BACA GEOTHERMAL DEMONSTRATION
PROJECT 34

QUARTERLY TECHNICAL PROGRESS REPORT,
FOR PERIOD JULY 1, 1980 - SEPTEMBER 30, 1980

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ABSTRACT

The purpose of this quarterly technical progress report is to document work completed on the Baca 50 Megawatt (MWe) Geothermal Demonstration Power Plant Project, Baca Location No. 1, New Mexico, during the period of July 1, 1980 to September 30, 1980. The work was performed by Union Geothermal Company of New Mexico and Public Service Company of New Mexico with the support and cooperation of the U.S. Department of Energy. Topics covered in this quarterly report include progress made in the well and steam production systems, the power plant and transmission systems, and in the project data management program.

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SECTION 1: INTRODUCTION

1.1 Introduction

The Baca Geothermal Demonstration Power Plant (GDPP) Project is organized and cost-shared under a cooperative agreement which brings together the U.S. Department of Energy, Public Service Company of New Mexico, and Union Geothermal Company of New Mexico as partners in a joint undertaking. For a brief outline of the organization of the Project please refer to the Quarterly Technical Progress Report for the period April 1, 1980 through June 30, 1980.

This demonstration project plays a significant role in the Geothermal Commercialization Plan of the Federal Government's Coordinated Program of Research and Development in Geothermal Energy. The goal of the federal government's geothermal energy program is to stimulate the economical, reliable, operationally safe, and environmentally and socially acceptable commercial development of this energy resource.

This Project is intended to stimulate commercial development of hydrothermal (liquid-dominated geothermal) resources in the United States. While technological capability to utilize these resources has been available for at least a decade, the actual risks and benefits associated with such utilization have not been accurately known. Without specific data obtained from actual operation of a commercial-scale hydrothermal facility, potential participants may well be reluctant to pursue hydrothermal options. Financial institutions and investors require accurate risk and project cost data before committing large amounts of capital. Utilities need hard data on the availability and reliability of a geothermal-based steam supply. A full-scale demonstration plant such as the Baca GDPP should thus provide such requisite data to the commercial sector.

The GDPP Project is to demonstrate that hydrothermal resources can be utilized to produce electric power on an economically competitive commercial scale and that power so generated is economically feasible and reliable, and can be integrated into existing system operations. Further requirements are to demonstrate that environmental and legal (licensing) considerations can be satisfactorily addressed at reasonable cost and in a reasonable time frame and that long term reservoir performance can be predicted with confidence.

To accomplish these objectives, the Project is to have a five-year operational demonstration period, during which all aspects of plant performance, environmental impact, and costs will be reported.

1.2 Scope of the Report

This Quarterly Technical Progress Report provides a review of progress made by Union Geothermal Company of New Mexico (Union) and Public Service Company of New Mexico (PNM) during the period of July 1, 1980 through September 30, 1980. More detailed treatment of specific topics will be covered in topical reports.

1.3 Summary of Progress: July 1, 1980 to September 30, 1980

Union's well drilling activities continued through the quarter with the completion of Baca No. 20 and the spudding of Baca No. 21. Well production rate testing was initiated on Baca No. 20 late in the quarter.

Efforts by Union to secure the State Engineer's approval of water rights transfers for the project were successful. However, an appeal of the decision has been filed by the Santa Ana Pueblo. Union is acquiring additional water rights to offset possible stream and surface water diminution, as required by the State Engineer's decision.

Production and injection system piping layout and design are progressing on schedule.

Power plant engineering and procurement activities progressed on schedule. Future progress may be paced by late receipt of vendor information on the turbine-generator.

Construction work during the quarter was limited to earthwork and site preparation due to a Cease and Desist Order imposed by the New Mexico Public Service Commission (PSC) pending issuance of a Certificate of Public Convenience and Necessity. At the end of the quarter the PSC was still considering PNM's request for the certificate.

The power transmission line corridor survey work was continued during the quarter. The in-service date for the transmission line has been changed from July 1981 to September 1981 due to a delay in the power plant in-service date.

Environmental studies and monitoring activities were on schedule through the quarter. Data collection at the meteorological stations and water quality sampling points is continuing.

SECTION 2: WELL AND STEAM PRODUCTION SYSTEM

2.1 Introduction

This section summarizes Well and Steam Production System progress during the quarter. Union Geothermal Company of New Mexico (Union) is responsible for work on this subsystem of the project.

2.2 Summary of Progress

The New Mexico State Engineer approved Union's application for water rights transfer to support plant operations, with the stipulation that Union secure additional water rights necessary to offset predicted stream and surface water diminution. Union is presently working to secure the additional water rights. An appeal of the State Engineer's ruling was filed by the Santa Ana Pueblo.

The drilling of Baca No. 20 was completed and the drilling of Baca No. 21 was initiated during the quarter. Production testing of Baca No. 20 was underway at the end of the quarter.

Union's Preliminary Production System Design Review Document was presented at the Project Design Review Meeting on September 24, 1980.

The design of Satellite Station No. 1 was completed. A contract was awarded for pipeline and right-of-way engineering.

Construction of a field office/shop facility was underway by the end of the quarter.

