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MYERS LETTER

Mr. Peter Myers
National Academy of Sciences
2001 Wisconsin Avenue, N. W.
Washington, D. C. 20418

Dear Mr. Myers:

Attached per our telecon of February 1, 1989 are:

1) Briefing charts used by DOE to describe their repository performance assessment program to the NRC's Advisory Committee on Nuclear Waste on January 24, 1989;

2) The NRC's Commission Paper on Regulatory Strategy and Schedules for the HLW Repository Program, SECY-88-285, dated October 5, 1988; and

3) NRC Announcement No. 3 dated January 9, 1989, on the recent reorganization affecting the Office of Nuclear Material Safety and Safeguards.

Sincerely,

ORIGINAL SIGNED BY

Robert E. Browning, Director
Division of High-Level Waste Management
Office of Nuclear Material Safety
and Safeguards

Enclosures: As stated

DISTRIBUTION: W/O ENCLOSURES

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NAME	:ETana	:JLinehan	:JYoungblood	:RBrowning	:	:	:
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Incl. to 2/3/89 letter from Bunning to Mupas Docket 1 (1989) 406.11

U.S. DEPARTMENT OF ENERGY
OFFICE OF CIVILIAN RADIOACTIVE WASTE MANAGEMENT

PRESENTATION TO THE ADVISORY COMMITTEE ON NUCLEAR WASTE

SUBJECT:	SELECTION OF SCENARIOS
DATE:	JANUARY 24, 1989
PRESENTER:	DR. FELTON W. BINGHAM
PRESENTER'S TITLE AND ORGANIZATION:	SUPERVISOR, REPOSITORY PERFORMANCE ASSESSMENT DIVISION SANDIA NATIONAL LABORATORIES
PRESENTER'S TELEPHONE NUMBER:	(505) 844-8816

Received w/Ltr Dated 2/3/89

RW20772.102

406.11

SELECTION OF SCENARIOS

1. INTRODUCTION
   - WHAT A SCENARIO IS
   - WHY SCENARIOS ARE USEFUL
2. SCENARIO SELECTION ACCOMPLISHED
3. FUTURE SCENARIO SELECTION

RW20772.009

DEFINITION OF A SCENARIO

DICTIONARY DEFINITION:

A HYPOTHETICAL SEQUENCE OF EVENTS

EXPANDED DEFINITION:

A HYPOTHETICAL SEQUENCE OF EVENTS AND PROCESSES THAT MAY AFFECT THE PERFORMANCE OF A REPOSITORY SYSTEM

RW20772.010

IMPLICATION OF THE WORD "SEQUENCE"

MOST SCENARIOS BEGIN WITH SOME "INITIATING EVENT" (WHICH MAY BE A PROCESS) AND CONTINUE THROUGH A SEQUENCE OF OTHER EVENTS OR PROCESSES

- THE INITIATING EVENT IS NOT THE SCENARIO

THE PROBABILITY OF THE SCENARIO IS GENERALLY A PRODUCT OF PROBABILITIES

- THE PROBABILITY OF THE INITIATING EVENT BOUNDS THE PROBABILITIES OF ALL THE SCENARIOS THAT FOLLOW FROM IT

RW20772.012

ROLE OF SCENARIOS IN COMPUTATION OF CCDF

THE EXPRESSION FOR THE CCDF IS

$$Pr(M>m)=\int \ldots \int u(M-m)f(v_1 \ldots v_n)dv_1 \ldots dv_n$$

SCENARIOS DEFINE THE RANGES OF STATE VARIABLES FOR WHICH THE $f(v_1 \ldots v_n)$ MUST BE DEFINED AND OVER WHICH THE INTEGRATION MUST BE DONE

RW20772.013

USES OF SCENARIOS

1. RESTRICTION OF CCDF INTEGRATION
   - CCDF MAY BE EXPANDED INTO INTEGRATION OVER SCENARIOS
2. AS A SHORTCUT TO DECIDING WHICH STATE VARIABLES WILL CONTRIBUTE SIGNIFICANTLY TO THE CCDF
   - THIS USE IS IMPORTANT TO THE GUIDING OF SITE CHARACTERIZATION
   - IT FURTHERS COMMUNICATION BETWEEN WORKERS IN PERFORMANCE ASSESSMENT AND IN FIELD INVESTIGATIONS

RW20772.014

A PROBLEM IN CONSTRUCTING SCENARIOS

THE SCENARIOS SHOULD BE EXHAUSTIVE AND MUTUALLY EXCLUSIVE

MANY SCENARIOS CAN BE CONCEIVED OF

HOW CAN THE CONSTRUCTORS FEEL SURE THAT THEIR SCENARIOS MEET THESE CONDITIONS?

ONE WAY IS TO CONSTRUCT MUTUALLY EXCLUSIVE CLASSES OF SCENARIOS

RW20772.011

SIMPLE EXAMPLE OF MUTUALLY EXCLUSIVE SCENARIO CLASSES

ASSUME SYSTEM WITH TWO INDEPENDENT KINDS OF DISRUPTIVE EVENTS: (Eg, E_1 = EXTREME TECTONIC ACTIVITY; E_2 = EXTREME CLIMATE CHANGE)

E_1 WITH PROBABILITY P_1
E_2 WITH PROBABILITY P_2

THEN FOUR OUTCOMES ARE POSSIBLE

NOT E_1 AND NOT E_2	$(1-P_1)(1-P_2)$
E_1 AND NOT E_2	$P_1(1-P_2)$
NOT E_1 AND E_2	$(1-P_1)P_2$
E_1 AND E_2	$P_1 P_2$

THESE FOUR OUTCOMES FORM FOUR MUTUALLY EXCLUSIVE SCENARIO CLASSES

NOTE ALSO: THE SUM OF THEIR PROBABILITIES IS 1

RW20772.104

PURPOSE OF SCENARIO SELECTION DONE SO FAR

TO GUIDE SITE CHARACTERIZATION

- GOVERNING PRINCIPLE IN PLANNING: TO OBTAIN THE DATA THAT ARE NEEDED
- SCENARIO SELECTION IS AN EARLY STEP IN PERFORMANCE ALLOCATION

IMPLICATION: THE SELECTION DONE SO FAR IS NOT THE SELECTION THAT WILL APPEAR IN THE LICENSE APPLICATION

RW20772.007

GENERAL PRINCIPLES FOR SCENARIO SELECTION DONE FOR SITE CHARACTERIZATION

- TAKE INTO ACCOUNT ALL SUFFICIENTLY CREDIBLE NATURAL PROCESSES AND EVENTS
  - GENERALLY OMIT CATEGORIES WITH LIKELIHOOD LESS THAN 10^{-4} IN 10,000 YEARS
  - OMIT THOSE THAT CONTRIBUTE INSIGNIFICANTLY TO CCDF
- DEVELOP SCENARIOS INITIATED BY HUMAN ACTIVITIES
- DEVELOP "NOMINAL" AND "DISRUPTIVE" SCENARIO CLASSES
- BE CONSERVATIVE: ENSURE THAT ALL NECESSARY DATA ARE COLLECTED
- BE RESPONSIBLE: DON'T WASTE RESOURCES ON INSIGNIFICANT SCENARIOS

RW20772.016

PRELIMINARY SELECTION OF SCENARIO CLASSES

GENERAL SOURCES: SOME GENERIC AND SOME SPECIFIC TO SITES

- EXAMPLES: IAEA LIST, STUDY OF KOPLIK, KAPLAN, AND ROSS (REV. MOD. PHYS.)

SPECIFIC SOURCES FOR SELECTION REPORTED IN SCP:

- DECISION-AIDING METHODOLOGY
- ROSS STUDY
- FAVORABLE AND POTENTIALLY ADVERSE CONDITIONS (10 CFR 60)
- REVIEW PROCESS FOR SCP
  - NEW INFORMATION AVAILABLE

RW20772.008

ROSS STUDY

SOURCES: IAEA LIST AND INFORMATION IN THE STATUTORY ENVIRONMENTAL ASSESSMENT FOR YUCCA MOUNTAIN

CONCLUSION: ABOUT 25 DISTINCT EVENTS, PROCESSES, OR FEATURES COULD CREDIBLY INITIATE A SEQUENCE OR SUBSTANTIALLY GUIDE ITS PROGRESS

- 29 OTHERS (FROM IAEA LIST) WERE ELIMINATED

SEQUENCES IDENTIFIED: 84 THAT COULD INFLUENCE THE PERFORMANCE OF ONE OR MORE BARRIERS

RW20772.026

EXAMPLES FROM ROSS STUDY

(INITIATING EVENT) — **CLIMATE CHANGE**

(SEQUENCES)

1. CLIMATE CHANGE → INCREASED INFILTRATION → INCREASED FLUX AT REPOSITORY

2. CLIMATE CHANGE → WATER-TABLE RISE ABOVE CALICO HILLS UNIT

-
-
-

6. CLIMATE CHANGE → PERCHED WATER → DRAINING BY FRACTURE FLOW

RW20772.105

EXAMPLES FROM ROSS STUDY (cont.)

(INITIATING EVENT) — **RESOURCE MINING**

(SEQUENCES)

1. MINING → INTERCEPTION OF CANISTER → MATERIAL BROUGHT TO SURFACE

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3. MINING → INTRODUCTION OF SURFACTANTS → CHANGED HYDRAULIC CHARACTERISTICS

RW20772.106

EXAMPLES OF ADDED SCENARIO CLASSES

LARGE-SCALE CHANGES IN TECTONIC REGIME

1. EVOLUTION OF CURRENT EXTENSIONAL REGIME → DECREASE IN APERTURE OF FRACTURES → WATER-TABLE RISE

2. CHANGE IN TECTONIC ENVIRONMENT → CHANGE IN TEMPERATURE GRADIENTS → CONVECTIVE WATER FLOW → WATER-TABLE RISE

FOLDING, UPLIFT, AND SUBSIDENCE

1. CHANGE IN DRAINAGE → CHANGE IN LOCAL PERCOLATION FLUX

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RW20772.021

SCENARIO CLASSES FOR SITE CHARACTERIZATION

TYPES OF CLASSES:

- "NOMINAL"
  - PRESENT CONDITIONS
  - SOME CONDITIONS NOT NOW PRESENT (16 CLASSES)
- "DISRUPTIVE" (13 CLASSES)

ALL CAN BE CHARACTERIZED

- AS DIRECTLY OR INDIRECTLY RELEASING WASTE
- BY THE BARRIERS THEY AFFECT

GROUPINGS BY AFFECTED BARRIERS ARE CONVENIENT FOR PLANNING SITE CHARACTERIZATION

RW20772.022

GROUPED SCENARIO CLASSES FOR GUIDING SITE CHARACTERIZATION

- DIRECT RELEASES (MAGMA, HUMAN INTRUSION)
- PARTIAL FAILURE OF ENGINEERED BARRIERS
- PARTIAL FAILURE OF UNSATURATED-ZONE BARRIERS (INCREASED FLUX, WATER-TABLE RISE, CHANGES IN HYDRAULIC OR GEOCHEMICAL PROPERTIES)
- PARTIAL FAILURE OF SATURATED-ZONE BARRIERS (FORESHORTENING OF ZONE, CHANGED PROPERTIES OF ZONE)
- UNDISTURBED PERFORMANCE OF ALL BARRIERS

RW20772.023

REPORTING OF SCENARIO SELECTION

SCP CONTAINS DISCUSSIONS, TABLES

SCP GOES ON TO REPORT RESULTS OF PERFORMANCE ALLOCATION BASED ON THE SCENARIO GROUPINGS

RESULTS ARE REVIEWED BY VARIOUS GROUPS

- INDIVIDUAL REVIEWS OF SOURCE MATERIALS
- SCP REVIEWS WITHIN DOE
- SCP REVIEWS OUTSIDE DOE

APPROPRIATE FOCUS OF REVIEWS

- WHETHER THE SELECTION ADEQUATELY GUIDES SITE CHARACTERIZATION

RW20772.024

FUTURE SCENARIO SELECTION

SELECTION WILL BEGIN FROM RESULTS ALREADY REPORTED

EMPHASIS WILL SHIFT TO USE ON CONSTRUCTING CCDF

INCREASED RELIANCE CAN BE MADE ON DATA

- SITE CHARACTERIZATION HAS BEEN PARTLY DESIGNED TO HELP SCENARIO SELECTION

FINAL SELECTIONS MUST REST ON JUDGMENT

- INFORMED JUDGMENT
- JUDGMENT FROM MANY SOURCES
- JUDGMENT CONTROLLED BY FORMAL PROCEDURES

RW20772.020

U.S. DEPARTMENT OF ENERGY
OFFICE OF CIVILIAN RADIOACTIVE WASTE MANAGEMENT

PRESENTATION TO THE ADVISORY COMMITTEE ON NUCLEAR WASTE

SUBJECT:	THE DOE APPROACH TO REPOSITORY PRECLOSURE SAFETY ASSESSMENT
DATE:	JANUARY 24, 1989
PRESENTER:	DAVID MICHLEWICZ
PRESENTER'S TITLE AND ORGANIZATION:	MANAGER, SAFETY ASSESSMENT SECTION OCRWM WESTON TECHNICAL SUPPORT TEAM
PRESENTER'S TELEPHONE NUMBER:	(202) 646-6600

RW20772.096

PRECLOSURE SAFETY ASSESSMENTS

- NRC & DOE PRECLOSURE SAFETY REQUIREMENTS
- TECHNICAL APPROACH
- TECHNICAL ISSUES

NRC REQUIREMENTS

- 10 CFR 20 (PROPOSED)
  - WORKERS: 5 REM EDE
  - PUBLIC: 0.1 REM EDE
- 10 CFR 60.111 (40 CFR 191, SUBPART A)
  - 25 MREM (WB), 75 MREM (THYROID), 25 MREM (OTHER ORGANS)

ROUTINE OPERATION

- 10 CFR 60.2
  - 0.5 REM WB, ANY ORGAN

ACCIDENTS (FOR SAFETY CLASSIFICATION)

RW20772.107

DOE REQUIREMENTS

- DOE 5480.11 (WORKERS)
  - 5 REM EDE
  - 1 REM EDE DESIGN OBJECTIVE
- DRAFT DOE 5400.XX (PUBLIC)
  - SIMILAR TO 10 CFR 20
  - POPULATION DOSE FOR ALARA

} NORMAL OPERATION

RW20772.108

DOE REQUIREMENTS (cont.)

- DRAFT DOE 6430.1A (DESIGN)
  - 25 REM (WB OR EDE), 300 REM (THYROID), 75 REM (LUNG)
  - DBA'S (OPERATING AND EXTERNAL)
  - 10^{-6} PER YEAR PROBABILITY
  - ON AND OFF-SITE DOSES
  - 2 HOUR OFF-SITE EXPOSURE

} ACCIDENTS

RW20772.109

TECHNICAL APPROACH

- SAFETY ASSESSMENT INTEGRAL TO DESIGN
  - DETERMINE IF STANDARDS ARE MET AT EACH DESIGN STAGE
  - EVALUATE NEED FOR FURTHER IMPROVEMENTS
  - FEEDBACK TO DESIGNERS - ACD, LAD
- ASSESSMENT OF CONCEPTUAL DESIGN
  - ACCIDENT ANALYSES FOR CONCEPTUAL DESIGN REPORT
  - INITIAL Q-LIST
  - PUBLIC DOSE ESTIMATES
- PRECLOSURE SAFETY ASSESSMENT WORKING GROUP
  - SELECTION OF APPLICABLE PROCEDURES, COMPUTER CODES, DATA, ASSUMPTIONS
  - IDENTIFICATION OF ADDITIONAL RESEARCH TO SUPPORT REPOSITORY SAFETY ASSESSMENT
  - DEVELOPMENT OF PROCEDURES GUIDES

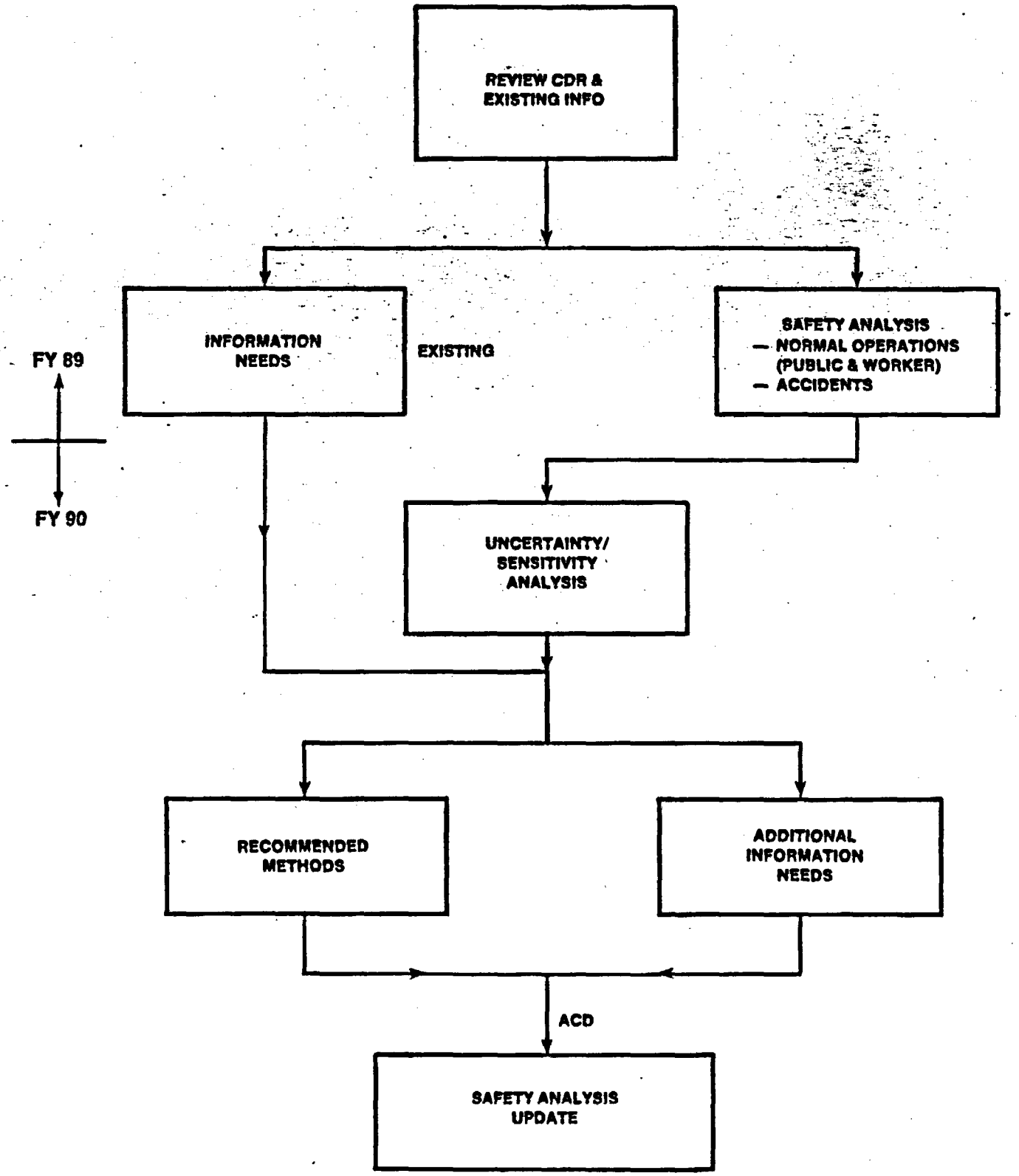
RW20772.049

ADDITIONAL INFORMATION NEEDS

- ACCIDENT SOURCE TERM
  - FUEL PULVERIZATION
  - PARTICLE SIZE DISTRIBUTION
  - BARRIER RETENTION
- SCENARIO DEVELOPMENT
  - INITIATING EVENTS
  - EQUIPMENT FAILURES
  - HUMAN ERRORS
  - COMMON CAUSE FAILURES
  - MINING TYPE INCIDENTS

RW20772.040

PRECLOSURE SAFETY WORK
GENERAL APPROACH



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SELECTED PRECLOSURE SAFETY ASSESSMENT ACTIVITIES FOR FY 1989

- DEFINE BOUNDING CASE RADIONUCLIDE INVENTORY; ORIGEN SENSITIVITY ANALYSIS
- EVALUATE TRANSPORTATION CASK CERTIFICATION ANALYTICAL METHODS AND RESULTS FOR APPLICABILITY TO REPOSITORY SAFETY ANALYSIS
- CHARACTERIZE PARTICLE TRANSPORT PHENOMENA
- ASSESS METHODOLOGIES FOR IDENTIFYING AND SCREENING INITIATING EVENTS

CONCLUSIONS

- REPOSITORY REQUIREMENTS FOR PRECLOSURE SAFETY SIMILAR TO OTHER FACILITIES
- EXTENSIVE BODY OF SAFETY ASSESSMENT TECHNIQUES EXISTS
- CONCEPTUAL DESIGN ANALYZED
- COORDINATED THROUGH PRECLOSURE SAFETY ASSESSMENT WORKING GROUP
- ADDITIONAL INFORMATION NEEDED ON SOURCE TERM AND DATA BASE DEVELOPMENT
- RESULTS OF LAD SAFETY ASSESSMENT - BASIS FOR SAR AND NRC LICENSE APPLICATION

U.S. DEPARTMENT OF ENERGY
OFFICE OF CIVILIAN RADIOACTIVE WASTE MANAGEMENT

PRESENTATION TO THE ADVISORY COMMITTEE ON NUCLEAR WASTE

SUBJECT:	DEVELOPMENT OF THE CCDF
DATE:	JANUARY 24, 1989
PRESENTER:	DR. LARRY D. RICKERTSEN
PRESENTER'S TITLE AND ORGANIZATION:	MANAGER ISSUES RESOLUTION SECTION OCRWM WESTON TECHNICAL SUPPORT TEAM
PRESENTER'S TELEPHONE NUMBER:	(202) 646-6600

RW20772.098

DEVELOPMENT OF THE COMPLEMENTARY CUMULATIVE DISTRIBUTION FUNCTION (CCDF)

- REGULATORY NEED FOR THE CCDF
- DEFINITION OF THE CCDF
- DOE APPROACH TO CONSTRUCTING THE CCDF
- TREATMENT OF HUMAN INTERFERENCE IN CONSTRUCTION OF THE CCDF

RW20772.073

REGULATION RELATED TO CCDF

- 10 CFR 60.112 IMPLEMENTS THE EPA STANDARDS OF 40 CFR PART 191

- THE CONTAINMENT REQUIREMENTS OF 40 CFR 191.13 REQUIRE THAT THE 10,000-YEAR CUMULATIVE RELEASES TO THE ACCESSIBLE ENVIRONMENT SHALL:

  1) HAVE A LIKELIHOOD OF ONE CHANCE IN TEN OF EXCEEDING A SPECIFIED QUANTITY

  2) HAVE A LIKELIHOOD OF ONE CHANCE IN 1000 OF EXCEEDING 10 TIMES THE SPECIFIED QUANTITY

RW20772.072

REGULATORY REQUIREMENT

- DEFINE $M = \sum_i Qi / RLi$

  Qi: PREDICTED 10,000-YEAR CUMULATIVE RELEASE TO ACCESSIBLE ENVIRONMENT FOR ITH RADIONUCLIDE

  RLi: SPECIFIED RELEASE LIMIT FOR ith RADIONUCLIDE FROM APPENDIX A OF 40 CFR PART 191

- $Pr(M>1) < 0.1$
- $Pr(M>10) < 0.001$

RW20772.121

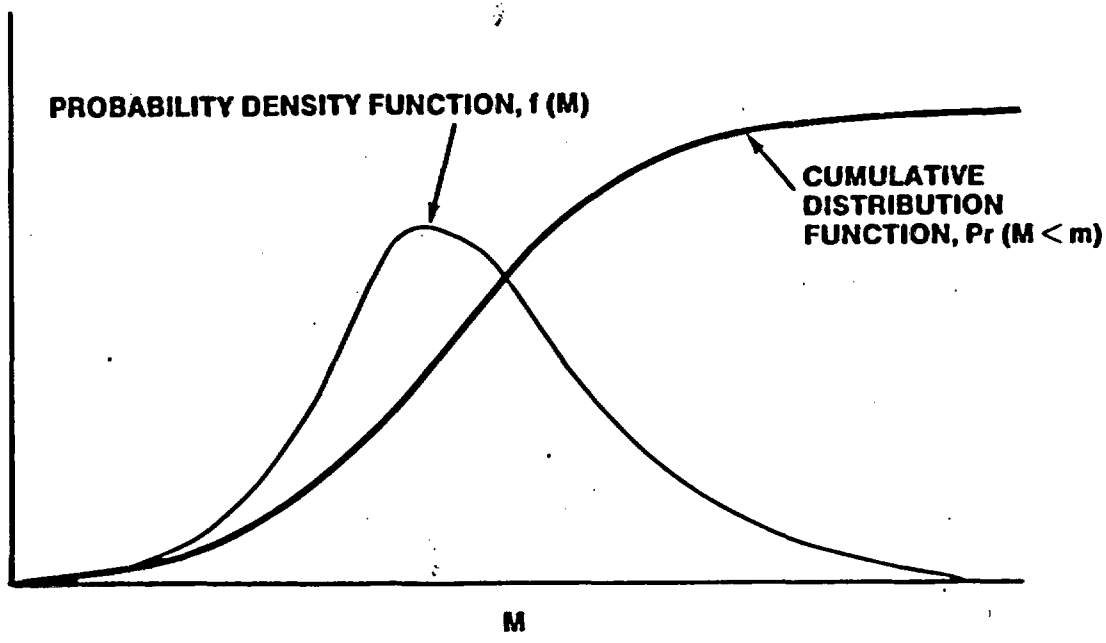
RELEASE LIMITS

40 CFR PART 191, APPENDIX A

RADIONUCLIDE	RL_i (Ci / 1000 MTHM)
AMERICIUM-241 OR 243	100
CARBON-14	100
CESIUM-135 OR 137	1,000
IODINE-129	100
NEPTUNIUM-237	100
PLUTONIUM-238,239,240, OR 242	100
RADIUM-226	100
STRONTIUM-90	1,000
TECHNETIUM-99	10,000
THORIUM-230 OR 232	10
TIN-126	1,000
URANIUM-233, 234, 235, 236 OR 238	100
ANY OTHER ALPHA EMITTER WITH $T^1/_2$>20 YEARS	100
ANY OTHER NON-ALPHA-EMITTER WITH $T^1/_2$>20 YEARS	1,000

RW20772.076

PROBABILITY DISTRIBUTIONS OF NORMALIZED RELEASES



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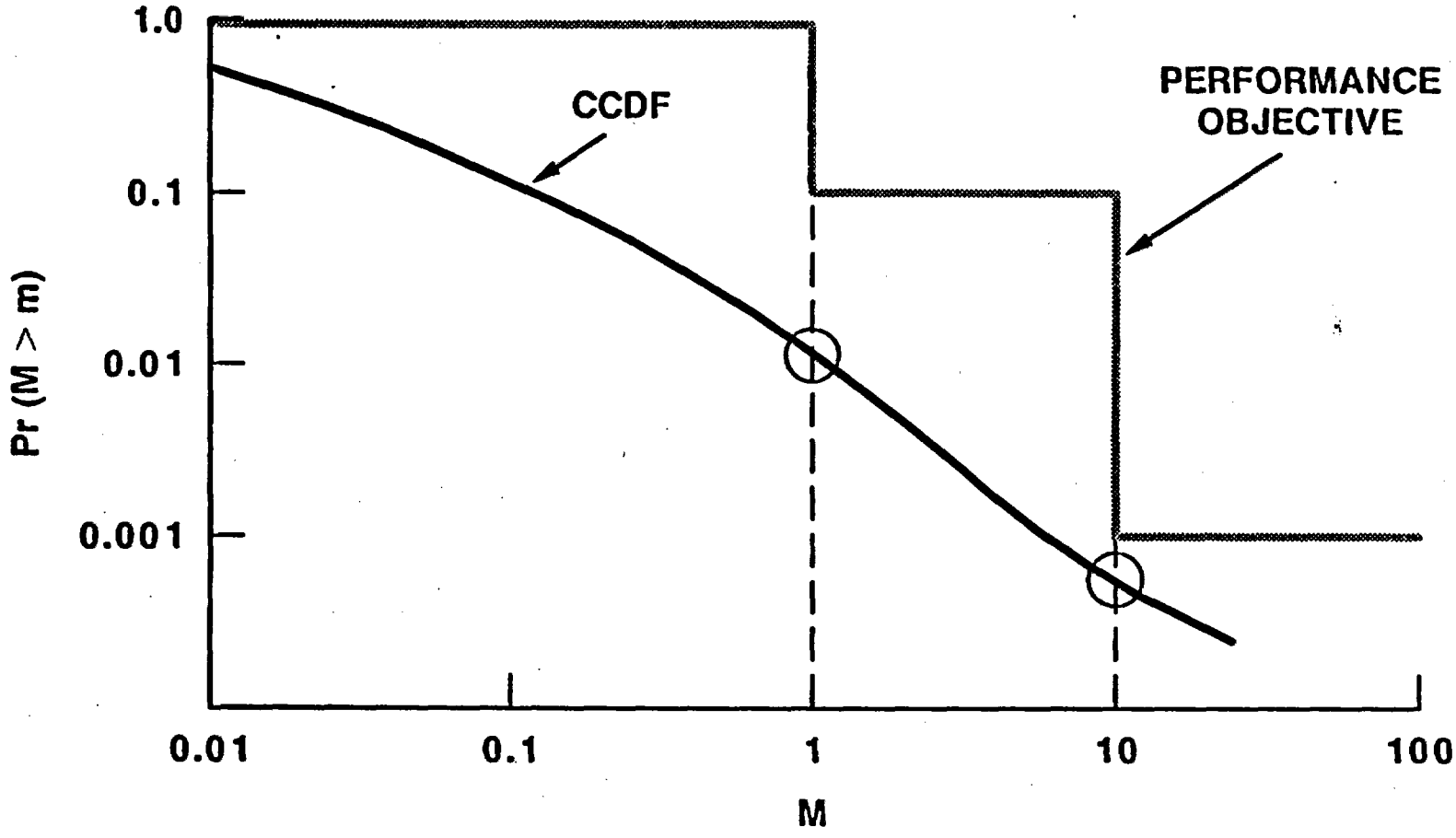
OVERALL COMPLEMENTARY CUMULATIVE DISTRIBUTION FUNCTION (CCDF)



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DEFINITION OF THE CCDF

$$\Pr(M > m) = \int_{v_1} dv_1 \int_{v_2} dv_2 \ldots \int_{v_n} dv_n \, U\,[M(v_1, v_2, \ldots, v_n) - m]\, f(v_1, v_2, \ldots, v_n)$$

v_i = VARIABLES OF THE SYSTEM IMPORTANT TO WASTE ISOLATION

$f(v)$ = JOINT PROBABILITY DENSITY FUNCTION FOR THE VARIABLES OF THE SYSTEM

$U(x)$ = HELMHOLTZ STEP FUNCTION

$U(x) = 1$ FOR $x > 0$

$= 0$ FOR $x < 0$

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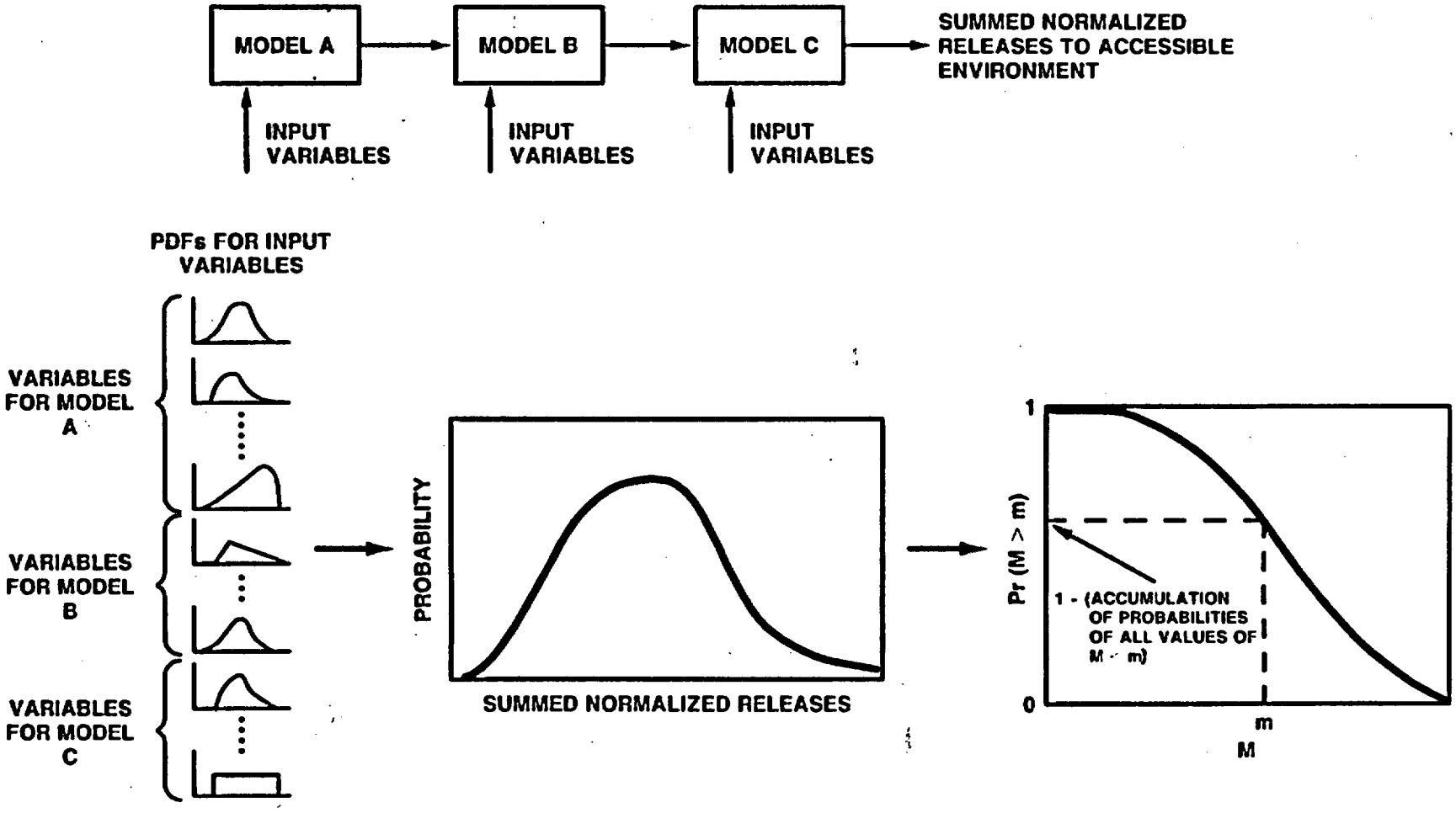
CONSTRUCTION OF THE COMPLEMENTARY CUMULATIVE DISTRIBUTION FUNCTION (CCDF)



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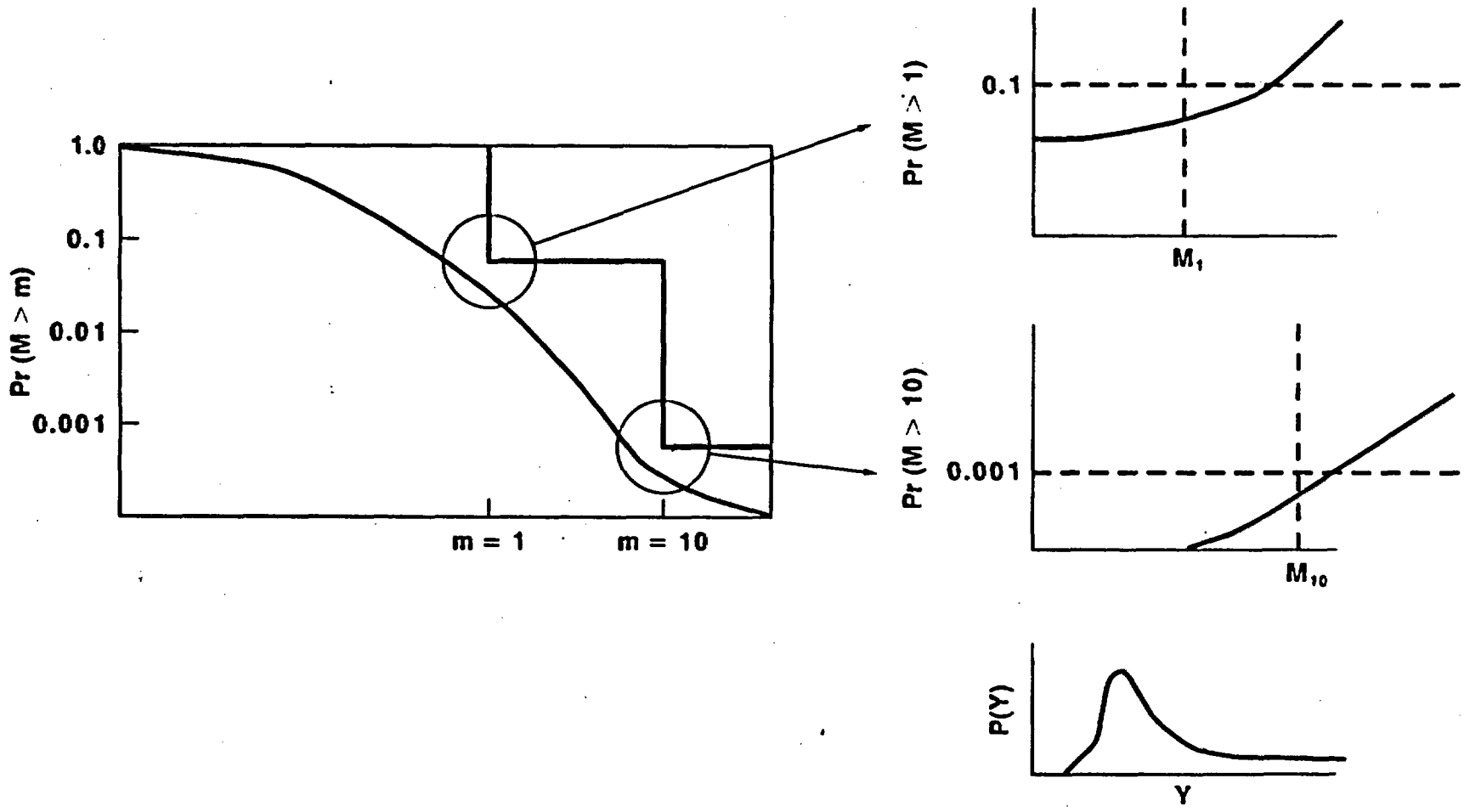
SENSITIVITY AND UNCERTAINTY ANALYSIS FOR THE CCDF



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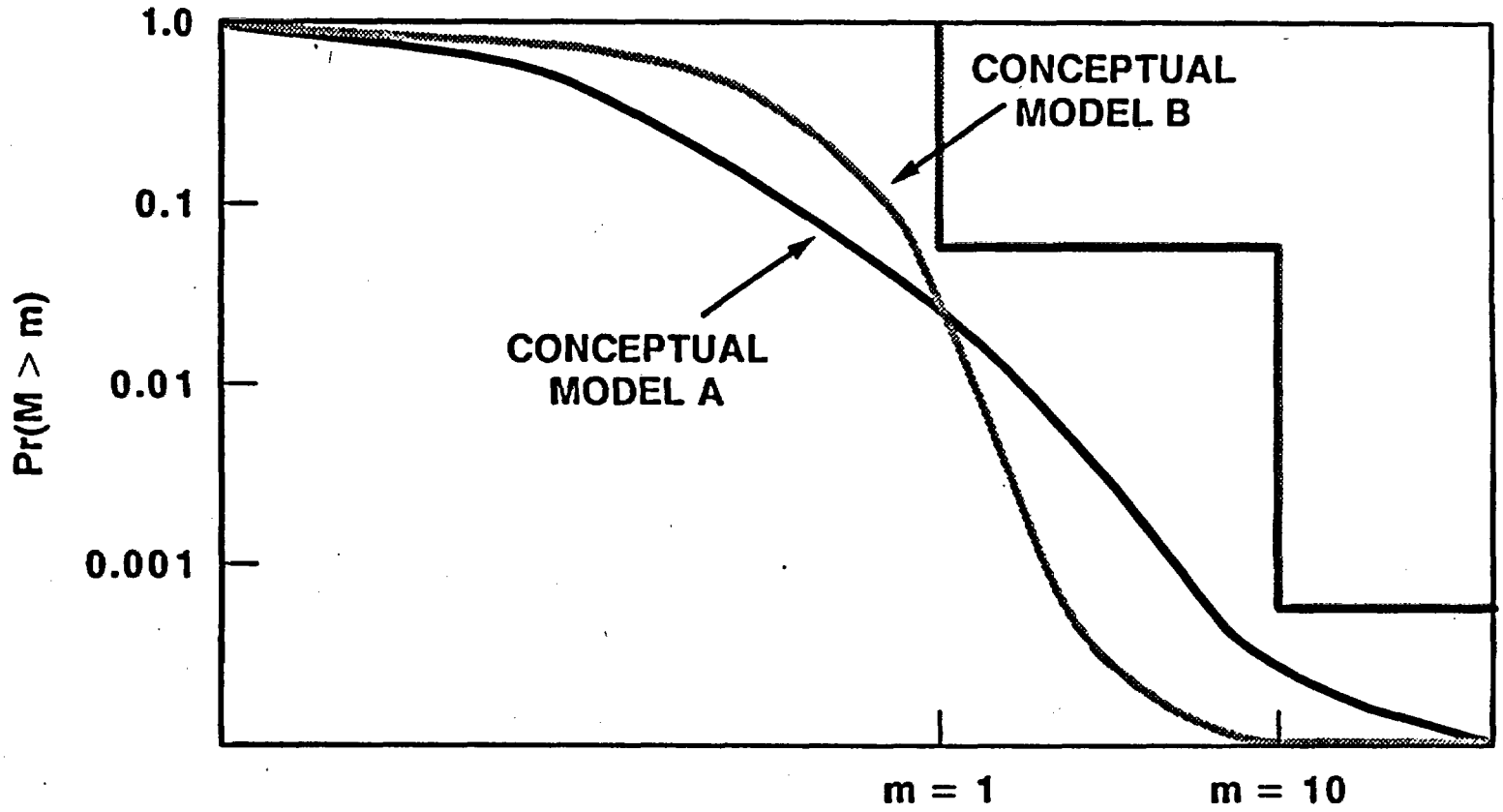
ANALYSIS OF ALTERNATE CONCEPTUAL MODELS



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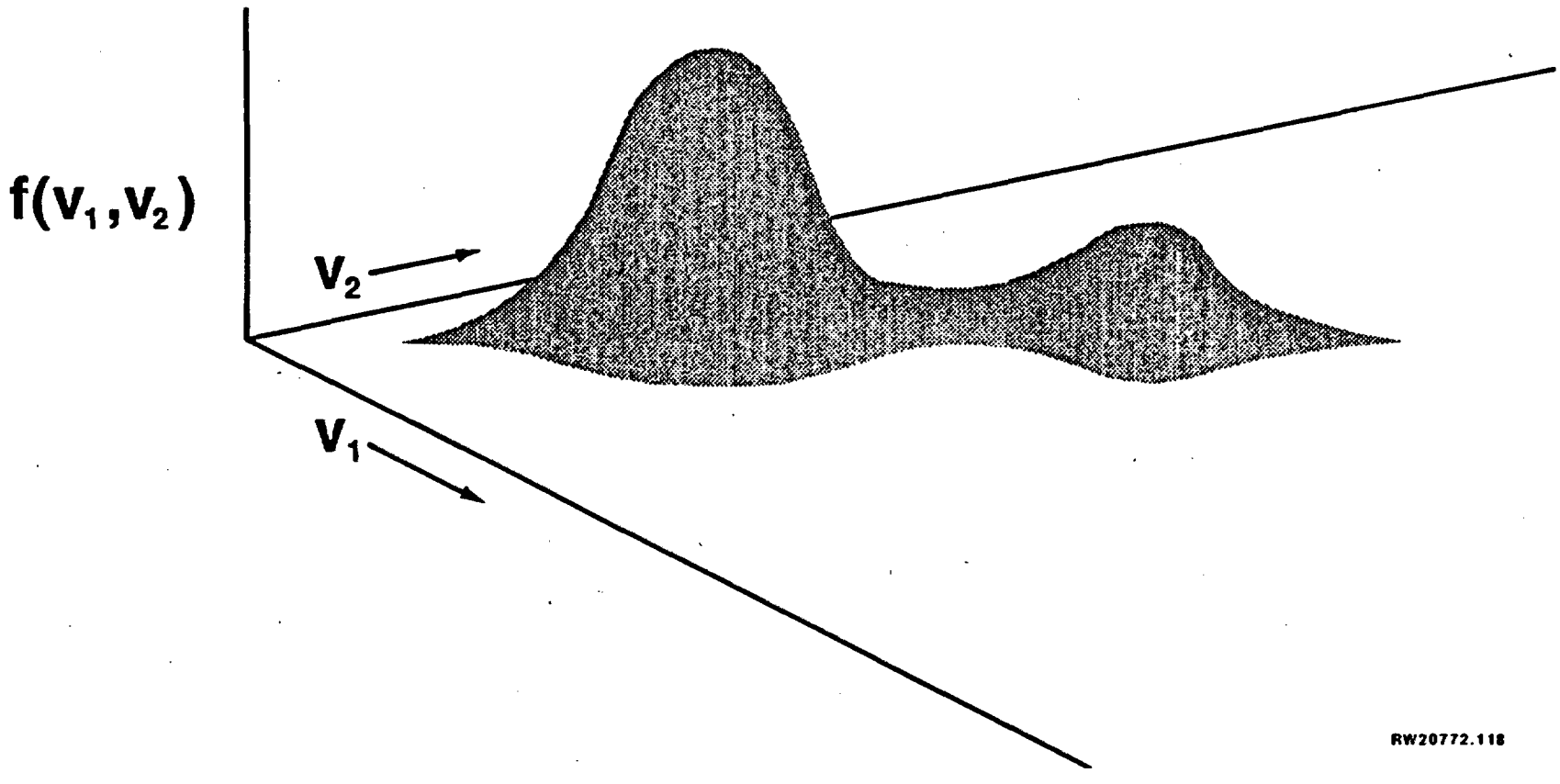
CONSIDERATIONS IN CONSTRUCTING THE CCDF

