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REPORTS

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PROJECT GASBUGGY WELL PLUGGING AND SITE RESTORATION PLAN



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ENGINEERING AND ENERGY APPLICATIONS DIVISION

UNITED STATES DEPARTMENT OF ENERGY
NEVADA OPERATIONS OFFICE

ABSTRACT

This document is the operational plan for conducting the final restoration work at the site of the first U.S. underground nuclear experiment for the stimulation of low-productivity natural gas reservoirs. The plan includes well plugging procedures, surface facilities decontamination and removal procedures, radiological guidelines, and environmental considerations.

PROJECT GASBUGGY
WELL PLUGGING AND SITE RESTORATION PLAN

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PROJECT GASBUGGY
WELL PLUGGING AND SITE RESTORATION PLAN

I. INTRODUCTION

A. Purpose

This plan has been developed to establish the objectives and set forth the procedures and guidelines for the restoration of the Project Gasbuggy site, which was the location of the first U.S. underground nuclear experiment for the stimulation of low-productivity natural gas reservoirs. The general objectives of the site restoration project are to plug and abandon all project-related bore holes, remove surface facilities, and return the site to its pretest status. Detailed objectives, specific procedures, and guidelines which will be followed during field activities are described herein.

B. Background

In 1958, the El Paso Natural Gas Company (EPNG) expressed interest in the stimulation of gas reservoirs with nuclear explosives. The practicability of such a procedure was presented in a feasibility study which was completed in 1965. The study was a joint effort undertaken by EPNG, the U.S. Atomic Energy Commission (AEC) (now part of the Department of Energy), and the Department of Interior's Bureau of Mines, with technical assistance from the Lawrence Radiation Laboratory (LRL) (now Lawrence Livermore Laboratory). The study, titled Project Gasbuggy, described the nuclear stimulation of a gas reservoir in the Pictured Cliffs sandstone formation in the San Juan Basin of northwestern New Mexico approximately 75 miles east of Farmington (Figure 1).

EPNG subsequently proposed to the AEC that Project Gasbuggy be conducted as a joint Government-industry venture. The AEC concluded that Gasbuggy would be a valuable technical experiment and, together with the Department of the Interior, signed a contract with EPNG on January 31, 1967.

Drilling to assess the potential of the site began in early 1967. Upon completion of two exploratory wells, GB-1 and GB-2, the New Mexico San Juan Basin site was accepted and in June 1967, drilling of the nuclear emplacement hole, GB-E, was started. On December 10, 1967, a 29-kiloton nuclear explosive was detonated at a depth of approximately 4,240 feet in the low-permeability Pictured Cliffs sandstone formation.

After reentry drilling, six major production tests were conducted. Two took place in 1968, three in 1969, and the last in 1973. A total of approximately 400 million cubic feet (MMCF) of gas was produced and flared to the atmosphere during this five-year testing period. The reentry well has been shut in since the 1973 productivity test, with only pressure monitoring being conducted and small gas samples periodically taken.

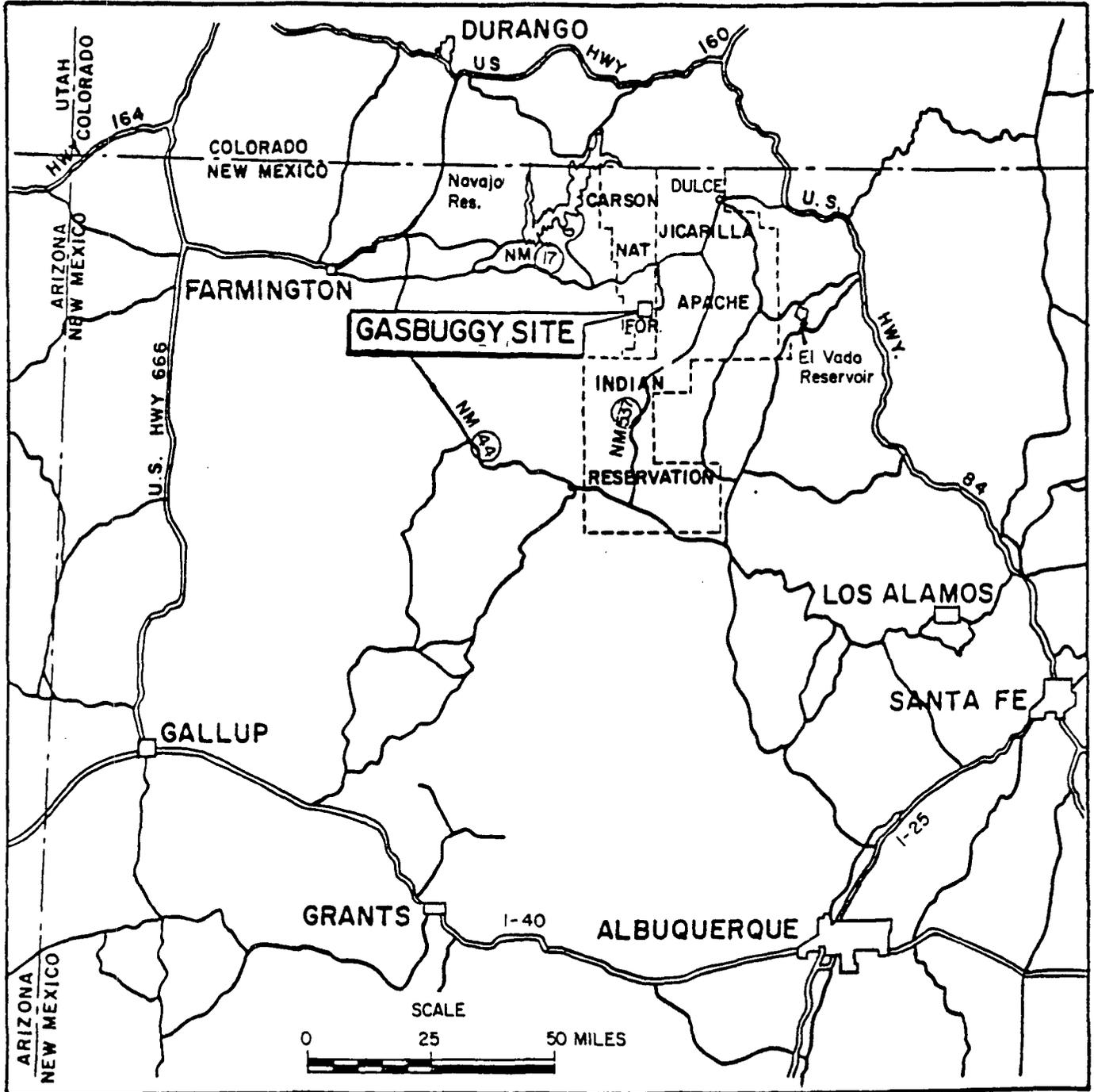


Figure 1 Project Gasbuggy Area Map

It has been determined that there is no longer a programmatic need to maintain the Project Gasbuggy well complex, and all involved project participants have agreed that the five project-related wells should be plugged and abandoned and the site released for unrestricted surface use.

C. Authority

1. References

- a. Contract AT(04-3)-711, dated January 31, 1967, signed by the AEC, Department of Interior, and the EPNG.
- b. Memorandum of Understanding, dated March 23, 1967, between the Department of Agriculture's U.S. Forest Service (USFS) and the AEC.
- c. EPNG letter dated July 23, 1976, D. N. Canfield to DOE/NV, M. E. Gates.
- d. DOE/NV letter dated August 11, 1976, to DOE/MA, DOE/OG&ST, LASL, LLL, and SL.
- e. Responses from all recipients of Reference 1.d. letter.

2. The basic responsibility of DOE to conduct the restoration is contained in the referenced contract and Memorandum of Understanding, with applicable portions shown here as follows:

- a. Reference 1.a. above, Article II(b):

"Project Gasbuggy, as delineated in this contract, is a cooperative effort between the Government and the Company; each of the parties is assuming responsibility for performing certain specified functions at its own cost and each is, accordingly, prepared to assume responsibility for increases in the cost of performing its functions as may develop during the execution of the project. Each party shall proceed promptly to perform its portions of the work in accord with a jointly coordinated time schedule to be issued by the Commission. Since the explosion of a nuclear device is involved in the execution of this project, the Commission, because of its responsibilities in connection therewith, must have and is hereby given the right to control the execution of the project in all phases of operations involving the nuclear device, including site preparation, emplacement, detonation, disposition of radioactive substances, and public health and safety."

- b. Reference 1.a. above, Article IV(b)(8)(vi):

"Roll-Up

Subsequent to detonation, the Company shall remove all trailers, technical structures, construction equipment, testing equipment and associated material to a point mutually agreed upon which is not more distant than the Gobernador Camp. The Company will also clean and remove surface debris from the area of the emplacement hole, control points and Recording Trailer Park areas; provided, however, the Company shall have no obligation to remove radioactive or contaminated material or debris."

- c. Reference 1.b. above, paragraph C.9:

"That upon termination of this agreement, the parties shall mutually agree on removal or other disposition of all structures and improvements which have been placed on National Forest lands in the exercise of this use."

3. The concurrence of all project participants to proceed with site restoration is contained in responses to Reference 1.d. letter above.

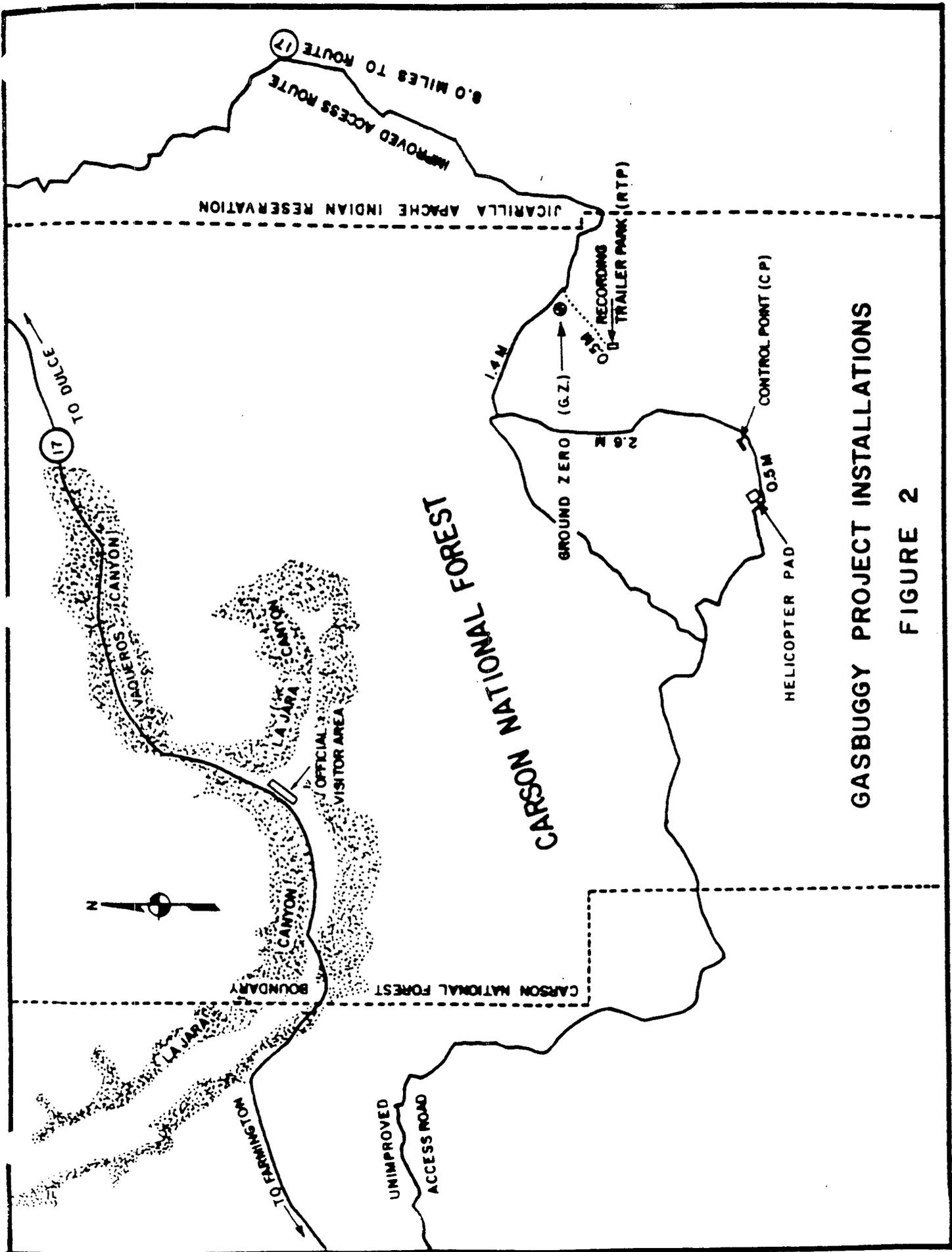
II. CURRENT SITE STATUS

A. Lands

The project installations (Figure 2) consisting of the ground zero (GZ) area, the recording trailer park (RTP), the control point (CP), and the helicopter pad were located on lands within the Carson National Forest. The use of these lands for the Gasbuggy project was established in the previously cited Memorandum of Understanding between the U.S. Forest Service and the U.S. Atomic Energy Commission. Additionally, by land withdrawal action of Public Land Order 4232, dated June 22, 1967, the Bureau of Land Management withdrew from all forms of appropriation, including mining and mineral leasing laws, and reserved for the use of the Atomic Energy Commission the surface and subsurface of lands within Section 36, T29N, R4W, New Mexico Principal Meridian. Surface and subsurface operating rights to lands within the SW 1/4 of the described section were reserved for the use of the AEC under stipulations of Contract AT(04-3)-711. Access to the project site was by a road traversing the Jicarillo Apache Indian Reservation. Upgrading and extending this roadway was accomplished by the New Mexico State Highway Department through EPNG under stipulations in Contract AT(04-3)-711. This road was provided for Project Gasbuggy use but the project did not acquire control or responsibility for its maintenance.

B. Wells and Appurtenances

Four wells (GB-1, GB-2, GB-3, and GB-E) were drilled for the performance of Project Gasbuggy. A fifth well, GB-D, not a part of Project Gasbuggy,



GASBUGGY PROJECT INSTALLATIONS

FIGURE 2

was drilled and instrumented as an add-on project for the Advanced Research Projects Agency (ARPA). Well locations are shown in Figure 3. General information on the wells is as follows:

1. Well No. GB-1: A preshot test well drilled by EPNG, to a total depth of 4,306 feet with a 9 5/8-inch production casing set and cemented at 3,741 feet. A 2 3/8-inch tubing string is set at 4,253 feet. The lower 1,500 feet of tubing is fiberglass with attached instrument packages and the upper 2,750 feet is steel. Conductor cables are attached to the exterior of the tubing, and it is cemented to 2,812 feet and mud-stemmed from 2,812 feet to the surface.
2. Well No. GB-2: A preshot test well drilled by EPNG to a total depth of 4,246 feet with 7-inch casing set at 3,906 feet. The original hole was stemmed to 3,000 feet with cement preshot and drilled out by AEC to 3,812 feet (GB-2R) where collapsed casing was encountered during postshot reentry attempts. The reentry was continued by sidetracking out of the 7-inch casing at 3,691 feet to a total depth of 4,600 feet (GB-2RS). A 2 3/8-inch production tubing string was set at 4,224 feet in the open hole sidetrack. The tubing was perforated from 4,052 feet to 4,063 feet, but no production was obtained.
3. Well No. GB-3: A postshot test well drilled by EPNG to a total depth of 4,809 feet and completed with a 4 1/2-inch liner hung inside a 7-inch casing at 3,743 feet. Liner setting depth is 4,809 feet with perforations from 3,922 to 4,200 feet. The liner is not cemented. Production is through 2 3/8-inch tubing set at 4,190 feet.
4. Well No. GB-E: The nuclear device emplacement hole drilled by the AEC to a total depth of 4,350 feet with a diameter of 28 inches. The hole was cased with 20-inch-diameter casing set at 4,324 feet and cemented to the surface. The device was emplaced with 4,227 feet of 7-inch-diameter casing containing eight slotted intervals and cables attached to the outer surface. The 7-inch casing and the 7-inch by 20-inch annulus were stemmed with cement and sand to the surface. The well was reentered postshot by the AEC by drilling and destemming to the chimney at 3,907 feet (GB-ER). A 2 7/8-inch production tubing string was run to 3,885 feet with a packer set at 3,800 feet. An obstruction currently exists in this tubing approximately 8 feet below the top master valve.
5. Well No. GB-D: An AEC-drilled preshot ground motion measurement hole (ARPA add-on, separately funded), located outside the fenced ground zero area approximately 1,500 feet southeast of the emplacement hole. Total depth is 4,725 feet with open hole below the 13 3/8-inch casing at 482 feet. The well contains four instrument packages suspended from a cable at depths of 4,600 feet, 4,218 feet, 3,600 feet, and 3,250 feet. The open hole from total depth to 3,106 feet is continuously grouted and the interval from 3,106 feet to the surface is filled with drilling mud. The messenger cable extends the full depth of the well.

PROJECT GASBUGGY

GROUND ZERO (GZ) AREA
STATUS AS OF DEC 1976

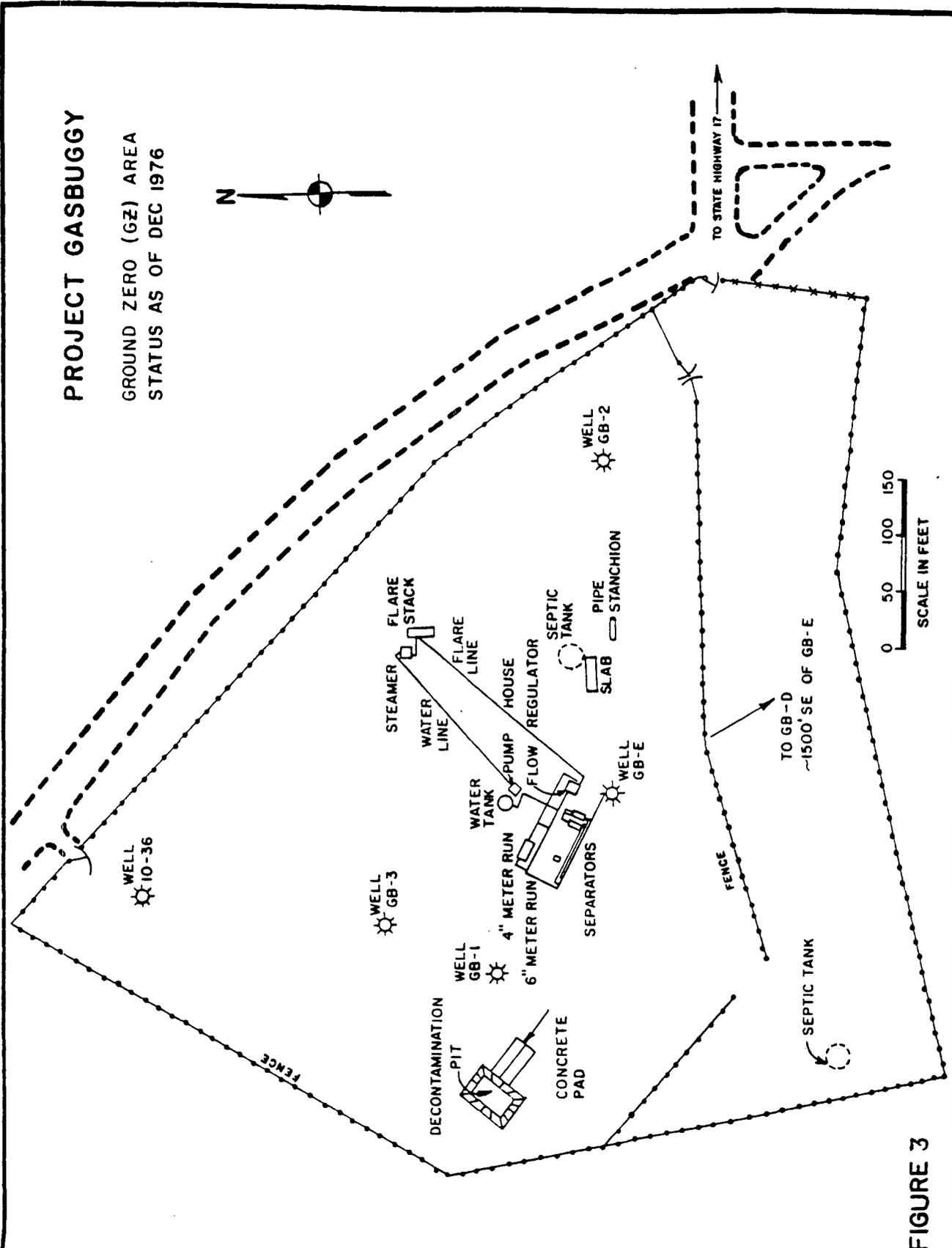
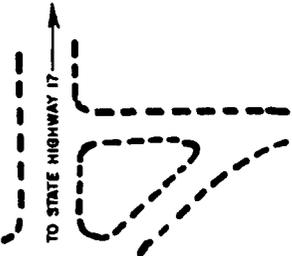


FIGURE 3

An additional well, EPNG No. 10-36, which existed prior to the project execution, is located within the bounds of the site abandonment work limits. It is currently being used as an aquifer monitoring well and will not be included in the site abandonment efforts other than for possible radiological monitoring. Final disposition of this well remains an EPNG responsibility. Wells GB-1, 2, 3, and E are each equipped with wellheads which will be removed as part of the well plug and abandonment procedures and returned to the appropriate owners. See Appendix D for equipment ownership determinations.

