DOE/MC/29309 -- 4054
(DE95009707)

Piñon Pine Power Project

Annual Report
January - December 1994

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Work Performed Under Contract No.: DE-FC21-92MC29309

For
U.S. Department of Energy
Office of Fossil Energy
Morgantown Energy Technology Center
Morgantown, West Virginia

By
Sierra Pacific Power Company
Reno, Nevada

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By
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P.O. Box 10100
6100 Neil Road
Reno, Nevada 89520-0400

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ABBREVIATIONS AND ACRONYMS

BFW	Boiler Feedwater
CCT	Clean Coal Technology Program
CRADA	Cooperative Research and Development Agreement
DOE	U. S. Department of Energy
EIS	Environmental Impact Statement
EMP	Environmental Monitoring Plan
FW USA	Foster Wheeler USA Corporation
HGD	Hot Gas Desulfurization
HGF	Hot Gas Filter
HRSG	Heat Recovery Steam Generator
IGCC	Integrated Gasification Combined-Cycle
KTDC	Kellogg Technology Development Center
LASH	Coal Ash with Spent Limestone
MWK	The M. W. Kellogg Company
NDEP	Nevada Department of Environmental Protection
NEPA	National Environmental Policy Act
NFPA	National Fire Protection Association
PDU	Process Development Unit
PMP	Project Management Plan
PON	Program Opportunity Notice
PSCN	Public Service Commission of Nevada
PSD	Prevention of Significant Deterioration
ROD	Record of Decision
SPPCo	Sierra Pacific Power Company
SUFCO	Southern Utah Fuel Company
UEPA	Utility Environmental Protection Act
UPS	Uninterruptible Power Supply

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1.0 EXECUTIVE SUMMARY

This annual report has been prepared to present the status of the Piñon Pine Project, a nominal 107 MWe (gross) integrated gasification combined-cycle (IGCC) power plant addition to Sierra Pacific Power Company's (SPPCo) system. This project is a demonstration project cost-shared by the U.S. Department of Energy (DOE) and SPPCo under DOE's Clean Coal Technology (CCT) Program. The goal of the CCT Program is to demonstrate advanced coal utilization technologies that are energy efficient and reliable and that are able to achieve substantial reductions in emissions as compared with existing coal technologies.

The Piñon Pine Project will demonstrate an IGCC system utilizing the Kellogg-Rust-Westinghouse fluidized-bed gasification process operating in an air-blown mode with in-bed desulfurization and hot gas clean-up with a western bituminous coal. The Piñon Pine Project will be constructed and operated at SPPCo's Tracy Power Station, an existing power generation facility located on a rural 724-acre plot approximately 17 miles east of Reno, NV (Appendix 1). This new unit will be designated as Tracy Unit No. 4.

SPPCo, the project participant, has contracted with the Foster Wheeler USA Corporation (FW USA) for the overall project management, engineering, procurement and construction of the project. FW USA in turn has subcontracted with The M. W. Kellogg Company (MWK) for the engineering and procurement of key components for the Gasifier Island.

Key accomplishments have been the following:

- Completion of the National Environmental Policy Act (NEPA) requirements, including the Draft and Final Environmental Impact Statements and the Record of Decision.
- Procurement of all permits required to construct the project, including the Utility Environmental Protection Act (UEPA) permit to construct, issued by the Public Service Commission of Nevada (PSCN).
- Completion of preliminary design and the Forty Percent Design Review with DOE.
- Completion of the Definitive Cost Estimate for the project (see Appendix 3 for estimate summary).
- Completion of the Continuation Request for continued funding of the project through construction.

- Successfully tested the viability of substituting the Transport Hot Gas Desulfurization System at the Kellogg Technology Development Center as an alternate to the more costly fixed bed system.

- Completion of the process design phase of the facility and start of preliminary and detailed engineering phases.

- Selected and released engineering of major equipment including the gas turbine generator, heat recovery steam generator and steam turbine generator.

As a result of the delay in the selection of the combustion turbine as well as the extended environmental activities, progress has been slower than originally planned, with expenditures also limited over the period. Nevertheless, despite the delays encountered, the start of the Demonstration Period (Phase III) is not currently projected to be affected. However, the initial plan to implement a phased construction approach, with installation and operation of the combustion turbine as a peaking unit, will not be implemented because of the installation of approximately 160 MWe of peaking capacity during 1994.

2.0 INTRODUCTION AND BACKGROUND

2.1 IGCC Technology Overview

Coal-fired power plants are still the mainstay of power generation world-wide. The emissions produced by coal combustion have led to an environmental burden to the point where the use of coal as fuel for electricity generation may be threatened. Parallel to the installation of flue gas scrubbers in conventional coal-fired power plants, research is proceeding on innovative power plant concepts which are not only more acceptable from an environmental standpoint but also feature higher efficiency. Technology of this kind is already available for oil and gas fuels in the form of combined cycle gas and steam turbine power plants. To apply combined cycle technology to power production from coal, conversion of coal to a gaseous fuel is required by a coal gasification process. The most common coal gasification process essentially involves partial combustion of coal. This partial combustion provides the energy for further conversion of coal primarily into carbon monoxide and hydrogen.

In many regions in the United States, the effective electric reserves have declined to low levels and it is predicted that there will be a surge in new power plant orders. The criteria used for selecting a power plant technology will have to take into consideration cost competitiveness, environmental superiority, module size, fuel flexibility, reliability and availability, and construction lead time. Based on these criteria, IGCC technology is a leading candidate for new capacity addition. Demonstration of this technology should provide a coal-based option with cost of electricity that is competitive with more conventional technologies.

The Piñon Pine Project to be located at SPPCo Tracy Station will incorporate the KRW gasification technology which produces a clean low-Btu gas for use as fuel in a combined cycle power plant for production of low cost electricity in an environmentally sound manner.

The KRW process improves upon first generation IGCC technology in several aspects. Its pressurized, air-blown fluidized bed gasification technology will provide a higher thermal efficiency than a similar oxygen-blown system because it consumes less auxiliary power. A portion of the sulfur pollutants are captured within the fluidized bed before they can exit the gasifier. Additional impurities are removed through an advanced hot gas cleanup system which operates with a regenerative sulfur sorbent to remove sulfur compounds and barrier filters to remove particulates. In addition, the inherent modular design of the system and simple process configuration are expected to yield significantly lower engineering and construction costs.

The Piñon Pine Project integrates a number of technologies fostered by DOE. Among these are the KRW Energy Systems fluidized-bed gasifier, in-bed desulfurization using limestone sorbent, and zinc based sorbent sulfur removal from a hot gas stream. DOE and its predecessor agencies have supported development of this fluidized-bed gasification technology since 1972 when the design of a process development unit (PDU) was first initiated under contract with Westinghouse Electric Corporation. Construction of the PDU was completed in 1975 at Westinghouse's Waltz Mill Facility near Madison, Pennsylvania. From 1984 to 1988 the addition of dolomite and limestone to the gasifier bed for in-bed sulfur removal was successfully demonstrated at the PDU. These tests indicated that 85 to 90 percent sulfur removal efficiencies could be routinely achieved while using coal feedstocks containing 2 to 4.5 percent sulfur. In addition, the use of these sorbents in the gasifier was found to increase the product gas heating value while decreasing the production of ammonia, a major contributor to NO_X emissions.

It is important that a demonstration of the advanced IGCC technology include actual integration of the gasifier with a combined-cycle power plant. This step is necessary in order to evaluate the adequacy of integrated control concepts and to measure actual performance of a complete power generation system on a utility grid. The modular concept of the proposed technology will provide information that is directly applicable to other commercial plants since such plants will essentially incorporate one or more replicates of the demonstration project plant configuration.

2.2 IGCC Development History

Almost all of the IGCC demonstration plants were designed around a more conventional approach, i.e., gas produced in the gasifier was either quenched or cooled and scrubbed for low temperature removal of sulfur compounds. These plants also removed ash/slag in a wet state. In order to limit the size of cool down trains and desulfurizer systems, gasifiers for these early plants were oxygen blown, thereby adding to capital cost and parasitic power consumption. Cooling of gas for sulfur removal not only lowered the cycle efficiency, but also required extensive equipment and handling of process water. These plants offered the advantage of reduced number of gasification trains and offered flexibility to adapt them to chemical production.

In order to meet challenges of the market place and environment, a simplified IGCC system incorporating air-blown gasification with hot gas cleanup has been developed. By eliminating the oxygen plant and minimizing the need for gas cooling and wastewater processing equipment, the capital cost is reduced and plant efficiency is improved. Key features of the simplified IGCC system are shown in Appendix 2 and described below:

- Air-Blown Gasification

  In the simplified IGCC system, about 15 to 20 percent of the gas turbine compressor discharge air is extracted for use as oxidant in the gasifier. A booster air compressor increases the pressure of this extracted air to compensate for pressure losses through the gasifier and downstream hot gas cleanup system and fuel control valve.

- Hot Gas Cleanup

  To date, most major gasification plants have utilized cold (wet) cleanup processes. The alternate approach of filtering the gas at high temperature enables the gas to maintain most of the sensible heat resulting in a higher plant efficiency. Equipment is minimized and there is no waste water production. Several types of filtering devices have been tested in pilot facilities and are available from several suppliers.

- Hot Gas Desulfurization

  Sulfur contained in coal is removed in two steps. Addition of limestone to the gasifier captures the hydrogen sulfide produced in the reducing environment of the gasifier. Sulfur not captured by the limestone leaves with the product gas and is removed in an external desulfurizer system.

- Sulfation

  Coal ash with spent limestone (LASH) contains calcium sulfide along with unconverted carbon. The sulfator oxidizes the CaS produced in the Gasifier into $CaSO_4$, combusts unconverted char and absorbs SO_2 in regeneration gas from external desulfurizer system. Small amounts of transport and depressurization gas also combust in the sulfator. The sulfator operates as a fluidized bed. The heat generated is removed by generating steam to maintain the bed material at a temperature of 1600°F. Additional heat is recovered from flue gas exiting the sulfator by generating and superheating steam. The sulfated lash is suitable for landfill. Results from the on-going bench scale testing are being used to develop design data.

2.3 Project Selection and Cooperative Agreement

In January 1991, the DOE issued a Program Opportunity Notice (PON) soliciting proposals to demonstrate clean coal technologies that were capable of being commercialized in the 1990's. These technologies were to be capable of achieving significant reduction in the emissions of sulfur dioxide and/or nitrogen oxides and to provide for future energy needs in an environmentally acceptable manner. In response to the PON, DOE received proposals for projects that involved both advanced technologies that can be "retrofitted" to existing facilities and "re-powering" technologies that increase plant generating capacity, extend the operating life of a facility, and also reduce air pollution. The project proposed by SPPCo of Reno, NV was one of the nine projects selected for funding. The project is to provide for the design, construction, and operation of a nominal 100 MWe (net), air blown KRW fluidized bed coal gasifier IGCC demonstration plant.

The Cooperative Agreement between SPPCo and the DOE was executed in August 1992. FW USA will provide engineering and construction management services for the project. MWK will provide engineering of the Gasifier Island.

2.4 Description of Existing Tracy Station

The existing plant site is located in Storey County in the Truckee River Canyon, on flat terrain abutting the Truckee River. The finished floor elevation of the plant is approximately 4,280 feet above sea level. Two mountain ranges flank the canyon. The Pah Rah Range is located to the north of the site, and the Virginia Range to the south. Clark Mountain, located approximately 3.5 miles to the south, is the largest feature in the area with an elevation of 7,195 feet above sea level. Figures 2-1 and 2-2 are maps showing the Tracy Station location and topography. Please refer to photographs in Appendix 5 for reviews of the existing site.

The Tracy Power Station is located on a 724-acre site approximately 17 miles east of the Reno/Sparks area adjacent to I-80. The facility consists of 3 steam generating units, producing 53 MW, 83 MW and 108 MW, respectively. Other facilities include an office building, two warehouses, a machine shop, a fuel oil storage area with five storage tanks, one diesel storage tank, one propane storage tank, two cooling towers, and one paved parking lot. There are 345 kilovolt (kV), 120 kV and 60 kV transmission lines, with accompanying towers servicing the Reno area and the North Valmy Power Plant. Figure 2-3 is a plan view of the existing plant and locations of the proposed projects.

At night, the main areas of the Tracy Power Station (stacks; Units 1, 2 and 3; and warehouses) are lighted and clearly visible from I-80. The lighting is directed toward plant facilities and not at surrounding areas.

SPPCo has recently installed two 83.5 MW simple-cycle combustion-turbine generating units and auxiliary equipment to supply 167 MW of electrical power. These units began commercial operation in July 1994. Two stacks are associated with these units, each 55' tall. The Tracy Power Station is the site for these turbines.

