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Technical Letter

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July 31, 1961

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UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
WASHINGTON 25, D. C.

HYDROLOGIC TEST PROGRAM

TATUM SALT DOME

LAMAR COUNTY, MISSISSIPPI

USGS-474-269

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UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

Federal Center, Denver 25, Colorado

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July 31, 1961

Mr. J. E. Reeves
Assistant Manager for Test Operations
Albuquerque Operations Office
U. S. Atomic Energy Commission
P. O. Box 5400
Albuquerque, New Mexico

Dear Mr. Reeves:

Transmitted herewith are three copies of

TECHNICAL LETTER: DRIBBLE-3

HYDROLOGIC TEST PROGRAM

TATUM SALT DOME

LAMAR COUNTY, MISSISSIPPI

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AUG 1 1961

V. E. MCKELVEY
ASSISTANT CHIEF GEOLOGIST.

Additional copies have been distributed as indicated below.

Sincerely yours,

W. S. Twenhofel

W. S. Twenhofel
Program Leader
Special Projects Branch

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UNITED STATES
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HYDROLOGIC INVESTIGATIONS, TATUM SALT DOME

Introduction

The objective of the hydrologic investigation at the Tatum salt dome is to appraise the hazard that would be created if the salt should fail to contain completely the nuclear detonations. In this case, radioactive contaminants might escape into the ground water and travel with it to places where it would constitute a hazard to public health and safety.

There are five fresh-water aquifers in the strata surrounding Tatum Dome. Three of them are present over the top of the dome and are presumed to continue laterally into adjacent areas, although there is the possibility that faults over the dome interrupt them. Two other aquifers are interrupted by the dome itself but otherwise are extensive.

Escape of radioactive materials at the sides of the dome could contaminate directly the two aquifers last mentioned. It might also indirectly contaminate the other three aquifers if artesian pressures are sufficient and the confining beds between aquifers are leaky.

Escape of radioactive materials at the top of the dome could contaminate directly the three aquifers believed to be continuous over the top. If leakage through confining beds should be downward (rather than upward as suggested in the preceding paragraph),

contaminants entering the three upper aquifers could, after movement laterally off the dome, contaminate the lower aquifers indirectly.

Except in the event of complete failure of the salt to contain the explosions, it seems improbable that all aquifers would be contaminated. No way is apparent for ascertaining in advance which aquifers might be contaminated and which not. Therefore, all fresh-water aquifers must be studied. In general, the ground water is likely to move farther and faster through the aquifers than across the confining beds, but the possibility of leakage between aquifers cannot be lightly dismissed.

Data Required

Needed with respect to all five aquifers is knowledge of the rate and direction of movement of the ground water in them, together with their capacity (storage) and their potential for tying up radioactive materials through ion exchange. In detail, these basic factors are established through determination of the following:

1. The characteristics of existing water wells and extent of water use within a 15-mile radius of the dome.
2. The depth, attitude, thickness, and areal extent of the fresh-water-bearing strata, and their geologic sequence.
3. The hydrologic characteristics, such as storage and coefficient of transmissibility of the aquifers.

4. The average rate and direction of water movement within the aquifers.
5. The rate and amount of interchange of water between aquifers, both pre- and post-shot might increase if aquicludes shatter.
6. The ion-exchange capacity of the strata above and surrounding the dome.
7. The chemical characteristics of the water in each aquifer, both pre- and post-shot.
8. The surface run-off pattern and chemical characteristics of stream water.

Methods

The data requirement is to be met through inventorying wells in the locality, the sampling of water from the different aquifers, and the testing of wells drilled specifically for the purposes of this investigation. The tests to be made in such wells include bailing and pumping tests, and packer or drill stem tests. In addition, water samples are analyzed for both chemical and radiochemical content, and samples of drill cuttings and core are tested in the laboratory. Water-level fluctuations in some of the wells will be recorded, and samples of water will be analyzed both before and after detonations in order to detect changes that may take place.

Plans

The plan for obtaining the necessary information includes the following:

1. Utilization of the Humble Hibernia well for hydrologic studies; FY-61; not fully successful because of difficulty experienced in completing the well. Little remains to be done.

2. Hydrologic tests of aquifers in the rim syncline surrounding the dome, total 2 tests, each requiring one well to be pumped and two to be observed. Begun in FY-61, these tests are nearly completed. All five aquifers are being tested by pumping.