2.3 Licensing and Permitting

Union's licensing and permitting effort has been chiefly directed at securing approval from the State Engineer for water rights transfers. The water is needed to offset the water losses associated with field production to support an initial fifty megawatt power plant.

On August 1, 1980, the New Mexico State Engineer's Office ruled in favor of Union's application for the transfer of water rights acquired with the purchase of land adjoining the Baca location. The ruling allows for a water rights transfer to Union of 43.93 acre-feet per year to support drilling and operating activities. The decision also approved the diversion of geothermal fluids in the amount of 8800 acre-feet per annum, with a maximum consumption for beneficial use of 2640 acre-feet per annum. These amounts represent the total annual mass production and steam production, respectively, required to supply the Baca 50 Megawatt GDPP Project. Union is acquiring an additional 155 acre-feet of water rights in the Jemez watershed to offset the State Engineer's predicted maximum stream diminution due to geothermal operations.

Subsequent to the State Engineer's decision, an appeal of the ruling was filed by the Santa Ana Pueblo. The case has been assigned to District Court; however, no hearing date had been set by the end of the quarter.

2.4 Preproduction Drilling and Testing

Union's responsibility for the development of the geothermal field and the production of steam from the liquid-dominated resource includes the drilling, preproduction flowrate testing, injectivity testing and interference/communication testing of the wells. The activities undertaken during the quarter are outlined in this section.

2.4.1 Drilling

Baca No. 20 was drilled to a depth of 2092m (6864 feet) by the end of July, and electric wireline logs were run. Flow could not be induced from the well during rig flow testing, therefore the well was plugged back to 774m (2540 feet) and directionally redrilled toward a new bottomhole target. Two experimental "Stratapax" drill bits (furnished by Sandia Laboratories, General Electric and Smith Bit) were briefly tested during directional redrilling. The well was drilled to a depth of 1676m (5500 feet), and electric wireline logs and rig flow testing were performed. A two-phase flow test indicated 30,800 kg (68,000 pounds) per hour of steam at 179 kPa (26 psig) wellhead pressure. Drilling continued to a depth of 1943m (6374 feet) where rig flow testing was again performed. A two-phase flow test indicated 48,500 kg (107,000 pounds) per hour at a wellhead pressure of 586 kPa (85 psig). Drilling operations at Baca No. 20 were completed on August 30, 1980.

The drill rig was moved to the Baca No. 21 wellsite. Baca No. 21 was spudded on September 9, 1980. At the end of the quarter, Baca No. 21 was being directionally drilled at a depth of 837m (2745 feet).

2.4.2 Well Testing

Baca No. 20 started flow testing through a vertical separator on September 24, 1980. With a controlled separator back pressure of 1,048 kPa (152 psig), the two-phase flow rate was approximately 26,900 kg (59,400 pounds) per hour of total mass, with a steam flow rate of about 17,400 kg (38,300 pounds) per hour (corresponding to a 64.5% flash rate). As flow testing continues into the next quarter, the separator back pressure will be controlled at two lower pressures to gather data for developing a deliverability production curve for Baca No. 20.

2.5 Production System Engineering

Union is providing production and injection system piping, steam separators, steam scrubbers and associated pumps, valves and controls for the Project. Union's engineering activities during this reporting period are summarized in the following sections.

2.5.1 Design Documents

Union issued a production and injection system Preliminary Design Review Document in September 1980. This document contains updated production and injection system pipeline routings, examples of computer-generated pipeline flexibility and stress calculations, updated process mass and heat balances, and revised piping and instrumentation drawings.

Union presented the preliminary design of the production system at the Project Design Review Meeting held for DOE and its subcontractors on September 24, 1980.

2.5.2 Production System Design

Union's design of the steam production system includes three satellite separator stations located in the wellfield, each combining the output of several wells. The locations of these stations are indicated in Figure 2.1, Conceptual Fluid Production Pipeline System. During the quarter, the design of Satellite Station No. 1 was completed.

Bovay Engineers (Bovay) of Albuquerque, New Mexico, has been contracted by Union to provide general engineering services. In August, Bovay completed realignment and subsequently prepared profile drawings of the Baca No. 5A injection line right-of-way for use in pipeline design. Bovay also prepared civil construction drawings for installation of Satellite Station No. 1, for slope stabilization around Baca No. 11 and No. 15 wellsites and for road widening.

2.5.3 Equipment Purchases

During the quarter, Union procured materials for Satellite Station No. 1, the first of three such stations to be installed.

The separator and scrubber pressure vessels were ordered from NATCO (a subsidiary of Combustion Engineering). NATCO pressure vessel drawings were received and approved by Union in August 1980. The vessels are under construction and scheduled for delivery at the Baca site by the end of October 1980.

Other equipment purchases during the quarter included gate valves, pipe shoes, and small valves and instrumentation for Satellite Station No. 1.

Civil (foundations and supports), mechanical, and insulation work for the erection of Satellite Station No. 1 was combined into a single bid package to allow the contractor to schedule the most economical and efficient sequence of work. In August, Union selected three contractors to bid on this work package. All bids received were rejected. It is expected that bid requests will be reissued in early 1981. Erection of Satellite Station No. 1 is scheduled to begin in the Spring of 1981.