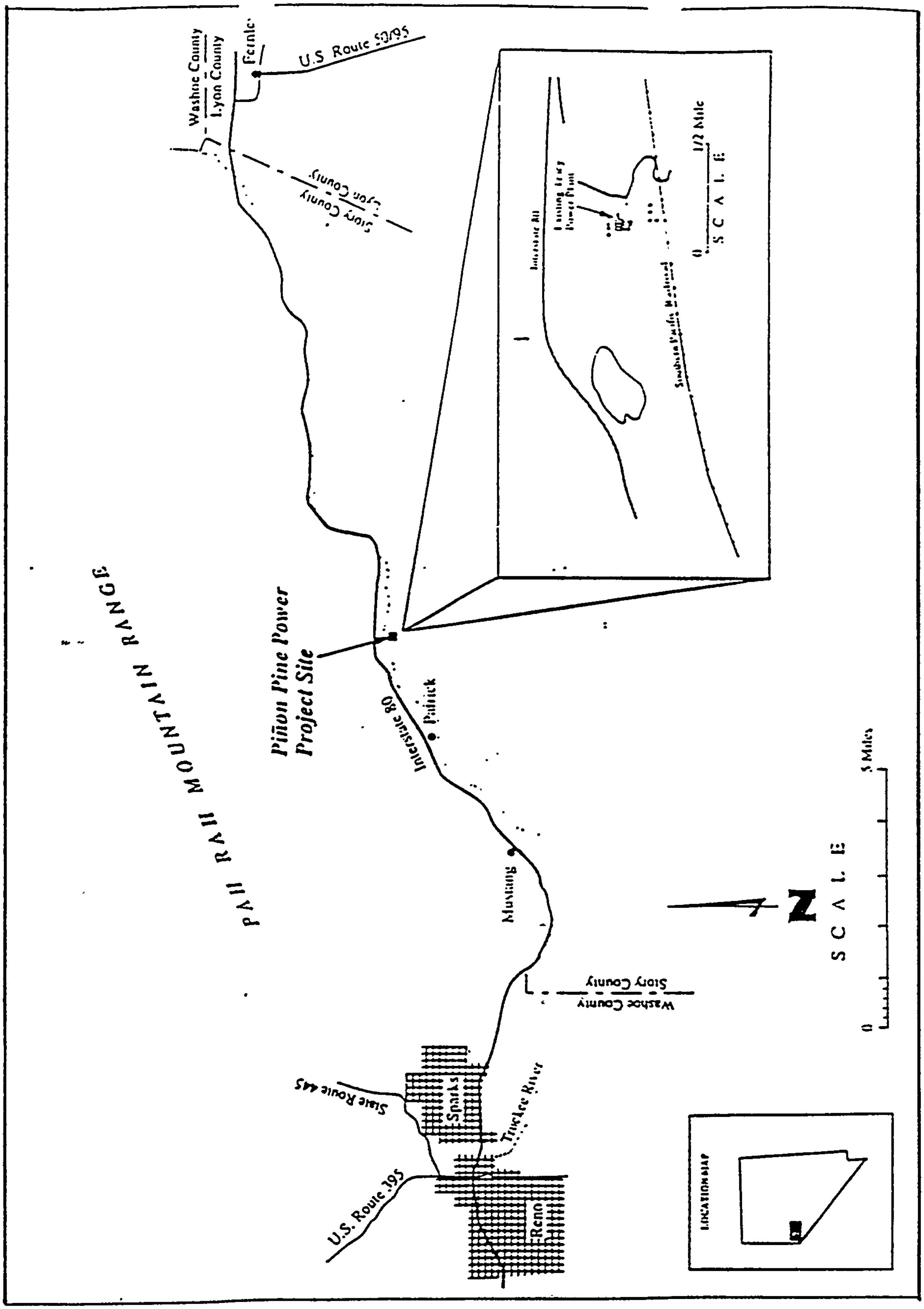


Figure 2-1. Tracy Station Location

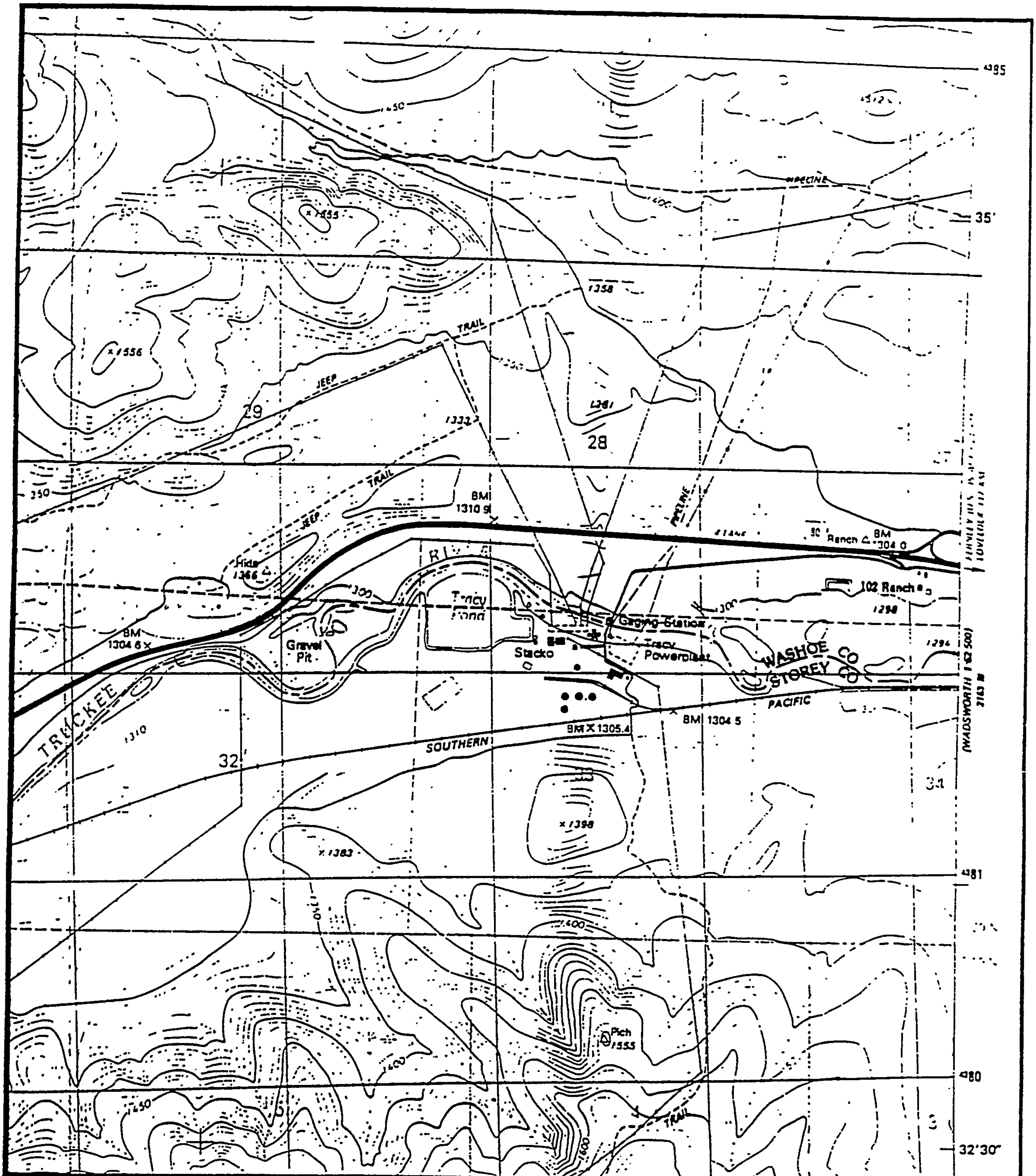


Figure 2-2. Tracy Station Topography

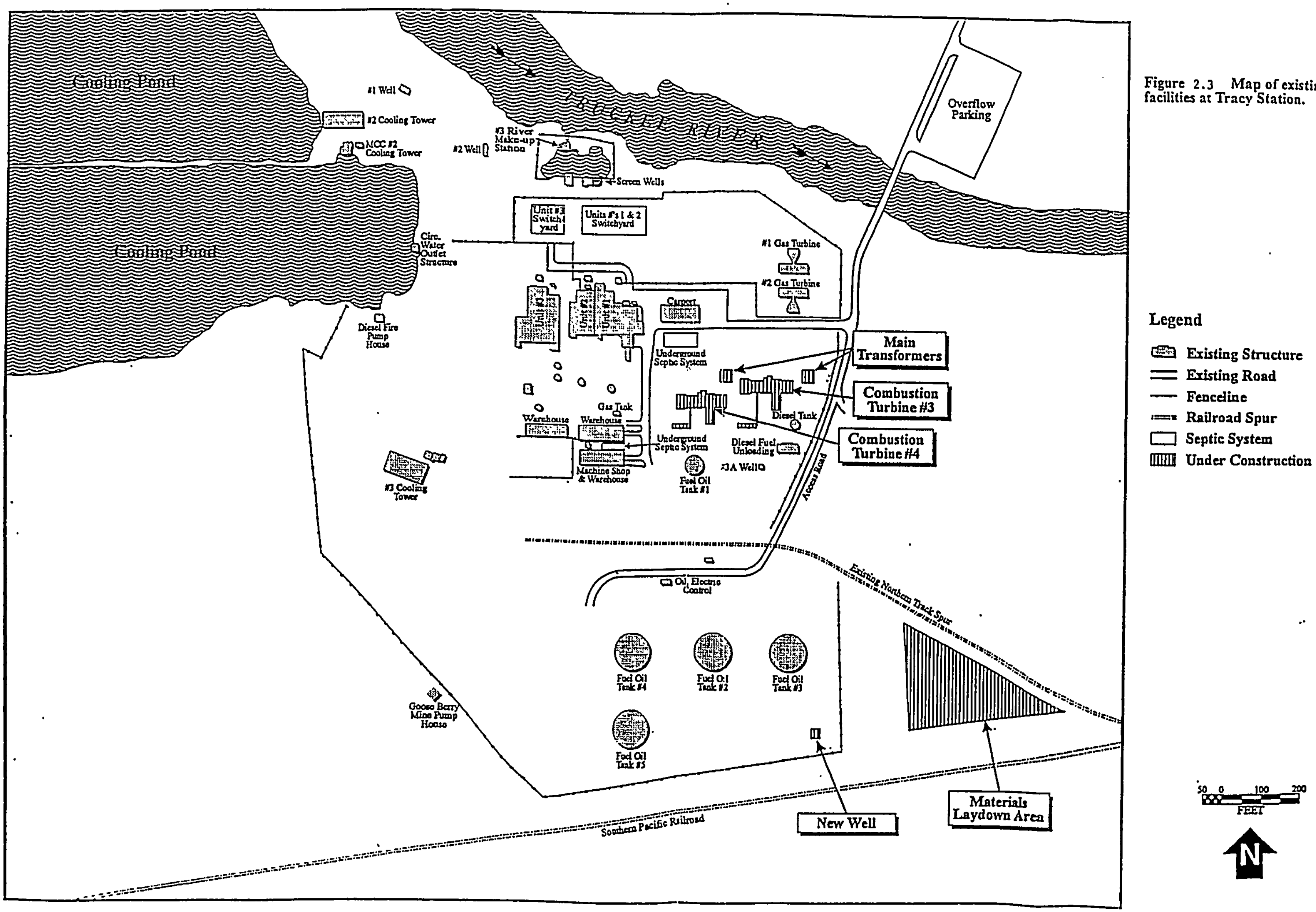


Figure 2.3 Map of existing facilities at Tracy Station.

3.0 PROJECT OBJECTIVES

3.1 Overview of Objectives

The objectives of the Piñon Pine Project are to meet the power needs of the SPPCo customers and to demonstrate the technical, economic and environmental viability of a commercial scale IGCC power plant. This plant is to be based on an air blown, fluidized-bed gasifier incorporating hot gas clean up and a combustion gas turbine capable of utilizing low Btu gas. The project will demonstrate that power plants based on this technology can be built at capital costs and with thermal efficiencies which significantly reduce electric power costs over more conventional technologies. The project will also demonstrate the effectiveness of hot gas clean-up in achieving a negligible environmental impact (reduced SO_2 and NO_X emissions) and the operation of a low-Btu fuel gas combustion turbine. The performance to be demonstrated will include all major sub-systems of the IGCC system including coal and limestone feed systems, pressurized air-blown fluidized bed gasifier, hot product gas filtering and desulfurization with a regenerative sulfur sorbent, sulfator system, combustion turbine and steam cycle, and integrated control systems. Another objective is to assess the long term reliability, maintainability, and environmental performance of the IGCC technology in a utility setting at a commercial module size.

3.2 Project Phases

The Piñon Pine Project will be divided into the following three distinct phases of activity as shown in the Summary Bar Chart Project Schedule included in Appendix 4:

3.2.1 Phase I - Design

The objective of activities during this phase is to provide the technical definition and definitive cost of the Piñon Pine Project. This effort provides process design, equipment identification and selection, integration of the gasifier system with the power plant, and system test planning as required to make certain that adequate design features exist to assure performance and operational success. Also, all required engineering information and support for all licensing, permitting and reliability activities will be prepared during this phase.

3.2.2 Phase II - Construction

This phase includes all activities required to construct the plant in concert with the overall project plan. This will ensure that the facility is procured and constructed to specification, on schedule, and within budget. Procurement activities during this task include purchasing, inspections, expediting, traffic and commercial aspects of in-place subcontracting. Included in this effort are home office construction activities such as safety, quality assurance, labor relations, budgeting and scheduling, and field construction management activities including functions such as supervision of equipment installation, erection of materials, field engineering, field accounting, cost, schedule and material control, and subcontract administration.

3.2.3 Phase III - Operation

This phase covers all the labor, materials and services needed for plant operation for a 42-month period. The objective is to provide all the operational and management direction that will be necessary to provide the private sector with technical, economic and environmental evaluations on the advanced coal gasification combined-cycle power plants.

3.3 Accomplishments

This section of the report provides a summary of major activities and accomplishments during 1994.

3.3.1 Laboratory Testing

In an attempt to reduce the total installed cost of the plant, an evaluation of the Transport Hot Gas Desulfurization (HGD) technology was performed as an alternate to the fixed bed HGD system. Significant savings were identified due to the reduced nitrogen required to support sorbent regeneration. Other savings in capital equipment and sorbent quantity costs were also identified. The evaluation included a preliminary feasibility investigation, technical risk evaluation, and a definition of a laboratory test program to be performed at the Kellogg Technology Development Center (KTDC). The test program, which was designed to demonstrate suitability of a zinc based sorbent such as Phillips Z-Sorb sorbent at transport Absorber/Regenerator conditions expected during operation, was conducted. The tests demonstrated the overall acceptability of the sorbent at the project operating conditions and provided the data required to establish the operating parameters affecting the design and operation of the desulfurizer and regenerator. A detailed report of test results was issued. Test results confirmed that the desulfurizer could be located upstream of the Hot Gas Filter with the addition of the desulfurizer feed cyclone to reduce the possibility of char build-up in the circulating sorbent stream.

