See Pocket for Enclosure

AUG 29 1983

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MEMORANDUM FOR: Michael J. Bell, Chief
High-Level Waste Licensing
Management Branch
Division of Waste Management

FROM: Kien C. Chang
High-Level Waste Licensing
Management Branch
Division of Waste Management

SUBJECT: REPORT OF MEETING ON THIRD DOE/NRC PRE-SCP MEETING, WASTE PACKAGE

WM Record File 106

WM Project 16
Docket No.
PDR ✓
LPDR ✓

Distribution:
(Return to WM, 623-SS)

Date: August 9 - 10, 1983

Place: Room 203, Building A, Battelle, Columbus, Ohio

Attendees: See Enclosure 1.

Purpose: To discuss ONWI and NRC questions on reliability, reasonable assurance, repository conditions in salt repositories, QA of design control, and other topics related to waste package in salt repositories.

Discussion:

1. An agenda of the subject meeting and a copy of ONWI viewgraphs on the topics discussed are enclosed (Enclosure 2). Many of the viewgraphs were not put up on the screen for discussion because of the long time spent on discussions on DOE/NPO's waste package reliability analysis and QA program.

2. The following are some of my observations about the meeting:

   a. NRC (Cook) was insistent on waste package performance reliability analysis at an early state in the conceptual design process so that the projected performance of one design concept could numerically be compared with those of alternate design concepts.

OFC	WMHL	WMHL					
NAME	KCChang:lmc	MRKnapp					
DATE	8/ /83	8/ /83					

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b. DOE/NPO had not done numerical reliability analysis of waste package performance to the level of detail desired by NRC (Cook). The reasons cited by DOE/NPO were limited time, cost and lack of data on the subject and the difficulty of using short time experiments to simulate waste package life of 300-1000 years and release rates over even longer intervals.

c. DOE/NPO stated that they follow standard QA in design control. However, because of the different nature of the various contracts awarded by DOE/NPO to the contractors (universities, consulting firms, laboratories), each contract required different levels of QA. The levels of QA required had been determined on a contract by contract basis. It appeared that no single document in DOE/NPO was used to control consistency of QA requirements. The degree of adherence of QA criteria (10 CFR Part 50, Appendix B) was determined by the individual contract officer. It appears that DOE/NPO has emphasized traceability but may have neglected consistency in their QA program.

3. Enclosure 3 is a draft of the minutes. It was prepared by NRC and DOE/NPO representatives. Copies of the final minutes were sent out to all attendees by the DOE/NPO office.

ORIGINAL SIGNED BY
Kien C. Chang
High-Level Waste Licensing
Management Branch
Division of Waste Management

Enclosures:
1. List of Attendees
2. Viewgraphs
3. Draft Meeting Minutes

*See previous concurrence.

OFC	WMHL*	WMHL				
NAME	KCChang:lmc	MRKnapp				
DATE	8/ /83	8/29/83				

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Kien C. Chang
High-Level Waste Licensing
Management Branch
Division of Waste Management

Enclosures:
1. List of Attendees
2. Viewgraphs
3. Draft Meeting Minutes

OFC	WMHL	WMHL				
NAME	KCChang:lmc	MRKnapp				
DATE	8/29/83	8/ /83				

Enclosure to 8/29/83 memo from Chang to Bell.

ATTENDEES
THIRD PRE-SCP MEETING
WASTE PACKAGE

NAME	ORGANIZATION
Leslie Casey	Doe/Columbus
M. B. McNeil	NRC/RES
Virgil Lowery	DOE/HQ
Kang Kun (Roger) Wu	DOE/NPO
Jack Parry	ONWI/Regulatory Department
Kyo S. Kim	NRC/Research
Roger Cote	ONWI
R. W. Klingensmith	ONWI/Regulatory Department
Julia Corrado	NRC/WMHT
Claudio Pescatore	BNL
Don Schweitzer	BNL
Jo Ellen Balon	ONWI
Don Clark	ONWI
Mike Glora	ONWI
Sam Basham	ONWI
John A. Carr	ONWI
Ken Stephens	The Aerospace Corp. (NRC contractor)
F. R. Cook	NRC/WM
Kien C. Chang	NRC/WMHL
Robert L. Johnson	NRC/WMHT
Malcolm R. Knapp	NRC/WMHL
John G. Ferrante	ONWI
Martin P. Hanson	Weston
Matt Golis	ONWI
Judith B. Moody	ONWI
Ram Lahoti	DOE/Columbus
E. R. Wiot	Weston
Ram Murthy	BPMD
John Kircher	ONWI
Don Hoak	ONWI

End 2

THIRD DOE/NRC PRE-SCP MEETING

WASTE PACKAGE

Battelle, Columbus, Ohio August 9-10, 1983

Encl 2

AGENDA

THIRD DOE/NRC PRE-SCP MEETING

WASTE PACKAGE

Room 203, Building A, Battelle, Columbus, OH August 9-10, 1983

Tuesday, August 9, 1983

8:30 - 8:45 am	Introduction/Opening Remarks	NPO/NRC
8:45 - 11:45 am	Discuss ONWI and NRC questions on the following topics:	NPO/NRC/ONWI
	• NRC Draft Technical Position on Waste Package Reliability	
	• Determination of reasonable assurance of containment for waste packages	
	• Evaluation of releases from spent fuel waste form and determination of the reliability of any given release rate	
	• Conditions in salt repositories, including brine quantities relative to evaluation of waste package performance	
11:45 - 1:15 pm	Lunch	
1:15 - 3:00 pm	Discuss QA program design control procedures using ANSI 45.2.11 as a basis for this discussion. Review selected design control procedures and examples of technical documents prepared in accordance with these procedures.	NPO/NRC/ONWI
	• Identify issues	
3:00	Adjourn	

Wednesday, August 10, 1983

8:30 - 10:00 am	Discuss NRC questions on ONWI 438 and 464. Relate the design specifications for waste packages on ONWI-423, 462, and 463 to the conceptual design. Discuss issues concerning the information and designs contained in these documents.	NPO/NRC/ONWI
10:00 - 11:45 am	Discuss analytical models used and planned for assessing waste package failure modes and prediction of conditions affecting these modes. Consider NRC questions arising from review of ONWI 452.	NPO/NRC/ONWI
	Discuss uncertainties in models as they apply to the conceptual waste package components and the prediction of conditions or material properties in salt repositories pertinent to waste package evaluation. Discuss methods of quantifying specific uncertainties.	
	Discuss testing to evaluate models or collect material properties for use in analyses. Relate testing to respective analytical models being used.	
11:45 - 1:00 pm	Lunch	
1:00 - 3:00 pm	Prepare meeting minutes	NPO/NRC/ONWI
3:00	Closing remarks, wrap up, adjourn	

MEETING ATTENDEES

NRC

Kien Chang
Bob Cook
Julia Corrado
Bob Johnson
Mal Knapp
Michael McNeil

AEROSPACE

Ken Stevens

BNL

Claudio Prescatore
Don Schweitzer

NPO

Leslie Casey
Roger Wu

ONWI

Sam Basham
John Carr
Don Clark
Mike Glora
John Kircher
Skip Klingensmith
Ram Murthy
Roger Cote
Matt Golis

DOE

Virgil Lowery

WESTON

Marty Hansen
Ed Wiott

NUREG - 0997

DRAFT TECHNICAL POSITION ON WASTE PACKAGE RELIABILITY, MAY 1983

DOE/ONWI OBSERVATIONS

- Definitions
  - Rigorous technical definitions
- Proposed approach for evaluating reliability of HLW package
  - Generally consistent with ONWI approach (NWTS-34, Chapter 3)
  - Model specification/development
  - Probability densities to be developed where practical
- Quantitative reliability analysis
  - Monte Carlo Simulation/Latin Hypercube sampling provide a means of evaluating relatively simple models
  - Adjoint sensitivity analysis can be combined with Monte Carlo simulation

