and *Journal of Urban History*, May 1994, special issue on "The City and the Environment," Joel A. Tarr and Christine M. Rosen, eds., in *Technology & Culture* 36 (October 1995): 1038-1041.

Review of *Water Towers* and *Gas Tanks*, by Bernd and Hilla Becher, in *Design Book Review* 35/36 (Winter/Spring 1995): 56-59.

Review of *The Texture of Industry: An Archaeological View of the Industrialization of North America* by Robert B. Gordon and Patrick M. Malone, in *Environmental History Review* 18 (Winter 1994): 102-104.

Review of *Bisbee: Urban Outpost on the Frontier*, Carlos A. Schwantes, ed., in *Technology and Culture* 35 (April 1994): 435-436.

Review of *In the Servitude of Power: Energy and Civilization through the Ages* by Jean-Claude Debeir, Jean-Paul Deleage, and Daniel Hemery, in *Environmental History Review* 17 (Summer 1993): 97-98.

Review of *The Colossus of 1812: An American Engineering Superlative* by Lee H. Nelson, in *IA: The Journal of the Society for Industrial Archeology*, 16 (1990), No. 1.

Review of *Song of the Hammer & Steel* by Duane Smith, in *IA: The Journal of the Society for Industrial Archeology*, 14 (1988), No. 1.

SCHOLARLY PRESENTATIONS

"Physical Setting and the Shaping of Giant Smelters: A Comparison of the Great Falls and Anaconda Smelters," paper given at the annual meeting of the Society for Industrial Archeology, Savannah, GA, June 1999.

"Landscapes as Industrial Artifacts: Lessons from Environmental History," paper presented at Whither Industrial Archeology, a symposium sponsored by the Society for Industrial Archeology at Lowell National Historic Park, MA, November 1998.

"Government Intervention v. Economic Efficiency in the Abatement of Smelter Smoke Pollution: The Case of the Anaconda Smelter in the 1910s, paper given at the annual meeting of the Society for the History of Technology, Baltimore, MD, October 1998.

"On the Nature of Tailings: An Overview of Early Attitudes Towards Tailings Disposal in the Montana Copper Industry," Montana State History Conference, Butte, MT, October 1996.

"Smoke and Tailings: An Environmental History of Copper Smelting Technologies in Montana, 1880-1920," public presentations based on PhD dissertation and illustrated with slides, given at the Environmental Studies Program, St. Olaf College, October 1999; a Colloquium of the Office for History of Science and Technology, Unversity of California at Berkeley, April 1999; the Parker Lecture Series, Lowell, MA, November 1998; Chemical Heritage Foundation, Philadelphia, October 1998; Froid Lutheran Church, July 1998; Center for the Rocky Mountain West, Missoula, MT, March 1996.

"Captain Couch of the Boston & Montana: A Self-Trained Mining Engineer and the Industrialization of Butte's Copper Mining District," paper presented at the annual meeting of the Western History Association, Denver, CO, October 1995.

"Conflict in the Science of Environmental Impact: The Anaconda Smelter Smoke Cases, 1902-1911," paper presented at the biennial meeting of the American Society for Environmental History, Las Vegas, NV, March 1995.

"Architects as Designers of Pre-World War II, Large-Scale Technological Systems: Edward W. Tanner and the Design of the Fort Peck Townsite," paper presented at session titled "Topics at the Intersection of Architectural History and the History of Technology" at the Annual Meeting of the Society of Architectural Historians, Seattle, WA, April 1995.

"The Concept of Industrial Waste: Smoke 'Nuisance' Cases in the Montana Copper Industry at the Turn of the Twentieth Century," paper presented at the annual meeting of the Society for the History of Technology, Lowell, MA, October 1994.

"Retarded Mechanization in the Connellsville Beehive Coke Industry," paper presented at the annual meeting of the Society for Industrial Archeology, Pittsburgh, PA, June 1993.

"EPA's Superfund in the Context of Other American Large-Scale Technological Systems," paper presented at the fifteenth annual meeting of the National Council on Public History, Valley Forge, PA, May 1993.

"Imposing an Industrial Order on the Northern Plains: Patterns of Truss Bridge Construction, 1880-1920," paper presented at the annual symposium of the Center for Great Plains Studies, Lincoln, NE, April 1993.

"Industrial Pollution on the Southwestern Pennsylvania Countryside: The Connellsville Beehive Coke Industry, 1880-1920," paper presented at the biennial meeting of the American Society for Environmental History, Pittsburgh, PA, March 1993. A longer version of this paper won the 1994 Newcomen Prize at the University of Pennsylvania.

