RAILROAD COMMISSION OF TEXAS

HEARINGS DIVISION

AMENDED PROPOSAL FOR DECISION

OIL AND GAS DOCKET NO. 8A-0286583

THE APPLICATION OF LEATHER NECK OILFIELD SERV, INC. PURSUANT TO STATEWIDE RULE 46 FOR A COMMERCIAL PERMIT TO DISPOSE OF OIL AND GAS WASTE BY INJECTION INTO A RESERVOIR PRODUCTIVE OF OIL OR GAS, SOLIZ SWD LEASE, WELL NO. 1, JESS EVERETT (CADDO REEF) FIELD, SCURRY COUNTY, TEXAS.

HEARD BY: Karl Caldwell - Technical Examiner
Marshall Enquist - Legal Examiner

PROCEDURAL HISTORY

Application Filed:	November 19, 2013
Protest Received:	August 27, 2013
Request for Hearing:	December 12, 2013
Notice of Hearing:	February 25, 2014
Hearing Held:	April 15, 2014
Transcript Received:	April 23, 2014
Proposal for Decision Issued:	April 22, 2015
Applicant's Response in Support of Examiners' Recommendation:	May 7, 2015
Motion to Intervene and Exceptions of the Oil & Gas Division:	May 7, 2015
Reply to Motion to Intervene and Exceptions of the Oil & Gas Division:	May 28, 2015
Amended Proposal for Decision Issued:	August 5, 2015

APPEARANCES:	**REPRESENTING:**
APPLICANT:	
	Leather Neck Oilfield Serv, Inc.
Kelli Kenney	
Alan Means	
PROTESTANTS:	
LaNell Cogdell	Self
Russell Cogdell	Self

STATEMENT OF THE CASE

Leather Neck Oilfield Serv, Inc. ("Leather Neck") requests commercial disposal authority pursuant to Statewide Rule 46[1] for the Soliz SWD Lease, Well No. 1 ("Soliz No. 1"), Jess Everett (Caddo Reef) Field, Scurry County, Texas. Requested injection fluids include salt water, produced water from local oil and gas production, brackish flowback water and RCRA-exempt waste.[2] Notice of the application was published in the *Snyder Daily News,* a newspaper of general circulation in Snyder, Scurry County, Texas on July 19, 2013. Notice of the application was mailed to the Scurry County Clerk, to the owner of the surface tract where the proposed disposal well will be located, and to adjacent surface owners to the tract where the proposed disposal well will be located. Leather Neck was identified as the only offset operator within a one-half mile radius of the proposed disposal well location. The application is protested by adjacent surface owners LaNell Cogdell and Russell Cogdell.

CASE SUMMARY

The Applicant is requesting to drill a new disposal well with an open-hole injection interval from 2,300 feet to 7,800 feet, from the San Andres Formation to the Ellenburger Formation. Not all of the formations within the 5,500 foot open-hole interval are expected to accept injected fluids, such as the Cline Formation. A potential risk identified, due to the extent of the open-hole injection interval, is the possibility of the wellbore collapsing. If this were to occur, it would result in an operational problem that would require clean-out of the open-hole section. The maximum requested surface injection pressure is 1,150 psi, and the maximum requested injection volume is 30,000 barrels per day. The Applicant has not identified a precedential case where the Commission has previously approved a disposal well application authorizing a maximum daily injection volume of 30,000 barrels into an open-hole interval of 5,500 feet.

A proposal for decision (PFD) in this matter was issued on April 22, 2015. In the original PFD, the Examiners did not recommend approval of the application as-applied-for by the Applicant. The Examiners did recommend approval of the application with a permit condition that the well be cased to the top of the Ellenburger Formation and the disposal interval be limited to the Ellenburger Formation. The Ellenburger Formation was the lowermost formation in the requested 5,500 foot injection interval, and identified by the Applicant as one of the formations expected to accept injected fluids. Had the recommendation in the original PFD been adopted, the disposal interval would have been from 7,670 feet to 7,800 feet.

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[1] 16 Tex. Admin. Code § 3.46 (Fluid Injection into Productive Reservoirs)

[2] Resource Conservation and Recovery Act: Examples of RCRA exempt oil and gas waste includes produced water, drilling fluids, hydraulic fracturing flow back fluids, rig wash and workover wastes.

On May 7, 2015, the Applicant filed a Case Summary and Response in Support of Examiners' Recommendation. On the same day, a Motion to Intervene and Exceptions of the Railroad Commission's Oil & Gas Division ("Oil & Gas Division" or " Staff") were filed. Staff requested that the Examiners take official notice of USGS data regarding the number, date, and magnitude of earthquakes in the immediate vicinity of the proposed disposal well location. Staff requested that the base of the approved injection interval be a minimum of 100 feet above the base of the Ellenburger Formation.

On May 28, 2015, the Applicant filed an Amended Case Summary and Reply to Motion to Intervene and Exceptions of the Oil & Gas Division. The Applicant proposed amending the open-hole injection interval from the San Andres Formation at 2,300 feet to the base of the Canyon Formation at 7,400 feet. This amended injection interval would remove the Ellenburger Formation from the injection interval and provide an additional 300 feet to 400 feet of separation from the basement rock. However, as detailed below, the Applicant's proposal still suffers from the same defects as its original application.

Consequently, as in the original PFD issued, the Examiners do not recommend approval of the application as originally applied-for, or approval of the amended open-hole injection interval from 2,300 feet to 7,400 feet as proposed by the Applicant in the Amended Case Summary and Reply to Motion to Intervene and Exceptions of the Oil & Gas Division.

MATTERS OFFICIALLY NOTICED

At the request of Staff, the Examiners take official notice of USGS earthquake data regarding the number, date, and magnitude of earthquakes in the immediate vicinity of the proposed disposal well. This includes historical events reported on the USGS website,[3] and earthquake events near Snyder, Scurry County as described in *Earthquake Hazard Associated with Deep Well Injection: A report to the U.S. Environment Protection Agency, US Geological Survey Bulletin 1951.* [4] The Examiners also take official notice of Form H-1 and H-1A in the application file, which lists the latitude and longitude coordinates for the proposed disposal well location.

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[3] http://earthquake.usgs.gov/earthquakes/search/

[4] Nicholson, C. and R.L. Wesson (1990), Earthquake hazard associated with deep well injection: A report to the U.S. Environment Protection Agency, US Geological Survey Bulletin 1951, pp. 44-47, 50.

DISCUSSION OF THE EVIDENCE

Leather Neck's Evidence

Soliz No. 1 Location

Cline Water Management has purchased a ten acre tract where the Soliz No. 1 commercial disposal well will be located, and contracted Leather Neck to be the operator of disposal well. The proposed location is situated off of State Highway 208 approximately 3.7 miles southeast of Snyder, Scurry County, Texas. No drilling activity or any construction of the proposed disposal well facility had occurred prior to the hearing. The Soliz No. 1 is intended to service oilfield activity in Mitchell County and southern Scurry County. Alan Means, (Mr. Means) Leather Neck's engineering witness, stated that the location was selected due to the tract's physical location in Scurry County in addition to the geological properties at the location.

Water-for-disposal generated in Howard County will be transported to the Soliz No. 1 along Highway 350 and across FM 2763. Highway 84 runs nearby the proposed location which serves Nolan County, located southeast of the proposed well location. In addition, Highway 180 runs east and west near the proposed Soliz No. 1 location and there is a high level of Cline Formation (Cline) horizontal activity along Highway 180 in Fisher County, located east of the proposed Soliz No. 1 location. [5]

Well Construction

The Soliz No. 1 has not yet been drilled. The Groundwater Advisory Unit (GAU) estimated the base of useable-quality water-bearing strata (BUQW) to occur at a depth of 400 feet at the proposed location of the Soliz No. 1. The base of underground sources of drinking water (USDW) was estimated to occur at a depth of 500 feet. Surface casing, 13 3/8-inch in diameter, will be set at a depth of 500 feet and cement will be circulated to the surface which will protect both the BUQW and USDW. Long string casing, 8 5/8-inch in diameter, will be set to a depth of 2,300 feet and cemented in place with cement circulated to surface. Tubing will be run inside the long string casing and a packer will be set at a depth of 2,200 feet.[6]

The requested maximum injection volume is 30,000 barrels per day (bpd). Mr. Means estimated a daily average injection volume of 15,000 bpd. The maximum surface injection pressure requested is 1,150 psi.