C. Surface Facilities

All facilities associated with the former control point (CP), recording trailer park (RTP), and helicopter pad locations have been removed; the areas have been graded, shaped, and reseeded; and existing surface conditions at these locations are considered to satisfy abandonment criteria. The areas where work remains to be performed during this site abandonment include the fenced area which encompasses Wells GB-1, 2, 3, E, and 10-36 (see Figure 3) and any area disturbed during the plugging of Well GB-D. The major facilities comprising the fenced area are as follows:

1. GB-E Production Testing System: Consists of two separators with insulating enclosures, manifold systems, skid-mounted metering runs, flow control equipment, 4 1/2-inch-diameter flare line, flare stack, 100-barrel water tank, 6-foot by 4-foot pump shed, steam-spray system in an 8-foot by 10-foot metal shed, plus connecting water and gas lines with associated valves.
2. Decontamination Pad and Pit: A 20-foot by 40-foot concrete pad sloped to an excavated pit approximately 40 feet by 20 feet by 4 feet deep surrounded by a 3-foot-high berm. The pit contains the deteriorated remains of an asphalt-plastic lining.
3. Fence: Approximately 3,500 feet of 6-foot-high mixed four-strand barbed wire and woven wire fence on steel posts with one 16-foot-wide double gate and two 12-foot-wide single gates.
4. Miscellaneous: Three separators, four 6-foot by 4-foot galvanized metal storage sheds, four light standards, three electrical panel boards, one pipe stanchion set in a concrete base, two abandoned septic tanks, three wellhead lubricator platforms, and miscellaneous concrete pads approximately 6 feet by 4 feet in size.

D. Topography

The existing land contours within the site abandonment surface work limits or previously described GZ fenced area conform to the surrounding terrain, which can be described as relatively flat to gently rolling. Mud reserve pits used during the drilling phase have been backfilled and there are no unnatural appearing land features except for the decontamination pit and surrounding berm at the edge of the concrete pad. Natural revegetation has taken place throughout the affected areas. EPNG and DOE

have graded and seeded all other project installation areas and no additional grading or seeding will be performed except as may be required because of surface disturbance during the site abandonment work.

E. Radiological Conditions

See Radiological Support Plan, Section V.

III. ORGANIZATION AND MANAGEMENT CONCEPT

A. Department of Energy, Nevada Operations Office (DOE/NV)

1. The DOE, through the Manager, NV, will appoint a DOE Project Director who will have the overall responsibility for the achievement of all project objectives. His major areas of responsibility and authority are as follows:
 - a. Provide a project plan.
 - b. Provide a general support contractor, Fenix & Scisson (F&S), and a radiological support contractor, Eberline Instrument Corporation (Eberline), to accomplish well plugging and site restoration work described in Sections IV through VI of this plan.
 - c. Review and certify the provisions for the safeguarding of personnel and property.
 - d. Provide radiological control, criteria, and interpretation.
 - e. Approve all major changes to the project plan.
 - f. Manage and coordinate F&S, Eberline, and DOE on-site activities.
2. The Project Director will be represented on site by individuals with the following designations and responsibilities:
 - a. Project Engineer: The Project Engineer will be responsible for the day-to-day general project direction including coordination of the F&S and Eberline interface. The Project Engineer will make project execution decisions within his prescribed limits of authority as required to expedite project accomplishment. He will keep the Project Director advised of the daily work status and will maintain an up-to-date project cost record.
 - b. Radiological Operations Supervisor (ROS): The ROS will be responsible for assuring that the Radiological Support Plan (Section V) and the Radiological Field Operations Plan (Appendix B) are in accordance with project requirements and current DOE radiological criteria. He will be cognizant of radiological conditions and will assist in the initial on-site coordination of the F&S/Eberline interface.

The ROS will be on site during the start-up of field activities, during the final site surveying period, and at other selected periods as determined by the DOE Project Director. The ROS will provide radiological guidance within his prescribed limits of authority as required to expedite project accomplishment.

B. Fenix & Scisson (F&S)

1. F&S, as the general support contractor under contract to DOE/NV, will provide the materials, services, and technical direction required to accomplish all well plugging and site restoration objectives except those associated with radiological support. In the exercise of the above function, F&S will appoint a Project Manager with the following major areas of responsibility:
 - a. Provide detailed well plugging and abandonment (P&A) procedures.
 - b. Obtain and/or coordinate all required permits and approvals for well P&A and site restoration, as necessary, through the USGS, the New Mexico Oil Conservation Commission, the U.S. Forest Service, and EPNG.
 - c. Execute subcontracts for the performance of well P&A, surface facilities decommissioning and site restoration activities, except labor support to Eberline; and provide on-site supervision for the work.
 - d. Coordinate as necessary with the radiological support contractor, Eberline, to ensure timely, safe, and cost-effective operations.
 - e. Provide advice to DOE and Eberline regarding procedures for the most economic method of project accomplishment.
 - f. Suspend site activities and initiate emergency procedures if any operation jeopardizes personnel or property.
 - g. Provide daily work progress and weekly cost reports to the DOE Project Engineer and provide assistance as required to evaluate the cost and schedule impact of plan changes prior to their implementation.
 - h. Provide a final report summarizing well abandonment and site restoration activities.
2. The Program Manager will staff the required field organization to carry out the above responsibilities.

C. Eberline Instrument Corporation (Eberline)

Eberline, as the radiological support contractor under contract to DOE/NV, will provide technical direction and on-site supervision to accomplish all radiological decontamination work in accordance with DOE radiological criteria. Major responsibilities are as follows:

1. Provide a Radiological Field Operations Plan which outlines a radiological monitoring, sampling, and analysis procedure and specifies radiological criteria to be used.
2. Provide on-site supervision and technical personnel to execute the Radiological Field Operations Plan.
3. Obtain and direct subcontractors as necessary to assist in sampling and decontamination procedures.
4. Coordinate radiological activities as necessary with the general support contractor efforts to achieve safe, economic, and timely operations.
5. Keep the ROS and/or the Project Engineer continually advised of radiological conditions and provide a daily work progress report.
6. Maintain a weekly cost status report and assist the Project Engineer in projecting and estimating the impact of approved program changes.
7. Provide a Radiation Contamination Clearance report upon completion of field operations.

D. El Paso Natural Gas Company (EPNG)

EPNG will assist in obtaining well plugging and abandonment permits and provide certain support items as specified in Section IV.

IV. GENERALIZED SITE ACTIVITIES AND LOGISTICS

A. Trailers

F&S will provide one office trailer (locally rented) with desks and chairs for administrative use by DOE, F&S, and Eberline personnel.

An additional trailer will also be provided through F&S for radiological support use by Eberline.

B. Electrical Power

EPNG will furnish a 40-kilowatt generator to provide operating power for the radiological support trailer and the office trailer.

C. Communications

F&S will arrange for a mobile telephone service. The service shall consist of separate units with different numbers installed in each of the two trailers.

D. Construction Water

Water will be hauled approximately 8 miles by truck from a water hole near the intersection of Highway 17 and the site access road.

E. Vehicles

Project organizations will be responsible for providing and maintaining their own vehicles.

F. Occupational Health and Safety

1. General

All operations and activities will be conducted in accordance with the standards of the Occupational Safety and Health Act of 1970 (OSHA).

All participating organizations are responsible for the health and safety of their own personnel and for conducting all activities in accordance with procedures that assure:

- a. A safe and healthful environment for the employees.
- b. Control and minimization of hazards to the public and to personnel or other participants.
- c. Minimization of the accidental damage or loss of equipment, materials, and property.
- d. Compliance with on-site radiological safety procedures.

2. Medical Services

- a. F&S will make arrangements with the San Juan Hospital in Farmington for any hospitalization that may be required.
- b. F&S will provide two physician-approved first-aid kits to be located in the officer trailer.

3. Fire Protection

Three hand-held fire extinguishers will be placed throughout the working area at convenient locations. Extinguishers will be the universal type for control of Class A, B, or C fires.

4. Radiological Protection

Eberline will provide personnel radiological safety services as described in the Radiological Support Plan, Section V.

5. Potable Water

F&S will provide potable water containers which will be maintained by each participating organization.

6. Sanitation

F&S will provide two chemical toilets which will be serviced on a weekly schedule.

G. Site Maintenance

F&S will provide generalized site maintenance such as trash removal, fuel for the EPNG-supplied electrical generator, and general policing of the work areas.

H. Miscellaneous

Reproduction Facility--F&S will provide a desk-top copying machine.

V. RADIOLOGICAL SUPPORT PLAN

A. Purpose

The purpose of this Radiological Support Plan is to establish guidelines, methods, and standards to ensure that all well plugging and site restoration activities to be described in Section VI are conducted in a manner that: (1) minimizes radiation exposure to participating personnel and the public, (2) eliminates radiological contamination in excess of DOE criteria at the Gasbuggy site, and (3) is technically and economically feasible.

B. Current Radiological Conditions

The extent and levels of surface contamination at the Gasbuggy site have been documented by soil and water sampling programs and site surveys by the Environmental Protection Agency (EPA), EPNG, and DOE. Analyses from these surveys have indicated that there is no radiological contamination of soil or surface waters exceeding DOE site disposal criteria set forth in Tables 1 and 2, Section V.E.

Radiological contamination in excess of DOE criteria is expected on interior surfaces of the gas production-testing system from the GB-ER well bore tubing through the flare stack. In addition, a small quantity (approximately 5 to 10 barrels) of tritium-contaminated liquid is contained in the 100-barrel water storage tank.

C. Personnel Safety

1. Bioassays

All operating personnel, i.e., those handling or controlling the handling of contaminated material, will submit a urine sample to Eberline upon arrival at the work site and again upon permanent departure from the site. Other samples may be required depending on operational conditions. Bioassays of other personnel may also be required. Eberline will assay the samples for tritium and conduct

any other analyses deemed appropriate by the ROS. After completion of the project, a report of these analyses will be submitted by Eberline to the NV Radiological Branch for inclusion in the REECO master dosimetry file.

2. Dosimetry

Operating personnel will be required to wear personnel dosimeters. The issuance and maintenance of the dosimeters will be consistent with Eberline's approved dosimetry program. At the conclusion of the project, personnel dosimetry results will be forwarded to the NV Radiological Branch for inclusion in the REECO master dosimetry file.

D. Radiological Procedures for Decontamination

An overall description of the decontamination procedures and system is given in Section VI.A. The associated radiological control, monitoring release, and sampling procedures are as follows:

1. Control

The decontamination area, consisting of a large drip pan and concrete pad described in Section VI.A., will be roped off and marked with appropriate signs. Another appropriately marked and roped off area will be established for holding contaminated materials. This will be designated as the contaminated holding area. Two additional areas will be established for radiologically clean EPNG- and Government-owned assets, respectively. These latter areas will not require special control measures.

Items of material and equipment will initially be radiologically surveyed in place; if they meet the release criteria, they will be appropriately marked and placed in one of the clean holding areas. If they do not meet the release criteria, they will be moved to the decontamination area, and after a reasonable decontamination effort, another survey will be conducted. Pending the results of this second survey, the item(s) of material and/or equipment will be moved to the appropriate clean or contaminated holding area for either release for unrestricted use or for disposal as contaminated waste.

2. Equipment Monitoring and Sampling

Items of equipment having inaccessible interiors will initially be flushed through with steam or appropriate cleaning solutions. When the exiting flush materials are below release limits for tritium, the item will be set aside for a 24-hour waiting period. As a final check for tritium following the 24-hour waiting period, an appropriate amount of distilled "clean" water (commensurate with the size of the internal area being checked, but not to exceed one liter) will be placed in contact with a portion of the surface being tested, e.g.,

pouring a liter of water through a pipe or allowing one liter of water to puddle on the inner surface of a tank for a minimum of 30 seconds. Most of this water should be collected and a one cc aliquot analyzed for tritium. If the concentration of tritium in this sample exceeds 5,000 dpm/ml, the decontamination process should be repeated, with DOE's concurrence, until it is determined the item cannot be decontaminated to an acceptable level for unrestricted use at a reasonable cost. In addition, representative wet swipes of the accessible inner and outer portions of the item being tested will be taken.

3. Release of Equipment

A release log will be kept to record the release of all material from the site. Also, appropriate photographic documentation shall be maintained throughout the cleanup. Criteria for release to unrestricted use will be that stated in Tables 1 and 2, Section V.E., which includes a reference to the American National Standards Institute proposed standard ANSI N328-1976, "Control of Radioactive Surface Contamination on Materials, Equipment and Facilities to Be Released for Uncontrolled Use," and the special criteria for internal inaccessible surfaces described above.

4. Sampling and Analysis Program

a. General

Soil, water, urine, swipe, and possibly gas samples will be collected and analyzed for tritium on site. In addition, selected samples will be analyzed for ^{137}Cs and ^{90}Sr at the Radiological Contractor's home laboratory.

b. Soil Sampling Program

At the conclusion of the 1973 production test, EPNG conducted an extensive soil sampling and analysis program. Soil samples were collected on a 50-foot grid pattern at a 2-foot depth and analyzed for tritium. A finer grid pattern was used in areas expected to be more highly contaminated. Results indicated that no samples exceeded approved cleanup criteria.

During this final cleanup operation, a complementary 50-foot grid pattern will be sampled near the surface. More extensive sampling will be used in areas expected to be of higher contamination. Additional samples will be collected as prescribed by the ROS at both the surface and at depth. All soil samples will be analyzed for tritium on site and selected samples will be analyzed for ^{137}Cs and ^{90}Sr . A total of 250 or more soil samples to be analyzed for tritium is foreseen. All sampling will be conducted to delineate the extent of the contamination.

c. Water Sampling Program

Deep well water samples are currently being collected by the EPA. Reference is made to Section IX for a description of this ongoing Long-Term Hydrological Program. During the cleanup operation, operational water samples will also be collected as required and analyzed for tritium.

d. Gas Sampling Program

It is not anticipated that gas samples will need to be analyzed. Provisions to collect and analyze these samples, should the need arise, will be made.

e. Vegetation Samples

A few vegetation samples from the Gasbuggy vicinity will be collected and analyzed for tritium for pathway documentation purposes. These analyses will be performed at an off-site laboratory.

f. Radionuclide Analysis Sensitivities

Water samples and moisture in soil samples will be analyzed for tritium with a detection sensitivity of 2 pCi/ml. Selected soil samples will be analyzed for ^{137}Cs with a detection sensitivity of 1 pCi/g (wet).

E. Radiological Criteria Project Gasbuggy

The following guidelines* apply to Project Gasbuggy. It is recommended that design and operational activities be conducted within these guidelines in such a manner as to reduce the release of radioactive effluents and radiation exposures to personnel, on and off site, to the lowest practicable levels. Further, with respect to planned operations and any associated controlled releases, exposures to members of the public should not exceed 10 percent of the limits specified in DOE Appendix 0524. For situations involving inadvertent or accidental releases, the overall design of the experimental program should be carefully reviewed to ensure that during the lifetime of the project, there will be no significant uncontrolled release of radioactivity off the controlled area.

1. General Radiological Criteria

The following radiological safety criteria shall apply during the entire operation period of these projects:

*These guides were extracted from letter, Kelly to Miller, April 17, 1972, "Radiological Safety Guidance for Experiments Involving Nuclear Stimulation of Natural Gas Wells," and letter, Biles to Johnson, April 5, 1973, same title, and from American National Standards Institute, ANSI N328-1976.

- a. For individuals within the controlled area, the radiation protection standards set forth in DOE Appendix 0524, paragraphs I-A and IV, shall apply.
- b. For individuals and population groups in uncontrolled areas, 10 percent of the radiation protection standards set forth in DOE Appendix 0524, paragraph II-A, shall apply. It is noted that the potential for radiation exposure to individuals in the uncontrolled area from planned operations existed only during the time of production testing (flaring) activities. There are no production testing activities involved in this restoration project.
- c. In the unlikely event that an inadvertent release of radioactivity to the uncontrolled area occurs, every effort shall be made to reduce potential radiation exposure to individuals off site to the lowest practicable level. Exposure control guideline shall be consonant with the principles and levels of protective action guidance provided in Federal Radiation Council Reports 5 and 7.
- d. All personal property, i.e., buildings, equipment, and materials, to be removed from the site for uncontrolled use shall meet the criteria specified in Table 1 or Table 2 and the special criteria for internal inaccessible surfaces previously set forth in Section D.2. All personal property, transferred from this site to another location where radiological controls are in effect, shall have the external surfaces of such property meet the criteria specified in Table 1 or Table 2 and be packaged for transport in compliance with DOE Appendix 0529 and U.S. Department of Transportation Regulations.

2. Site Disposal

Decontamination and cleanup, prior to release of control and responsibility for the site by the DOE, shall be effected after consideration of the following factors: (1) external radiation levels; (2) migration of radionuclides to man through resuspension in air, movement in water, or passage through food chains; (3) unrestricted property use, immediate and potential; (4) decay and other removal processes tending to reduce potential exposure to man; and (5) the feasibility, cost, and relative effectiveness of further decontamination activities. The cleanup shall be continued until potential future exposures to man are not likely to exceed a few percent of the limits specified in DOE Appendix 0524, paragraph II-A.

Numerical guidance provided herein should not be exceeded without careful consideration of the reasons for doing so. Different values than those provided here may be approved by DOE Headquarters, on a case-by-case basis.

TABLE 1
SURFACE CONTAMINATION LIMITS^{1/}

The levels may be averaged* over the 1 m² provided the maximum activity in any area of 100 cm² is less than three times the limit value.

<u>Nuclide</u>	<u>Limit (Activity)</u> dpm/100 cm ²	
	<u>Total</u>	<u>Removable</u>
Group 1: Nuclides for which the nonoccupational MPC** is 2×10^{-13} Ci/m ³ or less or for which the nonoccupational MPC ^a *** is 2×10^{-7} Ci/m ³ or less; includes Ac-227; Am-241, -242m, -243; Cf-249, -250, -251, -252; Cm-243, -244, -245, -246, -247, -248; I-125, -129; Np-237; Pa-231; Pb-210; Pu-238, -239, -240, -242, -244; Ra-226, -228; Th-228, -230.****	100	20
Group 2: Those nuclides not in Group 1 for which the nonoccupational MPC ** is 1×10^{-12} Ci/m ³ or less or for which the nonoccupational MPC ^a *** is 1×10^{-6} Ci/m ³ or less; includes Es-254; Fm-256; I-126, -131, -133; Po-210; Ra-223; Sr-90; Th-232; U-232.****	1,000	200
Group 3: Those nuclides not in Group 1 or Group 2.	5,000	1,000

^{1/}Taken from ANSI N328-1976.

* See Note following Table 2 on application of limits.

** MPC_a: Maximum Permissible Concentration in Air applicable to continuous exposure of members of the public as published by or derived from an authoritative source such as NCRP, ICRP or NRC (10 CFR, Part 20, Appendix B, Table 2, Column 1).

