PDR 40-8027

KERR-McGEE CORPORATION
KERR-McGEE CENTER • OKLAHOMA CITY, OKLAHOMA 73125

ENVIRONMENT AND HEALTH MANAGEMENT DIVISION

CERTIFIED MAIL RETURN RECEIPT REQUESTED

[redacted] Return to 396-SS

July 16, 1982

Mr. Donald A. Hensch, P.E., Director
Industrial Waste Division
Oklahoma State Department of Health
1000 Northeast 10th Street
Oklahoma City, Oklahoma 73152

Re: Application for an "Other Industrial Waste" Storage Well - Sequoyah UF_6 Facility

Attached find Kerr-McGee Nuclear Corporation's responses to questions contained in your March 23, 1982 letter regarding our application to operate a Waste Storage Well at the Sequoyah UF_6 facility near Gore, Oklahoma (submitted July 17, 1981).

We have conducted additional evaluations and tests and have obtained the information requested in your letter. In order to ensure the continuity of operations and treatment of liquid effluents at the Sequoyah facility, your timely review of this information and issuance of the draft permit to operate this well is requested.

Very truly yours,

W. J. Shelley

W. J. Shelley, Vice President
Nuclear Licensing & Regulation

WJS/ba

Attachment

add l rpd

Response to Oklahoma State Department of Health
Questions Dated March 23, 1982
(D. Hensch to W. J. Shelley)

1. Cement Bond Log - 7F 4.1(e)

Response: A cement bond log (CBL) and variable density log (VDL) were completed on May 24, 1982 under the supervision of Kerr-McGee Hydrology and H. K. Van Poollen and Associates. Using CBL/VDL logs and other electric and lithologic logs, area of cementation appeared to be well bonded, especially along the bottom portion of the casing. Log interpretation by the Schlumberger technical representative concurs with this evaluation. Copies of the CBL/VDL logs and a Schlumberger interpretation are included in attachment 1.

2. Logs and Surveys 7F 4.3

Response: 2. A&B.
The following logs were completed during well construction: Sidewall Neutron Porosity and Caliper Induction log including Spontaneous Potential, Short, Normal and Induction Resistivity; Gamma Ray, Density and Neutron Porosity and Compensated Formation Density. These logs are included as attachment 2.

Response: 2C.
An electro-magnetic thickness log (ETT) and caliper log of the inplace casing was completed at the time of the CBL/VDL log (See Attachment 3). Variations in wall thickness indicated by the ETT log were caused by different materials included in the initial well construction. The bottom two joints (60 feet) are composed of carpenter 20 alloy steel with a Howco guide shoe on the bottom and a float collar at the top of second joint. The bottom joint is equipped with two centralizers and six wall cleaners. Two centralizers were also attached on the third, fifth, and seventh joints and 15 additional centralizers were spaced at 90 foot intervals above the seventh joint. The bottom seven joints were sandblasted and "Ruff-coted".

Response: 2D.
On September 30, 1981, Gearhart-Owens Services conducted a pressure gradient test. Using a Hewlett-Pachard pressure gauge, measurements were made every 100 feet downhole and at 2000 feet and 1000 feet uphole. Bottom hole pressure was measured to be 1463.92 psia. Complete results of this testing are provided in attachment 4.

3. Tubing pressure test - 7.E.8

Response: On June 17, 1982, a 3½-inch seating nipple with a bypass blanking plug was installed at the packer. Using two joints of tubing, an initial pressure test was run at a pressure of 2000 psi. After this test proved successful, the total length of tubing was installed to a depth of 1615 feet. Pressure (3000 psi) held for a duration of 15 minutes.

The packer was set and tubing-casing annulus pressure tested at a total depth. A pump truck injected water into the annulus and when shut down, observed pressure immediately decreased to 300 psi and continued to decrease slowly. This procedure produced similar results when repeated at depths of 1366 feet and 1240 feet.

Subsequent calculations indicated that the tension packer set on June 17 and June 18 may have released when pressure was exerted. Therefore, a retrievable bridge plug and packer were utilized to test integrity of the annulus. A thirty foot section between the bridge plug and packer and the entire casing and well head were pressure tested. No leaks were evident during these tests. After removal of the plug, a pump truck injected 45 BBL Halliburton corrosion inhibitor down the tubing-casing annulus. The original reconditioned tension packer was set (30,000#) at a depth of 1614 feet. For a duration of 15 minutes, 400 psi was maintained in the annulus.

4. Monitoring Well - 7F 5.5.1.

Response: Appendix 7E.11 states that Water monitoring will be required as deemed necessary by the Department. Appendix 7F is specific for all new controlled industrial waste injection wells and the regulation cited (7F 5.5.1.) requires a minimum of at least one(1) monitor well to provide monitoring to the lowest fresh water aquifer beneath the site. Section 1.13 defines aquifer as a geologic formation, group of formations, or a part of a formation capable of yielding a significant amount of ground water to wells or springs. The hydrologic conditions in the immediate area of the Sequoyah Facility are typical of those described for the Atoka formation. As such, this formation is considered to have very poor water potential characteristics since it has poor permeability, water quality is poor, and yields average only .5 gallons per minute (gpm). (Kerr-McGee Nuclear Corporation, Sequoyah Uranium Hexafluoride plant Final Environmental Statement February 1975).

To obtain other information on site specific ground water conditions, in December 1981, the Oklahoma Corporation Commission Oil and Gas Conservation Division was contacted concerning the depth to the base of fresh water in the area of the injection well. No published maps with contours of this elevation are available for eastern Oklahoma and no data is available for the surrounding counties. However, review of observations provided in the original waste storage well drilling logs revealed additional information. During drilling, the uppermost Atoka formation, comprised primarily of shales and fine-medium cemented sandstones, was reported as non-porous. Saltwater was encountered in the Spiro Sandstone (343-373 feet) a basal member of the Atoka formation.

Confirmation of these formation characteristics (Atoka) are provided from other wells which have been drilled into the Atoka formation in the vicinity of the waste storage well. Wells have been drilled in the SE ¼ of the NW ¼ Section 21, the center of the SE ¼ Section 21, and in the SW ¼ of the SW ¼ of Section 22. Only the well in Section 22 provided sufficient quantities of water for domestic purposes (approximately 1 gpm or less). Another monitor well (2307) was installed approximately 5000 feet ESE of the waste injection well. This well (2307) was measured

on June 1982 to a total depth of 95 feet and is included in the current Sequoyah Plant monitoring program under USNRC license SUB-1010. (See Attachment 5 - 1981 Water Quality Analysis - Monitor well 2307)

Based upon this review of information available on site groundwater conditions, completion of additional groundwater monitor wells into the Atoka formation in vicinity of the waste injection well is not considered necessary nor appropriate, as a high probability exists that no significant amount of water would be encountered. Therefore, Kerr-McGee Nuclear Corporation proposes to use the existing monitor well (2307) which has an established record of water quality analyses to monitor the proposed injection program and fulfill your request of March 23, 1982.

5. Compatibility - 7F-4.2(c) - Is the waste injected compatible with the formation and formation fluid?

Response: As indicated in our response dated December 22, 1981, the proposed injection fluid (treated raffinate) is essentially neutral (ph-7.65-1980 average) and therefore, is not expected to adversely affect or be reactive with the Arbuckle formation.

Permeability measurements have been made to define the interaction of simulated waste liquids on core samples obtained from the well. Results were reported by Core Laboratories in 1970 (See Attachment 6). It should be noted that this testing was conducted with three types of solutions: (1) neutralized filtered raffinate, (2) diluted raffinate and (3) hydrofluoric acid. The test results obtained with neutralized, filtered raffinate are the only ones applicable as, currently, only treated raffinate is proposed for injection into the Waste Storage Well. Results obtained with neutralized, filtered raffinate indicated that in the higher porosity core, permeability to neutralized raffinate was essentially the same as that to formation water.

The Kerr-McGee Technical Center conducted tests on compatibility of treated raffinate to formation fluid. Samples of water obtained from the Sequoyah injection well and Sequoyah treated raffinate were mixed in a ratio 2:1, respectively. No heavy precipitation occurred, but a brown solution was formed which had characteristics of colloidal suspension. The suspension was filterable on a .45 micron membrane.

6. Public Participation - 8.8.2

In accordance with your letter dated June 23, 1982 we have prepared a draft notice for your review and approval (Attachment 7). Following issuance of the draft operating permit by your Department please inform us of the: (1) final date for receiving written comments, and (2) time, date, and place of the informal public meeting for presentation of written and oral views. Following receipt of this information from your Department, Kerr-McGee Nuclear Corporation will publish the notice in accordance with Section 8.8.2.2 which requires such notice to be published in two newspapers of general circulation in the area of the proposed facility and also requires the notice to be broadcast over at

least one local radio station.

7. Monitoring - 7.5 Automatic Surveillance System

Response: Sequoyah facility personnel will be on-site during actual injection operations and therefore Section 7.5.2 is not applicable.

8. Plan for Plugging and Abandonment

Response: Upon completion of injection well use and permanent abandonment of the Sequoyah No. 1 "other" industrial waste disposal injection well, provisions of 7.E 14 (Parts 1-8) will be followed to include:

(1) Kerr-McGee will provide notification to the Department of intent to plug and time during which all plugging will take place.

(2) The well will be filled with mud from the well bottom to a point one hundred (100) feet below the top of the highest disposal zone and then with a cement plug from there to one hundred (100) feet above the top of the disposal zone.

(3) A cement plug will also be set from a point fifty (50) feet below the shoe of the surface casing to a point five (5) feet above the lowest fresh water zone.

(4) A final cement plug will extend from a point thirty (30) feet below the ground surface to a point five (5) feet below the ground surface.

(5) All intervals between plugs will be filled with mud.

(6) The top of the plugged well will clearly show the well permit number and date of plugging by permanent markings; inscribed in cement or a steel plant imbedded in cement.

(7) Within fifteen (15) days after a well has been plugged, Kerr-McGee will file a plugging record in triplicate with the Department.

The Kerr-McGee Nuclear Sequoyah Facility operates under U.S. Nuclear Regulatory Commission License SUB-1010. As such, closure procedures for ancilliary facilities (i.e. pits, ponds, lagoons) which are not used exclusively in conjunction with the injection program will be conducted in accordance with License SUB-1010.

Schlumberger

SCHLUMBERGER WELL SERVICES
5000 GULF FREEWAY, P.O. BOX 2175
HOUSTON, TEXAS 77001, (713) 928-4000

PLEASE REPLY TO
CENTRAL CASED HOLE DIVISION
ENTERPRISE PLAZA
5600 N. MAY AVENUE, SUITE 165
OKLAHOMA CITY, OK 73112 (405) 843-4417

June 11, 1982

Engineering Services Dept. of Hydrology
Kerr McGee Corporation
Oklahoma City

RE: Sequoyah Facility Waste Disposal #1

Dear Sirs:

This letter is written in regards to the cement bond log that was run on the above stated well on May 24, 1982.

From the cement bond log, it appears that the interval from 1090' down to the bottom of casing is well bonded. There are some higher readings on the cement bond curve in this interval, but this is probably due to fast formation which is also an indication of good bond.

From 1090' up to 800' the bond is not quite as good, but it still appears to have some bonding. The interval from 800' up to 480' is another section that shows to have good bonding on the cement bond log. From 480' up to the last reading, the bond is not quite as good, but it appears that there is some cement behind the pipe.

In conclusion, from the bond log run on May 24, 1982; it appears that there is good enough bonding for zone isolation up to a depth of 480'. Even though the cement bond log does not show good bonding from 480' up to the last reading, it does indicate that there is some bonding.

Sincerely,

Dwayne Weaver

Dwayne Weaver
Sales Engineer
Central Cased Hole Division

DW:slf

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NO. OF PAGES 7

REASON

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GEARHART
THE GO COMPANY

GEARHART INDUSTRIES, INC.
WIRELINE SERVICES
P.O. BOX 1258 • FORT WORTH, TEXAS 76101 • TELEPHONE 817/293-1775

HEWLETT PACKARD PRESSURE DATA

Company KERR-McGEE Location SEQUOYAH FACILITY

Well Desposal Well #1 County Sequoyah State Okla.

Field West of Plant Formation Date 9-30-81 & 10-1-81

KERR-McGEE SEQUOYAH FACILITY
Desposal Well #1
Pressure Readings
9-30-81 & 10-1-81

o-level considered to be base of cement pit

SURFACE	100'	200'
11:56:40 14.29 PSIA 93.7 DEGF 1 PSI SPAN	14:2[illegible] 60.55 PSIA 62.2 DEGF 1 PSI SPAN	15:11:04 104.33 PSIA 62.6 DEGF 1 PSI SPAN
11:56:36 14.30 PSIA 93.7 DEGF 1 PSI SPAN	14:2[illegible] 60.55 PSIA 62.2 DEGF 1 PSI SPAN	15:11:[illegible] 104.31 PSIA 62.6 DEGF 1 PSI SPAN
11:56:28 14.30 PSIA 93.7 DEGF 1 PSI SPAN	14:2[illegible] 60.55 PSIA 62.3 DEGF 1 PSI SPAN	15:11:[illegible] 104.29 PSIA 62.6 DEGF 1 PSI SPAN
11:56:16 14.32 PSIA 93.7 DEGF 1 PSI SPAN	14:2[illegible] 60.55 PSIA 62.2 DEGF 1 PSI SPAN	15:11:[illegible] 104.29 PSIA 62.6 DEGF 1 PSI SPAN
11:56:04 14.32 PSIA 93.7 DEGF 1 PSI SPAN	14:2[illegible] 60.55 PSIA 62.2 DEGF 1 PSI SPAN	15:11:[illegible] 104.31 PSIA 62.6 DEGF 1 PSI SPAN
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	14:2[illegible] 60.55 PSIA 62.2 DEGF 1 PSI SPAN	15:11:[illegible] 104.31 PSIA 62.6 DEGF 1 PSI SPAN

300'

15:40:46
147.84 PSIA
63.4 DEGF
1 PSI SPAN

15:40:52
147.84 PSIA
63.4 DEGF
1 PSI SPAN

15:40:58
147.85 PSIA
63.3 DEGF
1 PSI SPAN

15:41:04
147.84 PSIA
63.4 DEGF
1 PSI SPAN

15:41:10
147.84 PSIA
63.3 DEGF
1 PSI SPAN

15:41:16
147.84 PSIA
63.3 DEGF
1 PSI SPAN

15:41:22
147.84 PSIA
63.4 DEGF
1 PSI SPAN

400'

16:27:46
191.78 PSIA
64.8 DEGF
1 PSI SPAN

16:28:52
191.78 PSIA
64.8 DEGF
1 PSI SPAN

16:28:46
191.79 PSIA
64.8 DEGF
1 PSI SPAN

16:28:52
191.77 PSIA
64.9 DEGF
1 PSI SPAN

16:28:58
191.78 PSIA
64.8 DEGF
1 PSI SPAN

16:29:04
191.78 PSIA
64.8 DEGF
1 PSI SPAN

16:29:10
191.77 PSIA
64.8 DEGF
1 PSI SPAN

500'

17:05:52
238.92 PSIA
66.5 DEGF
1 PSI SPAN

17:05:46
238.92 PSIA
66.5 DEGF
1 PSI SPAN

17:05:52
238.94 PSIA
66.5 DEGF
1 PSI SPAN

17:05:58
238.92 PSIA
66.5 DEGF
1 PSI SPAN

17:06:04
238.94 PSIA
66.5 DEGF
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17:06:10
238.94 PSIA
66.5 DEGF
1 PSI SPAN

17:06:16
238.92 PSIA
66.5 DEGF
1 PSI SPAN

600'

17:57:40
286.44 PSIA
69.3 DEGF
1 PSI SPAN

17:57:30
286.44 PSIA
69.3 DEGF
1 PSI SPAN

17:57:20
286.43 PSIA
69.4 DEGF
1 PSI SPAN

17:57:10
286.44 PSIA
69.3 DEGF
1 PSI SPAN

17:57:00
286.44 PSIA
69.4 DEGF
1 PSI SPAN

17:56:50
286.44 PSIA
69.3 DEGF
1 PSI SPAN

17:56:40
286.44 PSIA
69.4 DEGF
1 PSI SPAN

700'

