BW - ___33___

APPLICATION

Key Energy Services
6 Desta Drive
Suite 4300
Midland, Texas 79705

Telephone: 713.651.4300
Facsimile: 713.652.4005
www.keyenergy.com

Date: May 18, 2011

Glenn vonGonten- Acting Environmental Bureau Chief
Jim Griswold- Senior Hydrologist
1220 South St. Francis
Santa Fe, New Mexico 87505

Subject: Addendum to application for the new (replacement) brine well, Carlsbad, New Mexico

Dear Mr. vonGonten and Griswold:

Please find attached an addendum to the application originally submitted on January 31, 2011, for the new (replacement) brine well to be located near Carlsbad, New Mexico. The addendum up-dates the application in the following areas:

1. The public notices were modified to provide a better description of the site and to properly adhere to the public notice requirements. Enclosed are the up-dated public notices for your review and approval.

2. The original well design has been up-dated to include a salt roof blanket protection and monitoring system, and a different double tubing arrangement to facilitate tubing movement in order to properly develop and shape the cavern. Enclosed herein is an addendum to Section V1 appendix, updating the original brine well piping schematic and includes a new MSDS for the blanket fluid.

3. A rewrite of Section VII Brine Extraction Well(s) with up-dated appendices, (enclosed herein), includes PB Energy's recommended design, development, operation and monitoring plans that will be incorporated into the permit. PB Energy is one of the companies that designed and installed the US Strategic Petroleum Reserves in nature salt formations and has vast experience in brine well operations.

4. An up dated Section VII.A.1-4 appendix (enclosed herein) includes the C-101 form drilling permit and amended plan to coincide with the brine well design.

5. Also included is a geologic summary prepared by Dr. Dennis Powers, included at the end of the document.

Special note concerning water issues: The existing station used fresh water supplied from the city of Carlsbad. The new replacement well will continue to use city water as available and other municipal, commercial and local private water sources, including using treated water from various non-potable sources. Key Energy Services, LLC. (Key) will adhere to all local, state, federal laws, rules and regulations concerning water usage.

Key fully anticipates that the Oil Conservation Division may now make a proper administrative completeness determination. Upon division approval, Key will issue public notices and continue the permit process. If OCD requires additional information concerning this application please do not hesitate to call me at 432-571-7536 or Wayne Price at 505-715-2809, or E-mail wayneprice77@earthlink.net.

Sincerely,

Daniel K. Gibson, P.G.
Corporate Environmental Director

Attachments-1

Addendum for Application to the New (replacement) Brine Well Carlsbad, New Mexico

Submitted to:

New Mexico Oil Conservation Division

May 18, 2011

by:

Daniel K. Gibson
Corporate Environmental Director

Key Energy Services, LLC.
6 Desta Drive
Suite 4300
Midland, Texas 79705

Public Notice

Legal notification for 2'x3' signage per Water Quality Control Commission Regulations 20.6.2.3.108.B.1 NMAC

Key Energy Services LLC, 6 Desta Drive Suite 4300 Midland, TX 79705, Dan Gibson Corporate Environmental Director, has filed an application with the New Mexico Oil Conservation Division (OCD) to install and operate a replacement class III brine well for its existing brine and fresh water station previously permitted by the OCD as BW-19.

The existing water station and replacement brine well is located approximately One-half mile behind this sign. A detail description and aerial photo is hereby attached below.

A brine well pumps water into deep salt zones commonly found in this area and produces a concentrated Salt-water called "brine water". This brine water is used in the oilfield primarily for drilling and completion operations. It is anticipated brine water will be produced at a rate of less than 1700 barrels per day with a total dissolved concentration of 320,000 mg/l. Groundwater in this area may be present in limited quantities in zones ranging from 30 to 60 feet and from 100-250 feet below the ground surface. The concentration in total dissolved solids in this groundwater generally ranges from 500 to 2000 mg/l. The permit requires that the well and associated operations must be constructed and operated in a manner that will not adversely affect groundwater quality.

The New Mexico Oil Conservation Division (OCD) will accept comments and statements of interest regarding this application and will create a facility-specific mailing list for persons who wish to receive future notices. Interested persons may contact Jim Griswold, Oil Conservation Division (OCD) 505-476-3465 or by writing 1220 South Saint Francis, Santa Fe, New Mexico, 87505.

Para obtener más información sobre esta solicitud en espanol, sirvase comunicarse por favor: New Mexico Energy, Minerals and Natural Resources Department (Depto. Del Energia, Minerals y Recursos Naturales de Nuevo México), Oil Conservation Division (Depto. Conservacio´n Del Petróleo), 1220 South St. Francis Drive, Santa Fe, New México (Contacto: Dorothy Phillips, 505-476-3461)

Will contain the 8.5 x 11 inch detail off-site notice laminated in plastic Page 1	Will contain the 8.5 x 11 inch detail off-site notice laminated in plastic Page 2	Will contain the 8.5 x 11 inch Aerial photo of the site area Laminated in plastic.

Public Notice Display Ad

Legal notification for 3"x4" newspaper display add per Water Quality Control Commission Regulations 20.6.2.3.108.B.4 NMAC

Key Energy Services LLC, 6 Desta Drive Suite 4300 Midland, TX 79705, Dan Gibson Corporate Environmental Director, has filed an application with the New Mexico Oil Conservation Division (OCD) to install and operate a replacement class III brine well for its existing brine and fresh water station previously permitted by the OCD as BW-19. This well site will be located approximately 3 miles southwest of Carlsbad, New Mexico, Eddy County, in the Carlsbad ET Zone, located east of the airport and US highway 62-180. The portion of the land is actually part of the east side of the Old Carlsbad Army Airbase, currently used for commercial and industrial activity.

The existing water station is located in (SE/4 NE/4 UL H of Section 36 -Township 22 South- Range 26 East) on private land. The new replacement brine well will be located approximately 1000 feet east of the existing facility in (SW/4 NW/4 UL E of Section 31-Township 22 South-Range 27 East) on private land.

Brine water is used in the Oil and Gas industry to supply a "heavy pure sodium chloride" concentrated salt water (i.e. brine water) with a total dissolved solids concentration of approximately 320,000 mg/l and a density that is 20% higher than fresh water. Heavy brine water is essential in preventing blow-outs in high pressure gas wells and prevents loss of circulation when drilling through salt zones typically found in the Carlsbad area.

Fresh water will be injected deep into the Castile salt formation at a depth ranging from 1300 to 1500 feet below the surface to produce brine water. The Castile formation is the same deep stable formation found under the WIPP site. The formation is known to contain a pure "Sodium" salt that is preferred in the oil and gas drilling operations. Other salts typically found, in the potash area, playa lakes and salt-water aquifers, can interfere with the drilling mud programs, thus causing significant control problems and added cost.

The Castile formation contains thick continuous anhydrite rock layers, that act a lot like natural concrete beams, that overly the targeted salt section. These layers have been identified and geo-engineering calculations show they will provide a natural support and barrier for the cavern created as a result of solution mining. An engineering model that included safety factors was developed to verify the long- term stability of the site.

The brine well will be designed to produce at a rate of less than 1700 barrels per day, which equates to approximately 12 million barrels of brine water over a 20-year life period. The anticipated cavern radius will be approximately 150 feet. The well has been located on private land to generally provide a minimum of approximately 1000 foot separation from all existing significant features, such as houses, roads, utilities, pipelines, water supplies, buildings, schools, businesses, etc.

All land owners within 1/3 mile (i.e. 1760 ft) of the site will receive a special written notice.

This site has no public water supplies that may be impacted, and ground water in this area is somewhat limited, with some dry holes being encountered while in other wells groundwater may be present, both in shallow lenses 30-60 feet deep and in deeper horizons i.e. 100-250 feet. The shallow groundwater in this area is typically not used for drinking water and when found is in very limited quantity. The deeper zone is considered usable as an irrigation water source, when sufficient quantities are found, with an average quality concentration of 500-2000 mg/l of total dissolved solids.

This facility will be designed and permitted to have no intentional water contaminants discharged to the surface or subsurface for the protection of groundwater. The system will have concrete and synthetic liners to prevent any

spills or leaks from reaching the ground surface. The brine well will have double-cemented casing and tubing pipes to protect groundwater.

Key Energy has determined that bulk mixing of purchased pure salt is neither, economically feasible or environmentally safe. The volumes required during drilling programs cannot be met other than using brine caverns that can safely store large volumes of brine water.

If you have any questions or concerns please do not hesitate to contact Key Energy at the address above or you may contact Wayne Price 505-715-2809 or E-mail waynepriceZZ@earthlink.net. Key welcomes your input.

The New Mexico Oil Conservation Division (OCD) will accept comments and statements of interest regarding this application and will create a facility-specific mailing list for persons who wish to receive future notices. Interested persons may contact Jim Griswold, Oil Conservation Division (OCD) 505-476-3465 or by writing 1220 South Saint Francis, Santa Fe, New Mexico, 87505.

Para obtener más información sobre esta sollcitud en espanol, sirvase comunicarse por favor: New Mexico Energy, Minerals and Natural Resources Department (Depto. Del Energia, Minerals y Recursos Naturales de Nuevo México), Oil Conservation Division (Depto. Conservacio´n Del Petróleo), 1220 South St. Francis Drive, Santa Fe, New México (Contacto: Dorothy Phillips, 505-476-3461)

Public Notice Letter

Certified Mail:

Property Owner of Record:

Name:

Address:

City/County:

State:

Public Notice

Legal notification to property owner(s) of record within one-third mile per Water Quality Control Commission Regulations 20.6.2.3.108.B.2 NMAC

Key Energy Services LLC, 6 Desta Drive Suite 4300 Midland, TX 79705, Dan Gibson Corporate Environmental Director, has filed an application with the New Mexico Oil Conservation Division (OCD) to install and operate a replacement class III brine well for its existing brine and fresh water station previously permitted by the OCD as BW-19. This well site will be located approximately 3 miles southwest of Carlsbad, New Mexico, Eddy County, in the Carlsbad ET Zone, located east of the airport and US highway 62-180. The portion of the land is actually part of the east side of the Old Carlsbad Army Airbase, currently used for commercial and industrial activity.

The existing water station and replacement brine well may be located within one-third mile (i.e. 1760 ft) from your property boundary. An aerial photo has been attached in this notification for your review.

The existing water station is located in (SE/4 NE/4 UL H of Section 36 -Township 22 South- Range 26 East) on private land. The new replacement brine well will be located approximately 1000 feet east of the existing facility in (SW/4 NW/4 UL E of Section 31-Township 22 South Range 27 East) on private land.

Brine water is used in the Oil and Gas industry to supply a "heavy pure sodium chloride" concentrated salt water (i.e. brine water) with a total dissolved solids concentration of approximately 320,000 mg/l and a density that is 20% higher than fresh water. Heavy brine water is essential in preventing blow-outs in high pressure gas wells and prevents loss of circulation when drilling through salt zones typically found in the Carlsbad area.

Fresh water will be injected deep into the Castile salt formation at a depth ranging from 1300 to 1500 feet below the surface to produce brine water. The Castile formation is the same deep stable formation found under the WIPP site. The formation is known to contain a pure "Sodium" salt that is preferred in the oil and gas drilling operations. Other salts typically found, in the potash area, playa lakes and salt-water aquifers, can interfere with the drilling mud programs, thus causing significant control problems and added cost.

The Castile formation contains thick continuous anhydrite rock layers, that act a lot like natural concrete beams, that overly the targeted salt section. These layers have been identified and geo-engineering calculations show they will provide a natural support and barrier for the cavern created as a result of solution mining. An engineering model that included safety factors was developed to verify the long-term stability of the site.

The brine well will be designed to produce at a rate of less than 1700 barrels per day, which equates to approximately 12 million barrels of brine water over a 20-year life period. The anticipated cavern radius will be approximately 150 feet. The well has been located on private land to provide a ***minimum of*** ***(insert distance) feet separation from all your property line.***

This site has no public water supplies that may be impacted, and ground water in this area is somewhat limited, with some dry holes being encountered while in other wells groundwater may be present, both in shallow lenses 30-60 feet deep and in deeper horizons i.e. 100-250 feet. The shallow groundwater in this area is typically not used for drinking water and when found is in very limited quantity. The deeper zone is considered usable as an irrigation water source, when sufficient quantities are found, with an average quality concentration of 500-2000 mg/l of total dissolved solids.

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If you have any questions or concerns please do not hesitate to contact Key Energy at the address above or you may contact Wayne Price 505-715-2809 or E-mail waynepr[illegible]7@[illegible]. Key welcomes your input.

The New Mexico Oil Conservation Division (OCD) will accept comments and statements of interest regarding this application and will create a facility-specific mailing list for persons who wish to receive future notices. Interested persons may contact Jim Griswold, Oil Conservation Division (OCD) 505-476-3465 or by writing 1220 South Saint Francis, Santa Fe, New Mexico, 87505.

Para obtener más información sobre esta solicitud en espanol, sirvase comunicarse por favor: New Mexico Energy, Minerals and Natural Resources Department (Depto. Del Energia, Minerals y Recursos Naturales de Nuevo México), Oil Conservation Division (Depto. Conservacio´n Del Petróleo), 1220 South St. Francis Drive, Santa Fe, New México (Contacto: Dorothy Phillips, 505-476-3461)

Public Notice

Legal off-site notification per Water Quality Control Commission Regulations 20.6.2.3.108.B.1 NMAC

Key Energy Services LLC, 6 Desta Drive Suite 4300 Midland, TX 79705, Dan Gibson Corporate Environmental Director, has filed an application with the New Mexico Oil Conservation Division (OCD) to install and operate a replacement class III brine well for its existing brine and fresh water station previously permitted by the OCD as BW-19. This well site will be located approximately 3 miles southwest of Carlsbad, New Mexico, Eddy County, in the Carlsbad ET Zone, located east of the airport and US highway 62-180. The portion of the land is actually part of the east side of the Old Carlsbad Army Airbase, currently used for commercial and industrial activity.

An aerial photo has been attached in this notification for your review.

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All land owners within 1/3 mile (i.e. 1760 ft) of the site will receive a special written notice.

This site has no public water supplies that may be impacted, and ground water in this area is somewhat limited, with some dry holes being encountered while in other wells groundwater may be present, both in shallow lenses 30-60 feet deep and in deeper horizons i.e. 100-250 feet. The shallow groundwater in this area is typically not used for drinking water and when found is in very limited quantity. The deeper zone is considered usable as an irrigation water source, when sufficient quantities are found, with an average quality concentration of 500-2000 mg/l of total dissolved solids.

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Public Notice Letter

Legal notification to property owner(s) of the site per Water Quality Control Commission Regulations 20.6.2.3.108.B.3 NMAC

Certified Mail Return Receipt Requested:

Property Owner of Record:

Name:

Address:

City/County:

State:

Public Notice

Key Energy Services LLC, 6 Desta Drive Suite 4300 Midland, TX 79705, Dan Gibson Corporate Environmental Director, has filed an application with the New Mexico Oil Conservation Division (OCD) to install and operate a replacement class III brine well for its existing brine and fresh water station previously permitted by the OCD as BW-19. This well site will be located approximately 3 miles southwest of Carlsbad, New Mexico, Eddy County, in the Carlsbad ET Zone, located east of the airport and US highway 62-180. The portion of the land is actually part of the east side of the Old Carlsbad Army Airbase, currently used for commercial and industrial activity.

