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Scientific Core Hole VC-2A, Valles Caldera, New Mexico

Report of Remedial Action Activities and Results

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SCIENTIFIC CORE HOLE VC-2A, VALLES CALDERA, NEW MEXICO
REPORT OF REMEDIAL ACTION ACTIVITIES AND RESULTS

by

John Musgrave, Sue Goff, and Tom Turner

ABSTRACT

This report details the remedial action activities that were necessary to complete scientific core hole Valles caldera #2A (VC-2A) before it was relinquished to the landowners. Sandia National Laboratories, acting as the Geoscience Research Drilling Office (GRDO), managed the coring operations. Los Alamos National Laboratory (Los Alamos) obtained the proper drilling permits with the New Mexico State Engineers Office (SEO). A legal agreement between Los Alamos and the landowners states that the Laboratory will give the landowners the completed core hole with casing, wellhead, and other hardware at the end of May 1991, or earlier if scientific investigations were completed. By May 1988, the Science Team completed the planned scientific investigations in the VC-2A core hole. Upon the insistence of the GRDO, the New Mexico Oil Conservation Division (OCD) inspected the core hole, declared jurisdiction, and required that the 11.43- by 11.43-cm annular cement job be repaired to comply with OCD regulations. These regulations state that there must be a return to surface of cement in all cementing operations. We successfully completed a squeeze cementing operation and relinquished the core hole to the landowners in November 1988 to the satisfaction of the OCD, SEO, the landowners, and Los Alamos.

I. INTRODUCTION

Scientific core hole VC-2A was drilled in the Valles caldera of Northern New Mexico in September 1986. The Department of Energy/Office of Basic Energy Sciences (DOE/OBES) funded the drilling as part of its Continental Scientific Drilling Program (Goff and Nielson 1986). Los Alamos National Laboratory (Los Alamos) and the University of Utah Research Institute (UURI) designed the scientific plan and chose the drill site. Los Alamos signed a legal agreement

with the landowners in May 1986 (Appendix A) and then submitted the drilling permit application on June 23, 1986. The New Mexico State Engineers Office (SEO) approved the permitting of VC-2A as a scientific core hole on July 22, 1986 (Appendix B). Sandia National Laboratories, acting as the Geoscience Research Drilling Office (GRDO), managed the coring operations.

The VC-2A site at Sulphur Springs occupies two 20-acre patented mining claims owned by John Corbin and partners in the Baca Land Grant (Fig. 1). The drill site is on the western ring fracture zone of the valles caldera (Fig. 1). This zone surrounds a resurgent dome that was pushed up by the movement of renewed magma after the caldera was created about 1 Ma ago (Goff and Gardner 1987).

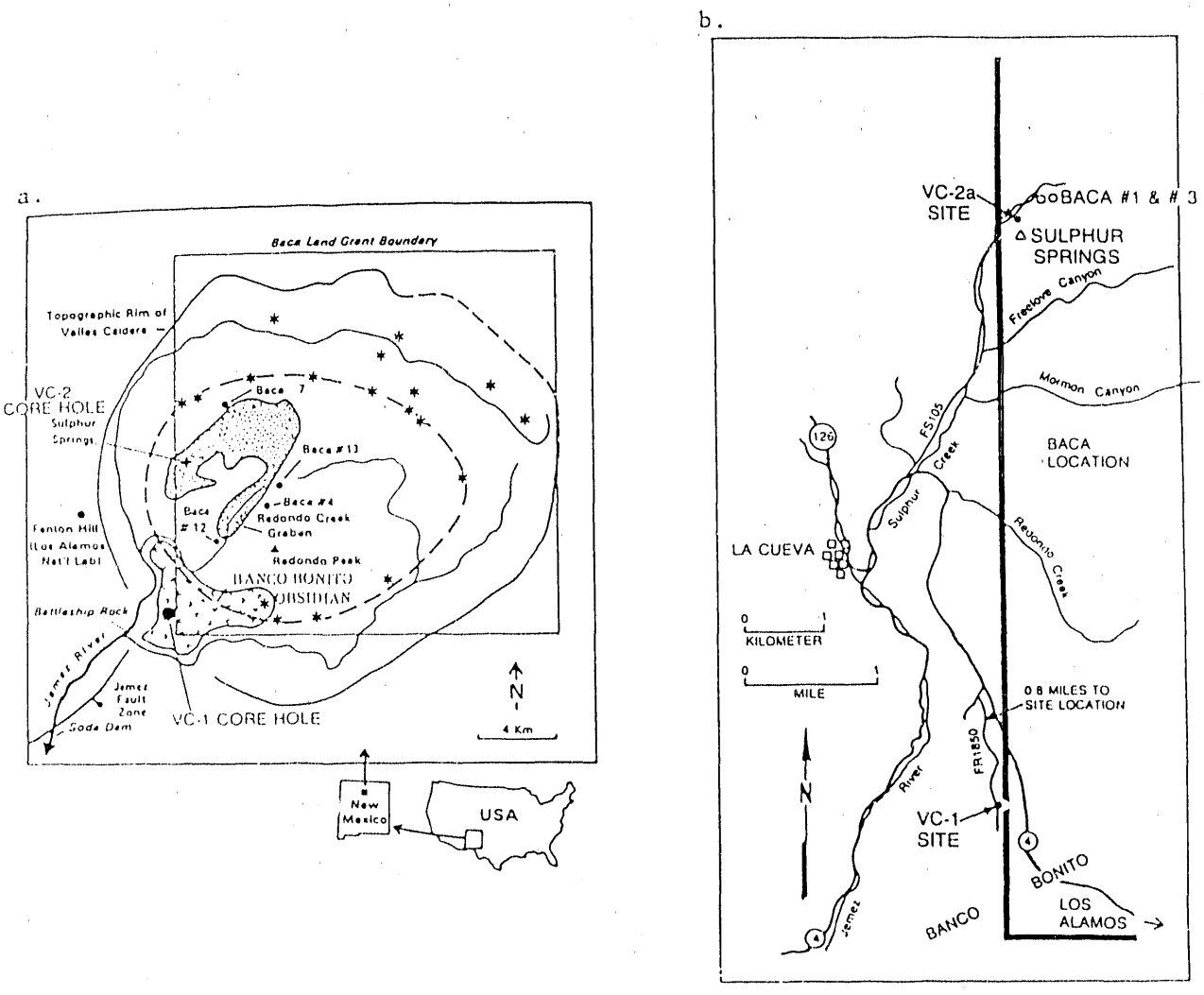


Fig. 1.
(a) Location map of CSDP core holes VC-1 and VC-2A in the Valles caldera. Stippled pattern is the area of intense surface hydrothermal alteration. (b) Detailed location map of CSDP core holes VC-1 and VC-2A.

The major scientific objective for drilling at Sulphur Springs was to penetrate the vapor zone beneath the acid sulfate hot spring system of Sulphur Springs. Other scientific objectives were to core through the interface between the vapor zone and the hot-water-dominated zone, to obtain structural and stratigraphic data on the caldera-fill rocks along the boundary between the ring fracture and the resurgent dome, and to determine the mechanisms of ore deposition in an active caldera hydrothermal system (Goff et al. 1987). Technical objectives were to drill to at least 500 m and 200°C and to recover continuous core.