18:41:40
333.80 PSIA
70.7 DEGF
1 PSI SPAN

18:41:30
333.84 PSIA
70.7 DEGF
1 PSI SPAN

18:41:20
333.81 PSIA
70.6 DEGF
1 PSI SPAN

18:41:10
333.85 PSIA
70.6 DEGF
1 PSI SPAN

18:41:00
333.79 PSIA
70.7 DEGF
1 PSI SPAN

18:40:50
333.86 PSIA
70.6 DEGF
1 PSI SPAN

18:40:40
333.80 PSIA
70.7 DEGF
1 PSI SPAN

800'

19:27:40
381.25 PSIA
72.4 DEGF
1 PSI SPAN

19:27:30
381.27 PSIA
72.4 DEGF
1 PSI SPAN

19:27:20
381.25 PSIA
72.4 DEGF
1 PSI SPAN

19:27:10
381.25 PSIA
72.4 DEGF
1 PSI SPAN

19:27:00
381.26 PSIA
72.4 DEGF
1 PSI SPAN

19:26:50
381.25 PSIA
72.3 DEGF
1 PSI SPAN

19:26:40
381.25 PSIA
72.4 DEGF
1 PSI SPAN

19:26:30
381.25 PSIA
72.4 DEGF
1 PSI SPAN

19:26:20
381.25 PSIA
72.4 DEGF
1 PSI SPAN

900'

20:11:30
428.69 PSIA
73.4 DEGF
1 PSI SPAN

20:11:20
428.69 PSIA
73.4 DEGF
1 PSI SPAN

20:11:10
428.70 PSIA
73.3 DEGF
1 PSI SPAN

20:11:03
428.68 PSIA
73.4 DEGF
1 PSI SPAN

20:10:53
428.69 PSIA
73.4 DEGF
1 PSI SPAN

20:10:43
428.68 PSIA
73.4 DEGF
1 PSI SPAN

20:10:33
428.70 PSIA
73.3 DEGF
1 PSI SPAN

1000'

20:58:20
475.86 PSIA
74.7 DEGF
1 PSI SPAN

20:58:10
475.87 PSIA
74.7 DEGF
1 PSI SPAN

20:58:02
475.86 PSIA
74.7 DEGF
1 PSI SPAN

20:57:52
475.84 PSIA
74.8 DEGF
1 PSI SPAN

20:57:42
475.86 PSIA
74.7 DEGF
1 PSI SPAN

20:57:32
475.86 PSIA
74.7 DEGF
1 PSI SPAN

20:57:22
475.86 PSIA
74.7 DEGF
1 PSI SPAN

1100'

21:48:4
523.18 PSI
75.9 DE
1 PSI SPA

21:48:3
523.18 PSI
75.9 DE
1 PSI SPA

21:48:2
523.18 PSI
75.9 DE
1 PSI SPA

21:48:1
523.18 PSI
75.9 DE
1 PSI SPA

21:48:0
523.18 PSI
76.0 DE
1 PSI SPA

21:47:5
523.18 PSI
76.0 DE
1 PSI SPA

21:47:4
523.18 PSI
75.9 DE
1 PSI SPA

1200'

22:4[illegible]
570.43 PSIA
77.2 DEGF
1 PSI SPAN

22:41:23
570.42 PSIA
77.2 DEGF
1 PSI SPAN

22:41:13
570.41 PSIA
77.2 DEGF
1 PSI SPAN

22:41:03
570.43 PSIA
77.3 DEGF
1 PSI SPAN

22:30:53
570.43 PSIA
77.3 DEGF
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22:30:43
570.43 PSIA
77.2 DEGF
1 PSI SPAN

22:30:33
570.41 PSIA
77.2 DEGF
1 PSI SPAN

1300'

23:27:43
617.43 PSIA
78.0 DEGF
1 PSI SPAN

23:27:33
617.42 PSIA
78.0 DEGF
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23:27:22
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23:27:12
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23:26:53
617.42 PSIA
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1400'

00:11:[illegible]
665.07 PSIA
78.9 DEGF
1 PSI SPAN

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665.07 PSIA
78.9 DEGF
1 PSI SPAN

00:10:52
665.06 PSIA
78.9 DEGF
1 PSI SPAN

00:10:[illegible]
665.07 PSIA
78.9 DEGF
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00:10:32
665.06 PSIA
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00:10:12
665.07 PSIA
78.8 DEGF
1 PSI SPAN

1500'	1600'	1700'
	01:47:40 759.62 PSIA 80.6 DEGF 1 PSI SPAN	02:33:10 807.16 PSIA 81.4 DEGF 1 PSI SPAN
00:51:40 712.38 PSIA 79.7 DEGF 1 PSI SPAN	01:47:30 759.62 PSIA 80.6 DEGF 1 PSI SPAN	02:33:00 807.16 PSIA 81.4 DEGF 1 PSI SPAN
00:51:30 712.38 PSIA 79.7 DEGF 1 PSI SPAN	01:47:20 759.62 PSIA 80.6 DEGF 1 PSI SPAN	02:32:50 807.16 PSIA 81.4 DEGF 1 PSI SPAN
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1800'

03:50:40
854.54 PSIA
82.1 DEGF
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03:50:30
854.53 PSIA
82.2 DEGF
1 PSI SPAN

03:50:20
854.54 PSIA
82.1 DEGF
1 PSI SPAN

03:50:10
854.52 PSIA
82.2 DEGF
1 PSI SPAN

03:50:00
854.53 PSIA
82.1 DEGF
1 PSI SPAN

03:49:50
854.54 PSIA
82.1 DEGF
1 PSI SPAN

03:49:40
854.55 PSIA
82.1 DEGF
1 PSI SPAN

1900'

04:42:50
902.65 PSIA
82.9 DEGF
1 PSI SPAN

04:42:40
902.63 PSIA
82.9 DEGF
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04:42:30
902.64 PSIA
82.9 DEGF
1 PSI SPAN

04:42:20
902.63 PSIA
82.9 DEGF
1 PSI SPAN

04:42:10
902.65 PSIA
82.8 DEGF
1 PSI SPAN

04:42:00
902.63 PSIA
82.9 DEGF
1 PSI SPAN

04:41:50
902.63 PSIA
82.9 DEGF
1 PSI SPAN

2000'

06:03:20
950.41 PSIA
83.7 DEGF
1 PSI SPAN

06:03:10
950.40 PSIA
83.7 DEGF
1 PSI SPAN

06:03:00
950.43 PSIA
83.6 DEGF
1 PSI SPAN

06:02:50
950.41 PSIA
83.7 DEGF
1 PSI SPAN

06:02:40
950.41 PSIA
83.7 DEGF
1 PSI SPAN

06:02:30
950.41 PSIA
83.6 DEGF
1 PSI SPAN

06:02:20
950.43 PSIA
83.6 DEGF
1 PSI SPAN

2100'

06:42:50
998.26 PSIA
84.4 DEGF
1 PSI SPAN

06:42:40
998.26 PSIA
84.4 DEGF
1 PSI SPAN

06:42:30
998.26 PSIA
84.4 DEGF
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06:42:20
998.27 PSIA
84.4 DEGF
1 PSI SPAN

06:42:10
998.25 PSIA
84.4 DEGF
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06:42:00
998.26 PSIA
84.4 DEGF
1 PSI SPAN

06:41:50
998.26 PSIA
84.4 DEGF
1 PSI SPAN

2200'

07:32:00
1045.89 PSIA
85.1 DEGF
1 PSI SPAN

07:31:50
1045.90 PSIA
85.1 DEGF
1 PSI SPAN

07:31:40
1045.90 PSIA
85.1 DEGF
1 PSI SPAN

07:31:30
1045.89 PSIA
85.1 DEGF
1 PSI SPAN

07:31:20
1045.90 PSIA
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1045.90 PSIA
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07:31:00
1045.90 PSIA
85.1 DEGF
1 PSI SPAN

2300'

08:14:40
1093.70 PSIA
85.8 DEGF
1 PSI SPAN

08:14:30
1093.71 PSIA
85.7 DEGF
1 PSI SPAN

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1093.70 PSIA
85.8 DEGF
1 PSI SPAN

08:14:10
1093.70 PSIA
85.8 DEGF
1 PSI SPAN

08:14:00
1093.71 PSIA
85.7 DEGF
1 PSI SPAN

08:13:50
1093.71 PSIA
85.7 DEGF
1 PSI SPAN

08:13:40
1093.70 PSIA
85.8 DEGF
1 PSI SPAN

2400'

08:52:40
1141.91 PSIA
86.5 DEGF
1 PSI SPAN

08:52:30
1141.91 PSIA
86.5 DEGF
1 PSI SPAN

08:52:20
1141.93 PSIA
86.5 DEGF
1 PSI SPAN

08:52:10
1141.96 PSIA
86.5 DEGF
1 PSI SPAN

08:52:00
1141.90 PSIA
86.5 DEGF
1 PSI SPAN

08:51:50
1141.91 PSIA
86.5 DEGF
1 PSI SPAN

08:51:40
1141.90 PSIA
86.6 DEGF
1 PSI SPAN

2500'

09:32:30
1190.01 PSIA
87.2 DEGF
1 PSI SPAN

09:32:20
1190.00 PSIA
87.2 DEGF
1 PSI SPAN

09:32:10
1190.01 PSIA
87.1 DEGF
1 PSI SPAN

09:32:00
1190.01 PSIA
87.1 DEGF
1 PSI SPAN

09:31:50
1190.01 PSIA
87.1 DEGF
1 PSI SPAN

09:31:40
1190.01 PSIA
87.1 DEGF
1 PSI SPAN

09:31:30
1190.01 PSIA
87.2 DEGF
1 PSI SPAN

2600'

10:19:00
1238.28 PSIA
87.9 DEGF
1 PSI SPAN

10:18:50
1238.26 PSIA
87.9 DEGF
1 PSI SPAN

10:18:40
1238.28 PSIA
87.9 DEGF
1 PSI SPAN

10:18:30
1238.26 PSIA
87.9 DEGF
1 PSI SPAN

10:18:20
1238.27 PSIA
87.9 DEGF
1 PSI SPAN

10:18:10
1238.27 PSIA
87.9 DEGF
1 PSI SPAN

10:18:00
1238.27 PSIA
87.9 DEGF
1 PSI SPAN

2700'

11:05:50
1286.12 PSIA
88.5 DEGF
1 PSI SPAN

11:05:40
1286.12 PSIA
88.6 DEGF
1 PSI SPAN

11:05:30
1286.10 PSIA
88.6 DEGF
1 PSI SPAN

11:05:20
1286.11 PSIA
88.6 DEGF
1 PSI SPAN

11:05:10
1286.11 PSIA
88.6 DEGF
1 PSI SPAN

11:05:00
1286.12 PSIA
88.6 DEGF
1 PSI SPAN

11:04:50
1286.12 PSIA
88.5 DEGF
1 PSI SPAN

2800'

11:50:30
1334.96 PSIA
89.4 DEGF
1 PSI SPAN

11:50:20
1334.95 PSIA
89.4 DEGF
1 PSI SPAN

11:50:10
1334.96 PSIA
89.3 DEGF
1 PSI SPAN

11:50:00
1334.95 PSIA
89.4 DEGF
1 PSI SPAN

11:49:50
1334.96 PSIA
89.3 DEGF
1 PSI SPAN

11:49:40
1334.95 PSIA
89.4 DEGF
1 PSI SPAN

11:49:30
1334.96 PSIA
89.3 DEGF
1 PSI SPAN

2900'

12:31:30
1383.38 PSIA
90.1 DEGF
1 PSI SPAN

12:31:20
1383.39 PSIA
90.0 DEGF
1 PSI SPAN

12:31:10
1383.39 PSIA
90.0 DEGF
1 PSI SPAN

12:31:00
1383.38 PSIA
90.1 DEGF
1 PSI SPAN

12:30:50
1383.39 PSIA
90.0 DEGF
1 PSI SPAN

12:30:40
1383.39 PSIA
90.0 DEGF
1 PSI SPAN

12:30:30
1383.39 PSIA
90.1 DEGF
1 PSI SPAN

3000'

13:14:10
1431.52 PSIA
90.7 DEGF
1 PSI SPAN

13:14:00
1431.52 PSIA
90.7 DEGF
1 PSI SPAN

13:13:50
1431.53 PSIA
90.7 DEGF
1 PSI SPAN

13:13:40
1431.52 PSIA
90.7 DEGF
1 PSI SPAN

13:13:30
1431.52 PSIA
90.7 DEGF
1 PSI SPAN

13:13:20
1431.53 PSIA
90.6 DEGF
1 PSI SPAN

13:13:10
1431.52 PSIA
90.7 DEGF
1 PSI SPAN

3067' TD

14:15:40
1463.91 PSIA
91.2 DEGF
1 PSI SPAN

14:15:30
1463.92 PSIA
91.2 DEGF
1 PSI SPAN

14:15:20
1463.93 PSIA
91.1 DEGF
1 PSI SPAN

14:15:10
1463.92 PSIA
91.1 DEGF
1 PSI SPAN

14:15:00
1463.93 PSIA
91.1 DEGF
1 PSI SPAN

14:14:50
1463.91 PSIA
91.2 DEGF
1 PSI SPAN

14:14:40
1463.92 PSIA
91.2 DEGF
1 PSI SPAN

14:14:30
1463.93 PSIA
91.1 DEGF
1 PSI SPAN

14:14:20
1463.91 PSIA
91.2 DEGF
1 PSI SPAN

14:14:10
1463.92 PSIA
91.1 DEGF
1 PSI SPAN

Stop Checks
Back up hole

2000'

15:36:40
950.43 PSIA
83.7 DEGF
1 PSI SPAN

15:36:30
950.45 PSIA
83.6 DEGF
1 PSI SPAN

15:36:20
950.45 PSIA
83.6 DEGF
1 PSI SPAN

15:36:10
950.43 PSIA
83.7 DEGF
1 PSI SPAN

15:36:00
950.43 PSIA
83.7 DEGF
1 PSI SPAN

15:35:50
950.42 PSIA
83.7 DEGF
1 PSI SPAN

15:35:40
950.45 PSIA
83.6 DEGF
1 PSI SPAN

1000'

16:38:10
476.52 PSIA
74.8 DEGF
1 PSI SPAN

16:38:00
476.54 PSIA
74.9 DEGF
1 PSI SPAN

16:37:50
476.53 PSIA
74.8 DEGF
1 PSI SPAN

16:37:40
476.54 PSIA
74.8 DEGF
1 PSI SPAN

16:37:30
476.52 PSIA
74.9 DEGF
1 PSI SPAN

16:37:20
476.54 PSIA
74.8 DEGF
1 PSI SPAN

16:37:10
476.54 PSIA
74.8 DEGF
1 PSI SPAN

16:37:00
476.52 PSIA
74.9 DEGF
1 PSI SPAN

Attachment 5

Date	Location	Parameter	Analysis
6/81	Monitor Well (2307)	NO_3(N)	1 mg/l
		Fluoride	.5 mg/l
		Gross αalpha	14 pCi/l
		Gross βbeta	< 20 pCi/l
		Uranium	.022 mg/l
		Ra-226	7.5 pCi/l

Oklahoma City

CORE LABORATORIES, INC.
Petroleum Reservoir Engineering
DALLAS, TEXAS

April 28, 1970

APR 30 REC'D

Kerr-McGee Corporation
Kerr-McGee Building
Oklahoma City, Oklahoma 73102

Attention: Mr. W. J. Robertson

Subject: Liquid Permeability Determinations
Sequoyah Waste Disposal No. 1 Well
Sequoyah County, Oklahoma
Our File Number: SCAL-7048

Gentlemen:

Presented herein are the results of permeability measurements made to define the interaction of simulated waste liquids with core samples from the above well. Twenty-four core samples were originally drilled and cleaned in our Oklahoma City laboratory. Permeabilities and porosities were determined on these cores which were subsequently shipped to Dallas for special tests. Samples selected for flow tests are identified as to depth on page one and lithological descriptions are presented on page two. Permeabilities and porosities are presented on page four for those samples prepared but not selected for further tests.

