# MANAGEMENT OF THE SALTON SEA SCIENTIFIC DRILLING PROGRAM

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## ABSTRACT

The Salton Sea Scientific Drilling Program was undertaken by the Department of Energy, the National Science Foundation, and the U.S. Geological Survey in order to investigate, by drilling a well and conducting scientific experiments, the roots of the Salton Sea hydrothermal system. A two-element organizational structure was established to focus on integration of the drilling and engineering operations with the scientific activities. This management plan, the delegation of site-operational authority to an on-site coordinating group, and the cooperative spirit of the participants have resulted in achievement of the drilling, engineering, and scientific objectives of the program.

## INTRODUCTION

The Salton Sea Scientific Drilling Program (SSSDP) was undertaken by the Department of Energy (DOE), the National Science Foundation (NSF), and the U.S. Geological Survey (USGS) in order to investigate, by drilling a well and conducting scientific experiments, the roots of the Salton Sea hydrothermal system. The program had its official start in Fiscal Year 1984 when Congress added $5.9 million to DOE's Geothermal and Hydropower Technologies Division (now Geothermal Technology Division - DOE/GTD) budget. Although the proposal for a deep scientific drillhole in the Salton Sea area had been received enthusiastically by the NSF, the USGS and DOE's Office of Basic Energy Sciences (DOE/OBES), these organizations had no direct appropriations for the program.

In January 1984, the Director of DOE/GTD established an interagency steering group in order to obtain advice and consultation from the other participating agencies and to coordinate their involvement. Thus began the formal management of this multi-million dollar, multi-agency program.

## GOALS AND PRIORITIES

The goals of the program are to study the thermal, physical, chemical, and mineralogical conditions within the deeper parts of the Salton Sea hydrothermal system in order to:

1) better define the geological and hydrological nature of the Salton Sea hydrothermal system and its geothermal reservoirs, and test for extension of this system to greater depths,
2) refine geothermal energy resource estimates for the Salton Sea area,
3) develop a better understanding of the genesis of hydrothermal ore deposits,
4) improve understanding of crustal formation processes in a continental spreading zone, and
5) investigate the possibility of the occurrence of "superconvection."

These goals were to be accomplished by:

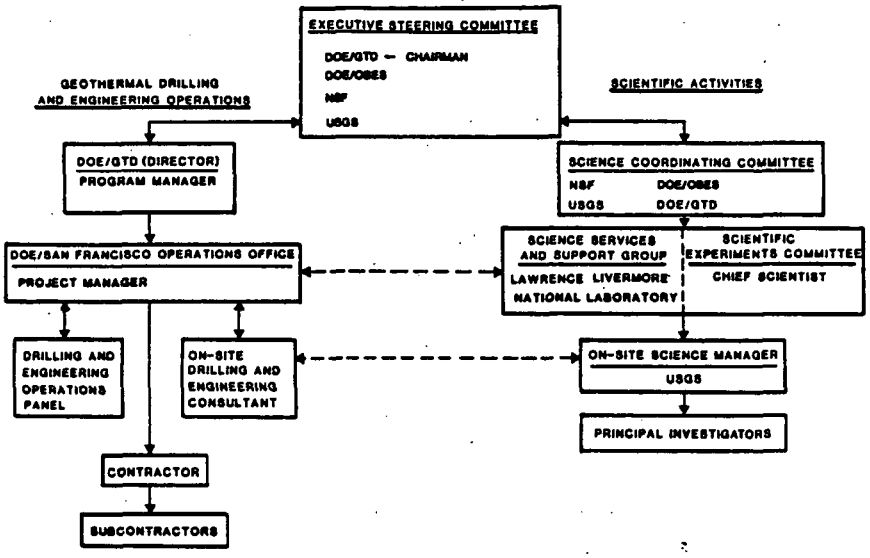
1) drilling a scientific well to a target depth of 10,000 feet,
2) obtaining core and drill cuttings for the entire depth of the well,
3) conducting flow tests of selected fluid production zones,
4) collecting fluid and gas samples during flow tests,
5) measuring temperature, pressure, and flow rate at appropriate depths,
6) obtaining comprehensive suites of geophysical logs, and
7) conducting geological, geophysical, and geochemical scientific experiments downhole.

Highest program priority was given by management during the drilling phase to data collection and sampling of rocks and fluids. However, a stark reality faced early in the program was the need to obtain high-temperature cable and instrumentation to test, measure, and sample the hostile subsurface thermal and chemical environment to be penetrated; otherwise, several major program goals could not be achieved. Another important program requirement was the release of all information obtained to the public domain.

## MANAGEMENT STRATEGY AND FUNCTIONS

In order to effectively manage this complex, multi-agency, multi-discipline program, a two-element organizational structure (Figure 1) was established among the participants to focus on integration of the drilling and engineering operations with the scientific activities. This structure was based on a SSSDP Management Plan, accepted by each participating agency, that was designed to place critical scientific and technical decision-making at the appropriate level, including on-site field managers. The strategy was to encourage cohesive and timely decision-making.

Figure 1. Management Plan for the Salton Sea Scientific Drilling Program.




Those associated with the program are pleased to report that most of these objectives have been achieved. Some have been exceeded. There are two important factors that explain this high degree of success. First is the cooperative spirit with which the key individuals entered into program activities. Opportunities for achieving maximum benefit from the total program were pursued, rather than focusing participation on specific interests of the individuals or their agencies. Second is the policy decision of the Executive Steering Committee (ESC) to delegate site-operational authority to the field, ie., to the group of individuals responsible for program success at the well site.

