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Pinon Pine IGCC Project Status Update, August 1992

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Authors:

Motter, J.W.
Pitcher, J.D.
Fankhanel, M.
Campbell, W.

Contractor:

Sierra Pacific Power Company
P.O. Box 10100
Reno, Nevada 89520

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CONTRACT INFORMATION

Contract Number	DE-FC21-92MC29309
Contractor	Sierra Pacific Power Company
Contract Project Manager	John W. Motter
Principal Investigators	John W. Motter [Sierra Pacific] Jon D. Pitcher [Foster Wheeler USA Corp.] Martin Fankhanel [The M.W. Kellogg Comp.] William Campbell [The M.W. Kellogg Comp.]
METC Project Manager	Douglas M. Jewell
Period of Performance	August 1, 1992 to July 31, 2000

FY93 Program Schedule

S O N D J F M A M J J A S

NEPA Activities	-----
State Permitting	-----
Nevada PSCN Approval [Expected]	X
Engineering/Design	-----

OBJECTIVES

Sierra Pacific Power Company (SPPCo.) plans to build an integrated coal gasification combined cycle (IGCC) power plant, burning 800 tons per day of western coal to produce 80 megawatts of electrical power at a high capacity factor. The project was selected by the U.S.

Department of Energy (DOE) for funding under the fourth round of the Clean Coal Technology Program and will be constructed at SPPCo.'s existing Tracy power plant site which is located approximately 20 miles east of Reno, Nevada. The project is named the Piñon Pine Power Project; a Cooperative Agreement for the project was executed

FUTURE WORK

Work in late 1992 and 1993 will be directed towards completion of the

environmental permitting process, design and initial engineering work, and preparation of a definitive cost estimate for the project.

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benefits expected to accrue to our ratepaying customers. The Company has requested approval from our regulators for this important project, and will be requesting fair and appropriate treatment of the expenses incurred.

RESULTS

Since the recent (August, 1992) execution of the Cooperative Agreement, the major focus of work has been on critical-path environmental permitting activities, both related to the NEPA process as well as state and local activities. Pending approval of the project by the Nevada Public Service Commission, detailed engineering activities will commence in November.

Federal funding of the project automatically invokes environmental review under the National Environmental Policy Act (NEPA). This project will require an Environmental Impact Statement, or EIS, with DOE as the lead agency for the NEPA reviews. The project

must also be approved by the Nevada Public Service Commission (PSCN) in the state's Resource Planning process. To date, milestones that have been met include publication of the Notice of Intent in June, Public Scoping Meetings in July of 1992, and the submission of SPPCo.'s Resource Plan to the PSCN, with the project included as part of the Recommended Resource Plan. SPPCo. has also completed an Environmental Information Volume for the project.

As shown in the project schedule, **Figure 4** below, SPPCo. expects to have the combustion turbine portion of the plant on line by late 1994, configured as a simple-cycle natural gas machine with either #2 diesel or propane being utilized as backup fuel. By phasing construction in this manner, SPPCo. gains approximately 45 MWe of peaking power capacity to match projections of customer loads. The gasifier, heat recovery steam generator (HRSG), and the balance of the IGCC plant will be commissioned in late 1996. A DOE demonstration period of 42 months is planned.

Figure 4. Project Schedule

substantially cleaner than today's pulverized-coal plants.

Fuels Considerations. As discussed above, the KRW-IGCC technology has significant fuel flexibility. The Piñon project will be designed to be capable of operation on at least three fuels, including coal, natural gas, and either #2 distillate oil or propane. Other fuels may be considered as potential feedstocks later. The ability to burn a variety of fuels is important for several reasons.

Coal is the most abundant fuel in the United States. Use of this fuel, as well as being economically advantageous, also reduces dependence on foreign oil. Natural gas, at least in SPPCo.'s service area suffers from deliverability constraints (SPPCo. is currently curtailed through much of the winter for power generation applications.) Depletion of the current natural gas "bubble" could result in significant real price increases. Piñon will provide a long-term ability to use the most economic fuel, as well as to provide an alternate fuel in the event of disruptions such as a strike which could interrupt coal deliveries, or during periods when the gasifier island requires maintenance or service.