*** MPC_w: Maximum Permissible Concentration in Water applicable to members of the public.

**** Values presented here are obtained from 10 CFR Part 20. The most limiting of all given MPC values (e.g. soluble vs insoluble) are to be used. In the event of the occurrence of mixtures of radionuclides, the fraction contributed by each constituent of its own limit shall be determined and the sum of the fractions must be less than 1.

TABLE 2
ALTERNATE SURFACE CONTAMINATION LIMITS^{1/}

(All alpha emitters, except U-nat and Th-nat are considered as a group.)

The levels may be averaged over 1 m²* provided the maximum activity in any area of 100 cm² is less than three times the limit value.

<u>Nuclide</u>	<u>Limit (Activity)</u> <u>dpm/100 cm²</u>	
	<u>Total</u>	<u>Removable</u>
If the contaminant cannot be identified; or if alpha emitters other than U-nat and Th-nat are present; or if the beta emitters comprise Ac-227, Ra-226, Ra-228, I-125 and I-129.	100	20
If it is known that all alpha emitters are generated from U-nat and Th-nat; and beta emitters are present which, while not identified, do not include Ac-227, I-125, I-129, Ra-226 and Ra-228.	1,000	200
If it is known that alpha emitters are generated only from U-nat and Th-nat; and the beta emitters, while not identified, do not include Ac-227, I-125, I-129, Sr-90, Ra-223, Ra-228, I-126, I-131 and I-133.	5,000	1,000

^{1/}Taken from ANSI N328-1976.

***NOTE ON APPLICATION OF TABLES 1 AND 2 TO ISOLATED SPOTS OF ACTIVITY:**

For purposes of averaging, any m² of surface shall be considered to be contaminated above the limit, L, applicable to 100 cm² if:

- a. From measurements of a representative number, n, of sections, it is determined that $1/n \sum Si \geq L$, where Si is the dpm/100 cm² determined from measurement of section i; or
- b. On surfaces less than 1 m², it is determined that $1/n \sum Si \geq AL$, where A is the area of the surface in units of m²; or
- c. It is determined that the activity of all isolated spots or particles in any area less than 100 cm² exceeds 3L.

For purposes of planning for disposal of a site for uncontrolled use, the following radiological safety guidance is provided:

a. Surface Waters

Contaminated surface waters in excess of 0.1 times the concentration values listed in DOE Appendix 0524, Annex A, Table 2, Column 2, shall be disposed of by methods approved by DOE Headquarters. For tritium, this is 300 pCi/ml.

b. Buildings, Equipment, and Materials

All personal property remaining at the site shall be decontaminated as near as practicable to the criteria specified in ANSI Standard N328-1976 specifically Table 1 or 2. For tritium only, this is 5,000 pCi/100 cm² total or 1,000 pCi/100 cm² total if ⁹⁰Sr is present and 1,000 pCi/100 cm² removable.

c. Soil

Residual contaminated soil to a depth of about four feet shall be decontaminated or treated to the extent practicable as follows:

- (1) Soil containing residual tritium concentrations exceeding 3×10^{-2} μ Ci/ml of soil moisture shall be excavated for disposition at an approved burial ground. Other means of disposal must be approved by DOE Headquarters. Based upon past experience, little or no soil shall be removed during this restoration.
- (2) Soil containing residual $\beta\gamma$ radiation levels exceeding 0.2 mrad/hr above background (including worldwide fallout) measured at 1 cm shall be excavated for disposition by means approved by DOE Headquarters. After surface restoration, the final average radiation levels shall not exceed 0.05 mrad/hr $\beta\gamma$ above background (including worldwide fallout) measured at 1 cm. All measurements shall be done with a probe having not more than 7 mg per cm² of absorbing material.
- (3) Soil gradients shall be examined by suitable sampling and residual contamination shall be removed and disposed of by methods approved by DOE Headquarters when these levels exceed 10^{-5} μ Ci/g for $\beta\gamma$ decay modes (except tritium) above background (including worldwide fallout). It is not anticipated that test-related radioactivity with an α decay mode will be encountered. If such should be the case, criteria will be provided by DOE Headquarters. Based upon experience at the Gasbuggy site, it is expected that tritium will be the only radionuclide of concern during this restoration.

- d. A final site survey shall be performed prior to release of the site and copies of a report of the cleanup effort and survey results shall be transmitted to DOE Headquarters. The report on the site cleanup operation shall include a description of the physical and legal measures taken to prevent deep drilling, mining, or other restrictions on use of the site. Agreements or arrangements for subsequent monitoring should also be described. The certification requirement, associated with this report, is defined in DOE Appendix 5301, dated January 10, 1973, for all real property and related personal property prior to any disposal or excessing action.
- e. Effective site cleanup will eliminate the need for periodic terrestrial and bioenvironmental surveys and only annual hydrology sampling will be required (see Section X).

F. Final Site Survey

The entire site surface will be surveyed on a 50-foot grid. Areas of known or possible contamination will be surveyed on a 10-foot grid. These surveys will be made at 1 cm distance with an HP-210 probe having less than 7 mg/cm² of absorbent material. This survey will be conducted near the end of the site restoration activities.

VI. SITE RESTORATION AND WELL PLUGGING PROCEDURES

A. Surface Facilities Decommissioning

It is the objective of DOE to radiologically decontaminate all EPNG materials and equipment to permit their release for unrestricted public use. The extent of the decontamination effort that may be required and the probability of success can only be determined as the work progresses.

The DOE will make a reasonable effort to acceptably decontaminate all equipment to conserve equipment and resources for future EPNG reuse. DOE, however, reserves the right to determine what constitutes a reasonable effort. Those items which DOE determines cannot be decontaminated with a reasonable effort and therefore at a reasonable cost will be immediately transferred at no cost to the ownership of DOE. DOE will be responsible for their subsequent disposal at an approved facility.

A detailed sequence for the surface facilities decommissioning work cannot be firmly established, but a description of the required primary activities is as follows:

1. Decontamination System: The first phase of the surface facility disposal will involve the construction of a decontamination system consisting of a large steel pan with 8-inch-high sides and a 500-gallon sump at one end. The pan will be set on the existing concrete decontamination pad. A portable steam cleaning unit will be set up adjacent to the pan. A handling, sampling, swiping, logging, and clearance procedure, as described in Section V, will be implemented to ensure that EPNG-owned equipment is not released for unrestricted public use unless it meets the radiological safety guidelines.

2. Production Testing System: The major components such as the two GB-E separators will be moved to the decon pan, partially disassembled and decontaminated by steam cleaning methods. The disassembly may include removal of separator tank ends with a cutting torch. The subsequent rewelding of the tanks will be the responsibility of EPNG. The steam condensate generated during the steam cleaning will be retained in the sump and additional containers as required. The flare stack and other tubular items such as metering runs and flow control manifolds will be cut into sections and steam cleaned in the decon pan. The flare stack steamer will be removed from the metal building and shipped to the Nevada Test Site as is. The 100-barrel water storage tank will be drained of all liquids; the inspection plate will be removed and the sludge shoveled out and solidified for final disposal by DOE at an approved radioactive waste burial facility. Final disposal of the condensate and other accumulated liquids will be accomplished by vaporization or injection into the nuclear cavity (see Section B).
3. Concrete Decontamination Pad and Pit: The pit will be deepened, the concrete pad broken up and placed in the pit along with the lining and buried during backfilling.
4. Fence: The previously described fence, including posts and gates, will be taken down for removal from the site by EPNG.
5. Miscellaneous Items: Certain items such as the three additional separators, metal storage sheds, light standards, wellhead lubricator platforms, etc., will be removed from the site as is by EPNG. The underground septic tanks will be filled with sand and abandoned in place. The existing pipe frame will remain in place and ownership transferred to the U.S. Forest Service for their use in site monumentation.

B. Radiological Waste

Radiological waste accumulated during the restoration process will include contaminated liquids and sludge from equipment interiors, and soil. The liquids will be disposed of by injection into the nuclear chimney region through the GB-ER well bore. Those contaminated liquids which are generated through final steam cleaning efforts after the GB-ER well bore is sealed will be disposed of by vaporization.* Sludge and soil will be mixed with diatomaceous earth and cement and sealed in DOT-approved containers for subsequent shipment as described below.

C. Packaging and Transportation

All materials, especially radiologically contaminated materials, will be packaged and shipped in a manner that assures protection of both personnel

*Approval for disposal by vaporization will be obtained, if required, from the appropriate Federal or State agency. If approval is not received, liquid will be solidified with diatomaceous earth, appropriately packaged and shipped as described in Section C.

and property. Materials for shipment will consist of radiologically clean EPNG assets, Government-owned property listed in Appendix D, any property which could not be economically decontaminated, and radiological waste material (see Section VI.B.).

The radiologically cleared EPNG assets will be placed in the custody of EPNG at the project site for final disposition by EPNG. Radiologically cleared Government-owned equipment will be loaded onto commercial carriers and transported to the Nevada Test Site. All radiologically contaminated property will be transferred to the custody of the Government and will be appropriately packaged and shipped via commercial carrier to an approved radiological waste burial facility.

D. Earthwork and Revegetation

The decontamination pit will be backfilled to blend with the surrounding ground and reseeded as required. Areas disturbed by the site abandonment work will be kept to a minimum, but where they do occur, they will be graded and seeded. The reseeded areas will not require protective fencing.

The one-mile access road extension from the edge of the Carson National Forest boundary to the GZ area, as well as other minimal dirt roads, will be left as is.

E. Site Monumentation

An existing pipe frame located approximately 200 feet east of the GB-E wellhead consisting of a horizontal steel pipe supported by two vertical pipes will be left in place for use by the U.S. Forest Service. A 4-inch-diameter pipe with 4 feet protruding above finished grade and labeled with the well name will be placed over Wells GB-1, 2, 3, and D. A concrete monument containing a metal plaque with an inscription denoting the historical significance of the site will be erected over the abandoned emplacement well. The inscription, which will also specify certain subsurface excavation and drilling restrictions, shall read as follows:

PROJECT GASBUGGY
NUCLEAR EXPLOSIVE EMPLACEMENT/REENTRY WELL (GB-ER)

Site of the first United States underground nuclear experiment for the stimulation of low-productivity gas reservoirs. A 29-kiloton nuclear explosive was detonated at a depth of 4,227 feet below this surface location on December 10, 1967.

No excavation, drilling, and/or removal of subsurface materials to a true vertical depth of 1,500 feet is permitted within a radius of 100 feet of this surface location, nor any similar excavation, drilling, and/or removal of subsurface materials between the true vertical depths of 1,500 feet and 4,500 feet is permitted within a 600-foot radius of this surface location in the SE quarter of the SW quarter of Section 36, T 29 N, R 4 W, New Mexico Principal Meridian, Rio Arriba County, New Mexico, without U.S. Government permission.

UNITED STATES DEPARTMENT OF ENERGY
NOVEMBER 1978

F. Final Land Disposition

At the conclusion of all site restoration work, land previously withdrawn from all forms of appropriation by Public Land Order 4232, dated June 22, 1967 (see Section II.A., page 4), will be returned to its original status subject only to those subsurface use restrictions noted in Section VI.E. above.

G. Well Plugging and Abandonment (P&A)

The general intent of the P&A work is to confine any gas, oil, or water to the strata in which it originally occurred and seal the fractured zone created by the nuclear explosive from communication with any well bore. The detailed P&A procedures for the five project-related wells are as follows:

1. Well GB-1

- a. Location: (Surface) 1,324' S, 1,614' W
Section 36, T 29 N, R 4 W
Rio Arriba County, New Mexico

Ground Elevation: 7,200 feet

- b. Type Hole: Preshot Test

- c. Present Conditions (See Figure 4.)

- (1) 13 3/8-inch, 48 pounds/foot, H-40 surface casing is set at 488 feet and cemented to the surface.
- (2) 9 5/8-inch, 36 pounds/foot, J-55 casing is set at 3,742 feet and cemented back to surface.
- (3) An 8 3/4-inch hole was drilled to 4,306 feet.
- (4) A combination string of steel and fiberglass tubing with instruments and cables attached was run to 4,254 feet.
- (5) The tubing was cemented and cement tagged inside tubing at 2,812 feet. The cement top on the outside of the tubing is calculated at 2,851 feet.
- (6) Mud was left in the tubing and casing annulus.

- d. Program (See Figure 5.)

- (1) Eberline Instrument Company will provide a radiological safety program to be followed by all parties involved.
- (2) Move rig on location and rig up.
- (3) Check for any trapped pressure on tubing or casing annulus. Bleed any trapped pressure off.

WELL NO. 68-1
PRESENT CONDITIONS

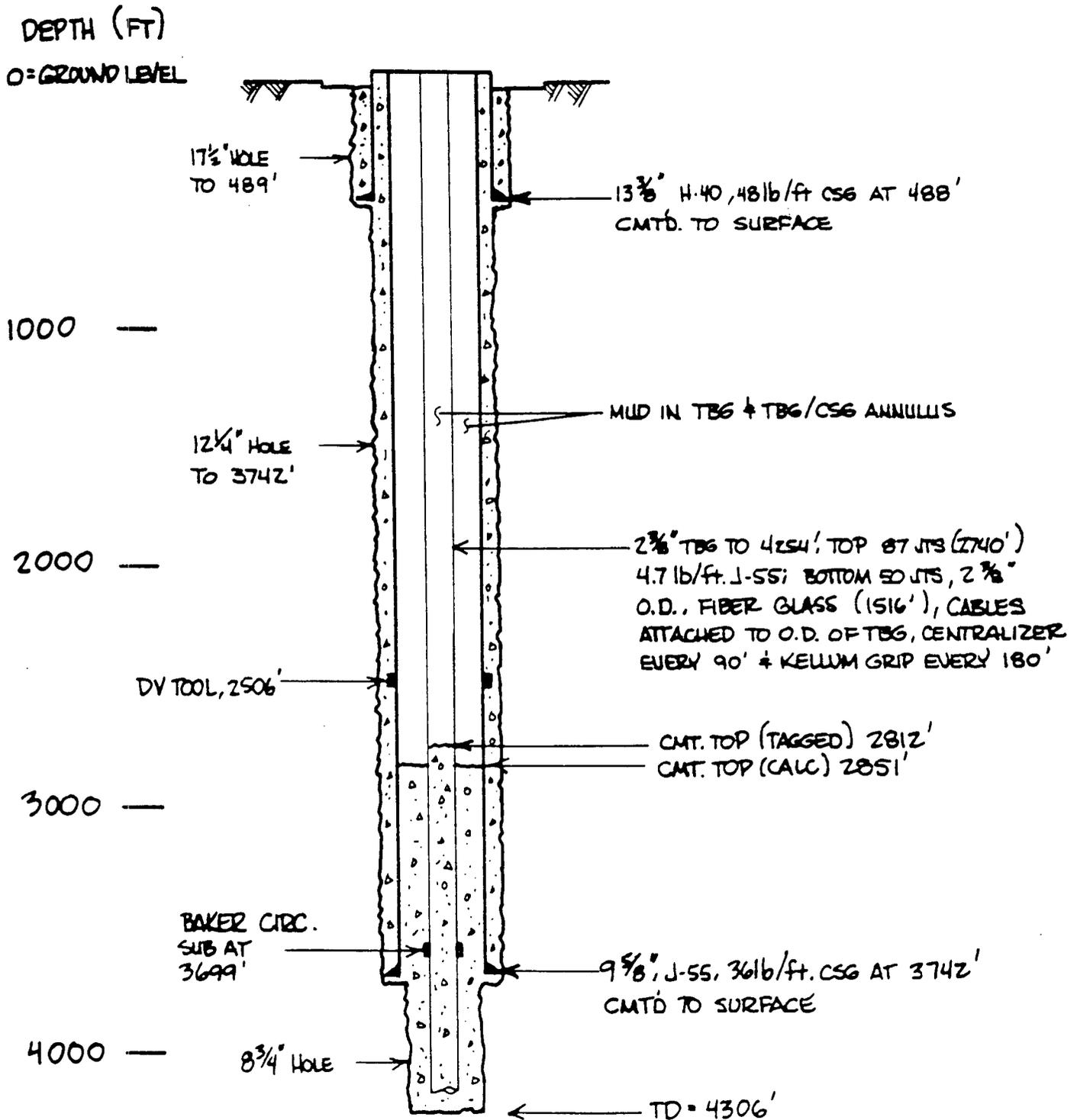


FIGURE 4

WELL NO. GB-1 PROPOSED ABANDONMENT

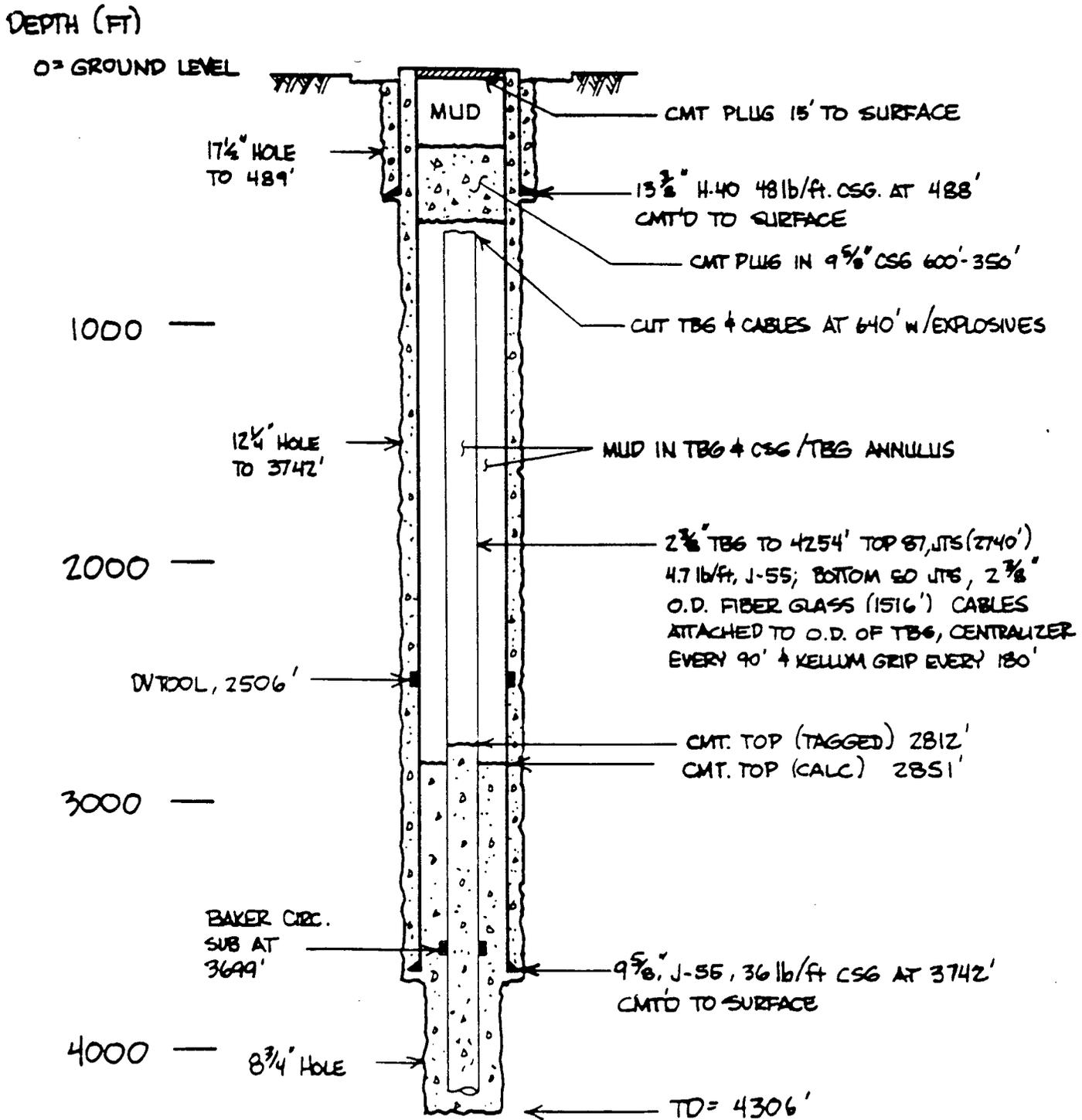


FIGURE 5

- (4) Unbolt gate valve at top of national tubing head (8-inch ser. 900 flange), back out hold-down bolt on tubing head.
- (5) Tie into tubing hanger with 2 3/8-inch, 4.7 pounds/foot, EUE, 8rd, J-55 tubing crossover.
- (6) Pull tension on tubing and run free point to \pm 640 feet inside tubing. Mud was left in the annulus. There is a possibility the tubing may be stuck above 2,812 feet.
- (7) Use a plastic-type explosive to blow off tubing and cables at \pm 640 feet if free point indicates tubing is free at this point.
- (8) Unbolt and remove tubing head. Pull and lay down 2 3/8-inch steel and fiberglass tubing and cables.
- (9) Go in the hole with 2 3/8-inch O.D., CS Hydril, 4.7 pounds/foot, J-55 tubing to \pm 640 feet. Spot a cement plug using Class A neat + 2 percent CaCl_2 from \pm 640 feet to 350 feet. 125 feet³ of cement will be required for this plug. After pumping cement, pull up to \pm 200 feet and flush the tubing with 10 barrels of water. Wait on cement until surface sample is set. Go back in hole and tag the top of the cement plug with tubing. Pull out of the hole laying tubing down. Spot a surface plug from 15 feet to ground level using Class A neat cement. This will require 5 feet³ of cement. Place 4-inch-diameter hole marker pipe into top plug such that 4 feet protrude above final ground level.
- (10) Rig down and prepare to move.