Overall planning, integration, and evaluation of the program, and the resolution of policy issues, were achieved through the Executive Steering Committee. This Committee consisted of policy-level individuals from the three funding agencies, with the member from the organization responsible for well drilling operations, the Director of DOE/GTD, as Chairman.

Drilling and engineering program activities were managed by a Program Manager representing DOE/GTD. The GTD delegated responsibility for conducting drilling and engineering project activities to DOE's San Francisco Operations Office (DOE/SAN), under the leadership of a Project Manager. These responsibilities consisted of pre-drilling and site preparation activities; drilling and completing the scientific well to a target depth of 10,000 feet; recovering the maximum amount of core and drill cuttings; conducting flow tests and collecting fluid and gas samples at the surface; providing instrumentation systems for measuring temperature, pressure, and flow rate, and for downhole fluid and gas sampling; providing maximum time during drilling for scientific experiments and geophysical logging; integrating scientific experiments into drilling operations, while preserving well integrity and avoiding environmental risk and hazards to personnel and equipment; and providing a six-month well-access period after completion of drilling for scientific experiments.

DOE/SAN conducted a solicitation for procurement of a contractor to perform the drilling and engineering operations in the field. The procurement process led to the selection of Bechtel National, Inc. as prime contractor for the scientific well to be drilled on California State lands in the Salton Sea Geothermal Field for which Kennecott Corporation had acquired geothermal prospecting permits. In addition, DOE/SAN contracted Well Production Testing, Inc. as their on-site drilling and engineering consultant. DOE/SAN also established a panel of geothermal industry experts and government representatives for consultation and advice on well construction and on drilling and engineering operations in the Imperial Valley area.

Scientific activities were managed by the Science Coordinating Committee (SCC) comprised of individuals from the three funding agencies. The Scientific Experiments Committee (SEC), under chairmanship of the Chief Scientist, aided the SCC in establishing the scientific content of the program. The On-Site Science Manager was responsible for the interests of the SSSDP scientific community at the well-site. Technical, logistical, and administrative assistance was provided to the SEC by a Science Services and Support Group. This Group also provided the SSSDP scientific community with a regular and continuing interface with the Project Manager at DOE/SAN.

To develop the scientific content of the program, the SCC published a notice of opportunity for submission of proposals to carry out scientific experiments and analyses. NSF, DOE/OBES, and USGS had no funding specifically appropriated for SSSDP science; therefore, each of these agencies allocated an amount, nominally $500,000, from existing appropriations to support selected proposals. The SEC reviewed these proposals for technical feasibility and relevance, and made recommendations to the SCC. The SCC, with assistance of a joint peer review panel established by NSF and DOE/OBES, and with consideration of SEC recommendations, evaluated the proposals and made funding recommendations to the appropriate agencies (in the case of NSF and DOE/OBES, with external programs) or endorsements (in the case of USGS, with only an internal program). Final selection of proposals for SSSDP projects remained the responsibility of each agency, but was coordinated among the agencies.

## ON-SITE COORDINATION

The on-site coordinating group to whom the ESC delegated site-operational authority was not included in the SSSDP Management Plan or on the chart of the SSSDP management structure. It was formed at the well-site to provide immediate response to problems affecting the success of program activities, health, and safety. Daily meetings of this group were extremely critical to successfully conducting drilling and engineering operations and scientific activities on-site.

## DISCUSSION

Management of this program has been characterized as an exercise in, "how to manage an over-scoped, under-funded program—champagne plans with a beer budget." As more accurate cost estimates were acquired early in 1985, it became evident that the $5.9 million appropriated was significantly less than the revised cost estimates for the drilling and engineering operations originally designed. An ad hoc task force consisting of DOE/SAN management, contractor, landholder, and scientific program representatives was established by the ESC to develop a fundable scope of work. Initial program objectives of a target well depth of 10,000 feet and gathering maximum scientific data were to be retained. The task force made major program revisions, including elimination of long-term flow tests, related surface facilities, and an injection well, in favor of several short-term flow tests using simple test facilities and a brine holding pond.

When the dust subsided from the painful efforts to reduce scope and increase funding, costs for the SSSDP from FY84 through FY86 totalled more than $9.3 million (Table 1). About 75% of this amount was required for drilling and engineering operations. A major element was the inclusion of coring costs as a maximum funded amount ($1 million), rather than as a specific plan and schedule of work.

Table 1. Summary of Drilling and Engineering, and Scientific Program Funding.

| | FUNDING BY AGENCY (IN $ 000's) | | | | |
|---|---|---|---|---|---|
| CATEGORY | NSF | GTD | USGS | OBES | TOTAL |
| DRILLING & ENGINEERING | 25 | 6,605 | 25 | 25 | 6,680 |
| 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 | 7,332 | 875 | 726 | 9,331 |
| TOTAL ACTIVITIES | 7 | 10 | 13 | 11 | 41 |

The usefulness of this management structure has been demonstrated not only by the successful achievement of most of the drilling, engineering, and scientific objectives, but also by the quick response that it provided to resolve urgent issues needing immediate attention and response from

all participants. An example of the latter was the provision of $135,000 of additional funding from DOE/GTD, DOE/OBES, NSF, and USGS in the last few days of drilling in order to properly complete and test the well at its total depth.

## CONCLUSIONS

The success of this program can be credited to the melding together of the key participants into a single-minded team. This was accomplished by open and frank communications between these participants and by their employment of lateral coordination with their counterparts, rather than resolving issues through their respective management channels. Although much knowledge has been gained from the SSSDP, the roots of the Salton Sea hydrothermal system were not fully penetrated. However, it has been shown to extend at least to 10,564 feet beneath the SSSDP well site. Additional drilling and scientific activities at the well-site are being considered.