



GL03100-2 of 4

Department of Energy

San Francisco Operations Office

1333 Broadway

Oakland, California 94612

REPORT OF MEETINGS ON COOPERATIVE GEOTHERMAL RESEARCH AT HEBER FIELD, CA CHEVRON RESOURCES CO. - U.S. DEPARTMENT OF ENERGY SEPTEMBER 24 AND OCTOBER 24, 1985

SUMMARY

Management and technical meetings were held between DOE and Chevron to explore the desirability of cooperative research at the Heber geothermal reservoir in southern California. Chevron is interested in deepening their understanding of the Heber reservoir and associated geothermal technology, including well testing and down-hole pumps. DOE conducts geothermal research in reservoir technology and brine injection (under Public Law 93-410) through national laboratories and universities; Availability of field-wide data is essential for developing and testing geothermal technology.

(Note: Until now, DOE field-wide studies of geothermal reservoirs have been limited to cooperative research with Mexico, Italy, New Zealand and Iceland, where the government controls wellfield drilling and powerplant development. The Heber Field has been unitized, with Chevron as the field operator. Unitization establishes legal relationships among the leaseholders for cooperation in production and sharing of revenues; it also decreases the operator's sensitivity to sharing data and cooperating in reservoir research with the government.)

Potential DOE-Chevron cooperative research at the Heber Field was discussed using the framework for the DOE-CFE Cooperative Agreement for Geothermal Research at the Cerro Prieto Field in Mexico. Individual research tasks (e.g., fractures, permeability distributions, etc.) are expected to be proposed by DOE laboratory and university researchers, and jointly negotiated by Chevron and DOE for funding and required field operations. Release of data by Chevron from areas outside the SDG&E-DOE sector of the Heber reservoir is expected to be limited to the information required to support each task.

Chevron is especially sensitive to any repetition of LBL's publication of field-wide reserve estimates, based on numerical modeling. Chevron has confidence in its own estimates, and wishes to avoid having to defend itself again with present and future customers, local government and tax authorities. To address this primary concern: Chevron plans early publication of their conclusions; joint review and publication is expected from each research task; and, a senior Research Manager from Stanford may be appointed to coordinate all cooperative research tasks at Heber.

BACKGROUND

Because the required field-wide data is available at foreign geothermal fields, DOE has conducted cooperative geothermal reservoir research with Mexico, Italy, New Zealand and Iceland, where the government controls wellfield drilling and powerplant operation. Until now, DOE has been unable to conduct reservoir-wide research at US geothermal fields because of proprietary data restrictions and future lease sales.

At the March 12, 1985 meeting of the LBL Industry Advisory Panel on Geothermal Reservoir Definition, industry members inquired why field cases, like the one funded by DOE at Cerro Prieto, Mexico, are not carried out in the US. Several members suggested that DOE contact Industry concerning joint DOE-Industry studies at geothermal fields like Heber, East Mesa and Coso CA; Beowawe NV; and Roosevelt Hot Springs UT. This suggestion led to DOE reviews with the unit operators of Heber Field (Chevron) and the East Mesa Field (Magma). Roosevelt Hot Springs' unit operator (Phillips) just announced agreement in principle to sell geothermal interests to Freeport-McMoRan Inc.; discussion of joint research has yet to be initiated by DOE.

The Heber geothermal field is being developed under a unique master plan for reservoir production and injection. Powerplants are clustered at the center of the field, around production well islands; injection wells are arranged in a circular curtain at the periphery of the field. The overall concept is like a donut with production of hot fluid at the center and injection of cold effluent at the edges, establishing a major thermal convection cell in the reservoir.

One 67 MW gross binary powerplant (SDG&E-DOE) is starting operations; a second 52 MW gross flash steam powerplant (Dravo) is completing construction. Plans show development of a total of 500 MW at the Heber reservoir. Under Chevron's heat supply contract with San Diego Gas and Electric (SDG&E), DOE receives data from the 1/10 of the Heber wellfield that supports the SDG&E-DOE powerplant.