NOTE: The 13 3/8-inch and 9 5/8-inch casing strings will be cut off at the bottom of the cellar, the CMP removed, and cellar backfilled with dirt after the rig has moved off location.

2. Well GB-2RS

- a. Location: (Surface) 1,218' S, 2,070' W
Section 36, T 29 N, R 4 W
Rio Arriba County, New Mexico

Ground Elevation: 7,198 feet

- b. Type Hole: Preshot Test, Postshot Reentry
- c. Present Conditions (See Figure 6.)

- (1) 9 5/8-inch casing, 32.3 pounds/foot, H-40 casing is set at 483 feet and cemented to surface.

WELL NO. GB-2 R8
PRESENT CONDITIONS

DEPTH (FT)

0 = GROUND LEVEL

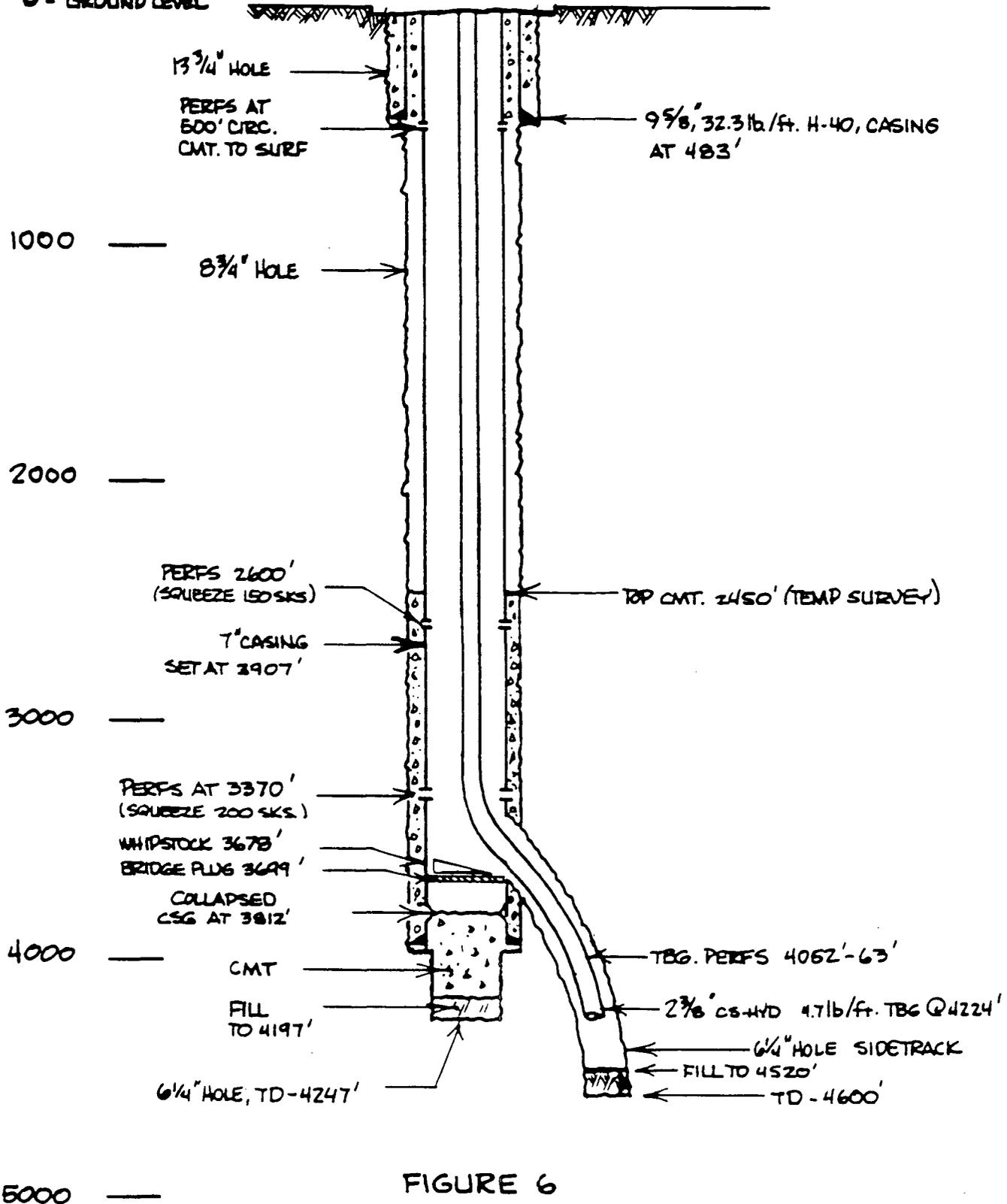


FIGURE 6

- (2) 7-inch, 20.0 pounds/foot, J-55 casing was set at 3,907 feet.
- (3) During reentry, collapsed casing was encountered and the hole was sidetracked at 3,678 feet.
- (4) A 6 1/4-inch hole was drilled to 4,600 feet.
- (5) 2 3/8-inch, 4.7 pounds/foot, CS Hydril tubing was run and landed at 4,224 feet.
- (6) The latest bottom-hole pressure was run January 6, 1976, and indicated a BHP of 866 psi at 4,205 feet and shut-in tubing pressure of 0 psi. The pressure on the 7-inch by 2 3/8-inch annulus was 167 psi. The pressure gradient indicated a fluid level in the tubing of 2,205 feet.

d. Program (See Figure 7.)

- (1) Eberline Instrument Corporation will provide a radiological safety program which will be followed by all parties involved.
- (2) Move rig on location and position over hole.
- (3) Check tubing pressure and tubing-casing annulus pressure:
- (4) If radiologically safe, attempt to bleed pressure from casing annulus while adding water to the tubing. If unable to bleed pressure off, hook up pump to the tubing and casing annulus and attempt to kill well by pumping water (tubing capacity is 16.5 barrels and annulus capacity is 146.5 barrels).
- (5) When well is static, unbolt 6-inch by 2-inch single studded bonnet from Shaffer tubing head, back out hold-down bolts from tubing hanger. Nipple up annular-type BOP and tubing stripper on tubing head.
- (6) Tie into tubing. Pull 2 3/8-inch tubing (a total of 139 joints). Inspect tubing while pulling out of hole and stand in derrick.
- (7) Go in hole with 2 3/8-inch O.D., 4.7 pounds/foot, J-55, CS Hydril tubing to 4,200 feet (orange peel and slot the bottom joint of tubing). Last logs run June 23, 1968, indicated fill at 4,520 feet.
- (8) Spot a continuous cement plug using Class A neat cement from T.D. to 3,400 feet. Tag the top of each stage with tubing. It is estimated that 375 feet³ of cement will be required for plug from 4,520-3,400 feet.

WELL NO. GB-2RS PROPOSED ABANDONMENT

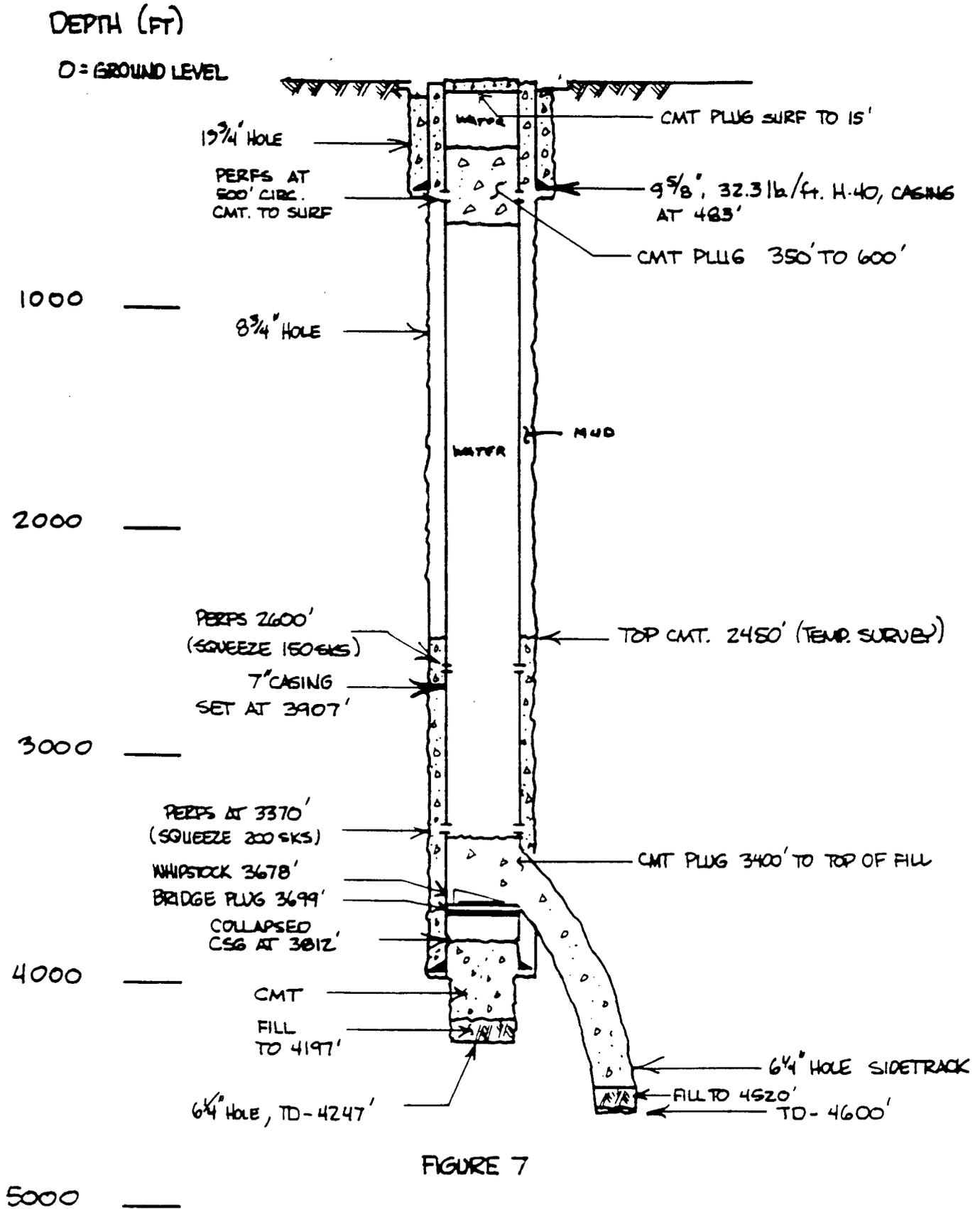


FIGURE 7

- (9) After tagging cement plug at \pm 3,400 feet, circulate hole to surface with water.
- (10) Pull 2 3/8-inch tubing from hole laying down same until a depth of 600 feet is reached. Spot a cement plug of Class A neat + 2 percent CaCl_2 from 600 feet to 350 feet. Inside 7-inch casing (requires 55 feet³ of cement slurry), pull up to 200 feet and wait until cement is set. Tag the top of the cement plug with tubing, pull out of hole laying down tubing. Spot a surface plug inside 7-inch casing using Class A neat cement from 15 feet to surface. Place 4-inch-diameter hole marker pipe into top plug such that 4 feet will protrude above final ground level.
- (11) Nipple down annular BOP and tubing stripper. Remove tubing head and Shaffer manual blowout preventer. Move rig off location.

NOTE: The 9 5/8-inch and 7-inch casing strings will be cut off at the bottom of the cellar, the CMP removed, and cellar backfilled with dirt after the rig has moved off location.

3. Well GB-3

- a. Location: 1,430' S, 1,636' W
Section 36, T 29 N, R 4 W
Rio Arriba County, New Mexico

Ground Elevation: 7,201 feet

- b. Type Hole: Postshot Test Well

- c. Present Conditions (See Figure 8.)

- (1) 9 5/8-inch 32.0 pounds/foot, H-40 casing is set at 538 feet and cemented to the surface.
- (2) 7-inch, 20.0 pounds/foot, J-55 casing is set at 3,791 feet with top of cement in 7-inch x 8 3/4-inch annulus at 2,120 feet.
- (3) A 4 1/2-inch, 10.5 pounds/foot, K-55 liner is set with bottom at 4,809 feet and top at 3,743 feet. The liner is perforated at following intervals: 3,922-34 feet, 3,988-4,000 feet, 4,045-66 feet, 4,120-32 feet, 4,188-4,200 feet (one shot per foot). The liner was not cemented.
- (4) A 2 3/8-inch, 4.6 pounds/foot, J-55 tubing string was run and hung in tubing head with bottom at 4,190 feet.

WELL NO. GB-3
PRESENT CONDITIONS

DEPTH (FT)
0 = GROUND LEVEL

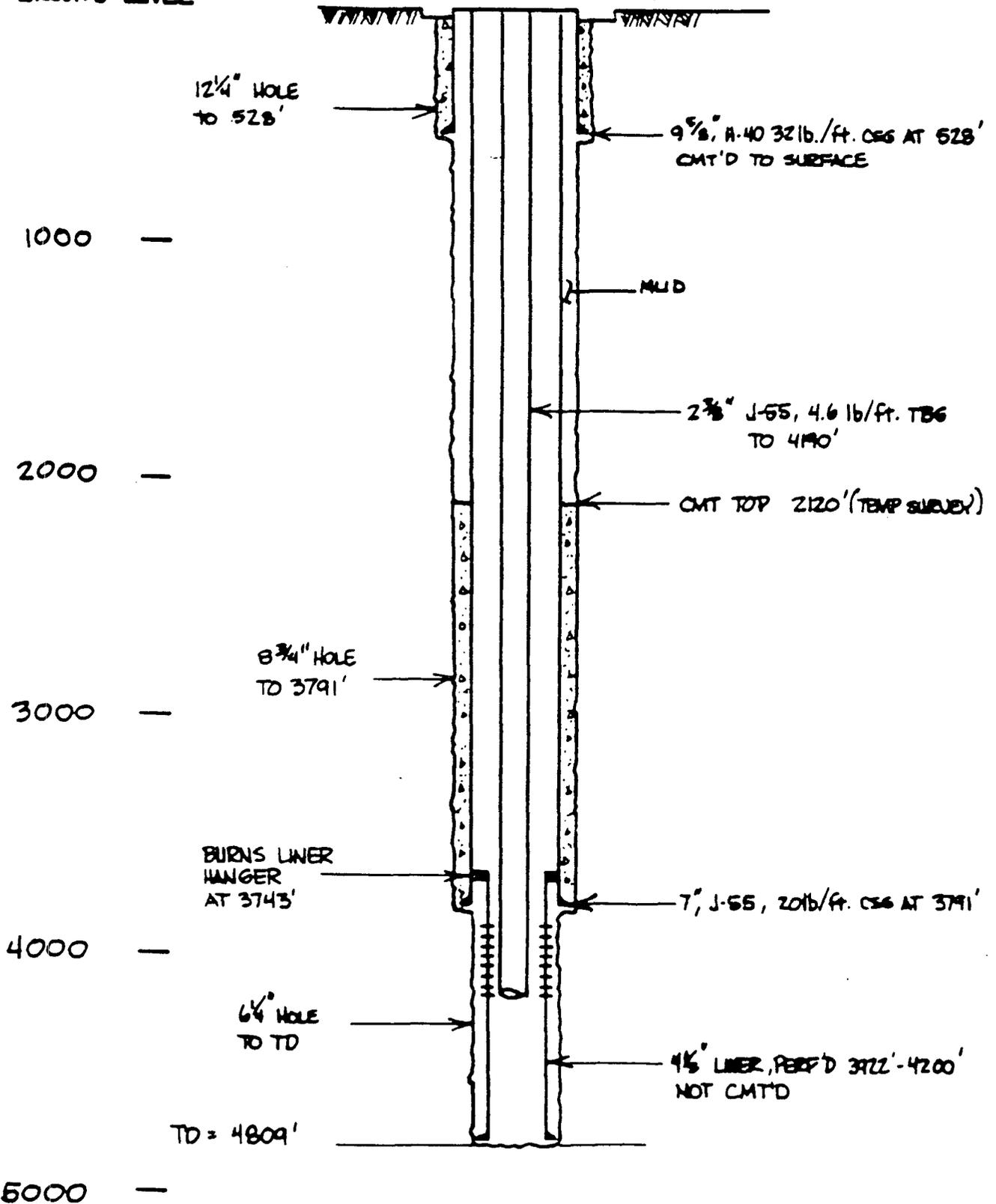


FIGURE 3

- (5) The latest bottom-hole pressure survey run January 6, 1976, indicates a pressure of 580 psi at 4,179 feet with a shut-in tubing pressure of 28 psi and casing pressure of 510 psi. The pressure gradient indicates a fluid level of $\pm 2,900$ feet in the tubing.

d. Program (See Figure 9.)

- (1) Eberline Instrument Corporation will provide a radiological safety program which will be followed by all parties involved.
- (2) Check wellhead pressure, measure and record same on both tubing and casing. Have Eberline perform radiological check on well effluent. If effluent is radiologically safe, attempt to bleed pressure off.
- (3) If effluent is unsafe or if unable to bleed pressure off tubing and casing, hook up rig pump to tubing and casing and kill well by "bullheading" water down casing and tubing. Tubing capacity is 16.3 barrels and annulus capacity is 140 barrels. It may be necessary to pump twice or three times this capacity to kill the well. Use a lightweight native or bentonite mud to kill well if attempts with water fail.
- (4) Unbolt wellhead above tubing head at 6-inch x 2-inch single studded bonnet. Nipple up annular-type BOP on top of tubing head and tubing stripper on top of BOP. Continue adding water to tubing and casing while working on wellhead to prevent any repressuring.
- (5) Back out hold-down bolts, pull 2 3/8-inch, 4.6 pounds/foot, J-55 tubing laying down same. Eberline will radiologically check tubing. It will be decided at this time if decontamination operations of tubing will be required. Keep hole full while pulling tubing.
- (6) Go in the hole picking up a string of 2 3/8-inch O.D., 4.7 pounds/foot, J-55, Hydril tubing open ended to total depth of 4,809 feet. This string will be comprised of tubing from both GB-2RS and GB-3.
- (7) Rig up cement truck and spot a cement plug inside 4 1/2-inch liner and 7-inch casing from total depth to 3,400 feet using Class A neat cement mixed to 15.6 ppg with fresh water. Approximately 350 feet³ of cement will be required. This plug can be set in a continuous stage as long as the cement continues to rise. Tubing must be pulled while cementing to keep the bottom of the tubing approximately at the top of the cement.
- (8) Flush tubing with water and pull up above calculated cement top approximately 200 feet. Wait on cement until surface sample has set. Tag top of plug with tubing.