3.3.2 Process

The process design was essentially completed and frozen. The Process Description, Process Flow Diagrams, and Heat and Material Balances were issued incorporating the Transport Hot Gas Desulfurization system and other process changes, which included the use of "as received" (undried) coal. Preliminary engineering activities proceeded on this basis in parallel with the Transport HGD test program, and they were later confirmed by the test results.

3.3.3 Engineering

Preparation of equipment requisitions and review of vendor proposals was started. Major equipment items selected and released for engineering include the Gas Turbine Generator, Heat Recovery Steam Generator, Steam Turbine Generator and Flue Gas Stack.

Because of the high cost and the developmental nature of the Hot Gas Filter (HGF), it was decided that potential suppliers of the item would undergo a pre-qualification evaluation based on technical merit including experience and risk. The pre-qualification inquiry was based on an HGD utilizing ceramic filter elements, and meetings were conducted in early 1994 with seven potential HGD suppliers. As a result of these pre-qualification meetings, three of the seven potential suppliers were eliminated from further consideration. Inquiry of the item proceeded with proposals invited from the remaining four pre-qualified vendors. Extensive evaluations were conducted of the proposals received. Late in 1994 a successful bidder was identified.

A value engineering study of the project resulted in numerous cost reduction proposals which were further evaluated. Several of these proposals related to improving efficiency within the operations of the project team, and these were adopted immediately. Some proposals proved to be either too experimental and risky to incorporate into the design of this project or not economical. The feasibility of the remaining proposals related to reducing the gasifier structure height and alternate solids handling systems was confirmed and the proposals were subsequently incorporated into the design. Implementation of these proposals resulted in significant cost savings to the project.

The Engineering Flow Diagram and Plot Plan development proceeded, and these documents were issued at a stage of progress where the physical design disciplines of piping and civil/structural could proceed with planning studies. The plot plan has undergone extensive review and revision incorporating constructability, operability and maintainability considerations.

A process hazard review was performed for the Gasifier Island to identify and communicate to the design engineers potential hazards that should be considered in the plant design. The review also identified operational hazards such as start-up, off-design operation and combinations of emergency conditions. A final report was issued and action items were worked.

A review of engineering work associated with the design at the forty percent completion point of Phase 1 (Engineering) activities was held with DOE, FW USA, MWK and SPPCo representatives in attendance.

An effort was initiated to define a dynamic simulation of the facility to study transients related to the normal operation of the plant, and failures and trips of its associated control and safety systems. This work is needed to evaluate the impact of transients in the operation of the Gasifier Island on the gas turbine and the controls necessary to minimize those impacts. This dynamic simulation effort will be accomplished in early 1995.

3.3.4 Environmental/Permitting Activities

All work in support of the DOE's preparation of the EIS was completed and the FEIS was issued in September 1994. The Record of Decision (ROD) was issued November 8, 1994.

The Special Use Permit and Building Permit for the project were approved by Storey County in November and December of 1994 respectively.

The Nevada Department of Environmental Protection (NDEP) approved the Prevention of Significant Deterioration (PSD) Permit and related Air Quality Permits to Construct in November 1994.

The Public Service Commission of Nevada rendered a favorable UEPA decision in mid December 1994. The Opinion and Order for the UEPA Permit is expected in early January 1995.

In March 1994, the Public Service Commission of Nevada reaffirmed the 1993 Opinion and Order approving SPPCo's Resource Plan to construct the Piñon Pine Project.

4.0 PLANT DESCRIPTION

The major systems of the Piñon Pine Project IGCC facility are described in this section.

4.1 Piñon Pine Project

The Piñon Pine Project will demonstrate the performance of a coal-based Integrated Gasification Combined Cycle (IGCC) power plant. The proposed facility is illustrated in Figure 4-1. The IGCC power plant will include a gasifier island based on KRW's pressurized, air-blown, fluidized-bed coal gasifier, coupled to a combustion turbine and steam-based power island. The Gasifier Island will include a pneumatic coal feed system, fed by lockhoppers, which will introduce the coal into the gasifier; and an air-blown KRW gasifier capable of producing low-BTU gas. The gas from the gasifier will be transferred to a hot gas conditioning system for removal of sulfur compounds, particulates, and other contaminants as necessary to meet environmental and combustion turbine fuel requirements. The power island will include a combustion turbine (approximately 61 MW gross) capable of using natural gas, coal gas, or propane; a heat recovery steam generator (HRSG) system capable of supplying superheated high pressure steam generated in the HRSG and the gasification and desulfurization sections; a steam turbine (approximately 46 MW gross); all control systems; and required auxiliary systems.

Key equipment items and systems, which will be part of the unique technology of the Piñon Pine Project include the KRW gasifier with in-bed desulfurization, external regenerable sulfur removal, fine particulate filters, and some aspects of the gas turbine generator. Advanced KRW gasification technology produces a low-BTU gas, which is used as fuel in a combined-cycle power plant, and includes hot gas removal of particulates and sulfur compounds from the fuel gas, resulting in lower atmospheric emissions. Desulfurization will be accomplished by a combination of limestone fed to the gasifier and treatment of the gas in a transport desulfurizer and a transport regenerator using a zinc-based sulfur sorbent. Particulates will be removed by one or more high-efficiency cyclones and a barrier filter. These operations will be carried out at an elevated temperature to eliminate the inefficiency and capital cost for cooling and cleaning the gas at low temperature, which is associated with other IGCC systems. Since water vapor is not condensed in the hot gas clean-up process, water effluents will be reduced and would consist only of a feedwater treating system effluent and boiler and cooling tower blowdown.

Raw coal, from western States, will be received at the plant from a unit train consisting of approximately 84 railcars of approximately 100 ton capacity, arriving approximately once a week. Currently, Southern Pacific Railroad facilities are on site; the railroad line is a main east-west supply route. Upgrading and extending the spur on SPPCo land will be required for the project.

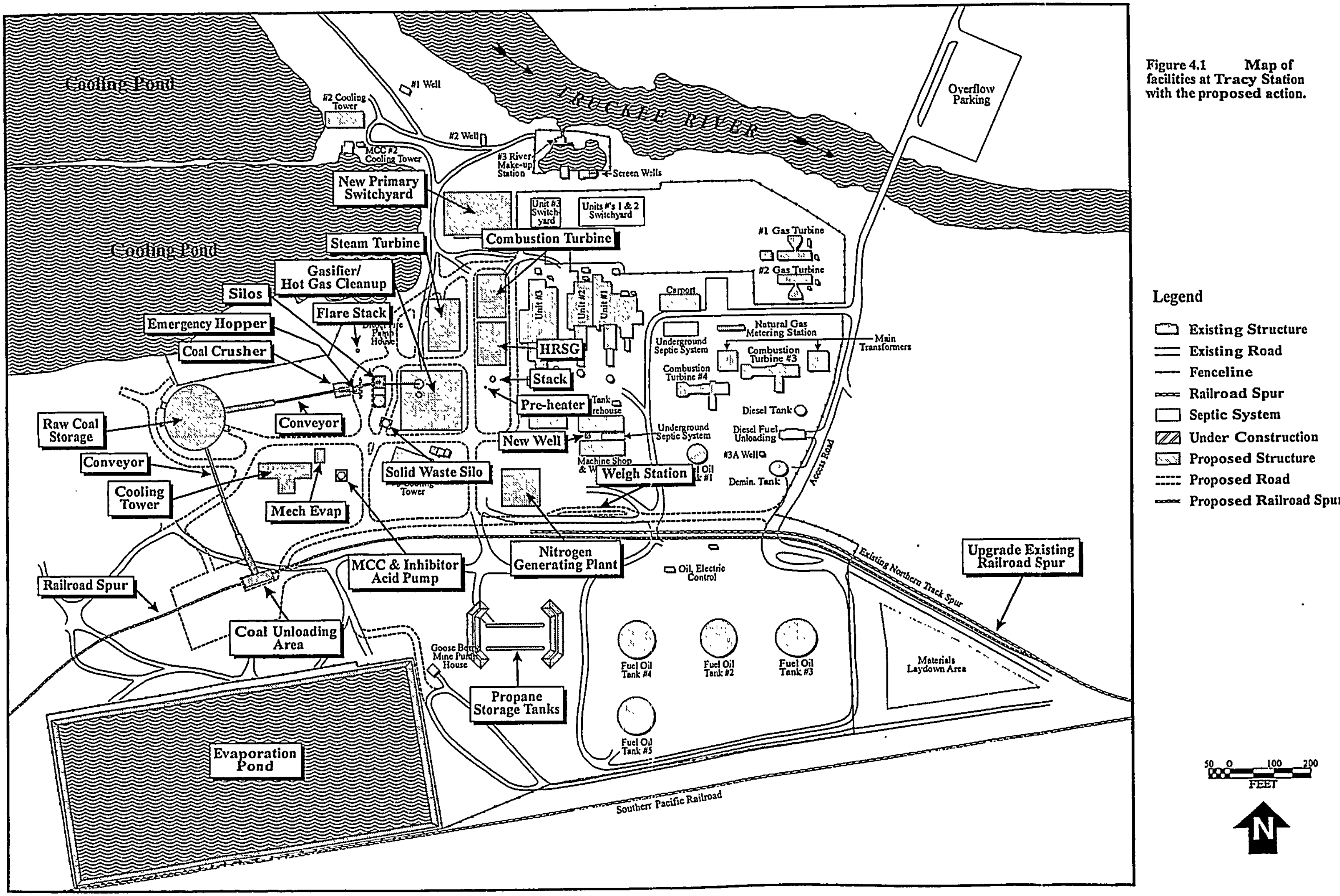


Figure 4.1 Map of facilities at Tracy Station with the proposed action.

Coal will be received at an enclosed unloading station and transferred to a coal storage dome. The unloading station will consist of two receiving hoppers, each equipped with belt-type feeders that will feed the raw coal conveyor system. All material handling systems will be enclosed and supplied with dust collection systems for environmental control. Dust control equipment will be utilized as required by state and federal regulations.

4.2 Gasifier Island

4.2.1 Oxidant Compression and Supply (Area 200)

This area provides air to the gasifier, air for regeneration of the desulfurization sorbent, air for coal and limestone feed pressurization and transport air for feeding coal and limestone into the gasifier.

Air for the Gasifier Island is extracted from the gas turbine's air compressor. A portion of this air is diverted for use during start-up of the gasifier. The major portion of the air, which is the oxidant feed to the gasifier, must be compressed above gasifier operating pressure. To minimize power consumption during compression, this air is cooled to 120°F in three exchangers in series. The knockout drum is provided downstream of these exchangers to remove any water condensed from air during cooling.

Air exiting the knockout drum is compressed by the boost air compressor to above gasifier pressure level. A portion of this air is cooled by cooling water in the transport air cooler and is split into two streams. One of these streams is used as transport air to feed solids into the gasifier. The other stream is diverted to the suction of the pressurization air compressor. The major portion of the air exiting the boost air compressor is reheated in the air recuperator and again divided into two streams. The major portion of this stream is fed to the gasifier while the other portion is used for regeneration of the zinc oxide based desulfurization sorbent.

4.2.2 Coal Gasification (Area 300)

This area contains the solids feed system and the gasifier with its associated cyclone. Solids feeds consist of the coal to be gasifier and limestone sorbent used for capture of sulfur components emitted during gasification.

Coal and limestone, as well as coke breeze during start-up, are fed from a single conveyor to a lock hopper system for feed to the gasifier. The feed hopper provides a continuous feed of coal and limestone to the gasifier through the coal feeder. Solids from the feeder are picked up by transport air and fed directly to the gasifier central feed tube. Additional air from the recuperator is also fed through the same feed tube and the streams merge to form a central jet where the coal is quickly devolatilized, with the remaining char and limestone entering the bed. Combustion of char and gas occurs within the jet to provide heat necessary for endothermic devolatilization, gasification and desulfurization chemical reactions. Extraction steam from the steam turbine is injected at the gasifier grid to aid in fluidization of the gasifier bed.

Carbon monoxide and hydrogen are the major combustible constituents of the product gas. Methane and other hydrocarbons are produced in lesser quantities, primarily from the devolatilization process. The operating temperature of the gasifier is sufficiently high to crack any tars or oils that might be produced.

Gasification also results in the release of sulfur from the coal, primarily in the form of hydrogen sulfide. At gasifier operating conditions, the limestone sorbent fed with the coal quickly calcines and reacts with the hydrogen sulfide. The amount of hydrogen sulfide that is captured is limited by chemical equilibrium. With the low sulfur Southern Utah Fuel Company (SUFCO) coal, approximately 50% of the sulfur released from the coal is removed from the gas. Sulfur exiting the gasifier in gaseous form is captured by the external desulfurizer system.

The product gas exiting the top of the gasifier contains a significant quantity of entrained solids, consisting of char (unconverted coal), ash and sorbent. The gas enters the gasifier cyclone which removes most of the solids. Gas from the cyclone is directed to the product gas cooler and the product gas trim cooler for heat recovery. Solids collected in the gasifier cyclone are returned to the gasifier via the dipleg. Recycle gas from the recycle gas compressor is used to fluff the dipleg to facilitate flow of solids back to the gasifier bed.

Recycle gas is also used to provide fluidization gas and for cooling of the spent solids in the annulus at the bottom of the gasifier. The spent solids are withdrawn from the gasifier annulus by the ash feeder and pneumatically transferred to the ash collection and depressurization hopper for further processing in the sulfator system.

4.2.3 Gas Stream Heat Recovery (Area 400)

This area includes cooling of the main product gas from the gasifier as well as cooling of the recycle gas.

Product gas from the gasifier cyclone is cooled to about 1000°F in the product gas cooler and the product gas trim cooler. Cooling is accomplished by generating steam from boiler feed water (BFW) supplied from the steam drum. Circulation through these two exchangers is by natural convection.