"EPA Superfund: After a Decade, Why Is It Not an Effective Technological System?" paper presented at the annual meeting of the Society for the History of Technology, Madison, Wisconsin, October 1991.

"A Comparison of the U.S. Bureau of Reclamation's Cylinder-Gate and Ring-Gate Designs for Spillway Controls," paper presented at the 20th Annual Meeting of the Society for Industrial Archeology, Chicago, June 1991.

"Contribution of Railroads to Montana's Historic Bridge Landscape," presentation at the Montana History Conference, Livingston, MT, October 1988.

"Power for the Copper Industry: Hydroelectric Developments Along the Great Falls of the Missouri River, 1890-1957," paper given at the 17th Annual Meeting of the Society for Industrial Archeology, Wheeling, WV, May 198.

"Historical Differences Between Hardrock Mining and Underground Coal Mining," presentation at the Montana History Conference, Helena, MT, October 1987.

"Industrial Urbanism on the Wheat Frontier: Minot, North Dakota, 1886-1929," paper given at the 15th Annual Meeting of the Society of Industrial Archeology, Cleveland, OH, June 1986.

"Superinsulation Retrofit: An Effective Integration of Community Economic Development and Community Energy Management," with James Masker and Ralph Wittcoff, presented at the Nebraska Energy Office National Colloquium on Community Energy Management as a Community Economic Development Strategy, Lincoln, NE, October 1984.

"Appropriate Technologies and Historic Preservation," paper given at the International Conference on the Conservation of Industrial Heritage (TICCIH), Lowell, MA, June 1984.

"Maintenance and Stabilization of Historic Bridges," paper given at the Annual Meeting of the Association for Preservation Technology, Banff, Alberta, October 1982.

"The Great Falls Smelter: Some Reflections on Its Significance," paper given at the Montana State History Conference, Great Falls, MT, October 1982.

"Superinsulation vs. Passive Solar Energy in Historic Buildings," paper given at the Annual Meeting of the Association for Preservation Technology, Washington, D.C., October 1981.

"Passive Solar Retrofit of Historic Structures," paper given at the Annual Meeting of the Association for Preservation Technology, Denver, CO, September 1979.

SCHOLARLY and RELATED EVENTS and PROJECTS

Chair of the Program Committed for the annual meeting of the Society for Industrial Archeology, Duluth, MN, June 2000.

Chair of the Program Committee, "Whither Industrial Archeology," a three-day symposium featuring twenty-four speakers and co-sponsored by the Society for Industrial Archeology, Historic American Engineering Record, and Lowell National Historic Park. Held at Lowell, MA, November 1998.

Organizer, industrial archeology tour of NE Montana, organized for the Klepetko (Montana) Chapter of the Society for Industrial Archeology, September 1995.

Panel organizer, "Topics at the Intersection of Architectural History and the History of Technology," a two-session panel featuring seven papers and a comment, presented at the Annual Meeting of the Society of Architectural Historians, Seattle, WA, April 1995.

Organizer, Coal and Coke Tour, organized for the Annual Meeting of the Society for Industrial Archeology, Pittsburgh, PA, June 1993.

Co-organizer with Brian Shovers, Fall Tour of Butte and Anaconda, Montana, organized by the Klepetko (Montana) Chapter for the Society for Industrial Archeology, October 1989.

Co-organizer with Brian Shovers, "Butte: The Urban Frontier," three-day history conference featuring twenty-six speakers and sponsored by the Butte Historical Society with major funding by the Montana Committee for the Humanities, Butte, MT, September 1982.

Project Director, Historic and Architectural Survey of over 3,000 structures in the Butte National Historic Landmark District, sponsored by the Butte Historical Society with major funding from the Montana State Historic Preservation Office and the Butte-Silver Bow Community Development Office, 1981-1985.

SELECT CONTRACT PUBLICATIONS AND PRESENTATIONS

"The Standard Mill at Bodie, CA," narrative history written under contract to the Historic American Engineering Record for California State Parks, work in progress.

"Expert Report," March 2000, prepared for the Environmental Defense Section, U.S. Department of Justice, in the Stibnite/Yellow Pine Superfund litigation (*Mobil Oil Corporation v. U.S.*) in Idaho. The report describes the tailings-disposal methods used by the Bradley Mining Company, 1932-1952.

