

OIL AND GAS DOCKET NO. 03-0238823

THE APPLICATION OF PRAXAIR, INC., FOR A PERMIT TO CREATE, OPERATE AND MAINTAIN AN UNDERGROUND GAS STORAGE FACILITY, PRAXAIR HYDROGEN STORAGE LEASE, WELL NO. 1, MOSS BLUFF FIELD, LIBERTY COUNTY, TEXAS

Heard by: Margaret Allen, Technical Hearings Examiner

Procedural history

Application received: May 12, 2004
Hearing held: June 10 and July 23, 2004
Proposal for decision issued: July 28, 2004

Appearances

Dexter R. McDonald	Representing
Marianne Corrao	Praxair, Inc.
Michael A. Criscitiello	
Harry Allison	
Douglas Formaniak	

EXAMINER'S REPORT AND RECOMMENDATION

STATEMENT OF THE CASE

Praxair, Inc., ("Praxair") is seeking a permit to create, operate and maintain an underground gas storage facility, the Praxair Hydrogen Storage Lease, Well No. 1, in Liberty County. Praxair plans to store hydrogen gas in a storage cavern that will be leached out of the Moss Bluff salt dome.

The examiner recommends several changes to the safety contingency plan prepared by Praxair. The applicant has no objection to these changes and will comply with them before operations begin.

DISCUSSION OF THE EVIDENCE

Hydrogen gas is a by-product of some hydrocarbon refining but refinery production is not always sufficient to meet anticipated demand. Some method of storage is necessary to provide stability and reliability to hydrogen supplies. Hydrogen readily combines with the sulfur present in many hydrocarbons, removing it from gasolines and other fuels. Refineries require additional hydrogen to produce the low-sulfur gasoline which is required in 2004 and low-sulfur diesel fuel that will be required by 2007. Refiners also need hydrogen to process increasing amounts of heavy, sour crude oil that is being produced.

Praxair is the largest industrial gas company in North America, providing hydrogen, oxygen, helium, nitrogen, carbon dioxide and argon to industry. Seven generating plants deliver hydrogen into Praxair's 260 miles of pipelines between Lake Charles and Texas City. Praxair projects that its daily hydrogen demand will increase from 220 MMCF in 2003 to over 700 MMCF in 2007.

The applicant proposes to create a storage cavern in the Moss Bluff salt dome of Liberty County to increase the reliability of hydrogen gas. When demand is low Praxair will store hydrogen

at a cavern pressure of 450 to 2146 psi; when demand increases cavern gas will be released back to the Praxair pipeline.

The proposed cavern will be approximately 1900' high and 200' in diameter though the diameter will vary. As the cavern is solution mined, the bottom portion will fill with insoluble material, leaving about 1500' of storage space. The cavern will be have a maximum permitted capacity of 20 MMCF (equal to 4 million barrels). Normal operating procedure will be to inject hydrogen into the cavern at an injection pressure of 1100 to 1950 psi. Hydrogen will free-flow back out into the pipeline as needed.

The top of the cavity created will be at 2700' and the base at 4600'. The Moss Bluff salt dome is an oval salt mass with a relatively flat top. Salt has lower density than the overlying rocks and salt has been squeezed upward from thousands of feet below the surface. The Moss Bluff salt dome has pierced the overlying rocks and risen to about 1000' below the ground surface. Salt has also pushed up the strata overlying the dome.

At the location of Well No. 1, the top of the salt is expected to be 1190' below the surface and the top of the caprock over the dome to be about 900' below the surface. The caprock formed from insoluble residue, mainly anhydrite, clays and sulfur, left after the top of the salt dome was dissolved by groundwater. Texasgulf Sulfur Co. extracted sulfur from numerous wells drilled into the caprock on the east side of the salt dome until 1982. The closest production of sulfur was from a well 2200' east of this proposed cavern.