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Addendum (5/2011) Section VI. Appendix for Brine Well Application Guideline
Includes:

1. Brine well piping schematic-***Updated to include Diesel Blanket Pressure System.***
2. Facility and Fluid Flow Diagram
3. Recent photo of the Key Energy brine water tank storage area.
4. ***Packer Fluid MSDS- Changed to #2 Diesel.***

Key Energy Brine Well Piping Schematic

Date: Up Dated 5/2011
Drawn by: LWP-Price LLC
New Carlsbad Replacement Brine Well and Water Station

BW	Brine Water	PT	Packer Fluid Tank		Pressure gauge
FW	Fresh Water	CV	Check Valve		Elect valve
LC	Level Control	HPC	Hi Press cut-off		
FM	Flow Meters		sump with liner	SW	Sump Water To
	Valves				

Material Safety Data Sheet

SECTION 1 PRODUCT AND COMPANY IDENTIFICATION

DIESEL FUEL No. 2

Product Use: Fuel
Product Number(s): CPS203410 [See Section 16 for Additional Product Numbers]
Synonyms: 15 S Diesel Fuel 2, Alternative Low Aromatic Diesel (ALAD), Calco LS Diesel 2, Calco ULS DF2, Calco ULS Diesel 2, Chevron LS Diesel 2, Chevron ULS Diesel 2, Diesel Fuel Oil, Diesel Grade No. 2, Diesel No. 2-D S15, Diesel No. 2-D S500, Diesel No. 2-D S5000, Distillates, straight run, Gas Oil, HS Diesel 2, HS Heating Fuel 2, Light Diesel Oil Grade No. 2-D, LS Diesel 2, LS Heating Fuel 2, Marine Diesel, RR Diesel Fuel, Texaco Diesel, Texaco Diesel No. 2, Ultra Low Sulfur Diesel 2
Company Identification
Chevron Products Company
Marketing, MSDS Coordinator
6001 Bollinger Canyon Road
San Ramon, CA 94583
United States of America

Transportation Emergency Response
CHEMTREC: (800) 424-9300 or (703) 527-3887
Health Emergency
Chevron Emergency Information Center: Located in the USA. International collect calls accepted. (800) 231-0623 or (510) 231-0623
Product Information
MSDS Requests: (800) 689-3998
Technical Information: (510) 242-5357

SPECIAL NOTES: This MSDS covers all Chevron and Calco non-CARB Diesel No. 2 Fuels. The sulfur content is less than 0.5% (mass). Red dye is added to non-taxable fuel. (MSDS 6894)

SECTION 2 COMPOSITION/ INFORMATION ON INGREDIENTS

COMPONENTS	CAS NUMBER	AMOUNT
Diesel Fuel No. 2	68476-34-6	100 %wt/wt
Distillates, hydrodesulfurized, middle	64742-80-9	0 - 100 %wt/wt
Distillates, straight run middle (gas oil, light)	64741-44-2	0 - 100 %wt/wt
Kerosine	8008-20-6	0 - 25 %wt/wt
Kerosine, hydrodesulfurized	64742-81-0	0 - 25 %wt/wt
Distillates (petroleum), light catalytic cracked	64741-59-9	0 - 50 %wt/wt
Naphthalene	91-20-3	0.02 - 0.2 %wt/wt
Total sulfur	None	0 - 0.5 %wt/wt

SECTION 3 HAZARDS IDENTIFICATION

****

EMERGENCY OVERVIEW

- COMBUSTIBLE LIQUID AND VAPOR
- HARMFUL OR FATAL IF SWALLOWED - MAY CAUSE LUNG DAMAGE IF SWALLOWED
- CAUSES SKIN IRRITATION
- MAY CAUSE CANCER BASED ON ANIMAL DATA
- TOXIC TO AQUATIC ORGANISMS

****

IMMEDIATE HEALTH EFFECTS

Eye: Not expected to cause prolonged or significant eye irritation.

Skin: Contact with the skin causes irritation. Skin contact may cause drying or defatting of the skin. Symptoms may include pain, itching, discoloration, swelling, and blistering. Contact with the skin is not expected to cause an allergic skin response. Not expected to be harmful to internal organs if absorbed through the skin.

Ingestion: Because of its low viscosity, this material can directly enter the lungs, if swallowed, or if subsequently vomited. Once in the lungs it is very difficult to remove and can cause severe injury or death. May be irritating to mouth, throat, and stomach. Symptoms may include pain, nausea, vomiting, and diarrhea.

Inhalation: Mists of this material may cause respiratory irritation. Symptoms of respiratory irritation may include coughing and difficulty breathing. Breathing this material at concentrations above the recommended exposure limits may cause central nervous system effects. Central nervous system effects may include headache, dizziness, nausea, vomiting, weakness, loss of coordination, blurred vision, drowsiness, confusion, or disorientation. At extreme exposures, central nervous system effects may include respiratory depression, tremors or convulsions, loss of consciousness, coma or death.

DELAYED OR OTHER HEALTH EFFECTS:

Cancer: Prolonged or repeated exposure to this material may cause cancer. Whole diesel engine exhaust has been classified as a Group 2A carcinogen (probably carcinogenic to humans) by the International Agency for Research on Cancer (IARC). Diesel exhaust particulate has been classified as reasonably anticipated to be a human carcinogen in the National Toxicology Program's Ninth Report on Carcinogens. The National Institute of Occupational Safety and Health (NIOSH) has recommended that whole diesel exhaust be regarded as potentially causing cancer. Diesel engine exhaust is known to the State of California to cause cancer. Contains naphthalene, which has been classified as a Group 2B carcinogen (possibly carcinogenic to humans) by the International Agency for Research on Cancer (IARC).

See Section 11 for additional information. Risk depends on duration and level of exposure.

SECTION 4 FIRST AID MEASURES

Eye: No specific first aid measures are required. As a precaution, remove contact lenses, if worn, and flush eyes with water.

Skin: Wash skin with water immediately and remove contaminated clothing and shoes. Get medical attention if any symptoms develop. To remove the material from skin, use soap and water. Discard contaminated clothing and shoes or thoroughly clean before reuse.

Ingestion: If swallowed, get immediate medical attention. Do not induce vomiting. Never give anything by mouth to an unconscious person.

Inhalation: Move the exposed person to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention if breathing difficulties continue.

Note to Physicians: Ingestion of this product or subsequent vomiting may result in aspiration of light hydrocarbon liquid, which may cause pneumonitis.

SECTION 5 FIRE FIGHTING MEASURES

See Section 7 for proper handling and storage.

FIRE CLASSIFICATION:
OSHA Classification (29 CFR 1910.1200): Combustible liquid.

NFPA RATINGS: Health: 0 Flammability: 2 Reactivity: 0

FLAMMABLE PROPERTIES:
Flashpoint: (Pensky-Martens Closed Cup) 52 °C (125 °F) (Min)
Autoignition: 257 °C (494 °F)
Flammability (Explosive) Limits (% by volume in air): Lower: 0.6 Upper: 4.7

EXTINGUISHING MEDIA: Use water fog, foam, dry chemical or carbon dioxide (CO2) to extinguish flames.

PROTECTION OF FIRE FIGHTERS:
Fire Fighting Instructions: For fires involving this material, do not enter any enclosed or confined fire space without proper protective equipment, including self-contained breathing apparatus.
Combustion Products: Highly dependent on combustion conditions. A complex mixture of airborne solids, liquids, and gases including carbon monoxide, carbon dioxide, and unidentified organic compounds will be evolved when this material undergoes combustion.

SECTION 6 ACCIDENTAL RELEASE MEASURES

Protective Measures: Eliminate all sources of ignition in the vicinity of the spill or released vapor. If this material is released into the work area, evacuate the area immediately. Monitor area with combustible gas indicator.
Spill Management: Stop the source of the release if you can do it without risk. Contain release to prevent further contamination of soil, surface water or groundwater. Clean up spill as soon as possible, observing precautions in Exposure Controls/Personal Protection. Use appropriate techniques such as applying non-combustible absorbent materials or pumping. All equipment used when handling the product must be grounded. A vapor suppressing foam may be used to reduce vapors. Use clean non-sparking tools to collect absorbed material. Where feasible and appropriate, remove contaminated soil. Place contaminated materials in disposable containers and dispose of in a manner consistent with applicable regulations.
Reporting: Report spills to local authorities and/or the U.S. Coast Guard's National Response Center at (800) 424-8802 as appropriate or required.

SECTION 7 HANDLING AND STORAGE

Precautionary Measures: Liquid evaporates and forms vapor (fumes) which can catch fire and burn with explosive force. Invisible vapor spreads easily and can be set on fire by many sources such as pilot lights, welding equipment, and electrical motors and switches. Fire hazard is greater as liquid temperature rises above 29C (85F).
Do not get in eyes, on skin, or on clothing. Do not taste or swallow. Do not breathe vapor or fumes. Do not breathe mist. Wash thoroughly after handling. Keep out of the reach of children.
Unusual Handling Hazards: WARNING! Do not use as portable heater or appliance fuel. Toxic fumes may accumulate and cause death.
General Handling Information: Avoid contaminating soil or releasing this material into sewage and drainage systems and bodies of water.
Static Hazard: Electrostatic charge may accumulate and create a hazardous condition when handling this material. To minimize this hazard, bonding and grounding may be necessary but may not, by themselves, be sufficient. Review all operations which have the potential of generating and accumulating an electrostatic charge and/or a flammable atmosphere (including tank and container filling, splash filling, tank cleaning, sampling, gauging, switch loading, filtering, mixing, agitation, and vacuum truck operations)

and use appropriate mitigating procedures. For more information, refer to OSHA Standard 29 CFR 1910.106, 'Flammable and Combustible Liquids', National Fire Protection Association (NFPA 77, 'Recommended Practice on Static Electricity', and/or the American Petroleum Institute (API) Recommended Practice 2003, 'Protection Against Ignitions Arising Out of Static, Lightning, and Stray Currents'.

General Storage Information: DO NOT USE OR STORE near heat, sparks, flames, or hot surfaces . USE AND STORE ONLY IN WELL VENTILATED AREA. Keep container closed when not in use.

Container Warnings: Container is not designed to contain pressure. Do not use pressure to empty container or it may rupture with explosive force. Empty containers retain product residue (solid, liquid, and/or vapor) and can be dangerous. Do not pressurize, cut, weld, braze, solder, drill, grind, or expose such containers to heat, flame, sparks, static electricity, or other sources of ignition. They may explode and cause injury or death. Empty containers should be completely drained, properly closed, and promptly returned to a drum reconditioner or disposed of properly.

SECTION 8 EXPOSURE CONTROLS/PERSONAL PROTECTION

GENERAL CONSIDERATIONS:

Consider the potential hazards of this material (see Section 3), applicable exposure limits, job activities, and other substances in the work place when designing engineering controls and selecting personal protective equipment. If engineering controls or work practices are not adequate to prevent exposure to harmful levels of this material, the personal protective equipment listed below is recommended. The user should read and understand all instructions and limitations supplied with the equipment since protection is usually provided for a limited time or under certain circumstances.

ENGINEERING CONTROLS:

Use process enclosures, local exhaust ventilation, or other engineering controls to control airborne levels below the recommended exposure limits.

PERSONAL PROTECTIVE EQUIPMENT

Eye/Face Protection: No special eye protection is normally required. Where splashing is possible, wear safety glasses with side shields as a good safety practice.

Skin Protection: Wear protective clothing to prevent skin contact. Selection of protective clothing may include gloves, apron, boots, and complete facial protection depending on operations conducted. Suggested materials for protective gloves include: Chlorinated Polyethylene (or Chlorosulfonated Polyethylene), Nitrile Rubber, Polyurethane, Viton.

Respiratory Protection: Determine if airborne concentrations are below the recommended occupational exposure limits for jurisdiction of use. If airborne concentrations are above the acceptable limits, wear an approved respirator that provides adequate protection from this material, such as: Air-Purifying Respirator for Organic Vapors.

When used as a fuel, this material can produce carbon monoxide in the exhaust. Determine if airborne concentrations are below the occupational exposure limit for carbon monoxide. If not, wear an approved positive-pressure air-supplying respirator.

Use a positive pressure air-supplying respirator in circumstances where air-purifying respirators may not provide adequate protection.

Occupational Exposure Limits:

Component	Agency	TWA	STEL	Ceiling	Notation
Diesel Fuel No. 2	ACGIH	100 mg/m3	--	--	Skin A3 total hydrocarbon
Diesel Fuel No. 2	CVX	--	1000 mg/m3	--	--
Kerosine	ACGIH	200 mg/m3	--	--	Skin A3 Total hydrocabon

					vapor
Kerosine	CVX	--	1000 mg/m3	--	--
Kerosine, hydrodesulfurized	ACGIH	200 mg/m3	--	--	Skin A3 Total hydrocabon vapor
Kerosine, hydrodesulfurized	CVX	--	1000 mg/m3	--	--
Naphthalene	ACGIH	10 ppm (weight)	15 ppm (weight)	--	Skin
Naphthalene	OSHA Z-1	50 mg/m3	--	--	--

SECTION 9 PHYSICAL AND CHEMICAL PROPERTIES

Attention: the data below are typical values and do not constitute a specification.

Color: Varies depending on specification
Physical State: Liquid
Odor: Petroleum odor
pH: Not Applicable
Vapor Pressure: 0.04 kPa (Approximate) @ 40 °C (104 °F)
Vapor Density (Air = 1): >1
Boiling Point: 175.6°C (348°F) - 370°C (698°F)
Solubility: Soluble in hydrocarbons; insoluble in water
Freezing Point: Not Applicable
Melting Point: Not Applicable
Specific Gravity: 0.8 - 0.88 @ 15.6°C (60.1°F) (Typical)
Viscosity: 1.9 cSt - 4.1 cSt @ 40°C (104°F)

SECTION 10 STABILITY AND REACTIVITY

Chemical Stability: This material is considered stable under normal ambient and anticipated storage and handling conditions of temperature and pressure.
Incompatibility With Other Materials: May react with strong acids or strong oxidizing agents, such as chlorates, nitrates, peroxides, etc.
Hazardous Decomposition Products: None known (None expected)
Hazardous Polymerization: Hazardous polymerization will not occur.

SECTION 11 TOXICOLOGICAL INFORMATION

IMMEDIATE HEALTH EFFECTS
Eye Irritation: The eye irritation hazard is based on evaluation of data for similar materials or product components.
Skin Irritation: The skin irritation hazard is based on evaluation of data for similar materials or product components.
Skin Sensitization: This material did not cause skin sensitization reactions in a Buehler guinea pig test.
Acute Dermal Toxicity: LD50: >5ml/kg (rabbit)
Acute Oral Toxicity: LD50: > 5 ml/kg (rat)
Acute Inhalation Toxicity: 4 hour(s) LC50: > 5mg/l (rat).