Coring of VC-2A began on September 5, 1986, and was completed on September 28, 1986. The hole is 528 m deep and was cored through tuffs and volcaniclastic rocks that fill the caldera. The VC-2A stratigraphic column is shown in Fig. 2. All rock units are moderately to intensely altered and are similar to those in the deep Valles hydrothermal reservoir described by

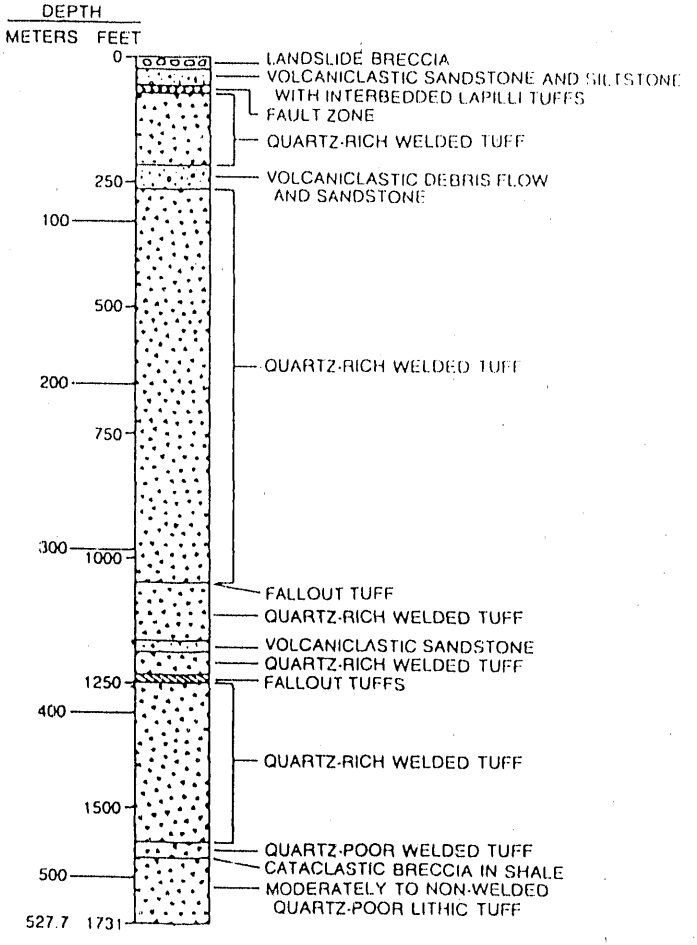


Fig. 2.
Stratigraphic column for VC-2A.

Hulen and Nielson (1986). Detailed lithologic logs can be found in Starquist (1987) and Hulen et al. (1988).

II. SUMMARY OF CORING OPERATIONS

Surface acid conditions and high-temperature fluids at Sulphur Springs provided a challenge for the coring operation. Several unique drilling design and operational features were used in VC-2A (Goff et al. 1987). These features included both a specially designed core tube loading chamber to allow for minimum open time for the drill rods and a wireline-retrievable check valve set in the core barrel to prevent the uncontrolled production of formation fluids.

Drilling operations are summarized in Table I. The core hole was spudded on September 5, 1986, and the target depth of 500 m was reached on day 21 of operations. A total depth of 527.7 m was reached on September 27, 1986, after fishing operations failed to retrieve the overshot and fully loaded core tube at the bottom of the hole. The HQ rods were hung in the hole to act as a liner.

Even with the length restrictions dictated by the special loading chamber that required the use of a short (1.5-m) core tube, drilling crews recorded three 12-hr shifts in which they were able to core about 30 m. Figure 3 presents the completion diagram of the hole, and Fig. 4 shows the wellhead configuration.

III. FLOW TESTING

One of the primary objectives of VC-2A was to obtain gas and fluid samples from various depths. In late April of 1987, VC-2A was perforated at a fluid entry that was identified in temperature logs at 489.3 m. VC-2A was stimulated by bailing and the core hole erupted flashed water and steam on May 1, 1987. Flow tests and fluid sampling activities were conducted over the next 10 months. For a more detailed discussion see Musgrave et al. (1989). By May 1988, the science team from Los Alamos completed the planned scientific investigations in the VC-2A core hole.

IV. REPAIR AND TRANSFER OF CORE HOLE VC-2A TO LANDOWNERS

The legal agreement between the Laboratory and the landowners (Appendix A) states that the Laboratory will give the landowners the completed core hole with casing, wellhead, and other hardware at the end of May 1991, or earlier if scientific investigations are completed.

TABLE I

SUMMARY OF DRILLING OPERATIONS

Date	Days Since Spud	Depth (m)	Day's Progress (m)	Core Run	Remarks
9/5/86	0	3	3	1-3	First run had no core recovery.
9/6/86	1	11	8	4-9	Ream to 11 m. Casing was cemented and BOP flange welded to casing. BOP stack installed. Coring resumes.
9/7/86	2	24	13	10-23	Coring continues.
9/8/86	3	49	25	24-40	Begin reaming for second casing. Downhole temperature = 47°C.
9/9/86	4	49	--		Reaming continues. Cement in casing.
9/10/86	5	49	--		Begin coring cement.
9/11/86	6	51.1	8	41-49	Coring of cement completed late in the day. Circulation lost at 188.5 m, quickly restored.
9/12/86	7	92	41	50-72	Continue coring.
9/13/86	8	98	6	73-76	Trip out and prepare for reaming. With seven rods remaining in the hole, a continuous stream of H_2S comes out the top of the rods at a concentration of 900 ppm. Well is capped and dense mud pumped downhole. H_2S level lowered and reaming begins.
9/14/89	9	98	--		Reaming continues through midday. Run casing and cement in casing.
9/15/86	10	98	--		Waiting on cement until midday. Begin coring cement.

TABLE I (continued)

Date	Days Since Spud	Depth (m)	Day's Progress (m)	Core Run	Remarks
9/16/86	11	133	35	77-100	Drilled through cement. Begin coring.
9/17/86	12	166	33	101-123	Continue coring.
9/18/86	13	210.9	45	124-154	Bit change.
9/19/86	14	263.9	53	155-189	Continue coring.
9/20/86	15	294.2	30	190-209	Bit change.
9/21/86	16	339.6	45	210-239	Continue coring.
9/22/86	17	360.9	21	240-256	Bit change. Slow drilling rate caused by vibration. High-temperature mud mix added; drilling rate increases.
9/23/86	18	397.2	36	257-280	Core coming out very hot. Bottom hole temperature = 147°C. Wireline breaks; have to trip out.
9/24/86	19	432.1	35	281-303	Coring continues.
9/25/86	20	472.1	40	304-331	Coring continues.
9/26/86	21	527.7	56	332-366	Late in the day wireline breaks from overshot. Begin fishing.
9/27/86	22	527.7	--	366	Continue fishing until midmorning when decision is made to terminate coring operations. Hole is at 1736 ft, but overshot and full core tube are left in the bottom of the hole. Total depth 1731 ft (527.7 m).