Overlying the caprock are discontinuous clays and sandstones which contain the Chicot Aquifer. According to the Texas Commission on Environmental Quality, usable-quality groundwater occurs to a depth of 500' at the location of Well No. 1. Well No. 1 will be at an elevation of 48' above sea level. The Moss Bluff salt dome is adjacent to the Trinity River but the dome itself has not flooded in several years. There are three active saltwater disposal wells northwest of the dome, and three caverns within the salt that are used by the Moss Bluff Hub Partners ("MHP") for hydrocarbon gas storage.

Praxair has contracted with MHP to provide the fresh water which will dissolve salt to create Praxair's cavern, and to dispose of the saltwater thus created. The Devers canal system provides irrigation water to this area and will be used by MHP for fresh water, while the saltwater will be injected into its disposal wells.

Praxair's area of review extended 1/4 mile from the maximum areal extent of the anticipated cavern, or 1420' from the wellhead. A portion of Highway 563 is located about 1400' from the wellhead. The closest residence is 1900' to the northeast. There are four plugged and abandoned wells within 1/4 mile of the cavern, but none penetrated more than a few feet into the salt. Two of MHP's storage caverns are in the area of review: MBGS-1 is 1000' to the west and MBGS-2 is 1400' to the

southwest. Sonar shows the closest part of the MBGS-1 cavern will be 791' from the edge of Praxair's proposed cavern. MHP is also planning to excavate a new cavern, MBGS-4, to the south of Praxair's proposed cavern. The closest points between the proposed cavern at MBGS-4 and the proposed Praxair cavern will be 717' apart.

Well No. 1 will have 36" surface casing set and cemented to 530'. Other strings of casing will be cemented to 940' (below the top of the caprock) and to 1420' (into the top of the salt). Production casing with a diameter of 13-3/8" will then be cemented at a depth of 2525'. Induction, neutron, density, gamma ray and SP logs will be run before each string of casing is cemented. After the production casing is cemented, Praxair will run a cement bond log.

The cavern will be developed by the injection of fresh water at rates from 1400 to 1700 gallons per minute. In addition to the logs and surveys planned during the cavern construction, the cavity boundary will be monitored by running sonar surveys at the completion of the sump development phase and at incremental developmental cavern volumes of 2 million barrels.

The cavern will be created as fresh water is injected through the annulus between two strings of hanging tubing, 10-3/4" and 7" in diameter. The brine produced will return through the 7" leaching tubing. Nitrogen will be injected as a blanket during the leaching operations. Density logs run during leaching will verify the nitrogen/brine interface which in turn provides for proper roof development. The brine produced will be analyzed for potassium¹ on a weekly basis to assist in proper development of the cavern roof. Additional blanket material will be injected if there is a large change in the potassium baseline. If a major increase in potassium is observed for more than 2 weeks, the solution mining operation will be shut down and a sonar survey will be run.

Praxair plans to take three thirty-foot cores in the salt and analyze them for soluble and insoluble salts and for clay content. The cores will also be subjected to sonic tests and creep measurements. When solution mining has been completed, another sonar survey will be run to determine cavern volume and shape prior to the storage of any hydrogen. After the solution mining operations are completed, a mechanical integrity test will be run on the wellbore.

Mechanical integrity tests and sonar surveys will be conducted a minimum of every five years after operations begin. During operations, Praxair will provide 24-hour monitoring from its office in Houston. There will be Emergency Shut-down Devices (ESDs) on all gas, brine and fresh water piping connected to the wellhead. The ESDs can be activated on site or remotely and will be tested twice a year. Pressure sensor switches can close ESDs automatically in response to changes in pressure. There will also be a conductivity sensor to detect hydrocarbon in the brine. Warning systems will be integrated with all leak detectors and pressure sensors to provide audible and visual warnings of hazards.

Changes in the ground surface can be caused by salt creeping inward and squeezing the caverns shut. Subsidence can result in partial collapse underground and breach the controls. There is already a subsidence grid in place to monitor changes in the ground surface and Praxair will share in the data. Praxair has contracted with a geotechnical safety company to monitor such operations.

