Golder Associates
CONSULTING GEOTECHNICAL AND MINING ENGINEERS

WM DOCKET CONTROL CENTER

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Distribution:
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U.S. Nuclear Regulatory Commission
Division of Waste Management
7915 Eastern Ave. - M/S-623-SS
Silver Spring, MD 20910

Attention: John T. Buckley

Subject: Contract No. NRC-02-81-037
Technical Assistance for Repository Design
Task 6, Project 22
Letter #98

Gentlemen:

Please find attached two documents as follows:

1) Memo: Trip Report - Pre-meeting in Washington, D.C. from Lou Gonano, October 27, 1983

2) Memo: DOE/NRC Pre SCP meeting, NRC office, Silver Spring, MD. October 12-14, 1983 from J. Daemen

These memoranda and this letter are our letter report for the pre-meeting in accordance with paragraph 4.5 of the subject contract. A similar letter report is in preparation for the October 25-26 meeting and will be sent to you next week.

Sincerely,

GOLDER ASSOCIATES

Richard H. Gates, Ph.D., P.E.
Project Manager

RHG/kap

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MEMORANDUM 813-1167V

TO: Dick Gates October 27, 1983

FR: Lou Gonano

RE: Contract NO. NRC-02-81-037 entitled "Technical Assistance for Repository Design," Golder Associates, Inc. (GAI)

Trip Report - Pre-Meeting in Washington, D.C.

This communication represents a letter report on behalf of Dr. Lou Gonano who attended a Design Workshop Pre-meeting at NRC, Silver Spring, MD on October 12 and 13. Authorization to attend this meeting and also the Design workshop itself in Columbus, Ohio on October 25 and 26 is contained in NRC letter #78 of September 30, 1983. Attendance at their meetings is in accordance with Task 6 of the subject contract.

The purpose of the pre-meeting was to prepare, together with NRC and other contractors, technical positions on Repository Design, In Situ Testing and Shaft Construction and Plans for discussion with DOE, specifically with respect to a repository in salt. It is understood that this will be the first formal technical meeting of NRC and DOE for a salt repository. Thus, the scope of the meeting will be an initial exchange of information, a communication of the status of investigations, site slection and design achieved by DOE and a statement of the technical positions envisaged by NRC as being necessary to meet the requirements of 10CFR60. In Golder Associates' view it is important to establish at an early stage at this meeting, and in an authoritative manner, the type and level of information required of DOE, so as to enable the NRC to fulfill its regulatory role.

Golder Associates were represented at the pre-meeting by Drs. Jaak Daemen and Lou Gonano. While they represent the specialists in in situ testing and shaft construction and design, no clear areas of technical responsibility were allocated. Instead, for the purposes of the meeting, technical disciplines for which individuals would act as prime spokesmen were selected, in collaboration with contributors from Engineers International, the Bureau of Mines and Science Appliations Inc. It was agreed that Dr. Jaak Daemen would make a presentation on the technical position for in situ testing while Dr. Gonano would act as the lead on shaft design and construction.

The following is a summary list of the main technical points and comments raised by Dr. Gonano at the pre-meeting. Many of these points have been included in the minutes of the meeting. The headings follow those selected in the tentative agenda for the October 25-26 meeting with DOE.

Exploratory Shaft Design and Construction

1. Various reports are avilable (e.g. ONWI-390,391,392) which outline DOE shaft designs at these sites. These present the "end product" without any information on how these designs were reached.

   It is necessary to know the basis for selecting the blind drilling method of construction (what trade-off study was done?)and the basis(criteria) for the design itself. Other questions additional to the extensive list contained in Attachment 2 of the June 15 letter to DOE which should be communicated include:

   a. What are the criteria for shaft design and seal performance

   b. What are the contingency plans for ensuring these criteria are met if unexpected conditions are encountered during construction

   c. What decision process exists for adjusting the shaft/seal construction practice according to conditions encountered.

   d. The importance of addressing creep aspects of lined hydrostatic shafts needs to be emphasized.

2. Generally the two concerns expressed in the above noted letter and amplified in the Attachment 2 are well founded and deserve explicit attendance by DOE. Many of these concerns are also raised in the review document presented at the pre-meeting by EI (Sept. 30 letter) and these comments by EI are also endorsed.

In Situ-Testing

1. The technical position document presented is a generic document prepared by Golder Associates (dated drafted 8/5/83) which is considered to have a general applicability to repositories in salt. The presentation of this document at the meeting, if desired by the NRC, is considered useful in illustrating the approach thought appropriate for designing an in situ test plan.

