Approved: May 1, 2001 Carl Dean Holmes
Date

MINUTES OF THE HOUSE COMMITTEE ON UTILITIES.

The meeting was called to order by Chairman Carl D. Holmes at 9:10 a.m. on March 8, 2001 in Room 526-S of the Capitol.

All members were present except: Rep. Ward Loyd

Committee staff present: Lynne Holt, Legislative Research
Mary Torrence, Revisor of Statutes
Jo Cook, Committee Secretary

Conferees appearing before the committee: Karl Mueldener, Kansas Department of Health & Environment
Lee Allison, Kansas Geological Survey

Others attending: See Attached List

Chairman Holmes welcomed Karl Mueldener from the Kansas Department of Health & Environment's Bureau of Water to the committee. Mr. Mueldener provided information on the Hutchinson natural gas explosions and leaks (Attachment 1). Mr. Mueldener described the Kansas underground facilities used for storage of hydrocarbons; which include propane, butane, natural gas and gasoline. He then outlined the regulatory history of natural gas storage and provided information on the types of injection wells addressed by the Federal Safe Drinking Water Act's program of Underground Injection Control (UIC). Mr. Mueldener sited the specific statutes and regulations that specifically address regulatory authority. Included with his testimony were maps showing: 1) the current natural gas storage facilities located in the United States, 2) the principal flow of natural gas and the areas that hold the most reserves, and 3) locations of methane gas incidents and investigation areas in Hutchinson. Mr. Mueldener provided the committee with diagrams showing a natural gas storage well, a hydrocarbon storage well and a conceptual monitoring system.

Dr. M. Lee Allison, State Geologist and Director of the Kansas Geological Survey (KGS), addressed the committee on the natural gas pathways and accumulations under Hutchinson (Attachment 2). Dr. Allison explained that the KGS is under statute to investigate and report on the natural resources of the state. Dr. Allison then explained the Geological Survey's role in the Hutchinson situation, what steps were taken, what had been discovered so far and what additional investigations needed to be done to return confidence to the people of Hutchinson and ensure that this cannot happen again.

Mr. Mueldener and Dr. Allison responded to questions from the committee. Those questions and responses, in nearly verbatim format, are incorporated into the minutes by attachment (Attachment 3).

Meeting adjourned at 10:59 a.m.

Next meeting is Friday, March 9, 2001.

HOUSE UTILITIES COMMITTEE GUEST LIST

DATE: March 8, 2001

NAME	REPRESENTING
Karl Mueldener	KDHE
Joe Dick	KCKBPU
Jack Glaves	PH · Duke · KM +[illegible]
DAVE WILLIAMS	KCC
Don Carlson	KDHE - BOW
LEO HAYNOS	KCC
[illegible]	Whitney Damron Assoc.
Diana Edmiston	KCC
WALKER HENDRIX	CURB
Bill Bryson	KGS
Whitney Damron	KS Gas Service
Bob Krehbiel	KIOGA
John Cronde	Sen. Stan Clark
Dawn Bos Osborne, Kan.	
Amber + Israel Bos "	
Jared Schamberger Natoma	
Justin Schamberger "	
Alana Beck "	
TOM DAY	KCC

Information on
Hutchinson Gas Incident
to
the House Utilities Committee

Presented by
Karl Mueldener
Kansas Department of Health & Environment
Bureau of Water

March 8, 2001

Describe Kansas Facilities

- Hydrocarbon storage
  - propane,butane,natural gas, gasoline
- Stored in salt formation
  - solution mined caverns, jugs
- 10 active facilities
  - 1 natural gas, 9 LPG
- Companies: Kansas Gas Service, Koch, Ferrellgas, NCRA, Texaco, Williams, Oneok
- 624 active wells, 159 plugged wells, 80 million bbls total Kansas storage
- 7 inactive facilities

KDHE/Bureau of Water
March 2001

HOUSE UTILITIES
DATE: 3-8-01
ATTACHMENT 1

Regulatory Program History

- Natural gas storage and LPG storage from 1950's
- Federal Safe Drinking Water Act, 1974 (UIC)
- KDHE regulations from 1981
- 1986, injection programs divided between KCC and KDHE
- KCC has oil field related waste brine disposal and production zone gas storage
- KDHE has industrial waste disposal, federal underground injection control w/o oil field, salt solution mining wells
- Related program is Underground Injection Control (UIC), from Federal Safe Drinking Water Act

KDHE/Bureau of Water
March 2001

History

- 5 types of injection wells addressed by UIC
  - Class 1, hazardous and non-hazardous waste injection (KDHE)
  - Class 2, oil field brine injection (KCC)
  - Class 3, salt solution mining (KDHE)
  - Class 4, hazardous waste into and above aquifers (illegal)
  - Class 5, others not covered above
- Hydrocarbon storage wells not covered by UIC, but are a state program

KDHE/Bureau of Water
March 2001

State Regulatory Authority

- KSA 65-171d(a), "protect the soil and waters of the state from pollution resulting from under ground storage reservoirs of hydrocarbons and liquid petroleum gas"
- KAR 28-45-1 through 11
- KCC statutory authority, KSA 74-623, jurisdiction "except refining, treating, or storing of oil or gas after transportation .."

