



UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

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TO: Mr. John J. Linehan, Project Director
Repository Licensing Project Directorate
Division of High-Level Waste Management, M/S 4-H-3

FROM: Paul T. Prestholt, Sr. On-Site Licensing Representative

DATE: October 19, 1988

SUBJECT: RESPONSE TO TECHNICAL CONCERNS RAISED BY USGS
HYDROLOGISTS IN THE AUGUST 17, 1988, MEMORANDUM TO
VERNE SCHNEIDER, USGS, RESTON, VA from Larry Hayes to
Carl Gertz; and, YUCCA MOUNTAIN PROJECT BRIEFING (Carl
Gertz, October 13, 1988).

Please find enclosed the above-referenced information.

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United States Department of the Interior

GEOLOGICAL SURVEY
BOX 25046 M.S. 421
DENVER FEDERAL CENTER
DENVER, COLORADO 80225

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IN REPLY REFER TO:

October 3, 1988

Carl P. Gertz, Project Manager
Yucca Mountain Project Office, MS 523
U.S. Department of Energy
P. O. Box 98518 Las Vegas, NV 89193-8518

Subject: Response to Technical Concerns Raised by USGS Hydrologists in the August 17, 1988, Memorandum to Verne Schneider, USGS, Reston, VA

Dear Carl:

The purpose of this letter is to present my and senior NHP/USGS (Nuclear Hydrology Program/United States Geological Survey) management's perspective on the specific technical concerns listed in the August 17 memorandum. Other issues presented in the August 17, 1988, memorandum will be addressed by USGS Headquarters.

1. Topographically affected air flow

Data collection with the awareness of management continued despite QA paperwork deficiencies to avoid irrecoverable loss of critical data. During data collection, we worked with the investigators involved to "retrofit" the QA paper work to the activity, and between about January 1987 and October 1987, worked with the investigators to produce, review, revise, and gain approval for the Scientific Investigation Plan that outlined the air-flow study and assigned quality-assurance levels. During March through May 1988, management assigned a data and QA specialist essentially full time to work with the investigators to develop and gain approval for the necessary technical procedures covering the data collection effort. On April 15, 1988, I reported to DOE that the data collection at the UZ-6 boreholes had occurred during and following the April 1986 SWO, and defended the data collection as necessary in order to avoid irrecoverable loss of data. Apparently, DOE accepted this position because no adverse action was taken as a result of the USGS reporting this violation of the SWO. The only consequence to date has been a nonconformance issued by the USGS QA Office which is being resolved by approval of the technical procedures (May 1988) and review of the data collected. It should be noted that the current drilling schedule indicates that the UZ-6 boreholes will be the last to be

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reamed and stemmed (late FY90 or early FY91). This should allow ample time and opportunity to conduct airflow experiments in open boreholes. The main impediments to expanding the topographically affected airflow study beyond the current airflow and gas-composition monitoring are SCP approval, completion and approval of the Study Plan, and preparation and approval of needed technical procedures. NHP/USGS management will continue to work with the investigators to complete these planning documents.

The SCP acknowledges the probable need for parameter input to systems-level models for gas-phase transport, in order to assess the potential for release of gas-phase carbon-14 to the accessible environment (see Section 8.3.5.13.3). However, the need for such analysis depends in part upon the containment strategy that is finally adopted. For example, if all the fast fraction of the C14 were to be released before waste emplacement, such an analysis may not be needed. However, the SCP also acknowledges another critical reason for conducting this study, and that is the potential effect of air circulation on net water-vapor flux. This aspect of gaseous-phase transport is addressed in SCP Study 8.3.1.2.2.7, "Characterization of gaseous-phase movement in the unsaturated zone". No significant changes have been made to plans for this study during the recent SCP revision process. Study consists of the following major elements:

- Determination of air circulation in open UZ-6 boreholes as a function of atmospheric pressure and temperature.
- Description of prewaste emplacement gas-flow field in Yucca Mountain.
- Measurement of total airflow, heat, and vapor transport in and out of the open UZ-6 boreholes.
- Gaseous tracer tests between Solitario Canyon scarp and UZ-6 borehole to determine effective air-filled fracture and/or bulk porosity and dispersivity.
- Measurement of gaseous flow and transport from geohydrologic units by obtaining profiles of air velocity, temperature, and composition in UZ-6.
- Determination of gas composition, including carbon isotopes of CO₂.
- Natural-stress, airflow-interference tests in all topographically affected boreholes on crest of Yucca Mountain to determine fracture interconnection.