Recycle gas from the hot gas filter is cooled to 270°F by the recycle gas cooler. The heat removed from the gas is used to increase the temperature of BFW makeup to the steam drum.

The gasifier steam drum operates at 1075 psia (nominal) and is supplied by BFW from Area 800. Steam from the gasifier steam drum is combined with superheated steam from the HRSG steam drum and passed through the superheater section of the HRSG in order to superheat it to 600°F prior to delivery to Area 800. Blowdown from the gasifier steam drum is combined with blowdown from the HRSG steam drum and also returned to Area 800.

4.2.4 Gas Stream Particulate Removal (Area 500)

This area provides final clean-up of particulates in the product gas stream and collection of all spent solids prior to final processing.

Desulfurized product gas from the desulfurization section still contains a small quantity of particulates. This stream is sent to the hot gas filter which essentially removes all of the remaining particulates. The hot gas filter is a ceramic candle type filter utilizing back pulse gas for cleaning. Candle elements used for filtration are housed in a steel vessel with access capability for replacement of candles. The particulate free desulfurized gas exits the filter and is sent to the gas turbine.

Blowback gas for cleaning of the filter elements is provided from the recycle gas system in Area 900. Fines removed by the filter elements are collected in the bottom of the filter vessel and discharged through the filter fines screw cooler, which cools the fines prior to discharging them into the filter fines collection hopper. Fines collected are depressurized and pneumatically conveyed to the sulfator system for further processing.

4.2.5 Desulfurization (Area 600)

This area desulfurizes the product fuel gas prior to delivery to the hot gas filter, and it conditions the solids waste for disposal.

4.2.5.1 Desulfurization (Fuel Gas)

Fuel gas is fed to the fuel gas desulfurization system at approximately 1000°F. Sulfur compounds are removed from the gas by a zinc oxide based sorbent. The sulfur compounds in the product gas to the gas turbine are reduced to less than 20 ppmv, and the mildly exothermic absorption reactions result in a small increase in the fuel gas temperature.

The fuel gas desulfurization system comprises a transport desulfurizer and a transport regenerator. The fuel gas is fed to the mixing zone at the bottom of the riser where it mixes with zinc oxide based sorbent from the desulfurizer cyclone, which has recirculated these solids back to the riser via the standpipe. Absorption of gaseous sulfur compounds takes place in the narrower riser section as the fuel gas and sorbent flow upward into the desulfurizer cyclone.

The sorbent is regenerated by contacting a slipstream with 1100°F air, liberating the sulfur dioxide. The regenerated sorbent is returned to the desulfurizer while the regenerator off-gas is cooled and sent to the sulfator.

4.2.5.2 Waste Solids Treatment

With the exception of a small quantity of sulfur in the fuel gas to the gas turbine, all of the sulfur in the coal is ultimately disposed of in the sulfator system. This system serves the following functions:

1. Combustion of residual char in the ash and fines collected from gasification.

2. Capture of sulfur dioxide from both the residual char combustion and the desulfurizer regeneration effluent gas.

3. Oxidation of calcium sulfide produced in the gasifier to calcium sulfate.

The sulfator is a bubbling bed reactor which is fluidized by air supplied by the sulfator air compressor. Solids exiting the gasifier bottom which contain unconverted calcined limestone, sulfided limestone and ash (LASH) are conveyed to the sulfator with cooled recycle gas. Regeneration effluent gas from the desulfurization system is also fed to the sulfator for capture of sulfur dioxide by reaction with the unconverted calcined limestone in the solids from the gasifier.

The sulfator is operated at essentially atmospheric pressure. In order to maximize the sulfur dioxide capture and sulfide oxidation, the sulfator temperature is maintained at about 1600°F. Flue gas leaving the sulfator passes through the sulfator cyclone for removal of particulates and is then mixed with flue gas from the fines combustor prior to cooling in the HRSG to about 350°F. The gas then passes through the sulfator flue gas bag house filter for final removal of particulates and is sent to the stack. Solids leaving the bottom of the sulfator are cooled in the sulfator solids screw cooler and collected in the sulfator solids collection hopper for disposal.

4.2.6 Recycle Gas Compression (Area 900)

This area provides for recompression and distribution of recycle gas to various users. The recycle gas from the recycle gas cooler is split into three streams. A portion is sent directly to the sulfator system for use as transport gas. A second stream is compressed by the recycle gas compressor to gasifier pressure for recycle directly to the gasifier and for use as fluffing gas in the desulfurizer area.

A third stream is further cooled in the recycle gas booster compressor trim cooler to 120°F before compression. The cooled gas is fed to the recycle gas booster compressor which can boost the pressure up to about 1200 psia. The high pressure gas is used as blowback gas to clean the hot gas filter elements. It is also used for pressurization of the ash depressurization hopper and the filter fines depressurization hopper.

4.3 Combined-Cycle

Gas Turbine Generator (Area 700)

A General Electric Model MS6001FA Gas Turbine Engine (70.1 MW ISO rating) has been selected as the prime mover for the Piñon Pine Plant. It is an industrial frame-type gas turbine, scaled-down from GE's MS7001FA (150 MW) model. The technologically advanced firing temperature and cooling system of F-class gas turbines provide such units operating in combined cycle power plants with the highest total-cycle efficiency of any proven type of fossil-fueled electric power generation system. The engine's output shaft power will be reduced in rotative speed in a gearbox, from the optimum-efficiency value for a gas turbine of this size. Mechanical power will then be converted to electrical power in a once-through air-cooled synchronous generator.

Steam Turbine Generator and Heat Recovery Steam Generator (Area 800)

Available thermal power in the exhaust gases will be captured in a heat recovery steam generator (HRSG) to drive a condensing steam turbine generator.

The HRSG generates steam at two pressure levels. Steam generated in the HRSG and high pressure steam generated in the Gasifier Island, are combined, superheated in the HRSG and sent to the steam turbine generator. Low pressure steam generated is sent to the steam turbine generator and also provides pegging steam for the deaerator heater. The HRSG also includes a condensate heating section.

The steam turbine generator is a condensing type. Extractions provide steam, after letdown and desuperheating, to the gasifier. Throttle steam letdown is used if and when low throttle steam rates cause the extraction pressure to fall unacceptably low. Additionally, this extraction will provide steam for injection at the gas turbine generator for NO_X control when operating on natural gas or propane fuel.

The steam turbine exhausts into a surface condenser. Cooling water is used to condense the exhaust steam. Condensate is pumped from the condenser by the hotwell condensate pumps through the HRSG condensate heating section for the recovery of low level heat and thence to the deaerator. Venting of the condenser is accomplished by a vacuum pump system.

High pressure boiler feed water is pumped from the deaerator to the evaporator and Gasifier Island by the high pressure boiler feedwater pumps. High pressure boiler feedwater to the high pressure evaporator is preheated in an economizer section of the HRSG. Deaerated low pressure boiler feed water is pumped to the low pressure evaporators by the low pressure boiler feed water pumps. Boiler feedwater is preheated in an economizer section of the HRSG.

4.4 Offsites

Solids Handling (Area 100)

Raw coal, size 2" x 0, is received at the plant from a unit train consisting of up to eighty-four 100 ton railcars approximately every seven days. The coal is received at the enclosed unloading station and transferred to the coal storage dome. The unloading station will be enclosed and provided with a dust collection system to avoid uncontrolled coal dust emissions. The unloading station consists of two receiving hoppers, each equipped with belt type unloading feeder which feed the raw coal conveyor system. The conveyor system consists of the raw coal transfer conveyor and raw coal elevating conveyor. All material handling systems will be supplied with dust collection systems for environmental control, with special attention being paid to dust generating areas such as transfer points. Coal is weighed in transit by the raw coal receiving scale located on the raw coal transfer conveyor. An automatic sampling system is located at the discharge of the raw coal transfer conveyor which collects a representative sample to determine the quality of coal received. The raw coal unloading and conveyor system is sized to handle an 84-railcar train unloading operation in a four-hour period.

The coal is stored in a large field erected storage dome which will be sized to store over 16,000 tons of coal, or approximately twenty day's requirement. No exposed storage of coal, such as a coal pile, is planned, thus all coal storage will be within the dome.

Coal in the storage dome is reclaimed by the automated coal pile reclaimer or discharged by emergency pile dischargers and vibratory feeders onto the raw coal collecting conveyor. This conveyor transfers the coal to the crushing station for crushing and screening.

In coal crushing and screening, the raw coal passes through a magnetic separator and is fed to the crusher to reduce the material size from 2" x 0" to ¼" x 0". A vibrating screen with ¼" square holes will control the product top size. Oversize material will return to the mill for further reduction through the oversize coal conveyor. The product-size material is conveyed away by a high angle conveyor and deposited in the coal silo. The coal silo is sized for 24-hour feed to the gasifier.

Gasifier feed conveying equipment is provided from the coal silo to the gasifier area. The conveying system consists of a gathering conveyor and an elevating conveyor. The conveying line can be utilized to handle coal, limestone and coke. As with the raw coal handling system, care will be taken to control any dust emission sources by means of dust collection system.

Dried coke breeze, ¼" x 0, is received in the plant via trucks with pneumatic trailers for initial plant start-up and for each subsequent gasifier start-up. The sized coke is conveyed pneumatically to an 800 ton capacity coke storage silo using the truck-trailer pneumatic blower. Exhaust air from the filling operation will be vented through a dust control filter system. The material from the coke silo is conveyed to the gasifier utilizing one of the coal conveyor systems. The coke silo will be equipped with a weigh feeder to feed the said coal conveyor system.

Sized limestone is received in the plant via trucks with pneumatic trailers on a daily basis. The sized limestone is conveyed pneumatically to a 300 ton (5-day) capacity limestone storage silo using the truck trailer pneumatic blower. Exhaust air from this filling operation will also be vented through a dust control filter system. The material from the limestone silo is then fed at a controlled rate by a weigh feeder and blended with the coal on the same conveying line feeding the gasifier. Provisions are also included to transport limestone to the sulfator limestone feed hopper by pneumatic conveying. The material is discharged from the limestone silo and fed to the pneumatic conveying line by rotary airlock feeder.

Dust collection systems will be provided in the plant for proper environmental control. Fabric filter collectors will be used to control fugitive dust emissions from the transport and transfer of coal, coke and limestone.

Waste Water Treatment (Area 1000)

Wastewater from the demineralization package and cooling tower blowdown will be discharged to the wastewater collection system. The wastewater system will discharge to a wastewater sump. The wastewater sump pumps will pump this effluent to the evaporation pond.

The pond will be double lined and the system will be designed to meet the requirements of the Nevada Division of Environmental Protection. The pond has a surface area of approximately 4 acres. The wastewater is not anticipated to result in any adverse effect on wildlife such as migrating water fowl. Monofilament line with a spacing of 25 feet has been used by SPPCo to successfully discourage migrating water fowl from landing in several of SPPCo's facilities and is unobtrusive to the human observer.

Solid Waste Handling (Area 1100)

Cooled solid waste (LASH) consisting of ash, fines and sulfated limestone from the sulfation unit is conveyed continuously to the solid waste storage silo using a pneumatic system. The air displaced from the silo and the conveyor is vented through the bin filter.

The LASH in the silo is loaded-out onto trucks during the day shift operation, 5 days per week. The silo is equipped with a bin discharger, discharge valve and a telescopic loading chute with a bag filter and fan to minimize dusting during the truck loading operation. The LASH is then hauled to the final disposal point. A local landfill has expressed interest in using the material as a cover, and other usages are being investigated.

The solid waste silo is sized for three days of storage (400 tons) to handle the solid waste production over the weekend without the need of the truck load-out operation.

Balance of Plant (Area 1200)

The raw water system provides water to the demineralization package which in turn provides boiler feedwater makeup to the deaerator. Additionally the raw water system provides water for the plant utility water system for miscellaneous users such as service wash stations. Well water is the source of water for the plant raw water system. Well water is pumped to the existing Unit 3 raw water tank and then pumped by the raw water pumps to the plant raw water system.

Water from an existing cooling pond provides makeup water for the cooling tower. Raw water is pumped from the existing pond to the cooling tower basin by an additional pump.

Water for safety showers and eyewashes will be provided by the existing plant system. Drinking water is provided as either a brought-in bottled source or from wells on site.

Fire protection water will be provided by the existing plant system to the fire protection water loop. The source of fire protection water is the existing cooling pond. Three fire protection water pumps are presently installed together with a jockey pump.

Makeup boiler feedwater is demineralized by a package consisting of cation, degasification, anion and mixed bed units. Also included are the storage and feeding of regenerating caustic and sulfuric acid, and appropriate local controls, including neutralization controls. Spare acid and caustic pumps and the neutralization air mixing system are also included.

Regeneration waste is stored in a neutralization tank, where the waste is mixed and neutralized before it is sent to the dirty water sewer. Acid and caustic pumps are provided for neutralization.

Demineralized water is stored in a storage tank and pumped to the condensate system by the demineralized water pumps.

A chemical injection package consisting of facilities to feed and control appropriate quantities of oxygen scavengers, scale and corrosion inhibitors, and filming and neutralizing agents to the appropriate locations within the boiler feedwater system is provided.

A conventional induced-draft counter-flow cooling tower will be used for the plant cooling water system. The basin is below grade. Cooling water is circulated by the vertical turbine cooling water pumps.

The cooling tower is designed for the 2½% occurrence condition of a 61°F wet bulb temperature and provides 71°F cooling water at that condition. Blowdown from the system will be sent to the evaporation pond.

Biocide injection is provided by a biocide feeder. Other additives, corrosion inhibitors, pH control biocides, and scale/deposit inhibitors, are injected into the cooling water by the water treatment injection system.

A conventional plant and instrument air compression system is provided. Two air compressors, one operating, one spare, are provided for the system. A single air receiver provides adequate surge capacity. The air is dried to a -40°F dewpoint using an air drying desiccant system prior to branching off to plant and instrument air headers.