2. This document emphasized the fundamentality of logically developing information needs and testing plans using a rational sequence of steps originating in10CFR60 and more directly from the design issues. The existence of this inter-relationship should be stressed to DOE. This inter-relationship also justifies NRC's regulatory authority as to the level of technical detail requested in the technical position.

3. While minor changes to the TP would enhance its applicability to salt-type repositories, the TP in its present form properly conveys the thrust of the technical position, at least for the kick-off meeting.

4. One suggestion for improvement of the text of the TP concerns the desireability of calculating and defining in the In Situ Testing Program Plan, a level of confidence and/or uncertainty for all the parameters being studied. Such a committment to accuracy levels prior to site characterization and testing, will allow an objective review, at any stage of the plan, of the adequacy of data being obtained, and the need for cessation or continuation of testing. In effect, this will serve as a "yardstick" for defining when tests, as presented on pages 7 to 8 as guidelines, are sufficient.

Repository Design Issues

1. The list of "design issues" presented appears to be based on a hard-rock repository. This is nevertheless a fairly extensive list which can serve as a basis for developing a site-specific list of issues for salt at a later date.

2. The cause-effect relationship between performance requirements, design issues and information needs must be recognized in preparing/refining such a list. Any such lists presented by the DOE should be structured in this content. It may be useful, to draw up a flow chart, if possible connecting all the issues and sub-issues to show this genesis and causual relationships. As an aid to simplifying such a chart, a breakdown in terms of repository performance time periods (construction, operation/retrieval, long-term) may be helpful.

Summary Review

The pre-meeting was considered eminently successful in confirming a technical concensus between NRC and contractors on matters to be raised and the technical positions to be established in the proposed meeting with DOE.

Borehole and Shaft Sealing - Draft Technical Position

Comments by DOE (Sept. 20) on this document were reviewed on Friday morning in conjunction with Jay Roderick and Jaak Daemen. The review notes are contained in the letter report by Jaak Daemen.

In-Situ Testing - Draft Technical Position

This document is in the final stages of preparation. In the following week, comments will be provided by Jaak Daeman to Lou Gonano and an updated version will be ready for John Greeves in Columbus. Subject to any modifications based on feedback from NRC, this draft document will be finalized and discussed with John Greeves for his presentation at the Waste Management Meeting in Washington, D.C. in December.

Administrative Matters

In order to finalize presentations for the NRC/DOE meeting in Columbus, it is proposed to meet at the Holiday Inn, Lane Avenue, Columbus at 2:00 p.m. Monday, October 23rd.

LPG/1-17-83-813-1167V

MEMORANDUM

TO: Dick Gates, Project Manager

FR: J. Daemen

SUBJECT: DOE/NRC PRE SCP MEETING, NRC OFFICE, SILVER SPRING, MARYLAND, OCTOBER 12-14, 1983

The following subjects are reported for the use of NRC staff, specifically John Greeves, Jay E. Rhoderick, Raj Nataraja, and John T. Buckley.

A. Borehole and Shaft Sealing - NRC Draft Technical Position - DOE Letter of 9-20-83 to R.E. Browning. Review Meeting - Silver Spring, 10-14-83

General Comments on DOE Letter

The first two and most important paragraphs of the letter essentially are quite strong endorsements of the NRC draft position. This is very encouraging, as it clearly indicates that a consensus is developing about major aspects of sealing.

As emphasized in the third paragraph, significant disagreements continue. A potentially very serious problem is the extent to which NRC needs to support its requirements by analysis. (This goes far beyond sealing requirements only). One possible NRC position might be that if DOE wants to rely on geological isolation and containment, then DOE needs to demonstrate that any breach (e.g., manmade penetration) of the rock mass (geological barrier) does not compromise the isolation and containment function.

Comments on DOE's Major Comments

I agree with DOE's points 1 and 2. I tend to agree with point 3, but more careful study is needed to develop a firmly based position. Of particular concern is identification and location of all holes, treatment of very shallow holes, treatment of cased holes, treatment of holes difficult to re-enter (e.g., because of partial collapse).

I tend to agree with the general thrust of the DOE statement, but am not prepared to take a firm position without considerable further study.

Major Comment 4

I have very serious reservations about the first sentence, which implies that sealing will be performed with the liner in place, a highly unreliable operation.