- IDENTIFYING IMPORTANT VARIABLES
- NUMBER AND RANGE OF VARIABLES
- CORRELATIONS AMONG VARIABLES
- TIME DEPENDENCE OF SYSTEM BEHAVIOR
- MODEL UNCERTAINTY

RW20772.074

TAKING ADVANTAGE OF SPECIAL PROPERTIES AND STRUCTURE OF THE JOINT PDF

$$f(v_1, v_2, \ldots, v_N) = \sum_j f(v_1, v_2, \ldots, v_N | j)\, Wj$$



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DECOMPOSITION OF THE CCDF TO SIMPLIFY CONSTRUCTION

- USING CONDITIONAL PROBABILITY DENSITY FUNCTIONS
- MUST ENSURE REPRESENTATION IS EXHAUSTIVE AND MUTUALLY EXCLUSIVE
- SCENARIOS CAN PROVIDE USEFUL DECOMPOSITION

$$Pr(M>m) = \sum_j \int dV_1 \int dV_2 \ldots \int dV_n U(M-m)\, f(V_1, V_2 \ldots, Vn \mid Sj) Wj$$

RW20772.123

DOE APPROACH TO THE CCDF

$$Pr(M>m) = \sum_j \int dV_1 \int dV_2 \ldots \int dV_n U(M-m)\, f(V_1, V_2 \ldots, Vn \mid Sj) Wj$$

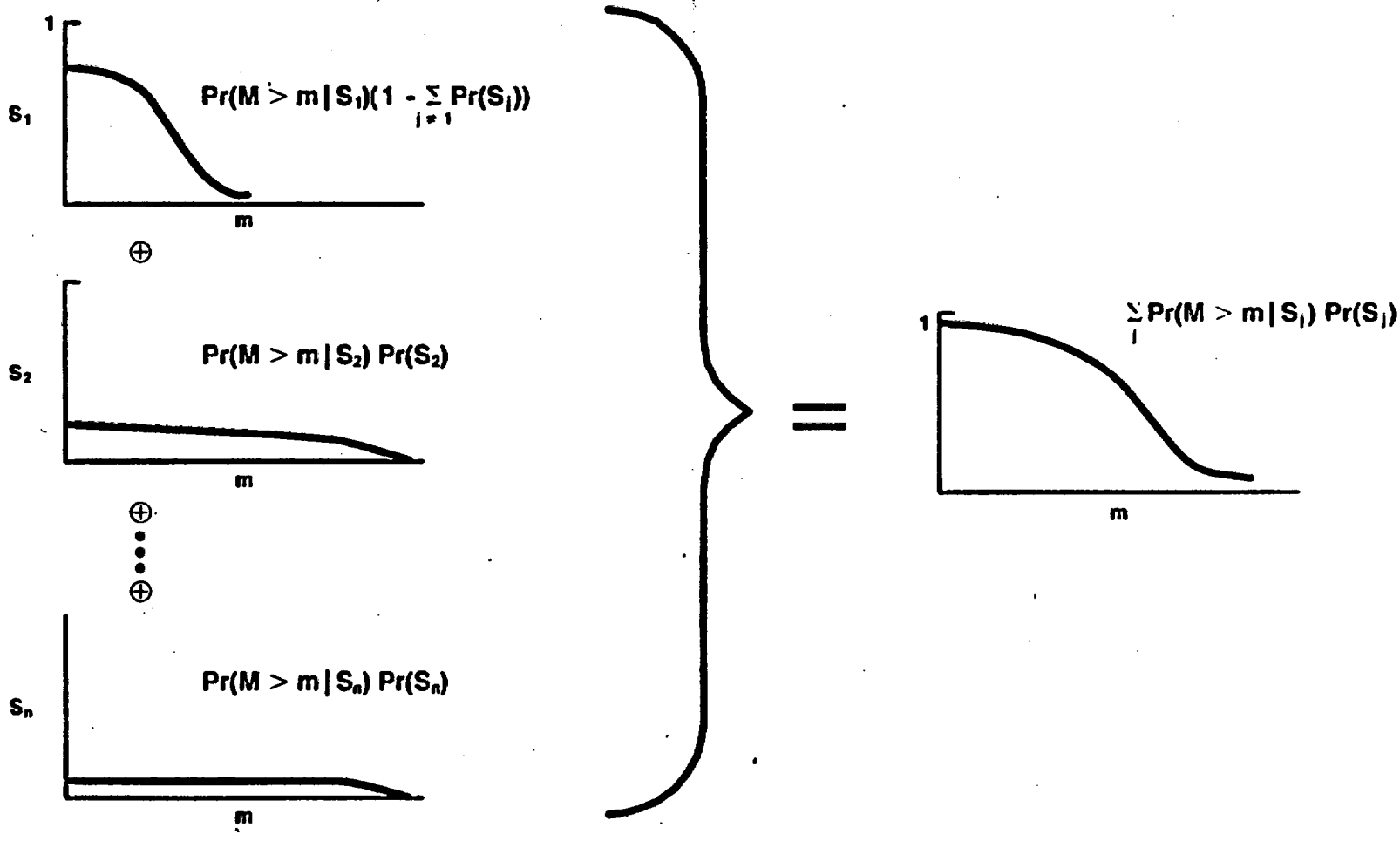
$$Pr(M>m) \cong \sum_j Pr(M>m \mid Sj)\, Pr(Sj)$$

$Pr(M>m \mid Sj)$ = CONDITIONAL CCDF ASSUMING THAT ONLY SCENARIO Sj OCCURS

$Pr(Sj)$ = PROBABILITY OF OCCURRENCE OF SCENARIO Sj

RW20772.122

CALCULATION OF OVERALL CCDF FROM SCENARIO CCDFs



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ESTIMATES OF SCENARIO PROBABILITY

- PROBABILITY MODELS
- PEER REVIEW
- EXPERT JUDGEMENT
- OTHER CONSIDERATIONS

$$\sum_{j} Pr(Sj) = 1$$

$$Pr(S_1) = 1 - \sum_{j \neq 1} Pr(Sj)$$

RW20772.120

EPPM A MEASURE OF IMPORTANCE OF A SCENARIO CLASS

- $EPPM(Sj) = E(M \mid Sj) \cdot Pr(Sj)$
- MARKOV'S INEQUALITY
  - $Pr(M>m) < E(M)/m$
  - $Pr(M>1) < 0.1 \Rightarrow E(M) < 0.1$
  - $Pr(M>10) < 0.001 \Rightarrow E(M) < 0.01$
- $E(M) \cong \sum_j E(M \mid Sj)\, Pr(Sj)$
- $\sum_j EPPM(Sj) < 0.01$

RW20772.119

TREATMENT OF HUMAN INTERFERENCE

- HUMAN INTERFERENCE WILL BE EXPLICITLY EVALUATED
  - POTENTIAL INTERFERENCES WILL BE IDENTIFIED
  - INFORMATION WILL BE OBTAINED
  - CREDIBLE SCENARIOS WILL BE DEVELOPED AS NEEDED
  - CONSEQUENCES WILL BE ESTIMATED
  - SCENARIOS WILL BE ASSESSED FOR REGULATORY PURPOSES

RW20772.003

ASSUMPTIONS FOR ASSESSMENT OF HUMAN INTERFERENCE

- MONUMENTS WILL SERVE INTENDED PURPOSES
- VALUE TO FUTURE GENERATIONS OF RESOURCES CAN BE ASSESSED
- UNDERSTANDING OF RADIOACTIVITY AND ITS HAZARDS WILL BE RETAINED
- INSTITUTIONS WILL BE ABLE TO ASSESS RISK AND TAKE REMEDIAL ACTION
- RELEVANT RECORDS WILL BE PRESERVED AND REMAIN ACCESSIBLE FOR SEVERAL HUNDRED YEARS

RW20772.004

TREATMENT OF HUMAN INTERFERENCE

- MAY NOT BE PRACTICAL TO INCORPORATE HUMAN INTERFERENCE INTO OVERALL CCDF
  - ESTIMATES OF ABSOLUTE PROBABILITY OF HUMAN ACTIVITY IN THE FUTURE MAY NOT BE FEASIBLE
  - SPECULATIVE PROBABILITY ESTIMATES OF HUMAN INTERFERENCE MAY LEAD TO MISJUDGEMENTS OF MORE CREDIBLE PROCESSES AND EVENTS

RW20772.002

APPROACH TO COMPLIANCE USING THE CCDF

- IDENTIFY ALL SIGNIFICANT PROCESSES AND EVENTS THAT MAY AFFECT THE GEOLOGIC REPOSITORY
- EVALUATE EFFECTS OF THESE PROCESSES AND EVENTS ON THE CUMULATIVE RELEASE OF RADIONUCLIDES TO THE ACCESSIBLE ENVIRONMENT

RW20772.005

APPROACH TO COMPLIANCE USING THE CCDF (cont.)

- COMBINE ESTIMATES OF THESE EFFECTS, TO THE EXTENT PRACTICABLE, INTO A CCDF DISPLAYING THE LIKELIHOOD THAT THE PREDICTED CUMULATIVE RELEASES EXCEED THE SPECIFIED QUANTITY
- COMPARE THE PREDICTIONS WITH THE PERFORMANCE OBJECTIVE, EVALUATING THE IMPORTANCE OF ANY UNCERTAINTIES ON CONCLUSIONS FROM THIS COMPARISON
- EVALUATE ANY OTHER EFFECTS THAT CANNOT BE DIRECTLY INCORPORATED INTO THE CALCULATED CCDF

RW20772.006

U.S. DEPARTMENT OF ENERGY OFFICE OF CIVILIAN RADIOACTIVE WASTE MANAGEMENT

PRESENTATION TO THE ADVISORY COMMITTEE ON NUCLEAR WASTE

SUBJECT:	TOTAL SYSTEM PERFORMANCE ASSESSMENT MODEL
DATE:	JANUARY 24, 1989
PRESENTER:	DR. SCOTT SINNOCK
PRESENTER'S TITLE AND ORGANIZATION:	SUPERVISOR NNWSI PROGRAM INTERFACE DIVISION SANDIA NATIONAL LABORATORIES
PRESENTER'S TELEPHONE NUMBER:	(702) 704-7200

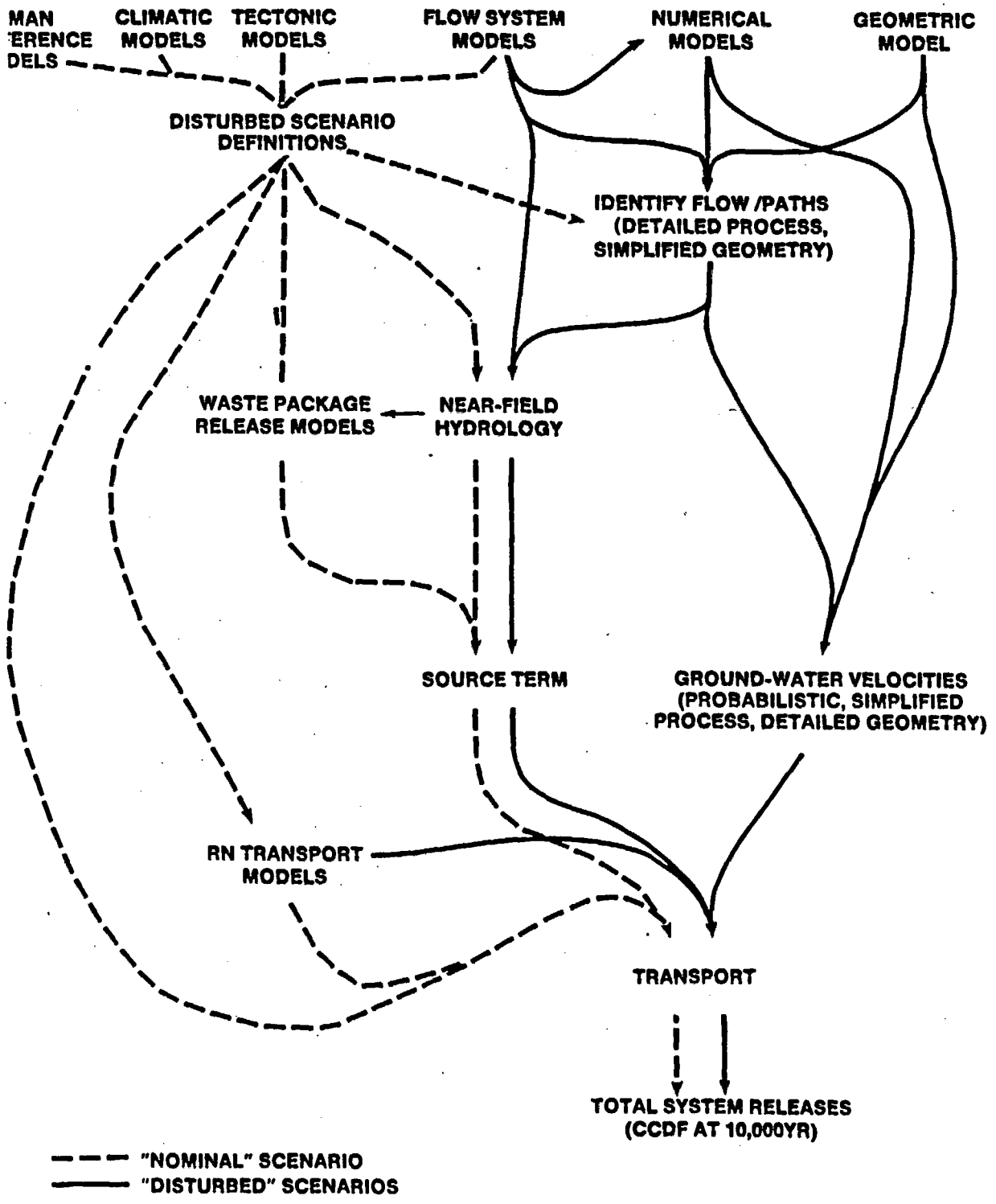
TOTAL SYSTEM PERFORMANCE ASSESSMENT MODEL

- MODELING HIERARCHY
- EXAMPLES OF TOTAL SYSTEM PERFORMANCE ASSESSMENTS
- CURRENT ACTIVITIES

RELATION OF SUBSYSTEM AND TOTAL SYSTEM FUNCTIONS AND PROCESSES

SUBSYSTEM	FUNCTION	PROCESS
ENGINEERED BARRIER SYSTEM	CONTAINMENT	CORROSION OF CONTAINER MECHANICAL BREAKAGE CHEMO-MECHANICAL DAMAGE
	RELEASE CONTROL	CORROSION OF WASTE FORM RADIONUCLIDE DECAY THERMAL CHANGES TO ENGINEERED BARRIERS CHEMICAL EFFECTS ON REPOSITORY MATERIALS
NATURAL BARRIERS	RETARD VAPOR AND GROUND-WATER FLOW	DARCY FLOW, FRACTURE AND MATRIX DISPERSION, DIFFUSION
	RETARD RADIONUCLIDE TRANSPORT	GEOCHEMICAL RETARDATION RADIONUCLIDE DECAY
	LIMIT LIKELIHOOD AND MAGNITUDE OF DELETERIOUS EFFECTS THROUGH TIME	TECTONIC CHANGE CLIMATIC CHANGE HUMAN INTERFERENCE
TOTAL SYSTEM	LIMIT RELEASES TO ACCESSIBLE ENVIRONMENT	ALL OF THE ABOVE

THE USE OF SUBMODELS IN SYSTEM PERFORMANCE ASSESSMENTS



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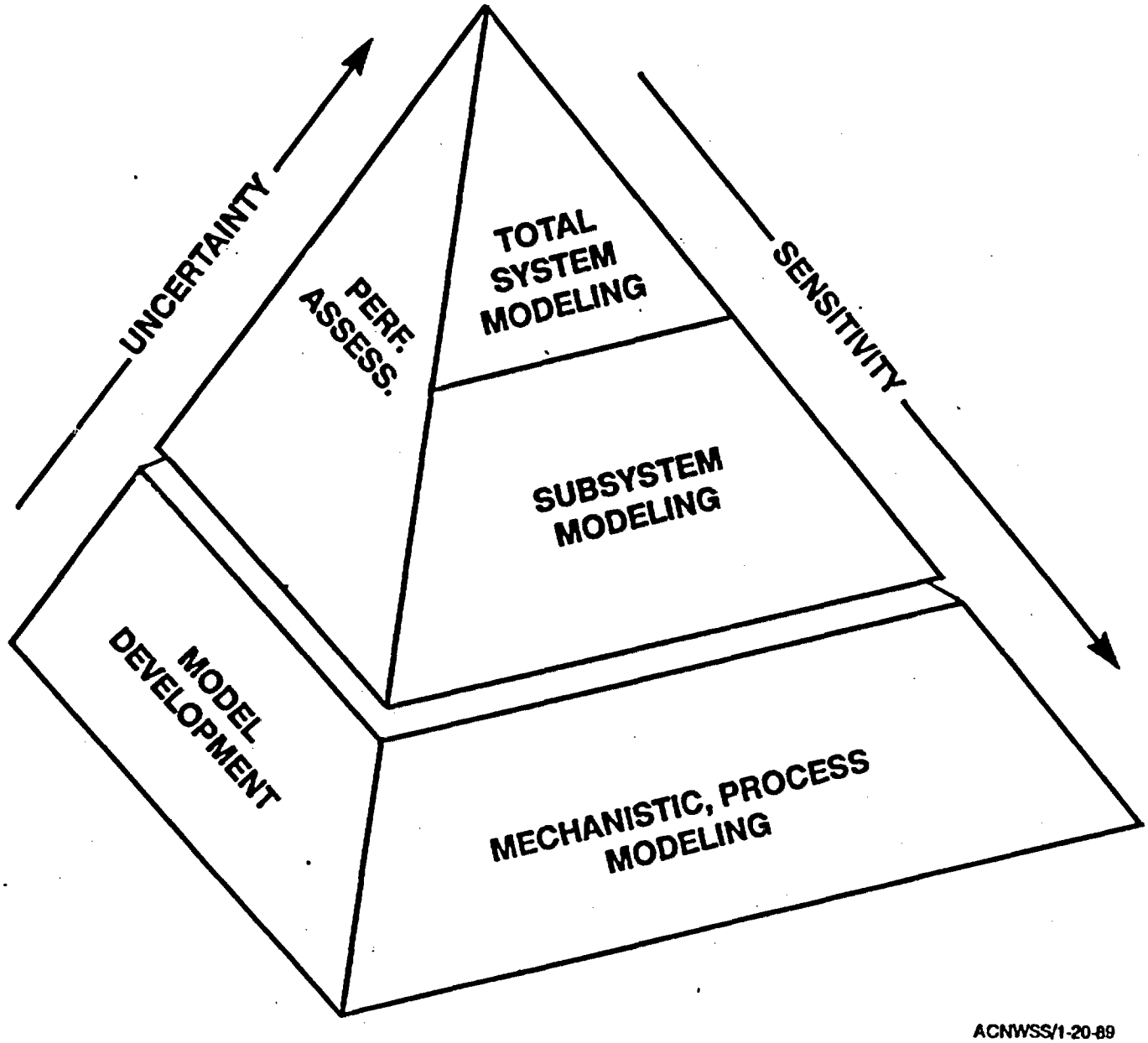

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PASSING UNCERTAINTY THROUGH HEIRARCHY OF MODELS

- INTERPRET RESULTS OF LOWER-LEVEL MODELS TO DEFINE APPROPRIATE, CONSERVATIVE INPUT VARIABLES AND CONCEPTUAL MODELS FOR NEXT UPPER LEVEL
- SELECT PROBABALISTIC, "BOUNDING", OR "BEST ESTIMATE" INPUT VARIABLES BASED ON THEIR INFLUENCE ON PERFORMANCE (SENSITIVITY)
- SELECT INPUT VARIABLES AND CONCEPTUAL MODELS FOR UPPER LEVELS TO ENSURE UNCERTAINTY IS CONSERVATIVELY ACCOUNTED FOR

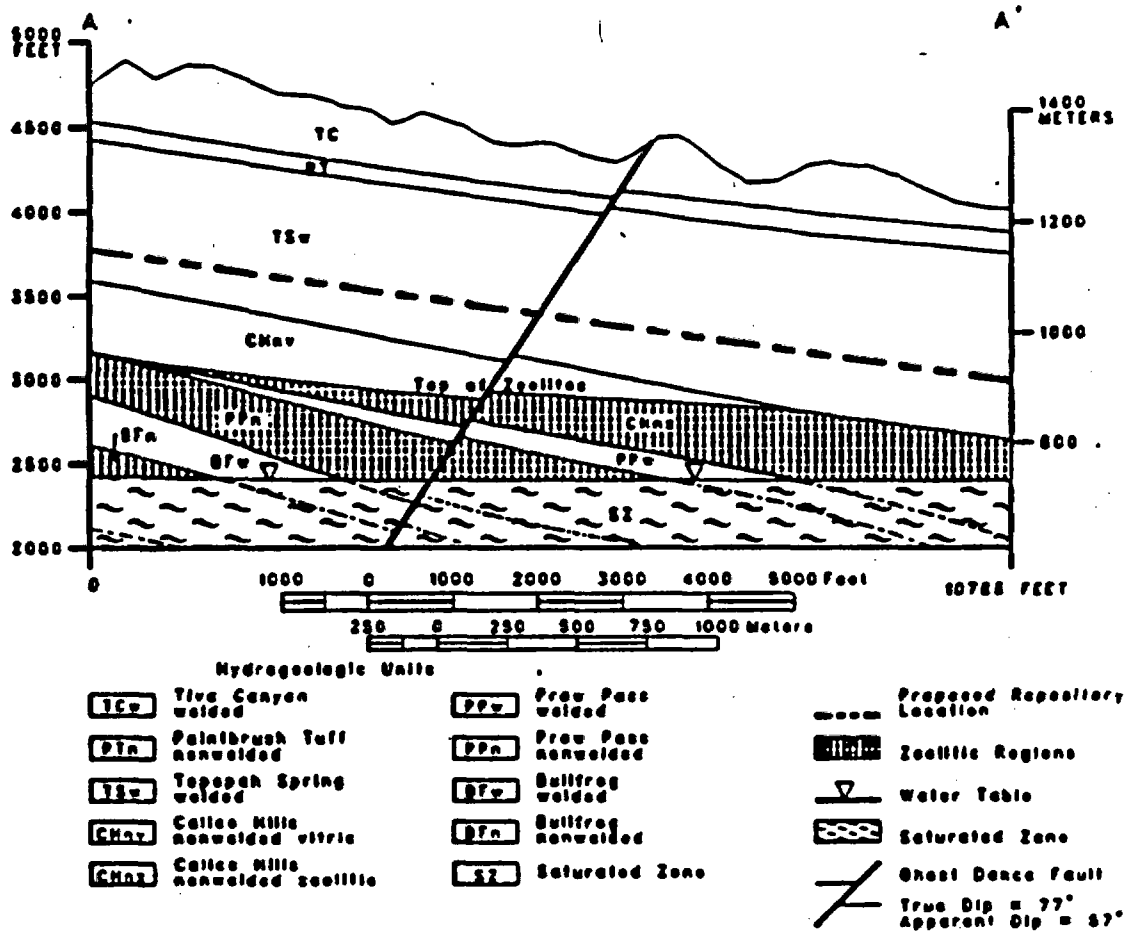
CHARACTERIZATION OF MODELS IN HIERARCHY

MODEL LEVEL	GEOMETRY	PROCESS	UNCERTAINTY	COMPUTER USAGE	USE	EXAMPLES
Mechanistic	Simple	Complex	Deterministic Parameters Bounding "Best Estimate"	FEM,RAM "HOGS" 2 or 3D Convergent Iterative Solutions; CPU time used for single runs; high calculation costs, low IO costs	Predict magnitude of effects of various processes; Provide insight about sensitive processes conditions; define input ranges and types for subsystem models	NORIA EQ3/EQ6 TRACR TOUGH FEMTRAN
Subsystem	Complex	Simple	Probabilistic, Bounding, or "Best Estimate" Parameters	Direct simulation or ID convergent-iterative solutions; CPU time used for multiple "Monte Carlo" runs; moderate calculation costs; high IO costs	Predict subsystem performance; Define input ranges and types for total system model	TOSPAC SPARTAN-GW AREST PANDORA LLUVIA
System	Simple to Absent	Simple to Absent	Probabilistic Scenarios, Bounding or "Best Estimate" Parameters	Indirect Simulator CPU times used for consideration of multiple scenarios	Predict total system releases	SPARTAN SYVAC

EXAMPLE OF USE OF VARIOUS MODELS LEVELS TO PRODUCE TOTAL SYSTEM ASSESSMENT

- GROUND WATER FLOW PROCESSES, EFFECTS, AND PATHS EVALUATED USING LOWER-LEVEL MODEL (SAGUARO)
- GROUND-LEVEL FLOWTIMES CALCULATED USING INTERMEDIATE-LEVEL MODEL (SPARTAN-GW)
- TOTAL-SYSTEM PERFORMANCE CALCULATED USING UPPER-LEVEL MODEL (SPARTAN)

EXAMPLE OF HYDROSTRATIGRAPHIC UNIT FROM COMPUTER GRAPHICS SYSTEM



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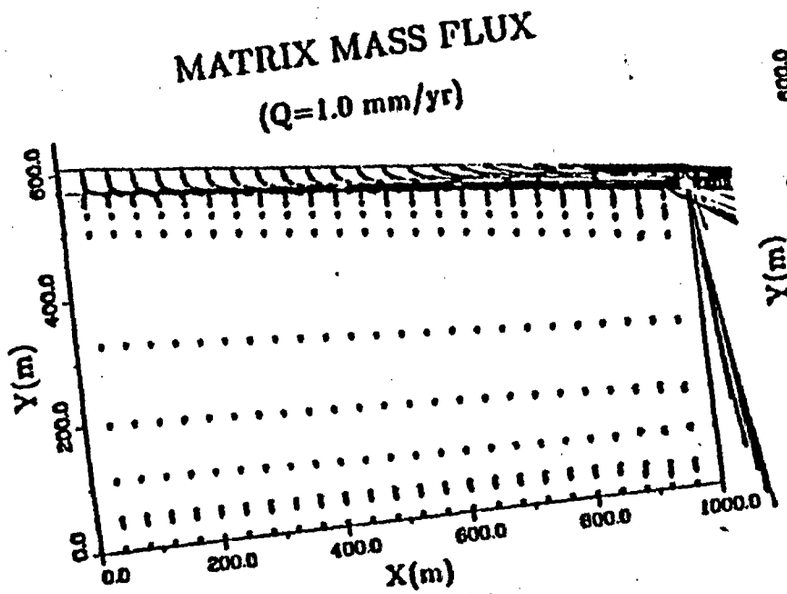
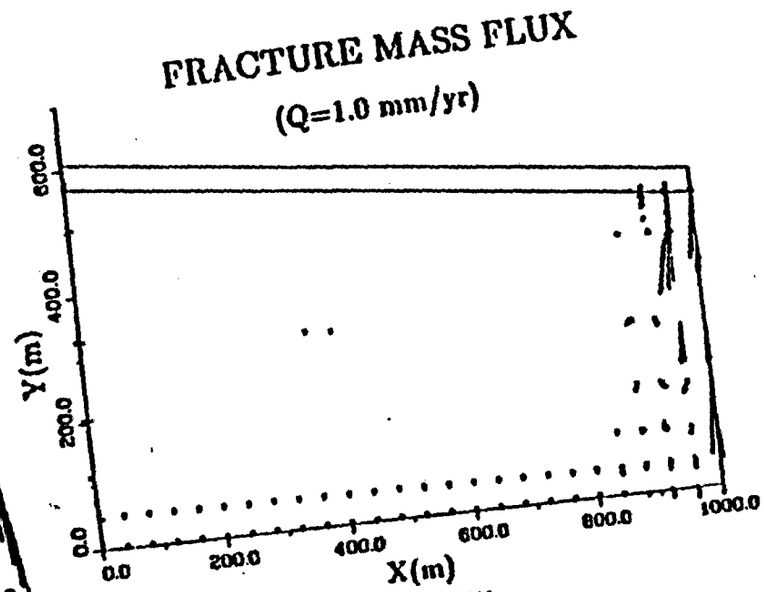
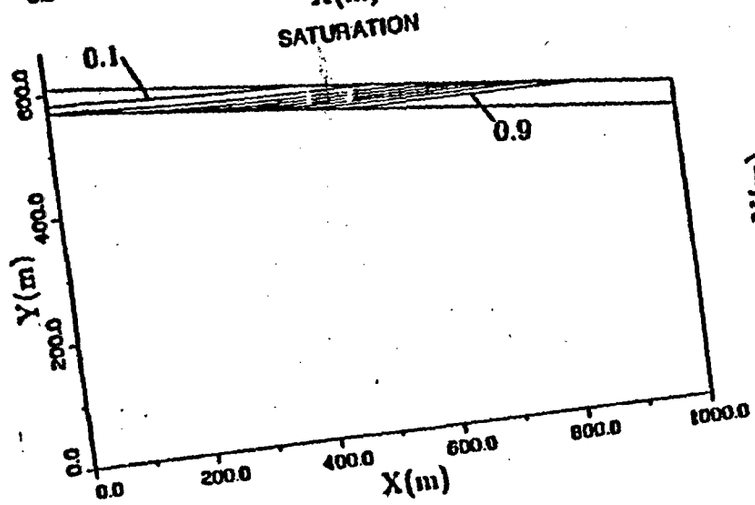
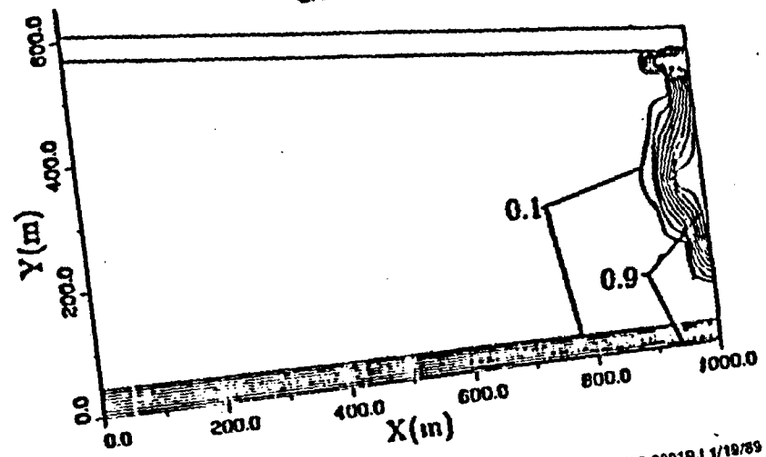
SAGUARO CALCULATIONS (MECHANISTIC, SIMPLIFIED GEOMETRY)









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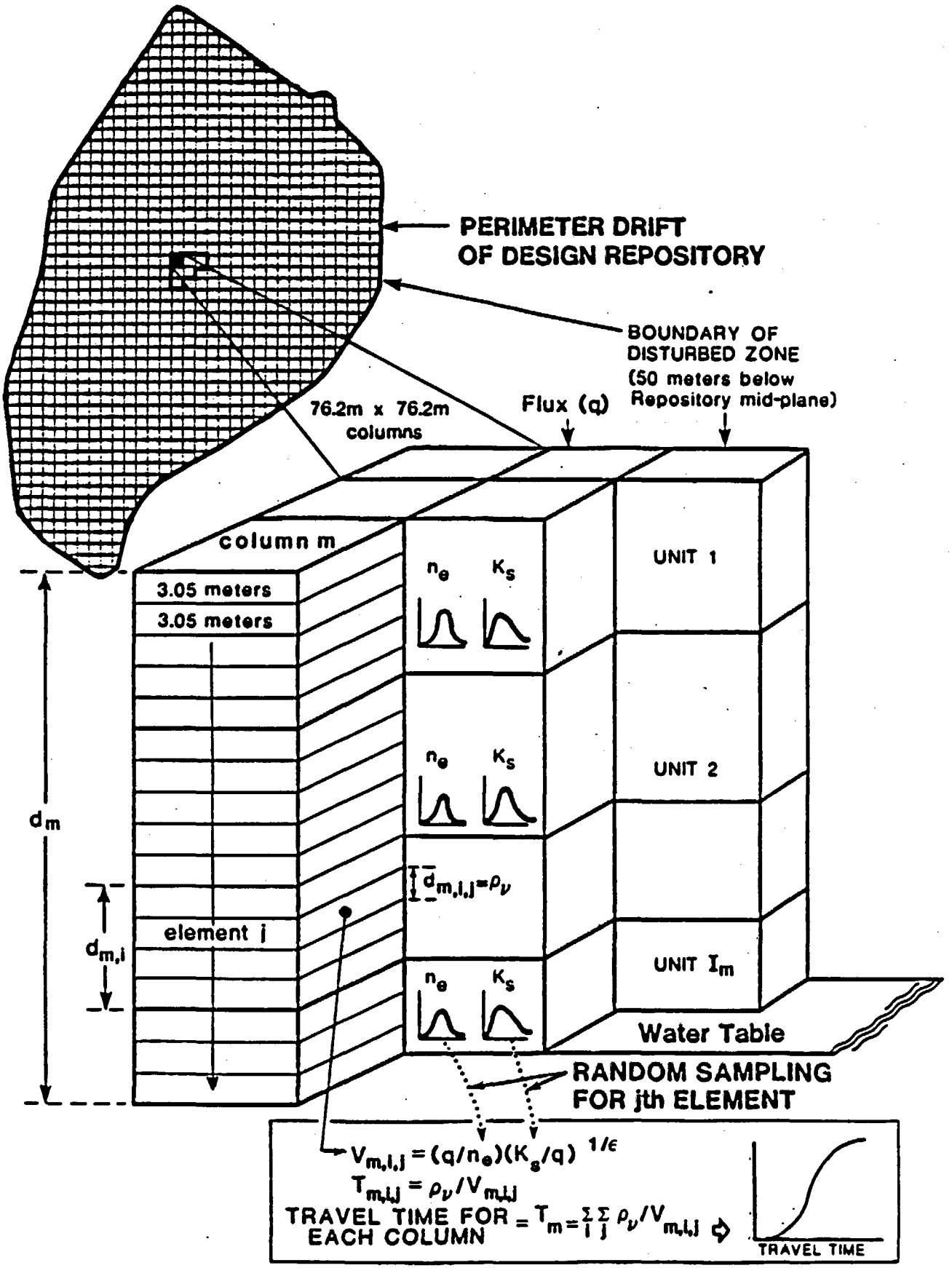
SPARTAN-GW CALCULATIONS
(COMPLEX GEOMETRY, SIMPLE PROCESS)



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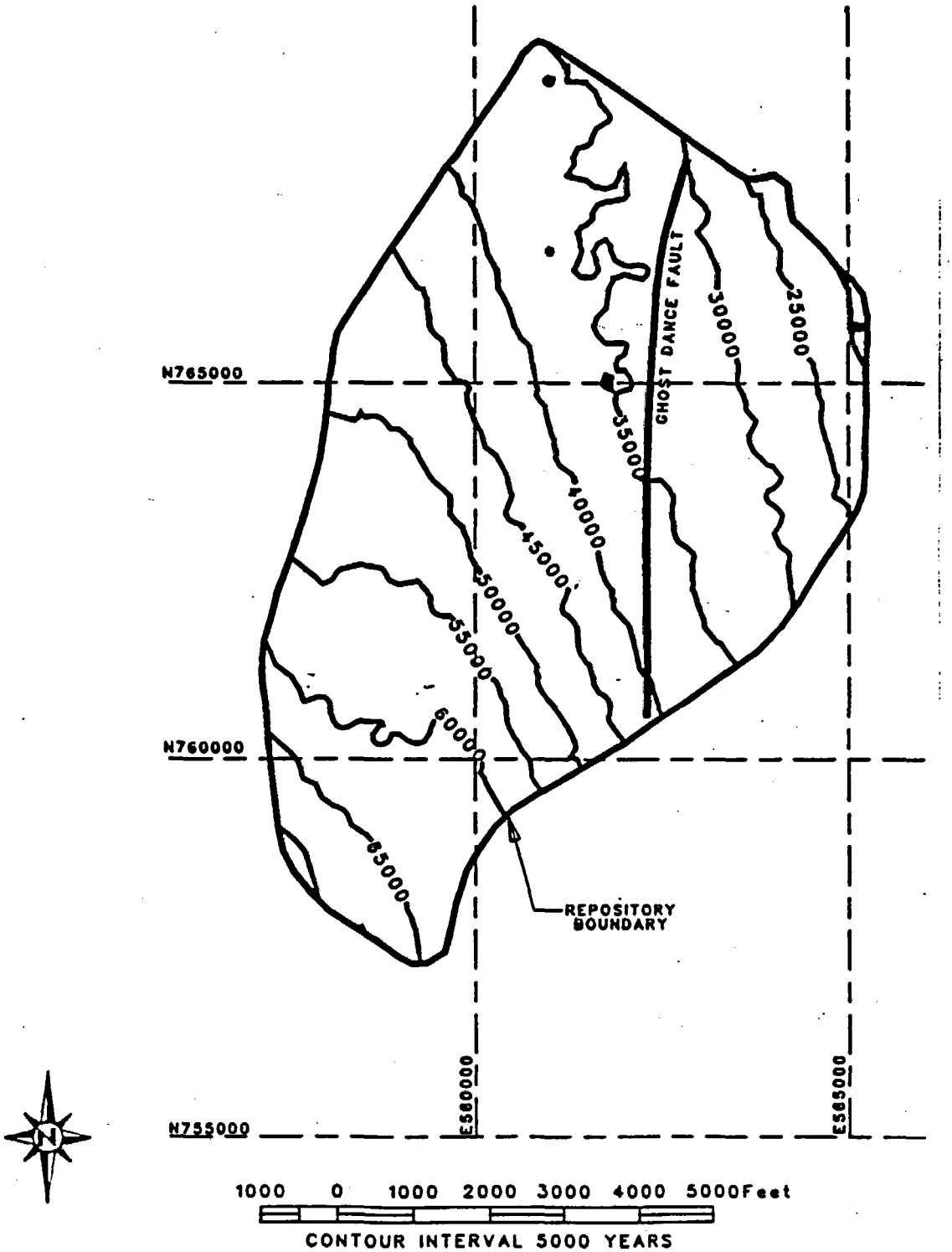
SPARTAN CALCULATIONS
(SIMPLE GEOMETRY, SAMPLE PROCESS)



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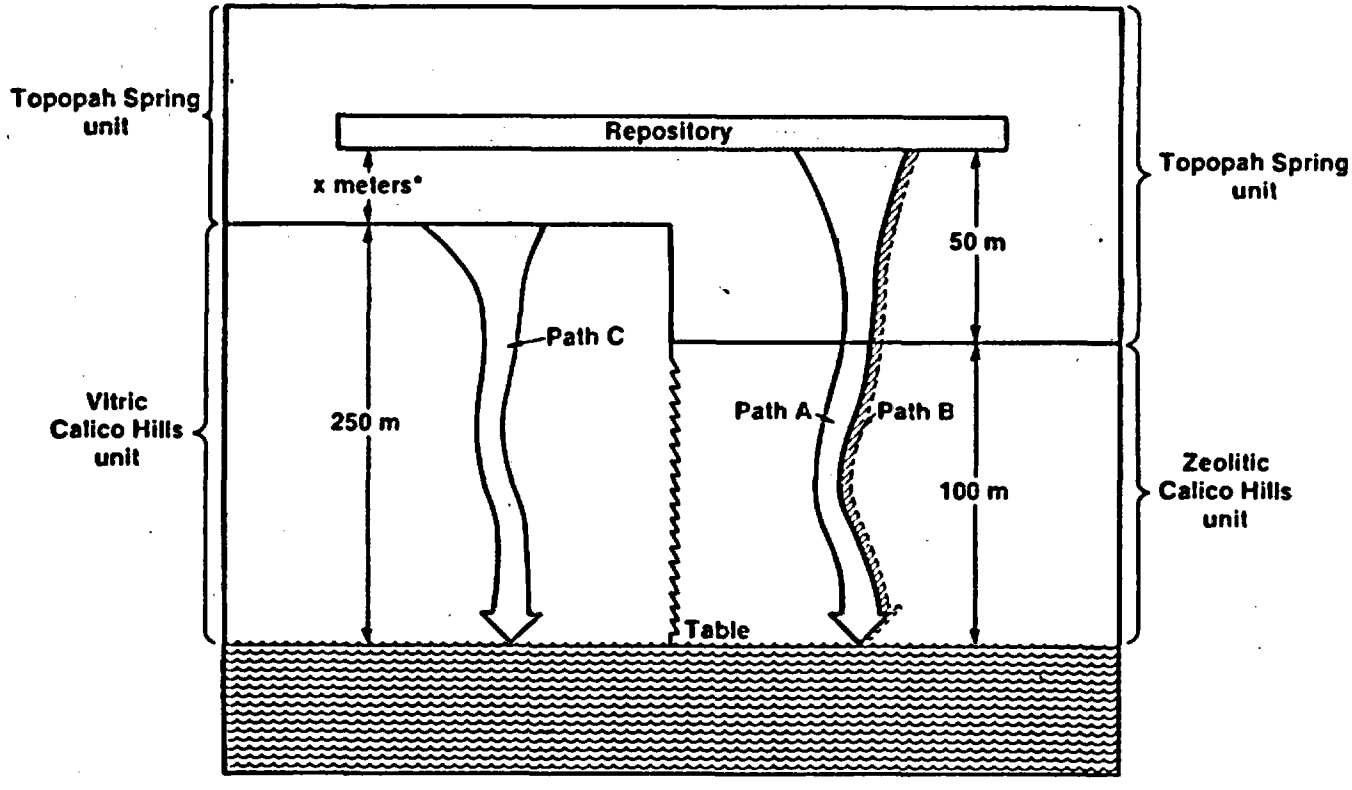
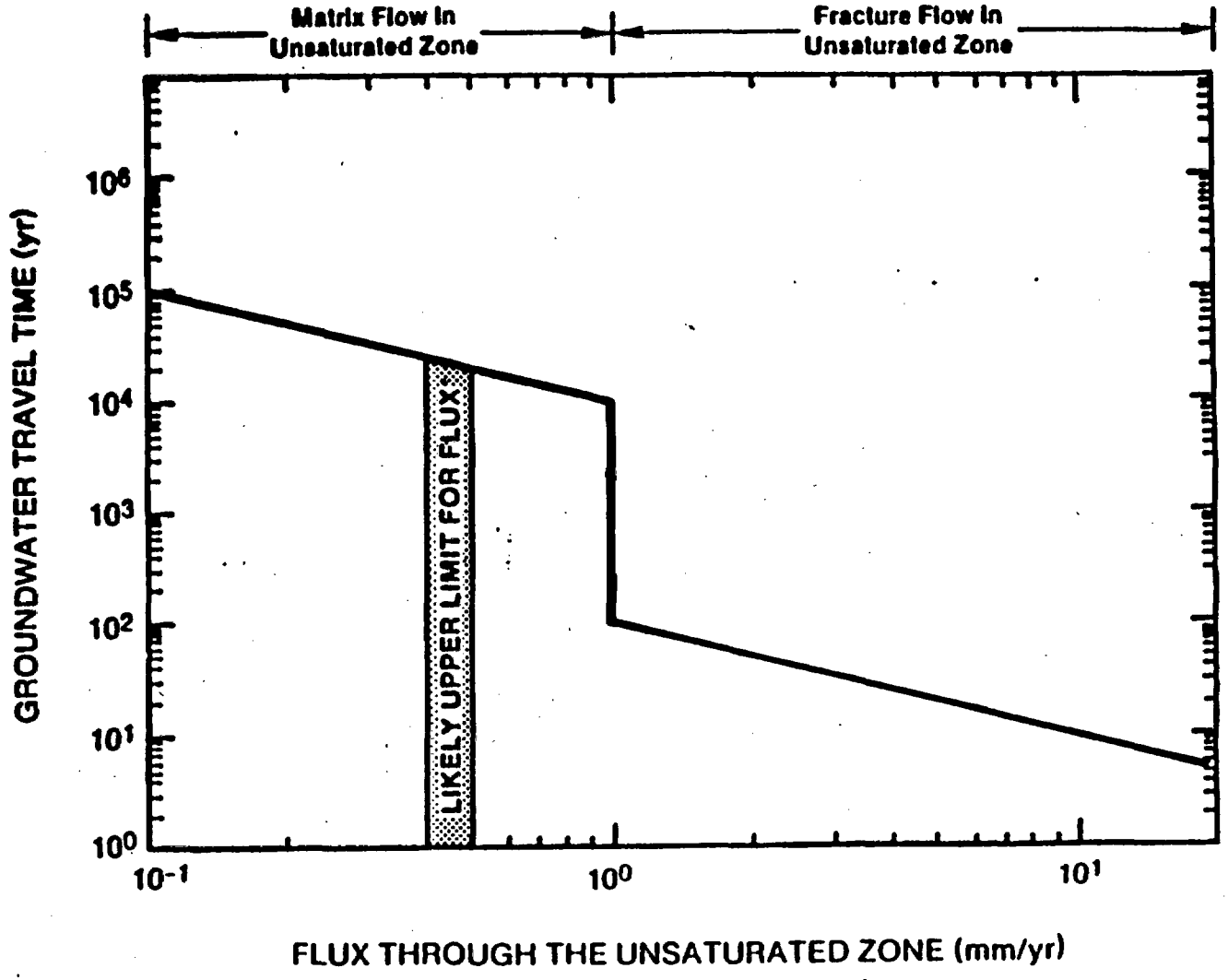
SPARTAN CALCULATIONS (SIMPLE GEOMETRY, SIMPLE PROCESS)



Path A: Fracture flow for flux in excess of 1 mm/yr, identical properties assumed for Topopah Spring and Calico Hills units
Path B: Matrix flow for flux up to 1 mm/yr
Path C: Matrix flow for all values of flux
*Undefined thickness of Topopah Spring unit ignored in calculations

SPARTAN CALCULATIONS (SIMPLE GEOMETRY, SIMPLE PROCESS)



