Golder Associates
CONSULTING GEOTECHNICAL AND MINING ENGINEERS

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October 6, 1982

U.S. Nuclear Regulatory Commission
High Level Waste Technical Development Branch
Division of Waste Management
Washington, D.C. 20555

ATTN: Mr. Lud Hartung, Project Manager

SUBJECT: Contract No. NRC-02-81-037
Technical Assistance for Repository Design
Task 6, Project No. 17-2
Letter No. 69

Gentlemen:

Pursuant to your request (ref. NRC letter #54, dated September 9, 1982), this letter report is submitted in accordance with the subject contract, Task 6, Project #17-2, consisting of Golder Associates' review of the Department of Energy's Request for Proposal (RFP) No. DE-RP06-82RL10343, entitled "Construction Manager/Construction Contractor for the Basalt Waste Isolation Project."

We were requested to make a "Best Level of Effort" critical technical review of the Statement of Work contained in the BWIP RFP. Portions of the RFP provided by NRC were:

1) Cover Letter
2) Cover Sheet and Table of Contents
3) Statement of Work (Appendix A) which includes the Task Description: Exploratory Shaft - Phase I.

This review was to consider the various engineering aspects of the RFP such as shaft design, grouting techniques, constructability, and the adequacy of the design assumptions. In addition, evaluation of the design in relation to the available proposed geologic information, as well as its compatability with 10 CFR 60 and the planned repository systems, were to be considered.

However, due to the lack of detailed technical data in the Statement of Work (SOW), the requested requirements of the review, as stated above, could not be fulfilled. The SOW does not provide any substantive data to describe the shaft design, grouting details, constructability issues or design assumptions. In a similar fashion, geologic information and its influence on facility design, facility compatibility with 10 CFR 60 and integration with the repository system are addressed only briefly or not at all.

Otherwise, whenever possible, the SOW was examined in terms of its technical content. Many of the proposed technical issues have been previously examined in detail under Task 6, Project 5 of the subject contract consisting of our technical review of two Rockwell International Reports: RHO-BWI-CD-49, Rev. 1, May 1980, entitled "Test Plan for an Exploratory Shaft Facility in Basalt," and RSD-BWI-TP-007 July 1981, entitled "Test Plan for Phase I of an Exploratory Shaft Test Facility in Basalt," (ref. our letter #13 (revised), dated September 11, 1981). We understand that these two documents discuss the basis for the design of the exploratory shaft, as presented in the subject RFP, although they are not specifically referenced.

In addition to consideration of technical issues, proposed contractual agreements were also examined, as appropriate.

As a result of our review, we have a number of referenced detailed comments, which are attached, and general comments, which are summarized below.

GENERAL COMMENTS

The subject RFP solicits the services of a combined Construction Manager (CM)/Construction Contractor (CC). Although the combination of such services has the appeal of simplicity for the client (i.e., ultimately DOE in this case), we do not consider it appropriate to combine the functions of CM and CC. The contract is of long term duration, as evidenced by the description of Task 1 (i.e., exploratory shaft construction) and the discussion of the optional future Tasks 2, 3, and 4, which result in the construction of the repository. This long term duration provides strong incentives for issuing separate contracts for CM and CC, wherein the CM would oversee construction, liaise with the architect-engineer (A-E) on design, and work with DOE, while one or more CC's would do the construction. In this way, the CM could be easily retained (for extended services) to provide continuity with the ongoing work, while individual CC's could be hired as needed for specific work items. To combine the two functions of CM and CC, especially on a cost-plus type contract, leads to confusion of responsibilities/authority and possible conflict of interest. Potential problems can arise particularly in the enforcement/application of design changes, potential for

changed conditions and cost overruns, cost control measures, solicitation and award of subcontracts, quality assurance and design verification. It is perceived that the potential for such issues to arise is very high at BWIP, considering that this would be the first-of-its-kind repository and may involve significant R&D.

The general nature of the subject RFP, and the absence of important technical information concerning the site conditions (e.g., complex geologic and geohydrologic systems, high rock strengths, low rock quality, highly anisotropic in situ stress conditions, etc.), misrepresents the potential difficulties of constructing the exploratory shaft and subsequent repository development. By not providing sufficient information in the RFP, DOE does not allow proper assessment, by the proposer, of shaft constructability or future repository development problems. Firms not fully familiar with the unusual nature of the job and the potentially adverse construction conditions risk underestimating the problems, and thus cost, of the job. This, in turn, may lead to a strained contractual relationship between the contractor and DOE. Although the technical content of the SOW may be sufficient for the CM, especially for a cost-plus type contract, it does not appear to be adequate for the CC.

Also, the SOW does not discuss the essential requirements for design verification and testing associated with the shaft drilling operation, to suggest how the "detailed experience on the suitability of blind hole boring" may be acquired during Task 1 or extended to full scale repository shafts. In order to maximize information on constructability of the exploratory shaft and other future shafts, the RFP should indicate the requirements to identify and document, in detail, correlations between geology, rock mass characteristics and construction progress or problems. For example, at least continuous or frequent sampling of drill cuttings should be required, as well as continuous recording of bit thrust, torque, rate of advance, speed of rotation, drill mud loss and water inflow.