ONWI

BATTELLE Project Management Division

DETERMINATION OF REASONABLE ASSURANCE OF CONTAINMENT FOR WASTE PACKAGES

DOE/ONWI OBSERVATION

- DEVELOPMENT OF SPECIFIC DEFINITION OF REASONABLE ASSURANCE REQUIRES
  - DETAILED ENVIRONMENT DEFINITION INCLUDING CHANGES WITH TIME
  - DATA ON MATERIALS EXPOSED TO SUCH CONDITIONS
  - ANALYSIS TO ESTABLISH EXPECTED FAILURE RATES
  - ESTABLISHMENT OF DESIGN LIMITS OR MARGINS WITHIN THE FAILURE ENVELOPES
  - TESTING OF COMPONENTS, SUBSYSTEMS, OR TOTAL SYSTEM, AS DESIGNED, TO FAILURE (ACCELERATED TESTING) WHERE POSSIBLE
  - ANALYSES OF COMPONENTS, SUBSYSTEMS, OR TOTAL SYSTEM, AS DESIGNED, TO FAILURE

ONWI

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EVALUATION OF RELEASES FROM SPENT FUEL WASTE FORM

DOE/ONWI OBSERVATION

- EVALUATION OF RELEASES FROM SPENT FUEL WASTE FORMS REQUIRES
  - DETAILED ENVIRONMENT DEFINITION INCLUDING CHANGES WITH TIME
  - DEFINITION OF EXPECTED CONTAINMENT FAILURE TIMES
  - DATA ON SPENT FUEL EXPOSED TO APPROPRIATE EXPECTED CONDITIONS
  - DEVELOPMENT OF MODELS FOR SPENT FUEL BEHAVIOR
  - TESTING TO OBTAIN DATA TO VALIDATE AND/OR MODIFY MODEL
  - INCORPORATION OF MODEL INTO WAPPA
  - PERFORMANCE ASSESSMENT OF SPENT FUEL RELEASES WITH APPROPRIATE UNCERTAINTY ANALYSES

ONWI

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NEAR-FIELD REPOSITORY CONDITIONS

FOR TESTING AND PREDICTIVE PURPOSES, EACH OF THE FOLLOWING MUST BE KNOWN AS A FUNCTION OF TIME:

(1) TEMPERATURE

(2) RADIATION FIELD

(3) OXYGEN PARTIAL PRESSURE

(4) BRINE COMPOSITION

(5) BRINE QUANTITY

(6) SALT COMPOSITION

(7) HEAT/RADIATION EFFECTS ON HOST ROCK AND BRINES

(8) STRESS STATE AROUND THE WASTE PACKAGE

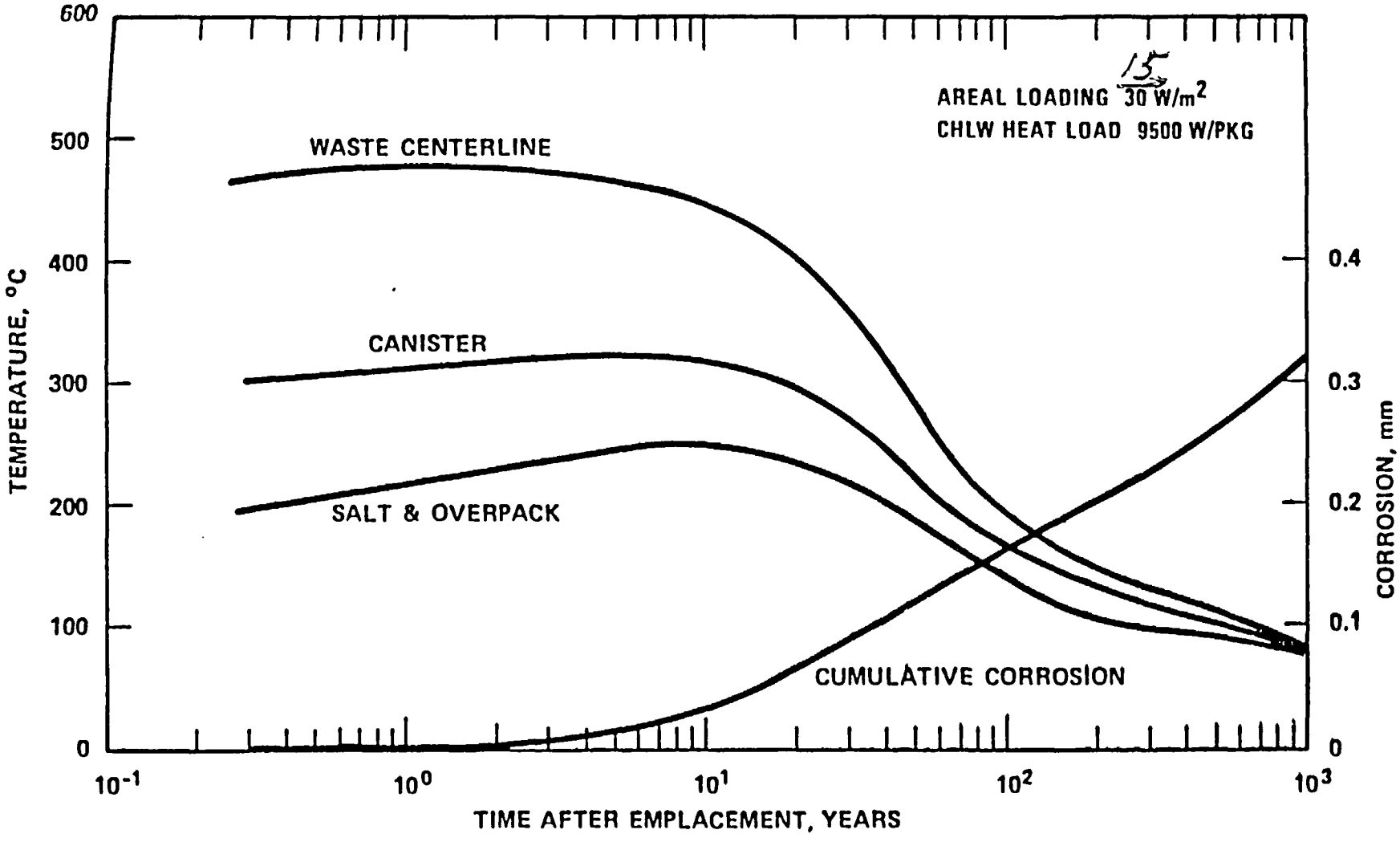
A CALCULATIONAL APPROACH WILL BE USED TO ESTABLISH A RANGE OF EXPECTED VALUES FOR SOME OF THE NEAR-FIELD REPOSITORY CONDITIONS

- TEMPERATURE
- RADIATION FIELD
- OXYGEN PARTIAL PRESSURE
- BRINE QUANTITY
- STRESS STATE

RADIATION FIELD

- SPATIAL DISTRIBUTION OF DOSE RATES IS REQUIRED (PARTICULARLY AT THE WASTE PACKAGE SURFACE AND IN THE SURROUNDING HOST SALT) AS A FUNCTION OF TIME

EXAMPLE CALCULATION OF THERMAL PROFILES AS FUNCTION OF TIME FOR A GIVEN WASTE PACKAGE DESIGN (TAKEN FROM ONWI-452)



