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Mr. John Buckley
U.S. Nuclear Regulatory Commission
7915 Eastern Avenue
Silver Spring, MD 20910

Subject: Selected Detailed Comments, Hanford Site

Dear John:

Enclosed are the selected detailed comments. I will send you the major comments tomorrow. Please call me if you have any questions.

Sincerely,

ENGINEERS INTERNATIONAL, INC.

V. Rajaram
Project Manager

VR/ja

Enclosure

cc: David Tiktinsky

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Chapter 2 - Decission Process by Which the Site Proposed for Nomination Was Identified

2.1 Section 2.3.1, Geohydrology (Input), page 2.67, paragraph 1.

The EA states that "... the pre-waste-emplacement ground water travel time to the accessible environment is expected to be greater than 1,000 years". This conclusion has not adequately addressed all uncertainties with respect to ground water travel times. Vertical flow paths have not been considered.

This has a direct impact on the environment because ground water is the major carrier of radionuclides.

Section 2.3.8.2, Summary of Environmental Quality Disqualifier Analysis (Input), page 2-71, paragraph 2.

The statement "no adverse environmental impacts have been projected that could not be mitigated to an acceptable degree" does not consider the following potential impacts:

- impact resulting from large amounts (710,000 gallons per minute) of contaminated water that may have to be disposed on the surface if a sudden inflow is encountered in the waste emplacement panel

- impact of water withdrawal from the Columbia River on current appropriations.

These are important since water is a valuable resource in the Pasco basin. Section 6.2.1.6.11 (page 6-36) should discuss these impacts, and mitigating measures should be proposed.

Section 2.3.11.2, Summary of the Hydrology Disqualifier Analysis (Input), page 2-73, paragraph 1.

The statement "current construction data, case history studies, ... repository construction, operation, or closure will only require reasonably available technology" is not demonstrated in Section 6.3.3.3.7. In spite of precautions taken to identify permeable zones in advance of excavation, the inherent variable nature of basalts requires that contingency measures be planned to deal with sudden inflows of hot water under high pressure.

This is very important to the safe operation of a repository in basalt. Case histories demonstrating the control of water inflows at depths comparable to the planned repository should be presented, with special emphasis on how the waste would be isolated from these sudden inflows.

Chapter 3 - The Site

3.1 Section 3.2.2, Stratigraphy, page 3-10, paragraph 2.

The data base for developing the stratigraphy of the reference repository location consists of 740 boreholes, and several miles of geophysical lines (site-specific information). A detailed analysis of this data base should provide some understanding of the variability of basalt flows.

The major uncertainty at this time, as presented in the EA, still remains the predictability of stratigraphy and structure at the site. NRC feels that the existing data base should form the basis for discussing geologic predictability, and how the confidence level in this area would be enhanced by planned site characterization activities.

Section 3.2.4, Seismicity of the Reference Repository Location, page 3-54, paragraph 7.

The effects of microearthquake activity on the stability of surface and underground facilities should be discussed. The allowable design limits should be discussed in light of the observed seismicity of the reference repository location.

Chapter 4 - Expected Effects of Site Characterization Activities

4.1 Section 4, Summary, page 4-1, paragraph 2.

The statement " the overall emphasis of the field studies would be to reduce uncertainty....... regulatory criteria can be examined" dictates that the DOE consider the possibility of drilling and blasting at least one of the exploratory shafts through the candidate flow horizons. This will permit the direct observation of the candidate flows, and will reduce the uncertainty concerning the geologic and the ground water flow systems.

Section 4.1.1, Field Studies (input), page 4-3, paragraph 2.

The basic geohydrologic model does not mention the effect of thermal/mechanical effects on the flow system, especially in the vicinity of repository openings. The effect of heat would be to alter the permeability in the disturbed zone around openings; hence, this should be considered in the geohydrologic model.

Section 4.1.1.3.4, Effects, page 408, paragraph 2.

This section does not describe the tests, and does not consider the effect of mud on the sealing program for boreholes and shafts. This section should be expanded to discuss methods that will be utilized to determine the effect of mud on the effectiveness of the grout/wall rock bond.

Section 4.1.1.5, Hydrochemical Characterization (input), page 4-9, paragraph 3.

This section does not address the thermo-dynamic data that would be gathered for use in geochemical modeling and radionuclide transport studies. The modeling of water-rock interactions and reactivity using non-equilibrium models should consider the effects of ambient temperature and pressure.