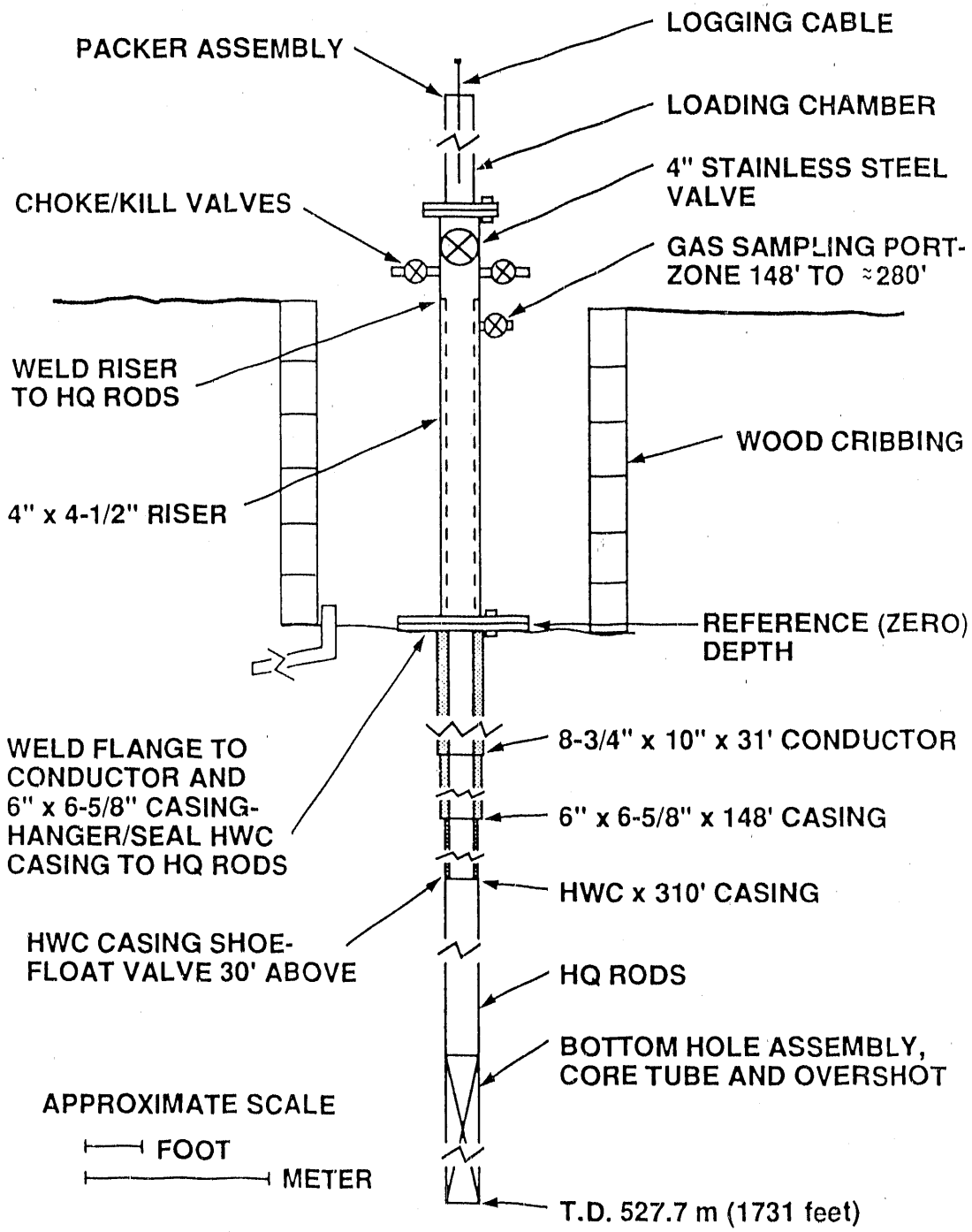
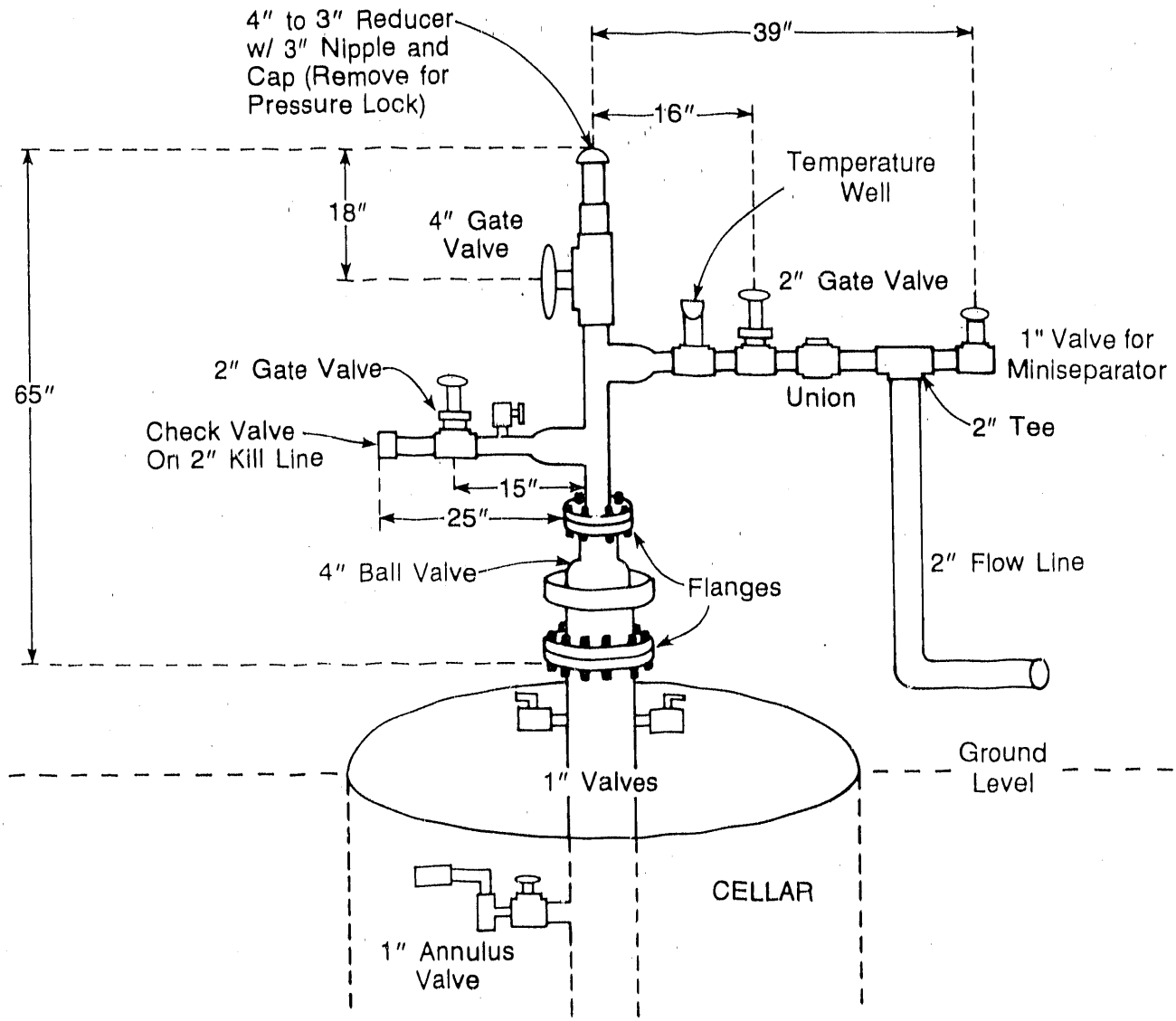


Fig. 3.

Well VC-2A completion diagram furnished by P. Lysne, Sandia National Laboratories.



Note: Figure not necessarily to scale

Fig. 4.
Wellhead configuration of VC-2A in preparation for flow tests commencing May 1, 1987. Wellhead was constructed by J. Skalski and D. Anderson, EES-4, Los Alamos National Laboratory.

The GRDO called in the New Mexico State Oil Conservation Division (OCD) to inspect the core hole before relinquishing it to the landowners. This action complicated the transfer of the core hole to the landowners because the OCD considers the core hole to be a geothermal well even though the original SEO permit designated VC-2A as a scientific core hole. It was necessary to comply with OCD regulations before transfer of the core hole could be completed. To repair the 11.43- by 11.43-cm annular cement job and comply with the OCD, the annulus was squeezed with cement.

A. State of Core Hole VC-2A Before Remedial Repair

Figure 3 shows the configuration of VC-2A at completion of drilling. The 25.4-cm-diam conductor pipe was cemented at 11 m in a 31-cm-diam hole. The 16.32-cm casing was cemented from 44.5 m to the surface in a 21.90-cm hole. The casing shoe was at 44.5 m. The BH (10.1-cm) drill rods were cemented in at 95.75 m in a 14.92-cm hole. A fair cement job was present from approximately 58.48 m to the casing shoe at 95.75 m; poor or no cement was present from 58.48 m to the surface. The 8.89-cm HQ drill rods were landed at 527.5 m and were open-ended. These rods were hung in a donut at the wellhead flange. The OCD requires that there be a cement return to the surface in cementing of casing in all geothermal wells.