Chant Corporation of Albuquerque, New Mexico, was awarded the contract for erection of Union's combined field office and shop facility. Construction began on September 23, 1980 and, at the end of the quarter, the contractor was forming for the foundation and flooring.

Figure 2.1 Conceptual Fluid Production Pipeline System

SECTION 3: POWER PLANT AND TRANSMISSION SYSTEM

3.1 Introduction

This section summarizes progress on the power plant and transmission system during the quarter. Public Service Company of New Mexico (PNM) is responsible for this task. Major PNM subcontractors are M.M. Sundt Construction Company and Bechtel Power Corporation.

3.2 Summary of Progress

Delays in obtaining a Certificate of Public Convenience and Necessity (CCN) from the New Mexico Public Service Commission (PSC) limited construction progress during the quarter. The PSC halted all plant construction work on July 18, 1980. A Cease and Desist Order, amended to allow some tasks already in progress to be completed, was issued on July 30, 1980. Hearings on the CCN continued through the end of the quarter.

Power plant engineering and procurement continued on schedule. The electric power transmission system design proceeded on schedule through the quarter. Centerline clearing of the transmission right-of-way now awaits the issuance of the CCN.

3.3 Licensing and Permitting

Legal and regulatory constraints limited power plant construction progress during the quarter. Hearings before the New Mexico Public Service Commission (PSC) on PNM's application for a Certificate of Public Convenience and Necessity (CCN) for construction of the power plant were underway at the beginning of the quarter. In early July the PSC was petitioned by intervenors to order PNM to stop site preparation and preliminary construction work underway at the Baca site. On July 18, 1980 the PSC ordered that all work related to the power plant be halted. A Cease and Desist Order was subsequently issued on July 30, 1980. An appeal from PNM to allow the completion of specific site preparation and safety related activities already underway was granted in the Cease and Desist Order of July 30, 1980 (these activities are discussed in Section 3.4.4). By the end of the quarter, no ruling on the CCN was made, and the public hearings were continuing.

A detailed summary of the process of obtaining the Certificate of Public Convenience and Necessity for the project will be prepared as part of the project legal and regulatory constraints reporting (see Section 5.6).

3.4 Power Plant Design and Construction

The major PNM contractors working on the Baca power plant design and construction effort during the quarter were Bechtel Power Corporation (Bechtel), F. M. Fox and Associates (Fox) and M. M. Sundt Construction Company (Sundt). Bechtel is responsible for engineering design, equipment procurement and construction management, while Sundt has been awarded the overall construction contract. Fox is

contracted to do materials testing in support of the Sundt work. Included in this section are progress reports on power plant engineering, equipment procurement and plant site preparation and construction.

3.4.1 Design Documents

Bechtel issued the Detail Design Document in June, 1980. This document defines the criteria used in the design of plant systems, in equipment selection, and in the evaluation of engineering alternatives. It also contains pertinent power plant construction drawings depicting the detail design progress for each discipline, as of June 1, 1980, at a design completion of 72 percent.

The detail design of the Baca Power Plant was presented by Bechtel to representatives of PNM, Union, and DOE and its subcontractors on September 24, 1980 as part of a formal Project Design Review Meeting.

Bechtel issued the Project Interface Document in July, 1980. This document defines the avenues of communication between Bechtel, PNM, and Union to ensure proper interfacing of power plant piping, electrical, instrumentation, and civil engineering work with the steam production and injection system. The document further states the agreed upon system design parameters at designated battery limits (i.e., steam pressures, steam quality, electrical power voltage levels, etc.). In addition, the responsibilities of Bechtel as Construction Manager are defined with respect to PNM's site contractors and in relation to Union's construction efforts.

3.4.2 Power Plant Engineering

Power plant engineering continued on schedule during the third quarter of 1980. Bechtel estimated their power plant engineering and support services to be 84 percent complete at the end of the quarter. The estimate of the total number of Bechtel engineering drawings required for the project has been revised from 356 to 363. At the end of the quarter, 285 drawings had been issued for construction or for construction planning.

General Electric Company (GE), the turbine-generator vendor, has not released certified drawings of turbine-generator design data according to the contract schedule.

Engineering progress for the quarter was dependent upon timely receipt of these certified drawings. Expediting efforts by Bechtel resulted in a revised drawing submittal schedule for the GE turbine-generator design data. Some of the critical design information was furnished by GE in the form of preliminary drawings; however, electrical schematics and turbine trip logic diagrams remained outstanding at the end of the quarter. GE expects to submit these drawings in October 1980. Bechtel will continue to expedite the GE drawing submittals.

Work continued during the quarter on updating the plant Control Logic Diagrams to incorporate the specific logic requirements of vendor-supplied equipment.

Bechtel completed a Project Procedures Manual that summarizes correspondence requirements, drawing submittal and approval procedures, procurement procedures, and identifies the Participant project organizations responsible for specific task areas. The manual was issued to PNM during the quarter.

3.4.3 Procurement

Under the terms of their engineering subcontract with PNM, Bechtel prepares specifications, solicits bids, and evaluates proposals for all power plant equipment. Proposal summaries, with purchase recommendations, are then submitted to PNM for approval.