WELL NO. GB-3 PROPOSED ABANDONMENT

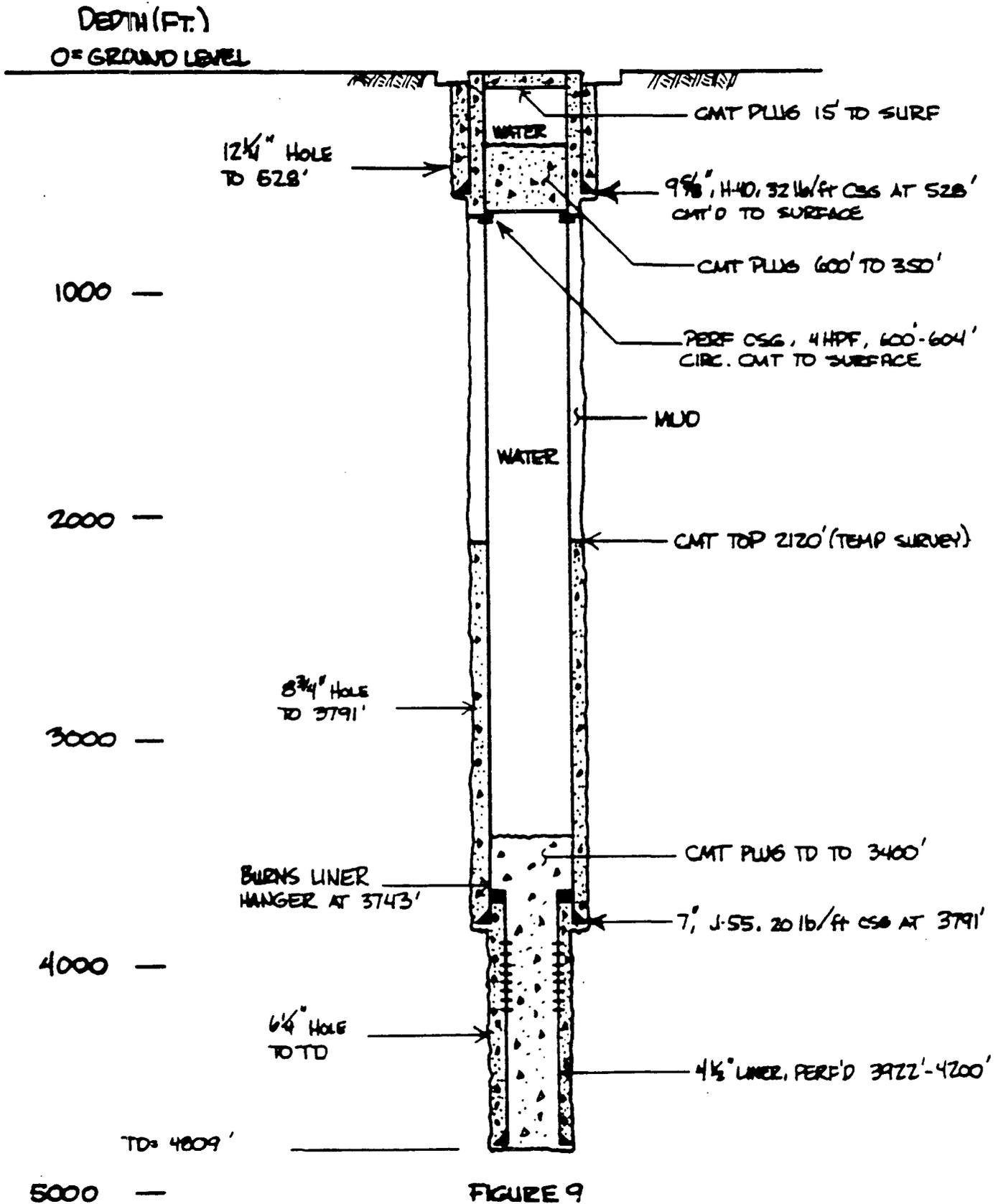


FIGURE 9

- (9) After tagging plug, circulate water to surface using cement pump truck. Pull out of hole standing 500 feet of tubing in the derrick and laying the remainder down.
- (10) Rig up electric line and perforate the interval 600-604 feet with 4 HPF. Rig down electric line.
- (11) Close annular BOP and attempt to circulate water down the 7-inch casing and out the 9 5/8-inch x 7-inch annulus valve. If able to circulate, go in the hole with 2 3/8-inch tubing to \pm 250 feet and close annular BOP around tubing.
- (12) Rig up cement truck and circulate cement until cement returns are observed at the 9 5/8-inch x 7-inch annulus valve. Displace cement out of tubing into casing to 350 feet. Hold pressure on tubing to prevent backflow until cement is set. An estimated 200 feet³ of Class A + 2 percent CaCl₂ will be required.
- (13) Tag the top of the cement plug with tubing. Pull out of hole laying down tubing. Spot a surface plug inside of 7-inch casing from 15 feet to surface. Place 4-inch-diameter hole marker pipe into top plug such that 4 feet will protrude above final ground level.
- (14) Nipple down tubing stripper and annular BOP. Remove tubing head. Move rig off location.

NOTES:

If unable to circulate cement around outside of 7-inch casing, perforations 600-604 feet will be squeezed and 7-inch casing perforated at bottom of 9 5/8-inch casing (+ 528 feet). Cement will then be circulated to surface using a similar procedure.

The 9 5/8-inch and 7-inch casing strings will be cut off at the bottom of the cellar, the CMP removed, and cellar backfilled with dirt after the rig has moved off location.

4. Well GB-ER

- a. Location: (Surface) 1,218' FSL, 1,770' FWL
Section 36, T 29 N, R 4 W
Rio Arriba County, New Mexico

Ground Elevation: 7,204 feet

- b. Type Hole: Postshot Reentry of Emplacement Hole
- c. Present Conditions (See Figure 10.)

- (1) A 28-inch emplacement hole was drilled to 4,350 feet.

DEVICE EMPLACEMENT HOLE WELL NO. GB-ER PRESENT CONDITIONS

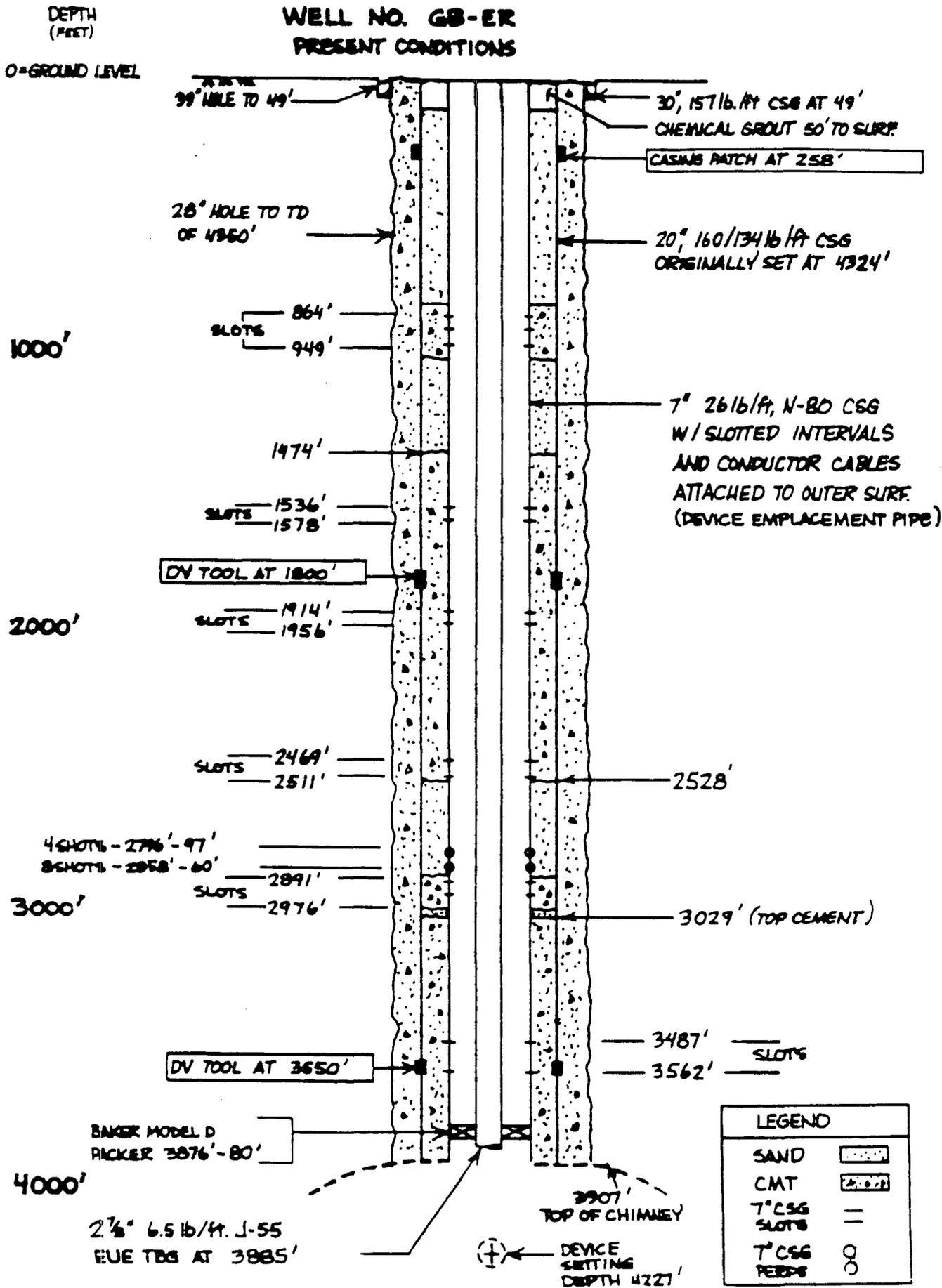


FIGURE 10

- (2) 20-inch O.D., 133 pounds/foot and 160 pounds/foot casing was run to 4,350 feet and cemented back to surface.
- (3) The device was run on 4,227 feet on 26 pounds/foot, N-80, 8rd, LT&C casing with cables attached to the casing.
- (4) The hole was reentered after the shot and 7-inch casing destemmed to 3,916 feet. The chimney was encountered at 3,907 feet.
- (5) A Baker Model D packer with flapper valve was set at 3,876 feet and 119 joints of 2 7/8-inch, 6.5 pounds/foot, EUE, 8rd tubing was run and landed in the packer.
- (6) The latest bottom-hole pressure survey run was January 6, 1976. It indicates a shut-in tubing pressure of 425 psi and a gas gradient to 3,790 feet with a pressure of 473 psi at 3,790 feet. The 7-inch casing by 2 7/8-inch tubing annulus had no pressure.
- (7) At the present time, there is an obstruction in the tubing 8 feet below the top master valve.

d. Program (See Figure 11.)

- (1) Eberline Instrument Corporation will provide a radiological safety program which will be followed by all parties involved.
- (2) The first objective is to establish the nature of and remedy for the tubing obstruction. This may be accomplished prior to moving the rig over the well as follows:
 - (a) Rig up a wire line unit with lubricator for 2 7/8-inch EUE, 8rd top tree connection.
 - (b) Run an impression block and wire line tool string using the lubricator to determine the nature of the obstruction. The obstruction is believed to be an impediment rather than collapsed tubing since there are no external stresses at this point in the tubing string.
 - (c) If the impression block indicates that the obstruction is foreign matter, run the guage cutter and jars and remove the impediment or jar it downhole. The pressure above the obstruction should be equalized to 425 psi using a hand pump before jarring.
- (3) After the obstruction is removed, the guage cutter should be run to the top of the packer to assure that the tubing is clear.

DEVICE EMPLACEMENT HOLE

WELL NO. GB-ER
PROPOSED ABANDONMENT

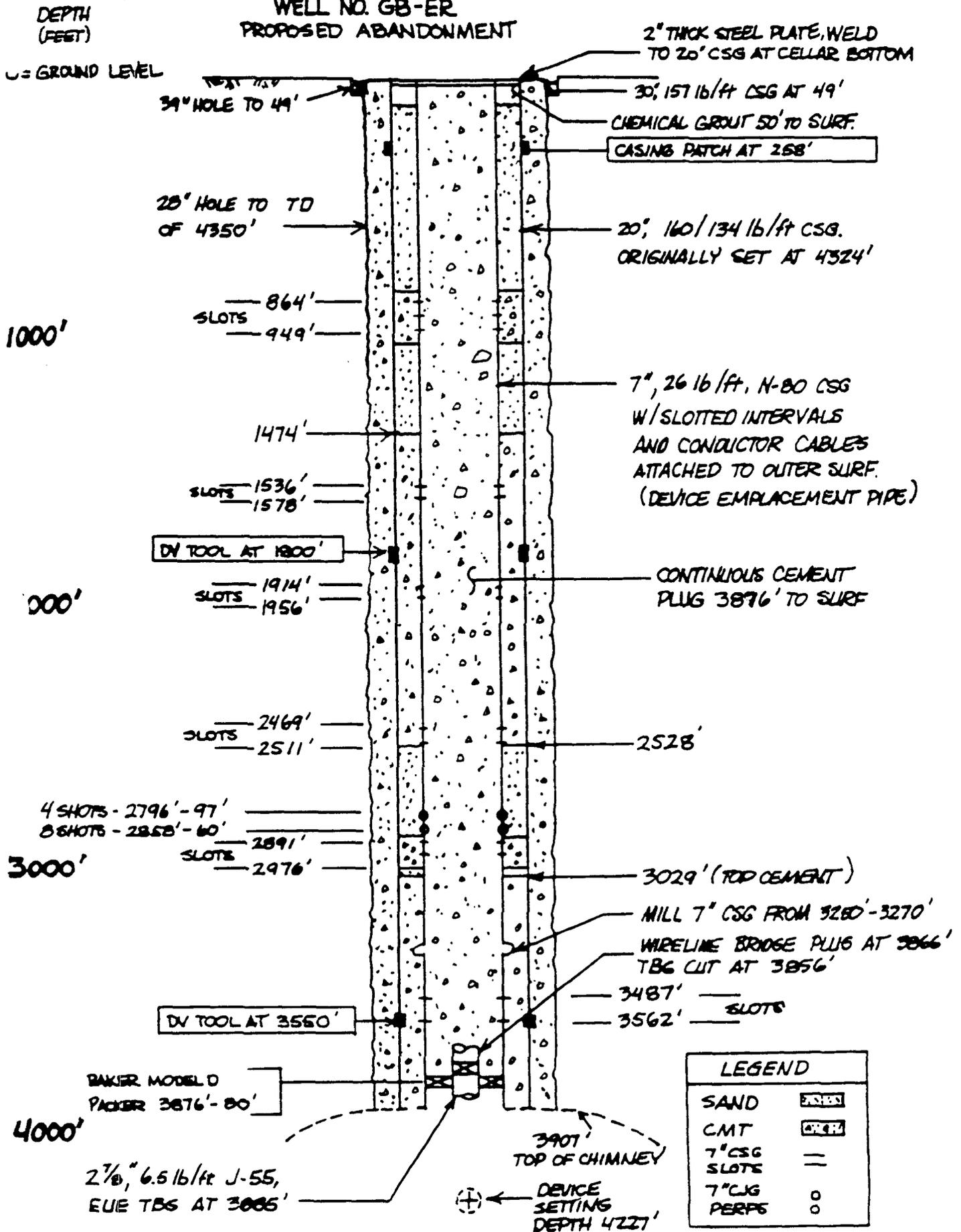


FIGURE 11.

- (4) Move the rig up over the well.
- (5) Check pressure on both tubing and 7-inch casing annulus.
- (6) Hook up rig pump to 7-inch x 2 7/8-inch annulus and attempt to fill annulus with water. Pressure up on annulus to 200 psi to test packer seals on annulus side.
- (7) Disconnect from casing annulus and rig up pump to 2 7/8-inch tubing. Pump three times the capacity of the tubing (\pm 68 barrels) of water. Shut pump down and monitor tubing pressure. Record the time interval between pump shutdown and tubing pressure buildup. If possible, continue adding water to prevent any tubing pressure buildup.*
- (8) Rig up electric line unit with grease seal lubricator and 3/16-inch line. Run collar locator and tie in packer at 3,876 feet. Run a Baker Model P-1 wire line bridge plug and set at approximately 10 feet above the packer. Attempt to keep tubing filled with water while running bridge plug. The bridge plug is run with a Baker Model E-4 wire line pressure setting assembly. Pull wire line from hole and rig down lubricator.
- (9) Fill tubing with water and test bridge plug with 200 psi surface pressure (tubing capacity is 21.8 barrels).
- (10) Disconnect flow line from tree and decontaminate same. Unbolt bonnet above Cameron tubing head and back out hold-down bolts on tubing hanger. Decontaminate upper portion of tree removed.
- (11) Nipple up Hydril annular BOP on top of tubing head with a tubing stripper on top of the Hydril.
- (12) Tie into tubing head with a joint of 2 7/8-inch tubing. Rig up electric line and cut 2 7/8-inch tubing using jet cutter \pm 10 feet above bridge plug.
- (13) Hook up pump to tubing and circulate hole with water. Observe if hole will stand full of water.
- (14) Rig up cement truck and spot 125 feet³ of tubing on top of tubing stub. The top of the cement should be at 3,300 feet. Pull tubing up to 3,000 feet and run a fluid density log to determine the top of the cement.
- (15) If cement is in place and not dropping, pull out of the hole laying down 2 7/8-inch tubing. Tubing will have to be decontaminated or transported to an approved disposal site.

*Accumulated fluids from the surface facilities decommissioning work (see Section VI.A. and B.) should be injected down the GB-ER tubing at this time.

- (16) Go in the hole picking up a string of 3 1/2-inch, 13.3 pounds/foot, 3 1/2-inch IF, Grade E drill pipe, a section mill for 7-inch, 26.0 pounds/foot casing and ten 4 3/4-inch O.D., 3 1/2-inch IF drill collars. Space one 6 1/8-inch blade x 4 3/4-inch body stabilizer just above the section mill and one stabilizer one joint up from mill.
- (17) Rig up mud circulating system with fine screen shaker for removal of metal cuttings. Go in hole to \pm 3,250 feet and condition hole with lightweight 8.5-9.0 pounds/gallon high-viscosity mud (80-100 seconds). Mill a 20-foot section in 7-inch casing from \pm 3,250-3,270 feet. Mill will have a 5 7/8-inch body O.D. and 3 1/2-inch API regular pin top connection.
- (18) Circulate hole clean, pull and lay down 3 1/2-inch drill pipe.
- (19) Go in the hole picking up 2 3/8-inch O.D., 4.7 pounds/foot, J-55, EUE, 8rd tubing to top of cement at 3,300 feet. Plug back hole with cement from 3,300 feet to bottom of cellar. Use Class A neat cement. This should be done in a continuous stage pulling 180 feet of pipe for every 40 feet³ of cement pumped. 710 feet³ of cement should be required to plug back from 3,300 feet to the bottom of the cellar.
- (20) Remove annular BOP, tubing head, and casing head. Decontaminate necessary components of well head.
- (21) Move rig off location.

NOTE: 30-inch, 20-inch, and 7-inch casing strings will be cut off at the bottom of the cellar, a steel plate welded on top of the 20-inch casing, CMP removed, cellar backfilled with dirt, and hole marker/monument placed in accordance with Section VI.E. after rig is moved off location.

5. Well GB-D

- a. Location: (Surface) \pm 1,500' S 37^o E
of GB-ER
Section 36, T 29 N, R 4 W
Rio Arriba County, New Mexico

Ground Elevation: 7,208 feet

- b. Type Hole: Preshot Ground Motion Measurement

c. Present Conditions (See Figure 12.)

- (1) 20-inch, 133 pounds/foot casing is set at 29 feet and cemented to surface.
- (2) 13 3/8-inch, 48 pounds/foot casing is set at 482 feet and cemented to surface.
- (3) A 12 1/4-inch hole was drilled to a total depth of 4,725 feet.
- (4) A messenger cable with four instrument packages was run. Instruments are located on individual cable at 3,250 feet, 3,600 feet, 4,218 feet, and 4,600 feet.
- (5) The hole was cemented from T.D. to 3,106 feet.

d. Program (See Figure 13.)

- (1) Eberline Instrument Corporation will provide a radiological safety program which will be followed by all parties involved.
- (2) Move rig on location and rig up.
- (3) Remove wellhead plate from 13 3/8-inch casing without damaging the messenger or instrument cables. (There are four instrument cables attached to the messenger cable. Each instrument cable is 1-1 1/4 inches in diameter; the messenger cable is 1/2-inch wire wrapped.)
- (4) Rig up on electric line unit and run a depth check, using sinker bars, to \pm 620 feet.
- (5) Fabricate a guide using a short length of 7-inch casing which will be slipped over the bundle of cables.
- (6) Attach the guide to the electric line and run in the hole over the cable bundle to 600 feet.
- (7) If dry run with fabricated guide is successful, run in with plastic explosive and blow cables apart at 600 feet. Measure footage of cables pulled from hole (pull tension in cables when blowing apart).
- (8) Go in hole picking up 2 3/8-inch, 4.7 pounds/foot, J-55 tubing to 600 feet.
- (9) Mix and spot a cement plug of Class A neat + 2 percent CaCl_2 from 600 feet to 350 feet. Pull tubing up to \pm 200 feet. Flush with 5 barrels water, wait on cement to set, and then tag top of plug with tubing.