A flare system is provided to incinerate the full product gas flow from the gasifier in the event of a power plant outage, gasifier start-up, or other emergencies. The flare is a vertical free-standing system. Pilots will be designed to use natural gas or propane.

Propane is planned as a tertiary emergency fuel to the combustion gas turbine. Liquid propane will be delivered by tank truck or tank car and stored in two 100,000 gallon (nominal) storage drums. The drums will be oriented, and earthen berms constructed, to minimize damage in the event of tank failure. Storage will be in accordance with the applicable NFPA requirements. When required, liquid propane is drawn off the storage drums and pumped to the vaporizer prior to combustion as fuel in the combustion gas turbine.

Nitrogen is required by the process for maintaining a constant flow of purge gas through selected equipment and instruments. The nitrogen package is a cryogenic air separation plant wherein the constituents of air are separated by cryogenic distillation delivering high purity nitrogen in the required quantity. Components of the package include compressors, storage tanks, a liquid nitrogen pump and vaporizers sized to provide for start-up, normal operation and a safe shutdown of the facility.

The existing Tracy sub-station is supplied at 120 kV. Connection to this system will be through tie and service breakers feeding unit transformers connected to the gas turbine and steam turbine generators. The generators will be rated at 13.8 kV with maximum generator output equal to elevated temperature and/or auxiliary cooling transformer rating as required. The auxiliary power will be fed from each unit transformer servicing large motors 250 HP and over at 4.16 kV and 480 V for general distribution. The 4.16 kV and 480 V will be radial distribution. A second feeder from an existing 4.16kV transformer will permit alternate service in the event of maintenance turnarounds or equipment outages. However, this transformer will not be able to carry the coal gasification process in addition to the generator auxiliaries.

Auxiliary systems within the plant will be provided through an Uninterruptible Power Supply (UPS) or DC Batteries to support personnel safety and critical equipment during shutdowns or power outages where required.

5.0 SCOPE OF WORK

5.1 General Project Requirements

The objective of this project is to demonstrate IGCC at a large scale for use in commercial electric generating plants. The project is to demonstrate equipment and system operability, performance and reliability, as well as process performance in removing sulfur dioxide and minimizing the formation of oxides of nitrogen. The specific goal of the project is to demonstrate that the air-blown IGCC technology is a cost effective, reliable, more efficient and environmentally superior alternative to conventional coal-fired electric power generation with flue gas desulfurization.

The project is aimed at demonstrating IGCC technology in a plant that is to be integrated into the SPPCo system. SPPCo proposes to design, construct and operate a grass-roots, integrated coal gasification combined-cycle facility at its Tracy Station near Reno, Nevada.

In this application of the process, one KRW gasifier, operating in the air blown mode with in-bed desulfurization and hot gas cleanup technology, will convert approximately 880 tons per day of bituminous coal into a low BTU fuel gas for use in a combustion turbine generator. The exhaust gases from the turbine will generate steam in an HRSG to drive a steam turbine generator. The plant will produce a nominal 100 MWe (net) of total electric power.

5.2 Project Management

The project will be centrally managed by the Project Director of SPPCo. All management, reporting, and project reviews for the project shall be as required by the Cooperative Agreement. The Project Director shall be the official point of contact between SPPCo and DOE for the execution of the Cooperative Agreement. The Project Director shall be responsible for assuring that the project is conducted in accordance with the cost, schedule and technical baseline established in the Project Management Plant (PMP) and subsequent updates.

SPPCo has entered into the management and execution of a contract with FW USA for design and construction of the facility. MWK will be a subcontractor to FW USA for the design of the KRW fluidized bed gasification process.

Implementation details for all tasks shall be provided in a detailed schedule and Work Breakdown Schedule for the overall project presented in the PMP. An outline matrix of planned tests and procedures for the operational phase of the project shall be included to ensure that the basic design and installation philosophy match required operating and testing philosophies. The PMP shall be updated during each budget period of the project to reflect changes to the project baseline.

The Project Team under the direction of the Project Director will be responsible for coordination, monitoring and reporting requirements in accordance with the Cooperative Agreement.

5.3 Engineering and Design

This effort provides process design, equipment identification and selection, integration of the gasifier system with the power plant, and system test planning as required to make certain that adequate design features exist to assure performance and operational success. The engineering and design effort is split into three separate tasks:

5.3.1 Gasifier Island

The areas of the plant addressed under this task include:

Area 200	Oxidant Compression and Supply
Area 300	Coal Gasification
Area 400	Gas Stream Heat Recovery
Area 500	Gas Stream Particulate Removal
Area 600	Desulfurization
Area 900	Recycle Gas Compression

a. Process Design

Work under this task will provide a process specification package with supporting details for the gasification portion of the plant and plans for the integration of MWK's KRW gasification technology with the combined-cycle power plant. This effort will include, but not be limited to:

- Equipment Arrangement/Process Description
- Material and Energy Balances/Process Flow Diagrams
- Start-Up, Shutdown and Normal Operating Conditions
- Operating Philosophy/Test Plans
- Control Philosophy/Test Plans
- Supporting Technical Data/Process Loadsheets
- Special Design Requirements
- Catalyst and Chemical Requirements

b. Preliminary Engineering

Information to be generated under this task will include, but is not limited to, materials of construction, vessel analytical sketches, equipment design specifications, equipment summary sheets, process control diagrams, furnace data, exchanger data, plot plans, planning layout drawings, piping and instrument diagrams, requests for quotation, selection of equipment design and vendors, equipment general arrangement and elevation drawings, requisitions for certain instrumentation and piping items, piping flexibility/support studies of major lines, preliminary instrumentation and electrical runs, instrumentation power requirements, material take-off and requisition of alloy piping, and vendor utility requirements.

c. Detailed Engineering

This task will focus on the production phase of the project including the detailed design work and bulk material requisitions required prior to construction as well as the requisite coordination work during the construction phase for the following areas:

- Piping
- Structural
- Concrete
- Buildings
- Electrical
- Instrumentation
- Insulation

5.3.2 <u>Combined-Cycle</u>

The areas of the plant addressed under this task are:

Area 700	Gas Turbine Generator
Area 800	Steam Turbine Generator and Heat Recovery Steam Generator

This effort will proceed under three tasks mirroring that of the gasification and offsites activity.

a. Process Design

The primary effort involved during this task will be to establish requirements for the interfacing enumerated below:

- Low-Btu Fuel Gas Requirements
- Auxiliary Natural Gas Requirements
- Extraction Air Limitations
- Boiler Feedwater Requirements
- Cooling Water Requirements
- Steam System Integration
- Feedwater and Condensate Integration
- Electrical Power, Generated and Auxiliary, Integration
- Control and Operating Philosophy and Systems
- Facilities Requirements

This task shall include an evaluation of the combustion properties of the low-Btu fuel, establishment of the combustor design requirements, preliminary design of the valving and fuel delivery system, and an analysis of the overall plant control system and operating procedures.

b. Preliminary Engineering

This task shall entail development of all the analytical and design planning work to refine the design details of the combined-cycle plant sections. Selection of vendors for various subcontracted equipment items, notably the heat recovery steam generator, will be made. Other efforts will include final block diagrams, preparation of piping and instrumentation drawings, equipment specifications, plot plans, utility requirements, planning layout drawings, piping flexibility analyses, and instrumentation and electrical drawings.

c. Detailed Engineering

This task will focus on the production phase of the project including detailed design work, bulk material requisitions and procurement for materials. The work will encompass piping drawings with bill of materials, electrical and conduit drawings, building and foundation drawings, instrument drawings, insulation details and all other necessary construction drawings.

5.3.3 Offsites

The areas of plant addressed under this task include:

Area 100	Solids Receiving, Drying and Grinding
Area 1000	Wastewater Treatment
Area 1100	Solid Waste Handling
Area 1200	Balance of Plant

The engineering effort for these areas will proceed in parallel with that of the gasification and combined-cycle efforts.

a. Process Design

Primary emphasis will be centered on establishing requirements for the areas noted above as they interface with the gasification and combined-cycle systems including the following:

- Utility flow diagrams and descriptions, motor list, coal receipt and handling flow diagrams and descriptions, equipment lists, steam and water balances, effluent summaries, preliminary building requirement and site preparation requirements.

b. Preliminary Engineering

This task involves analytical and planning phase work for the offsites areas described above. Aspects of the two include development of the following:

- Plot plan, plant road drawings, utility block flow diagram, utility detailed description, coal receipt and handling detailed descriptions, waste treatment descriptions, piping & instrumentation diagrams, materials of construction, vessel analytical sketches and mechanical drawings, equipment summary sheets, exchanger data, selection of packaged system and equipment vendors, requisitions of some instruments and piping items, electrical one line diagrams, planning layout drawings, instruments and electrical runs, instrument power requirements, material take-offs and requisition of alloy piping.

c. Detailed Engineering

This task will focus on the production phase of the project including detailed design work and bulk material requisitioning needed to start construction, together with the coordination required to be performed during the construction phase. The work includes the following:

- Preparation of piping, structural steel, concrete, electrical, instrumentation, building and insulation drawings, details and requisitions.

5.4 Procurement Services

This task includes the activities required to develop vendor and subcontractor lists, issue inquiries, and select vendors for the equipment and materials. This task is divided into two areas:

a. Procure Vendor Engineering Services

Procure the engineering services from vendor for key equipment items to assist in estimating and design activities. Key equipment items will include, but are not limited to:

- Gas Turbine Generator
- Heat Recovery Steam Generator
- Steam Turbine Generator

b. Inquire and Select Balance of Equipment and Construction Subcontracts

The balance of the equipment and the construction subcontracts will be inquired, the bids will be analyzed, and the vendors/subcontractors selected in preparation for the purchase orders/subcontracts which are placed in Phase II.

5.5 Construction & Start-Up

5.5.1 Construction

This task includes all activities required to construct the plant in concert with the overall project plan. This will ensure that the facility is procured and constructed to specification, on schedule, and within budget. Procurement activities during this task include purchasing, inspection, expediting, traffic and commercial aspects of in-place subcontracting. Included in this effort are home office construction activities such as safety, quality assurance, labor relations, budgeting and scheduling, and field construction management activities including functions such as supervision of equipment installation, erection of materials, field engineering, field accounting, cost, schedule and material control, and subcontract administration. This task will include, but not be limited to:

- Issue purchase orders and subcontracts to the vendors/subcontractors. Work includes expediting, inspecting, and coordinating traffic for the equipment.

- The work effort during this task includes development of a construction execution plan, detailed schedule, qualified bidder's list, site survey, tool and equipment lists, field administration procedures, material control procedures, safety procedures and reports, construction engineering reports, quality assurance plans and procedures, welding engineering reports, scheduling reports and construction progress reports.

- The work effort during this task includes development of the final safety and accident prevention reports, final constructions progress reports, material receiving and exception reports, non-conformance reports and quality control reports.

5.5.2 Infrastructure Requirements

- Identify, evaluate and contract for the most appropriate coal supply source. Develop a program of testing as-received coal.

- Identify, evaluate and contract for the source of limestone. Develop a program for testing as-received sorbent.

- Identify and contract for supplies of makeup water for the project.

- Contract for disposal of sanitary waste.

- Contract for disposal of solid waste materials from the gasification system to an approved landfill site.

- Perform systems studies with Nevada DOT to determine the need for highway upgrading. Identify routing of site access roadways and bridging requirements.

5.5.3 Start-Up

- The objective of this task is to provide the resources for the precommissioning and initial systems operations for the project. Training, maintenance, safety, analysis and reporting procedures will be developed.

  This task is divided into four subtasks:

  - Provide the resources for all required training of operating staff, including development of the detailed operating procedures.

  - Provide the resources required for the pre-commissioning and initial systems checkout of the project. Maintenance and safety procedures will be executed to verify their effectiveness.

  - Provide the resources required for the commissioning and initial integrated operation of the project. Analysis and data acquisition procedures will be implemented. Methodology for reporting total demonstration plant performance results will be established.

  - Perform all plant modifications including minor design revisions necessary to achieve acceptable demonstration plant performance at design specifications.

5.6 Environmental Permitting and Licensing

The activities under this task include completion of all required environmental data collection, finalization of environmental and socioeconomic impact assessments, preparing the Environmental Monitoring Plan (EMP), obtaining required environment-related permits and incorporating health and safety considerations in design and operation. This task includes, but is not limited to, the following activities:

5.6.1 Environmental Studies

Collect and analyze environmental data required to support the regulatory and permitting processes, the EMP requirements and the DOE effort in support of the National Environmental Policy Act (NEPA). Data to be collected include:

- Air Quality and Climatology
- Water Quality
- Terrestrial Ecology
- Geohydrology

- Noise
- Archaeological and Historical Resources
- Land and Water Use
- Socioeconomics
- Other requirements which may be added during the working sessions with federal, state and local agencies

Efforts include the following activities:

- Collect and analyze data on the physical, biological, cultural and socioeconomic environment that is required for permitting
- Collect, analyze and report information for the EMP Outline that describes the existing environment

5.6.2 Environmental Monitoring Plan Requirements

Develop an EMP Outline and an EMP that are acceptable to DOE and provide the reports agreed upon with DOE. These efforts include the following:

- Develop the EMP Outline
- Develop the EMP which will provide detailed descriptions of the tasks set forth in the EMP Outline
- Collect, analyze and report on the required information described in the EMP

5.6.3 Environmental Related Permits

Obtain the required environment-related permits for construction and operation of the project. Required permits include one or more each for discharges into the atmosphere, discharge of wastewater, construction in navigable airspace, earth disturbance, dams and impoundments, sewerage facilities, construction in floodplains, non-community water supply, solid waste disposal, hazardous waste disposal and land use. Activities under this task are scheduled to take place from the award of the cooperative agreement through obtaining operating permits and the permit for the solid waste disposal facility. The following tasks will be performed in the period from detailed design to commercial operation.