At the end of the quarter, Bechtel estimated their procurement effort to be 58 percent complete. Equipment purchased by Bechtel (as agent for PNM) during the quarter included:

- Pneumatic Field Instruments
- Orifice Plates
- Air and Vacuum Release Valves
- API Fabricated Gate Valves
- Reinforced Plastic Pipe
- Protective Relay Equipment
- Venturis and Flow Nozzles
- Main Transformer Lightning Arresters
- 600 Volt Power and Control Cable
- General Service Control Valves
- Pressure Regulators
- Sample Coolers
- Backflow Preventers
- Shop Fabricated Non-Critical Piping

3.4.4 Plant Site Preparation and Construction

The order to halt all Baca site work related to the power plant, issued by the PSC (discussed in Section 3.3) on July 18, 1980, brought construction of the power plant portion of the project to a virtual standstill. The Cease and Desist Order, issued later by the Commission on July 30, 1980, granted a PNM request to allow specific site preparation tasks to continue. These tasks comprised approximately 25 percent of the work scheduled for the power plant portion of the project in the month of July 1980. Progress on these tasks is described in the following paragraphs.

Construction of a retaining wall behind the cooling tower pad was in progress at the beginning of the quarter. The PSC allowed this work to continue so that possible erosion of the slopes behind the cooling tower might be prevented. At the end of the quarter, the wall was about 90 percent complete and was expected to be completed in early October.

The PSC allowed Sundt, the general construction contractor, to continue to receive and store construction materials and plant equipment. A warehouse for storage of material and equipment was under construction at the beginning of the quarter. The PSC allowed work to continue on the warehouse. The construction of the warehouse was completed in late September.

Storm drain installation was initiated during the previous quarter and was allowed to continue under the PSC order. The expected date of completion is October 15, 1980.

Bechtel and PNM construction management office activities were allowed to continue in support of the limited work being performed. Erection of a construction office building was also permitted and at the end of the quarter was near completion.

The New Mexico Environmental Improvement Division's (EID) analysis of a sample taken from on-site potable water indicated a high bacteria count. Bids received for the drilling of a potable water well were being evaluated at the end of the quarter.

3.4.5 Power Plant Construction Schedule

The construction schedule has been significantly impacted by delays in obtaining a Certificate of Public Convenience and Necessity (CCN) and particularly by the Cease and Desist Order issued by the PSC during the quarter.

The original Project schedule called for erection and enclosure of the turbine-generator building by December 1, 1980. Enclosure of the building prior to the onset of winter is necessary to allow piping, electrical, and equipment erection to proceed during the winter months, due to the extreme effects of the local winter weather. During post-award discussions with Sundt, the general construction contractor, it was determined that the building should be enclosed by November 1, 1980 to allow an adequate margin for inclement weather. The schedule was subsequently revised to parallel other construction activities to allow enclosure of the building by November 1.

As the end of the quarter approached, the PSC's Cease and Desist Order was still in effect. It became increasingly apparent that the turbine building could not be erected and enclosed before the onset of winter. In addition, standby charges for Sundt were estimated at about \$10,000 per day and, by the end of the quarter, nearly all the work allowed under the Cease and Desist Order was complete. Accordingly, Bechtel investigated the alternatives available to PNM in view of the continuing delays in obtaining the CCN from the PSC. One such alternative was to instruct Sundt to demobilize their construction forces and equipment until Spring 1981, thereby reducing most of the standby charges. By Spring 1981, it was anticipated that the PSC would have ruled on PNM's application for the CCN, and the inclement weather would have passed. This alternative would result in a possible nine month delay in the commercial operation date of the power plant, but may be economically advantageous to the Project. At the end of the quarter, Bechtel was analyzing the alternatives for presentation to PNM in October 1980.

3.5 Transmission System

Electrical power generated by the Baca GDPP will be routed to a PNM substation near Los Alamos, New Mexico, approximately 35 km (22 miles) east of the power plant facility. Progress in design and construction of the transmission system is described in the following sections.

3.5.1 Right-of-Way

Work on the right-of-way, during this quarter, was limited due to delays in obtaining CCN from the PSC, which is a prerequisite for most of the remaining corridor preparation and construction work. The U.S. Forest Service is expected to issue a right-of-way permit in October 1980 for the portion of the corridor in the Santa Fe National Forest. Approximately 7.4 km (4.7 miles) of the total 35 km (22 mile) length of the transmission corridor is on U.S. Forest Service land.

Approximately 6.3 km (4 miles) of the corridor is on DOE land (part of Los Alamos Scientific Laboratory). Right-of-way maps were prepared and submitted to DOE in September 1980 in an application for a right-of-way permit for this portion of the corridor.

Corridor centerline and structure staking was completed during the quarter for the entire corridor. Preparation for centerline clearing for the portion of the corridor on the Baca Location began on July 8, 1980. A contract for tree marking was awarded in July 1980 and this work was completed in August 1980.

3.5.2 Transmission Line Design and Procurement

Design of the transmission system continued with transmission line design approximately 70 percent complete and substation design approximately 40 percent complete at the end of the quarter. Procurement continued with a requisition for switches and breakers for the substations. The in-service date for the transmission system has been revised from September 1981 to November 1981; however, this is subject to adjustment based on the final power plant construction schedule.

SECTION 4: ENVIRONMENTAL MONITORING

4.1 Introduction

Environmental monitoring programs have been established by the Participant and WESTEC to record baseline conditions prior to monitoring the effects of geothermal development. Progress and activities in these programs are discussed in the following sections.