For boreholes, it is virtually impossible to guarantee that sealing of a cased hole can be performed satisfactorily. Considerable published technical literature can be referenced to support the position that grouting the annulus between a borehole casing and the surrounding rock is difficult, and no performance guarantees are possible except by individual case-by-case testing.

The situation is less obvious for shafts, where successful annulus grouting is far more likely.

In either case, leaving a liner in-place adds two interfaces to the systems, and raises serious questions about long-term stability.

NRC's position probably should be that seals must be installed in uncased sections, unless it can be demonstrated by DOE that isolation and containment do not require it.

Major Comment 5

Some clarification is indeed needed. Some sealing design - testing - demonstration - performance prediction is needed at licensing.

"Verification" of long-term (post-closure) performance clearly is not possible experimentally.

Major Comment 6

Highly commendable commitment. It would be highly desirable to add a commitment specifying a maximum time lapse between data acquisition and data release to NRC.

Major Comment 7

A brief supplementary discussion might be appropriate, identifying problems specific for holes, e.g., casing, re-entry, smaller cross-section, more numerous (more chances for circuit). A firm final position requires more analysis, hence at this stage "draft" qualifiers are needed.

Major Comment 8

A broad generic statement early in the position, e.g., that manmade penetrations in a repository in the unsaturated zone should not allow direct water inflow from the surface to the repository, might be appropriate.

Major Comment 9

Section 5 in the draft position does not say intact rock, but rock mass (in the 2-17-83 draft) or rock units mass (July and September '83 statement).

Serious reservations, of which NRC is well aware, exist in the technical community about this requirement. It is probable that further arguments against the requirement will be developed (consequence analysis, etc. . .).

NRC needs to develop a position on how they will respond, including:

- independent assessment of studies indicating that there is no need for sealing

- a comprehensive acceptable defense of the position that sealing is not needed.

Unless NRC can develop both of these, and until both of these can be developed, I do not see how NRC can accept a penetration which might compromise geological waste isolation and containment.

Major Comment 10

I would consider rephrasing to exclude long-term (post-closure) design measures.

COMMENTS ON SPECIFIC COMMENTS

Page	Section	
--	---	Agreed, needs updating. How significant the progress is since 1980 is debatable, especially with regard to the disturbed zone. (On the latter, need specific references from DOE; if only published ONWI reports are given, this is a valuable first step, but a long way from a final answer).
4	2.2.2	To me, 60.142 (a) and (c) seems very clear and explicit. I do not see the problem.
7	3.1	I fundamentally and totally agree with the NRC position statement. I would give some examples, e.g., bentonite/clay (natural environment), old cements, cementitious materials in nature, (maybe bituminous, asphaltic natural deposits), referring back specifically to ONWI supported work at Penn State, WES. I strongly disagree that "accelerated" should be deleted, but it must be recognized that the problem identified by DOE is a very serious one. "Accelerated" implies more than just healing, and clearly must incorporate physio-chemical (geo-, thermo-) stability and composition change analyses and predictions.
8	3.1	I do not necessarily agree that there is an inconsistency, because the context usually makes the intent clear. I do agree that being more specific would be highly desirable. An example of one approach might be to specify each time:

Page	Section	
8	3.1	e.g., - pre-licensing testing (3-5 years) - pre-closure testing (50 yr. time frame) - post-closure predictions (300-1,000 - 10,000 yr. time frame)
8	3.1	I would leave ASTM reference as an example, not as part of a guideline, and include in the introductory paragraph or in a concluding paragraph, not under the list of methods and analyses.
8	3.2	The first paragraph of this DOE comment is very narrow in scope and one-sided. The primary concern is decidedly not with microfractures that may close upon recompression. Primary concerns are: - slip along pre-existing weakness planes (joints, bedding planes), resulting in open gaps in the damaged zone - separation of pre-existing weakness planes, resulting in aperture increases - macrofractures accompanied by shear displacement. In all of these cases hydraulic conductivity could increase significantly (by orders of magnitude). These voids will not close upon recompression, unless - geometrically match perfectly, which is extremely unlikely if any shear displacement takes place - rock is very viscous (e.g., halite, especially at elevated temperatures) or plastic (e.g., soft shale, clay). I agree that (Lingle, 1982) and ONWI 411 must be referenced, emphasizing that ONWI 411 is a very valuable first step in the right direction, but is entirely hypothetical and can not, at present, be quantified or supported by any experimental evidence.
9	3.2	I agree that this might be done in an exemplary mode, e.g., - risk of steel corrosion, embrittlement - risk of concrete shrinkage, cracking, composition changes - risk of interface separations all of these with possible consequences of - strength reductions - stiffness reductions