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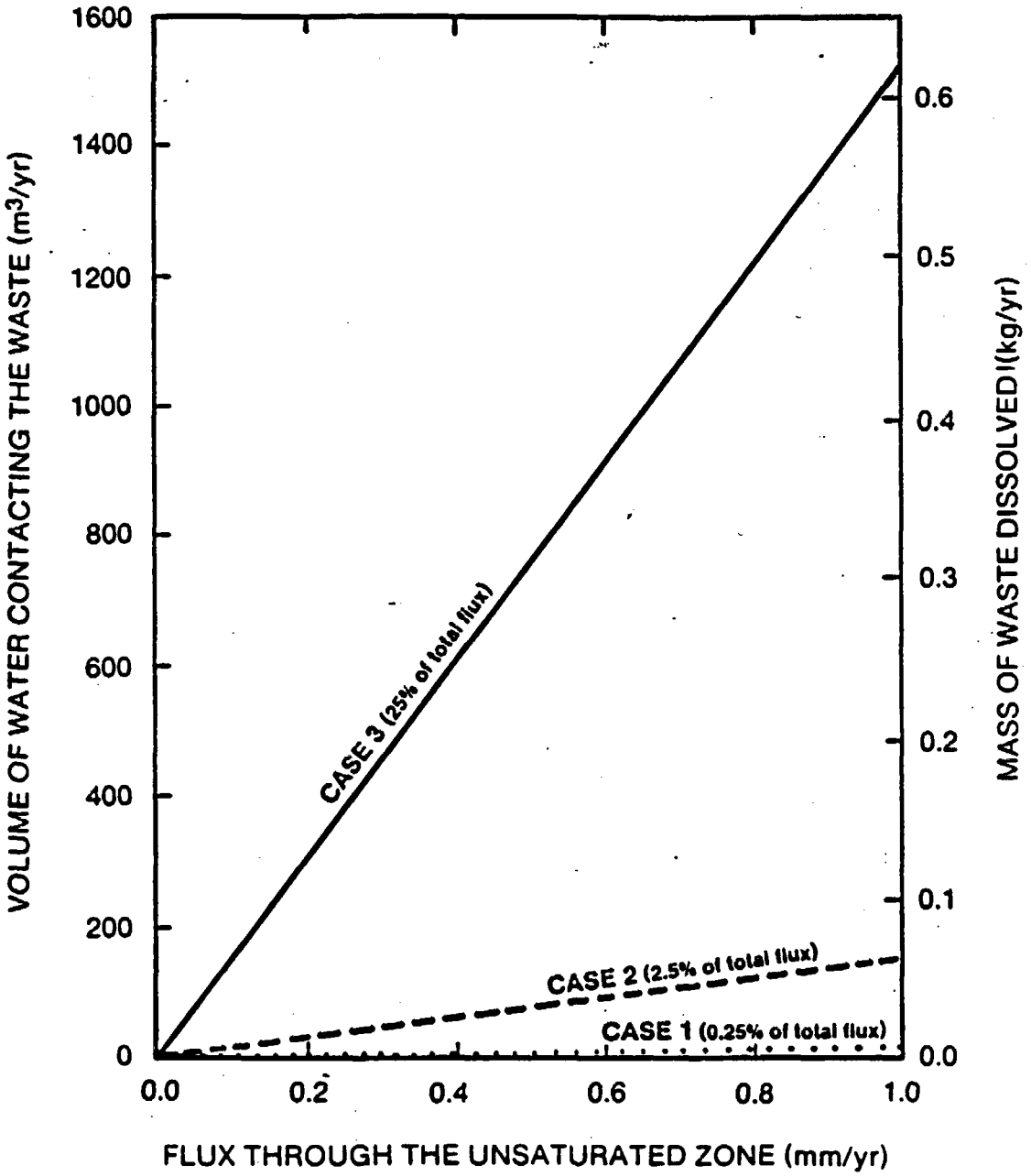
SPARTAN CALCULATIONS
(SIMPLE GEOMETRY, SAMPLE PROCESS)



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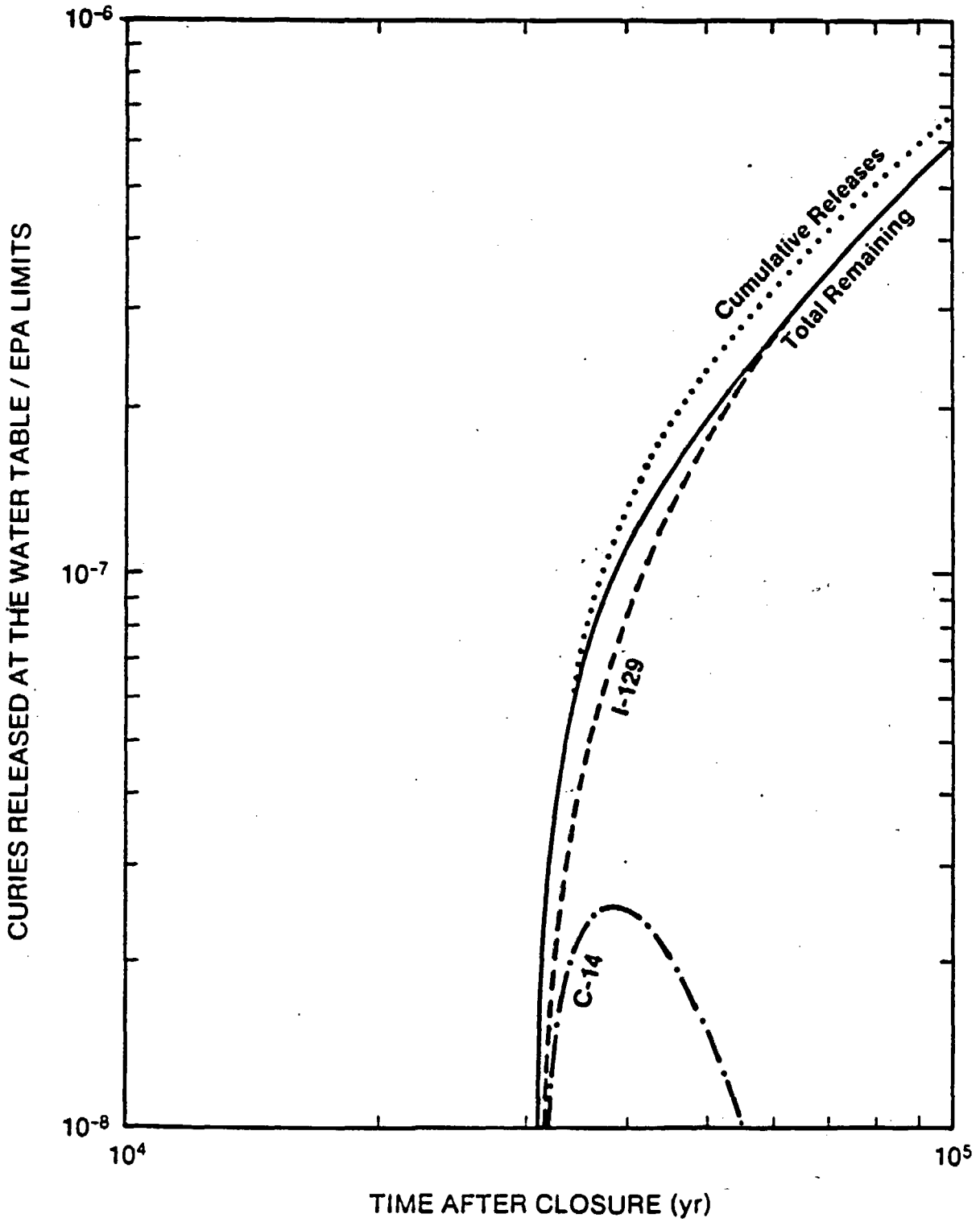
SPARTAN CALCULATIONS
(SIMPLE GEOMETRY, SIMPLE PROCESS)



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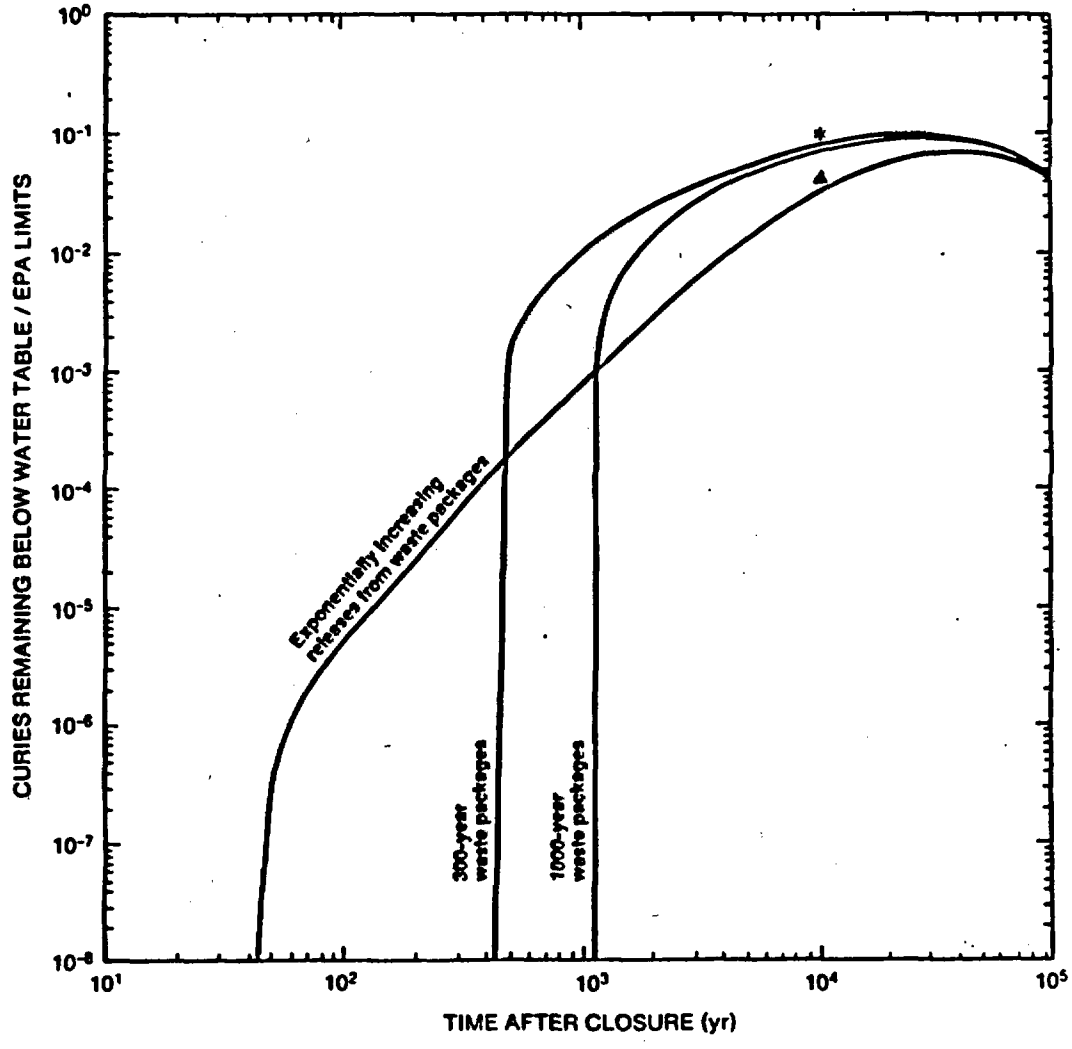
SPARTAN CALCULATIONS (SIMPLE GEOMETRY, SAMPLE PROCESS)



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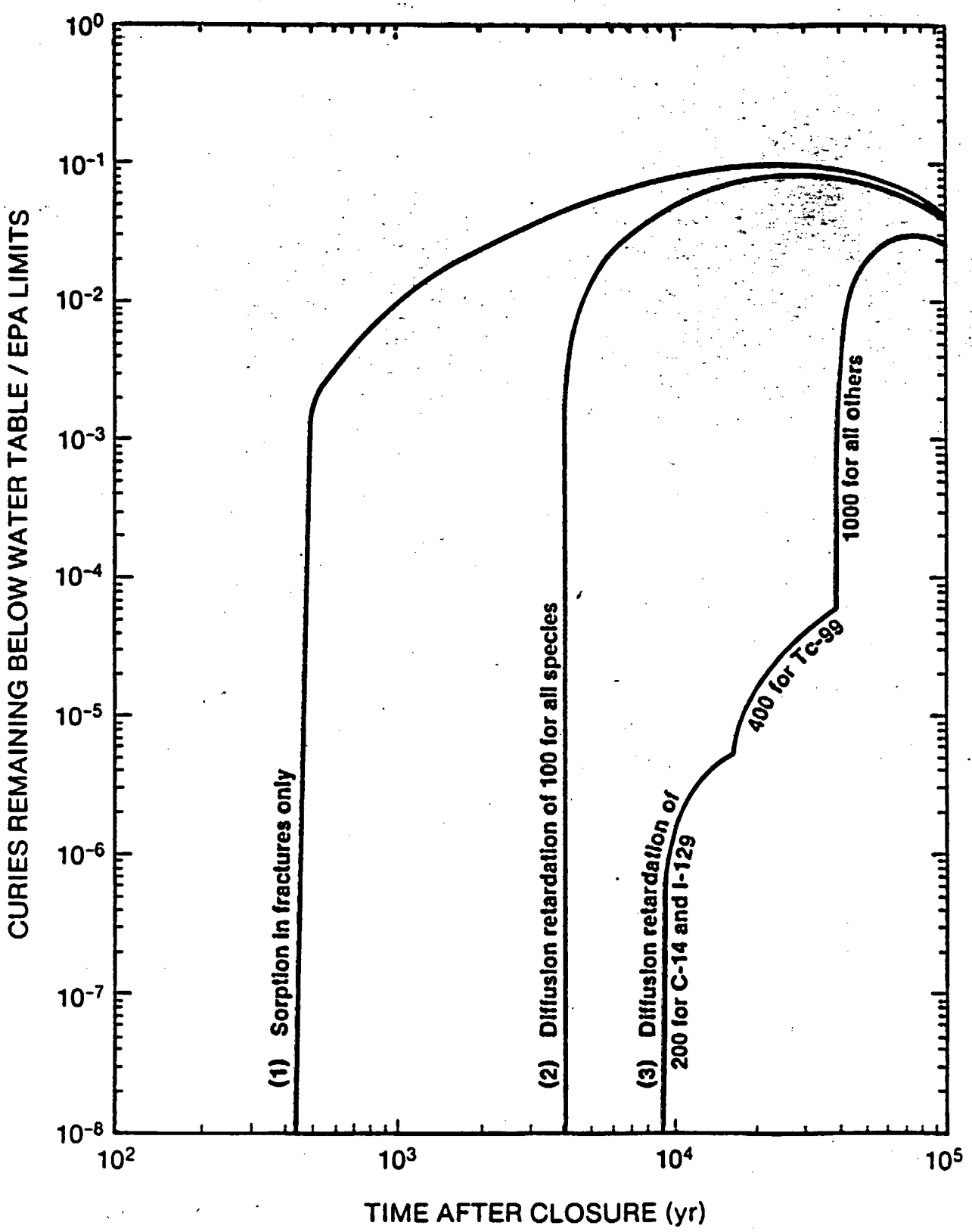
SPARTAN CALCULATIONS
(SIMPLE GEOMETRY, SAMPLE PROCESS)



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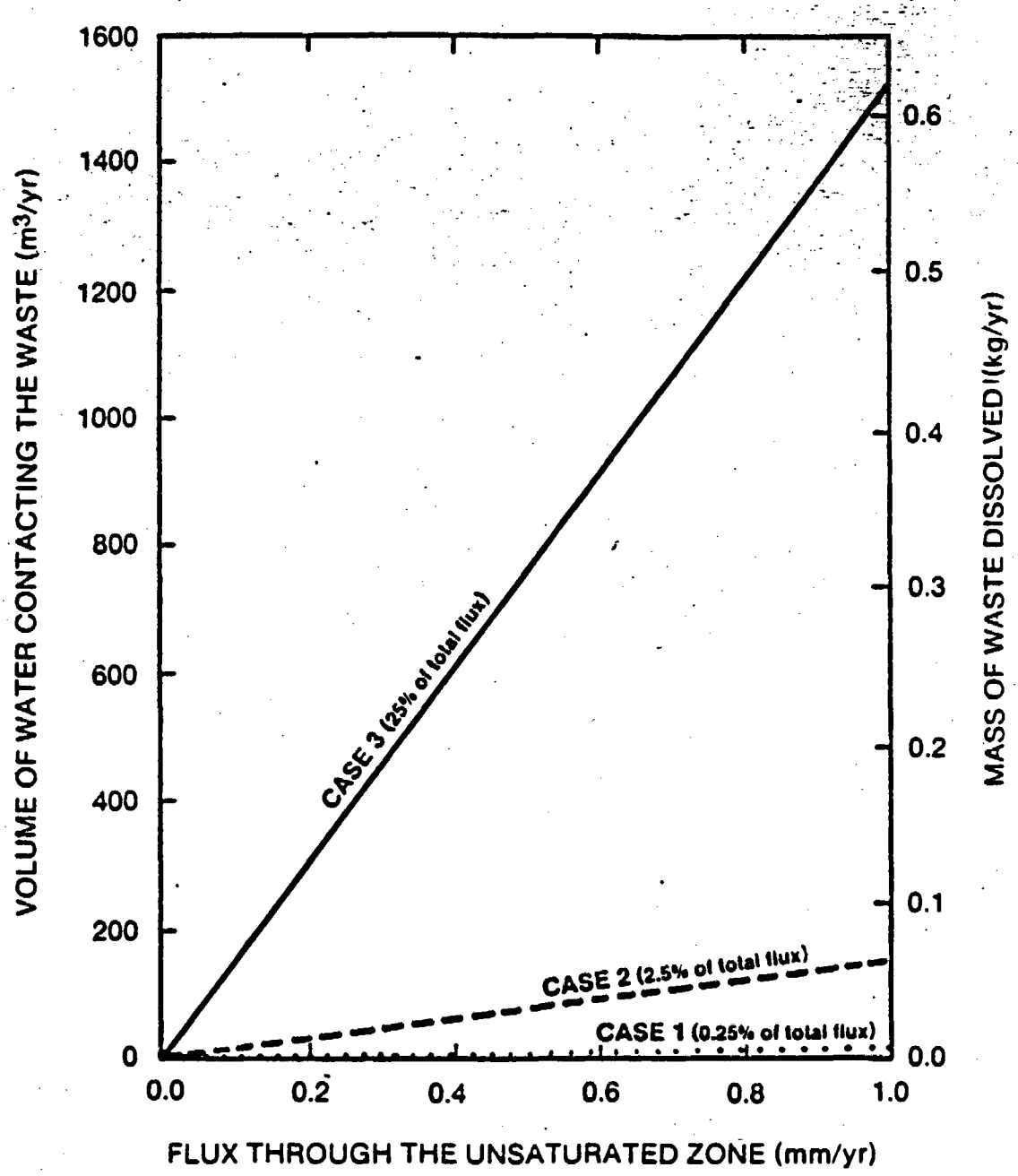
SPARTAN CALCULATIONS
(SIMPLE GEOMETRY, SIMPLE PROCESS)



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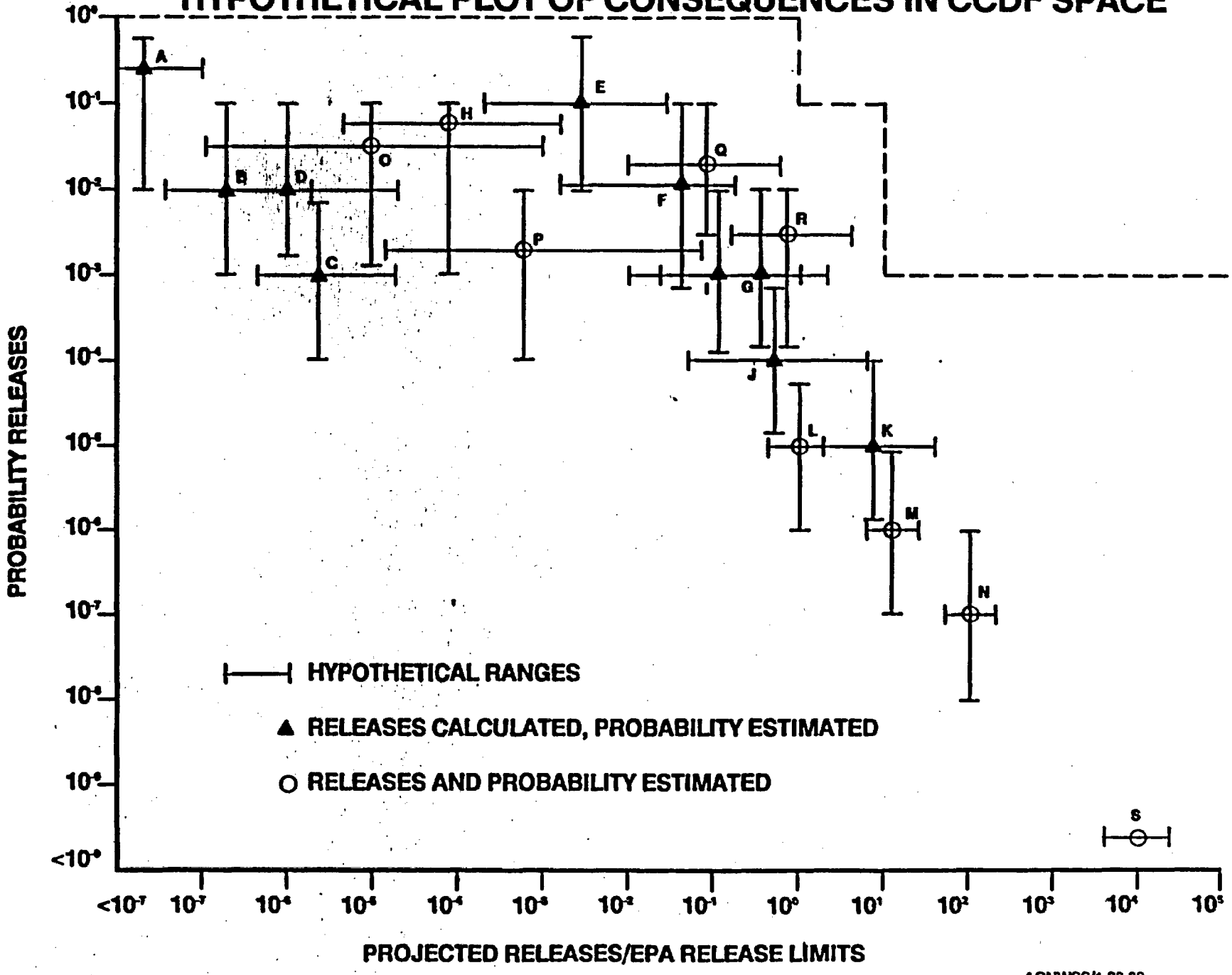
HYPOTHETICAL PLOT OF CONSEQUENCES IN CCDF SPACE



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ANALYSES PLOTTED IN CCDF SPACE

Analysis	Probability	Description	Reference
A	$5x10^{-1} - 10^{-2}$	Nominal scenario, all aqueous releases, flux $\leq$ 1.0 mm/yr, all matrix flow, 0.25% of flux contacting waste saturated with uranium oxide, solubility limited releases, congruent leaching.	1
B	$10^{-1} - 10^{-3}$	Same as A, but 2.5% of flux contacting waste.	1,2
C	$10^{-2} - 10^{-4}$	Same as A, but 25.0% of flux contacting waste.	1
D	$10^{-1} - 10^{-3}$	Nominal fracture flow scenario, massive sustained fracture flow, conceptual uncertainty in hydrology, flux $\leq$ 5 mm/yr, retardation by matrix diffusion for flux in fractures, also reasonable climate change scenario to increase flux.	6
E	$5x10^{-1} - 10^{-2}$	Bounding release scenario at repository, limit on aqueous releases at place of emplacement, flux $\leq$ 1.0 mm/yr, 0.25% of flux contacting waste saturated with uranium oxide, solubility limited releases, congruent leaching, very high Eh for unsaturated conditions, no credit for transport through site.	3
F	$10^{-1} - 10^{-3}$	Same as E, but 2.5% of flux contacting waste.	3
G	$10^{-2} - 10^{-4}$	Same as E, but 25.0% of flux contacting waste.	3
H	$10^{-1} - 10^{-3}$	Bounding release scenario through saturated zone, limit on aqueous releases through saturated zone assuming lower Eh and precipitation of waste species due to lower solubility where Eh drops in saturated zone.	None, See 3,8
I	$10^{-2} - 10^{-4}$	Bounding fracture flow scenario under high flux, (5 mm/yr), massive sustained fracture flow (60% of flux), no retardation by matrix diffusion, 2.5% of flux contacting waste, compare scenario D.	4,5
J	$10^{-3} - 10^{-5}$	Bounding climate change scenario, 20 mm/yr flux, massive, sustained fracture flow (60% of flux), no retardation by matrix diffusion, 2.5% of flux contacting waste.	4
K	$10^{-4} - 10^{-6}$	Same as J, but 25% of flux contacting waste	4
L	$5x10^{-5} - 10^{-6}$	Volcanic Penetration Scenario, 0.01% of waste inventory at 1000 yr entrained in rising magma and deposited on surface, initiating event probability $2x10^{-4}$ to 10^{-5}.	None See 9,10
M	$10^{-5} - 10^{-7}$	Same as L, but 0.1% of waste entrained in magma.	None See 9,10
N	$10^{-6} - 10^{-8}$	Same as L, but 1.0% of waste entrained in magma.	None See 9,10
O	$10^{-1} - 10^{-3}$	Conceptual hydrology scenario, limited periodic fracture flow due to infiltration pulses, seismic pumping, surface flooding, lateral diversion, etc.	None
P	$10^{-2} - 10^{-4}$	Severe tectonic scenarios, raised water table, direct rupture of waste packages, etc.	None

Analysis	Probability	Description	Reference
Q	$10^{-1} - 10^{-3}$	Gaseous release scenario, 1.0% of ^{14}C released at 1000 yrs	None See 7
R	$10^{-2} - 10^{-4}$	Same as Q, but 10% of ^{14}C released at 1000 yrs.	None See 7
S	10^{9}	Total inventory of waste at 1000 yrs., maximum possible releases.	7

References

1. Sinnock, et al., 1987, Figure 12
2. Sinnock, et al., 1987, Figure 13
3. Sinnock, et al., 1987, Figure 11
4. Sinnock, et al., 1984, Figure 27
5. Sinnock, et al., 1987, Figure 15
6. Sinnock, et al., 1984, Figure 20
7. Sinnock, et al., 1987, Table 1
8. Sinnock, et al., 1984, Figure 8
9. Logan, et al., 1982
10. Crowe, et al., 1982

Sinnock, S., Lin, Y.T., and Brannen, J.P., 1984, Preliminary Bounds on the Expected Postclosure Performance of the Yucca Mountain Repository Site, Southern Nevada; SAND84-1492, Sandia National Laboratories, Albuquerque, NM, 82 pp.

Sinnock, S., Lin, Y.T., and Brannen, J.P., 1984, Preliminary Bounds on the Expected Postclosure Performance of the Yucca Mountain Repository Site, Southern Nevada; Jour. Geophysical Research, vol. 92, No. B8, pp. 7820-7842.

Crowe, B.C., Johnson, M.E., and Beckman, R.J., 1982, Calculation of the Probability of Volcanic Disruption of a High-Level Radioactive Waste Repository within Southern Nevada, USA; in Radioactive Waste Management and the Nuclear Fuel Cycle, Harwood Academic Publishers GMBH vol. 3 (2), pp. 167-190.

Logan, S.E., Link, R., Ng, H.S., Rockenback, F.A., and Hong, K.J., 1982, Parametric Studies of Radiological Consequences of Basaltic Volcanism; SAND81-2375, Sandia National Laboratories, Albuquerque, NM, 219 pp.

U.S. DEPARTMENT OF ENERGY
OFFICE OF CIVILIAN RADIOACTIVE WASTE MANAGEMENT

PRESENTATION TO THE ADVISORY COMMITTEE ON NUCLEAR WASTE

SUBJECT:	VALIDATION OF MODELS
DATE:	JANUARY 24, 1989
PRESENTER:	DR. ABRAHAM VAN LUIK
PRESENTER'S TITLE AND ORGANIZATION:	STAFF SCIENTIST PACIFIC NORTHWEST LABORATORY
PRESENTER'S TELEPHONE NUMBER:	(202) 646-5207

RW20772.099

6

VALIDATION OF MODELS

- DEFINITION OF VALIDATION
- REGULATORY REQUIREMENTS OF MODEL VALIDATION
- GENERAL DOE APPROACH TO MODEL VALIDATION
- ENSURING INTERACTION BETWEEN MODELERS AND EXPERIMENTALISTS
- SPECIFIC PLANS AND SCHEDULES FOR TESTING CONCEPTUAL MODELS

DEFINITION OF MODEL VALIDATION

- MODEL VALIDATION IS ESTABLISHING THE SOUNDNESS OF SPECIFIC COMPUTER MODELS AND THE LEGITIMACY OF SPECIFIC APPLICATIONS BEING MADE OF THOSE MODELS

RW20772.057

REGULATORY REQUIREMENTS FOR MODEL VALIDATION

10 CFR 60.21(c)(ii)(F):

"ANALYSIS AND MODELS ... SHALL BE SUPPORTED USING AN APPROPRIATE COMBINATION OF SUCH METHODS AS FIELD TESTS, IN SITU TESTS, LABORATORY TESTS WHICH ARE REPRESENTATIVE OF FIELD CONDITIONS, MONITORING DATA, AND NATURAL ANALOG STUDIES."

RW20772.058

THE VALIDATION OVERSIGHT GROUP

- ESTABLISHED TO GUIDE AND COORDINATE REPOSITORY PROGRAM MODEL VALIDATION EFFORTS
- ESTABLISHED TO FORMULATE A UNIFIED APPROACH FOR CARRYING OUT DOCUMENTING, AND REVIEWING MODEL VALIDATION ACTIVITIES
- FOCUS ON THREE PHASES OF PERFORMANCE ASSESSMENT MODELING:
  - MODEL DEVELOPMENT
  - COMPARING RESULTS AND EXPERIMENTAL DATA
  - PEER REVIEW

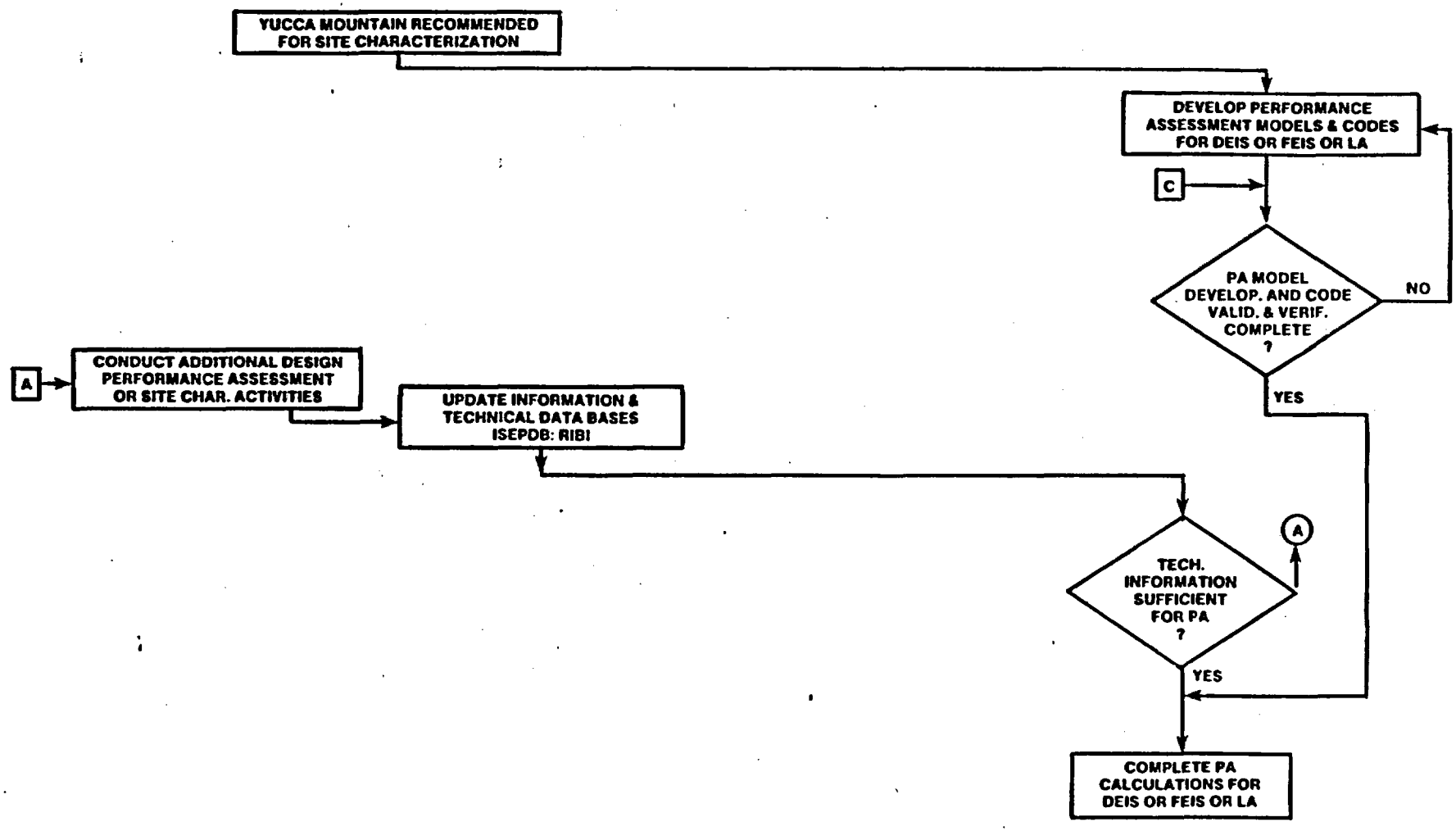
GENERAL APPROACH TO MODEL VALIDATION

- EVALUATING RELEVANT NATURAL AND MAN-MADE ANALOGS, SUCH AS
  - NATURALLY-OCCURRING RADIONUCLIDES NEAR YUCCA MOUNTAIN
  - FIELD AND LABORATORY TRANSPORT EXPERIMENTS (INTRAVAL)
- PEER REVIEW OF MODEL VALIDATION EFFORTS
- SITE-CHARACTERIZATION STUDIES IDENTIFIED IN THE SITE CHARACTERIZATION PLAN

DIFFICULTIES IN VALIDATING MODELS

- SIGNIFICANT UNCERTAINTIES IN LONG-TERM PERFORMANCE EVALUATIONS DUE TO INHERENT UNCERTAINTIES IN:
  - MODELS, BECAUSE OF SYSTEM HETEROGENEITY AND LIMITS ON EXPLORATION AND TESTING
  - SCENARIOS, BECAUSE OF A LACK OF HISTORICAL EVIDENCE RELATING TO FREQUENCY OF OCCURRENCE AND CONSEQUENCES
- REDUCTION OF UNCERTAINTIES MUST RELY ON THE STUDY OF NATURAL AND LABORATORY SYSTEMS THAT ONLY APPROXIMATE THE CONDITIONS IN QUESTION
- TEST PROGRAMS CANNOT SIMULATE THE FULL RANGE OF POSSIBLE AND RELEVANT CONDITIONS OVER THE TIME PERIODS FOR WHICH REPOSITORY PERFORMANCE MUST BE EVALUATED

PERFORMANCE ASSESSMENT PORTION OF SCP GENERAL LOGIC DIAGRAM



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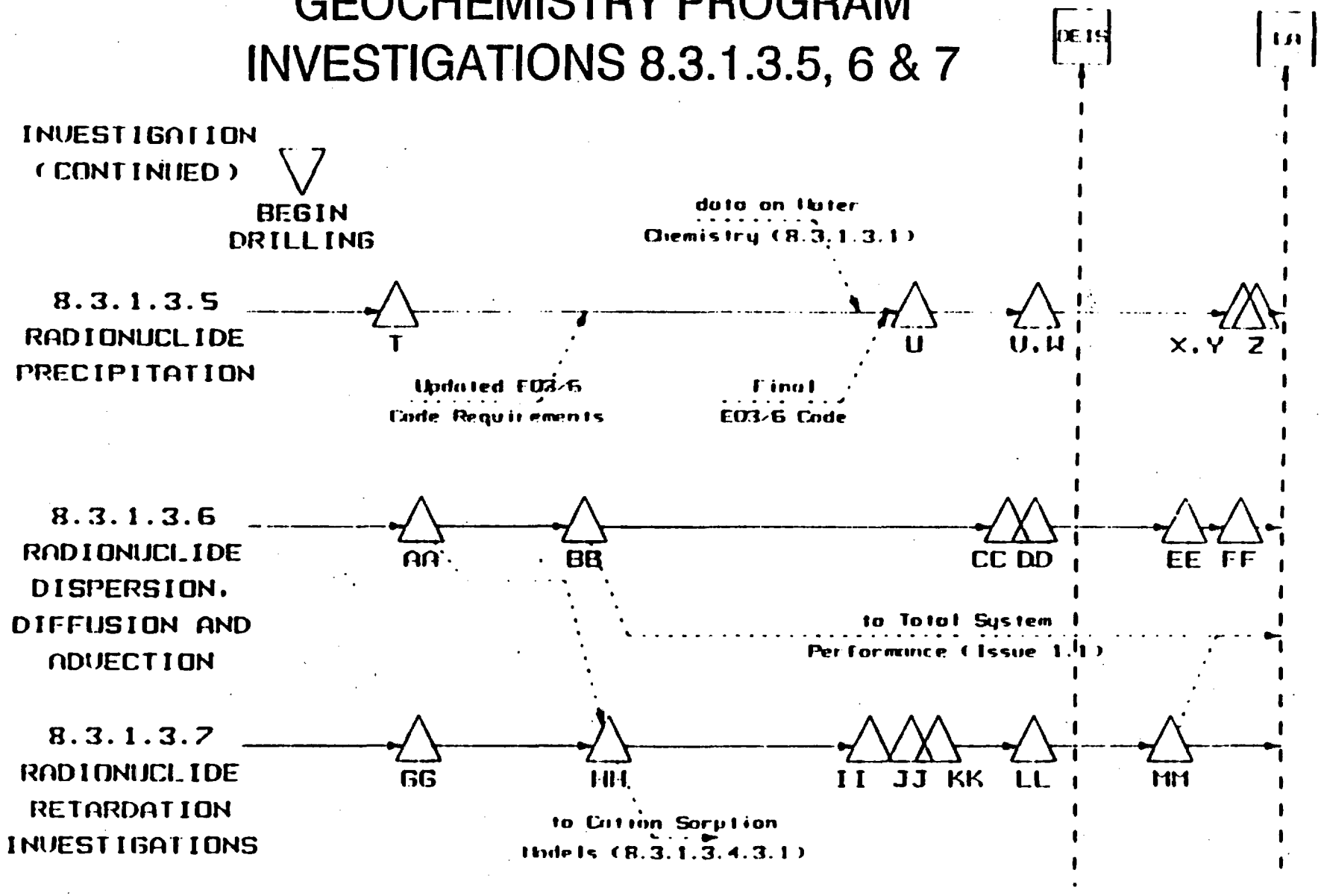
MODELER/EXPERIMENTALIST INTERACTIONS

- NEED FOR CLOSE DIALOGUE BETWEEN THE FIELD AND LABORATORY EXPERIMENTALISTS AND THE PERFORMANCE ASSESSORS RECOGNIZED IN PROGRAM
- WORK IS PLANNED AND ORGANIZED TO ENSURE EXPLICIT INTERACTIONS BETWEEN MODELERS AND EXPERIMENTERS
- THIS INTERACTION IS ILLUSTRATED BY SCHEDULES FOR INVESTIGATIONS 8.3.1.3.5, 6&7 OF THE GEOCHEMISTRY PROGRAM

GEOCHEMISTRY PROGRAM
INVESTIGATIONS 8.3.1.3.5, 6 & 7



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GEOCHEMISTRY PROGRAM INVESTIGATIONS 8.3.1.3.5, 6 & 7

- MAJOR EXPERIMENTALISTS/MODELER INTERACTIONS
  - THE EQ3/6 GEOCHEMICAL MODEL FEEDS REQUIREMENTS TO INVESTIGATION 8.3.1.3.5, AND RECEIVES DATA FROM THIS INVESTIGATION AS WELL AS 8.3.1.3.1 FOR MODEL DEVELOPMENT
  - DEVELOPMENT OF SIMPLIFIED SYSTEM MODEL FOR TOTAL SYSTEM PERFORMANCE ISSUE 1.1 DIRECTLY SUPPORTED BY INVESTIGATIONS 8.3.1.3.6 & 7
  - FORMULATION OF CATION SORPTION MODELS DIRECTLY SUPPORTED BY 8.3.1.3.7
- INVESTIGATION 8.3.1.3.7 DIRECTLY ADDRESSES VALIDATION IN 8.3.1.3.7.2

STUDY 8.3.1.3.7.2

DEMONSTRATION OF APPLICABILITY OF LABORATORY DATA TO REPOSITORY TRANSPORT CALCULATIONS

- DIRECT MODEL VALIDATION ACTIVITIES
  - (1) MODELING
  - (2) LARGE SCALE LABORATORY EXPERIMENTS
  - (3) FIELD TESTING
- OTHER VALIDATION-RELATED ACTIVITIES
  - (1) EVALUATION OF MIGRATION DATA FROM THE NEVADA TEST SITE
  - (2) INVESTIGATION OF NATURALLY OCCURRING RADIONUCLIDES NEAR YUCCA MOUNTAIN
  - (3) REVIEW OF CONTAMINANT TRANSPORT WORK IN SOILS
  - (4) PARTICIPATION IN INTRAVAL

VALIDATION APPROACH FOR A GIVEN MODEL
HYPOTHESIS TESTING

- IDENTIFY A SUITABLE MODEL, FOCUSING ON ITS APPLICATION
- IDENTIFY MODEL ASSUMPTIONS AND UNCERTAINTIES
- FORMULATE CREDIBLE ALTERNATIVE MODELS
- IDENTIFY COMPETING HYPOTHESES UNDERLYING ALTERNATIVE MODELS
- SPECIFY AND CONDUCT APPROPRIATE TESTS OF HYPOTHESES TO:
  - SELECT FROM AMONG COMPETING MODELS
  - EVALUATE SELECTED MODELS
- WHERE CREDIBLE ALTERNATIVE MODELS REMAIN, CONDUCT ANALYSES WITH EACH MODEL OR WITH A BOUNDING MODEL

HYPOTHESIS-TESTING PLAN EXAMPLE: GEOCHEMISTRY MODEL HYPOTHESIS TABLES

- THREE COMPONENTS OF GEOCHEMICAL MODEL
  1) RETARDATION MODEL,
  2) WATER CHEMISTRY MODEL
  3) MINERAL EVOLUTION MODEL
- EACH COMPONENT MODEL IS DISCUSSED INTERMS OF A "CURRENT REPRESENTATION" AND "ALTERNATIVE HYPOTHESES" IN THE SCPS TABLE 8.3.1.3-2
- THUS, THE RETARDATION MODEL WILL BE USED AS AN EXAMPLE

Table 8.3.1.3-2. Current representation and alternative hypotheses for geochemical model for site geochemistry program (page 1 of 8)

Current representation		Uncertainty and rationale	Alternative hypothesis	Significance of alternative hypothesis				Studies or activities to reduce uncertainty
Model element	Current representation			Performance measure, design or performance parameter	Needed confidence in parameter or performance measure	Sensitivity of parameter or performance measure to hypothesis	Need to reduce uncertainty	
RETARDATION MODEL	Radionuclide mobility is substantially retarded by (1) sorption, (2) solubility, and (3) dispersion/diffusion/filtration	High--mechanisms of transport and and retardation are only generally known	Retardation is largely bypassed by flow field characteristics (i.e., rapid along fractures) One retardation process dominates Retardation processes in the natural situation are too complex to model reliably	NA*	NA	NA	NA	8.3.1.3.7--retardation, all processes
Gaseous pathway	Gaseous radionuclide release from the near field is upward through the unsaturated zone, rate and amount of transport can be bounded by engineered barrier system performance assessments and data on vapor phase transport collected in the pre-emplacement time frame	High--site data very limited, calculational models not tested with field data	Vapor transport cannot be modeled adequately	NA	NA	NA	NA	8.3.1.3.7--retardation, all processes

RETARDATION MODEL
ALTERNATIVE HYPOTHESIS EXAMPLE

- CURRENT REPRESENTATION OF THE RETARDATION MODEL IS THAT RADIONUCLIDE MOBILITY IS SUBSTANTIALLY RETARDED BY
  - (1) SORPTION
  - (2) SOLUBILITY
  - (3) DISPERSION/DIFFUSION/FILTRATION
- ALTERNATIVE HYPOTHESES:
  - (1) RETARDATION IS LARGELY BYPASSED BY FLOW FIELD CHARACTERISTICS
  - (2) ONE RETARDATION PROCESS DOMINATES
  - (3) RETARDATION IN THE REPOSITORY IS TOO COMPLEX TO MODEL RELIABLY

RETARDATION MODEL BREAKDOWN FOR DEFINING TESTABLE HYPOTHESES

- RETARDATION MODEL (AS IN SCP TABLE 8.3.1.3-2)
  - GASEOUS PATHWAY
    - DISPERSION/DIFFISION
    - ISOTOPIC EXCHANGE
  - LIQUID PATHWAY
    - SORPTION
      - SORPTION AS FUNCTION OF SUBSTRATE, WATER CHEMISTRY, AND SORBATE CONCENTRATION
      - SORPTION ON PARTICULATES AND COLLOIDS
      - MICROBIAL ACTIVITY
    - SOLUBILITY
      - PRECIPITATION (AQUEOUS SPECIATION AND SOLUBILITY MODELING)
      - COLLOID FORMATION AND STABILITY
    - DISPERSION/DIFFUSION/FILTRATIONS

HYPOTHESES AND STUDIES FOR AN ELEMENT OF THE RETARDATION MODEL

- RETARDATION MODEL ELEMENT/LIQUID PATHWAY/SORPTION
- CURRENT REPRESENTATION: SORPTION IS AN ELEMENT-SPECIFIC FUNCTION OF WATER COMPOSITION, SOLIDS, REDOX CONDITIONS, PH, TEMPERATURE, ROCK TEXTURE, HYDROLOGIC PROPERTIES
- ALTERNATIVE HYPOTHESES
  - SITE-SPECIFIC BEHAVIOR FOR SPECIFIC RADIONUCLIDES IS TOO COMPLEX TO PREDICT WITH CONFIDENCE
  - SORPTION "BARRIER" IS BYPASSED BY PHYSICAL CONDITIONS, RAPID FRACTURE FLOW, COLLOIDAL TRANSPORT
- PLANNED STUDIES TO TEST THE CURRENT AND ALTERNATE REPRESENTATIONS:
  - SORPTION MODELS
  - C-HOLE REACTIVE TRACER TEST