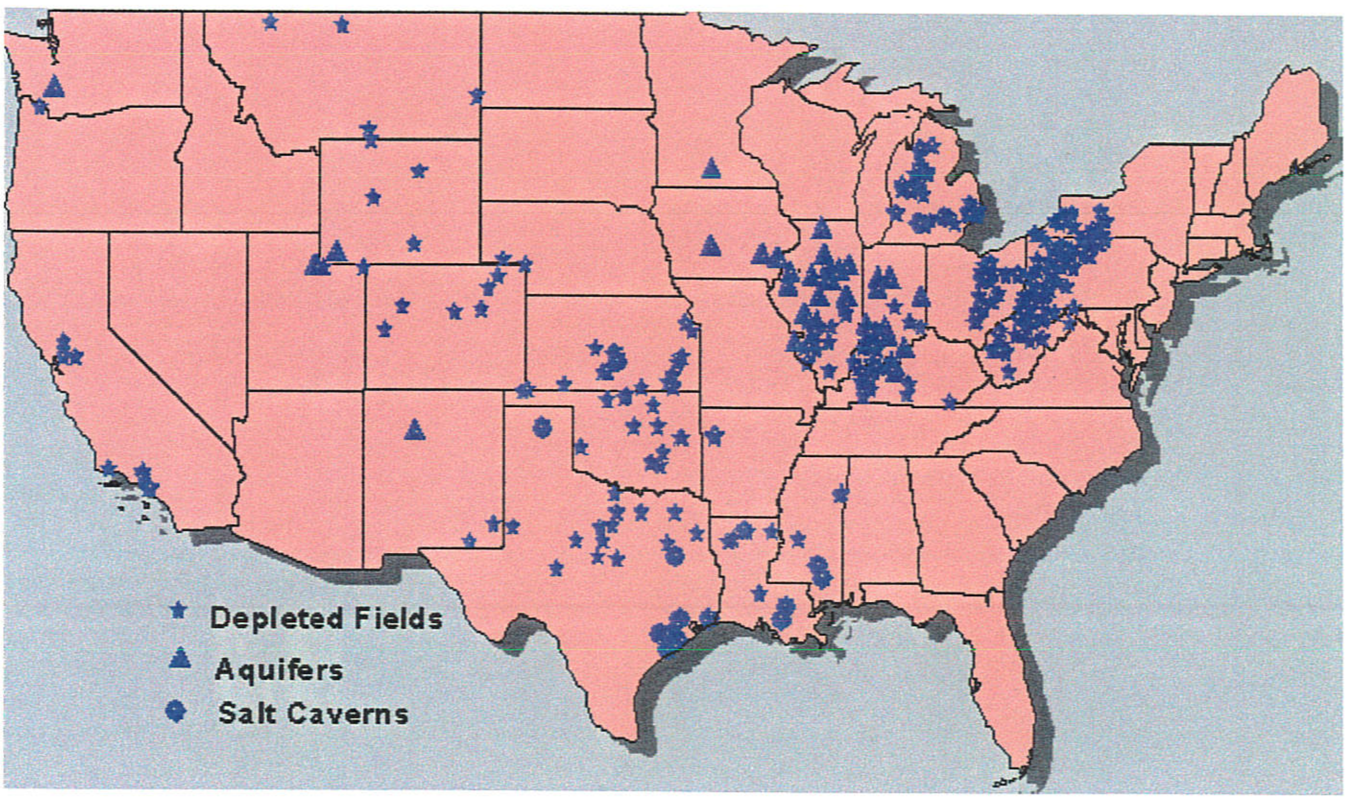
KDHE/Bureau of Water
March 2001

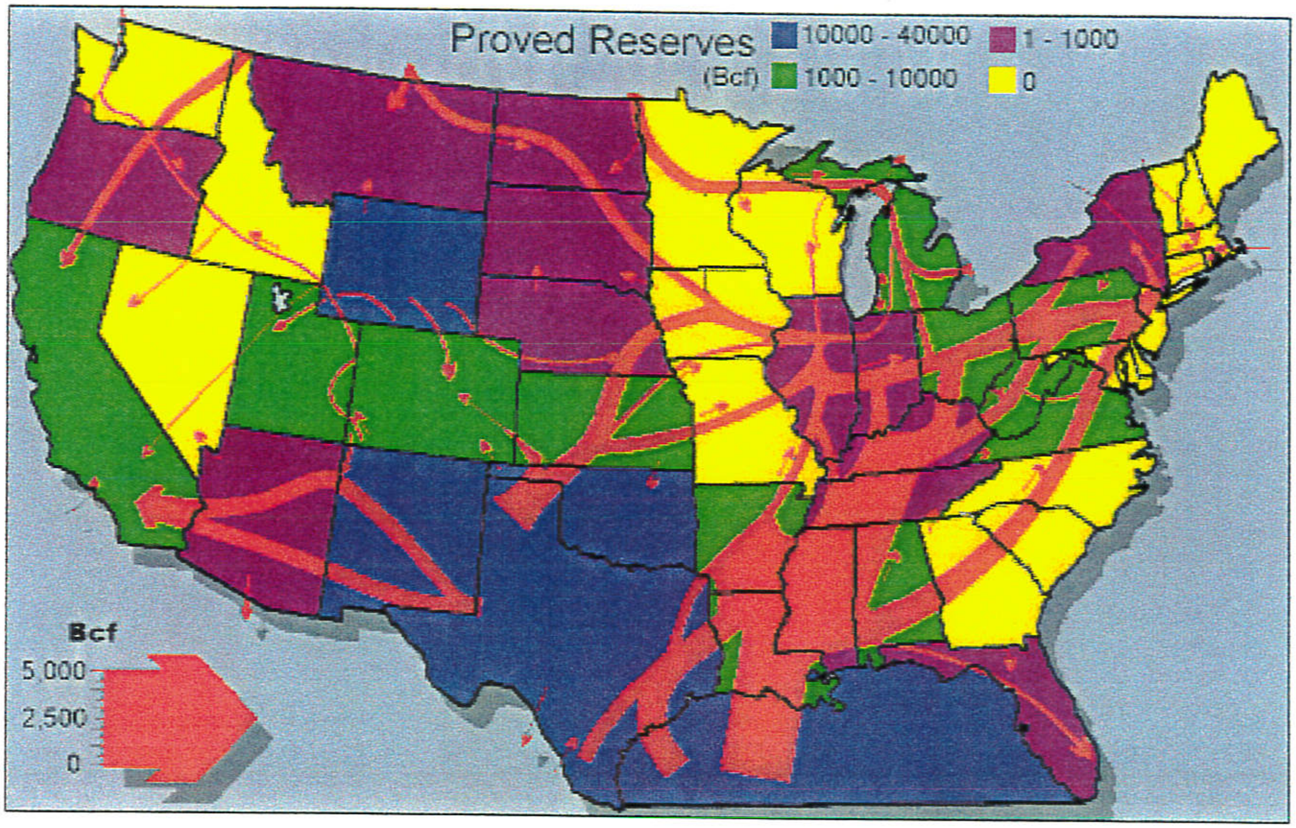
Regulation Plans

- Update started in 1996
- Meetings with industry
- Hutchinson incident gives new priority to regulation update
- Staff temporarily assigned to regulation process