Employees will be provided training along with an operations and maintenance manual. The

¹ Potassium is preferentially soluble and a large amount dissolved in brine could indicate the cavern is not developing uniformly in all directions.

emergency shut-down system can close all the valves to the cavern, blow down the system and isolate it from the pipeline. Shut-down can be initiated by an operator or will activate automatically when certain pressure conditions exist.

Praxair prepared a contingency plan for emergencies such as hydrogen gas fires, hydrogen gas releases, brine water, storm water, and spills of coolant or engine oils. Emergencies are categorized by levels. Level 1 can be handled by a technician on site. Level 2, which involves a release of 10 minutes or less, can be handled by Praxair employees. Level 3 involves a release of greater than 10 minutes duration and will require outside assistance to contain and control.

Praxair employees will be available to reach the facility within 30 minutes. Other emergency personnel may include response contractors, fire departments and law enforcement agencies. The contingency plan provides names and contact numbers of emergency responders.

EXAMINER'S OPINION

The examiner believes that Praxair has not demonstrated the openness that is necessary for effective safety operations. Nor has it made sufficient provision for the safety of the public, including the closest residents of Liberty County, that might be affected by an accidental release of hydrogen gas. Hydrogen is extremely flammable and explosive, though will not pool near the ground like hydrocarbon gas after release.

According to Statewide Rule 97(6), which requires an applicant to provide an emergency response plan:

...each storage facility shall submit to the commission a written emergency response plan. The plan shall address gas releases, fires, explosions, loss of electricity, and loss of telecommunication services. The plan shall describe the facility's emergency response communication system, procedures for coordination of emergency communication and response activities with local authorities, use of warning systems, procedures for citizen and employee emergency notification and evacuation, and employee training. The plan shall also include a plat of the facility showing the locations of wells, processing areas, and other significant features at the facility. The initial plan must be designed based upon the existing safety measures at the facility. The plan shall be updated as changes in safety features at the facility occur, or as the commission or its designee requires. A copy of the plan shall be provided to the local, emergency response committee and to any other local governmental entity that submits a written request for a copy of the plan to the operator. Copies of the plan shall also be available at the storage facility and at the company headquarters.

Praxair's contingency states that the Purpose and Scope of its Emergency Action Plan is "...to outline the requirement's [sic] for employees to follow when responding to emergencies within the Moss Bluff Storage Facility to ensure safe and efficient emergency mitigation and to ensure compliance with applicable Federal and State regulations." The examiner believes another major purpose of a contingency plan should be to provide an organized plan of action for alerting and protecting the public following the accidental release of a potentially hazardous volume of gas.

Praxair's 71-page contingency plan only mentions procedures for citizen emergency notification and evacuation twice. On the list of actions required of Praxair's Area Supervisor, item 14 is:

Anticipate the possibility of the fire or explosion escalation. Consideration shall be given to the evacuation of homes within a 2-mile radius of the release and extending the roadblocks beyond 200 yards from the facility. This will most likely be coordinated with local officials dispatched to the scene. [Page 7]

The only other mention of procedures for citizen emergency notification and evacuation is on a list of nine training topics. The complete third topic is listed as follows:

1.6.3 *Identifying geographic areas or populations most likely to be affected by a release.*

- Hospitals
- Pipelines of gas facilities
- Nursing homes
- Populated areas (homes, business)
- Schools
- Egress and access difficulties

The plan includes a list of facilities within two miles which references a boat ramp on the adjacent Trinity River, two "business districts" and three "residential areas", but does not include an occupied house less than 2000' from the proposed storage well. The examiner believes the plan does not show sufficient planning for the safety of the public in the area. The contingency plan should include the location, names and telephone numbers for all houses and businesses within two miles as well as a contact telephone number for the State boat ramp.

Rule 97 requires a map with the contingency plan. The plan submitted by Praxair contains no map at present. There is no map in the entire application showing the location of the well, processing areas, and other significant features at the facility in relation to the area that might have to be evacuated.

