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SALTON SEA SCIENTIFIC DRILLING PROGRAM

Fifth Quarterly Progress Report: Report of the First Quarter (October Through December) FY 1986

March 1986

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

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EXECUTIVE SUMMARY

The Salton Sea Scientific Drilling Program (SSSDP) is a major project within the context of the much broader Continental Scientific Drilling Program (CSDP). The SSSDP is being coordinated through a supplement to the "Interagency Accord" on Continental Scientific Drilling, a working agreement between the U.S. Department of Energy (DOE), the U.S. Geological Survey (USGS), and the National Science Foundation. The goal of the SSSDP is to address specifically scientific and technical issues related to the "roots" of a hydrothermal system within a continental spreading zone.

Drilling of the scientific well began on October 23, 1985, and initiated the many scientific activities associated with the project. Scientists at the wellsite began gathering what is expected to be the most comprehensive set of public data concerning deep hydrothermal systems ever to be assembled.

By the end of this reporting period, the well had been drilled to a depth of 6,227 ft, estimated equilibrium temperatures had exceeded 300°C, and several significant milestones had been achieved. Drilling, coring and logging operations were proceeding with excellent results. More than 550 feet of core had been recovered and several suites of "open-hole" geophysical logs had been acquired from the interval drilled. The single most significant event thus far in the program was the successful flow testing and fluid sampling of the 6,119 to 6,166 ft production zone. Participating geochemists were satisfied that nearly pristine fluid samples had been collected.

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INTRODUCTION

The Salton Sea Scientific Drilling Program (SSSDP), a scientific study of the "roots" of the hydrothermal system in the Salton Sea Geothermal Field (SSGF), is sponsored jointly by the U.S. Department of Energy, the U.S. Geological Survey, and the National Science Foundation, with Bechtel National, Inc. as prime contractor. The drilling phase of the program officially began on October 23, 1985, with the spudding of a deep scientific well near the southeast shore of the Salton Sea, a significant milestone in the context of the overall project. The SSSDP is being conducted as a supplement to the much broader Continental Scientific Drilling Program (CSDP).

A major objective is the acquisition of the most complete set of scientific data possible within existing budget limitations. Scientific activities associated with the SSSDP, excluding hardware development, consist of 27 funded projects and 5 projects requiring nonfunded access to the SSSDP samples. Data sets to be acquired will consist of cores, cuttings, geophysical logs from the USGS and a commercial logging company, and fluid samples from flow tests. Experiments include both surface and borehole geophysics, petrology, geochemistry of fluid and rock samples, and the study of bio-organisms in the deep hydrothermal system of the Salton Sea Geothermal Field (SSGF).

The well, which is planned to be drilled to a target depth of 10,000 ft, is scheduled for completion in March of 1986. During the drilling phase of the program, geophysical well logging, and recovery of core and fluid samples are the primary objectives. In order to obtain accurate temperature data to support the scientific experiments, the well will be shut in following completion for a period of about 6 months to allow the wellbore to approach thermal equilibrium. Upon completion of the program, the well will either be plugged and abandoned, or be turned over to the leaseholder, Kennecott Corp.

It is expected that results of the scientific experiments from this subsurface environment will contribute greatly to a better understanding of the Earth's thermal processes and the genesis of hydrothermal ore deposits.

PROGRAM PLAN

Current Program

In keeping with the technical and scientific goals of the program, the regulatory requirements imposed by the State of California and budget limitations, program activities have been planned to achieve maximum scientific return and meet production testing requirements. Coring, logging, flow testing and fluid sampling have been integrated for this purpose. The final program plan called for (1) providing a minimum of four open-hole logging periods for the U.S. Geological Survey and the commercial logging contractor (Schlumberger); (2) attempting to retrieve 750 feet of core above a depth of 6,000 feet and 900 feet of core below 6,000 feet; (3) collecting drill-cutting samples from uncored intervals -- every 30 ft above 3,000 ft, every 20 ft to 6,000 ft, and every 10 ft to total depth; and (4) performing three short duration flow tests to collect fluid samples and measure reservoir parameters.

The scientific well was spudded on October 23 at midnight. By the end of the reporting period (12/31/85), the well had been drilled to a depth of 6,227 ft; about 557 ft of core had been taken; the entire interval had been logged by both the U.S. Geological Survey and Schlumberger; and the first flow test had been completed.

A chronology of events is presented below.

Summary of Events

- o October 23 - The scientific well was spudded.
- o October 31 - The first coring point was reached after having set conductor casing (30 inch) to 150 ft and surface casing (20 inch) to 1,032

ft. The first core was taken from the interval 1,553 to 1,578.0 ft (100 percent recovery) and consisted of indurated mudstones. The temperature of the mud at this point was 135°F (57°C) which related to an estimated downhole temperature of 220°F (104°C). The drilling rate ranged from 50 to 100 ft/hr.

- November 1 - The second core was taken from the 17.5-inch hole between 1,983 and 2,013.0 ft, and consisted of indurated granule conglomerate, mudstone, and siltstone. Secondary minerals included calcite in veins, galena, sphalerite, and chalcopyrite. The drilling rate was 30 to 40 ft/hr.

- November 2 - The third core, consisting of indurated mudstone, siltstone, and minor sandstone, was taken between 2,448 ft and 2,478 ft. Some calcite veining was also noted in the core.

- November 4 - The fourth core was taken between 2,970 ft and 3,029 ft. The lithology consisted of fractured sandstone and claystone with epidote and chlorite. Calcite and pyrite occurred along open fractures. A loss of 200 barrels of drilling fluid was noted at this depth, probably due to the fracturing.

- November 5 - A suite of commercial geophysical logs was obtained from the interval 1,032 to 3,000 ft. The U.S. Geological Survey began running a suite of specialized logs for the same interval. A maximum temperature of 374°F (190°C) was obtained at bottom-hole (cooler than expected).

- November 7 - The USGS completed logging runs. All instruments functioned, with the exception of the acoustic borehole televiewer that could not record properly in the large diameter mud-filled wellbore.

- November 8 - The hole was reamed to 17 1/2 inches in diameter from 3,000 ft to a depth of 3,030 ft. Drilling resumed to 3,078 ft where two roller cones from the bit were lost in the well. The lost cones were retrieved with a "junk" basket along with 7 feet of core (core #5).