OXYGEN PARTIAL PRESSURE

- CONCENTRATION OF OXYGEN IN THE NEAR-FIELD ENVIRONMENT, AS A FUNCTION OF TIME FOLLOWING BACKFILLING AND CLOSURE OPERATIONS, MUST BE KNOWN IN ORDER TO CALCULATE THE RATES OF PREDICTED REACTIONS INVOLVING OXYGEN

This includes oxygen at closure, to be generated by radiolysis and source from groundwater (brine)

BRINE QUANTITY

- THE BRINE QUANTITY WHICH MAY REACH THE WASTE PACKAGE IS IMPORTANT FOR EVALUATING EFFECTS OF ALL BRINE/WASTE PACKAGE INTERACTIONS

STRESS STATE

- CALCULATIONS OF STRESS ON THE WASTE PACKAGE, INCLUDING THERMAL EXPANSION, AS A FUNCTION OF TIME, ARE REQUIRED FOR THE EXPECTED REPOSITORY CONDITIONS

LABORATORY EXPERIMENTS ARE ALSO UNDERWAY TO ESTABLISH PROBABLE NEAR-FIELD REPOSITORY CONDITIONS

- BRINE COMPOSITION ; Magnesium content influences corrosion rate of metal in brine
- BRINE QUANTITY
- SALT COMPOSITION
- HEAT/RADIATION EFFECTS ON HOST ROCK AND BRINES

methane does exist in brine (i.e. salt site).

ONWI'S WASTE PACKAGE ENVIRONMENT AND MATERIALS TESTING PROGRAM

- WILL PROVIDE A DATA BASE ON WASTE PACKAGE PERFORMANCE AND NEAR-FIELD REPOSITORY CONDITIONS

- WORK IS UNDERWAY IN FOUR MAJOR AREAS:

  1. SALT STUDIES
  2. CORROSION STUDIES
  3. WASTE FORM STUDIES
  4. MODELING

IN THE SALT STUDIES AREA, A CURRENT EMPHASIS, FOR TESTING AND PREDICTIVE PURPOSES, IS TO OBTAIN A CLEAR DEFINITION OF THE NEAR-FIELD ENVIRONMENT

- BRINE COMPOSITION
- BRINE QUANTITY
- SALT COMPOSITION
- SALT IRRADIATION EFFECTS
- BRINE RADIOLYSIS

BRINE COMPOSITION/QUANTITY

- SITE-SPECIFIC BRINE TYPES ARE REQUIRED FOR INVESTIGATIONS OF BRINE INTERACTIONS WITH THE WASTE PACKAGE, RADIATION, AND THE NEAR-FIELD ENVIRONMENT
- EXPERIMENTAL DETERMINATION OF QUANTITY OF OF BRINE EXPECTED TO CONTACT THE WASTE PACKAGE
- BRINE COMPOSITION CAN VARY WITH TEMPERATURE, RADIATION EXPOSURE, AND OTHER PREVIOUS HISTORY

SALT COMPOSITION

- CHARACTERIZATION OF SITE-SPECIFIC ROCK SALT IS IMPORTANT FOR CONSIDERATION OF INTERACTIONS WITH THE WASTE PACKAGE AND IN THE NEAR-FIELD ENVIRONMENT

RADIATION EFFECTS ON THE NEAR-FIELD ENVIRONMENT

- RADIOLYSIS OF ROCK SALT, SODIUM CHLORIDE, PRODUCING MAINLY COLLOIDAL SODIUM AND CHLORINE, WHICH THEN MAY BACK-REACT OR OTHERWISE RESULT IN SOME PERMANENT ALTERATION OF THE NEAR-FIELD ENVIRONMENT OVER TIME

(BNL) Levi

- RADIOLYSIS OF ANY BRINE ENTERING REGIONS OF SIGNIFICANT RADIATION EXPOSURE (RADIOLYTIC CHANGES WILL OCCUR IN THE BRINE AS A FUNCTION OF DOSE AND TIME)

(PNL) Molay

- RADIATION-INDUCED INTERACTIONS OF BRINE (POSSIBLY ALTERED BY IRRADIATION) WITH ROCK SALT (POSSIBLY ALTERED BY IRRADIATION) AND WITH THE WASTE PACKAGE

- OTHER RADIATION EFFECTS (PROBABLY MINOR)

DESIGN CONTROL PROCEDURES

ANSI N45.2.11, QUALITY ASSURANCE REQUIREMENTS FOR THE DESIGN OF NUCLEAR POWER PLANTS

- INTRODUCTION
- PROGRAM REQUIREMENTS
- DESIGN INPUT REQUIREMENTS
- DESIGN PROCESS
- INTERFACE CONTROL
- DESIGN VERIFICATION
- DOCUMENT CONTROL
- DESIGN CHANGE CONTROL
- CORRECTIVE ACTION
- RECORDS
- AUDITS

ONWI

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ONWI-423

ENGINEERED WASTE PACKAGE SYSTEM

DESIGN SPECIFICATION

- "BASIS FOR DESIGN" DOCUMENT FOR CONCEPTUAL DESIGN
- BASIS FOR FORMAL DESIGN REVIEW OF CONCEPTS

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ONWI-438

- CONCEPTUAL DESIGNS FOR HLW IN SALT
- RESULTED FROM ONWI-423 AND FORMAL DESIGN REVIEW
- PRESENTS ALTERNATE CONCEPTS AND TENTATIVE REFERENCE CONCEPT

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FUTURE DESIGN & DEVELOPMENT ACTIVITIES

- PRELIMINARY DESIGN OF HLW PACKAGES
- CONCEPTUAL DESIGNS
  - TRU
  - SITE GENERATED WASTES
  - REMEDIAL ACTIONS/SPECIAL WASTES
- CLOSURE WELD DEVELOPMENT AND INSPECTION
- REPOSITORY DESIGN INTEGRATION