ADDITIONAL TOXICOLOGY INFORMATION:
This product contains gas oils.
CONCAWE (product dossier 95/107) has summarized current health, safety and environmental data available for a number of gas oils, typically hydrodesulfurized middle distillates, CAS 64742-80-9, straight-

run middle distillates, CAS 64741-44-2, and/or light cat-cracked distillate CAS 64741-59-9.
CARCINOGENICITY: All materials tested have caused the development of skin tumors in mice, but all featured severe skin irritation and sometimes a long latency period before tumors developed. Straight-run and cracked gas oil samples were studied to determine the influence of dermal irritation on the carcinogenic activity of middle distillates. At non-irritant doses the straight-run gas oil was not carcinogenic, but at irritant doses, weak activity was demonstrated. Cracked gas oils, when diluted with mineral oil, demonstrated carcinogenic activity irrespective of the occurrence of skin irritation. Gas oils were tested on male mice to study tumor initiating/promoting activity. The results demonstrated that while a straight-run gas oil sample was neither an initiator or promotor, a blend of straight-run and FCC stock was both a tumor initiator and a promoter.
GENOTOXICITY: Hydrotreated & hydrodesulfurized gas oils range in activity from inactive to weakly positive in in-vitro bacterial mutagenicity assays. Mouse lymphoma assays on straight-run gas oils without subsequent hydrodesulphurization gave positive results in the presence of S9 metabolic activation. In-vivo bone marrow cytogenetics and sister chromatic exchange assay exhibited no activity for straight-run components with or without hydrodesulphurization. Thermally or catalytically cracked gas oils tested with in-vitro bacterial mutagenicity assays in the presence of S9 metabolic activation were shown to be mutagenic. In-vitro sister chromatic exchange assays on cracked gas oil gave equivocal results both with and without S9 metabolic activation. In-vivo bone marrow cytogenetics assay was inactive for two cracked gas oil samples. Three hydrocracked gas oils were tested with in-vitro bacterial mutagenicity assays with S9, and one of the three gave positive results. Twelve distillate fuel samples were tested with in-vitro bacterial mutagenicity assays & with S9 metabolic activation and showed negative to weakly positive results. In one series, activity was shown to be related to the PCA content of samples tested. Two in-vivo studies were also conducted. A mouse dominant lethal assay was negative for a sample of diesel fuel. In the other study, 9 samples of No 2 heating oil containing 50% cracked stocks caused a slight increase in the number of chromosomal aberrations in bone marrow cytogenetics assays. DEVELOPMENTAL TOXICITY: Diesel fuel vapor did not cause fetotoxic or teratogenic effects when pregnant rats were exposed on days 6-15 of pregnancy. Gas oils were applied to the skin of pregnant rats daily on days 0-19 of gestation. All but one (coker light gas oil) caused fetotoxicity (increased resorptions, reduced litter weight, reduced litter size) at dose levels that were also maternally toxic.

This product contains naphthalene. GENERAL TOXICITY: Exposure to naphthalene has been reported to cause methemoglobinemia and/or hemolytic anemia, especially in humans deficient in the enzyme glucose-6-phosphate dehydrogenase. Laboratory animals given repeated oral doses of naphthalene have developed cataracts. REPRODUCTIVE TOXICITY AND BIRTH DEFECTS: Naphthalene did not cause birth defects when administered orally to rabbits, rats, and mice during pregnancy, but slightly reduced litter size in mice at dose levels that were lethal to the pregnant females. Naphthalene has been reported to cross the human placenta. GENETIC TOXICITY: Naphthalene caused chromosome aberrations and sister chromatid exchanges in Chinese hamster ovary cells, but was not a mutagen in several other in-vitro tests.CARCINOGENICITY: In a study conducted by the National Toxicology Program (NTP), mice exposed to 10 or 30 ppm of naphthalene by inhalation daily for two years had chronic inflammation of the nose and lungs and increased incidences of metaplasia in those tissues. The incidence of benign lung tumors (alveolar/bronchiolar adenomas) was significantly increased in the high-dose female group but not in the male groups. In another two-year inhalation study conducted by NTP, exposure of rats to 10, 30, and 60 ppm naphthalene caused increases in the incidences of a variety of nonneoplastic lesions in the nose. Increases in nasal tumors were seen in both sexes, including olfactory neurobiastomas in females at 60 ppm and adenomas of the respiratory epithelium in males at all exposure levels. The relevance of these effects to humans has not been established. No carcinogenic effect was reported in a 2-year feeding study in rats receiving naphthalene at 41 mg/kg/day.

This product may contain significant amounts of Polynuclear Aromatic Hydrocarbons (PAH's) which have been shown to cause skin cancer after prolonged and frequent contact with the skin of test animals. Brief or intermittent skin contact with this product is not expected to have serious effects if it is washed from the skin. While skin cancer is unlikely to occur in human beings following use of this product, skin contact

and breathing, of mists, vapors or dusts should be reduced to a minimum.

SECTION 12 ECOLOGICAL INFORMATION

ECOTOXICITY
96 hour(s) LC50: 21-210 mg/l (Salmo gairdneri)
48 hour(s) EC50: 20-210 mg/l (Daphnia magna)
72 hour(s) EC50: 2.6-25 mg/l (Raphidocelius subcapitata)
This material is expected to be toxic to aquatic organisms.

ENVIRONMENTAL FATE
On release to the environment the lighter components of diesel fuel will generally evaporate but depending on local environmental conditions (temperature, wind, mixing or wave action, soil type, etc.) the remainder may become dispersed in the water column or absorbed to soil or sediment. Diesel fuel would not be expected to be readily biodegradable. In a modified Strum test (OECD method 301B) approximately 40% biodegradation was recorded over 28 days. However, it has been shown that most hydrocarbon components of diesel fuel are degraded in soil in the presence of oxygen. Under anaerobic conditions, such as in anoxic sediments, rates of biodegradation are negligible.

SECTION 13 DISPOSAL CONSIDERATIONS

Use material for its intended purpose or recycle if possible. This material, if it must be discarded, may meet the criteria of a hazardous waste as defined by US EPA under RCRA (40 CFR 261) or other State and local regulations. Measurement of certain physical properties and analysis for regulated components may be necessary to make a correct determination. If this material is classified as a hazardous waste, federal law requires disposal at a licensed hazardous waste disposal facility.

SECTION 14 TRANSPORT INFORMATION

The description shown may not apply to all shipping situations. Consult 49CFR, or appropriate Dangerous Goods Regulations, for additional description requirements (e.g., technical name) and mode-specific or quantity-specific shipping requirements.

DOT Shipping Description: GAS OIL, COMBUSTIBLE LIQUID, UN1202,III

IMO/IMDG Shipping Description: UN1202, GAS OIL, 3, III, FLASH POINT SEE SECTION 5

ICAO/IATA Shipping Description: UN1202, GAS OIL, 3, III

SECTION 15 REGULATORY INFORMATION

EPCRA 311/312 CATEGORIES:

1.	Immediate (Acute) Health Effects:	YES
2.	Delayed (Chronic) Health Effects:	YES
3.	Fire Hazard:	YES
4.	Sudden Release of Pressure Hazard:	NO
5.	Reactivity Hazard:	NO

REGULATORY LISTS SEARCHED:

01-1=IARC Group 1	03=EPCRA 313
01-2A=IARC Group 2A	04=CA Proposition 65
01-2B=IARC Group 2B	05=MA RTK
02=NTP Carcinogen	06=NJ RTK

07=PA RTK

The following components of this material are found on the regulatory lists indicated.

Diesel Fuel No. 2	07
Distillates, straight run middle (gas oil, light)	06
Kerosine	05, 06, 07
Naphthalene	01-2B, 02, 03, 04, 05, 06, 07

CERCLA REPORTABLE QUANTITIES(RQ)/EPCRA 302 THRESHOLD PLANNING QUANTITIES(TPQ):

Component	Component RQ	Component TPQ	Product RQ
Naphthalene	100 lbs	None	55556 lbs

CHEMICAL INVENTORIES:
All components comply with the following chemical inventory requirements: AICS (Australia), DSL (Canada), EINECS (European Union), IECSC (China), KECI (Korea), PICCS (Philippines), TSCA (United States).

NEW JERSEY RTK CLASSIFICATION:
Refer to components listed in Section 2. Under the New Jersey Right-to-Know Act L. 1983 Chapter 315 N.J.S.A. 34:5A-1 et. seq., the product is to be identified as follows: DIESEL FUEL

WHMIS CLASSIFICATION:
Class B, Division 3: Combustible Liquids
Class D, Division 2, Subdivision A: Very Toxic Material - Carcinogenicity
Class D, Division 2, Subdivision B: Toxic Material - Skin or Eye Irritation

SECTION 16 OTHER INFORMATION

NFPA RATINGS: Health: 0 Flammability: 2 Reactivity: 0

(0-Least, 1-Slight, 2-Moderate, 3-High, 4-Extreme, PPE:- Personal Protection Equipment Index recommendation, *- Chronic Effect Indicator). These values are obtained using the guidelines or published evaluations prepared by the National Fire Protection Association (NFPA) or the National Paint and Coating Association (for HMIS ratings).

Additional Product Number(s): CPS203413, CPS203417, CPS220122, CPS225114, CPS225115, CPS225150, CPS266176, CPS270000, CPS270005, CPS270094, CPS270095, CPS270096, CPS271006, CPS272006, CPS272007, CPS272008, CPS272009, CPS272010, CPS272011, CPS272012, CPS272013, CPS272093, CPS272102, CPS272126, CPS272152, CPS272185, CPS272190, CPS272195, CPS272593, CPS272601, CPS272693, CPS272793, CPS273003, CPS273030, CPS273053, CPS275000
REVISION STATEMENT: This revision updates the following sections of this Material Safety Data Sheet: 16.
Revision Date: July 31, 2006

ABBREVIATIONS THAT MAY HAVE BEEN USED IN THIS DOCUMENT:

TLV - Threshold Limit Value	TWA - Time Weighted Average
STEL - Short-term Exposure Limit	PEL - Permissible Exposure Limit

	CAS - Chemical Abstract Service Number
ACGIH - American Conference of Government Industrial Hygienists	IMO/IMDG - International Maritime Dangerous Goods Code
API - American Petroleum Institute	MSDS - Material Safety Data Sheet
CVX - Chevron	NFPA - National Fire Protection Association (USA)
DOT - Department of Transportation (USA)	NTP - National Toxicology Program (USA)
IARC - International Agency for Research on Cancer	OSHA - Occupational Safety and Health Administration

Prepared according to the OSHA Hazard Communication Standard (29 CFR 1910 1200) and the ANSI MSDS Standard (Z400.1) by the Chevron Energy Technology Company, 100 Chevron Way, Richmond, California 94802.

The above information is based on the data of which we are aware and is believed to be correct as of the date hereof. Since this information may be applied under conditions beyond our control and with which we may be unfamiliar and since data made available subsequent to the date hereof may suggest modifications of the information, we do not assume any responsibility for the results of its use. This information is furnished upon condition that the person receiving it shall make his own determination of the suitability of the material for his particular purpose.

*VII. **Addendum 5/2011** -Brine Extraction Well(s)- In-situ brine extraction wells must meet the requirements of Part 5 of the Water Quality Control Commission Regulations in addition to other applicable requirements of WQCC and Oil Conservation Division Rules and Regulations.*

Answer and Description for New Brine Well(s):

Brine Well, Cavern Development, Operation and Design Considerations:

The original well bore design has been changed to the following configuration. Drill and install 40 feet of 16 inch 75 #/ft J-55 BT&C conductor pipe and cement to the surface. The well bore will still consist of two casing and tubing strings, but arranged in the following manner. The water protection casing string will consist of 13.375 inch 61 #/ft J-55 BT&C and cemented to the surface, and set at a depth of approximately 500 ft below ground level. A 1250-foot long casing string consisting of 10.75 inch 40.5 #/ft J-55 BT&C will be installed where at least 50 feet will be cemented into the Castile Salt I Zone and cemented back to the surface.

The original design called for a double tubing packer set to isolate the salt formation from the annulus. This design has been changed to have no packer, with two integral tubing strings, one inside the other, hung from the surface.

The outer tubing string will consist of 1300 feet of 7 inch J-55 20 #/ft pipe, and will be set approximately 50 feet below the casing shoe. This string will normally act as the brine water return pipe. The inner tubing string consisting of 1548 feet of 4.5 inch, 9.5 #/ft J-55 tubing will be set approximately 250 feet below the outer tubing string. This inner string will normally be used for fresh water injection.

Even though the original design was inline with the OCD Brine Well Work Group discussions held in 2009, Key Energy opted to change the design after discussions with PB Energy Storage Services, Inc., a company with extensive experience in developing caverns for the US Strategic Petroleum Reserves. Key Energy contracted PB Services to assist in providing procedures to develop the cavern properly and innovative techniques to protect the roof salt zone. In addition, PB Services conducted cavern modeling for optimum shape and size.

It was determine that a design change was in order to be able to properly develop the cavern and provide protection of the roof salt. The most noted change was the fact that the original design did not allow for a viable means to install and maintain a blanket fluid and monitor cavern pressure on a full time basis. Also, the original design would have been very cumbersome in moving the tubing strings to allow for cavern shaping.

The original design generally would have allowed the cavern to grow from the bottom up, creating an elongated conical cavern resembling a flask. The new design uses techniques mastered by PB Services by using modeling programs to provide information on times, flow rate, tubing placement, including reversing flow at times for optimal cavern shaping. In addition, the new design allows for a more aggressive and accurate sonar testing.

The annulus will be filled with a protective roof blanket fluid, like diesel. This fluid will be monitored on a continuous basis and fluid added as required. The original well design has been up-dated to include a salt roof blanket protection and monitoring system, and a different double tubing arrangement to facilitate tubing movement in order to properly develop and shape the cavern. Enclosed in the addendum to Section VI Appendix, is an updated brine well piping schematic that includes the changes and a new MSDS for the blanket fluid.

Enclosed in the updated addendum to Appendix Section VII, is PB Energy's proposal showing the new well bore design, Plan for Brine Well Operations, Brine Well Leaching Plan, and System Hydraulics.

An updated *C-101 form, with attachments, that includes the changes from the original design, including the casing/tubing/packer/cement type, size, installation depths, location, formation details and drilling plan are included in the addendum to appendix VII.A.1-4 attached herein.*

The lithology of the formation has been described In detail in the Geological Characterization Report in section IX Site Characteristics. The brine well has been selected to be located in UL E (1000 FWL & 2140 FNL) of Section 31, Township 21s, Range 27e. This zone provides approximately 500 feet of Surface/Rustler/Salado, 330 feet of the Anhydrite III-IV, 200 feet of Salt II, 150 feet of Anhydrite II, 350 feet of Salt I, and 300 feet of base consisting of Anhydrite I.

An updated W-E cross-section showing the location of the brine well cavern in the proposed zone is included in the addendum for Section VII Appendix for review. The original location was accidently located in the wrong unit letter. In addition, the original cross-section indicated the limestone found on the west side was marked as Capitan Reef Limestone. The updated cross-section indicates it's a limestone, which most likely is the Carlsbad Limestone.