- Cross-hole, gaseous-injection tests at UZ-6 and UZ-9 complexes to determine fracture permeability and storativity.
- Gaseous-phase modeling of Yucca Mountain to interpret gas movement under natural conditions.
- Studies of gaseous radionuclide transport also are included in the Geochemistry Program (SCP Section 8.3.1.3.8.1).

2. Water in the neutron holes

I and senior NHP management agree that this is a puzzling and potentially very significant technical problem. Obviously, the mechanism by which water accumulated in the neutron holes needs to be determined. Accordingly, NHP/USGS management did not try to prevent sampling of water in the neutron holes, but in fact, encouraged this sampling. NHP/USGS senior management was notified within hours following the discovery of water in a few of the neutron holes and upon request from the individuals reporting the findings, gave immediate verbal approval for measuring water levels, collecting water samples if possible, and analyzing samples. Water levels were measured, samples collected, and submitted for various types of chemical analyses. By reacting in this manner, NHP/USGS management demonstrated concern for the scientific interests of their technical staff and for potential loss of irrecoverable data. In addition, it should be noted that, although the scientists concerned with this activity have not completed a proposal to address this problem, I expect that an investigative strategy will be included in the "Infiltration" Study Plan. Additionally, I believe that despite the current SWO, if a well thought-out and well written proposal were presented to you, approval would be given to allow necessary field work to investigate this problem. Nevertheless, this issue demonstrates the critical need for a DOE-sanctioned procedure, complete with quality-assurance and NTS contractor support, that allows immediate investigation of unanticipated phenomena. This procedure should allow limited field-data collection and interpretation prior to approval of the SCP and Study Plans in order to prevent irrecoverable loss of potentially critical data. Water accumulation in the neutron holes is not addressed specifically in the SCP because its occurrence was unexpected. It is not known whether the water entered the neutron holes as leakage around the surface casings, or as flow in fractures in consolidated tuff that intersect the neutron holes at depth. Both possibilities need to be investigated. But, SCP Activity 8.3.1.2.2.1.3, "Evaluation of artificial infiltration," does address the fracture-flow mechanism that may be responsible for water accumulation in the neutron holes. Specifically, this activity contains the following pertinent elements:

- Ponding tests at selected neutron access holes will be used to track wetting-front advancement via neutron moisture-logging, geotomography, and other geophysical methods.
- Results of ponding tests will be used to estimate flow velocities and to evaluate relative importance of fracture and matrix flow.
- Organic dye tracer will be added to ponded water and several sites will be excavated after ponding tests to map flow pathways.
- Rainfall-simulation studies will be conducted to investigate the degree to which pressure head of perched water in the shallow subsurface causes flow in open fractures in the consolidated tuff underlying the unconsolidated surficial material.

3. Strain-related water-table fluctuations

I and NHP/USGS management have encouraged and supported technical efforts to investigate such water-table fluctuations by (1) assuring that plans for such investigations are incorporated in the SCP and appropriate Study Plans, and (2) providing funding in FY 88 to begin technical planning for measurement of tectonic strain at Yucca Mountain. The main impediments to beginning measurement of volumetric strain at Yucca Mountain are SCP approval, completion and approval of the Study Plan, availability of suitable boreholes, and availability of funds for the purchase and calibration of strain meters (\$30,000 each). Also, in recent months, NHP/USGS management has given investigators concerned about these phenomena wide latitude to pursue the problem. While it is true that the current SWO temporarily prevents further interpretation of the water-level data, the SWO does not prevent the actual collection of the data. Understanding that interpretation of the data must be ongoing to assure data quality, USGS-NNWSI management is formulating rationale to have some of the SWO restrictions lifted.

This phenomena and its potential for being a negative factor for the stability and predictability of the repository environment is addressed in SCP Activity 8.3.1.2.3.1.2, "Site potentiometric-level evaluation." Extensive changes have been made to plans for this activity during the recent SCP revision process to describe collection and interpretation of data on strain-related water-table fluctuations. The SCP revisions have been authored by the technical staff that expressed concern about strain-related water-table fluctuations. The new elements of this activity are as follows:

- Analysis of water-level fluctuations in response to volume/strain changes in the saturated zone.
- Detection and analysis of water-level response to earth tides, atmospheric loading, seismically detectable earthquakes, and underground nuclear explosions to determine (1) relation between formation fluid pressure and strain, and (2) formation elastic properties.
- Detection and analysis of water-level response to coseismic or aseismic earthquakes (slow earthquakes or fault creep).
- Concurrent measurement of volumetric strain in boreholes at Yucca Mountain using strain meters similar to those used in studies of the San Andreas fault.
- Installation of volumetric strain meters on the crest, flank, and flat adjacent to Yucca Mountain.
- Determination of temperature field in the vicinity of each strain meter prior to its emplacement.
- Continuous monitoring of strain meters using intelligent data loggers.
- Transmittal of strain data by satellite telemetry to the field office on a real-time basis so that additional water-level measurements can be made immediately.