ONWI

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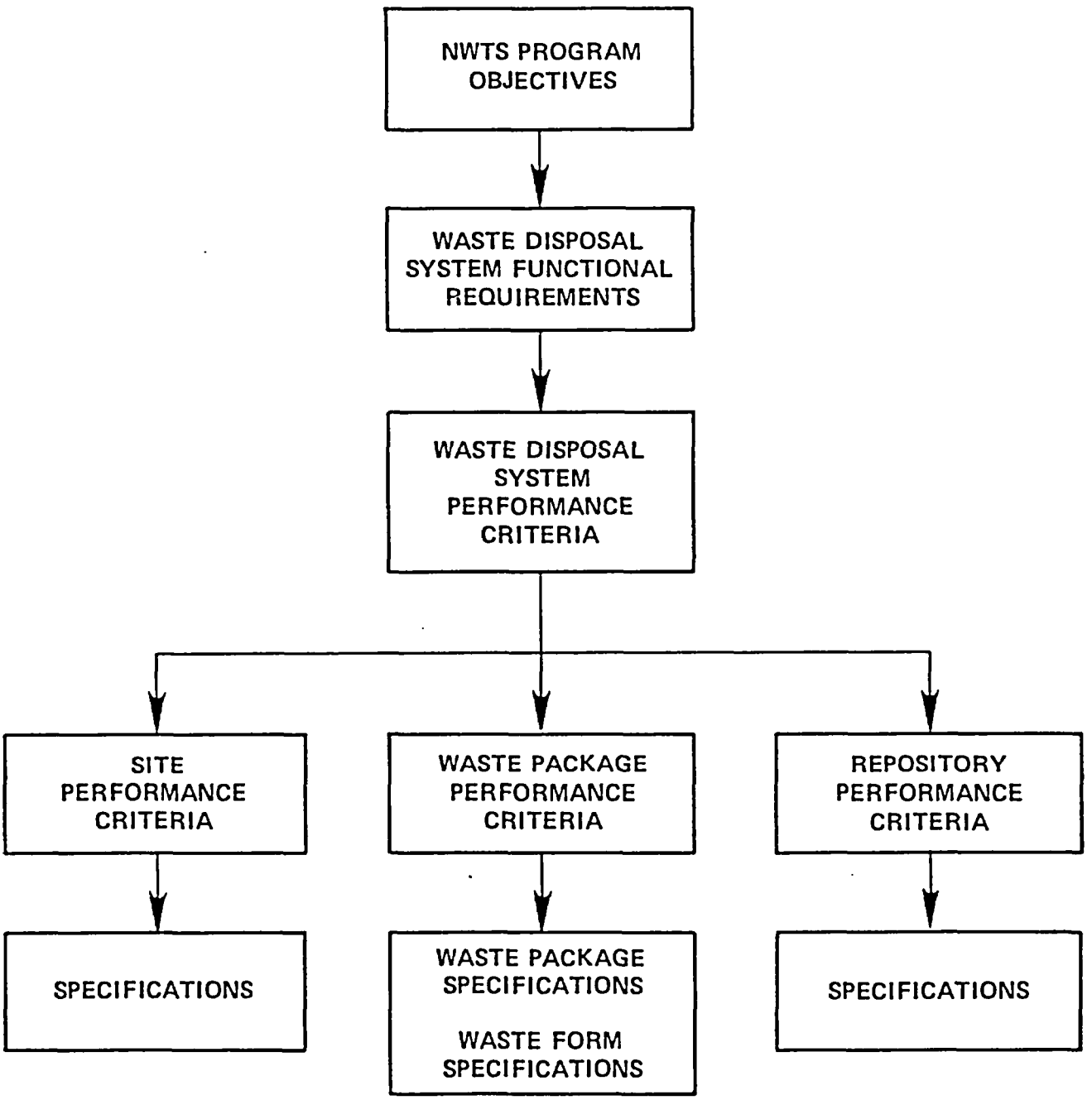
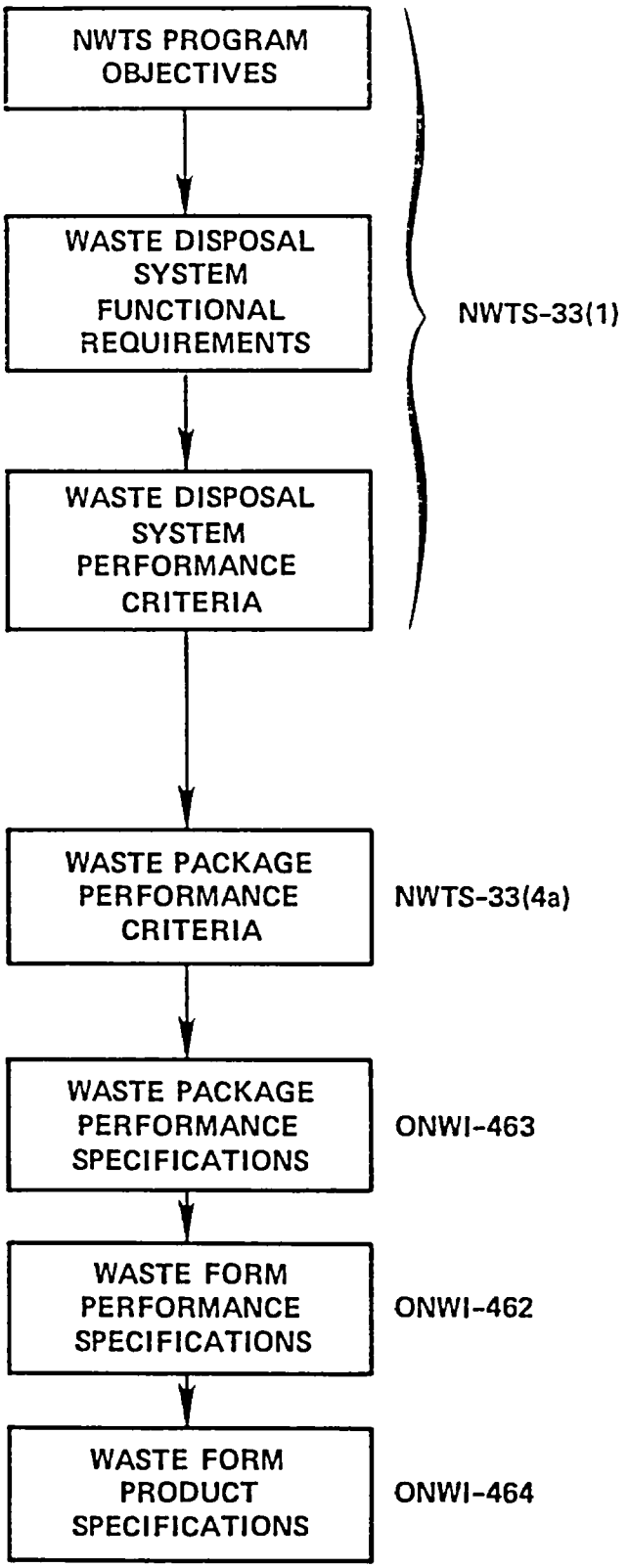


HIERARCHY OF OBJECTIVES, REQUIREMENTS, CRITERIA, AND SPECIFICATIONS (ONWI 463, FIGURE 1)



HIERARCHY OF OBJECTIVES, REQUIREMENTS, CRITERIA, AND SPECIFICATIONS (ONWI 464, FIGURE 1)

SPECIFICATION RATIONALE

- RESPONSIVE TO 10 CFR 60 RECOGNIZING DRAFT STATUS OF SAME AS SPECIFICATIONS WERE BEING DEVELOPED
- INTERIM DOCUMENTS ARE USED PENDING DEVELOPMENT OF ADDITIONAL DATA AND POSITIONS ON APPROACH
- COMPREHENSIVE
- MORE DETAILED AS PROCEED DOWN FROM GENERAL CRITERIA TO PRODUCT SPECIFICATIONS FOR SPECIFIC WASTE FORMS

ONWI

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Interim Performance Specifications
For Conceptual Waste Package
Designs For Geologic Isolation
In Salt Waste Packages (ONWI 463)

Specification	Item Addressed
1	containment
2	waste types
3	containment life
4	expected containment conditions
5	components chemically inert
6	containment withstand environmental loads
7	containment withstand normal handling loads
8	transfer heat
9	heat generation rate limited
10	radionuclide content limited
11	waste form release limited
12	waste form withstand environmental loads
13	container materials not significantly enhance radionuclide mobility
14	waste form materials not significantly enhance radionuclide mobility
15	protection of personnel during handling
16	retrievable
17	withstand credible accidents
18	withstand specified drop
19	wastye form fines limited after drop
20	withstand specified fire
21	waste form volatile release limited after specified fire
22	waste form solubility limited in water
23	waste form shape retention during normal handling
24	waste form free liquid limit
25	package standardization
26	weight limit
27	radiation limit
28	surface contamination limit
29	waste form standardization
30	waste form heat generation limit
31	combustion limit
32	toxic material limit
33	materials interaction limit
34	waste form combustion limit
35	waste form pyrophoric and organics limit
36	fire retardants in waste form not significantly enhance other deterioration modes
37	waste form explosive content limit

Interim Performance Specifications
For Conceptual Waste Package
Designs For Geologic Isolation
In Salt Waste Packages ONWI 463 (Continued)