3. Hydrologic studies in the six exploration (E) holes, which are on top of the dome and near its margin. Begun late in FY-61, this work still is in progress. Hydrology is incidental to the principal objective in drilling the E holes and, therefore, may be sacrificed or skimped in order to gain these objectives. Hydrologic properties of the caprock and of aquifers in the overlying strata are sought. Pumping tests probably cannot be made in these holes.

4. Hydrologic properties of aquifers over the dome, proposed for FY-62. Test will require one well about 1,000 feet deep to be pumped, and one well 800 feet deep to be observed. Test in turn, from top downward, three aquifers and the caprock.

Location: near the shaft to be excavated near WP-1.

5. Hydraulic testing near the Humble Hibernia oil-test well, proposed for FY-62 and intended to test the most prolific aquifer of the locality. Will require one well 1,100 feet deep to be pumped, and three wells 800 to 1,050 feet deep for observation.

Unlike hydrologic tests 1 and 2, this test will have the

observation wells aligned radially with respect to the dome. They will be 1,200 feet, 2,400 feet, and 4,000 feet from the discharge well and the most distant one will be over the dome. Thus, the test will help to define the continuity and hydraulic properties of the aquifer between points both over and off the dome. As the most productive aquifer is to be tested, the results will set an upper limit for the rate of ground water movement.

6. Records of water levels will be made in several holes, both over the dome and off its flank, as a means of detecting changes in head that may be caused by the detonations.

7. Samples of water from many wells in the locality have been analyzed, and other samples will be taken as wells are drilled for this purpose. Sampling will be repeated as necessary after detonations in order to detect the appearance of contaminants in the several aquifers and the movement of the water.

8. Selected samples of rock from the different test wells will be analyzed in the Survey laboratory to determine their ion-exchange capacity.

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Test Wells	Location	Depth: (ft.)	Aquifer to be tested	Pump test	Measurements: of water level fluctuations:	Progress
Hydrologic Test No. 1:	NE flank, rim syncline:	2616:	1,2,3,4, and 5:	Yes, in aquifer:	Yes	) Wells and pumping tests
Observation No. 1	: Same	: 1000:	: 2	: No	: Yes	) completed
Observation No. 2	: Same	: 1000:	: 2	: No	: Yes	)
Hydrologic Test No. 2:	SW flank, rim syncline:	2620:	1,2,3,4, and 5:	Yes, in aquifer:	Yes	) Wells and pumping tests
Observation No. 3	: Same	: 1000:	: 2	: No	: Yes	) completed
Observation No. 4	: Same	: 1000:	: 2	: No	: Yes	)
Humble-Hibernia Oil Test	: SE flank, rim syncline:	: :	: 2	: Unsuccessful	: Yes	: Unsuccessful perforation
	: :	: :	: :	: :	: :	: of No.2 aquifer caused
	: :	: :	: :	: :	: :	: abandonment of hole
	: :	: :	: :	: :	: :	: except for water-level
	: :	: :	: :	: :	: :	: measurements
Hydrologic Test No. 3:	SE flank, rim syncline:	1100:	2	: Yes	: Yes	)
Observation No. 5	: 1200' NW of Hydro. Test:	: 1050:	: 2	: No	: Yes	)
	: No. 3	: :	: :	: :	: :	)
Observation No. 6	: 2400' NW of Hydro. Test:	: 850:	: 2	: No	: Yes	) Proposed
	: No. 3	: :	: :	: :	: :	)
Observation No. 7	: 4000' NW of Hydro. Test:	: 800:	: 2	: No	: Yes	)
	: No. 3	: :	: :	: :	: :	)
Hydrologic Test No. 4:	Domal area, near shaft:	1200:	1,2 and 3	: Yes, in aquifers:	: Yes	)
	: :	: :	: :	: 1, 2, and 3	: :	) Proposed
Observation No. 8	: Same	: 800:	: 3	: No	: Yes	)
E-holes	: Domal area	: :	: :	: :	: :	)
Category 1	: :	: 1450:	: Caprock	: Bailing test	: Yes	)
	: :	: :	: limestone	: :	: :	) Proposed
Category 2	: :	: 800:	: Catahoula and	: Bailing test	: Yes	)
	: :	: :	: 2	: :	: :	)

TATUM SALT DOME