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[5] Tr. pg. 15, ln 18-20.

[6] The outside diameter (O.D.) of the tubing will be 4.5 inches.

Proposed Injection Interval

As-applied-for, the proposed disposal well will consist of an open-hole injection interval from 2,300 feet to 7,800 feet. The proposed injection interval includes the following formations from shallowest to deepest:

(1) San Andres Formation;
(2) San Angelo Formation;
(3) Clearfork Formation;
(4) Wolfcamp Formation;
(5) Cline Formation;
(6) Cisco Formation;
(7) Canyon/Caddo Formations;
(8) Strawn/Odom Formations; and
(9) Ellenburger Formation.

Mr. Means stated that the lower San Andres Formation will be the upper zone of the proposed interval. The Cline Formation "is a shale that's probably not going to accept anything...the Cisco, Caddo, Strawn, and Ellenburger will probably be the primary injecting formations." [7]

During cross-examination regarding the Applicant's proposed open-hole injection interval of 5,500 feet and consisting of nine different formations, Mr. Means stated that "they're basically opening everything that is nonproductive right in that area and there will be some of those zones that will not take water. There is no doubt...If there is porosity and permeability in the Ellenburger (Formation), that will be the number one zone that will accept the water. The Ciscos, the Canyon Reefs, they will take some water if they have permeability." [8]

In response to the Examiners' question as to whether the open-hole could sustain the requested daily injection volume of 30,000 bpd and whether the open-hole may collapse, Mr. Means testified "That is obviously a potential with this much open-hole. Absolutely." [9] "Any time you have this kind of open-hole section, you have a potential risk, and that turns into an operational problem for the operator having to clean out that open-hole section. No doubt." [10]

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[7] Tr. pg. 19, ln 10 - 15.

[8] Tr. pg. 49, ln 16 - 23.

[9] Tr. pg. 33, ln 13 - 17.

[10] Tr. pg. 34, ln 5 - 9.

Confining Intervals

A three-well log cross-section was used to show the proposed injection interval at the Soliz No. 1 location, which include:

(1) The Parks Lease, Well No. 1 (API No. 415-33260), located approximately 2.4 miles northwest of the Soliz No. 1 location. This well was completed on September 1, 1993 to a total depth (TD) of 7,702 feet.

(2) The Berry-Massingill Lease, Well No. 1 (API No. 415-32268), located approximately 1.8 miles southeast of the Soliz No. 1 location. This well was drilled to a TD of 7,910 feet on June 1, 1962 and later abandoned.

(3) The Ernest SWD Lease, Well No . 1 (API No. 415-34558), located approximately 4.5 miles southeast of the proposed Soliz No. 1 location. This is a commercial disposal well, with a TD of 2,516 feet, completed on January 1, 2010.

Based on the offset logs, the top of the injection interval at 2,300 feet is the lower portion of the San Andres Formation. Mr. Means stated that the San Andres Formation "will be pretty dense in the bottom but it will be very porous...in the middle to the top". [11] As an example, the witness referred to the Ernest SWD No. 1 commercial disposal well which is perforated in the middle to the lower San Andres Formation (1,800 feet to 2,100 feet), demonstrating that an injection well has been permitted in the San Andres Formation nearby. Mr. Means pointed out that the perforated injection interval in the Ernest SWD No.1 is above the top of the requested injection interval in the Soliz No. 1.

At the bottom of the injection interval at 7,800 feet, fluids will be injected into the Ellenburger Formation. Mr. Means estimated the top of the Ellenburger Formation to be at a depth of approximately 7,670 feet at Soliz No. 1 location based on correlative depth of 7,700 feet in the Berry-Massingill No. 1 well. Below the Ellenburger Formation is "close to basement rock...Cambrian Sand" [12] which Mr. Means described to be "basically weathered-granite." [13]

Review of Nearby Wellbores

No wells have been drilled within a quarter-mile or half-mile radius of the proposed Soliz No. 1 location. Seven dry holes have been drilled between a one-mile and two-mile radius of the

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[11] Tr. pg. 35, ln 4 - 13.

[12] Tr. pg. 35, ln 5- 7.

[13] Tr. pg. 38, ln 5 - 6.

proposed disposal well location. There has been past production from one well on the edge of the two-mile radius that produced from Canyon Reef intervals.[14] Just outside the two-mile radius, there are additional wells that have produced from the Canyon Reef intervals, and wells that have produced from either the Strawn Formation or the Caddo Reef-Caddo Lime intervals.

In Mr. Means opinion, no wells have been drilled within a half-mile of the proposed disposal well location due to a "geologic low...the formations that you typically produce in this area are conventional, your reefs. They are going to be water-filled at this location." [15] Mr. Means would be surprised if there were any possible production in the vicinity of the proposed disposal well since the location is in a geologic low, which was one of the factors considered in selecting this site for the Soliz No. 1. [16]

Oil and Gas Activity in the Area

Within 4.5 miles of the proposed Soliz No. 1 there is production to the southeast and to the northwest. The oilfield activity to the southeast includes horizontal drilling and completions by King Operating Company, with production from the Canyon, Strawn, and Caddo Formations. The majority of production to the west and northwest is from the Canyon, Strawn, and Caddo Formations. Leather Neck is anticipating water requiring disposal to be generated from horizontal well development by King Operating to the southeast, as well as many other sources. "We know that the activity in the Cline is moving north in Mitchell County. Obviously King Operating would not be sufficient to justify this disposal site. We are anticipating on water coming from many other sources." [17]

There was greater than a two-fold increase in the number of drilling permits approved by the Railroad Commission for Scurry County between 2012, when 110 permits were issued, and 2013, when 232 permits were approved. "A lot of this again is the Cline moving into that area, the Cline horizontal." [18] Based on the doubling of drilling activity in Scurry County, Mr. Means anticipates a need for additional disposal capacity at the proposed disposal well location.

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[14] Leather Neck Exhibit No. 10 indicated the Canyon Reef intervals are located between the Cisco and Strawn Formations.

[15] Tr. pg. 39, ln 18 - 22.

[16] Tr. pg. 39, ln 23 - pg. 40, ln 5.

[17] Tr. pg. 28, ln 25 - pg. 29, ln 7.

[18] Tr. pg. 30, ln 16 - 24.

Nearby Disposal Wells

There are three active disposal wells within 4.5 miles of the Soliz No. 1 location.

(1) The Ernest SWD Lease, Well No . 1, API No. 415-34558, located approximately 4.4 miles southeast of the proposed Soliz No. 1 location. This is a commercial disposal well, with a TD of 2,516 feet, completed on January 1, 2010.

(2) The Tater "A" Lease, Well No. 2 (Tater A No. 2), API No. 415-31237, is located approximately 4 miles northwest of the proposed disposal well location. This well was drilled on March 15, 1978, and was permitted as a disposal well on July 1, 1993 with a maximum disposal volume of 3,000 bpd. The disposal interval is from 1,750 feet to 3,826 feet in the San Andres-Clearfork-Glorietta Formations. Surface casing is set to a depth of 1,750 feet and the injection interval is open-hole from 1,750 feet to 3,826 feet. A cement plug was set from 3,826 feet to 3,961 feet.