HYPOTHESES AND STUDIES FOR AN ELEMENT OF THE SORPTION MODEL

- SORPTION MODEL ELEMENT/SORPTION AS FUNCTION OF SUBSTRATE, WATER CHEMISTRY, AND SORBATE CONCENTRATION
- CURRENT REPRESENTATION: SORPTION IS CONTROLLED BY THESE PARAMETERS
- ALTERNATIVE HYPOTHESIS: SORPTION CANNOT BE MODELED AS A FUNCTION OF THESE PARAMETERS
- PLANNED STUDIES TO TEST THE CURRENT AND ALTERNATIVE REPRESENTATIONS:
  - MINERAL DISTRIBUTION
  - SORPTION AS A FUNCTION OF SOLID PHASE COMPOSITION
  - SORPTION AS A FUNCTION OF GROUND-WATER COMPOSITION
  - STATISTICAL ANALYSIS
  - CRUSHED TUFF COLUMN EXPERIMENTS
  - MASS TRANSFER KINETICS
  - UNSATURATED TUFF COLUMN EXPERIMENTS

U.S. DEPARTMENT OF ENERGY
OFFICE OF CIVILIAN RADIOACTIVE WASTE MANAGEMENT

PRESENTATION TO THE ADVISORY COMMITTEE ON NUCLEAR WASTE

SUBJECT:	EXAMPLE OF PERFORMANCE ALLOCATION THE WASTE PACKAGE TESTING PROGRAM FOR ISSUE 1.4
DATE:	JANUARY 24, 1989
PRESENTER:	DR. U-SUN PARK
PRESENTER'S TITLE AND ORGANIZATION:	SENIOR STAFF SYSTEMS ENGINEER SCIENCE APPLICATIONS INTERNATIONAL CORPORATION
PRESENTER'S TELEPHONE NUMER:	(702) 733-9958

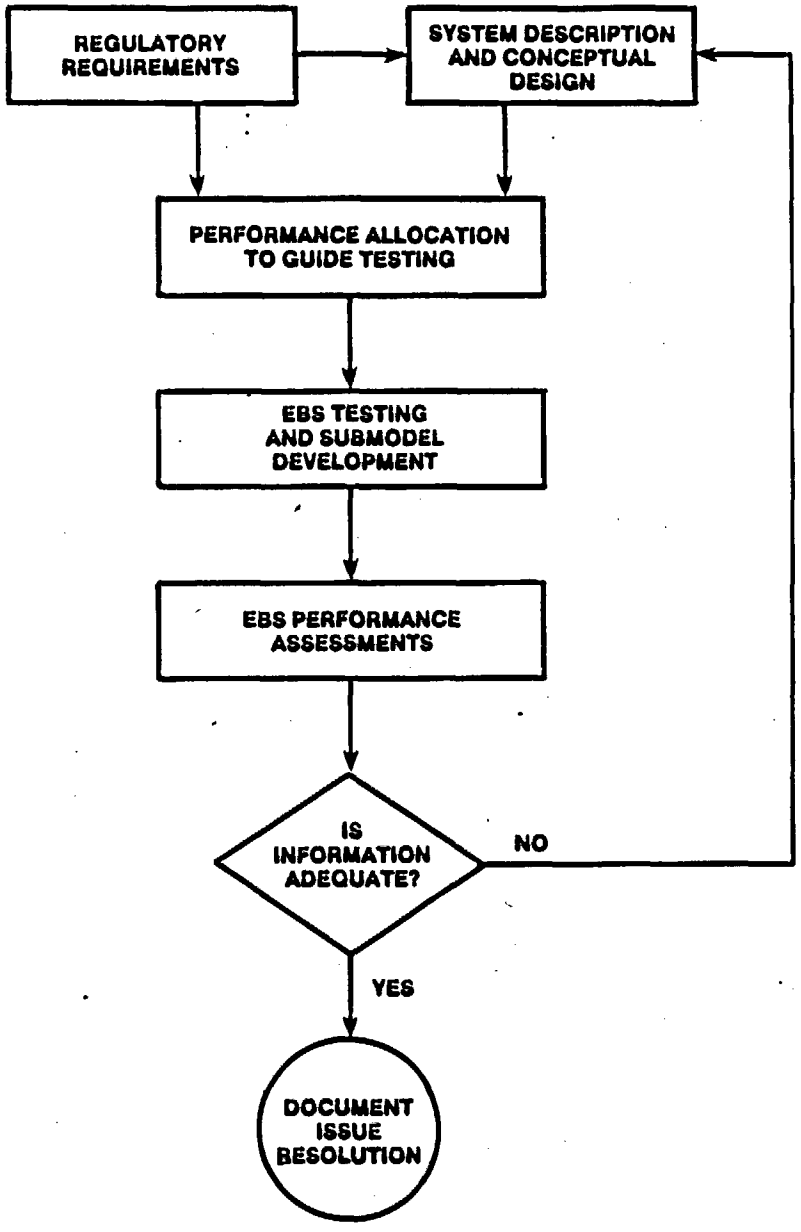
RW20772.100

PERFORMANCE ALLOCATION FOR ISSUE 1.4

- REGULATORY REQUIREMENTS
- SYSTEM DESCRIPTION AND ANALYSES
- TECHNICAL STRATEGY FOR LICENSING
- PERFORMANCE GOALS
  - OVERALL GOALS
  - WASTE PACKAGE COMPONENT GOAL

RW20772.061

STRATEGY FOR ENGINEERED BARRIER SYSTEM (EBS) ISSUE RESOLUTION



0103-0042DS 1/17/89

SUBSTANTIALLY COMPLETE CONTAINMENT REQUIREMENT ON WASTE PACKAGE

- 10 CFR 60.113 (a)(1)(ii)(A)

  CONTAINMENT OF HLW WITHIN THE WASTE PACKAGES WILL BE SUBSTANTIALLY COMPLETE FOR A PERIOD TO BE DETERMINED BY THE COMMISSION TAKING INTO ACCOUNT THE FACTORS SPECIFIED IN 60.113(b) PROVIDED, THAT SUCH PERIOD SHALL BE NOT LESS THAN 300 YEARS NOR MORE THAN 1,000 YEARS AFTER PERMANENT CLOSURE OF THE GEOLOGIC REPOSITORY

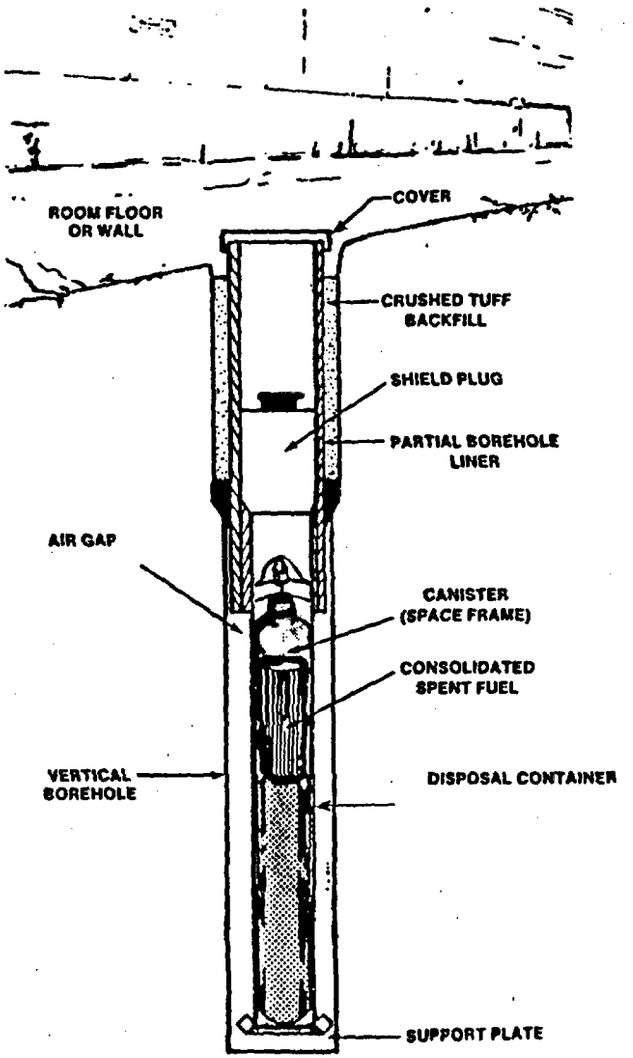
RW20772.037

RELEASE RATE CONTROL REQUIREMENT ON ENGINEERED BARRIER SYSTEM

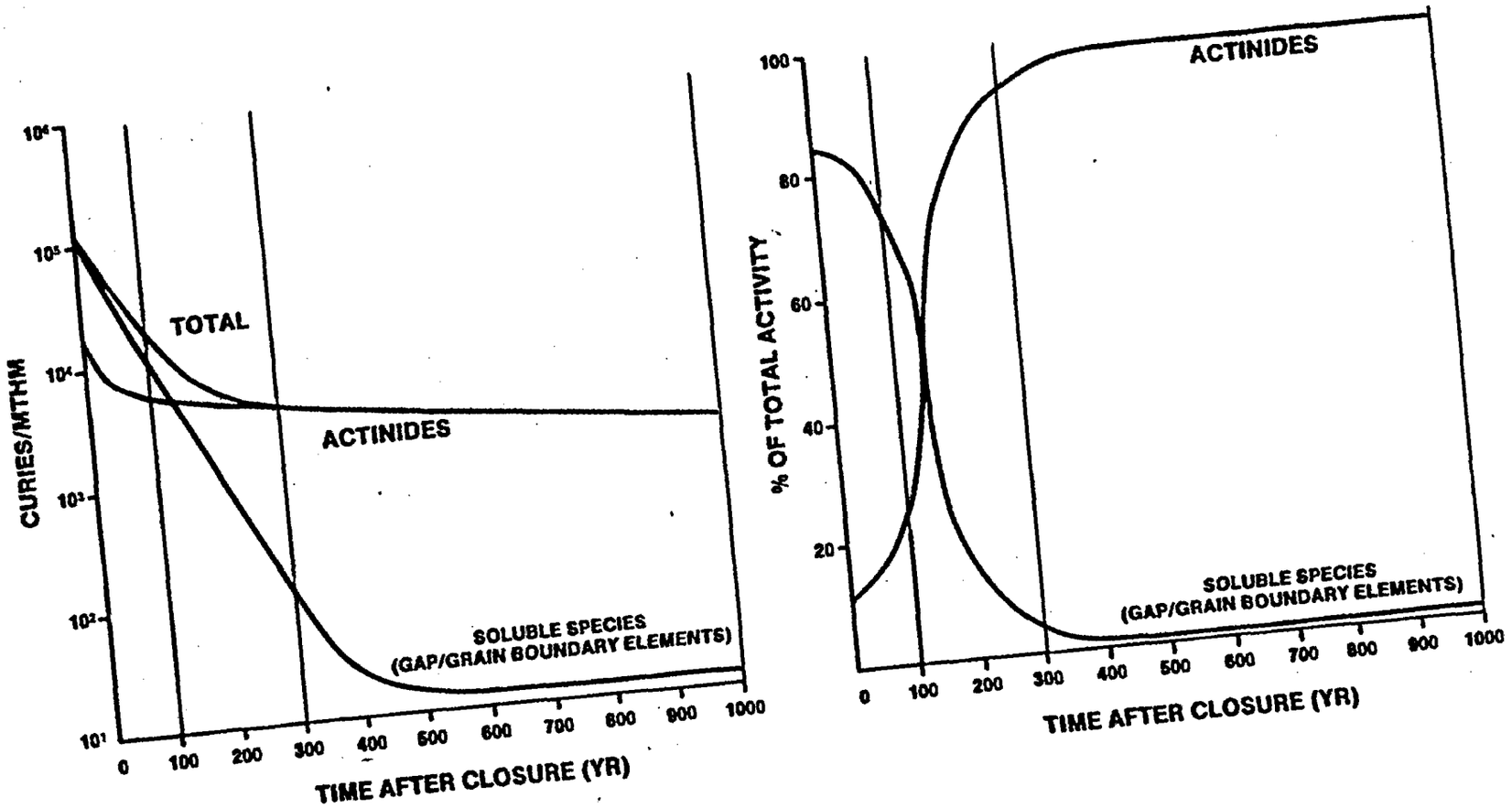
- 10 CFR 60.113(a)(1)(ii)(B)

  THE RELEASE RATE OF ANY RADIONUCLIDE FROM THE ENGINEERED BARRIER SYSTEM FOLLOWING THE CONTAINMENT PERIOD SHALL NOT EXCEED ONE PART IN 100,000 PER YEAR OF THE INVENTORY OF THAT RADIONUCLIDE CALCULATED TO BE PRESENT AT 1,000 YEARS FOLLOWING PERMANENT CLOSURE, OR SUCH OTHER FRACTION OF THE INVENTORY AS MAY BE APPROVED OR SPECIFIED BY THE COMMISSION: PROVIDED, THAT THIS REQUIREMENT DOES NOT APPLY TO ANY RADIONUCLIDE WHICH IS RELEASED AT A RATE LESS THAN 0.1% OF THE CALCULATED TOTAL RELEASE RATE LIMIT. THE CALCULATED TOTAL RELEASE RATE LIMIT SHALL BE TAKEN TO BE ONE PART IN 100,000 PER YEAR OF THE INVENTORY OF RADIOACTIVE WASTE, ORIGINALLY EMPLACED IN THE UNDERGROUND FACILITY, THAT REMAINS AFTER 1,000 YEARS OF RADIOACTIVE DECAY.

ENGINEERED BARRIER SYSTEM



KEY RADIONUCLIDE GROUP ACTIVITIES AND THEIR RELATIVE CONTRIBUTIONS IN SPENT FUEL



0319-J001DS 1/11/88

SUBSTANTIALLY COMPLETE CONTAINMENT

- DOE INTERPRETATION

  DOE UNDERSTANDS SUBSTANTIALLY COMPLETE CONTAINMENT MEANS THAT THE SET OF WASTE PACKAGES WILL FULLY CONTAIN THE TOTAL RADIONUCLIDE INVENTORY FOR A PERIOD OF 300 TO 1,000 YEARS FOLLOWING PERMANENT REPOSITORY CLOSURE, ALLOWING FOR RECOGNIZED TECHNOLOGICAL AND PREDICTIVE LIMITATIONS

- DESIGN BASIS

  DOE WILL IMPOSE DESIGN REQUIREMENTS ON THE WASTE PACKAGE TO ENSURE THAT

  (1) A LARGE FRACTION OF THE RADIOACTIVITY WILL BE CONTAINED WITHIN THE ENSEMBLE OF THE WASTE PACKAGES FOR THE DURATION OF THE CONTAINMENT PERIOD, AND

  (2) ANY RADIOACTIVITY RELEASED FROM THE SET OF WASTE PACKAGES WILL BE RELEASED AT A VERY LOW RATE, RELATIVE TO THE TOTAL INVENTORY

RW20772.039

OBJECTIVES OF WASTE PACKAGE TESTING PROGRAM FOR ISSUE 1.4

ISSUE 1.4

WILL THE WASTE PACKAGE MEET THE PERFORMANCE OBJECTIVE FOR CONTAINMENT AS REQUIRED BY 10 CFR 60.113 (a)(1)(ii)(A)?

↓

PRIMARY OBJECTIVE:

PROVIDE TOTAL CONTAINMENT OF THE ENCLOSED WASTE FOR THE CONTAINMENT PERIOD UNDER ANTICIPATED REPOSITORY CONDITIONS RECOGNIZING TECHNOLOGICAL LIMITATIONS AND RESIDUAL UNCERTAINTIES

FOR BREACHED CONTAINERS

↓

SECONDARY OBJECTIVE:

LIMIT THE RELEASE OF RADIONUCLIDES FROM THE ENSEMBLE OF WASTE PACKAGES TO A VERY LOW RATE RELATIVE TO THE TOTAL INVENTORY

RW20772.093

SETTING WASTE PACKAGE AND COMPONENT GOALS

- PROVIDES GUIDE TO WASTE PACKAGE TESTING PROGRAM
- IS BASED ON MULTIPLE BARRIER APPROACH
- IS AN ITERATIVE PROCESS USING INPUTS FROM SITE AND WASTE FORM CHARACTERIZATION, REPOSITORY AND WASTE PACKAGE DESIGN (CONCEPTUAL DESIGN, ACD AND LAD), AND WASTE PACKAGE PERFORMANCE ASSESSMENT
- GOALS ARE SET BASED ON ASSESSMENT OF AVAILABLE DATA AND THEORY FOR PERFORMANCE OF THE WASTE PACKAGE COMPONENTS UNDER BOUNDING CONDITIONS UTILIZING CURRENT KNOWLEDGE
- THE GOALS ARE FOR THE WASTE PACKAGE TESTING PROGRAM AND THEY ARE NOT DESIGN CRITERIA

RW20772.036

OVERALL TENTATIVE GOALS FOR WASTE PACKAGE TESTING PROGRAM FOR ISSUE 1.4

(1) FOR EACH OF THOSE RADIONUCLIDES WHOSE RELEASE IS LIMITED BY 10 CFR 60.113(a)(1)(ii)(B), THE RELEASE RATE FROM THE SET OF EMPLACED WASTE PACKAGES DURING THE CONTAINMENT PERIOD DOES NOT EXCEED 1 PART IN 1,000,000 PER YEAR OF ITS INVENTORY CALCULATED TO BE PRESENT AT 1,000 YEARS FOLLOWING REPOSITORY CLOSURE, AND

(2) FOR EACH OF THOSE RADIONUCLIDES WHOSE RELEASE IS NOT LIMITED BY (1) ABOVE, THE RELEASE RATE FROM THE SET OF EMPLACED WASTE PACKAGES DURING ANY YEAR OF THE CONTAINMENT PERIOD DOES NOT EXCEED 1 PART IN 100,000 PER YEAR OF THE INVENTORY OF THAT RADIONUCLIDE CALCULATED TO BE PRESENT IN THAT YEAR

IMPLICATIONS OF THESE OVERALL TENTATIVE GOALS FOR WASTE PACKAGE TESTING PROGRAM

GOAL 1

- THE RELEASE RATE GOAL IS SUBSTANTIALLY LESS THAN THE RELEASE RATE ALLOWED DURING POST CONTAINMENT PERIOD FROM THE EBS
- AT THIS RATE, THE TOTAL AMOUNT OF RADIONUCLIDES RELEASED DURING THE CONTAINMENT PERIOD WOULD BE LESS THAN 1% OF THE TOTAL ALLOWED RELEASE FROM THE EBS FOR THE ENTIRE 10,000 YEAR PERIOD

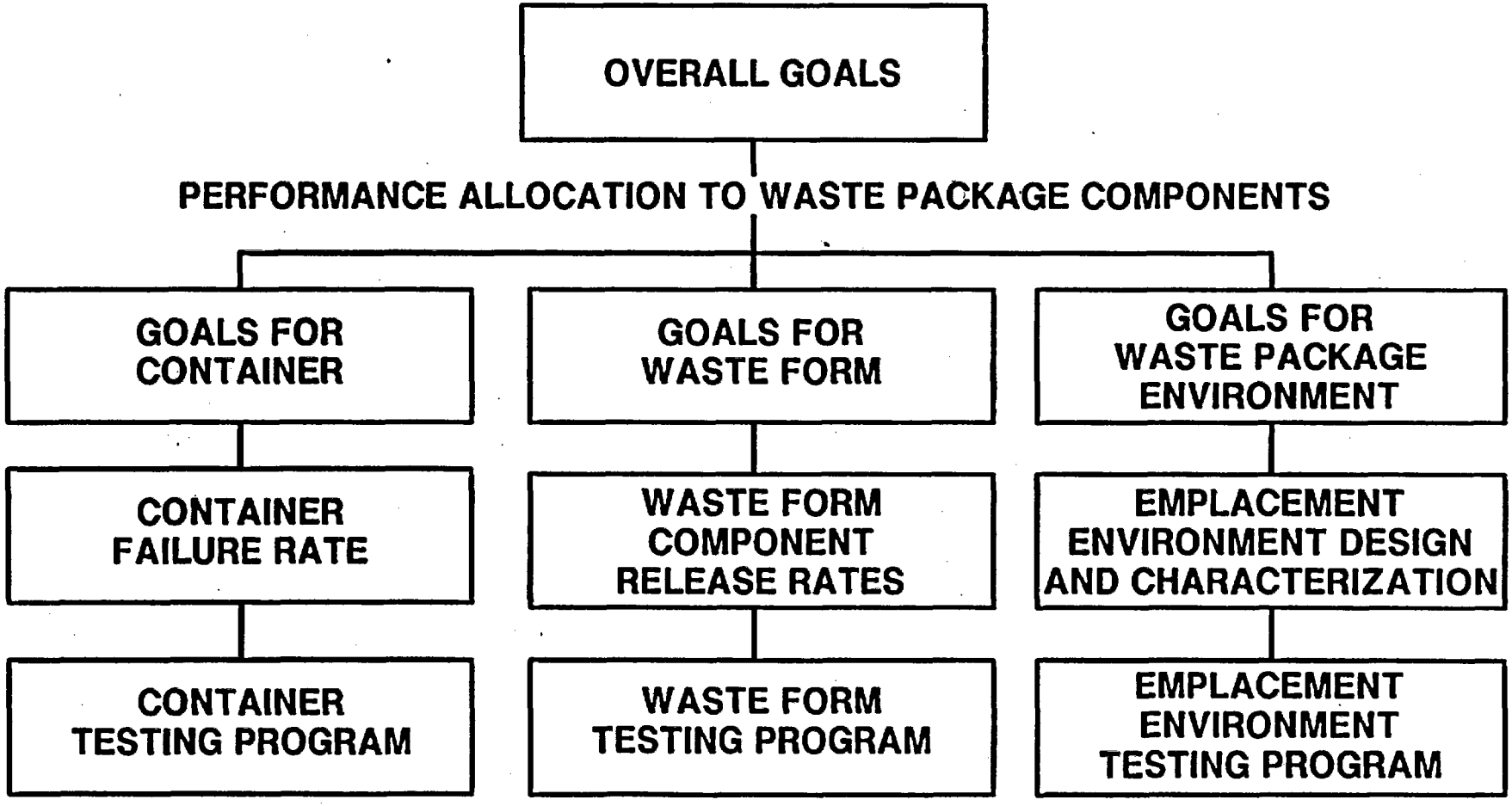
IMPLICATIONS OF THESE OVERALL TENTATIVE GOALS FOR WASTE PACKAGE TESTING PROGRAM (cont.)

GOAL 2

- THIS GOAL APPLIES TO RADIONUCLIDES WHICH HAVE FAST DECAYING NATURE WITH A RAPIDLY DECREASING INVENTORY AND WHICH HAVE PARTICULAR RELEASE CHARACTERISTICS
- RELEASE OF THESE RADIONUCLIDES WILL CONTRIBUTE AN INSIGNIFICANT AMOUNT TO THE TOTAL AMOUNT OF RELEASE TO THE ACCESSIBLE ENVIRONMENT FOR THE ENTIRE 10,000 YEAR PERIOD
- THESE RADIONUCLIDES ARE NOT LIKELY TO HAVE SIGNIFICANT CONSEQUENCES ON THE PUBLIC HEALTH AND SAFETY DUE TO RAPID DECAY DURING TRANSPORT TO THE ACCESSIBLE ENVIRONMENT

RW20772.128

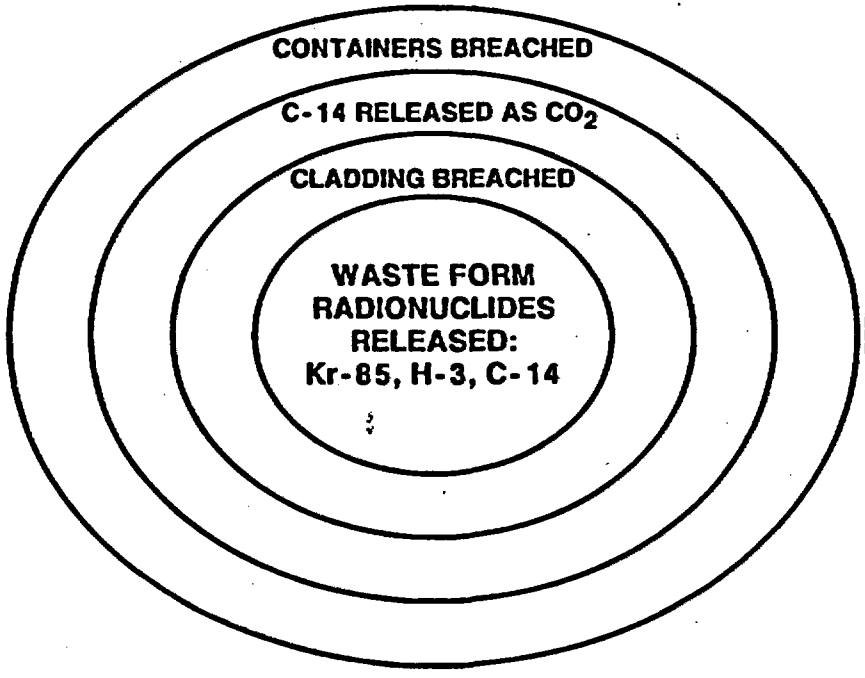
TENTATIVE GOALS FOR WASTE PACKAGE TESTING PROGRAM



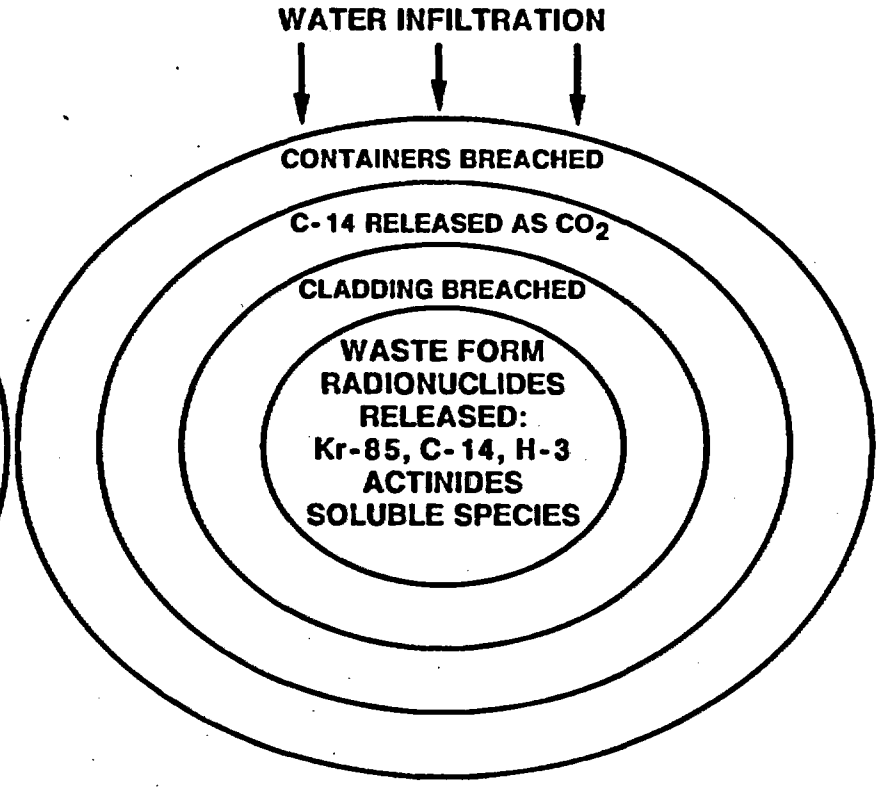
RW20772.092

CONSIDERATIONS FOR WASTE PACKAGE COMPONENT GOALS

NO LIQUID WATER CONTACTS WASTE PACKAGE (EXPECTED CASE)



SOME LIQUID WATER CONTACTS WASTE PACKAGE



RW20772.116

CONSIDERATIONS FOR WASTE PACKAGE COMPONENT GOALS

RATIONALE FOR DIVIDING CONTAINMENT PERIOD (1000 YR) INTO SEGMENTS

$0<t\leq100$ YR:*

- HIGH TEMPERATURES
- FUEL MOST VULNERABLE TO OXIDATION IF CONTAINER AND CLADDING FAILS
- INVENTORY DOMINATED BY 10-30 YR HALF-LIFE FISSION PRODUCTS
- Kr-85 AVAILABLE FOR GASEOUS RELEASE

$100<t\leq300$ YR:

- TEMPERATURES LOWER BUT >100 C
- ACTINIDE FRACTION OF INVENTORY INCREASES FROM APPROXIMATELY 50% TO >95%

$300<t\leq1000$ YR:

- TEMPERATURES AT ROCK SURFACE FALL BELOW BOILING FOR NEARLY ALL PACKAGES
- ACTINIDES DOMINATE INVENTORY
- C-14 AND Tc-99 ARE SIGNIFICANT DUE TO RAPID RELEASE MECHANISMS

*TIMES ARE POST-CLOSURE

RW20772.054

CONSIDERATIONS FOR WASTE PACKAGE COMPONENT GOALS

MAJOR RADIONUCLIDE RELEASE CONCERNS

TIME AFTER CLOSURE (YR.)	RADIONUCLIDE SPECIE	HALF LIFE (YR)
$t \leq 100$	C-14	5,730
	Kr-85	11
	Cs-137 (Ba)	30
	Sr-90 (Y)	29
$100 < t \leq 300$	C-14	5,730
	Cs-137 (Ba)	30
	Sr-90 (Y)	29
	Am-241	432
$300 < t \leq 1000$	Am-241	432
	C-14	5,730
	Pu-240	6,537
	Pu-239	24,065
	Ni-59	75,000
	Tc-99	2.1×10^5

RW20772.077

TENTATIVE PERFORMANCE GOALS FOR CONTAINER

(1) A VALUE FOR THE LIMIT OF CUMULATIVE BREACHES (PRIMARY OBJECTIVE) WILL BE DETERMINED AS PART OF THE CONTAINER MATERIAL STUDIES AND WILL BE CONSISTENT WITH REGULATORY INTENT, AND

(2) FOR THE SMALL FRACTION OF CONTAINERS THAT BREACH

	MAXIMUM CONTAINER BREACH RATE (FRACTION/YR)	
TIME AFTER CLOSURE	CONTAINERS WITH NO LIQUID WATER CONTACT	CONTAINERS WITH LIQUID WATER CONTACT
$t \leq 100$	<0.0001	<0.0005
$100 < t \leq 300$	<0.0005	<0.0005
$300 < t \leq 1000$	<0.001	<0.001

RW20772.078

TENTATIVE PARAMETER GOALS FOR WASTE FORMS

TIME AFTER CLOSURE (YR.)	CUMULATIVE RELEASE OF RADIONUCLIDES AS FRACTION OF TOTAL CURIE INVENTORY OF THE ENSEMBLE OF BREACHED PACKAGES
$t \leq 300$	$< 2 \times 10^{-2}$
$300 < t \leq 1000$	$< 1 \times 10^{-2}$

RW20772.079

TENTATIVE PARAMETER GOALS FOR WASTE FORM COMPONENTS

TIME AFTER CLOSURE (YR.)	FRACTION OF BREACHED CLADDING	FRACTION OF C-14 THAT CAN BE RELEASED RAPIDLY	FRACTION OF Kr-85 AND SOLUBLE SPECIES RELEASABLE	FRACTION OF ACTINIDE RELEASABLE	FRACTION OF OTHER MATRIX RADIONUCLIDES RELEASABLE
$t \leq 100$	<0.02	<0.01	<1.0	$<1 \times 10^{-4}$	<0.01
$100 < t \leq 300$	<0.05	<0.002	<0.2	<0.001	<0.01
$300 < t \leq 1000$	<0.5	<0.001	<0.03	<0.01	<0.01

RW20772.080

TENTATIVE PERFORMANCE GOALS FOR WASTE PACKAGE ENVIRONMENT

1) QUANTITY OF WATER CONTACTING WASTE PACKAGES

   EXPECTED CASE: NO LIQUID WATER CONTACTS WASTE PACKAGE
   BOUNDING CASE:

TIME AFTER CLOSURE (YR.)	CONTAINERS CONTACTED BY LIQUID WATER	ANNUAL WATER VOLUME CONTACTING WASTE PACKAGES (DRY)(L/PKG)
$t \leq 300$	5	<5
$300 < t \leq 1000$	10	<5

2) WATER CHEMISTRY ACCEPTABLE FOR CONTAINER AND WASTE FORM PERFORMANCE FOR 1000 YEARS

3) FRACTION OF NUMBER OF WASTE PACKAGE EMPLACEMENT BOREHOLES THAT WILL BE INITIALLY CONTACTED BY LIQUID WATER ≤ 0.01 PER YEAR FOR 1000 YEARS

RW20772.081

ISSUE 1.4 SPENT FUEL RADIONUCLIDE RELEASE CALCULATION FOR EXPECTED CASE

RADIO-NUCLIDE	YEARS AFTER CLOSURE	MAXIMUM FRACTION OF INVENTORY RELEASABLE	x	MAXIMUM FRACTION BREACHED CONTAINERS	x	MAXIMUM FRACTION OF FAILED CLADDINGS	=	MAXIMUM FRACTION OF INVENTORY RELEASED
C-14	0-100	0.01 I_c		0.0001/yr.		-		1×10^{-6} I_c/yr.
	100-300	0.002 I_c		0.0005/yr.		-		1×10^{-6} I_c/yr.
	300-1000	0.001 I_c		0.001/yr.		-		1×10^{-6} I_c/yr.

RW20772.082

ISSUE 1.4 SPENT FUEL RADIONUCLIDE RELEASE CALCULATION FOR EXPECTED CASE (cont.)

RADIO-NUCLIDE	YEARS AFTER CLOSURE	MAXIMUM FRACTION OF INVENTORY RELEASABLE	x	MAXIMUM FRACTION BREACHED CONTAINERS	x	MAXIMUM FRACTION OF FAILED CLADDINGS	=	MAXIMUM FRACTION OF INVENTORY RELEASED
Kr-85	0-100	1.0 I_{Kr}		0.0001/yr.		0.02		2×10^{-6} $I_{Kr/yr.}$
	100-300	0.2 I_{Kr}		0.0005/yr.		0.05		5×10^{-6} $I_{Kr/yr.}$
	300-1000	0.02 I_{Kr}		0.001/yr.		0.5		(b)
H-3	0-100	1.0 I_H		0.0001/yr.		0.02		2×10^{-6} $I_{H/yr.}$
	100-300	0.2 I_H		0.0005/yr.		0.05		5×10^{-6} $I_{H/yr.}$
	300-1000	0.02 I_H		0.001/yr.		0.5		(b)

(a) GASEOUS RELEASE ONLY SINCE REPOSITORY REMAINS DRY.
(b) INVENTORY IS LESS THAN 10^{-8} I_T AND IS BELOW 0.1% CRRL THRESHOLD.

RW20772.083

ISSUE 1.4 SPENT FUEL RADIONUCLIDE RELEASE CALCULATION FOR BOUNDING CASE

RADIO-NUCLIDE	YEARS AFTER CLOSURE	MAXIMUM FRACTION OF INVENTORY RELEASABLE	x	MAXIMUM FRACTION BREACHED CONTAINERS	x	MAXIMUM FRACTION OF FAILED CLADDINGS	x	MAXIMUM FRACTION OF WATER EXPOSED CONTAINERS	=	MAXIMUM FRACTION OF INVENTORY RELEASED
C-14	0-100	0.01 I_c		0.0001/yr.		-		-		1×10^{-6} I_c/yr.
(GASEOUS)	100-300	0.002 I_c		0.0005/yr.		-		-		1×10^{-6} I_c/yr.
	300-1000	0.001 I_c		0.001/yr.		-		-		1×10^{-6} I_c/yr.
C-14	0-100	0.7 I_c		0.0005/yr.		0.02		0.05		4×10^{-7} I_c/yr.
(AQUEOUS)	100-300	0.14 I_c		0.0005/yr.		0.05		0.05		2×10^{-7} I_c/yr.
	300-1000	0.014 I_c		0.001/yr.		0.5		0.1		7×10^{-7} I_c/yr.

RW20772.084

ISSUE 1.4 SPENT FUEL RADIONUCLIDE RELEASE CALCULATION FOR BOUNDING CASE (cont.)

LONG HALF-LIVED SOLUBLE SPECIES	YEARS AFTER CLOSURE	MAXIMUM FRACTION OF INVENTORY RELEASABLE	x	MAXIMUM FRACTION BREACHED CONTAINERS	x	MAXIMUM FRACTION OF FAILED CLADDINGS	x	MAXIMUM FRACTION OF WATER EXPOSED CONTAINERS	=	MAXIMUM FRACTION OF INVENTORY RELEASED
Tc-99	0-100	1.0 I_{LS}		0.0005/yr.		0.02		0.05		5×10^{-7} $I_{LS/yr.}$
Ca-135	100-300	0.2 I_{LS}		0.0005/yr.		0.05		0.05		3×10^{-7} $I_{LS/yr.}$
I-129	300-1000	0.02 I_{LS}		0.001/yr.		0.5		0.1		1×10^{-6} $I_{LS/yr.}$
ACTINIDES	0-100	0.0001 I_A		0.0005/yr.		0.02		0.05		5×10^{-11} $I_{A/yr.}$
	100-300	0.001 I_A		0.0005/yr.		0.05		0.05		1×10^{-9} $I_{A/yr.}$
	300-1000	0.01 I_A		0.001/yr.		0.5		0.1		5×10^{-7} $I_{A/yr.}$

RW20772L.085

U.S. DEPARTMENT OF ENERGY
OFFICE OF CIVILIAN RADIOACTIVE WASTE MANAGEMENT

PRESENTATION TO THE ADVISORY COMMITTEE ON NUCLEAR WASTE

SUBJECT: ENGINEERED BARRIER SYSTEM SUBMODELS

DATE: JANUARY 24, 1989

PRESENTER: DR. WILLIAM J. O'CONNELL

PRESENTER'S TITLE AND ORGANIZATION: TECHNICAL AREA LEADER FOR WASTE PACKAGE PERFORMANCE ASSESSMENT
LAWRENCE LIVERMORE NATIONAL LABORATORY

PRESENTER'S TELEPHONE NUMBER: (415) 422-8789

RW20772.101

ENGINEERED BARRIER SYSTEM SUBMODELS

- ROLE OF SUBMODELS IN ENGINEERED BARRIER SYSTEM PERFORMANCE ASSESSMENT
- CONTAINER DEGRADATION MODELING
- WASTE FORM ALTERATION MODELING
- WASTE PACKAGE ENVIRONMENT MODELING

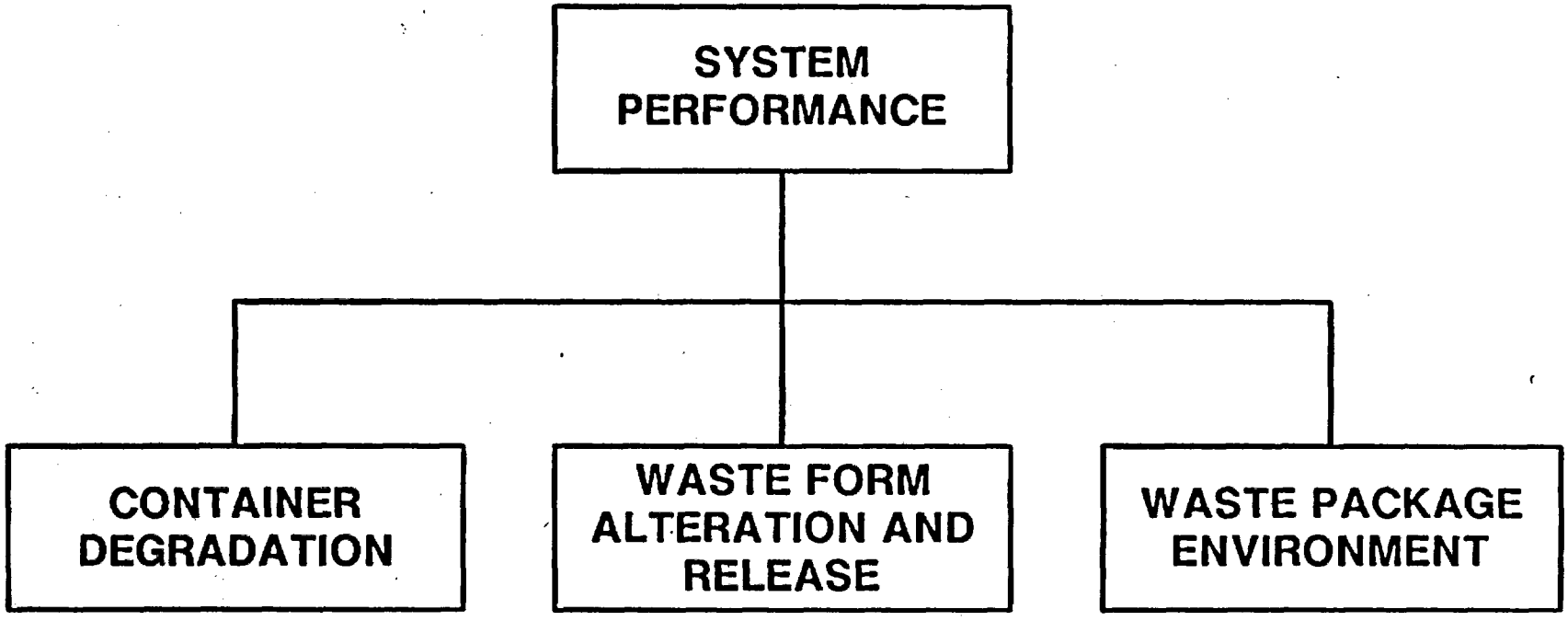
RW20772.060

ENGINEERED BARRIER SYSTEM MODELING

- UNIFICATION OF SUBMODELS
  - WASTE PACKAGE AS A SYSTEM
  - SET OF WASTE PACKAGES IN THE REPOSITORY
  - CHARACTERIZATION OF UNCERTAINTY
- STRUCTURING OF SUBMODELS
- INTERACTION BETWEEN MODELING AND EXPERIMENTAL DATA COLLECTION

RW20772.035

THE SYSTEM MODEL USES HIERARCHICAL STRUCTURE TO PROVIDE A CONTROLLED EXAMINATION OF INTERACTIONS AMONG SUBMODELS



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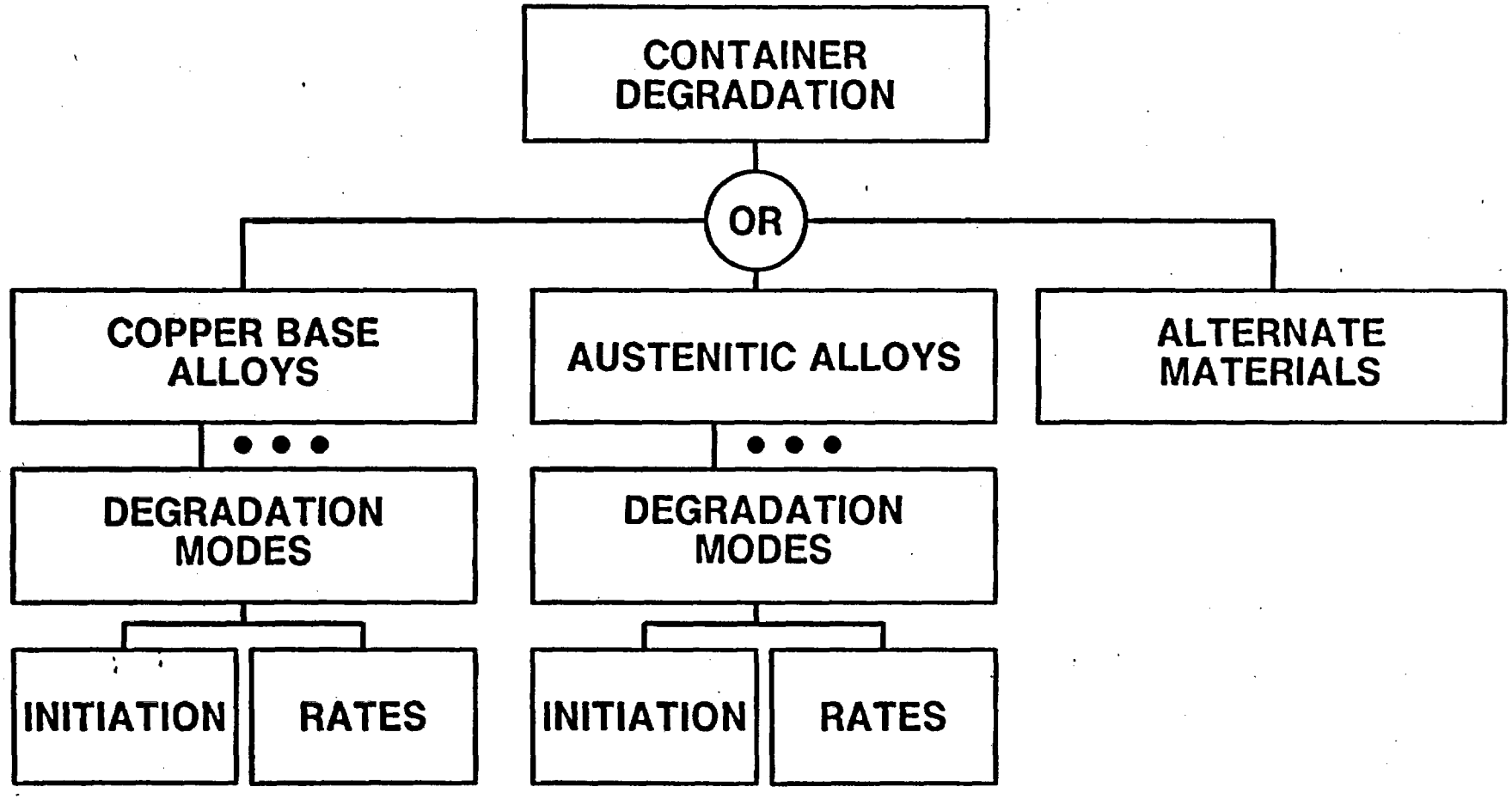
FURTHER LEVELS OF MODEL STRUCTURE CORRESPOND TO COMPONENTS OR PROCESSES



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CONTAINER DEGRADATION MODELING

CONTAINER

- IDENTIFY DEGRADATION MODES
- IDENTIFY PHENOMENOLOGY
- DEVELOP PARAMETRIC DEPENDENCIES
  - OCCURRENCE
  - RATES
- IDENTIFY MECHANISMS
- DEVELOP MODELS
- DEFINE TESTS OF MODELS, CONSIDER ALTERNATIVE MODELS
- COMPARE PREDICTIONS TO EXPERIMENTS AND REFINE
- COMBINE INTO MODEL COVERING ALL DEGRADATION MODES

CONTAINER/SYSTEM

- PREDICT BEHAVIOR FOR ENSEMBLE OF REPOSITORY CONDITIONS
- DO SENSITIVITY AND UNCERTAINTY ANALYSIS

RW20772.028

CONTAINER DEGRADATION MODES

- PRINCIPAL MODELING ISSUES WILL BE OCCURRENCE OR NON-OCCURRENCE OF LOCALIZED CORROSION MODES
- SIX CANDIDATE MATERIALS:

304L STAINLESS STEEL	COPPER (O_2-FREE OR DEOX.)
316L STAINLESS STEEL	70/30 CUPRONICKEL
ALLOY 825 (HIGH-NICKEL ALLOY)	7% ALUMINUM BRONZE

- SELECTION CRITERIA TO BE ISSUED SOON
- END OF FY89-SELECTION OF ONE CANDIDATE AND ONE ALTERNATE FOR MORE DETAILED TESTS AND MODELING
- ALTERNATE MATERIALS PROGRAM

RW20772.059

CONTAINER DEGRADATION MODES (cont.)