The objective of this study was to define the ability of high porosity and low porosity rock to accept the designated waste solutions. Three solutions were tested in this evaluation. Test solutions were (1) a neutralized raffinate prepared by neutralizing synthetic raffinate with lime to a pH of eight, (2) a solution of diluted raffinate prepared by mixing 400 milliliters of synthetic raffinate with 1800 milliliters of two grams per liter hydrofluoric acid and (3) dilute hydrofluoric acid.

The test program consisted of evacuating and pressure saturating each core with formation water. Permeability to this water was determined. A high and low porosity sample were then designated for flow tests using each

solution. The selected solution was flowed through the cores to displace the formation water. Where possible, permeability as a function of injected volumes was monitored. The solution flowed through each sample was again displaced by formation water and permeability to formation water was determined.

Results of the various flow tests are presented on page three. Permeability was so low in some cases that only a limited amount of solution was flowed through each core. It was observed that in the high porosity core, permeability to the neutralized filtered raffinate was essentially the same as that to formation water. The low porosity sample had a permeability to the neutralized raffinate approximately one-half that to formation water.

The diluted raffinate plugged the high porosity sample resulting in a measurable decrease in permeability. Initially it improved the permeability of the low porosity core but eventually caused a slight reduction in permeability.

The hydrofluoric acid flow resulted in a slight increase in permeability. Final formation water permeability was slightly less than to acid.

The low porosity material had extremely low permeability and it is unlikely that it will be satisfactory for disposal. Even the high porosity zone had a much lower permeability than is desirable for disposal projects.

We appreciate this opportunity to assist you.

Very truly yours,

Core Laboratories, Inc.

Dare K. Keelan (EH)

Dare K. Keelan, Manager
Special Core Analysis

DKK:dl
7 cc. - Addressee

CORE LABORATORIES, INC.
Petroleum Reservoir Engineering
DALLAS, TEXAS

File SCAL-7048

Company Kerr-McGee Corporation
Formation
Number of Wells One
County Sequoyah
Field
State Oklahoma

Identification of Samples

Sample Number	Company	Well	Depth, Feet
1	Kerr-McGee Corporation	Sequoyah Waste Disposal No. 1	1456
2			1462
3			1456
4			2301
5			1471
6			3023

Lithological Description

Sample Number	Description
1	Dol, gry, v/fnly xln, sucrosic, many pp-1mm dia vugs, scattered med sd size qtz grns, lmy
2	Dol, gry, v/fnly xln, dns w/sucrosic stringers, some pp vugs, v/lmy, anhy nodules
3	Dol, white, v/fnly xln, dns, med sd stringers, some pp-1mm dia vugs, v/lmy, anhy nodules
4	Dol, gry, v/fnly xln, v/dns, v/lmy, some vugs 5-15mm dia w/cse secondary xls
5	Dol, gry, v/fnly xln, v/dns, lmy, anhy veins
6	Sd, white, fn-med grn, calc, v/well indurated

Liquid Permeability Data

Sample Number:	1	2	3	4	5	6
Porosity, Per Cent:	13.8	13.4	13.3	7.4	6.7	6.0
Air Permeability*, Md.:	0.27	2.4	0.29	0.04	0.03	0.29
Liquid Permeability*, Md.:	0.17	1.7	0.18	0.02	0.02	0.18
Permeability to Formation Water, Md.:	0.25	0.51	0.07	0.002	0.002	0.002
Permeability to Neutralized Raffinate						
0.5 Pore Volume Throughput:			0.07	0.001		
1.0 Pore Volume Throughput:			0.07	0.001		
5.0 Pore Volume Throughput:			0.07	0.001		
9.0 Pore Volume Throughput:			0.07			
Permeability to Diluted Raffinate						
0.5 Pore Volume Throughput:	0.08				0.004	
1.0 Pore Volume Throughput:	0.09				0.003	
2.0 Pore Volume Throughput:	0.09				0.002	
10 Pore Volume Throughput:	0.09					
Permeability to Hydrofluoric Acid						
0.5 Pore Volume Throughput:		0.50				0.03
1.0 Pore Volume Throughput:		0.57				0.03
2.0 Pore Volume Throughput:		0.56				0.03
20 Pore Volume Throughput:		0.54				
Permeability to Formation Water:	0.09	0.40	0.07	0.001	0.001	0.02

* Developed for sandstones and approximate value only.

Permeability and Porosity Data
(Samples not selected for further testing)

Sample Number	Depth, Feet	Air Permeability, Md.	Porosity, Per Cent
7	1453	<0.1	8.0
8	1453	<0.1	11.5
9	1455	<0.1	12.0
10	1455	<0.1	11.6
11	1456	<0.1	11.9
12	1458	<0.1	12.7
13	1459	0.3	8.6
14	1459	0.5	7.9
15	1462	5.0	14.7
16	1464	<0.1	8.4
17	1464	<0.1	10.2
18	1469	<0.1	7.1
19	1471	0.1	5.0
20	2294	<0.1	2.3
21	2302	<0.1	3.1
22	2303	12	11.5

ISSUANCE OF DRAFT PERMIT
NOTICE

On July 17, 1981, an application for an operating permit for an "other" industrial waste facility was submitted to the OSDH, Industrial Waste Division, by Kerr-McGee Nuclear Corporation, P. O. Box 25861, Oklahoma City, Oklahoma, 73125. The facility is to be located at the Kerr-McGee Nuclear Corporation's Sequoyah uranium hexafluoride (UF_6) facility, the location of which is described as: SE ¼, SW ¼, NE ¼, Section 21, Township 12 North, Range 21 East, Sequoyah County, Oklahoma.

The application was filed for the purpose of operating a non-hazardous waste storage well (OSDH Regulations, Chapter 9, category: "other" Industrial Waste Disposal) for disposition of Sequoyah Facility pretreated, liquid effluent (treated raffinate). Treated raffinate is a near neutral ph, ammonium nitrate solution. The treated raffinate will be injected through the waste storage well which penetrates into the Arbuckle formation to a total depth of approximately 3,122 feet. The operation of the waste storage well will provide for an integrated system of liquid effluent control at the Sequoyah UF_6 facility.

Additional information may be obtained from W. J. Shelley, Kerr-McGee Corporation, P. O. Box 25861, Oklahoma City, Oklahoma 73125, (405)270-2631, or from the Director of the Industrial Waste Division, OSDH, by calling (405)271-5338 or writing to the address listed below.

A draft permit has been prepared and is available from the Industrial Waste Division, Oklahoma State Department of Health, P. O. Box 53551, Oklahoma City, Oklahoma 73152. Any person wishing to do so may submit comments on the draft permit. All comments must be written and received at the Industrial Waste Division, Oklahoma State Department of Health, P. O. Box 53551, Oklahoma City, Oklahoma 73152, by the close of business _____.

(If a public meeting has been requested, the statement:) an informal public meeting for the presentation of written and oral views will be held (time, date and place to be determined by the Department.)

file

KERR-McGEE CORPORATION
KERR-McGEE CENTER • OKLAHOMA CITY, OKLAHOMA 73125

ENVIRONMENT AND HEALTH MANAGEMENT DIVISION

June 9, 1982

Okla. State Department of Health
Donald A. Hensch, Director
Industrial Waste Division
1000 Northeast 10th Street
P.O. Box 53551
Oklahoma City, OK 73152

Dear Mr. Hensch:

Please refer to your letter dated March 23, 1982 regarding the operation permit application (submitted July 17, 1981) for the Kerr-McGee Nuclear Sequoyah UF_6 facility "other industrial waste injection well."

Currently, we have completed the majority of items and are developing detailed responses to your letter. However, item 6, pg. 2 states that in accordance with 8.8.2, Rules & Regulations for Industrial Waste Management, the public notices required by regulation must be made and proof of publication submitted to the Department.

This regulation (8.8.2) was adopted February 9, 1982, subsequent to Kerr-McGee's submission of application to operate an "other industrial waste injection well" at the Sequoyah Facility. Since 8.8.2.1 states that notices must be provided "[u]pon submission of an application for permit...", and no retroactive provisions for such notice are provided in this regulation. Kerr-McGee feels that compliance with this regulation in a retroactive manner is not warranted nor is it mandated by law. Further, such retroactive compliance would be inconsistent with the Department's own guidelines for application review which states on pg. 1:

> "Critical evaluation...will be made...based upon compliance with all applicable State and Federal statutes, rules, and regulations governing such wells which are in effect at the time of application..."

Kerr-McGee, therefore, requests that public notice requirements not be included as a provision of permit approval. If you have questions related to this request, please call.

Very truly yours,

W. J. Shelley

W. J. Shelley, Vice-President
Nuclear Licensing & Regulation

WJS/pm

Oklahoma
State Department of Health

1000 Northeast 10th Street
Post Office Box 53551
Oklahoma City, Oklahoma 73152

Commissioner
JOAN K. LEAVITT, M.D.

June 23, 1982

W. J. Shelley, Vice President
Nuclear Licensing and Regulation
Kerr-McGee Corporation
Kerr-McGee Center
Ok. City, Ok. 73125

Dear Mr. Shelley:

Thank you for your letter of June 9, 1982. We are anxious to continue the permit review process for the Kerr-McGee Nuclear Sequoyah UF_6 facility injection well.

In regard to Regulation 8.8.2 of the Oklahoma Rules and Regulations for Industrial Waste Management, the Department recognizes that Kerr-McGee's application was submitted before the application went into effect. However, the Oklahoma Controlled Industrial Waste Disposal Act, as amended in 1981, requires the Department to hold a public meeting, if requested, to allow the public an opportunity to comment on all permit applications. The public meeting must be held before any permit can be issued. The statute, 63 O.S. 1981 § 1-2006, went into effect July 1, 1982. Compliance with Regulation 8.8.2 insures compliance with the statute. The public participation activities described in Chapter 8 of the Regulations are necessary for permit approval.

It is possible to reduce the amount of time necessary for public participation by assuming that a public meeting will be requested and publishing one public notice announcing the meeting, the draft permit and the comment period. We would be happy to work with you in constructing such a notice to ensure that it includes all of the required information.

I am looking forward to working with Kerr-McGee in the resolution of this permit application. Please call me at (405) 271-5338 if I may be of assistance.

Very truly yours,

Donald A. Hensch

Donald A. Hensch, P.E.
Director, Industrial Waste Division

DAH/HM/sf

Commissioner

JOAN K. LEAVITT, M.D.

Oklahoma
State Department of Health

1000 Northeast 10th Street
Post Office Box 53551
Oklahoma City, Oklahoma 73152

March 23, 1982

W.J. Shelley, Vice President
Nuclear Licensing and Regulation
Kerr-McGee Nuclear Corporation
Kerr-McGee Center
P.O. Box 25861
Oklahoma City, Oklahoma 73125

Dear Mr. Shelley:

The Industrial Waste Division has completed its evaluation of the operation permit application submitted July 20, 1981, for an "other industrial waste" injection well at Kerr-McGee's Sequoyah UF_6 facility. While the Division agrees with the basic contention that the formation at the site is capable of containing the proposed volume of waste at the proposed rates and pressures, all applicable State regulations must be complied with before a permit could be issued. The Division feels Kerr-McGee has not complied with the following requirements (reference the Rules and Regulations for Industrial Waste Management as amended and adopted by the State Board of Health effective February 9, 1982, copy enclosed).

1. Cement Bond Log-7F.4.1(e) - Depth of top and bottom of all cemented areas, verified by a cement bond log (CBL). Kerr-McGee did not submit a CBL in their application. Not only is a CBL necessary for compliance with State regulations, Division staff believe that the CBL would be an excellent mechanical integrity test. The injection well at the Sequoyah facility is a special case because it was constructed in 1969 and has not been used for waste disposal. Before a permit could be issued, the physical and technical suitability of the site (including the well) at the present time must be proven. The CBL would prove the integrity of the well in addition to satisfying Regulation 7F.4.1(e). Regardless of the method Kerr-McGee elects to use to prove the integrity of the well, the CBL is required by regulation.

2. Logs and Surveys - 7F4.3 - The following logs were not submitted with the application but are required by regulation. These logs were most likely done during well construction.
   A. An electric resistivity or induction log with an S.P. curve and resistivity curve.
   B. A porosity log with S.P. or gamma ray curve and borehole caliper survey, accompanied by micro-resistivity, interval transit time, compensated density, neutron or other curve developing similar information regarding porosity and potential faulting.
   C. Electro-magnetic thickness log and caliper log of the in-place casing.
   D. Bottom hole pressure test.

3. Tubing pressure test - 7E.8 - Tubing is to be tested at 150% of its maximum proposed operating pressure or 300 psi, whichever is greater, before operation. Proof of compliance must be submitted before a permit could be issued.

4. Monitoring Well - 7F5.5.1 - A minimum of one monitoring well, sufficient to provide monitoring of the lowest fresh water aquifer beneath the site, is required. Information submitted by Kerr-McGee December 22, 1981, indicates that saline ground water was contacted while drilling the injection well at approximately 400 feet. Existing monitoring wells do not appear to comply with this regulation. Additional information about the base of fresh water in the area of the injection well may be obtained from the Oklahoma Corporation Commission and may be of help in determining the depth to which a monitoring well must be drilled. Specifications for the location, construction and maintenance of monitoring wells must be approved by the Department prior to installation (Regulation 7F.5.5).

5. Compatibility - 7F4.2(c) - Is the waste to be injected compatible with the formation and formation fluid? The information on page 6 of the application does not provide adequate information about compatibility. Specific information about compatibility testing and methods should be provided. If at all possible, the actual formation fluid and waste should be used in these tests.

6. Public Participation - 8.8.2 - The public notices required by regulation must be made and proof of publication submitted to the Department.

7. Monitoring - 7.5 - Information supplied by Kerr-McGee is not adequate to determine if this regulation is applicable. If the injection well is not to have personnel on-site during actual injection operations, monitoring equipment as follows must be provided.
   A. An alarm system to notify personnel and shut off all equipment and valves if a malfunction or possible failure occurs.

8. A plan for plugging and abandonment of the injection well is to be developed by Kerr-McGee and would become a condition of any permit issued by the State Health Department.

The Industrial Waste Division will be happy to provide any assistance necessary to aid Kerr-McGee in achieving compliance with the above-referenced State regulations. We look forward to working with you in the final processing of this permit application. Please call me at (405) 271-5338 if you have any questions or if I may be of assistance.

Very truly yours,

Donald A. Hensch

Donald A. Hensch, P.E.
Director, Industrial Waste Division

DAH/HM/ml

Enclosure

KERR-McGEE CORPORATION
KERR-McGEE CENTER • OKLAHOMA CITY, OKLAHOMA 73125

ENVIRONMENT AND HEALTH MANAGEMENT DIVISION

CERTIFIED MAIL RETURN RECEIPT REQUESTED

February 1, 1982

Mr. Donald A. Hensch, P.E.
Director Industrial Waste Division
Oklahoma State Department of Health
P.O. Box 53551
Oklahoma City, Oklahoma 73125

Re: Application for Non-hazardous Industrial Waste Storage, Sequoyah UF_6 Facility.

Dear Mr. Hensch:

Please refer to my letter dated January 18, 1982 which transmitted preliminary construction design for pumps and piping at the Kerr-McGee Nuclear Sequoyah Facility injection well (Response to question #20 in your July 17, 1981 letter).

Attached find final design for the pumps and piping layout (drawing No. 290-M-2012 Rev. 2) and a detailed flow diagram of instrument locations (Drawing No. 290-M-1012).

This completes response to your questions related to this application, and your timely review of this information is appreciated.