Section 4.1.1.6.1, Construction, page 4-12, paragraph 2 and 3.

This section does not discuss the following aspects which are essential to ensure a tight seal in the annulus between the liner and the wallrock:

- quality assurance program for grout placement and monitoring

- placement of portholes for testing grouting effectiveness

- effect of mud coating on the wall rock, and large voids within flow tops and bottoms, on the grouting program.

These are not discussed anywhere in the EA, and should be addressed since the current design is predicted on using the exploratory shafts as part of the repository.

Section 4.1.1.6.3, Chamber Tests, page 4-14, paragraph 2.

The possibility of bulkheading the chamber test area and conducting the test under elevated temperatures should be considered so that effect of heat on hydraulic conductivity can be measured. This type of test is feasible using the current site characterization program layout.

Section 4.1.1.6.4, Geomechanics Characterization, page 4-15, paragraph 2.

The effect of heat on the stability of repository rooms could be evaluated by incorporating heaters in the mine by test. This test will help determine the following:

- the effect of heat on rock supports
- the effect of heat on the nature of movement (if any) along joints and fractures.

A test similar to this has been conducted at the Climax facility on the Nevada Test Site.

Section 4.2.1.2.2, Ground Water Impacts (input), page 4-22, paragraph 3.

The ground water quality should be monitored before and after shaft sinking to determine the impacts of mud loss or aquifer mixing that might occur during the sinking operations. The monitoring system could be an asset in determining if the shaft grouting is effective in isolating aquifers over the repository operating period.

Chapter 5 - Regional and Local Effects of Locating a Repository at the Site

5.1 Section 5-1, The Repository, page 5-2, figure 5-1, table 5-1, page 5-5.

Figure 5-1 (Page 5-2) shows the operating period for a two stage repository, and Table 5-1 (Page 5-5) shows the changes in projected impacts due to alternative repository designs. There are several inconsistencies between the Figure and the Table as listed below.

1. A distinction should be made between a two-phase repository and a two-stage repository

2. Item 10 in Table 5-1 shows 92 years as the repository preclosure period for the two-phase repository whereas Figure 5-1 shows 90 years.

3. Item 14 in Table 5-1 shows a total of 8 years 5 months construction period before waste emplacement, whereas Figure 5-1 shows 6 years

These inconsistencies should be resolved because they have an impact on cost and schedule.

The two-phase repository concept envisages the inclusion of exploratory shafts for repository operation. The 12-foot ID second exploratory shaft (Table 5-1, page 5-5) would significantly increase the amount of data that can be obtained during the site characterization program.

The 35-year retrieval option period is mentioned without providing any basis.

Section 5.1.2, Description of 1982 Conceptual Design, page 5-12, paragraph 4.

The EA states, "Following the retrieval period, the emplacement holes would be packed and the underground openings backfilled with an engineered fill material of low permeability". Adequacy of the backfill material under heated conditions must be demonstrated. Also, method of placement, which has a direct bearing on permeability achieved, is not discussed.

Performance of the backfill is important, because it provides for ground water flow retardation and radionuclide sorption during the post closure period.

Section 5.1.2, Description of 1982 Conceptual Design, page 5-18, paragraph 2.

The EA states, "For the purposes of this environmental assessment, only those facilities that would affect the handling or monitoring of nuclear waste or other pollutants are discussed". The environmental assessment of the surface facilities are based on the 1982 design. However, current design requires a 3-month lag storage capacity, which is not provided for in the 1982 design. The EA should discuss handling and safety procedures for lag storage.

Section 5.1.2.1.1, Ventilation - 1982 Conceptual Design, page 5-18, paragraph 7.

The EA states, "A radiation monitoring system would extend throughout the confinement airways would extend throughout the confinement airways and in the exhaust shaft". The adequacy of the instrumentation system under heated conditions is not discussed. QA procedures for installation, monitoring and maintenance of instruments are not outlined. It is not clear whether redundant instruments are to be provided.

Section 5.1.2.1.4, Nonradioactive waste control and disposal, 1982 Conceptual Design, page 5-22, paragraph 1.

Normal water accumulation in the repository is discussed; however, there has to be provision made for disposal of sudden inrushes that could be encountered during repository construction and/or operation. The effect of a sudden inrush on repository operations, and methods of handling and disposal on the surface, should be discussed.

