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WM Project 10,11,16
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LPDR ✓ (B.D.S.)

Distribution:
Tiktinsky
(Return to WM, 623-SS)

Mr. David Tiktinsky
Project Officer, Mail Stop 623-SS
Waste Management Engineering Branch
Division of Waste Management
U.S. Nuclear Regulatory Commission
7915 Eastern Avenue
Silver Spring, MD 20910

Subject: Final Letter Report entitled "Review of the Statement of Work (SOW) for Salt Repository Conceptual Design, Architect/Engineer Services", Task Order 008, Contract No. NRC-02-82-030.

Dear Mr. Tiktinsky:

Pursuant to our phone conversation of July 20, 1984 and your letter of June 28, we have prepared the above-mentioned final letter report. We have identified where the performance objectives are located in the SOW, and the extent of their coverage.

Please call me if you have any questions.

Sincerely,

ENGINEERS INTERNATIONAL, INC.

V. Rajaram
Project Manager

1435

REVIEW OF THE
STATEMENT OF WORK FOR SALT REPOSITORY CONCEPTUAL DESIGN
ARCHITECT/ENGINEER SERVICES

The National Waste Terminal Storage (NWTS) program outlines a four-phase project to design, construct, operate, and decommission a repository. The advanced development phase (Phase I) includes sinking an exploratory shaft (ES), characterizing the site, developing a data base, constructing a test and evaluation facility (TEF), license application (LA), and completing architect/engineering conceptual design studies. The document under review (Statement of Work for Architect/Engineer Services: Conceptual Design of a High-Level Nuclear Waste Repository in Salt, Volumes 1 and 2, September 02, 1983, Revision 4) is part of the NWTS program.

The Scope of Work involves:

- project management
- conceptual engineering design activities
- special engineering and design studies
- engineering and design work supporting DOE repository licensing activities
- estimation of design and operating costs
- technical consulting, review, and comment on NWTS program issues as requested by DOE.

The Contractor is responsible for engineering and design work specified in the Statement of Work. Task items involved with underground facilities have been reviewed and critiqued to determine their conformance with 10CFR60 requirements, and relevance to requirements for licensing. Engineering management and surface facility studies were not reviewed as they are outside the scope of this request.

1.0 CONFORMANCE WITH 10CFR60 PERFORMANCE OBJECTIVES

A cursory review of the Statement of Work determined that performance objectives of 10CFR60 were not specifically addressed. The attached table presents the results of this review.

Many performance objectives are not addressed such as duration of waste package containment, maximum radionuclide release rates, or groundwater travel time. Effectiveness of geologic setting and engineered barriers are discussed relative to their behavior rather than their effectiveness, although a separate contract to define

STATEMENT OF WORK (SOW) COVERAGE OF PERFORMANCE OBJECTIVES

PERFORMANCE	OBJECTIVES	SECTION OF SOW	DOES NOT ADDRESS	DOES NOT ADDRESS ADEQUATELY	EXTENT OF COVERAGE	PAGE
60.111.	Protection Against Radiation Exposure and Release	4.5.1.6	-	X	Monitoring system design criteria is discusseed	88
	Retrievability Option in a A Reasonable Time	4.1.6.6	-	X	Impacts on repository design and engineering requirements are discussed.	39
60.112	Effectiveness of Geologic Setting and Engineered Barriers	4.1.2.4 4.6.1	-	X	 Design criteria not provided	20 97,98
60.113	Barrier Performance After Permanent Closure	4.6.1.2	X	-	-	99
	Waste Package Containment of 300 to 1000 Yrs		X	-	-	-
	Max. Release Rate (1 part/ 100,000/Yr)		X	-	-	-
	1000 Yr groundwater travel time from disturbed zone to accessible environment		X X	- -	- -	- -

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natural phenomenon conditions is mentioned (p.20). Engineered barrier systems and materials are also discussed; however, design criteria are not given.

Protection against radiation exposure is addressed through development of monitoring system design criteria. The retrievability option is mentioned briefly, referring to the contractor's responsibility to identify impacts on repository design, develop engineering requirements, and make recommendations. Nevertheless, the performance objectives are not considered in a manner which will provide guidance to the contractor in developing design criteria and design information needs. Specific comments in the areas of repository integration, repository shafts, subsurface facilities, and sealing system design are given in sections 2, 3, 4, and 5 of this review.