Very truly yours,

William R. Dooley for

W. J. Shelley, Vice President
Nuclear Licensing & Regulation

ALD/ba

enclosure

DOCUMENT/ PAGE PULLED

ANO. 8209130328

NO. OF PAGES 2

REASON

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KERR-McGEE CORPORATION
KERR-McGEE CENTER • OKLAHOMA CITY, OKLAHOMA 73125

ENVIRONMENT AND HEALTH MANAGEMENT DIVISION

January 18, 1982

CERTIFIED MAIL, RETURN RECEIPT REQUESTED

Mr. Donald A. Hensch, P.E.
Director, Industrial Waste Division
Oklahoma State Department of Health
Post Office Box 53551
Oklahoma City, OK 73125

RE: Application for Nonhazardous Industrial Waste Storage Well, Sequoyah UF_6 Facility

Dear Mr. Hensch:

Enclosed are answers to the remaining questions contained in your November 30, 1981 letter regarding the Kerr-McGee Nuclear Corporation application to operate a waste storage well at the Sequoyah UF_6 Facility (submitted July 17, 1981).

We have calculated the cumulative, expected aquifer response based on five planned injections (60-day injection period) conducted over a period of five years. This schedule of planned injections corresponds to the five-year period for permits issued by your Division. However, we intend to supply your division with information and monitoring results obtained from the initial injection; subsequent injections will be based on evaluation of results obtained from this initial injection.

Your timely review of this information will be appreciated.

Very truly yours,

A. J. Shelley, Vice President
Nuclear Licensing and Regulation

ALD/bec
Enclosure

Response to State Department of Health Questions
Regarding Sequoyah Waste Storage Well
Don Hensch's Letter of November 30, 1981, to W. J. Shelley

Part I, Page 1, Question 8
Part II, Page 2, Questions 1, 2, 7 and 11
Part III, Page 3, Questions 1, 2, 3 and 4

Simulation of Aquifer Responses to Injection

Response: Head buildup at any point in a fully confined aquifer as a result of injection into a single, completely penetrating well was computed based on five injection periods (60-day duration) over a five-year period. A program was modified after Warner and Yow (1979). Injection rate, duration and timing are shown on the enclosed diagram (Figure M-1). Pressure head values were computed for two times, one immediately after an initial 60-day injection period (60 gpm) and another immediately after a fifth injection period of the same duration. Four 305-day recovery periods (no injections) were considered between the first and fifth injections.

Aquifer coefficients were provided by data and results from H. J. Gruy and Associates Inc. (Engineering Study of the Arbuckle Comm., to Kerr-McGee Waste Storage Well, May 1972). Five permeable zones delineated in that report were evaluated; and by using a weighted average, aquifer transmissivity was computed to be 6,525 gpd/foot. A storage coefficient was computed to be $1.0 \times 10^{-6} \times 181$ feet of thickness, or 1.81×10^{-4} for the S value. (Lohman 1972)

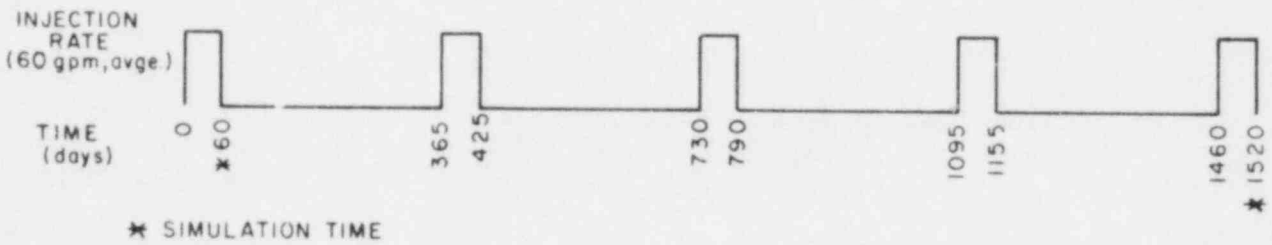
From a regional structure map contoured on the top of the Arbuckle Formation, two impermeable hydraulic boundaries were constructed to simulate the effects of faults located to the northwest and southeast of the injection well. To facilitate use of image wells in the computations, these boundaries were assumed to be linear and parallel as shown on the enclosed maps.

Results of head buildup for two periods with and without boundaries are shown in four maps (M-2 through M-5). Maximum increased head at the well boundary was computed to be less than 25 feet following the fifth injection period and considering fault boundaries. At the end of each recovery period, head buildup will decay to within a few tenths of a foot of static conditions in the vicinity of the well.

References: Lohman, S. W., Ground-Water Hydraulics, Geol Sur Prof., Paper 708, 1972
Warner, D. L. and You, G. M., Ground Water, 1979, Volume 17, Number 6

Question 20: What are the main site features?

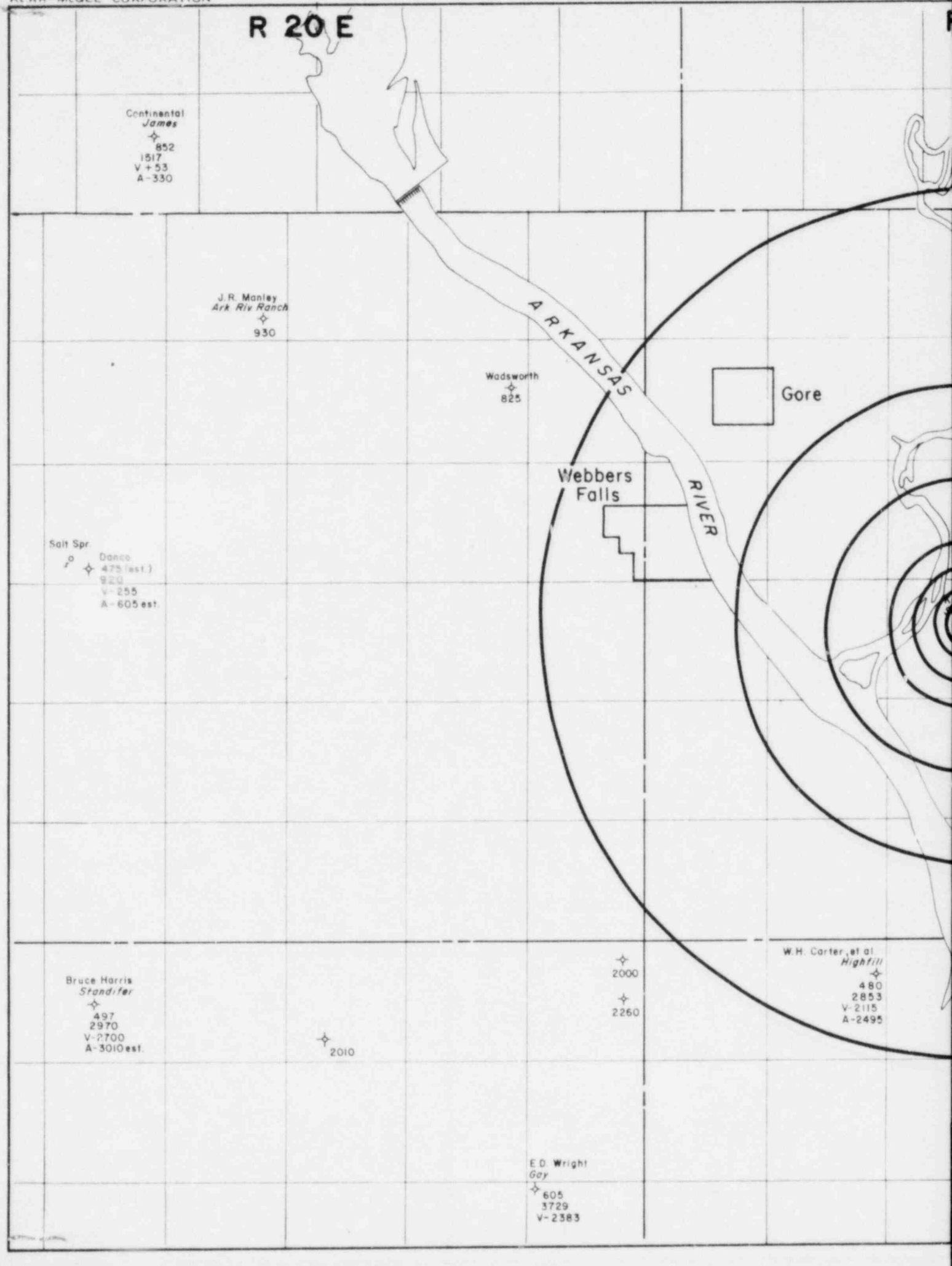
Response: The attached drawing (Number 290-M-2012) provides a preliminary construction design for pumps and piping at the injection well. A schematic of monitoring equipment was previously supplied in the application (Figure 2 page 9 and Table 1 page 10). Final design drawings are currently under development and will be forwarded when available (in approximately 10 days). However, main site features are not expected to change substantially.

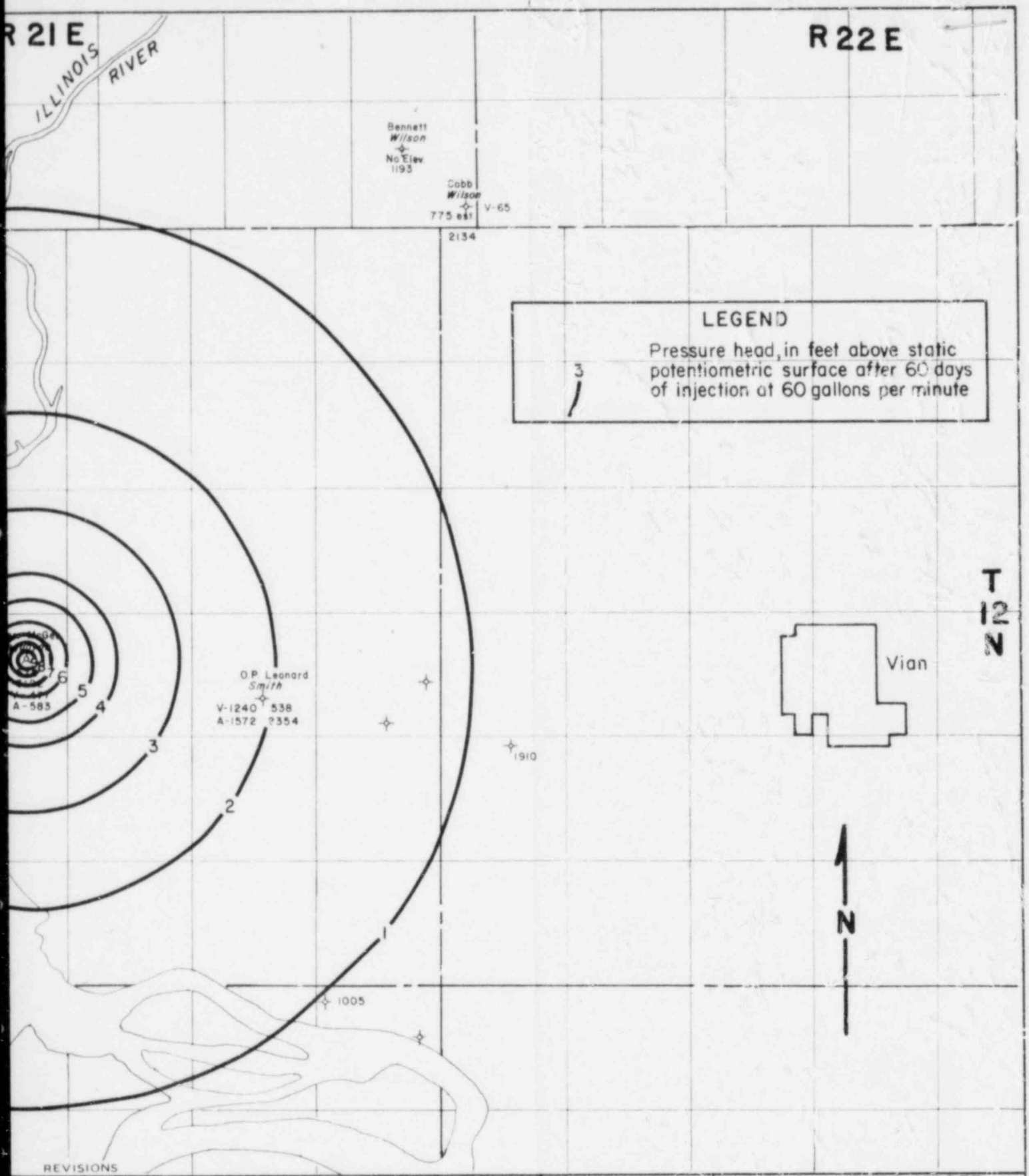


PERIODS OF INJECTION-RECOVERY

FIGURE NO. M-1

KERR-McGEE CORPORATION





REVISIONS

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CONE OF IMPRESSION AFTER 60 DAYS

(Assuming no hydrologic boundaries)

SEQUOYAH FACILITY
GORE, OKLA.

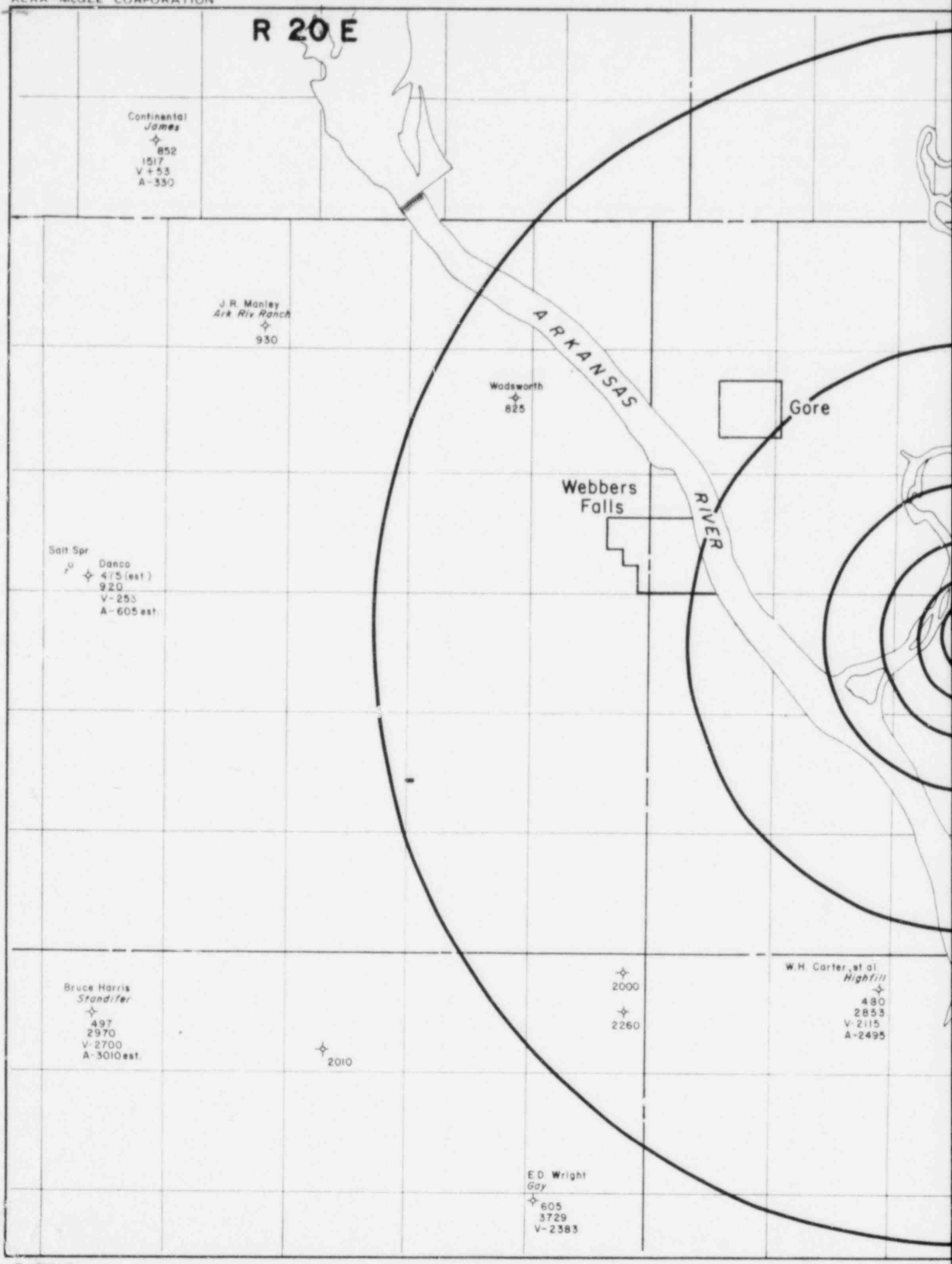
SCALE 1" = One Mile		
DRAWN BY H. F	DATE 1-15-82	
CHECKED BY	DATE	
APPROVED BY	DATE	