The major emphasis of the RFP appears to be toward constructing the exploratory shaft as quickly as possible. This attitude is also reinforced by the lack of any detailed discussion on required quality assurance and performance verification programs. Quality assurance problems may arise especially where the CM/CC must utilize items already acquired by BWIP without the initial documentation required by NQA-1.

The critical nature of the repository and the attendant requirements should be pointed out. Although the Exploratory Shaft, by itself, will not require licensing, it will have to be constructed according to licensing standards if it is to be ultimately incorporated into the repository, as implied.

There appears to be a contradiction regarding the schedule of repository development. In the Program Background Section, it is stated that:

- Exploratory and test facilities are required prior to a site suitability decision

- The current BWIP schedule reflects exploratory and test program completion in 1990.

This seems to conflict with the currently known schedule (based on NRC communications) that a license application will be made in 1988, by which time the exploratory and test program required for site suitability will have to have been completed.

We trust that you will find these comments and observations regarding the BWIP Request for Proposal helpful. Should you have any questions or require further discussion on any point, please feel free to call on us.

Respectfully submitted,

GOLDER ASSOCIATES

William J. Roberds, Sc.D.
Assistant Project Manager

WJR:nh
D241
Enclosure

Enclosure #1 to Letter #69

Detailed Comments on U.S. Department of Energy Request for Proposal No. DE RP06-82RL10343, dated February 25, 1982, "Construction Manager/Construction Contractor for the Basalt Waste Isolation Project."

STATEMENT OF WORK

Page	Detailed Comment
1	The words drilling and boring are not interchangeable. They are two different techniques and the terminology in the construction industry is currently confused. BWIP is describing drilling, which is a method where a surface located power plant transfers energy through the drill stem to a cutting head at the bottom of the shaft (see, e.g., Golder Associates' Task 3 report under the subject contract).
1	The summary task descriptions imply that this is a simple, straightforward construction job. There is no reference to design verification or the need to ensure that construction and design are iterative. The references to the QA program, which is left entirely to the CM/CC, does not appear to adequately cover this aspect, nor does it ensure licensability.
1	The function of Figures 1 through 3 is not clear. They are inadequate for the purpose of conveying the true nature of site conditions or the required scope of work; e.g., the rock bolt scheme depicted in Figure 3 is obviously schematic only, and the support design or design requirements is not addressed.
1	The RFP should reference (or include) other documents (e.g., CD-49, TP-007, etc.) describing the requirements for instrumentation to monitor construction, and other routine data gathering functions.

Page	Detailed Comment
1	No long-term isolation design criteria or performance requirements are presented for the Exploratory Shaft except as implied from "grout sealed to prevent vertical movement of groundwater within the hole".
2	Task 2 will require additional surface facilities to handle the underground development needs (shops, ventilation air, etc.).
2	It is not clear who will be responsible for the testing within the first and second phases of the Exploratory Shaft.
2	Task 3 will also require additional surface facilities such as nuclear waste handling facilities.
2	Within Task 3, the 10 ft work shaft and the 4 ft ventilation shaft are assumed to be drilled. Considering that one of the ES-I's objectives is to assess construction feasibility, presumption of the construction method for the Task 3 shafts is premature.
2	Within Task 4, the design concept of vertical in-floor storage is now outdated, based on recent NRC communications.
2	The relationship between Figures 5 and 6 is not clear; i.e., the design basis for the shafts is not clear. Figure 6 implies that the exploratory shaft (6') and the air shaft (4') shown in Figure 5 may both be increased in diameter to fulfill a major role in the repository. If this is true, then initial construction must be tested/verified to ensure licensability.
2	As shown in Figure 6, portions of the Exploratory Shaft and Test and Evaluation Facility are connected to the confinement air return tunnel. This passageway will exhaust air which has been used to ventilate storage rooms where wastes have been emplaced. This implies the complete test facility will serve only for a short-term period (i.e., up to the time when wastes are emplaced). If not, how will personnel within the test facility be protected from the hot and possibly radioactive environment? How will this higher than ambient air temperature influence the testing or monitoring results within the test facility?
3	The relative timing and contractural interface between shaft sinking and testing activities is unclear.

