SAN/RA 50239-SDG&E-0011

HEBER GEOTHERMAL BINARY DEMONSTRATION PROJECT

QUARTERLY TECHNICAL PROGRESS REPORT FOR THE PERIOD APRIL 1, 1982 – JUNE 30, 1982

San Diego Gas & Electric
Post Office Box 1831
San Diego, California 92112

Prepared for
The Department of Energy
Under Cooperative Agreement No. DE-FC03-80RA50239

DISCLAIMER

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This report was prepared as an account of work performed by San Diego Gas & Electric; sponsored by the Electric Power Research Institute, the Imperial Irrigation District, the California Department of Water Resources, and the Southern California Edison Company, hereinafter called Sponsors; and supported by the U. S. Department of Energy, an agency of the United States Government. Neither San Diego Gas & Electric, nor the Sponsors, nor the United States Government nor any agency thereof, nor any of their employees or subcontractors, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise, does not necessarily constitute or imply its endorsement or recommendation by San Diego Gas & Electric, or the Sponsors, or the United Stated Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of San Diego Gas & Electric, or the Sponsors, or the United States Government or any agency thereof.

ABSTRACT

The purpose of this quarterly technical progress report is to document work completed on the nominal 65 Megawatt (Mwe gross) Heber Geothermal Binary Demonstration Project, located at Heber, California, during the period of April 1, 1982, through June 30, 1982. The work was performed by San Diego Gas & Electric Company under the support and cooperation of the U. S. Department of Energy, the Electric Power Research Institute, the Imperial Irrigation District, the California Department of Water Resources, and the Southern California Edison Company. Topics covered in this quarterly report include progress made in the areas of Wells and Fluid Production and Injection Systems, Power Plant Design and Construction, Power Plant Demonstration, and Data Acquisition and Dissemination.

TABLE OF CONTENTS

SUMMARY

Recognizing the desirability of demonstrating the operation of the binary cycle process for commercial-scale electric production, San Diego Gas & Electric (SDG&E), the United States Department of Energy (DOE), the Electric Power Research Institute (EPRI), the California Department of Water Resources (DWR), the Imperial Irrigation District (IID), and the Southern California Edison Company (SCE) joined together to carry out the Heber Geothermal Binary Demonstration Project.

The purpose of the Heber Binary Project is to design, construct, and operate a nominal 65 MWe (gross) commercial-scale, binary cycle power plant to demonstrate the technical and economic feasibility of geothermal power generation. The Project will be the first commercial-scale hydrothermal generating facility in the United States utilizing liquid-dominated resources and the binary energy conversion process. It is expected that information developed by this demonstration project will be applicable to a wide range of moderate-temperature, low-salinity hydrothermal reservoirs. Geothermal generation from the Project offers the possibility of displacing 525,000 barrels of oil per year that would otherwise have to be burned in Southern California. Figure 1 shows an artist's rendering of the Project and Figure 2 shows the location.

This report describes the Project's progress for the period of April 1, 1982, through June 30, 1982.

Agreement was reached on the geothermal sales contract between SDG&E and Union Oil. A contract between the two parties has been signed and the SDG&E Board of Directors approved a resolution authorizing execution of the contract on April 27. Approval of the contract by DOE and CPUC is currently being sought.

The environmental monitoring program (New River temperature and Heber groundwater level) has been discontinued. The program will resume once the Project begins discharging wastewater to the New River.

SDG&E's Process/Mechanical Engineering group completed their review and issued comments on 79 technical documents. Other work was directed towards reducing capital costs by reducing equipment and material requirements.

A study released by the SDG&E System Planning Department indicated that the starting of Heber's large motors and/or tripping the main generator at full load (with a post trip load of 10 Mw) will not adversely impact the IID system.

A DOE/SAN procurement review team has indicated that the use of OMB Circular A-110, Attachment O, will be recommended for use in the Cooperative Agreement. This will eliminate the need for DOE pre-award review and consent of procurement contracts.

The construction manager, Dravo Utility Constructors, Inc. (DUCI), and SDG&E negotiated an amendment to the DUCI contract, which incorporated the points raised by the Defense Contract Audit Agency (DCAA). SDG&E submitted a consent package to DOE on April 16, 1982.

On June 30, 1982, California Governor Brown signed the state government's 1982-1983 budget bill, effective July 1, 1982. Included in the Department of Water Resources budget is the Heber Binary Project's $2 million appropriation.

INTRODUCTION

The scope of the Heber Binary Project is to design, construct, and operate a commercial-size, binary cycle geothermal power plant at the Heber reservoir for a two-year demonstration period. The goal of the Project is to demonstrate the technical and economic feasibility, as well as the environmental acceptability, of geothermal power generation using the binary process. Our work plan for the Project consists of four major tasks, or Work Breakdown Structure (WBS) elements (see Figure 3), that are described below:

WBS 1.1 - WELLS AND FLUID PRODUCTION AND INJECTION SYSTEMS

Primary responsibility for this task has been assigned to the heat supplier. The task consists of well drilling, the construction of surface facilities for geothermal fluid production and injection, including the brine return pipeline, and operation of the field facilities to support plant operation.

WBS 1.2 - POWER PLANT DESIGN AND CONSTRUCTION

This task consists of the work by SDG&E, the architect/engineer, and the construction manager to manage the design, procurement, construction, and start-up of the power plant systems and the associated switchyard and distribution system. The task includes obtaining necessary permits, associated monitoring, design, procurement, construction, start-up, and project management activities.

WBS 1.3 - POWER PLANT DEMONSTRATION

This task consists of the work by SDG&E to operate the power plant for a two-year period to achieve the basic objectives of the Project. The task includes services, repairs, facilities, overhaul, cleaning, consumables, testing, spare parts, and the tools necessary to operate the plant in a safe and reliable manner.