Page	Section	
9	3.2	and hence, possibilities for enhanded displacements and sealing (isolation, containment) performance loss. Only examples should be cited, as an exhaustive complete statement would require considerably more analysis on the part of NRC.
9	3.2	"control of" needs clarification.
9	3.3	"demonstrated" is preferable.
10	3.4	Agree with DOE request, and with second statement.
10	3.5	Agree.
11	3.6	I fundamentally agree with DOE, on whom the burden rests to demonstrate that isolation and containment will not be compromised by penetrations of higher permeability (NRC should allow for this option).
11	4.0	Agree with DOE comment.
12	4.2	I agree; longevity, expansion and shrinkage might be identified in a separate class of characteristics.
13	4.3	Agree; but see comments under 8 3.2, i.e., DOE may be understating the rate of stress relaxation. It might be true in highly viscous or in very soft plastic rocks that the permeability will return to the original upon recompression. It almost certainly is not true in hard rock (e.g., basalt, granite, tuff). In soft rock one needs to consider: - time frame, i.e., how long will recompression take - homogeneity . in pure halite, recompression and sealing will occur . if brine, gas is present, cavities filled with fluids will not close unless fluids migrate . if clay or non-halite evaporites are present, time frame for closure will change . if "brittle" or "semi-hard" rock beds are involved in the recompression displacement fields (e.g., sandstone, shale, limestone), it is by no means obvious that recompression/resealing will take place.
14	4.3	Agree.

COMMENTS ON SPECIFIC COMMENTS (Cont.)

Page	Section	
15	4.4	Agree.
15	4.5	Agree, but some comments are needed to indicate that some type of validation is necessary for non-standard tests.
16	4.5	The introduction about licensing clearly precludes an interpretation as "final (as-built?) shaft seal". The last four bullets could indeed be combined, but it is essential to then include an explicit statement, strongly worded, to emphasize the NRC concern about the in-situ performance of a seal, including effects of installation, as compared to the seal material performance.
16	5.0	Refer to 8-3.2/13-4.3.
17	6.0	Might give Bell Canyon as an example. Might clarify, e.g., in situ tests are site specific, while field tests are rock type specific.
18	8.0	Agree with first paragraph. The fact of not obtaining directly an inaccurate indication of the importance of each component is insufficient to satisfy NRC performance assessment requirements.

SUMMARIZING COMMENTS

The meeting on 10-14-83 consisted of a detailed point by point review of the DOE letter.

On virtually all points agreement was reached by the NRC reviewers.

It appears that the following main differences remain between NRC and DOE position:

- must penetrations be sealed to the same isolation (hydraulic conductivity, radionuclide release) capability of the in situ rock mass?
- must NRC support its requirements with analysis?
- what experimental demonstration is needed, and when?
- has the disturbed zone (damaged zone around shafts and drifts) uncertainty been resolved?

Many of the DOE comments are appropriate, and the draft technical position can be revised accordingly without compromising the NRC responsibilities. It can be expected that additional points of controversy can be resolved by clarifications, by NRC in the position, by DOE in its comments. This leaves several significant conflicting points of view, as summarized above.

B. Some General Suggestions Based on NRC Pre-Meeting Silver Spring, Maryland, October 12-13, 1983

A critical issue is for NRC to establish its authority to raise questions and ask for information, e.g., on in-situ testing, repository design, exploratory shaft design and constructon, shaft and borehole sealing. My basic suggestion is that in order to establish this authority:

- John Greeves, very early in the meeting, establishes NRC authority based on the rule
- all other speakers clearly and directly make a connection between their requests for information and John's presentation, and thereby to the rule.

Such an approach should help considerably in presenting a clear unified NRC position, which is especially important in light of the probable presence at the meeting of ONWI subcontractors and of State Representatives, all of whom need a clear understanding of the NRC position.

In my own case, for the presentation on in situ testing, I see the following sequence:

10-25-83 8:30 - 9:00 a.m.: John Greeves establishes NRC position, with justification in the rule, referring to EPA.

2:00 - 2:10 p.m.: Raj (or John) present integrated TMHC needs.