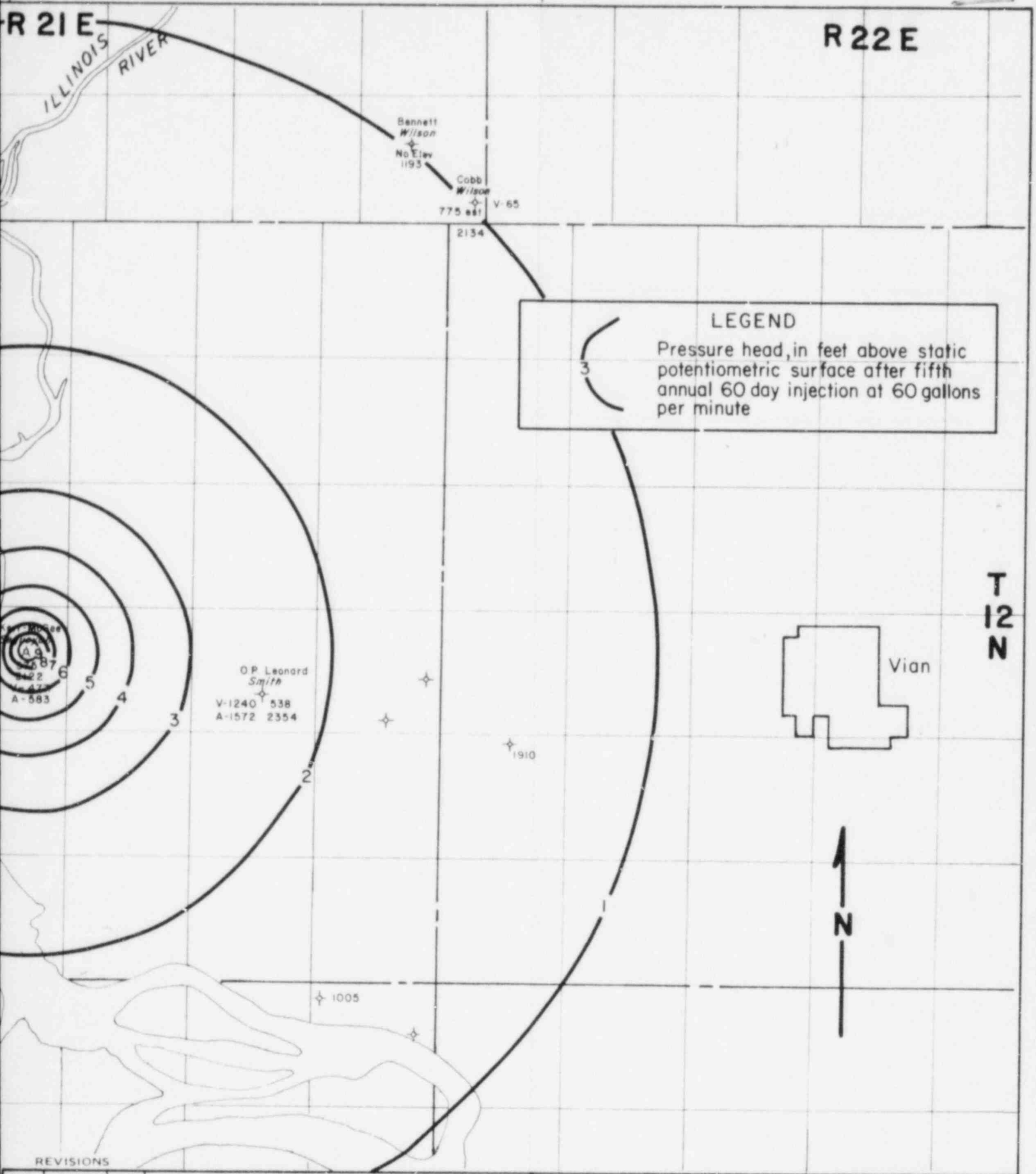
KERR-McGEE
DIVISION Envir. & H.M./N.L.R.
LOCATION OKC., OK.

DRAWING NUMBER
FIGURE NO. M-2

REV.

KERR-McGEE CORPORATION





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CONE OF IMPRESSION
FIFTH ANNUAL INJECTION
(Assuming no hydrologic boundaries)
SEQUOYAH FACILITY
GORE, OKLA.

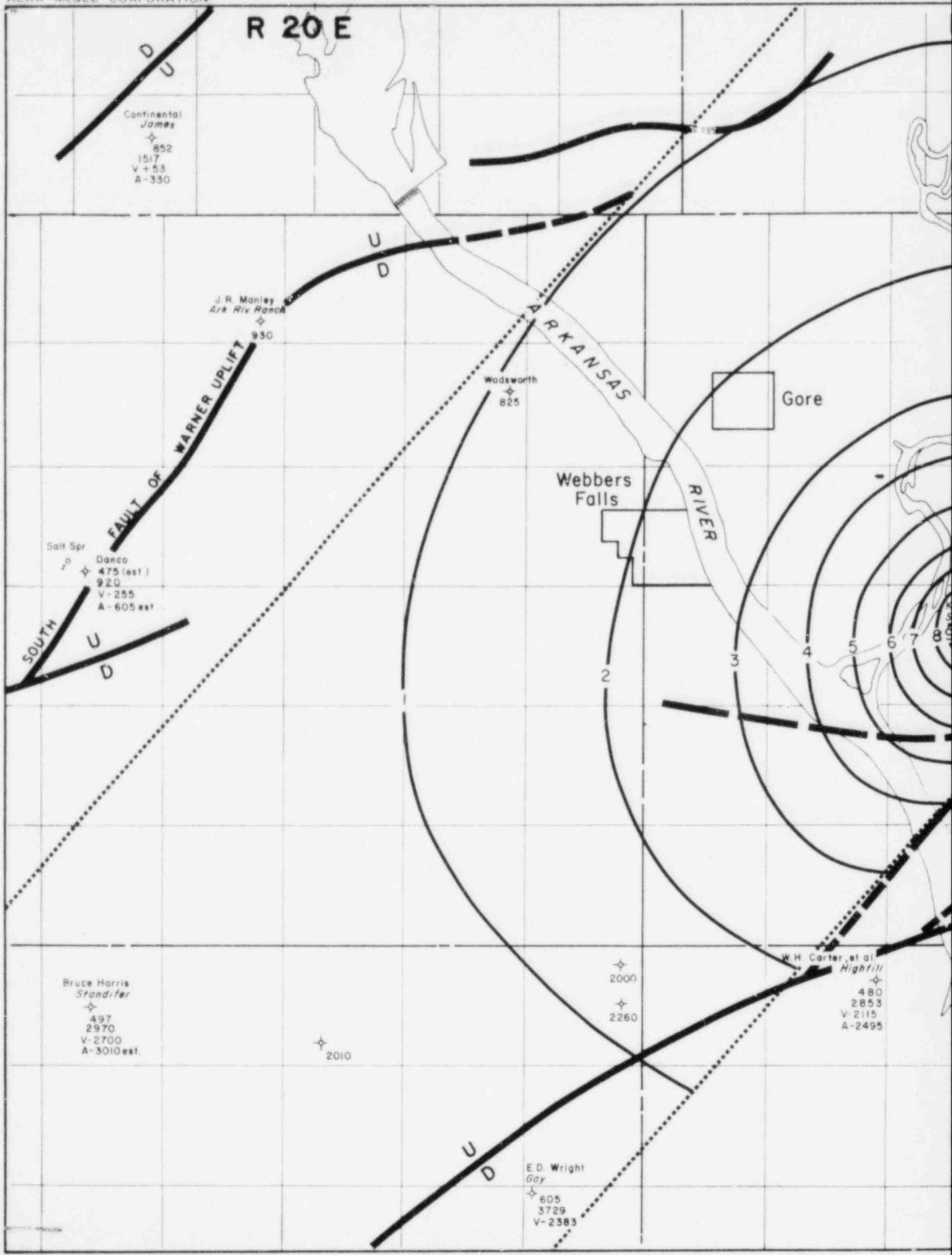
SCALE	1" = One Mile
DRAWN BY	H. F
DATE	1-15-82
CHECKED BY	
DATE	
APPROVED BY	
DATE	

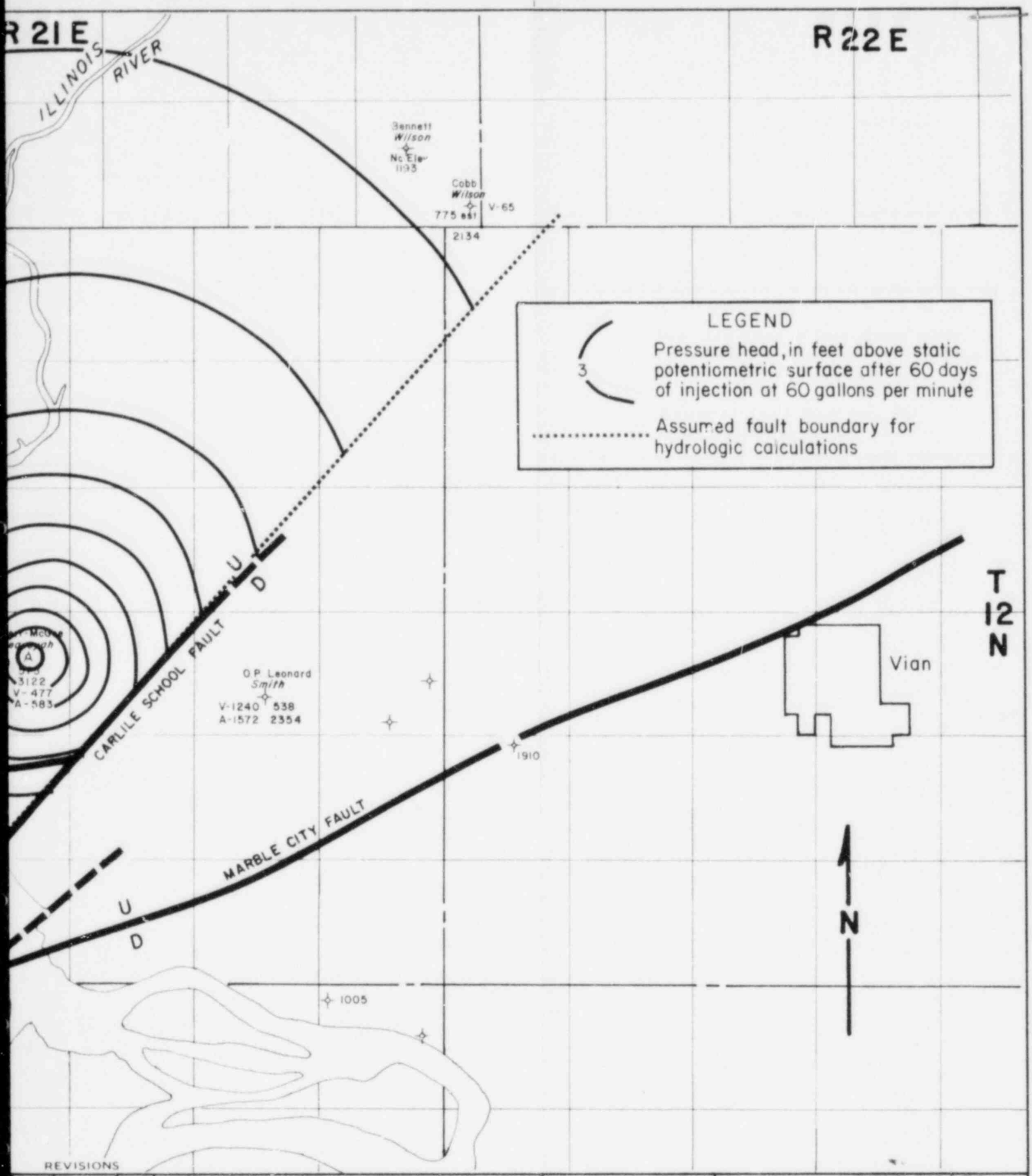
KERR-McGEE
DIVISION Envir. & H.M./N.L.R.
LOCATION OKC., OK.

DRAWING NUMBER
FIGURE NO. M-3

REV.

KERR-McGEE CORPORATION





REVISIONS

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CONE OF IMPRESSION
AFTER 60 DAYS
(Assuming hydrologic boundaries)
SEQUOYAH FACILITY
GORE, OKLA.

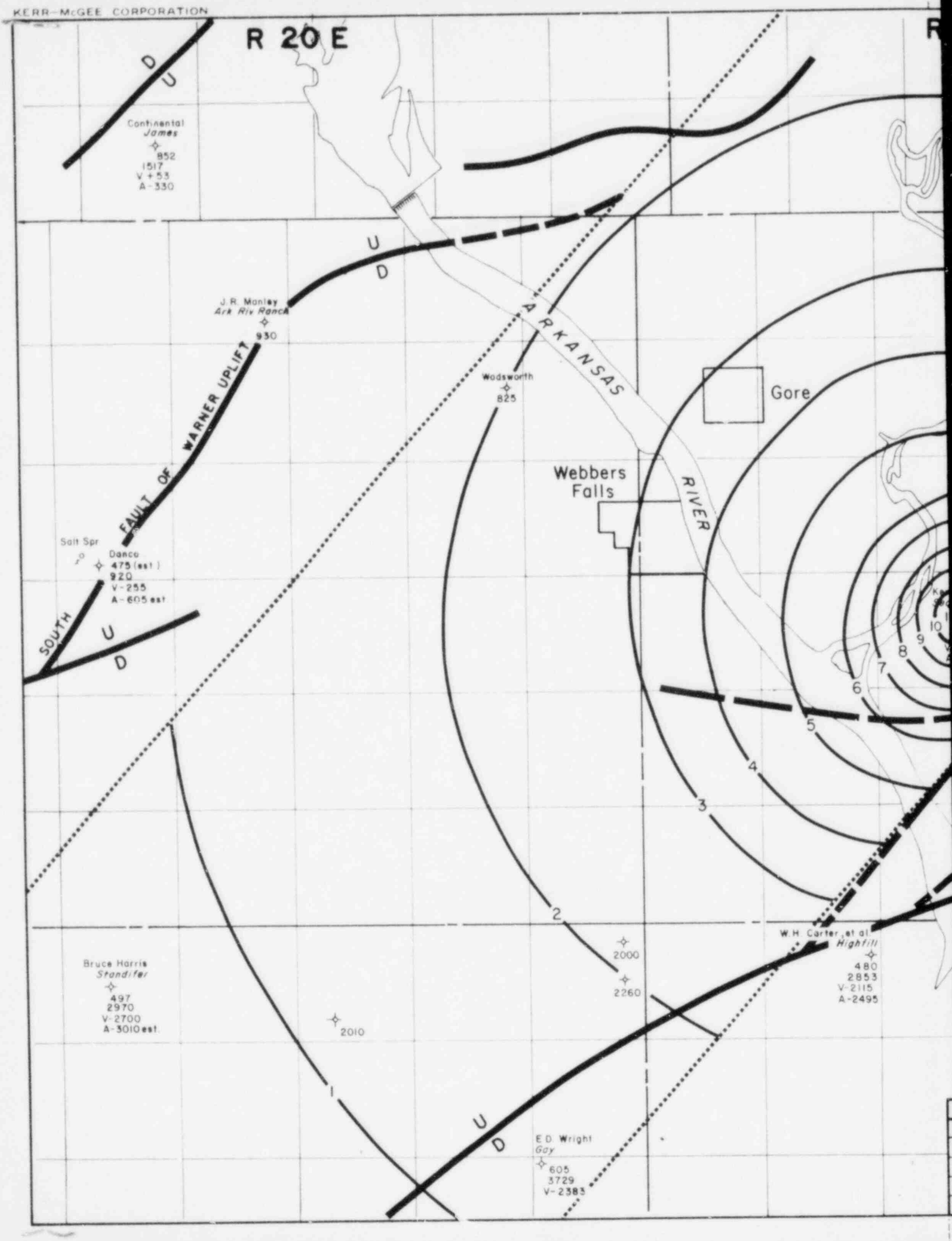
SCALE	1" = One Mile
DRAWN BY H.F.	DATE 1-15-82
CHECKED BY	DATE
APPROVED BY	DATE