"Expert Report," February 2000, prepared for the firm Muchmore & Wallwork, representing the plaintiffs in the Superfund litigation *Pinal Creek Group v. Newmont Mining Corporation, et al.* The report is a corporate and operational history of the Inspiration Consolidated Copper Company in the context of the corporate and operational history of the Anaconda Copper Mining Company, which owned a minority share of Inspiration stock but controlled the Inspiration operations.

"Expert Report," August 1999, prepared for the Environmental Enforcement Section, U.S. Department of Justice, in the Bunker Hill (ID) Superfund litigation (*U.S. v. ASARCO, et al*). The report includes technological and business histories of the lead-silver concentrators operating in the Coeur d'Alene mining district and a history of the movement of tailings and other contaminants through the Coeur d'Alene River system.

"Expert Report," August 1997, prepared for the Environmental Enforcement Section, U.S. Department of Justice, in the Clark Fork (MT) Superfund litigation (*U.S. v. ARCO*). The report includes technological histories of the silver mills, copper smelters, zinc concentrators, and manganese plant at Butte and Anaconda, Montana, as well as histories of the Anaconda Smelter Smoke Commission and a series of land exchanges effected by the Anaconda Copper Mining Company and the U.S. Forest Service.

"The Anaconda Smelter Smoke Commission: A Technological History," May 1997, Expert Report prepared for the Environmental Defense Section, U.S. Department of Justice, in the Clark Fork (MT) Superfund litigation (*U.S. v. ARCO*). In addition to a history of the Smoke Commission, the report includes a technological and pollution history of the Anaconda Copper Mining Company's smelters at Anaconda.

"Sheridan Electric Co-op: A History of Its Organizing," a history written to commemorate Sheridan Electric's 50th annual membership meeting, October 1997. The project is accompanied by the recording of about a dozen oral histories of early co-op members recalling the impacts of rural electrification on farm life in northeast Montana.

"Connellsville Coal and Coke Study," a business and technological overview of the Connellsville Coke Region for the America's Industrial Heritage Project, Historic American Engineering Record, National Park Service, September 1992. Transmitted to the Library of Congress as historical narrative accompanying Historic American Engineering Record measured drawings of beehive coke ovens in the region as "Connellsville Coal & Coke Region, HAER No. PA-283," 1995.

"Selby Avenue Bridge, HAER No. MN-61," Historic American Engineering Record narrative and large format photographs, sub-contract to Robert M. Frame III for the Department of Public Works, St. Paul, MN, September 1992.

"Historic Bridges in North Dakota," statewide survey and determination of eligibility, with Lon Johnson, Mark Hufstetler, and Charlene Roise, contract to North Dakota State Department of Transportation, May 1992.

"Deer Flat Embankments, HAER No. ID-17-B," with Amy Slaton (RTI), Historic American Engineering Record narrative history, contract to Pacific Northwest Region, U.S. Bureau of Reclamation, December 1991.

"Owyhee Dam, HAER No. OR-17," with Amy Slaton (RTI), Historic American Engineering Record narrative history, contract to Pacific Northwest Region, U.S. Bureau of Reclamation, September 1991.

"Determination of Eligibility for Historic Resources at Camp Grafton, ND," contr. to Omaha District U.S. Army Corps of Engineers for the North Dakota National Guard, March 1991.

"Boise Project Office, HAER No. ID-17-C," (RTI) Historic American Engineering Record narrative history, contract to Pacific Northwest Region, U.S. Bureau of Reclamation, September 1990.

"Dams of the Upper Souris National Wildlife Refuge, HAER No. ND-3" and "Dams of the J. Clark Salyer National Wildlife Refuge, HAER No. ND-4," with Mary McCormick (RTI), Historic American Engineering Record narrative history & large-format photography, contract to St. Paul District U.S. Army Corps of Engineers for U.S. Fish and Wildlife Service, August 1990.

"Historic Bridges in South Dakota," statewide survey & determination of eligibility, with Lon Johnson, contract to South Dakota Department of Transportation, October 1990.

"Determination of Eligibility for Seven Bureau of Reclamation Dams in Oregon, Idaho, and Wyoming," with Jeffrey A. Hess, contract to Pacific Northwest Region, Bureau of Reclamation, October 1989.

"Blaine Spring Creek Bridge, HAER No. MT-63" and "Upper Madison Bridge, HAER No. MT-64," with Lon Johnson, Historic American Engineering Record narrative history and large format photographic documentation, sub-contract to Ethos Consulting for Montana Highway Department, June 1989.

"Crow Agency Historic Complex, HABS N. MT-79," with Mary McCormick, Historic American Buildings Survey narrative history and large format archival photographic documentation of five buildings at Crow Agency, contract to the Bureau of Indian Affairs, June 1989.