4.2 Summary of Progress

Surface water analyses for the 12 month period ending in September 1980 are being compiled into an annual report.

High surface run-off, which prevented the Spring groundwater sampling, subsided by July 1980 permitting groundwater samples to be taken. Air quality and meteorology data collection continued on schedule. In addition, data collection from PNM's acoustic sounder station was initiated in July 1980. During the quarter, planning began for the atmospheric tracer studies scheduled for late January 1981.

Summer vegetation baseline monitoring was completed and the analytical results were forwarded to the Participant. Faunal studies included the electric shocking of Redondo Creek to determine the local fish population. An archaeological survey of the transmission corridor was completed, permitting final transmission corridor right-of-way layout.

4.3 Water Quality

Surface waters in the plant and wellfield areas and in the Jemez watershed are monitored for flow rate and water quality on a monthly basis.

Union monitors Redondo Creek at a site near Baca No. 12, effectively downstream from both the plant site and wellfield, and at six additional sites in the Jemez watershed. Monitoring at these seven sites continued on schedule during the quarter. Data analyses for the twelve months ending in September 1980 are being summarized by Union in an annual report scheduled for completion in early 1981.

WESTEC's surface water sampling program proceeded on schedule during the quarter. The July sampling was done at the three original sampling sites, while the August and September samplings included two additional sites as requested by the Participant and DOE. Analytical results from the July and August samplings were transmitted to the Participant during the quarter.

4.4 Hydrology

The effects of geothermal fluid withdrawal on groundwater levels and quality are monitored through sampling of local springs and observation wells.

Union's groundwater monitoring program includes six springs measured for discharge rate and water quality changes, and twelve surface water observation wells in which depth to water is periodically recorded. Sampling frequency is typically two to three times per year, to include spring and fall. Union's Spring 1980 samples were taken in mid-July following postponement due to excessive surface runoff in June 1980.

WESTEC's Spring 1980 groundwater monitoring was also completed in July after being postponed due to high surface runoff. (High surface run-off induces excessive amounts of water, debris and soluble material to enter the surface water, which dilute and disturb high level groundwater.) Static water level measurements at wells east and north of the Baca site, and discharge estimates and water quality samples from the Jemez Springs/Indian Springs complex were completed during the week of July 14, 1980. The results of this spring/summer groundwater sampling were received in September and transmitted to the Participant. The fall groundwater sampling is planned for the week of October 6.

4.5 Air Quality/Meteorology

Air quality and meteorology data are being collected continuously on and around the Baca Location to provide a basis for hydrogen sulfide (H_2S) dispersion modeling and to establish baseline data prior to power plant start-up. PNM and WESTEC have developed complementary data collection programs in order to provide a broad data base.

Operation of PNM's acoustic sounder station, designed to obtain upper level atmospheric data, began in July 1980. The mini-sonde program (tracking of periodic balloon releases for vertical temperature data), the H_2S "tab" program for monitoring relative H_2S concentrations, and PNM's mobile meteorological station are all continuing to gather data on schedule.

Data continued to be collected from PNM's 62 meter (200 foot) meteorological tower located near the plant site in Redondo Canyon and from the Central Monitoring Station located next to the tower. Data was also collected from PNM's two mobile meteorological stations.

Operation of WESTEC's two mechanical weather stations (MWS's) atop 30 meter (100 foot) towers began during late June 1980 and continued during the quarter. Reduced meteorological data from the operation of the MWS's and a preliminary analysis of the data are being prepared for submission to the Participant.

Planning efforts for the winter atmospheric tracer study (planned for late January 1981) were initiated in August and continued during September. These studies will use controlled releases of tracer gases to determine transport and dispersion characteristics within the plantsite areas. The field support personnel and equipment needed to conduct these studies will be selected during the next quarter.

4.6 Floral Studies

The WESTEC floral monitoring program focuses on assessment of the effects of cooling tower emissions on the local ecosystems, while supplementing Participant vegetation studies.

Summer vegetation baseline sampling was completed by WESTEC field biologists during the month of July 1980. The samples were submitted to Nelson Laboratories for analysis, and results were received in August and September. The analytical results are currently being evaluated by WESTEC biologists.

WESTEC collected soil invertebrate samples from the Baca site in August, and vegetation and final soil samples for the fall sampling period during September 1980. These samples were submitted for analysis with results to be available next quarter. WESTEC is preparing the first annual Ecology Monitoring Status Report, which will summarize the results of this on-going study. This report is scheduled for delivery to the Participant at the end of the next quarter.

Union continues to perform floral surveys at existing and planned wellsites and along proposed pipeline corridors to identify unique or endangered floral species. No such species have yet been found.

4.7 Revegetation

As part of the environmental impact mitigation program set forth in the final Environmental Impact Statement, disturbed areas not in general use are being returned to their originally vegetated state. During this quarter, Union contracted with Plants of the Southwest, Inc. to supply native seed stocks for the revegetation of disturbed areas such as wellsites, cut slopes around pipeline corridors and access roads. Union is using a hydroseeder, which sprays a mulch and seed slurry, to reseed open slopes wherever practical. Seedlings from areas scheduled for grading or clearing are also being transplanted to cut areas resisting natural revegetation.