WELL NO. GB-D
PRESENT CONDITIONS

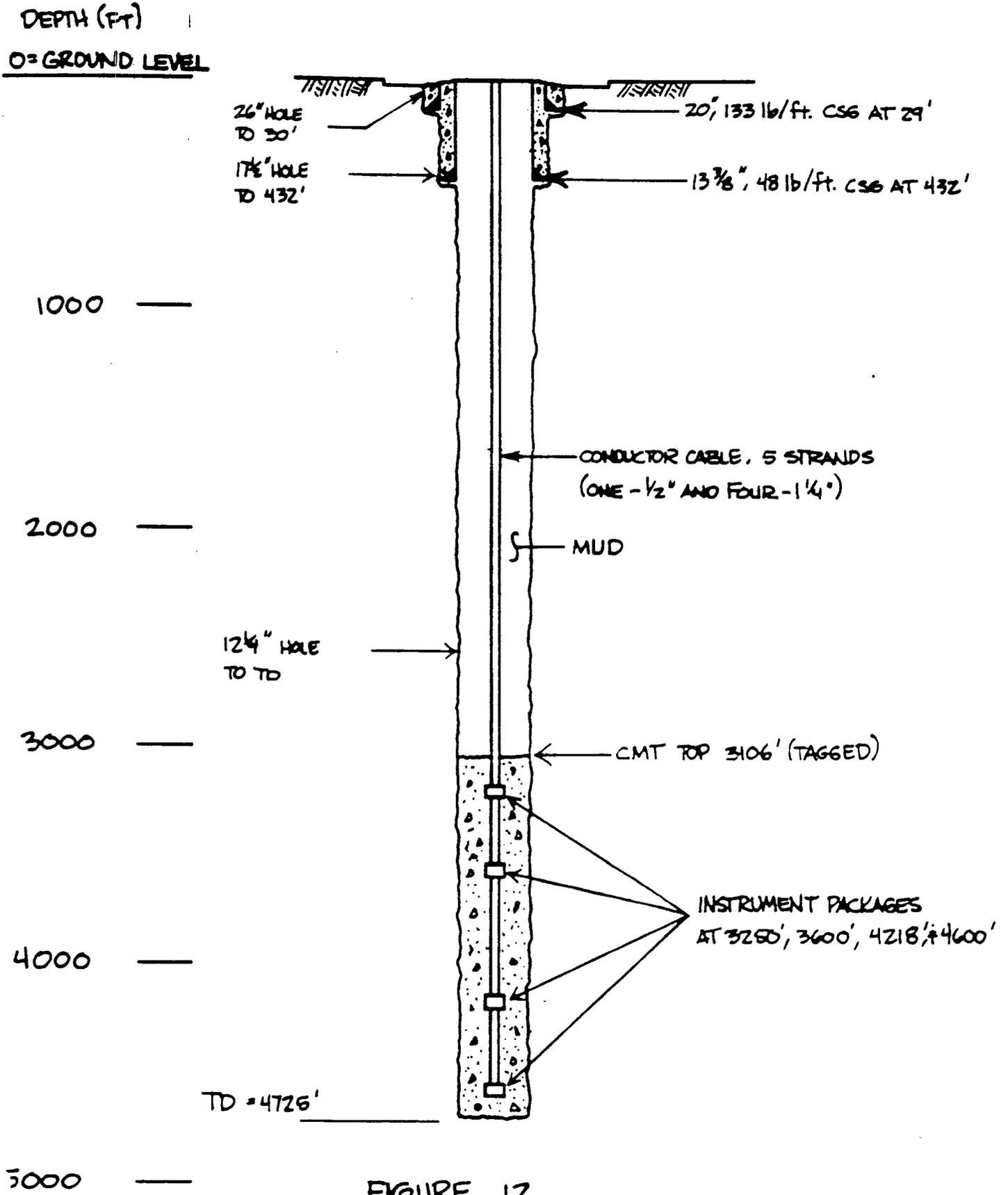


FIGURE 12

WELL NO. GB-D
PROPOSED ABANDONMENT

DEPTH (FT)

0 = GROUND LEVEL

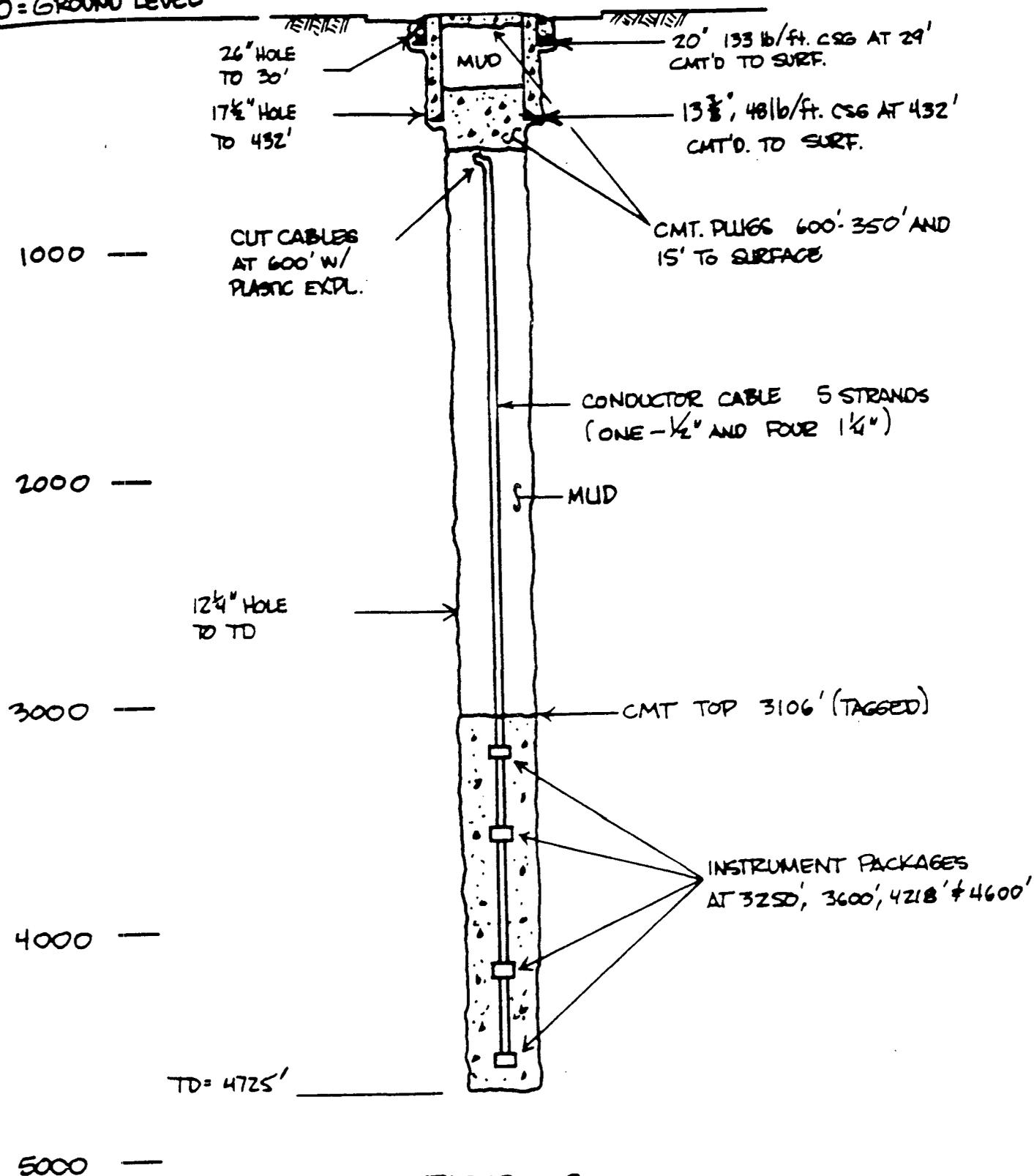


FIGURE 13

(10) After tagging plug, pull out of hole laying down tubing. Spot a surface plug using Class A neat from 15 feet to ground level. Place 4-inch-diameter hole marker pipe into top plug such that 4 feet will protrude above final ground level.

(11) Rig down and prepare to move.

NOTE: The 20-inch casing strings will be cut off at the bottom of the cellar, the CMP removed, and cellar backfilled with dirt after the rig has moved off.

H. Salvable Wellhead Components

It is expected that all wellhead components will be successfully decontaminated, allowing their release for unrestricted use. The Government-owned components listed in Appendix D will be placed in a designated holding area for return to the Nevada Test Site. The EPNG-owned components, i.e., those not listed in Appendix D, will be placed in the designated EPNG materials holding area.

VII. PUBLIC INFORMATION

A. News Releases

The DOE/NV Office of Public Affairs and EPNG will issue a joint public announcement regarding the restoration work approximately one week before F&S seeks approval of the well plugging and abandonment procedures and another announcement upon completion of field activities.

B. Individual Correspondence

Appropriate state and local officials will be sent a copy of the first public announcement via transmittal letter before release to the general news media.

VIII. REPORTS

F&S and Eberline will submit periodic and final reports as identified below.

A. F&S

1. Daily Work Progress Report: An informal report will be submitted to the Project Engineer at the end of each workday. The report will consist of a handwritten summary narrative of well plugging and abandonment operations and general support work. The report will contain information pertinent to the field operations of that day.
2. Weekly Cost Status: This report will include all costs incurred during the preceding workweek and will be submitted to the Project Engineer on the first workday following the reporting week.

3. Final Report: This report will summarize all abandonment and restoration activities and record the site status at project conclusion. Included will be final disposition of all materials and equipment and an as-built status of all plugged and abandoned wells.
4. Other: F&S will provide all reports required by the State of New Mexico, Oil Conservation Commission, the USGS, and the U.S. Forest Service.

B. Eberline

1. Daily Work Progress Report: An informal report will be submitted to the Project Engineer through the ROS at the end of each workday. The report will consist of a handwritten summary narrative of radiological operations for that day. Significant progress made or major problems encountered should be highlighted.
2. Weekly Cost Status Report: This report will include field costs and laboratory support costs incurred for radiological work during the preceding workweek. The report will be submitted in a DOE-prescribed format to the Project Engineer on the first workday following the reporting week.
3. Radiation Contamination Clearance Report: This report will summarize all site restoration radiological activities, describe final site radiological conditions, and contain other information as required by DOEM Appendix 5301. The report shall be due in draft form 45 days after conclusion of field operations. The procedure for review and publication of the report in final form will be stipulated in the DOE/Eberline contract.

IX. SURVEILLANCE PROGRAM

In accordance with DOE policy, a long-term hydrologic monitoring program has been established for the Gasbuggy site. The ongoing program, conducted by the Environmental Protection Agency (EPA), consists of annual sampling and analyses of waters for tritium and other radionuclides in the Project Gasbuggy area. The elements of the sampling program are as follows:

A. Sampling Network (See Figure 14.)

The following sampling points were selected as being representative of water supplies in the Gasbuggy area:

1. <u>Wells</u>	<u>Approx. Distance From Surface Ground Zero (SGZ)</u>
a. EPNG, Well #10-36*	450 feet (on site)
b. Windmill #2	4 miles
c. Lower Burrow Canyon	7 miles

*EPNG has indicated a desire to P&A this well concurrently with the site restoration activities and it shall therefore be eliminated from the Long-Term Surveillance program unless agreement can be obtained from EPNG to defer P&A.

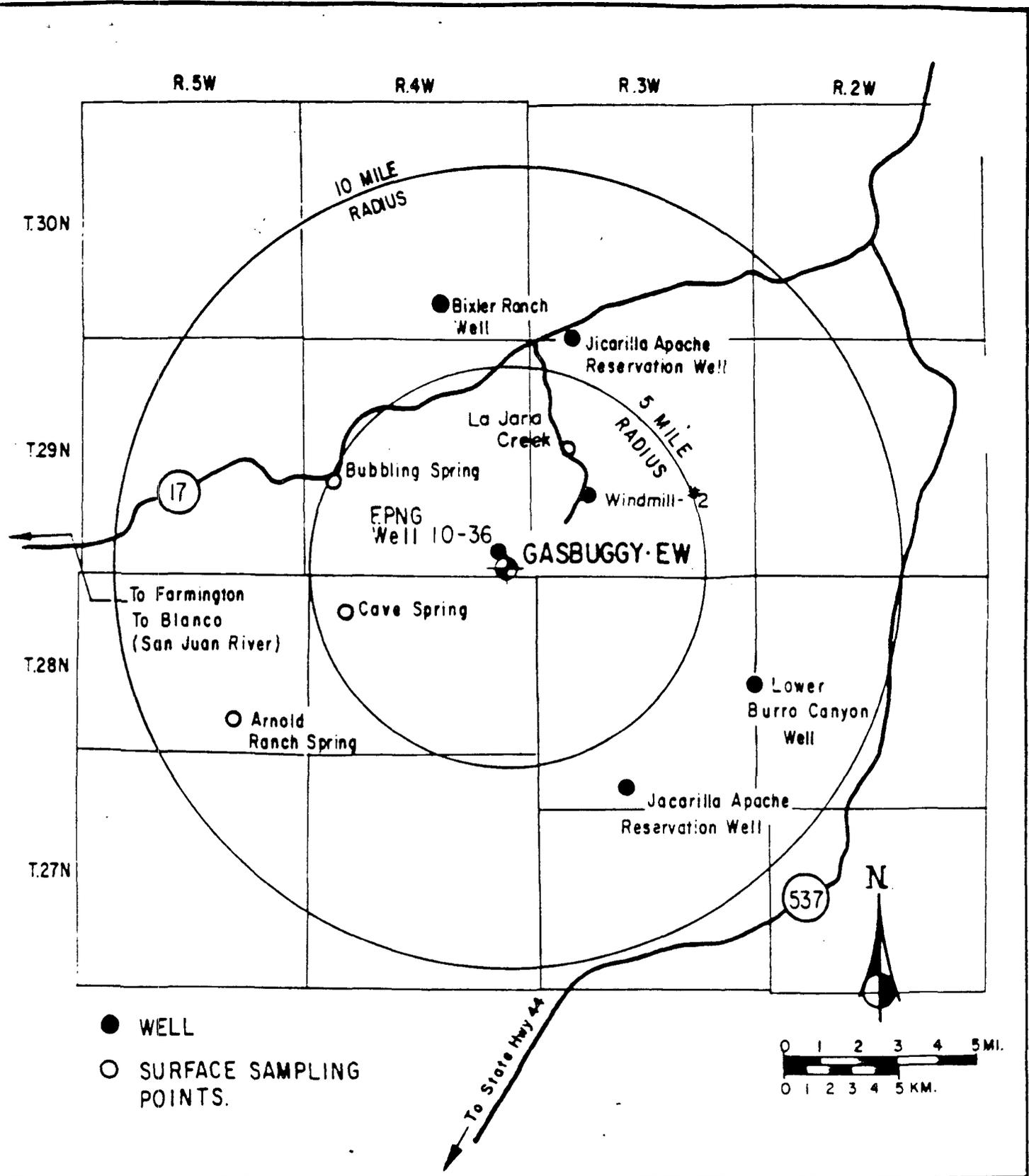


Figure 14. LONG TERM WATER SAMPLING NETWORK

<u>Wells</u>	<u>Approx. Distance From Surface Ground Zero (SGZ)</u>
d. Bixler Ranch	7 miles
e. Jicarilla Apache Res. (South Well)	6 miles
f. Jicarilla Apache Res. (North Well)	6 miles

2. Surface Waters

a. Cave Spring	4 miles
b. Bubbling Spring	5 miles
c. Arnold Ranch	8 miles
d. La Jara Creek	3 miles

Samples are collected annually from the above locations. The program is scheduled to continue indefinitely.

B. Analyses

The depth to water (head), temperature in °C., pH, and electrical conductance are recorded at the time of collection. All samples are analyzed for gross alpha and gross beta radioactivity and for gamma-emitters by gamma spectroscopy. All samples are analyzed for tritium, first by the conventional method for the purpose of screening, and then those samples having concentrations less than the minimum detectable concentration are analyzed by the enrichment method.

Based on the results of these analyses, any suspect samples will be analyzed for additional appropriate specific naturally occurring or man-made radionuclides.

C. Reports

The EPA Environmental Monitoring and Support Laboratory, Las Vegas (EMSL-LV), shall prepare annual reports which contain the following:

1. Description of the sampling network.
2. Results, with a comment on analytical techniques used and degree of accuracy achieved.
3. Interpretation of results.
4. Evaluation of the monitoring program with suggested modifications for its improvement.

X. SCHEDULE

Figure 15 depicts the schedule for abandonment of the Project Gasbuggy site.

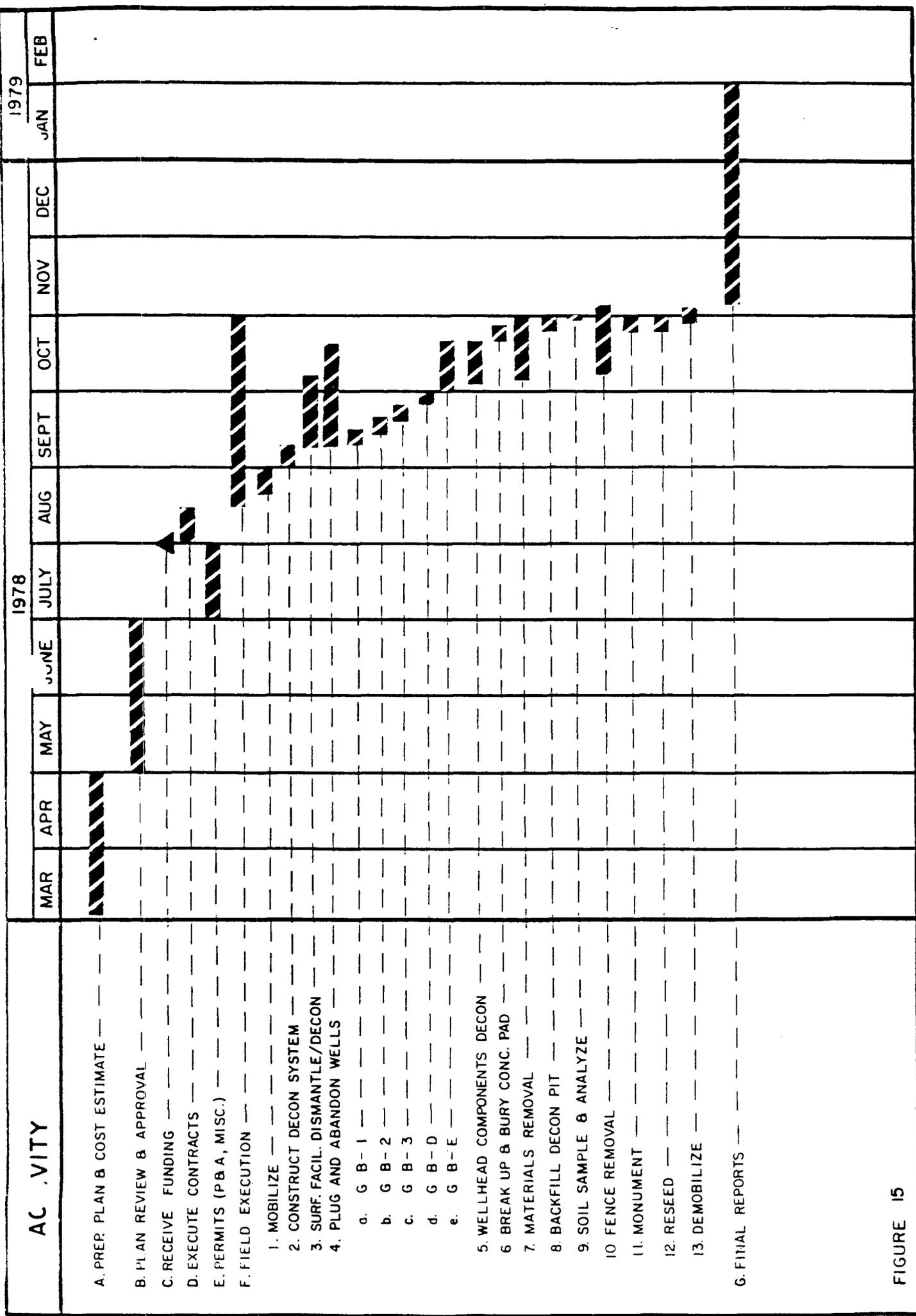


FIGURE 15

APPENDIX A
ENVIRONMENTAL CONSIDERATIONS

APPENDIX A

ENVIRONMENTAL CONSIDERATIONS

1. Introduction

The environment at the Gasbuggy site endured some stress in the past from the construction and nuclear testing activities in 1967 and to a lesser extent during the gas production testing in 1968-1969 and 1973. Primarily the activities and procedures proposed in Section VI of this plan are in fact mitigating measures intended to achieve environmental benefits. The cleanup of the site and the removal and safe disposal of any contaminants, equipment and facilities remaining within the fenced Gasbuggy compound are intended to erase any insults to the environment which still exists from past activities. Plugging of all test-related drill holes is also intended to protect against potential environmental hazards which otherwise might occur in the future. Even though these activities are intended to produce a net enhancement to the environment, they cannot be accomplished without some disturbance to the environment which exists today. This appendix considers the significance of the impacts ensuing from the proposed cleanup action in order to determine if further environmental documentation is necessary.