"Rocky Boy's Agency Flour Mill, HABS N. MT-76," Historic American Building Survey narrative history & photographic documentation, contract to Billings Area Office, Bureau of Indian Affairs, October 1988.

"Reconnaissance Surveys of Crosby and Velva, North Dakota," with Dale Martin, contract to State Historical Society of North Dakota, September 1988.

"Determination of Eligibility of Five C&NW Bridges and a Freight Depot at Sioux Falls, South Dakota," contract to Chicago and Northwestern Railroad, June 1988.

"Historic Iron and Steel Bridges in Minnesota, 1873-1940," statewide survey and preparation of historical context for the Minnesota Historical Society, with Dale Martin, subcontract to Jeffrey A. Hess, June 1988.

"Determination of Eligibility of Four Montana Power Company Hydroelectric Generating Facilities Near Great Falls, Montana," with Mary McCormick, contract to the Montana Power Company, May 1988.

"Hardin City Water Works, HABS No. MT-71," Historic American Buildings Survey Narrative Architectural History, contract to City of Hardin, Montana, September 1987.

"Determination of Eligibility of Buildings at Six BIA Agencies in Montana," with Mark Fiege, contract to Billings Area Office, Bureau of Indian Affairs, September 1987.

"Fort Peck Townsite, HABS No. MT-70," Historic American Buildings Survey Narrative Architectural History, contract to Omaha District U.S. Army Corps of Engineers, May 1987.

"Determination of Eligibility of the Madison River Dam and Power Plant," with Mark Fiege, contract to Montana Power Company, April 1987.

"Historic Resources of North Side Fargo: Inventory and Assessment," with Mark Fiege and Jack Crowley, contract to the Fargo Historical Society, August 1986.

"Final Report on the Intensive and Reconnaissance Surveys for Minot, North Dakota," with Mary McCormick, contract to the State History Society of North Dakota, December 1985.

"Flint Creek Powerhouse and Dam: A Determination of Eligibility for the National Register of Historic Places," with Mark Fiege, contract to the Montana Power Company, December 1985.

"Preservation of a Neighborhood: A Neighborhood Preservation Plan for Central Butte," with Bruce von Alten & Jim E. Richard, contract to Butte Community Union, November 1985.

"Industrial Heritage of Butte and Anaconda: An Analysis of the Historical Significance of the Surviving Physical Features of the Anaconda Copper Mining Company," with Mark Fiege and Brian Shovers, contract to the Butte Historical Society, September 1985.

"Butte-Anaconda Historical Park System Master Plan," with Dennis Glick and Mark Fiege, contract to the Butte Historical Society, September 1985.

"The Western Clay Manufacturing Co.: An Historical Analysis of Its Plant and Its Development," contract to the Archie Bray Foundation, February 1985.

"Milltown Dam: A Determination of Eligibility for the National Register of Historic Places," contract to the Montana Power Company, December 1984.

"Development of the Built Environment in the Original Townsite of Hardin, Montana," contract to the Big Horn County Historical Museum, September 1984.

"Cultural Resource Inventory and Evaluation Project, Homestake Mining Company Properties, Jardine, Montana," with Peter Steere and Paul Anderson, contract to Homestake Mining Company, April 1982.

NATIONAL REGISTER NOMINATIONS

"Historic Bridges of South Dakota," with Lon Johnson and Mary McCormick, 10/90.

"Boise Project Office," Boise, ID, 9/90.

"Owyhee Dam," near Adrian, OR, 2/88.

"McKay Dam," near Pendleton, OR, 2/88.

"Deadwood Dam," near Cascade, ID, 2/88.

"Historic Metal Bridges in Minnesota," with Dale Martin, 6/88.

"Antler State Bank," Antler, North Dakota, 10/87.

"Historic Resources of Minot, North Dakota," with Mary McCormick and Mark Fiege, 1986.

"Headframes and Mineyards of Butte," with Mark Fiege and Brian Shovers, 1985.

"The Butte, Anaconda and Pacific Railway Historic District," with Mark Fiege, 1985.

"The Foundry Department of the Anaconda Copper Mining Company Historic District," with Mark Fiege, 1985.

"Old Works Smelter Historic District," 1985.

"Western Clay Manufacturing Company Historic District," 1985.

"Historic Resources of Hardin, Montana," 1984.

"Silver Bow Brewery Malt House," 1982.

"Silver Bow County Poor Farm," 1979.