WBS 1.4 - DATA ACQUISITION AND DISSEMINATION

This task consists of the work by SDG&E in gathering, reducing, evaluating, and reporting on reservoir and plant performance data.

The WBS will serve several functions. It divides the work into discrete and manageable work packages which, taken in the aggregate, will constitute Project implementation. To some extent, it will dictate organizational lines, and will be an important management tool. It provides a method of accounting for all work that must be performed, and is the basis for manpower loading and scheduling. In addition, it will be used for cost and schedule control and progress audit.

The following describes each subtask objective and status to date.

WBS 1.1
WELLS AND FLUID PRODUCTION AND INJECTION SYSTEMS

WBS 1.1.1 - DESIGN AND CONSTRUCTION

OBJECTIVE:

This WBS element will be performed and funded entirely by the heat supplier. It will include work to design, build, and test production and injection systems necessary to deliver fluid from the reservoir to the power plant and, after use, return the fluid into the reservoir.

STATUS:

Final SDG&E review was completed on the geothermal sales contract, and it was signed by Union Oil on April 14. Visits were made to EPRI on April 19 and the California Department of Water Resources on April 21 to go over the revised economic analysis and to ask for their approval. A meeting was also held with DOE on April 22 to review the entire contract; subsequently final copies were sent to DOE on April 23 to commence the consent process.

The SDG&E Board of Directors approved a resolution authorizing execution of the geothermal sales contract on April 27; it was signed on April 29. The Sponsors' Management Committee unanimously approved the contract on April 30.

In May, Chevron Resources Company formed a new subsidiary, Chevron Geothermal Company of California, to participate in the reservoir development for the Project. Chevron Geothermal Company of California agreed on May 19 to abide by the substance of the terms of the geothermal sales contract between Union Oil and SDG&E. It is expected that Chevron Geothermal Company will be the operator for the geothermal field for the Project.

There was a lot of activity during June directed toward the objectives of obtaining DOE and CPUC approval of the geothermal sales contract. SDG&E representatives met with Chevron in San Francisco on June 1 to go through the contract and the economic analysis. Following the meeting, Chevron provided the Project with a letter, dated June 15, in which they stated that Chevron will assume its proportionate share of the obligations imposed by the geothermal sales contract. It is the Project's understanding that Chevron's share is 67.2%.

On June 4, SDG&E met with Union and DOE in Los Angeles to discuss DOE's concerns about the geothermal sales contract. On June 7, SDG&E met with Union in Los Angeles and drafted an amendment to the contract addressing Chevron's participation and DOE's concerns. Another negotiating session was held in San Diego on June 10.

At the quarter's end, negotiations were continuing on the final wording for the amendment to the contract. Jim Nugent of SDG&E will meet with Union the afternoon of July 6 to complete the amendment. When it is signed by Gary Cotton (SDG&E Vice President of Engineering) and Dr. Otte (of Union Oil), the consent package can be submitted to DOE.

The CPUC requested in May that SDG&E seek approval of the geothermal sales contract by means of filing an application rather than by means of filing an advice letter. This will delay CPUC approval somewhat. The Project's best estimate of time required to process such an application ranges from two to five months, depending on the need for hearings and length of staff review. CPUC staff has indicated that exparte treatment might be possible if the City of San Diego does not desire hearings.

SDG&E plans to work with Chevron in July to make adjustments to the contract language so that it can be signed with Chevron. The CPUC application should also be filed in July.

SDG&E's Forecasting and Analysis Department completed revised runs for the price analysis with the elements of the price adjustment factor estimated consistent with escalation indices used to calculate SDG&E's avoided cost. The avoided cost estimates are expected on July 6.

WBS 1.2
POWER PLANT DESIGN AND CONSTRUCTION

WBS 1.2.1 - ENVIRONMENTAL STUDIES AND PERMITS

OBJECTIVE:

The objective of this WBS element is to obtain the necessary permits and to provide environmental studies and monitoring to facilitate plant design and ensure compliance with government regulations for plant construction and operation.

STATUS:

Following discussions with the construction manager, it was determined that a National Pollutant Discharge Elimination System (NPDES) permit will be required for construction activity wastewater discharges to the New River. SDG&E's Licensing & Environmental Department met with the State Water Resources Control Board (SWRCB) on June 9, 1982, to review the permit requirements for surface water discharge. An application for an NPDES permit is expected to be filed in July 1982 pending the receipt of additional engineering data. Discharges of hydro-test waters during construction will not require permits.

On June 18, 1981, SDG&E met with the staff of the Imperial County Air Pollution Control District (APCD) to discuss hydrocarbon emissions from the valves and joints of the binary fluid system of the Project. After the discussion, the APCD Staff agreed that the expected hydrocarbon emissions would in fact be less than 250 pounds per day, and therefore offsets would not be needed. The APCD now expects to issue an Authority to Construct permit in early August 1982.

Temperature monitoring continued at the New River. Temperature monitors containing data for March and April were removed and sent to the consultant for data reduction. At the same time, new monitors were installed each month. Monitoring continued through May 14, 1982, at which time it was determined that adequate data had been obtained to file for an NPDES permit. The monitoring program will be required to resume once the Project begins discharging wastewater to the New River.

Groundwater level monitoring continued at the Heber site through May 14, 1982. Discussions with Fluor indicated that no further monitoring would be required and the program has been discontinued. A report was issued by SDG&E's Licensing & Environmental Department presenting the results of the program.

WBS 1.2.2 - POWER PLANT ENGINEERING, DESIGN, AND PROCUREMENT

OBJECTIVE:

The objective of this WBS element is to prepare engineering and design specifications and to procure major equipment to build a nominal 65 Mw (gross) electrical geothermal power plant. Special studies also will be accomplished whenever required.