- November 10 - Drilling was resumed, and the 6th and 7th cores were recovered from 3,107 to 3,167 ft and 3,470 to 3,505 ft, respectively. The 6th core was predominantly sandstone characterized by abundant epidote and chlorite alteration. Claystone was predominant in Core #7. A wellbore deviation of 3°45'N 33°E was measured.

- November 13 - A second suite of Schlumberger geophysical logs were obtained from 3,000 to 3,515 ft and a questionable bottom-hole temperature of 358° F (181° C) was measured, using bare Kuster tools.

- November 15 - The 13 3/8-inch casing was set to 3,515 ft and cemented. The cement bond was only partially achieved between 830 and 3,230 ft with no cement from 180 to 830 ft. It was decided to set and test the blow-out prevention stack and drill ahead with the 12-1/4 inch bit.

- November 20 - Total well depth reached 4,067 feet, with cores #8 and #9 having been taken from the intervals 3,790 to 3,850 ft and 4,007 to 4,067 ft, respectively. Cores #8 and #9 were largely indurated mudstones

with some granule conglomerate, sandstone and siltstone. The USGS measured a temperature of 400°F (204°C) at 3,790 ft.

- o November 22 - The 10th and 11th cores were recovered from the intervals 4,241 to 4,301 ft and 4,301 to 4,337 ft, respectively. The upper part of core #10 was indurated mudstone and granule conglomerate, similar to cores #8 and #9. The lower part of core #10 and the upper part of core #11 consisted primarily of sandstone with calcite, epidote and sulfide-bearing veins. Directional surveys indicated that the wellbore was trending 3°45'N 30°E.

- o November 26 - Core #12 showed that the interval from 4,643 to 4,676 ft was predominantly sandstone and siltstone, containing abundant epidote and hematite veins. After taking this extensively fractured core, the USGS recorded continuous bottom-hole temperatures, measuring a maximum temperature of 414°F (212°C) at 4,676 ft. Equilibrium temperature estimates ranged from 260 to 309°C. Core #13 was then cut from 4,676 to 4,686 ft, where the core barrel jammed. Core #13 consisted of 2 feet of fractured, epidotized sandstone and siltstone containing thin (1 cm) veins of specular hematite, and large chalcopyrite crystals.

- o November 27 - The decision was made to run a "mini-injection" test of the interval 3,515 to 4,710 ft. By pumping 200 barrels of 2% KCl solution into the wellbore, hydraulic connection and flow were expected to be achieved. The operation was unsuccessful. After resuming drilling operations, four welded stabilizers broke off at a depth of 4,718 ft. Fishing operations resulted in no recovery of junk, but 1-foot of epidotized rock (core #14-4,718 to 4,718.6 ft). At 4,943 ft, drilling engineers began adding 6 percent diesel oil to the drilling fluid to prevent sticking and enhance penetration properties.

- o December 1 - Core #15 was cut from 5,188 to 5,218 ft. It consisted of black, aphanitic, indurated mudstone with pyrite. Directional surveys on December 2nd indicated that wellbore deviation had increased from 4°45'N 58°E to 6°15'N 73°E, at depths of 5,228 and 5,336 ft.

- o December 3 - A full-scale injection test was performed on the open-hole interval from 3,515 to 5,422 ft. About 1,000 barrels of 2% KCl solution were injected and pressured to 1,500 psi for 45 minutes. Pressure declined to 320 psi. Additional tests yielded similar results. It was concluded that permeability was insufficient to sustain flow. Therefore, the first scheduled intermediate flow test was cancelled.

- o December 5 - After drilling to 5,424 ft, a drill collar twisted off at 5,108 ft. The severed drill collar was recovered and drilling resumed at 5:00 a.m., December 6.

- o December 7 - The 16th core was recovered from the depth interval 5,574 to 5,591 ft. It consisted of black, aphanitic, indurated mudstone with pyrite. A deviation survey at 5,564 ft indicated a wellbore deviation of 7°30'N 76°E.

- o December 9 - Schlumberger and the USGS obtained geophysical and mechanical

logs of the open-hole depth interval between 3,515 and 6,000 ft. Borehole deviation increased to 8°15'N 78°E at 6,000 ft.

- December 13 - The well was reamed, and the 9 5/8 inch casing string (137 joints) was run to 6,000 ft and cemented in two-stages (1st stage -- 3,315 ft to 6,000 ft, 2nd stage -- surface to 3,315 ft). Bottom hole location was calculated to be 240.09 ft, N 45°48' E of the surface location.

- December 17 - Drilling resumed and core #17 was cut between 6,026 and 6,044 ft. At total depth, a significant pressure drop and decreased drill string weight of 20,000 lbs occurred. The drill stem had twisted off leaving 10-6 1/4-inch drill collars and the core barrel (341 feet total) in the well. Recovery was accomplished, including 17 ft of core. The core was composed of mudstone with minor epidote. To decrease torque, 120 barrels of diesel oil were added to the 8.8 ppg (pounds per gallon) mud.

- December 19 - A downhole mud motor (turbodrill) was run into the hole with the bit and a series of attempts were begun to correct the wellbore deviation problem. The first attempt was unsuccessful, but successive attempts using a new motor were successful. The bit and turbo mandrel were lost in the hole at 6,112 ft, but were later recovered.

- December 21 - Turbodrilling continued to 6,166 ft, as borehole deviation was changed from 7°15'N, 87°E at 6,086 to 4°30'S 86°E at 6,153 ft. While drilling from 6,119 to 6,166 ft, 34 to 66 barrels of drilling fluid were lost per hour to the formation. The well was deepened to 6,227 ft, as directional drilling continued. Drilling fluid loss decreased to 2-20 barrels per hour below 6,166 ft. The high loss of drilling fluid and evidence from drill cuttings resulted in the decision to flow test. The drilling fluid was replaced with water, the blow-out preventer stack was replaced with a test tree and the rig was placed in standby-secured mode until after the test.

- December 28 - A full-scale flow test of the interval from about 6,119 to 6,166 ft was begun. The well was stimulated with nitrogen and flowed at the rate of about 475,000 lbs per hour. At full flow, wellhead temperature and pressure were 220°F (104°C) and 180 psi, respectively. The well was placed "on choke" in order to modify the weirbox from "V" to rectangular notch to accommodate the higher flow rate. On choke, the wellhead temperature was 450°F (232°C) and the wellhead pressure was 450 psi.

