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~~WMEG/JCV/POST-WASTE PACKAGE~~ 106

NOTE TO: John T. Greeves

THROUGH: Timothy C. Johnson

FROM: John C. Voglewede

SUBJECT: SUPPLEMENTAL COMMENTS ON SALT WASTE PACKAGE WORKSHOP

DOE/NRC observations of the Salt Waste Package Workshop held January 22-24, 1986 in Columbus, Ohio were previously provided to you. The following are supplemental comments on the final NRC and SRP presentations delivered on Friday morning, January 24, 1986 (see enclosed meeting handouts). The topics covered were:

1. Waste Package Reliability Analysis - The Salt Repository Project was informed that were a number of comments (from NRC/RES) were incorporated into the Final Generic Technical Position on Waste Package Reliability Analysis of which they may not be aware. The Project agreed to re-examine the final document. Any response from the SRP will be directed to Ev Wick.

2. Substantially Complete Containment Definition - Copies of Ev Wick's Albuquerque paper and a supplemental report by Brookhaven National Laboratory were provided to the SRP. The Project has similar calculations but they were not provided to the NRC staff at this time. The SRP did, however, raise two interesting concepts during the discussion. First, they consider the containment afforded by a perforated cannister in an environment where there is no moisture to transport radionuclides through the perforation to be substantially complete. Second, the SRP approach to further quantifying the substantially complete concept is to assume that the biological impact of any acceptable release during the containment period should be similar to that permitted after the end of the containment period. This approach may be contrasted with that proposed by Wick, wherein the activity level of any acceptable release during the containment period is assumed to be similar to that permitted after the end of the containment period.

3. Individual Radionuclide Release Data for Licensing - Treatment of individual radionuclides within 10 CFR 60.113, 40 CFR 191.13 and 40 CFR 191.16 were pointed out (e.g., 10 CFR 60.113 states that any radionuclide release at a rate less than 0.1% of the calculated total release rate limit may be neglected, 40 CFR 191.16, unlike 10 CFR 60, states that radium must be considered). The possibility of using

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surrogate radionuclides was admitted. The Project asked whether they could demonstrate compliance with 10 CFR 191 by meeting containment requirements for 10,000 years. The NRC staff responded affirmatively. The containment question appeared to be motivated by the "catch-all" limits at the bottom of the Table for Subpart B, Appendix A, 40 CFR 191, which are not radionuclide specific (see attachment).

4. Engineered Barrier System Boundary Definition - Germane sections of 10 CFR 60 and the Nuclear Waste Policy Act of 1982 were cited. An NRC staff position was provided wherein the engineered barrier system boundary (for release calculations) is considered to be the limit of excavation of the underground facility. In contrast, the SRP interprets "underground structure" as including significant portions of the virgin host rock (e.g., pillars, walls) which provide mechanical support for the facility. In addition to the fact that the SRP interpretation may preclude any separation of engineered and geologic systems (the intent of the regulation), there are a number of other issues involved in the development of this definition. No closure was reached on this issue.

5. Application of 10 CFR Part 61 Methodology to High Level Waste - The SRP is reviewing the staff's evaluation of the NUPAC FL-50 High Integrity Container as precedent for extrapolating data for long periods of time. Acceptance criteria for High Integrity Containers require that the stability of the waste form to be maintained for 300 years. Acceptance criteria for the high level waste package require that containment of radionuclides be "substantially complete" for a 300 - 1000 year period. Although the acceptance criteria are different in these two applications, it was conceded that LLW evaluations may be helpful to the HLW program.

6. SRP Reference Design Flowchart - A flowchart outlining the logic of the SRP reference design was presented (see attachment). The flowchart is instructive, but does not consider scheduling difficulties that will be encountered in some of these flowpaths.

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DOE/NRC SALT WASTE PACKAGE WORKSHOP
January 22-24, 1985
Columbus, Ohio

NRC/WMEG/JCV/01/24/85

WASTE PACKAGE RELIABILITY ANALYSIS

° DOE COMMENTS ON DRAFT GENERIC TECHNICAL POSITION

R. Stein (DOE) letter to R.W. Browning (NRC) dated February 26, 1985.

° FINAL GENERIC TECHNICAL POSITION ISSUED

H.J. Miller (NRC) memorandum for J.M. Felton (NRC) on "Federal Register Notice Regarding Availability of Technical Position" [on Waste Package Reliability Analysis] dated December 23, 1985.