Project Risks and Risk Mitigation. Any technology has a certain intrinsic level of associated technical risk. The Piñon project is no exception. Utilities by nature generally tend to be risk averse. Cofunding of CCT programs by the DOE is one important way of mitigating financial risk. As SPPCo.'s President and CEO, Mr. William L. Keepers has stated:

"As members of a regulated and highly competitive industry, electric utilities have a very limited ability to finance the

development and demonstration of new technology. New generating technologies' demonstrations require significant first time costs. Given these circumstances, it is appropriate that the Clean Coal Technology Program provides a means for the U.S. consumer to share in the development, demonstration and benefits of this new technology. Our view of the potential for this technology and its highly probable success makes us confident that it will benefit our customers in California and Nevada for many years into the future."

Project risks are mitigated in several ways, including federal cost-sharing, the fact that much of the plant utilized now commercial technology, and the substantial body of research on the developmental portions of the plant. The four areas of the gasification system and hot gas cleanup systems having a moderate level of technical risk are: (1) gasifier and in-bed desulfurization, (2) gas conditioning, filtration and external desulfurization, (3) low Btu gas combustor and controls, and (4) fluidized bed sulfator.

Finally, the technical strength, experience and commitment of both Foster Wheeler USA and The M. W. Kellogg Company as industrial allies in this project were significant factors in decreasing SPPCo.'s risk associated with the construction of a project such as Piñon. Westinghouse, the supplier of the combustion turbine for this project also has extensive experience with coal based IGCC including very low Btu content fuel gas, and, as noted above, has been associated with the KRW technology from its inception.

Also critical to the success of this project is the support of our customers and regulators. Although the project has some risks, SPPCo. believes that they are manageable, and more than offset by the

Need for the power. SPPCo. has experienced strong load growth in recent years. Over the past ten years, system sales have grown at an annual rate of 5%. Load growth between 1992 and 1997, even considering an aggressive program of demand-side measures, is forecast to increase at an average rate of 4%, which will result in a need for 227 MWe of new capacity by the year 2000.

"Least Cost" Basis of Project. SPPCo. has conducted internal "Resource Planning" for decades to assess and best meet its customers needs for electrical power. In 1983 the Nevada Legislature added Resource Planning requirements to Nevada Statutes. The administrative regulations implementing that decision, called Nevada General Order 43 ("G.O. 43") presented a comprehensive set of guidelines for conducting Resource Planning. The intent of G.O. 43 is to ensure that load forecasts were as accurate as possible, that all appropriate demand-side and supply side options were considered, and that the preferred plan recommended by Nevada utilities for meeting their customer loads was developed and implemented in a "least-cost" manner. A "least-cost" plan was one that minimized the present value of revenue requirements, although the utility may also consider other factors such as reliability, financial constraints, fuel mix, environmental factors, etc.

In preparing SPPCo.'s mandatory 3-year Electric Resource Plan submittal which the Company filed on July 1, 1992, Piñon was modeled as one of the possible generation options. A key finding was that under a relatively broad range of economic assumptions, Piñon, in major part due to the DOE support of this demonstration, was selected as part of the "least cost" plan for meeting future

customer needs. Consequently, SPPCo. included Piñon as an integral part of it's latest Resource Plan, and requested approval from the Public Service Commission of Nevada. The Company expects a favorable decision on the project in November of this year, when the Commission issues it's "Opinion and Order" on the Resource Plan submittal.

Environmental Factors. SPPCo. and its management place a high level of importance on protecting and/or improving the environment. The Company recently strengthened that commitment through the adoption of the "Company's Statement on Commitment to the Environment", approved by our Board of Directors. This document contains policy and action elements directing the company to make decisions that seek to integrate engineering, economics, and the environment in all of its decision processes. A major directive from the Company's top management was that, for the Piñon project to proceed, it not only comply with, but be a major contributor to SPPCo.'s goal to demonstrate excellence in environmental execution of all aspects of its business.