KDHE/Bureau of Water
March 2001

Natural Gas Storage Facilities in the United States

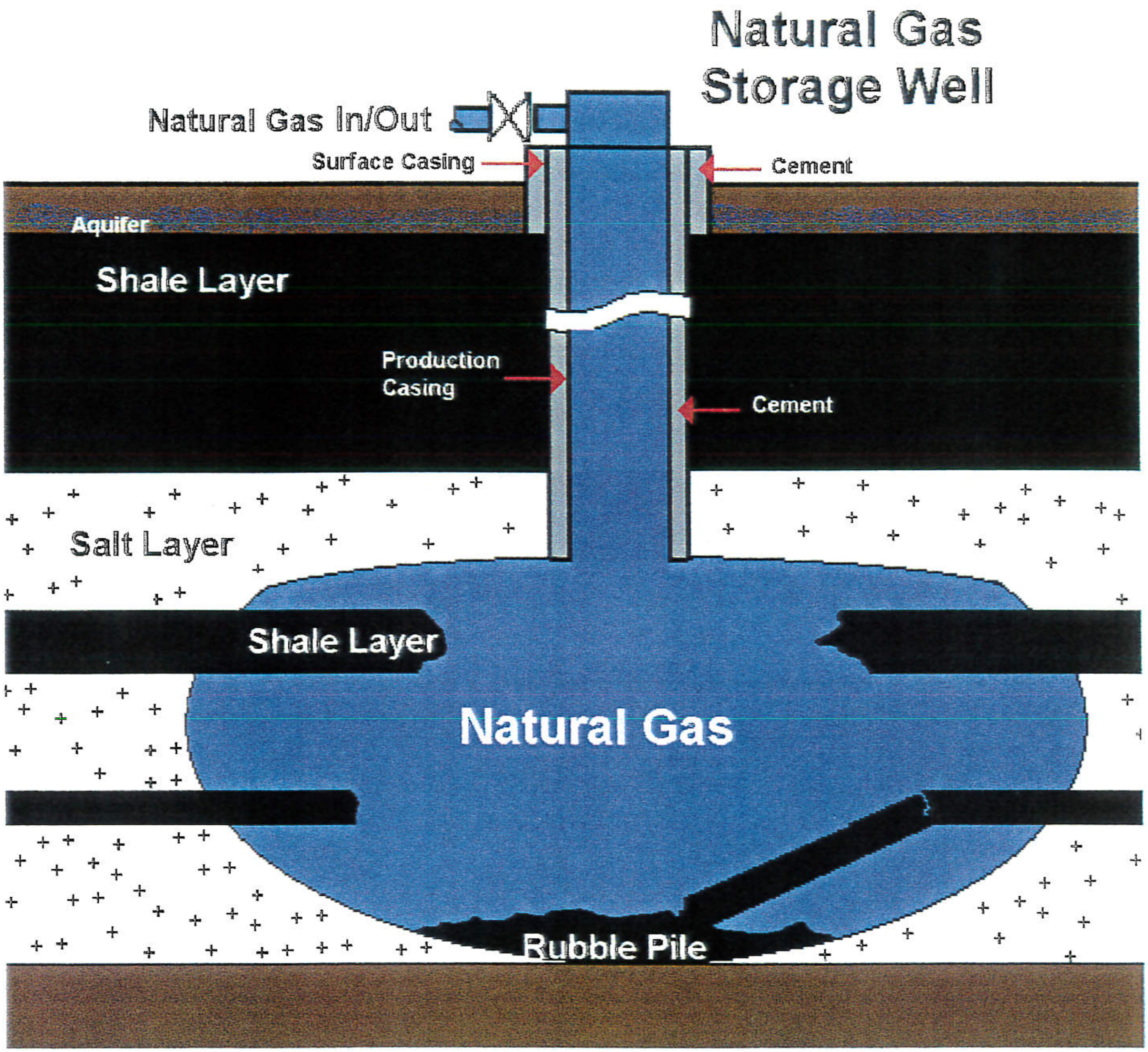




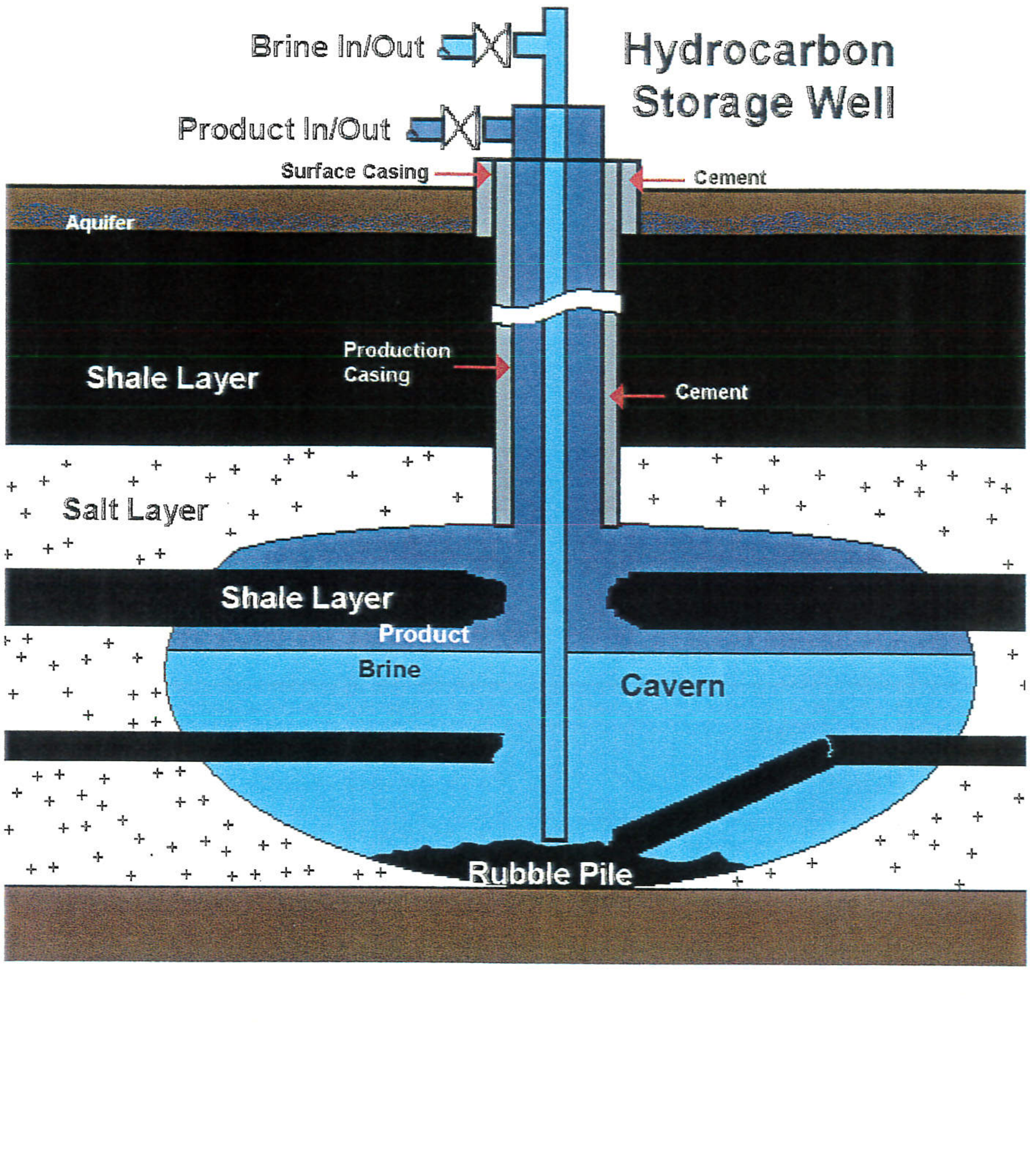
This map shows the principal flow of natural gas in the lower 48 states. It also shows the areas that hold most of the nation's proved reserves. The flow of natural gas from the Gulf region is nearly 5,000 Bcf annually.

Kansas Gas Service
Yaggy Facility
Storage Well S-1

1-6


Natural Gas
Storage Well
Natural Gas In/Out
Surface Casing
Cement
Aquifer
Shale Layer
Production
Casing
Cement
Salt Layer
Shale Layer
Natural Gas
Rubble Pile

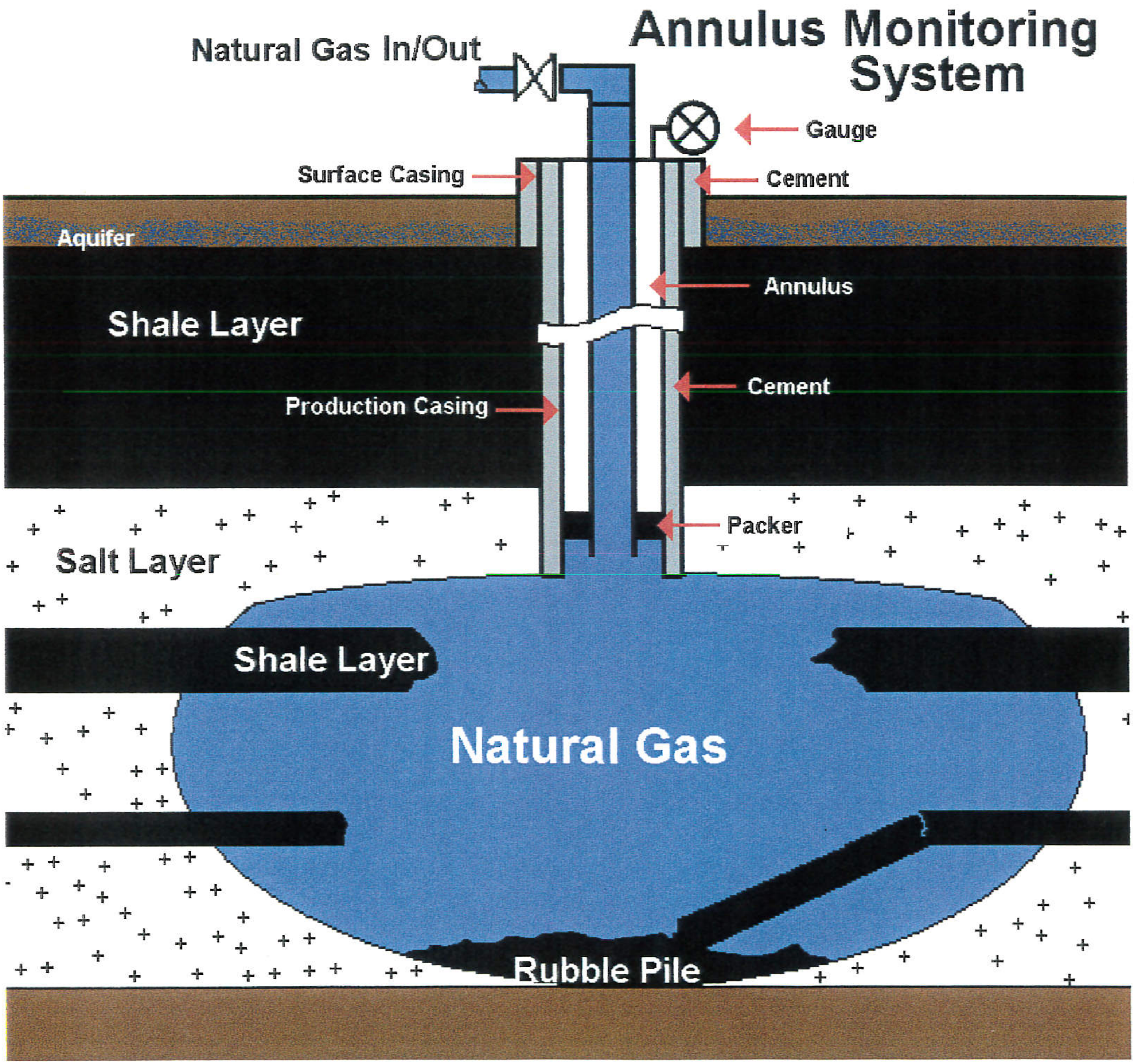
17



Hydrocarbon Storage Well
Brine In/Out
Product In/Out
Surface Casing
Cement
Aquifer
Shale Layer
Production Casing
Cement
Salt Layer
Shale Layer
Product
Brine
Cavern
Rubble Pile

18

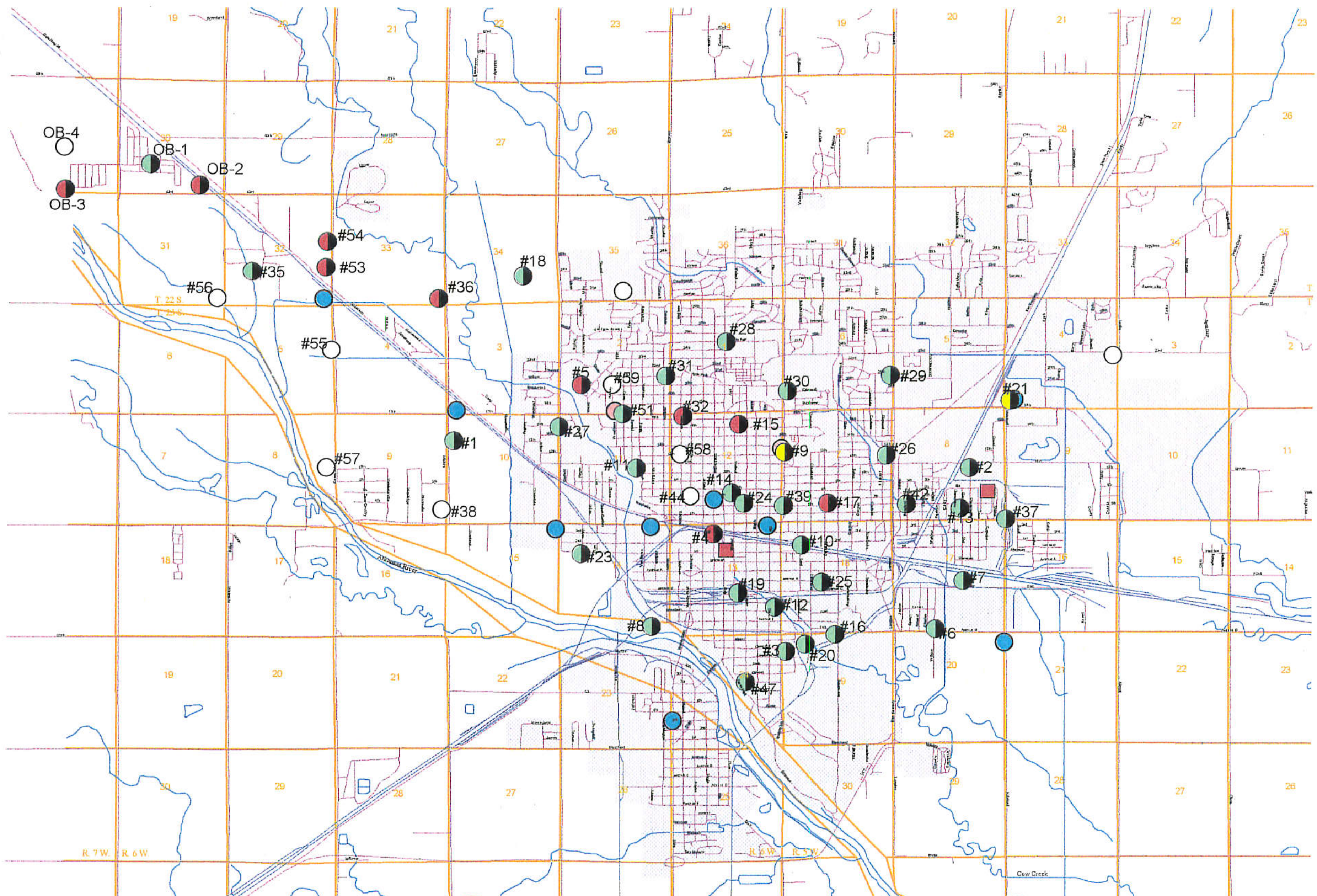
concept



Annulus Monitoring System
Natural Gas In/Out
Gauge
Surface Casing
Cement
Aquifer
Annulus
Shale Layer
Cement
Production Casing
Packer
Salt Layer
Shale Layer
Natural Gas
Rubble Pile