- December 29 - Vapor and fluid samples were successfully collected at the surface from a specially designed facility consisting of four in-line sets of sampling ports. Preparations to conduct downhole pressure and temperature measurements during flow were started. These measurements were cancelled when the well was shut-in for three hours to repair a leak above the main valve of the test tree. The flow test was subsequently resumed using the modified weirbox and James tube, but was hampered by salt encrustation and back pressure.

- December 30 - A second period of fluid sampling at the surface facility was conducted, and downhole pressure and temperature measurements were

made using "Dewared" Kuster tools during flow and shut-in. The maximum bottom-hole temperature was 581°F (305°C) and maximum pressure was 2,492 psi.

- o December 31 - Three downhole fluid sampling runs were made into the well using the LANL fluid sampler. The first two runs were made using the high-temperature 7-conductor cable to 6,120 and 5,000 ft, respectively. Due to electrical problems, the inlet valve failed to open on the first run and failed to close on the second. The third run was made on slick line to 6,120 ft using the Sandia battery pack as a power source. Only 30 ml of fluid were retrieved during the three attempts because of salt encrustation of the valve ports. This probably occurred as the heated brine flashed into the two-liter sample chamber. Overall, project scientists were satisfied with the results of this flow testing and fluid sampling operation, and the flow test was terminated.

Status of Funding

Since the outset of the program, when Congress appropriated $5.9 million in September of 1983, a number of funding-related events have necessitated changes of approach and rescoping of program elements. The original contract for the Drilling and Engineering program was awarded to Bechtel National, Inc. for $5.3 million in September of 1984. In January of 1985, new cost projections, based upon reevaluation of existing program elements, indicated that large cost overruns would occur. This resulted in DOE's San Francisco Operations Office (DOE/SAN) issuing a "stop work" order to Bechtel. Subsequently, the program was rescoped, eliminating some of the original elements and adding some new ones. This led to a revised SSSDP program estimated to cost $6.2 million. A renegotiated contract of $6.1 million was then established. The House Appropriations Committee extended funding for FY-1986. This House action was endorsed by the Senate Appropriations Committee as follows:

> The Committee directs that the Department continue, not less than $1,000,000, within available funds, to pursue the initiative begun in FY 1984 to drill a deep research well in the Salton Sea Geothermal Field to aid in understanding of future geothermal resources and for other scientific purposes.

A breakdown of the distribution of the FY 1986 funds is:

Appropriated by Congress, including $500K initially requested by DOE/GTD.	$1,000K
DOE Headquarters management initiatives.	- 100K
	$ 900K
FY86 incremental funding of drilling and engineering operations:	- 795K
$6,099K - Renegotiated contract price (FY 85)	
+ 446K - for flow tests at 3,000 ft and 6,000 ft; a suite of commercial logs; and for a 2-month extension of post-drilling access to the well (6-months total).	
$6,545K	
-5,750K - from FY 84 and FY85 funding	
$ 795K	$ 105K
To USGS for reservoir properties studies	- 55K
To Sandia for an Electronic Memory-Temperature and Pressure Tool	$ 50K

Drilling and Engineering

Major activities of the drilling and engineering phase of the program have centered on downhole measurements in, and flow testing and sampling of the well. Much concern was expressed early in the program planning stages about the limited budget for flow testing and fluid sampling. Recognition that a significant number of scientific experiments depended upon collection of near pristine fluid samples increased markedly the need for a strong testing and sampling program.

The final plan approved prior to drilling included three short-duration flow tests. The first test, scheduled to occur at the first zone of lost circulation below 3,000 ft, was cancelled after two unsuccessful injection tests were conducted within the interval 3,515 to 5,422 ft. Tests of this interval indicated that permeability was too low to sustain production.

The second flow test was planned for the first lost circulation zone below 6,000 ft. On December 21st, as directional drilling was proceeding to correct for wellbore deviation, a significant loss of drilling fluid (34-66 barrels per hour) occurred between 6,119 and 6,166 ft. The loss of drilling fluid decreased to 20 barrels per hour or less, as directional drilling proceeded to 6,227 ft. At this time, the decision was made to flow test an estimated 45 ft of this open-hole interval. Accordingly, the blowout preventer was removed and replaced by a "test tree." The drilling fluid in the well was replaced with a dilute $BaCl_2$ solution, and a temperature log was run on December 24. Connections were made from the wellhead to the brine handling facility and a second temperature log was run on December 27. An equilibrium temperature of 305°C was estimated. On the afternoon of December 28, after a wellhead pressure of 160 psi was measured, the well was opened to discharge into the mud pit. Wellhead temperature at this time was 93°C (199°F). The well was stimulated with nitrogen to induce flow that evening for a period of 10 minutes, after which the well was capable of flowing without stimulation. For the next three hours, the well flowed at a rate of about 475,000 lbs/hr at 220°F (104°C) and 180 psi. After it was determined that the weirbox could not handle the volume of fluid, flow was choked back and the wellhead pressure increased to 450 psi. Wellhead temperature at this point was 450°F (232°C). The weirbox was then modified by changing from "V" notch to rectangular notch to accommodate the higher flow rate. Enthalpy measurements using the James tube, which also required modification, were made difficult by back-pressure and rapid salt encrustation.

On December 29, about 20 scientists and technicians were on site to collect fluid and vapor samples from the surface fluid sampling facility (Figure 1). Measurement of downhole temperatures and pressures, using Dewared Kuster tools, was attempted by researchers from Sandia National Laboratories. The first