2.0 SECTION 4.1 - REPOSITORY INTEGRATION

2.1 Comments

This section of the Statement of Work is very general and broadly covers many of the sections to follow, or at least discusses how they are given an "open field," having the dual purpose of identifying design criteria and evaluating the systems developed. The system used to check the Contractor's performance and the criteria to check against are not defined. The only information that will be available is generated by the Contractor. Without a means or basis for comparison, it will not be possible to assure that the Contractor's work is thorough.

". . . Contractor will select flexible repository design for handling a variety of miscellaneous and abnormal waste forms . . ." (p.33)

It is reasonable to expect that "variety" and "abnormal" should be defined before a repository design can be established and judged as flexible. DOE should specify what waste forms are possible. The rule does not allow for "abnormal" waste but does allow "other" waste. The term "abnormal" has an undesirable negative connotation in this usage.

2.2 Conformance to 10CFR60

Items in the section conform to regulations with a few exceptions. Section 60.71(b) general recordkeeping requirements, requires a record covering the history of movement of waste through all phases of storage and disposal. This requirement is not addressed in the procedures manual or engineering management plan discussions. The section does seem to acknowledge flexibility in

design adequately as required in 60.133 (b) Additional Design Criteria.

3.0 SECTION 4.4 - REPOSITORY SHAFTS

3.1 Comments

The arbitrary shaft interface of 50 ft has been defined as a guide (p.63). This entire approach needs clarification. What is the point in requiring documentation and assuring that data is traceable if it is arbitrary? The logic for choosing an interface distance needs to be based on the actual rock mechanics and operational interactions of the shafts with repository openings.

It is reasonable to expect that certain data pertaining to shafts have been finalized. That is, the number of shafts, thickness of shaft pillars, and placement of shafts are items that may have been acceptably defined, and should be outlined in the Statement of Work (p. 63). In order to maintain a logical progression of past analyses, the SOW may need to include provisions for review of the existing data base.

P. 64: Can a Contractor reasonably assure the long term effectiveness of grouts and seals? Is reasonable assurance good enough (60.134)? The Contractor will need to devise a plan to define the effectiveness of the grouts and seals. A coordination plan and design criteria must be established among the numerous subcontractors working in this area.

P. 65: No reference is made to the shaft lining material (steel or concrete) or any other design specifications. Certainly minimum design guidelines, judged adequate by the NRC and others, exist.

Similarly, shaft safety devices are not defined nor are design criteria (p.68). A reasonable safety factor for cables and other components can be defined here. Safety is a specific identifiable concern in 10CFR60.

P. 72: Water handling is addressed and requires the Contractor to "prepare a general arrangement." Some water handling capacity should be stipulated along with requirements for redundancy.

P. 73: The Contractor has to address the required level of detail in construction documentation in contrast to that used in traditional mine design. Specifically, the Contractor should be referred to 10CFR60, Subpart D, 60.72, and Subpart G, 60.151, for accomplishing the appropriate level of QA and documentation.

3.2 Conformance to 10CFR60

Throughout this section, very little is mentioned about safety devices, emergency capability of equipment, and a maintenance program that must be developed and approved to assure compliance (10CFR60.131) It appears the design studies in this section are based on thorough and complete site characterization. A discussion of how and what pertinent information obtained from the ES and TEF will be integrated into a detailed data base for developing design criteria would be appropriate.

4.0 SECTION 4.5 - SUBSURFACE FACILITIES

4.1 Comments

4.1.1 Section 4.5.1.2 Underground Facility Design

The Contractor is to identify constraints imposed by 10CFR60 and the repository functional design criteria documents (p.78). Should the 10CFR60 regulations and functional design criteria be looked upon as constraints? These elements serve as an outline from which to design a repository, and the word constraint implies the elements unnecessarily inhibit repository design and operations.

The Contractor is charged with making trade off studies to evaluate alternative underground facility designs. The issues being traded off should be clearly identified and may include time, costs, retrievability, room sizes and maneuverability.

"The roof support system developed will form the basis for subsequent safety analysis required for licensing" (p.81). One system may not be satisfactory, but rather several will be required at different areas in the repository. Successful designs will require experience over the long term, and it appears too much emphasis is placed on initial studies and documentation which may reflect short-term solutions. Initial studies appear to be concentrating on active support of the roof in terms of hardware and systems. Options for support including methodologies such as Stress Control need to be identified along with the basis for trade off studies.

Deformation criteria may be included as a portion of the functional opening life definition. The definition may be affected by the type of support or reinforcement. The stability of rooms will be a function of local geology, and the support system or method. These conditions may change across the repository, requiring a definition reflecting the range of conditions expected.