° NOTICE OF AVAILABILITY

"Availability of Final Generic Technical Position in High-Level Waste Program," Federal Register, Vol. 51, No. 3, Monday, January 6, 1986, pp. 460-461.

The Department of Energy's comments have generally been incorporated into the Final Generic Technical Position. However, a significant number of internal NRC comments (Office of Nuclear Regulatory Research) were also incorporated into the Generic Technical Position before it was issued. The Department should review the final document.

SUBSTANTIALLY COMPLETE CONTAINMENT DEFINITION

NRC Staff Report [Meeting Presentation]	E.A. Wick, "How Reliable Does The Waste Package Have To Be?," Proceedings of the Workshop on the Source Term for Radionuclide Migration From High-Level Waste or Spent Nuclear Fuel Under Realistic Repository Conditions, Albequerque, NM, November 13-15, 1984 (Published July 1985).
BNL Letter Report	T.M. Sullivan, Estimates of the Maximum Permissible Fractional Number of High Level Waste Container Failures and Failure Rates That Allow Post Containment Radionuclide Release Criteria to be Met During the Containment Period, Brookhaven National Laboratory Informal Report, October 1985. [Transmitted by T. Sullivan (BNL) letter to E.A. Wick (NRC) dated October 16, 1985.]

These documents assume that it is permissible to release the same amount of radioactivity in the containment period as in the post containment period. The Brookhaven calculations were performed on a nuclide specific basis. The calculations indicate that isotopes of americium, carbon, cesium, plutonium, selenium, strontium and technetium are limiting radionuclides during the containment period. Results indicate that only a relatively small number of container failures are acceptable during the containment period.

INDIVIDUAL RADIONUCLIDE RELEASE DATA FOR LICENSING

° The rule exempts certain radionuclides:

> "This requirement [10 CFR 60.113(a)(1)(A)] does not apply to any radionuclide which is release at a rate less than 0.1% of the calculated total release rate limit."

° The EPA Containment Requirements:

> "Disposal systems for spent nuclear fuel or high-level or transuranic radioactive wastes shall be designed to provide a reasonable expectation, based upon performance assessments, that the cumulative release of radionuclides to the accessible environment for 10,000 years after disposal from all significant processes and events that may affect the disposal system shall:
>
> (1) have a likelihood of less than one chance in 10 of exceeding the quantities calculated according to Table 1 (Appendix A); and
>
> (2) have a likelihood of less than one chance in 1,000 of exceeding ten times the quantities calculated according to Table 1 (Appendix A)
>
> 40 CFR 191.13

° The EPA Ground Water Protection Requirements:

> "Disposal systems for spent nuclear fuel or high-level or transuranic radioactive wastes shall be designed to provide a reasonable expectation that, for 1,000 years after disposal, undisturbed performance of the disposal system shall not cause the radionuclide concentrations averaged over any year in water withdrawn form any portion of a special source of ground water to exceed:
>
> (1) 5 picocuries per liter of radium-226 and radium-228;
>
> (2) 15 picocuries per liter of alpha-emitting radionuclides (including radium-226 and radium-228 but excluding radon); or
>
> (3) the combined concentrations of radionuclides that emit either beta or gamma radiation that would produce an annual dose equivalent to the total body or any internal organ greater than 4 millirem per year if an individual consumed 2 liters per day of drinking water from such a source of ground water.