STATUS:

PROCESS/MECHANICAL ENGINEERING

Several changes in system criteria and requirements were implemented. These were based upon review, analysis, and evaluation of the process, engineering development of performance, control, and operation of the power cycle. Several modifications were needed in the cycle's systems in order to meet these new requirements.

Hydrocarbon System

The main hydrocarbon line sizes were reduced as part of an effort to reduce capital costs. Process data sheets for hydrocarbon control valves were updated to reflect the revised power cycle control scheme and startup procedures. Process data sheets for the hydrocarbon booster pumps were updated to reflect the change from three 33-1/3% pumps to four 25% pumps and the changes in line sizes.

Based on a check of latest hydrocarbon equipment and piping sizes and layout, it was found that the hydrocarbon storage tank size can be reduced from 9,600 barrels gross capacity to 8,100 barrels gross capacity.

A review of the vacuum pump requirements was conducted. As a result, Fluor revised the vacuum requirements from 1 psia to 10 psia, which reduced the size of the vacuum pumps considerably (from about 225 hp to about 60 hp).

Brine System

Meetings were held on June 17 and 29 between Fluor and Chevron to review the status of the brine system design. Items requiring further investigation include brine supply design pressure, brine return pump scheme, and brine system warmup. Resolution is expected by the end of July.

The brine/hydrocarbon heat exchanger proposals have been partially evaluated. The evaluation is being delayed pending resolution of specifying a higher design pressure for the tube side (channels) of the heat exchangers.

Brine gas breakout pressure curves were developed for various non-condensible gas compositions and issued to SDG&E by Fluor on April 29, 1982.

Cooling Water and Service Water Systems

The main cooling line sizes were reviewed from the standpoint of reducing capital costs. It was found that these lines can be reduced in size primarily because line lengths and number of fittings were less than estimated in previous calculations. Process data sheets for the main cooling water pumps were updated in early June to reflect revised line sizes and the latest cooling tower head requirement. The head requirement is based on a crossflow type tower and is lower than previously estimated.

Service water requirements were reviewed taking into account updated vendor data for the turbine generator, hydrocarbon booster pumps, hydrocarbon condensate pumps, brine return pumps, and air compressors. Service water usage was found to be approximately 50% lower than previously estimated primarily because of much lower flows for pump bearing cooling. This reduction has led to the elimination of one service water circulation pump and one service water cooler pump, to a reduction in the size of each service water cooler, and to a reduction in the main service water header sizes.

Based on the findings of a supplementary geotechnical report by Ertec Western, Fluor has decided, with SDG&E's concurrence, to lower the cooling water ponds elevation in order to supply canal water by gravity flow. This will enable Fluor to eliminate two canal pumps and to gain a small amount of net savings in construction costs. No impact in engineering cost and schedule is expected.

Chemical Injection System

The chemical injection system (alum and polyelectrolyte portion) was changed from a dry to a liquid injection system. At the same time inhibitor treatment for the service water system was added. This action negated the proposal that came in on the original chemical injection inquiry and will require rebidding.

ELECTRICAL AND I&C ENGINEERING

The SDG&E System Planning Department presented a draft report this quarter to Fluor, IID, and SDG&E engineers on the impact that the Project will have on the Imperial Irrigation District system transient stability. An analysis studied the impact of starting large motors and tripping the main generator at full output power. Results indicated that tripping the generator at full load with a post trip load of 10 Mw will not adversely impact the IID system. Starting the proposed 4000 HP booster pumps will not impair IID system voltages, but the number of starts per day should be limited.

SDG&E's Electrical Generation Engineering Section assumed an engineering/ coordinating role for design of a temporary electrical distribution system to supply 480 volt construction power and building loads from IID's 12 kV lines. The construction drawings and specifications for the temporary electrical system will be issued to DUCI for incorporation into the site development contract.

A study was initiated on the technical feasibility and economics of replacing most of the medium voltage (4160V) circuit breakers with fused motor starting contactors.

Comments were issued on the SDG&E Transmission Planning Section's draft report on computer stability studies of the Heber unit's impact on IID's systems. A meeting to discuss results of this report with IID will be scheduled once the report is finalized.

A preliminary schedule issued by IID indicated that transmission line upgrading work could begin this summer and would take about a year to complete. However, initiation of this work will probably be postponed until the construction agreement between IID and SDG&E is signed in January 1983. This postponement should not have any negative impact on overall schedule.

CIVIL/STRUCTURAL ENGINEERING

A contract has been drafted between SDG&E and the Heber Public Utility District (HPUD) for the construction of water and sewer lines to the plant site to provide a source of potable water. The contractual arrangements for such construction are much more complex than HPUD originally thought, and more work is necessary on this matter. HPUD forwarded a contract covering installation of a 4-inch water line and a 6-inch sanitary sewer line to serve the plant. They asked for a $30,000 deposit to cover engineering fees, etc. The contract limits the Project's utilization to non-industrial use; this may not be satisfactory. SDG&E has asked that Fluor forward detailed engineering data inventorying the proposed use for potable water.

All architectural drawings and specifications for the main building and for the shop and storage building have been submitted to SDG&E for review. Most of the SDG&E comments have been incorporated by Fluor, except that the specification for the shop and storage building is being revised to a supply, engineered, and installed structure. This work will be finalized by July 15, 1982.

EQUIPMENT SPECIFICATIONS AND DRAWINGS

A review was completed of the following technical documents and letters were issued to Fluor containing combined multi-discipline and DUCI comments and recommendations. Mechanical, electrical, and civil/ structural features, overall design, materials, and operational performance requirements were checked for conformance with the intended use.