1-9

01-1



LEGEND

- Deep Drilled Vent Well - No Methane Gas Detected
- Deep Drilled Vent Well - Methane Gas Venting
- Deep Drilled Vent Well - Methane Gas No Longer Venting
- Deep Drilled Vent Well - Current/Proposed Drilling
- Cathodic Protection Well - Venting Gas or No Longer Venting Gas
- Cathodic Protection Well
- Explosion Site
- Railroad
- Incorporated Areas

LOCATIONS OF METHANE GAS INCIDENTS AND INVESTIGATION AREAS - HUTCHINSON

Printed 2/23/01

KANSAS GEOLOGICAL SURVEY
Office of the Director

The University of Kansas
1930 Constant Ave., Campus West
Lawrence, Kansas 66047-3726
phone 785-864-3965
fax 785-864-5317

GEOLOGY OF NATURAL GAS PATHWAYS AND ACCUMULATIONS UNDER HUTCHINSON, KANSAS

Presented to the House Utilities Committee

March 8, 2001

M. Lee Allison, PhD, R.G.
State Geologist and Director
Kansas Geological Survey
University of Kansas

The Kansas Geological Survey is tasked under statute to investigate and report on the natural resources of the state. We are established as a research unit of the University of Kansas to bring unbiased and scientifically sound expertise to bear on resource issues.

Our role in the Hutchinson situation began the day after the trailer park explosions when it became known that geological investigations were needed. We served initially as geologic advisors to KDHE. When many of the early vent wells turned out to be dry holes, it became clear that complex geologic conditions were likely controlling the pathways and accumulations of the gas. Our work consisted of:

- Determining what layers might serve as geologic conduits for gas under the city;
- Compiling subsurface information on the shape and nature of the geologic layers;
- Compiling information on sinkholes and subsidence in the Hutchinson area;
- Examining rock cores from the Yaggy field and surrounding oil and gas fields;
- Examining geophysical wireline logs from wells to identify possible conduits;
- Producing subsurface geologic maps of relevant horizons;
- Developing a geologic model to guide drilling of vent wells and other remediation actions;
- Recommending additional investigative and exploratory steps.

The Kansas Geological Survey has done the following so far:

- Collected, processed, and interpreted a 3.5-mile long seismic reflection line along Wilson Road between Yaggy and Hutchinson, and a 1/4 mile long line at Rice Park;
- Completed specialized computer processing on the seismic data to identify two possible gas-bearing amplitude anomalies (both were drilled and produced gas);
- Created structure contour maps on a variety of geologic horizons using 3700 oil and gas wells;
- Created a detailed structure contour map on the gas-bearing layer using water well and vent well data;
- Identified and correlated the gas-bearing layer on geophysical logs from oil and gas wells and vent wells in the area;
- Compiled reports on the history of subsidence in the Hutchinson area;
- Examined well cores to determine the geologic origin of the gas-bearing layers in order to predict possible pathways, including the Atomic Energy Commission core in Rice County;

HOUSE UTILITIES

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ATTACHMENT 2

- Acquired, digitized, and processed sonic well logs to create a synthetic seismogram to correlate the seismic lines to the wells;
- Calculated that there are geologically feasible conditions under which high- pressure gas could have traveled 7 miles underground in a few days;
- Examined outcrops in the region that might be equivalent to the gas-bearing layer;
- Advised the Groundwater Management District on a groundwater-monitoring program;
- Analyzed brine samples from the geysers for inorganic materials for source studies;
- Considered the potential for subsidence due to collapse of brine well caverns;
- Produced digital orthophoto quadrangle air photos for plotting data;
- Briefed federal, state, and local officials on the geology;
- Briefed U.S. Department of Energy and NASA; discussed cooperative efforts;
- Organized a one-day technical meeting for involved parties to plan further geologic investigations;
- Worked with KDHE, Kansas Gas Service, and the City of Hutchinson to recommend drilling locations, core locations, and types of logs to run; and
- Responded to scores of inquiries from citizens, consultants, attorneys, and the news media.

We have found that:

- The gas is confined to a relatively thin geologic layer at the top of the Permian-aged (approximately 250 million years old) Wellington Shale, about 200 feet above the Hutchinson Salt Member;
- The regional dip of the deeper rock layers is to the west, meaning that, all other factors being equal, gas would move in general to the east (because methane is lighter than water, it will tend to move updip – from lower to higher areas - through rock);
- The large number of vent wells that are dry holes suggests that the gas pathways are discrete and cover a relatively small area under the city;
- The seismic amplitude anomalies were drilled and found to contain gas; each is about 150-200 feet across;
- The gas-bearing layer may be composed of siltstones that are locally fractured;
- There are anticlines present (rocks folded into an arch) that could serve to direct gas along their crests; and
- There are deep faults or fractures (many thousands of feet deep) that appear to control the orientation of the Arkansas River channel and may have controlled the location and orientation of geologic deposition during the Permian period as well.

What investigations need to be done to return confidence to Hutchinson and ensure that this cannot happen again?

- Determine which of these factors or combination of factors is responsible for the gas moving under Hutchinson: pathways along buried channels or similar sedimentary features; along structural dip or anticlines; along fractures and faults; or along some combination of these features;
- Verify that the vent wells have adequately drained all the pockets of gas;
- Monitor water wells for contamination;
- Locate abandoned brine wells drilled from the late 1800s onward;
- Evaluate gas accumulations in the surrounding areas;
- Establish base line studies in the event of subsidence;
- Identify other potential gas pathways.

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Types of Natural Gas Storage Facilities

The three principal types of underground storage sites used in the United States today are: (1) depleted reservoirs in oil and/or gas fields, (2) aquifers, and (3) salt cavern formations. (Several reconditioned **mines** are also in use as gas storage facilities). Each type has its own physical characteristics (porosity, permeability, retention capability) and economics (site preparation costs, deliverability rates, cycling capability), which govern its suitability to particular applications. Two of the most important characteristics of an underground storage reservoir are its capability to hold natural gas for future use and the rate at which gas inventory can be withdrawn, its deliverability rate.

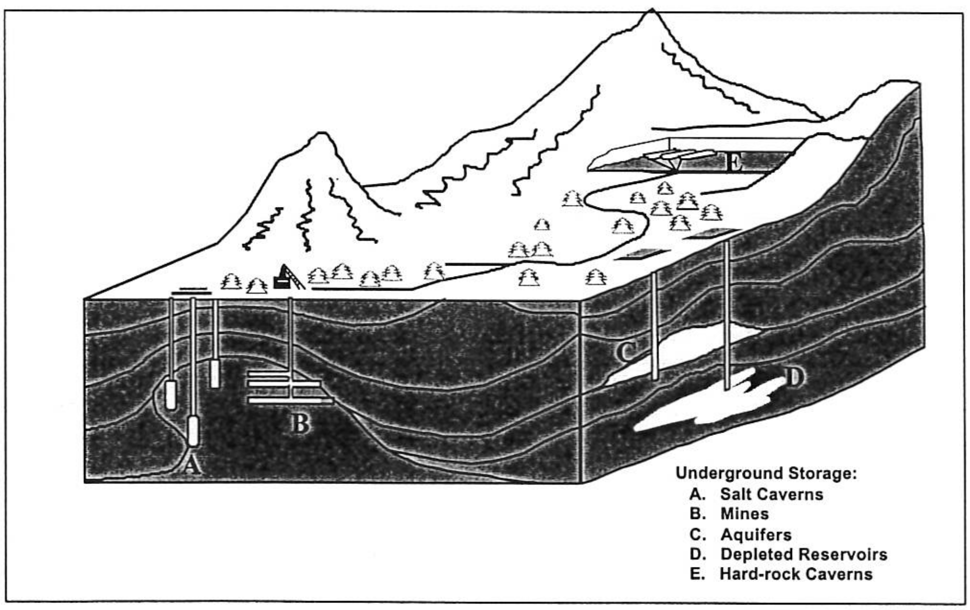
Most existing gas storage in the United States is in **depleted natural gas or oil fields** that are close to consumption centers. Conversion of a field from production to storage duty takes advantage of existing wells, gathering systems, and pipeline connections. Depleted oil and gas reservoirs are the most commonly used underground storage sites because of their wide availability.