4.1.2. Section 4.5.1.3 Excavation Process Systems

Development operations lack any guidance for design and scheduling criteria (p.81). There is no stipulation, for example, of development being concurrent with storage operations. The Contractor is to select equipment, but R&D of special equipment is not considered. Is the Contractor to be responsible for this?

The Contractor is charged to "consider whether routine backfilling operations may be desirable after the initial retrievability verification period is completed." In order to evaluate equipment requirements, coordination of facilities, material handling requirements, and ventilation requirements, a thorough study of the backfill options would be appropriate. The problem of backfilling needs to be coordinated with stable opening design, and criteria established for when and if to backfill.

The excavation equipment for backfill is not specifically mentioned as part of the work. If the backfill option is considered, equipment to remine in the hot, perhaps poorly ventilated conditions must be assessed. Present state-of-the-art should be identified. Likely future developments should be evaluated, and an assessment of the ability to excavate backfilled rooms should be made with the equipment likely to be available at the time of waste emplacement.

The Contractor is to make equipment comparisons and evaluations based on performance requirements, and select proper units (p.82). The Contractor cannot evaluate and judge equipment performance without basic performance data, particularly if the equipment does not exist for operations such as remining backfill and waste package retrieval.

4.1.3 Section 4.5.1.4 Special Process Equipment

Retrieval is a critical area for waste handling equipment design. Discussion of retrieval is minimal, and equipment studies in this regard are not emphasized (p.83).

Waste emplacement area preparation includes trade-off studies incorporating cost and procurement time of related equipment. The contractor is also to assess reliability and performance requirements for each component. Paper studies are limited and should not be prolonged beyond their limits of usefulness. How well can equipment be evaluated if it does not exist? Reliability can only be guessed. Perhaps a better program would be to require basic equipment prototypes

that could be altered or revised as necessary according to trials in an experimental panel.

4.1.4 Section 4.5.1.5 Ventilation Systems

The Contractor is to prepare conceptual designs of ventilation systems (p.86). It may be of considerable help if a general mode of nuclear waste storage were chosen such as open rooms, bulkheaded rooms, or immediately backfilled rooms. Development and emplacement ventilation system separating techniques and design criteria need to be identified. Leakage limits, directions, and preferred locations may need to be developed.

Retrieval operations requirements are identified as an item to be included in the Contractor's work. The retrieval requirement should consider the effect of special equipment such as spot coolers, brattices on the retrieval effort.

The Statement of Work does not discuss the need for flexibility in design which most assuredly will be needed over the life of the repository. An operational logic for the range of conditions expected would allow decisions to be made within an established framework.

"The ventilation systems safety-related functions and the consequences of the thermal design problems will require special efforts from the Contractor" (p.86). These special efforts are not discussed.

4.1.5 Section 4.5.1.6 Monitoring and Control Systems

Development of the monitoring system may require equipment design and reliability studies. These aspects are not discussed in the Statement of Work.

The geotechnical monitoring system should be related to the ES Facility monitoring system in a traceable way. The measurement limits of the instruments in the program should be established with consideration of the expected and acceptable limits of deformation, stress, or other measured parameters. Based on the operational life definitions for various repository openings, working limits for measured geotechnical parameters should be established. The interface of the geotechnical monitoring system with the repository operations needs careful evaluation. Operations should not preclude timely monitoring just as monitoring should not hinder operations.

4.1.6 Section 4.5.2 Engineering Design Studies

Information obtained from tests in the ES is expected to have the greatest influence on repository design work but the conceptual design for the TEF may also exhibit an influence (p.92). There is no discussion in the Statement of Work addressing the mechanism for feedback of this valuable information to the Contractor for use in design. In addition, the terminology used in the SOW omits what ONWI has called At-Depth-Testing (ADT). The ADT will have the greatest influence on establishing the rock mechanics behavior of the salt. The timing of information availability may be critical to the design. The thermomechanical behavior on a room scale will be developed during the ADT. Final repository scale behavior will not be available until the TEF has been operating for a period of time. Projections of data from the Exploratory Shaft Facility (ESF) and ADT need qualification as to the uncertainties involved.

The Contractor is to review studies of salt behavior and conduct complementary studies (p.93). Modeling studies have been previously reviewed by NRC and its Contractors. Specific model studies should be highlighted here. Also, the review by the Contractor may be premature in view of the fact that more credible information will be obtained in the Exploratory Shaft Facility (ESF). The Contractor, having identified elements of design and design criteria, can provide input to formulating test criteria. This approach may be better than Contractor review "after the fact".

