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SALTON SEA SCIENTIFIC DRILLING PROGRAM

Report of the Second Quarter

FY 1986

July 1986

U.S. DEPARTMENT OF ENERGY
Office of Renewable Energy Technologies
Geothermal Technology Division

SALTON SEA SCIENTIFIC DRILLING PROGRAM

Sixth Quarterly Progress Report:
Report of the Second Quarter
(January through March)
FY 1986

July 1986

U.S. Department of Energy
Office of Renewable Energy Technologies
Geothermal Technology Division

EXECUTIVE SUMMARY

This is the sixth in a series of quarterly reports outlining the progress and direction of the Salton Sea Scientific Drilling Program, or SSSDP. Through this reporting period, January 1 to March 31, 1986, the drilling phase of the program was completed, and most of the major objectives were either met or exceeded. The well was drilled to a depth of 10,564 ft, exceeding the original target depth of 10,000 ft. The bottom-hole temperature measured soon after completion of drilling was 353°C. This may exceed 370°C after thermal equilibrium is established following the six-month shut-in period.

Results of the second flow test and sampling period, performed after having hung a protective 7-inch liner from 5,735 to 10,136 ft, were inconclusive. The test was designed to produce fluid from the 10,136 to 10,564 ft interval. However, evidence from the 37.6-hour test indicated that the fluids produced were comingled from more than one zone, and contaminated by lost circulation material (LCM) and other drilling materials. An intermediate flow zone near 8,600 ft may have dominated production. Moreover, duration of the flow test was restricted by the 1.1 million gallon capacity of the brine-holding pond, thereby lessening chances of collecting pristine fluid samples.

Cores and cuttings were collected as a major part of the overall science effort. Coring was hampered by loss of circulation, high temperatures, corrosive brine, and the tendency of fractured rock and excessive LCM in the drilling mud to become jammed within and around the core barrel. During this period, 240 ft of coring was attempted and 73% of the core was successfully recovered. Cuttings were collected for the downhole interval not cored during drilling, except for zones of total circulation loss.

Downhole fluid sampling was attempted nine times immediately following the second flow test using three different sampling devices. On five of the runs, a LANL/Sandia fluid sampler was deployed. This device was successful in

obtaining fluid and gas samples on one of the runs. A commercial (Leutert) sampler was deployed three times, but failed to obtain samples. Finally, a sampler deployed by researchers from Lawrence Berkeley Laboratory was successful in obtaining an unpressured fluid sample.

Geophysical logging was attempted only sparingly during this reporting period, because temperatures encountered in the deeper part of the well exceeded the 300°C operational limit of the TFE insulation within the MP35N armored and sheathed logging cable.

Downhole temperature and pressure measurements were successfully made using three mechanical, slickline (non-conductive wireline) tools acquired from the Kuster Company. The tools, which were dewared to allow extended operation in high-temperature environments, performed satisfactorily in that temperature and pressure readings were obtained on several occasions from near the bottom of the well.

Scientific experiments performed in the well involved (1) a synthetic fluid-inclusion experiment (2) a vertical seismic-profiling experiment, and (3) a downhole gravity experiment. With the exception of the fluid inclusion experiment, which was lost in the well, all of the experiments were successful from the standpoint of data collection and demonstration of the usefulness of the experimental techniques.

Funding for the drilling phase of the project was exceeded during the period. However, the three sponsoring agencies increased the budget by $135,000 in order to complete the drilling and testing phase. Furthermore, a detailed proposal, presenting costs vs scientific benefits of deepening the well to 13,000 or 14,000 ft and conducting extended flow tests, was received from the on-site Science Committee by Department of Energy Headquarters. Justification was partly based upon the observation that the roots of the Salton Sea hydrothermal system had not yet been fully penetrated.

CONTENTS

PAGE

EXECUTIVE SUMMARY

INTRODUCTION.. 1

PROGRAM PLAN.. 4

Current Program... 4
Summary of Events... 4
Program Funding... 12
Drilling & Engineering Program.. 14
Scientific Experiments Program.. 17
Instrumentation Developed for the SSSDP............................... 24
Reporting of Scientific Results....................................... 26
Proposed SSSDP Deepening and Flow Testing.............................. 27

SIGNIFICANT MEETINGS.. 33

ESC Meeting - 1/30/86... 33
Site Meeting - 2/5/86... 34

TABLES

Table 1: Brief description of the drilling phase - SSSDP.............. 5

Table 2: Summary of Drilling & Engineering and Scientific Program funding.. 13

Table 3: SSSDP final flow test schedule............................... 16

Table 4: Coring summary for the reporting period...................... 18

Table 5: Summary of downhole fluid sampling........................... 19

Table 6: Summary of geophysical logging............................... 20

FIGURES

Figure 1: General lithology and summary of the drilling phase of the SSSDP scientific well.. 3

Figure 2: SSSDP well completion schematic............................. 11

Figure 3: Flow-test organization...................................... 15

Figure 4: Well construction schematic: lower section.................. 29

Figure 5: Well construction schematic: lower section - ready for well deepening.. 30

INTRODUCTION

The drilling phase of the Salton Sea Scientific Drilling Program (SSSDP), a program sponsored jointly by the U.S. Department of Energy--Office of Basic Energy Sciences (DOE/OBES) and Geothermal Technology Division (DOE/GTD), U.S. Geological Survey (USGS), and the National Science Foundation (NSF), was ended on March 17, 1986. This marked the conclusion of the second task in an intensive effort to gather information in the form of drill cuttings and cores; geophysical logs; temperature, pressure and flow measurements; and fluid samples from a deep (10,564 ft) research well drilled in the Salton Sea Geothermal Field (SSGF), and to place that information into the public domain.

In keeping with the strong scientific emphasis of the overall program, activities associated with the project have been focused on obtaining data for more than 30 scientific studies that include geophysics, petrology, geochemistry (rock and fluid) and bio-organics. In general, the goals of the project are:

- Gain a better understanding of Earth's continental crust and its formation processes for further insight into Earth's history.
- Study a unique, hostile environment in a comprehensive manner never before attempted; and extend technology to provide the instruments to test, measure and sample in this hostile environment.
- Acquire new (public domain) scientific data and samples for study by university, industry and government researchers.

In addition to the three Federal sponsoring agencies, the major industrial contractors include Bechtel National, Inc. (prime contractor); Kennecott Corporation (permit holder); and Well Production Testing, Inc. (drilling consultant to DOE/San Francisco Operations Office).

The program evolved as a subset of the Continental Scientific Drilling Program (CSDP) and is the first major project to be coordinated by the three agencies under an Interagency Accord on Continental Scientific Drilling.

Objectives under the Accord are:

1. Define interests and responsibilities for each agency in a new national scientific undertaking -- the CSDP.

2. Identify projects to be carried out within the CSDP (Second supplement; Salton Sea Scientific Drilling Program).

3. Establish a management plan to coordinate joint scientific and engineering efforts.

The Salton Sea Geothermal Field, was chosen as the site for one of the first deep drilling projects within the context of the CSDP because of its tectonic setting. It is the only active continental spreading zone in the United States; is one of the largest liquid-dominated hydrothermal convection systems in the world; and has active ore-forming processes associated with the hydrothermal system.

The SSSDP has been divided into two program elements; (1) Drilling and Engineering, and (2) Scientific Experiments. The general objectives of the Drilling and Engineering Program, which is now essentially complete (pending consideration of a proposal for well deepening and extended flow testing), were to: (1) drill and complete a scientific well to approximately 10,000 ft; (2) obtain rock and fluid samples; (3) perform an evaluation of the resource through flow-testing; and (4) obtain geophysical logs, and measure downhole temperature, pressure and flow. The objectives of the Scientific Experiments program are to: (1) perform studies of petrology, fluid geochemistry, geophysics, and bio-organisms; and (2) provide for on-site science management and support. Figure 1 presents a general description of the lithology penetrated and a summary of activities during drilling of the scientific well.