Statewide Rule 97(6) requires that copies be made available to the local, emergency response committee and to any other local governmental entity that submits a written request for a copy of the plan to the operator. However, according to Praxair's Emergency Action Plan, the plan is available only at the storage facility and at company regional operations headquarters. In fact, on the title page the plan is referred to as proprietary and that it is provided to the facility personnel in confidence and solely for use by them. Praxair has stated that the Emergency Action Plan may not be reproduced or its contents disclosed to third parties without the prior written consent of Praxair, Inc.

Statewide Rule 97(8) requires an annual emergency drill. Praxair's contingency plan does mention an annual discharge drill, but makes no mention the part of Rule 97(8) which states:

Written notice of the drill to be provided to the appropriate commission district office, the county emergency management coordinator, and the county sheriff's office at least seven days prior to the drill. Local emergency response authorities shall be invited to participate in all such drills. The operator shall file a written evaluation of the drill and plans for improvements with the appropriate district office and the county emergency management coordinator within 30 days after the date of the drill.

The contingency plan submitted makes no provision for the education of contractors. Rule 97(9)(B) requires that employee emergency training include contractor employees:

Each operator shall hold a safety meeting with each contractor prior to the commencement of any new contract work at an underground gas storage facility. Emergency measures, including safety and evacuation measures specific to the contractor's work, shall be explained in the contractor safety meeting.

This application should be approved only if Praxair's contingency plan is amended to include the following provisions in addition to those in the existing plan:

1. The contingency plan shall provide for written notice of an annual emergency drill to be provided to the appropriate commission district office, the county emergency management coordinator, and the county sheriff's office at least seven days prior to the drill. Local emergency response authorities shall be invited to participate in all such drills. The operator shall file a written evaluation of the drill and plans for improvements with the appropriate district office and the county emergency management coordinator within 30 days after the date of the drill.
2. The contingency plan shall include instructions and procedures for alerting the general public and public safety personnel of the existence of an emergency.
3. The contingency plan shall include procedures for follow-up action to remove the public from a two-mile radius in addition to procedures for requesting assistance.
4. The contingency plan shall include a plat detailing the area within a two-mile radius. The plat shall include the locations of private dwellings or residential areas, public facilities, such as schools, business locations, public roads, or other similar areas within two miles where the public might reasonably be expected.
5. The contingency plan shall include names and telephone numbers of residents within a two-mile radius. This contact list shall be updated as often as necessary.
6. The contingency plan shall include a list of the names and telephone numbers of the responsible parties for each of the possibly occupied public areas or facilities within a two-mile radius.
7. The contingency plan shall include provisions for advance briefing of the public within a two-mile radius. Such advance briefing shall include the following elements:
 - a. the hazards and characteristics of hydrogen gas;
 - b. the necessity for an emergency action plan;
 - c. the possible sources of hydrogen gas within a two-mile radius;
 - d. instructions for reporting a gas leak;
 - e. the manner in which the public will be notified of an emergency;
 - f. steps to be taken in case of an emergency.
8. The contingency plan shall provide for a safety meeting with each contractor prior to the

commencement of any new contract work at an underground gas storage facility. Emergency measures, including safety and evacuation measures specific to the contractor's work, shall be explained in the contractor safety meeting.

9. The contingency plan shall be kept updated to insure its current applicability and copies of the amended plan distributed to the emergency agencies that need it.