Section 5.1.2.2, Subsurface facilities - 1982 Conceptual Design, page 5-23, paragraph 2.

The two independent ventilation circuits from the confinement ventilation system could contain radioactive gases. Hence, adequate redundancy of instrumentation and maintenance of the instruments to ensure operation under elevated temperature, is a prerequisite to monitor if leakage is occurring from the confinement ventilation circuits to the development circuits. Silica dust generated during drill-and-blast operations should also be monitored.

The suggested resolution would include an assessment of instruments under heated conditions, outlining of QA procedures and providing redundant instruments.

This has a direct impact on the radiation safety of personnel working in the repository (current design concepts may have provided this, however this EA is based on the 1982 design). The possibility of installing a radiation monitoring system in the development airways may also be considered (this would provide a safety margin for personnel in development airways in case of a ventilation system malfunction.

Section 5.1.3.1, Optimization and alternative studies, page 5-25, paragraph 2.

The main entries, although subjected to much lower heat loads, should have a width to height ratio of 2:1 to accommodate the high horizontal stresses.

The rock support method should consider the expected elevated temperatures, especially in the confinement exhaust drifts where cycles of heating and cooling could occur during retrieval (planned contingency).

In light of repository isolation requirements, the disturbed rock zone around repository panels must be minimized. Therefore, QA procedures to be followed for drill and blast operations should be outlined.

Section 5.1.3.1, Optimization and Alternative Studies, page 5-25, paragraph 2.

Item 2 under the Tunnel Optimization Study states, "Excavation Methods - The drill-and-blast method was recommended for waste panel development".

Careful drill and blast operations has a direct impact on the extent of the disturbed zone and thereby the isolation potential of the repository.

A statement outlining the QA procedures should be made.

Section 5.1.3.2.3, Design approach and assumptions, page 5-31, paragraph 2.

The EA states, "The reduced rock mass strength for each size of opening was then used as the allowable stress for design purposes". It is not clear whether the heated rock conditions were incorporated in the rock mass strength analysis.

This has an impact on the design and support requirements for the different repository openings, and therefore the performance requirements of the repository.

An assessment of the rock mass strength under heated conditions should be included.

Chapter 6 - Suitability of the Reference Repository Location for Site Characterization and for Development as a Repository

6.1 Section 6.3.1.1.3, Geohydrology, favorable condition (input), page 6-63, paragraph 3.

The range of travel times presented indicate the sensitivity of the result to the range of input parameters. The stochastic simulations of Clifton et al, 1984a, should consider the confidence level for the input parameters (vertical and horizontal transmissivities, hydraulic gradient and thickness), and develop the travel time estimates based on these confidence levels.

Section 6.3.1.1.12, Geohydrology, conclusion on qualifying condition, page 6-86, paragraph 3.

The statement "the engineered barrier system, in concert with the natural site characteristics, is expected to constrain radionuclide releases to a small fraction of allowable limits" is not demonstrated by DOE. The transport of radionuclies through the engineered barrier into the host rock, and potential pathways that might develop in shaft seals, are not discussed.

Section 6.3.1.3.3, Rock characteristics, Favorable condition 1, page 6-99, paragraph 2.

Uncertainties about the dense interior below vesicular zone (DIBVZ) are quite significant for all the four candidate flows. The Cohasset flow has the thickest DIBVZ compared to all other candidate flows. One cannot easily move from one flow to the other after initiation of construction. Hence, the statement "the option to select from the three other candidate horizons may provide further flexibility at depth when selecting a repository host rock horizon" is not correct.

Section 6.3.1.3.4, Rock characteristics, Favorable condition 2, page 6-100, paragraph 1 and 4.

There is an apparent inconsistency between the statements "hydrothermal alteration of the basalt in the vicinity of the waste package..... isolation characteristics" and "the basalt dense interior is not expected............ to seal repository related fractures". The statement "This favorable condition .... due to the relatively low coefficient of thermal expansion of the host rock" should be supplemented with the statement "However, the thermal conductivity is low and ductility is such that repository related fractures may not be sealed".

Section 6.3.1.3.5, Rock characteristics, Potentially adverse condition 1, page 6-104, paragraph 3.

The EA states that, "At appropriate packing densities, provided that the clay fills the interconnected voids between the crushed rock aggregate and there is a tight interface with the host rock, such a seal can prevent preferential pathways to the accessible environment". Unless the backfill material is formulated and placement methods and densities identified, one cannot conclude that a tight interface can be provided between the seal and host rock interface.