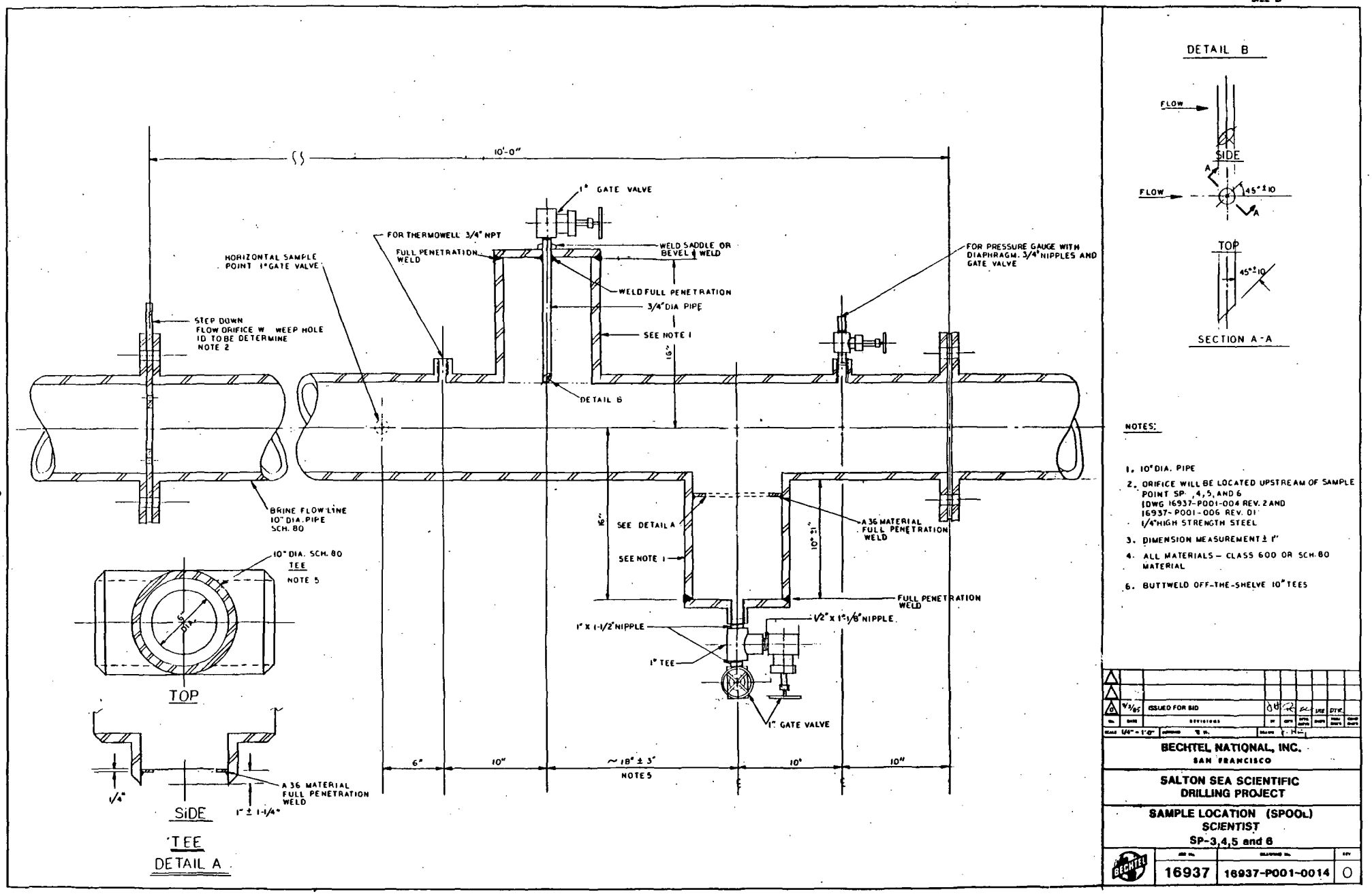

Figure 1: Specifications for SSSDP Surface Fluid Sampling Facility

attempt was aborted after it was found that steam was escaping from a flange immediately above the master valve on the wellhead unit. After wellhead repair and additional fluid sampling, Sandia personnel performed downhole flowing and shut-in pressure and temperature measurements, using the Dewared Kuster tools. The well was shut in at 1700 hours to measure pressure and temperature build-up. The tools were retrieved at 2400 hours and read. Maximum recorded temperature was 581°F (305°C) and the maximum recorded pressure was 2,492 psi.

A coring summary for the reporting period is shown in Table 1. From a total of 581.2 ft of core drilling, 545.3 ft of core was recovered for an overall recovery factor of 98.1 percent. Filling the core barrels used (720 ft total length or 6 x 30 + 9 x 60) has been hampered largely by jamming of the barrels with the fractured and altered sedimentary rocks being cored. Original coring plans had scheduled about 800 ft of coring above the depth of 6,000 ft.

CORE #	INTERVAL START (FT)	CORED END (FT)	TOTAL CORED (FT)	CORE RECOVERED (FT)	(%)	GENERAL DESCRIPTION
1	1553.0	1577.6	24.6	24.6	100.0	Mudstone: indurated.
2	1983.0	2013.0	30.0	30.0	100.0	Conglomerate: Indurated granular, minor mudstone and siltstone, with calcite veins, galena, sphalerite, and chalcopyrite.
3	2447.0	2477.0	30.0	30.0	100.0	Mudstone and siltstone: indurated, with minor sandstone, some calcite veining
4	2970.0	3030.0	60.0	59.6	99.3	Sandstone and claystone: fractured, with epidote and chlorite, and contains sulfide-bearing veins with well crystallized chalcopyrite, and traces of hematite.
5	3080.0	3087.0	24.0	0.0	0.0	Rock recovered with junk.
6	3107.0	3167.0	60.0	55.0	91.0	Sandstone: laminated, containing pyrite and calcite veins, epidote, and chlorite.
7	3470.0	3505.0	35.0	34.0	97.0	Claystone: minor calcite veins and traces of disseminated pyrite.
8	3790.0	3850.0	60.0	57.0	95.0	Mudstone: indurated, some granular conglomerate, sandstone and siltstone, scarce veining.
9	4007.0	4067.0	60.0	61.0	100.0	Mudstone: indurated, some granular conglomerate, sandstone, and siltstone, scarce veining.
10	4241.0	4301.0	60.0	59.0	100.0	Mudstone:indurated, granular conglomerate, sandstone and siltstone, anhydrite porphyroblasts, lower part contains calcite, epidote, and sulfide veinlets.
11	4301.0	4334.0	33.0	33.0	100.0	Sandstone: with calcite, epidote and sulfide-bearing veins.
12	4643.0	4676.0	33.0	33.0	100.0	Sandstone and siltstone: abundant epidote with specular hematite in veins, extensively fractured.
13	4676.0	4686.0	6.0	3.5	59.0	Sandstone and siltstone: contains much epidote, 1 cm veins of specular hematite, and large chalcopyrite crystals.
14	4718.0	4718.6	0.6	0.6	100.0	Mudstone: epidotized (rock recovered with junk).
15	5188.0	5218.0	30.0	30.0	100.0	Mudstone: black, aphanitic, indurated with pyrite.
16	5574.0	5591.0	17.0	17.0	100.0	Mudstone: indurated, with brecciated fractures, abundant epidote and hematite, and traces of sulfides.
17	6026.0	6044.0	18.0	18.0	100.0	Mudstone: some epidote, with quartz veins and traces of pyrite.
** TOTAL **			581.2	545.3		

Table 1: SSSDP Coring Summary

Sandia National Laboratories, in addition to providing the downhole pressure, temperature and flow measurement tools for the project, are planning to assist with the testing of new commercial downhole temperature and pressure probes. This equipment, developed by Downhole Systems, Inc., will be tested during the shut-in phase after completion of the scientific well.