(3) The Fred Lease, Well No. 1 (Fred No. 1), API No. 415-00635, is located approximately 3.9 miles west-southwest of the proposed disposal well location. This well was drilled on October 31, 1949, and was permitted as a disposal well on April 24, 1992 with a maximum disposal volume of 3,000 bpd. Surface casing is set to a depth of 1,649 feet and the disposal interval is an open-hole interval from 1,649 feet to 6,700 feet in the San Andres, Clearfork, and Glorietta Formations. A cement plug was set from 6,700 feet to 6,900 feet.

Mr. Means stated that the Ernest No. 1 is the only commercial disposal well of the three, and is "on a dirt road and has limited capacity." [19] Means described the Tater A No. 2 and the Fred No. 1 as in-field, on-lease, (non-commercial) disposal wells for disposing of fluids produced on-lease.

Financial Assurance

Leather Neck has an active P-5 (Organizational Report) on file with the Commission and a $25,000 letter of credit as financial assurance.

Protestants Evidence

Adjacent landowners LaNell Cognell and Russell Cognell (Cognells) appeared in protest of the application to protect their property and mineral rights. The Cognells are concerned the proposed disposal well could potentially ruin their water and eliminate any possible income from their minerals in the future. The Cognells are certain that productive reservoirs extend under their property.

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[19] Tr. pg. 27, ln 20 - 25.

The Cognells stated that there have been earthquakes in the Snyder area in the past. "I know in '86 they had a pretty good one." [20] The Cognells questioned the Applicant's witness whether the proposed disposal well would have an effect on earthquakes in the area. "What about the earthquakes they have up there at Snyder occasionally, will it have any effect on it? ...What about the earthquakes in the area, in the Snyder area just shortly north of Snyder...it can be felt 100 miles away. Would it affect that in any possible --" [21] "I cannot answer that. I am not qualified to answer that question." [22]

EXAMINERS' OPINION

Pursuant to Texas Water Code § 27.051(b), the Commission has authority to permit disposal and injection wells if it finds:

(1) that the use or installation of the injection well is in the public interest;

(2) that the use or installation of the injection well will not endanger or injure any oil, gas, or other mineral formation;

(3) that, with proper safeguards, both ground and surface fresh water can be adequately protected from pollution; and

(4) that the applicant has made a satisfactory showing of financial responsibility if required by Section 27.073 of this code.

The issuance of a disposal permit is also subject to certain casing requirements. Texas Water Code § 27.055 states that the casing shall be set at the depth, with the materials, and in the manner required by the Commission. In accordance Texas Water Code § 27.056, before setting the depth to which casing shall be installed, the Commission shall consider:

(1) known geological and hydrological conditions and relationships;

(2) foreseeable future economic development in the area; and

(3) foreseeable future demand for the use of fresh water in the locality.

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[20] Tr. pg. 51, ln 7 - 8.

[21] Tr. pg. 50, ln - 19 - 23. Cross-examination of the Applicant's witness by Mr. Cogdell.

[22] Tr. pg. 50, ln 24 - 25. Testimony of the Applicant's witness.

In the PFD issued on April 22, 2015, the Examiners did not recommend approval of the application with an open-hole injection interval from the San Andres Formation at 2,300 feet to the Ellenburger Formation at 7,800 feet as-applied-for by the Applicant. The Examiners did recommend approval of the application with a permit condition that long string casing be set to the top of the Ellenburger Formation at a depth of 7,670 feet, and a permit condition that injected fluids be confined to the Ellenburger Formation.

On May 7, 2015, the Applicant filed a Case Summary and Response in Support of Examiners' Recommendation. On the same day, a Motion to Intervene and Exceptions of the Railroad Commission's Oil & Gas Division were filed. Staff requested that the Examiners take official notice of USGS data regarding the number, date, and magnitude of earthquakes in the immediate vicinity. Staff requested that the base of the injection interval be a minimum of 100 feet above the base of the Ellenburger Formation.

The May 7, 2015 Motion to Intervene and Exceptions of the Railroad Commission's Oil & Gas Division was not timely filed. Pursuant to Commission Rules of Practice and Procedure §1.64, titled "Intervention", a Motion to Intervene must be filed no later than five days prior to the hearing date. The original hearing date was March 18, 2014, which was continued to April 15, 2014. Staff's Motion to intervene was filed over a year late. However, pursuant to Commission Rules of Practice and Procedure §1.22, titled "Classification of Pleadings", the Examiners construe the Motion to Intervene and Exceptions of the Railroad Commission's Oil & Gas Division as being in the nature of an amicus brief. As such, it will be included in the Commissioners' Conference notebooks for their consideration. By letter dated May 13, 2015, the Examiners provided a copy of the Motion to Intervene and Exceptions to counsel for applicant, requesting a response within five days. Counsel for Applicant requested an extension of time in which to consult with Staff and respond, which was granted, allowing an extension to May 28, 2015.

On May 28, 2015, the Applicant filed an Amended Case Summary and Reply to Motion to Intervene and Exceptions of the Railroad Commission's Oil & Gas Division ("Reply"). The Applicant stated that if the Commission were to approve the application as recommended by the Examiners, with casing set to the top of the Ellenburger Formation and injected fluids confined to the Ellenburger Formation, and Staff's recommendation that the base of the approved injection interval be a minimum of 100 feet above the base of the Ellenburger Formation, the injection interval would be limited to 30 feet.[23] In the Reply, the Applicant proposed amending the open-hole injection interval from the San Andres Formation at 2,300 feet to the base of the Canyon Formation at 7,400 feet, which would provide an additional 300 feet to 400 feet of separation from the basement rock.

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[23] Leather Neck Oilfield Serv. Inc.'s Reply to Motion to Intervene and Exceptions of the Railroad Commission's Oil & Gas Division p. 2.

In the Examiners' opinion, the Applicant's applied-for application as well as the proposed amended application do not meet the requirements of Statewide Rule 46 or Chapter 27 of the Texas Water Code.

Whether the Use or Installation of the Injection Well is in the Public Interest

Need For Additional Disposal Capacity

In the Examiners' opinion, the proposed injection well in both the applied-for application and the proposed amended application is not in the public interest. The Applicant's evidence is contradictory and failed to show that additional disposal capacity is needed in this area at this time. The Applicant's witness stated that the current level of activity within 81 square miles would not be sufficient to justify this disposal well. The Applicant's witness would be surprised if there were to be any production from conventional formations in the immediate area surrounding the proposed well site due to being at a geologic low point. The Applicant provided evidence of an increase in the number of drilling permits issued for Scurry County, partially attributed to horizontal well drilling and completion of the Cline Formation, yet the Cline Formation is included in the injection interval. The Applicant did not provide any evidence whether unconventional formations, namely the Cline Formation, would be productive at the proposed disposal well location, or in the immediate area of the location.

Seismic Activity

The Applicant does not know whether the proposed installation and use of the injection well would have any effect on earthquakes in the Snyder area. [24] The proposed disposal well location is 3.7 miles southeast of Snyder.[25] Survey information from the USGS regarding the locations of historical seismic events indicates one event has occurred within a 5 mile radius of the proposed disposal well location. The event occurred on September 12, 2011, with a magnitude of 2.5. A total of seven seismic events have occurred within a 10 mile radius, with the most recently reported event occurring on May 14, 2014, less than 4.5 miles (7 km) north-northeast of Snyder, with a magnitude of 3.1. Within a 15 mile radius, a total of twenty seismic events have been reported since 1971 (Attachments A1 - A3).

According to *Earthquake Hazard Associated with Deep Well Injection: A Report to the U.S. Environment Protection Agency, US Geological Survey Bulletin 1951,* a small local network of

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[24] At the time the injection well application was submitted and the hearing was conducted, there was no requirement to provide USGS seismic data. Statewide Rule 46 was amended to be effective November 17, 2014 and now requires the Applicant to include a survey of information from the USGS regarding the locations of any historical seismic events within a circular area of 100 square miles centered around the proposed disposal well location.