This is directly related to the post closure isolation potential of the repository because the main function of the backfill is to absorb radionuclides and retard ground water flow.

A backfill composition should be formulated and backfill placement methods and placement densities should be outlined.

Section 6.3.1.3.5, Rock characteristics, Potentially adverse condition 1, page 6-106, paragraph 1.

The EA states, "...the disturbed rock zone joints and fractures could be pressure injected with grout, using grout curtain construction techniques similar to those used to improve rock foundations at dam sites". Grout curtain construction at damsites and grouting the disturbed zone in an approximately 3000 feet deep shaft may not be directly comparable. It must be demonstrated that the proposed method can be implemented.

Relevant case histories in shafts where similar grout curtain construction has taken place should be cited.

Section 6.3.1.3.5, Rock characteristics, Potentially adverse conditions 1, page 6-106, paragraph 1.

The EA states, "...portions of the liner, the liner supporting grout, and the damaged host rock-liner grout interface would be removed, thereby providing a quality interface for installation of the shaft interior bulkhead". Since, construction of the bulkhead is predicated on removing the liner and the liner supporting grout, the methods of removal should be outlined and demonstrated.

Section 6.3.1.3.5, Rock characteristics, Potentially adverse condition 1, page 6-106, paragraph 2.

A preliminary performance assessment study evaluated the potential for radionuclide release, via the damaged rock zone around repository openings, to the shaft. However, the more important consideration should be the potential for release through the shaft to the accessible environment. Hence, the sealing of the shafts and the behavior of the seal materials under repository conditions, should be emphasized in performance assessments.

Section 6.3.1.3.6, Rock characteristics, Potentially adverse conditions 2, page 6-107, paragraph 2.

The statement " the potential development of these stress-induced instabilities around emplacement rooms or emplacement boreholes may be controlled by reducing the thermal load (i.e., increased emplacement borehole spacing)" does not address the issue. The nature of instabilities that might develop under the design thermal load (17.5 watts per square meter) should be discussed, and mitigating measures that will be taken to maintain canister integrity and room stability should be addressed.

In addition, the EA states that, ".... there is adequate room for expanding the repository since the current repository conceptual design encompasses only one-fifth the size of the reference repository location". Although there is sufficient room to expand the repository, all repository facilities are laid out according to a specific repository plan, and changing this during operations will be difficult in terms of logistics, cost, and schedule.

Section 6.3.1.3.7, Rock characteristics, Potentially adverse condition 3, page 6-109, paragraph 5.

Credit is not presently taken for isolation potential of the Cohassett flow dense interior. However, the option of taking partial credit is maintained for the future (6-263). Hence, the thermal-induced fracturing around boreholes and rooms should be discussed. In addition, canister integrity and waste retrieval operations are significantly affected by the nature of thermal-induced fracturing around boreholes and rooms.

Section 6.3.3.2.3, Rock characteristics, Favorable condition 1, page 6-154, paragraph 2.

The EA states that, "...a minimum thickness criterion of three room heights above and below the emplacement room was assumed, resulting in a 21-meter (70-foot) minimum thickness criterion". It is possible that this criterion is valid; however, proper justification should be provided.

In addition, the EA states that, "Drift grades are currently designed at a uniform 0.5 percent grade; however, the repository...... waste panel drift grades may be altered so that the slope of the waste panels would be approximately equal to the slope of the flow". Using a 0.5% grade and assuming that the sumps are at the bottom of the shafts at the middle of the repository, the change in height at the repository extremity is approximately 10 m. The minimum thickness criterion does not seem to account for this 10 m.

Section 6.3.3.2.4, Favorable condition, page 6-159, table 6-13.

The Group I/DIBVZ, at a 97.5 confidence interval, is 20.47 m. This is just sufficient to meet the minimum thickness, and other candidate flows show lesser thickness for DIBVZ. Hence, the statement on Page 6-157, paragraph 1, "the Cohassett flow provides more than twice the minimum thickness (21 meters) necessary to construct the repository" is not accurate. Additional discussion is required of the geologic variability within the deep basalt at the site, and the manner in which statistical analyses was conducted using a range of 7 to 17 samples.

Section 6.3.3.2.4, Rock characteristics, Favorable condition 2, page 6-169, paragraph 2.