MEETINGS

A management meeting held September 24, 1985 at Chevron's offices in San Francisco, established the interest of both parties in cooperative research at the Heber Field. Representing Chevron Geothermal Co. were:

Al Cooper, Vice President-Geothermal,
Dale Santee, Operations Manager,

→ Jerry Epperson, Supervising Engineer-Reservoir and Geology.

Representing the DOE Geothermal Program (HQ, ID and SAN) were:

Tony Adduci, SAN Branch Chief, Fossil and Geothermal,
Marty Molloy, Program Manager, Geothermal Reservoir Technology.

A follow-up technical meeting was held at Chevron on October 24th to discuss the technical framework, content, and significant tasks for geothermal research at the Heber field. Present were Jerry Epperson, Marty Molloy, and Bill Holman of DOE's Geothermal Loan Guarantee Program.

INTEREST

DOE conducts geothermal research in reservoir technology and brine injection through national laboratories and universities. Availability of field-wide data is essential for developing and testing geothermal technology. DOE's interest in geothermal research at the Heber Field is to understand the world's premier geothermal heat sweep system, in terms of:

- conceptual model,
- production/injection reservoir management
- prototype for application to other reservoirs, and
- development of associated technology.

Chevron is interested in additional testing of the reservoir and wellfield equipment, and feels that they have just scratched the surface in understanding the Heber reservoir. Chevron wants to improve reservoir management by an order of magnitude in 10-15 years. To do so, Chevron will have to do R&D, including:

- tracer tests,
- high technology instrumentation,
- long-term pressure monitoring, and
- downhole submersible pumps.

HEBER RESERVOIR DATA

Chevron has already collected substantial geothermal information in developing the Heber Field. Exhaustive drilling and well test data exist for ~16 new production wells and ~8 new injection wells that support the SDG&E and Dravo (ex-SCE) powerplants. In addition, Chevron has data from:

- geophysical surveys (seismic, magneto-telluric, gravity),
- temperature gradient drillholes,
- geochemical analyses,
- well monitoring (15 original wells plus new wells),
- downhole pump performance and problems,
- injection operations and performance, and
- exceptionally good seismic network and monitoring data, incl. downhole instrumentation.

Both parties are sensitive to the need to restrict any joint efforts to research, avoiding either routine field operations conducted by wellfield service companies or data analysis normally conducted by geothermal consultants. If such routine activities are required as part

of a broader research experiment, the intent is for Chevron or DOE to prepare a specification for bid, and then to incorporate the results into the broader research effort.

RESERVOIR HEAT SWEEP

Surprisingly, Chevron will not rely on heat sweep (reinjection and reheating by reservoir rock) to sustain present and future powerplants at Heber. In 30 years, Chevron expects that reinjected spent brine will move only half the distance from their peripheral injection wells to their central production wells. Chevron does not plan to rely on heating of surrounding cool fluid (<320 F) by hotter reservoir rock, as the fluid moves toward the production wells. Chevron feels that their reservoir reserve calculations are conservative; any heating of cooler fluids before production would increase reservoir reserves.

SUBMERSIBLE PUMP TECHNOLOGY

Chevron is particularly interested in submersible pump technology, to permit production below the 1,000' depth limit of their current pumps, that are driven by line-shaft from the surface. Submersibles would also permit pumping in directionally inclined wells, since line-shaft pumps are limited to the upper, vertical portion of directional wells. Chevron's Heber wells are directionally drilled from central drilling islands; many are highly inclined in order to reach different volumes of the reservoir.

DOE maintains a Pump Test Facility at the DOE wells at the East Mesa Field, 15 miles east of Heber, and has conducted substantial research on submersible pump technology with REDA Pump.

CHEVRON CONCERN - PUBLICATION OF RESERVES

At the March 12, 1985 meeting of the LBL Industry Advisory Panel, Industry members expressed concern "that under such joint projects a DOE-sponsored group might publish that a given field has a much lower energy production potential or productive lifetime than presently estimated by the developer. Such conclusion would adversely affect the prospects of that particular venture."