2:10 - 2:30 p.m.: Daemen on in situ testing. Start with connection to John then connection to all other meeting topics, i.e., present in situ testing as supporting (reducing uncertainties) in other technical positions:
- Exploratory Shaft Design and Construction
- Thermo Mechanical Hydrologic Chemical (TMHC) Modeling
- Repository Design
- Issues

Integrated, Unified NRC Position

Time will not permit it, but I believe that it would be desirable in all future meetings with DOE programs to establish a unified NRC position. This would require for example that explicit connections be established between in-situ testing, design, exploratory shaft, THMC needs, and between all of these and the rule. I would have preferred a schedule as follows:

First day	am : 1.	NRC information needs - general justification based on the rule
	2.	TMHC needs
	pm : 3.	Design
Second day	am : 4.	Key issues
	5.	Exploratory shaft
	6.	In situ testing.

This would allow a logical progression:

- how design will meet isolation/containment needs as defined in TMHC
- how exploratory shaft will help in providing information for TMHC, design, and key issues
- how in situ testing will help resolve uncertainties in all of the preceding.

In order to present an integrated unified NRC position at future meetings, I would recommend:

- regular meetings (at least biannually, preferably quarterly), to keep everyone updated
- more efficient NRC information exchange, report distribution, draft position distribution
- expanded NRC staff, to keep closer in-house track of the huge DOE programs
- pre-meetings held by NRC in preparation of DOE/NRC meetings should be held at least two full weeks in advance of DOE/NRC meetings, with a final coordinating meeting the afternoon before the DOE/NRC meeting.

All of these will contribute to the continuity and uniformity of NRC positions.

C. <u>This Section Addresses Specifically Some Issues Raised by E512-09900R, Enclosure No. 1, Appendix A, In Situ Testing in an Exploratory Shaft in Salt, Statement of Work, March 14, 1983.</u>

Attached will be prepared as a viewgraph, to raise some specific questions about in situ testing plans.

Main concerns raised by this document are:

- "Repository Horizon" only?
  It is repeatedly stated in this document (e.g., under 3.1; 3., line 12; several references thereafter to host rock) that in situ testing will characterize the repository horizon host rock. It is of concern that neither overlying nor underlying formations are mentioned

- Will Site Characterization (ES construction) compromise longterm isolation and containment capabilities?

This is specifically identified as one of the two broad areas of concern to NRC. It is not at all addressed in this statement of work.

- Construction and In Situ Testing appear to be totally separated.

Will any attempt be made to monitor the response of the rock mass (geomechanical, hydrological) due to shaft and drift construction?

D. Specific Questions per Request of John Greeves

The following questions have been prepared in response to the request by John Greeves for specific questions. A brief rationale is included for raising some of the questions. All these questions deal with In Situ Testing

Salt Design Questions

1. Does DOE have, or does DOE intend to develop, a criterion for minimum salt "cover", i.e., salt thickness between excavations and edge of salt formation, or more specifically between waste containers and nearby non-salt rock formations? What is the rationale behind the required "cover" thickness?

2. Does DOE have, or does DOE intend to develop, no in-destructive in-situ methods to ascertain that the required salt thickness is present at and near disposal holes?

Rationale: one of the most serious risks with salt repositories is that of an accidental breaching of the salt barrier. This has in the past been the major cause of salt mine disasters, especially when very productive aquifers are close to the salt formation, separated only by relatively thin and weak (e.g., clay, shale) aquitards.

Questions Based on Design Issues (Engineers International, Draft 10-16-83)

Rationale: a large number of questions can be generated by rephrasing the design issues in terms of questions related in situ testing, i.e., how will uncertainties about design be resolved by in situ testing?

Examples:

4.1.1 What type of in situ testing will be performed to confirm the validity of the design criteria--i.e., how will it be demonstrated that they are adequate to maintain releases within the prescribed limits?

4.1.2 What type of in situ testing is planned to demonstrate retrievability?

4.1.3 What type of in situ testing will be performed to validate the conceptual design?

4.3 How will in situ testing be used to demonstrate that the required isolation capability can be maintained?

4.3.1 - 1/2/3 What type of in situ testing will be used to monitor changes in ground water conditions induced by repository construction and operation?

4.3.2 What type of in situ testing will be used to identify brine/gas migration behavior?

4.3.3 What type of in situ testing will be performed to assess the validity of temperature, stress, displacement, creep, strain rate predictions?

4.3.4 What type of in situ testing will be used to determine vertical permeability?

4.4 What type of in situ testing will be performed to assess the validity of release rate predictions?

4.4.2 What type of in situ testing will be performed to demonstrate the validity of the predictions of backfill behavior, including the influence of backfill emplacement procedures?