4. The steep hydraulic gradient of the water table

While it is true that no studies are currently underway to investigate the steep gradient, technical plans along several lines of investigation have been developed for inclusion in the SCP and Study Plans. In recent months, several workshops have been held specifically to formulate a unified technical strategy for studying problematic features and phenomena such as the steep gradient. USGS hydrologists, geologists, and geophysicists have been integrally involved in these workshops. I and NHP/USGS management have encouraged, supported, and facilitated these technical workshops. While it is true that interpretation of the water-level data is prevented by the current SWO, there is a view that the current water-level data are insufficient to perform a conclusive analysis of the steep gradient based on these data alone. Additional wells and expanded stratigraphic, structural, and geophysical investigations, and reevaluation of the existing data base are planned. The main impediments to beginning the new investigative work are approval of the SCP, completion and approval of Study Plans, preparation of technical procedures, and drilling of new holes.

The steep hydraulic gradient and its potential as a disqualifying factor for siting the repository at Yucca Mountain is addressed, primarily, in two SCP Activities: 8.3.1.2.1.3.2, "Regional potentiometric-level distribution and hydrologic framework studies," and 8.3.1.2.3.1.1, "Solitario Canyon fault study in the saturated zone." Extensive changes have been made to plans for the regional potentiometric-level and hydrologic framework study during the recent SCP revision process. These changes have focussed intensively on investigation of the steep hydraulic gradient. The SCP revisions have been authored, primarily, by technical staff that have expressed concern about the steep gradient and are responsible for its investigation. The new elements of this activity are as follows:

- Results of regionally oriented geophysical surveys conducted under SCP Activity 8.3.1.4.2.1.2 (Surface-based geophysical surveys) will be interpreted to obtain stratigraphic, structural, and water-table data.
- Results of geophysical surveys (such as telluric traverses, audio-magnetelluric soundings, and close-spaced gravity surveys) will be used to site new drillholes, including WT-23, WT-24, and G-5.
- Multiple, working hypotheses have been developed for investigation of the cause of the steep gradient: (1) existing faults acting as nontransmissive barriers to flow, (2) presence of a rhyolitic, argillaceous, or intrusive body that is less subject to fracturing than the tuffs, and (3) change in direction of regional stress field affecting fracture permeability.
- Consideration of neotectonics or alteration of stress fields as possibly affecting the stability of the low-transmissive zone and causing dramatic changes in the water table.
- Analysis of existing and planned borehole fracture data (SCP Activity 8.3.1.4.2.2.3) and surface fracture-network studies (SCP Activity 8.3.1.4.2.2.2) to determine fracture characteristics.
- Determination of in situ stress on either side of gradient (SCP Activity 8.3.1.17.4.8).

In addition, the Solitario Canyon fault study will address the steep hydraulic gradient as follows:

--Hydraulic testing and water-chemistry analysis in drillholes WT-8, H-7, and H-6 to determine the nature of hydraulic connection and flow across the Solitario Canyon fault (SCP Activity 8.3.1.2.3.1.1).

5. Extravagant Nevada Test Site contractor costs

(Not addressed in this letter)

6. Research and Engineering

(Not addressed in this letter)

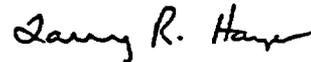
7. Quality Assurance

(Not addressed in this letter)

As you well know, the Yucca Mountain Project is an extremely complex program with many difficult constraints and unpredictably ever changing conditions, which in total make successful communications a difficult challenge. In response to this challenge, we have begun a systematic dialogue between management and technical staff from among USGS, and the Bureau of Reclamation. Through this process, we intend to identify problems that are inhibiting both technical and administrative progress, and propose constructive solutions to the problems. In this way, we will accomplish a closer and more effective working relationship between management and technical staff in order to assure that the overall goals of the Yucca Mountain Project are met.

I look forward to sharing with you the results of this effort and to working with you to implement constructive changes that will improve the effectiveness and products of the site-characterization effort.