TASK NO. 1
TASK DESCRIPTION: EXPLORATORY SHAFT - PHASE I

Page	Section	Detailed Comments
1	I	Discussions on time deadlines imply that the contractor will be responsible for testing, although no mention is made of this in the scope of work.
2	II A	Although many sections of the RFP do not offer enough detail, this section on drilling specifications offers too much and may be too restrictive to allow market forces to operate for the benefit of the client. Of course, as presently stated, all costs and risks associated with the failure of equipment provided by BWIP is borne by the client.
3	II C.1	It is unclear how much preliminary work and/or specification has been done to ensure that the design of starter hole and concrete pad will be compatible with the ultimate drill rig selection.
3	II D.1	Is the HVAC system components specified for underground facilities as well as surface facilities? The material presented does not indicate this.
5	III A	It is not clear how these provisions relate to design verification. This section seems oriented toward contract settlements or change-orders rather than the implementation of technical changes.
5	III B	Does Contractor (CM or CC) have authority to reject A-E designs on grounds of cost or difficulty of implementation? What are the relative roles/strengths of the Contractor and the A-E.
8	III E	The statement "The Contractor will participate on design reviews to assure proper construction implementation" does not adequately address the need for site verification and quality assurance programs.
11	Table 1	The drill tools which have or are being acquired by BWIP restrict the contractor in his operation. The list of drill tools should be checked to verify that these list items are complete and required, and that they are integral to the most optimum blind drilling system which will be used.

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REMARKS

Comments on BWIP Design Workshop, Oct 5-6, 1982

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COMMENTS ON BWIP DESIGN WORKSHOP--Oct. 5-6, 1982

by E. L. Corp

This report summarizes my concerns on major issues discussed at the workshop meeting in Richland, Wash. Aside from these concerns, I was impressed by the fact that significant progress has been made by Rockwell Hanford Operations (RHO) over the past year in addressing many key issues, and laying out a program to analyze and solve major problems. The comments are arranged in the order they were covered in the meeting agenda.

Conceptual Design

1.) The latest repository design based on elastic analysis of stresses at the crown of the openings does not represent real conditions and may obligate RHO to opening configurations that in actuality are not the safest or most cost effective. The design is not realistic because:

a. it assumes a maximum compressive strength failure criterion,

b. the compressives strengths selected do not have a realistic basis,

c. the analysis does not account for jointing in the basalt and a more probable elastic-plastic behavior,

d. the analysis does not take into account deformation which is the most likely factor limiting failure.

2.) It was recommended a year ago that some conceptual design be done using an elastic-plastic finite-element program. Even though in situ stress, strength and physical properties information is not precise, a sensitivity analysis could be conducted using a range of values. This would give some idea of what problem areas in design are most likely. Alternative designs could be proposed based on changes in the more sensitive parameters.

In Situ Stress/Rock Strength

1.) Because of the variations in in-situ stress data obtained at the Near Surface Test Facility
(NSTF),
there appears to be some disillusionment with overcoring techniques and a greater reliance placed on hydrofracturing. There is even talk about building a small-scale hydrofracturing tool for use at the repository horizon. The preclusion of overcoring and use of hydrofracturing as a result of this experience may not be the best decision. Overcoring is a more reliable technique even in jointed basalt.

The poor repeatability in readings taken at the NSTF could to some extent be expected. Low stress levels at the test horizon are close to the level of measurement accuracy, and the use of downholes versus horizontal holes produced unnecessary water problems and gage bonding problems.

2.) The most reliable in situ strength data can be obtained from mining full size openings in the experimental shaft test facility, instrumenting these

openings, and then backcalculating the modulus, etc. using a suitable finite-element model. Also, a mine by test or the use of tunnel stress relief gages ahead of a development heading would provide useful properties information.

Exploratory Shaft (ES I/II) Test Plan

1.) A six-foot-diameter drilled shaft is very small for determining the extent and geologic suitability of the repository horizon. NRC should verify RHO's statements regarding maximum diameters for drilled shafts based on the current state of the art. This information will also help determine future sizes of drilled shafts in the repository, the number that will be required, and whether or not conventional sinking (with freezing) will be needed.

2.) One of the most important tasks before licensing is to establish the geologic suitability of the repository horizon. This can be done by:

a. establishing a reliable predictive technique during mining of ES II,

b. sinking more boreholes around and within the repository perimeter,

c. exploratory drifting around the repository.

It is imperative that a suitable repository horizon be established before repository construction proceeds.

3.) It appears that mechanically-anchored bolts have been selected as a means of support and instrumentation in the experimental shaft test facility. Other means of bolting should be tested as part of a support evaluation plan. These include resin- and cement-grouted rebar, cable bolts, and angle bolting with trusses. Vertical jointing in the back may necessitate something other than vertical bolts. Also, the use of white hydrocal as a cement grout will provide as quick a setting time as resin. Resin-grouted bolts may not be as impractical as first thought.

Load cells on expansion-anchored bolts do not provide reliable results because of creep. It is more effective to point grout a piece of rebar or cable and attach the load cell.

Exploratory Shaft Grouting

1.) The shaft grouting and sealing plan proposed by RHO is a 20-year-old technology used in the oil industry. There is little doubt that it will be successful over the working life of the repository, however, long-term effectiveness after abandonment is an unknown. Some effort should be made to determine the effects of long-term mechanical and chemical deterioration on the cement materials. Also, there were discussions a year ago about removing the steel liner on abandonment. This could effect seal integrity before permanent plugging is installed.

2.) If conventional shaft sinking with freezing is needed for the main repository shafts, an entirely different sealing scheme may have to be used. How will such a system be evaluated prior to shaft development?