Scientific Experiments

In affirming the roles of the Federal participants in the SSSDP, the USGS, DOE, and NSF agreed in November 1985 to add a Salton Sea Scientific Drilling Program supplement to the Interagency Accord on Continental Scientific Drilling. A summary of the supplement is as follows:

- o Collaboratively, the agencies will arrange to constitute and conduct a program of scientific experiments and analyses.
- o The principal objectives of this scientific program are to carry out a series of coordinated scientific studies and related activities, centered on the availability of the geothermal research well that will be drilled in the Salton Sea geothermal field during 1985-86. It is expected that researchers from universities, national laboratories, Federal agencies, and industry will participate in the scientific program and provide data contributive to the overall program goals of the parties hereto.
- o It is planned (i) to obtain cores at various depths, (ii) to take cuttings at certain intervals, (iii) to extract fluid and gas samples, (iv) to make various downhole measurements, and (v) to engage in other related scientific and technical activities.

    (1) Management of the scientific activities shall be coordinated with the management of the drilling and engineering operations in accordance with the SSSDP Management Plan.

    (2) The Department of Energy shall use its best efforts to help assure that pertinent functions of its Office of Basic Energy Sciences, Office of Renewable Energy Technologies - Geothermal Technology Division (GTD), San Francisco Operations Office, and its contractors engaged in the Salton Sea geothermal drilling and engineering operations are suitably coordinated to enable the effective conduct of these operations in harmony with the scientific activities.

o Current activities of the parties hereto include:

Nature of Activity	Funded by *	Estimated Cost **
Drilling and Engineering Operations		
(1) Scoping and site preparation	DOE/GTD	$1,600,000
(2) Drilling and coring	DOE/GTD	3,500,000
(3) Flow test, standby, and site abandonment	DOE/GTD	1,100,000
(4) Drilling and engineering consultant	DOE/GTD	163,000
Scientific Activities		
(1) Geochemistry	DOE/BES	$ 55,000
	NSF/EAR	174,000
	USGS	165,000
(2) Petrology	DOE/BES	150,000
	NSF/EAR	280,000
(3) Geophysics	DOE/BES	310,000
	USGS	175,000
(4) Bio-organic	USGS	70,000
(5) Science-related tools and equipment	DOE/GTD & USGS	667,000

* DOE/GTD - Department of Energy/Geothermal Technology Division
DOE/BES - Department of Energy/Office of Basic Energy Sciences
NSF/EAR - National Science Foundation/Division of Earth Sciences
USGS - U.S. Geological Survey

** FY-1984 and FY-1985, exclusive of Agency administrative costs.

The overall scientific experiments plan is comprised of 31 activities that include geochemistry, geophysics, petrology and bio-organic studies. Most of the activities involve the study of rock and fluid samples obtained during the drilling phase, and are funded and will be performed separate from the Drilling and Engineering program. Five of the scientific activities involve the study of borehole geophysical records obtained during the drilling phase, including both research and commercial geophysical logs. In addition to three logging periods by Schlumberger (Table 2), the U.S. Geological Survey has obtained logs of the intervals 1,032 to 3,000 ft and 3,515 to 6,000 ft. A summary of USGS

DATE:	11/5/85
INTERVAL LOGGED:	1,032 ft to 3,000 ft
LOGGING PERIOD:	15-hour period beginning approximately 6:00 A.M.
LOG TYPES:	o Dual Induction Log o Formation Compensated Density Log o Compensated Neutron Log o Gamma Ray Log o Sonic Log o 4-Arm Caliper Log*

* 3 runs, average borehole diameter - 19.5 inches

DATE:	11/13/85
INTERVAL LOGGED:	3,000 ft to 3,515 ft
LOGGING PERIOD:	14-hour period beginning approximately 10:00 A.M.
LOG TYPES:	o Dual Induction Log o Formation Compensated Density Log o Compensated Neutron/Gamma Ray Log o Sonic and Gamma Ray Log o 4-Arm Caliper Log

DATE:	12/9/85
INTERVAL LOGGED:	3,515 ft to 6,000 ft
LOG TYPES:	o Dual Induction Log o Formation Compensated Density Log o Compensated Neutron Log o Gamma Ray Log o Sonic Log o 4-Arm Caliper Log

Table 2: Schlumberger Logging Periods

logging activities is shown in Tables 3 and 4. The complete logging plan for the program is shown in Table 5.

Log Type	Date	In Hole	Out of Hole
Resist temp.	11 - 5	09:00	13:00 (before circulation)
Natural gamma	11 - 5	21:00	23:00 (2-sec time const.)
Resist temp.	11 - 6	04:00	10:00 (after circulation)
Caliper	11 - 6	04:00	10:00
Televiewer	11 - 6	11:00	13:00 (no useful logs)
Resist temp.	11 - 6	13:00	17:00 (many stationary readings)
Caliper	11 - 6	13:00	17:00
Acoustic DT	11 - 6	18:00	21:00 (3-ft spacing)
Acoustic DT	11 - 6	21:00	23:00 (2-ft spacing)
Waveform	11 - 7	01:00	03:30 (2-microsec. sampling)
Resist temp.	11 - 7	04:00	06:00 (stationary readings temp vs. time)
Natural gamma	11 - 7	08:00	11:30
Gamma spec.	11 - 7	08:00	11:30 (spectrum at 5 depths)
Resist temp.	11 - 7	12:30	14:30 (stationary readings at bottom)

Table 3: Chronology of USGS Logs for the Logging Period 11/5/85-11/7/85; 1,032 to 3,000 ft.