1. Service Water Cooler Specification
2. Gas Chlorination System Specification
3. Single Line Metering and Relaying Drawing
4. Site Grounding Grid System Drawing
5. Main Building Grid System Drawing
6. Standard Grounding Details Drawing
7. Hydraulic Model of the Intate Structure for the Main Cooling Pumps Specification
8. Furnishing Structural Steel and Miscellaneous Metal Specification
9. Guard Shelter Specification
10. Finish Hardware Specification
11. Bridge Crane and Hoist Specification
12. Schematic Landscape Plan
13. Reinforced Concrete Standard Details
14. Main Building Foundation Plan
15. Main Building Sections & Details
16. Main Building Architectural Plans and Evaluations
17. Shop Building Reflected Ceiling Plan
18. Main Building Masonry Wall Details
19. General Notes
20. Main Building Door and Window Sections
21. Typical Handrail and Stair Details
22. Main Building Roof Framing Plan
23. Access Floor Specification
24. Caulking Specification
25. Roll-Up Doors Specification
26. Resilient Flooring Specification
27. Gypsum Drywall Specification
28. Erection of Metal Decking Specifications
29. Furnishing Metal Decking Specification
30. Building Insulation Specification
31. Cooling Water Pump Pit Drawing
32. Metal Shower Compartment Specification
33. Ceramic Tile Specification
34. Built-Up Roof and Insulation Specification
35. Suspended Ceiling System Specification
36. Aluminum Doors, Windows, and Frames Specification
37. Sheet Metal Specification
38. Metal Lockers Specification
39. Prefabricated Shop Building
40. Heating, Ventilating, and Air Conditioning Specification
41. Building Plumbing and Piping Specification
42. Piping Material Purchase Specifications for Valves, Pipes, Fittings, and Flanges
43. Welding Shop and Field Fabricated Piping Specification
44. Metalic Expansion Joints Specification
45. General Piping Field Pressure Test Specification
46. Hydrocarbon Unloading and Recovery Compressor Specification
47. Main Building HVAC Plan
48. Shop Building HVAC Plan
49. Main and Shop Buildings HVAC Details
50. Main and Shop Buildings HVAC Equipment Schedules
51. Main and Shop Buildings Plumbing Plans
52. Main and Shop Buildings Plumbing Diagrams

53. Main and Shop Buildings Plumbing Details
54. Piping Fabrication and Erection Specification
55. Painting Specification
56. Pipe Support Elements Specification
57. Moisture Vapor Barrier Specification
58. Landscaping Design Criteria
59. Metal Doors and Frames Specification
60. Carpentry and Architectural Woodwork Specification
61. Main Cooling Water Piping Engineering & Fabrication Specification
62. Site Fencing Drawing
63. Plot Plant Drawing
64. Brine and Wastewater Disposal System P&ID
65. Plant and Instrument Air System P&ID
66. Diesel Generator System P&ID
67. Fire Protection System P&ID
68. Hydrocarbon Filter Coalescer Specification
69. Electrical Installation Specification for Plant Buildings
70. Erection of Structural Steel Specification
71. Installation of Main Cooling Water Piping Specification
72. General Arrangement Drawing
73. Site Lighting Layout Drawing
74. Standard Lighting Details Drawings
75. Main and Shop Building Lighting Layout Drawings
76. Main and Shop Building Reception and Phone Layout Drawings
77. Main Cooling Water Piping Sections and Details
78. Underground Utilities Drawing
79. Intake Water and Blowdown System Piping, Structures, and Details Drawing

AVAILABILITY/RELIABILITY ENGINEERING

Amendment No. 4 to the Pickard, Lowe & Garrick contract was prepared to meet requirements of DOE's consent letter of March 24. It, plus answers to the other points raised in the consent letter, were submitted to DOE/SAN on April 16.

PL&G issued a series of reports on the maintainability and reliability of the major process equipment based on user and vendor data services. The final two reports, entitled "Unavailability Distributions for Principal Pumps" and "Unavailability Distributions for Principal Valves," were issued during this quarter.

A major revision to the plant availability assessment was issued entitled "Plant Design Availability Assessment." It documents the availability impact of the elimination of the spares of the major process pumps and the operation of the plant at 50% brine flow.

PROCUREMENT

San Diego received consent from DOE to its contract with Elliott for the purchase of the turbine generator, subject to certain conditions. SDG&E's Major Project Buying section has reviewed those conditions and has indicated it has no substantive problems with the suggested changes.

Amendment No. 1 resolved difficulties in patent clauses, and was submitted to DOE in mid-April. DOE issued a consent letter on April 30, subject to certain conditions. To satisfy those conditions, Amendment No. 2 was drafted in June, executed in July, and sent to Elliot for their execution.

Currently, the procurement of an alternate generator, which is already built but was not delivered because of a cancellation, is being investigated. The proposed generator appears to meet the specifications and would result in a significant savings.

A draft letter was prepared and submitted to DOE regarding Fluor's authority to act as San Diego's representative for the administration of the Elliott contract. Input from Project Management has necessitated changing this letter before transmission to Elliott. The amended letter will also be resubmitted to DOE. In addition, the letter will serve as an exemplar for all future equipment contracts.

In April, a DOE/SAN procurement review team spent 2½ days reviewing SDG&E's procurement policies and procedures. The representatives indicated they would recommend the Cooperative Agreement be modified to use OMB Circular A-110, Attachment O, criteria for SDG&E's procurement system, and eliminate the requirement for DOE pre-award review and consent of procurement contracts. Upon confirmation by DOE/SAN, the Cooperative Agreement will be modified accordingly.

The standard equipment contract has received final modifications to comply with DOE patent requirements as revealed to San Diego in conjunction with the DUCI contract. Fluor has submitted the revised standard equipment contract to the bidders of all open procurement items.