4.5 What type of in situ testing will be performed to demonstrate that shafts and boreholes can be sealed?

4.5.1/2 What type of in situ monitoring will be performed to confirm the predicted influence of exploratory shaft and holes on isolation and containment?

4.5.3 What type of in situ testing will be performed to determine the environment (physico-chemical) and its impact on seals.

4.5.4 What type of in situ testing will be used to demonstrate adequate shaft sealing, especially where the shaft penetrates the lowest impermeable formation above the salt?

Exploratory Shaft Questions

Based on 6-15-83 letter, Chase to Neff, one can generate a set of specific questions addressing the issues and concerns raised in the letter.

Examples based on Attachment 2.

I.

- What type of in situ testing will be performed to assess the validity of the analysis made to predict the effects of construction on long term sealing?

- What type of in situ testing will be performed to evaluate the impact of excavation technique and shaft design on long term sealing?

II. -

- How will damage be determined in situ?

III. - How will in situ grouting be tested, especially full scale emplacement?

E. In Situ Testing - Draft Technical Position 8/5/83

Overall a very good document. A few specific comments are listed below.

It might be desirable to stress, e.g., in the general introduction, that penetrations, especially of the lowest impermeable formation above the salt, should be of major concern, and hence should be minimized. Conversely one might stress indirect, "nondestructive" geophysical methods.

1. General

Under the second point, core drilling and geologic mapping, one might include explicitly geophysical surveys, particularly cross surveys between excavation, holes, the surface etc. . .

Under the third point, with respect to "dimensional base" and "scale effects", it would be desirable for testing in salt to include explicitly the dimension time, i.e., all testing in salt should be continued for a sufficient time length to allow establishing "long term" behavior.

To the rationale, p. 7, top, one might add a bullet for data presentation and analysis. As stated on pp. 8/9, this is an extremely important integral part of the tests.

Under 2. Hydrological and/or 4. Geochemical, one might address explicitly some of the more serious risks for a repository, that of a sudden water inrush due to a breakthrough or a washout, or that of a slow dissolution due to breaching the impermeable barrier above, below or adjacent to the repository salt horizon.

Discussion (p. 9)

First sentence should include geophysical methods, and probably remote sensing.

F. Design Issues

A very good summary of key issues related to a salt repository. Some specific comments:

- One of the most probable causes of serious difficulties with a salt repository, based on mining experience, is an accidental breaching of the impermeable barrier above (bed and dome salt) or adjacent to (dome) salt formations. This could be due to inadequate sealing at penetrations, or due to excessive deformations caused by repository construction and operation. Design should probably specifically address the need to prevent this type of failure.

- It is very unclear how detail questions 4.2.3.1.2 and 3 relate to the leader question 4.2.3. They are important questions, but probably should not be positioned under this heading.

- To 4.2.5 one might add "and confirmed after excavation".

- With regard to 4.3.1.3, primarily a resource question, it is necessary to point out that regional drawdown near a salt repository would be highly undersirable.

- 4.3.4. How do ?

- With respect to sealing (4.5), of particular concern is sealing of shafts and boreholes above the salt formation, and especially at the intersection with the impermeable cap directly above the salt.

G. Viewgraphs

Enclosed is a set of the viewgraphs prepared for the presentation of the NRC Position on In Situ Testing. Below are explanatory notes with each viewgraph.

Viewgraph 1 gives an outline of the presentation, which follows the sequence:

1. Regulatory framework: establish firmly the justification for NRC information needs
   (for oral presentation this could be reinforced by direct inclusion of a few viewgraphs from the earlier presentation by John Greeves).

2. NRC position on In Situ Testing
   a. Outline the NRC draft position
   b. Establish explicitly the relationship between In Situ Testing and the other sessions at this DOE/NRC meeting.

Viewgraph 2 gives a summary of the introductory part of the Technical Position, draft 8/5/83. Key words from the Position are used here to establish a close relation between presentation and text.

The "objectives" come from top, p. 2, of draft.
The "approach" corresponds to the central part of p. 5.
The "logic" follows the upper half of p. 6.

Viewgraph 3 is a continuation of the presentation of the draft technical position, i.e.,
Scope: bottom of p. 6, top of p. 7
the rest summarizes pp. 7-9.

Viewgraph 4 is a summary of the connection between the draft technical position on "Design Information Requirements" and In Situ Testing.

This is done to emphasize that In Situ Testing is not a stand alone topic, but must be referenced to information needs.