LOG TYPE	DATE	TIME IN	TIME OUT	COMMENTS
Resis temp	12-4	24:00	14:00	Stationary readings on bottom
Resis temp	12-9	21:15	03:00	Stationary readings on bottom
Resis temp	12-10	14:00	18:00	
Caliper	12-1	18:00	20:00	
Televiewer	12-10	20:00	22:00	No pictures below casing
Nat gamma	12-10	22:00	02:00	
Gamma spec	12-11	02:00	04:00	Analyzer failed after one spec.
Acoustic DT	12-11	05:00	11:00	Poor analog record
Waveform #1	12-11	11:00	14:00	Total waveform
Waveform #2	12-11	14:00	17:00	Magnified first arrival
Caliper	12-11	17:00	19:00	Tool hangs near 4700 ft
Resis temp	12-11	19:00	24:00	Tool hangs near 5100 ft
Caliper	12-12	12:00	15:00	
Neutron	12-12	15:00	18:30	

Table 4: Chronology of USGS Logs for the Logging Period 12/4/85-12/12/85; 3,515 to 6,000 ft.

Approx. Date	Depth	*Log*	*Operator*
Oct. 3		Spud Date	
Nov. 4	3,000' ±	Production Logs	Contractor
		USGS Geophysical Logs	Morin
Nov. 15		Casing (13 3/8")	
		Cement Bond Logs	Contractor
Nov. 22	3,500' ±	Production Logs	Contractor
	5,500' ±	Bottom Hole Temp.	WRD or bare Kuster in drill pipe or deward Kuster in open hole (depends on temp.) - Sass
Dec. 20	6,000' ±	Bottom Hole Temp.	Deward Kuster, slickline, openhole - Sass
		Production Logs	Contractor
		USGS Geophysical Logs	Morin
		Casing (9 5/8")	
		Cement Bond Logs	Contractor
Dec. 28	6,200' ±	Temperature log	Deward Kuster tools, - Sass
		Flow Test	Temp., pres., flow - deward Kuster, open hole, slickline - Contractor
		Fluid Sampling	Post-flow test, GD hoist - Sass
		Borehole Televiewer (?)	Morin
	7,000' ±	Bottom Hole Temp.	Deward Kuster, openhole, GD hoist - Sass
	8,000' ±	Bottom Hole Temp.	Deward Kuster, openhole, GD hoist - Sass
	9,000' ±	Bottom Hole Temp.	Deward Kuster, openhole, GD hoist - Sass
Apr. 7	TD (10,000')	USGS Geophysical Logs (?)	Morin, (depends on temp.)
		Set 7" Liner	
		Release Rig	
		Temp Log	Electronic temperature Tool - Sass
		Flow Test	Temp., pres., flow - deward Kuster, openhole, slickline - Contractor
		Fluid Sampling	Post flow test, GD hoist - Sass, F. Goff
		Vertical Seismic Profiling	McEvilly
		Gravity	Hearst
		Fluid Inclusion Sampling	GD hoist, Bethke, Sass
		Serial Temp. logs	Electronic temperature tool, - Sass

Table 5: REVISED LOGGING PLAN fOR SSSDP

SIGNIFICANT MEETINGS

Site Meetings (10/21/85)

Meetings were held on the afternoon of October 21 and on the following day to acquaint representatives of Kennecott, Bechtel, DOE, and project scientists with the design and operation of the flow-test facilities. From these meetings, a committee from the project participants was formed to establish criteria for deciding when to conduct flow testing. In the interest of safety, responsibilities were also delegated for a number of activities during periods of flow testing.

Science Coordinating Committee (SCC) Meeting (11/22/85)

A meeting was held at NSF to discuss a number of items regarding, among others, (1) requests for new science projects, (2) the future role of the Scientific Experiments Committee (SEC), and (3) DOE/GTD plans for FY 86 funding of SSSDP activities. A number of questions were raised concerning appropriate replies to inquiries from additional researchers who want to become involved in the SSSDP. The following points summarize these discussions:

- Researchers can continue to propose SSSDP scientific projects to NSF and to DOE/OBES (the USGS has no external program for continental scientific drilling, and DOE/GTD conducts its external program through DOE National Laboratories); but neither agency has been appropriated FY 86 funds for the SSSDP, nor have they set aside FY 86 funds for additional SSSDP research, as they did for the initial science package last year. These new proposals would need to address FY 86 program objectives of a participating agency in order to be considered for funding.

- Anyone interested in proposing new SSSDP projects should first discuss them with the Chief Scientist (Dr. Wilfred Elders) to find out how their proposed research would fit into the current SSSDP science package and to determine technical feasibility. The SCC would lend assistance in this matter. In addition to the Chief Scientist, members of the SCC who could lend assistance with inquiries for scientific research are as follows:

  - Mike Mayhew - National Science Foundation
  - Ed Schreiber - DOE/OBES
  - Don Klick - USGS (USGS inquiries only)
  - Ray Wallace - DOE/GTD (geothermal technology related studies only)

- There will be no joint SCC action to evaluate new SSSDP proposals for funding in FY 86, but the SCC will continue to coordinate proposals received by the Agencies for SSSDP research and would seek the SEC's advice on them. They would be evaluated for funding within the receiving Agency, using that Agency's existing proposal review process.

- Proposals submitted and evaluated last year that were not accepted for funding have been formally declined.

The SCC also identified six tasks for which the SEC/Chief Scientist will be responsible. These tasks are:

- Evaluating new proposals on behalf of the SCC for SSSDP relevance and technical feasibility.

- Advising the SCC about procedures for announcing the availability of records and samples, and about procedures for funded researchers to obtain records and samples.

- Suggesting to the SCC policies for charging requestors the costs of reproducing well logs and other records.

- Organizing and conducting the SSSDP conference planned to take place 12 months after completion of the well; assisting in preparation of the conference proceedings volume.

- Advising the SCC on activities, options, and trade-offs involving the use of the well after completion.

- Assisting in the preparation of a case history of the SSSDP for use in future continental scientific drilling activities.

Site Review and Inspection of Drilling Operations (12/7/85)

A review and inspection of drilling operations was held at the well-site near Niland, California. The major topics reviewed were the status of drilling operations and of program funding by the agencies involved. At the time of the review, the major scientific concerns were (1) lower than expected well-bore temperatures, and (2) failure to encounter adequate production zones. The major drilling and engineering issues were (1) lower than expected bit life, (2) control of well-bore deviation, (3) partial cementing of the 13 3/8-inch casing, and (4) cost increases due to fishing operations. A site-operations organization chart (Figure 2) was presented.