Specification	Item Addressed
38	waste form toxic material limit
39	criticality limit
40	waste form geometry consideration in criticality control
41	waste form fissile materials
42	waste form fissile materials after containment period
43	unique identification
44	information keyed to unique identification
45	waste form information
46	waste form unique identification
47	waste package testing documentation
48	waste form testing documentation
49	waste package modeling conservation
50	waste form modeling conservations
51	non-destructive testing of waste packages
52	items to be tested to meet specification 51
53	number of packages to be tested to meet specification 51
54	monitoring of waste packages
55	retrieved waste package inspection
56	waste package materials data base
57	waste package data base
58	waste form testing
59	waste form data base
60	waste package QA
61	waste form QA

Conceptual Waste Package Interim
Performance Specifications For
Waste Forms For Geologic Isolation
In Salt Repositories (ONWI 462)

Specification	Item Addressed
1	heat generation rate limited
2	radionuclide content limited
3	release limited
4	withstand environmental loads
5	materials not significantly enhance radionuclide mobility
6	withstand specified drop
7	fines limited after drop
8	withstand specified fire
9	volatile release limited after specified fire
10	solubility limited in water
11	shape retention during normal handling
12	free liquid limit
13	standardization
14	heat generation limit
15	combustion limit
16	pyrophoric and organics limit
17	fire retardants not significantly enhance other deterioration modes
18	explosive content limit
19	toxic material limit
20	geometry consideration in criticality control
21	fissile materials
22	fissile materials after containment period
23	information
24	unique identification
25	testing documentation
26	modeling conservations
27	testing
28	data base
29	QA

Conceptual Waste Package Interim
Product Specifications and Data
Requirements For Disposal of
Borosilicate Glass Defense
High-Level Waste Forms In
Salt Geologic Repositories (ONWI 464)

Performance Specification	Product Specification	Item Addressed
1	1-1	1500 with canister heat generation limit actual value to be specified with $\pm$ 100W
	1-2	retain performance characteristics after containment period during which centerline temperature does not exceed 500 C
	1-3	develop basis for centerline temperature above which product specifications 1-2 would be violated
2	2-1	radioactivity not to exceed 100,000 Ci/l for fission products and 1,000 Ci/l for activities
3	3-1	source term for release to be less than 10^{-4}/yr
	3-2	data and analysis required to show 3-1 is met
	3-3	properties of waste form shall be controlled to extent necessary to meet 3-1
4	4-1	waste form to meet 3-1 when subject to triaxial compressive stress of 18 MPa
5	5-1	Chemical composition of waste form to be controlled such that 3-1 is met
6	6-1	the waste form in its production container (canister) must withstand a drop of 9 M or two times the canister length (whichever is greater) with release of greater than 10^{-5} atmos c/sec and also not exceed dose limits of paragraphs 103, 105 and 106 of 10 CFR 20
	6-2	develop basis for drop height above which product specification 6-1 would be violated

Conceptual Waste Package Interim Product Specifications and Data Requirements For Disposal of Borosilicate Glass Defense High-Level Waste Forms In Salt Geologic Repositories (ONWI 464) (Continued)

Performance Specification	Product Specification	Item Addressed
7	7-1	data on fraction of fines resulting from test defined in product specification 6-1 to be developed for both 10 microus or less and 200 microus or less
8	8-1	canister to not breach after exposure to 800 C fire lasting 15 minutes
	8-2	data or calculations to determine the maximum internal pressure and canister wall temperature for a canister subject to test in product specification 8-1
	8-3	develop basis for fire temperature versus fire duration curve at which canister buret strength is exceeded
9	9-1	data or calculations of materials volatilized by subjecting canister to test in product specification 8-1
10	10-1	no requirement needed beyond meeting product specification 3-2
11	11-1	data on thermal expansion coefficient, uniaxial compressive strength and bulk modulus to be presented to show waste form is a solid during expected handling
12	12-1	free liquids to the extent that will permit loss of containment from internal corrosion during the operating period (50-80 years) not permitted
	12-2	radionuclide source term available for transport in event of breach during operating period to be specified
13	13-1	major parameters to be controlled as follows: upper weight limit - 5,000 lb weight - $\pm$ 25 lb length - $\pm$ 0.12 in diameter - $\pm$ 0.12 in

Conceptual Waste Package Interim
Product Specifications and Data
Requirements For Disposal of
Borosilicate Glass Defense
High-Level Waste Forms In
Salt Geologic Repositories (ONWI 464)
(Continued)

Performance Specification	Product Specification	Item Addressed
		ovality - $\pm$ 0.05 in bowing - $\pm$ 0.31 in lifting device geometry - $\pm$ 0.02 in
	13-2	removable contamination to be as low as practical and not to exceed 220 dpm/100 cm^2 2200 dpm/100 cm^2
14	14-1	thermal output during operational period to be less than the limit set for the containment and isolation periods (see product specificaiton 1-1)
15	15-1	canistered waste form not capable of sustaining combustion after exposure to fire as defined in product specification 8-1 in manner to compromise effectiveness of other canisters
16	16-1	type and quantities of pyrophoric or flammable materials to be specified
17	17-1	type and quantities of fire retardant or incombustible materials to be specified
18	18-1	type and quantities of class A and B explosive materials to be specified
19	19-1	type and quantities of Poisons A and B to be specified
20	20-1	a single package not to exceed $k_{eff} \pm 30$ of 0.95
21	21-1	during normal handling or accident conditions during the operating period a single package not to exceed $k_{eff} \pm 30$ of 0.95
22	22-1	during the containment and isolation period a single package not to exceed $k_{eff} \pm 30$ of 0.95

Conceptual Waste Package Interim Product Specifications and Data Requirements For Disposal of Borosilicate Glass Defense High-Level Waste Forms In Salt Geologic Repositories (ONWI 464) (Continued)

Performance Specification	Product Specification	Item Addressed
23	23-1	information to be provided as follows: - waste producer - description of contents - fissile material content - production canister material - deviations from normal operating conditions for product formation, post-formation treatment and interim storage - thermal power - certification of compliance with specifications
24	24-1	label to be unique and to function through operational period
25	25-1	tests of waste form and canister to be performed under expected salt repository conditions for operating, containment, and isolation periods
26	26-1	degree of conservation in performance evaluation models to be specified
27	27-1	test data and information on properties and parameters of the waste form and canister to be provided conserving about 50 specific items listed in product specification 27-1
28	28-1	data base to be developed as defined in product specification 27-1 to consist of tests as defined in product specification 25-1
29	29-1	a QA program consistent with 10 CFR 50, Appendix B to be executed

MODELING

TOPICS OF DISCUSSION ARE THE FOLLOWING:

- ONWI 452, WAPPA
- MODEL UNCERTAINTIES
- TESTING (ONWI'S WASTE PACKAGE ENVIRONMENT AND MATERIALS TESTING PROGRAM)

WAPPA: A WASTE PACKAGE PERFORMANCE ASSESSMENT CODE

- DOCUMENTATION: TECHNICAL REPORT ONWI-452 (APRIL 1983)
- WAPPA IS A DRIVER (EXECUTIVE) CODE, CONSISTING OF THE FOLLOWING FIVE MODELS:

  (1) RADIATION MODEL

  (2) HEAT TRANSFER MODEL

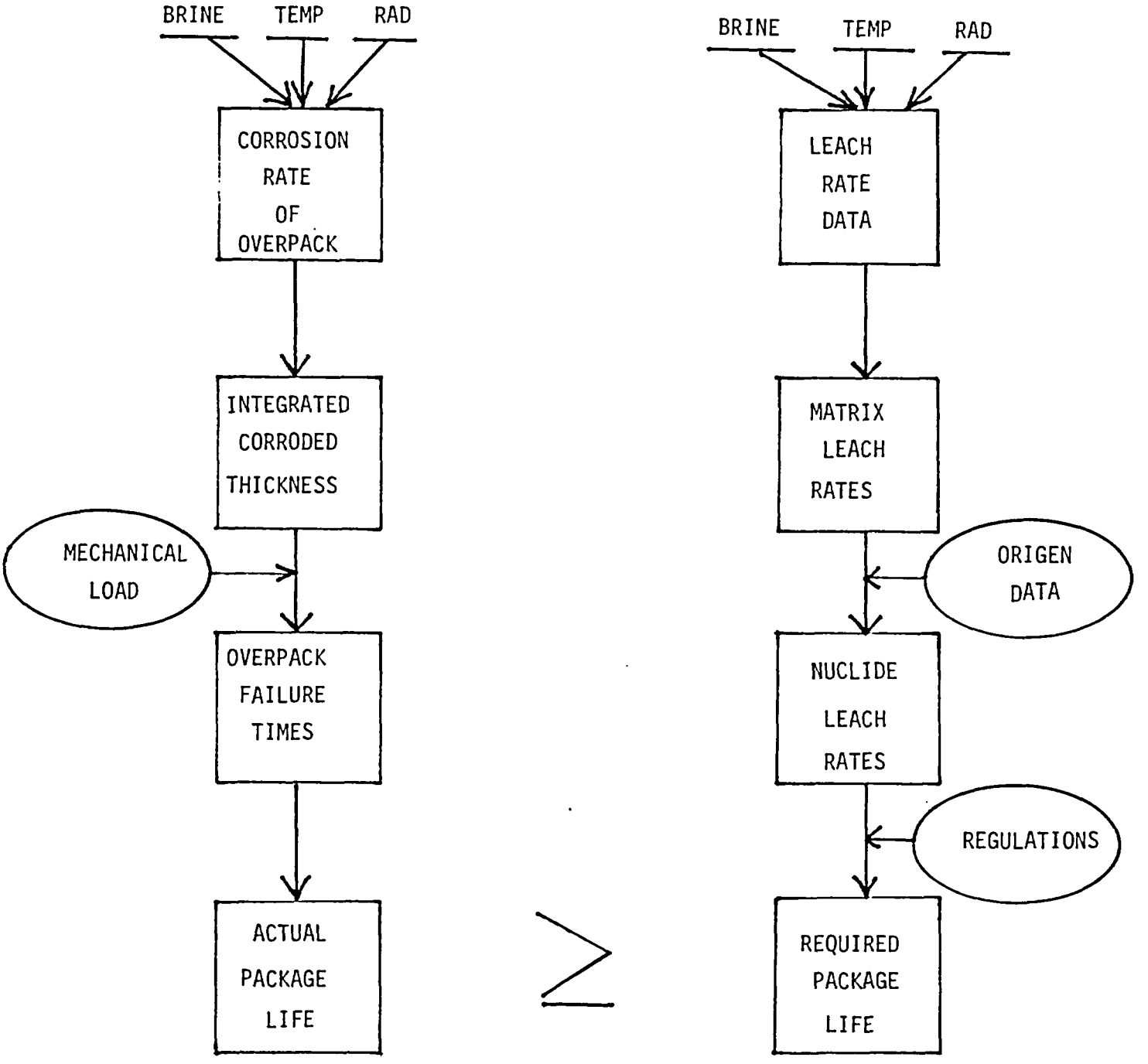
  (3) MECHANICAL MODEL

  (4) CORROSION MODEL

  (5) LEACH MODEL

EXAMPLE CALCULATION (LOGIC DIAGRAM) OF WASTE PACKAGE

PERFORMANCE ANALYSIS USING WAPPA*



*As described in ONWI-452

MODEL UNCERTAINTIES

- WHAT UNCERTAINTIES (CLASSES) MUST BE ADDRESSED?

- WHAT IS THE ANTICIPATED NRC POSITION WITH RESPECT TO MODEL UNCERTAINTIES?

WASTE PACKAGE ENVIRONMENT AND MATERIALS TESTING PROGRAM

- OBJECTIVE: TO SUPPORT DESIGN DECISIONS AND LICENSING ACTIVITIES FOR A SALT REPOSITORY

TO THIS END, THE FOLLOWING MAJOR DELIVERABLES WILL BE FORTHCOMING:

(1) WELL-DOCUMENTED AND HIGH-QUALITY DATA BASE TO SUPPORT DESIGN DECISIONS

(2) SPECIFICATIONS, WITH SUPPORTING BASES, FOR MATERIALS AND TECHNIQUES

(3) CODES AND MODELS WHICH ARE BASED ON THE DATA AND TREAT MECHANISMS IN SUFFICIENT DETAIL TO PREDICE WASTE PACKAGE PERFORMANCE

WASTE PACKAGE ENVIRONMENT AND MATERIALS TESTING PROGRAM

1. SALT STUDIES
2. CORROSION STUDIES
3. WASTE FORM STUDIES
4. MODELING

WASTE PACKAGE ENVIRONMENT AND MATERIALS TESTING PROGRAM

SALT STUDIES -- DEFINITION OF THE NEAR-FIELD ENVIRONMENT SURROUNDING THE WASTE PACKAGE

(A) SALT IRRADIATION EFFECTS

(B) NATURAL ANALOG SALTON SEA GEOTHERMAL FIELD

(C) BRINE RADIOLYSIS

WASTE PACKAGE ENVIRONMENT AND MATERIALS TESTING PROGRAM

CORROSION STUDIES -- WASTE PACKAGE OVERPACK MATERIAL SELECTION

(A) IRON ALLOY (STEEL)

LOW-CARBON STEEL IS PRIME CANDIDATE FOR THE WASTE PACKAGE OVERPACK MATERIAL

REFERENCE ALLOY (ASTM CASTING SPECIFICATION A216-77, GRADE WCA) WILL UNDERGO INTENSIVE TESTING

DECISION ON THE USE OF CARBON STEEL AS THE OVERPACK MATERIAL (BASED ON AN EXTENSIVE AMOUNT OF TESTING) IS CURRENTLY SCHEDULED FOR AUGUST OF 1984

(B) TITANIUM ALLOY

TICODE-12 IS THE PRIMARY BACKUP OVERPACK MATERIAL

LONG-TERM TESTING OF TICODE-12 WILL CONTINUE AT SNL UNDER SUPPORT OF THE WIPP PROGRAM

WASTE PACKAGE ENVIRONMENT AND MATERIALS TESTING PROGRAM

WASTE FORM STUDIES -- PORTION OF THE PROGRAM CONCERNED WITH SLOW RADIOACTIVITY RELEASE AFTER CONTAINMENT FAILURE

(A) SPENT FUEL

(B) GLASS

(C) SOLUBILITIES/SPECIATION

WASTE PACKAGE ENVIRONMENT AND MATERIALS TESTING PROGRAM

MODELING -- INTERPRETATION OF DATA AND DEVELOPMENT OF TOOLS TO AID IN PROGRAM DECISIONS AND SUPPORT APPLICATION OF PERFORMANCE ASSESSMENT MAJOR CODES