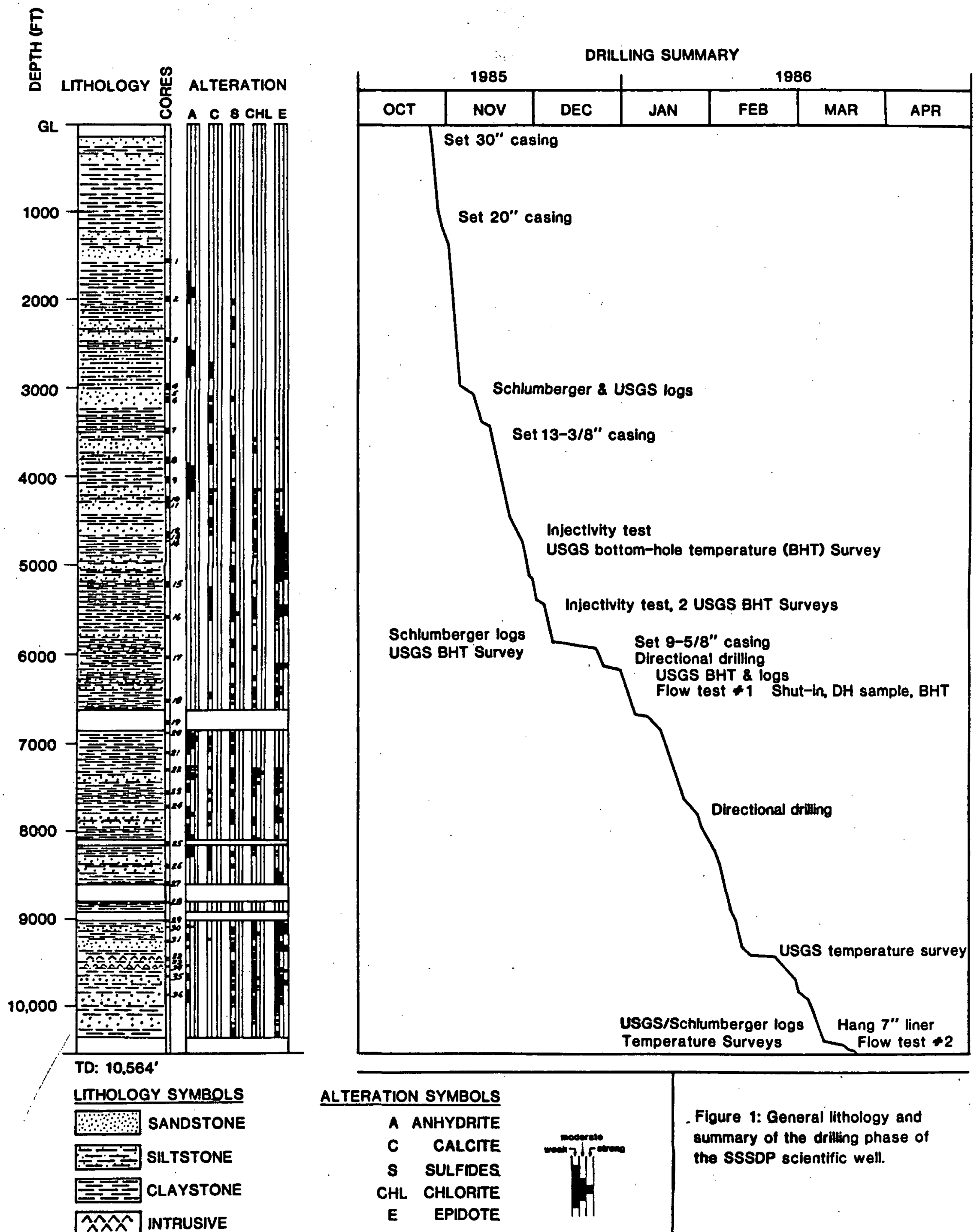

Figure 1: General lithology and summary of the drilling phase of the SSSDP scientific well.

PROGRAM PLAN

Current Program

During the second quarter of FY-1986, the SSSDP achieved or exceeded nearly all objectives established at the outset of the project. Briefly, those objectives were:

- Drill and complete a well to 10,000 ft target depth.
- Attempt to recover 750 ft of core above 6,000 ft, and 400 ft of core below 6,000 ft, while remaining within an established budget of $1 million.
- Collect drill cutting samples from uncored intervals.
- Provide instrumentation systems for measuring temperature, pressure and flow rate, and for collecting downhole fluid and gas samples.
- Conduct three flow tests, and collect fluid and gas samples.
- Provide over 250 hours during drilling for scientific experiments and geophysical logging.
- Provide a six-month access period to the well for scientific experiments after completion of drilling.

With the exceptions of coring and flow-testing, all of these objectives have been or will be met. Coring operations were hampered by penetration of highly fractured and altered formations in a hostile thermal and chemical environment. Flow-testing was curtailed in that only two of the three short-duration flow tests originally proposed were performed because insufficiently permeable formations were penetrated in the shallower part of the well. Table 1 presents a brief summary of the results of the drilling phase.

A chronology of events for this reporting period is given below.

Summary of Events

- January 1 - Began reinjection of approximately 500,000 gallons of cooled geothermal brine produced during the first flow test. The process was completed on January 2.
- January 2 - Resumed directional drilling (turbo-drilling) after the first flow test to prevent encroachment on a neighboring lease. Turbo-drilling continued to a depth of 6,316 ft.

PROJECT LOCATION:	Salton Sea Geothermal Field in California's Imperial Valley, 4 miles southwest of Niland, California.
DRILLING:	
Start Date:	October 23, 1985
End Date:	March 17, 1986
Total Well Depth:	10,564 feet
Estimated Temperature:	353°C (10,400 ft) (March 22, 1986)
SAMPLING:	
Core Footage Recovered:	725 feet
Drill Cutting Samples:	Collected every 30 ft above 3,000 feet Collected every 20 ft to 6,000 feet Collected every 10 ft to total depth
Fluid Samples:	Collected during 2-periods of flow testing and downhole sampling.
FLOW-TESTING:	
1st Flow Test:	Performed within the interval 6,119 to 6,227 ft.
2nd Flow Test:	Performed within the interval 10,136 to 10,564 ft.

Table 1: Brief Summary of the Drilling Phase - SSSDP

- January 4 - Core #18 was cut from 6,506 to 6,517 ft. The core barrel became jammed after cutting only 11 ft of highly fractured, silicified shale.

- January 5 - A total loss of circulation was experienced at a depth of 6,637 ft. Following this, five LCM treatments were made, but they failed to re-establish circulation. Drilling proceeded without returns to 6,758 ft, where core #19 was cut from 6,758 to 6,771 ft. Eight feet of siltstone and sandstone were recovered.

- January 6 - The rig was placed on "standby-secured" mode after setting a cement plug in an effort to control loss of circulation. The shut-down was necessary in order for the Imperial County Irrigation District to clean the canal providing make-up water for the drilling operations.

- January 11 - Drilling was resumed. The cement plug was drilled out and the well deepened to 6,803 ft, where a total loss of circulation was again experienced.

- January 12 - The lost circulation zone was treated with LCM pills and cement, after which only partial circulation was regained. Drilling continued to 6,850 ft, where another total loss of returns occurred.

- January 14 - Two cement plugs and LCM pills were set between 5,749 and 6,850 ft, and then drilled out. Drilling continued to 6,880 ft where returns were lost again. Core #20 was cut from 6,880 to 6,889 ft where the core barrel became jammed. Only 3.5 ft of the total 9 ft cored was recovered. The core consisted of laminated dark grey and light grey indurated mudstone.

- January 16 - Following placement of another cement plug, from 6,889 ft up to 6,243 ft, drilling was resumed. Major fluid-loss zones (up to 90 Bbls/hr) were encountered between 6,970 and 7,100 ft. Core #21 was taken from 7,100 to 7,109 ft. Seven feet of indurated mudstone were recovered.

- January 17 - Core #22 was cut from 7,300 to 7,313 ft. Fluid-losses reached 50 Bbls/hr after recovering the 11.5 ft of indurated mudstone.

- January 19 - A depth of 7,547 ft was reached and core #23 was cut from 7,547 to 7,577 ft. It consisted of indurated, medium-grey mudstone.

- January 20 - A directional survey made at 7,654 ft, indicated that wellbore deviation had increased from 4° 45' to more than 6 degrees to the southeast. Core #24 was cut from 7,704 to 7,734 ft with 100% recovery. The core contained indurated mudstone with anhydrite porphyroblasts.

- January 23 - Following coring, turbo-drilling to correct for wellbore deviation was performed from 7,734 ft to a depth of 7,935 ft.

- January 25 - Conventional drilling and reaming was resumed, and proceeded to 7,972 ft, where turbo-drilling was reinitiated and continued to a depth of 8,070 ft. As a result of turbo-drilling, the angle of wellbore deviation was changed to about 4 degrees to the southwest.

- January 26 - Conventional drilling resumed and circulation was lost at a depth of 8,094 ft. Drilling was continued blind (i.e. without returns) to 8,126 ft. CO_2 content of the drilling fluid increased to 64,000 ppm and methane was detected at a level of 375 ppm. This gas pulse may have been an indication that a reservoir of higher gas content had been penetrated.

- January 27 - Turbo-drilling was again initiated at 8,126 ft to correct wellbore deviation. The well flowed during drilling and several LCM pills were placed to kill the flow. Turbo-drilling was ended at a depth of 8,133 ft.

- January 28 - Core #25 was cut from 8,133 to 8,161 ft. It consisted of mostly dark siltstone and minor sandstone that contained micaceous fractures and significant chlorite.

- January 30 - Drilling reached a depth of 8,395 ft. A directional survey taken at 8,342 ft indicated the wellbore was oriented 4° 15' to the southwest. Therefore, no further directional drilling was required.