[25] The coordinates listed on Form H-1 in the application file: latitude: 32.673142, longitude: -100.883111

stations were operated from February 1979 through August, 1981 in the Cogdell Canyon Reef Field near Snyder, due to the proximity of earthquakes to oilfield operations. In the early 1970's the Cogdell Canyon Reef Field experienced an increase in the number of injection wells and volume of fluid injected for waterflooding and pressure maintenance purposes. The report noted that the many of the wells in the Cogdell Canyon Reef Field penetrate the Canyon Reef Formation between 6,791 feet and 7,431 feet (Attachment B).

Commission Staff requested that the injection interval be a minimum of 100 feet above the base of the Ellenburger Formation, due to a concern with injection in close proximity to the basement rock. In response, the Applicant proposed to move the bottom of the injection interval to the base of the Canyon Formation, at a depth of 7,400 feet. In the Examiners' opinion, there is no evidence in the record to show whether raising the bottom of the injection interval from the Ellenburger Formation to the base of the Canyon Formation would be any more or less likely to contribute to seismic activity. There is no evidence in the record of injection into the Ellenburger Formation in the immediate area. However, there is evidence of injection operations occurring in wells that penetrate the Canyon Reef Formation near Snyder.

Although the Applicant was not required to provide any seismic data at the time the application was filed, if the application were to be approved, the use and operation of the well would be required to be in compliance with the current requirements of Statewide Rule 46.

Endangerment or Injury to Any Oil, Gas, or Other Mineral Formation

One of the Protestants' concerns with the application is the elimination of any potential income from their minerals in the future. If any part of the proposed injection zone is, or has ever been productive, then the permit application is required to be filed on Form H-1/H-1A and analyzed pursuant to Statewide Rule 46. The Commission has interpreted a productive reservoir to be a reservoir with past or current production within a two-mile radius of the proposed injection well.[26] The record shows that there has been one well with reported production within a two mile radius of the proposed disposal well location. This well produced from the Canyon Formation, and the current well status is plugged and abandoned.

There have been several dry holes reported within a two mile radius of the proposed disposal well location. The Applicant's witness stated that one reason the Applicant selected this particular location was due to the site being located at a geological low point. As a result, the witness concluded that the formations typically productive in this area are conventional reefs, which will be water-filled as opposed to hydrocarbon-bearing. The Applicant provided no evidence or testimony as to whether unconventional formations at the proposed disposal well location, such as the Cline Formation, would be productive. In the Examiners' opinion, the Applicant failed to show that the

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[26] http://www.rrc.state.tx.us/oil-gas/publications-and-notices/manuals/injectiondisposal-well-manual/summary-of-standards-and-procedures/administrative-review/

use or installation of the proposed injection well will not endanger oil, gas or mineral formations.

The Applicant's witness stated that the Cline Formation is not expected to accept any injected fluids. However, the Applicant failed to show any confining interval above or below the Cline Formation that would isolate the Cline Formation from injected fluids for any potential future development. Unconventional, tight reservoirs typically require hydraulic-fracture stimulation. The Applicant failed to show that including the Cline Formation in the injection interval would not result in waste and potential loss of hydrocarbon recovery.

If the proposed well is completed open-hole through the Cline Formation, future horizontal development in the area would have to maintain a distance from the wellbore sufficient to prevent hydraulically fracture stimulating into the open-hole wellbore, or creating a conductive pathway in the Cline Formation that may allow injected fluids from the applied-for well to enter the Cline Formation. This would result in waste of hydrocarbons.

Protection of Ground and Surface Fresh Water

The GAU estimated the BUQW to occur at a depth of 400 feet, and the USDW to occur at a depth of 500 feet at the proposed disposal well location. Surface casing, 13 3/8-inch in diameter, will be set at a depth of 500 feet and cement will be circulated to surface to ensure the BUQW and USDW are protected. The Applicant proposes to set 8 5/8-inch long string casing to a depth of 2,300 feet and cement the casing with cement circulated to the surface. The depth of 2,300 feet corresponds to the lower section of the San Andres Formation, which is dense and will confine fluids injected below 2,300 feet from migrating to the BUQW. The San Andres Formation is included as the upper injection interval in three disposal wells within five miles of the proposed well site. Tubing will be run inside the long string casing and a packer set at a depth of 2,200 feet.

Financial Responsibility

The Examiners conclude that the Applicant has made a satisfactory showing of financial responsibility as required by Section 27.073 of the Texas Water Code. The Applicant has a current approved Form P-5 (Organization Report) and a $25,000 letter of credit on file with the Commission for financial assurance. There is no evidence to suggest any current active enforcement matters involving the Applicant.

Casing Depth Requirements

Pursuant to Texas Water Code § 27.056(1), the Commission is required to consider known geological and hydrological conditions and relationships in setting casing depth. Additionally, § 27.056(2) requires consideration of the foreseeable future economic development in the area when establishing casing depth requirements. In the Examiners' opinion, problems may arise if the application were to be approved with an open-hole disposal interval from 2,300 feet to 7,800 feet,

as requested in the original application, or from 2,300 feet to 7,400 feet, as proposed as the Applicant's amended injection interval. The Applicant's witness acknowledged that there is a potential for the wellbore to collapse given the 5,500 feet of open-hole interval requested for disposal in the original application. The witness testified that the potential risk, if realized, would turn into an operational problem that would require the operator to clean-out the well. In the Examiners' opinion, the construction of a yet-to-be-drilled disposal well should be designed to minimize potential risks and operational issues from the onset.

In response to the Examiners' questions, the Applicant's engineering witness testified that he did not recommend designing the disposal well in its current form. The design was client-driven based on the desire to expose as much of the underlying formations as possible to ensure injection of fluids. [27] During the hearing, the Applicant's engineering witness was also unable to identify an example where a 5,500 foot open-hole interval has been authorized for injection. [28]

Applicant's Late-Filed Exhibit No. 21-2 showed the Fred No. 1 (previously described in the *Nearby Disposal Wells* section) has a permitted open-hole injection interval from 1,649 feet to 6,700 feet, an open-hole injection interval of 5,051 feet. However, this disposal well differs from the current permit application in several important areas:

(A) the Fred No. 1 was drilled October 31, 1949 as a producing well, and therefore, the 5,051 foot open-hole section previously existed in this well; and

(B) the Fred No. 1 was converted from a producing well to a disposal well on April 24, 1992, authorized to inject a maximum of 3,000 bpd. The application in this case in its current form requests to inject a maximum of 30,000 bpd, a 10-fold increase in the maximum daily volume as compared to the Fred No. 1.

Therefore, there is no evidence in the record of any disposal wells intentionally drilled with an open-hole injection interval of 5,500 feet, as in the applied-for application, or 5,100 feet, as in the proposed amended application, authorized to inject a maximum volume of 30,000 bpd. In the Examiners' opinion, the applied-for open hole injection interval, and the proposed amended injection interval should not include the Cline Formation due to the potential to cause waste, as previously described in *Endangerment or Injury to Any Oil, Gas, or Other Mineral Formation.*

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[27] Tr. pg. 55, ln 19 - pg. 56, ln 1.

[28] The Examiners requested late-filed exhibits with information on two nearby disposal wells that were described as in-field disposal wells by the Applicant. See *Nearby Disposal Wells.*

FINDINGS OF FACT

1. Leather Neck requests commercial disposal authority pursuant to Statewide Rule 46 for the Soliz SWD Lease, Well No. 1, Jess Everett (Caddo Reef) Field, Scurry County, Texas.

2. At least 10 days' notice of the hearing was provided to the owner of the surface tract where the proposed disposal well will be located, to all adjacent surface owners to the tract where the proposed disposal well will be located and to the Scurry County Clerk, the Applicant was identified as the only offset operator within a one-half mile radius of the proposed disposal well location.

3. Notice of the application was published in the *Snyder Daily News,* a newspaper of general circulation in Snyder, Scurry County, Texas on July 19, 2013.

4. The Applicant failed to meet its evidentiary burden to show that the use or installation of the injection well is in the public interest.