- State agency coordination will be a continuation of on-going activities wherein the regulatory agencies are updated on the design and schedule for the project and the project is updated on new and pending regulatory changes. This task supports the tasks that follow.

- A document will be prepared that will describe the regulations that must be met, the information required for the permit applications, and the schedule for application preparation.

- Design guidance will be provided consisting of a series of focused coordination activities wherein specific agreements on design and information details are negotiated with regulatory agencies and are then communicated to designers. The purpose of the design guidance activity is to develop permit applications that are complete and in accordance with acceptable limits as submitted, thus expediting the permitting schedule.

- Permit applications will be prepared with the design, environmental and modeling information required, and with the required approved and supplemental documents (e.g., Erosion and Sedimentation, Control Plans, Endangered Species Survey, and Archaeological Reports for all activities that disturb the earth. Preparedness Prevention and Contingency Plan for the Industrial Waste permit).

- The regulatory agency review and analyses of permit applications will be expedited with prompt responses to agency comments and questions.

- The support necessary for public hearings will be provided that will result in overall favorable support for the project. Support activities include expert witnesses, environmental data and analyses and additional project information. Also included is the preparation of responses to questions and comments resulting from the public hearing and the written comment period.

- Permits and approvals will be obtained required for constructing the project, constructing the off-plot solid waste disposal facility, operating the project through start-up and shakedown, operating the project through the demonstration period, and making and supplying copies for DOE.

5.6.4 Public and Occupational Health and Safety Analyses

Incorporate into the plant design and requirements of (Federal) Occupational Safety and Health Administration (OSHA) regulations, guidelines of the National Institute of Occupational Safety and Health (NIOSH), fire and safety codes, etc., that are applicable to the project. Effort will be applied to ensure that reliable health and safety programs for construction and plant operation phases will be developed. Specific activities to be completed are as follows:

- Incorporate health and safety considerations during design

- Provide training and implementation health and safety procedures for construction and operation

5.7 Start-Up and Operation

This phase covers all the labor, materials and services needed for plant operation for a 42-month period during Phase III of the Piñon Pine Project. The objective is to provide all the operational and management direction that will be necessary to provide the private sector with technical, economic and environmental evaluations on the advanced coal gasification combined-cycle power plants.

5.7.1 Operations

This task involves operating the gasifier system, combined-cycle power plant and associated systems at the required temperature, pressure, and coal and sorbent feed rates to meet the required power output of the facility. Specific data generated during this period of time include the following:

Operation - Plant operational data recorded by instruments and stored in the data acquisition system, daily operational logs, process or equipment anomalies, samples and chemical analysis of process and effluent streams as required, operational schedules and man-hour records.

Plant Modifications - Modifications made to the facility in order to meet the required power output of the facility under various operating conditions.

Maintenance - Routine maintenance records, instrument repair records, compressor records, mechanical and rotating equipment records, pressure vessel certification, maintenance schedules, and man-hours records.

This task is broken into three subtasks:

- Baseline operation of the plant using the design coal feeds.

- SPPCo will obtain sufficient operating data on high sulfur coals to enhance the marketing and licensing of this technology to a broad.based energy sector.

- The plant will be modified based on the experience of extended operations on both high- and low-sulfur coals.

5.7.2 Data Collection and Reporting

The purpose of this task is to collect the process performance data gathered on the 42-month operational phase of the Project and summarize it in a form that will be useful for the technical, economic and environmental evaluation of the advanced coal gasification combined-cycle. Data generated and maintained during this period will include the following:

- Monthly summary of minimum and maximum performance, monthly summary of process performance anomalies, heat and energy balance for selected performance periods, monthly summary of chemical/physical analysis, test plant/schedule for special performance testing, maintenance of instrument configuration drawings, maintenance of piping and instrument diagrams and process flow diagrams, document equipment modifications and equipment list changes.

6.0 TECHNICAL IMPACTS ON SCHEDULE

The Project Schedule has changed since the start of the project to include changes resulting from key project decisions. Phased installation of the combustion turbine, combined-cycle and coal gasification areas has been changed to installation of the total project in one construction cycle. This change came through SPPCo's changing load forecast and the development of a more efficient plant through improvements in available hardware.

SPPCo's load forecast required the installation of two (2) combustion turbines for peaking generation. These units, which became operational July 1994, removed the need for the phased installation of the Piñon Pine Project. By allowing the project's construction to not be hindered by the restraints of unit operation and a stretched construction schedule, installation costs will be reduced.

The development of a new, high firing temperature, combustion turbine by GE and the decision not to employ the steam-use-intensive zinc ferrite sulfur sorbent, resulted in further improvements in cycle efficiency.

These changes eliminated the phased implementation while maintaining December 1996 as the date for operation on coal. The current schedule is supported by the Record of Decision on the EIS in November 1994 and a Permit to Construct in January 1995.

A Summary Bar Chart Project Schedule is included in Appendix 4.

7.0 CONCLUSIONS AND LOOK AHEAD

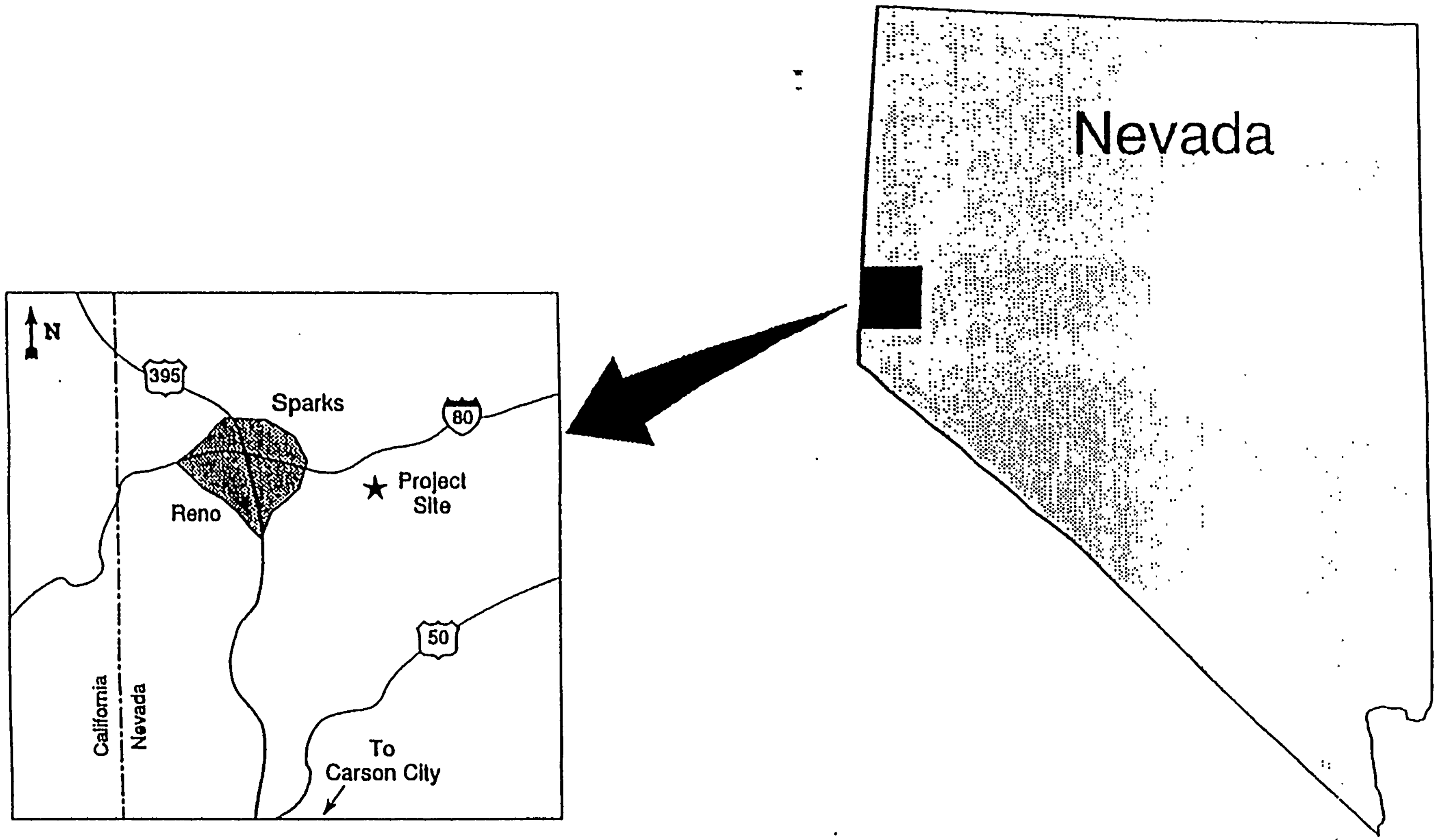
SPPCo has completed the data collection for the PSD Permit and has completed its Utility Environmental Protection Act (UEPA) filing with the State of Nevada. The UEPA application required a favorable Record of Decision on the EIS. The Record of Decision was received in November 1994. The Permit to Construct was issued allowing construction to start in February 1995.

During the first quarter of 1995, Phase II activities will begin including the following major activities:

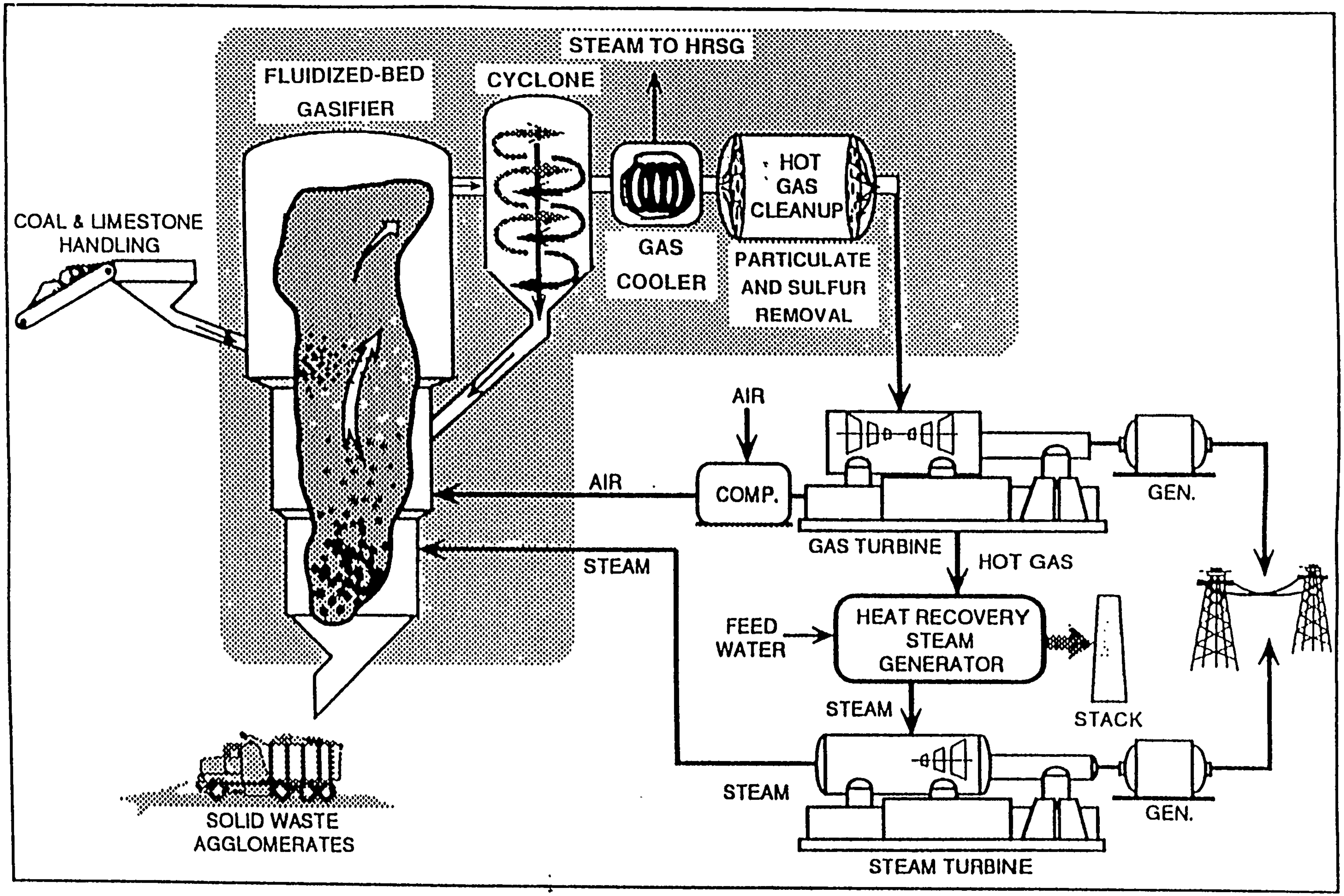
- All major equipment items purchases will be committed including the release of material procurement and fabrication. Vendor design data will be received for review and detailed design use.
- Detailed engineering and design will proceed in the civil, structural and piping areas.
- Process safety reviews will continue; and start-up, operating and shutdown philosophies will be developed.
- Site preparation and mass excavation construction work will begin.
- The foundation and underground construction subcontract inquiry package will be prepared and issued.