A contract for the purchase of the main power transformer from McGraw-Edison was received from Fluor. SDG&E review of the contract was completed, and a consent package was transmitted to DOE. Problems with wording of the patent clauses will require amendment of the contract before receipt of DOE consent.

A review was initiated on the bid evaluation/recommendation from Fluor for the segregated phase bus system.

GENERAL

A safety analysis will be performed prior to the start of construction. The analysis will be a review and comment report on the safety of the design. It will focus on those features of the plant (systems and equipment) that may pose a safety hazard, and make recommendations to further enhance the safety of the plant. Requests for quotation were mailed to potential consultants in early June; bids are due in July.

SDG&E reviewed Fluor's Quality Assurance Manual and recommended its approval.

Development of two models by Fluor for the Project neared completion. One model shows the entire plant area in a small scale, and the other is a larger scale model showing piping in more detail. Multi-discipline reviews by Fluor and SDG&E personnel are tentatively scheduled every two weeks to identify and document potential problems for Fluor resolution.

WBS 1.2.3 - POWER PLANT CONSTRUCTION

OBJECTIVE:

The objective of this WBS element for Phase I is to provide construction input to the architect/engineer during the design of the power plant to allow construction in an orderly, cost-effective manner. In Phase II, efforts will focus on actual construction of the geothermal binary power plant.

STATUS:

DUCI and SDG&E negotiated an amendment to the DUCI contract, which incorporated the points raised by the DCAA. SDG&E submitted a consent package to DOE on April 16, 1982.

DUCI representatives have provided input for the preparation of the standard construction contract, which includes general specification requirements plus controls DUCI has found effective on previous jobs. The standard construction contract, with amendments, received SDG&E review and approval in May and is ready for execution. A copy of the document has been transmitted to Fluor to commence construction procurement for the cooling tower.

The DUCI Quality Assurance Program was reviewed by SDG&E, and the program was revised to incorporate SDG&E suggestions. A cost estimate to implement the program was submitted to SDG&E in May.

Work has continued on developing a Construction Project Procedures Manual (Project Guide) as part of the Construction Management Plan effort. These procedures were issued to SDG&E for approval on May 11, 1982.

The Work Breakdown Structure and Code of Accounts were revised to incorporate Fluor revisions to equipment lists and to add subaccounts for site development contract package.

Plans were revised for temporary construction facilities required at the job site, including: laydown areas; DUCI, SDG&E, and contractor's areas; construction personnel parking areas; temporary fencing; and construction power.

On June 2, 1982, DUCI submitted their proposed security plan for SDG&E's review and approval. A meeting between DUCI, SDG&E Security, and SDG&E Electric Production was held June 23, to discuss the proposed plan. DUCI will revise their plan and will resubmit for approval by SDG&E Security.

Vendor Surveillance will be added to the DUCI scope of work. An evaluation of DUCI's proposed costs for their vendor surveillance program is currently underway.

DUCI has broken down the plant construction into the following packages:

1. Site Development
2. Civil/Structural
3. Mechanical
4. Electrical
5. Paving
6. Landscaping
7. Painting
8. Cooling Tower
9. Hydrocarbon Storage Tank

The first construction package, Site Development, will be split into two phases to facilitate the adherence to construction start dates. The first phase will consist of all the rough grading and major earthwork, including the underground drainage system. The second phase will include the temporary construction facilities, plant fencing and guard house, all underground piping and wiring, and the erection of the shop and main buildings. DUCI completed a bidder's list for both phases of the Site Development construction package and sent inquiries to each of the bidders on their interest in the job.

The Paving, Landscaping, and Painting packages are specifically broken out to facilitate award of part of the construction to small and disadvantaged contractors. The Cooling Tower and Hydrocarbon Storage Tank are separate construction packages since they will be erected by the equipment supplier.

DUCI issued the latest revision of their Project Master Control Network, which indicated the schedule of the major activities in each of the nine construction packages.

WBS 1.2.4 - POWER PLANT START-UP

OBJECTIVE:

The objective of this WBS element is to start-up, check-out, and test the completed power plant. These efforts shall include the necessary personnel training and the correction of equipment or system problem areas identified during plant start-up.

STATUS:

DUCI's Start-up Supervisor met with SDG&E start-up personnel to further develop an integrated start-up procedure for SDG&E, DUCI, and contractors.

WBS 1.2.5 - PROJECT MANAGEMENT

OBJECTIVE:

The objective of this WBS element is to provide Project management by establishing interfaces and control between SDG&E, the heat supplier, the architect/engineer, the construction manager, other subcontractors, and the Sponsors; defining schedules and reporting progress based on actual accomplishments; finalizing procedures for management, engineering, start-up and design, construction cost and scheduling, accounting, procurement, and reporting; providing cost control by combining estimating, recording, reporting, analyzing, forecasting, and trending of cost data; monitoring work package budget estimates and reporting progress; negotiating and administering Project agreements and contracts; coordinating legal, public information, geothermal heat supply, and procurement activities; and preparing, reviewing, and publishing information regarding the technical status, cost, and schedules of the Project.

STATUS:

DOE FUNDING AND COOPERATIVE AGREEMENT

Modification A005 to the Cooperative Agreement between DOE and SDG&E to obligate DOE for their share of costs during the extended Phase I effort was executed by both parties in May 1982. Specifically included was funding for the construction management effort, increased funding for the availability enhancement effort, contractual coverage for SDG&E's effort on data acquisition, and provision for initiation of major equipment procurement in Phase I. Also included in the Modification was a revised Subcontracting Plan.

The Project submitted to DOE, for pre-award audit, the Fluor Incremental Estimate for Phase I. This estimate will cover engineering costs for Fluor from the end of June through August 31, 1982 (end of Phase I). A consent package on the Fluor contract change is being prepared by SDG&E's Major Project Buying section.

