

State of Kansas

Bill Graves



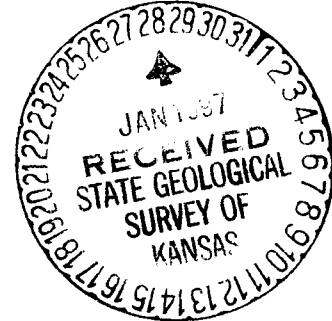
Governor

Department of Health and Environment

James J. O'Connell, Secretary

January 22, 1997

Dr. Lee C. Gerhard, Ph.D.
Director
Kansas Geologic Survey
1930 Constant Avenue
Campus West
University of Kansas
Lawrence, KS 66046



Dear Dr. Gerhard:

The Kansas Department of Health and Environment (KDHE) is requesting assistance from the Kansas Geological Survey (KGS).

The KDHE Environmental Geology Unit regulates hydrocarbons storage wells in which cavities have been solutioned in the salt deposit for the purpose of storing hydrocarbons. The salt cavity is accessed by a well. Common products stored under pressure in liquid state include propane, butane and ethane. Natural gas is stored in vapor form.

One of the more significant requirements is that the storage pressure used not cause fracturing of the salt deposit. As a "rule of thumb" the maximum storage pressure gradient is limited to 0.75 psi/foot of depth to prevent fracturing. It is believed this value includes a safety factor. Observations in the field indicate the actual fracture gradient is more near 1.50 psi/foot of depth. Experience has shown that the weakest points in the salt deposit are the salt/shale layer interfaces and these interfaces are where the fractures initiate and then propagate, generally on a horizontal plane.

Western Resources, Inc. operates a hydrocarbon storage well facility located west of Hutchinson, Kansas. Natural gas is stored in the salt cavities in the Hutchinson Salt member. Late in 1996 Western obtained rock cores of the confining shale and of the salt deposit. A mechanical properties study was conducted on samples from the cores to determine the fracture pressure gradient. The study results reported to KDHE indicate an average fracture pressure gradient of 0.89 psi/foot of depth with one rock sample having a fracture pressure gradient of 0.72 psi/foot of depth.

Western is using the study results in support of a request to KDHE to increase the maximum storage pressure gradient from the currently KDHE approved pressure gradient of 0.75 psi/foot of depth to a pressure gradient of 0.88 psi/foot of depth. KDHE has concerns in regards to the request because the study results indicate the salt deposit fracture pressure gradient is close to the

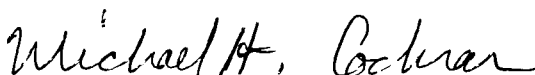
"rule of thumb" maximum pressure gradient of 0.75 psi/foot of depth. If the study results are correct, then the "rule of thumb" value provides little safety factor. In addition, the maximum storage pressure gradient requested by Western exceeds the 0.72 psi/foot of depth fracture pressure gradient of the one rock sample. Several other rock samples also had fracture pressure gradients of less than the 0.88 pressure storage gradient requested.

We request the KGS examine the mechanical properties study report and comment to KDHE on the following:

1. Was the test procedure used to determine fracture pressure gradients appropriate?
2. Are the study results valid?
3. Is KDHE interpreting the results correctly? Are we missing something? Is the average fracture gradient reported 0.89 psi/foot of depth and did the one rock sample have a fracture pressure gradient of 0.72 psi/ft. of depth?

The assistance of KGS in this matter will be greatly appreciated. We have enclosed a copy of the mechanical properties study, correspondence between KDHE and Western concerning the study and a diagram of a typical hydrocarbon storage well. If there are any questions or more information is needed please contact me at 913/296-5560. I also need to know if KGS will be unable to assist us.

Sincerely,



Michael H. Cochran
Chief, Environmental Geology
Industrial Programs Section
Bureau of Water

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Enclosures

c - Western Resources LPG Core Study File