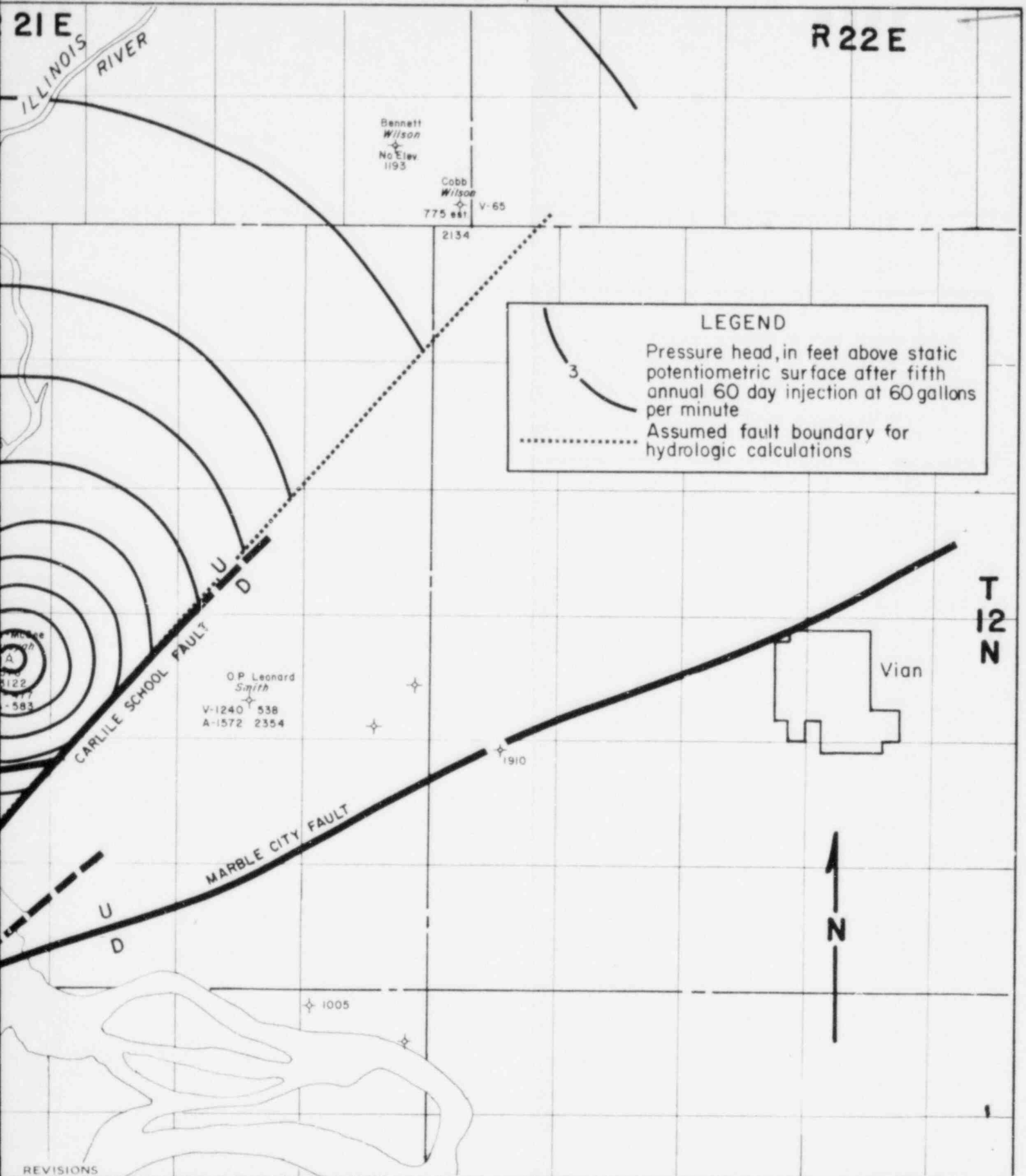
KERR-McGEE
DIVISION Envir. & H.M./N.L.R.
LOCATION OKC., OK.

DRAWING NUMBER
FIGURE NO. M-4

REV.

KERR-McGEE CORPORATION





REVISIONS

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CONE OF IMPRESSION
FIFTH ANNUAL INJECTION
(Assuming hydrologic boundaries)
SEQUOYAH FACILITY
GORE, OKLA.

SCALE	1" = One Mile
DRAWN BY	H. F
DATE	1-15-82
CHECKED BY	
DATE	
APPROVED BY	
DATE	

KERR-McGEE
DIVISION Envir. & H.M/N.L.R.
LOCATION OKC., OK.

DRAWING NUMBER
FIGURE NO. M-5

REV.

KERR-McGEE CORPORATION
KERR-McGEE CENTER • OKLAHOMA CITY, OKLAHOMA 73125

ENVIRONMENT AND HEALTH MANAGEMENT DIVISION

CERTIFIED MAIL RETURN RECEIPT REQUESTED

December 22, 1981

Mr. Donald A. Hensch, P.E.
Director Industrial Waste Division
Oklahoma State Department of Health
P. O. Box 53551
Oklahoma City, Oklahoma 73125

RE: Application for Non-Hazardous Industrial Waste Storage Well-
Sequoyah UF_6 Facility

Dear Mr. Hensch:

Attached find resporses to several questions contained in your November 30, 1981 letter regarding the Kerr-McGee Nuclear Corporation Application to Operate a Waste Storage Well at the Sequoyah UF_6 facility near Gore, Oklahoma (submitted July 17, 1981). Responses to remaining questions are currently being developed and will be forwarded in the near future.

It is requested that future review of this application be conducted in accordance with the existing Chapter 16.0 Other Industrial Waste Disposal of the Rules and Regulations for Industrial Waste Management of the Board of Health. The treated raffinate to be injected is not classified as controlled industrial waste under these regulations.

The requirements for testing of tubing and a cement bond log are considered to be unnecessary to evaluate the integrity of this injection well and further, will result in damage to the PVC coated tubing. Due to the method of construction employed for the waste storage well, adequate testing for integrity can be accomplished by pressure testing (to 300 p.s.i.) the annulus.

It should also be recognized that this waste storage well was originally constructed to handle injection of raw raffinates containing approximately 1 molar nitric acid, and therefore, the well design and construction parameters were more rigorous than those required for the injection of treated raffinates as is currently planned.

In order to ensure continuity of operations and treatment of waste materials at the Sequoyah facility, your expeditious review of this application is appreciated.

Very truly yours,

W. J. Shelley

W. J. Shelley, Vice-President
Nuclear Licensing & Regulation

two copies
ALD/ba

Response to State Department of Health Questions
Regarding the Sequoyah Waste Storage
(letter November 30, 1981 Don Hensch to W. J. Shelley)

Part I - page 1 and 2

Question 1: The thickness of the Arbuckle at the site.

Response: The thickness of the Arbuckle information at the injection site is given on page 5 of the Permit Application as 1,765 feet.

Question 2: A structural map of the Arbuckle.

Response: The attached Figure 1 provides a structural map contoured on the top of the Arbuckle formation in this vicinity and also provides an inventory of oil and gas wells, in the area.

Question 3: All faults and their extents.

Response: Information provided by well logs, aerial photos and field inspection has indicated the presence of two faults that are located within 5 miles of the well. The faults are approximately parallel and strike northeast for a distance of approximately 15 miles. An apparent throw as great as 1300 feet occurs along these normal faults which resulted from tensional forces developed by the emergence of the Ozark geanticline and subsidence of the Arkoma Basin. This relatively gentle tectonic activity ended by Middle De Moinesian time and the region has been structurally stable since the Middle Pennsylvania Period or approximately 300 million years (Huffman et al, Oklahoma Geol. Sur Bul. #77).

Question 4: All vertical and horizontal fractures.

Response: Formation fractures were observed in hand specimen and thin section from cores at the well. Recorded depths and general descriptions are listed below.

Depth (ft)	Lithology	Description
1050-60	limestone	fracture fills
1500-1530	dolomite	fracture fills
1458-1477	dolomite	some fracture porosity reduced by dolomite, calcite, and gypsum
1913-1925	dolomite	few fractures, healed with calcite
2294-2312	dolomite	fractures, some partially cemented

Primary porosity was comprised on intercrystalline, channel, and vug porosity. Fracture porosity did not appear to be vertically extensive and is confined by several impermeable strata in the Arbuckle formation and overlying formations.

Question 5: Fresh water contacted during drilling process

Response: The presence of well casing and formation gas at shallow depths makes the determination of the depth to the base of fresh water from electric logs difficult. Results provided by an electric log indicated that saline groundwater appeared to be contacted at approximately 400 feet and this contact may be gradation for several hundred feet.

Questions 6 and 7: Oil and gas well producing formations in the area.

Response: Figure 1 provides an inventory of all oil and gas wells located within the area. No oil or gas producing formations exist in the vicinity of the injection well.

Question 9: Lubrication of faults

Response: It is planned that seismic monitoring instruments will be installed and monitoring will be conducted immediately prior to and during the proposed injection of treated raffinate solutions. In this way, fault conditions during injection will be monitored.

Question 10: Specific disposal period (life expectancy of well).

Response: Based upon a review of disposal plans by our consultant, H. Van Poolen, current plans are for Kerr-McGee Nuclear to inject a total of 5×10^6 gallons of treated raffinate for a period of 60 days at a rate of approximately 60 gallons per minute into the No. 1 waste storage well at Sequoyah. This injection program will be conducted annually for 5 years to correspond to the permit life.

Question 11: The number of monitor wells and their location.

Response: Over forty shallow monitoring wells have been installed in the Atoka formation, and these wells are located throughout the facility property. Monitor well number 2307 was installed in the Carlisle School fault zone approximately 500 feet from the proposed disposal point. As indicated in the application (p. 12), monitoring of shallow wells will be continued to confirm that the deep well reservoir containing fluid and injected wastes are being confined at the lower levels as planned.

Question 12: Waste yield and accumulation.

Response: Current treated raffinate production at the Sequoyah Facility is approximately 5.6×10^6 gallons per year. This material is currently stored in lined waste retention ponds and distributed on land as fertilizer in accordance with USNRC license amendments.

Question 13: Request copies of all data submitted to W.A.C.O. It is believed that a construction permit application has been submitted to the Water Resources Board or the Corporation Commission.

Response: See Figure 1. The application for Amendment to License No. Sub 1010 Docket No. 40-8027 to permit subsurface storage at the Sequoyah facility was reviewed by the O.W.R.B. and their review letter dated October 3, 1972 is included in the introduction of the permit application.

Question 14: List of materials used for tracing radioactivity and procedures followed.

Response: Exhibit C, Item 1-1, of the Permit Application outlines radioactive materials injected and methodology and procedures followed in this test.

Question 15: The actual disposal zone.

Response: Page 4 of the Permit Application identifies 7 - inch casing from 498 feet to 1,619 feet (282 feet below the top of the Arbuckle Dolomite). The hole is open below 1619 feet in the Arbuckle group to a total depth of 3122 feet penetrating granite. This zone (below 1619 feet) in the Arbuckle group represents the actual disposal zone.

Question 16: Request recent data indicated in application but not included in same.

Response: The application provided the most recent data collected on the injection well. Further data will be obtained just prior to and during the injection program under the direction of our consultant (K. Van Poollen).

Question 17: Constituency of test injection fluids.

Response: Analysis of test injection fluids is provided on Table 3 (pg. 15) of the Permit Application for the average composition of treated raffinate materials produced during 1980. An expanded list of parameters has been included in the attached table.

Question 18: Pressure alarms.

Response: As indicated on Figure 2 (schematic) and Table 1, pressure alarms (high and low) will be installed to monitor injection pressures.

Question 19: Response plans relative to waste management.

Response: Currently, liquid waste storage at the Sequoyh Facility is accomplished in lined retention ponds located south of the facility. It is expected that if a shutdown of the injection well system is required, liquid wastes would be transferred to these lined retention ponds as is the current practice authorized under the Sequoyah facility Source Material License.

Question 3: Is this a disposal or an experimental application?

Response: Kerr-McGee proposes to inject approximately 5×10^6 gallons of treated raffinate into the No. 1 waste storage well over a period of approximately 60 days. This injection program will be conducted annually for 5 years to correspond to the permit life. As such, this Permit Application is for a 5-year injection period and will include evaluation of the Arbuckle formation's response.

Question 4: What will the effect of acidization be especially on the calcium dolomite and other components of the formation and the cementing materials within these fractures and faults?

Response: The proposed injection fluid (treated raffinate) is essentially neutral (ph 7.65 - 1980 average), and therefore, is not expected to adversely affect or be reactive with the Arbuckle formation.

Question 5: What have they done since W.A.C.O's studies?

Response: The well was shut in following these studies. Recently the well was opened and pressure and temperature profiles conducted in preparation for test injection.

Question 6: Is the well bore the only communication throughout the depth?

Response: Yes.

Question 8 and 9: What other radioactive waste are to be injected into the same structure? What is the half-life of these radioactive elements or compounds.

Response: No other radioactive wastes are to be injected during this proposed test. Ra-226 has a half life of 1622 years; Uranium-238 4.5×10^9 years; and Th-230 8×10^4 years. For comparison, the Arbuckle formation water contains 1400 pCi/l Ra-226 versus 1.07 pCi/l (Ra-226) in treated Raffinates (average 1980).

Question 10: What was actually injected by WACO? What is the final constitution of the raffinate proposed for injection?

Response: Fresh water was injected by WACO during testing. (See Exhbit C). The constitution of treated raffinate proposed for injection is provided in Table 3 of the application.

Table 3a. Treated Raffinate Analysis-Additional Parameters

Parameter	1973-1975 Analysis	Average 1980
mg/ℓ		
Ag	<.001	
As	.54	
Ba	3.0	
B	23.	
Cd	<.001	
Co	.5	
Cr	.04	
Cu	50.	5.4
Fe	1.	
Hg	<.001	
Mg	310.	
Mo	260.	9.65
Ni	16.	12.0
Pb	.004	
Se	<.005	
V	.8	
Zn	1.4	
U	.80	.045
pCi/ℓ		
Ra-226	.55	1.07
Th-230	.89	.065
gms/ℓ		
Total Nitrogen, (NH_3, NO_3)	28.7	36.5

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ANO. 8809130328

NO. OF PAGES 1

REASON

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Oklahoma
State Department of Health

1000 Northeast 10th Street
Post Office Box 53551
Oklahoma City, Oklahoma 73152

Commissioner
JOAN K. LEAVITT, M.D.

November 30, 1981

Mr. W.J. Shelley, Vice President
Nuclear Licensing and Regulation
Kerr-McGee Corporation
Kerr-McGee Center
Oklahoma City, Oklahoma 73125

Dear Mr. Shelley:

On July 20, 1981, we received in this office an application for a Controlled Industrial Waste Disposal Site Operation Permit, specifically for an Industrial Waste Injection Well at your Sequoyah UF_6 facility near Gore, Oklahoma. This application has now been reviewed by the staff of the Industrial Waste Division. Taking the application at face value the possibility of granting an operating permit appears possible; however, there are several areas of concern, which we feel will require additional information for a complete evaluation of the physical and technical suitability of this project as relates to the issuance of an operating permit.