   (A) The proposed disposal well location is 3.7 miles southeast of Snyder, Texas;

   (B) The Applicant's witness stated that the existing activity alone within 81 square miles of the proposed well site does not justify the proposed disposal well; and

   (C) Seismic activity has been reported in the Snyder, Texas area;

      (a) USGS historical seismic events shows one event has occurred within a 5 mile radius of the proposed disposal well location. The event occurred on September 12, 2011, with a magnitude of 2.5.

      (b) A total of seven seismic events have occurred within a 10 mile radius of the proposed well location, with the most recently reported event occurring on May 14, 2014, less than 4.5 miles (7 km) north-northeast of Snyder, with a magnitude of 3.1.

      (c) Within a 15 mile radius of the proposed disposal well location, a total of twenty seismic events have been reported since 1971.

5. The Applicant failed to show that the use or installation of the injection well will not endanger or injure oil, gas, or other mineral formations:

(A) there is no evidence to show that unconventional formations will be unproductive at the proposed disposal well location;

(B) the number of drilling permits have increased more than two-fold in Scurry County between 2012 and 2013,in part as a result of horizontal development of the Cline Formation;

(C) the Cline Formation is included in the disposal interval; and

(D) an open-hole completion through the Cline Formation will endanger future horizontal development in the immediate area of the proposed disposal well. Hydraulic fracture stimulation necessary to complete a Cline Formation well could create a conductive pathway for injected fluids to enter the Cline Formation and reduce the ultimate recovery of hydrocarbons, causing waste.

6. In setting the depth of the casing, the application fails to factor known geological and hydrological conditions and relationships or foreseeable future economic development in the area:

(A) the wellbore has the potential to collapse given an open-hole injection interval in excess of 5,000 feet containing atleast seven distinct formations;

(B) if the wellbore were to collapse, it would turn into an operational problem that would require the operator to clean-out; and

(C) an open-hole injection interval that includes the Cline Formation poses a risk to any future economic development of this formation at the proposed disposal well location;

7. Leather Neck has made a satisfactory showing of financial responsibility.

CONCLUSIONS OF LAW

1. All notice requirements have been satisfied. 16 TEX. ADMIN. CODE § 3.46.

2. Resolution of the subject application is a matter committed to the jurisdiction of the Railroad Commission of Texas. TEX. NAT. RES. CODE § 81.051.

3. Leather Neck did not meet its burden to sufficiently demonstrate that the use or installation of the proposed commercial disposal well is in the public interest. Texas Water Code § 27.051(b)(1).

4. Leather Neck did not meet its burden to sufficiently demonstrate that the proposed fluid disposal operations will not endanger oil, gas or geothermal resources. Texas Water Code § 27.051(b)(2).

5. Leather Neck has not met its burden of proof and its application does not satisfy the requirements of Chapter 27 of the Texas Water Code and the Railroad Commission's Statewide Rule 46.

EXAMINERS' RECOMMENDATION

Based on the above findings of fact and conclusions of law, the Examiners recommend that the application of Leather Neck Oilfield Serv, Inc. for commercial disposal authority pursuant to Statewide Rule 46 for the Soliz SWD Lease, Well No. 1, Jess Everett (Caddo Reef) Field, Scurry County, Texas, be denied, as set out in the attached Final Order.

Respectfully submitted,

Karl Caldwell
Technical Examiner

Marshall Enquist
Legal Examiner

Search Results

1 earthquakes - Download
Updated: 2015-07-12 22:09:45 UTC
Showing event times using UTC

1 earthquakes in map area

2.5 western Texas	2011-09-12 02:29:31 UTC	5.0 km

Search Results

7 earthquakes - Download
Updated: 2015-07-12 21:51:05 UTC
Showing event times using UTC

7 earthquakes in map area

3.1 7km NNE of Snyder, Texas	2014-05-14 15:52:17 UTC	4.5 km
2.5 western Texas	2011-12-29 06:19:07 UTC	5.0 km
3.2 western Texas	2011-12-17 14:46:58 UTC	5.0 km
2.7 western Texas	2011-09-12 09:26:12 UTC	5.0 km
2.5 western Texas	2011-09-12 02:29:31 UTC	5.0 km
2.7 western Texas	2011-09-12 00:31:49 UTC	5.0 km
2.5 western Texas	2011-09-11 18:36:35 UTC	5.0 km

Search Results

20 earthquakes - Download
Updated: 2015-07-12 22:05:50 UTC
Showing event times using UTC

20 earthquakes in map area

2.4	14km NNE of Snyder, Texas	2015-01-26 05:37:07 UTC	5.0 km
3.5	17km NNE of Snyder, Texas	2015-01-06 21:55:19 UTC	4.0 km
3.1	7km NNE of Snyder, Texas	2014-05-14 15:52:17 UTC	4.5 km
2.9	18km NNE of Snyder, Texas	2014-01-28 01:17:38 UTC	3.8 km
2.5	western Texas	2011-12-29 11:48:08 UTC	5.0 km
2.5	western Texas	2011-12-29 06:19:07 UTC	5.0 km
3.2	western Texas	2011-12-17 14:46:56 UTC	5.0 km
2.6	western Texas	2011-09-13 07:21:35 UTC	5.0 km
3.5	western Texas	2011-09-12 14:18:34 UTC	7.9 km
2.7	western Texas	2011-09-12 09:26:12 UTC	5.0 km
2.6	western Texas	2011-09-12 09:19:46 UTC	5.0 km
2.5	western Texas	2011-09-12 02:29:31 UTC	5.0 km
2.7	western Texas	2011-09-12 00:31:49 UTC	5.0 km
2.5	western Texas	2011-09-11 18:36:35 UTC	5.0 km
4.3	western Texas	2011-09-11 12:27:44 UTC	5.0 km
2.5	western Texas	2011-04-25 16:56:31 UTC	5.0 km
3.0	western Texas	2011-03-12 15:22:00 UTC	5.0 km
2.5	western Texas	2011-03-01 08:31:59 UTC	5.0 km
3.1	western Texas	2011-03-01 03:30:12 UTC	5.0 km
2.7	western Texas	2008-07-18 20:38:41 UTC	5.0 km

ATTACHMENT B

Earthquake Hazard Associated With Deep Well Injection– A Report to the U.S. Environmental Protection Agency