In some areas, most notably the Midwestern United States, natural **aquifers** have been converted to gas storage reservoirs. An aquifer is suitable for gas storage if the water-bearing sedimentary rock formation is overlaid with an impermeable cap rock. While the geology of aquifers is similar to depleted production fields, their use in gas storage usually requires more base (cushion) gas and greater monitoring of withdrawal and injection performance. Deliverability rates may be enhanced by the presence of an active water drive.

Salt caverns provide very high withdrawal and injection rates compared with their working gas capacity. Base gas requirements are relatively low. The large majority of salt cavern storage facilities have been developed in salt dome formations located in the Gulf Coast States. Salt caverns leached from bedded salt formations in Northeastern, Midwestern, and Western States are also being developed to take advantage of the high volume and flexible operations possible with a cavern facility. Cavern construction is more costly than depleted field conversions when measured on the basis of dollars per thousand cubic feet of working gas capacity, but the ability to perform several withdrawal and injection cycles each year reduces the per-unit cost of each thousand cubic feet of gas injected and withdrawn.

The potential use of **Hard-rock cavern** storage is currently undergoing testing in the United States. None are operational as natural gas storage sites at the present time.

Types of Underground Storage



Source: PB-KBB Inc. Recreated by Energy Information Administration, Office of Oil and Gas.

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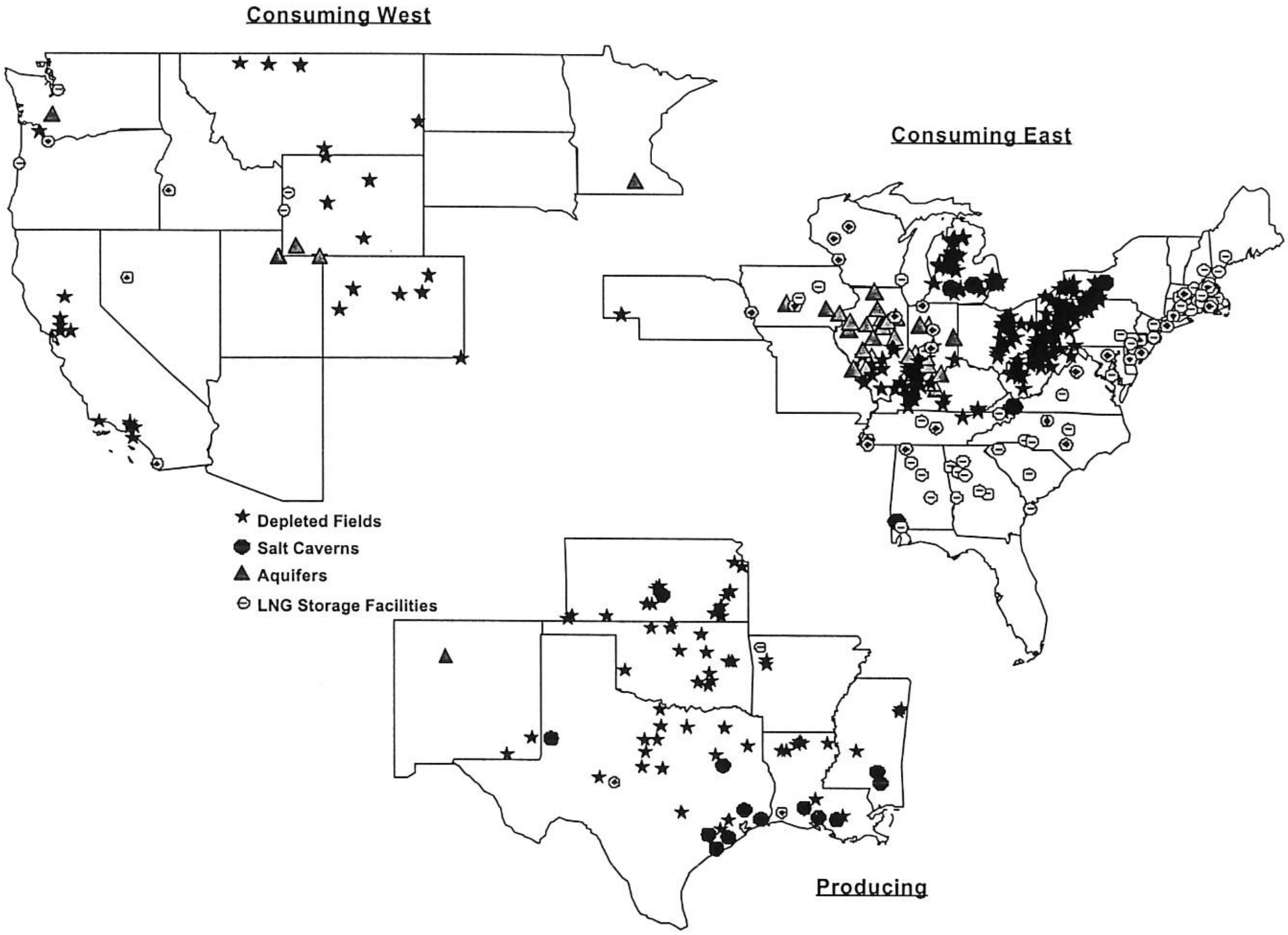
Figure 1. **The Largest Number of Underground and LNG Storage Sites Are Located in the Consuming East Region**

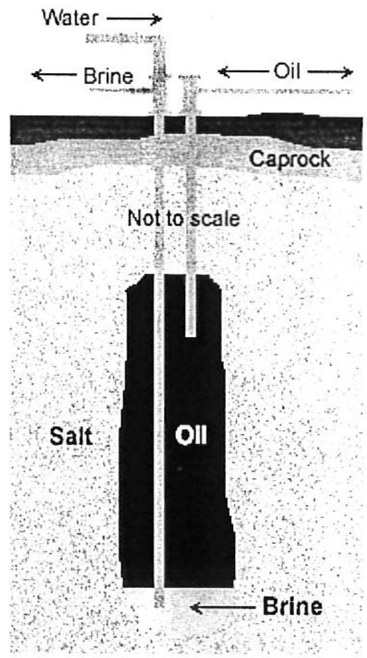


Summary of Underground and LNG Storage, by AGA Region and Reservoir Type, 2000

Region	Depleted Gas/Oil			Aquifer Storage			Salt Cavern Storage			Total			LNG Facilities		
	Sites	Working Gas Capacity (Bcf)	Daily Deliver-ability (MMcf/d)	Sites	Working Gas Capacity (Bcf)	Daily Deliver-ability (MMcf/d)	Sites	Working Gas Capacity (Bcf)	Daily Deliver-ability (MMcf/d)	Sites	Working Gas Capacity (Bcf)	Daily Deliver-ability (MMcf/d)	Sites	Site Capacity (Bcf)	Daily Deliver-ability (MMcf/d)
East	243	1,690	31,888	33	351	7,457	4	4	298	280	2,045	39,643	83	73	10,135
West	31	590	8,620	6	39	1,175	0	0	0	37	628	9,795	13	12	1,186
Producing	74	1,089	17,166	1	1	12	23	135	11,118	98	1,226	28,296	3	7	312
Total	**348**	**3,368**	**57,674**	**40**	**392**	**8,644**	**27**	**139**	**11,416**	**415**	**3,899**	**77,734**	**99**	**92**	**11,633**

Bcf = Billion cubic feet. MMcf/d = Million cubic feet per day. LNG = Liquefied natural gas.
Note: Regions are those established by the American Gas Association.
Source: Energy Information Administration, Form EIA-191, "Underground Gas Storage Report."

How Oil is Stored in the Strategic Reserve



Early in the Strategic Petroleum Reserve program, underground storage in salt domes was chosen as the most cost-effective method of petroleum storage.

The Strategic Petroleum Reserve has created or acquired 62 storage caverns. The caverns were created through a technique called "solution mining." Solution mining begins with a well drilled into the salt dome. Fresh water is pumped into the salt formation to dissolve the salt. As the salt dissolves, the brine created is pumped from the cavern into deep disposal wells or into the Gulf of Mexico.

As more fresh water is injected, the cavern grows in size. By regulating the flow of fresh water at different depths, the cavern shape and size can be controlled. It typically takes 7 barrels of water to create space to hold 1 barrel of crude oil.

A typical Strategic Petroleum Reserve cavern holds 10 million barrels of crude oil and has a diameter of 200 feet and a height of 2,000 feet. This size cavern is large enough to hold the New York World Trade Center. The roofs of most of these caverns are more than 2,000 feet below the surface. At these depths, the surrounding salt is under such pressure that any cracks that may occur will close almost instantly. This "self-healing" phenomenon makes the deep salt caverns very geologically stable.

To store crude oil, oil is pumped into the cavern at the top which causes a displacement of the brine from the bottom. The brine flows through pipes to the surface where it is disposed of.