B. Remedial Repair Work to VC-2A

The 11.43- by 16.83-cm annulus primary cement was leaking. This allowed the flow of steam and gas, which contained high levels of hydrogen sulfide, to the surface at a shut-in annular pressure of approximately 45 psig.

The integrity of the pressure seal between the 8.89-cm (HQ) tubing and the 11.43-cm riser, and the 11.43- by 16.83-cm and/or 8.89- by 11.43-cm annular spaces was tested and found to be sound. The integrity of the annular spaces was tested by killing the fluid entry zone at 489.3 m with cold water and establishing a vacuum in the 8.89-cm tubing while a positive pressure existed in the annulus.

On November 17, 1988, cementing equipment moved in and rigged up. The cementing equipment consisted of a pump truck, bulk dry cement transport, sodium silicate transport, and a vacuum truck containing city water from Farmington, New Mexico. Farmington water was used so the cement would have the same curing characteristics as the cement tested at the Dowell-Schlumberger Laboratory.

The 8.89-cm tubing was killed with 1590 *l* of fresh water and the annulus was killed with 1908 *l* of fresh water. The initial kill-fluid injection was 199 *l*/min, which stabilized at 119.2 *l*/min after injection of 636 *l*. The kill-water was followed with 795 *l* of calcium chloride water to gel the sodium silicate in the lost circulation zone at approximately 62.6 m. The mixture for the calcium chloride solution was 13.8 kg/159 *l* of fresh water. The calcium chloride solution was pumped at a stable rate of 199 *l*/min and was followed by a 1272 *l* freshwater spacer that was injected at a stabilized rate of 143 *l*/min. The freshwater spacer was followed by 1590 *l* of sodium silicate at a rate of 95.4 *l*/min and a wellhead pressure of 35 psig. The tubing pressure increased from 10 to 35 psig during the pumping of sodium silicate. Five hundred and fifty-six liters of Tierras Valley API Class "H" sulfate-resistant cement were premixed 1:1 with pozzolan, 2% gel, 35% silica flour, and 0.5% friction reducer (D-65). The amount of water required per sack of cement was 21.8 *l*. The cement mixture yielded 0.04 m^3 of slurry per sack of cement and had a thickening time of 2 hr 5 min at 93.3°C. The cement pumping rate decreased rapidly while the pump maintained a constant rpm until a wellhead squeeze pressure of 30 psig was achieved and no more cement could be pumped. The cement was over-flushed with 4 *l* of water at 50 psig after the lines were cleared of cement. The cementing equipment was rigged down at approximately 1300 hr, and the core hole was shut-in overnight. The squeeze cementing operation was witnessed and approved by Roy Johnson, District Supervisor, New Mexico OCD (Appendix C).

On November 18, 1988, the integrity of the cementing job was tested. The 8.89-cm tubing was bled down and the annulus valve was opened. A slight blow of steam at the surface was caused by boiling of the 4 *l* of water left on top of the annular squeeze cement. This boiling was the result of the high wellhead temperatures that were induced while bleeding down the 8.89-cm tubing. The steam from the annulus was checked for hydrogen sulfide and no measurable amounts were detected. This indicated that the annular seal integrity was good and that no communication presently exists in the annulus between the surface and the flow and lost circulation zones below the shoe of the 16.83-cm casing at 43 m. The wellhead was allowed to cool down and no further annular steam flow was noted. The annulus was then pressurized with air to 58 psig and, when all minor surface pipe couplings were tightened, the annulus held 58 psig for 15 min. No measurable leakoff was noted, further substantiating the integrity of the annular squeeze cement job. Pressure testing equipment was rigged down, the wellhead was shut-in, and the cellar was filled with pea gravel. Ownership of the core hole was then

relinquished to the landowners (Appendix D) to the satisfaction of Los Alamos, the landowners, OCD, and SEO.

V. CONCLUSIONS

VC-2A was permitted under the SEO as a scientific core hole and functioned as such. However, when the OCD declared jurisdiction after the core hole had been completed, they determined that additional work was required to complete VC-2A as a geothermal test well. Fortunately, it was possible to use oil field and geothermal field procedures (a cement squeeze) to complete VC-2A to OCD geothermal field requirements. The borehole was transferred to the landowners as promised in the original agreement between them and Los Alamos, therefore preventing possible litigation. Future scientific drilling projects also may find themselves caught between regulatory agencies and their respective (and at times conflicting) regulations.

ACKNOWLEDGMENTS

The remedial actions on core hole VC-2A were funded by an Institutional Supporting Research grant from Los Alamos National Laboratory. We thank Don Dreesen of Los Alamos for designing the cement squeeze.

REFERENCES

Goff, F., and Nielson, D. L. (eds.), "Caldera Processes and Magma Hydrothermal Systems, Continental Scientific Drilling Program—Thermal Regimes, Valles Caldera Research, Scientific, and Management Plan," Los Alamos National Laboratory report LA-10737-OBES (May 1986).

Goff, F., and Gardner, J. N., "Jemez Volcanics Cored in Second D.O.E. Hole," *Geotimes* **32**, no. 3, 11-12 (1987).

Goff, F., Nielson, D. L., Gardner, J. N., Hulen, J. B., Lysne, P., Shevenell, L., and Rowley, J. C., "Scientific Drilling at Sulphur Springs, Valles Caldera, New Mexico: Core Hole VC-2A," *EOS* **60**, no. 30, 649, 661-662 (1987).

Hulen, J. B., and Nielson, D. L., "Stratigraphy and Hydrothermal Alteration in Borehole Baca-8, Sulphur Springs Area, Valles Caldera, New Mexico," *Geoth. Res. Counc. Trans.* 10, 187-192 (1986).

Hulen, J. B., Gardner, J. N., Nielson, D. L., and Goff, F., "Stratigraphy, Structure, Hydrothermal Alteration, and Ore Mineralization Encountered in CSDP Core Hole VC-2A, Sulphur Springs, Valles Caldera, New Mexico: A Detailed Overview," University of Utah Research Institute report ESL-88001-TR (1988).

Musgrave, J. A., Goff, F., Shevenell, L., Trujillo, P. E., Counce, D., Luedemann, G., Garcia, S., Dennis, B., Hulen, J. B., Janik, C., and Tomei, F. A., "Selected Data from Continental Scientific Drilling Core Holes VC-1 and VC-2A, Valles Caldera, New Mexico," Los Alamos National Laboratory report LA-11496-OBES (February 1989).

Starquist, V. L., "Core Log, Valles Caldera #2A, New Mexico," Los Alamos National Laboratory report LA-11176-OBES (January 1988).

APPENDIX A

LEGAL AGREEMENT BETWEEN LOS ALAMOS AND THE LANDOWNERS

APPENDIX B

STATE ENGINEER'S PERMIT FOR VC-2A

APPENDIX C

PROPOSAL TO PERFORM "BRADENHEAD" SQUEEZE AND
OIL CONSERVATION DEPARTMENT APPROVAL

APPENDIX D

AFFIDAVIT OF RESPONSIBILITY CONVERSION TO CORE HOLE

APPENDIX E

PHOTOGRAPHS OF REMEDIAL OPERATIONS ON VC-2A

APPENDIX A

LEGAL AGREEMENT BETWEEN LOS ALAMOS AND THE LANDOWNERS

A G R E E M E N T

This Agreement is by and between the Regents of the University of California, operating Los Alamos National Laboratory for the United States Department of Energy ("Los Alamos"), and John Corbin, Ken Corbin, Henry McHarney, and Caryl McHarney (the "OWNERS").