APPENDIX A – TABLE FOR SUBPART B

TABLE 1 – RELEASE LIMITS FOR CONTAINMENT REQUIREMENTS
(Cumulative Releases to the Accessible Environment
for 10,000 Years After Disposal)

Radionuclide	Release Limit per 1000 MTHM or other unit of waste (see Notes) (curies)
Americium–241 or –243	100
Carbon–14	100
Cesium–135 or –137	1000
Iodine–129	1
Neptunium–237	100
Plutonium–238, –239, –240, or –242	100
Radium–226	100
Strontium–90	1000
Technetium–99	10000
Thorium–230 or –232	10
Tin–126	1000
Uranium–233, –234, –235, –236, or –238	100
Any other alpha–emitting radionuclide with a half–life greater than 20 years	100
Any other radionuclide with a half–life greater than 20 years that does not emit alpha particles	1000

ENGINEERED BARRIER SYSTEM BOUNDARY DEFINITION

The rule, 10 CFR 60.113(a)(1)(B), states:

> "The release rate of any radionuclide from the engineered barrier system following the containment period shall not exceed one part in 100,000..."

In order to clarify the intent of this portion of the rule, one must describe the physical location where the release rate is to be evaluated. The rule, 10 CFR 60.2, defines both the engineered barrier system and the underground facility:

> "...'Engineered Barrier System' means the waste package and underground facility."
>
> "'Underground Facility' means the underground structure, including openings and backfill materials, but excluding shafts, boreholes, and their seals."

This definition of the engineered barrier system is in keeping with the Nuclear Waste Policy Act of 1982 (Public Law 97-425 - January 7, 1983), which states:

> "The term 'engineered barriers' means manmade components of a disposal system designed to prevent the release of radionuclides into the geologic medium involved. Such term includes the high-level radioactive waste form, high-level radioactive waste canisters, and other materials placed over and around such cannisters."

It is the position of the NRC staff that this defines the engineered barrier system boundary as the limit of excavation in the underground facility. Performance assessments for the engineered barrier system should consider any materials (e.g., backfill) or voids within the underground facility. Performance assessments should not consider shaft seals, effects of the disturbed zone, or any engineered treatment of the disturbed zone except as they may affect input parameters that effect the engineered barrier system.

APPLICATION OF 10 CFR PART 61 METHODOLOGY TO HIGH LEVEL WASTE

Reference: "Staff Evaluation Report related to the Topical Report covering the FL-50/EA-50 High Integrity Container manufactured by Nuclear Packaging, Inc. (Docket No. WM-45)," U.S. Nuclear Regulatory Commission Report, October 1985.

Because of the 300 year period involved, the 10 CFR Part 60 and 10 CFR Part 61 criteria appear similar:

> "Containment of HLW within the waste packages will be substantially complete for a period . . . not less than 300 years nor more than 1,000 years after permanent closure of the geologic repository."
>
> 10 CFR Part 60.113(a)(1)(A)