- January 31 - While attempting to cut the 26th core from 8,395 ft, the core barrel became jammed at 8,402 ft and the coring run was terminated. The core was retrieved and found to consist of 7.0 ft (100% recovery) of black mudstone containing chalcopyrite.

- February 1 - The 27th core was attempted at a depth of 8,585 ft, but the barrel (again) became jammed at a depth of 8,604 ft. The 12.0 ft of core recovered consisted of grey sandstone containing abundant epidote and secondary quartz.

- February 3 - Conventional drilling proceeded blind to 8,800 ft, after having placed five LCM pills in the well in an effort to regain circulation. Circulation was regained with placement of the 5th LCM pill. Core #28 was then taken from 8,800 to 8,807 ft. The core consisted of 4.0 ft of hornfelsic mudstone.

- February 4 - Circulation was lost again at 8,911 ft. However, drilling continued and the well was deepened to 9,004 ft. Core #29 was cut, without circulation, from 9,004 ft to 9,027 ft. Only 4.5 ft of hornfelsic mudstone was recovered.

- February 6 - A combination of cement and LCM was placed and allowed to set, after which drilling continued to 9,070 ft with 50% fluid loss. After treatment with LCM, drilling resumed and continued to 9,095 ft. Core #30 was cut from 9,095 to 9,098 ft. It consisted of 3.0 ft of shale and fine-grained sandstone. Fractures, which were abundant in the core, were filled with epidote, chlorite and sulfides.

- February 9 - Circulation was regained after placing LCM pills and cement plugs, and drilling was continued to 9,248 ft. With mud losses of 50 Bbl/hr, the 31st core was attempted, but the barrel became jammed after only 5 ft. The well tried to flow twice during coring and 400 barrels of fluid were gained.

- February 10 - CO_2 in the drilling fluid reached a maximum of 72,000 ppm. A depth of 9,450 ft was reached, where it was discovered that about 5 ft of diabase intrusive rock had been penetrated.

- February 12 - Circulation was lost three times during reaming from 9,420 to 9,450 ft and milling with junk-sub to 9,453 ft (to recover buttons broken from roller cone bit #51). Several LCM pills were placed in an effort to control fluid losses. The pills failed to seal-off the fluid-loss zones and a cement plug was then set. Circulation was eventually regained and the well was reamed to 9,453 ft.

- February 13 - Cores #32 and #33 were taken from 9,453 to 9,458 ft, and from 9,458 to 9,473 ft, respectively; both with poor recovery. Core #32 consisted of aphanitic, mafic intrusive that continued in the upper part of core #33, the lower part of which contained a brecciated contact with epidote-rich mudstone.

- February 14 - After pumping 350 barrels of water downhole, with only 20 barrels returned, the well began to flow. The flow was stopped, and the well was reamed to 9,473 ft, as returns declined from 20 percent to 0.

- February 15 - A continuous temperature log was run by the USGS that showed several cooled zones, which were interpreted as multiple zones of fluid loss. A downhole flow-meter (spinner) tool, also run at this time, malfunctioned due to excess LCM in the drilling mud.

- February 18 - The well was re-reamed, while flowing, to 9,473 ft. Following this, a coring run was attempted, only to be aborted 12 hours later as circulation could not be re-established.

- February 21 - More than a half dozen cement plugs were set between the depths of 6,292 and 9,230 ft in an effort to regain circulation. The efforts were temporarily hampered when the drill stem became stuck near 9,230 ft.

- February 22 - Cement plugs were cleaned out, and the coring assembly was tripped into the well. The drill stem became stuck near 9,440 ft, but was freed after 4 hours by pumping 3,000 gallons of diesel and additives into the well.

- February 23 - Core #34 was cut from the interval 9,473 ft to 9,477 ft. Damage to the core bit resulted in recovery of only 2 ft of hornfelsic mudstone. Normal drilling resumed, and another mafic intrusive was penetrated between 9,505 ft and 9,517 ft. An attempt to core part of the intrusive was terminated when the drill stem became stuck in a tight zone near 9,458 ft. The drill stem was freed and the tight zone was reamed.

- February 25 - Normal drilling was resumed after reaming and continued through the intrusive (9,517 ft to 9,530 ft) and into a sedimentary rock sequence. A depth of 9,694 ft was reached on the following day.

- February 28 - Core #35 was cut from 9,694 to 9,698 ft, and contained 3.5 ft of epidote-rich quartzite. On tripping-out, the well began to flow and a 10-ppg slug was required to kill the flow.

- March 2 - A new core bit (7 5/8-inch) was tried in cutting Core #36 from 9,907 to 9,912 ft. After rotating on bottom for 8 1/2 hours, only 0.8 ft of core was recovered. The bit was badly damaged.

- March 4 - Drilling continued to a depth of 10,061 ft, after which operations were temporarily shut-down to repair the blowout-preventer.

- March 5 - The well was deepended to 10,212 ft. While reaming, the drill stem became stuck near 10,170 ft and 5,000 gallons of diesel were pumped down the well to dislodge the pipe. When the pipe was freed on the following morning, the well began flowing. The drilling mud was badly contaminated by highly-saline formation brine. The mud was treated for contamination and circulated for 2 1/2 hours to kill the flow.

- March 7 - The well was deepened to 10,350 ft. While tripping-out, the well began flowing and CO_2 in the drilling mud increased sharply to 128,000 ppm. A wellbore deviation survey failed when high, downhole temperatures destroyed the film in the multishot.

- March 8 - Drilling continued with slow penetration rates experienced below 10,350 ft. As it was being decided to pull out of the well, the drilling rate began to increase, along with fluid-loss (200 Bbls/hr at 10,460 ft). All circulation was lost at 10,475 ft.

- March 9 - A temperature log was made using the USGS wireline logging unit, and a temperature of 287°C (549°F) was measured near the bottom. A caliper log was attempted, but failed when the tool's motor burned-out.

- March 10 - Several unsuccessful attempts were made to regain circulation by pumping sand into the bottom of the well, and by placing LCM pills at 10,350 and 10,425 ft. A dual-induction log was attempted by Schlumberger while waiting for the pills to set, but a constriction in the wellbore at 8,819 ft prevented logging below this depth.

- March 11 - The drilling budget was expended, requiring additional funds before the well could be completed. An additional $135,000 was added to the drilling budget by the sponsoring agencies.

- March 12 - After two cement plugs were placed in the well from 10,414 ft up to 10,114 ft, temperature and caliper logs were attempted, but failed to get below a constriction at 8,700 ft. Maximum temperature after 9 hours was 225°C (437°F). Acoustic televiewer logging was attempted, but, due to high temperature, was restricted to the uppermost lostcirculation zone that extended from the base of the 9 5/8-inch casing (6,000 ft) to about 6,600 ft.

- March 13 - An acoustic waveform log was obtained after repeated runs between 6,000 and 7,000 ft. The interval contained two production zones separated by a competent rock unit.

- March 16 - A liner was hung in the well from 5,735 to 10,136 ft. The liner consisted of 102 joints of 7-inch, 29 lb/ft, N-80, LT&C casing.

- March 17 - Drilling was resumed, with no returns, to a total well depth of 10,564 ft! Figure 2 is a schematic diagram of the final well construction.

- March 20 - With the wellhead test tree installed, the well was opened at 8:50 a.m. and initially allowed to flow for a hydro-test of all lines, except the scientist's sampling loop. Flow was then diverted into the brine-holding pond, and later through the James Tube, rock muffler and weir box. Flow was later diverted through the science loop for testing, check-out and modification prior to sampling.

- March 21 - Geochemists and other scientists spent about one-half day collecting fluid and gas samples from the sampling loop. A maximum flow of 700,000 lbs/hr at a wellhead pressure of 450 psi and a temperature of 238°C (460°F) was achieved for 1-hour. Down-hole flow and pressure measurements were conducted. The dewared, Kuster pressure instrument worked. However, the flow-meter malfunctioned. The well was shut-in at 10:00 p.m. after 37.6 hours of flow.

- March 22 - Two Kuster temperature/pressure runs were made. Although the temperature baseline on the first run was in error, both tools worked properly on the second run recording a bottom-hole temperature of 353°C, and a shut-in pressure of 4,287 psi at 10,400 ft. Two attempts were made to obtain downhole fluid samples using the LANL/Sandia sampler. Both attempts failed due to seal problems.

- March 23 - Three sampling runs were made using a commercial (Leutert) mechanically-tripped sampler. All three attempts were unsuccessful because various sampler components failed in the high-temperature environment. A synthetic fluid-inclusion experiment package was deployed, but was lost in the well when corrosion caused separation of the wireline after 24 hours. A subsequent fishing attempt failed.

- March 25 - The LANL/Sandia downhole fluid sampler obtained about 1.5 liters of brine and 0.5 liters of gas from a depth of 10,200 ft. A flow-through sampler deployed by LBL scientists obtained about 1.0 liter of unpressured fluid.

- March 27 - The produced brine was injected into the well and a temperature log was run using a platinum-resistance thermometer on the USGS seven-conductor cable. Fresh water was injected intermittently to cool the wellbore for scientific experiments.