WITNESSETH:

WHEREAS Los Alamos is participating in the Continental Scientific Drilling Program, which is a collaborative effort of the United States Department of Energy ("DOE"), U.S. Geological Survey ("USGS") and the National Science Foundation, (NSF),

WHEREAS such program includes a plan to study the Valles Caldera of North-Central New Mexico, such plan envisioning core-drilling operations and initial scientific investigation extending over a seven-year period from 1985 to 1993,

WHEREAS a Valles Caldera Scientific Drilling Team of principal and collaborating investigators has been organized to carry out such plan, Los Alamos being heavily represented on such team,

WHEREAS scientific drilling in the Valles Caldera would expand knowledge of heat/mass transfer processes associated with magmatic and volcanic phenomena and their role in the evolution of the Earth's crust,

WHEREAS application of the basic scientific knowledge gained would enhance discovery and definition of energy resources associated with geothermal systems,

WHEREAS Los Alamos has no commercial interests in this program. All activities of this program are only for scientific knowledge and the data and information obtained from this program will become part of the public domain,

WHEREAS the OWNERS hereinbefore noted own in aggregate the surface rights and certain geothermal rights of a tract within the Valles Caldera that is scientifically attractive to the Valles Caldera Scientific Drilling Team, such tract being called Patented Mining Claims M.S. No. 553 (Sulphur Bank Places Mining Claim) and M.S. No 1019 (Sulphur Bank No. 2 Placer Mining Claim) and being more specifically described in Attachment 1 hereto, and

WHEREAS said OWNERS desire to aid the objectives of the Drilling Team and to share in the knowledge and experience acquired in the program.

NOW THEREFORE:

IN CONSIDERATION OF the premises and mutual covenants contained herein, the parties hereto agree as follows:

1. The OWNERS hereby give permission, for those members of the Drilling Team and their agents necessary to perform the scientific operations contemplated hereunder, to enter upon and pass over the applicable lands and/or leasehold estates and to conduct such scientific operations at any site mutually agreed upon by the OWNERS and Los Alamos.

2. All equipment and hardware necessary to conduct the operations will be provided by the Drilling Team, Los Alamos, and/or their subcontractors.

3. Under no circumstances whatsoever shall the OWNERS either individually or collectively be liable for, or otherwise be obligated to pay or bear any costs or expenses of whatever nature pertaining to the operations and activities performed hereunder. Los Alamos shall indemnify, defend and hold harmless the OWNERS and any of their respective officers, directors, agents, and employees from and against any and all claims, demands, liabilities, costs and expenses of whatever nature, including attorneys' fees and court costs, arising out of, or alleged to arise out of, any injury to or death of any person or persons or loss of or damage to any property caused by, or allegedly caused by, the willful acts or negligence of Los Alamos, or its officers, agents, employees, invitees or guests, including members of the Drilling Team.

4. In the event the operations or related scientific activities cause physical damage to the real or personal property of the OWNERS, Los Alamos shall replace or repair such property or pay the OWNERS fair compensation.

5. All data, core and fluid samples shall become the property of the Department of Energy. However, copies of the data shall be given to the OWNERS in the form of both raw and analytical data no later than six months after the completion of operations and not less than 60 days in advance of publication of the data.

6. Los Alamos and the Drilling Team shall exercise reasonable care in performance of the operations to prevent fire, in accordance with the Fire Prevention Plan. This plan will be provided to the owners 30 days before coring operations commence.

7. Los Alamos and the Drilling Team shall conduct all operations in accordance with the Ecological Damage Mitigation & Restoration Plan. This Plan will be provided to the owners 30 days before coring operations commence.

8. Los Alamos and the Valles Caldera Scientific Drilling Team hereby extend to the OWNERS an invitation to select a representative to join the Team as an ex-officio member; The OWNERS hereby accept such invitation, and nominate John W. Corbin.

9. This agreement shall be in effect for 5 years, beginning June 1, 1986 and ending May 31, 1991.

10. Both Los Alamos and the OWNERS reserve the right to terminate this agreement on September 30 of each year, with 60 days advance notice in writing provided to the other party (i.e. by August 1 of the year of termination).

11. Los Alamos will give to the OWNERS the completed corehole with casing, well head, and other hardware at the end of May, 1991 or earlier if scientific investigations are completed.

11. 5/15/86 Jr WC

11a. The term "other hardware" referred to in paragraph 11 consists of, but not limited to, pipes, valves, pressure gauges. The University's best estimate for "other hardware" is not to exceed $500.00.

12. Los Alamos or their designated agents will assume full responsibility for plugging and abondoning the corehole if the coring operations result in blowout or if the corehole is mechanically unstable or unsafe. In such an event, Los Alamos or their agents are not obligated to core another hole for the use of the OWNERS.

13. Los Alamos will have the right to enter the corehole periodically during the 5 years of this agreement to make repairs, perform geophysical logs, take fluid samples, etc. as necessary. It is understood that should re-entry be done during periods of heavy snow, Los Alamos will pay the cost of snow removal necessary for such access.

14. Los Alamos requests the right to use the utilities and telephone services of the Sulphur Springs property, and will reimburse the owners the costs of using such services. It is understood that the OWNERS shall be paid one time a use fee of $250. It is further understood that the use fee and reimbursement costs will be paid to the OWNERS by the Drilling Subcontractor as a third-party item.

Amendment to #3 addition - to paragraph 3:
Owners will not be liable for any injuries sustained by Los Alamos or its officers, agents, employees, invitees or guests, including members of the Drilling Team while occupying the premises ~~adjacent~~ or the right-of-way for business or any other purpose.
#15 Los Alamos shall cause to be erected signs at the borders of the property stating it is private property and dangerous to the public.

Caryl McHarney, Owner

4/4/84

RWC

THEREFORE WITNESSETH THE PARTIES:

UNIVERSITY OF CALIFORNIA
LOS ALAMOS NATIONAL LABORATORY
P.O. Box 1663
Los Alamos, NM 87545

OWNERS

5/5/86

NEWBY G. ELLINGTON
MAT-DO, MS P274

Date

Date

4/03/86

Approved, Los Alamos National Laboratory Legal Counsel

Date

Date

3-27-86

NOTARY EXP. Aug 27th 1988
BERN. CO. NM

3/27/86

Date

3-27-86

3/27/86

Date

APPENDIX B

STATE ENGINEER'S PERMIT FOR VC-2A

IMPORTANT-READ INSTRUCTIONS ON BACK BEFORE FILLING OUT THIS FORM

APPLICATION FOR PERMIT

86 JUN 23 P2:08

To Drill Test Holes For Scientific Purposes

Date Received June 23, 1986 File No. RG-46071 - Expl.

1. Name of applicant Los Alamos National Laboratory
   Mailing address P.O. Box 1663, HSE-8, MS K490
   City and State Los Alamos, NM 87545 (505)667-0819 (Micheline Devaurs)
2. Source of water supply None, located at 106°-37'W Long; 35°-52'N Lat (1)
   (artesian or shallow water aquifer) (name of underground basin)
3. The well is to be located in the ___ ¼ ___ ¼ ___ ¼, Section ___ Township ___
   Range ___ N.M.P.M., or Tract No. ___ of Map No. ___ of the ___ District,
   on land owned by John Corbin, Ken Corbin, Henry McInarney & Caryl McInarney
4. Description of well: name of driller Valles Caldera No. 2A, Driller To Be Determined
   Outside Diameter of casing Open Hole (2) inches; Approximate depth to be drilled (500 m) 1500 feet;
5. Quantity of water to be appropriated and beneficially used None acre feet,
   (consumptive use, diversion)
   for Scientific coring and fluid sampling (3) purposes.
6. Acreage to be irrigated or place of use None acres.