STATE FUNDING

On June 30, 1982, Governor Brown signed the state government's 1982-1983 budget bill, Assembly Bill 21, effective July 1, 1982. Included in the Department of Water Resources budget ($42 million) is the Heber Binary Project's $2 million appropriation. This appropriation has to be expended by June 30, 1983.

DEFINITIVE ESTIMATE

1. During the negotiations between SDG&E and DOE for the Cooperative Agreement, the Project was divided into two phases. Phase I covers all activities from September 1, 1982, to the end of the Project. A

Definitive Estimate of the Phase II costs was completed and submitted to DOE in June 1982.

The Definitive Estimate was a six-month combined effort by SDG&E, Fluor (Architect-Engineer), and Dravo (Construction Manager). The estimate details the cost of engineering, procurement of major equipment, construction of the plant, project management, start-up of the plant, and demonstration of the plant. It also includes the cost of geothermal fluid produced by the heat supplier and, in accordance with CPUC Decision 91271 on the Project, assumes a credit for the value of energy produced during the plant demonstration period.

The Definitive Estimate summarizes the estimated cost by Work Breakdown Structure (WBS) as listed below:

WBS 1.2.1	Environmental Studies and Permits
WBS 1.2.2	Engineering, Design, and Procurement
WBS 1.2.3	Power Plant Construction
WBS 1.2.4	Power Plant Start-up
WBS 1.2.5	Project Management
WBS 1.3.1	Demonstration, Operation, and Maintenance
WBS 1.4.1	Data Collection System
WBS 1.4.2	Data Acquisition, Analysis, and Dissemination

The Definitive Estimate also contains cost plans, which project the estimated costs by federal (DOE) fiscal year. These plans categorize the costs both by element (material, direct labor, labor overheads, travel, consultant/subcontractor, other expense, and general and administrative expense) and by WBS. Also included is a Travel Plan (cost), a Manpower Plan by WBS, and a Subcontracting Plan.

2. The following breakdown compares the December 1979 proposal with the projected total Project costs based on actual expenditures (through June 1982) and the Definitive Estimate:

	x(000)$ Dec 1979 Proposal	Definitive Estimate
• Wells & Fluid Production & Injection Systems (Heat Supplier)	-0-	(Not Included) -0-
• Power Plant Design & Construction	$ 84,181	$106,182
• Power Plant Demonstration	38,610	44,243[1]
• Data Acquisition & Dissemination	5,657[2]	368
TOTAL	$128,448	$150,793

[1] Includes a conservative energy credit of $45,549,400 based on SDG&E's current projection of marginal energy costs assuming the mix of fuels that result from the current resource plan. No capacity credit is included.

[2] To be funded 100% by DOE.

The Definitive Estimate projects a potential increase of sharable Project costs (ignoring costs which were to be paid by DOE 100%) of $28,002,000. SDG&E's plan for eliminating this shortfall is discussed in part 3., which follows.

A number of factors have caused the Power Plant Design & Construction costs to increase. A delay in the Project schedule of 12 months caused an increase due to escalation of approximately $7,000,000. The as-designed heat exchangers and condensers are significantly more complex than originally planned, resulting in an increase in the cost of this equipment of approximately $19,000,000. These increases were reduced to some extent by an aggressive cost cutting effort. Project cost trends, which are being recorded, indicate there is a strong possibility the actual costs for Power Plant Design & Construction will be significantly less than estimated. Evaluated bid costs for equipment are averaging well below the estimated amounts.

The costs of the Power Plant Demonstration have increased largely because the brine costs are higher than originally projected. This is due, in part, to escalation during the Project delay of 12 months. Another reason for the higher brine costs is the termination provision in the Heat Sales Contract, which has no payment requirement. In addition, the start-up, checkout, and demonstration period has been extended from 24 months to 39 months. Finally, the phased reservoir development required by the heat supplier sharply reduces plant output for the first 18 months of the Demonstration Period and, consequently, reduces the amount of energy credit.

The cost of the Data Acquisition and Dissemination effort has been reduced due to a cutback in the scope of work.

3. The following table compares the Project cost sharing arrangements at the time of the CPUC decision on the Project (January 29, 1980) and current cost sharing, based on the original estimate.

	Cost Sharing x(10^6)$			
Participant	(%)	CPUC Authorization	(%)	Projected
DOE	50.0[1]	$ 67.1[2]	50.0[1]	$ 67.4[2]
SDG&E	31.0	37.6	31.3	38.2
EPRI	7.0	8.4	10.0	12.2
IID	6.0	7.2	3.8	4.6
SCE	3.0	3.6	2.0	2.5
DWR	1.0	2.0	1.2	1.5
State of Calif.	-0-	-0-	1.7	2.0
Others	2.0	2.5	-0-	-0-
TOTAL	100.0	$128.4	100.0	$128.4

[1] Plus DOE 100% Funded Amounts
[2] Includes 100% DOE Funded Amounts

SDG&E intends to take the following steps to eliminate the shortfall in Project funding:

a. Continue aggressive cost cutting and cost control effort.

b. Reevaluate the value of the energy credit prior to the start of the Demonstration Period in light of the current alternate fuel costs and resource plan.

c. Seek additional sources of outside funding.

d. Request the other Project Participants to increase their funding obligation.

e. If necessary, provide justification to the CPUC for increased SDG&E R&D funding.

LINE CONSTRUCTION AGREEMENT

The use or sale of power from the Heber power plant requires that it be transmitted over IID's 34.5 kv line between the Valley and Calexico Substations. Technical studies have indicated that the line must be upgraded for it to be capable of carrying the loads from the plant.