4.8 Faunal Studies

Faunal studies and inventories of the wellfield, project area and transmission corridor are periodically performed as part of the environmental impact assessment of the project. Small mammal and bird monitoring transects were established by Union in the wellfields during July; however, small mammal trapping has been postponed until October 1980 due to scheduling conflicts. Transects for monitoring the Jemez Mountain Salamander, an endangered species, have not yet been established in the wellfields.

In September 1980, New Mexico Game and Fish Department and PNM personnel electrically shocked Redondo Creek on the Baca Location to inventory fish types and quantities present. The results of this procedure indicated that fish life is absent in Redondo Creek in the GDPP Project area.

A survey to identify potential habitat areas of the Jemez Mountain Salamander, an endangered species, in the general area of the transmission corridor was initiated by PNM in June 1980 and was completed in July 1980. Potential and known habitat areas were avoided wherever possible by the final transmission corridor routing. A complete follow-up inventory study of endangered species in the corridor will be performed for construction of the transmission line in 1981.

4.9 Archaeological Surveys

The Office of Contract Archaeology (OCA) of the University of New Mexico was contracted by Union to identify and catalog historically significant sites in the wellfield area. The wellfield area was surveyed by OCA during the preceding quarter. A draft report of their findings, originally scheduled for issue in July 1980, is now expected to be completed in October 1980.

The PNM archaeological study of the transmission corridor area was initiated in mid-June 1980, and completed in July 1980. The survey identified lithic scatters (indicating potentially valuable archaeological sites) that are to be avoided by the final alignment of the portion of the corridor passing through the Santa Fe National Forest. Archaeological sites that cannot be avoided will be excavated to avoid potential adverse effects.

SECTION 5: DATA GATHERING AND DISSEMINATION

5.1 Introduction

Work performed under the Work Breakdown Structure (WBS) Task 1.3, the Data Gathering and Dissemination Task, has been subcontracted by the Participant to WESTEC Services, Inc. (WESTEC). All funding for this segment of the project is provided by DOE. The data management subcontract places primary responsibility for data collection with the Participant, while the data subcontractor is to compile, store, evaluate and report the project data. In addition to the information communication function, the data subcontractor supplements the data gathering efforts of the Participant in the areas of ecology, hydrology and meteorology, and supports the Participant's efforts in the areas of project promotion and public relations.

5.2 Summary of Progress

Administrative activities reported for the quarter include the: completion of the Executive Summaries Document, the establishment of the WESTEC field operations office and the contracting of WESTEC consultants, Coopers & Lybrand and Systems, Science and Software (S³).

Development of the data base management system centered on initial hardware procurement and software familiarization.

Industrial and financial community survey worksheets were finalized and distributed to members of the geothermal industry to assess their relative interests in receiving project data. An evaluation of the results of the survey worksheets will be used to further define the data requirements and reporting techniques on the project.

Documentation of the legal and regulatory aspects of the overall resource development effort continued with emphasis on the Record of Decision and Certificate of Public Convenience and Necessity processes.

The subsurface data management subcontractor continued to analyze the existing reservoir and well log data during the quarter to determine project data file formats. An equation-of-state program, developed during the preceding quarter for modeling the water-carbon dioxide mixture in the hydrothermal fluid in reservoir simulations, was used in the preliminary analysis of well data. Compilation of geological and geophysical data on the Baca geothermal reservoir continued. The data is being utilized to develop a conceptual model of the reservoir in its predevelopment state.

WESTEC, in conjunction with DOE, published a paper on the Data Dissemination Task in the Transactions of the Geothermal Resources Council 1980 Annual Meeting held in September. A project brochure was designed and printed and made available, along with copies of the executive summaries, to meeting attendees at a project display booth designed by WESTEC.

5.3 Data Management Task Administration

Reported in this section are items which relate mainly to the administration of the Data Management Task and which cannot be classified in any one task under the Work Breakdown Structure.

5.3.1 Executive Summaries

WESTEC completed executive summaries of the sixty-one (61) historical project documents (technical, financial, environmental, etc.) obtained by DOE under the terms of the Cooperative Agreement and submitted them to the Participant for approval during the quarter. During the month of August 1980, all of the summaries were approved for release and two-hundred (200) copies of the complete document were produced. One hundred and forty (140) of these copies were distributed to attendees of the 1980 GRC Annual Meeting (see Section 5.12).

5.3.2 WESTEC Field Office

During the quarter WESTEC established a field office in the PNM construction trailer to serve as a base for field operations in support of the data gathering effort. At present, the office is being utilized on an "as-needed" basis by the WESTEC field technician. As WESTEC's field activities increase, this field office will be utilized on a full-time basis.

5.3.3 Data Management Subcontracts

Contracts were executed this quarter between WESTEC and its two major data management subcontractors, Coopers & Lybrand and Systems, Science and Software. Coopers & Lybrand is managing the financial data on the project while Systems, Science and Software is managing the geological, geophysical and subsurface data.

5.4 Data Base Development

The data base development task is composed of activities necessary to provide an automatic data processing capability for the electronic storage and retrieval of project-generated information. This task consists of the general areas of system definition, design, installation and operation. Progress made during the quarter in the areas of system definition and design is described in the following paragraphs.