To withdraw crude oil, fresh water is pumped into the cavern at the bottom which causes a displacement of the crude oil to the surface.

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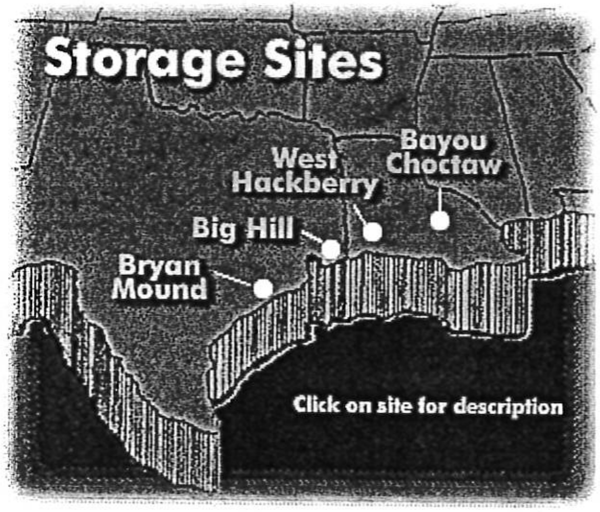
Emergency crude oil is stored in the Strategic Petroleum Reserve in salt caverns. Created deep within the massive salt deposits that underlie most of the Texas and Louisiana coastline, the caverns offer the best security and are the most affordable means of storage, costing up to 10 times less than above-ground tanks and 20 times less than hard rock mines.



Bryan Mound | Big Hill | West Hackberry | Bayou Choctaw

Storage locations along the Gulf Coast were selected because they provide the most flexible means for connecting to the Nation's commercial oil transport network. Strategic Reserve oil can be distributed through interstate pipelines to nearly half of the Nation's oil refineries or loaded into ships or barges for transport to other refineries.

Strategic Petroleum Reserve caverns range in size from 6 to 30 million barrels in capacity; however, the typical cavern is 10 million barrels and cylindrical in shape having a diameter of 200 feet and a height of 2,000 feet. A typical cavern is large enough for New York City's World Trade Center to fit inside. The Reserve has created over 50 of these huge underground caverns.

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QUESTIONS & ANSWERS MARCH 8, 2001

HOLMES: Let's flip back to the chart that showed us the cross section of the Yaggy Field and the brine well and underneath Hutchinson. There's been reports in the news media that there's a hole in the casing, are you aware of that or maybe KDHE needs to respond, is there not a hole and, if there is, at what level is the hole in the casing?

ALLISON: Yes sir, I'm familiar with it, I think Mr. Mueldener has more specific information, but in the briefings I've been, they did find that a ?? sized hole in the steel casing at a depth of about 601 feet was report just at the top of the salt formation.

HOLMES: At the very top of the salt formation?

ALLISON: Right, now the jug that is hollowed out here, I believe is at least 40 feet or more below the top of the salt, with the idea that the sale, because it is very plastic, will form a good impermeable seal above that. So, our feeling is, our gut feeling, the hypothesis we would work on is that the, with the hole in casing, then between the casing and the salt or higher up between the casing and the rock around it, when you complete this well, you pump cement behind that to fill the void so that there is steel casing to cement to rock in the voids. With a hole in the casing you still don't have a pathway for the gas to get, unless it punches through the salt or it works up between the casing and the rock by channeling through th cement. Now there are some thoughts that the hole in the casing may have been formed as early as 1993 cause this well had been temporarily abandoned and was filled with cement. They went back in when Kansas Gas took over the field and about '93 they went in to drill the cement out and they either hit metal or found something in the salt, I mean the cement there at that depth so they may have done some damage to the side of the casings hypothesized at the time they were drilling the cement out. So they may have even damaged it or even started a hole at that time, so one scenario could be that the weakened casing had allowed a high pressure gas to start getting out behind there it could have started working through that cement in either eroding or corroding or breaking the channel through the cement behind the casing. Now that's just a speculation at this point. But then, if the gas is moving between the casing and the rock and moves up until it hits geologic units here where it can't go any higher then starts moving up along that, those thin beds on top of the Wellington shale.

HOLMES: I'm going to use a term that you probably need to explain to the committee and the question will be is whether they have done that. Have they done, has there ever been a cement bonding log run on that particular well? Explain to the committee what a cement bonding log is and then go ahead or maybe Karl will have the answer.

ALLISON: I'll have to defer to Mr. Mueldener ...

HOLMES: Explain what a cement bonding log is.

HOUSE UTILITIES

DATE: 3-8-01

ATTACHMENT 3

ALLISON: A cement bond log is ....??.. tool that's run down through the casing and it sends signals out through the steel casing that bounce off the rock behind it and it looks for voids in the cement so it is determining how well the cement is bonding to the casing and to the rock. And it is quite often run to look for voids or openings to make sure we have solid cement all the way into the zones you want to look....

HOLMES: Before we do that, explain to the committee how the cement is put in the hole once a well is drilled to bring the cement up behind the casing.

ALLISON: There's a couple of different ways to do that. One common way would be to put a plug in below, at the lowest depth you want to slant off into the casing. So you push a plug down in there to seal off the bottom of the casing. Then you may put holes into the casings and pump cement in pipe down, you pump cement in to that depth and it's pushed out through the holes and comes up behind the casings. And to insure that you get cement all the way, they'll make sure that you see cement from all the way to the surface and you have good solid returns and it would suggest then that the cement went through those holes and all the way to the surface. You could also put a plug below the casing in the open hole and seal that off and then you pump cement down so that it's through holes in the casing, it goes out the bottom of the casing and fills all the way to the surface or up to the level you want and then you come back in with a drill bit and just drill out the little bit of cement that's left inside that before you put it on production.

HOLMES: Thank you. Karl, what methodology was used to put cement in this hole when the well was developed and was there ever a cement bonding log run on this well?

MUELDENER: I don't think I can answer without checking the record of the technique, I don't know, I would have to, I don't know which technique, other than what Dr. Allison is describing. There was, in terms of tests run on the well, I'm immediately familiar with when it was bored out and had been plugged and a rig came back and bored out the old plug and as Dr. Allison said speculation that some damage occurred them. We did require an MIT on all the wells including this one back at time. And then there has been two tests ran since then. Sorry, as I stand here, I can't tell you, ...electron density or which category exactly they meld into, whether .....cement. I can find that out.

HOLMES: Okay, do your rules and regs require cement bonding log on wells that are used for high pressure gas storage?

MUELDENER: I'd have to look through it real quick to see.

HOLMES: I read through it twice last night and did not find it.

MUELDENER: The, I might jump a little bit ahead, the MIT's ...

HOLMES: Explain, you're using a terminology, explain to the committee what an MIT is. You've got a drawing that you handed that would help explain it to the committee.

MUELDENER: Let's see if I can do it without even the drawing. MIT stands for Mechanical Integrity Test. There are several different ways that can be done. Probably the simplest way to explain is simply pressuring a section of pipe or cavern or vessel, all that pressure, pushing pressure into then hutting it off and seeing does it hold that pressure. If the pressure sinks back down you know you, it's an indication that there would be a leak or some kind of problem that needs to be corrected. There's a number of different ways that can be ran and I won't pretend to understand all those different techniques. I would point out to you that with an MIT it does, it answers questions, it tells you if you have a leak at that time. It won't tell you, necessarily, if your gonna have a leak at a later date in time. To get in to those sort of tests, there are other groups of tests that we think need to be ran as far as the category Chairman now has, make sure I get this right, Casing Integrity Test. Which, for instance, would show that if the casing is damaged or has thin spot, there's ways effectively to detect. The type of test that you're describing, the Cement Bond, looks beyond the steel casing and looks into that next level of protection, which is the cement between the outside of the casing out to the hole that was originally drilled. So there's way both those could be checked. Both of those, I point out, are not required in the existing regulations.

HOLMES: MIT test is not required?

MUELDENER: I believe that's generally correct. There is general phraseology about, in certain conditions, we can require, the department can require some tests be ran, but on a standard practice in terms of every 5 years, you're correct, there's no...

HOLMES: There's nothing in the regs that I could find on that. Is there a Cement Integrity Test required?

MUELDENER: There's a gamma ray density log, cement bond log, center caliber survey as determined necessary, that's locating the roof, the roof thickness of the cavern.

HOLMES: That's basically maintaining, checking the roof thickness and see what kind of a hole you got down there.

MUELDENER: That's correct

HOLMES: But none of these tests are required. Isn't it normal practice in your hazardous well program that you require these type of tests?

MUELDENER: Require which?

HOLMES: Require the MIT test in hazardous well program?

MUELDENER: The MIT and some other tests as well, yes.

HOLMES: The hole has been explained at being the very top of the salt layer. Maybe Lee may have to answer this or you might be able to answer it. Is there moisture above that salt level in that formation?

ALLISON: Yes sir, Mr. Chairman. All of the geological units there will be filled with brine basically, not from the salt, but these are, these units are naturally filled with water in our Bradbury units and as you get below the equispread they tend to be a much salter water, brine.

HOLMES: The upper arm of shale, does that normally have water it in?