Chevron does not wish the proposed cooperative study to result in presentation to the public of opinions or conclusions that are in opposition to Chevron's proposals (to utility customers and California Public Utility Commission. At both meetings, Chevron expressed serious concern with any repetition of LBL's publication of reservoir reserve and lifetime estimates. (In 1983, LBL estimated that the Heber Field could support only two 50 MW powerplants for their 30-year lifetimes. Chevron has 100 MW under contract, and plans to develop a total of 500 MW.) Such actions disrupt Chevron's relations with existing customers, negotiations with other utilities for future production, and reviews by regulatory and tax authorities.

To address this major concern of Chevron, a combination of three actions is proposed:

- First, Chevron plans to publish their own substantial findings on the Heber reservoir early in the cooperative relationship.
- Second, joint publication by Chevron and DOE researchers is expected to result from each research task; Chevron expects to call upon Chevron Research staff to augment their efforts.
- Third, Chevron has developed confidence in Stanford's Petroleum Engineering Department as a result of long-term educational and consulting relationships. Appointment of a senior Heber Research Manager from Stanford is suggested to coordinate all cooperative tasks at the field, to assure scientific quality, to avoid duplication, and to respect legitimate sensitivities of participants.

PROPRIETARY DATA

Possible use of proprietary data restrictions was considered, together with time delays in releasing data and resulting analyses. Handling of proprietary data by Government employees, university and laboratory personnel raises many serious problems (see Appendix).

Time delays in release of data and resulting analyses have been negotiated under past cooperative research agreements. These permit the data to "cool off" in terms of sensitivity and competitive value, and still permit results of value to be disseminated to the scientific community and the geothermal industry. If possible, agreements involving time delays should avoid any handling of data marked "proprietary".

DOE and Chevron technical personnel felt that use of proprietary data could be avoided by limiting any release of "existing data" in Chevron's files to that required to support specific research tasks. Required data would be identified and justified in each research proposal, and reviewed by Chevron and DOE as part of the cooperative research approval and funding process.

"Existing data" includes: information from the 15 wells drilled before the Heber Field was developed by Chevron; data from production and injection wells already drilled by Chevron; data from old and new wells used to observe pressure interference tests; geochemical analyses; field-wide subsurface geology (e.g. stratigraphic correlations); temperature gradients; geophysical surveys; etc. "New data" will result from ongoing field development, operations and monitoring, including future well tests, and any joint experiments conducted at the field under a cooperative agreement.

OUTLINE OF JOINT RESEARCH AREAS - CHEVRON HEBER GEOTHERMAL FIELD

The following outline of joint research areas was reviewed during the technical meeting: (the outline covers the main sections of DOE's Reservoir Technology and Brine Injection Programs; the groundrules were proposed by Tom Hinrichs of Magma for cooperative research at the East Mesa Field):

Reservoir Definition

- Conceptual geologic model:
 - geology/geophysics/geochemistry/hydrology
- Physical characteristics of reservoir rocks and fluids:
 - well logs, cuttings/core/fluids, well tests
- Reservoir capacity and performance estimates:
 - heat & mass balance, depletion and recharge modeling
- Field management and production engineering:
 - match reservoir & energy conversion process over lifetime
 - optimum wellfield design and operation
 - subsidence, seismicity, groundwater, etc. monitoring
- Reservoir lifetime predictions, plus:
 - refined models and technology transfer.

Brine Injection

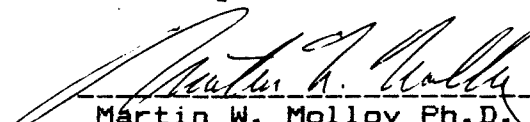
- migration of fluids in the reservoir: thermal front movement and breakthrough predictions, heat extraction efficiency, fluid transport and dispersion, fracture geometry, formation permeability-thickness and skin, reservoir heterogeneity, and significance of fracture vs. porous matrix flow:
 - tracer tests (well-to-well injection/recovery)
 - pressure transient tests (well-to-well interference)
 - geophysical methods (microseismic monitoring, self-potential, multi-borehole electrical imaging, and gravity surveys)
 - short-term heat transfer and intersecting fractures (single well injection-backflow tests)
- fluid/fluid and fluid/rock interactions, including chemical interactions (injected brine vs. formation fluid & rock), and formation plugging potential:
 - single well injection/flowback tests
- surface treatment of fluids:
 - particle content
 - chemical conditioning.
- well completion technology:
 - high volume disposal, maintenance/cleanout, lifetime/replacement.