The three physical scales identified for analyses in the SOW are the very near field, near field, and far field. A scale which is often employed to evaluate overall mine stability encompasses the entire mined area. Such analyses identify which portions of the repository are taking load and which areas are shedding load. These will be key factors in identifying stability criteria.

The roof support systems studies are to identify and define local roof support problems. A secondary item which may need to be addressed is the possibility of roof instability creating preferential pathways.

The Contractor is to study excavation systems prior to the major conceptual design effort (p.94). The equipment necessary to operate under gassy conditions must also be evaluated in both design and practice. The effects of numerous closely spaced crosscuts to account for gassy conditions need to be evaluated in terms of opening stability and ventilation requirements.

In the area of special process equipment, the equipment required to excavate backfill and retrieve waste from a

backfilled room requires study. Demonstration of prototype equipment in this area may require special efforts to prove equipment adequacy.

4.2 Conformance to 10CFR60

60.131 General design criteria for the geologic repository operations area, (b7), criticality control, requires all systems to be designed to ensure that a nuclear criticality accident is not possible unless at least two unlikely, independent and concurrent or sequential changes have occurred in the conditions essential to nuclear criticality safety. Section items in the Statement of Work appear to follow this; that is, each system is intrinsically safe.

60.133 (3) requires separate ventilation for excavation and waste emplacement. This is not clearly addressed in the Statement of Work.

Flexibility of design (60.133) is not emphasized in this section although alternative systems are to be evaluated. 10CFR60.43 License Specifications (3) requires restrictions as to the amount of waste permitted per unit volume of storage space, considering the physical characteristics of both waste and the host rock. There is no mention of this requirement in this section of the Statement of Work.

5.0 SECTION 4.6 - REPOSITORY SEALING SYSTEM

5.1 Comments

The requirements that the sealing system must meet in satisfying the performance objectives of the repository are not adequately addressed. The role of performance assessment models in defining the design criteria for the sealing system is not mentioned. It is anticipated that the DOE will use site-specific performance assessment models in demonstrating that the repository seal system in conjunction with the host rock far-field characteristic will meet the NRC and EPA release criteria. The Contractor should use the results from these performance assessment models in defining the design criteria for seals.

The manner in which the short term shaft seal placed during shaft construction will be integrated into the long term seal left upon permanent closure should be addressed by the Contractor. This is briefly mentioned (p.99); however, the QA considerations and long term seal requirements should be carefully considered by the Contractor in developing the criteria for seal design.

The importance of site-specific data from the ESF, ADT, and TEF in designing the seal system is not emphasized. The Contractor should define these data requirements, and should develop schedules for the implementation of long-lead time testing of seal materials

and emplacement techniques. The testing in the ES and TEF is essential for the development of prototypical seal designs, and should be conducted in parallel with performance assessment modeling efforts.

5.2 Conformance to 10CFR60

There is no mention of 10CFR60.134 in this section. This part of the rule provides general guidelines for the design of shaft and borehole seals. There is recognition of 10CFR60.142, Design Testing, and the Contractor is required to define an outline for the full-scale testing of a backfill placement system and of seals to be placed in shafts, boreholes and entries. The requirement of 60.113, Performance of Particular Barriers After Permanent Closure, are not specifically mentioned. For example, the requirement that the design of the seals should consider the geochemical characteristics of the host rock is not mentioned.

6.0 CLOSURE

In general, the SOW provides for much re-review of already-completed work, especially modeling and opening stability. New work to be accomplished is rather sketchily-defined technically, but a management control system appears to be in place to provide interaction with, and direction to the Contractor.

Licensing and 10CFR60 requirements have been specifically addressed; however, the performance objectives specified in 60.113 are not addressed. In addition, requirements of 60.111 and 60.112 are not adequately addressed.

The emphasis on the use of site-specific data for the sealing system design is lacking. The role of performance assessment modeling in developing seal design criteria is not being addressed by the Contractor. The differences in QA requirements of a geotechnical data gathering program and a hardware-oriented program (as stated in NQA-1 standards) is not emphasized in the Statement of Work.

Retrieval is underemphasized, and needs a much more directed treatment. The manner in which data from the ESF and TEF will be integrated into the conceptual design effort is not spelled out. This integration is critical to obtain a design which is site specific, and defensible from a performance assessment standpoint.