PROGRESS-DEGRADATION MODES

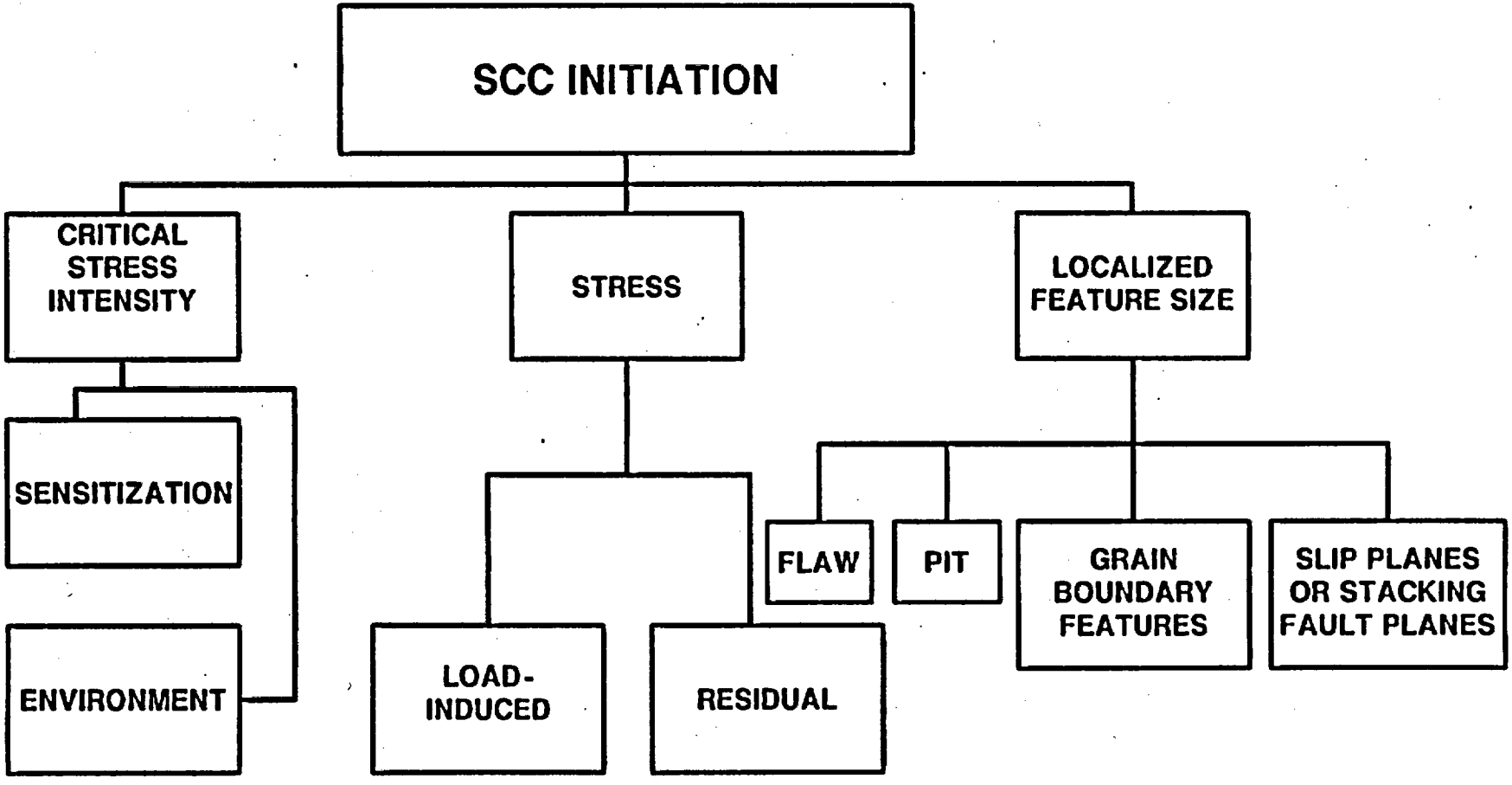
- SURVEYS READY FOR REVIEW
- DEGRADATION PROCESSES VARY FROM ALLOY TO ALLOY

PROGRESS-MECHANISMS

- SURVEY OF EMPIRICAL AND MECHANISTIC MODELS IS READY FOR REVIEW
  - EXTENSIONS FOR ALLOYS AND ENVIRONMENTS AND FIRST MODELS FOR SOME MODES ARE NEEDED
  - DATA FOR MODEL PARAMETERS ARE NEEDED
  - VALIDATION TESTS ARE NEEDED

RW20772.034

FACTORS IN STRESS CORROSION CRACKING (SCC) OCCURRENCE



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EXAMPLE-PITTING INITIATION ON STAINLESS STEEL

HALIDE NUCLEI THEORY: HALIDE NUCLEUS ON THE PASSIVE OXIDE FILM

- CRITICAL PITTING POTENTIAL DEPENDS ON HALIDE ION CONCENTRATION, TEMPERATURE, AND ACIDITY
- TIME TO INDUCTION DEPENDS ON ELECTROCHEMICAL POTENTIAL, HALIDE ION CONCENTRATION, AND TEMPERATURE
- COEFFICIENTS OF PARAMETERS DEPEND ON THE ALLOY

RW20772.029

STRESS CORROSION CRACKING RATE

ANDRESEN-FORD MODEL LOOKS USEFUL

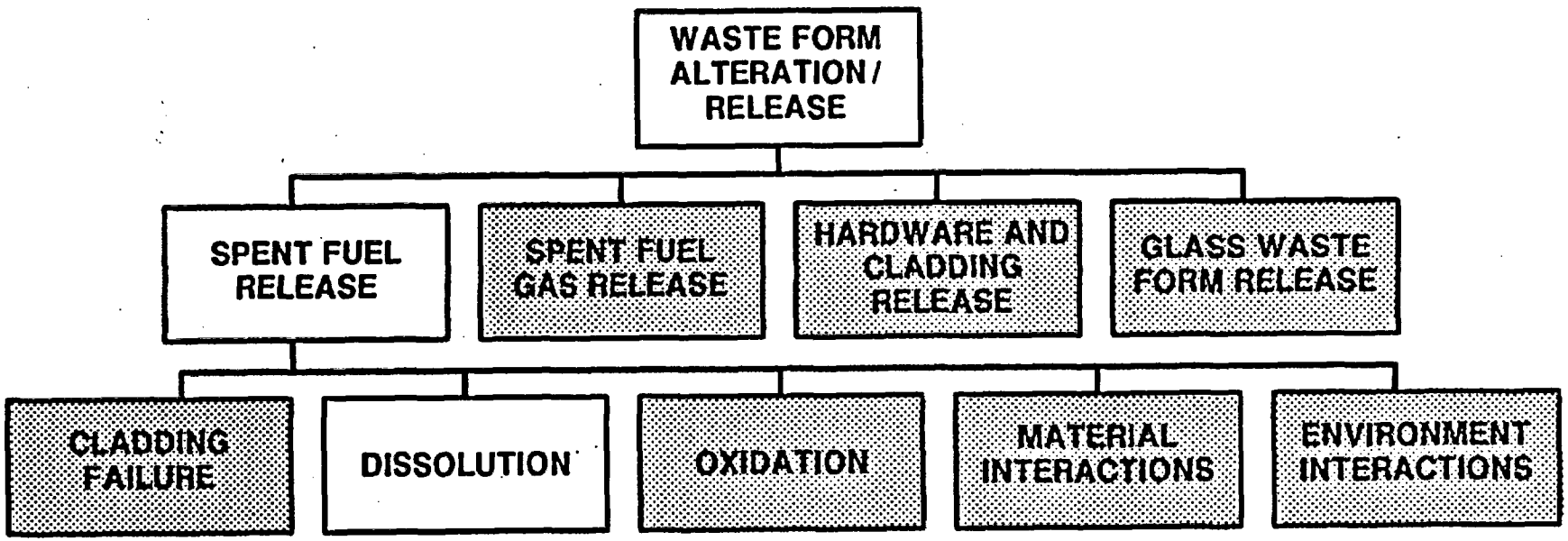
- INCLUDES
  - SLIP DISSOLUTION -REPASSIVATION (DEPENDENCE ON STRAIN RATE)
  - DEPENDENCE ON IONIC TRANSPORT IN THE CRACK
  - DEPENDENCE ON APPLIED POTENTIAL AND TEMPERATURE
- AGREES WITH EXPERIMENTAL DATA UNDER BWR CONDITIONS
- REQUIRES EXTENSION TO OTHER ALLOYS

RW20772.031

WHAT CORROSION MODELS ARE WE CONSIDERING, AND WHAT DATA SUPPORT THE MODELS?

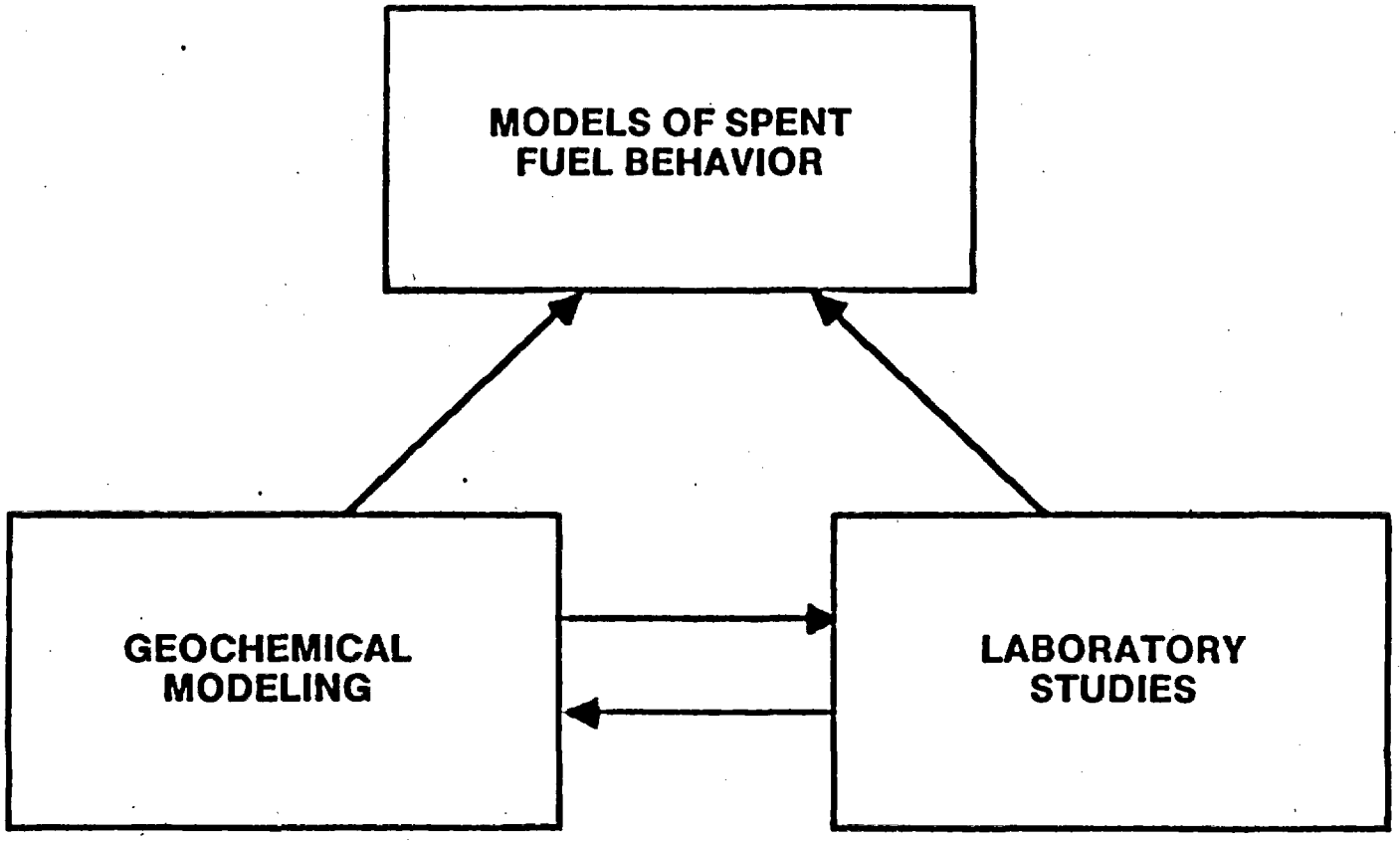
- WE HAVE A SYSTEMATIC PROCESS FOR DEVELOPING A SET OF DATA AND MODELS
- THE RANGE OF OBSERVED AND POSSIBLE PHENOMENA IS BEING SURVEYED
- MULTIPLE HYPOTHESES ARE BEING CONSIDERED
- DATA TO DEVELOP AND REFINE MODELS WILL BE ACQUIRED

WASTE FORM ALTERATION MODELING



RW20772.087

GEOCHEMICAL MODELING STUDIES SUPPORT EXPERIMENTS AND SUPPORT DEVELOPMENT OF SPENT FUEL MODELS



0319-M001DS 1/19/89

HIGHLIGHTS OF INFORMATION EXCHANGE

EXPERIMENT→CALCULATION	CALCULATION→EXPERIMENT
• URANIUM MINERALS	• PROPOSED CHEMICAL FORMS OF TRACE PRECIPITATES
• CONCENTRATIONS OF RADIONUCLIDES IN SOLUTION	• IMPORTANCE OF Eh (OR O_2 FUGACITY)
• QUANTITY OF RADIONUCLIDES IN SOLIDS	• UPPER LIMITS ON CONCENTRATIONS IN SOLUTION

- INFORMATION FROM BOTH EXPERIMENT AND CALCULATION HELP DEFINE DATA NEEDS FOR THERMODYNAMIC DATA BASE DEVELOPMENT

0319-M001DS

LABORATORY STUDIES TO SUPPORT DEVELOPMENT OF SPENT FUEL DISSOLUTION MODEL

- MEASUREMENT CONDITIONS:
  - IN SITE-SPECIFIC WATER (WELL J-13) AND OTHER WATER
  - IN J-13 WATER IN THE PRESENCE OF TUFF ROCK
  - ADD ZIRCALOY AND CONTAINER MATERIAL
  - BATCH/REFRESH WATER
  - IMMERSED/DRIP WATER
  - SEALED/OPEN TO REFRESH AIR
- MEASURE
  - CONCENTRATIONS AS FUNCTION OF TIME
  - SOLUTE SPECIES
  - ALTERED AND REPRECIPITATED SOLID SPECIES
- SIMPLER CHEMICAL SYSTEMS
- BASIC THERMODYNAMIC DATA

RW20772.032

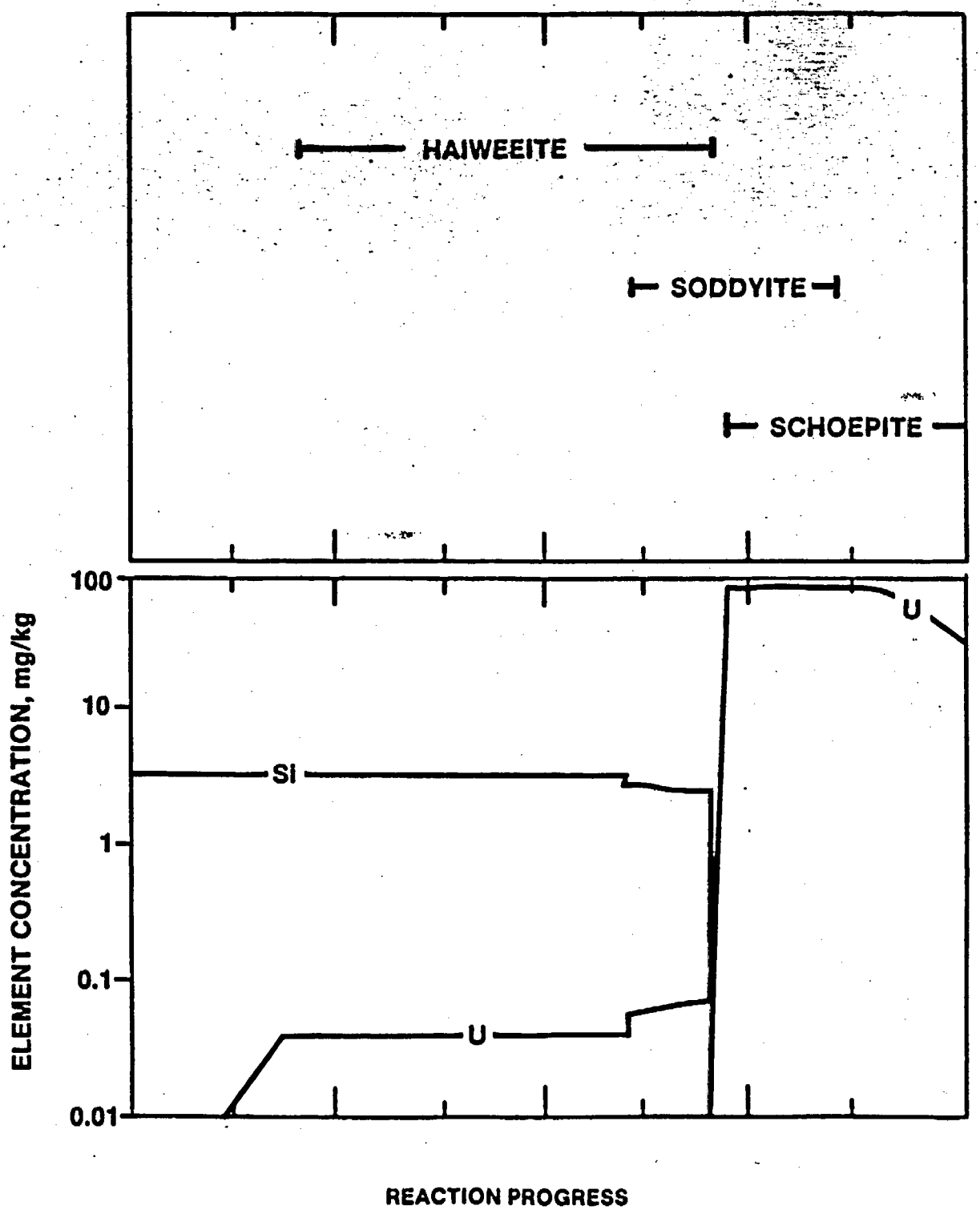
SPENT FUEL SIMULATION

ASSUMPTIONS

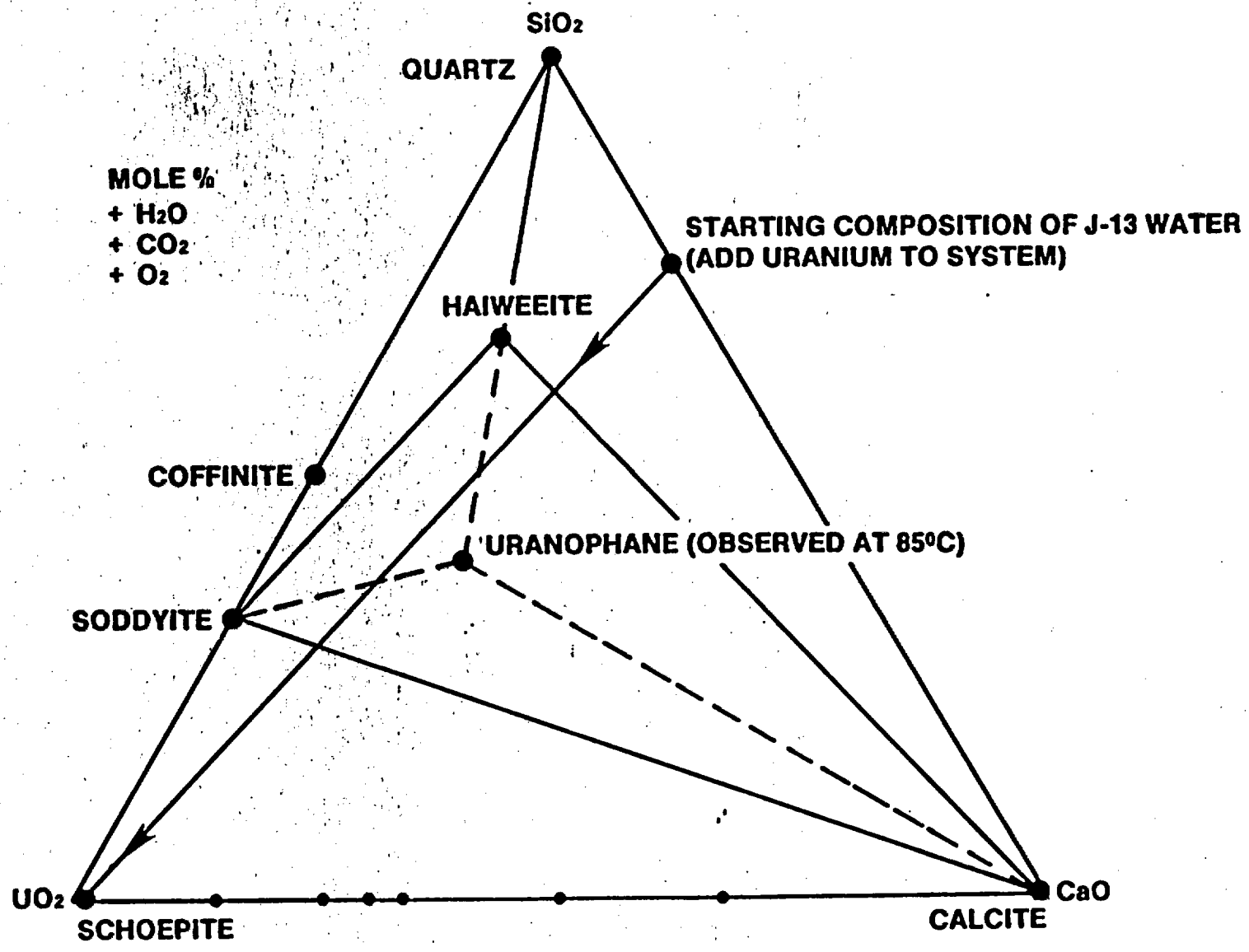
- SPENT FUEL DISSOLVES INTO FIXED MASS OF WATER AT 25°C AND 90°C
- CONGRUENT DISSOLUTION OF SPENT FUEL
- FUGACITIES OF $O_{2(g)}$ AND $CO_{2(g)}$ ARE FIXED AT EQUILIBRIUM WITH THE ATMOSPHERE
- NO INHIBITIONS TO PRECIPITATION OR RE-DISSOLUTION
- ALL SOLID PHASES ARE CONSIDERED TO BE POTENTIAL PRECIPITATES
- NO MATERIALS INTERACTIONS, RADIOLYSIS, SORPTION, OR SOLID SOLUTIONS CONTAINING RADIONUCLIDES

RW20772.030

SPENT FUEL SIMULATION RESULTS



SPENT FUEL EXPERIMENTAL RESULTS



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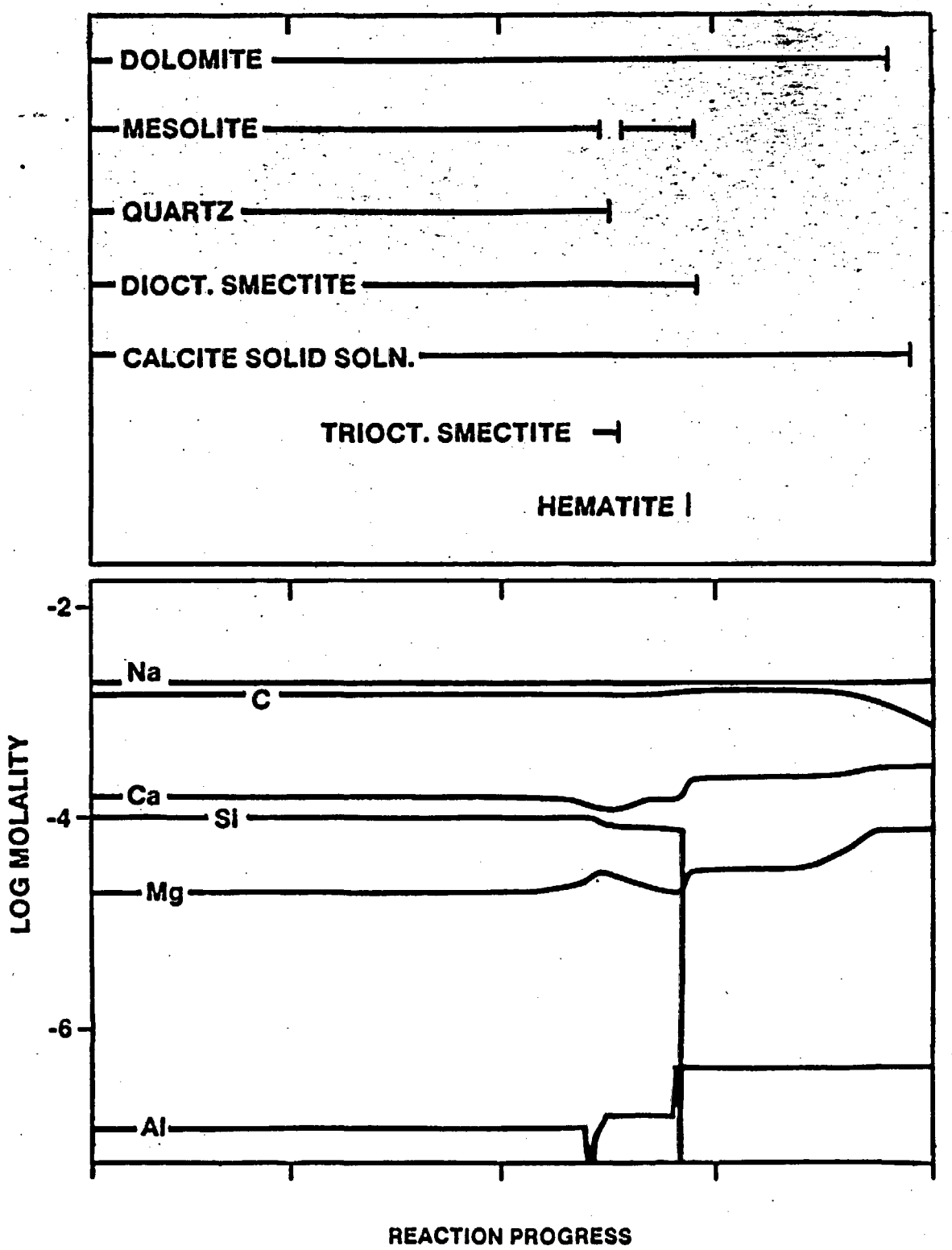
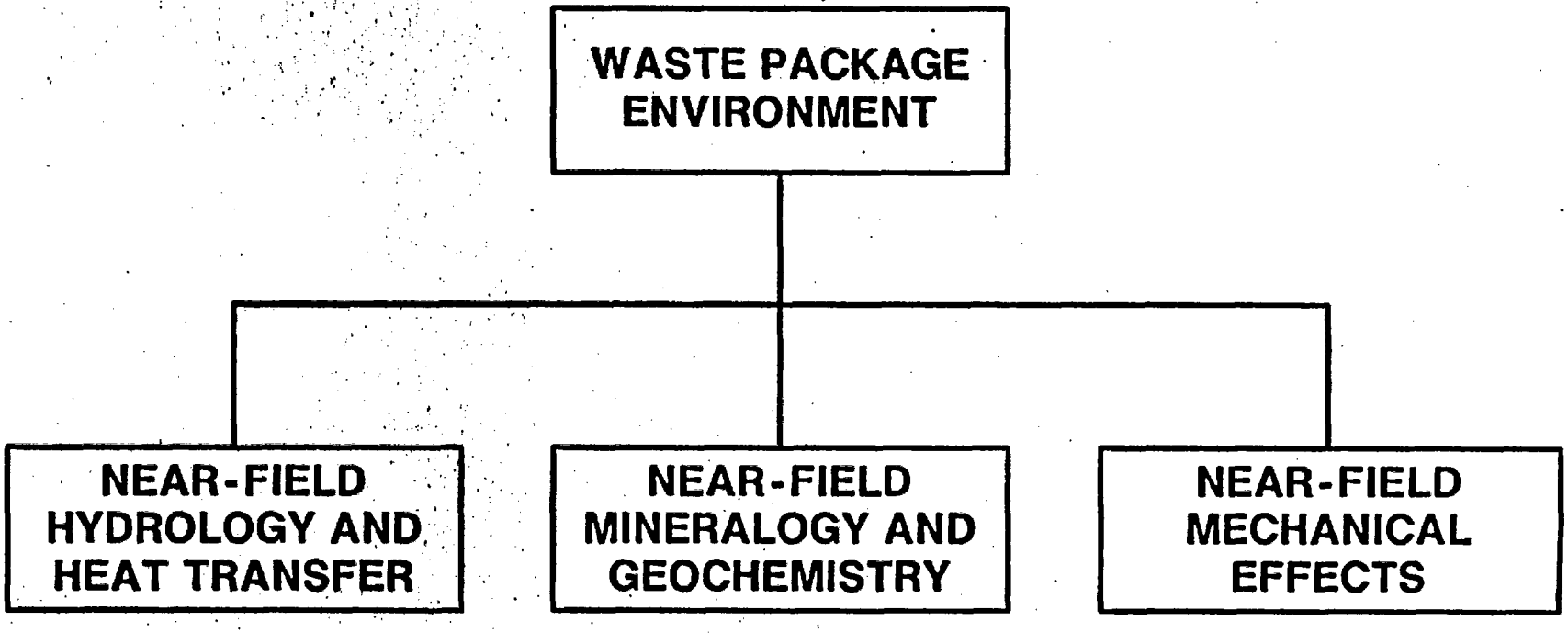
SPENT FUEL SIMULATION RESULTS



WASTE PACKAGE ENVIRONMENT MODELING



RW20772.088

U.S. DEPARTMENT OF ENERGY
OFFICE OF CIVILIAN RADIOACTIVE WASTE MANAGEMENT

PRESENTATION TO THE ADVISORY COMMITTEE ON NUCLEAR WASTE

SUBJECT: ENGINEERED BARRIER SYSTEM MODEL

DATE: JANUARY 24, 1989

PRESENTER: DR. MICHAEL J. APTED

PRESENTER'S TITLE AND ORGANIZATION: DEPUTY MANAGER, PERFORMANCE ASSESSMENT
SCIENTIFIC SUPPORT PROGRAM
PACIFIC NORTHWEST LABORATORY

PRESENTER'S TELEPHONE NUMBER: (509) 376-4601

RW20772.103

ENGINEERED BARRIER SYSTEM (EBS) MODEL

- APPROACH TO EBS MODELING
- EBS ANALYTIC MODELS
- EXAMPLES OF ANALYSES CONDUCTED
- CURRENT ACTIVITIES

SYSTEM PERFORMANCE ANALYSIS

SINGLE WASTE PACKAGE

- SYSTEM DESCRIPTION
- FAILURE MODES
- SEMI-EMPIRICAL MODELS
- MECHANISTIC MODELS
- BOUNDING PROCESSES

↓

SET OF WASTE PACKAGES

- SPATIAL VARIABILITY IN ENVIRONMENT
- PROBABILISTIC TREATMENT OF PROCESSES
- INTEGRATION OVER ALL WASTE PACKAGES
- BOUNDING ANALYSIS

↓

PREDICTED SYSTEM PERFORMANCE

- UNCERTAINTY ANALYSES
- SENSITIVITY ANALYSES

RW20772.094

EBS PERFORMANCE ASSESSMENT CODES

- PROPER (KBS-3)
- WAPPA (SRP)
- SYVAC/VAULT (AECL)
- PANDORA (YMP)
- AREST (PASS)

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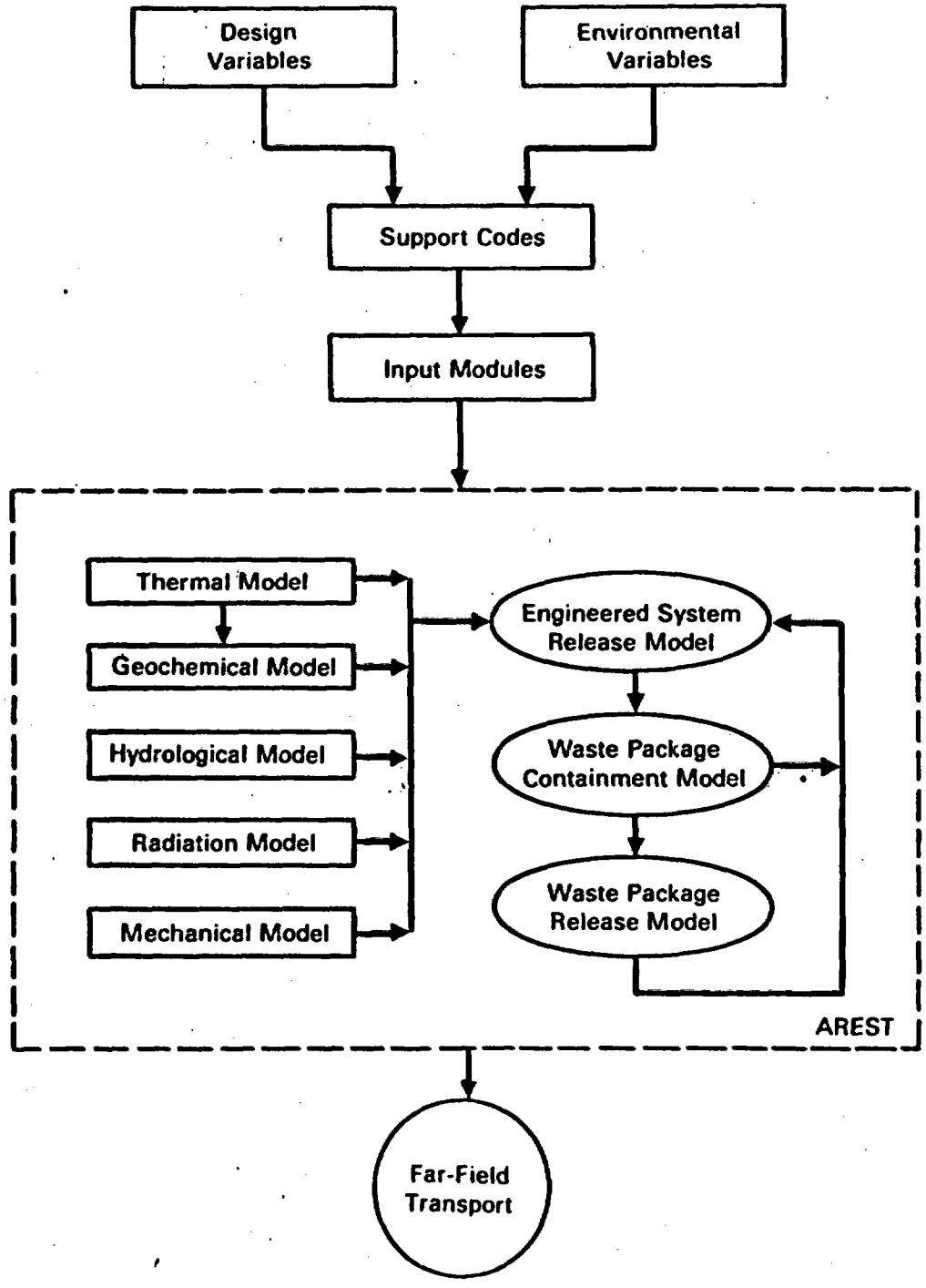
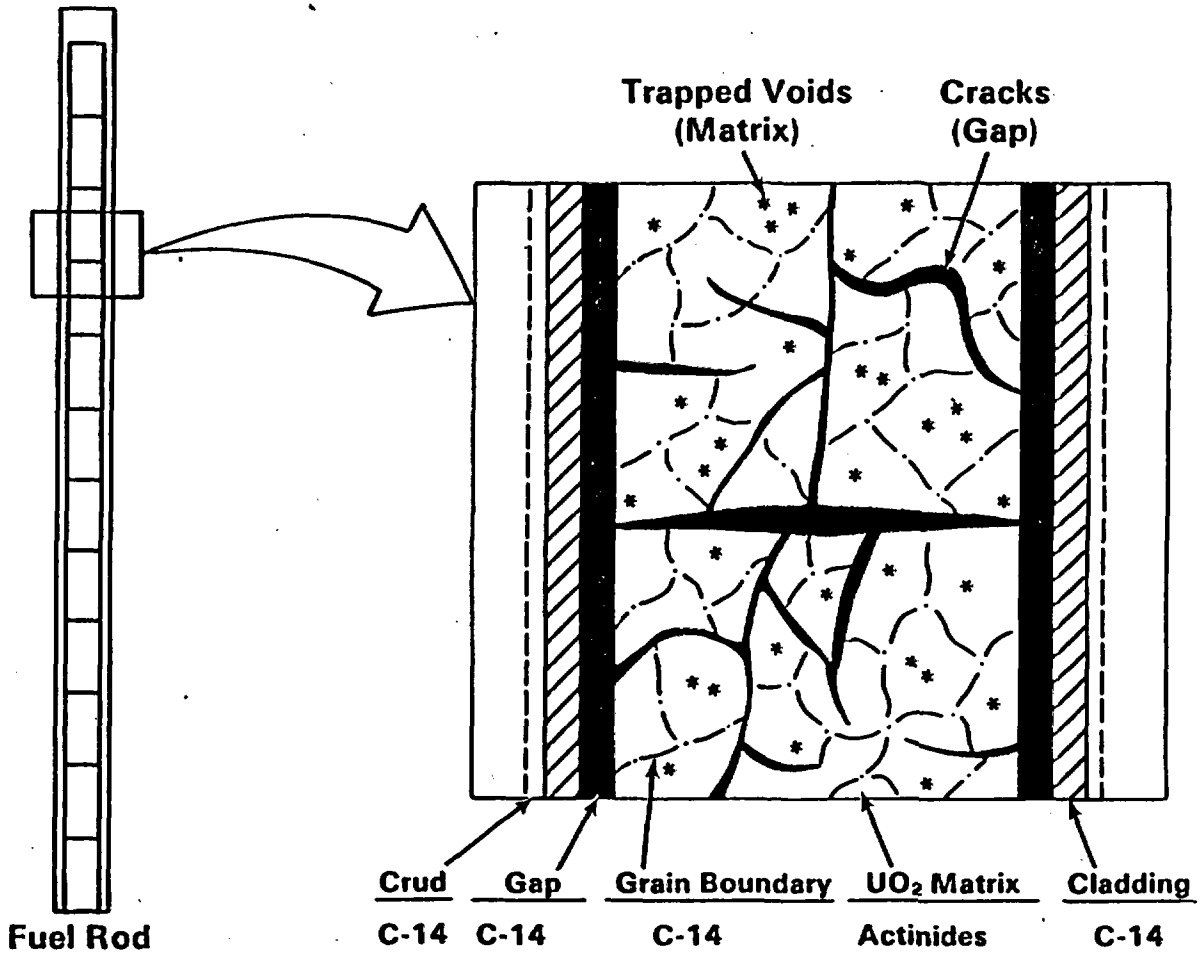
AREST Code


Design Variables
Environmental Variables
Support Codes
Input Modules
Thermal Model
Geochemical Model
Hydrological Model
Radiation Model
Mechanical Model
Engineered System Release Model
Waste Package Containment Model
Waste Package Release Model
AREST
Far-Field Transport

Schematic of Spent Nuclear Fuel



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LIMITATIONS TO SPENT FUEL ASSESSMENT

RELEASE DEPENDS ON:

- WASTE PACKAGE DESIGN
- WASTE PACKAGE MATERIALS
- SPENT FUEL CHARACTERISTICS
- SITE CHARACTERIZATION INFORMATION
- SOLUBILITY DATA
- LONG-TERM CORROSION MODELS
- STORAGE BEFORE EMPLACEMENT

CONSIDERATIONS FOR EBS RELEASE MODEL

- SCENARIO DEPENDENCE
- CONTAINMENT DEPENDENCE
- RELEASE PATHWAY
  - DISCONTINUOUS
  - CONTINUOUS
- PHYSICAL FORM OF RELEASED NUCLIDES
  - GASEOUS
  - AQUEOUS
  - SOLID (COLLOIDS)
- CHEMICAL CONSTRAINTS ON RELEASE
  - SOLUBILITY
    - STABLE MATRIX (MATRIX SOLUBILITY)
    - UNSTABLE MATRIX (INDIVIDUAL NUCLIDE SOLUBILITIES)
  - REACTION RATE
    - CONGRUENT
    - INCONGRUENT
  - INVENTORY - LIMITED

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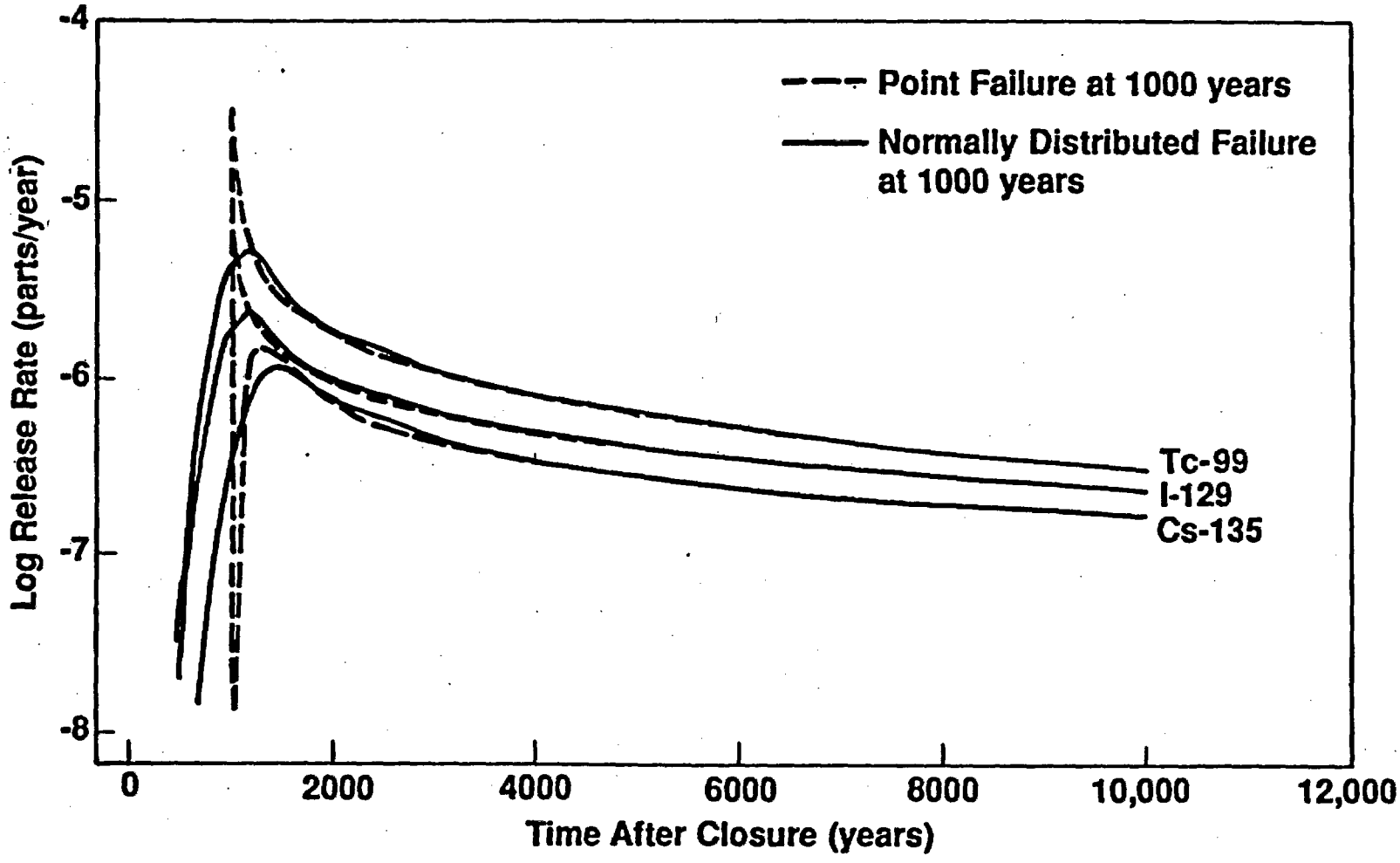
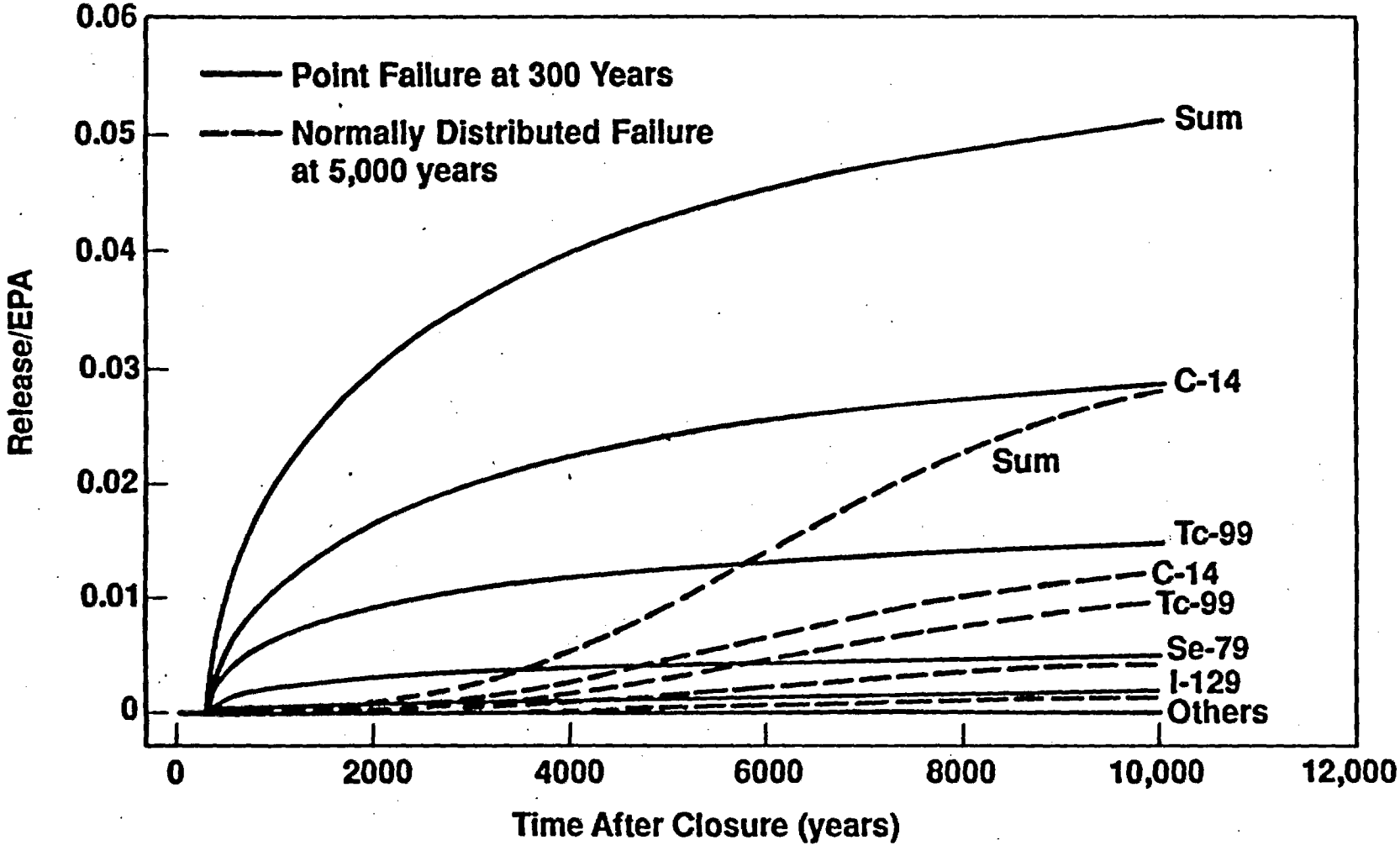
EBS RELEASE CALCULATION: EXAMPLE 1