The first line reaffirms the regulatory framework (as is done in the technical draft position).

The "Technical Position" section directly follows the NRC draft,
p. 2, 2.1 : detail
2.2 : process

3. Examples: is taken from Appendix C.

Viewgraph 5 summarizes the In Situ Testing aspects of the ES, based on the 6-15-83 Chase to Neff letter, with attachment. The correspondence between the viewgraph and the text is very straightforward.

Viewgraph 6 specifies some NRC concerns related to ES, based on the ONWI (DOE) Statement of Work (SOW), and is used to illustrate NRC information needs. Typical problems identified are:

- heavy emphasis in SOW on "repository horizon" only. Particularly in salt, the overburden characterization should be of considerable priority, as well as probably the underlying formations (for bedded salt) and adjacent formations (for domed salt).

  The concern is related directly to the second broad area of concern raised in the 6-15-83 letter: will exploratory shaft allow sufficient exploration, i.e., will sufficient site characterization be possible?

- the SOW appears to give scant attention to the possibility that ES might compromise long term isolation and containment capabilities.

  In particular, very little in situ demonstration of shaft sealing performance is asked for.

  In view of the long well-documented history of disastrous consequences of salt mine penetrations, boreholes and shafts, and the difficulties encountered in sealing salt mine shafts, this aspect of in situ testing deserves a much higher priority than perceived from the SOW.

  This concern is related directly to the first broad area of concern raised in the 6-15-83 letter.

- the SOW strongly implies a complete separation between ES and In Situ Test Site Construction and the In Situ Testing. The NRC is concerned that this might result in a lost opportunity to determine in situ the response (geomechanical, hydrological) of the host rock mass to construction, a key issue in site characterization (as identified on p. 4, second bullet, 8-5-83 Draft Technical Position on In Situ Testing).

Viewgraph 7 summarizes In Situ Testing Needs based on "Design Issues", Engineers International, Inc., draft 10-16-83. The viewgraph gives the main points of the draft, the connection should be fairly obvious.

Viewgraph 8 presents the bottom line, i.e., the legal requirements for the necessary information to make licensing findings. In Situ Testing needs are based directly on the requirement to resolve uncertainties in all areas that affect long term release rates.

D277C

IN SITU TESTING

NRC POSITION

DOE/NRC PRE-SCP MEETING

BATTELLE, COLUMBUS, OH, OCTOBER 25, 1983

OUTLINE

1. REGULATORY FRAMEWORK: INFORMATION NEEDS
   LICENSING FINDINGS - 10 CFR 60/EPA STD./NWPA

2. IN SITU TESTING: RESOLVE UNCERTAINTIES
   - DESIGN
   - THMC MODELING
   - KEY ISSUES
     - OPENING STABILITY
     - RETRIEVABILITY
     - CANNISTER FAILURE (DISPLACEMENTS/STRESSES)
     - ENGINEERED BARRIERS
     - THMC FACTORS
   - EXPLORATORY SHAFT/SEALING

3. SUMMARY

IN SITU TESTING

OBJECTIVES

- "REASONABLE ASSURANCE" ON KEY ISSUES
- INPUT TO PERFORMANCE ASSESSMENTS

APPROACH: DEFENSIBLE RATIONALE FRAMEWORK

- IDENTIFY KEY ISSUES
- ADAPTABILITY TO CHANGES
    - IN SITU
    - PERCEPTION OF INFORMATION NEEDS
- PREDICT PERFORMANCE - UNCERTAINTY

LOGIC

- ESTABLISH INFORMATION NEEDS FOR LICENSE APPLICATION
- ASSESS TESTING CAPABILITIES
- MATCH TESTS TO INFORMATION NEEDS
    - SIMULATE RESPOSITORY CONSTRUCTION-OPERATION
    - ASSESS - SITE: - CHARACTERISTICS
        - RESPONSE
    - ENGINEERED COMPONENTS
- DEVELOP AND VALIDATE NEEDED TESTS
- CONDUCT IN SITU TESTS
- DATA PRESENTATION/ANALYSIS

IN SITU TESTING: SCOPE

NRC PERCEPTION: - INFORMATION NEEDS
- TESTING TECHNOLOGY

1. GENERAL
   - IN SITU OPENINGS: LAYOUT - EXTENT
   - TEST SITE: REPRESENTATIVENESS - VARIABILITY
   - TEST DIMENSIONS: - GEOMETRICAL
     - TIME
   - AVOID COMPROMISING SITE CAPABILITIES