This construction agreement will provide for IID performing the line upgrade and billing the Project, through SDG&E as Project Manager, for the costs of the upgrade. The participants in the Project will receive credits on transmission charges from IID in return for the expenditures to upgrade the line. These principles come from the Heber Participation Agreement. The principles for handling the transmission charge credits are laid out in this construction agreement. The exact method of handling these credits will be dealt with in the transmission service agreements the participants will establish with IID. The first draft of this agreement is being reviewed and is scheduled for execution in January 1983.

PLANT CONNECTION AGREEMENT

This connection agreement will provide for the physical arrangements for connecting the plant to IID's system, how the power flows will be metered, and what SDG&E's and IID's obligations are in terms of scheduling, receiving, and dispatching power production from the plant. The first draft of this agreement will be reviewed upon the completion of the review of the line construction agreement. It also is scheduled for execution in January 1983.

GENERAL

The Sponsors' Technical and Management Committee meetings were held on April 29 and 30, respectively. Discussions centered around the heat sales agreement and the definitive estimate. Other items, such as the technical status and SCE participation in the Project, were also discussed.

The Heber Binary Project Manager and SDG&E's Governmental Affairs provided a status report to Energy Commissioner Karen Edson and elected officials of Imperial County in a meeting on May 14 in Imperial, California.

A presentation on the Project status and major technical studies was made at the Sixth EPRI Geothermal Conference in Salt Lake City, Utah.

WBS 1.3
POWER PLANT DEMONSTRATION

WBS 1.3.1 - DEMONSTRATION, OPERATION, AND MAINTENANCE

OBJECTIVE:

The objective of this WBS element is to demonstrate reliable and economic geothermal power generation.

STATUS:

Work has begun on specifying the standard hand tools that will be necessary for each maintenance person at Heber. When complete, the lists will be sent to the Project Supervisor for approval.

SDG&E's Electric Production Department requested and will receive a complete set of operating and maintenance instructions from EG&G's Raft River Geothermal Project. These instructions will be used as a guide toward the preparation of the instructions for Heber.

WBS 1.4
DATA ACQUISITION AND DISSEMINATION

WBS 1.4.2 - DATA ACQUISITION, ANALYSIS, AND DISSEMINATION

OBJECTIVE:

The overall objective of the data management effort is to acquire, store, evaluate, and report Project data to the energy generation industry and to their parties interested in liquid-dominated geothermal power plant performance. The intended result is to stimulate commercial development of hydrothermal resources in the United States.

STATUS:

A preliminary design review meeting on the leakage detection system was held in April with representatives from DOE, Fluor, and Battelle/Pacific Northwest Laboratories. The status of the leakage detection system design was discussed, as well as the status of the corrosion monitoring instrumentation.

The system description and flow diagram for the proposed Battelle leak detection system was reviewed by SDG&E and Fluor personnel in June. Comments will be returned to Battelle so that detailed design of the system can begin.

The problem of procurement of the equipment for the corrosion monitoring program was resolved with DOE in May. DOE will fund the design, procurement, and operational testing of one of each type of the leak detection systems. The remaining systems will be purchased by SDG&E using the Battelle drawings and specifications for the original systems. The remainder of the equipment will be procured under a contract with the commercial arm of Battelle, which is currently developing similar equipment under DOE sponsorship.

Testing of coupons of AL 29-4 and AL 29-4c was begun at the DOE test facility at East Mesa in June. The tests will be monitored by Battelle and will be completed in July in time for the heat exchanger and condenser award.