- March 29 - Scientists from LBL completed a vertical seismic-profiling (VSP) experiment in the well, after which gamma and neutron logs were run by USGS throughout the cased hole. This was followed by a Dia-Log casing caliper log that showed well construction to be good.

- March 31 - Scientists from LLNL carried out a downhole gravity experiment within the 9 5/8-inch cased part of the well.

- April 1 - A continuous temperature log was completed using the USGS wireline unit. The scientific well was shut-in for the final time at 2:30 a.m., marking the end of phase-two, and the beginning of the standby period.

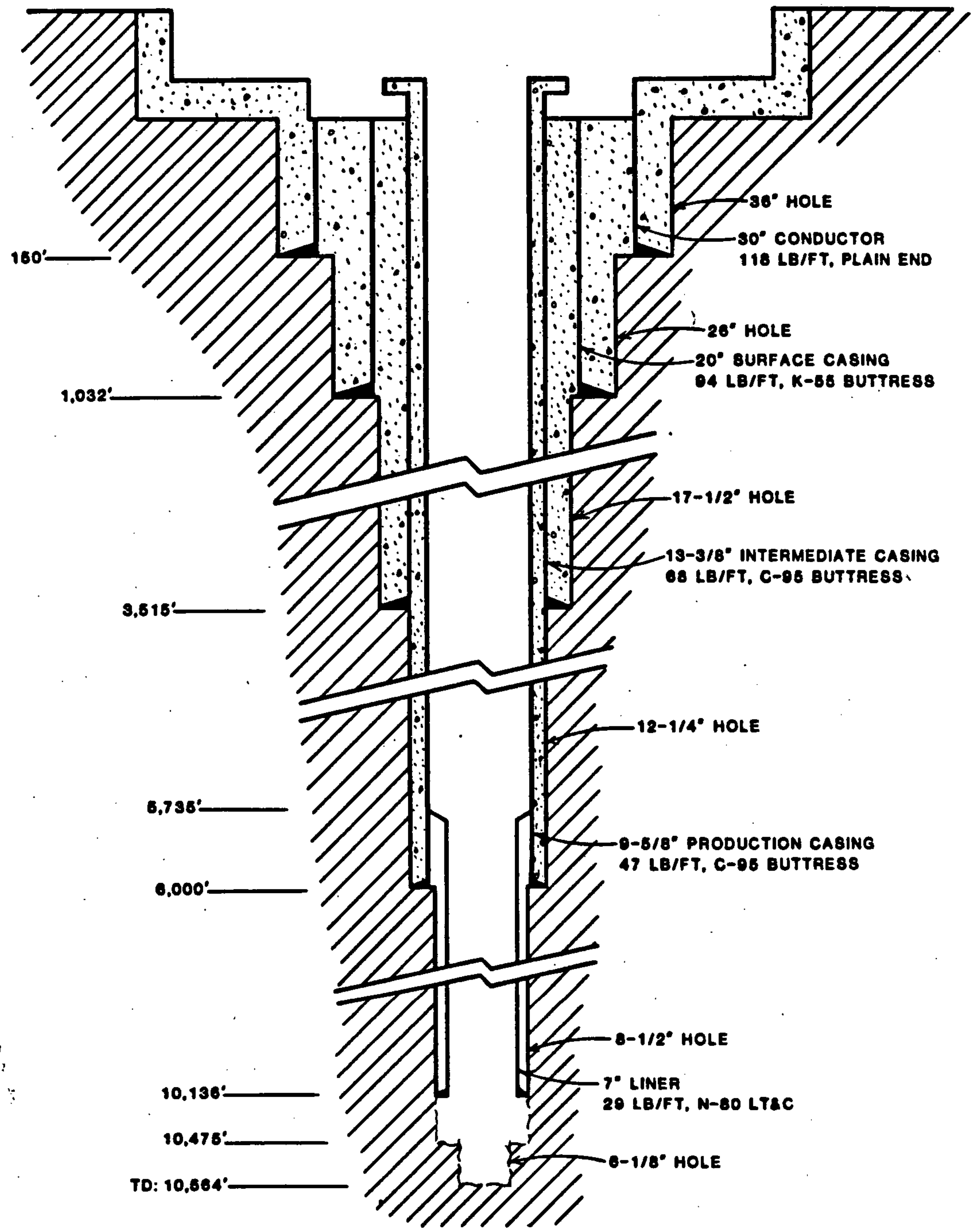

Figure 2: SSSDP Well Completion Schematic

Program Funding

Funding for the SSSDP has been supplemented in order to meet scientific objectives as the project has progressed, while solving the drilling and engineering problems encountered. Overall funding, as summarized in Table 2, has been provided by the participants to support the two major SSSDP program elements -- the Drilling and Engineering Program and the Scientific Experiments Program. The Drilling and Engineering Program was designed to support achievement of the scientific objectives. These objectives are:

1. Provide on-site science management and support, and
2. Conduct studies of --
   - -- Geochemistry (12 experiments)
   - -- Petrology (8 experiments)
   - -- Geophysics (8 experiments)
   - -- Bio-organisms (1 experiment)

Near the end of the drilling phase, a critical decision point was reached that required additional funds to properly complete the well before conducting the second scheduled flow test. The augmentation of the operational budget was required for the following reasons:

- o On the morning of March 8, a very hot zone was encountered at a depth of 10,475 ft where all circulation was lost. This fluid-loss zone appeared to have a lower pressure than loss zones higher in the well, suggesting a completely separate hydrothermal convection system.
- o Placing of lost circulation materials within this fluid-loss zone, and filling the bottom 200 ft of the borehole with sand was ineffective.
- o In order to control the well while installing the 7-inch liner that was required for the flow test, it was necessary to cement-off this zone. Since the earlier plan had been to hang the 7-inch liner from 6,000 to 9,000 ft, isolation of the lowermost loss zone below 10,475 ft for testing could not have been accomplished.
- o The on-site scientists agreed that high priority should be given to (1) attempting to obtain uncontaminated fluid samples from this deep, lower-pressured zone; and (2), measuring the equilibrium temperature profile of this zone. Accomplishing these tasks would have been impossible if the liner had been hung to 9,000 ft and the cement plug left at the bottom of the well.
- o The proposed alternative was then to: (1) cement the lower production zone; (2) run the liner to 10,000 ft (or as deep as possible); (3) hang

	FUNDING BY AGENCY (in $ 000's)				
CATEGORY	NSF	GTD	USGS	OBES	TOTAL
Drilling and Engineering	25	6,771	25	25	6,846
Geochemistry	168	-	165	103	436
Petrology	280		-	150	430
Geophysics (Lab)	-	55	15	132	202
Geophysics (Site)	-		180	170	350
Bio-Organic	-	-	70	-	70
Instrumentation	-	597	120	-	717
Science Support & Management	-	-	300	146	446
Total Funding	473	7,423	875	726	9,497
Total Activities	7	11	13	11	42

Table 2: Summary of Drilling and Engineering, and Scientific Program Funding

the liner in place, (4) drill out the cement plug using a 6 1/8-inch bit; and (5) flow test the lower zone.

In response to the scientist's request for additional funding of this unique opportunity to test and sample the deepest, hottest hydrothermal reservoir encountered, discussions were quickly initiated between the respective sponsoring agencies. Initial estimates showed that the activities proposed would cost about $90,000. This estimate was later revised to $135,000 and the necessary funds obtained from the U.S. Geological Survey ($25,000), the National Science Foundation ($25,000), the DOE -- Office of Basic Energy Science ($25,000) and the DOE -- Geothermal Technology Division ($60,000).

Drilling and Engineering Program

Drilling operations continued to be hampered by problems as the well was deepened and downhole conditions became more hostile. Wellbore deviation, one of the major problem areas, was controlled by directional drilling. This was required in order to keep the well from deviating eastward from Kennecott's leasehold. This activity, which consumed a considerable part of the drilling budget, was terminated when agreement was reached with Unocal Geothermal to allow the well to deviate onto their property, provided Kennecott would not produce the well commercially.

Loss of fluid circulation was the major factor contributing to increased drilling costs. On numerous occasions, drilling ceased while efforts were made to control fluid loss by placing lost circulation material and cement in multiple zones of fluid loss. Drilling operations were most severely affected below 6,500 ft, where the well was drilled blind through five zones, and where only partial circulation was maintained throughout much of the remainder of this interval.

Two production zones were flow-tested in the SSSDP well. During the first test, completed just prior to this reporting period, a lost circulation zone encountered between 6,119 to 6,160 ft was flowed and sampled (see SSSDP Report of the 1st Quarter -- FY 86). The second flow test was conducted over a 38-hour period on March 20th and 21st. The test was implemented with responsibilities assigned according to the organization chart on Figure 3, and following the general proposed test program detailed in Table 3.