2. HYDROLOGICAL

3. GEOCHEMICAL

4. GEOMECHANICAL

5. THERMOMECHANICAL

6. T-H-M-C COMBINED

IN SITU TESTING

DESIGN INFORMATION NEEDS (SCP)

REGULATORY FRAMEWORK: 10 CFR 60 - NWPA - EPA

TECHNICAL POSITION

1. INFORMATION DETAIL

   TEST CONFIRMATION OF MEETING DESIGN REQUIREMENTS

2. DESIGN PROCESS

   1. SITE PARAMETERS: UNCERTAINTY
   2. ENGINEERED COMPONENTS
   3. ALTERNATIVE DESIGN CONCEPTS
      - SITE PARAMETER UNCERTAINTY
      - INTER-RELATIONSHIPS
      - TRADE-OFFS

3. EXAMPLES

   - PERFORMANCE REQUIREMENTS
   - DESIGN ASSUMPTIONS
   - SHAFT STABILITY
   - MECHANICAL PROPERTIES OF ROCK MASS

IN SITU TESTING

EXPLORATORY SHAFT

NRC CONCERNS:

1. WILL SITE CHARACTERIZATION COMPROMISE ISOLATION AND CONTAINMENT?
2. WILL EXPLORATORY SHAFT ALLOW ADEQUATE EXPLORATION?

IN SITU TESTING NEEDS:

I. SHAFT AND SEAL DESIGN CONSIDERATIONS
   - VALIDATION ASSESSMENT OF ANALYSIS OF POTENTIAL EFFECTS OF ES CONSTRUCTION

II. CONSTRUCTION PLANS AND PROCEDURES
   - ROCK MASS DAMAGE

III. SEALING AND GROUTING PLANS - PROCEDURES
   - IN SITU CONFIRMATION

IV. CONSTRUCTION TESTING AND INSPECTION
   - DURING EXCAVATION
   - DURING GROUTING
   - POST-GROUTING "SEAL" PERFORMANCE

V. INFORMATION GATHERING-SITE CHARACTERIZATION
   - GEOLOGICAL MAPPING/ROCK MASS CHARACTERIZATION
   - GROUNDWATER CHARACTERIZATION/HYDROLOGICAL RESPONSE
   - GEOMECHANICAL CHARACTERIZATION/ROCK MASS RESPONSE

ENCLOSURE NO. 1
E 512-09900R

APPENDIX A

IN SITU TESTING
IN AN EXPLORATORY SHAFT
IN SALT
STATEMENT OF WORK
MARCH 14, 1983

NRC CONCERNS

SCOPE: - "REPOSITORY HORIZON" ONLY?

- WILL SITE CHARACTERIZATION (ES) COMPROMISE LONGTERM ISOLATION AND CONTAINMENT CAPABILITIES?

- CONSTRUCTION - IN SITU TESTING TOTALLY SEPARATED?

IN SITU TESTING

RESOLVING DESIGN ISSUES

1. DEMONSTRATION THAT DESIGN CRITERIA ARE SATISFIED:
    1. RADIONUCLIDE RELEASE: ISOLATION-CONTAINMENT
    2. RETRIEVABILITY: - CREEP
       - BACKFILL

2. OPENING STABILITY
    1. VERIFY DESIGN BASIS
       STRESS-STRENGTH: SITE CHARACTERISTICS
    2. VERIFY ANALYSIS/DESIGN: SITE RESPONSE

3. ISOLATION
    1. HOST ROCK LATERAL AND VERTICAL EXTENT?
    2. GROUNDWATER FLOW - DISSOLUTION
    3. BRINE/GAS MIGRATION
    4. ENGINEERED COMPONENTS
       CANNISTERS - BARRIERS - SEALS
    5. RELEASE RATES?

IN SITU TESTING--NRC POSITION

SUMMARY

REGULATORY FRAMEWORK: EPA--NRC--NWPA

LICENSING INFORMATION NEEDS: RESOLVE UNCERTAINTIES

E.G.
- SITE CHARACTERIZATION
- SITE RESPONSE CHARACTERIZATION
- DESIGN ISSUES
  - OPENING STABILITY
  - RETRIEVABILITY
  - ENGINEERED BARRIERS
- THMC FACTORS/MODELING
- EXPLORATORY SHAFT
  - EXPLORATION: SITE CHARACTERIZATION
  - MAINTAIN ISOLATION--CONTAINMENT