U.S. GEOLOGICAL SURVEY BULLETIN 1951

Prepared in cooperation with the Environmental Protection Agency

1990

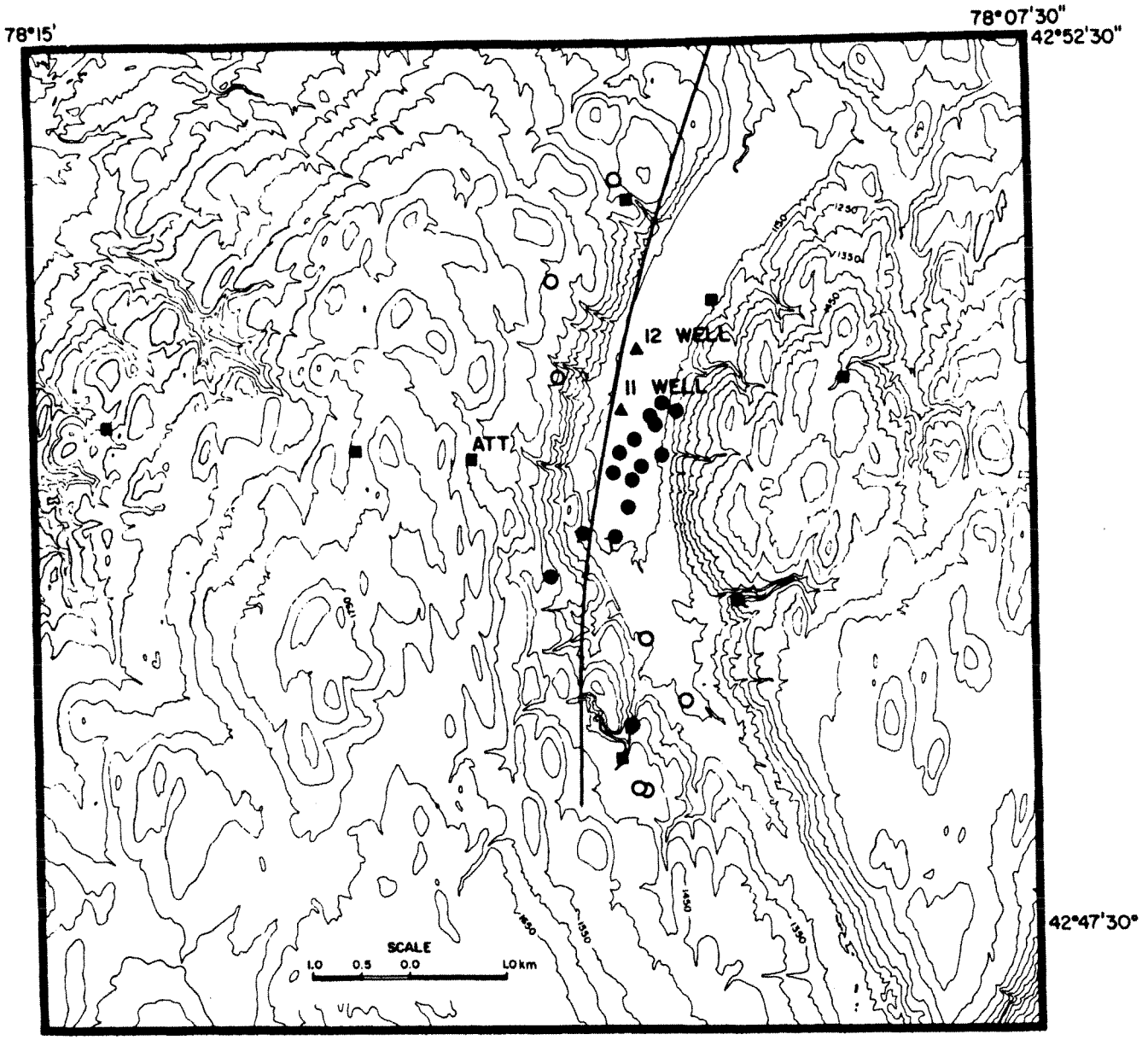
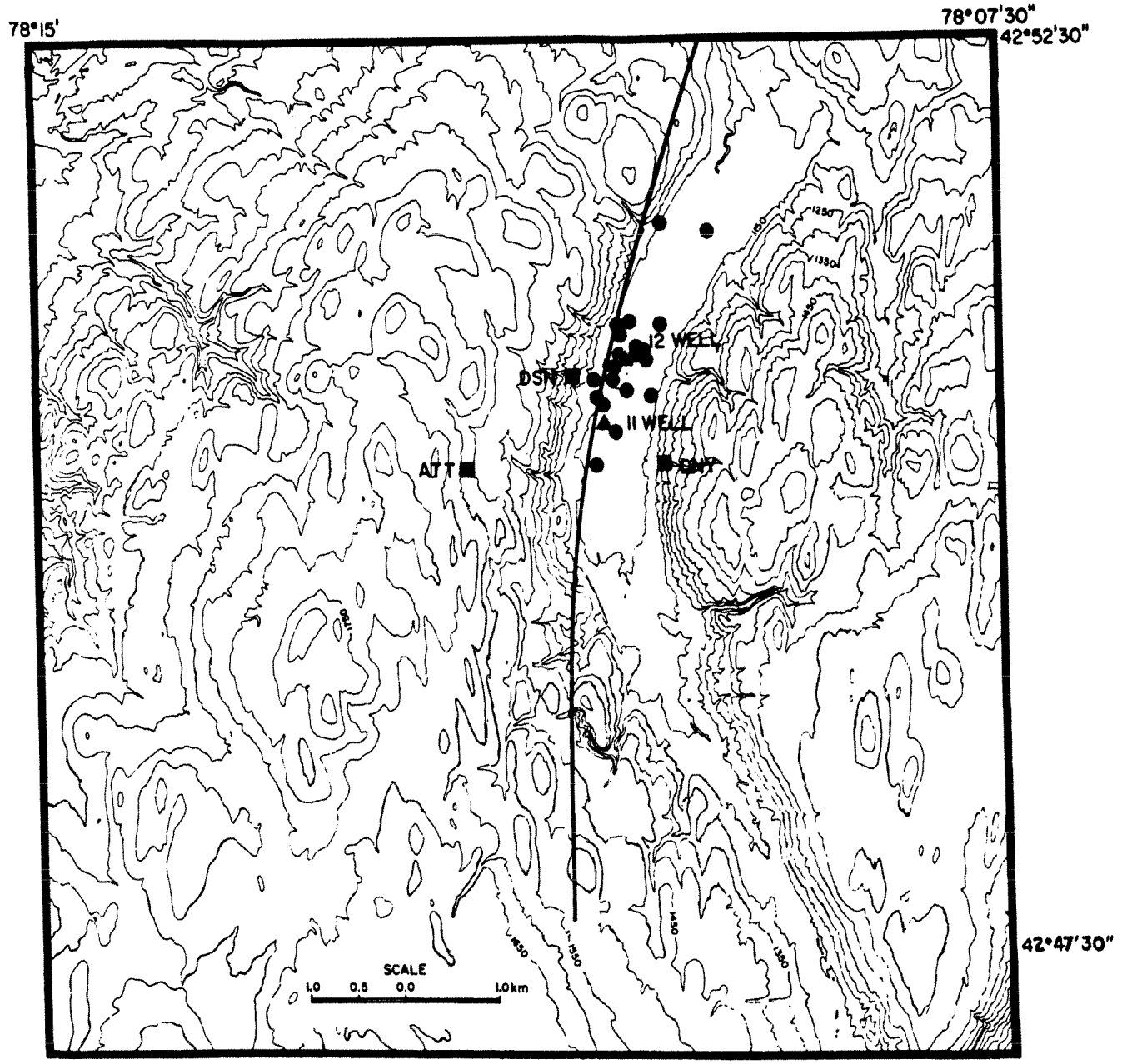


Figure A4. Epicenters of well located earthquakes near the Dale brine field, New York. Solid circles, well located earthquakes; squares, monitoring stations; triangles, injection wells; open circles, epicenters that have poor resolution; and solid line, Clarendon-Linden Fault. *A*, October 1971. *B*, November 1971. Reprinted from Fletcher and Sykes (1977) and published with permission.

of 150 bars and a minimum compressive stress of 85 bars at depths of about 485 m.

Cogdell Canyon Reef Oil Field, West Texas

The largest earthquake to occur in known association with an oil field injection operation within the United States was a magnitude 4.6 to 4.7 event near Snyder in June 1978. This earthquake, which was part of a sequence of events that apparently had been active since 1974 (Davis, 1985), was located in the Cogdell Canyon Reef oil field of West Texas (fig. A8). Initial formation pressure at the time of discovery (1949) amounted to 215 bars BHP. By 1956, pressure in the field had dropped to 79 bars BHP, which necessitated a water-flooding and pressure-maintenance program. A dramatic increase in the numbers of injection wells, volumes of fluid pumped, and effective pressures took place in the early 1970's, shortly after which the first felt earthquake was experienced (Harding, 1981a). Surface injection pressures ranged as low as 45 to 95 bars, but



B

Figure A4. Continued.

typically operated between 186 to 217 bars THP. By using the Mohr-Coulomb failure criterion, these higher values of injection pressure were determined to be sufficient to induce slip on favorably oriented fractures (Davis, 1985). Because injection pressure in the field remained fairly constant, there is little correlation between the injection pressure and the episodic nature of the earthquake activity. There is some correlation, however, between volumes of fluid injected and the rate of local earthquake occurrence (fig. A9). The data were interpreted to suggest that large (felt) earthquakes were preceded by a reduction in field permeability (which corresponded to a drop in volume of water accepted by the reservoir at constant pressure) followed by an increase in permeability after each of the major earthquake sequences (Harding, 1981a).