- SCENARIO - "WET"
- CONTAINMENT - DISTRIBUTED FAILURES
- RELEASE PATHWAY - CONTINUOUS
- PHYSICAL FORM - AQUEOUS
- CHEMICAL CONSTRAINT - SOLUBILITY

Effect of Distributed Containment Failures on EBS Release



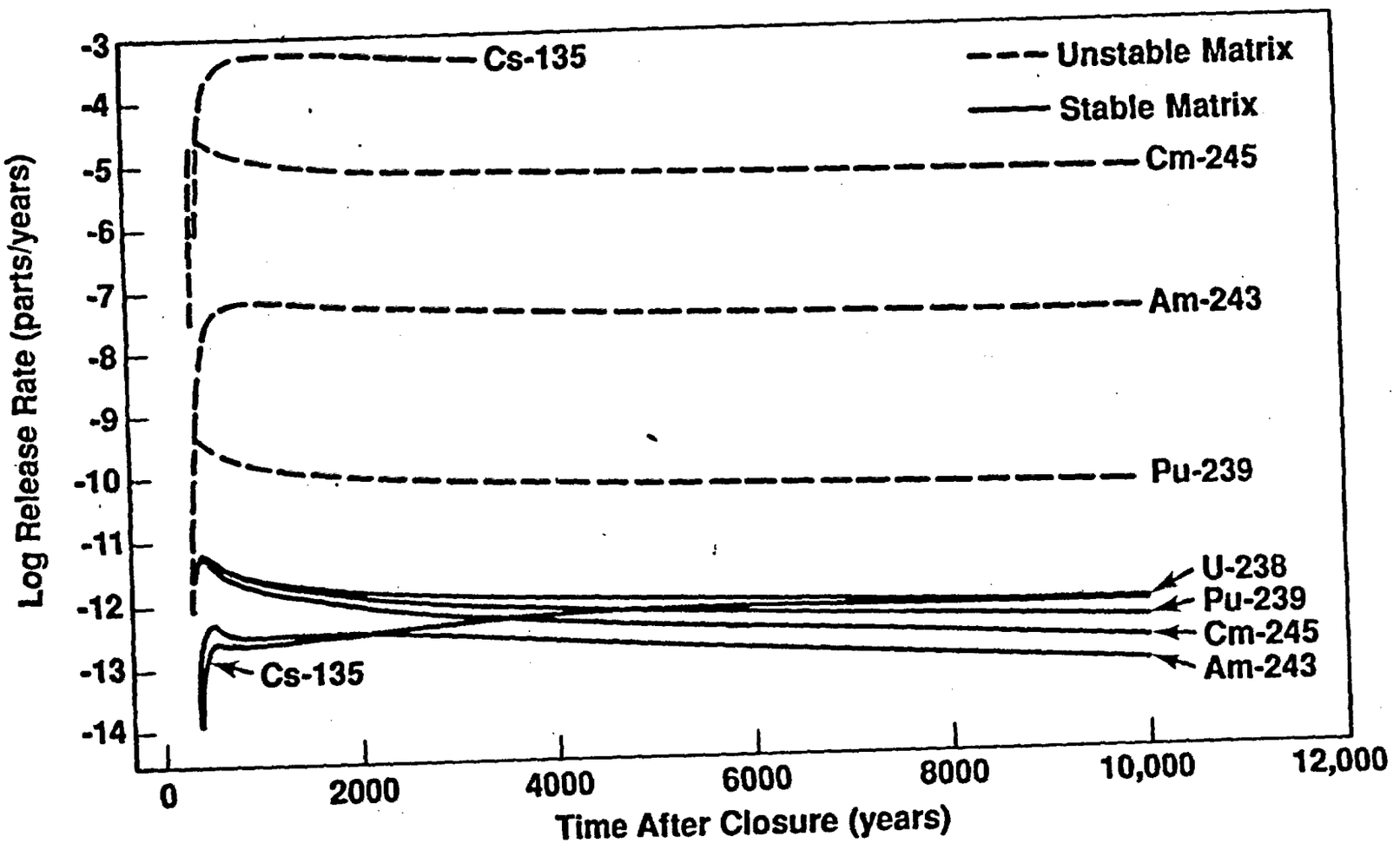
Evaluation of EPA Release Limits Applied at the Waste Package Boundary



EBS RELEASE CALCULATION: EXAMPLE 2

- SCENARIO - "WET"
- CONTAINMENT - INSTANTANEOUS FAILURES AT 300 YEARS
- RELEASE PATHWAY - CONTINUOUS
- PHYSICAL FORM - AQUEOUS
- CHEMICAL CONSTRAINT - STABLE VS. UNSTABLE MATRIX

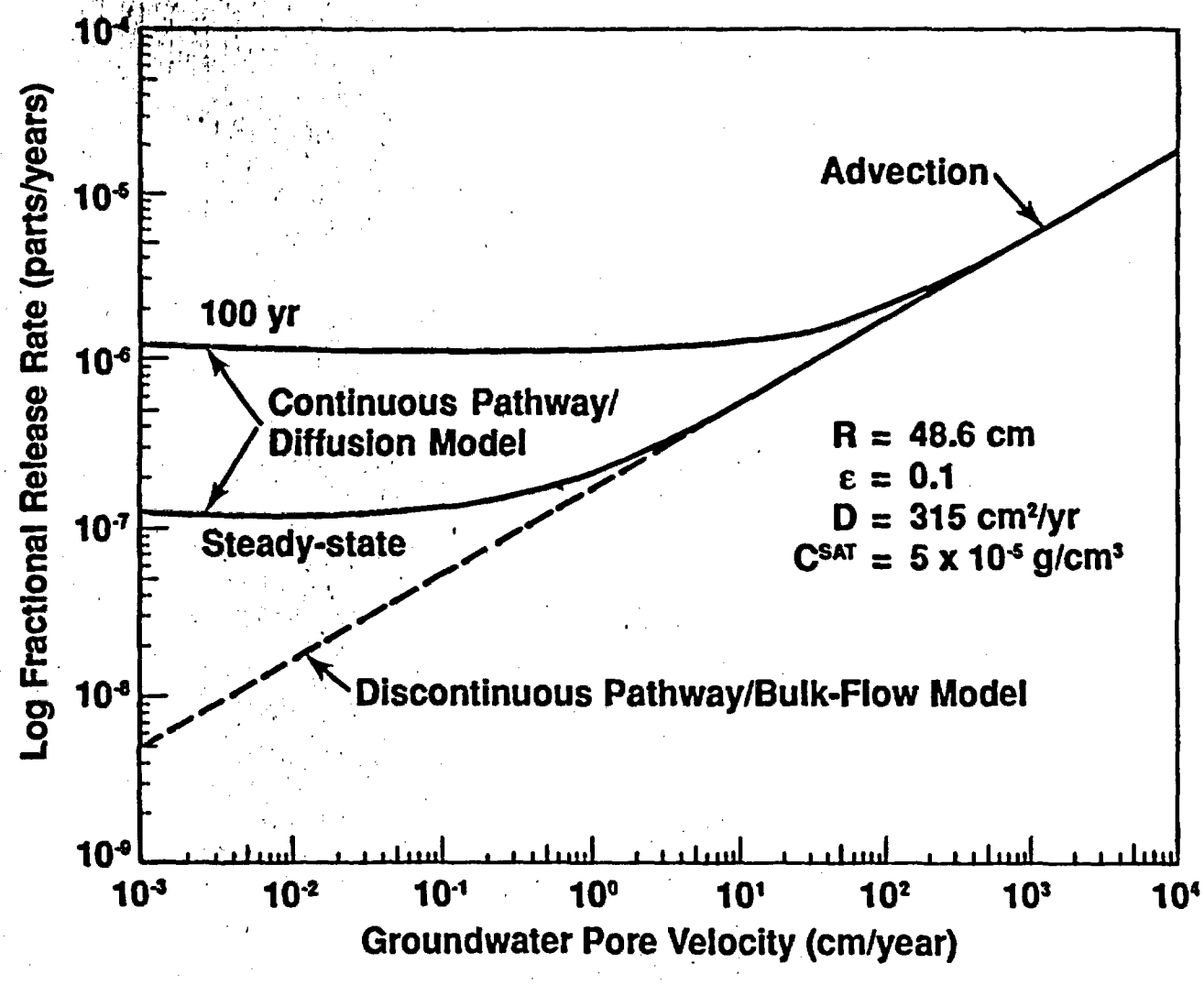
Effect of Stability of Waste Form Matrix on Release (Point Failure at 300 Years)



EBS RELEASE CALCULATION: EXAMPLE 3

- SCENARIO - "WET"
- CONTAINMENT - INSTANTANEOUS FAILURES AT 1000 YEARS
- RELEASE PATHWAY - CONTINUOUS VS. DISCONTINUOUS
- PHYSICAL FORM - AQUEOUS
- CHEMICAL CONSTRAINT - SOLUBILITY

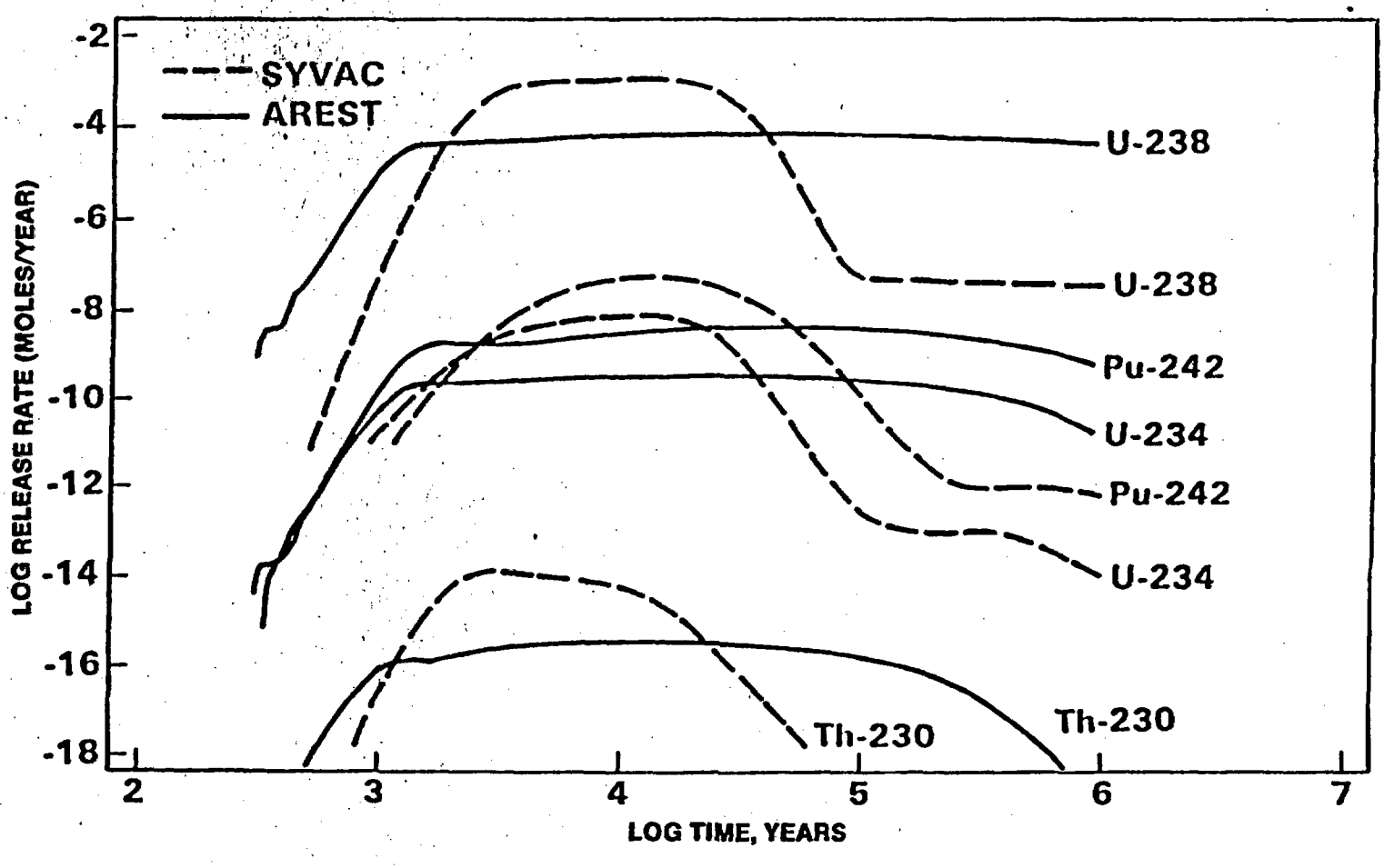
Extrapolations of Fractional Release Rates for UO_2 to Low Flows in an Oxidizing Environment (Pigford and Chambre' 1988)



EBS RELEASE CALCULATION: EXAMPLE 4

- SCENARIO - "WET" (SATURATED)
- CONTAINMENT - DISTRIBUTED FAILURES
- RELEASE PATHWAY - CONTINUOUS
- PHYSICAL FORM - AQUEOUS
- CHEMICAL CONSTRAINT - SOLUBILITY
- CODE COMPARISON - SYVAC VS AREST FOR CANADIAN VAULT DESIGN

COMPARISON OF SYVAC WITH AREST
(EXAMPLE 4)



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SENSITIVITY AND UNCERTAINTY ANALYSES

- SOURCES OF UNCERTAINTY
  - DATA
  - CONCEPTUAL MODEL
  - FUTURE CONDITIONS
  - CALCULATIONAL LIMITATIONS
- IDENTIFY IMPORTANT PARAMETERS AND SOURCES OF UNCERTAINTY
- QUANTIFY UNCERTAINTIES IN TERMS OF PROBABILITY DENSITY FUNCTIONS, AS APPROPRIATE
- QUALITATIVE JUDGEMENT FROM TECHNICAL EXPERTS WILL BE USED IN THE ASSESSMENT
- RECOGNIZE CORRELATIONS AMONG PARAMETERS AS PART OF UNCERTAINTY ANALYSIS

RW20772.025

U.S. DEPARTMENT OF ENERGY OFFICE OF CIVILIAN RADIOACTIVE WASTE MANAGEMENT

PRESENTATION TO THE ADVISORY COMMITTEE ON NUCLEAR WASTE

SUBJECT:	SUMMARY PRESENTATION
DATE:	JANUARY 24, 1989
PRESENTER:	DR. DONALD H. ALEXANDER
PRESENTER'S TITLE AND ORGANIZATION:	CHIEF REGULATORY COMPLIANCE BRANCH OFFICE OF CIVILIAN RADIOACTIVE WASTE MANAGEMENT U.S. DEPARTMENT OF ENERGY
PRESENTER'S TELEPHONE NUMBER:	(202) 586-4889

SUMMARY

- REVIEW OF QUESTIONS ASKED BY ACNW
- OTHER AREAS NEEDING CLARIFICAITON

QUESTIONS
RELATED TO PERFORMANCE ASSESSMENT PROGRAM
PRESENTATION BY DOE TO THE ACRS
JUNE 6, 1988

I*. Is performance assessment done by a separate organization unit?

How does performance assessment interface with ongoing tests and investigations at the site and the contractors doing the work?

IIB. What interchanges of information between modelers and lab/field researchers are planned? How early in the program will information feedback for validation of models begin?

C. What steps are being taken to ensure that all significant scenario are included in the complementary cumulative distribution function (CCDF) and that they are mutually exclusive? How will human intrusion be included in deriving a CCDF?

D. What explicit criteria are proposed for screening scenarios? Will the expected partial performance measures (EPPM) play a role in scenario screening?

IIIB. What corrosion models for waste package reliability analysis are being considered? What data or tests support these models?

General. Where do you think you need guidance from NRC?

---

*Numbers refer to agenda items.

SELECTION OF SCENARIOS FOR CONSTRUCTION OF THE CCDF

- SELECTION WILL BEGIN FROM RESULTS REPORTED IN SCP
- EMPHASIS WILL SHIFT TO EFFECTS ON CCDF
- INCREASED RELIANCE ON DATA
- FINAL SELECTION MUST REST ON JUDGEMENT
  - INFORMED JUDGEMENT
  - JUDGEMENT FROM MANY SOURCES
  - JUDGEMENT CONTROLLED BY FORMAL PROCEDURES

ROLE OF EPPM IN SCENARIO SCREENING

- EPPM A CONSERVATIVE AND VIABLE MEASURE OF IMPORTANCE OF SCENARIO CLASS
- EPPM USED TO LIMITED EXTENT FOR SCP
- EPPM MAY OR MAY NOT BE USED IN FUTURE SCENARIO SCREENING

TREATMENT OF HUMAN INTERFERENCE

- POTENTIAL INTERFERENCES WILL BE IDENTIFIED
- RELEVANT SITE DATA WILL BE OBTAINED
- SCENARIOS WILL BE DEVELOPED TAKING INTO ACCOUNT SITE DATA AND FACTORS SPECIFIED IN REGULATION
- CONSEQUENCES WILL BE ESTABLISHED THROUGH JUDGEMENT
- SCENARIOS MAY NOT BE INCORPORATED INTO OVERALL CCDF

APPROACH TO WASTE PACKAGE CORROSION MODELING AND TESTING

- SYSTEMATIC PROCESS FOR DEVELOPING THE SET OF DATA AND MODELS
- RANGE OF OBSERVED AND POSSIBLE PHENOMENA IS BEING SURVEYED
- MULTIPLE HYPOTHESES ARE BEING CONSIDERED
- DATA TO DEVELOP AND REFINE MODELS ARE BEING ACQUIRED

OTHER PERFORMANCE ASSESSMENT AREAS THAT NEED CLARIFICATION

- APPROACH TO EVALUATION OF ENGINEERED BARRIER SYSTEM PERFORMANCE
- APPROACH TO EVALUATION OF GROUND-WATER TRAVEL TIME
- DETERMINATION OF EXTENT OF DISTURBED ZONE

APPROACH TO EVALUATION OF ENGINEERED BARRIER SYSTEM PERFORMANCE

- TREATMENT OF GASEOUS RELEASE OF C-14 FROM EBS
- TREATMENT OF RELEASE OF SOLUABLE RADIONUCLIDES IN GAP OR ON GRAIN BOUNDARIES OF SPENT FUEL
- DEFINITION OF BOUNDARY OF THE ENGINEERED BARRIER SYSTEM
- TREATMENT OF ALL WASTE PACKAGES IN REPOSITORY AS A SINGLE SYSTEM

APPROACH TO EVALUATION OF GROUND-WATER TRAVEL TIME

- GROUND-WATER TRAVEL TIME AS A PERFORMANCE MEASURE (RELATED TO WASTE ISOLATION)
- CALCULATION IN TERMS OF TRAVEL TIME OF INERT TRACER CONTAMINANTS
- STOCHASTIC TREATMENT VS DETERMINISTIC TREATMENT

DETERMINATION OF EXTENT OF DISTURBED ZONE

- WHAT CONSTITUTES A DISTURBANCE
- EFFECTS ON GROUND-WATER TRAVEL TIME

ONGOING DIALOGUE FOR EARLY RESOLUTION OF TECHNICAL ISSUES

- DRAFT TECHNICAL POSITION PAPERS
- MEETINGS BETWEEN DOE AND NRC STAFFS
- RULE-MAKING TO DEFINITIVELY CLOSE CERTAIN TECHNICAL ISSUES

U.S. DEPARTMENT OF ENERGY
OFFICE OF CIVILIAN RADIOACTIVE WASTE MANAGEMENT

PRESENTATION TO THE ADVISORY COMMITTEE ON NUCLEAR WASTE

SUBJECT: INTRODUCTION AND OVERVIEW OF PERFORMANCE ASSESSMENTS

DATE: JANUARY 24, 1989

PRESENTER: DR. DONALD H. ALEXANDER

PRESENTER'S TITLE AND ORGANIZATION: CHIEF
REGULATORY COMPLIANCE BRANCH
OFFICE OF CIVILIAN RADIOACTIVE WASTE MANAGEMENT
U.S. DEPARTMENT OF ENERGY

PRESENTER'S TELEPHONE NUMBER: (202) 586-4889

RW20772.097

Detailed Agenda for
OCRWM Presentation to the ACNW
on Performance Assessments
24 January, 1989

Location: Room P-144, Phillips Building
7920 Norfolk Avenue
Bethesda, Maryland

Time: 8:00 a.m. - 5:00 p.m.

1. Introduction and Overview of Performance Assessments
Dr. Donald Alexander

2. Preclosure Safety Assessments
David Michlewicz

3. Development of the Complementary Cumulative Distribution Function
Dr. Larry D. Rickertsen

4. Selection of Scenarios
Dr. Felton W. Bingham

5. Total System Performance Assessment Model
Dr. Scott Sinnock

6. Validation of Models
Dr. Abraham Van Luik

7. Example of Performance Allocation for the Waste Package Testing Program
Dr. U-Sun Park

8. Engineered Barrier System Submodels
Dr. William J. O'Connell

9. Engineered Barrier System Submodels
Dr. Michael J. Apted

10. Summary Presentation
Dr. Donald H. Alexander

DOE PERFORMANCE ASSESSMENT PROGRAM INTRODUCTION AND OVERVIEW

- GENERAL PERFORMANCE ASSESSMENT PROGRAM TO ADDRESS REGULATIONS
- OVERVIEW OF THE MANAGEMENT AND ORGANIZATION FOR PERFORMANCE ASSESSMENTS
- INTERFACE OF PERFORMANCE ASSESSMENTS WITH THE TESTING PROGRAM
- CURRENT PROJECTS

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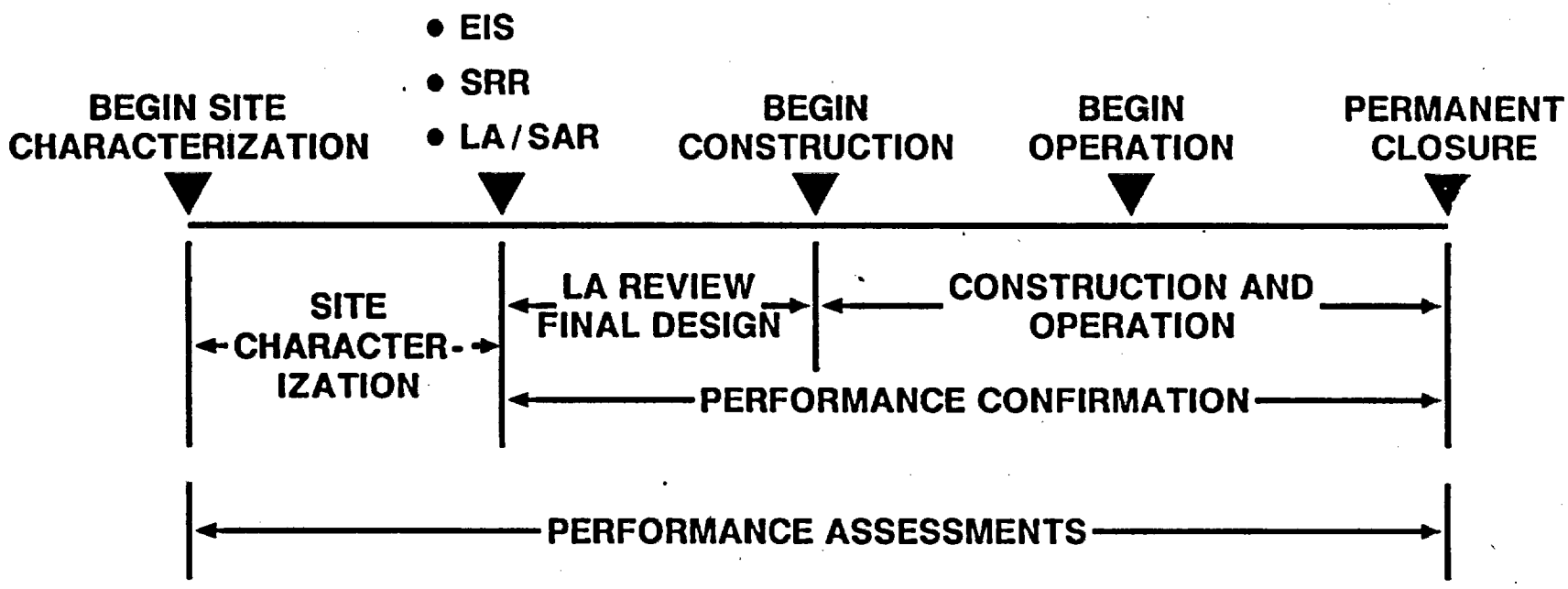
PROGRAM NEEDS FOR PERFORMANCE ASSESSMENTS



- PERFORMANCE ALLOCATION FOR SITE CHARACTERIZATION
- PA FOR EIS, SRR, SAR
- PA FOR LA AMENDMENTS
- PA FOR ENGINEERING AND DESIGN
- PA FOR PERFORMANCE CONFIRMATION

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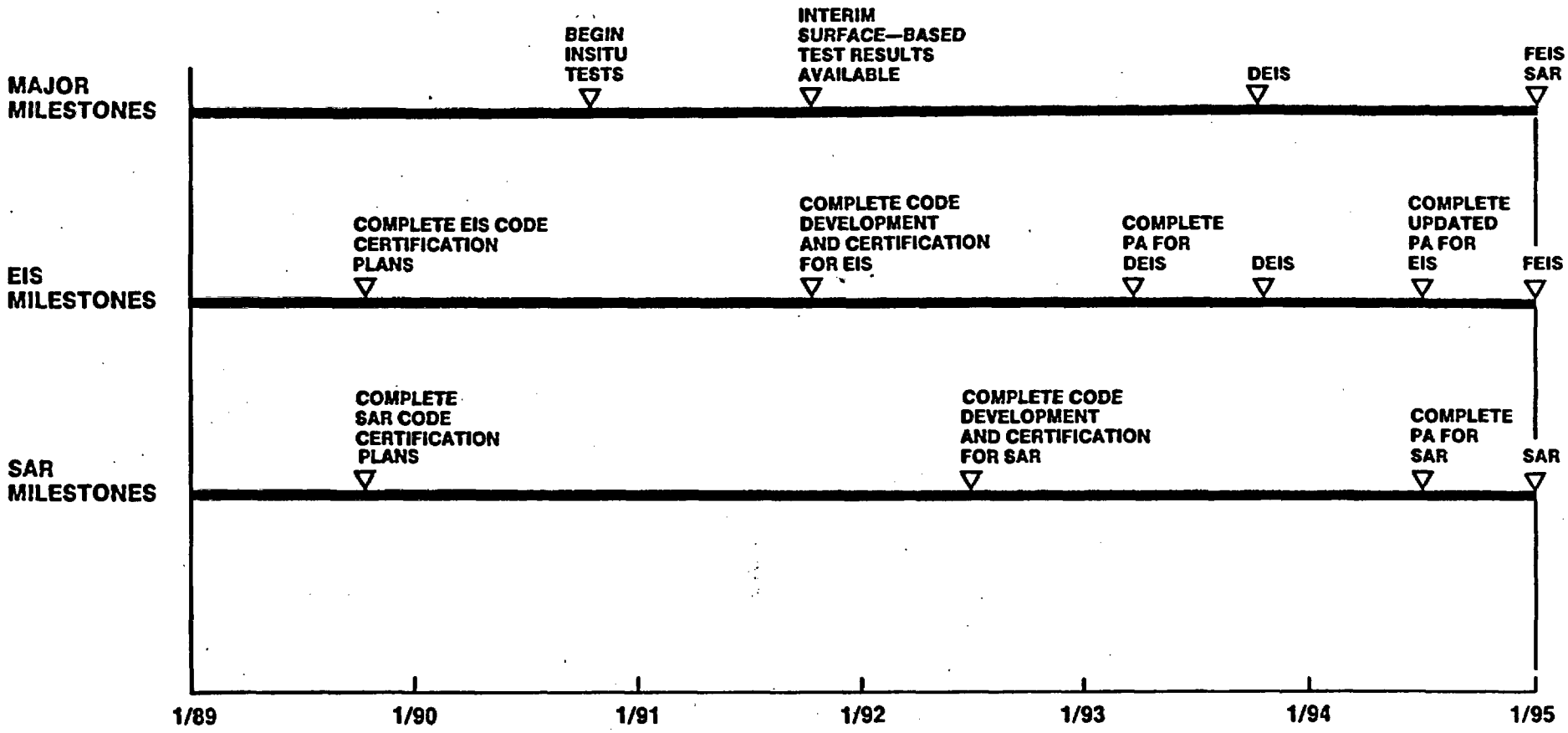
PERFORMANCE ASSESSMENT (PA) MILESTONES FOR LICENSING



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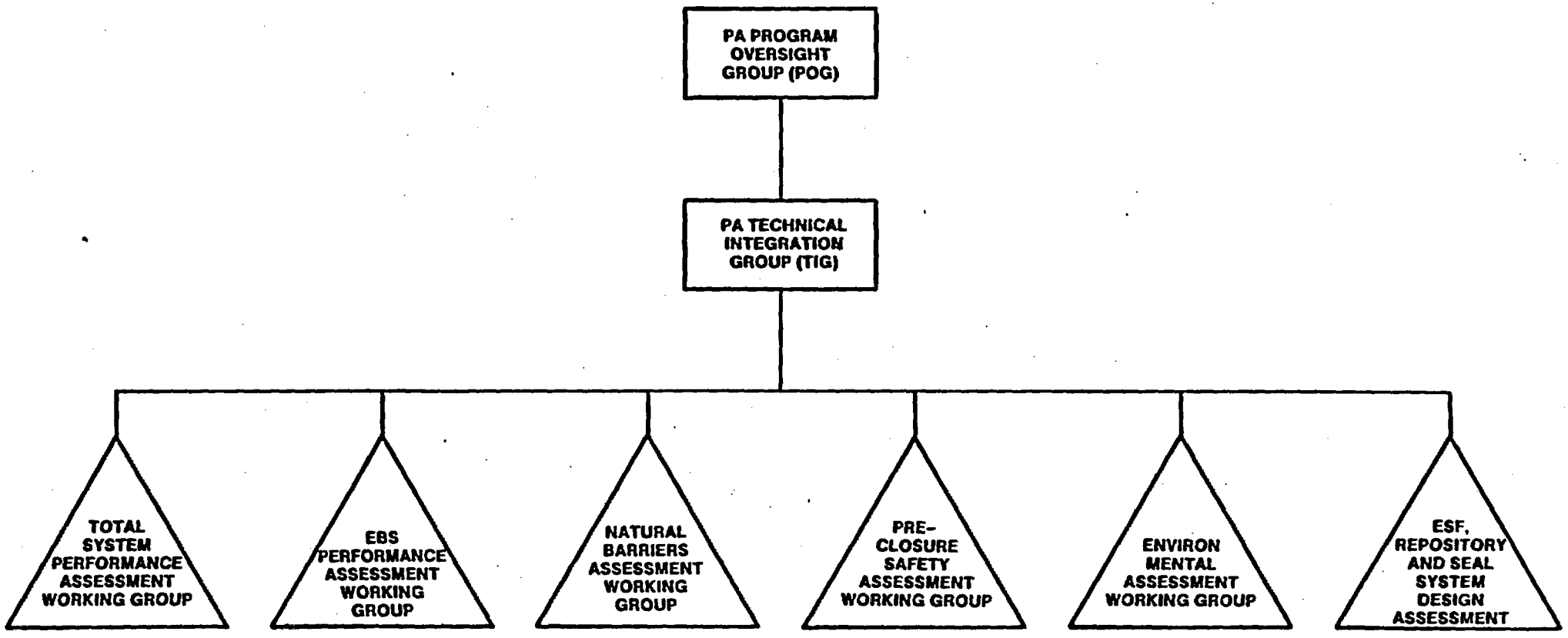
PERFORMANCE ASSESSMENTS FOR EIS, SAR

- THE PERFORMANCE ASSESSMENTS REQUIREMENTS ORGANIZED ACCORDING TO THE ISSUES HIERARCHY
- THE APPROACHES FOR THE PERFORMANCE ASSESSMENTS SPECIFIED IN THE LICENSING STRATEGIES FOUND IN THE SCP
- THE ASSESSMENTS FALL INTO SIX CATEGORIES:
  - PRECLOSURE SAFETY ASSESSMENT
  - POSTCLOSURE TOTAL SYSTEM PERFORMANCE ASSESSMENT
  - ENGINEERED BARRIER SYSTEM PERFORMANCE ASSESSMENT
  - REPOSITORY AND SEAL SYSTEM DESIGN ASSESSMENT
  - NATURAL BARRIER ASSESSMENT
  - ENVIRONMENTAL ASSESSMENT

PROGRAM PERFORMANCE ASSESSMENT MANAGEMENT STRUCTURE



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CURRENT ORGANIZATION

POG

D. Alexander, DOE/HQ
M. Blanchard, DOE/YMP

TIG

P. Gnirk, REISPEC
L. Rickertsen, Weston
J. Younker, SAIC

WORKING GROUPS

Total System Performance

A. Van Luik, PNL
H. Ahagen, DOE/YMP
F. Bingham, SNL
Others

Engineered Barrier Performance

S. Gomberg, DOE/HQ
M. Cloninger, DOE/YMP
M. Apted, PNL
U. Park, SAIC
Others

Natural Barrier Performance

A. Bindokas, DOE/RT
R. Dyer, DOE/YMP
D. Hoxie, USGS
C. Tsang, LBL
Others

Preclosure Safety

D. Michlewicz, Weston
N. Morley, DOE/YMP
R. Sandoval, SNL
Others

Repository and Seals Design

C. Voss, PNL
C. Stewart, SAIC
V. Montenyohl, Weston
Others

Environment

J. Friedman, SRA
Others

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OTHER PERFORMANCE ASSESSMENT WORKING GROUPS AND OVERSIGHT GROUPS ORGANIZED AS NEEDED

- VALIDATION OVERSIGHT GROUP ORGANIZED TO GUIDE AND COORDINATE PROGRAM MODEL VALIDATION EFFORTS
- PAMP WORKING GROUP ORGANIZED TO DEVELOP PERFORMANCE ASSESSMENT MANAGEMENT PLAN

PERFORMANCE ASSESSMENT PLANS AND REPORTS

- SITE CHARACTERIZATION PLAN (SCP)
- PERFORMANCE ASSESSMENT STRATEGY PLAN (PASP)
- PERFORMANCE ASSESSMENT IMPLEMENTATION PLAN (PAIP)
- PERFORMANCE ASSESSMENT ACTIVITY PLANS
- ASSESSMENT REPORTS

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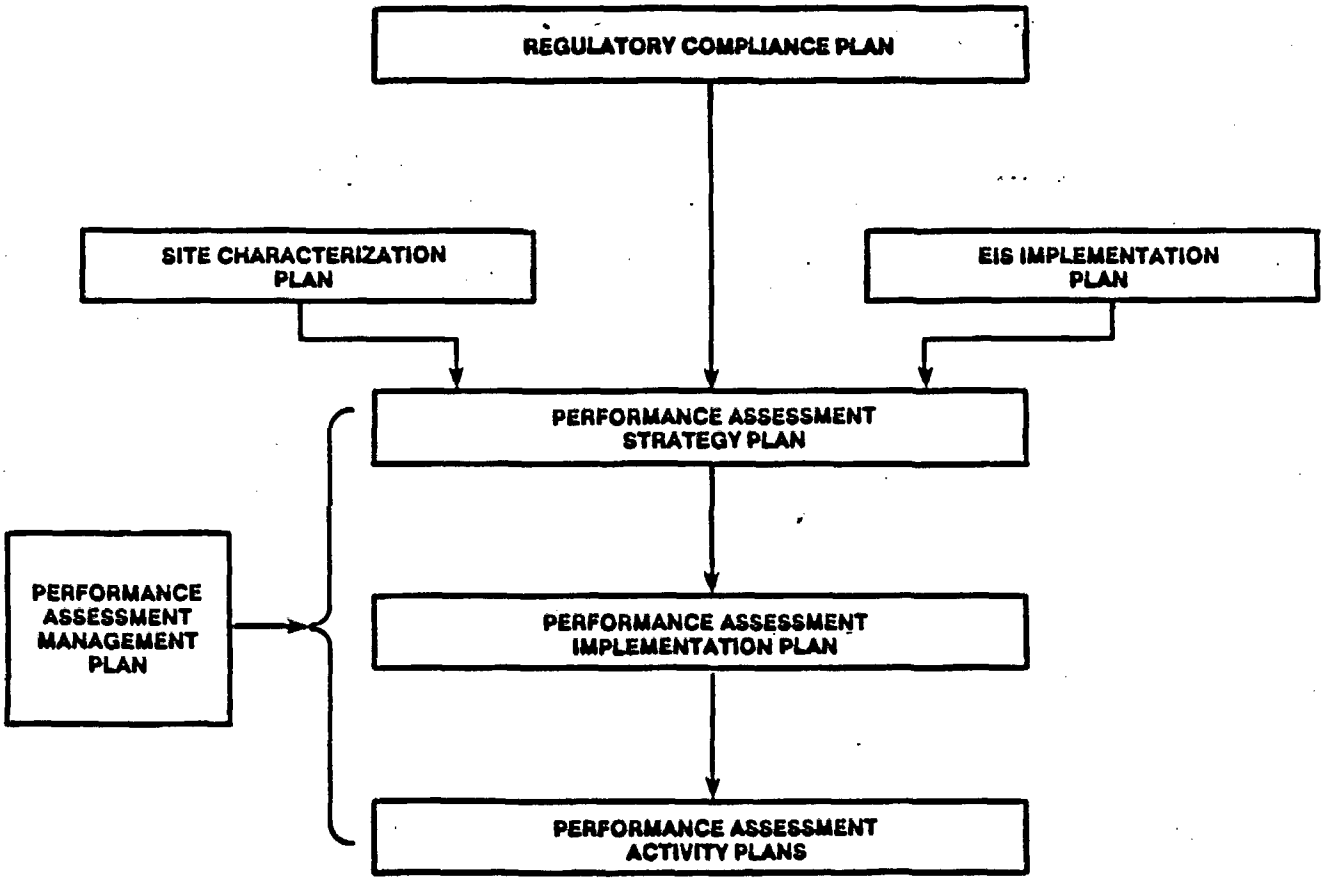
PERFORMANCE ASSESSMENT PLANS



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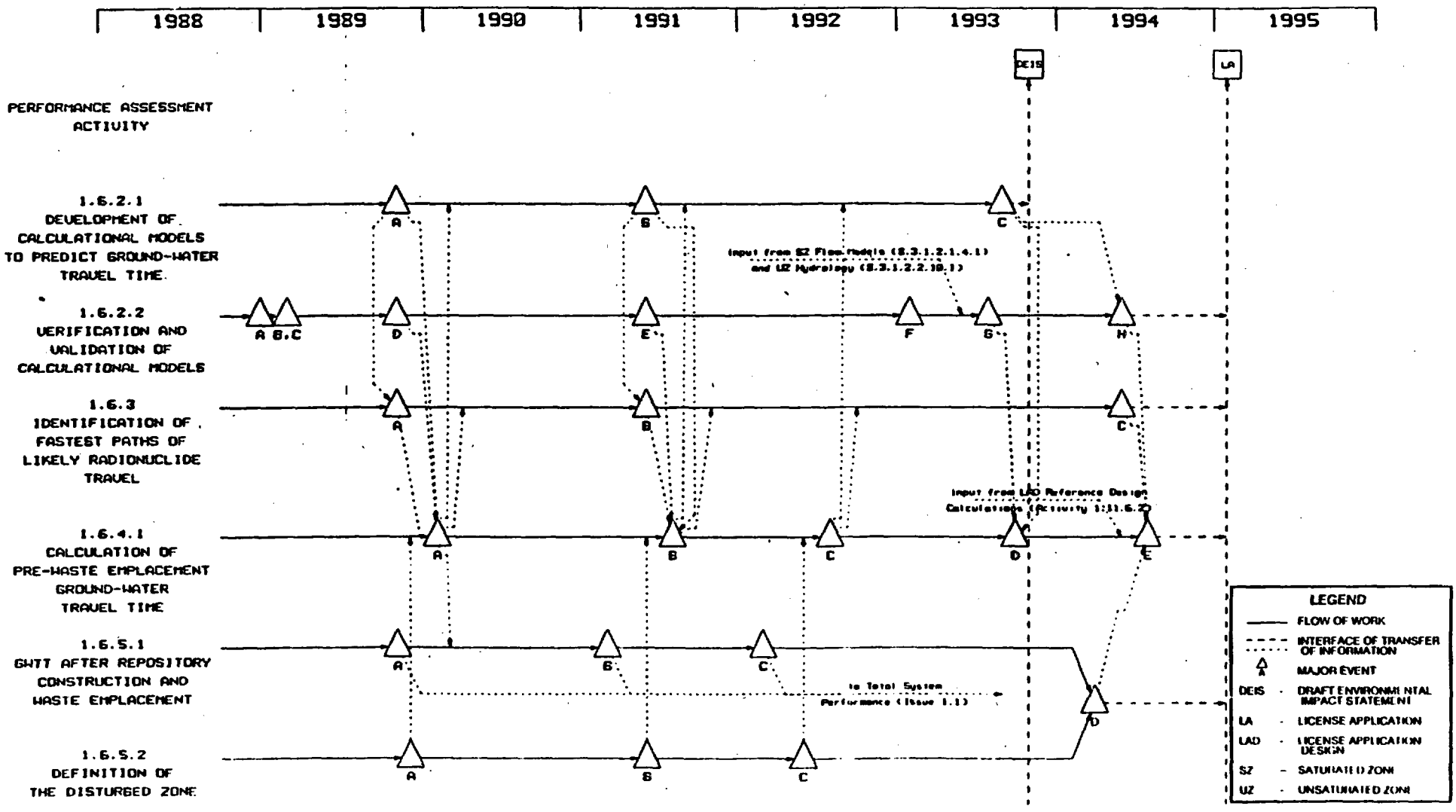

Figure 8.3.5.12-9. Schedule information for Issue 1.12 (ground water travel time). See Table 8.3.5.9.6 for description of major events. This network is consistent with the Draft Mission Plan Amendment (DOE, 1988a) schedule. Revisions will be published in semiannual site characterization progress reports as new information becomes available.