Nevada has recently modified its Resource Planning regulations to quantify and consider the value of so-called "environmental externalities"--adders to the present value of revenue requirements designed to capture all of the social or external costs from emissions, and economic benefits from employment, taxes, etc.

A fundamental issue associated with the decision to propose construction of any coal-burning powerplant, even a "clean coal technology" project is just how "clean" is the power? Piñon will have emissions among the lowest for any coal-fired powerplant, and will be

and air. This process sends the regenerator gas stream to the sulfator where the sulfur oxides react with lime and air to form calcium sulfate, which exits the system along with the coal ash

in a form suitable for landfill, or potentially to be used as a commercial byproduct.

Figure 3. Process Flow Diagram

In the power island, the clean coal gas will be delivered to a Westinghouse CW251 B12 combustion turbine, which is coupled to an electric generator designed to produce approximately 56 MWe (gross). Special turbine first stage blades will accommodate the extra mass flow produced by the low-Btu gas (as low as 90-95 Btu per standard cubic foot). The heat recovery steam generator (HRSG) receives high pressure steam from the gasifier island slightly above saturation, and uses the exhaust gas from the combustion turbine to superheat the steam as well as to generate additional high pressure steam. The steam is heated to 900° F. and 900 psig for expansion in a non-reheat steam turbine to produce approximately 30 MWe (gross). High pressure boiler feed water is circulated to

the sulfator and the gasifier's product gas cooler. Steam at 400 psia is used in the gasifier island for the gasification reactions, gas quenching, and sorbent regeneration and is generated in the HRSG and/or by extraction from the steam turbine. Steam is also produced at 50 psia for various auxiliary plant purposes.

Rationale for CCT Participation

A number of factors persuaded Sierra Pacific Power Company to participate in this clean coal technology demonstration project. The effect of the combination of these factors was compelling, leading to SPPCo.'s participation in the CCT program with the Piñon project.

fuel and operations & maintenance expenses during the 42 month demonstration phase.

SPPCo will contract with Foster Wheeler USA Corporation (FWUSA) for the engineering, procurement and construction of the project. FWUSA in turn will subcontract with The M.W. Kellogg Company for engineering and other services related to the gasifier island. Figure 2 depicts the project organization.

Figure 2. Project Organization

PROJECT DESCRIPTION

Technical Overview of Process

Raw coal will be received at the plant in weekly unit trains consisting of 100-ton automated bottom dumping railcars. Once unloaded, coal will be stored and transported within enclosures to minimize dust emissions. The coal is received and stored as 2" x 0 and is then transferred to a preparation area where it is crushed, dried, sized and passed to a

day-bin for feeding the gasifier island. Sized limestone and dried coke breeze (for startup) are received by covered truck and are also stored in silos close to the gasifier island.

The two major components of the plant are the gasification island and the power island. Figure 3 is a block diagram of the processes to be employed in the Piñon project.

In the gasification island, crushed and sized coal and limestone are metered through lockhoppers and fed pneumatically through a central feed tube in the bottom of the gasifier. The temperature of the bed is controlled by metering the air and steam into the gasifier's central jet. The coal/limestone bed is maintained in a fluidized state in the gasifier via gas recirculation. Partial combustion of char (devolatilized coal) and gas occurs within the bed to provide the heat necessary for the endothermic reactions of devolatilization, gasification, calcination, and desulfurization. Ash and spent limestone are removed from the bottom of the bed.

Coal gas leaving the gasifier passes through a cyclone to remove the majority of the particulate matter that is returned to the fluidized bed. The gas leaving the gasifier is cooled to about 1050° F. before entering the hot gas cleanup section. Ceramic candle filters remove essentially all the remaining particulate material prior to the clean gas entering the sulfur sorbent bed. In the desulfurizing reactors, nearly all the remaining sulfur compounds are removed in a fixed bed of zinc ferrite sorbent. Zinc titanate is currently being tested in cooperation with DOE-METC and The M. W. Kellogg Company, and may be used in place of the zinc ferrite. The zinc ferrite (or titanate) is subsequently regenerated with steam

dioxide and/or nitrogen oxides from existing facilities and/or (2) providing for future energy needs in an environmentally acceptable manner.