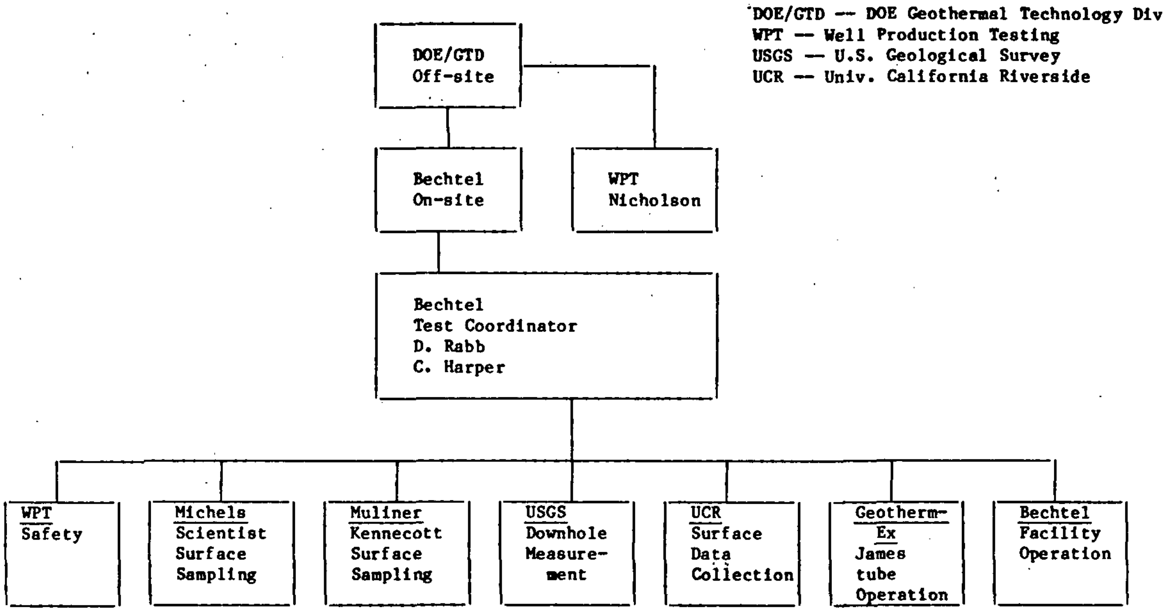

Figure 3: Flow Test Organization

On March 18 and 19, the wellhead and test tree equipment was installed. Early on March 20th, the 10-inch master valve was opened, and the well was allowed to flow for a hydro-test of all lines except the scientist's line of sampling spools. The flow passed initially through the small blooie line. Then, it was diverted through the main blooie line to the 1.1 million gallon brine-holding pond. After discharge of solids was found to be insignificant, flow was diverted from the blooie line through the James Tube, rock muffler, and weirbox. Rediversion to the blooie line was necessary after about 2 1/2-hours of flow in order to repair a leaking access door on the rock muffler, and to reinforce a weir plate in the weir box that was warped by high-temperature water flow.

Table 3: Salton Sea Scientific Drilling Program
Final Flow Test Schedule

ACTIVITY	HOURS	CUMULATIVE DAYS
Circulate & cool well, POOH*	10	
Rig-up USGS	2	
USGS log (Temperature/caliper)	10	
Rig-down USGS	2	1
Place sand plug	15	
RIH**, condition, POOH	12	2
Rig-up Schlumberger	2	
Schlumberger deep induction log	8	
Rig-down Schlumberger	2	
RIH and clean-out	10	3
RIH and place cement plug	24	4
Circulate and cool	12	
Rig-up USGS	2	
USGS log (Caliper/temperature)	5	5
USGS log (Televiewer)	10	
Circulate and cool	12	
USGS log (Sonic)	10	6
Rig-down USGS	2	
Condition hole and cool	12	7
Install 7" liner from 5,700 to 10,000'	32	8
RIH, drill-out cement plug	24	9
Displace mud with water	10	9.5
POOH, lay-down pipe	24	10.5
Install well head	24	11.5
Flow test	72	14.5
Post flow pressure/temp build-up	36	16
Downhole fluid sampling (Los Alamos/Sandia)	24	17
Fluid inclusion sampling (Bethke, USGS)	24	18
Reinject brine	48	20
Vertical seismic profiling (McKevilly, LBL)	36	21.5
Inject cool water	2	
Casing caliper log	4	
Downhole gravity (Hearst, LLNL)	36	23.25
Temperature log	12	23.75
Total	570	23.75

Begin shut-in period
Demobilize rig

* Pull-Out of Hole
** Run-In Hole

After switching flow back through the muffler, the scientist's sampling loop was opened at 3:45 p.m. However, fluid sampling was delayed while the sampling loop was tested and the orifice plates were changed, along with some gauges and valves. Maximum wellhead temperature and pressure recorded on March 20th were 243°C (470°F) and 448 psi, respectively. The well was flowed at rates of about 300,000 to 500,000 lbs/hr. Flowing enthalpy was estimated between 480 to 520 BTU/lb with a steam fraction of 0.4.

The maximum flow rate achieved for one hour on March 21 was about 700,000 lbs/hr at a wellhead pressure of 450 psi and temperature of 238°C (460°F). Enthalpy was estimated to be 480 BTU/lb. The highest wellhead temperature recorded on the 21st was 252°C (486°F) with a pressure of 500 psi.

Scientific Experiments Program

To achieve maximum scientific yield from the well, the recovery of core, cuttings and fluid samples was assigned the highest priority. In order to assist in the analysis of these samples and allow for the evaluation of zones in the well where no other data were collected, high priority was also assigned to obtaining geophysical logs and temperature data.

Core and Cuttings

A summary of the results of coring operations for this reporting period is shown in Table 4. Overall, core recovery was good during most of the drilling phase, but decreased as downhole conditions worsened with depth. Problems occurred primarily below 5,000 ft, where fractures within the formations caused drilling fluid to be lost, thereby reducing lubrication and cooling of the core bit and bottom-hole assembly. Excessive heat under these conditions greatly shortened equipment life. Core often became broken and lost from the barrel. Most commonly, however, it became jammed in the barrel and around the bit so tightly as to prohibit further penetration. Excessive lost circulation material

CORE #	INTERVAL CORED START (FT)	INTERVAL CORED END (FT)	TOTAL CORED (FT)	CORE RECOVERED (FT)	CORE RECOVERED (%)	GENERAL DESCRIPTION
18	6506.0	6517.0	11.0	11.0	100.0	Claystone: grayish, with minor epidote.
19	6758.0	6771.0	13.0	8.0	61.5	Sandstone and siltstone: grayish-green.
20	6880.0	6889.0	9.0	3.5	38.9	Mudstone: indurated, laminated dark grey to light grey.
21	7100.0	7109.0	9.0	7.0	77.7	Mudstone: indurated, with minor amounts of siltstone; authigenic minerals include chlorite, hematite, and anhydrite.
22	7300.0	7313.0	13.0	11.5	88.5	Mudstone: indurated, with minor amounts of siltstone; authigenic minerals include chlorite, hematite, and anhydrite.
23	7547.0	7577.0	30.0	28.5	95.0	Mudstone: medium grey, indurated, with a single narrow bed of epidotized siltstone.
24	7704.0	7734.0	30.0	30.0	100.0	Mudstone: moderately indurated, containing anhydrite porphyroblasts.
25	8133.0	8161.0	28.0	28.0	100.0	Siltstone: dark, with minor sandstone, contains mica and epidote along fractures.
26	8395.0	8402.0	7.0	7.0	100.0	Mudstone: black, containing chalcopyrite.
27	8585.0	8604.0	19.0	12.0	63.2	Sandstone: grey, with abundant epidote along inclined bedding.
28	8800.0	8807.0	7.0	4.0	57.1	Mudstone: primarily hornfelsic, minor quartzitic sandstones with greenchist facies alteration minerals.
29	9004.0	9027.0	23.0	4.5	19.6	Mudstone: primarily hornfelsic, minor quartzitic sandstones with greenschist facies alteration minerals.
30	9095.0	9098.0	3.0	3.0	100.0	Shale: with interbedded fine grained sandstone, numerous fractures lined with epidote, chlorite, pyrite, and pyrrhotite.
31	9248.0	9253.0	5.0	3.5	70.0	Mudstone: hornfelsic, with minor quartzose sandstone exhibiting greenschist alteration.
32	9453.0	9458.0	5.0	2.3	46.0	Mafic intrusive: fairly fresh, fine-grained diabasic texture, containing minor pyrite, epidote and quartz inclusions.
33	9458.0	9473.0	15.0	5.0	33.0	Mafic intrusive: aphanitic, containing brecciated contact with hornfelsic, epidote-rich mudstone.
34	9473.0	9477.0	4.0	2.0	50.0	Mudstone: hornfelsic.
35	9694.0	9698.0	4.0	3.5	88.0	Quartzite: epidote-rich.
36	9907.0	9912.0	5.0	.8	13.0	Hornfels: fractured, black, silicified and cherty.
Total			240.0	175.1	73.0	

Table 4: Coring Summary for the Reporting Period

and in-situ stresses may also have contributed to poor recovery of deep core.