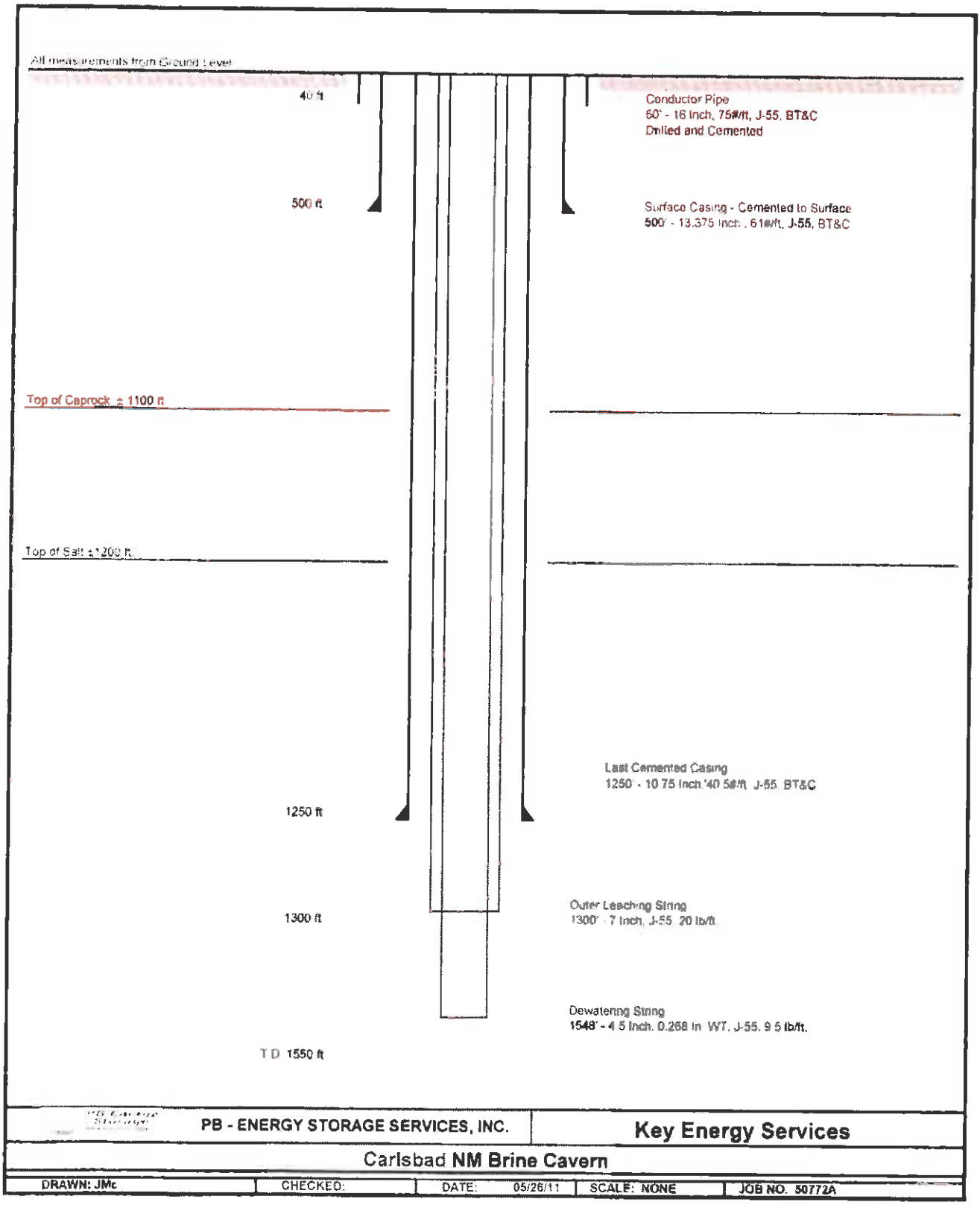
A Key Geology Summary composed by Dr. Dennis Powers, a consulting Geologist with extensive experience in the Key Study area, is attached for reference.

This geologic location provides for approximately 480 feet of anhydrite overlying the anticipated mined area. A Brine Well Roof Stability Steady State Model was developed to determine critical parameters such as maximum safe diameter and is included in the original submittal section VII.

Addendum (5/2011) Section VII. Appendix for Brine Well Application Guideline

Includes:

1. Conceptual Brine Well Drawing- *Replaced with PB-Energy Storage Services, Inc. Well Bore Diagram.*
2. *PB Energy's Plan for Brine Well Operations.* (14 pages)
3. *PB Energy's Brine Well Leaching Plan. (10 pages)*
4. ***PB Energy's System Hydraulics Schematics.*** (3 pages)
5. Modified West-East Cross-Section showing locations of Old Brine BW-19 and the New Proposed Brine Well in the Castile Formation- ***Minor corrections made.***
6. Figure of the Fractured Anhydrite Circular Plate over Brine Cavern
7. Brine Well Cavern Volume Calculation
8. Results of Model for Key Proposed Brine Well
9. JWS Model Results
10. Loco Hills Model Results
11. I&W Model Results
12. Key P&A Model Results
13. Drawing of Cantilever Beam Design



	PB - ENERGY STORAGE SERVICES, INC.			Key Energy Services	
Carlsbad NM Brine Cavern					
DRAWN: JMc	CHECKED:	DATE: 05/26/11	SCALE: NONE	JOB NO. 50772A	

16285 Park Ten Place, Suite 400
Houston, Texas 77084

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Key Energy Well Brine Well Operations

Introduction

Key Energy proposes to operate a brine production facility at Carlsbad, New Mexico. This facility will supply brine for oil and gas drilling activities in the region. During the course of a year, the brine demand will vary considerably. Key Energy desires that the well be capable of producing saturated brine at about 200 gpm.

Key Energy will drill one new well and will develop it to produce brine as required. This report describes the activities needed to mine the Key Energy Well. The challenge in mining Key Energy Well is to produce saturated brine (over 310 grams of salt per liter of water) in as short a time as possible.

Technical Approach to Brine Production

Brine is produced by dissolving salt with water. In a well, this is generally accomplished by injecting water in one string of tubing and having brine forced out a second string of tubing. The degree of saturation of the resulting brine is a function of temperature and contact time of the water with the salt.

In a salt cavern, the temperature is a function of the temperature of the salt body at the depth of the cavern and the temperature of the injected water and is essentially unchangeable by the operator. In solution mining operations the saturation of the produced brine is controlled through the contact time between the water and salt. The operator can control some items that affect the saturation such as the area of salt exposed to water (the height and volume of the cavern), the rate of water injection, and the position of the tubing strings.

Cavern Design

The cavern for Key Energy Well was designed using SANSMIC, a numerical simulation code which approximates the dissolution of salt by water. SANSMIC is a widely used cavern modeling program developed by Sandia National Laboratories.

The program is an axisymmetric model that provides information on the cavern radius with depth and the rate of salt mining. The primary inputs into the model are:

1. Initial cavern or well radii with depth.
2. Water injection rate.
3. Positions of the tubing strings used for mining,
4. Location of the roof blanket material,
5. Insoluble content of the salt, and
6. Temperature of the cavern.

The outputs from the model are the cavern radii with depth and the salinity of the brine both produced from and remaining in the cavern.

As with all numerical models, SANSMIC does not fully represent the actual salt caverns. In the case of SANSMIC, this is due to 1) the axisymmetric assumption in the model (that the cavern will develop evenly about the central wellbore) and 2) limitations in the equations for flow within the cavern.

In most flat lying bedded salts the caverns tend to be regular and the axisymmetric assumption is *generally* not a significant limitation to modeling.

The limitations in the hydraulic equations result in over-estimation of development near the bottom of the injection tubing in both reverse and direct mining and a corresponding underestimation of mining in the upper portions of the cavern. This limitation is more pronounced at higher water injection rates than will be used by Key Energy. These limitations also affect the simulated specific gravity of the cavern brine. SANSMIC generally predicts the brine specific gravity to be about 0.001 to 0.003 points lower than will be obtained in the field.

Solution Mining

General

The concept for Key Energy Well was based on the desire to minimize required workovers and to maximize brine production. The cavern design has two stages of development:

1. Sump (Stage 1) from 1,550 to 1,300 feet depth with a volume of about 45,000 barrels
2. Development (Stage 2) from TD to 1,300 feet with a volume of about 547,000 barrels
3. Production (Stage 3) as needed at 200 gpm to a final volume of about 1,760,000 bbls.

The volumes given are the volumes of salt produced, not the open volume of the cavern. The open volume of the cavern will be about 3% less than the mined volume due to bulking of the insolubles. The maximum production capability of the well is limited to 200 gpm after the second stage. The plan is given in Table 1. The SANSMIC simulated shape of the cavern is shown in Figure 1.

The initial borehole radius was assumed to be a constant one foot. The average temperature of the brine in the cavern was estimated to be 75° F during mining. The insoluble content of the salt was estimated to average 1% by volume. The depth of the tubing strings was to minimize the need for workovers and to obtain an acceptable cavern shape and was then kept constant. The water injection rates were varied with time to match maturity of the cavern.

Table 1 Solution Mining Plan for Key Energy Well

Stage	Blanket Depth (ft)	Production Depth (ft)	Injection Depth (ft)	Insoluble Depth (ft)	Water Injection (gpm)	Cumulative Brine Produced (barrels)	Mined Salt Volume (barrels)
1	1300	1400	1550	1547	75	272,000	45,000
2a	1300	1540	1400	1537	125	1,679,000	282,000
2b	1300	1525	1400	1532	150	2,405,000	405,000
2c	1300	1525	1400	1525	175	3,251,000	547,000
3	1300	1525	1400	1495	200	10,481,000	1,763,000

Solution mining was evaluated from initial development of a sump, through a development stage and to completion of the cavern. The plan *requires* no workover involving a rig. **However, workovers may be needed if the tubing string plugs or to perform sonar surveys to monitor cavern development.** Several casing cuts using wireline tools will be required during solution mining in order to keep the inner tubing above the insolubles.

The plan assumes that weak brine from the sump stage will be piped to surface tanks and recirculated through the well until saturated. This assumption is necessary to produce saturated brine from the early stages of development.

The first two stages of development (sump) use direct mining (water injection through the inner string and brine production from the shallower string) to develop a large area in the bottom of the caverns for accumulation of insolubles in the salt that will fall to the bottom of the cavern during leaching. The subsequent stages of development use reverse circulation (injection in the shallower, outer tubing with brine production from the deeper, inner tubing string). This method of mining develops the upper portion of the cavern and mines the salt more efficiently so that saturated brine is produced.

Preparation

Prior to starting leaching in Key Energy Well, the well must be prepared for solution mining operations. The final casing will have been set and cemented at about 1,250 feet depth, or about 50 feet into the lower salt. The borehole will have been drilled to about 1,550 feet (about 10 feet below the base of the lower salt) and opened to a diameter of 12".

In the well the tubing strings used for leaching must be hung at the correct depths. The outer 7" tubing string should be set at 1,400 feet depth and hung in its spool. The inner 4-1/2" mining string should be set and hung in its spool at about 1,550 feet.

The blanket to protect the roof should be set at about 1,300 feet. This will require about 58 bbls of fluid. The depth of the blanket must be verified with an appropriate geophysical (interface) log. A well schematic is shown in Figure 1.

On the surface, the water and brine lines should be connected to the site systems. For the first stage of mining in Key Energy Well, the brine line should be connected to a pump to allow the brine to be injected into the well from the brine storage tanks. This step is crucial for producing saturated brine for the initial 272,000 barrels produced from leaching operations in the well.

The wellhead should be equipped with pressure gauges or transmitters to allow monitoring of the water, brine and blanket pressures, and flow meters on both the water and brine lines. Prior to the start of leaching, the well must be tested to ensure mechanical integrity.

Sump Stage

The initial step in mining will create a sump at the bottom of the borehole. This sump will provide space for collection of the insolubles that are contained within the salt and are freed during the dissolution of the salt.

Mining in the sump stage will be conducted in direct circulation – water injection in the inner deeper tubing string and brine production from the outer, shallower tubing string. This will concentrate most of the initial mining near the bottom of the borehole creating the desired *sump* for accumulation of the insolubles during later mining.

In order to form the sump and to minimize fill up of the borehole and proto cavern, the blanket should be set at a depth of 1,300 feet. If the blanket is set higher than the specified depth, there may be insufficient borehole to perform required mechanical integrity tests later in the life of the well.

During the sump stage, the flow will need to be regulated to be as low as possible and recycled through the surface brine holding tanks. Model simulations indicate that the brine will be unsaturated until it has circulated through the well about four times. As the cavern size increase, the amount of recirculation that is needed to saturate the brine will decrease slightly. The brine salinity will have to be monitored closely at the surface to produce the desired strength for each customer.

During the sump stage, the blanket level should be monitored constantly by observing the pressure on both the brine and blanket. The difference in the pressures should remain relatively constant at similar flow rates. In the event that the differential pressure changes, the blanket level should be checked by an interface log run in the well. Initially, the interface depth should be verified by a geophysical log at least every two months. As experience indicates that the blanket

pressure is tracking the interface depth, the frequency of the interface logging can increase to every six months (even if production has not been continuous.)

The sump stage will be completed once about 45,000 bbls of salt have been mined. Approximately 272,000 barrels of saturated brine will be produced during the sump development. To be useable for Key Energy, this brine will need to be recirculated through the well to become saturated.

Development Stage

Upon completion of the sump stage, solution mining of the well can be changed to reverse mining – water injected in the 7" string and brine produced from the 4-1/2" string. The 4-1/2" string may need to be cut to be about five feet above the insolubles on the floor of the cavern in order to avoid plugging by solid materials that may be carried up the string with the brine. The roof blanket needs to be kept at about 1,300 feet depth.

Mining in the development stage will be conducted in reverse circulation. This method of mining will develop the upper section of the cavern above the shoe of the 7" tubing, and will result in production of almost saturated brine from the base of the cavern at low flow rates.

The development stage is divided into three steps in Table 1. Each step is a period of constant and progressively higher raw water injection rate into Key Energy Well to complete the development stage.

The development stage of Key Energy Well will continue until an additional 235,000 (total of about 280,000) barrels of salt have been mined producing about 1,400,000 barrels of brine. The flow rate initially will be low (an estimated 125 gpm) to produce saturated brine. The flow rate can be increased slowly as field measurements indicate that saturated brine is being produced.

The duration of the development stage will be determined by the rate of brine required from Key Energy Well. During this stage, the 4-1/2" tubing will need to be kept above the insolubles.

During the development stage, the blanket level should continue to be monitored constantly by observing the pressure on both the brine and blanket. The difference in the pressures should remain relatively constant at similar flow rates. In the event that the differential pressure changes, the blanket level should be checked by an interface log run in the well.

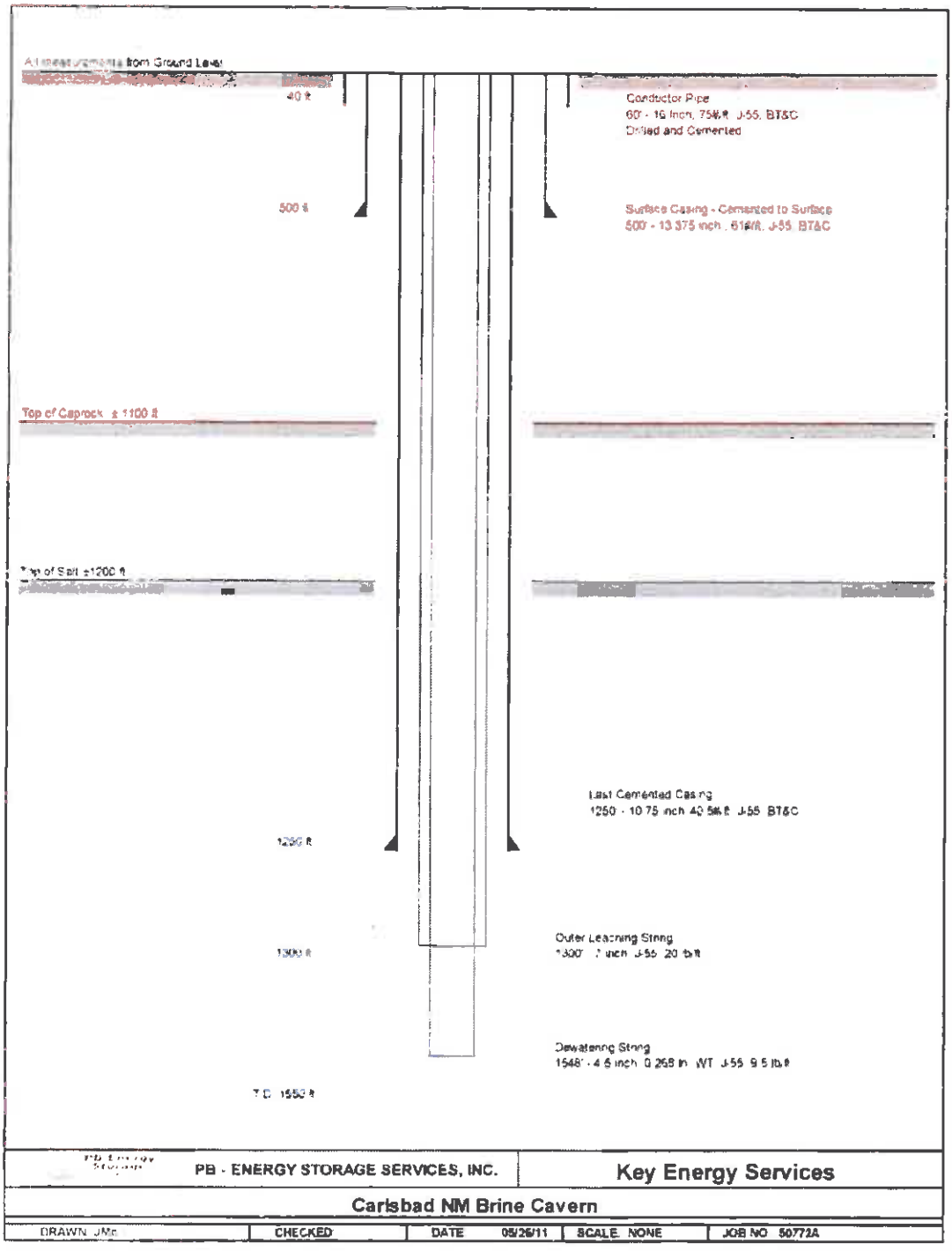


Figure 1 Well Schematic

In any event, the interface depth should be verified by a geophysical log at least every six months (even if production has not been continuous.) About one barrel of blanket material should be added to the well at each interface log to compensate for the increasing roof diameter and very minor losses that occur with brine production.