To get the automatic data processing system functioning in a timely manner, a decision was made during the preceding quarter to contract initially for computer timesharing services during the slower development phase of the Data Management Task. During this quarter, WESTEC contracted with United Computing Systems (UCS) for this service. As a result, the collection of actual timesharing costs as a function of computer usage was initiated. This cost data will be utilized to reevaluate the decision to contract for computer timesharing services versus procuring a stand-alone mini-computer system.

A Digital Electronics Corporation (DEC) PDP 11V03 microcomputer system that will function both as a timesharing terminal and as an off-line data processor, was ordered during the quarter. The full complement of hardware is not scheduled to arrive until mid-October; therefore, a loaner computer terminal/printer was installed. This terminal provides immediate access to the UCS timesharing system, allowing for data base system design to proceed while the microcomputer system is being procured and installed.

Progress made during the quarter on the data base system design centered around software familiarization. TRIAD, a data base management system software available on UCS, is being used for the management of the overall data base. The TRIAD software allows the user to write data base management programs using simplistic commands which are then computer processed into FORTRAN language programs. The FORTRAN programs are then utilized to load and maintain the data base. Formal TRIAD software training was completed by WESTEC personnel at UCS' office in Denver during August 1980.

An initial test data base made up of the responses from the Geothermal Community Survey Worksheets (described in Section 5.5) is being designed. A test design program was entered onto the UCS timesharing system, "debugged" and successfully run on the TRIAD software system. Preparations are currently being made for computer entry of the survey data.

A copy of GEOCOST, a geothermal power plant simulation program developed by Battelle Pacific Northwest Laboratories (Battelle), was ordered from the National Energy Software Center. Implementation of this FORTRAN program, for use in a sensitivity analysis of engineering and economic design parameters, will be coordinated with the UCS staff in order to address possible conversion problems due to differences in the operating system software between the Battelle and the UCS computers. Timesharing cost data collected from the running of the GEOCOST program will contribute to the reevaluation of the computer hardware alternatives.

5.5 Information Communication Planning

The primary objective of the Baca Data Gathering and Dissemination Task is to identify the potential project information user groups and to provide them with the quantitative bases for assessing the technological and economic risks and benefits associated with involvement in a geothermal development project such as the Baca GDPP Project.

To meet this objective, industrial and financial community survey worksheets were prepared and distributed to a representative sampling of the geothermal community. The surveys were formulated with seven sets of worksheets. The first set addresses the organization's perspective on geothermal development, identifying its level of geothermal involvement and its perceived risk levels in the development of geothermal power plants. The remaining six sets of worksheets address specific technical areas of interest within six functional categories. The six functional categories defined in the survey worksheets are:

- 1) Financial
- 2) Legal and Regulatory Constraints
- 3) Environmental Compliance
- 4) Exploration (Geological and Geophysical)
- 5) Resource Development and Production
- 6) Facilities Engineering and Operation

The community survey worksheets were addressed to representative members of ten information user communities, within the overall geothermal community, which were identified during the previous quarter. The individuals to be surveyed were chosen, on the basis of their involvement in geothermal development, by the project personnel most knowledgeable of each user community. The user communities identified were:

- 1) Utilities
- 2) Energy Developers and Producers
- 3) Architect/Engineers
- 4) Equipment Manufacturers
- 5) Field Support Services
- 6) Technical Support Services
- 7) Research and Academic
- 8) Regulatory Agencies
- 9) Financial Institutions
- 10) Special Interest Groups

A mailing list of 101 contacts within these groups was compiled and the survey was mailed out on September 5, 1980, with a requested return date of October 3, 1980. Several responses were received by the end of the quarter. The responses to the industrial and financial community survey worksheets will be evaluated to clearly define the information needs of each of the user communities. Following this evaluation, a basic plan for communicating with each of the ten user communities will be formulated.

5.6 Legal and Regulatory Constraints Impacts

WESTEC is compiling a history and analysis of the impacts of legal and regulatory constraints on the project as a guide for future geothermal development. Throughout the quarter, WESTEC personnel attended New Mexico Public Service Commission hearings to document the on-going history of the impact of legal and regulatory constraints on the project. A draft of the first semiannual Legal and Regulatory Constraints Report is being prepared by WESTEC and is expected to be completed and submitted to the Participant by mid-October.

5.7 Financial Analyses

WESTEC will provide financial analyses appropriate to the needs of specific user communities identified in the Information Communication Plan (see Section 5.5). Work in this area has been subcontracted by WESTEC to Coopers & Lybrand, Certified Public Accountants. The current level of effort involves planning and organizing financial data files. The ongoing communication with the Participant continued through the quarter to define the types, sources, and availability of financial information on the Baca Project to be used to develop the standard financial analysis reports for the financial community. An evaluation of the Community Survey worksheets during the next quarter will provide needed input to this planning effort.

5.8 Geological and Geophysical Data Management

Systems, Science and Software, Inc. (S³) has been subcontracted by WESTEC to evaluate new and previously developed geological and geophysical data on the Baca reservoir and to develop a computerized project data file for this data. Development of the Geological and Geophysical Data File was initiated during the quarter. Gravity data from the historical reports furnished by the Participant were selected as the first to be incorporated into the data file.