Because of the proximity of the earthquakes to oil field operations, a small local network of stations was operated from February 1979 through August 1981 (fig. A8; Harding, 1981a). As of 1985, a total of about 30 earthquakes had been spatially associated with the Cogdell

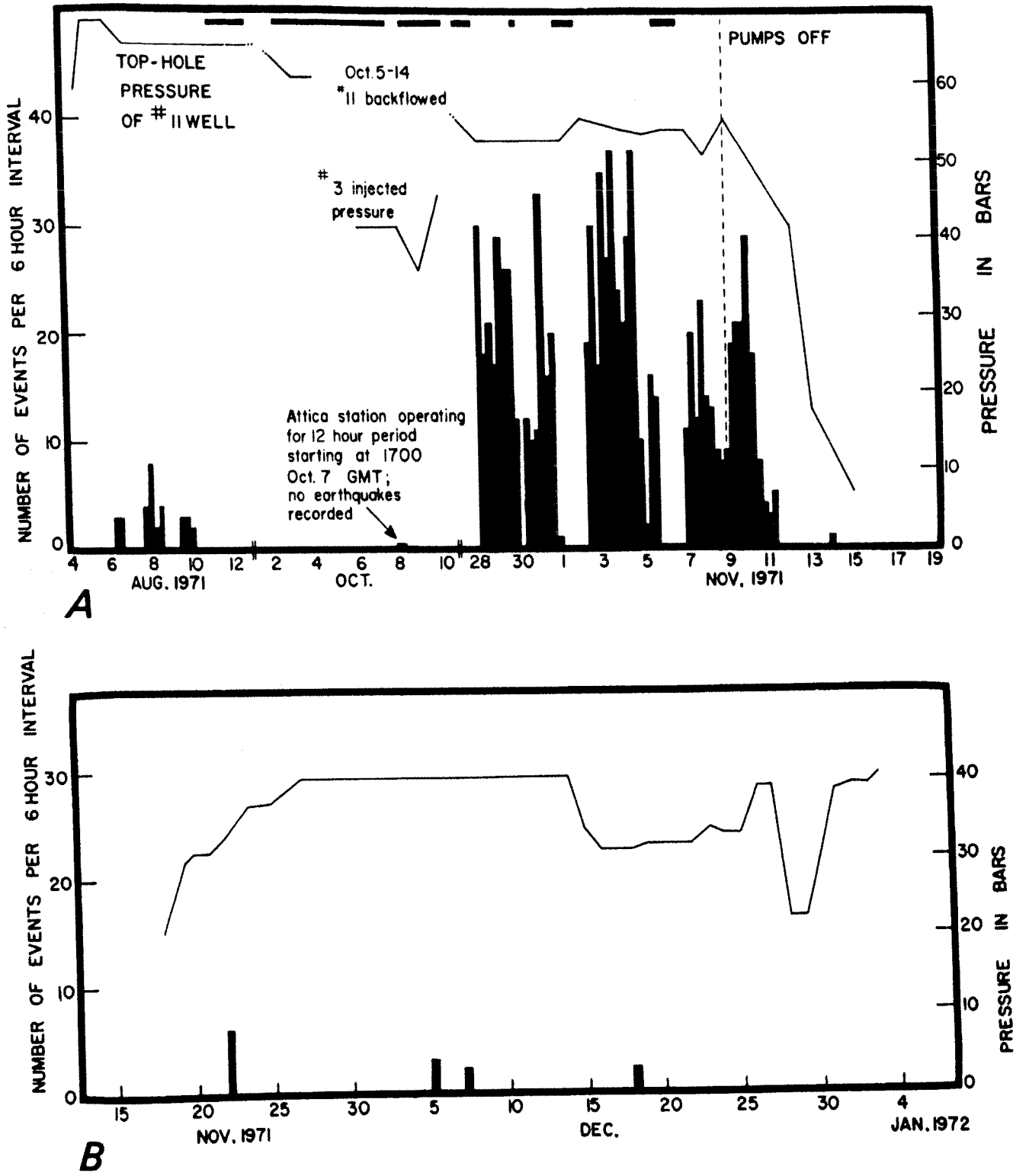


Figure A5. Number of earthquakes and pumping pressures (light solid lines) with time in the Dale brine field, New York. *A*, From August 4 to November 19, 1971, when top-hole injection pressures in well 11 typically exceeded 50 bars. Note the abrupt cessation of activity after pumping was shut down on November 9. *B*, Similar to *A* but from November 15, 1971, to January 4, 1972, when the maximum injection pressure did not exceed about 40 bars. Reprinted from Fletcher and Sykes (1977) and published with permission.

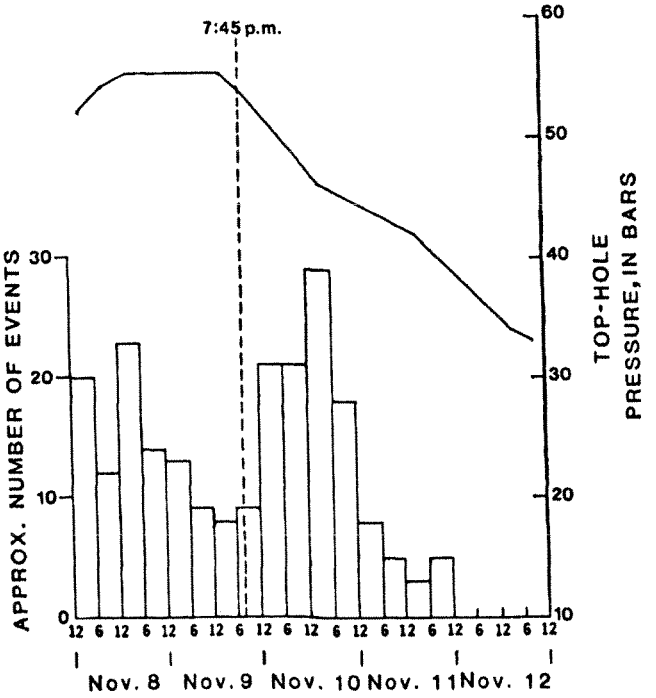


Figure A6. Enhanced section of figure A5 for well 11 of the Dale brine field, New York, showing the rapid decrease in seismicity after pumping ceased at 7:45 p.m. on November 9, 1971, and well pressure (solid line) subsequently declined below about 50 bars (from Nottis, 1986).

Canyon Reef oil field (fig. A8); most of the events occurred between April 1977 and August 1979. Many of the wells that penetrate to the Canyon Reef Formation operate at depths of between 2,070 and 2,265 m. These well depths coincide with the shallow focal depths (on the order of 3 km or less) of the earthquakes located within the oil field (Harding, 1981b) and are nearly the same as the focal depth (3 km) determined for the June 1978 event (Voss and Herrmann, 1980).

Atascosa County, South Texas

Seismic activity also has been identified with the *withdrawal* of oil and gas from two fields in south Texas (pl. 1; Pennington and others, 1986). Production from the Imogene oil and gas field began in 1944; the depth of the producing horizon is 2.4 km. Initial fluid pressure in the field was approximately 246 bars and was reduced to 146 bars by 1973. In the Flashing gas field, production began in 1958 at a depth of 3.4 km. Initial pore pressure in the producing formation was 352 bars but was reduced to only 71 bars (or 20 percent of the original value) by 1983. The rapid withdrawal of fluid and gas apparently resulted in subsidence and differential compaction of the producing horizon in both fields, which is similar to the situation in the War-Wink gas field. Seismic activity began in 1973; the largest earthquake (M 3.9) occurred in the Imogene field in March 1984. In both cases, the sizes and the number of earthquakes increased over time, which is consistent with a model for the evolution of the hydrologic characteristics of the field whereby the strength of the rock increases as fluid pressure decreases. The earthquakes are believed to be generated as formation pore pressure is reduced to the point that further fluid extraction and subsequent subsidence results in strain accumulation in the newly strengthened rock. If the strains are large enough, then the amount of energy accumulated in the rock is apparently sufficient to cause earthquakes as large as magnitude 3 to 4 (Pennington and others, 1986).