Sincerely,



Larry R. Hayes
Technical Project Officer,
Yucca Mountain Project

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YUCCA MOUNTAIN PROJECT BRIEFING

PRESENTED BY

CARL GERTZ
PROJECT MANAGER

OCTOBER 13, 1988

AGENDA

**SCP SCHEDULED FOR RELEASE IN
DECEMBER**

RECENT VOLCANISM STUDIES

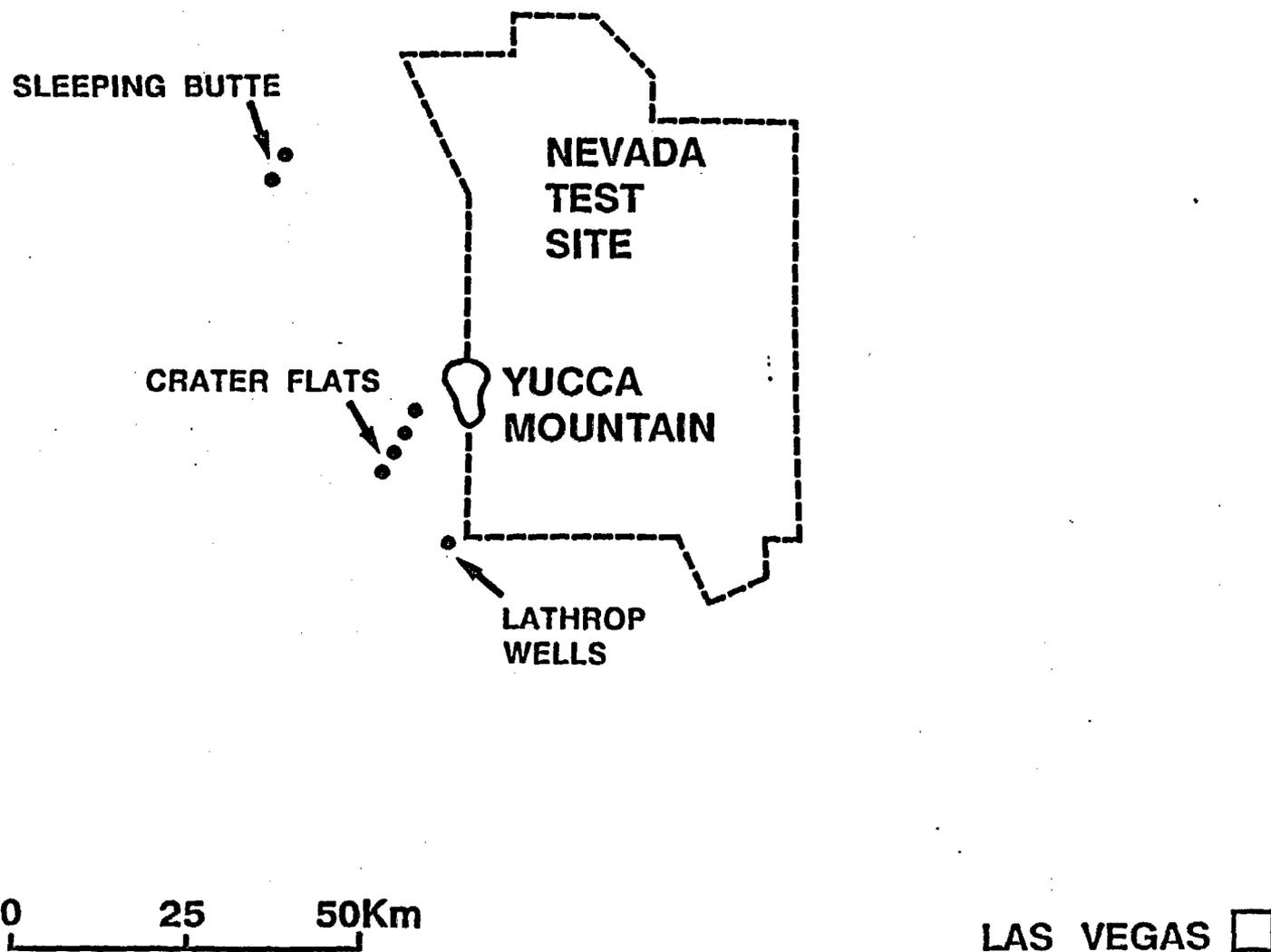
SWEDEN OPENS NEW REPOSITORY

QUESTIONS

**SITE CHARACTERIZATION PLAN (SCP)
CURRENTLY ON SCHEDULE FOR RELEASE
IN LATE DECEMBER 1988**

- **SCP CONSULTATION DRAFT ISSUED JANUARY 1988**
- **TECHNICAL MEETINGS HELD WITH STATE AND NRC**
- **PREPARING A COMMENT-RESPONSE SUMMARY FOR COMMENTS RECEIVED**
 - **NRC**
 - **USGS/RESTON**
- **STATE'S COMMENTS RECEIVED TOO LATE TO INCORPORATE IN SCP; COMMENTS WILL BE REFLECTED IN SEMI-ANNUAL SCP PROGRESS REPORTS**
- **PUBLIC BRIEFINGS AND HEARINGS SCHEDULED IN WINTER/SPRING 1989**
- **PREPARING 106 STUDY PLANS TO SUPPLEMENT SCP**