In the opinion of the staff the application did not address or contain adequate information on the following:

1) The thickness of the Arbuckle at the site

2) A structural map of the Arbuckle

3) All faults and their extents

4) All vertical and horizontal fractures

5) Fresh water contacted during drilling process

6) Oil and gas producing formations in the area

7) Oil and gas well inventory and status of all wells within a two mile radius of site

8) Pressure propagation from disposal well

9) Lubrication of faults

10) Specific disposal period (life expectancy of well)

11) The number of monitoring wells and their location

12) Waste yield and accumulation

13) The department requests a copy of all data submitted to W.A.C.O.. It is believed that a construction permit application has been submitted to the Water Resources Board or the Corporation Commission.

14) The department requests a list of materials used for tracing the radioactivity and the procedures followed.

15) The actual disposal zone

16) The department requests the recent data indicated in your application but was not included in same

17) Constituency of test injection fluids

18) Pressure alarms

19) Response plans relative to waste management

20) What are the main site features

Although some of the following questions have been covered, this is a condensed summary of questions raised by the staff.

1) Why was the "model" developed for a five year period? Is that the disposal duration? Where will the pressure propagation curves be in ten years?

2) Where is the pressure boundary?

3) Is this a disposal or experimental permit application?

4) What will the effect of acidization be especially on the calcium, dolomite, and other components of the formation and the cementing materials within these fractures and faults?

5) What have they done since W.A.C.O.'s studies?

6) Is the well bore the only communication throughout the depth?

7) How were the propagation lines established?

8) What other radioactive wastes are to be injected into the same structure?

9) What is the half-life of these radioactive elements or compounds?

10) What was actually injected by W.A.C.O.? What is the final constitution of the raffinate proposed for injection?

11) What is the relevance of the model? What was its sensitivity? Where is the base data?

From the information and data presented in the application, the following conclusions, which are in variance from those given are made:

1) Calculations made by use of the lowest, average and highest percentages of porosity do not show the same reservoir volumes or extents of lateral migration.

2) It is believed that there is vertical communication between the disposal layers (zones).

3) The apparent distance from the well to the fault on the south side is about 0.68 of a mile. The fault(s) north of the site are not shown on map.

4) The proposed disposal point is surrounded by faults on the south and north. This gives exposure of greater than 120°.

Based on the information submitted in your application the department has concluded that your application is incomplete and therefore is returning your application.

We would welcome the opportunity to discuss any and all aspects of this project and your application at anytime. Please feel free to contact either myself or anyone on my staff concerned with this project at anytime.

Very truly yours,

Donald A. Hensch

Donald A. Hensch, P.E.
Director, Industrial Waste Division

DAH:RH:ml

KERR-McGEE CORPORATION
KERR-McGEE CENTER • OKLAHOMA CITY, OKLAHOMA 73125

ENVIRONMENT AND HEALTH MANAGEMENT DIVISION

July 17, 1981

CERTIFIED MAIL - RETURN RECEIPT REQUESTED

Mr. H. A. Caves, Chief
Industrial and Solid Waste Service
Oklahoma State Health Department
P. O. Box 53551
Oklahoma City, OK 73152

Dear Mr. Caves:

Attached find Kerr-McGee Nuclear Corporation's application for a permit to operate a waste storage well at the Sequoyah UF_6 facility near Gore, Oklahoma.

The Sequoyah facility operates under Source Material License SUB-1010 under authority of the US Nuclear Regulatory Commission. Beginning in 1969, Kerr-McGee Nuclear Corporation constructed, tested, and evaluated the use of the No. 1 waste storage well for disposition of Sequoyah facility liquid wastes. The application for amendment to License No. SUB-1010 to permit subsurface storage was also reviewed by the Oklahoma Water Resources Board (see attached letter dated October 3, 1972, Forrest Nelson to L.M. Muntzing). However, authorization to use the waste storage well was subsequently denied by AEC in 1973 due largely to the fact that appropriate standards for such wells did not exist.

Since that time, enhanced plant effluent control techniques and methods have been developed and implemented at the Sequoyah facility to: (1) reduce the volume of liquid plant effluents, (2) treat remaining process streams to reduce radiological and non-radiological components, (3) develop alternative disposal methods and, (4) improve the surface impoundment systems currently in use for treated raffinate storage.

As a result of this continuing effort to integrate the effluent control systems at the Sequoyah facility, Kerr-McGee Nuclear Corporation proposes to complete the development and testing of the No. 1 waste storage well and accordingly, herein submits information required under the "Rules and Regulations for Industrial Waste Management".

Your early consideration of this permit application is requested and if you require further information, please contact me.

Sincerely,

W. J. Shelley

W. J. Shelley, Vice President
Nuclear Licensing and Regulation

WJS/pls

xc: Don Hensch
Robert Craig

Attachment

APPLICATION

CONTROLLED INDUSTRIAL WASTE DISPOSAL SITE OR PROCESSING FACILITY

OPERATION PERMIT (Temporary)

TO: Industrial & Solid Waste Division
Oklahoma State Department of Health
Oklahoma City, Oklahoma

Date July 17, 1981

Kerr-McGee Nuclear Corporation proposes the operation and
(Name of Applicant)

maintenance of No. 1 Sequoyah Waste Storage Well
(Name of controlled industrial waste disposal site or processing facility)

located at 3094 feet m the south line, 1482 feet from the east line, Section 21,
(legal descri... on to nearest 10 acres or portion thereof including metes and bounds)

12N R21E, Sequoyah County, Oklahoma

and hereby makes application for a permit to operate and maintain a controlled industrial waste disposal site or processing facility as required by the Oklahoma Controlled Industrial Waste Disposal Act, Title 63, O.S. 1976, Sections 2751-2765 and rules and regulations pursuant thereto.

It is proposed to start operating this site or facility on or about September, 1981.
(date)

Construction Permit Number N/A Date Issued N/A

REMARKS: The Sequoyah UF_6 facility operates under US Nuclear Regulatory Commission Source Material License SUB-1010. (See attachments).

Signature W. J. Shelley W. J. Shelley Title Vice President, Nuclear Licensing & Regulation

Address Kerr-McGee Center P. O. Box 25861 Oklahoma City, Oklahoma 73125
(Zip code)

Application and plans and specifications submitted in quadruplicate.

DO NOT USE THIS SPACE - OSDH USE ONLY

OKLAHOMA WATER RESOURCES BOARD
DIALEX BUILDING • 2241 N.W. 40TH STREET • OKLAHOMA CITY • OKLAHOMA • 73112

October 3, 1972

Mr. L. M. Muntzing
Director of Regulation
United States Atomic Energy Commission
Washington, D. C. 20545

Re: Application for Amendment to License
No. SUB-1010, Docket No. 40-8027, to
Permit Subsurface Storage of Certain
Liquids at Kerr-McGee's Sequoyah Facility.

Dear Mr. Muntzing:

We at the Oklahoma Water Resources Board have reviewed the above referenced application. At our request the application has also been reviewed by the Oklahoma Geological Survey.

After a thorough examination of all factors relating to the Kerr-McGee Sequoyah disposal well, we have found sufficient information to support the application.

Sincerely,

Forrest Nelson
Executive Director

FN:DM:mt
cc: George B. Parks

KERR-McGEE NUCLEAR CORPORATION
SEQUOYAH UF_6 FACILITY NO. 1 WASTE STORAGE WELL
SEQUOYAH COUNTY, OKLAHOMA

INTRODUCTION

The Atomic Energy Commission (AEC) issued a Source Material License SUB-1010 on February 20, 1970 authorizing operation of a conversion plant (Kerr-McGee Nuclear Sequoyah Facility) for processing uranium ore concentrates (yellowcake) to produce purified Uranium Hexafluoride (UF_6). The initial step of the conversion process is dissolution of yellowcake, containing approximately 95% uranium oxide (U_3O_8), in nitric acid. Uranium is separated from the impurities present in the yellowcake in a solvent extraction system. The impurities rejected by the solvent extraction system are contained in an aqueous 6% nitric acid solution. This solution (raffinate) is neutralized with ammonia to produce an ammonium nitrate solution. While the initial design of the facility contemplated the discharge of raffinate in a deep disposal well, such disposal was not permitted when License SUB-1010 was issued. As a result, surface holding ponds have been constructed to contain the raffinate.

Beginning in 1972, laboratory testing was conducted to further treat the raffinate to eliminate radionuclide content of the solution. It was shown that radioactivity could be sharply reduced by addition of a soluble barium salt, either barium nitrate or barium chloride. Barium treatment resulted in the removal of radium with the precipitate of barium sulfate. The resultant by-product ammonium nitrate solution was considered to be a valuable material which would be suitable for use as a commercial fertilizing compound. A program of land application of treated by-product raffinate as fertilizer was

initiated in 1973 and has continued as authorized by the United States Nuclear Regulatory Commission (USNRC) license amendments.

Surface impoundments and land application represent the current disposal techniques employed at the Sequoyah facility. Both of these disposal methods require a considerable operating cost and surface land area.

As an alternative to existing methods, Kerr-McGee Nuclear proposes to utilize the No. 1 Sequoyah waste storage well for disposal of treated raffinate at the Sequoyah facility. Beginning September 1, 1981, Kerr-McGee Nuclear proposes to inject 5×10^6 gallons of treated raffinate (30 days of 125 gpm) into the No. 1 waste storage well. Additional tests will be completed on the storage well to further determine disposal zone characteristics. The location of this storage well in relation to other plant facilities is provided in the site plan and area map (attached).

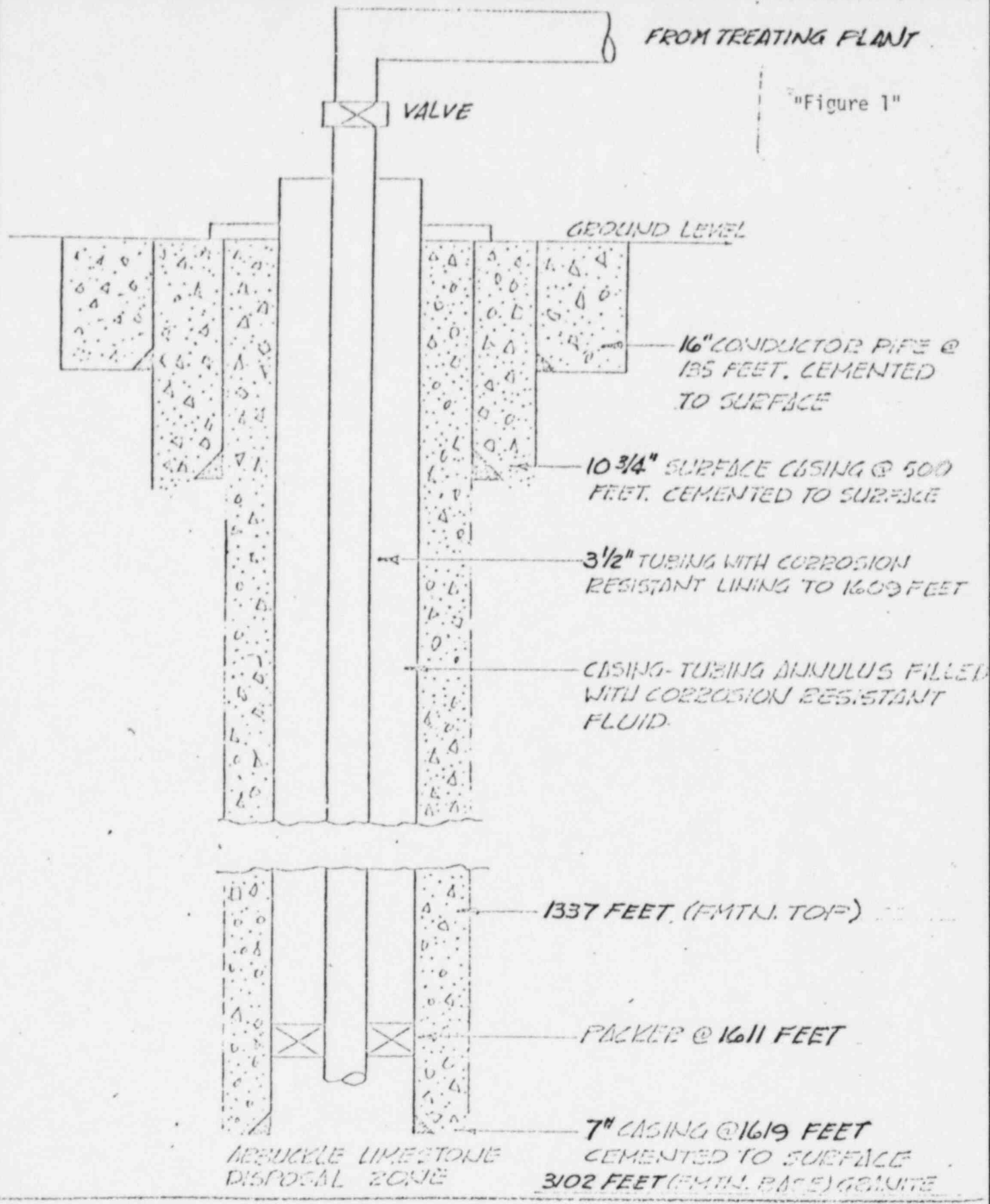
The following information is submitted for a permit to operate the subject injection facility in accordance with the Oklahoma State Department of Health (OSDH) Rules and Regulations for Industrial Waste Management.

Section 5.5.1 Parts (a) - (e) (See Figure 1)

a. Total Depth - The well was drilled in 1969 by the rotary method to a total depth of 3122 feet penetrating granite.

b. Depth and relative thickness of formations and lithologies penetrated.

"Figure 1"



KERR-McGEE CORPORATION

NUCLEAR DIVISION — OKLAHOMA CITY, OKLA.

DRAWN	DATE	SKETCH OF WASTE DISPOSAL WELL - SEQUOYAH NUCLEAR FACILITY	SCALE None
MORTON	8-11-70		DRAWING NUMBER
APPROVED			

Formation	Thickness	Lithology	Character
Pennsylvania Atoka	395'	Shale & sandstone	Non-porous, except for the basal Spiro sandstone from 342' to 373'. Contains saltwater.
Morrow	170'	Limestone & shale	Non-porous.
Mississippian	185'	Limestone & shale	Non-porous.
Siluro-Devonian Hunton	240'	Dense limestone	Non-porous.
Ordovician			
Sylvan	40'	Shale	Non-porous.
Viola	50'	Dense limestone	Non-porous.
Simpson	250'	Sandstone and interbedded dense limestone	Sandstone is porous in part, contains saltwater.
Cambro-Ordovician Arbuckle	1620'	Dolomite	Dense to very porous. Contains saltwater.
Reagan	145'	Dolomitic sand stone and sandy dolomite	Impermeable.

c. Depth and Construction of All Casings

A sixteen inch casing (16") was installed from 0-135 feet; 10 3/4 inch casing from 135-498 feet and 7 inch casing from 498-1619 feet (282 feet below the top of the Arbuckle Dolomite). The Arbuckle group is 1765 feet thick at the well site.

d. Depth of Packer

The injection string is 3½ O.D., 9.3# J55 EUE tubing internally coated with plasticap 600 PVC. The tubing is set in a Baker Model A tension packer set at a depth of 1611'. The packer is internally and externally coated with plasticap 600 PVC.

e. Depth of Top and Bottom of All Cemented Areas

Figure 1 is a sketch of the waste storage well. The well was cased and cemented as follows: (all depths measured from rotary drive bushing):

Casing Size	Weight	Grade	Type	Depth	Cement
16" O.D.	55#	H40	ST&C	135'	200 sacks regular with 2% CaCl and ¼# Flocele per sack. Cement circulated to surface.
10 3/4" O.D.	32.75#	H40	ST&C	498'	350 sacks HLC with 2% CaCl. Cement circulated to surface.
7" O.D.	20#	J55	ST&C	1619'	400 sacks HLC with 10# Gilsonite per sack plus 100 sacks 50-50 Pozmix with 9% CRF-Z and 10% CaCl. Cement circulated to surface.

