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WM Record File D1016 ITASCA
WM Project 10, 11, 16
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Distribution: Tiktinsky
(Return to WM, 623-SS)

6 August 1987

David Tiktinsky - SS623
U.S. Nuclear Regulatory Commission
Division of Waste Management
Washington, D.C. 20555

"NRC Technical Assistance
for Design Reviews"
Contract No. NRC-02-85-002
FIN D1016

Dear David:

Enclosed is our review of the document "Task V Engineering Study No. 11 — Shaft Casing Design Criteria and Methodology: by RKE/PB (SD-BW-ES-02, April 1986). Please call me if you have any questions.

Sincerely,

Roger D Hart

Roger D. Hart
Program Manager

WM DOCKET CONTROL CENTER
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cc: R. Ballard, Engineering Branch
Office of the Director, NMSS
E. Wiggins, Division of Contracts
DWM Document Control Room

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ITASCA DOCUMENT REVIEW

File No.: 001-02-28

Document Title: "Task V Engineering Study No. 11 — Shaft Casing Design Criteria and Methodology" by RKE/B (SD-BW-ES-02, April)

Reviewer: Itasca Consulting Group, Inc. (M. Board)

Date Review Completed: 5 August 1987

Approved: Roger D Hart

Date Approved: Aug 7, 1987

Importance to NRC Waste Management

The ES shafts at Hanford will be required to cross a large number of high pressure, high volume aquifers prior to intercepting the repository horizon. The casing for these shafts provides the only means of eliminating water in-rush. The casing design is of great importance and is to be accomplished to NQA Level 1 standards. Although not considered so by BWIP, the reviewer considers the shaft and casing design to be important to safety and waste isolation.

Summary

This document presents the methodology for examination of the casing design for the ES shaft. The various possible loads to be applied to the liner are discussed, including:

(1) service dead and live loads;
(2) construction loads (grout loads, hole cave-in);
(3) rock loads;
(4) hydrostatic load;
(5) wind load;

(6) hole misalignment (bending);
(7) temperature differential;
(8) impact loads;
(9) earthquake loads;
(10) tornado load;
(11) conveyance load;
(12) fire load; and
(13) flood load.

The load sources above are excluded from analysis if they have a probability of occurrence of less than 10^{-5} per year, or if the result of the load is determined to have no effect on the casing. After eliminating several of the above sources, the final loading is determined only from hydrostatic water pressure, temperature differential, dead loading and seismic loading.

Equations are presented for determination of the stress induced in the casing by these load sources. A procedure for calculating the casing stability using these equations is given, but no actual calculation of casing stability is given.

Problems, Limitations and Deficiencies

The report presents, in this reviewer's perspective, a haphazard approach to the casing design. An acceptable initial list of possible loading sources is given, but each category needs to be treated systematically with illustrative calculations of load. One example is rock loading. This load category is eliminated as being unimportant, without showing calculations to support this assertion. Instead, an incomprehensible set of equations pertaining only to hydrostatic, temperature and seismic loading is simply lumped together, leaving the reader to sort out how they are to be applied and of what importance they are to the overall induced casing stress.

The effect of rock loading of the casing is ignored in the calculations. The report states that only loading resulting from creep is of importance, and that creep is not expected in the RRL. This concept is not appropriate for several reasons.

1. Instantaneous rock loading (i.e., creep) will occur when the water used to sink the casing is pumped out. The rock mass response may be elastic or plastic.

2. Minimal creep deformation for basalt is based on the fact that intact basalt is a brittle, elastic rock. The rock mass, however, is heavily jointed with 10 - 20 fractures per meter. It is highly possible that time-dependent deformations will occur, resulting in a continued load build-up in the casing. The existence of time-dependent behavior at the Hanford site is evidenced by phenomena such as micro-earthquake activity at depth and borehole spalling and breakout in exploration holes.

This source of loading could be quite significant.

Seismic loading due to vertically-migrating waves is accounted for, but not horizontal. Possible shear effects due to horizontal displacement at the boundary of basalt and soil are not examined.

Appendix A of the report is a BWIP licensing decision memorandum which determines that the shaft and casing are not important to isolation or safety. The basis for this position ignores the possibility of flooding in the event that the casing fails at an aquifer location. Inflow rates for a drift intersecting a flow top have been estimated at 3500 gpm of +50° water. An inflow of this magnitude, if occurring during waste emplacement would provide both a safety and waste isolation threat.

Conclusions

The methodology for casing design is poorly presented in this document. No calculations of design loads are given, even though the casing has already been manufactured. One of the most important possible sources of casing load, rock deformation, is not included in the analyses. Plans for routine instrumentation, inspection and repair of the casing are not included, and must be considered an integral portion of the design.