The statement "Any increase in support requirements .... repository waste panel layout design and container emplacement density" does not consider the support behavior under elevated temperatures. The behavior of cement-grouted dowels and micro-silica shotcrete under repository conditions should be determined during the site characterization program. In addition, the EA should discuss the monitoring program, and mitigating measures that might be necessary to maintain stable openings in the waste panels.

Section 6.3.3.2.6.1, Rock characteristics, Potentially adverse condition 2, shaft construction, page 6-173, paragraph 2, 4.

The EA states, "......and (3) experience gained from other blind-hole drilling projects where constraints similar to those which may be encountered during shaft construction at the reference repository location, have been encountered". The case-histories are not directly applicable to the RRL. Shafts with finished diameters of 12 feet have not been drilled to 3960 feet. The deeper shafts ($\geq$ 3960 feet) appear to have been drilled at a much smaller diameter and rock strengths are also considerably lower.

In addition, the EA states, "These exploratory boreholes have been subjected to the same geological and hydrological conditions as proposed repository shafts in the reference repository location". Comparison of the constructibility of small diameter (3 in. to 17 in.) boreholes to that of 6-foot or 12-foot diameter shafts is not valid.

A conclusive statement on this potentially adverse condition should not be made based on these case histories.

Section 6.3.3.2.8, Rock characteristics, Potentially adverse condition 4, page 6-194, paragraph 2.

The statement that "the potential for safety hazards on difficulty in retrieval can be handled by using standard practices" is not true. Uncertainties exist in the following areas:

- thermal-induced fracturing, and hydration and dehydration of mineral components in the fractures is possible around waste emplacement boreholes. This can cause water inflow which will turn to steam in the borehole

- canister integrity could be jeopardized by rock spalling and impinging on the canisters

- retrieval operations would have to be performed after room cooling, stabilizing the ground (if necessary), and in a generally hostile environment.

Section 6.3.3.2.9, Rock characteristics, Potentially adverse condition, page 6-196, paragraph 3.

The statement "if stratigraphic or structural features ...... could be relocated in a more geologically favorable area" has two major implications. These are:

- disruption of operations which have to be accommodated by careful planning

- the abandoned area should be properly isolated from the rest of the repository.

These should be discussed in the EA, using examples of stratigraphic or structural features that could compromise the safety of personnel.

Section 6.3.3.2.10, Rock characteristics, Disqualifying condition, page 6-197, paragraph 3.

The EA states, "While some water inflow into excavated openings is anticipated, the volumetric flow rate is expected to be minimal based on current knowledge". There appears to be no basis to this statement.

The geologic anomalies are mentioned as the source of water inflow into the repository facilities. However, no bounding ranges for the quantity of inflow are presented. The following should be discussed under this section:

- types of anomalies that may be encountered and estimates of inflow that may result from each type

- discussion of case histories to demonstrate that these magnitudes of water inflow under high pressure and temperature can be handled with available technology.

Section 6.3.3.2.10, Rock characteristics, Disqualifying condition, page 6-199, paragraph 6.

The EA states, "....Barton analysed the case of thermal induced stresses on rock support requirements by increasing the stress reduction factor in the rock quality system approach .... No support increase was estimated by main access drifts and the shaft area". Confinement exhaust drifts will experience high heat loads due to hot exhaust air, and will experience alternate heating and cooling due to the precooling required during retrieval operations. Roof support systems in these drifts should consider potential instabilities resulting from alternate heating and cooling.

Section 6.3.3.2.11, Rock characteristics, Conclusion on disqualifying condition (input), page 6-203, paragraph 2.

The EA states, "Other potentially adverse conditions...... are also not expected to cause undue risk". This statement does not include accident conditions such as a breached container and its associated radiological safety hazards. The risk associated with a breached container should be discussed.

Section 6.3.4.1.2, Evaluation Process, page 6-216, paragraph 2.

The statement "these are similar to the tunnel seal requirements at damsites" indicates that the DOE is not giving adequate consideration to the following factors:

- temperature of 125°F or more
- high horizontal stresses
- hydraulic pressures of about 1400 psi.

Section 6.4.2.3, Subsystem performance assessment, page 6-233, paragraph 1.

The statement "when stresses reach the yield strength...... and prevent mechanical rupture of the wall" does not account for the rupture that might occur if rock wedges impinge on the container wall. The impact of waste emplacement borehole instability on canister integrity should be discussed.