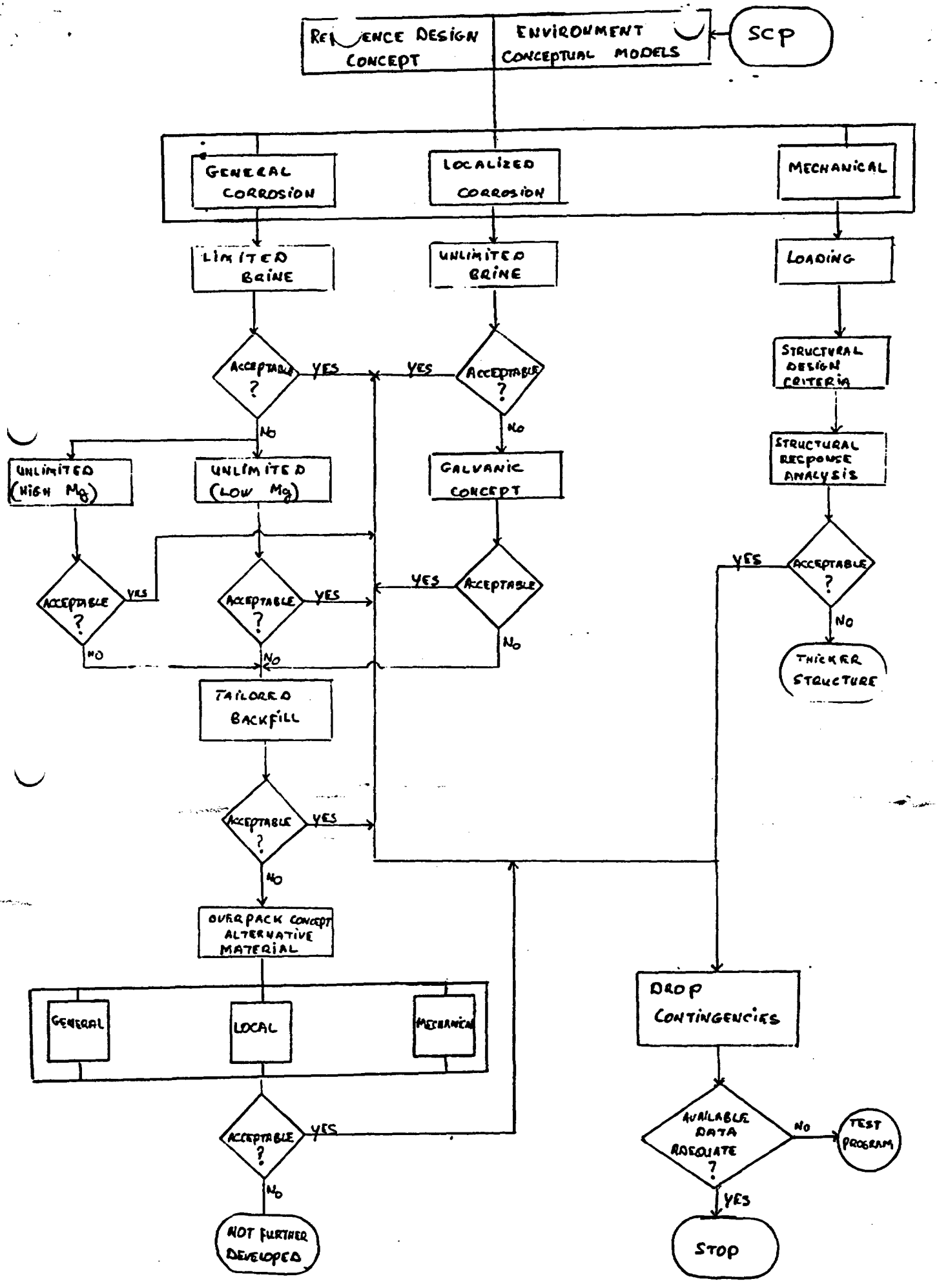
> "The high integrity container design should have as a design goal a minimum lifetime of 300 years. The high integrity container should be designed to maintain its structural integrity over this period."
>
> Section C.4.b.
> Final Technical Position on Waste Form
> Rev. 0, U.S.NRC, May 1983.

> "To the extent practical Class B and C waste forms should maintain gross physical properties and identity over a 300 year period."
>
> Section B. Background
> Final Technical Position on Waste Form
> Rev. 0, USNRC, May 1983.

Conclusions:

1. The 10 CFR 60 and 10 CFR 61 criteria are significantly different. That is, 10 CFR 60 requires substantially complete containment (essentially no leaks) where staff's interpretation of 10 CFR 61 suggests structural integrity, gross physical properties and identity be maintained (leaks are permitted) over the 300 year period.

2. Although similarities are expected between the methodology used in the FL-50 High Integrity Container Report (to extrapolate data over long periods of time) and the methodology to be used in a 10 CFR 60 application, differences between the 10 CFR 60 and 10 CFR 61 criteria are also expected to have a significant impact on the rigor with which the methodology is applied.


REFERENCE DESIGN CONCEPT
ENVIRONMENT CONCEPTUAL MODELS
SCP
GENERAL CORROSION
LOCALIZED CORROSION
MECHANICAL
LIMITED BRINE
UNLIMITED BRINE
LOADING
ACCEPTABLE ?
YES
NO
STRUCTURAL DESIGN CRITERIA
STRUCTURAL RESPONSE ANALYSIS
UNLIMITED (HIGH Mo)
UNLIMITED (LOW Mo)
GALVANIC CONCEPT
THICKER STRUCTURE
TAILORED BACKFILL
OVERPACK CONCEPT ALTERNATIVE MATERIAL
GENERAL
LOCAL
MECHANICAL
DROP CONTINGENCIES
AVAILABLE DATA ADEQUATE ?
TEST PROGRAM
STOP
NOT FURTHER DEVELOPED