Special Research Interests at Heber Reservoir

- heat sweep
- fractures
- permeability distributions
- boundaries in reservoir
- history match (production & injection) and projection
- scaling/deposition (surface facilities & reservoir), and
- downhole submersible pump technology

Proposed Groundrules

1. Each party would fund their own aspects of the research with no money crossing between the two parties.
2. Each party to provide to the other all scientific and operating data available at present and that developed in the future.
3. A jointly agreed to time schedule and respective tasks be established with quarterly reviews of the program.
4. DOE to provide the services of LBL logging truck for spinner and temperature/pressure surveys. Chevron to assist in providing necessary operational personnel.
5. DOE to carry out jointly agreed to injection tracer studies, seismic and other activities which will have the possibility of providing accurate reservoir definition.
6. Development of a conceptual geological model, a reservoir simulation model, and an optimum production and injection scheme will be the final goal of the venture.


----- 11-5-85
Martin W. Molloy Ph.D., Manager
Geothermal Reservoir Technology Program

cc: Chevron/Cooper, Santee, Epperson
HQ/Skalka, Reed, Bresee
ID/Prestwich; EG&G/Stiger
SAN/Adduci, Holman, Belt, Brosler, Bromberg, Richards, Thrash
LBL/Lippmann, Benson, Bodvarsson, Goldstein, Halfman, Pruess
Stanford/Gudmundsson, Horne
UURI/Wright, Nielson, Moore
LLNL/Kasameyer
USGS/Muffler, Nathenson
New File: DOE-Chevron Heber Cooperative Agreement

APPENDIX

- PROPRIETARY DATA -

As a result of these meetings, SAN program and patent staff reviewed data policy and legal penalties associated with unauthorized release of proprietary data by government employees and researchers at universities and laboratories. The DOE Fossil (oil and gas) research program avoids the use of proprietary data as a matter of policy. Penalties are so severe (see attached US Code 18 Section 1905), and the ability to control data transmitted to laboratories and universities is so weak, that any use of proprietary data is rigorously avoided.

If access to proprietary data cannot be avoided in order to accomplish the cooperative research, two deliberate actions must be taken to safeguard the confidential information:

- 1) the offeror may mark the title page and each sheet of data it wishes to restrict with the authorized restrictive legend from FAR 52.215-12 (see attached memo, page 1), and,
- 2) DOE must specifically pass through and enforce any written restrictions imposed on such information to universities and laboratories given access to this proprietary data, through DOE contract with that institution (see attached provision (2) from DOE's prime contract with the University of California).

ATT. 1: US Code 18 Section 1905, Crimes.

ATT. 2: DOE-Univ. CA Prime Contract W-7405-ENG-48, Mod. 24, p 45.

ATT. 3: "Information to be Retained in Confidence and Restrictive Legends", memo from DOE-SAN/Office of Patent Counsel to All Employees, Feb. 21, 1985.

§ 1905. Disclosure of confidential information generally

Whoever, being an officer or employee of the United States or of any department or agency thereof, or agent of the Department of Justice as defined in the Antitrust Civil Process Act (15 U.S.C. 1311-1314), publishes, divulges, discloses, or makes known in any manner or to any extent not authorized by law any information coming to him in the course of his employment or official duties or by reason of any examination or investigation made by, or return, report or record made to or filed with, such department or agency or officer or employee thereof, which information concerns or relates to the trade secrets, processes, operations, style of work, or apparatus, or to the identity, confidential statistical data, amount or source of any income, profits, losses, or expenditures of any person, firm, partnership, corporation, or association; or permits any income return or copy thereof or any book containing any abstract or particulars thereof to be seen or examined by any person except as provided by law; shall be fined not more than \$1,000, or imprisoned not more than one year, or both; and shall be removed from office or employment.