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Table 8.3.5.12-6. Major events and planned completion dates for activities in Issue 1.6 (ground-water travel time) (page 1 of 4)

Performance assessment activity/ information need number	Brief description of performance assessment activity/ information need	Major event[a]	Event description	Date
1.6.2.1	Development of calculational models to predict ground-water travel time (GWTT)	A	Information on conceptual and numerical models of flow and transport in unsaturated and partially saturated tuff available for GWTT calculations	10/89
		B	Update of conceptual and numerical models of flow and transport available for updating GWTT calculations	5/91
		C	Complete code development	8/93
1.6.2.2	Verification and validation of calculation models	A	Draft report available to the U.S. Department of Energy (DOE) on Cove 3 benchmarking	12/88
		B	Draft report available to DOE on the results of preliminary lab studies for validation of the unsaturated zone flow model	2/89
		C	Draft report available to DOE on the specific strategy for validating non-isothermal performance assessment codes	2/89
		D	Information supporting validation of flow and transport models available for GWTT calculations	10/89

Table 8.3.5.12-6. Major events and planned completion dates for activities in Issue 1.6 (ground-water travel time) (page 2 of 4)

Performance assessment activity/ information need number	Brief description of performance assessment activity/ information need	Major event[a]	Event description	Date
1.6.2.2	Verification and validation of calculation models (continued)	E	Updated information from lab studies for validation of flow and transport models available for updating GWTT calculations	5/91
		F	Begin final update/validation of non-isothermal flow models	1/93
		G	Complete certification of computer codes for the calculation of GWTT	7/93
		H	Final information on the validation and verification of models available for final update of GWTT calculations	1/94
1.6.3	Identification of fastest paths of likely radio-nuclide travel	A	Information on initial analysis of flow paths available for GWTT calculations	2/89
		B	Update of flow path analysis available for updating GWTT calculations	5/91
		C	Final results of flow path analysis available for final update of GWTT calculations	1/94
1.6.4.1	Calculation of pre-waste-emplacement ground-water travel time	A	Draft report available to DOE on the ranges of potential GWTT based on current data	1/90

Table 8.3.5.12-6. Major events and planned completion dates for activities in Issue 1.6 (ground-water travel time) (page 3 of 4)

Performance assessment activity/ information need number	Brief description of performance assessment activity/ information need	Major event[a]	Event description	Date
1.6.4.1	Calculation of pre-waste-emplacement ground-water travel time	B	Draft report available to DOE on the ranges of GWTT based on interim site characterization data	7/91
		C	Draft report available to DOE on pre-waste-emplacement GWTT to support the draft environmental impact statement (EIS)	7/92
		D	Complete updating calculations of pre-waste-emplacement GWTT for final EIS and license application	9/93
		E	Final report on GWTT calculations available to DOE	7/94
1.6.5.1	Ground-water travel time after repository construction and waste emplacement	A	Complete development of the approach for calculating post-emplacement GWTT	10/88
		B	Complete calculation of post-emplacement GWTT using available site data	2/91
		C	Complete update of post-emplacement GWTT calculations	2/92
		D	Final report on post-emplacement GWTT and definition of the disturbed zone available to DOE	3/94

PERFORMANCE ASSESSMENT
FY 1989 ACTIVITIES

- COMPLETE PASP, PAIP
- DEVELOP METHODOLOGIES AND CONDUCT ACTIVITIES IN KEY PERFORMANCE ASSESSMENT AREAS
  - TOTAL SYSTEM PERFORMANCE
  - WASTE PACKAGE PERFORMANCE
  - GROUND-WATER TRAVEL TIME
  - PRECLOSURE SAFETY
  - ENVIRONMENT
  - ESF

RW20772.048

SELECTED TOTAL SYSTEM PERFORMANCE ASSESSMENT ACTIVITIES FOR FY 1989

- REFINE SYSTEM MODEL USED IN EARLIER TSPA
- SCOPING ANALYSES USING SYVAC AND TOSPAC
- DEVELOPMENT OF RADIONUCLIDE TRANSPORT MODELS
- EVALUATION OF SCENARIO CLASSES
- DEVELOP METHODOLOGY FOR CODE CERTIFICATION

RW20772.068

SELECTED ENGINEERED BARRIER SYSTEM PERFORMANCE ASSESSMENT ACTIVITIES FOR FY 1989

- DETERMINE ANTICIPATED SCENARIOS
- DOCUMENTATION OF EBS ANALYTICAL MODELS
- COMPARISON OF CODES (E.G., AREST AND PANDORA)
- ANALYSIS OF EBS RELEASE PERFORMANCE FOR DEFENSE HIGH LEVEL WASTE GLASS
- UPDATE PROCESS SUBMODELS

SELECTED GROUND-WATER TRAVEL TIME ASSESSMENT ACTIVITIES FOR FY 1989

- GENERAL FLOW EVALUATION FOR UNSATURATED ZONE
- FRACTURE FLOW EVALUATION
- NATURAL ANALOG STUDIES
- PARTICIPATION IN INTRAVAL
- DEVELOP METHODOLOGY FOR EXTENT OF DISTURBED ZONE
- PRELIMINARY EVALUATION OF GWTT

RW20772.070

SELECTED PRECLOSURE SAFETY ASSESSMENT ACTIVITIES FOR FY 1989

- DEFINE BOUNDING CASE RADIONUCLIDE INVENTORY; ORIGEN SENSITIVITY ANALYSIS
- EVALUATE TRANSPORTATION CASK CERTIFICATION ANALYTICAL METHODS AND RESULTS FOR APPLICABILITY TO REPOSITORY SAFETY ANALYSIS
- CHARACTERIZE PARTICLE TRANSPORT PHENOMENA
- ASSESS METHODOLOGIES FOR IDENTIFYING AND SCREENING INITIATING EVENTS

SELECTED ESF PERFORMANCE ASSESSMENT ACTIVITIES FOR FY 1989

- DESIGN ACCEPTABILITY ANALYSIS
- REVIEW AND ACCEPT CONCEPTUAL MODELS, NUMERICAL MODELS, BOUNDARY CONDITIONS, AND ASSUMPTIONS
- CONDUCT SENSITIVITY ANALYSES
- IDENTIFY CONFIRMATORY TESTS AND ANALYSES

RW20772.063

SELECTED ENVIRONMENTAL ASSESSMENT ACTIVITIES FOR FY 1989

- REVIEW AVAILABILITY OF SITE-SPECIFIC DATA FOR EIS
- REVIEW PERFORMANCE ASSESSMENTS THAT CAN BE CONDUCTED
- PREPARE FOR EIS SCOPING

RW20772.064

UNITED STATES
NUCLEAR REGULATORY COMMISSION

ANNOUNCEMENT NO. 3

DATE: January 9, 1989

TO: All NRC Employees

SUBJECT: NRC ANNOUNCES ORGANIZATIONAL CHANGES AND APPOINTMENTS OF SENIOR EXECUTIVES

Organizational and personnel changes at the senior level of the Nuclear Regulatory Commission's staff are being announced today.

The Commission has appointed a second Deputy Executive Director for Operations and has assigned specific areas of responsibilities to the two deputies, both of whom will report to Victor Stello, Jr., Executive Director for Operations.

The Executive Director for Operations is the senior staff official with very important responsibilities. Victor Stello has been operating with a single deputy, James Taylor. The Commission, in approving the staff reorganization in the spring of 1987, recognized the need for a second Deputy Executive Director for Operations to accommodate the heavy workload of this key office. Today, we have appointed a second deputy, Hugh L. Thompson, Jr., and we have designated the program offices which will report to each of the deputies.

Mr. Taylor will serve as Deputy Executive Director for Nuclear Reactor Regulation, Regional Operations, and Research. Mr. Taylor's responsibilities will include supervision, management and oversight of Nuclear Reactor Regulation, Research, and all of NRC's Regional Operations, except Nuclear Material Safety and Safeguards activities. Mr. Thompson will be Deputy Executive Director for Materials Safety, Safeguards and Operations Support. Mr. Thompson's responsibilities will include supervision, management and oversight of enforcement and investigation functions, Nuclear Material Safety and Safeguards programs, including that portion of regional operations dealing with NMSS issues, and NRC's Offices of Consolidation, Administration and Information Resource Management. The attached chart describes the offices which will report to each deputy.

Other appointments announced today are Robert Bernero as Director of the Office of Nuclear Materials Safety and Safeguards and Stewart D.

Ebneter as Administrator of the NRC's Region II Office at Atlanta, GA. Mr. Bernero succeeds Mr. Thompson, and Mr. Ebneter will succeed Mr. Malcolm Ernst, who has been serving as Acting Administrator in Region II. Mr. Ebneter's appointment will be effective March 1, 1989.

The Commission also approved the reorganization of the functions of the Office of Administration and Resource Management. Functions of the office will be reassigned to a new Office of the Controller (reporting to the EDO) and an Office of Administration and an Office of Information Resource Management (reporting to the Deputy EDO for Materials Safety, Safeguards and Operational Support). Details of this realignment will be provided at a later date.

Mr. Taylor has been Deputy Executive Director since April 1987. He previously served as Director and Deputy Director of the former Office of Inspection and Enforcement. He joined NRC in May 1980, coming from the Department of Energy where he was Associate Director of High Speed Submarine Projects. He earlier served for 20 years as an officer in the U.S. Navy Nuclear Power Program. Mr. Taylor was graduated from the U.S. Naval Academy in 1956 with a Bachelor of Science degree. He received a Master of Science and an Engineer's degree in 1961 from the Massachusetts Institute of Technology.

Mr. Thompson has been Director, Office of Nuclear Material Safety and Safeguards. He joined the former Atomic Energy Commission in October 1972. Since then, he has held a number of progressively responsible positions at the NRC, including Technical Assistant to former Chairman Marcus Rowden and former Commissioner Peter Bradford; Director, Planning and Program Analysis Staff, Office of Nuclear Reactor Regulation (NRR); Director, Division of Human Factors Safety, NRR; Director, Division of Licensing, NRR; and Director, Division of PWR Licensing - A, NRR. Mr. Thompson also served as Acting Director, TVA Projects Staff. Before joining the Commission, Mr. Thompson was a Senior Nuclear Engineer with the Alabama Power Company. He also served as an officer in the U.S. Navy Nuclear Power Program. Mr. Thompson holds a Bachelor of Science degree from the U.S. Naval Academy, a Master of Science degree in Nuclear Engineering from Georgia Institute of Technology, and a Juris Doctor degree from George Washington University. Mr. Thompson is a member of the District of Columbia Bar.

Mr. Bernero has been Deputy Director of the Office of Nuclear Material Safety and Safeguards since April 12, 1987. He previously had served as Director, Division of Boiling Water Reactor Licensing in the Office of Nuclear Reactor Regulation and, before that, as Director of the Division of Systems Integration in the same office. Mr. Bernero joined the Atomic Energy Commission regulatory staff in February 1972 as a Licensing Project Manager. He was promoted to Chief of the Fuel Reprocessing and Recycle Branch in 1976, and in 1977 he became Assistant Director for Material Safety Standards in the Office of Standards Development. Following completion of an assignment on the Rogovin Special Inquiry after the TMI accident, he was named Director of the Probabilistic Analysis Staff, Office of Nuclear Research. Mr. Bernero has also served as Director of the Accident Source-Term Program Office. Prior to joining the AEC, Mr. Bernero worked as a fluid systems design engineer and later as a construction and test engineer for the General Electric Knolls Atomic Power Laboratory. He has also worked in the GE Space Division as a project manager and section

manager for the study and development of space nuclear power devices. Mr. Bernero holds Bachelor degrees in Philosophy from the University of St. Mary of the Lake Seminary, Illinois and in Chemical Engineering for the University of Illinois. He received his Masters degree in Chemical Engineering from Rensselaer Polytechnic Institute in 1961.

Mr. Ebneter joined the AEC/NRC in December 1973 as a reactor inspector in the Region I Office at King of Prussia, Pennsylvania. He also has served as a non-destructive test engineer in the NRC's Region II office at Atlanta, and as Chief, first of the Engineering Inspection Branch and later of the Engineering Branch of Region I. In January of 1985 he was appointed Director of the Division of Reactor Safety in Region I. He also served as Director of the NRC's Office of Special Projects at headquarters before returning to a senior position in the Region I office. He currently is Director of the Division of Radiation Safety and Safeguards at Region I. Mr. Ebneter received his Bachelor of Science degree in electrical engineering from Tri-State University in 1959, and a Masters Degree in business administration from Athens State College in 1971.

Lando W. Zech, Jr.
Chairman

Attachment

ATTACHMENT

REORGANIZATION OF THE OFFICE OF THE EXECUTIVE DIRECTOR FOR OPERATIONS

Executive Director for Operations

Assistant for Operations

Office for Analysis and Evaluation of Operational Data

Office of Personnel

Office of the Controller

Office of Small and Disadvantaged Business Utilization and Civil Rights

Deputy Executive Director for Nuclear Reactor Regulation, Regional Operations and Research

Office of Nuclear Reactor Regulation

Regional Offices (except NMSS matters)

Office of Research

Deputy Executive Director for Nuclear Materials Safety, Safeguards, and Operations Support

Office of Nuclear Material Safety and Safeguards

Office of Investigations

Office of Enforcement

Office of Consolidation

Office of Administration

Office of Information Resources Management

POLICY ISSUE
(Information)

October 5, 1988

SECY-88-285

For: The Commissioners

From: William C. Parler
General Counsel

Victor Stello, Jr.
Executive Director for Operations

Subject: REGULATORY STRATEGY AND SCHEDULES FOR THE HIGH-LEVEL WASTE REPOSITORY PROGRAM

Purpose: To inform the Commission of the staff's strategy and schedule for the overall high-level waste repository program, with emphasis on the regulatory framework.

Summary: The Commission requested the staff to inform it about the status of the regulatory framework for the high-level waste (HLW) repository program, as well as about the overall program strategy and schedule. The staff has already written one Commission paper (SECY-88-227, dated August 4, 1988) that covered the rulemaking actions that the Executive Director for Operations (EDO) has already approved and for which resources already have been budgeted, as well as the subjects for potential future rulemaking. This present paper expands on the first paper by describing: (1) the existing regulatory framework for licensing a repository; (2) the approaches for identifying uncertainties in the framework; and (3) the current strategy and schedules for further refining the regulatory framework, to reduce uncertainties, using a mix of rulemakings, Technical Positions, and Regulatory Guides. No additional resources are needed in FY89 for the potential new rulemakings. However, as the staff gains experience in preparing rulemakings and Technical Positions and as new candidates for both are identified, changes in the program will be factored into the annual update of the Five-Year Plan and Budget.

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Background: By memorandum dated June 6, 1988, (M880512B) the Office of the Secretary identified several Commission requests, to the staff, for information dealing with the HLW repository program. In Item 2 of that memorandum, the Commission requested that the EDO and the Office of the General Counsel (OGC) prepare a joint paper carefully examining relevant regulations and guidance (e.g., staff Technical Positions, Regulatory Guides, rulemakings), to determine whether the proper mix of regulatory tools is in place for the U. S. Nuclear Regulatory Commission (NRC) to make a licensing determination for the HLW repository. Furthermore, in Item 3, the Commission requested a staff paper listing proposed rulemakings, Technical Positions, and standards, etc., that the staff may suggest within the next six months, to enhance the licensing of a HLW repository. Previously, a May 26, 1988 memorandum from Commissioner Rogers to Chairman Zech requested that an overall licensing program strategy and a detailed (level 1 or level 2) schedule be prepared.

In response to the above requests, the staff has already written one Commission paper (SECY-88-227, dated August 4, 1988) that covered the rulemaking actions that the EDO has already approved and for which resources already have been budgeted, as well as subjects for potential future rulemaking. This present paper expands on the first paper by describing: (1) the existing regulatory framework; (2) the staff's ongoing efforts to identify uncertainties in the existing regulatory framework; and (3) the current strategy and schedules for refining the regulatory framework, using a mix of rulemakings, Technical Positions, and Regulatory Guides. Although this paper focuses on the regulatory framework part of the program, a summary of the overall program and schedules is given in Enclosure 1. This summary explains all the major activities in the program and, most importantly, the interrelationships among developing the regulatory framework, developing the staff's independent review capability, and conducting prelicensing reviews and consultations with DOE.

In response to an earlier Commission request, a Commission paper was prepared (SECY-86-323, dated October 30, 1986) on approaches to licensing a geologic repository (Enclosure 2). Approaches were discussed for streamlining the hearing process, identifying and resolving licensing issues early, and improving the appeal process. Specific approaches such as the licensing support system (LSS), pre-licensing consultation, Technical Positions, and rulemakings were evaluated. The October 1986 paper is a foundation upon

which this current paper builds in refining the existing regulatory framework. Many of the ongoing and new activities described in this present paper implement some of the approaches originally discussed in the October 1986 paper.

Some additional background is given below about the statutory framework for the HLW repository program. The Nuclear Waste Policy Act of 1982 (NWPA) establishes the statutory milestones and responsibilities, among other things, for the overall nuclear waste management program for which the repository program is one part. The U. S. Department of Energy's (DOE's) Mission Plan and Project Decision Schedule (PDS) periodically update the schedules for the milestones. The status of the actions that the NWPA requires NRC to take is tracked in an enclosure to the staff's Quarterly Progress Report on the Pre-licensing Phase of the DOE Civilian High-Level Radioactive Waste Management Program. The NWPA milestones and current schedules for both DOE and NRC actions are defined, for the staff's planning purposes, as level one milestones and are given in Enclosure 3. These level one milestones make up the basic statutory framework which NRC's program must meet.

Under the statutory framework established by the NWPA, the overall repository licensing process can be divided into five distinct phases (Enclosure 4). The first phase is the prelicense application phase. This phase precedes DOE's License Application submission and NRC's decision on docketing it. This phase consists of two parts, the pre-Site Characterization Plan (SCP) part, which involves informal reviews and consultations, and the post-SCP part, which primarily involves NRC's review of DOE's SCP and semi-annual progress reports. The first phase is referred to as "informal," because NRC has no licensing authority over DOE. The second phase, which begins after docketing of the License Application, involves the formal licensing activities related to the NRC decision on authorizing construction of the repository. The third phase results in the NRC decision on granting a license to receive waste. The fourth phase leads to the NRC decision on amending the license to allow permanent closure, and finally, the fifth phase ends in the NRC decision on terminating the license.

The staff is currently concentrating on the first and second phases of the licensing process. During the first phase, the Office of Nuclear Material Safety and Safeguards (NMSS), OGC, and the Office of Nuclear Regulatory Research (RES) staffs

will ensure that in the second phase the staffs will be able to conduct an effective review and that the construction authorization decision can be made within the NWPA-mandated three-year time period. To achieve this during the first phase, NMSS and RES in close consultation with OGC will: (1) refine the existing regulatory framework to support licensing; (2) ensure that DOE will submit a complete and high quality License Application that the staffs will find acceptable for conducting the licensing review and hearing process within the statutory time period; and (3) develop their technical capabilities to review DOE's License Application. During the first phase, both DOE and NRC will need to address many unique and complicated technical uncertainties related to the predictions of repository performance over 10,000 years, as required by the U. S. Environmental Protection Agency (EPA) Standard. Reducing these uncertainties will be an evolving and iterative process. Finally, during the first phase, the OGC staff will primarily focus on revising the procedural requirements for repository licensing in order to expedite the Hearing on the issuance of the Construction Authorization, in the second phase.

NRC's program during the first phase of the licensing process is subdivided into three levels of activities. The summary level of program activities is designated as level two. Current schedules for these are shown in Enclosure 5 and discussed in Enclosure 1. This discussion and the levels one and two scheduled activities demonstrate how NRC's program supports the statutory framework. A further level of schedule detail is designated as level three. The key rulemaking activities shown in Enclosure 6 are an example of the level three detail. A fourth level of detail, now being developed, will include the specific input and coordination activities with RES, OGC, the Advisory Committee on Nuclear Waste (ACNW), the Commission, DOE, and NRC contractors. Therefore, the specific integration of NRC's HLW repository program will be identified by these fourth-level activities and tracked by the High-Level Waste Management Division's (HLWM's) detailed operating plan.

Discussion: I. The Existing Regulatory Framework

The existing regulatory framework consists of the following primary regulations:

- 10 CFR Part 60, "Disposal of High-Level Radioactive Wastes in Geologic Repositories";

- 10 CFR Part 2, "Rules of Practice for Domestic Licensing Proceedings"; and

- 10 CFR Part 51, "Environmental Protection Regulation for Domestic Licensing and Regulatory Functions."

Additional regulations are incorporated by reference into the above primary regulations. With respect to 10 CFR Part 60, in February 1981, the Commission finalized "Licensing Procedures for HLW in Geologic Repositories," (46 FR 13980) and in June 1983, the Commission finalized "Technical Criteria for HLW in Geologic Repositories" (48 FR 28204).

In addition to the basic regulations, the existing regulatory framework also includes staff guidance to DOE in the form of Technical Positions and one Regulatory Guide on the format and content of DOE's SCP. Enclosure 7 lists the rulemakings, Technical Positions and Regulatory Guide, issued to date, applicable to the Yucca Mountain Site.

II. Strategy to Identify Uncertainties within the Existing Regulatory Framework

The staffs' identification of uncertainties within the existing regulatory framework has been and will be a continuous process to refine the regulatory requirements and improve the effectiveness of the licensing process for use by NRC reviewers, adjudicatory boards, and DOE. For example, a rulemaking completed in 1985 was conducted to resolve regulatory uncertainties of a technical nature about disposal in the unsaturated zone, after DOE began considering a repository in the unsaturated zone at the Yucca Mountain site in Nevada. Similarly, the passage of NWPA created institutional uncertainties of a procedural nature about site characterization and State/Tribal participation. These uncertainties were resolved by a 1986 rulemaking. In addition, the Commission recently issued a proposed rule amending 10 CFR Part 51, to establish the Commission's NEPA review procedures for repository licensing in accordance with the NWPA.

As a follow-up to the October 1986 Commission Paper on approaches to licensing, the NMSS, OGC and RES staffs have been identifying the most significant regulatory, technical, and institutional uncertainties related to 10 CFR Part 60, to determine what refinements to the regulatory framework might be needed. Regulatory uncertainties exist where the

meaning of a requirement or definition in 10 CFR Part 60 is subject to more than one interpretation (e.g., definition of disturbed zone) or where what must be proven in general terms to demonstrate compliance with a requirement (i.e., elements of proof) is not completely defined in the requirement itself. Technical uncertainties are related to how compliance with a requirement should be demonstrated (i.e., an acceptable method or sufficient information). Institutional uncertainties pertain to conflicting or unclear roles, actions or schedules, between NRC and other participating agencies, that could adversely affect licensing (e.g., NRC's adoption of DOE's Environmental Impact Statement (EIS) and NRC's role in reviewing compliance with mine safety regulations or other regulations referenced in 10 CFR Part 60). These also include procedural reforms relating to repository licensing.

The staff has identified and will continue to identify uncertainties based on: (1) the experience with applying the regulation to prelicensing technical reviews of the DOE program; (2) the results of NMSS and RES contractor studies; and (3) the identification of uncertainties by DOE, the State of Nevada, and other parties. For example, the staff's review of the consultation draft SCP resulted in a concern with DOE's interpretation of "substantially complete containment" in 10 CFR Part 60. As a result, the staff has commented to DOE and is considering a rulemaking to clarify these terms. Another example relates to the recent concern about the lack of compatibility between the methods used in on-site spent fuel storage at reactor sites and DOE's transportation and disposal systems. As a followup to this concern, the staff will review, from a systems engineering standpoint, the need for a rulemaking which would standardize container requirements for reactor storage, transportation, and disposal in a repository, so as to minimize the handling and repackaging of waste.

The staff is also using two other approaches to identify uncertainties and evaluate the regulatory framework. The first is a coordinated effort, among the CNWRA, NMSS, and OGC staffs, to systematically analyze the regulations related to NRC's NWPA responsibilities, including those related to the repository. This approach will be a more systematic and complete analysis of the regulations to identify regulatory, technical, and institutional uncertainties. It will also recommend mechanisms to reduce the uncertainties found. The first portion of this analysis is focused on siting-related uncertainties and is currently scheduled to be completed in late December 1988. The full-

scale analysis is scheduled to be completed by September 1989. The staff's consideration of the resulting recommendations may result in a future adjustment to the current plans, described below, to improve the regulatory framework. New or modified research needs and priorities may also result.

A second approach to identifying regulatory and technical uncertainties involves the staff developing capability to use computer models and perform analyses related to determining compliance with the performance objectives of 10 CFR Part 60, including the EPA standard (i.e., performance assessments). Recently, a coordinated effort has been started between NMSS and RES to develop the staffs' modeling capability (initially based on a transfer of contractor-developed capability). The ultimate objective of this effort is to ensure that the NRC staff will be able to review the demonstration of repository compliance with 10 CFR Part 60 that DOE must provide in its License Application. However, in developing this capability, a short-term benefit will also be gained, which will allow the staff to perform independent, site-specific performance assessments throughout the prelicense application phase as DOE collects data. These assessments are expected to be an important additional way to identify both regulatory and technical uncertainties and to assess their significance. Thus, they can identify areas where new or modified rules, guidance, or research may be needed. They will also be used to prepare or revise the staffs' review plans and focus staff reviews of DOE's site characterization program on significant areas of technical uncertainty and site features of concern. Ultimately, these assessments will be repeated in the licensing review process to determine whether the site is acceptable.

The staff will assess the results of the ongoing efforts described above and, as needed, will revise the plans to improve the regulatory framework. This will be done as part of the Five-Year Plan and Budget planning process. In addition, any significant changes to the plan that are necessary during the year will be brought to the Commission's attention in Item 7 (early resolution of issues through a program of Licensing Topical Reports and other mechanisms) of the Quarterly Progress Reports to the Commission on the Pre-licensing Phase of the DOE's Civilian High-level Radioactive Waste Management Program.

III. Reducing Uncertainties and Refining the Regulatory Framework

The plans for both ongoing work and new work to revise the existing regulatory framework are described below. The staff's objectives are to reduce regulatory uncertainties, reduce institutional uncertainties involving NRC's licensing role and procedures, and provide DOE with guidance in areas of high technical uncertainty.

As previously mentioned, the staff has categorized uncertainties as regulatory, technical, and institutional. Therefore, the discussion below will address each of the three categories of uncertainty by identifying the mechanisms and the specific activities NMSS, OGC, and RES staffs will use for reducing these uncertainties.

A. Reducing Regulatory Uncertainty

It is clear that reducing regulatory uncertainties identified by NRC, DOE and others is NRC's responsibility. The staff will use rulemakings, Technical Positions, and at least one Regulatory Guide to reduce major regulatory uncertainties. Rulemakings will be considered where authoritative and binding clarification or elaboration is needed on the meaning of requirements or definitions in the 10 CFR Part 60. Rulemakings might also be used to address what must be proven to demonstrate compliance with a requirement (i.e., elements of proof) for selected requirements. In either case, however, rulemakings would be pursued only where practicable. For example, reducing regulatory uncertainty may depend on site-specific information to provide a firmer basis for determining what additional requirements may be necessary to protect health and safety. Therefore, attempting to reduce such an uncertainty in the abstract might not be worth the additional effort of rulemaking.

A major benefit to rulemaking is that uncertainties can be formally resolved and then, according to 10 CFR Section 2.758, the Commission's rules generally cannot be challenged in a licensing proceeding. Therefore, rulemaking can provide more assurance that uncertainties have been reduced and will not be contested in the Hearing. However, rulemaking is, of course, subject to litigation. This potential risk, along with the resources commitment necessary to conduct a rulemaking, will be considered before recommending topics to the EDO for rulemaking.

As previously noted in SECY-88-227, the staff has tentatively identified nine new topics (listed in Enclosure 8) where regulatory uncertainties could be reduced by means of rulemaking. In FY89 the staff will first develop preliminary positions for these topics and then decide which of them to recommend to the EDO for approval to initiate the formal two-year rulemaking process. Those not so recommended may be issued as Technical Positions. These rulemakings are currently scheduled (see Enclosure 6) to be completed by FY92, which is when DOE is currently planning to begin developing its License Application. One of the candidate rulemaking topics is a result of previous Commission action. In the development of 10 CFR Part 60, the staff identified the need for regulations dealing with emergency planning criteria. Another rulemaking on conforming Part 60 to the EPA standard issued in June 1986 is being held in abeyance, pending the completion of a court-ordered EPA review of these standards. Finally, it is important to note here that the potential rulemaking on establishing criteria for containment of greater-than-Class-C low-level waste is dependent on the proposed amendment to 10 CFR Part 61 regarding disposal facilities to be used for such waste.

In addition to rulemakings, the staff will prepare a Regulatory Guide for the format and content of the License Application. Regulatory Guides have consistently been the mechanism used by other NRC programs to give format and content guidance to applicants. Guidance will be given on the specific content of the License Application. The staff might also include the essential elements of proof (i.e., what must be proven to demonstrate compliance with the requirements of 10 CFR Part 60). This Regulatory Guide will also give guidance on the format and organizational structure of the License Application and, therefore, will be a framework for the staff's License Application Review Plan.

B. Reducing Technical Uncertainties

The staff considers it to be DOE's responsibility to reduce technical uncertainties (e.g., develop acceptable test and analysis methods) through site characterization activities and prelicensing consultations with NRC, the State of Nevada, and other parties. However, the staff intends to prepare Technical Positions in areas of high uncertainty where standard testing or analysis methods are either not available or existing methods are controversial. The staff

considers it more appropriate for NRC as a regulatory agency to develop Technical Positions which give criteria for acceptable methods than to prescribe specific acceptable methods developed by the staff. Criteria would also provide a basis for the staff's review of DOE's methods. Technical Positions will be developed through a process of involving all interested parties, including targeted technical groups, so that their questions and concerns can be addressed in an open and documented manner.

Technical Positions will allow testing and analysis methods to evolve that are appropriate for the Yucca Mountain Site. Presently, the staff considers that reducing technical uncertainties by rulemaking is not appropriate since reduction may depend on collection of site-specific data or development of site-specific methods requiring further understanding of the site. In addition, for some cases, rulemaking may be unreasonable for methods where technology is still evolving. Therefore, as mentioned above, it is DOE's responsibility to reduce technical uncertainties. The staff, however, will continue to consider the appropriateness and timeliness of using rulemakings for resolving technical uncertainties that require authoritative and binding clarification or elaboration.

The staff also considers that the prelicense application review and consultation process will complement Technical Positions in giving DOE guidance on reducing technical uncertainties before DOE submits the License Application. In its review of DOE's Topical Reports and Issue Resolution Reports, the staff will identify objections, that if not resolved by DOE, would result in the staff not accepting the License Application. Objections will be identified for areas where DOE's reduction of technical uncertainties is unacceptable to the staff. Any unresolved objections would also be factored into NRC's Preliminary Site Characterization Sufficiency Comments (required by Section 114(a)(3) of NWPA) that will be submitted as part of the President's Site Recommendation to Congress.

There are several benefits from DOE's resolving NRC objections. One benefit is to have a complete and high-quality License Application which will reduce the number of technical uncertainties and focus the remaining uncertainties that would be adjudicated in the Hearing. The extent to which objections to DOE's reduction of technical uncertainties do not become licensing issues in the Hearing will be an important factor in meeting the three-year licensing requirement. Even if resolved

objections are raised in the Hearing, the Hearing Licensing Board will be able to deal with them more directly and quickly because of the documentation that will exist. The staff's open item tracking system will provide access to this documentation by identifying all the documents related to the identification and resolution of objections (and other concerns) with DOE's reduction of technical uncertainties. Documents would include DOE's resolution, and NRC's comments and acceptance, along with comments from other parties. Resolving objections will also streamline the staff's review of the License Application regarding sufficiency of information and acceptable methods since, ideally, these will have already been reviewed and DOE's resolution of NRC objections accepted by the staff. This would allow the staff to concentrate its review on DOE's compliance demonstrations and the results compared to the regulatory requirements.

At this time, the staff has identified 22 topics for which work is ongoing or will begin on developing Technical Positions (see Enclosure 8). Work will begin in FY89 on topics that are considered to be most important to DOE's surface-based testing and exploratory shaft construction testing. Work will begin later, in FY89 and FY90, on other topics important to longer-term DOE work, such as repository design and in-situ testing that will start in FY91 after the two exploratory shafts are connected. As site characterization proceeds, additional topics will probably be identified.

C. Reducing Institutional Uncertainties

The staff will reduce institutional uncertainties using a variety of mechanisms, depending on the nature of the uncertainty. Possibilities include rulemakings, memoranda of understandings, and comments and consultations on DOE's PDS.

Four rulemakings to resolve institutional uncertainties in 10 CFR Parts 2, 51, and 60 are listed in Enclosure 8 and their schedules shown in Enclosure 5. Two of these rulemakings are going on now and will resolve uncertainties of a procedural nature. The first rulemaking, for which a proposed rule has been recently issued, deals with amending 10 CFR Part 51 to implement the NWPA provisions that require NRC to adopt DOE's Environmental Impact Statement (EIS) to the extent practicable. This rulemaking will complete all rulemakings required for conformance to NWPA and the Nuclear Waste Policy Amendments Act (NWPAA).

The second ongoing rulemaking is the negotiated rulemaking on the LSS. The draft proposed rule was recently forwarded to the Commission (SECY 88-249). In general this draft proposed rule revises 10 CFR Part 2 to establish the basic procedures and schedules for the HLW licensing proceeding, including procedures for the use of the LSS in the HLW proceeding. Specifically, the draft proposed rule establishes requirements for: submission and entry of material to the LSS; access to the LSS; a Pre-License Application Licensing Board to resolve disputes during the period before DOE submits the License Application for the repository; LSS administration; the electronic transmission of formal papers during the licensing hearing; discovery; intervention and participation in the Hearing; appeals; and the Commission's immediate effectiveness review of the initial Licensing Board decision on the repository. OGC believes that the LSS rulemaking will establish the fundamental procedural framework necessary for the effective conduct of the licensing proceeding. As such it addresses the critical issues related to streamlining the hearing and appeal process identified in SECY 86-232 (Enclosure 2).

A potential future rulemaking of a procedural nature deals with revising the existing content requirements in 10 CFR Part 60 for the License Application and establishing criteria for acceptance of the License Application. The purpose of such a rulemaking would be to have DOE either (1) resolve, before submittal of the License Application, NRC's objections raised during the prelicense application reviews concerning sufficiency of information and acceptable compliance demonstration methods, or (2) explain in the License Application why resolution was not achieved, and the significance to licensing.

Finally, the staff's upcoming review of the PDS and the systematic analysis of the regulations are two activities that may yield additional institutional uncertainties.

III. Effects on the Five-Year Plan and Budget

The activities described above for improving the regulatory framework affect the NMSS FY89-93 Five-Year Plan and FY91 Budget only in the areas of rulemakings and Technical Positions. Other activities and associated resources are not affected. The plans described above show an increase in potential rulemakings (from two to nine) and a decrease in Technical Positions (down from 29 to 22). The NMSS resources needed for the additional rulemaking have become

available from both the decrease in the number of Technical Positions and a delay in starting some Technical Positions from FY89 to FY90. Therefore, NMSS does not need additional resources at this time.

The RES resources needed for the additional rulemakings identified in this paper will be made available by delaying completion of regulatory efforts such as achieving comparability with EPA regulations to implement the Uranium Mill Tailings Recovery and Conservation Act (UMTRCA) and the development of lower priority Regulatory Guides. Therefore, RES does not need additional resources in FY89. Furthermore, NMSS and RES have not identified the need to initiate additional research other than what is ongoing and currently projected in the Five-Year Plan to develop rulemakings. Finally, no additional resources are needed in FY89 for OGC.

It should be emphasized that the resource estimates are best estimates at this time and may change as the staff gains experience in preparing rulemakings and Technical Positions and as new candidates for both are identified. Such changes in resource estimates will be factored into the annual update of the Five-Year Plan and Budget.

Conclusions: Based on the discussion above, the staff has the following major conclusions:

1. A regulatory framework for licensing a repository is currently in place.

2. As a result of its ongoing program to identify uncertainties and refine the existing regulatory framework, the staff has the following coordinated set of activities scheduled:

   a) Nine potential new rulemakings and one Regulatory Guide are currently planned to reduce regulatory uncertainties. The topics being considered for rulemaking will be evaluated to determine if rulemaking is needed and practicable. If not, Technical Positions will be prepared.

   b) Four ongoing and potential rulemakings are planned to resolve institutional uncertainties involving NRC's licensing role as well as procedures and schedules for the licensing proceeding.

c) Twenty-two Technical Positions are planned which will give guidance for DOE's reduction of major technical uncertainties.

4. The prelicense application review and consultation process will complement Technical Positions in guiding DOE's reduction of technical uncertainties before submittal of the License Application. This process could also help streamline the detailed review of the License Application by the staff.

5. No additional resources are needed in FY89 for the potential new rulemakings.

6. Finally, it should be emphasized that the resource estimates are best estimates at this time and may change as the staff gains experience in preparing rulemakings and Technical Positions and as new candidates for both are identified. Changes in the program will be reflected in the Quarterly Progress Reports to the Commission and factored into the annual update of the Five-Year Plan and Budget.

William C. Parler
General Counsel

Victor Stello, Jr.
Executive Director for Operations

Enclosures:
1. Summary of High-level Waste Repository Licensing Program Activities
2. Commission Paper on Approaches to Licensing a Geologic Repository (SECY-86-323)
3. Timeline of Level One NRC and DOE NWPA Major Repository Milestones
4. Phases of the Repository Licensing Process
5. Timeline of Level Two Summary Schedule of NRC Repository Program Activities
6. Timeline of Level Three schedules for NRC Rulemaking Activities
7. List of Issued Rulemakings, Technical Positions, and Regulatory Guides Applicable to the Yucca Mountain Site
8. List of Ongoing and Planned Potential Rulemakings, Technical Positions, and Regulatory Guides

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ENCLOSURE 1

Enclosure 1

SUMMARY OF HIGH-LEVEL WASTE REPOSITORY LICENSING PROGRAM ACTIVITIES

1. INTRODUCTION

The U.S. Nuclear Regulatory Commission's (NRC's) high-level waste repository licensing program is both proactive and reactive. Proactive activities include such events as NRC initiating the actions of preparing Technical Positions or rulemaking which are timely enough to support the U.S. Department of Energy's (DOE's) key programmatic milestones, but do not depend on a DOE action such as issuance of the Site Characterization Plan (SCP). In contrast, reactive activities involve an NRC action in response to a DOE action. These include reviewing DOE programmatic reports (e.g., SCP, Mission Plan, and Project Decision Schedule (PDS)) and auditing the DOE program. Both proactive and reactive work forms the basic program; however, in the event of delay in reactive work (e.g., delay in issuance of the SCP) resources will be balanced by adjusting the priorities and schedules of proactive activities.

2. PROACTIVE ACTIVITIES

The proactive part of the program involves an ongoing effort of: (1) identifying uncertainties in the regulatory framework; (2) developing regulatory requirements and guidance to resolve uncertainties; (3) developing the staff's independent site characterization and license application review capability; and (4) evaluating progress toward meeting the Nuclear Waste Policy Act (NWPA) and Nuclear Waste Policy Amendments Act (NWPAA) requirements. The ongoing effort of identifying uncertainties in the regulatory framework will be complemented by two new activities. The first effort is an ongoing systematic review of all the relevant regulations in order to identify the regulatory, technical, and institutional uncertainties that need to be addressed during the pre-licensing period, so that licensing can be conducted within the three-year time period mandated by the NWPA. Regulatory uncertainties exist where the meaning of certain existing regulatory requirements are subject to more than one interpretation or where what must be proven in general terms to demonstrate compliance with a requirement (i.e., element of proof) is not completely defined in the requirement itself. Technical uncertainties are related to how compliance with a requirement should be demonstrated. Institutional uncertainties pertain to conflicting or unclear roles, actions, or schedules between NRC and other participating agencies (e.g., NRC's adoption of DOE's Environmental Impact Statement (EIS)). These also include procedural reforms relating to repository licensing. The second new effort involves the Office of Nuclear Materials Safety and Safeguards (NMSS) and the Office of Nuclear Regulatory Research (RES) developing and using performance assessment models

with Yucca Mountain site data. While the direct purpose of this effort is to develop the staff's technical assessment capability, it will have the additional benefit of identifying areas of regulatory and technical uncertainty.

2.1 Programmatic and Regulatory Requirements and Technical Guidance

Rulemakings will focus on resolving regulatory and some institutional uncertainties related to significant ambiguities in the meaning of a requirement or definition in 10 CFR Part 60 and those regulations incorporated by reference in 10 CFR Part 60. Rulemakings, in some cases, may also include defining the elements of proof for certain requirements where these are unclear and where resolution by rulemaking is important enough to make the investment of time and resources worthwhile. The License Application Format and Content Regulatory Guide will provide a format and organizational structure, for the information to be included in the License Application, that will facilitate the staff's review. Therefore, the outline of the Guide will provide a framework for the License Application Review Plan. This Guide might also contain the essential elements of proof (i.e., what DOE must prove to demonstrate compliance with the regulation). Technical Positions will focus primarily on technical uncertainties related to acceptable methods for how compliance should be demonstrated for selected areas that are both controversial and critical to repository performance. These Technical Positions will consist of the criteria that will be guidance to DOE and that the staff will use to review the methods DOE develops to resolve the technical uncertainties. Both the Technical Position mechanism and the use of criteria (rather than prescribe specific methods) allow DOE flexibility in its application of state-of-the-art technology to demonstrate compliance. Technical Positions will become major components of the License Application Review Plan. To the extent practicable, the staff will resolve significant regulatory uncertainties with final rulemakings and Technical Positions before 1992, which is generally when DOE will begin preparing its License Application. Draft Technical Positions and proposed rulemakings, however, will provide DOE and other parties an early opportunity to understand and comment on the staff's evolving position. Finally, the process of developing the above mentioned rulemakings and guidance involves all interested parties, including targeted technical groups, so that their questions and concerns can be addressed in an open and documented manner before licensing.

2.2 Technical Assessment Capability

In addition to developing guidance for DOE, the proactive activities result in developing the staff's independent review capability in the form of review plans, assessment methods (including models and codes), and the capability to

apply these tools to review DOE's program. The SCP Review Plan, the Study Plan Review Plan, and the Quality Assurance (QA) Review Plan guide the staff's review of both the technical and QA plans for DOE's overall prelicensing and site characterization program. The License Application Review Plan will guide the staff's review of the data collection activities, data, and assessments resulting from the DOE site characterization program; preliminary site characterization sufficiency; and ultimately the License Application itself. This plan will integrate and focus all the staff's proactive work by referencing staff Technical Positions and assessment methods and combining these with the review criteria and procedures the staff will use to conduct its independent review of DOE's License Application. The Performance Assessment Review Strategy will be prepared as an initial phase in developing the License Application Review Plan. This strategy will determine how thorough and independent the staff's reviews of DOE's compliance demonstration modeling should be. Such guidance will be a basis for further developing the License Application Review Plan and will also be a justification for which areas and what types of assessment capabilities should be developed by the staff. Those methods developed will be referenced in the License Application Review Plan. NMSS and RES have recently completed a memorandum of understanding to assure a coordinated effort in developing and implementing a staff modeling capability consistent with the Performance Assessment Review Strategy.

The final proactive activity is the quarterly evaluation of progress on NRC statutory actions required by NWPA and NWPAA and DOE actions that the staff considers critical for a successful prelicensing program. This evaluation is documented in the Quarterly Progress Reports to the Commission on the Pre-Licensing Phase of the DOE's Civilian High-Level Radioactive Waste Management Program and sent to DOE. This evaluation complements the numerous more specific reviews and consultations by taking a broad view of progress and identifying fundamental concerns, based on a synthesis of specific concerns.

3. REACTIVE ACTIVITIES

The reactive part of the program consists primarily of the QA activities and prelicensing and site characterization technical reviews and consultations following the review plans that the NRC staff prepares for the proactive part of the program. This work depends on a specific DOE action such as the issuance of the SCP or the scheduling of a DOE audit. These reactive activities are for a selected sample of DOE's program, including followup on previously identified concerns with DOE's program and how DOE is resolving them. These activities will focus on areas of significant technical uncertainty. They will give DOE programmatic guidance for the specific parts

of the program reviewed, and will be used to resolve problems with the effectiveness of DOE's implementation of the overall issue resolution process given in the SCP.

3.1 QA Program Activities

The QA activities consist of reviewing DOE's and DOE's contractor QA plans and evaluating their implementation. Both NRC audits and NRC observations of DOE audits, using both QA and technical staff, will check implementation. The objective of these reviews and audits is to identify and resolve staff concerns so that NRC can accept DOE's program before significant data collection activities are performed during site characterization. The QA activities complement the selective nature of technical reviews described below by independently assuring that DOE is effectively implementing a qualified QA program to assure the quality of its work from the start of its program and to assure that DOE is also verifying that its program is being implemented properly.

3.2 Prelicensing and Site Characterization Reviews

NRC's prelicensing and site characterization reviews follow DOE's sequence and schedule of activities. Therefore, in the early stages of the program, the emphasis is on reviewing plans such as the SCP (required by NWPA and NRC regulation) and the more detailed study plans and procedures which implement the SCP. The SCP review will focus on the top-level strategies, assumptions, and content of DOE's program, as described in DOE's issue resolution strategies and each of the program and investigation plans. NRC will review all study plans to determine if DOE's study plan process is effective and if there are any objections to starting work (i.e., potential adverse effects on either waste isolation or other site characterization activities). However, detailed reviews will be conducted for only a sample (about 20 percent) of the approximately 100 study plans. This sample is less than half of the study plans where key concerns already have been identified, for studies related to potential adverse conditions at the site, areas of significant uncertainty, and for certain nonstandard or controversial test methods. These detailed reviews will also be used to determine the proper implementation of the SCP at the detailed level.

As site characterization proceeds the SCP will be updated semiannually by DOE and reviewed semiannually by NRC, until DOE submits its License Application. NRC's review of these SCP semiannual progress reports will focus on: (1) evaluating DOE's resolution of previously identified NRC concerns (open items) and (2) identifying new concerns with new information about the site and designs, new plans, or changes to the original plans and schedules.

Also during site characterization, NRC will conduct on-site reviews of selected DOE testing activities and the data that are collected by them. These activities are another way to check the proper implementation of the SCP by DOE. In addition, NRC will review selected DOE study reports and position papers which document the detailed results of DOE's work. NRC will review DOE's topical reports and issue resolution reports which summarize, integrate, and evaluate the site characterization work for individual licensing topics and DOE issues related to demonstrating compliance with NRC's regulation. As such, these reports will become inputs to the License Application, and therefore, the staff's review of these will identify concerns that DOE needs to resolve before submittal of the License Application. Similar concerns might also result from the staff's review of site characterization sufficiency, as required by NWPA, before DOE's site recommendation to the President and Congress.

All concerns identified in the staff reviews and DOE's progress toward resolving them and their root causes will be tracked by the staff as open items. The tracking system, presently being implemented, will focus the staff prelicensing review activities on identifying and resolving concerns with how DOE is resolving technical uncertainties. The tracking system will also provide a document trail, to use in licensing, of all the NRC and DOE actions related to resolving specific concerns.

Lastly, on-site representation at the Yucca Mountain site will continue to facilitate direct information exchange with DOE as well as the State of Nevada, and will provide both QA and technical oversight of data, documents, and site characterization activities.

ENCLOSURE 2

ENCLOSURE 2

POLICY ISSUE
(Information)

October 30, 1986 SECY-86-323

For: The Commissioners

From: William C. Parler
General Counsel

Victor Stello, Jr.
Executive Director for Operations

Subject: APPROACHES TO LICENSING A GEOLOGIC REPOSITORY FOR THE DISPOSAL OF HIGH-LEVEL WASTE

Purpose: To inform the Commission of the staff's evaluation of possible approaches to licensing a geologic repository for the disposal of high-level waste (HLW).

Background: In a June 12, 1986 memorandum to the Executive Director for Operations (EDO) and the General Counsel (OGC), Chairman Palladino requested that the staff identify and evaluate potential approaches to licensing a HLW repository (Enclosure 1).