Cuttings were recovered from all but about 650 ft of the drilled interval. Zones where cuttings samples were not recovered, due to total loss of circulation, are illustrated on Figure 1.

Fluid Samples

Another major part of the scientific program has been the collection of fluid samples. During this reporting period, fluid and gas samples were collected at the surface as part of scheduled activities during the second flow-test, and also immediately following the test using downhole samplers (Table 5). Generally, downhole fluid sampling proved to be a difficult task under the hostile conditions that were encountered in the well. Only one sampling run, out of a total of 9 runs, obtained pressurized fluid and vapor samples. One additional sampling attempt was successful in obtaining liquid, but no gas.

DATE	DEPTH(FT)	RUN	COMMENTS
3/22-23	10,400	LANL/Sandia #1	Seal failure - No Sample
3/23	10,400	LANL/Sandia #2	Seal failure - No Sample
3/23	10,400	Leutert #1	LCM clogged bullnose
3/23	10,200	Leutert #2	Canister failed to open
3/23	10,200	Leutert #3	O-rings failed
3/25	10,200	LANL/Sandia #3	No sample recovered
3/25	10,200	LANL/Sandia #4	1.5 liters-liquid, 0.5 liter-gas
3/25	10,200	LANL/Sandia #5	Bottle failed to open
3/25	10,200	LBL	1.0 liter unpressurized fluid

Table 5: Summary of Downhole Fluid Sampling

Geophysical Logs

Geophysical logs were obtained by the USGS research logging unit and by Schlumberger. However, the majority of logging during this reporting period was that of the USGS, as shown in Table 6. Schlumberger attempted a dual induction log on March 10, but the wellbore had become constricted at a depth of 8,819 ft, preventing the logging of the interval below. Most of the logging by the USGS, WRD unit was in obtaining temperature profiles before and immediately following flow testing. A temperature log obtained over a 5-hour period on March 8 and 9 recorded a temperature of 287°C (532°F) near 10,400 ft. At the end of temperature logging, an attempt to obtain a caliper log failed when the motor that operates the tool burned-out. The tool had been performing well at slightly lower temperatures.

DATE	LOG TYPE	ORGANIZATION	INTERVAL(FT)
2/15	Temperature	USGS	6,000 - 9,400
3/8-9	Temperature	USGS	0 - 10,500
3/9	Caliper	USGS	(Tool Malfunctioned)
3/10	Dual Induction	Schlumberger	6,020 - 8,819
3/12	Temperature	USGS	Tool hangs at 8,600
3/12-13	Televiewer	USGS	6,000 - 7,000
3/13-14	Acoustic Waveform	USGS	6,000 - 7,000
3/27	Temperature	USGS	0 - 10,200
3/29-30	Gamma Ray/Neutron	USGS	5,690 - 10,000
3/30	Casing Caliper	Dia-Log	0 - 5,700
3/31-4/1	Temperature	USGS	0 - 10,200

Table 6: Summary of Geophysical Logging

Another period of logging was attemped on March 12, using the temperature probe, caliper tool and acoustic televiewer, but a constriction in the well at 8,700 ft prevented the tools from being lowered further. After a 9-hour period at this depth, a maximum temperature of 225°C was recorded. The acoustic borehole televiewer was then lowered into the well, but logging was restricted to a short interval from 6,000 to 6,600 ft due to the deteriorating performance of the tool in the high temperature environment. An acoustic waveform log was obtained after repeated runs, from 7,000 ft to the casing shoe at 6,000 ft, on March 13-14. The log indicated good acoustic response within a competent rock unit separating two "production" zones.

A temperature log, using a platinum resistance thermometer run on MP35N, 7-conductor cable, was obtained by the USGS on March 27 following injection of brine produced from the flow test. The log revealed a temperature of 193°C (379°F) at a depth of 5,740 ft (near the hanger for the 7-inch liner). The temperature declined steadily with depth to a minimum value of 147°C (297°F) at 8,600 ft (the location of a major lost circulation zone). From this point downward, temperature increased to 190°C (374°F) near the base of the 7-inch liner and then rose rapidly to 278°C (532°F) at 10,220 ft, where the logging run was terminated in order to remain within the 300°C limit of the cable and probe.

On-site scientists suggested that the temperature minimum noted at 8,600 ft was the result of a lost circulation zone, or flow-zone, encountered earlier during drilling between 8,600 and 8,800 ft. This flow-zone may have yielded a significant volume of the fluid produced during the 38-hour flow test, since it was apparently a major recipient of the reinjected (cool) brine. During the flow test, fluid from this zone probably flowed out into the annulus between the wellbore and the 7-inch liner, and down the annulus to comingle with fluid from other flow zones below the base of the liner (10,136 ft). This combined fluid then flowed upward, through the liner and production casing to the surface. Part of the evidence cited for this hypothesis was the fact that during the second day of the flow test, when the flow-rate had been throttled back, there was a copious discharge of brown foam into the brine-holding pond. This foam contained diesel fuel that had been used as a lubricant on several occasions during drilling (particularly through the loss zones from 8,600 to 8,800 ft) and a large amount of lost circulation material. In view of this, the fluid sampled at the surface was likely contaminated by drilling additives. Further, the fluid was probably combined from multiple flow zones.

Final logging activities included gamma and neutron logs that were run on March 29-30 throughout the 7-inch liner, a Dia-Log casing caliper survey to 5,700 ft run on March 30, and a continuous temperature log run on March 31 to a depth of 10,200 ft.

Downhole Experiments

Downhole scientific studies in addition to seismic and gravity experiments included temperature, pressure and downhole flow measurements. Because of the extreme conditions that were anticipated in the SSSDP well--and because of the 300°C temperature constraint of the seven conductor, TFE-teflon insulated, MP35N armored cable--three mechanical, slickline tools (a temperature tool, pressure tool and flow tool) were obtained by Sandia National Laboratories from the Kuster Company. The tools were designed by Kuster in conjunction with Sandia, and were manufactured and assembled by the Kuster Company. In order to be effective in such extreme conditions, the tools were dewared. The high-temperature components were housed in an evacuated heat shield, and designed to function for at least ten hours at 400°C. Another slickline device developed by Sandia for the project was an electronic-memory, combination temperature and pressure tool that was designed to operate for eight hours at 400°C. The electronic tool was not used during this reporting period, but the mechanical tools were utilized on several occasions as follows:

- o March 21 - Kuster spinner and pressure tools were run in tandem to 5,000 ft. The spinner tool failed. The pressure tool worked.
- o March 21 & 22 - Kuster temperature and pressure tools were run in tandem to 10,000 ft. The temperature baseline was in error.
- o March 22 - Kuster temperature and pressure tools were run in tandem to a depth of 10,400 ft. A preliminary estimate from both Kuster T/P runs indicated a temperature of 353°C (667°F) and a pressure of 4,287 psi.

Other scientific experiments carried out in the well included (1) an experiment involving synthetic fluid inclusions by annealing quartz crystals, (2) a vertical seismic-profiling experiment, and (3) a downhole gravity experiment.

The fluid inclusion experiment was deployed in the well for an intended test period of 24 hours. The experiment package was lost, however, when the Otis slickline broke at the cable head because of corrosion. The package fell to the bottom of the well and could not be recovered.

While intermittently injecting fresh water to cool the well, a vertical seismic-profiling (VSP) experiment by scientists from Lawrence Berkeley Lab began at 1:00 p.m. on March 27 and continued until 8:00 a.m. on March 29. The detection unit was run into the well on the USGS 7-conductor cable, and radio communication was maintained between the hoist operator and the recording vans. The vibrator source was first located on the drill pad and then approximately 1/2 mile east on McDonald Road. Two good data sets were obtained.

A downhole gravity experiment was performed by researchers from Lawrence Livermore National Lab on March 30. The experiment was carried out with support from Edcon and Schlumberger, and conducted within the 9 5/8-inch cased part of the well. Cool, fresh water was periodicly injected during the experiment in order to protect delicate instrumentation. It was reported that good data sets were recovered.

Instrumentation Developed for the SSSDP

Due to the unique nature of SSSDP research, several downhole measurement and sampling systems were developed to support the overall scientific program. The systems, built under the direction of Sandia National Laboratories specifically for use in high-temperature corrosive environments, consisted of five slickline devices. The devices were (1) a mechanically operated pressure tool (2) a mechanically operated temperature tool, (3) a mechnically operated flow tool, (4) an electronic memory pressure/temperature tool, and (5) a power-pack to operate the down-hole fluid samplers fabricated for this operation by Los Alamos National Laboratory (LANL). Also acquired were two copies of a modified version of the fluid sampler originally developed by LANL. Certain specifications for these tools, which were used on an number of occasions, are shown below.