(A) COMPONENT MODELS

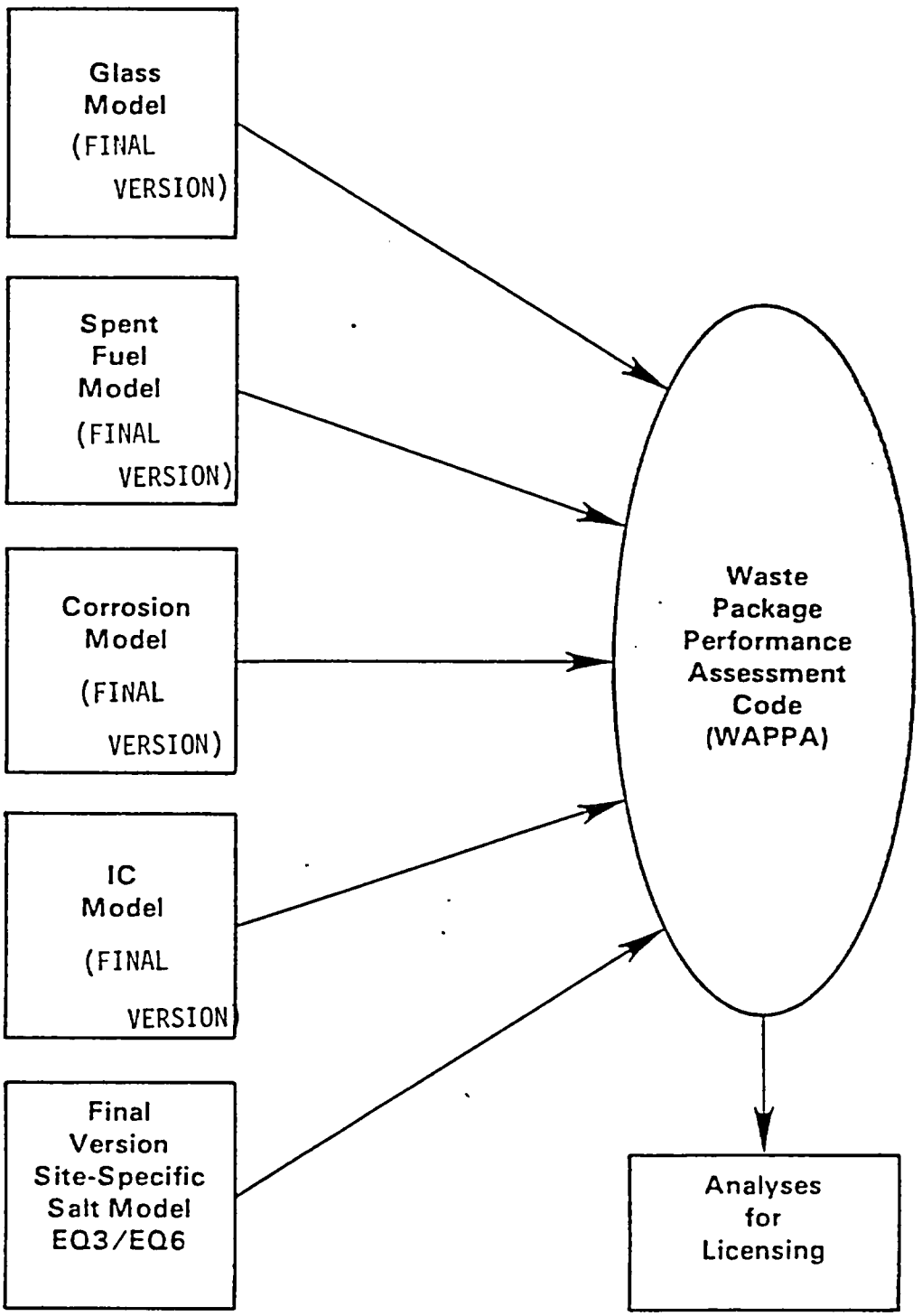
- CORROSION
- GLASS
- SPENT FUEL

(B) INTERACTIONS COUPLING MODEL

(C) NEAR-FIELD GEOCHEMICAL MODEL -- THERMODYNAMICS/KINETICS EQ3/EQ6

SUMMARY OF MODEL COUPLING

TO DEVELOP LICENSING ANALYSES



MINUTES OF THE THIRD MEETING
OF NRC AND DOE/NPO PREPARATORY
TO SUBMITTAL OF THE SALT SITE SCP

AUGUST 9-10, 1983
Columbus, Ohio

Background and Facts

NRC, DOE/NPO and contractor representatives met at the DOE/NPO offices in Columbus, Ohio on August 9-10, 1983 to discuss issues related to waste package design and performance. The agenda (Attachment 1) was ~~followed~~ used as a discussion guide and ~~completed~~. A list of actual attendeees is also attached (Attachment 2). None of the state representatives were in attendance.

The meeting minutes which consist primarily of observations and agreements keyed to the agenda topics were drafted before the close of the meeting, reviewed, and signed by R. Johnson, M. Knapp and R. Cook of NRC and L. Casey and K.W. of DOE. What follows here is the typed and edited version of the signed rough record. The attached copies of viewgraphs and handouts give more detail about the meeting. They were provided to the attendees and will be transmitted to the invited state contacts in Louisiana, Mississippi, Texas and Utah.

Meeting Observations and Agreement

1. Waste Package Reliability

   a. There was agreement between NRC and DOE on the need to quantify reliability and confidence in the waste package performance, and for DOE to specify interim reliability goals (see Attachment 3). NRC ~~noted~~ has defined ~~that~~ confidence ~~is the measure of the applicability of models to actual waste package performance~~. Confidence in models may have to be determined by expert opinion based on available facts.

   b. DOE discussed their comments on the NRC draft waste package Reliability Technical Position (RTP) (see Attachment 4). ~~There was agreement between NRC and DOE on the method of reliability analysis identified in the RTP~~. It was agreed that there are alternate methods available for handling random variables in a reliability analysis other than the one used in the RTP. ~~NRC anticipates discussing~~ adjoint and latin hypercube sampling approaches ~~in the upcoming Salt Performance Assessment Workshop. DOE agreed to give NRC the results of adjoint work done by ONWI.~~ has not conducted any adjoint analysis on waste package.

   c. Distributions of ~~environmental~~ nearfield conditions and their interactions with the waste package are significant to and should be used in determining the confidence and reliability of the waste package.

DOE agrees to provide their comments to NRC on the RTP in the first week September ~~30~~, 1983. It was recognized by both DOE and NRC that this document stresses the use of Monte Carlo simulation and latin hypercube sampling techniques in determining ~~evaluation of~~ reliability ~~results~~, other techniques are available. Emphasis in this area would be directed toward those ~~quantities~~ parameters with appreciable impact

Encl 3

MINUTES OF THE THIRD MEETING
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TO SUBMITTAL OF THE SALT SITE SCP
(Continued)

d. ONWI questioned whether the scope of the RTP covered functional requirements other than containment and controlled release. NRC explained that the RTP is limited to long-term performance after emplacement of waste.

e. By the first week in September, ONWI agreed to provide comments on the RTP including specific word changes for definitions.

f. It is NRC's intent to assess all components of the waste package. For example, spent fuel assessments would consider cladding as well as fuel integrity and effects on the system. NRC believes this approach is desirable but not mandatory. This approach will aid in understanding of the total system performance, and will help assess the need for test programs.

2. Reasonable Assurance

a. [illegible] Knapp presented a discussion of the NRC's definition of reasonable assurance at the time of Construction Authorization. (See Attachment 3 and minutes of the second NRC/DOE meeting of June 27-28, Section 2C)

b. ONWI noted that NWPA prohibits any in situ testing of radioactive waste packages at a site before Construction Authorization. Therefore, reasonable assurance must be determined without such test results. NRC noted that such large-scale, in situ radiation tests would be desirable to confirm small-scale, laboratory tests and related analytical models. NRC requested that ONWI identify what alternatives to large-scale, in situ radiation tests at a site are being considered. ONWI mentioned that tests will be conducted at Asse beginning in October of 1983, and DOE agreed to give NRC the plans for these tests. ONWI also stated that the high-level waste testing at WIPP can not be relied on to provide the necessary data because of the noncharacteristic heat generation rates of defense waste packages compared to commercial waste packages.