ALLISON: Yes sir, yes

HOLMES: Without running a cement bonding log, how would you know if there was a void in the cement put in the hole at the top of that salt?

ALLISON: I think the cement bond long would be the best tool to determine whether is there's a good bonding between casing and the surrounding rock with cement. I'm not aware of other tools that are specifically designed to do that. Cement bond log are not infallible, but they are the only tool that I know of that are designed to look at that.

HOLMES: Would it probably be corrosive where that salt was, since a hole at the very top of the salt level and the bottom of the upper Wellington, would it probably be most corrosive at that point on the casing, if that salt was adjacent to the casing on the outside of it?

ALLISON: I would presume that you'd have pretty corrosive conditions, yes sir.

HOLMES: But really since no test was run, we don't know if the cement filled that gap or not.

ALLISON: Now you're getting in to the regulatory dispute and I can't....

HOLMES: Karl, you really don't know what was there until we had a failure. You don't know today whether there is cement behind the casing where the hole was.

MUELDENER: ....??..

HOLMES: Could you give us a little history of Yaggy?

MUELDENER: Yaggy was originally developed as a LPG storage facility. I know it attracted a lot of my attention back, when they were active we were pushing the company .... expecting to plug out the facility at the time the owner was, I just remember a gentleman from Missouri. They did not appear to have much in way of resources and were not getting things plugged out. Then Gas Service entered the scene, excuse me- Western Resources, and that was in 1988, anyway Kansas Gas, Western Resources at the time bought the facility with the contact to converting them....

HOLMES: What year?

MUELDENER: That's what were trying.......'92.

HOLMES: '92, so up until '92 that storage field was operated as a liquified petroleum gas storage field?

MUELDENER: That's essentially true, it had been sitting in a pretty much inactive state in terms of no storage for some years before these, what I would call interim owners, including the original developers and Western Resources came in.

HOLMES: When was Yaggy first developed as petroleum storage field?

MUELDENER: 1980 - '81

HOLMES: That's what I suspicioned. You know it would've helped if we had the history from the time it first started up to current date. My understanding the initial ownership went into bankruptcy and was in bankruptcy when Western bought them out and was not used for a couple years.

MUELDENER: I believe that's correct. I can remember, that we were, what I'm gonna call chasing around these interim owners and then when Western Resources bought the facility we were please because we had the responsible business.

HOLMES: Was this particular well used as a petroleum storage facility or was this one of the jugs that was developed after that?

MUELDENER: This particular one, it was plugged, I know it was in plugged division in 1992 and that....

HOLMES: So it was probably used as a petroleum storage before that?

MUELDENER: I would say that was a safe assumption.

HOLMES: Your rules and regs that you have in place were drafted in 1981 and you made some changes in 1984. In reading through those rules and regulations, it's my belief they were designed to regulate liquid petroleum type products and not high pressure gas.

MUELDENER: They're called hydrocarbon and yes, they are primarily aimed at the LPG section, propane and butane.

HOLMES: Reading through those regulations last night I saw where several places referred to fluid. I never found a reference in it referring to gas.

MUELDENER: .....I believe it would fit, your point's still well taken Mr. Chairman, in terms of these were intended primarily to cover, intended to cover the LPG.

HOLMES: And the way LPG works is that, to get the LPG out you insert brine into the well to bring the LPG out, is that correct?

MUELDENER: At least the last parts of it, yes.

HOLMES: How do you define hydrocarbon? I did not find any definition of hydrocarbon in the statutes last night.

MUELDENER: ...look at the regs......??????

HOLMES: I guess one of my concerns, looking back at statutory authority that you reference in your rules and regs in 65-171d, that prior to 1998 it said that your authority is for underground reservoirs of hydrocarbons, natural gas, and liquid petroleum gas. In 1998 when we worked the .... laws, I believe that was Senate Bill 800, maybe in 1998, natural gas was taken and your authority to protect soil and water in the state from pollution resulting from underground storage reservoirs of hydrocarbons and liquified petroleum gas, why was natural gas taken out of the definition of your authority.

MUELDENER: I'm not aware that it was at that time, I don't know.

HOLMES: But it would be clear that before 1998, you had clear authority to regulate natural gas and now your authority to regulate it is how you define hydrocarbons is in the original statutes.

MUELDENER: I don't know why that change was made in 1998, what I understand...

HOLMES: The reference chapter 143, 1998 it was changed and natural gas was taken out of your authority for rules and regs.

MUELDENER: I'm not aware of it, at least if it's involved with other changes that might have been occurring, I don't remember.

HOLMES: And this is the same,177d and this is in a(1) in the statute.

MUELDENER: I understand your point, from my understanding, what I think you're looking at Mr. Chairman, you're saying that in '98 natural gas disappeared from that statute.

HOLMES: That's right. In 1996 you started to update the regulation plans on underground storage fields?

MUELDENER: Yes

HOLMES: And it says, according to your testimony, you had meetings with industry. How many meetings did you have with industry?

MUELDENER: Well, we're counting. The one in '96 and we met with them last June of 2000, two.

HOLMES: Why have you not moved forward, you started in '96, and I guess, my question, why'd you wait until we have a problem before you got serious about rules and regs?

MUELDENER: I think you've got an answer to your question. We were not predicting an incident of this, the main reason would be simply one of manpower, how much people we had to dedicate to this program.

HOLMES: Is there some national standards for regulations for oil and gas facilities.

MUELDENER: There are some industry national standards and there's some Canadian, there's something called a Canadian Standard Association and the, I don't know if it's fair to call this industry or not, but the Interstate Oil and Gas Compact Commission.

HOLMES: And they established guidelines in 1997, is that correct?

MUELDENER: My notes are showing October 1995.

HOLMES: Okay, the information I have shows 1997. I guess my question is that you start doing regulations in 1996, there's model regulations in 1997 here we are in 2001 and we're still looking at regulations that were drafted in 1981 for liquid hydrocarbons.

MUELDENER: That's correct.

HOLMES: Why is it so difficult, when there's model regulations to draft new regulations?

MUELDENER: It's a matter of priority and staff time.

HOLMES: Let's go to the handouts. Let's go to the one titled 'Hydrocarbon Storage Well", this is the one that ....??.... operated when they were using it for LPG's I assume?

MUELDENER: It has the tubing around the.....

HOLMES: Yes

MUELDENER: That's the one.

HOLMES: I've got a question for Lee and then I'll come back to you. The chart that's supplied by the department indicates that there's a shale layer in the salt.

ALLISON: Right, I don't know exactly how many, but it's typical for in bedded salt to have innerbedded shale, so, this is schematic but there ....

HOLMES: How coarse is that shale that's in the salt bed?

ALLISON: I don't have the numbers handy on that, it's something we could probably determine, but typically the shale may be relatively porous but not permeable, so that it may have the ability to hold a lot of water compared to ......filling or transmitting that water at a distance.

HOLMES: What about gas, under high pressure?

ALLISON: The big concern there would be, under pressure, if the pressure got high and fractured the salt, which tends to flow back together again so it's very plastic, whereas the shale would be more likely to be brittle and could fracture and create a long fracture through the shale, we do not see the salt.........

HOLMES: Is 600 pounds of pressure enough to fracture the shale, normally?

ALLISON: It depends on the depth, you'd have to look hydrostatic or lipostatic reading so we, at the request of KDHE looked at pressure readings from 1997 when this facility was asking to raise their pressure reading from .75, in other words 75%, I believe they had asked in late '96 to increase the allowable pressure from 75% of what would be the natural, defining pressure of the rock, from 75% to 86%, so we looked at that only and reviewed that. So, it's not the actual pounds, but it's the pressure rating. So at 600 psi, I think you're 15, 14, 15% below the pressure that would be needed to lift and break the rock.

HOLMES: Okay, for KDHE. Have you run any tests that would show what the possible permeability or porosity of the shale is?

MUELDENER: We did some, at the same point in time, there was some.....core from this area in terms of calculations and estimates that Dr. Allison just described. Sorry, ...answer the question. This is something I asked the other. Based on our work salt solution mining cavities in the area, when you, when a salt company wants to crack, they go up to about, our experience shows, 1.4 psi per foot in terms of radian. SO what they, I might just ask Dr. Allison, that my understanding is the request for the increase pressure was from .75 psi per foot of radian to .88 .... so it's not necessary 75% of crack pressure. We would estimate crack pressure based on our salt solution mining experience in the area at 1.4 psi per foot. There request was to operate at .88 psi per foot.

HOLMES: Okay, let's go to the handout titled 'Natural Gas Storage Well.' Is this the type of system operating at Yaggy?

MUELDENER: Yes

HOLMES: So if there's a hole in the casing, there's absolutely no protection from that going into the formation?

MUELDENER: Uh, Yes

HOLMES: Let's go to the one you called 'Concept.'

MUELDENER: Other than, in respect to the other question, other than the cement that ....

HOLMES: If the cement can hold that kind of pressure, if there's a hole in cement it doesn't make any difference.

MUELDENER: Yea, I generally don't think of the cement as, I think it would be there for structural reasons and...

HOLMES: On the one marked 'Concept,' isn't this the same methodology used for an MIT test?