2. The Existing Environment

Section II and Section V.B., of this plan have described the environment and the radiologic conditions as they exist today. Several additional factors need to be considered to evaluate the potential environmental stresses.

a. Bioenvironmental Factors:

Vegetation in the surrounding areas consists primarily of piñon pine in the lower levels and ponderosa pine and juniper in the higher elevations. The valley flora consists principally of sage and chamisa (rabbitbush). Natural revegetation of forbes and grasses has taken place in areas previously disturbed. Other vegetation results from the grading and seeding which has taken place in the past, as noted in Section II of this plan.

Resident fauna consists of muledeer, coyotes, rabbits, porcupines, several species of ground squirrels and other rodents, birds, reptiles and insects. In certain seasons, bobcat, cougar, and migratory birds such as dove and waterfowl can be seen in the area. Animals larger than the rabbit are excluded from the Gasbuggy site since the surrounding fence has restricted their egress for nearly a decade.

No formal investigation of the existence of threatened and endangered species has been conducted at the site. Lists of such proposed species have been published in the Federal Register (40 FR 27823-27924, July 1, 1975 and 40 FR 24523-24572, June 16, 1976).

Past actions which have taken place include the construction of roads, off-road traffic, construction of facilities, installation of trailer parks, etc. If rare and endangered species did exist in this area previous to the actions which have taken place in the past, their survival is uncertain in the disturbed areas.

b. Archaeological and Historic Cultural Sites:

For several years relatively intense activities have been conducted at the Gasbuggy site by a considerable number of project people. During this time, no evidence of archaeological or historic cultural sites has been found and reported within the areas under consideration for this proposed action.

c. Air Quality:

Air quality investigations have not been conducted for the Gasbuggy site. During the Gasbuggy experiment and subsequent studies, visual observations indicated that visibility was consistent with that usually encountered in the higher mesa areas of New Mexico. Previous construction activities resulted in no significant increase in the particulate airborne quality beyond the site boundaries. During the drillback activities and the gas production testing which followed, some 2,250 curies of tritium and 370 curies of krypton-85 were released into the atmosphere. Careful monitoring of personnel and the environment by the Eberline Instrument Corp., and the U. S. Environmental Protection Agency (EPA) during all activities thru 1973 indicated that these radioisotopes were either undetectable or so far below the criteria cited in Section V that no hazards existed to the workers on site, nor to the residents, animals, or vegetation in surrounding areas. Since 1973, the reentry well and other wells have been shut in, except for periodic monitoring of pressure and fluid levels.

d. Water Qualities:

No surface streams or lakes exist on or near the site. The nearest major surface water bodies are the San Juan River, about 30 miles to the north, the Navajo and El Vado Reservoirs, about 25 miles to the northwest and east, respectively (see Figure 1.) La Jara Lake is a small reservoir about 10 miles east of the site. The Environmental Protection Agency (EPA) has collected and analyzed water samples from wells, springs, streams and ponds at and near the Gasbuggy site as part of the Long-Term Hydrologic Monitoring Program (see Section IX of the plan.)

Throughout the area, the major cations and anions, such as potassium, magnesium, sodium and chloride are at low levels, as are most of the trace elements such as lithium and aluminum. However, alkalinity is high (>100 milligrams per liter of calcium carbonate) at the points sampled. La Jara Lake shows higher pH values (more alkaline) than do the other points sampled.

Water quality is a problem in the area. Sulfates and manganese levels are in excess of water quality criteria for drinking water (EPA) at most of the locations where samples for these parameters were collected. Sulfates are particularly high at La Jara and Arnold Lakes. Manganese periodically exceeds recommended criteria for irrigation water as well as drinking water. Iron levels are occasionally in excess of drinking water criteria.

Total dissolved solids (TDS) levels are quite low at Cave Springs, and moderate at Bixler Ranch and Bubbling Springs. At all other sampling points TDS exceeded 1500 mg/l: although there are no established criteria recommended by EPA for TDS, the EPA does consider that water with TDS in excess of 1000 mg/l will have adverse effects on many crops and usage requires careful management practices.

3. Potential Environmental Impacts

The proposed cleanup activities which except for the plugging of the well GB-D, will be totally contained within the 170,000 square foot fenced area. It is inevitable that some dust will be stirred into the air by the cranes, drilling rigs, trucks and other vehicles required to dismount the surface facilities, conduct the required decontamination procedures, to cement and plug up the event related holes and to remove the fencing around the periphery. It is also inevitable that some growing vegetation will be crushed and broken by these activities.

The movement of a drilling rig, cement truck and other vehicles to and from the GB-D well site will produce the same kinds of insult along a 1500 foot trail outside of the fenced area. The plan as expressed in Section VI calls for these areas to be reseeded as necessary, as will certain areas within the site itself. Because the land is relatively flat, little restorative contouring is contemplated and it will not be eroded by the summer rains. The loss of habitat through these actions is expected to be minor and temporary, and affect only a small portion of the faunal community present. The loss of habitat within the fenced area will not affect animals larger than the rabbit since they have been excluded from the site for nearly a decade. All of these effects are expected to be minor as compared to the environmental insults which have taken place in the past, and those which have occurred in the past have not created any criticism nor adverse opinions on the part of the interested population. On the positive side, when the cleanup is accomplished and the fence removed, these few acres (approximately four) will be available for habitat and forage by the larger wildlife species.

The proposed cleanup activities will disturb only a minimal amount of surface area which has not been previously disturbed. If any rare and endangered species have persisted within the site or along the trail leading to the GB-D well site, they will experience considerably less insult than that which has already occurred. Since no archaeological or historic cultural sites have been found or reported in the past it is not expected that this condition will change.

The nearest source of water for the well plugging and site cleanup is a small unnamed reservoir about eight miles north of the site, heretofore used by EPNG as a water source. For the proposed cleanup operation, it is planned that water will be trucked from this source to the site. The amount of water used will be less than one percent of the capacity of the reservoir and is not considered an excessive expenditure of a natural resource. Water could be trucked from larger reservoirs at longer distances, but in turn would require greater expenditure of fuel.

Previous site surveys have documented that there is no radioactive contamination of soil or surface water which exceed DOE site disposal criteria. (See Tables 1 and 2, Section V of this plan.) Radioactive contamination in excess of DOE criteria is believed likely on the interior surfaces of the gas-production testing system, from the GB-ER well bore tubing, and in piping through the flare stack. These items of material and equipment will be surveyed and checked for adherence to the radiological criteria set forth, using the procedures specified in Section V.D. If they fail to meet the release criteria they will be decontaminated and remonitored, and a determination made whether they are sufficiently clean to be released for unrestricted use or retained for disposal as contaminated waste.

It is planned that the water resulting from the decontamination operations will be collected in the 500 gallon sump at the end of the decontamination pan. The contaminated liquids will be disposed of by injection into the nuclear chimney region through the GB-ER tubing string after it has been determined that the tubing is clear of obstructions. The fluids can be injected under sufficient pressure to overcome any gas pressure which may persist in the well and sealed against leakage by a secure connection to the 2-7/8 inch tubing head valve. It is possible that during this operation or the operations for clearing and plugging the well, that some gas could accidentally escape into the atmosphere. This gas would contain tritium and krypton-85. These operations will be closely monitored for radioactivity and can be shut down and the well closed off if it becomes necessary. The amount of gas which could escape under such conditions would only be a small fraction of the 400 MMcf of gas which has been released in the past and would quickly dissipate and disperse into the atmosphere. Essentially, no environmental effects would result if such an accidental release of gas were encountered.

In summary, the proposed cleanup and well plugging activities would produce only minor environmental effects for the short term and would primarily affect the biota. There will be no significant change in the air or water quality in the area. Over the long term, however, the impact will be to improve the esthetic aspects of the site by removal of all surface facilities, to mitigate the potential health hazards due to radioactive contamination associated with some of the facilities, to enhance the accessibility of the site to native fauna and other visitors, including humans, and to close one of the last open chapters in the Plowshare Program.

The primary natural resources present below the surface have been shown to be largely gas and oil. The excavation and drilling restrictions within a radius of 100 feet of the monument will not have any significant influence

upon the future recovery of these resources from the area. The monument itself can become a historical marker, enhancing the potential uses of the site by the U. S. Forest Service after its release to that agency.

It is anticipated that periodic radiological monitoring after the site is cleaned up will not be required other than the annual water samples taken from Well # 10-36, which will not be plugged, but will continue to be used as part of the Long-Range Hydrologic Monitoring Program described in Section X.

4. Alternatives

The only alternative to the proposed action is to take no action. Not doing the proposed action at Gasbuggy would leave the internally contaminated equipment on the surface at the site, which in addition to the potential hazard, is unattractive within the surrounding environs. Also, not doing the program would not allow the Plowshare site to be used for the purposes from which it was set aside over 10 years ago.

There is an alternative to the disposal of the tritiated water which will result from decontamination, and which exists in a 100-barrel tank from earlier gas production tests. It is proposed that this radioactive liquid material be injected into the well GB-ER before it is plugged. An alternative is to solidify this liquid and transport it to an approved burial site, most likely in Nevada. Evaporation can be used as part of the process for solidification and will require concurrence from the State of New Mexico authorities. Taking this alternative would significantly increase the volume and expense of transporting radioactive materials over about 700 miles on public highways. Even though this would be low-level radioactive material and not hazardous, the psychological impact on the public cannot be overlooked.

5. Cumulative and Long-Term Environmental Effects

As discussed previously, the proposed cleanup activities are intended to erase any insults to the environment which still existed from past activities. A pool of radioactivity formed by this nuclear detonation is trapped in rock 4,000 feet below the surface and will remain as a long-term consequence of the experiment. However, because of its depth, it will be isolated from and out of communication with the biosphere. The plugging of all test related drill holes is intended to protect against possible environmental hazards which otherwise might occur in the future. Except for the restrictions imposed on drilling or excavation within the 100-foot radius of the monument, the site will be returned to its natural state. This is intended to be an end point and no other activities are planned by DOE for the site so that no cumulative effects beyond this end point are anticipated.

6. Risk of Credible Accidents

It is possible that during disassembly and decontamination of the gas testing equipment, some cleanup personnel may be exposed to tritium. While the levels are not known, and careful personnel monitoring will be in force, it is believed that no dose above the stated criteria will be accumulated by any individual. If any tritium containing liquids were spilled, assessment and cleanup of the spill would be effected promptly.

Similarly, if during the transporting of low-level radioactive materials to a suitable repository in Nevada, an accident occurred which caused a spill on the roadway, some human exposure could arise.

However, the low-level radioactivity could be safely and expeditiously cleaned up and any residual diluted to less than that permitted in drinking water by sufficient flooding with uncontaminated water. No significant long-term exposure would be expected from this kind of incident.

7. Potential Conflicts With Land Use and Other Programs

There are no known plans by local, state or other Federal agencies which would conflict with the proposed action. The return of the land to U. S. Forest Service control is consistent with the arrangement agreed upon by the original withdrawal order and represents a logical termination of the program.

8. Conclusions and Recommendations

Considering the environmental setting of the Gasbuggy site and the activities which led to its present condition, against the impacts which will accrue if the present cleanup and restoration plan is implemented, leads to the conclusion that the site and human environment will be improved. In viewing the anticipated impacts, it is obvious that the safety, appearance and utility of the site will be enhanced over the long term, without significant additional cost to the environment.

It is recommended that because the proposed action does not constitute a major Federal action, and will have no significant impact on the quality of the human environment of the region, an Environmental Assessment need not be prepared.

APPENDIX B

RADIOLOGICAL FIELD OPERATIONS PLAN
(To be supplied by Eberline)

APPENDIX C

PERMITS AND SUNDRY NOTICES

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

SUNDRY NOTICES AND REPORTS ON WELLS

(Do not use this form for proposals to drill or to deepen or plug back to a different reservoir. Use Form 9-331-C for such proposals.)

1. oil well gas well Natural Gas Stimulation
other Experiment Instr. Hole

2. NAME OF OPERATOR
U.S. Dept. of Energy/El Paso Natural Gas Co.

3. ADDRESS OF OPERATOR
U.S. DOE, P.O. Box 14100, Las Vegas, NV 89114

4. LOCATION OF WELL (REPORT LOCATION CLEARLY. See space 17 below.)
T-29-N,
AT SURFACE 1324' FSL, 1614' FWL, Sec. 36, R-4-W
AT TOP PROD. INTERVAL:
AT TOTAL DEPTH: 113.62' N 60°38' E of Surface

16. CHECK APPROPRIATE BOX TO INDICATE NATURE OF NOTICE, REPORT, OR OTHER DATA

REQUEST FOR APPROVAL TO:		SUBSEQUENT REPORT OF:	
TEST WATER SHUT-OFF	<input type="checkbox"/>		<input type="checkbox"/>
FRACTURE TREAT	<input type="checkbox"/>		<input type="checkbox"/>
SHOOT OR ACIDIZE	<input type="checkbox"/>		<input type="checkbox"/>
REPAIR WELL	<input type="checkbox"/>		<input type="checkbox"/>
PULL OR ALTER CASING	<input type="checkbox"/>		<input type="checkbox"/>
MULTIPLE COMPLETE	<input type="checkbox"/>		<input type="checkbox"/>
CHANGE ZONES	<input type="checkbox"/>		<input type="checkbox"/>
ABANDON*	<input checked="" type="checkbox"/>		<input type="checkbox"/>
(other)			

5. LEASE
Carson National Forest

6. IF INDIAN, ALLOTTEE OR TRIBE NAME

7. UNIT AGREEMENT NAME:

8. FARM OR LEASE NAME

9. WELL NO.
GB-1

10. FIELD OR WILDCAT NAME
Choza Mesa Pictured Cliffs

11. SEC., T., R., M., OR BLK. AND SURVEY OR AREA
Sec. 36, T-29-N, R-4-W

12. COUNTY OR PARISH
Rio Arriba

13. STATE
New Mexico

14. API NO.

15. ELEVATIONS (SHOW DF, KDB, AND WD)
KDB-7215', DF-7214', GL-7203'

(NOTE: Report results of multiple completion or zone change on Form 9-330.)

17. DESCRIBE PROPOSED OR COMPLETED OPERATIONS (Clearly state all pertinent details, and give pertinent dates, including estimated date of starting any proposed work. If well is directionally drilled, give subsurface locations and measured and true vertical depths for all markers and zones pertinent to this work.)*

1. Tie into tubing, pull tension and run freepoint to $\pm 640'$.
2. Use plastic explosive to blow tubing and cables apart at $\pm 640'$.
3. Unbolt tubing head, pull and lay down 2-3/8" tubing and cables.
4. Go in hole with 2-3/8" tubing and spot a 125 ft³ cement plug from 640' to 350'. Tag the top of the plug with tubing.
5. Spot a cement plug from 15' to the bottom of the cellar. Install a 4.0" O.D. pipe for well marker extending from 6' below ground level to 4' above ground level with top orange peeled and welded closed. Well name will be inscribed using a welded bead.
6. Cut 13-3/8" and 9-5/8" casing strings at the bottom of the cellar. Remove the CMP and backfill the cellar with dirt.

NOTE: Above operations are expected to be accomplished between 9-1-78 and 9-7-78.

Subsurface Safety Valve: Manu. and Type _____ Set @ _____ Ft.

18. I hereby certify that the foregoing is true and correct

SIGNED J. B. Carter TITLE Dir., E&EA Div. DATE June 12, 1973

(This space for Federal or State office use)

APPROVED BY _____ TITLE _____ DATE _____

CONDITIONS OF APPROVAL, IF ANY:

APPROVED

JUN 29 1978

E. A. SCHMIDT
DISTRICT ENGINEER

*See Instructions on Reverse Side

C. Chen

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JUN 19 1978

U. S. GEOLOGICAL SURVEY
DURANGO, COLO.

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

SUNDRY NOTICES AND REPORTS ON WELLS

(Do not use this form for proposals to drill or to deepen or plug back to a different reservoir. Use Form 9-331-C for such proposals.)

1. oil well gas well other Natural Gas Stimulation Experiment PS Test Well

2. NAME OF OPERATOR
U.S. Dept. of Energy/El Paso Natural Gas Co.

3. ADDRESS OF OPERATOR
U.S. DOE, P.O. Box 14100, Las Vegas, NV 89114

4. LOCATION OF WELL (REPORT LOCATION CLEARLY. See space 17 below.)
1430' FSL, 1636' FWL, Sec. 36,
AT SURFACE: T-29-N, R-4-W
AT TOP PROD. INTERVAL:
AT TOTAL DEPTH: Same as above (Vertical Hole)

16. CHECK APPROPRIATE BOX TO INDICATE NATURE OF NOTICE, REPORT, OR OTHER DATA

REQUEST FOR APPROVAL TO:		SUBSEQUENT REPORT OF:	
TEST WATER SHUT-OFF	<input type="checkbox"/>		<input type="checkbox"/>
FRACTURE TREAT	<input type="checkbox"/>		<input type="checkbox"/>
SHOOT OR ACIDIZE	<input type="checkbox"/>		<input type="checkbox"/>
REPAIR WELL	<input type="checkbox"/>		<input type="checkbox"/>
PULL OR ALTER CASING	<input type="checkbox"/>		<input type="checkbox"/>
MULTIPLE COMPLETE	<input type="checkbox"/>		<input type="checkbox"/>
CHANGE ZONES	<input type="checkbox"/>		<input type="checkbox"/>
ABANDON*	<input checked="" type="checkbox"/>		<input type="checkbox"/>
(other)			

5. LEASE
Carson National Forest

6. IF INDIAN, ALLOTTEE OR TRIBE NAME

7. UNIT AGREEMENT NAME

8. FARM OR LEASE NAME

9. WELL NO.
GB-3

10. FIELD OR WILDCAT NAME
Choza Mesa Pictured Cliffs

11. SEC., T., R., M., OR BLK. AND SURVEY OR AREA
Sec. 36, T-29-N, R-4-W

12. COUNTY OR PARISH
Rio Arriba

13. STATE
New Mexico

14. API NO.

15. ELEVATIONS (SHOW DF, KDB, AND WD)
KDB-7213', DF-7212', GL-7200'

(NOTE: Report results of multiple completion or zone change on Form 9-330.)

17. DESCRIBE PROPOSED OR COMPLETED OPERATIONS (Clearly state all pertinent details, and give pertinent dates, including estimated date of starting any proposed work. If well is directionally drilled, give subsurface locations and measured and true vertical depths for all markers and zones pertinent to this work.)*

1. Kill well by pumping water down tubing and 7" casing annulus.
2. Nipple up annular BOP and tubing stripper on tubing head, keeping hole full.
3. Pull and inspect 2-3/8" tubing.
4. Go in hole with tubing and spot a cement plug from T.D. (4809') to 3400'. (Inside 7" casing above 4-1/2" liner top.) Tag top of plug with tubing.
5. Circulate 7" casing with water.
6. Perforate interval 600 - 604' with 4 HPF. Circulate water down 7" casing and out 7" x 9-5/8" annulus.
7. Circulate cement in 7" x 9-5/8" annulus to surface. Displace cement inside 7" annulus to 350'. Hold pressure until cement is set. Tag top of cement inside 7" casing w/tubing. Spot surface cement plug from 15' to bottom of cellar. Nipple down tubing stripper and annular BOP.
8. Install a 4" O.D. pipe for well marker extending from 6' below G.L. to 4' above G.L., w/top orange peeled & welded closed. Well name will be inscribed using a welded bead.
9. Cut 9-5/8" & 7" casings @ bottom of cellar. Remove CMP & backfill cellar w/dirt.