" Fashing"

The Geysers, California

In a case similar to Atascosa County, Tex., a large number of small earthquakes ($M_L \leq 4$) have been triggered by the reduction in steam pressure caused by energy production in The Geysers geothermal area near Clear Lake in northwestern California (fig. A10; Oppenheimer, 1986). The Geysers is the site of a vapor-dominated steam field where, by the early 1980's, 150 wells had been drilled to depths of between 0.8 and 3.0 km. Earthquake activity has increased in The Geysers area by nearly a factor of two over seismicity levels before production; about 10 microearthquakes that have magnitudes of greater than 0.5 typically occur each day. Evidence that the increased seismicity was induced relied upon the spatial and the temporal distribution of the microearthquakes in the vicinity of the producing steam wells. During the period from 1975 to 1981, earthquakes were found to occur in previously aseismic areas within months following the initiation of steam extraction from newly developed regions of the reservoir. Seismic activity also correlated with energy production or rate of steam extraction (fig. A11). Earthquake hypocenters were found to extend from 0 to 6.5 km in depth, but earthquakes that had focal depths of less than 3.5 km were typically located within a few hundred meters laterally from the sites of active steam wells (Eberhart-Phillips and Oppenheimer, 1984). Although some of the extracted steam is condensed and reinjected, the reduction in effective normal stress caused by increased pore pressure is not considered to be the likely mechanism to explain the induced seismicity. Steam pressure in the field actually has declined by about 1 bar/yr since 1966 as a result of cooling, and the number of earthquakes did not correlate with volumes of steam condensate injected into the wells. The two possible mechanisms thought to be responsible for the increased seismicity are the increased shear stresses that are a result of volumetric thermal contraction caused by reservoir cooling (Denlinger and others, 1981) and by reservoir subsidence arising from large fluid mass withdrawal (Majer and McEvilly,

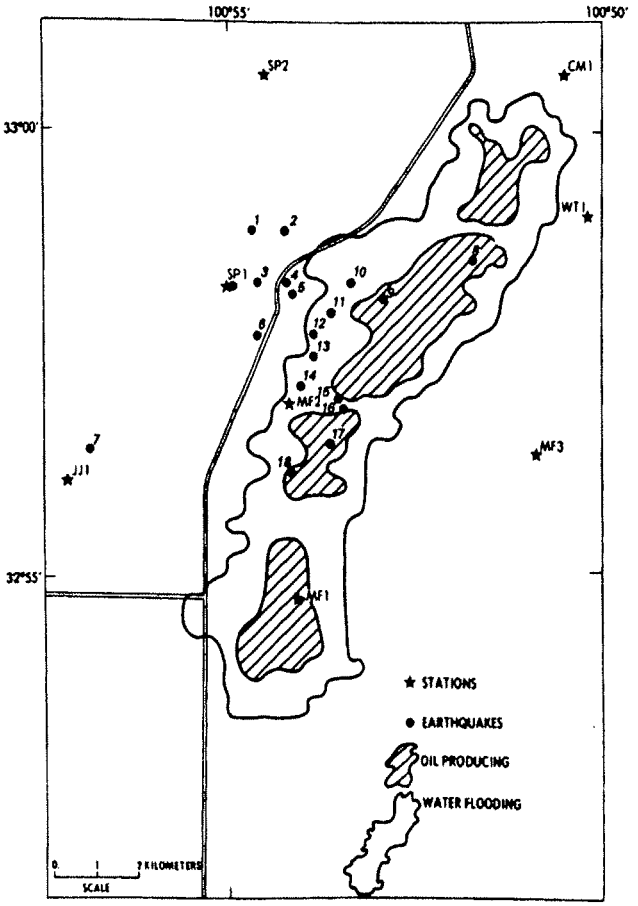


Figure A8. Epicenters of well located earthquakes in the Cogdell Canyon Reef oil field near Snyder, Tex. Also shown are the locations of network stations and the extent of water flooding and oil production (from Harding, 1981a).

activity was identified near the Kansas-Nebraska border (pl. 1). From March 1979 to March 1980, subsequent investigations using portable instruments (fig. A12*A*) detected 31 earthquakes in close proximity to the most productive oil field in the State—the Sleepy Hollow (Evans and Steeples, 1987). Water flooding to enhance recovery had been in operation since 1966. As shown in figure A13*A*, water injection typically operated at 52 bars THP within the Lansing Group (depths of 1,050–1,130 m) and 22 bars within the Sleepy Hollow sandstone (Reagan) formation (1,150–1,170 m depth), which corresponded to 172 and 142 bars BHP, respectively. Most of the well located earthquakes occurred within the confines of the producing field and at depths of less than 2 km (Rothe and Lui, 1983) in an area where well-defined subsurface faults (fig. A13*B*) were present, based on structure contour maps. Maximum magnitude of the induced seismicity was 2.9. In a later monitoring program, an additional 250 microearthquakes were detected within the active field between April 1982 and June 1984 (fig. A12*B*; Evans and Steeples, 1987),

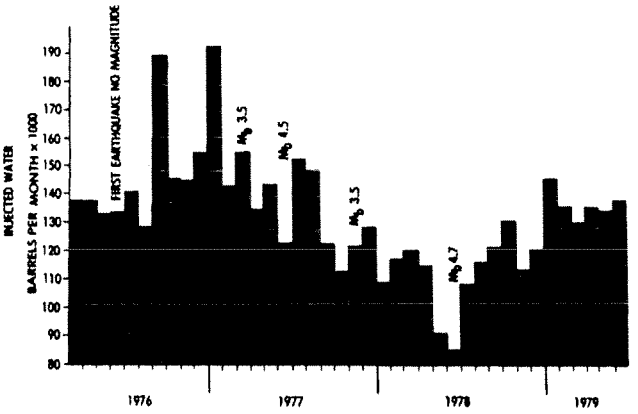


Figure A9. Cumulative monthly volume (barrels) of water injected in the Cogdell Canyon Reef oil field, Texas, and times of reported felt earthquakes (from Harding, 1981a). M_b, body-wave magnitude.

when the average THP in the field reached as high as 56 bars.

Southwestern Ontario, Canada

Oil and gas production from the Gobles oil field, which is located in southwestern Ontario about 55 km east-northeast of London (fig. A14*A*) began in 1960 (Mereu and others, 1986); the producing horizon is 884 m deep. Because formation fluid pressure was lower than expected, water-flooding operations to enhance recovery began in 1969. Historically, this area of southwestern Ontario has had a very low level of seismic activity. In December 1979, a M 2.8 earthquake was detected in the vicinity of the oil field. From July 1980 through August 1984, a portable network of stations recorded 478 earthquakes within and around the producing area (fig. A14*B*). All the locatable events were shallow and exhibited travel-times consistent with hypocenters at a focal depth coincident with the producing horizon. No spatial correlation with specific wells was identifiable, however, and, although earthquake activity varied considerably in time, fluctuations in activity rate did not correlate with injection pressure, which, for the most part, remained nearly constant. This area is located just west of the Dale brine field in western New York and just north of injection-induced seismicity in northeastern Ohio (see section "Recent Seismicity and Injection Operations—Northeastern Ohio").

Matsushiro, Japan

Besides the Rangely oil field experiment, one of the few attempts to specifically manipulate earthquake behavior by fluid injection occurred near Matsushiro, Japan. In 1970, 2.9 million L of water was injected at a depth of 1,800 m,