MUELDENER: I guess you could say, in a sense you're running an MIT test all the time with this idea. At least in terms of what's blue, if you have a colored photo, yes. With the one the Chairman is looking at there, the inner most pipe on this concept, the tube in here is blue, and darker, that's where the product in this concept would be going in and out of the cavern. If that blue line then were tubing, casing whatever you want to call it, were to leak it would go into the white space, the open or be filled with whatever you want it to be, and that could then be conceptual.

HOLMES: And this is the same methodology used to take gas out of the ground of a production field, you have a casing on the outside and you have tubing on the inside to draw the gas with a packer at the bottom. Isn't this the same methodology that's used most only in reservoir type natural gas storage fields?

MUELDENER: I don't know if I can answer that question.

HOLMES: We'll get into that tomorrow, but I think this practice what we're seeing here has been around for a long, long time.

MUELDENER: This is...uh

HOLMES: ...normal in the industry.

MUELDENER: It does resemble a disposable activity.

HOLMES: I've got more questions, are you going to be back tomorrow?

MUELDENER: I can be.

HOLMES: I appreciate it. Don Dahl.

DAHL: This should be an easy question compared to the last ten. Could you, oh this is probably for Dr. Allison. What is a cathotic protection well?

ALLISON: Representative, I only learned of those in the past few weeks. I'm not really familiar with them. I've had it explained to me that it's a well that's drill a couple hundred feet into the ground and it's basically a sacrificial lamb for pipe line systems. It's a way of putting electric currents in this pile of metal in the ground to attract the corrosion to hit and keep pipelines in the area from corroding. I really don't understand how it works. The significance has been that these were wells that were, perhaps, a couple hundred feet deep in Hutchinson and in a few cases it was natural gas and water bubbling up along those well bores. So, those were again places where they were wanting to go in try to seal them off before they vent those and try to draw the gas off of them.

DAHL: Okay, so these are new wells that have gone in since the explosion?

ALLISON: No.

DAHL: Okay, they've been there a long time?

ALLISON: These have been, were put in in modern times, I'd say within the last tens of years as a corrosion resistant procedure for pipelines running through the cities. There's a number of these wells scattered around town and the idea is, I don't truly understand how it works, but an electrical charge helps bring the corrosion into meet these cathotic protection wells and keeps it from protecting the pipelines and they served as conduits for some of the gas then ....

DAHL: Thank you

HOLMES: Mary

COMPTON: Thank you Mr. Chairman. You kind of touched on this yourself, but I would to know if there could be a leakage from jug to jug within the shale compartment?

ALLISON: Geologically, that's possible. What Kansas Gas has told us is that they have seen no communication or leakage of communication between the jugs, so that they believe that the only leakage occurred out of jug S-1 and that one is now filled with brine and they saw no pressure drops associated with any other jugs. So, yes it geologically and physically possible for ......in the well.

COMPTON: And my other question is, is there any monitoring, I've heard a little bit about that you do check it some times, the well the check the pressure and the amount of gas that's in the jug.

ALLISON: Again, I'd have to defer to KDHE on that.

MUELDENER: Mr. Chairman, with your permission, I would have her ask the question again, I was writing something. I understand your first question I was going to add something to, to add on to your first question. We don't want the different jugs communicating with each other and we do have a separation of distance. Now the way it is worded it's not good enough. We want to make sure the walls, that there is so much distance so that the jugs aren't necessarily, aren't hooked together. That's a, shall I say, a deficiency in our existing regs addressing, but not adequately addressing. That needs to be included, just as a carry on for your question, I believe.

COMPTON: And the second question. Okay, well they were talking about checking every five years and I'm not sure if I remember about that. But I was wondering how often they are checked.

MUELDENER: That depends on what we monitoring for and I would have to simply walk through the existing regs and give you fig , compliance, jump beyond, what we think he would see more. But we do hear a lot about the MIT, occasional pressure testing. Those tell you what's going on at that moment, so if you fail the MIT, then you need to do something. Something's wrong and it needs to be fixed right then. If you have a leak, the test that I think would go over, much more important I think would need to be done that these ones that show, say where you had a weak spot in the casing or in the protection line, that cement bond test that the chairman mentioned. Those need to be added, I think, to the regulations. Another area we do monitor is, with wells, surface wells called deep and shallow, but they're essentially, they're not storage wells they're observation wells. They're intended to yield product, catch product for salt .... indicators, operational property facility has those ringed around .... and those are tested on a frequent basis.

COMPTON: It seems to me that, or if we knew how much pressure was in a jug and was checking it regularly and if that fluctuated up or down you would know that there was a problem. Thank you.

MUELDENER: Yes, in terms of a quick explanation on that, at least .... does have two types of things you're trying to regulate to be sure. One is the jug itself, the geologic, what's going on geologically in the, within the salt, in the salt is the intent, and the other part then would be plumbing, essentially, from not only what we call the well but also then above it, eventually to the pipeline.

COMPTON: Thank you Mr. Chairman

HOLMES: Nile

DILLMORE: Mr. Chairman, just a question, just a ... question, but first of all I just want, who's going to be testifying tomorrow? Will these gentlemen be back?

HOLMES: I've asked both of them to be back for questions and KCC and tomorrow what I'm going to do is contrast what the KCC does in their regulation.

DILLMORE: I can defer these questions if these two gentlemen will be back tomorrow.

HOLMES: Lee, can you be back. Joe?

McLELAND: Yea, just a quick question. Are you seeing pressure drops in all of the vent wells that they drilled in Hutch, are they decreasing at the same rate?

ALLISON: That's a good question. We asked Kansas Gas for some help, called pressure draw down tests. We asked that last Thursday and on Tuesday they called to announce that they were starting pressure draw down tests on all the non-flaring wells as of yesterday. And the day we start pressure build up with drawn down tests on flaring wells as early as tomorrow. So what we've seen is, yes, there has been a decrease in the volume of gas and the pressure for the first few weeks, it was just visual, we just had to look at the flare and get a sense of that. Then they started putting instruments on the wells measuring the volume and flow rates and pressures. So flaring wells do have pressure devices on them and flow rates and we've asked for that information and they were assembling and providing it to us. In general they are decreasing, but as they drill some new wells, some of those wells come along with pretty good flow rates, pretty good pressures initially. So one of the questions we have is there a single reservoir now underground that's all connected and actively one reservoir, so as we drain it over here it'd be draining over there. Or as the pressure is dropped, it is broken up into a series of reservoirs that are now isolated and each one of these is being done separately. The pressure draw down test we hope will allow us to make that kind of calculation and if the information is as good as we hope it could be, it would also allow us to estimate how much gas is remaining in the reservoir or multiply reservoirs under the cap. So those are very important numbers and Kansas Gas has agreed to cooperate with us fully and provide us that as quickly as they, as fast they could.

McLELAND: If they get the information before end of session, could you come back and give us an update on what they found?

ALLISON: I'd be happy to do that, if they can get the information and we can interpret it to get something useful. Everything we've done so far has had contradictory results, so when we get something we feel confident about, we'd be happy to.

McLELAND: I appreciate that, we don't have much in session, so thank you.

HOLMES: I have a follow up question. Right now you're depending upon the gas that flows to the top of the ground to vent it. Have you thought the next step through of putting a vacuum on to actually try to pull the gas out of the ground that won't flow to the surface after the pressure drops?

ALLISON: I know that there's been some discussion on that, Mr. Chairman. We have not been involved in that. One of the concerns we have, and it's a very minor concern at this point, is that as that gas comes out at a high volume, and particularly with the geysers that are around, that we don't want to leave voids in the rock before the water gets in....to the syphons. So, if we leave a residual amount of gas at hyperstatic pressures under the city it would not be a problem, not be a safety hazard. But it might be total perception concern.

HOLMES: Tom

SLOAN: Do either of your agencies have the plastic, physical maps of a cavern, your diagram shows a regular jug, a vessel. But I've seen where they have gone down and mapped the interior and you see where the shale layers and such are. Do either of you have, apparently not.

ALLISON: I don't think in the ways you're describing it.

MUELDENER: Are you speaking of a model or a picture or?

SLOAN: It's a model, based on the logs of when they run down, that's fine.

MUELDENER: No, I tell you what tell you. Lee gets quite excited about some of the scientist things.

ALLISON: We could generate a three dimensional block diagram of a one of these.

SLOAN: When Getty Oil owned some of the storage fields they had physically constructed models of the cavern down below and I thought that, visually, might be something useful for the committee but you don't have it.

ALLISON: We could generate a block diagram, a cartoon, a three dimensional block diagram of one of the jugs.

HOLMES: Gene, short and we'll be back tomorrow.

O'BRIEN: Thank you, Mr. Chairman. I was kind of wondering, I don't know whole a lot about these types of operations, but I know that in residential areas they put in chemical in the gas to make it smell. Do they put that in these underground staff caverns and if they had done this without ..?.. assistance before there was a big problem that there was a potential problem?

ALLISON: They did not put the scenting gas coming out of the Yaggy because it is a distribution center. The scent is added at the local distribution pump node so since this part of a national network it was not added. I would presume that if there had been a scent, the people in the trailer court, at least, would have smelled and it's possible the people downtown would have noticed it as well.

O'BRIEN: Thank you Mr. Chairman.