Mechanical Tools

- 3" diameter, 8' long, approximately 100 lbs a piece
- dewared to perform 10 hours at 400°C
- can be run in tandem

Pressure Tool

- Bourdon Tube
- 0-600 psi range
- 10 psi accuracy

Temperature Tool

- Bimental Element
- 0-425°C range
- 2°C accuracy

Flow Tool

- Spinner with rotating magnets
- Developmental Sensor, range and accuracy uncertain

Electronic Tool

- 3-1/2" diameter, 5' long, approximately 100 lbs
- deward to perform 8 hours at 400°C
- can be run with Kuster tool

Pressure Measurement

- Quartz crystal gauge
- 0-15,000 psi range
- 3 psi accuracy

Temperature Measurement
- RTD circuit
- 0-1100°F range
- 4°F accuracy

Memory
- Programmable time steps
- 3800 data points

Sampler Power-Pack
- 3-1/2" diameter, 4-1/2' long, approximately 75 lbs
- dewared to perform for 4 hours at 400°C
- can be run with Kuster tools
- programmable time delays
- designed to power LANL fluid sampler

Sampler (LANL)
- 3-1/2" diameter, 6-1/4' long, approximately 140 lbs
- dewared to perform for 4 hours at 400°C
- 2-liter capacity, side-port fluid entry
- can be run with Kuster tools
- can operate on conducting or non-conducting cable

Reporting of Scientific Results

In order to assure the maintenance of reasonable balance between early dissemination of information acquired during the SSSDP and respecting the rights of individual members of the SSSDP science team for publishing their own results, the Science Coordinating Committee (SCC) presented to the Executive Steering Committee (ESC) its recommendations for the reporting of scientific results. The recommendations are summarized as follows:

(1) Members of the groups conducting management, drilling and engineering, and scientific activities of the SSSDP were urged to combine on a paper, or papers, for presentation at the Geothermal Resources Council (GRC) annual meeting in the Fall of 1986, to be a status report of the activities of the SSSDP as of that time. If the remaining SSSDP schedule proceeds as planned, the well shut-in period should have just ended at the time of the meeting. Borehole lithology, logging, coring, and flow tests accomplished, parameters of the well drilled, drilling and logging problems encountered, temperature and fluid composition, and similar status-type information could be presented. However, no other results of scientific investigations need to be included at that time.

(2) It then would be desirable to have a public report of preliminary results of research investigations soon after the GRC meeting. This might be accomplished by a summary of the "letter reports to the Chief Scientist within 6 months of completion of the drilling of the well," according to the protocol. This should be a general summary of findings. It could be authored by the entire science team or by the Chief Scientist on behalf of the science team, and published in a fast turn-around news forum, such as the EOS publication of the American Geophysical Union.

(3) The protocol calls for a SSSDP conference within 12 months of the completion of the well and a proceedings volume of this conference. The SCC agreed that the Fall 1986 AGU meeting is an appropriate forum for such a conference, but this meeting may occur too early. Before this conference takes place, data should not be released outside the community of SSSDP investigators, and, except for the conference report, an embargo should be placed on all publication of data and interpretations. After the conference, all data should be placed in the public domain.

(4) Concerning reports of Department of Energy (DOE) San Francisco Operations Office contractors on behalf of DOE Geothermal Technology Division, primarily for field activities (including reservoir evaluation), these reports are an important component of the body of information resulting from the SSSDP, but, like other components, should not be publicly released until the time of the initial SSSDP conference. Included in this consideration are the reports being prepared by GeothermEx, Inc., that are to be delivered to DOE through Bechtel within three months of completion of the shut-in period following the end of the drilling of the well.

Proposed SSSDP Deepening and Flow-Testing

As the SSSDP approached the conclusion of the drilling phase, DOE project managers from the San Francisco Operations Office (DOE/SAN) working with the Site Coordinating Committee--the Bechtel Project Manager (Dr. Charles A. Harper), the Chief Scientist (Dr. Wilfred A. Elders), the On-site Science Manager (Dr. John H. Sass), DOE's on-site drilling consultant (Dr. Robert W. Nicholson of Well Production Testing), the Drilling Supervisor (Mr. Gerald W. Reich), and the Drilling Foreman (Mr. V.M. Gardiner) -- prepared an assessment of the scientific accomplishments to date and those that could be achieved by deepening the well and performing extended flow tests. The assessment and proposal, which was directed to the attention of DOE Headquarters officials, addressed the status of the current project and projected the costs vs scientific benefits for extending the well downward to between 13,000 and 14,000 ft. The salient points brought out by the assessment were:

- Temperatures (at a depth of 10,200 ft) have reached 353°C, and may go as high as 370°C at 11,000 ft.
- The well has penetrated massive lost circulation zones below 6,100 ft to total depth (10,564 ft). This depth range is of great interest to commercial operators in the Salton Sea Geothermal Field (SSGF).
- Highly metamorphosed sediments (hornfels, quartzite, etc.) have been drilled through. They are considered to be the result of very high temperature alteration of Salton Trough sediments by injection of magma, as new crust, into this continental spreading zone.
- The most significant scientific event has been the discovery and coring of two igneous intrusive bodies (dikes or sills) which are presumably related to the source of heat for the SSGF. The intrusives are considerably less altered than the enclosing 4.5 MY old sediments, suggesting that they are at least contemporaneous with, and more likely younger, than the geothermal system.
- The well is thought to have penetrated (at the present depth) into the upper margin of a sheeted dike swarm. Sheeted dike complexes are created during the formation of new crust, and lie above the magma softening zone (at approximately 6 km, or 20,000 ft).

The benefits to be gained from deepening and testing the well were summarized by the Science Team as follows:

- Deepening the well would allow for the investigation of a hotter (>350°C) regime in an, as yet, unknown part of the SSGF.
- Temperatures at 13,000 ft would possibly exceed 400°C, based on analysis of temperature data, and assuming that impermeable rocks (conductive gradient) are encountered to that depth.
- If this temperature is achieved, an important boundary of thermal metamorphism -- the greenschist - amphibolite boundary -- would be crossed (350-400°C).
- Many more igneous dikes, which are believed to be directly related to the magmatic heat source would be penetrated.
- Temperature gradient measurements from the deeper well might verify the depth of the base of the Salton Sea hydrothermal convection system; whether or not deeper, stacked systems exist; or if the system is driven by conductive heat transfer from the sides or from below.
- Flow-testing of deeper zones might produce hotter, less saline fluids of potential commercial importance.
- Current drilling methodologies could be improved to extend the temperature/pressure envelope for deep geothermal exploration.

A schematic diagram showing the details of the present well completion for the lower section is illustrated on Figure 4. If deepening were to proceed, modifications to the existing well design would be necessary. Figure 5 illustrates the modified well design for the lower section in the event of deepening.

A rough estimate of the costs associated with deepening the well was developed for three situations. The first two would have involved deepening the well to 13,000 and 14,000 ft, respectively, as a continuation of the project without releasing the rig. The third situation would necessitate waiting for FY87 funds to become available and then remobilizing the rig to deepen the well. A summary of the estimated costs is shown below for the latter situation.