Subdivision	Section	Township	Range	Acres	Owner
Not Applicable					

86 JUN 27 P 1:54

7. Additional statements or explanations —
   (1) See attached map, usually described as Patented Mining Claims M.S. 553, Sulphur Bank Placer Mining Claim, and M.S. 1019 Sulphur Bank No. 2 Placer Mining Claim No. 2.
   (2) HQ Core bit size (3.782 inches), HW Casing 3½ inch OD if needed

   (3) This program is funded in FY86 to core and sample the Valles Caldera in the Thermal Regimes element of the Continental Scientific Drilling Program. The cores, fluid samples, measurements and borehole geophysics, and related experiments to be conducted in the proposed corehole will be used to investigate and study the geologic structure, volcanic history, and geochemistry of subsurface fluids, and especially to study the evolution of a steam zone of hydrothermal systems. It is expected that operations during the summer of 1986 will be completed in 20 to 30 days. Following the coring, the drill site pad will be cleaned, cleared, and no permanent structure will remain behind. Access to the corehole will be requested for a period of five years following completion of the core drilling for occasional downhole studies, tests and experiments. At the end of this occasional experimental period, transfer of ownership of the corehole to the land owner is planned.

I, [signature: Donald Lucero], affirm that the foregoing statements are true to the best of my knowledge and belief and that development shall not commence until approval of the permit has been obtained.

N/A - Not required of a federal agency.

______________________, Permittee,

By: ______________________.

Subscribed and sworn to before me this ________ day of ____________, A.D., 19____.

My commission expires ______________ ______________
Notary Public

Number of this permit RG-46071-Expl.

ACTION OF STATE ENGINEER

By authority vested in me, this application is approved provided that all rules and regulations of the State Engineer pertaining to the drilling of shallow wells be complied with; and further subject to the following conditions:

1. Well shall be drilled by a drilling contractor licensed by the State Engineer of the State of New Mexico.

2. No water shall be diverted from this well except for testing purposes, which shall not exceed ten (10) cumulative days, and well shall be plugged on or before July 15, 1987 unless a permit to use water from this well is acquired from the office of the State Engineer.

3. A complete and properly executed well record, on the form provided by the State Engineer, shall be filed not later than ten (10) days after completion of the well. Test data shall be filed not later than ten (10) days after completion of the test(s).

Proof of completion of well shall be filed on or before n/a, 19____

Proof of application of water to beneficial use shall be filed on or before n/a, 19____

Witness my hand and seal this 22nd day of July, A.D., 19 86.

S. E. Reynolds, State Engineer

By D. A. Esparza

D. A. Esparza, District I

INSTRUCTIONS

This form shall be executed, preferably typewritten, in triplicate and shall be accompanied by a filing fee of $5.00. Each of triplicate copies must be properly signed and attested.

A separate application for permit must be filed for each well used.

Secs. 1—4—Fill out all blanks fully and accurately.

Sec. 5—Irrigation use shall be stated in acre feet of water per acre per annum to be applied on the land. If for municipal or other purposes, state total quantity in acre feet to be used annually.

Sec. 6—Describe only the lands to be irrigated or where water will be used. If on unsurveyed lands describe by legal subdivision "as projected" from the nearest government survey corners, or describe by metes and bounds and tie survey to some permanent, easily located natural object.

Sec. 7—If lands are irrigated from any other source, explain in this section. Give any other data necessary to fully describe water right sought.

APPENDIX C

PROPOSAL TO PERFORM "BRADENHEAD" SQUEEZE AND
OIL CONSERVATION DEPARTMENT APPROVAL

ENERGY AND MINERALS DEPARTMENT

P. O. BOX 2088
SANTA FE, NEW MEXICO 87501

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N. M. B. M.		
U. S. G. S		
Operator		
Land Office		

SUNDRY NOTICES AND REPORTS ON GEOTHERMAL RESOURCES WELLS

5. Indicate Type of Lease: State ☐ Mining Claim Fee ☐

5.a State Lease No.: *See below

Do Not Use This Form for Proposals to Drill or to Deepen or Plug Back to a Different Reservoir. Use "Application For Permit —" (Form G-101) for Such Proposals.)

1. Type of well: Geothermal Producer ☐ Temp. Observation ☐ Stratigraphic Test ☒ Low-Temp Thermal ☐ Injection/Disposal ☐ Borehole ☒

7. Unit Agreement Name: N/A

2. Name of Operator: Los Alamos National Laboratory

8. Farm or Lease Name: Corbin/Sulphur Springs

3. Address of Operator: P.O. Box 1663, ESS-1, Mail Stop D462, Los Alamos, NM 87545

9. Well No.: VC-2A

4. Location of Well
Unit Letter 2000 Feet ~~From The~~ South ~~Line~~ and 1625 Feet ~~From The~~ East ~~Line~~ of / the NE corner Section 4 Township 19 N. Range 3E. NMPM.

10. Field and Pool, or Wildcat: Stratigraphic Test

15. Elevation (Show whether ~~DF, RT,~~ GR, etc.): 8344 feet above sea-level

12. County: Sandoval

16. Check Appropriate Box To Indicate Nature of Notice, Report or Other Data

NOTICE OF INTENTION TO:				SUBSEQUENT REPORT OF:			
PERFORM REMEDIAL WORK	☒	PLUG AND ABANDON	☐	REMEDIAL WORK	☐	ALTERING CASING	☐
TEMPORARILY ABANDON	☐			COMMENCE DRILLING OPNS.	☐	PLUG & ABANDONMENT	☐
PULL OR ALTER CASING	☐	CHANGE PLANS	☐	CASING TEST AND CEMENT JOB	☐		
OTHER	☐			OTHER			

17. Describe Proposed or completed Operations (Clearly state all pertinent details, and give pertinenet dates, including estimated date of starting any proposed work) SEE RULE 103.

*Patented mining claims MS-553, Sulphur Bank Mining Claim, and M.S. 1019, Sulphur Bank No. 2 Placer Mining Claim No. 2

(All depths refer to ground level).

Withdrawal 11-17-88

Present Condition of Well:
10 in. conductor pipe cemented at 36 ft in 12-1/4 in. hole.
6-5/8 in. casing cemented from 153 ft to surface in 8-5/8 in. hole; shoe at 153 ft.
4-1/2 in., BH drill rods, cemented at 316 ft in 5-7/8 in. hole. Fair cement from approximately 193 ft to the casing shoe at 316 ft. Poor or no cement from 193 ft to the surface.
3-1/2 in., HQ drill rods landed at T.D. at 1741 ft open ended and hung in donut in the wellhead flange.

Proposal
In order to repair the primary cement job in the 4-1/2 in. x 5-7/8 in. and the 4-1/2 in. x 6-5/8 in. casing annulus, it is proposed to down or "Bradenhead" squeeze the open annulus with cement from the surface to the top of the presently existing cement and lost circulation zone at 193 ft. The annulus will be injection rate tested prior to cementing and lost circulation will be mitigated by injecting LCM and sodium silicate gel prior to pumping

(see Attachment "A" for Proposal continuation)

18. I hereby certify that the information above is true and complete to the best of my knowledge and belief.

SIGNED [signature] TITLE Drilling Consultant DATE 11-3-88

APPROVED BY [signature] TITLE DISTRICT SUPERVISOR DATE 11-3-88

CONDITIONS OF APPROVAL, IF ANY:

Proposal (continued)

low density, high temperature, salt and sulphate resistant cement. The final integrity of the remedial cement job will be tested by demonstrating that the annulus will hold a column of water and by testing the annulus for shutin pressure buildup. (Present annulus gas pressure is approximately 45 psig.)