Brine Production

Upon completion of the development stage, reverse injection can continue as needed. The position of the interface at 1,300 feet should be verified by an interface log, but no adjustment to the blanket depth is required. During reverse injection, water will be injected in the outer shallow 7" tubing and brine will be produced from the deeper inner 4-1/2" tubing. This mining will continue to develop the upper section of the cavern above the shoe of the 7" tubing, and will result in production of almost saturated brine from the base of the cavern at rates up to about 200 gpm.

The reverse stage continues until the cavern has reached the maximum allowable size. Although no workovers are required to reconfigure the strings for subsequent mining of Key Energy Well, Key Energy should plan on a workover every three years. These workovers are for the purpose of removing at least one string of tubing and running a sonar caliper survey of the cavern to ensure that it is developing as planned.

During this long stage of mining, water injection can be conducted as needed for operations at rates up to about 200 gpm. The only operational constraint is to ensure that the inner production tubing is above the insoluble pile on the floor f the cavern.

The final stage of leaching of Key Energy Well will continue until a total of about 1,760,000 barrels of salt have been mined. This will produce about 10,480,000 barrels of saturated brine. The time that the mining will last is dependent upon the demand for the product. The minimum life of the well is five and one-half years at full production.

The blanket level should continue to be monitored by pressure readings as well as interface logs every six months (even if production is not continuous.) The addition of one to two barrels of blanket material at each interface log should also continue.

During this long stage, the depth of the cavern floor and the bottom of the 4-1/2" tubing should be monitored on a semi-annual basis (at the same time as interface surveys). This is to ensure that the inner tubing is high enough above the insolubles for the mining projected to occur in the next six months in order to prevent plugging of the inner string by insolubles. The 4-1/2" tubing should be kept at least five feet above the insolubles.

Key Energy Reporting Requirements

Key Energy personnel will need to maintain a log of operational parameters for Key Energy Well. These parameters include:

1. Water pressure
2. Brine pressure
3. Blanket pressure
4. Water (recirculated brine) injection rate
5. Brine production rate
6. Water temperature
7. Brine temperature
8. Salinity of water or brine injected
9. Salinity of brine produced
10. Volume of blanket material injected or removed
11. Calculated volume of salt mined daily
12. Calculated cumulative volume of salt mined

This information should be tabulated on a daily basis. Pressures should be monitored at least once a day but more often is preferable.

Once every 100,000 barrels, Key Energy should obtain a sample of the water injected into and brine produced from Key Energy Well. These fluid samples should be sent to a laboratory to be tested for:

1. Chloride
2. Sodium
3. Calcium
4. Magnesium
5. Potassium
6. Sulfate
7. Total Hardness
8. pH

The testing will provide some verification on the progress of mining as well as possibly providing warning if anomalous areas in the salt are intercepted by the cavern.

Key Energy will supervise all scheduled interface surveys and blanket material additions. The schedule for these activities is given in the "Technical Approach to Brine Production" above. Key Energy should keep copies of all geophysical logs, sonar caliper surveys and wireline casing cuts run in Key Energy Well.

Expected Well Completions and Modifications

Key Energy Well will be completed with 10-3/4" casing cemented at about 1,250 feet depth. The borehole below the casing will be drilled to about 1,550 feet depth and opened to a diameter of 12".

Tubing Settings

Tubing strings for mining will be run in the well upon completion of drilling. The 7" tubing will be run and set at about 1,400 feet depth, and 4-1/2" tubing will be run and set at about 1,550 feet depth. These tubing strings will be used for solution mining for the life of Key Energy Well unless there is an accident, such as a salt fall, that damages one or both strings.

The outer string will be left at the 1,400 feet setting for the duration of solution mining in Key Energy Well. The 4-1/2" tubing will be shortened as needed to keep it above the insolubles that accumulate on the floor. During the sump stage it is not necessary to shorten the 4-1/2" tubing as long as water is continuously injected through it. If water injection stops abruptly, as in the event of a power outage, it is possible the 4-1/2" tubing will become plugged with insolubles that will be carried up inside the tubing. In this event the 4-1/2" tubing may have to be perforated or cut above the blockage to allow water injection to resume. Due to the short height of the cavern, a workover may be required to pull and reset the tubing to keep the entire section of available salt exposed to mining.

During the reverse mining stage (the bulk of the mining program) it is important to keep the 4-1/2" tubing above the insolubles so that they are not carried up into the tubing string with the brine being produced from it. The 4-1/2" tubing can be shortened by cutting it with a wireline conveyed casing cutter or perforating it. Unless the string is plugged with insolubles, a workover involving a rig is not necessary for shortening the string.

Sonar Surveys

Sonar surveys are required every three years during the solution mining of the Key Energy Well. These sonar surveys will probably require a workover rig to pull the inner string. Sonar survey tools can adequately survey caverns through one string of tubing but not two strings. At the completion of the sonar survey, the inner tubing can be run back into the well and set about five feet above the floor of the cavern as seen by the survey. Additionally, any workover required to repair or unplug the tubing strings should be used as an opportunity to run a sonar survey to inspect the cavern.

Following completion of the sonar survey the results of the survey will be incorporated into the Sansmic model. The model will allow any required alterations of the hanging string depths or blanket interface which are necessary to ensure proper cavern development.

Another sonar survey should be run at completion of mining operations. This sonar survey will also require a workover to remove the inner string to allow the survey to be run.

Completion of Leaching

At the completion of mining operations, a workover will be needed to properly plug and abandon the well. Details on this workover will depend upon the state regulations at that time.

Well Testing

During the construction of Key Energy Well, the various casing strings and cement jobs will be tested as they are emplaced. Mechanical integrity testing will be performed annually using a fluid pressurization method approved by the State of New Mexico.

Prior to Leaching

Upon completion of drilling and before solution mining operations begin, the entire well assembly must be tested to verify integrity. This test will preferably be run with blanket material in the wellbore. The well will be pressurized to about 75% of lithostatic pressure at the 10-3/4" casing shoe by injecting brine. The pressure on all three strings, the 10-3/4", the 7" and the 4-1/2", will be monitored for 24 hours. There should be no pressure drop during the test.

Subsidence Monitoring

Key Energy will develop a formal subsidence monitoring plan prior to the start of leaching. Subsidence monuments will be constructed on site and subsidence surveys will be performed and evaluated on an annual basis.

Appendix I Potential Problems

Unable to Inject Water

During the sump or development stage, Key Energy may experience difficulties in injecting water into Key Energy Well. This may be evidenced by the water injection pumps shutting off do to high pressure or a restricted rate of water injection. The brine production from the well will decrease rapidly at the same time. The pressure on the brine and blanket sides of the cavern will remain constant.

The problem will likely be the result of the inner 4-1/2" tubing having been plugged by insolubles. This can be verified by running a log in the tubing to determine the depth to the bottom. A log may also show the top of insolubles outside the tubing, in the event the plug is near the bottom of the tubing and below the floor.

If the plug inside the tubing is below the floor of the cavern or is within five feet of the estimated level of the floor (based on previous depth measurements or modeling), the tubing can be perforated or cut five feet above the floor. This will allow water injection to be resumed.

If the plug inside the tubing is more than five feet above the floor, then a workover rig will be required to either wash out the tubing or pull the tubing out of the well until the plug falls free or is brought to the surface.

Unable to Produce Brine

During reverse mining, a problem in producing brine from the well may develop even though water can be injected into the well. As water continues to be injected, the pressures on the water and blanket will slowly increase with the brine pressure remaining constant.

This problem is likely caused by the inner tubing, now used for brine production, becoming plugged. This can be verified by running a log in the tubing to determine the depth to the bottom. A log may also show the top of insolubles outside the tubing, in the event the plug is near the bottom of the tubing and below the floor.

If the plug inside the tubing is below the floor of the cavern or is within five feet of the estimated level of the floor (based on previous depth measurements or modeling), the tubing can be cut or perforated five feet above the floor or above the plug. This will allow brine production to resume.

If the plug inside the tubing is more than five feet above the floor, then a workover rig will be required to wash out the plug inside the tubing or pull the tubing until the plug falls free or is brought to the surface.

Brine Saturation Drops

During routine mining operations, the saturation of the brine may decrease with no change in operational procedures. This drop in salinity may be minor and stable or gradually increasing or sudden and large.

A sudden, large drop indicates that most likely the tubing strings have been broken off. The damaged area will be very near to or above the bottom of the outer 7" tubing. A density log will indicate where the tubing has broken off.

A minor drop in salinity indicates that one or more collars in the inner string are leaking. A small drop in the salinity that does not continue to decrease indicates a small leak that is relatively stable. A drop in the salinity that continues to decrease indicates that a collar leak is worsening due to washing of the threads. Such a leak, if it continues, could result in the collar losing integrity and allowing the string to drop. A noise log or flow log may indicate which collar(s) is bad.

A workover will be required to pull the tubing strings and replace the damaged joints. If the leak is minor and stable, Key Energy may elect to not repair the tubing string and instead use the slightly weakened brine.

Blanket Material is brought to Surface in the Brine

During mining of Key Energy Well, blanket material may show up in the produced brine during direct mining. The blanket material may appear as a large volume slug or may be small quantities entrained in the brine. If the blanket shows up as a large quantity, the outer 7" hanging string has been severely damaged. If small quantities of blanket material are produced with the brine, one or more collars of the 7" tubing have developed leaks.

Both failures will require a workover to pull the tubing strings and replace the damaged joints in the 7" tubing. If the blanket has come up as a slug, mining must be suspended immediately with the brine side of the cavern shut-in to prevent further contamination of the brine system. Small quantities of blanket material in the brine may not require *immediate* suspension of mining if Key Energy can tolerate minor contamination of the brine, but close attention should be paid to the blanket pressure to ensure that the blanket is at the proper depth.

Brine-Blanket Interface Not Found

When attempting to run an interface log, occasionally the interface may not be detected. This may occur even if the relative pressures of the brine, water, and blanket indicate that the blanket is at approximately the correct depth. The blanket may be at the correct level with the density difference between the blanket and brine just difficult to discriminate through the tubing strings or the cavern may have mined into an anomalous zone that has allowed the blanket on the roof of the cavern to move into a void above the intended roof.

The location of the blanket can probably be ascertained by injecting several barrels of blanket material while monitoring the intended roof location. The amount of blanket added should not need to exceed about one half foot of thickness for the estimated roof diameter to be found. If this quantity of blanket is still not detected, it may be necessary to shut in mining, bring in a workover rig to pull a string of tubing and run a sonar survey.

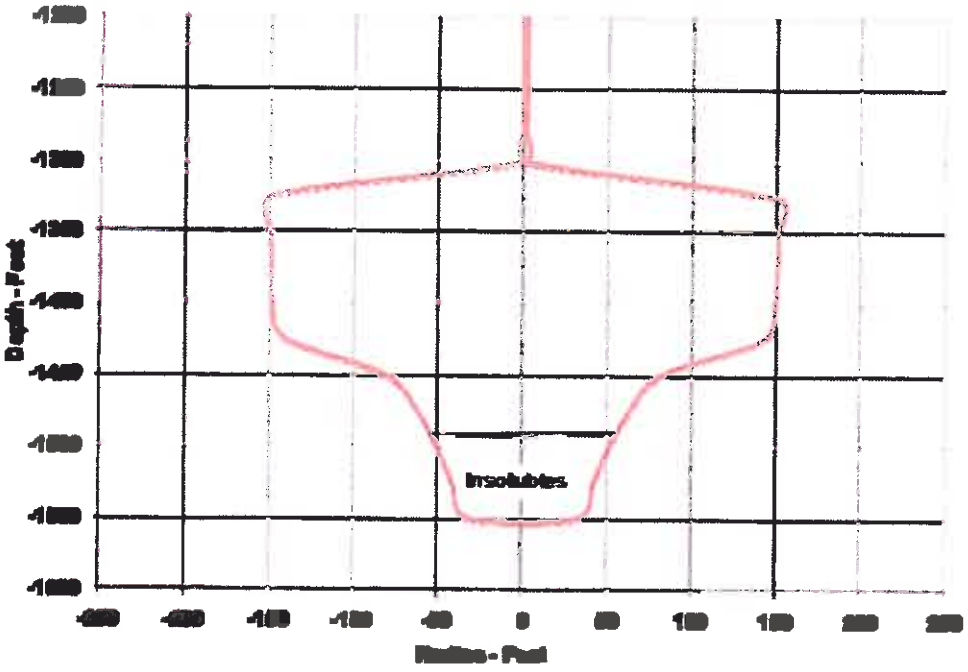


Figure 2 – Sansmic Image of Cavern at Completion

Brine Well Development Plan

Introduction

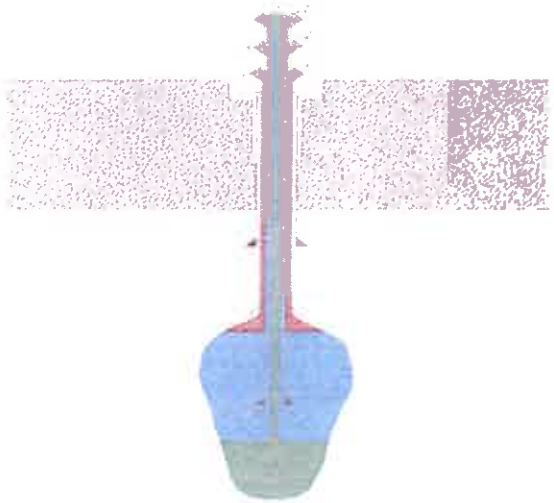
Key Energy Services LLC Develop new brine production cavern at its Carlsbad Fresh and Brine Water Station. The cavern is designed to produce saturated brine from an interval within the Lower Castile Salt between approximately 1,300 ft and 1,550 ft. The cavern is to have a maximum diameter of 300 ft. The cavern will have a protective roof blanket to control cavern roof growth. The cavern development has been modeled using the Sansmic Solution Mining Code, which was developed by Sandia National Labs.