3. Evaluation of Releases from Spent Fuel

a. ONWI indicated that the spent fuel evaluation would be difficult due to the inhomogeneities in the fuel (e.g., surface area and radioisotope concentrations). NRC noted that with the reliability analysis it was not necessary to assume a worst case situation, and that an appropriately designed sampling program would ascertain the distribution of characteristics of spent fuel planned for the repository.

b. The Barrier code will not be used by ONWI for waste package evaluation. MAPPA will be used as a driver program with changes to subroutines and data files as indicated for salt.

MINUTES OF THE THIRD MEETING
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(Continued)

c. NRC noted that in evaluating spent fuel for overall reliability of release rates, evaluation of cladding as noted in 1.f is considered desireable.

Near-Field (Environmental)

4. ~~Environmental~~ conditions in Salt Repositories

a. ONWI presented a list of conditions that would be determined for salt repositories (Attachment 3).

b. NRC asked whether three dimensional thermal analysis in the area around waste packages would be accomplished to provide information on temperature gradients. ONWI indicated that such calculations would be done. NRC noted that they consider that temperature gradients would be important to the transport of radionuclides through waste package materials, the transport of gases and chemical reactants in the surrounding salt (including brine inclusions), and the degradation mode for containers involving corrosion.

c. NRC ~~noted~~ considers that radiation effects on the chemical environment of the waste package in salt would be limiting in waste package reliability analyses. Hence, testing in such environments is desireable. ONWI noted that no large-scale site specific radiation testing is planned to assess radiation conditions in combination with other conditions (e.g., temperature gradients, brine quantities, etc.). (See comment 2.~~a~~b)

d. NRC and DOE agreed that the amount and composition of brine is important to waste package evaluation. Such constituents as magnesium, dissolved methane, bromide, sulfate, perchlorate, are considered important for evaluation of corrosion mechanisms and radiation effects. by NRC to be

e. NRC noted that the determination of hydrogen concentration around waste packages was important from the standpoint of assessing hydrogen embrittlement of carbon steel overpacks. It was agreed that Asse tests could provide information on this area if appropriate salt and brine characteristics ~~were introduced~~ exist.

f. Due to the importance of radiation effects, NRC noted that it was desireable to arrange a meeting ~~between experts (PNL and BNL personnel)~~ to discuss important features of such testing and to provide a basis for NRC to comment on such testing. NRC will request such a meeting in the future. We agreed that this will be conducted under DOE and NRC auspices

g. NRC and DOE agreed that in conducting reliability analyses for the waste package, uncertainties in ~~environmental~~ parameters should be considered through the use of statistical distributions of pertinent parameters in time and space.

near-field

5. QA Program Design Control

a. NRC and DOE/ONWI discussed the applicability of QA standards to the waste package design process. ANSI N45.2.11 was the basis for this discussion.

b. NRC stated its position that the Requirements of 45.2.11 applied directly to all testing activities now underway that may ultimately contribute to determination of the waste package design and materials.

c. DOE/ONWI described the general approach to QA and design control including the implementation of QA responsibilities from DOE down through the contractor chain. DOE further noted that the provisions of 45.2.11 are ~~included~~ in NQA-1 and that QA responsibilities are defined in contractual documents and individual DOE and subcontractor plans.

d. DOE recognizes the importance of ~~[redacted]~~d QA ~~but continued to maintain its position that the~~ current responsibility assignment approach is standard industry practice and is acceptable.

e. NRC requested that an index of QA procedures be prepared which identifies those QA documents which have been prepared to comply with the requirements for such procedures in ANSI N45.2.11 - 1974, Section 2.2 (as related to 10 CFR 50, App. B). In addition, NRC noted there is a major interest in QA procedures which address design verification, item 11 of Section 2.2, and procedures which address the process of determining level of confidence of the applicability of models to waste package performance in a repository environment.

It was agreed that a generic meeting was desirable on QA issues among the various projects, DOE Headquarters and NRC. DOE also indicated a desire to have a meeting on QA for the Salt Project prior to the generic meeting.

6. Waste Package Specifications

a. The waste package specifications of ONWI 423, 462, and 463 were reviewed with respect to selected specifications, including those for criticality control, which NRC used as an example of how to improve specifications by making them more quantitative. For example, NRC noted that the use of Keff + 3 in the criticality specification (ONWI-463 Specification 4) is more desirable than the approach used in Section 3.1.1.2.5 of ONWI-423, where no probability was specified. Further needed specification in this case includes the interval of time over which the requirement applies.

b. NRC referred DOE to the minutes of the NRC/NPO meeting of June 27-28 (page 6) and to NRC's Draft Site Characterization analysis for Basalt (NUREG #0960), Chapter 9 and Figure 9.2 for a discussion of NRC's views on the establishment and modification of interim reliability goals. Such goals should be established early and can be changed as new knowledge is gained. These goals should contribute to DOE's SCP.

This part of the SCP can be developed to different levels depending on when the studies will be done and the level of information available at the time of the SCP. DOE and NRC agree on the need for these goals to be as specific and quantitative as practical (including intervals and probabilities addressed) to enable NRC to assess the completeness and adequacy of DOE goals and plans in the SCP. NRC considers that these goals and plans should address the performance of the entire repository system and not be limited to site characteristics.

c. ONWI is drafting a revision to ONWI-438 (to be titled "Waste Package Reference Conceptual Designs for a HLW/Spent Fuel Repository in Salt") by December 1983, and will provide NRC with a copy of this report as soon as practical.

7. Waste Package Conceptual Design and Failure Mode Models

a. NRC asked about the current waste package conceptual designs including alternates that would be described in the SCP. ONWI stated that the material being identifed for overpacks for spent fuel, commercial high level waste and defense high level waste packages was carbon steel. The method of fabrication was not identified nor was the method(s) of welding. NRC expressed a desire to know fabrication techniques and weld methods as soon as they are identified to direct research in the area of determination of the effects of fabrication and welding on container performance.

Other characteristics of the waste package identified by ONWI included container wall thicknesses of from 8.6 to 10 cm and outside diameters of containers of 84.5 cm. Max heat generation rates per package were an areal heat loading of 9500W corresponding to 60KW/acre. Closure weldments are 16-18 cm thick. Base metal for the container is ASTM-276 grade WCA.

ONWI noted there was no attempt to specify a fabrication welding process which would optimize long-term performance. Their objective is to identify corrosion rates of materials resulting from the vendor selected fabrication and welding processes.

b. NRC asked what were the effects of heterogenities in salt (e.g., interbeds and partings of nonsalt lithologies and percentage of impurities such as in muddy salt lithofacies) on the conceptual designes. The borehole concept chosen by DOE would require a thicker unit of rock to be excavated (drifts and emplacement boreholes) compared to the self-shield concept. DOE stated they presently expect that the borehole concept would be able to accommodate any of the presently expected salt heterogenities. DOE also stated that the degree of characterization of the salt in the immediate vicinity of the underground facility would not be different for either conceptual design.

NRC suggested that the SCP describe the chosen conceptual design, as well as the alternatives considered. Included would be an analysis and discussion of the advantages and disadvantages of each of the conceptual designs considered including the effects of salt heterogeneities.

c. NRC asked about the analyses planned for comparison of the alternate conceptual waste package designs (a shelf-shielded package) and the reference design. ONWI noted that they did not plan to quantitatively evaluate reliability and confidence of the various performance parameters, i.e., containment, controlled release, Keff, etc., pertinent to waste packages and the engineered system. NRC noted these quantitative measures of performance and confidence were desirable to allow NRC staff to evaluate and compare alternate conceptual designs and effectively comment on ~~past~~ SCP R&D ~~programs~~ and the conceptual designs selected for further detailed verification. NRC noted that the establishment of interim quantitative design goals was related to this objective of understanding where the design ranked relative to the identified goals.