QUATERNARY AGE VOLCANIC CENTERS IN THE YUCCA MOUNTAIN REGION



ADDITIONAL FINDINGS IN VOLCANISM STUDIES

VOLCANISM STUDIES SHOW THAT THE LAST ERUPTIONS FROM TWO OF SEVEN VOLCANIC CENTERS LOCATED ABOUT 12 AND 27 MILES FROM YUCCA MOUNTAIN MAY HAVE OCCURRED LESS THAN 10,000 YEARS AGO

SCIENTISTS BELIEVE THIS NEW INFORMATION DISCOVERED BY STATE-OF-THE-ART TECHNIQUES FOR STUDYING VOLCANIC LANDFORMS DOES NOT AFFECT THE INTEGRITY OF YUCCA MOUNTAIN

THESE VOLCANIC CENTERS ARE BEING STUDIED INTENSIVELY

TWO POSSIBLE VOLCANIC SCENARIOS AT YUCCA MOUNTAIN:

- **ANOTHER SMALL-VOLUME ERUPTION AT SLEEPING BUTTE
AND/OR LATHROP WELLS**
 - **ONLY WAY SITE COULD BE AFFECTED IS IF ERUPTIONS WERE
ACCOMPANIED BY SIGNIFICANT EARTHQUAKE ACTIVITY**
 - **UNLIKELY DUE TO DISTANCE OF VOLCANOES FROM SITE**
- **FORMATION OF NEW VOLCANOES**
 - **PROBABILITY OF A NEW VOLCANO BREACHING A REPOSITORY
AT YUCCA MOUNTAIN IS ABOUT 1 IN 10 MILLION TO 1 IN A
BILLION PER YEAR**

SUMMARY

- **NEW DATA IS IMPORTANT TO BETTER UNDERSTAND THE VOLCANIC PROCESSES IN THE AREA SO SCIENTISTS CAN BETTER PREDICT THE FUTURE**
- **THE VOLCANIC CENTERS AROUND YUCCA MOUNTAIN HAVE BEEN STUDIED THOROUGHLY AND THE TWO "YOUNG" ONES WILL CONTINUE TO BE INVESTIGATED**
- **SCIENTISTS BELIEVE THAT EVEN IF AN ERUPTION OCCURS WITHIN THE NEXT 10,000 YEARS, IT WOULD NOT AFFECT A REPOSITORY AT YUCCA MOUNTAIN**



Swedish Nuclear Fuel and Waste Management Company (SKB) plans, builds and operates facilities and systems for the management and disposal of spent nuclear fuel and radioactive waste from the Swedish nuclear power stations. SKB is also in charge of the extensive research activities within the field of nuclear waste. SKB is owned by the four utilities in Sweden that produce electricity in nuclear power stations.

For more information, call Sveve Ungermark, Director of Media Relations, office +46 8 665 28 21, mobile phone +46 10 73 52 45 and private +46 8 97 69 01.

September 5, 1988

Governor at inauguration of Swedish Final Repository (SFR):

"The Swedish nuclear industry is displaying greater responsibility by developing new technology to isolate radioactive waste"

Governor Hans Alsén of Uppsala county inaugurated the Swedish Final Repository (SFR) August 30, by declaring that the County government considers the facility as an extremely good example of new and advanced technology to meet today's environmental demands. SFR is located 50 metres under the Baltic Sea close to the nuclear power station at Forsmark north of Stockholm. The nuclear industry in Sweden displays clear and greater responsibility in taking care of its waste, added the governor.

There is a need in the society for education as to the operation of a facility such as this, said governor Alsén. This is the probable cause for the anxiety that has been displayed by the general public. With my knowledge of the greater care with which SFR has been designed and constructed I am certain that the facility will function well and that it will find public acceptance, declared governor Alsén.

During the time since the debate in the seventies the development of waste management has come a long way, said another speaker, director general Karl-Erik Nyquist of the Swedish State Power Board who also is the chairman of the SKB Board. SKB is the company that owns and manages SFR. In Sweden we have today a complete system for managing nuclear waste. The first plans for SFR were launched in 1975 and since 1979 the plans have been to take the facility in operation during the spring 1988. That was also the case and the record is good from the first four months of operation.

PRESS RELEASE