(June 25, 1948, c. 645, 62 Stat. 791; Sept. 12, 1980, Pub.L. 96-349, § 7(b), 94 Stat. 1158.)

- (2) In addition, the University agrees that to the extent it receives or is given access to proprietary data, or other confidential or privileged technical, business, or financial information under this contract, it shall treat such information in accordance with any written restrictions imposed on such information.
- (3) The University shall have, subject to patent, data, and security provisions of this contract, the right to use technical data it first produces under this contract for its private purposes provided that, as of the date of such use, all reporting requirements, if any, of this contract have been met.
- (d) Subcontracts and Consultants. The University and DOE agree to develop mutually acceptable procurement procedures to apply the requirements of DOE-PR 9-1.54 to its proposed subcontracts and consultant agreements.
- (e) Waiver. Requests for waiver under this clause shall be directed in writing to the Contracting Officer and shall include a full description of the requested waiver and the reasons in support thereof. If it is determined to be in the best interests of the Government, the Contracting Officer shall grant such a waiver in writing.

SEE DOEPR 9-1.54

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rucl/cg

memorandum

DATE: February 21, 1985

REPLY TO
ATTN OF: Office of Patent Counsel

SUBJECT: Information to be Retained in Confidence and Restrictive Legends

TO: All Employees

In accordance with a request at a recent CTB, attached is an updated copy of the OPC memo commonly referred to as "How to Keep Out of Jail." The suggestions contained in the memo for handling proprietary or commercial confidential information continue to be appropriate.

In order to protect proprietary or confidential information, you need to know that it is that type of information either by being informed about it or by the document containing the information being marked by a restrictive legend. Any proprietary data you have should contain a restrictive legend and be protected from unauthorized disclosure. The most common ways of receiving proprietary data would be data contained in a proposal or in a technical report.

The offeror or proposer may mark their proposals with authorized restrictive legends. The authorized restrictive legend is found in FAR 52.215-12 and is as follows:

(a) Mark the title page with the following legend:

"This proposal or quotation includes data that shall not be disclosed outside the Government and shall not be duplicated, used, or disclosed—in whole or in part—for any purpose other than to evaluate this proposal or quotation. If, however, a contract is awarded to this offeror or quoter as a result of—or in connection with—the submission of this data, the Government shall have the right to duplicate, use, or disclose the data to the extent provided in the resulting contract. This restriction does not limit the Government's right to use information contained in this data if it is obtained from another source without restriction. The data subject to this restriction are contained in sheets [insert numbers or other identification of sheets]"; and

(b) Mark each sheet of data it wishes to restrict with the following legend:

"Use or disclosure of data contained on this sheet is subject to the restriction on the title page of this proposal or quotation."

Any other restrictive legend (including any notice of copyright) on a proposal or quotation should be questioned and coordinated with OPC. The use of any other restrictive legend is unauthorized unless previously approved by OPC.

Under existing DOE policy, technical reports submitted by contractors should not contain any proprietary data unless requested by the Contracting Officer. Accordingly, such technical reports normally should not contain any restrictive legend.

In the event the receipt of proprietary data is necessary and is requested by the Contracting Officer, the contractor may mark the document containing the proprietary data with the DOE authorized restrictive legend as set forth in DEAR 952.227-79 limited rights in proprietary data. The authorized Limited Rights Legend is as follows:

Limited Rights Legend (Apr 1984)

"This Technical data contains "proprietary data," furnished under contract No. _____ with the U.S. Department of Energy (and purchase order No. _____ if applicable) which may be duplicated and used by the Government with the express limitations that the "proprietary data" may not be disclosed outside of the Government or be used for purposes of manufacture without prior permission of the following purposes:

(a) This "proprietary data" may be disclosed for evaluation purposes under the restriction that the "proprietary data" be retained in confidence and not be further disclosed;

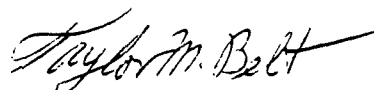
(b) This "proprietary data" may be disclosed to other contractors participating in the Government's program of which this contract is a part for information for use in connection with the work performed under their contracts and under the restriction that the "proprietary data" be retained in confidence and not be further disclosed; or

(c) This "proprietary data" may be used by the Government or others on its behalf for emergency repair or overhaul work under the restriction that the "proprietary data" be retained in confidence and not be further disclosed.