Section 5.5.2 Geological/Hydrological Report on Disposal Zone

a. Depth to Top and Bottom of Disposal Zone

The Arbuckle group (proposed injection zone) is a carbonate sequence dominantly dolomite with minor shale and chert. The top of the zone is at 1337' and is 1765' thick at the well site; including the basal Reagan Sandstone.

b. Porosity and Permeability of Disposal Zone

Rocks of the Arbuckle group vary in character from dense and impermeable to very porous and permeable. In general, the upper part of the Arbuckle is essentially non-porous dolomite.

The lower one-third of the section is characterized by thick zones of high porosity. Measured porosity values of Arbuckle dolomite

range from less than 2% to as high as 20%. Permeability ranges from less than 964 millidarcy to a high of 2480 millidarcies. The average porosity ranges from 5.8% to 9.9% in the injection zone.

c. Compatability with the Industrial Waste to be Injected

The chemical and physical characteristics of the Arbuckle formation includes:

Sp. Gravity	-	1.104 at 75°F
pH	-	7.0
Resistivity	-	.093 ohms/m^2
T.D.S.	-	142,000 ppm
Chloride	-	88,300 ppm

Laboratory permeability tests were conducted by Core Laboratories with synthetic raffinate fluids and tests demonstrated that the injected waste fluids and formation water were essentially compatible.

d. Flow Tests and Stimulation Practices

e. Discussion of Direction and Distribution of Flow Within the Zone

f. Discussion of Geologic Anomalies, Such as Faults or Caverns

During the research program to better define the proposed storage reservoir, Kerr-McGee conducted injection tests monitoring the flow into the various permeable zones, performed pressure fall off testing, and measured with in-hole flow monitoring devices the backflow of some zones through the well bore into other zones after a period of water injection and gradual pressure increase. The injection profiling was conducted to determine the rates of water injection into each permeable zone of the total Arbuckle section at various times during the injection period. The

pressure fall off testing was conducted to reflect the transient pressure characteristics of the reservoir system. Exhibit A (attached) provides results of the testing program. Exhibit B provides a detailed description and schedule of the testing program, as well as a tabulation of injection flow rates and surface pressures. Exhibit C provides test results of various in-hole measurements.

In summary, these studies reveal the reservoir to have five layers having a total pore volume of at least 860 million barrels (3.6×10^{10} gallons). These layers exhibit different permeabilities and no effective communication exists between layers except at the well bore. The areal extent and dimensions for the various layers are presented in the reports. The analyses show that the boundaries reflected by the pressure data are sealing and that other communicating faults or fracture zones do not exist within the areas analyzed in the calculations.

Section 5.5.3 Logs and Surveys

Section 5.5.4 Lithological Description of All Formations Penetrated

Exhibit D provides core analysis data, logs and surveys of formation resistivity, gamma-ray, lithological characteristics, and density for the No. 1 waste storage well.

Section 5.6 Construction and Operation Standards

Description of System and Location

Treated raffinate is stored in 14.5 million gallon storage ponds located approximately 1,500 feet south of the No. 1 waste storage well. The treated raffinate liquid is pumped via a pipeline to a surge tank located

adjacent to the storage well. The liquid level in the surge tank is controlled by a control valve.

Injection pumps are located adjacent to the waste storage well and are fed directly from the surge tank. This system is shown schematically on Figure 2.

Details

Holding Tanks and Flow Lines

The surge tank has a nominal capacity of 18,000 gallons and is constructed of Carbon steel. The pipeline materials are specified on Table 1.

Filters

There are no filters in the system.

Pumps

Two centrifugal waste disposal pumps are provided, one of which is an installed spare. Both are Sundyne Pump Model LMV-311 manufactured by Sundstrand-Denver. Each is capable of 125 gpm at 400 psi. The wetted surfaces of the pumps are made of Hastelloy "C". The pumps are driven by 75 hp Louis Allis motors.

Flow and Pressure Monitoring Devices

The treated raffinate supply pump discharge is equipped with a pressure switch for pump shutdown on pressure loss. The surge tank level is controlled by a proportional control valve on the pipeline discharge, with a low-level indication on the control panel.

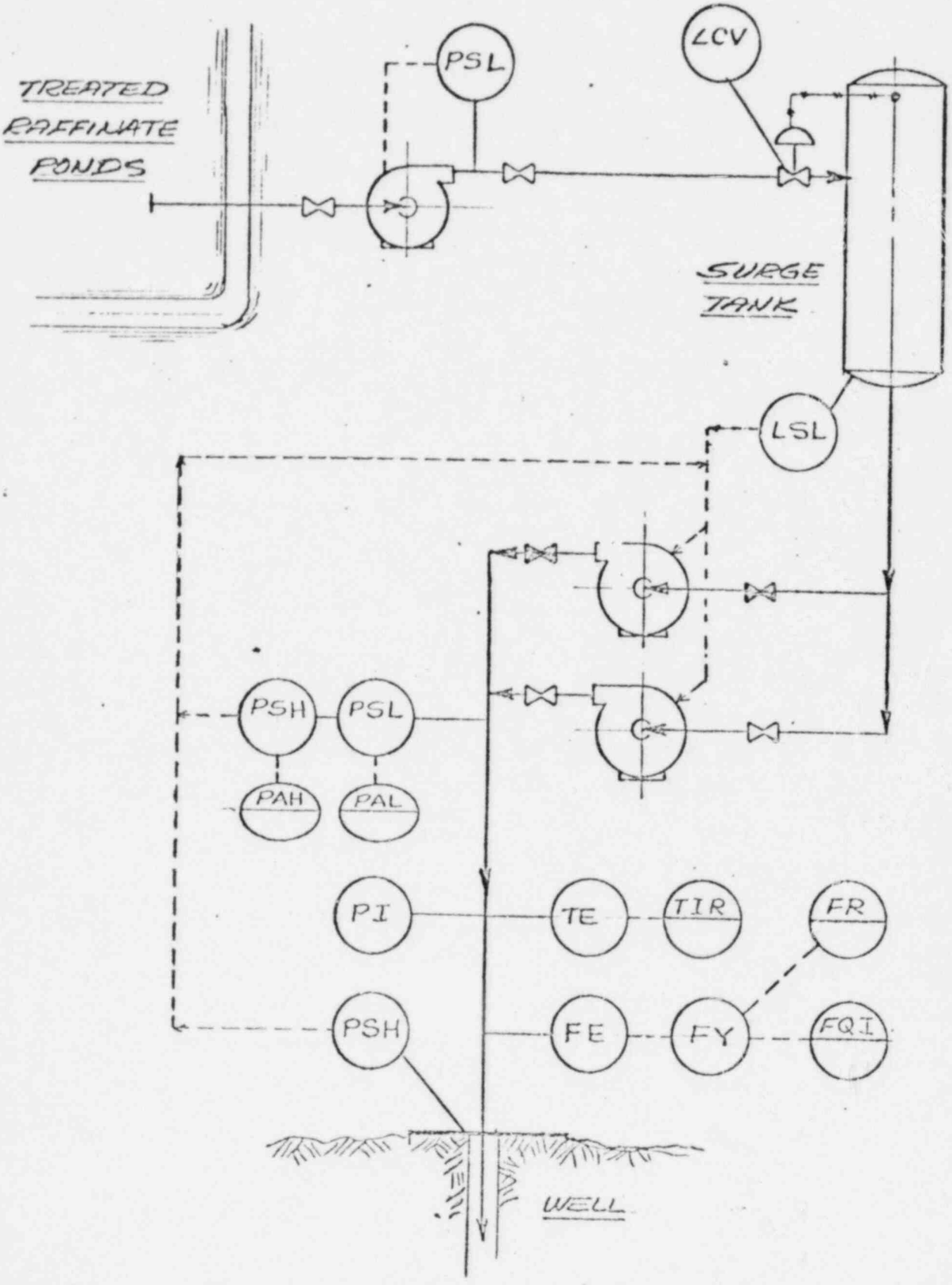


Fig 2. RAFFINATE DISPOSAL
DEEP-WELL

CT 7-8-81

TABLE 1

LOCATION	LINE DESCRIPTION	VALVE DESCRIPTION
Feed lines to surge tank	High density polyethylene "Phillips-Drisco Pipe"	150 lb. ball valve, flanged Carbon steel with SS balls and Teflon seats
Lines from surge tank to disposal well pump	Schedule 40 carbon steel	150 lb. ball valve, flanged Carbon steel with SS ball and Teflon seats
Lines from disposal pump to well	Schedule 40, 304L SS	600 lb. ball valve, flanged SS with Teflon seats
Injection tubing from well head to injection zone	3 1/2" diameter well tubing with 30 mil coating of PVC	None

Symbols for Figure 2

PSL	-	Pressure Switch Low
PSH	-	Pressure Switch High
LCV	-	Level Control Valve
LSL	-	Level Suction Low
PAH	-	Pressure Alarm High
PAL	-	Pressure Alarm Low
TE	-	Temperature Element
TIR	-	Temperature Indicator Recorder
FR	-	Flow Recorder
FE	-	Flow Element
FY	-	Flow Yield
PI	-	Pressure Indicator

Well head liquid flow, pressure, and temperatures are measured and recorded and a low and high pressure alarm is provided. There is also a pressure indicator on the well head annulus. The instrumentation is shown schematically on Figure 2.

Sampling

A grab sample of treated raffinate injected into the No. 1 Waste Storage well will be obtained from the surge tank once each shift.

Initially, Kerr-McGee Nuclear proposes to inject 5×10^6 gallons of treated raffinate (30 days at 125 gpm) into the No. 1 waste storage well. Additional tests will be completed on the storage well during this period to further determine characteristics of the disposal zone.

Monitoring and Reporting Program

The injection pressure at the well head and the annulus pressure will be monitored and recorded continuously. Records will be maintained to reflect the volume of fluid injected on any given day. A monthly report will be submitted as required by the Oklahoma Controlled Industrial Waste Disposal Act which will include copies of charts reflecting well head and annulus pressures. These records will be maintained as part of the permanent site records. Inspections will be conducted by Kerr-McGee personnel of all major features of the site during each day of operations. Such inspections will include well pressures, spillage, leaks, repairs, general maintenance, storage, and general site appearance. A complete inspection of all features of the site will be conducted weekly. A daily log initiated by the person conducting the

inspections will be maintained as part of the permanent site records. All deficiencies noted during inspections shall be promptly corrected.

A monitoring program of surface and shallow subsurface liquids from nearby streams, run-off collection ponds, and shallow wells will be continued to confirm that the deep well reservoir containing fluid and injected wastes are being confined at the lower levels as planned. In the unlikely event that some type of loss of confinement occurred which was not detected by other means as planned, the monitoring program will provide early warning so that environmental effects will be avoided or minimized through the appropriate action.

The monitoring program of sampling and analyses shown in the attached table will detect the presence of either waste fluids or formation waters which are very high in calcium, sodium, chlorides, and bicarbonates.

To provide baseline values for the four constituents mentioned in the paragraph above, a series of baseline samples and analyses will be made for one month prior to the start of waste injection. Baseline values for the other constituents are already available.

Section 5.7 Pre-treatment

Solvent extraction raffinate treatment facilities are provided. The raffinate treatment facilities include a raffinate decanter, barium treatment system, raffinate holding tanks and associated pumps and lines.

TABLE 2. MONITORING LOCATIONS

Sample Source	Sample Volume	Sampling Collection	Frequency of Analysis	Sample Analysis Performed N	Ca	Na	Cl	HCO_3
Rivers and Creeks								
a) Arkansas River-Upstream	1 gal	Monthly	Monthly	X	X	X	X	X
b) Arkansas River-Downstream	1 gal	"	"	X	X	X	X	X
c) Illinois River-Upstream	1 gal	"	"	X	X	X	X	X
d) Illinois River-Downstream	1 gal	"	"	X	X	X	X	X
e) Salt Fork Creek	1 gal	"	"	X	X	X	X	X
f) Vian Creek	1 gal	"	"	X	X	X	X	X
g) Dirty Creek	1 gal	"	"	X	X	X	X	X
Lakes and Ponds								
a) Tenkiller Lake (7 miles North of Facility)	1 gal	"	"	X	X	X	X	X
b) Surface Pond (1/2 mile East of Facility)	1 gal	"	"	X	X	X	X	X
c) Surface Pond (1/4 mile Southeast of Facility)	1 gal	"	"	X	X	X	X	X
d) Surface Pond (1/2 mile Southeast of Facility)	1 gal	"	"	X	X	X	X	X
Shallow Well								
a) KM Monitor Well(3/4 mile East-Southeast of facility)	1 gal	"	"	X	X	X	X	X

One purpose of the solvent extraction raffinate treatment system is to prepare the raffinate for injection into the waste storage well system. The barium treatment system minimizes the radioactivity contained in the raffinate effluent which is injected to the formation via deep well disposal.

Raffinate wastes generated to date have been neutralized with anhydrous ammonia and treated with barium prior to storage in ponds. These neutralized raffinates have undergone precipitation of chemical and radioactive contaminants resulting in a material which is low in radioactivity (See Table 3).

Section 5.8 Emergency Procedures (See also 3.9)

Monitoring techniques provide for continuous measurement of injection flow, well head injection pressure and temperature, and recording of tubing using annulus pressure. This primary detection system is reinforced by the environmental monitoring program outlined in Section 5.6.

The primary monitoring system will allow rapid system shutdown in the unlikely event of some breach of waste confinement occurred or any other condition existed which impaired storage well operation. The Sequoyah facility is equipped with adequate first aid equipment and trained health and safety personnel to respond to emergency situations or accidents which might occur at the waste storage well. The existing Sequoyah facility emergency response plan will be utilized for waste storage well operations.

TABLE 3. Average Composition of Treated Raffinate - 1980.

Sample Type	pH	Ra-226 pCi/ℓ	Th-230 pCi/ℓ	U mg/ℓ	Cu mg/ℓ	Mo mg/ℓ	Ni mg/ℓ	Ave. N Conc. gms N/ℓ
Treated Raffinate	7.65	1.07	.065	.045	5.4	9.65	12.0	36.5

If emergency procedures are instituted, the OSDH will be notified immediately. A written statement delineating the nature of the problem and time required to resume disposal operations will be submitted within forty-eight (48) hours. Any remedial or emergency work will be commenced immediately. Approval of the Department will be obtained prior to resumption of injection and a final report submitted within ten (10) days following completion of repair work.

Section 3.8 Warning Signs

The No. 1 waste storage well is located within the Sequoyah facility restricted area. Access to this area is already limited to authorized Kerr-McGee personnel. Warning signs, sufficient to provide basic information regarding the purpose and function of the facility will be posted at the site. Due to the location within the facility restricted area, additional warning signs are not considered necessary.

Conclusion

Although Kerr-McGee's Sequoyah facility has a USNRC licensed waste treatment and storage system in operation, the current system employing temporary storage of liquid raffinates in surface impoundments is not adequate for the approximately 5.6×10^6 gallons of treated raffinate which are produced each year during Sequoyah facility operations. Construction of additional pond capacity offers only temporary storage of these liquid wastes. The 1980 land application program provided for permanent disposal of approximately 1.5×10^6 gallons of treated raffinate but currently is restricted to suitable Kerr-McGee owned acreage.

The operation of the No. 1 waste storage well at the Sequoyah facility represents an environmentally safe, permanent method of treated raffinate disposal. Initially, Kerr-McGee proposes to inject approximately 5×10^6 gallons of treated raffinate into the Arbuckle formation. Based upon extensive engineering and hydrologic studies, the Arbuckle formation has five layers having a total pore volume of at least 3.6×10^{10} gallons. No effective communication exists between layers except in the well bore. The analyses show that the boundaries reflected by the pressure data are sealing and that other communicating faults or fracture zones do not exist within the areas analyzed.

It is requested that the OSDH issue a temporary permit to allow injection of treated raffinate to commence September 1, 1981 into this existing No. 1 storage well. This permit to be revocable at any time that injection is determined to be harmful. Further well test data taken during the period of operation would be presented to the OSDH to evaluate feasibility of permanent operation of the injection well for disposal of treated raffinates.