Well Configuration

Number of wells:	1
Surface casing (Groundwater Protection):	13-3/8" Diameter – Cemented to Surface
Last cemented casing: 10-3/4" (50' Into Salt):	Cemented to Surface
Outer suspended string:	7" to 1,400 ft
Inner suspended string:	4-1/2" to 1,550 ft
Insoluble Roof Blanket Depth:	1,300 ft

Brine Production Process Description

1. Inject Protective Roof Blanket
2. Inject Fresh Water (75 gpm) into 4-1/2" and Recover Brine Through 7" to Storage Tanks
3. Re-Inject Brine from Storage Tanks Until Brine Reaches Saturation (10 lb/gal)
4. Continue Leaching Using this Method until cavern volume reaches 45,000 bbl (280 days)
5. Begin Reverse Flow – Inject Water at 125 gpm down 7" and recover brine through 4-1/2"
6. Produce saturated (10 lb/gal) Brine until Cavern Volume Reaches 282,000 bbl (630 days)
7. Increase Injection Rate to 175 gpm
8. Produce Saturated Brine until cavern volume reaches 405,000 bbl (780 days)
9. Increase Injection Rate to 200 gpm
10. Cavern Can Sustain Production of Saturated Brine at 200 gpm



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Key Energy Well Brine Well Leaching Plan

Introduction

This document presents alternate solution mining plans for the development of the Key Energy (KE) Well. This well will be used for production of saturated brine for use in drilling operations in the Southeast New Mexico area. The well will be used only as brine demand from oil field services requires it.

The well has not been drilled. For this study the final cemented casing string was assumed to be set at 50 feet in the Lower Castile Salt. The top of the cavern will be about 50 feet below the last cemented casing. The total depth of the well will be about 1,550 feet based on cross-sections developed from nearby wells.

This report presents two conceptual plans to accommodate the development of saturated brine from the KE Well. The report also discusses the possibility of using two wells to produce saturated brine more quickly than with a single well.

Methodology

The study utilized the SANSMIC cavern simulation model to project the development of the cavern utilizing a single well. SANSMIC is a two-dimensional numerical simulation code which approximates the dissolution of salt by water. SANSMIC is a widely used cavern-modeling program developed by Sandia National Laboratories.

The basic input for the model consists of average radii of the well, the depth of the water injection and brine production strings, the depth of the product level, water injection rates, and duration of mining. If a cavern exhibits a region of abnormal or non-symmetric growth, SANSMIC cannot fully evaluate continued growth in such a region.

As with all numerical models, SANSMIC does not fully represent the actual salt caverns. This is due to 1) the axisymmetric assumption in the model (that the cavern will develop evenly about the central wellbore) and 2) limitations in the equations for flow within the cavern.

The axisymmetric assumption is not necessarily a significant limitation to modeling the development of salt caverns in bedded salts. Most caverns developed in flat lying bedded salt deposits tend to be uniform in horizontal cross-sections when developed by means of a single well. There are localized exceptions to the symmetry. The limitations in the hydraulic equations result in over-estimation of development near the bottom of the injection tubing in both reverse and direct mining and a corresponding underestimation of mining in the upper portions of the cavern. This limitation becomes more evident at high water injection rates (over 4,000 gpm).

which were not utilized in this study, and at prolonged stage durations (over one year) which were used in the simulations.

SANSMIC and other commercially available cavern simulation models cannot simulate development of two-well caverns. Discussion of two well caverns will rely on anecdotal experience.

For this model, the cavern interval from total depth of the well at 1,550 feet to the top of the lower Castile Salt at about 1,200 feet depth was divided into fourteen 25-feet tall cells. The final cemented casing was assumed to be 10-3/4 inches. The inner string was assumed to be 4-1/2" tubing and the outer string to be 7-5/8" tubing. The casing sizes do not impact the final solution mining plan, although they have some influence on the very early days of mining. The roof was kept below 1,200 feet depth.

The production flow rate was modeled at numerous injection rates of between 20 gpm and 210 gpm. The insoluble content of the salt was set at 2%. A normal dissolution factor of "1" was used for the salt. The SANSMIC simulations were carried out until saturated brine can be produced at a maximum rate from a single well configuration without recycling.

Cavern Development Plan

General

Several plans were developed for mining of the Carlsbad KE Well. The plans for initial development of the cavern differed in the height of salt available for mining, the amount of the recycling of the brine to increase saturation, the flow rates and the direction of flow.

The mining plans begin from a borehole completed in the salt in the Lower Castile at a depth of about 1,550 feet. The initial mining method for all the plans is direct – water injected in the deeper, inner tubing and brine produced form the outer, shallower tubing. The inner tubing string should be set within a few feet of the total depth of the wellbore. This is necessary to develop a sump at the bottom of the cavern for accumulation of material that will fall to the bottom of the cavern.

The final 10-3/4" casing is cemented at about 1,250 feet, 50 feet above the proposed roof of the cavern. The tubing strings used for solution mining are assumed to be 4-1/2" inside of 7-5/8". The sizes of the tubing are immaterial to the mining plan after the first few tens of barrels of salt have been mined. Solution mining rates vary between plans and during mining.

Direct Mining Solution Mining Plan

Mining begins with the inner tubing string set close to the bottom of the borehole as shown in Table 1. The outer string is set about 1,350 feet depth, about 150 feet below the top of

the lower salt. The blanket in the plan is set at about 1,300 feet depth or about 50 feet below the final cemented casing.

Mining in this combined sump and chimney stage develops a sump near the bottom of the cavern for accumulation of the insolubles that will be freed during mining of the salt and begins development of the chimney throughout the exposed length of the salt. This direct mining continues for all mining of the salt. The setting depths and cavern volumes for the various stages of the plan are shown in Tables 1 and 2.

Table 1 Setting Depths for Development of KE Well in Direct Flow

Mining Step	Blanket Setting – Feet	Production Setting - Feet	Injection Setting – Feet	Insoluble Depth – Feet
Sump/Chimney	1350	1400	1550	1547
Mining	1350	1400	1540	1547
Mining	1350	1400	1540	1547
Mining	1350	1400	1540	1547
Mining	1350	1400	1540	1547

Table 2 Duration and Volumes for Development of KE Well in Direct Mining

Mining Step	Mining Rate - gpm	Total Mining Time – Days	Gross Cavern Volume – barrels	Cumulative Brine Produced - Barrels	Brine Specific Gravity
Sump/Chimney	Cycling at 75	280	45,000	279,000	1.202
Mining	20	780	100,000	612,000	1.204
Mining	40	930	132,000	809,000	1.204
Mining	60	1,080	178,000	1,097,000	1.204
Mining	50	1,230	218,000	1,344,000	1.203

During the mining, the inner tubing may need to be cut one or more times to keep it above the building insoluble pile. In order to maintain the maximum height of the cavern and exposure of salt to water, the inner tubing should be kept as near to the floor during the mining as is practical.

During the sump/chimney stage, which develops the cavern to about 45,000 barrels, the brine will need to be cycled through above ground storage tanks with a total capacity of 2,500

barrels and back into the well to bring the saturation to 10 pounds per gallon (specific gravity of 1.201). For this study, this was assumed to be done at a rate of 75 gpm until saturation was achieved. Initially, five days of pumping through the well at 75 gpm are required. As the cavern grows in size, exposing more salt surface for dissolution, the recycling time drops to about 3 days after about 70 water-brine cycles.

After the cavern volume reaches about 45,000 barrels (about 279,000 barrels of produced brine) the cavern will be able to produce saturated brine without recycling at a rate of 20 gpm. The sustainable saturation rate will slowly increase as the cavern grows in size, but will peak at around 60 gpm with mining in the direct mode.

During mining no workover is required. However, the inner tubing string will need to be cut to be above the insolubles on the floor. In conformance with New Mexico regulations, a sonar calliper survey should be run every three years. This will most likely require a workover to remove one or both strings so that the entire cavern can be surveyed. The shape of the cavern during development as simulated by SANSMIC is shown in Figure 1.

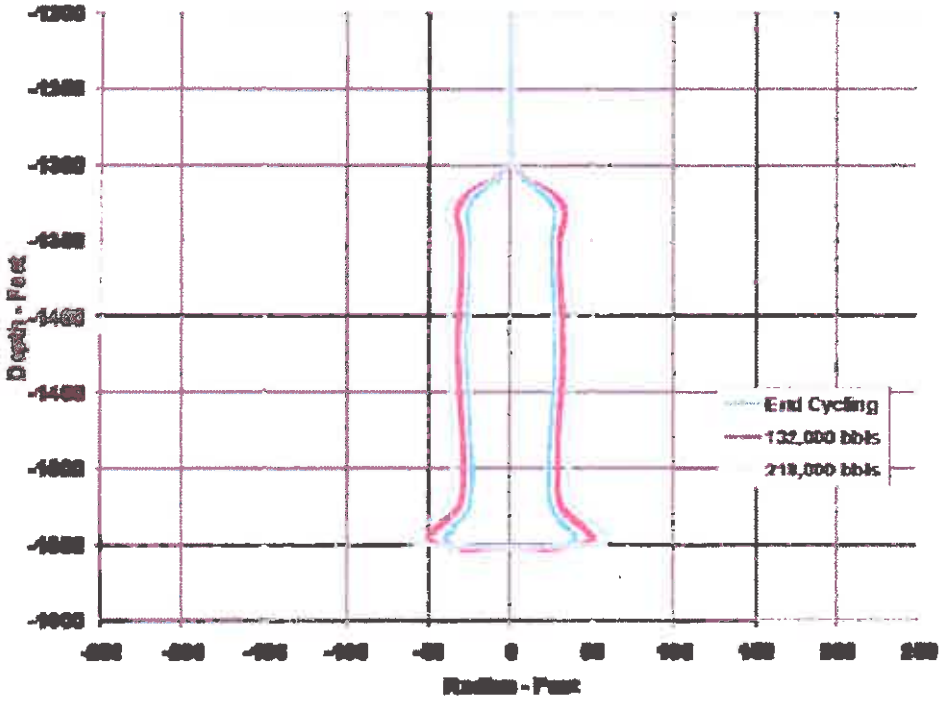


Figure 1 SANSMIC Simulation of KE Well during Mining

Reverse Mining Solution Mining Plan

Mining begins with the inner tubing string set close to the bottom of the borehole as shown in Table 3. The outer string is set about 1,400 feet depth, about 200 feet below the top of the lower salt. The blanket in the plan is set at about 1,300 feet depth or about 50 feet below the final cemented casing.

Mining in this combined sump and chimney stage develops a sump near the bottom of the cavern for accumulation of the insolubles that will be freed during mining of the salt and begins development of the chimney throughout the exposed length of the salt. This direct mining continues for all mining of the initial 45,000 barrels of salt. The setting depths and cavern volumes for the various stages of the plan are shown in Tables 3 and 4.

Table 3 Setting Depths for Development of KE Well in Reverse Mining

Mining Step	Blanket Setting – Feet	Production Setting – Feet	Injection Setting – Feet	Insoluble Depth – Feet
Sump/Chimney	1300	1400	1550	1547
Reverse Mining	1300	1540	1400	1537
Reverse Mining	1300	1525	1400	1532
Reverse Mining	1300	1525	1400	1525

Table 4 Duration and Volumes for Development of KE Well in Reverse Mining

Mining Step	Mining Rate – gpm	Total Mining Time – Days	Gross Cavern Volume – barrels	Cumulative Brine Produced - Barrels	Brine Specific Gravity
Sump/Chimney	Cycling at 75	280	45,000	277,000	1.202
Reverse Mining	125	630	282,000	1,703,000	1.204
Reverse Mining	175	780	405,000	2,446,000	1.203
Reverse Mining	200	930	547,000	3,303,000	1.202

During the mining, the inner tubing will need to be cut one or more times to keep it above the building insoluble pile. In order to maintain the maximum height of the cavern, the inner tubing should be kept as near to the floor during this stage as is practical.

During the sump/chimney stage, which develops the cavern to about 45,000 barrels, the brine will need to be cycled through above ground storage tanks with a total capacity of 2,500 barrels and back into the well to bring the saturation to 10 pounds per gallon (specific gravity of 1.201). For this study, this was assumed to be done at a rate of 75 gpm until saturation was achieved. Initially, five days of pumping through the well at 75 gpm are required. As the cavern grows in size, exposing more salt surface for dissolution, the recycling time drops to about 3 days after about 70 water-brine cycles.

After the cavern volume reaches about 45,000 barrels (about 277,000 barrels of produced brine) the cavern will be able to produce saturated brine at least 125 gpm without recycling if the flow is switched to reverse - water injected in the outer shallower tubing and brine produced from the deeper inner tubing. The sustainable saturation rate will continue to increase as the cavern grows in size, reaching a sustainable saturation rate of 200 gpm once the cavern is about 400,000 barrels in size. The shape of the cavern during development as simulated by SANSMIC is shown in Figure 2.

During mining no workover is required. However, the inner tubing string will need to be cut to be kept above the insolubles on the floor, especially after reverse mining beings. In conformance with New Mexico regulations, a sonar calliper survey should be run every three years. This will most likely require a workover to remove one or both strings so that the entire cavern can be surveyed.

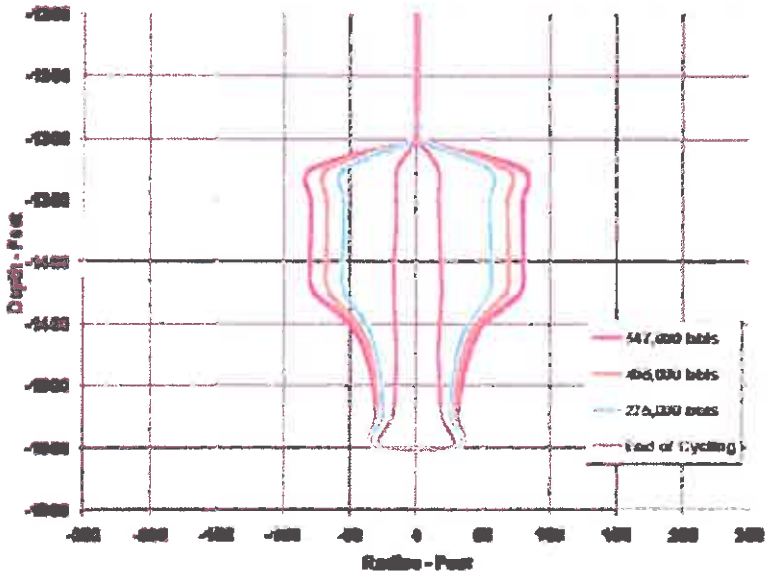


Figure 2 SANSMIC Simulation of KE Well during Reverse Mining

Two Well System

Salt producers in bedded salt regions (Kansas, Northeast U.S.) frequently use two or more wells to produce saturated brine. The wells are connected either by directional drilling of one well or by hydro-fracturing between wells. One well is then used for water injection and the other well or wells are used for brine production. The multiple-well concept allows production of saturated brine at much greater rates than could be produced from a single-well setup.

Generally the distance between the wells is on the order of hundreds of feet to allow a long exposure of salt for high-rate brine production. Some wells, primarily storage wells in salt domes, have been developed less than 100 feet separation.