8.0 APPENDICES

1. Location of Piñon Pine IGCC Power Project
2. Piñon Pine IGCC Power Project Schematic
3. Definitive Estimate Summary
4. Summary Bar Chart Project Schedule
5. Photographs of existing Tracy facility



Appendix 1. Location of Piñon Pine IGCC Power Project



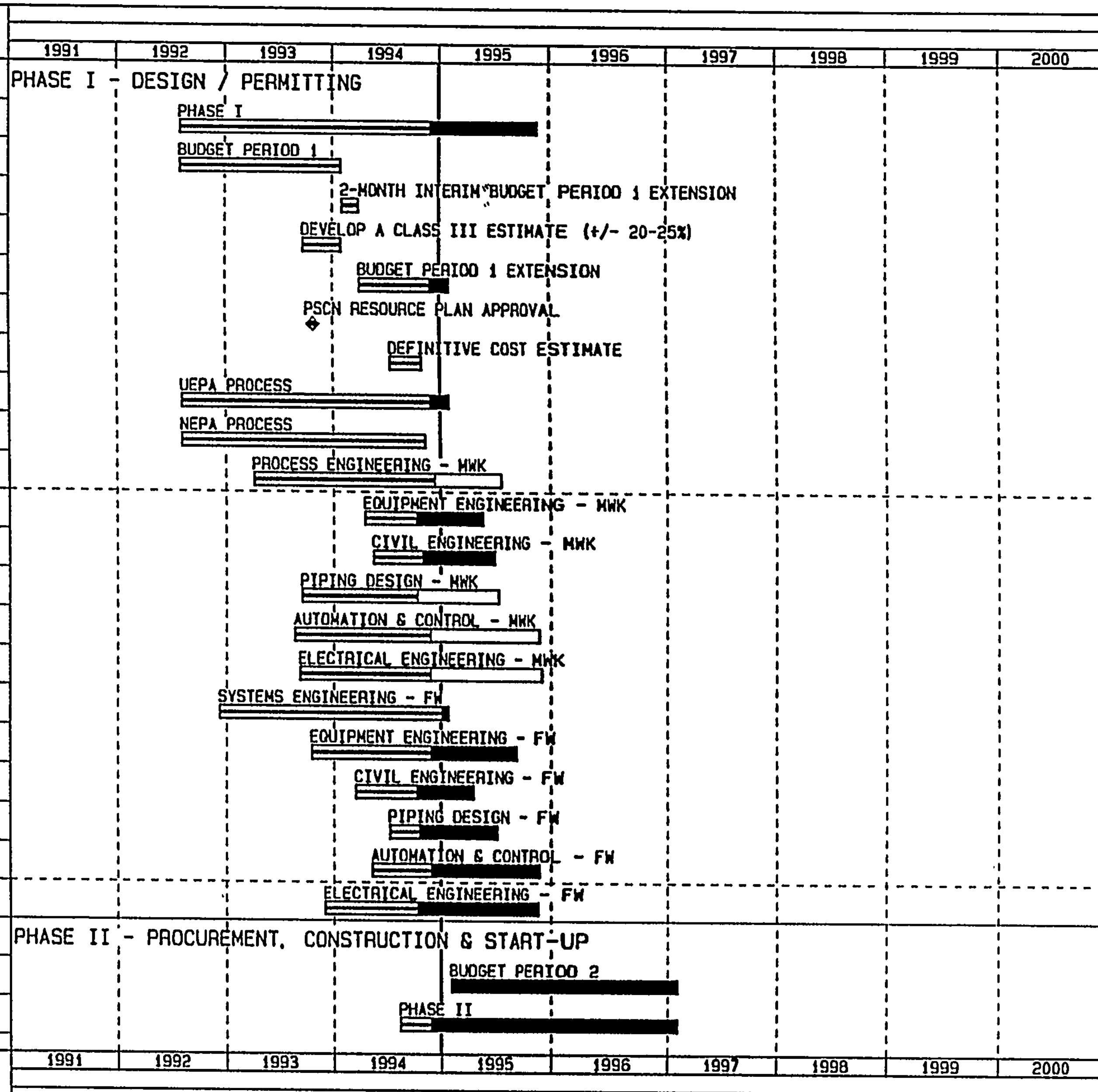
Appendix 2. Piñon Pine IGCC Power Project Schematic

APPENDIX 3
DEFINITIVE ESTIMATE SUMMARY
(Details by WBS)

		Definitive Estimate ($M)
PA-1	Pre-Award	404
1.1	Phase I	
1.1.1	Develop Gasifier Design	11,633
1.1.2	Develop Combined Cycle Design	3,818
1.1.3	Develop Offsites Design	4,357
1.1.4	Environmental & Permitting	2,435
1.1.5	Procurement Services	7,832
1.1.6	Project Coordination & Follow-Up	12,401
	Total Phase I	42,476
1.2	Phase II	
1.2.1	Construct Gasifier	50,464
1.2.2	Construct Combined Cycle	54,930
1.2.3	Construct Offsites	53,440
1.2.4	Secure Infrastructure Requirements	----
1.2.5	Start-Up	7,429
1.2.6	Project Coordination & Follow-Up	13,549
1.2.7	Sales & Use Taxes	5,872
1.2.8	Property Taxes	2,701
	Total Phase II	188,385
1.3	Phase III	
1.3.1	Operation	----
1.3.2	Data Collection & Reporting	----
1.3.3	Administration	----
1.3.4	Disposition	----
1.3.5	Sales & Use Taxes	----
1.3.6	Property Taxes	----
	Total Phase III - To be reviewed in 1996	77,286
	Total Estimated Shared Cost	308,551

APPENDIX 4
SUMMARY BAR CHART
PROJECT SCHEDULE

ACTIVITY ID	EARLY START	EARLY FINISH	ORIG DUR	REM DUR	Activity
					PHASE I - DESIGN / PERMITTING
1001	31JUL92A	29NOV95	783	239	PHASE I
1003	31JUL92A	31JAN94A	411	0	BUDGET PERIOD 1
1004	1FEB94A	31MAR94A	44	0	2-MONTH INTERIM BUDGET PERIOD 1 EXTENSION
1005	20SEP93A	31JAN94A	83	0	DEVELOP A CLASS III ESTIMATE (+/- 20-25%)
1008	1APR94A	31JAN95	218	23	BUDGET PERIOD 1 EXTENSION
2455		25OCT93A	0	0	PSCN RESOURCE PLAN APPROVAL
2480	11JUL94A	28OCT94A	82	0	DEFINITIVE COST ESTIMATE
2488	3AUG92A	30JAN95	651	22	UEPA PROCESS
2700	3AUG92A	8NOV94A	592	0	NEPA PROCESS
3300	5APR93A	24JUL95	463	147	PROCESS ENGINEERING - MWK
3332	15APR94A	23MAY95	288	103	EQUIPMENT ENGINEERING - MWK
3343	13MAY94A	30JUN95	296	131	CIVIL ENGINEERING - MWK
3354	13SEP93A	14JUL95	480	141	PIPING DESIGN - MWK
3372	19AUG93A	30NOV95	596	240	AUTOMATION & CONTROL - MWK
3386	6SEP93A	8DEC95	590	246	ELECTRICAL ENGINEERING - MWK
3400	7DEC92A	26JAN95	559	20	SYSTEMS ENGINEERING - FW
3500	15OCT93A	13SEP95	499	184	EQUIPMENT ENGINEERING - FW
3705	14MAR94A	20APR95	289	80	CIVIL ENGINEERING - FW
3735	6JUL94A	7JUL95	263	136	PIPING DESIGN - FW
3771	9MAY94A	30NOV95	409	240	AUTOMATION & CONTROL - FW
3775	1DEC93A	27NOV95	519	237	ELECTRICAL ENGINEERING - FW
					PHASE II - PROCUREMENT, CONSTRUCTION & START-UP
5000	1FEB95	31JAN97	523	523	BUDGET PERIOD 2
5060	11AUG94A	31JAN97	647	546	PHASE II



Plot Date 31JAN95
Data Date 30DEC94
Project Start 1JUN92
Project Finish 1AUG00

Activity Bar/Early Dates
Critical Activity
Progress Bar
Milestone/Flag Activity

SP12

Sheet 1 of 2

FOSTER WHEELER USA-CONTRACT 15-4140
SIERRA PACIFIC-TRACY 4-PINON PROJECT
SUMMARY BAR CHART

Date	Revision	Checked	Approved

ACTIVITY ID	EARLY START	EARLY FINISH	ORIG DUR	REM DUR	1991–2000
					PHASE II - PROCUREMENT, CONSTRUCTION & START-UP
5100	31JAN95	19MAR96	296	296	PROCUREMENT/RELEASE FOR FABRICATION
7990	31OCT94A	14MAY96	402	353	CONSTRUCTION BID PACKAGES
8004	1FEB95	5MAR96	285	285	SITE PREPARATION/FOUNDATIONS/UNDERGROUND
8071	22MAY95	6JUN96	274	274	STEEL ERECTION
8084	23AUG95	4OCT96	293	293	MECHANICAL CONSTRUCTION
8100	2JAN96	26AUG96	170	170	SET & ERECT GAS TURBINE GENERATOR
8144	21DEC95	15OCT96	214	214	ELECTRICAL/INSTRUMENTATION
8174	1FEB96	10OCT96	181	181	EQUIPMENT & PIPE INSULATION
8204	6FEB96	17OCT96	183	183	EQUIPMENT & PIPE PAINTING
8249	27FEB96	21OCT96	170	170	PRECOMMISSIONING
8250		17OCT96	0	0	CONSTRUCTION MECHANICAL COMPLETION
8275	31OCT96		0	0	READY FOR COMMISSIONING
8280	5NOV96	30DEC96	40	40	COMMISSIONING
8285		17DEC96	0	0	COMPLETION OF CONSTRUCTION
8290	30DEC96	30DEC96	1	1	FIRST SYNGAS OPERATION
					PHASE III - OPERATION & DATA COLLECTION
9000	31JAN97	1AUG00	913	913	BUDGET PERIOD 3
9020	31JAN97	1AUG00	913	913	PHASE III

Plot Date 31JAN95
Data Date 30DEC94
Project Start 1JUN92
Project Finish 1AUG00

(c) Primavera Systems, Inc.

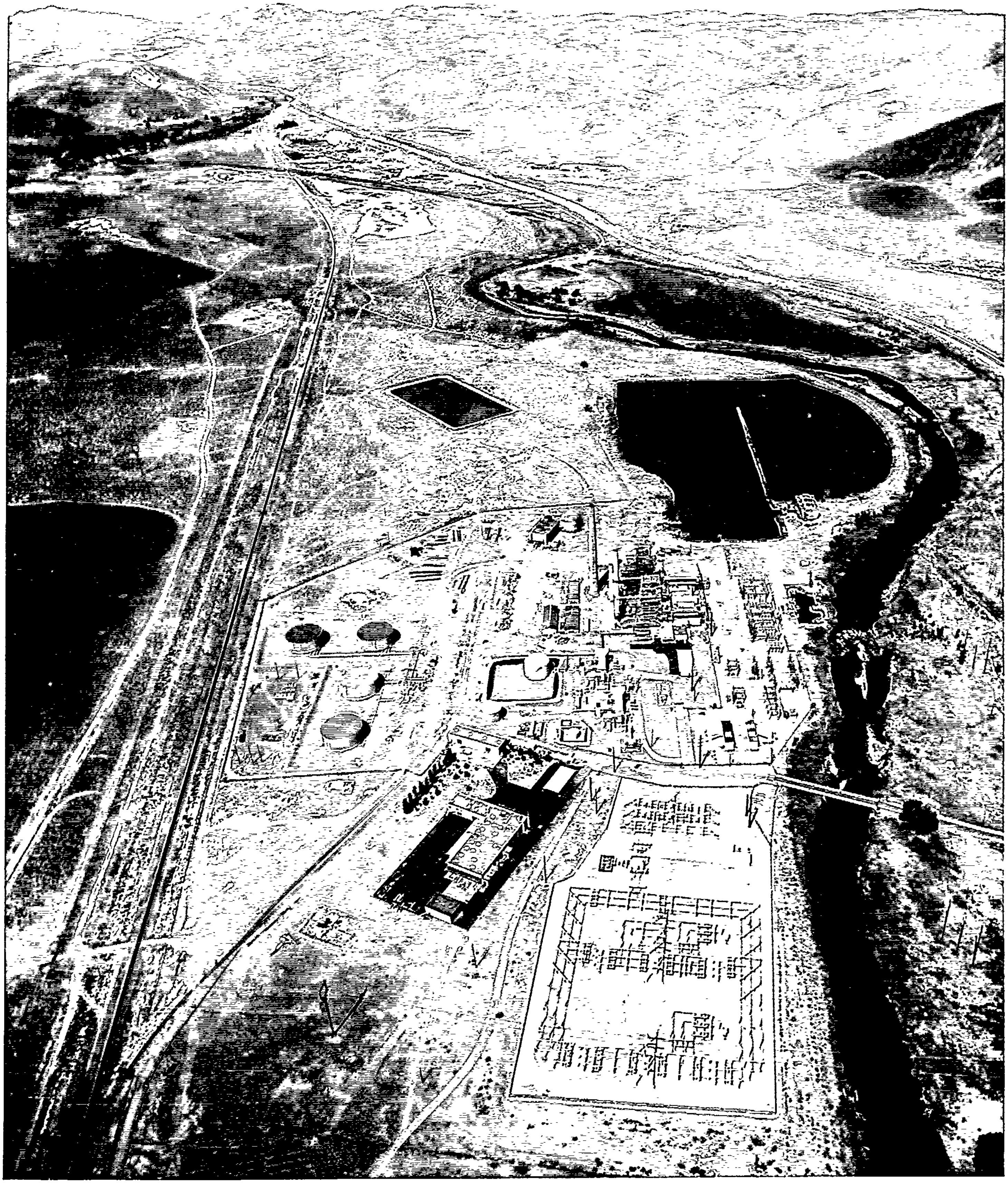
Activity Bar/Early Dates
Critical Activity
Progress Bar
Milestone/Flag Activity