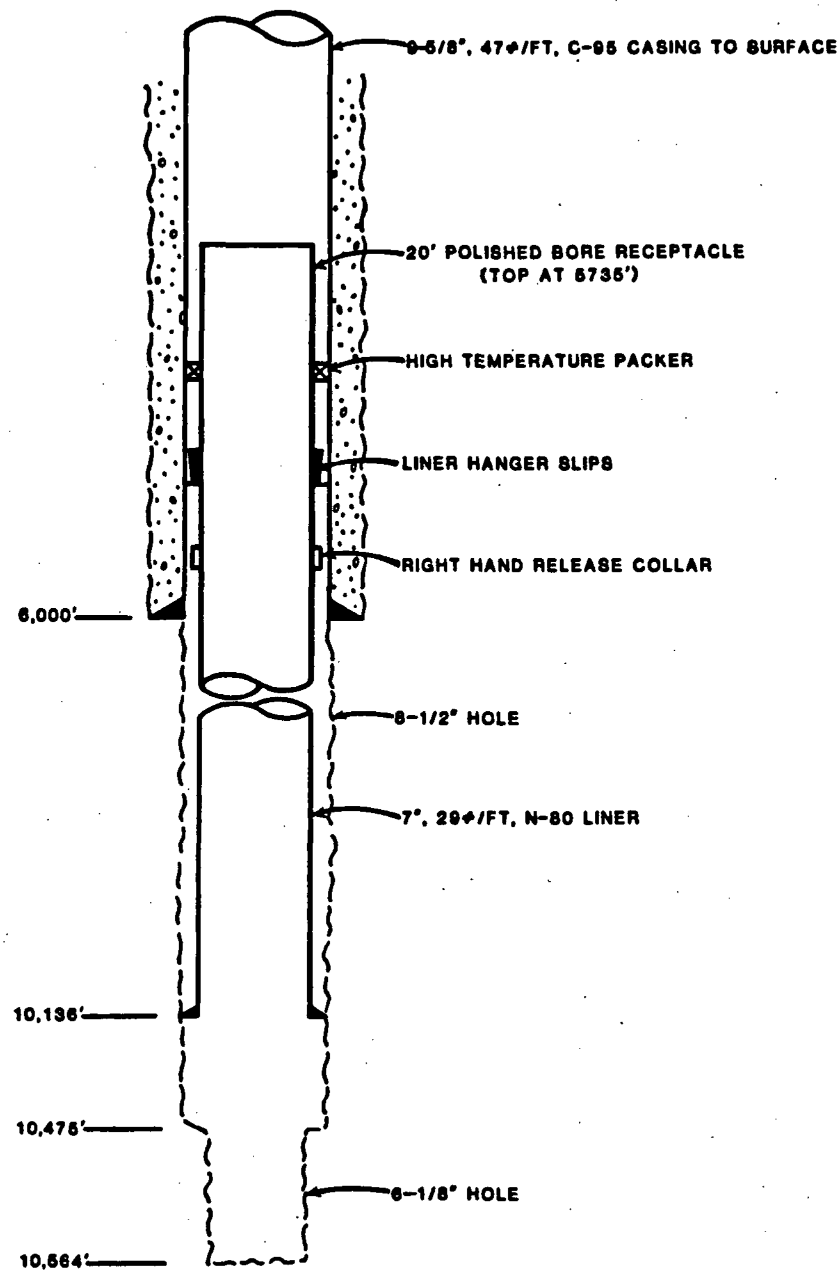

Figure 4: Well Construction Schematic: Lower Section

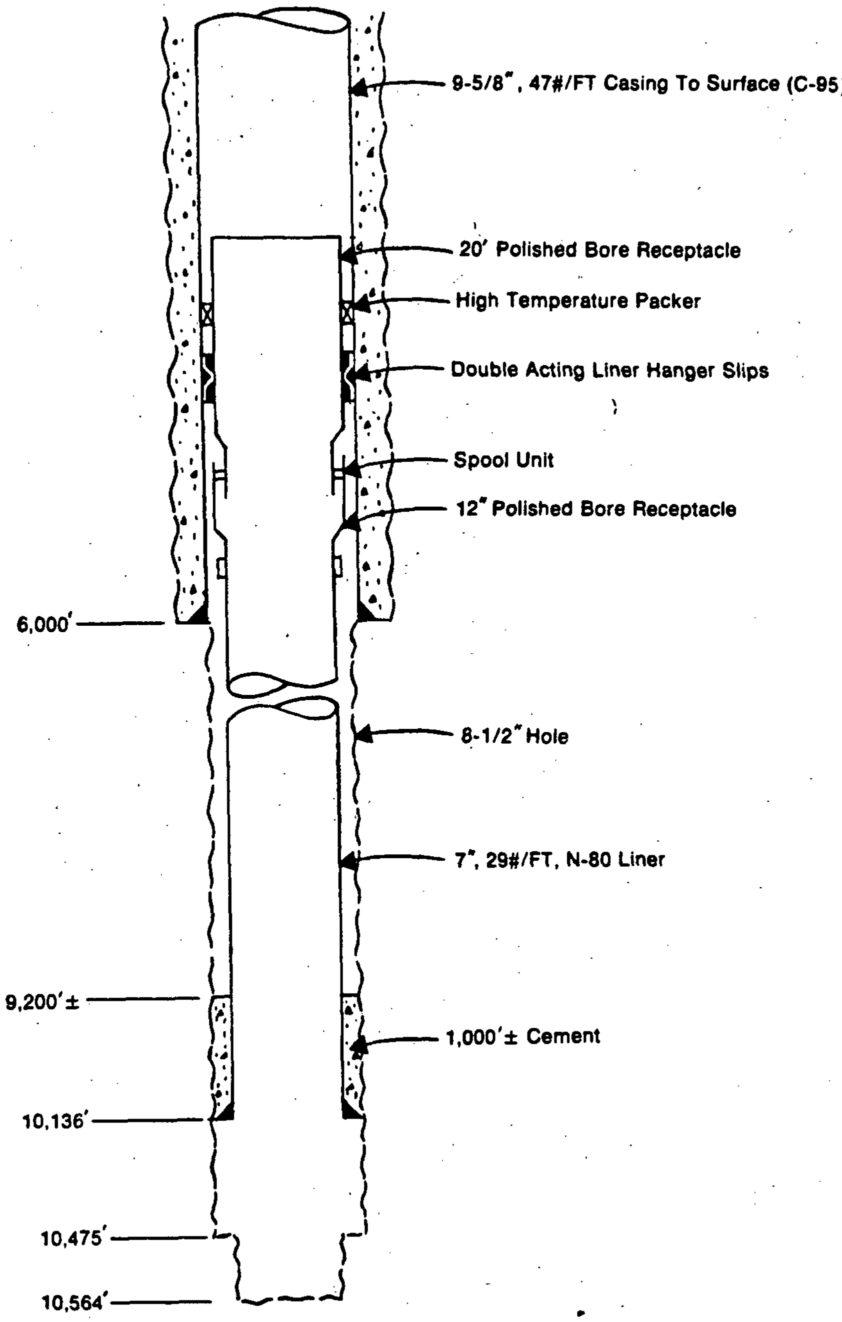

Figure 5: Well Construction Schematic: Lower Section - Ready for Well Deepening

Operation	Estimated Cost* ($x000)
Mobilize & demobilize rig	$ 500
Drill and core from 10,500 to 13,000 ft	450
Drill and core from 13,000 to 14,000 ft	300
Log interval from 10,500 to total depth (may not be possible due to limitations of tools), conduct flow test and reinject brine	130
Subtotal	$1,380
Contingency	200
Total	$1,580

* based upon estimated daily costs of $18,000 to $25,000 per day.

In addition to the costs shown above, it was estimated that additional scientific measurements and experiments would add between $500,000 and $1,000,000 to the total project costs.

Conducting a long-term flow test of one or more flow zones in the SSSDP well has been a major concern since the outset of the project. Performing a long-term test would not only provide geochemists with reliable fluid and gas samples, but would also provide much needed reservoir engineering data for an assessment of production characterisitics.

In assisting with these goals, Kennecott Corporation -- one of the industrial participants and the leaseholder of the project site -- through a letter to the DOE/SAN Project Manager, dated February 24, 1986, expressed interest and support for long-term flow testing. In this letter, Kennecott stated that they would consider contributing to a cost-sharing participation of an extended flow test of one or more potential production zones in the State 2-14 well. By way of participation, Kennecott proposed to drill a well at their own expense to be used for reinjection of the brine.

The proposed well (Wilson 1-12) would be located about 1 1/4 miles north of State 2-14, and be completed as a commercial well in order to qualify a prospecting permit for conversion to a State Land Commission Lease. Provisions could be made for performing a separate science program within the well (i.e. additional rig time, logging, etc.) similar to the program for State 2-14. The earliest start-up for such a project would be mid-1987.

SIGNIFICANT MEETINGS

Executive Steering Committee Meeting (1/30/86)

The eighth meeting of the SSSDP Executive Steering Committee was held at DOE headquarters in Washington, D.C. Major topics of discussion included the progress of drilling, acquisition of scientific data sets, on-site procedures, project costs, and reporting of results.

In addition, the Chief Scientist presented a video recording, prepared by the University of California-Riverside, of the first flow test performed within the interval from 6,120 to 6,227 ft.

Of particular importance was the report by the DOE/SAN Project Manager, which presented the estimated daily drilling costs of the program. The average daily costs presented were:

Drilling	=	$ 18,500
Coring	=	19,000
Logging	=	14,500
Flow testing	=	10,000
Standby Secured	=	6,000
Problem Day	=	24,000

Additional proposals for scientific studies would continue to be encouraged from researchers, and would be referred to the Chief Scientist for determing the feasibility of the investigations. However, no funds had been set aside for additional experiments, nor had action been taken to review any additional studies.

A review of activities surrounding the organizing, cataloguing, curating, and disseminating of downhole scientific information was presented. It was reported that cores and cuttings were being described and compiled as part of a parastratigraphic description. Core and cuttings were being temporarily curated at the University of California-Riverside. Other scientific activities reviewed included fluid sampling, geophysical logging and temperature measurements.

A number of operational items were also discussed. These included well completion designs, delegation of authority at the site, directional drilling and, among other items, the cost of additional commercial logging.

Site Meeting (2/5/86)

A meeting was held between representatives of DOE, the drilling supervisor, Chief Scientist, and Kennecott personnel to resolve several issues related to well completion. It was agreed that a 7-inch liner would be hung from about 5,800 ft to just above the flow zone, and that the top of the liner would have a polished-bore receptacle (PBR). Conditions to be met in order for Kennecott to assume responsibilty for the well were established. Establishment of these conditions allowed the transfer to drilling operations of some of the funds that had been set aside for plugging and abandoning (P&A) of the well, and complete site restoration.