FINDINGS OF FACT

1. Notice of hearing on this application to create and use the proposed cavern was issued to all interested persons at least ten (10) days prior to the re-opened hearing.
 - a. Notice of the application (Form H-4) was mailed to the surface owners of the subject and adjoining tracts, mineral interest leasehold owners on the subject and offsetting tracts and to the Liberty County Clerk on March 26, 2004.
 - b. Notice of this hearing was issued by the Commission to the same persons on June 14 and a request was received for the hearing to be reopened.
 - c. Notice of the application was published in *The Vindicator*, a newspaper of general circulation in Liberty County, on August 31, September 7 and 14, 2003.
2. The proposed Praxair, Inc. Hydrogen Storage Lease, Well No. 1, will be used to store hydrogen gas which will increase supply stability for refiners along its Gulf Coast pipeline.
3. Praxair will create a cavern with a maximum permitted capacity of 4,000,000 barrels (20MMCF), by injecting fresh water to dissolve salt out of the Moss Bluff salt dome.
4. The cavern will be created between 2700' and 4600' below the surface and have an average diameter of 200'.
5. Hydrogen will be added to the cavern at an injection pressure of 1100 to 1950 psi, and cavern pressure will be 450 to 2146 psi. When needed hydrogen will free-flow back out into the pipeline.
6. Usable-quality groundwater occurs to a depth of 500' at the location of Well No. 1.
7. At the location of Well No. 1, the top of the salt is expected to be 1190' below the surface and the top of the caprock over the dome to be 900' below the surface.
8. Well No. 1 will have surface casing set and cemented to 530'. Other strings of casing will be cemented to 940' (below the top of the caprock) and to 1420' (into the top of the salt).
9. Production casing, with a diameter of 13-3/8", will be cemented to a depth of 2525'.
10. Induction, neutron, density, gamma ray and SP logs will be run before each string of casing is cemented.

11. After the production casing is cemented, Praxair will run a cement bond log.
12. Prior to beginning storage operations, Praxair will conduct a mechanical integrity test of the wellbore and will sonar the cavern to determine its size and shape.
13. All four of the wellbores within 1/4 mile of the maximum lateral extent of the cavern penetrated only the very top of the salt and have been plugged.
14. There are two hydrocarbon gas storage caverns within 1/4 mile and a third one proposed, but the closest point within any of these caverns to the proposed hydrogen storage cavern is 717'.
15. Hydrogen gas is flammable and explosive, but unlike natural gas, does not pool near the ground if released.
16. There will be an emergency shut-down system which can close all the valves to the cavern, blow down the system and isolate it from the pipeline in an emergency.
17. Shut-down can be initiated by an operator either on site or remotely and will also activate automatically when certain pressure conditions exist.
18. Operations will be monitored 24 hours a day from a site in Houston. Praxair personnel will always be able to reach the site within a maximum of 30 minutes.
19. There will be a conductivity sensor to detect hydrocarbon in the brine and warning systems will be integrated with all leak detectors and pressure sensors to provide audible and visual warnings of hazards.
20. Praxair will share in data from a subsidence grid already in place which monitors the changes in the ground surface that can be caused by salt creep or other factors.
21. Praxair prepared a contingency plan to cover emergencies such as hydrogen gas fires, hydrogen gas releases, brine water, storm water, and spills of coolant or engine oils.
22. A major emergency may require Praxair safety personnel to notify and evacuate residences and public areas.

CONCLUSIONS OF LAW

1. Proper notice was given to all necessary parties as required by Statewide Rule 97 [Tex. R.R. Comm'n, 16 TEX. ADMIN. CODE § 3.97] and other applicable statutory and regulatory provisions.
2. All things necessary to give the Commission jurisdiction to decide this matter have been performed or have occurred.

3. Granting the application to create a cavern in the Moss Bluff salt dome for the storage of hydrogen gas under the terms and conditions set forth in the attached Final Order, will not endanger fresh water resources nor endanger oil or gas resources in the area.
4. Granting the application with the required conditions is in the public interest because refineries require a reliable source of hydrogen to produce low-sulfur fuel.
5. The application to use the cavern and its associated wellbore to inject, store and remove hydrogen gas will not endanger public safety pursuant to Statewide Rule 97, as long as the requested conditions are met.
6. The terms and conditions set forth in the attached Final Order are reasonably necessary to protect usable-quality water from pollution.
7. The terms and conditions set forth in the attached Final Order are reasonably necessary to protect public safety.

EXAMINER'S RECOMMENDATION

Based on the above findings and conclusions, the examiner recommends that the application of Praxair, Inc., to create, maintain and operate a hydrogen storage cavern and associated wellbore at its Hydrogen Storage Lease, Well No. 1, Moss Bluff Field, Liberty County, be **GRANTED**, with the conditions proposed in the attached Final Order.

Respectfully submitted,

Margaret Allen
Technical Hearings Examiner