APPENDIX D

AFFIDAVIT OF RESPONSIBILITY CONVERSION TO CORE HOLE

AFFIDAVIT OF RESPONSIBILITY
CONVERSION TO CORE HOLE

STATE OF NEW MEXICO) ss.
County of Los Alamos)

Wayne Morris, being first duly sworn according to law, upon his oath deposes and says:

1. That he is Group Leader, ESS-1 (Title) of Los Alamos National Laboratory (Operator)

whose address is P.O. Box 1663, ESS-1, Mail Stop D462, Los Alamos, NM 87545

2. That Los Alamos National Laboratory (Operator) is the operator of a hole cored on land belonging to John Corbin (Landowner), whose address is P.O. Box 78, Mountain Route, Jemez Springs, NM 87025, said well being drilled to test for geothermal scientific information and described as the VC-2A, being located 2000 feet from the South line and 1625 feet from the East of the NE corner line of Section 4, Township 19 N., Range 3E., NMPM, Sandoval County, New Mexico.

3. That said well was drilled to a total depth of 1741 feet from the ground level, and that casing has been set and cemented as follows:

See attached letter to John Corbin, 11-18-88, from Wayne Morris, ESS-1.

4. That operator has back filled the cellar with gravel and cleared the site of all junk. Operator has left all casing in the core hole and has relinquished the core hole to landowner for his use as a heat source via a downhole heat exchanger. (See Attached.)

Los Alamos National Laboratory
(Operator)
By Wayne A Morris

Subscribed ~~and sworn to~~ before me this 18TH day of November, A. D. 19 88

OFFICIAL SEAL
Signature: Douglas L Lewis
DOUGLAS L LEWIS
NOTARY PUBLIC - NEW MEXICO
NOTARY BOND FILED WITH SECRETARY OF STATE
My Commission Expires 5-17-92

Sandoval
Notary Public in and for the County of

STATE OF New Mexico) ss.
County of Sandoval)

John W. Corbin, being first duly sworn according to law upon his oath deposes and says that the provisions of Paragraphs 3 and 4 above have been complied with, he accepts the above-described core hole for his personal use as noted on the Attachments, and that he assumes all responsibility for the core hole, the location, and the conversion of the core hole to such personal use.

John W. Corbin
(Landowner)

Subscribed and sworn to before me this 18TH day of November, A. D. 19

OFFICIAL SEAL
Signature: Douglas L Lewis
DOUGLAS L LEWIS
NOTARY PUBLIC - NEW MEXICO
NOTARY BOND FILED WITH SECRETARY OF STATE
My Commission Expires 5-17-92

Sandoval
Notary Public in and for the County of

APPENDIX E

PHOTOGRAPHS OF REMEDIAL OPERATIONS ON VC-2A

Fig. E-1. Bleeding down the HQ rods before pumping in cold water to kill the well.

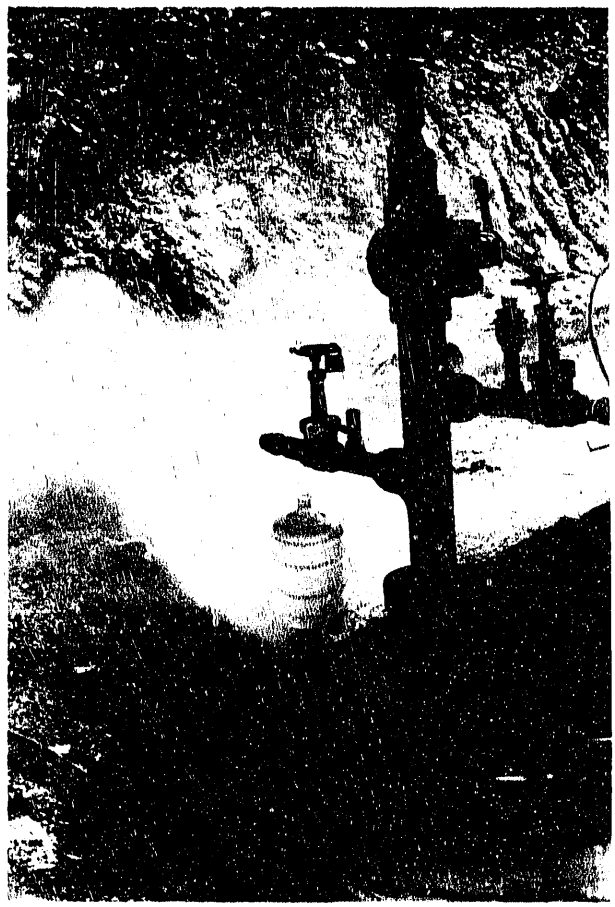

Fig. E-2. One-half horsepower submersible pump used to pump cold water to kill the well. Pump easily supplied the required pressure to the wellhead even though the pump was about 5 m below the level of the wellhead and 75 m away.

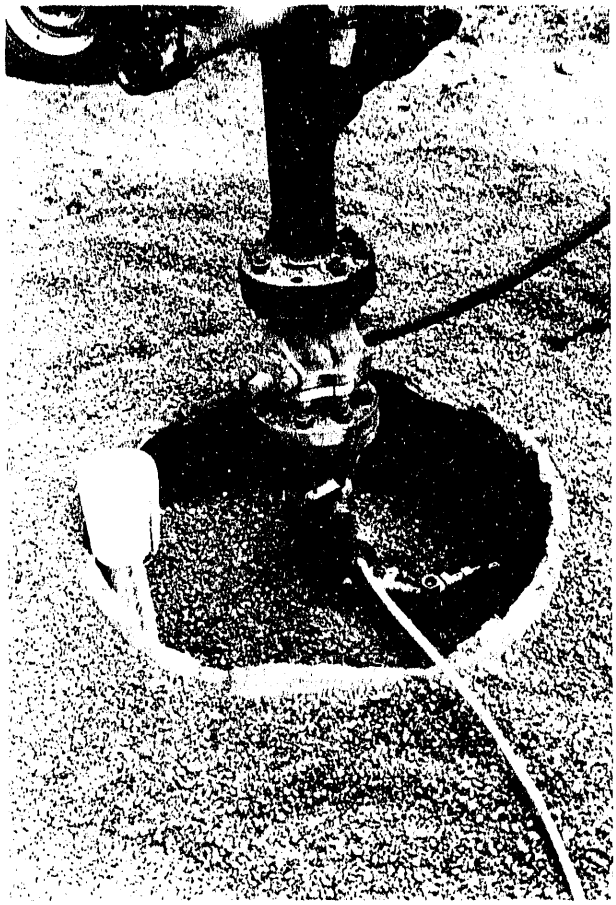

Fig. E-3. One and one-half cubic meters of pea-sized gravel was put into the cellar of VC-2A as a safety measure. To allow monitoring of H_2S levels at the bottom of the cellar, 7.0-cm PVC pipe was placed along the wall of the cellar.

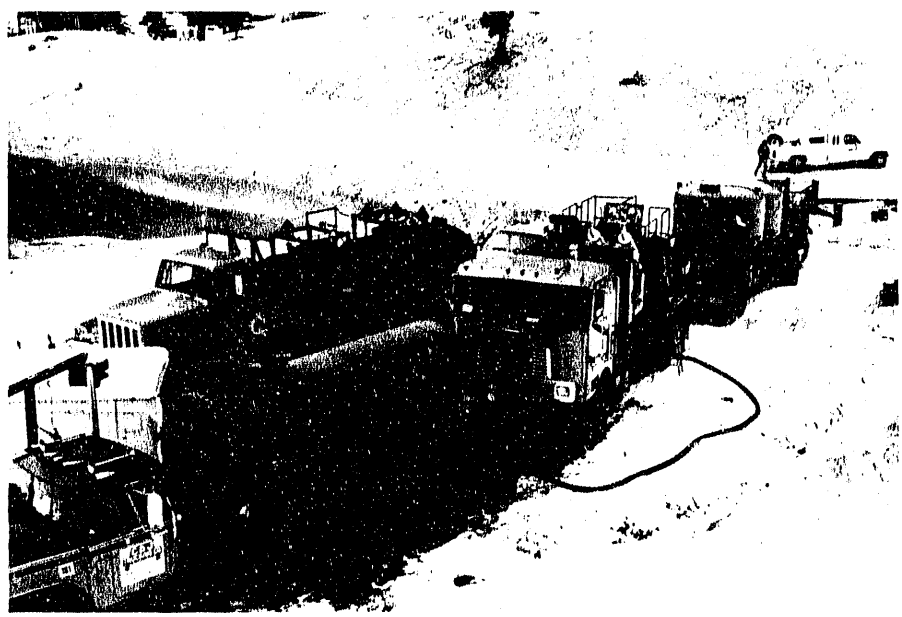

Fig. E-4. Overview of cementing operation. Conical tank in middle background contains dry cement blended to the specifications required for this job. Black tanks on truck at left center contain sodium silicate solution. Truck adjacent to sodium silicate truck is the mixing and pumping truck. Tank truck contains 80 barrels of water for cementing and killing operations.