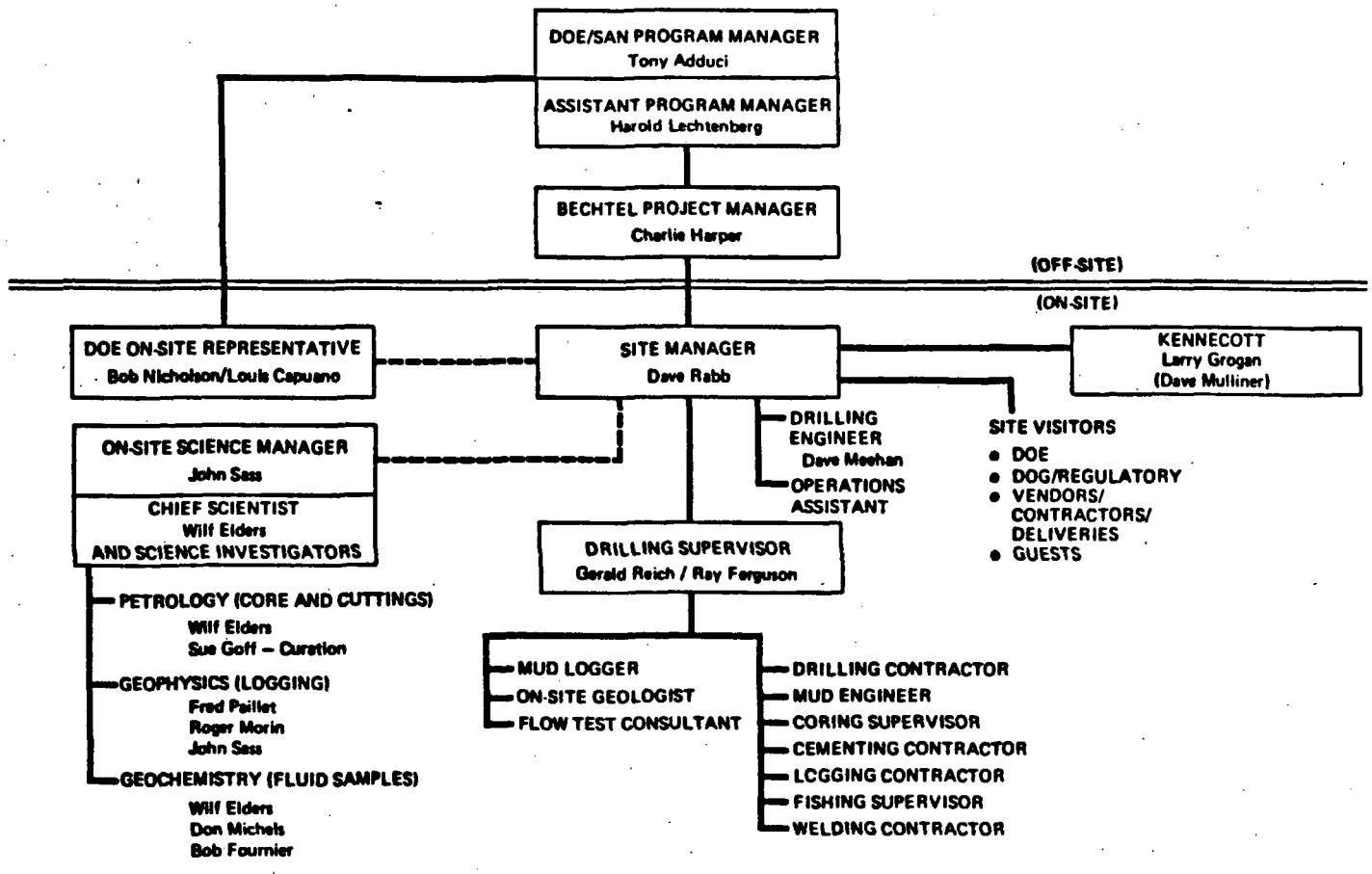

Figure 2: SSSDP On-Site Operations Organization

PROJECT SCHEDULE

The SSSDP was running slightly ahead of schedule at the end of this reporting period with projected completion of the drilling phase in early March (Figure 3). A summary of activities to date and a general description of activities associated with the drilling phase is illustrated on Figure 4. Barring unforeseen problems, it is estimated that the target depth will be reached within the available budget.

A 24-hour flow test is planned for a production zone near total well depth. In addition, comprehensive downhole measurements and fluid sampling will be attempted. Acquisition of cuttings, cores, and geophysical logs will continue as planned.