5.9 Subsurface Data Management

WESTEC has subcontracted S³ to store, evaluate and disseminate reservoir engineering data including well tests, interference tests and geophysical and hydrological data and to simulate the characteristics of the Baca geothermal reservoir using an S³ proprietary computer program. The following is a summary of these efforts during this quarter.

5.9.1 Reservoir and Well Test Data

S³ is scoped to perform pressure transient analyses of well test data to determine reservoir properties. During the quarter, S³ completed a second series of analyses which are a prerequisite to the realistic interpretation of the Baca well tests.

Examination of the data from flow tests of the various Baca wells shows evidence of flashing taking place in the formation prior to entering the wells. At present, only very limited analytical techniques are available for interpreting pressure transient data for two-phase geothermal wells. Accordingly, the S³ geothermal reservoir simulator was employed in a series of runs to investigate:

- 1) The drawdown/buildup response of hot water wells,
- 2) The drawdown/buildup behavior of initially two-phase (water/steam) reservoirs,
- 3) The drawdown/buildup response of an initially single-phase (liquid water) reservoir which undergoes in-formation flashing as a result of fluid production,
- 4) Fluid injection into single-phase and two-phase reservoirs.

The calculated response (especially from items 2 and 3) displays a striking resemblance with observed data from several Baca wells.

An Interim Topical Report describing all of the well test simulations in detail has been prepared in draft form and submitted to WESTEC for review. The draft report describes the physical mechanisms for all of the cases treated in the well test simulations. The results provide a quantitative understanding of the phenomena which may be expected to occur during the testing of wells perforated in single-phase and two-phase regions of the Baca reservoir.

5.9.2 Equation-of-State Development

A detailed description of the thermodynamic and calculative procedures used in the equation-of-state software package developed for water-carbon dioxide mixtures has been prepared in draft form and will be submitted to the Participant during the following quarter. S³ will also complete incorporation of the equation-of-state package as a subroutine in their reservoir simulator during the next quarter. Completion of these two objectives will mark the completion of the equation-of-state development task.

5.9.3 Reservoir Case History

S³ is developing a case history of the Baca geothermal reservoir system. During the quarter, S³ began the construction of cross-sections giving reservoir lithology and initial fluid state for the Baca system. This is a necessary step in quantizing the preliminary conceptual model of the heat and mass transport in the system.

5.9.4 Reservoir Data File

During the reporting period, S³ was initially delayed in proceeding with the assimilation and compilation of data for the Reservoir Data File due to a lack of information in the Participant's historical reports on the deviations from the vertical for each of the Baca wells. Deviation data for all wells are necessary in order to accurately specify depth-dependent information. Clarification of some questions regarding the deviation data for new wells (Baca 17, 18 and 19), together with the bottomhole location for older wells (Baca 4, 5A, 6, 10, 11, 12, 13, 14, 15 and 16), has recently been provided by Union.

A brief program has been written to translate from the Universal Transverse Mercator (UTM) Coordinate System to the New Mexico State Plane (NMSP) Coordinate System. This program is being used to translate some well data and maps supplied in terms of the UTM System to the NMSP System. This permits all information to be specified uniformly.

5.10 Production System Data Management

WESTEC will compile production system engineering data furnished by the Participant into site specific and general design criteria that will be useful to other resource developers. Review of production system design data began in September, following receipt of Union's Preliminary Design Review Document. WESTEC will await more detailed design data from the Participant before documenting the production system design criteria.

5.11 Power Plant Data Management

During this quarter, WESTEC continued to review the Participant's engineering design, system reliability, capital and operational cost parameters that were used to evaluate electric generation expansion plans and support commercialization strategies. WESTEC has ordered a copy of the geothermal power plant simulator computer program GEOCOST from the National Energy Software Center. This program will be evaluated for use in sensitivity studies of cost and performance parameters.

5.12 Project Promotion/Public Relations

WESTEC coordinates with the Participant's public relations personnel and provides specific public relations services necessary to stimulate interest in the project and promote data availability in support of the project's primary objectives. A summary of activities in these areas follows.

5.12.1 Information Request

WESTEC received requests from groups outside the project for existing project data. Based on a written agreement with DOE and the Participant, the historical data requested was furnished at the requestor's expense.

5.12.2 Presentations and Symposia

WESTEC participated in the 1980 Geothermal Resources Council (GRC) Annual Meeting, held September 9 through 11, in a coordinated effort with the Participant to stimulate interest in the GDPP Project and promote data dissemination. WESTEC, in conjunction with DOE, submitted a technical paper to the GRC which has been published in the proceedings of the 1980 GRC Annual Meeting. A project display booth was exhibited at the GRC Meeting. WESTEC personnel staffed the project display and solicited interest in the project from the conference attendees. Approximately thirty (30) Information Requests were obtained at the conference, while one hundred and forty (140) Executive Summaries Documents and two hundred and fifteen (215) Project Brochures were distributed.

A preliminary symposium plan was submitted to the Participant during August for the First Annual Baca Symposium to be held in 1981. A proposed symposium announcement has been approved by the Participant and will be distributed as soon as a firm date and a location for the symposium (in the Albuquerque or Santa Fe areas) has been assigned.