FIGURE 1

HEBER BINARY PROJECT
ARTIST'S RENDERING

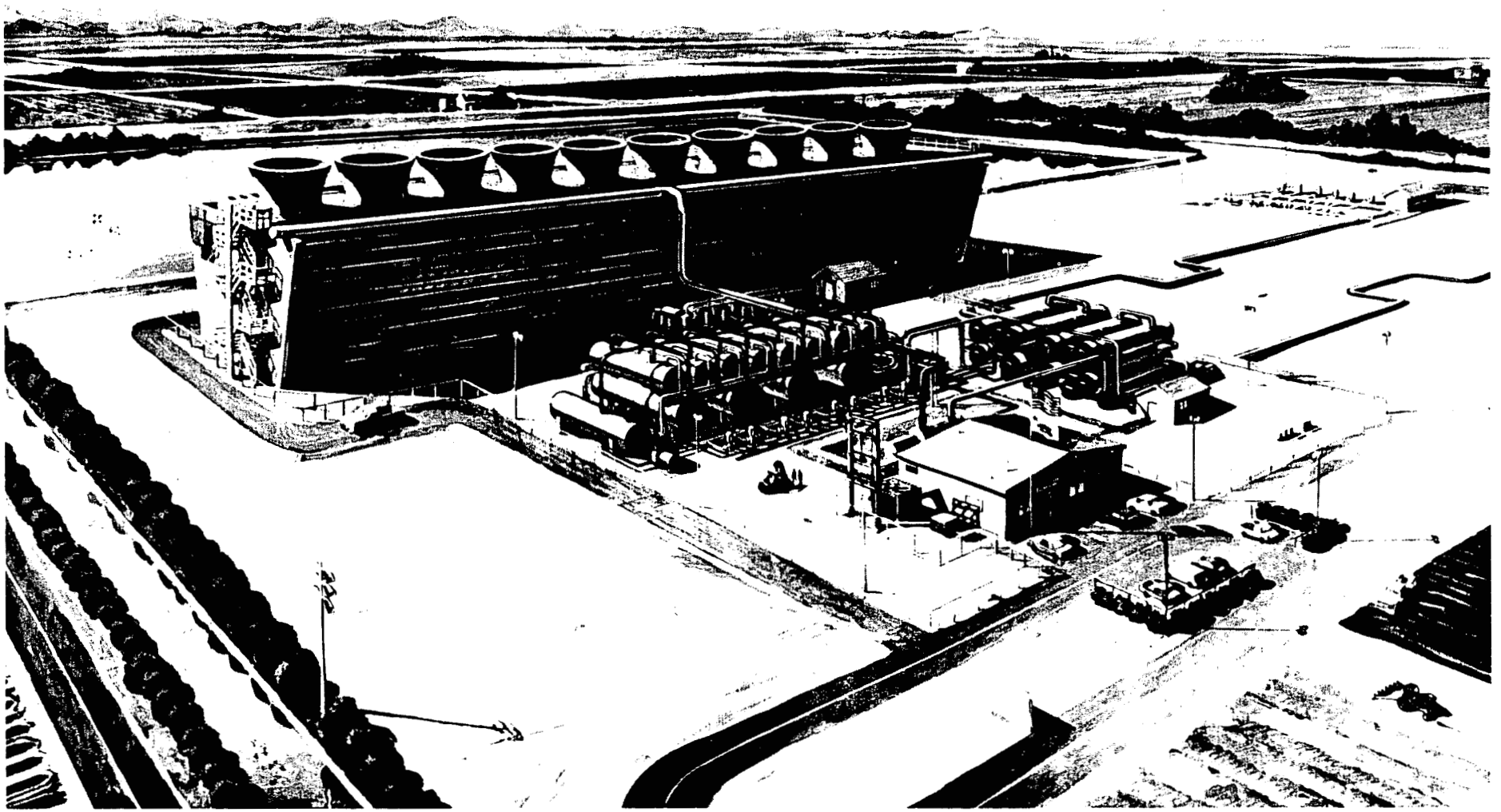

FIGURE 2
HEBER BINARY PROJECT
PLANT LOCATION

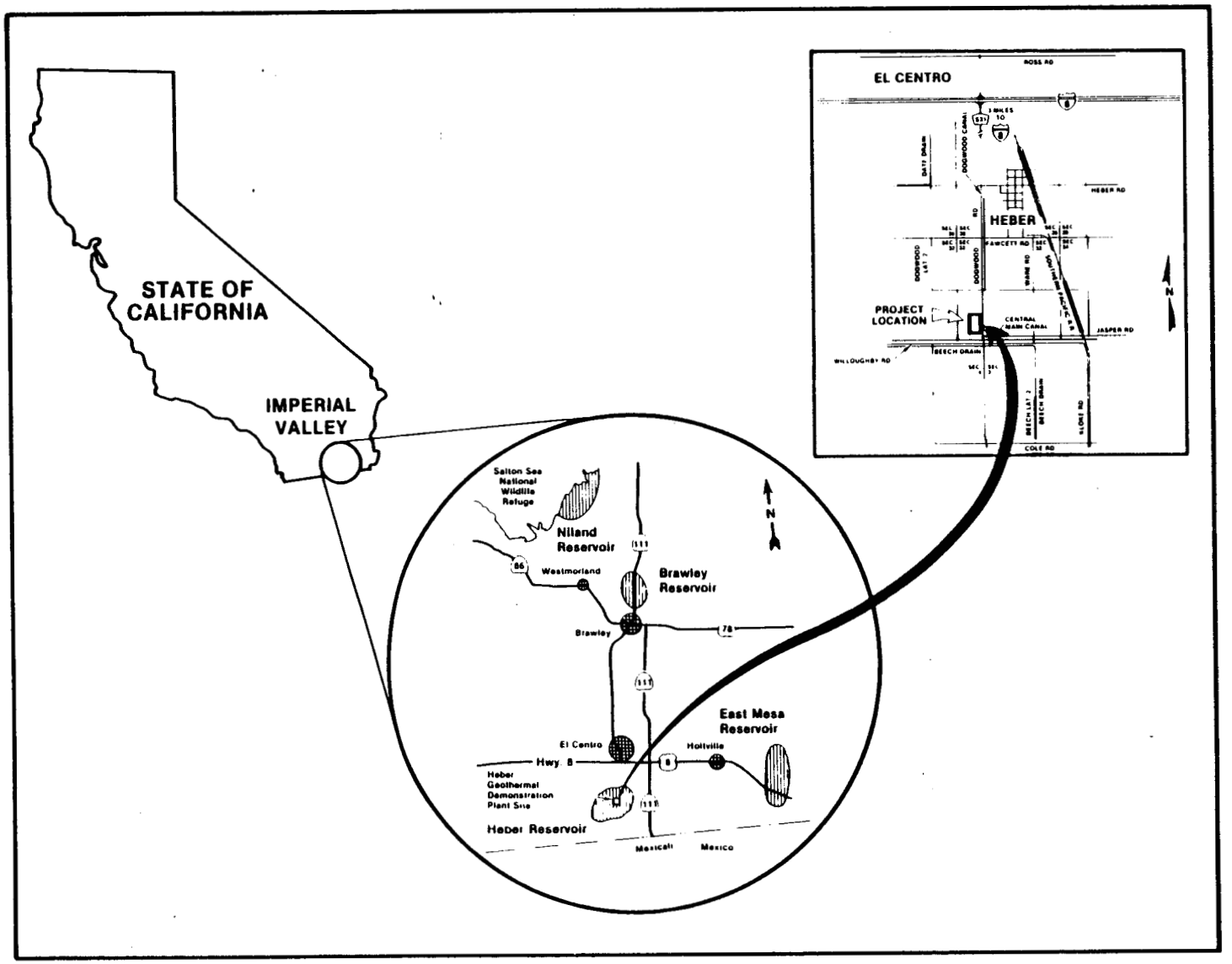

FIGURE 3
HEBER BINARY PROJECT
WORK BREAKDOWN STRUCTURE