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Experience with the KRW technology dates back to 1972 when the government first funded design of a process development plant at Westinghouse Electric Corporation's Waltz Mill facility near Madison, PA. This pilot unit demonstrated successful operation of the air-blown fluidized bed gasification process on a wide variety of coals, and included testing of in-bed desulfurization, and operation with ceramic candle filters and external hot gas desulfurization.

Sierra Pacific Power Company (SPPCo.) submitted a proposal in May 1991 in response to the CCT-IV PON requesting 50% co-funding of the Piñon Pine Power Project. SPPCo.'s proposal was for the design, engineering, construction, and operation of a nominal 800 ton-per-day (86 MWe gross), air-blown integrated gasification combined cycle (IGCC) project to be constructed at SPPCo.'s existing Tracy Station, a 244 MW, gas/oil-fired power generation facility located on a rural 400-acre plot about 20 miles east of Reno (see **Figure 1**). SPPCo. will own and operate the demonstration plant, which will provide power to the electric grid to meet its customer needs.

Figure 1. Location of Proposed Project

Of the 33 proposals submitted to DOE under CCT-IV, 9 proposals, including Piñon were selected for award. Following several months of negotiations, and Congressional Review of the proposed project, a Cooperative Agreement was executed. The project, including the

demonstration phase, is scheduled to take 96 months at a total cost of \$269,993,100. SPPCo. and DOE will share equally in project costs, in the amount of \$134,996,550 each. Of this approximately \$135 million, SPPCo. is projecting a capital cost of roughly \$92 million, with the remaining \$43 million being used for

August 1, 1992 and will provide for approximately \$135 million of funding from the government--50% of the expected total project costs for construction and 42 months of O&M and fuel cost sharing during the demonstration period.

SPPCo.'s objective in the Piñon Pine Power Project is to use the advanced technologies to produce a clean and low-cost power supply to meet our growing customer needs. Additional goals of the project are to demonstrate air-blown, pressurized fluidized-bed IGCC technology incorporating hot gas cleanup; to evaluate a low-Btu gas combustion turbine; and to assess long-term reliability, maintainability, and environmental performance at a scale sufficient to demonstrate further commercial potential.

The Piñon Pine IGCC is similar to, and improves upon, first generation IGCC technology in several aspects. The Piñon Pine Project integrates a number of technologies fostered by the DOE. Among these are the KRW Energy Systems fluidized bed, ash-agglomerating coal gasifier, with in-bed desulfurization using limestone sorbent, and zinc ferrite (or zinc titanate) sulfur removal from a hot fuel gas stream. SPPCo. believes the project's pressurized, air-blown fluidized-bed gasification technology with hot-gas cleanup may provide an attractive alternative for new electric generating plants for several reasons:

- Air-blown gasification offers several potential advantages over commercially available oxygen-blown systems:
 - lower capital cost by eliminating the need for an oxygen plant
 - higher plant efficiency and lower capital costs by eliminating oxygen plant power consumption; and

- inherent control of nitrogen oxide emissions (NOx) which may eliminate the need for a two-stage combustor or selective catalytic reduction (SCR)

- Hot gas cleanup is an attractive alternative to "cold" or "wet" chemical cleanup and offers several potential advantages:

- hot gas sorbents can operate dry, thus eliminating the need for wastewater treatment; and,
- the dry cleanup processes are generally more familiar to the utility industry than wet chemical systems.

- Components of the simplified IGCC are modular and fewer, thus providing better economy at small plant sizes.

The demonstration of the advanced IGCC technology will 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 measure actual performance of a complete power generation system on a utility grid. The modular concept of the proposed technology will provide information directly applicable to other commercial plants, since such plants will essentially incorporate one or more replicates of the demonstration project plant configuration.

BACKGROUND INFORMATION

Public Law 101-121 provided \$600 million to conduct a fourth round of federally cost-shared Clean Coal Technology (CCT) projects to demonstrate technologies capable of replacing, retrofitting or repowering existing facilities. These technologies were to be capable of (1) achieving significant reduction in the emissions of sulfur

**DATE
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