SALTON SEA SCIENTIFIC DRILLING PROJECT

FORECAST COMPLETION SCHEDULE

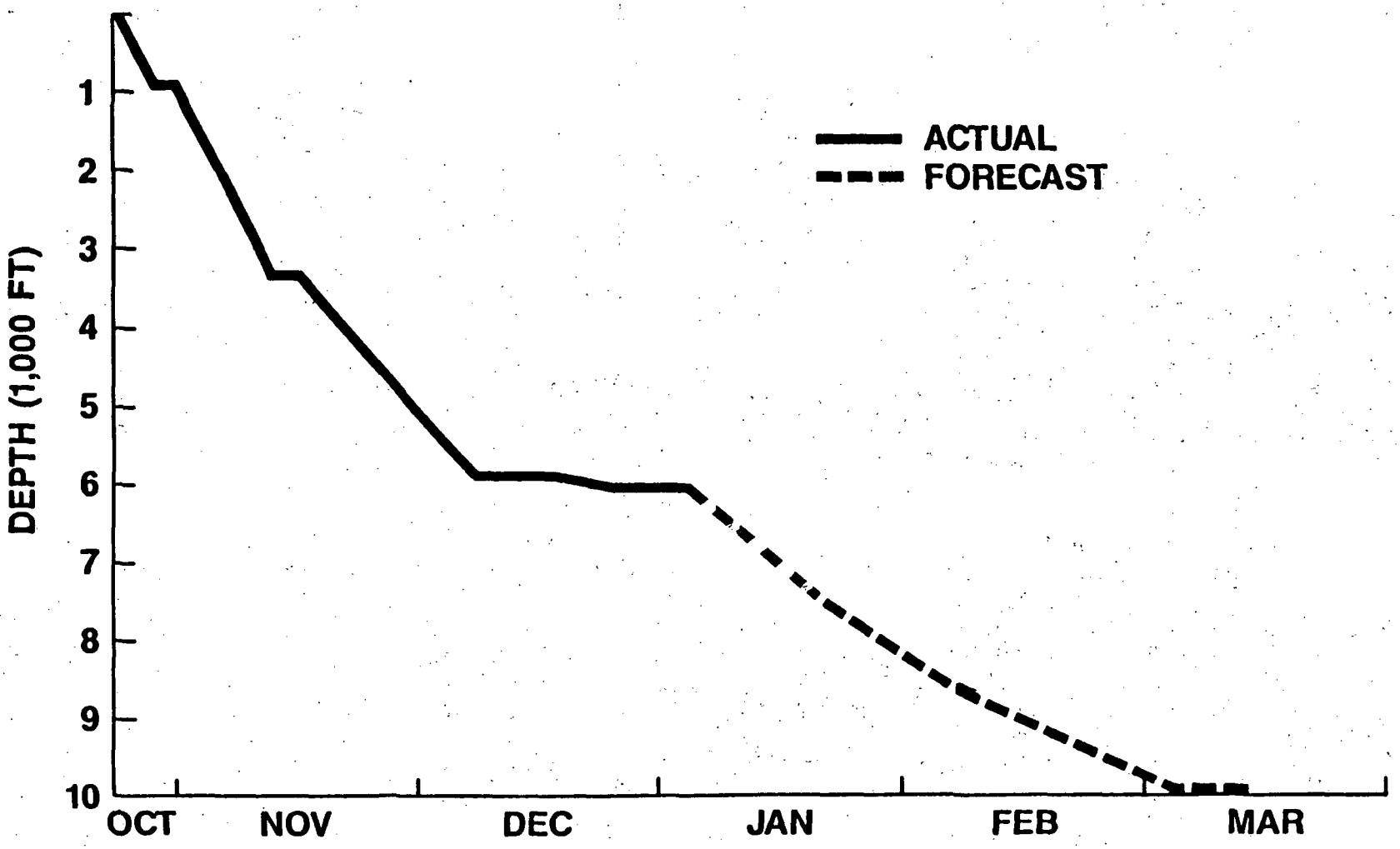

Figure 3: Forecast Completion Schedule

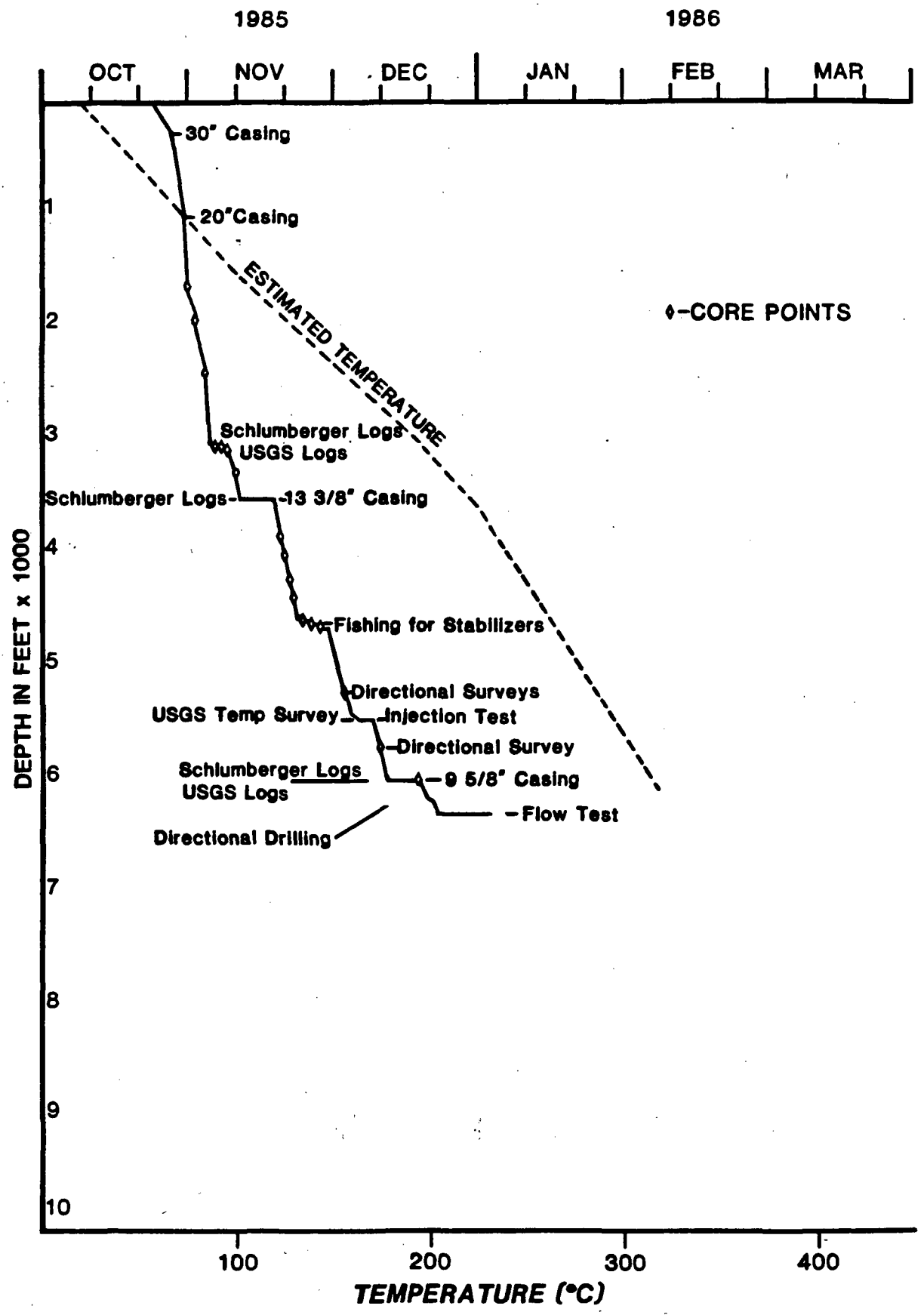

Figure 4: SSSDP Drilling Summary