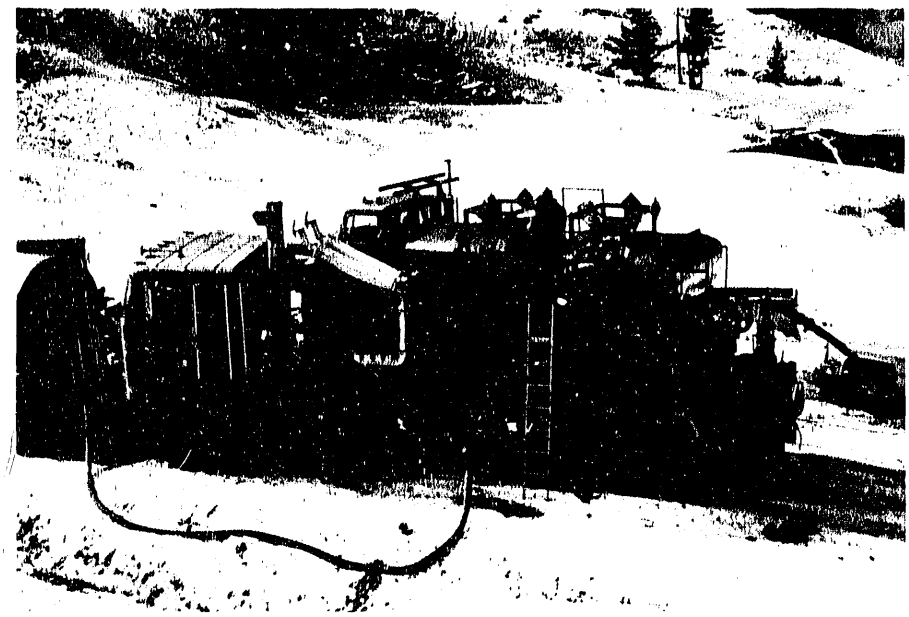

Fig. E-5. Pumping truck during the cementing operation.

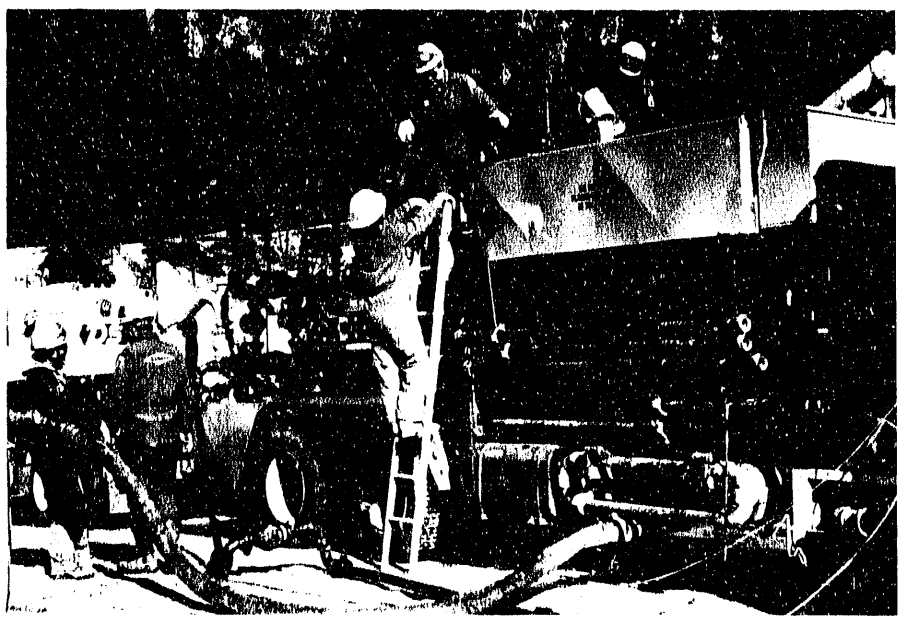

Fig. E-6. Activity around the well site during cementing. White powder being added is calcium chloride. A 12.5-cm hose connects sodium silicate tanks to the pumping truck.

Fig. E-7. Roy Johnson (right) of the State of New Mexico OCD; Tom Turner (center), consultant to Los Alamos; and David Catanach (left), also of the OCD, talk during preparation for cementing.

Fig. E-8. Close-up of well configuration. A 12.5-cm hose is a water line to kill the well, and a 6.0-cm pipe carries the cement.

Fig. E-9. Close-up of wellhead during cementing. The 6.0-cm cement line is reduced to 2.5 cm at the annulus port. Gauge reads 25 psi pressure during cementing. The other gauge monitors pressure on the HQ rods.

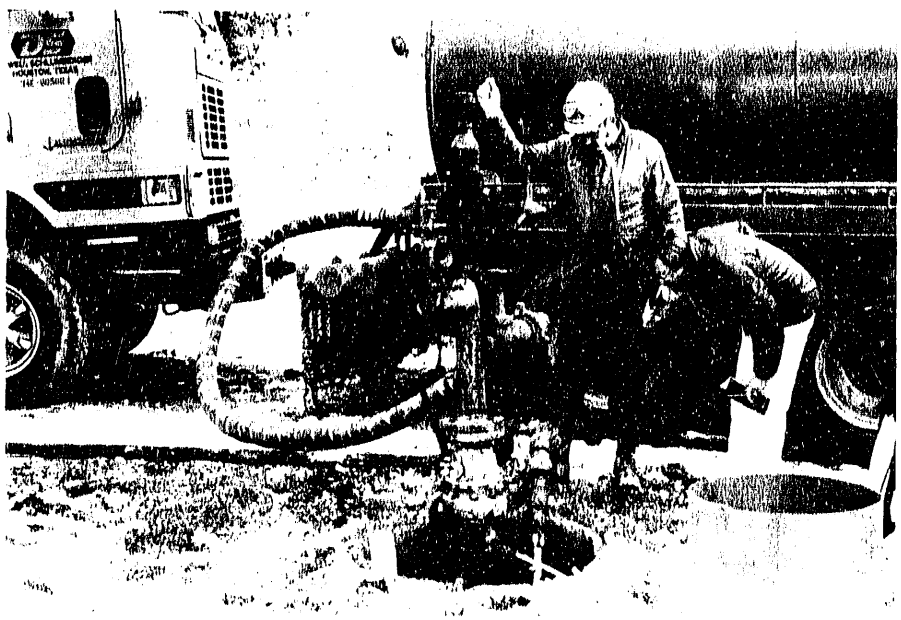

Fig. E-10. Tom Turner watches pressure gauge as S. Christensen (Dowell Schlumberger) signals to pump operator to "squeeze" the last amount of cement into annulus.

Fig. E-11. Close-up of pressure gauge during cement integrity test. The annulus held 58 psig for 15 min, indicating the cementing was successful.

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