SP12

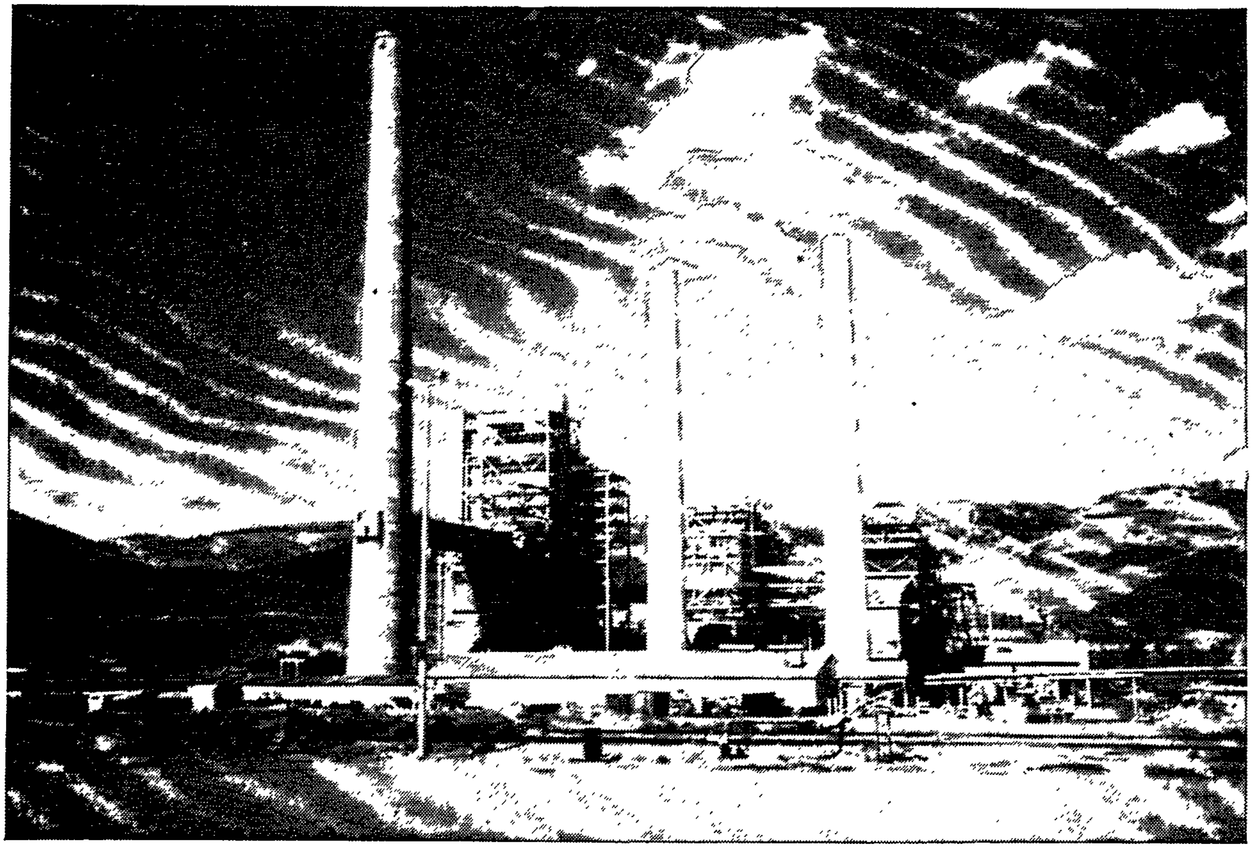
Sheet 2 of 2

FOSTER WHEELER USA-CONTRACT 15-4140
SIERRA PACIFIC-TRACY 4-PINON PROJECT
SUMMARY BAR CHART

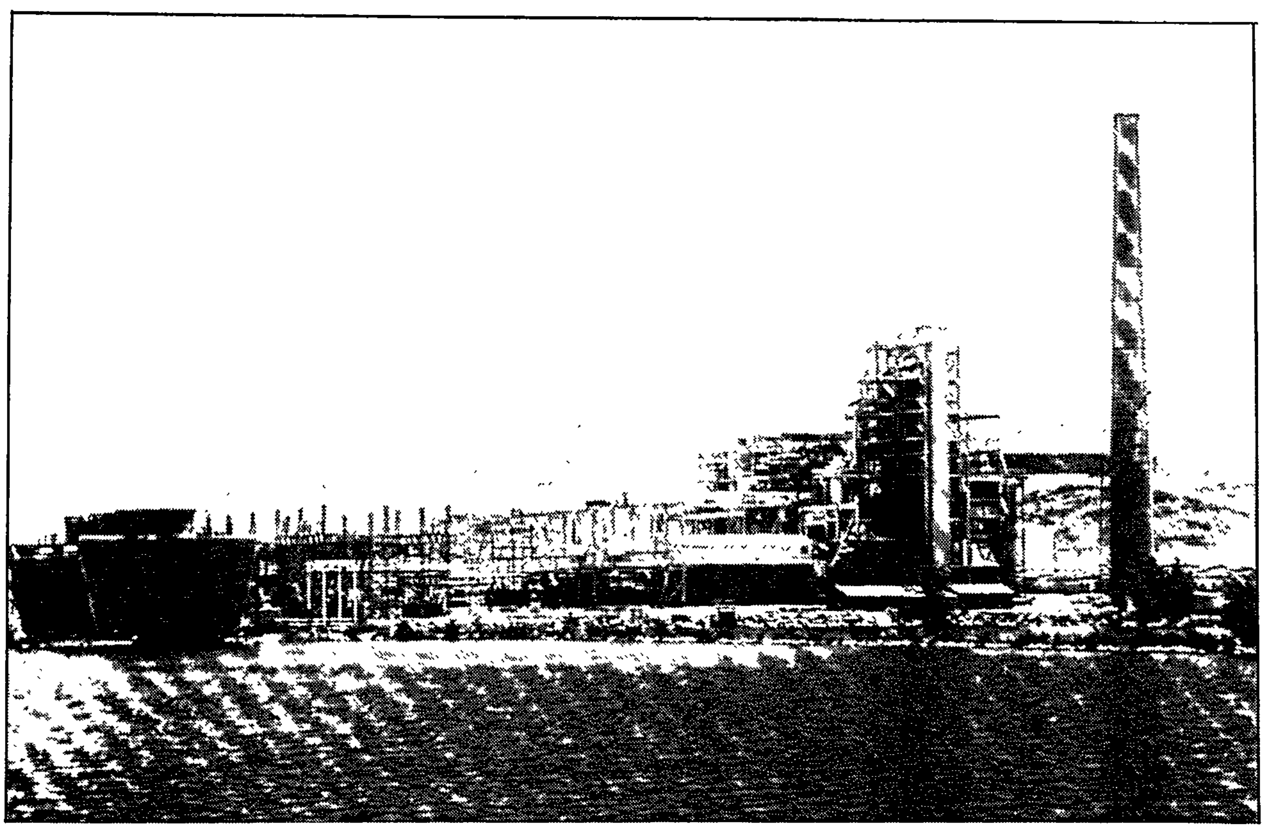
Date	Revision	Checked	Approved



Aerial photograph of Tracy Power Station looking west
with 120/345 kV switchyard in foreground.

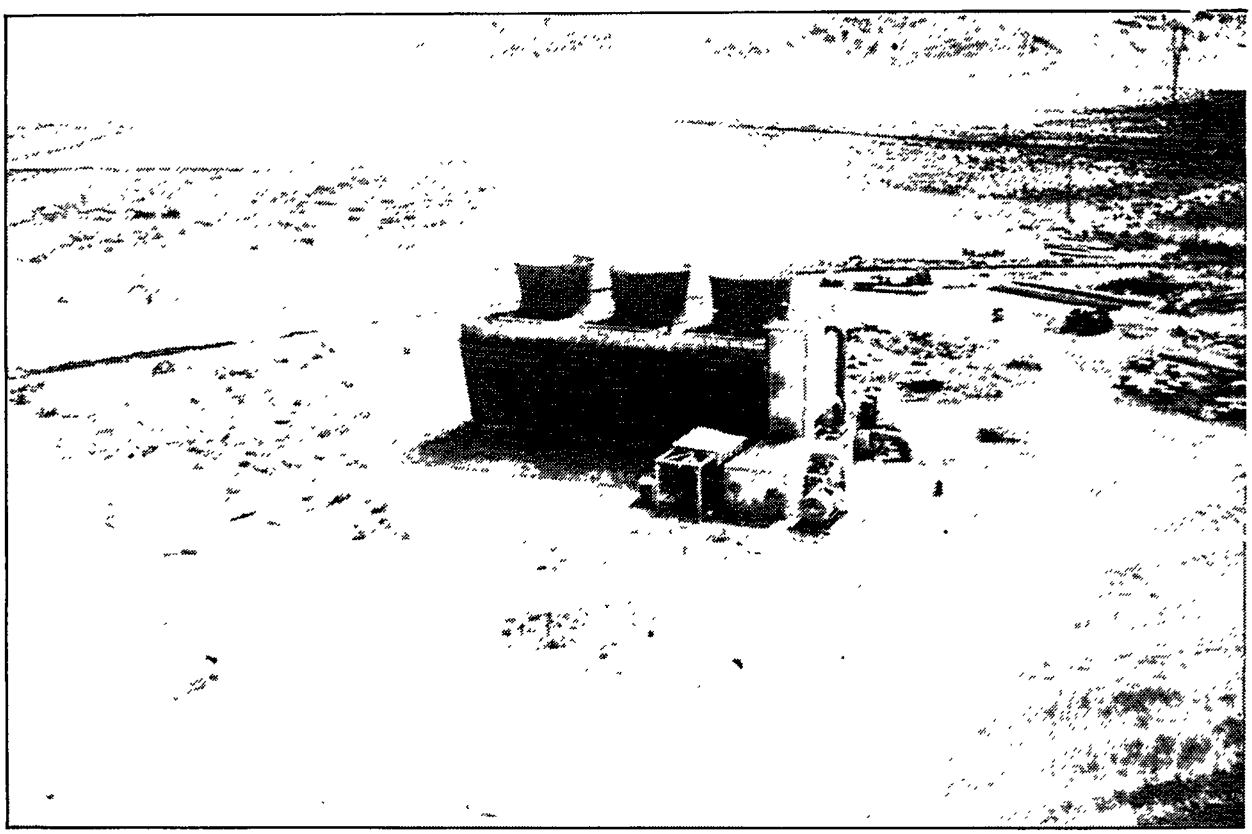


Existing Tracy steam electric generating Units No. 1 through No. 3 (from right-to-left). Photo looking north.

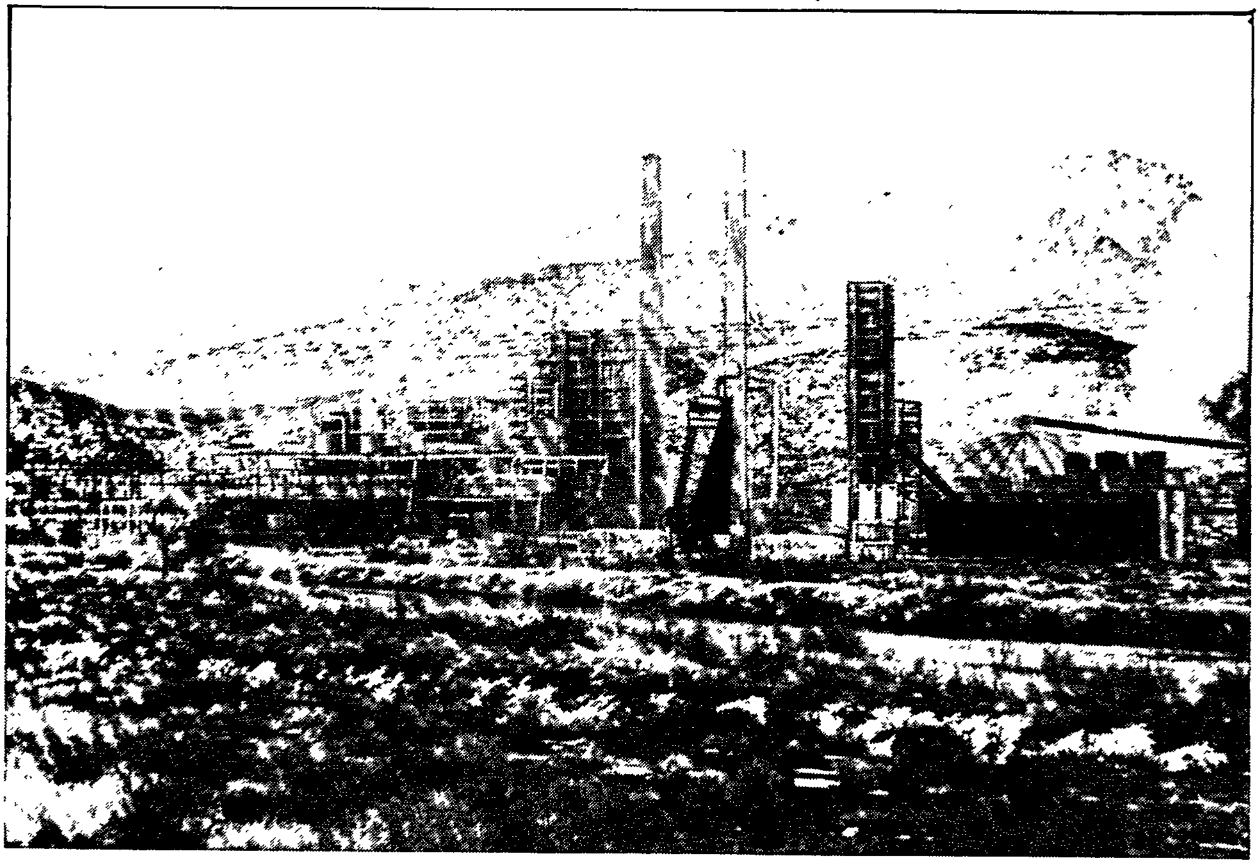


Existing steam electric units. Photo looking southeast across cooling pond for Tracy Units No. 1 and No. 2.

Existing 120 kV switchyard for Units No. 1 (right) through No. 3 (left).
Photo looking north.



Cooling tower for Tracy Unit No. 3.
Photo looking southwest from top of Unit No. 3.



Existing Tracy units (3 units on left) and future Piñon Project (right).
Photo looking southwest.