This legend shall be marked on any reproduction of this data in whole or in part."

The authorized legend may contain one or more of the subparagraphs a, b, or c or none as provided in the contract Patent Rights clause. The use of any other restrictive legend (including any copyright notice) should be questioned and coordinated with OPC as such a legend would be unauthorized unless previously approved by OPC.

In the event you have questions regarding the information presented or would like assistance pertaining to the marking and protection of proprietary data, please contact one of the patent counsels in OPC.



Taylor M. Belt
Asst. Chief for Procurement
Office of Patent Counsel

memorandum

DATE: February 21, 1985

REPLY TO
ATTN OF: Office of Patent Counsel

SUBJECT: Treatment of Information to be Retained in Confidence by SAN Employees -
Or How to Keep Out of Jail

TO: All SAN Employees

Our office is getting more and more involved with people who are providing us with confidential information, particularly in the nonnuclear area. Confidential as used herein is not a security classification, but pertains to information which has been received in confidence or which should be retained in confidence.

This kind of information is also referred to as proprietary information. This information can come in many ways; for example, in proposals, in reports, from inventors, and from the general public. Confidential information can be in the area of data, inventions, trade secrets, or even business information such as income, profits, losses or expenditures. In most cases confidential information is considered very valuable. (Just imagine the value of the formula for Coca Cola.)

The Government does its utmost to protect confidential information. It has passed a law (18 USC 1905), copy attached, that makes it a crime for an officer or employee of the United States (that's us) to disclose confidential information. The law subjects us to a fine of not more than \$1,000 or imprisonment for not more than one year, or both, and loss of our job.

It's very important that you, as a SAN employee, know how to protect yourself in these situations where confidential information is involved. The receipt of confidential information in many cases is very subtle. You may find yourself unintentionally involved with confidential information before you know it.

Suggestions In Handling:

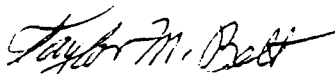
1. Run The Other Way. Don't get confidential information in the first place. In some cases you can do your job without knowing the confidential information. For example, knowing that a battery works in a certain way may be enough. It may not be necessary to know the specific details of the construction of the battery that are confidential.

Make it clear in advance that you're not going to receive or discuss confidential information. If necessary, make the other party sign an agreement, in advance, that he agrees he will not disclose any confidential information if you're going to skirt this area.

2. Don't Sign Anything. If you agree in writing to keep information confidential, you might be personally responsible even if someone else releases it. So don't sign anything unless this is part of your job, or you have such authority.

3. Get It In Writing. If you must discuss confidential information, try to get it in writing. This is so there'll be no question later on as to what was discussed. Otherwise, it'll be your word against the word of the owner of the confidential information. This'll put you at a disadvantage.
4. Control It. This is very important. If you're responsible for confidential information, you must prevent disclosure to people who aren't supposed to see it. Keep it away from competitors, GOCOs, other contractors, or even fellow employees who don't need the information. This normally means maintaining control over the information. Put it in a cabinet that can be locked, or keep it in an area where other people can't get at it. The object is to let only people who need the information have access to it. But even in this case, make sure that each time you do discuss or disclose confidential information you have permission or are permitted to do so under the terms that the information was entrusted to you.
5. Get Rid Of It. When you're done with confidential information .
immediately,
 - a) send it back to the source from which received by registered mail, or
 - b) get permission from the person or organization providing it to you to destroy it, destroy it and maintain proof of destruction.

If there are any questions or any problems, contact the SAN Office of Patent Counsel, 273-6241, for assistance. We promise not to say, "I told you so."



Taylor M. Belt
Asst. Chief for Procurement
Office of Patent Counsel

Attachment