NOTE: Above operations are expected to be accomplished between 8-20-78 & 8-31-78.
Subsurface Safety Valve: Manu. and Type _____ Set @ _____ Ft.

18. I hereby certify that the foregoing is true and correct

SIGNED J. A. Little TITLE Dir., F&EA Div. DATE June 12, 1978

(This space for Federal or State office use)

APPROVED BY _____ TITLE _____ DATE _____
CONDITIONS OF APPROVAL, IF ANY:

RECEIVED
JUN 19 1978

APPROVED
JUN 29 1978
E. A. Schmidt
E. A. SCHMIDT
ACTING DISTRICT ENGINEER

*See Instructions on Reverse Side

U. S. GEOLOGICAL SURVEY
DURANGO, COLO.

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

SUNDRY NOTICES AND REPORTS ON WELLS

(Do not use this form for proposals to drill or to deepen or plug back to a different reservoir. Use Form 9-331-C for such proposals.)

1. oil well gas well Natural Gas Stimulation
other Experiment PS Reentry

2. NAME OF OPERATOR
U. S. Dept. of Energy/El Paso Natural Gas Co.

3. ADDRESS OF OPERATOR
U.S. DOE, P.O. Box 14100, Las Vegas, NV 89114

4. LOCATION OF WELL (REPORT LOCATION CLEARLY. See space 17 below.)
1218'FSL, 2070'FWL, Sec. 36, T-29-N,
AT SURFACE: R-4-W
AT TOP PROD. INTERVAL: 3678'TVD 15.14'N, 17.14'E
of surface
AT TOTAL DEPTH: At 4600'MD, 4590.69'TVD, 38.54'S
& 76.15'W of surface.

16. CHECK APPROPRIATE BOX TO INDICATE NATURE OF NOTICE, REPORT, OR OTHER DATA

REQUEST FOR APPROVAL TO:		SUBSEQUENT REPORT OF:	
TEST WATER SHUT-OFF	<input type="checkbox"/>		<input type="checkbox"/>
FRACTURE TREAT	<input type="checkbox"/>		<input type="checkbox"/>
SHOOT OR ACIDIZE	<input type="checkbox"/>		<input type="checkbox"/>
REPAIR WELL	<input type="checkbox"/>		<input type="checkbox"/>
PULL OR ALTER CASING	<input type="checkbox"/>		<input type="checkbox"/>
MULTIPLE COMPLETE	<input type="checkbox"/>		<input type="checkbox"/>
CHANGE ZONES	<input type="checkbox"/>		<input type="checkbox"/>
ABANDON*	<input checked="" type="checkbox"/>		<input type="checkbox"/>
(other)			

5. LEASE
Carson National Forest

6. IF INDIAN, ALLOTTEE OR TRIBE NAME

7. UNIT AGREEMENT NAME

8. FARM OR LEASE NAME

9. WELL NO.
GB-2RS

10. FIELD OR WILDCAT NAME
Choza Mesa Pictured Cliffs

11. SEC., T., R., M., OR BLK. AND SURVEY OR AREA
Sec. 36, T-29-N, R-4-W

12. COUNTY OR PARISH | 13. STATE
Rio Arriba | New Mexico

14. API NO.

15. ELEVATIONS (SHOW DF, KDB, AND WD)
KDB-7212', DF-7211', GL-7199'

(NOTE: Report results of multiple completion or zone change on Form 9-330.)

17. DESCRIBE PROPOSED OR COMPLETED OPERATIONS (Clearly state all pertinent details, and give pertinent dates, including estimated date of starting any proposed work. If well is directionally drilled, give subsurface locations and measured and true vertical depths for all markers and zones pertinent to this work.)

- Kill well by pumping water down tubing and 7" annulus.
- Nipple up annular BOP and tubing stripper on tubing head.
- Pull 2-3/8" tubing, keeping hole full of water. Inspect tubing.
- Go in hole with 2-3/8" tubing and spot a continuous cement plug from Total Depth (top of fill at 4520') to 3400'. Tag top of plug with tubing.
- Circulate hole to surface with water.
- Spot a cement plug inside 7" casing from 600' to 350' (55 ft³ of cement). Tag the top of the plug with tubing.
- Spot a surface plug inside 7" casing from 15' to bottom of cellar.
- Nipple down annular BOP and tubing stripper, remove tubing head.
- Install a 4.0" O.D. pipe for well marker extending from 6' below ground level to 4' above ground level with top orange peeled and welded closed. Well name will be inscribed using a welded bead.
- Cut the 9-5/8" and 7" casing strings at the bottom of cellar, backfill the cellar with dirt.

NOTE: Above operations are expected to be accomplished between 8-7-78 & 8-19-78.
Subsurface Safety Valve: Manu. and Type _____ Set @ _____ Ft.

18. I hereby certify that the foregoing is true and correct
SIGNED [Signature] TITLE Dir., E&EA Div. DATE June 12, 1978

(This space for Federal or State office use)

APPROVED BY _____ TITLE _____ DATE _____
CONDITIONS OF APPROVAL, IF ANY: _____

APPROVED
JUN 29 1978
E. A. SCHMIDT
ACTING DISTRICT ENGINEER

*See Instructions on Reverse Side

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JUN 19 1978
U. S. GEOLOGICAL SURVEY
DURANGO, COLO.

Open.

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

SUNDRY NOTICES AND REPORTS ON WELLS

(Do not use this form for proposals to drill or to deepen or plug back to a different reservoir. Use Form 9-331-C for such proposals.)

1. oil well gas well other Post Shot Reentry of Emplacement Hole

2. NAME OF OPERATOR
U.S. Dept. of Energy/El Paso Natural Gas Co.

3. ADDRESS OF OPERATOR
U.S. DOE, P.O. Box 14100, Las Vegas, NV 89114

4. LOCATION OF WELL (REPORT LOCATION CLEARLY. See space 17 below.)
1218' FSL, 1770' FWL, Sec. 36,
AT SURFACE: T-29-N, R-4-W
AT TOP PROD. INTERVAL:
AT TOTAL DEPTH: Same as above (Vertical Hole)

16. CHECK APPROPRIATE BOX TO INDICATE NATURE OF NOTICE, REPORT, OR OTHER DATA

REQUEST FOR APPROVAL TO:	SUBSEQUENT REPORT OF:
TEST WATER SHUT-OFF <input type="checkbox"/>	<input type="checkbox"/>
FRACTURE TREAT <input type="checkbox"/>	<input type="checkbox"/>
SHOOT OR ACIDIZE <input type="checkbox"/>	<input type="checkbox"/>
REPAIR WELL <input type="checkbox"/>	<input type="checkbox"/>
PULL OR ALTER CASING <input type="checkbox"/>	<input type="checkbox"/>
MULTIPLE COMPLETE <input type="checkbox"/>	<input type="checkbox"/>
CHANGE ZONES <input type="checkbox"/>	<input type="checkbox"/>
ABANDON* <input checked="" type="checkbox"/>	<input type="checkbox"/>
(other) <input type="checkbox"/>	<input type="checkbox"/>

5. LEASE
Carson National Forest

6. IF INDIAN, ALLOTTEE OR TRIBE NAME

7. UNIT AGREEMENT NAME

8. FARM OR LEASE NAME

9. WELL NO.
GB-ER

10. FIELD OR WILDCAT NAME
Choza Mesa Pictured Cliffs

11. SEC., T., R., M., OR BLK. AND SURVEY OR AREA
Sec. 36, T-29-N, R-4-W

12. COUNTY OR PARISH
Rio Arriba

13. STATE
New Mexico

14. API NO.

15. ELEVATIONS (SHOW DF, KDB, AND WD)
KDB-7227', DF-7226', GL-7211'

(NOTE: Report results of multiple completion or zone change on Form 9-330.)

17. DESCRIBE PROPOSED OR COMPLETED OPERATIONS (Clearly state all pertinent details, and give pertinent dates, including estimated date of starting any proposed work. If well is directionally drilled, give subsurface locations and measured and true vertical depths for all markers and zones pertinent to this work.)*

- Run Wireline bridge plug using grease seal lubricator. Set bridge inside 2-7/8" tubing ± 10' above top of packer.
- Fill tubing with water and test bridge plug with 200 psi surface pressure.
- Remove upper portion of tree, nipple up annular BOP and tubing stripper.
- Cut 2-7/8" tubing with jet cutter ± 10' above bridge plug. Circulate 7" casing with water.
- Spot 125 ft³ of cement above packer inside 7" casing.
- Pull 2-7/8" tubing. Run 3-1/2" drill pipe, circulate hole with mud, mill section in 7" casing from 3250' to 3270'.
- Plugback 7" casing-top of existing plug to bottom of cellar with cement.
- Remove tubing stripper, annular BOP, casing and tubing heads.
- Cut 30", 20", and 7" casing strings at bottom of cellar, remove CMP and backfill with dirt.

10. A concrete monument containing a metal plaque with an inscription denoting the historical significance of the site will be erected over the abandoned emplacement well.

NOTE: Above operations are expected to be accomplished between 9-8-78 & 9-25-78.
Subsurface Safety Valve: Manu. and Type _____ Set @ _____ Ft.

18. I hereby certify that the foregoing is true and correct

SIGNED [Signature] TITLE Dir., E&EA Div. DATE June 12, 1978

(This space for Federal or State office use)

APPROVED BY
JUN 29 1978
E. A. SCHMIDT
ACTING DISTRICT ENGINEER

TITLE _____ DATE _____

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JUN 19 1978
U. S. GEOLOGICAL SURVEY
DURANGO, COLO.

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

SUNDRY NOTICES AND REPORTS ON WELLS

(Do not use this form for proposals to drill or to deepen or plug back to a different reservoir. Use Form 9-331-C for such proposals.)

1. oil well gas well Pre-Shot Ground
other Motion Measurement

2. NAME OF OPERATOR
U.S. Dept. of Energy

3. ADDRESS OF OPERATOR
U.S. DOE, P.O. Box 14100, Las Vegas, NV 89114

4. LOCATION OF WELL (REPORT LOCATION CLEARLY. See space 17 below.)
1500' S 37' E of GB-ER, Sec. 36,
AT SURFACE: T-29-N, R-4-W
AT TOP PROD. INTERVAL:
AT TOTAL DEPTH: Same as above (Vertical Hole)

16. CHECK APPROPRIATE BOX TO INDICATE NATURE OF NOTICE, REPORT, OR OTHER DATA

REQUEST FOR APPROVAL TO:		SUBSEQUENT REPORT OF:	
TEST WATER SHUT-OFF	<input type="checkbox"/>		<input type="checkbox"/>
FRACTURE TREAT	<input type="checkbox"/>		<input type="checkbox"/>
SHOOT OR ACIDIZE	<input type="checkbox"/>		<input type="checkbox"/>
REPAIR WELL	<input type="checkbox"/>		<input type="checkbox"/>
PULL OR ALTER CASING	<input type="checkbox"/>		<input type="checkbox"/>
MULTIPLE COMPLETE	<input type="checkbox"/>		<input type="checkbox"/>
CHANGE ZONES	<input type="checkbox"/>		<input type="checkbox"/>
ABANDON*	<input checked="" type="checkbox"/>		<input type="checkbox"/>
(other)			

5. LEASE
Carson National Forest

6. IF INDIAN, ALLOTTEE OR TRIBE NAME

7. UNIT AGREEMENT NAME

8. FARM OR LEASE NAME

9. WELL NO.
GB-D

10. FIELD OR WILDCAT NAME
Choza Mesa Pictured Cliffs

11. SEC., T., R., M., OR BLK. AND SURVEY OR AREA
Sec. 36, T-29-N, R-4-W

12. COUNTY OR PARISH
Rio Arriba

13. STATE
New Mexico

14. API NO.

15. ELEVATIONS (SHOW DF, KDB, AND WD)
GL 7203'

(NOTE: Report results of multiple completion or zone change on Form 9-330.)

17. DESCRIBE PROPOSED OR COMPLETED OPERATIONS (Clearly state all pertinent details, and give pertinent dates, including estimated date of starting any proposed work. If well is directionally drilled, give subsurface locations and measured and true vertical depths for all markers and zones pertinent to this work.)*

1. Blow cables apart with plastic explosive at \pm 600'.
2. Pull cables out of hole.
3. Go in hole with 2-3/8" tubing. Spot a cement plug from 600' to 350'. Tag top of plug with tubing.
4. Spot a surface cement plug from 15' to the bottom of the cellar.
5. Install a 4" O.D. pipe for well marker extending from 6' below ground level to 4' above ground level, with top orange peeled and welded closed. Well name will be inscribed using a welded bead.
6. Cut 20" and 13-3/8" casing strings at the bottom of the cellar. Remove CMP and backfill the cellar with dirt.

NOTE: Above operations are expected to be accomplished between 9-26-78 and 10-2-78.

Subsurface Safety Valve: Manu. and Type _____ Set @ _____ Ft.

18. I hereby certify that the foregoing is true and correct

SIGNED [Signature] TITLE Dir., F&EA Div. DATE June 12, 1978

(This space for Federal or State office use)

APPROVED BY _____ TITLE _____ DATE _____
CONDITIONS OF APPROVAL, IF ANY:

APPROVED
JUN 24 1978
[Signature]
E. A. SCHMIDT
ACTING DISTRICT ENGINEER

*See Instructions on Reverse Side

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U. S. GEOLOGICAL SURVEY
DURANGO, COLO.

APPENDIX D

PROJECT GASBUGGY
GOVERNMENT-OWNED MATERIALS INVENTORY

<u>Item No.</u>	<u>Description</u>
1	Gas Flare Stack
2	Steam Generator, Model HS110, SN 140050
3	Flare Line (approx. 175' of 4 1/2"-diameter pipe)
4	Pipe Stanchion (from high-pressure recirculating system)
5	GB-1 Wellhead Components <ul style="list-style-type: none"> a. Tubing Head, National, 12" S900 bottom flange by 8" S900 top flange with two 4" S900 outlets at 45°. b. Tubing Hanger, 8" S900, Type H-1, 2 3/8" APS
6	GB-2 Wellhead Components <ul style="list-style-type: none"> a. 2 BOPs, Shaffer Type 45, manual, with 10" S900 top flange and 10" S600 bottom flange b. Spool, 10" S900 top flange by 10" S900 bottom flange c. Tubing Head, Shaffer, Type YB, 10" S900 by 6" S900 with two 4" S900 outlets at 45°. d. Two 4" S900 Shaffer Flow Seal Valves e. One 2" S600 Shaffer Flow Seal Valves
7	GB-E Wellhead Components <ul style="list-style-type: none"> a. Casing Flange, 20" S600 b. Casing Head Assembly, 20" x 10" c. Holddown Flange, 10" d. Tubing Head Assembly e. Blind Flange, 6"

PNE-G-15

WATER ANALYSES

GB-1
10-36

by
USEM

DESERT RESEARCH INSTITUTE
LIBRARY
LAS VEGAS

U. S. BUREAU OF MINES
BARTLESVILLE PETROLEUM RESEARCH CENTER
BARTLESVILLE, OKLA.

OILFIELD WATER RESEARCH LABORATORY

67 014 Sample

Sample Date: 2-23-67
Analysis Date: 3-22-67

Specific gravity at 60°/60°F			1.006	Analyst CP			
Resistivity in Ohm-meters at 80°F				pH 7.2			
CATION	mg/l ÷ mg/me = me/l			ANION	mg/l ÷ mg/me = me/l		
Na	2,314	23.0	100.62	Cl	350	35.5	9.86
Ca	134	20.0	6.70	Br	0	79.9	--
Mg	9	12.2	.74	I	0	126.9	--
Sr	170	43.8	3.88	F		19.0	
Ba	0	68.7	--	SO ₄	4,575	48.0	95.31
K		39.1		HCO ₃	413	61.0	6.77
Li		6.9		CO ₃		30.0	
Rb		85.5		OH		17.0	
Cs		132.9		Total Solids	7,965		
Fe		27.9					
Mn		27.5					
B		3.6					
Cu		63.5					
Zn		32.7					
Ni		29.4					
Cr		26.0					

Na = (me/l Anions - me/l Cations) x 23.0 mg/me = mg Na/l
Total Dissolved Solids = (mg Anions/l + mg Cations/l)
Choza Mesa

FIELD
COUNTY Rio Arriba, N. Mex.

LOCATION

WELL NO. EB-1

LEASE

FORMATION L. Ojo Alamo

COMPANY EPNE (Gasbuggy)

U. S. BUREAU OF MINES
BARTLESVILLE PETROLEUM RESEARCH CENTER
BARTLESVILLE, OKLA.

OILFIELD WATER RESEARCH LABORATORY

76 015

Sample

Sample Date: 2-26-67

Analysis Date: 3-22-67

Specific gravity at 60°/60°F 1.005

Analyst CP

Resistivity in Ohm-meters at 80°F

pH 9.5 H₂S

CATION	mg/l ÷ mg/me = me/l			ANION	mg/l ÷ mg/me = me/l		
	Na	2,141	23.0		93.10	Cl	489
Ca	268	20.0	13.40	Br	0	79.9	
Mg	34	12.2	2.79	I	0	126.9	
Sr	80	43.8	1.86	F		19.0	
Ba	0	68.7		SO ₄	4,195	48.0	87.40
K		39.1		HCO ₃	271	61.0	4.40
Li		6.9		CO ₃		30.0	
Rb		85.5		OH		17.0	
Cs		132.9		Total Solids	7,478		
Fe		27.9					
Mn		27.5					
B		3.6					
Cu		63.5					
Zn		32.7					
Ni		29.4 29.4					
Cr		26.0					

Na =(me/l Anions - me/l Cations) x 23.0 mg/me = mg Na/l
Total Dissolved Solids = \sum (mg Anions/l + mg Cations/l)
Choza Mesa

FIELD

COUNTY Rio Arriba, N. Mex.

LOCATION

WELL NO. GB-1

LEASE

FORMATION L. Ojo Alamo

COMPANY EPNE (Gasbuggy)

BUREAU OF MINES
U. S. DEPARTMENT OF THE INTERIOR
BARTLESVILLE PETROLEUM RESEARCH CENTER
OILFIELD WATER RESEARCH LABORATORY

Sample Date: April 1967
Analysis Date: 4-18-67

67 024

Sample

Specific gravity at 60°/60° F 1.006

Analyst C.P.

Resistivity in Ohm-meters at 80° F

pH 6.1

CATION	mg/l ÷ mg/me = me/l			ANION	mg/l ÷ mg/me = me/l		
	mg/l	mg/me	me/l		mg/l	mg/me	me/l
Sodium Na	713	23.0	31.00	Chloride Cl	2,673	35.5	7.53
Calcium Ca	31	20.0	1.55	Bromide Br		79.9	
Magnesium Mg	11	12.2	.90	Iodide I	9	126.9	.07
Strontium Sr		43.8		Fluoride F		19.0	
Barium Ba		68.7		Sulfate SO ₄	0	48.0	0
Potassium K		39.1		Bicarbonate HCO ₃	1,577	61.0	25.85
Lithium Li		6.9		Carbonate CO ₃		30.0	
Rubidium Rb		85.5		Hydroxide OH		17.0	
Cesium Cs		132.9					
Iron Fe		27.9		T.S.	5,014		
Manganese Mn		27.5					
Boron B		3.6					
Copper Cu		63.5					
Zinc Zn		32.7					
Nickel Ni		29.4					
Ammonium		18.0					

Na = (me/l Anions - me/l Cations) x 23.0 mg/me - mg Na/l

Total Dissolved Solids = \sum (mg Anions/l + mg Cations/l)

FORMATION Pictured Cliff

STATE New Mexico

COUNTY Rio Arriba

FIELD

COMPANY El Paso Natural Gas Co.

WELL 10-36

LOCATION

LEASE Unit 29-4