Based on experience with multiple well caverns, use of two wells at the Key facility in Carlsbad will likely reduce the time that cycling is needed from about 280 days (70 cycles) to about 70 days (15 cycles or total production of about 37,500 barrels of brine), assuming that the wells are hydraulically connected almost from the start. After this initial recycling, the pair of wells will probably be able to produce saturated brine at a rate of 60 gpm. The sustained rate of saturated brine production will increase to over 125 gpm after producing about 300,000 barrels of brine.

Discussion

Development of the KE Well will require an extensive period of recirculating brine to increase its saturation to near 100%. The actual mechanics of this recycling will be difficult to accomplish. Essentially, it involves water injected, brine production to the tanks until filled, then discontinuing water injection and switching to injecting the brine in the tanks until the desired saturation is achieved. SANSMIC modeling indicates this will take 5 days at 75 gpm to saturate 2500 barrels of brine in this method at the very beginning of production.

This method of cycling 2500 barrels of brine would likely need to continue for about 70 cycles. The duration of each cycle will decrease slightly with time as the cavern enlarges, but the total time will approach 280 days before the well is capable of producing brine without recirculating. Each cycle of five days (eventually decreasing to about three days) will produce 2,500 barrels of saturated brine, or an average of 500 barrels per day.

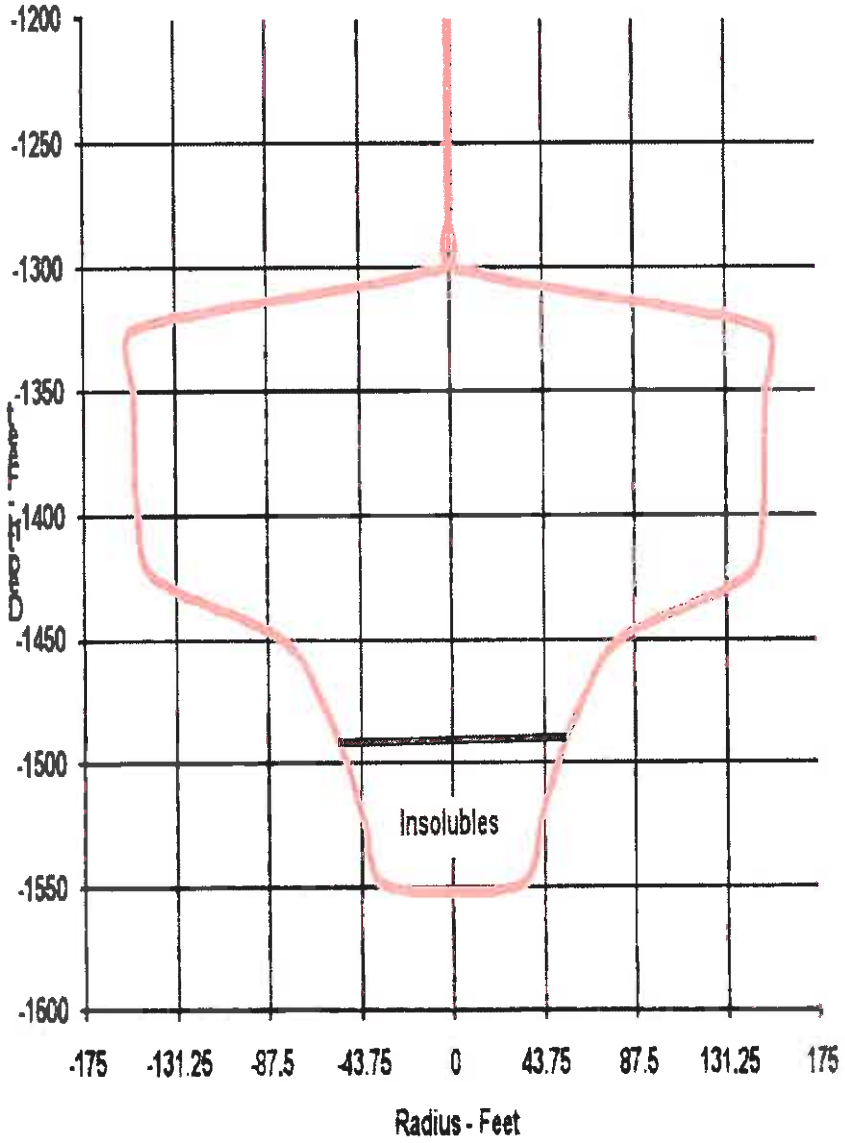
SANSMIC simulation indicates that the cavern will not be capable of producing saturated brine from injected fresh water at a rate of 100 gpm until the cavern size is at least 39,000 barrels (about 240,000 barrels of saturated brine production) in size for the short cavern (roof 100 feet

below the top of the lower salt) or about 35,000 barrels (about 215,000 barrels of saturated brine production) for the tall cavern. The production of saturated brine at this point requires that flow be changed to reverse at those cavern volumes with prior mining done in direct (using recycled brine) to create a sump.

SANSMIC modeling indicates that saturated brine from sustained fresh water injection of 50 gpm in the direct mode cannot be produced until the cavern volume is about 128,000 barrels.

The actual production from the well will be intermittent although the modeling in the report has continuous production. Intermittent production will result in slightly higher saturation of produced brine when mining is first resumed. As the cavern increases in size and as the idle period increases in duration, the amount of saturated brine initially produced from the well will increase.

If Key Energy proceeds with development of a brine well at Carlsbad, the mining simulations should be updated after each sonar survey of the cavern.


-1200
-1250
-1300
-1350
-1400
-1450
-1500
-1550
-1600
Depth - Feet
Insolubles
-175
-131.25
-87.5
-43.75
0
43.75
87.5
131.25
175
Radius - Feet

Brine Well Operation Management Plan

1. **Predict Cavern Development (completed)**
   a. Used to Determine Injection and Production String Depths
   b. Used to Determine Protective Blanket Depth for Control of Roof Height
   c. Used to Predict Cavern Shape and Growth Through Time
2. **Confirm Cavern Development**
   a. Perform Sonar Through Pipe Survey Every 3 Years
   b. If Infeasible Perform Workover and Perform Sonar Each 3 Years
3. **Update Cavern Development Prediction**
   a. Use Sonar Data to Update Sansmic Modeling
   b. Re-Evaluate Cavern Development Plan
4. **Monitor Roof Blanket Depth**
   a. Measure Blanket Pressure Daily
   b. Perform Confirmatory Blanket Interface Survey Every 6 Months
5. **Add Blanket Material to Maintain Roof Depth**
   a. As required based upon interface data
6. **Ensure Continued Mechanical Integrity**
   a. Perform Daily Monitoring of Blanket Pressure
   b. Perform Annual Fluid Pressure Test of Cavern
7. **Perform Annual Subsidence Monitoring**

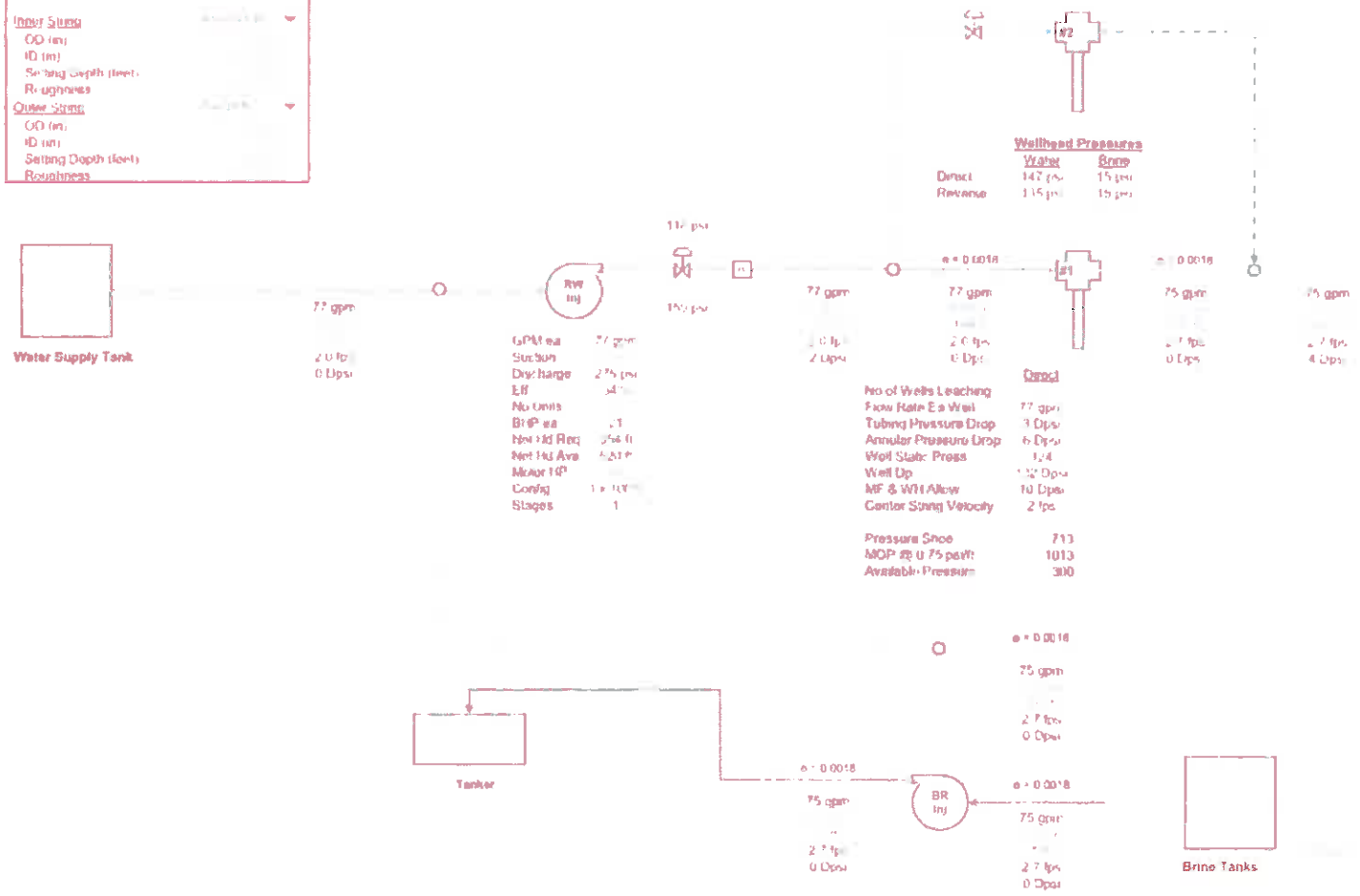
Fluid Properties

	Water	Brine	Wk Brine
BPT	11.7	107	103
GPM		75	75
Viscosity (cp)			
Specific Gravity			

Well Configuration

Inner String
- OD (in)
- ID (in)
- Setting Depth (feet)
- Roughness

Outer String
- OD (in)
- ID (in)
- Setting Depth (feet)
- Roughness



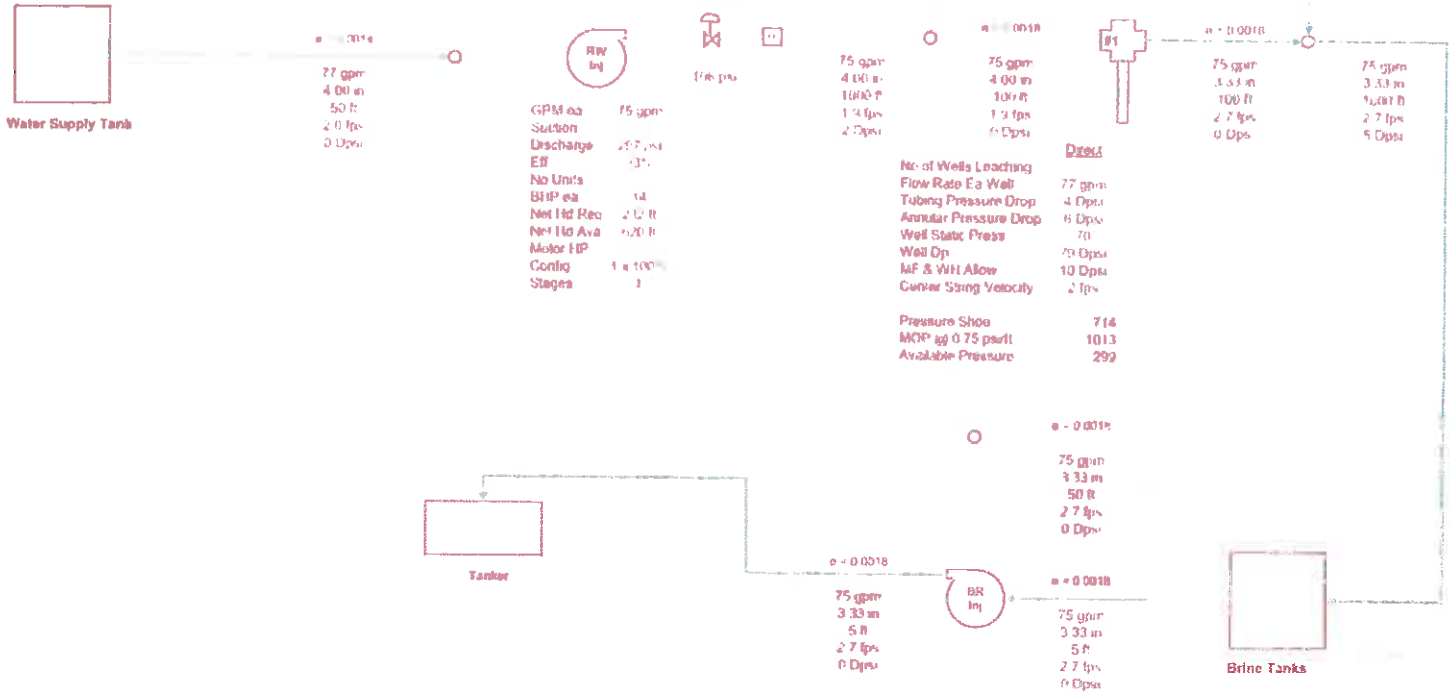
Fluid Properties

	Water	Brine	Wtr Brine
BPH	110	107	103
GPM		75	75
Viscosity (cp)			
Specific Gravity			

Well Configuration

Inner String
OD (in)
ID (in)
Setting Depth (feet)
Roughness

Outer String
OD (in)
ID (in)
Setting Depth (feet)
Roughness



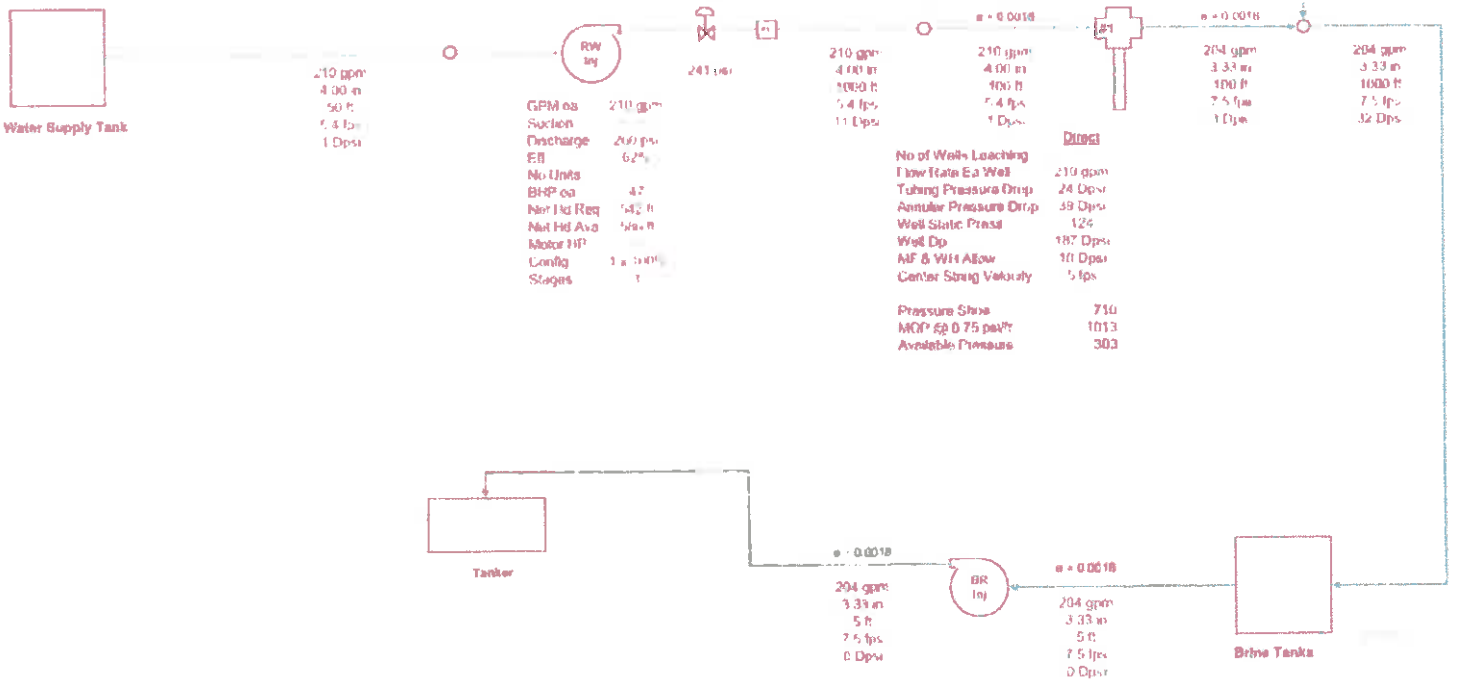
Fluid Properties

	Water	Brine
BPH	300	291
GPM		204
Viscosity (cp)		
Specific Gravity		

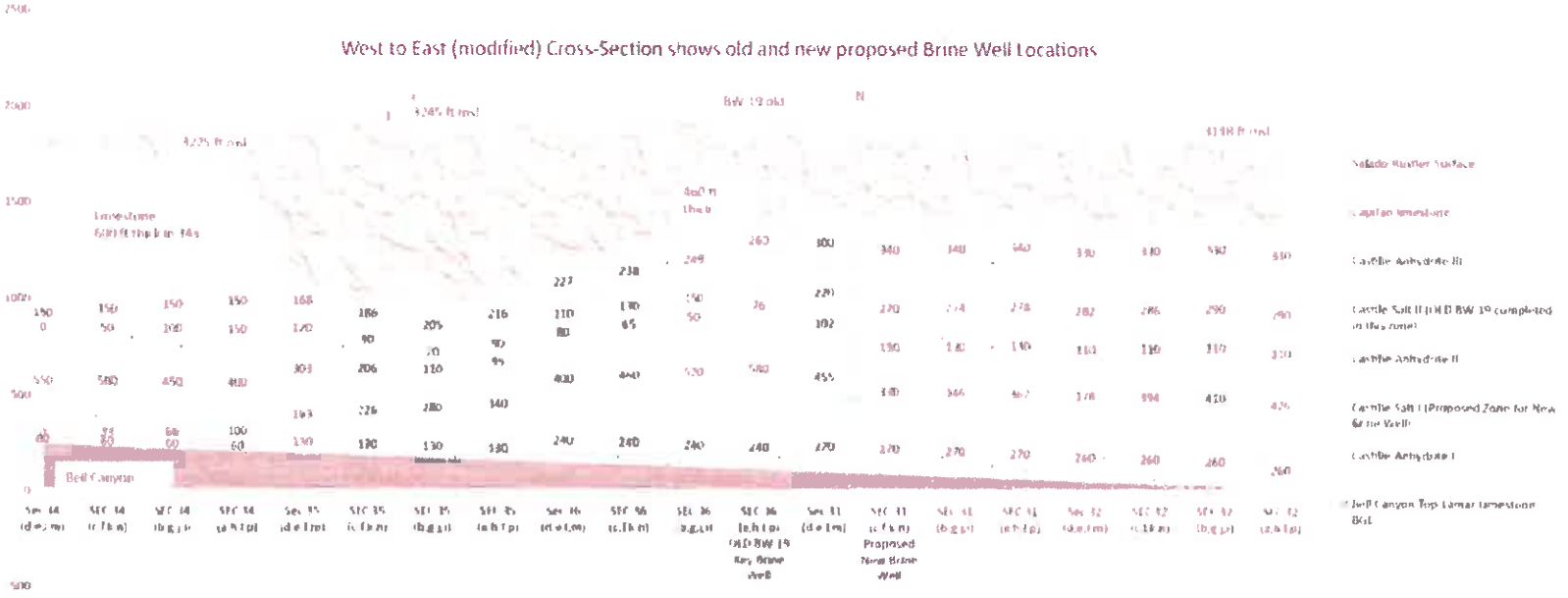
Well Configuration

Inner String
- OD (in)
- ID (in)
- Setting Depth (feet)
- Roughness

Outer String
- OD (in)
- ID (in)
- Setting Depth (feet)
- Roughness



West to East (modified) Cross-Section shows old and new proposed Brine Well Locations



Addendum (5/2011) Section VII.A.1-4 Appendix for Brine Well Application Guideline

Includes:

1. ***Updated C-101 form "Application for Permit to Drill, Deepen, or Plug Back" with drilling plan attachments and*** C-144 CLEZ and C-102 "Well Location and Acreage Dedicated Plat".
2. Copy of original Notice of Intent.
3. OCD's response letter to Notice of Intent.

State of New Mexico
Energy, Minerals and Natural Resources

Form C-101
Revised

Oil Conservation Division
220 South St. Francis Dr.
Santa Fe, NM 87505

☐ AMENDED REPORT

APPLICATION FOR PERMIT TO DRILL, RE-ENTER, DEEPEN, PLUGBACK, OR ADD A ZONE

Surface Location

Proposed Bottom Hole Location If Different From Surface

Additional Well Information

Proposed Casing and Cement Program

OIL CONSERVATION DIVISION

State of New Mexico
Energy, Minerals and Natural Resources
Oil Conservation Division
Form C-101 Attachment pg 1

Operator: Key Energy Services, LLC
6 Desta Drive, Suite 6000
Midland, TX 79705

Property Name: Carlsbad Brine Well #2

22.) Describe the proposed program:

All activities of the design plan will be in compliance with the appropriate requirements of 19.15.17.9 NMAC

All drilling activities will be utilizing a closed loop system in compliance with the appropriate requirements of 19.15.17.9 NMAC

Drill 18" hole to 60' install 75#/ft 13-3/8" J-55 BT&C casing and cement to surface with 46 sacks cement (twice the annular volume

Drill 17-1/2" hole to 500'

Condition hole to stabilize

Run deviation survey

Log 500' to surface (run Triple Combo log – Dual Induction Resistivity/Compensated Neutron Log/Litho-Density

Condition hole to run casing

Run 500' of 13-3/8" 54.5# J-55 BT&C casing

Cement to surface with 695 sacks cement (twice annular volume

Wait on cement for 24 hours, notify NMOCD to witness test

Pressure test casing to 1000 psi for 30 minutes

Run cement evaluation tool from TD to surface

Cut off conductor and surface casing and weld on 13-3/8" x 11" 5M slip-on casing head

Install 11" 5M BOP stack (double ram and annular preventer) and choke manifold

Test BOP and casing to 5000 psi

State of New Mexico
Energy, Minerals and Natural Resources
Oil Conservation Division
Form C-101 Attachment pg 2

Operator: Key Energy Services, LLC
6 Desta Drive, Suite 4000
Midland, TX 79705

Property Name: Carlsbad Brine Well #2

Drill 12-1/4" hole with Automated Drilling System (ADS or similar) to ~ 1250' (or 50' into top of salt) to insure ~0° deviation

Condition hole to stabilize

Log from 1250' to surface: run Triple Combo log – Dual Induction Resistivity/Compensated Neutron Log /Litho-Density

Run mechanical sidewall coring tool and sample

Condition hole to run casing

Run ~ 1250' of 10-3/4" J-55 40.5#/ft BT&C casing

Cement to surface with 486 sacks cement, twice annular volume

Wait on cement 24 hours, notify NMOCD to witness test

Pressure test casing to 950 psi for 30 minutes

Run [illegible] evaluation tool from TD to surface

Drill 9-1/4" hole to ~1550'

Clean hole and stabilize

[illegible]

Run 1500' of 4-1/2" J-55 9.5#/ft casing

Rig down and move off and clean location

KEY Geology Summary

The proposed location is located in the northwest corner of the Delaware Basin, a major depositional feature for ~250 Ma during the Paleozoic Era. The Capitan reef surrounded the basin near the end of this time, restricting circulation from the open ocean and resulting in the deposition of the salt-bearing formations (Castile, Salado, and Rustler, from base upward) in southeastern New Mexico (SENM). Castile salt is the proposed source at the brine well location.

Castile rocks are restricted to the basin (inside the rimming Capitan reef) by definition. It consists of beds of laminated sulfate-carbonate (A-1, A-2, etc., upward) alternating with salt (H-1, H-2, etc). A-1 is commonly 200-250 ft thick. H-1, the target salt bed, is generally greater than 300 ft thick and is locally more than 500 ft thick. Thicker (generally 300 ft or more) sulfate beds of the Castile overlie H-2. It is likely that all salt has been dissolved from the Salado, and the Rustler is poorly represented or removed by erosion in the vicinity of the site. The upper sediments are alluvial to fan deposits from Dark Canyon and the low Guadalupe escarpment.

The Delaware Mountain Group-Castile contact is well mapped and shows a slight eastward dip that is related to uplifts to the west that largely ended before Ogallala deposition beginning ~13 Ma. Lineaments along the eastern Guadalupe Mountain escarpment have been examined and are not faulted. US Geological Survey mapping indicates that the nearest younger faulting of tectonic origin is along the western escarpment of the Guadalupe Mountains. Low-magnitude seismic activity in SENM continues to be recorded, and occasionally felt, that is believed associated with oil and gas recovery. An igneous intrusion into the evaporite beds east of the location is ~34 Ma old.

Other potential geologic issues include flooding, salt deformation, pressurized brine, possible H_2S, and evaporite dissolution. Drainage is established through Dark Canyon Draw for outflow from Dark Canyon. Castile salts and overlying rocks are deformed most commonly near the northern perimeter of the basin, especially northeast of WIPP and at the WIPP site. Some wells encounter pressurized brine and H_2S. The Castile at the proposed brine well is deformed, providing a thicker salt interval for brine operations. If encountered, pressurized brine and H_2S should be controllable through safe drilling practices. Pressurized brine without H_2S may be used as an asset. Along the western part of the Delaware Basin, Castile to Rustler rocks have been exposed by erosion and subjected to both erosion and dissolution. While the upper Castile appears generally intact at the site, Salado salts and sulfates have been removed or thinned by erosion/solution. The Rustler crops out to the southwest, but is generally poorly preserved or removed in the area of the brine well. There is no surface evidence of sinkholes or collapse features at or near the well location indicating recent or modern natural solution of significance. Bedded salt tends to maintain internal fluid pressures greater than normal fresh water hydrostatic levels, countering invasion by fresh water. In the absence of a natural break and conduit (e.g., fault) or man-made access (e.g., uncased and unplugged drillholes), such processes are expected to be very slow and not a short-term concern.

Key Energy Services
6 Desta Drive
Suite 4300
Midland, Texas 79705

Telephone: 432.620.0300
Facsimile: 432.571.7173
www.keyenergy.com

November 23, 2010

Glenn vonGonten- Acting Environmental Bureau Chief
Jim Griswold- Senior Hydrologist
1220 South St. Francis
Santa Fe, New Mexico 87505

Subject: ***NOTICE OF INTENT TO DISCHARGE***
WQCC 20.6.2.1201 NMAC

Dear Mr. vonGonten and Griswold:

Key Energy Services LLC is notifying the New Mexico Oil Conservation Division of its intent to permit a new brine well to be located in Eddy County, New Mexico. Pursuant to the Water Quality Control Commission Regulations (WQCC) 20.6.2.1201.B and C. NMAC the following information is provided:

(1) The name of the person making the discharge;
Key Energy Services LLC,

(2) The address of the person making the discharge;
Corporate office: 6 Desta Drive Suite 4400 Midland, TX 79705
Local: 1609 E. Green St. Carlsbad NM 88221

(3) The location of the discharge;
Brine Well Location: SW/4 NW/4 UL E- Section 31 - Township 22 South - Range 27 East.
Existing Water Station Location: SE/4 NE/4 UL H Section 36 -Township 22 South- Range 26 East.

(4) An estimate of the concentration of water contaminants in the discharge; and
Injection Water: Fresh water from City of Carlsbad <500 mg/l TDS.
Produced Brine Water: approximately 300,000 mg/l TDS.

(5) The quantity of the discharge.
Estimated Instantaneous flow rate: 3-5 barrels per minute.
Estimated monthly totals: 0-50,000 barrels per month.

According to WQCC 20.6.2.1201.D; Based on information provided in this notice of intent, the department will notify the person proposing the discharge as to which of the following apply: (1) a discharge permit is required; (2) a discharge permit is not required; (3) the proposed injection well will be added to the department's underground injection well inventory; (4) the proposed injection activity or injection well is prohibited pursuant to 20.6.2.5004 NMAC.

If OCD requires additional information concerning this notice of intent please do not hesitate to call me at 432-571-7536 or Wayne Price at 505-715-2809, or E-mail wayneprice77@earthlink.net.

Sincerely,

Daniel K. Gibson, P.G.
Corporate Environmental Director

New Mexico Energy, Minerals and Natural Resources Department

Bill Richardson
Governor

Jim Noel
Cabinet Secretary

Karen W. Garcia
Deputy Cabinet Secretary

Mark Fesmire
Division Director
Oil Conservation Division

December 14, 2010

Daniel K. Gibson, P.G.
Corporate Environmental Director
Key Energy Services
6 Desta Drive, Suite 4300
Midland, Texas 79705

RE: Proposed Brine Well in Unit E of Section 31, Township 22 South, Range 27 East NMPM; Eddy County, New Mexico

Dan,

The Oil Conservation Division is in receipt of Key Energy's Notice of Intent to Discharge (dated 11/23/10) regarding possible installation of a brine well at the above-referenced location. New Mexico Water Quality Control Commission regulation 20.6.2.5101 B. states:

> "*Operation of a…Class III well must be pursuant to a discharge permit meeting the requirements of Sections 20.6.2.3000 through 20.6.2.3999 NMAC and Sections 20.6.2.5000 through 20.6.2.5299 NMAC.*"

A brine well injects fluids into the subsurface for the in situ extraction of salt and is thus considered a Class III well within the Underground Injection Control program. An approved discharge permit is therefore required for your proposed operation. Within 120 days of receipt of this notice, please submit a discharge plan in conformance with the provisions of 20.6.2.3106 C., 5000 through 5299 NMAC, and any other applicable requirements along with a filing fee of $100.00. Make any check payable to the "*Water Quality Management Fund*." An *Application for Permit to Drill* (Form C-101) should also be filed at an appropriate date and, if approved, the well will be added to our underground injection inventory.

Respectfully,

Jim Griswold
Senior Hydrologist