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The approaches considered by the staff are discussed under three categories: 1) streamlining the hearing process; 2) early identification and resolution of licensing issues; and 3) the appeal process.

The first category, "streamlining the hearing process," evaluates several alternatives for making the licensing hearing more efficient. One alternative includes the implementation of an information management system (Licensing Support System) to facilitate the management of documents that will be generated in support of the licensing application. A second alternative discusses the development of an approach for adopting the Environmental Impact Statement prepared by DOE pursuant to §114(f) of the Nuclear Waste Policy Act of 1982 (NWPA). A third approach considers potential efficiencies to the hearing process through the adoption of the proposed amendments to 10 CFR Part 2 "Rules of Practice for Domestic Licensing Proceedings--Procedural Changes in the Hearing Process," or through the adoption of the Federal Rules of Evidence as guidance in Commission licensing proceedings.

The category "early identification and resolution of issues" examines a number of mechanisms for identifying and closing issues, to the extent practicable, prior to the receipt of the license application. These include the effective use of the pre-license application consultation period, staff guidance, and rulemaking. Other mechanisms considered include the use of partial initial decisions, a multiple licensing board approach, the use of stipulations, and the early identification of potential safety problems. This section also includes a discussion of early approval of the surface facilities for the repository through a Limited Work Authorization (LWA).

The final category, "the appeal process," addresses the issues of how much appellate review is required and who will do it. Specific issues examined in this section are the potential role of the appeal board, interlocutory review of licensing board decisions, and application of the immediate effectiveness rule.

Discussion: Under Section 114(d)(2) of the Nuclear Waste Policy Act of 1982 (NWPA), the Commission is required to issue a final decision approving or disapproving the issuance of a construction authorization no later than 3 years after the application is submitted, although the Commission could extend this deadline for twelve months for good cause. The NRC staff believes the 3 year period for reaching a

licensing decision on repository construction is tight. Meeting this schedule depends on early and open consultation between NRC and DOE on the information that will be needed for licensing and on DOE plans and activities, and on the submission by DOE of a high quality and complete license application. Given these assumptions, the staff has evaluated various alternatives that would streamline the HLW licensing process without sacrificing fairness and quality. Effective implementation of these alternatives is also going to be dependent on the cooperation of DOE, and on the participation of the States, Tribal governments, and other interested persons.

In developing this paper, recommendations were considered from DOE, the public, the electric utility industry, the Atomic Safety and Licensing Board Panel ("Licensing Panel"), and the Atomic Safety and Licensing Appeal Panel ("Appeal Panel"). For example, recommendations for licensing reform, including several proposed by the electric utility industry, were presented in a March 1986 report by the Subcommittee on Energy Research and Production of the U.S. House of Representatives Committee on Science and Technology entitled "Nuclear Waste Policy Act of 1982: Progress and Problems" (Enclosure 2). Other suggestions were proposed by the National Association of Regulatory Utility Commissioners (NARUC) in an April 15, 1986 appearance before the Commission, and in a follow-up letter to Chairman Palladino (Enclosure 3). An evaluation of these and other alternatives is provided in this paper. While a few of these alternatives are new, some are already in the process of implementation.

The alternatives examined are confined to those that are consistent with the basic licensing approach established in 10 CFR Part 60. For example, the staff did not consider alternative dispute resolution techniques such as arbitration, or the use of hybrid or informal adjudicatory hearings, or the elimination of the existing "two-step" licensing process for the repository (construction authorization and license to emplace waste). These alternatives were not considered because of the Commission's long-standing policy on formal hearings and a "two-step" licensing approach for the repository. The Congress was cognizant of this policy in its deliberations on the NWPA, and the expectation of the States and Tribes is that this approach will not change.

In the last several years the Commission has initiated numerous reforms of the hearing process, including the proposed amendments discussed below in Section I.C.. In order to put the existing hearing process, and the HLW proceeding, into some perspective for the Commission, the staff has enclosed a timeline of the hearing process as it exists today (Enclosure 4). However, this timeline represents the minimum time required for hearing, and most hearings run substantially longer. A proceeding of the size and complexity as the HLW proceeding would have a particularly high potential for a lengthy hearing if no steps were taken to streamline the licensing process. For example, as noted by the Licensing Panel, the HLW proceeding involves a facility whose cost will be substantially greater than the average reactor facility, will involve a multi-million document data base (approximately thirty to forty times more documents than the average reactor operating license proceeding), and will involve substantially more and better funded parties than the average reactor operating license proceeding.

In terms of the types of reforms that might prove most effective, the staff believes that the greatest potential for decreasing the length of the hearing process lies in reforms related to the procedural aspects of the hearing process. Although proposals for reducing or better defining the issues to be litigated in the proceeding will have an impact on the length of the proceeding, no matter how few or contentious the issues in a particular proceeding, the existing procedural aspects of the hearing assure that a certain length of time will be involved. One such reform, the development of a licensing information management system and its use for discovery in the HLW proceeding, is discussed below.

I. Streamlining The Hearing Process

A. Licensing Support System (LSS)

One of the most significant contributors to the length of licensing review has been the time associated with sending, receiving, and handling information and data. This is true for docketed correspondence between receivers and applicants, for discovery by the production of documents and by interrogatories, and service of documents during adjudication. Current technology for electronic storage, retrieval, and mail could substantially reduce the time needed for information processing.

If the Commission is to reach its construction authorization decision within the allotted time, it will be necessary to facilitate the discovery process, as well as to reduce the delays normally associated with the physical service of documents. Hence, the information and data supporting a DOE application should be made available to all interested persons, to the extent practicable, before the application is submitted and formal NRC review begins. This would entail DOE development of a licensing information system providing ready access to all pertinent documents. The system would not involve the generation of new data, but rather, would capture in electronic form all the data that would normally be generated relevant to the licensing decision. As such, it would serve as a means for efficient management of the information to be used in the licensing decision. To meet this intended purpose, all parties to the licensing proceeding would provide access to relevant data within their control by making the data available in a standard electronic format for easy incorporation into a centralized computer data base in the licensing information system. The standardized electronic format will ensure compatibility of information and data submitted by parties to the licensing hearing. It would also eliminate the need to re-key information and data into an NRC-accessible system. The compatible information and data would then be accessible to all interested parties (States, Tribes, and others).

The staff proposes to implement this process through a rulemaking which would require all parties to the HLW licensing proceeding to place all of their relevant documents in the data base and to use the licensing information data base for discovery purposes. Because all relevant licensing information would already be available through access to the LSS, this type of process would eliminate the traditional filing of first round discovery requests and thus would eliminate accompanying search times by the party from whom the records were requested. It would also eliminate the mailing time associated with the request and the response, and would substantially reduce requests for extensions of time in the proceeding because documents were not provided or because adequate search time was not available. Furthermore, it would ensure, to the extent practicable, the availability of data at the earliest possible time, thereby facilitating the early resolution of licensing issues. In SECY-86-133, the EDO informed the Commission that the Staff intended to use the process of negotiated rulemaking to develop the proposed rule that would provide for the use of the LSS in the HLW

proceeding. In SECY-86-308, the staff has recently transmitted a proposal to initiate this negotiated rulemaking for the Commission's review and approval.

The staff believes that implementation of the LSS has the greatest single potential for substantially reducing the hearing time for the HLW proceeding. A preliminary analysis of recent reactor operating license hearings show that 30% to 50% of a typical four year hearing is occupied by the discovery process and the time expended on the physical submission of documents. The staff anticipates that the use of the LSS in the HLW proceeding should substantially reduce the amount of time traditionally spent on these aspects of the hearing.

B. NEPA

In SECY-86-51, the staff set forth three rulemaking options for developing NEPA review procedures to be used in connection with the issuance of a construction authorization and license for a HLW geologic repository. The rulemaking options would establish procedures and criteria to govern the Commission's review and adoption of the Department of Energy's environmental impact statement (EIS) "to the extent practicable" as required by § 114(f) of the NWPA. These rulemaking alternatives attempted to balance the clear mandate of Congress to avoid duplication of work (and expenditure of public resources) with the independent responsibilities of the Commission to assure compliance of the repository with the Commission's public health and safety standards.

Under the approach recommended by the staff (Option 2 in SECY-86-51), the NRC would conduct a review of the DOE EIS and identify specific environmental issues addressed in the DOE EIS which would be adopted and would not be subject to challenge or change during NRC review. Traditional NRC practice would be followed as to environmental issues that the Commission did not adopt; i.e., independent analysis of those issues by the Commission and litigation of those issues in the Commission's licensing proceeding. This approach would be implemented by conducting a rulemaking indicating the procedures the Commission intended to follow in adopting the DOE EIS and spelling out exactly how the adoption determination would be made when the EIS was issued. The staff recommended Option 2 as the most balanced approach to the Commission's NEPA responsibilities under §114(f) of the NWPA. Commission approval of this

rulemaking approach should reduce the time and staff resources normally devoted to litigation on EIS issues in the licensing proceeding. Adoption of Option 1 in SECY-86-51 could substantially increase the Commission's litigation risk in regard to the implementation of §114 of the NWPA. Adoption of Option 3 could seriously jeopardize the Commission's ability to meet the three year statutory timetable.

C. Regulatory Reform

In order to improve the licensing process, the Commission recently issued a proposed rule that would amend certain provisions of its rules of practice, 51 Federal Register 24365, July 3, 1986. The proposed revisions address the admission of contentions, discovery against the NRC staff, the use of cross-examination plans, the timing of motions for summary disposition, and limitations on intervenor's filings of proposed findings of fact, conclusions of law, and appellate briefs. Although these proposed revisions were directed primarily toward the licensing of nuclear power plants, they would also be applicable to other licensing proceedings conducted under 10 CFR Part 2, Subpart G, including the HLW proceeding. The staff believes that these proposals would achieve efficiencies in the HLW licensing proceeding similar to those anticipated for reactor licensing.

For example, the Licensing Panel has suggested, in the context of raising the threshold for the admission of contentions, that the Commission should require detailed fact pleadings, or adopt some variant of Federal Rule of Civil Procedure 12(b)(6). This approach would revise the Rules of Practice to require more factual specificity in all pleadings, including contentions. However, the proposed regulatory reform amendments, cited above, already include a proposal for raising the threshold for contentions. Proposed 10 CFR §2.714 would require the proponent of the contention to supply information showing the existence of a genuine dispute with the applicant or the NRC staff on an issue of fact. The showing must include references to the specific portions of the application which are disputed. The contention must be supported by a concise statement of the alleged facts or expert opinion, together with specific sources and documents of which the petitioner is aware, which will be relied on to establish the facts or expert opinion. The purpose of the increased threshold is to sharpen the issues in dispute throughout the pre-hearing and hearing

phases and to ensure that the resources of all parties are focused on real rather than imaginary issues. The staff believes that this proposal is particularly appropriate for the HLW proceeding, which requires the resolution of many complex issues within a specific period of time.

In addition, the Administrative Conference of the United States (ACUS) has recently recommended that agencies should adopt evidentiary regulations applicable to adjudications that clearly confer on presiding officers discretion to exclude unreliable evidence and to use the weighted balancing test in Rule 403 of the Federal Rules of Evidence (FRE), which allows exclusion of evidence the probative value of which is substantially outweighed by other factors, including its potential for undue consumption of time. ACUS Recommendation No. 86-2, 51 Fed. Reg. 25641, 25643, July 16, 1986. Although it is the NRC's well-established practice to use the FRE as guidance, the practice is followed less by some boards than others. The Licensing Panel believes there would be an advantage to codifying the practice of using the FRE as guidance, particularly Rule 403. In the view of the Licensing Panel, codifying the FRE as advance guidance for litigants would provide predictability in the HLW proceeding.

However, as noted by the Appeal Panel, the Commission's Rules of Practice already authorize and direct the boards to exclude unreliable, unduly repetitious, cumulative, and "time-wasting" evidence. Promulgating a regulation to "codify" this practice is unnecessary, and may actually cause a board to exclude more evidence at the outset of the hearing than it would otherwise, thereby providing more issues for appellate or judicial review. It may be more efficient in the long run to admit more evidence initially and give it appropriate weight later as part of the decision-making process. Finally, the Commission, in its order establishing the HLW proceeding, can make explicit reference to the use of existing case-management techniques, such as those on the exclusion of evidence, to ensure their application.

II. Early Identification And Closure of Issues

DWM High-Level Waste Program Five Year Plan FY86-FY90 (Enclosure 5) calls for the development and implementation of a systematic process for identifying, examining, and closing issues to the extent practicable prior to the receipt

of the repository license application. The process includes mechanisms for the identification, prioritization, and resolution of issues; focusing technical meetings and technical positions on issue resolution; assuring active and effective participation by affected States and Tribes; identifying issues that are ripe for early closure; better definition of issues through the issuance of Staff Technical Positions (STP); and formal closure through rulemaking or possible early litigation of selected issues. This process is designed to reduce the number of, and to better define, the issues that will be litigated during the licensing hearing.

A. Pre-Licensing Consultation

The principal means for the early identification and resolution of issues is through pre-licensing consultation with DOE, States and Tribes. During this period, generic and site specific issues are identified through our ongoing consultation with DOE, States, and Tribes, and staff reviews of DOE data or documents (e.g., Environmental Assessments, Site Characterization Plans) or other documents bearing on the repository program. This ongoing consultation and review process helps to ensure the early identification of potential licensing issues so that they are addressed by DOE's site characterization program. As part of the above process, an open item tracking system is currently being developed to track and document the status of the resolution of issues.

This process provides a mechanism for focusing NRC/DOE interactions and NRC action on the identification of critical issues; the extent of uncertainty associated with a particular issue; potential information needs; alternative approaches to addressing an issue; and to the extent practicable, on formal closure of issues. NRC/DOE meetings, which solicit the active participation of States and Tribes, are scheduled on these issues. Minutes are drawn up at the close of these meetings to document the progress towards resolution of the issues, the extent of agreements or disagreements, as well as any further actions needed to resolve the issues. The staff intends to implement closure of these issues through the development of formal Staff Technical Positions and through rulemaking. It may also be possible to use the consensus developed through the pre-licensing process as a basis for later stipulations by the parties (see Section II F).

B. Staff Guidance

Staff Technical Positions (STP's) provide a means to 1) establish NRC's technical positions and provide guidance to DOE on strategies and methodologies acceptable for demonstrating compliance with NRC regulations, and 2) move toward resolution of particular issues. The process of developing an STP assures that the topic is open to public review in order to obtain input and strive for consensus from the technical community, interested parties, and other targeted groups. Draft STPs are noticed in the Federal Register and also forwarded to interested parties and targeted groups for comment. Comments received on a draft STP are considered in the development of a final position. The final STP will formally document any consensus between DOE, NRC, States and Tribes relative to the issue(s) under consideration. The staff has developed a number of draft and final STPs on such issues as the items and activities that are subject to the quality assurance requirements in 10 CFR Part 60, the interpretation of the disturbed zone concept in 10 CFR Part 60, the waste package reliability analysis, design information needs in the site characterization plan, and the licensing assessment methodology for the HLW repository.

Traditionally, the use of technical positions and regulatory guides has been intended to provide guidance to licensees and license applicants concerning what information the staff will require for review of the license application, what standards will be employed in the staff review of a license application, and those methods that the staff finds acceptable for implementing the general criteria found in the NRC regulations. As such, this guidance makes the licensing process more efficient. However, the existence of formal NRC guidance does not preclude a licensee or license applicant from utilizing a method different from that contained in the guidance document to demonstrate compliance with the regulations. It also does not preclude other parties in the hearing from challenging the way that the guidance documents interpret the regulations, or otherwise demonstrating that the methods approved in the guidance documents are inadequate. Therefore, it may be advisable to close selected key issues out through rulemaking, rather than through the use of staff technical positions.

C. Rulemaking

In order to resolve selected major issues more formally prior to the licensing hearing, the Staff plans to use

rulemaking where appropriate. Unlike staff technical positions, the regulatory approach set forth in the Commission's rules generally cannot be challenged in a licensing proceeding. Therefore, rulemaking can provide more certainty in the early resolution of technical issues. However, rulemaking is more resource-intensive than the development of staff guidance, and requires longer lead-times for resolution. Issues closed in this manner must be mature, and important enough to make the investment of time and resources worthwhile. The staff is in the process of identifying, on a systematic and continuing basis, issues that are appropriate for resolution through rulemaking. Although some concern has been expressed by the Licensing Panel over the time required for rulemaking, past practice demonstrates that disciplined rulemaking efforts can be completed in a timely manner.

Possibilities for rulemaking include the methodology for demonstrating compliance with the EPA standard, and waste package compliance. For example, the Commission's regulations in 10 CFR Part 60 now establish design requirements for the HLW waste package. A rulemaking to establish more specific criteria on the methodology for compliance with the waste package requirements would not only contribute to a more efficient hearing process, but would also allow DOE to proceed with more certainty in the design of the waste package.

D. Partial Initial Decision

It is also possible to use the mechanism of partial initial decisions by the Licensing Board for the early and systematic closure of issues. Partial Initial Decisions are typically used by the Boards to reach a decision on discrete issues in the hearing after the complete license application is filed. Use of a Partial Initial Decision after the complete application is filed would achieve efficiencies in the hearing process. In the promulgation of the final rulemaking on the technical criteria in 10 CFR Part 60, the Commission recognized the desirability of Partial Initial Decisions when it stated that the identification of anticipated and unanticipated processes and events under 10 CFR Part 60 will have such a pervasive effect on the design basis for the repository that--

> ...rulings made in the course of construction authorization hearings on the scope of anticipated and unanticipated processes and events be separately identified by the presiding officer and certified to the

Commission for interlocutory review... 48 Fed.Reg. 28195, 28200, June 21, 1983.

Partial Initial Decisions could also be used to close out selected issues in advance of the full license application being submitted by DOE. Used in this manner, selected issues could be eliminated from the hearing before the three year decision period begins. However, use of Partial Initial Decisions in this manner would require the early filing of a portion of the license application, selection of parties, filing of contentions on the particular issue involved, and discovery on those contentions. Therefore, the issue to be decided would need to be mature enough for consideration, with site characterization having provided sufficient information on the issue. In addition, if the issue was dependent on other repository licensing issues that could only be addressed after the full application was submitted, then the issue could not be resolved without taking these interdependencies into account. This approach would require a revision to Commission regulations to provide for early convening of the licensing board and to establish criteria for what types of issues could be considered.

However, use of the Partial Initial Decision before DOE submits its completed license application could have adverse consequences. For this first-of-a-kind facility, with its technical complexity and uncertainty, it would be advisable for the Commission to adopt a conservative approach to the review of the license application, and to defer any adjudication of issues until a complete license application is submitted. This would allow each issue to be reviewed in the context of the total information submitted in the license application, and for the staff and the licensing board to be fully aware of the interrelationships among the various segments of the license application and the extent of the gaps and uncertainty in the total information submitted. In addition, because of the high visibility of the HLW program, the submittal of the license application in increments could place a distorted focus on the first issues brought to hearing, causing more NRC, DOE, and intervenor resources to be expended than ordinarily would have been devoted to those issues. It is also possible that the hearing on the incremental issues would proceed slowly, leading to later coordination problems when the full application was submitted. Early filing would also cause the ex parte rules to apply to any portions of the application that were in adjudication. This would constrain the Commission from having the benefit of

viewing these issues in the context of its periodic comprehensive review of pre-licensing issues.

Based on the current DOE Project Decision Schedule, the use of Partial Initial Decisions before the complete license application is submitted may be impractical in light of the time remaining before the DOE license application is filed. Assuming that some amount of site characterization is necessary to gather sufficient information on the particular issue to be closed, there will not be much time before the full DOE license application is due in 1991. Therefore, it may not be feasible, and could be counterproductive, to initiate a Partial Initial Decision process during this time period. Finally, other alternatives such as rulemaking may provide a satisfactory method for resolving certain issues.

Although the Appeal Panel agrees that the use of Partial Initial Decisions before DOE submits its completed application would be risky, the Licensing Panel believes that an early and segmented DOE license application is desirable so that issues can be heard as documentation is completed. The Licensing Panel cited waste package compliance, and EIS issues as examples of where a segmented, early application could be filed.

E. Multiple Licensing Boards

A new approach suggested by the Licensing Panel is the creation of a "Managing Board" to coordinate multiple licensing boards. The Appeal Panel also endorses the use of multiple licensing boards. Each board would decide different issues and the "Managing Board" would have primary responsibility for: (1) issuing the final Initial Decision; and (2) management responsibility for the entire case. Multiple boards have been used successfully in reactor licensing, and the addition of the Managing Board concept would complement the use of Partial Initial Decisions in the HLW proceeding. However, as noted in the discussion of Partial Initial Decisions, the effective use of Partial Initial Decisions and multiple boards will be dependent on the extent to which it is feasible to segment the HLW licensing issues. The Commission should establish the multiple board framework by specifically addressing this issue in its order establishing the HLW proceeding.

As part of the hearing management process, the Managing Board could develop a number of pre-trial management orders that could make the hearing process more efficient. Pre-trial orders could be issued on such subjects as

defining and redefining issues in detail and certifying them as ready for hearing, establishing lead counsel and liaison counsel, and procedures for obtaining stipulations on various issues. Such orders are within the authority of the presiding officer under 10 CFR 2.718. However, such orders must be consistent with the other specific requirements in the Rules of Practice, including for example, the anticipated rules governing the use of the Licensing Support System for discovery purposes.

F. Stipulations

10 CFR 2.753 permits stipulations as to facts in a licensing hearing after the license application has been docketed. Agreement of all parties to comprehensive stipulations can avoid time-consuming evidentiary hearings on some issues and the resulting delay and costs. The staff anticipates that its attempts to resolve selected issues during the pre-licensing phase, and to develop consensus among the interested parties on these issues, can profitably be used to reach agreement on stipulations which will reduce delay in the licensing proceeding.

G. Early Identification of Potential Safety Problems

In an April 15, 1986 appearance before the Commission, and in a follow-up letter to Chairman Palladino of June 18, 1986, the National Association of Regulatory Utility Commissioners (NARUC) recommended that the Commission explore the feasibility of "a more continuous type of licensing process" where the NRC Staff would "continuously follow the progress of DOE, reviewing and signing-off as identifiable tasks are completed by the DOE thus eliminating delays that could lead to expensive retrofits." The Commission's discussion with NARUC on this issue focused on the identification of potential safety deficiencies and how this could eliminate delay in the licensing of the repository.

The staff does intend to monitor the progress of DOE after a construction authorization is issued to ensure compliance with Commission regulations and construction authorization conditions, as well as to avoid future compliance problems. In terms of ensuring that potential safety and licensing problems are identified and addressed well before the Commission's decision on the license to emplace waste at the repository, 10 CFR 60.32(b) now provides for the incorporation of provisions into the construction authorization requiring DOE to furnish reports on any data

about the site obtained during construction which are not within the predicted limits upon which the facility design was based, and on any deficiencies in design and construction, which, if uncorrected, could adversely affect safety at any future time.

H. Early Approval of Surface Facilities

DOE had initially planned to obtain an LWA from the Commission for the HLW repository. The LWA envisioned by DOE would enable it to excavate additional shafts, construct the waste receiving building, and conduct some limited underground construction. Based on subsequent analysis by the NRC staff, DOE abandoned this proposal. A summary of the legal and technical analysis of the LWA alternative is provided below for the Commission's information.

Commission regulations in 10 CFR 50.10(c) prohibit the commencement of construction of a production or utilization facility until a construction permit has been issued. Commencement of construction includes any clearing of land, excavation or other substantial action that would adversely affect the environment of the site, but does not include pre-construction monitoring activities necessary to establish background environmental values.

The Commission's regulations in 10 CFR 60.3(b) contain similar restrictions in regard to a HLW repository. However, unlike the regulatory framework for the HLW repository, Section 50.10(e) of the Commission's regulations authorizes the granting of a LWA to permit certain site preparation activities to occur before a construction permit is granted. Provision of an LWA is currently limited to utilization facilities, and does not extend to any other type of Commission license. Section 50.10(e)(1) authorizes the issuance of what is commonly referred to as an "LWA-1" for site preparation activities such as the construction of temporary access roads, excavation for facility structures, the construction of service facilities such as sewage treatment plants, and the construction of structures, systems and components that will not eventually be involved with accident prevention or mitigation. Section 50.10(e)(2) authorizes the issuance of what is commonly referred to as an "LWA-2" for the installation of structural foundations for structures, systems, or components which prevent or mitigate the consequences of accidents. An "LWA-1" may only be issued after the licensing board, in a separate hearing,

has made all of the NEPA findings required by 10 CFR Part 51 of the Commission's regulations for a construction permit and has determined that there is reasonable assurance that the proposed site is a suitable location for the facility in question. In addition to these findings, an "LWA-2" may be issued if the licensing board determines that there are no unresolved safety issues related to the additional work that is authorized.

The NWPA neither prohibits nor mandates the use of an LWA in the Commission's repository licensing process. However, the broad authority provided in the Atomic Energy Act over nuclear materials would allow the Commission to extend the LWA concept to a licensing proceeding to receive or possess source, special nuclear or byproduct material at a geologic repository. The procedures in 10 CFR Part 60 do not currently provide for a LWA. Specifically, 10 CFR 60.3(b) prohibits DOE from commencing construction until it obtains a construction authorization from the Commission. In language transferred verbatim from 10 CFR 50.10(c) "commencement of construction" is defined in Part 60 as the clearing of land, surface or subsurface excavation or other substantial actions that would adversely affect the environment of the site.

In the development of the 10 CFR Part 60 rule, the Commission explicitly considered the type of activities that would be permitted prior to the Commissions's initial licensing decision and did not provide for an LWA. Under the Commission's Proposed General Statement of Policy, which outlined the proposed procedures for the licensing of geologic repositories for high-level radioactive waste, only surface exploration combined with some test borings would have been permitted prior to the Commission's issuance of a construction authorization or a provisional construction authorization. 43 Fed.Reg. 53869, November 17, 1978. After further review of this issue, the Commission determined that exploration and in-site testing at depth should be allowed prior to the issuance of construction authorization. 44 Fed.Reg. 70408, December 6, 1979. In arriving at this position, the Commission noted that the incremental costs for these activities would be small, in the context of overall project costs for a repository, and implied that such increased financial investments and institutional commitments were warranted only because of the substantial improvement in the quality of available data that could be expected. While the character of DOE activities under an LWA is unclear, there

would appear to be no comparable benefit in terms of improved data for licensing. As the above commentary indicates, the Commission heretofore has not been favorably disposed to the concept.

In addition, establishing LWA procedures may not provide substantial time savings because of the required hearing on site suitability and environmental issues. Traditional LWA criteria require the completion of the final EIS and a hearing and favorable decision on all the NEPA findings of 10 CFR Part 51. In the licensing of a first of a kind facility, these will be difficult issues and the hearing process could occupy a substantial amount of time. The Commission's ultimate approach to the implementation of its NEPA responsibilities in HLW licensing (see Section I.B.) would affect this process. For example, a decision by the Commission to adopt the DOE EIS in its entirety, although not the approach recommended by the staff in SECY-86-51, would foreclose litigation of NEPA issues in the licensing hearing. In this case, the traditional LWA criteria would be superfluous. If the Commission adopted the staff recommendation, which allows for partial adoption of the DOE EIS, the number of issues to be addressed in the LWA hearing would be reduced to the extent of the Commission's adoption. Finally, the potential exists for the work performed under an LWA to adversely affect the satisfaction of the performance objectives in 10 CFR Part 60, or to necessitate costly mitigation measures.

It should also be emphasized that 10 CFR Part 60 would now permit DOE, prior to submitting the license application, to pursue all activities related to site characterization and other pre-construction monitoring and investigation necessary to establish background information related to the suitability of the site. This could include many site preparation activities such as the clearing of land, the construction of roads and support facilities, and the sinking of exploratory shafts, that will ultimately prove useful in expediting the construction of the repository.

The same considerations discussed previously on the LWA concept would also apply to the proposals that the Commission consider surface facility construction at the start of the licensing hearing. A favorable Partial Initial Decision could then allow surface facility construction to begin in advance of the final decision on construction of the entire repository. This post-license application alternative was recommended by the industry in testimony

before the Subcommittee on Energy Research and Production (Enclosure 6). As with the LWA, this alternative would require both submission of a complete license application for the entire repository, and revision of the Commission's regulations to explicitly provide for this procedure.

III. The Appeal Process

The Commission has not yet determined the specific procedures for appellate review of the licensing board's Initial Decision. The existing requirements in 10 CFR Part 2 only specify that the decision of the presiding officer shall not be immediately effective. 10 CFR § 2.764. Because this is not a 10 CFR Part 50 proceeding, the licensing board decision could not be appealed to an appeal board under the existing regulations, unless specifically directed by the Commission. 10 CFR §2.785. Therefore, the issues of how much appellate review is required or desirable, and who will do it, still remain to be determined.

One option for appellate review is to not involve an appeal board in the review process, and provide for direct review of all appeal issues by the Commission. The non-involvement of the appeal board is the situation that exists under current rules, and will remain as the status quo, unless the Commission specifically directs an appeal board to hear and decide any appeals from the licensing board decision on the HLW repository. Providing for appeal board involvement obviously adds more time to the licensing process. However, use of the appeal board would provide a careful, detailed review of the hearing record. This would facilitate Commission review and should also serve to reduce the litigative risk of the Commission's ultimate licensing decision being overturned on judicial review. The additional time devoted to appeal board review could be mitigated by allowing the licensing board's Initial Decision to become immediately effective.

As noted above, 10 CFR §2.764 specifies that the decision of the presiding officer will not be immediately effective. The Commission could revise this policy to provide for immediate effectiveness of the licensing board decision. This would permit compliance with the three year statutory timetable while allowing appellate review to proceed at a more deliberate speed. In this regard, requests for a stay of the licensing board's decision should go only to the Commission and not both to the Commission and an appeal

board. This approach has the advantage of removing the time period necessary for appellate review from the three year statutory license review period. This would increase the possibility that the Commission would meet the statutory requirement, and would also allow careful review of the licensing board decision before the Commission's final review. However, it also entails revision of a long-standing Commission policy that is based on the desirability of having the Commission itself examine the construction authorization decision on its merits before allowing DOE to proceed with construction. However, as with the use of the immediate effectiveness rule in reactor licensing, it will be possible for parties to request a stay of the initial decision. If the Commission decides to adopt this approach, the staff anticipates that a process similar to that recommended in SECY-86-296 concerning the Commission's immediate effectiveness procedures, would be used to implement this approach.

The Commission could opt to omit formal partial initial decisions and appeals entirely by receiving only "findings" from the licensing board and reserving the issuance of the final decision to itself. This would eliminate the formal appeal stage entirely, but would require close monitoring of the licensing proceeding by Commission representatives. This approach would be a new and untested method for the Commission. As such, there would be considerable uncertainty as to the effectiveness of this approach. It would also necessitate detailed review of the entire licensing board record by the Commission, requiring substantially more resources and time than would normally be expended by the Commission.

The Commission's regulations now prohibit interlocutory appeals from licensing board decisions. 10 CFR 2.730(f). There would be a benefit in suspending this prohibition for the HLW proceeding for certain categories of issues. Requiring parties to appeal the admission or rejection of contentions, as well as summary disposition rulings, at the time those decisions are made, rather than at the conclusion of the proceeding, would have obvious benefits. The litigation of improper issues would be minimized, and issues wrongly excluded would be identified and remedied before the hearing is closed and licensing action is taken. It would also keep the appellate process more in step with

the evidentiary hearings. As noted previously in the discussion on Partial Initial Decisions, the Commission, in the Supplementary Information to the rulemaking on the final technical criteria in 10 CFR Part 60, did contemplate that licensing board decisions on the identification of anticipated and unanticipated processes and events would be certified to the Commission for interlocutory review. However, unless the Commission is prepared to review the many anticipated interlocutory appeals on such issues as the admission of contentions, providing for appeal board review of the licensing board decision would be a necessary complement to the suspension of interlocutory review.

Conclusions: Based on suggestions from various sources knowledgeable in the hearing process, the Staff has identified and evaluated several approaches for streamlining the HLW licensing process. After evaluating these approaches from the perspective of which approaches offer the most potential for ensuring that the statutory review schedule is met in a cost-efficient manner, the staff has concluded that the development of the Licensing Support System, adoption of Option 2 in SECY-86-51 for implementation of the Commission's NEPA responsibilities, and the resolution of issues through rulemaking are the approaches that the Commission should pursue in the pre-license application phase. Accordingly, the staff has recommended that the Commission approve the recommendation in SECY-86-308 on the use of negotiated rulemaking to implement the use of the Licensing Support System, and the recommendation in SECY-86-51 on the implementation of the Commission's NEPA responsibilities. In terms of using rulemaking to resolve selected issues, the staff is currently in the process of identifying those issues which are appropriate for resolution through rulemaking. The Commission will be informed of any issues considered suitable for resolution in this manner.

For the post-license application phase, the Commission could endorse the concept of the use of Partial Initial Decisions, final adoption of the proposed rule on regulatory reform, and multiple hearing boards. In order to facilitate the soundest decision-making process, the Commission could provide

for appeal board review. However, to allow for both appeal board review and meeting the statutory timetable, the Commission should revise the regulations to provide for immediate effectiveness of the licensing board decision.

The staff does not believe that the use of Partial Initial Decisions before the complete license application is filed, generic adoption of the Federal Rules of Evidence, or the initiation of LWA procedures, are satisfactory approaches for streamlining the licensing process.

The staff is aware that it is possible to place the emphasis on other combinations of approaches than those recommended by the staff. For example, among the suggestions made by Judge Cotter of the Licensing Board Panel, is that the Commission establish a two-part HLW Task Force to manage the HLW licensing process (page 3, Cotter Memorandum, Enclosure 7). One segment of the Task Force would manage all pre-application issues, and the other segment would manage all hearing issues. Each segment would hold bi-weekly meetings, and the head of each segment would report monthly to a "lead" Commissioner, as well as meeting with Mr. Rusche and DOE.

The staff is sympathetic to Judge Cotter's objectives of keeping the Licensing Panel informed, and ensuring the coordination of activities among all affected elements of the HLW program. However, the staff believes that these objectives could be achieved without the creation of a new bureaucracy, with the attendant problems of duplication of resources, overlapping responsibilities, and potential conflicts. In addition, an approach which promotes and formalizes the role of the Licensing Panel in pre-application issues, especially where interaction with DOE is involved, carries a substantial risk of tainting the credibility and neutrality of the licensing board(s) that will ultimately adjudicate the HLW licensing issues. Finally, the staff has already established an ongoing dialogue with DOE, and regularly briefs the Commission on the overall HLW

program. In order to keep the Licensing Panel informed, as well as to solicit its input, the staff will periodically brief the Licensing Panel on all issues which may affect the hearing process.

William C. Parler
General Counsel

Victor Stello, Jr.
Executive Director for Operations

Enclosures: (Not included)
1. June 12, 1986 Commission Memorandum to EDO and OGC
2. March, 1986 Subcommittee Report
3. Transcript of April 15, 1986 Commission Meeting with NARUC, and June 18, 1986 follow-up letter to Commission
4. Licensing Time Line
5. DWM Five Year Plan
6. Tomonto Statement Before Subcommittee
7. October 7, 1986 Cotter Memorandum to Olmstead

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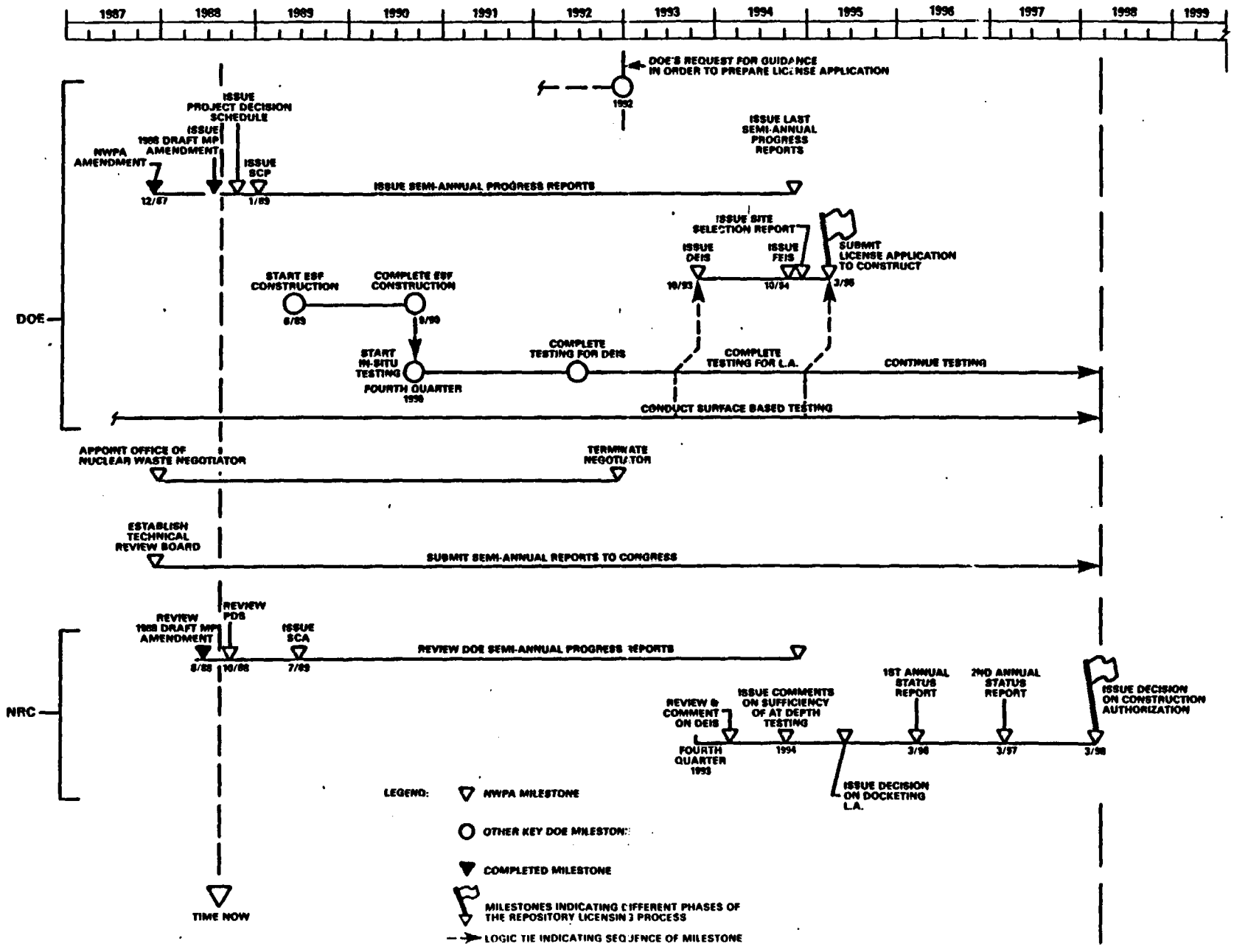
ENCLOSURE 3

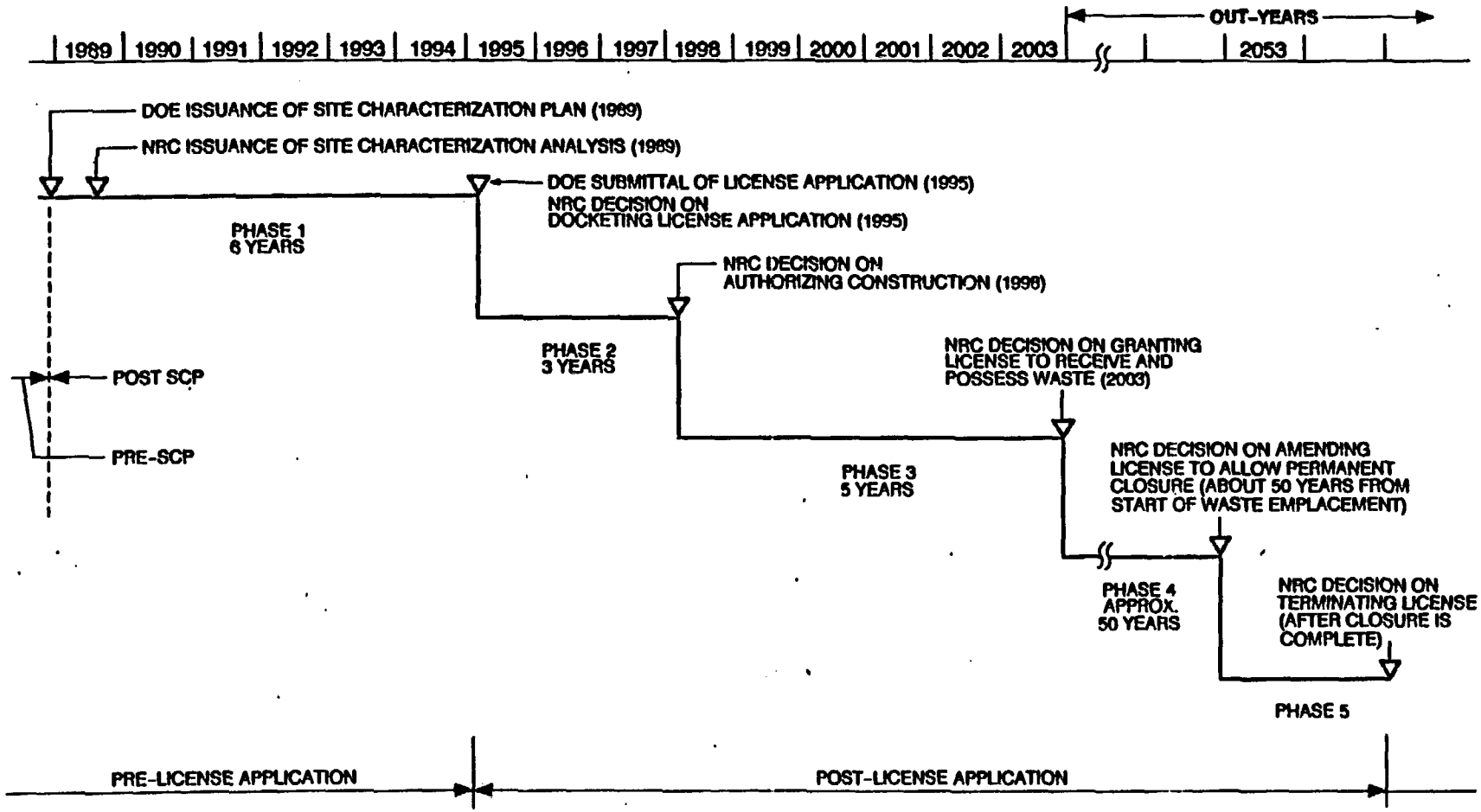
TIMELINE OF LEVEL I NRC & DOE NWPA MAJOR REPOSITORY MILESTONES

ENCLOSURE 3



ENCLOSURE 4

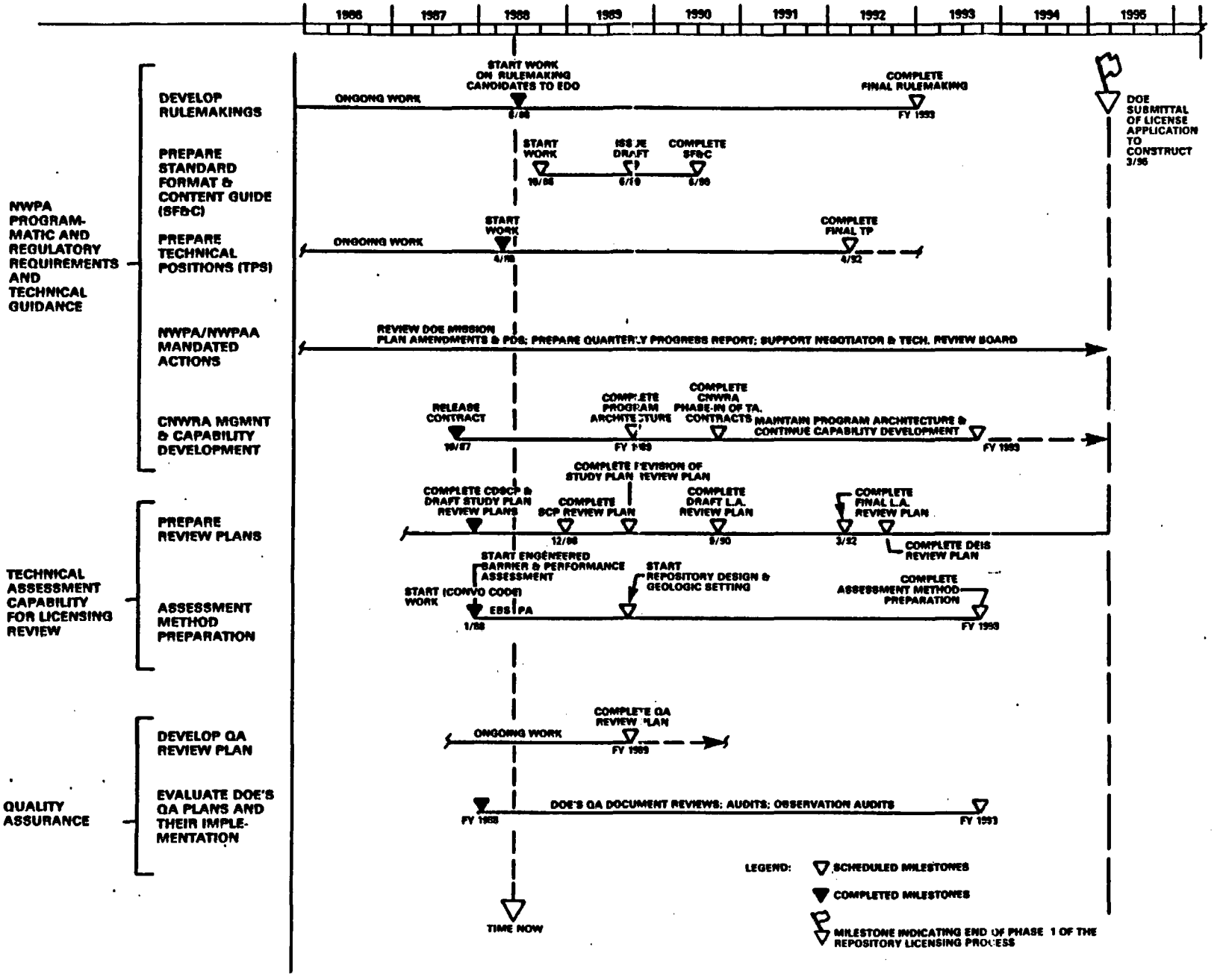
PHASES OF THE REPOSITORY LICENSING PROCESS

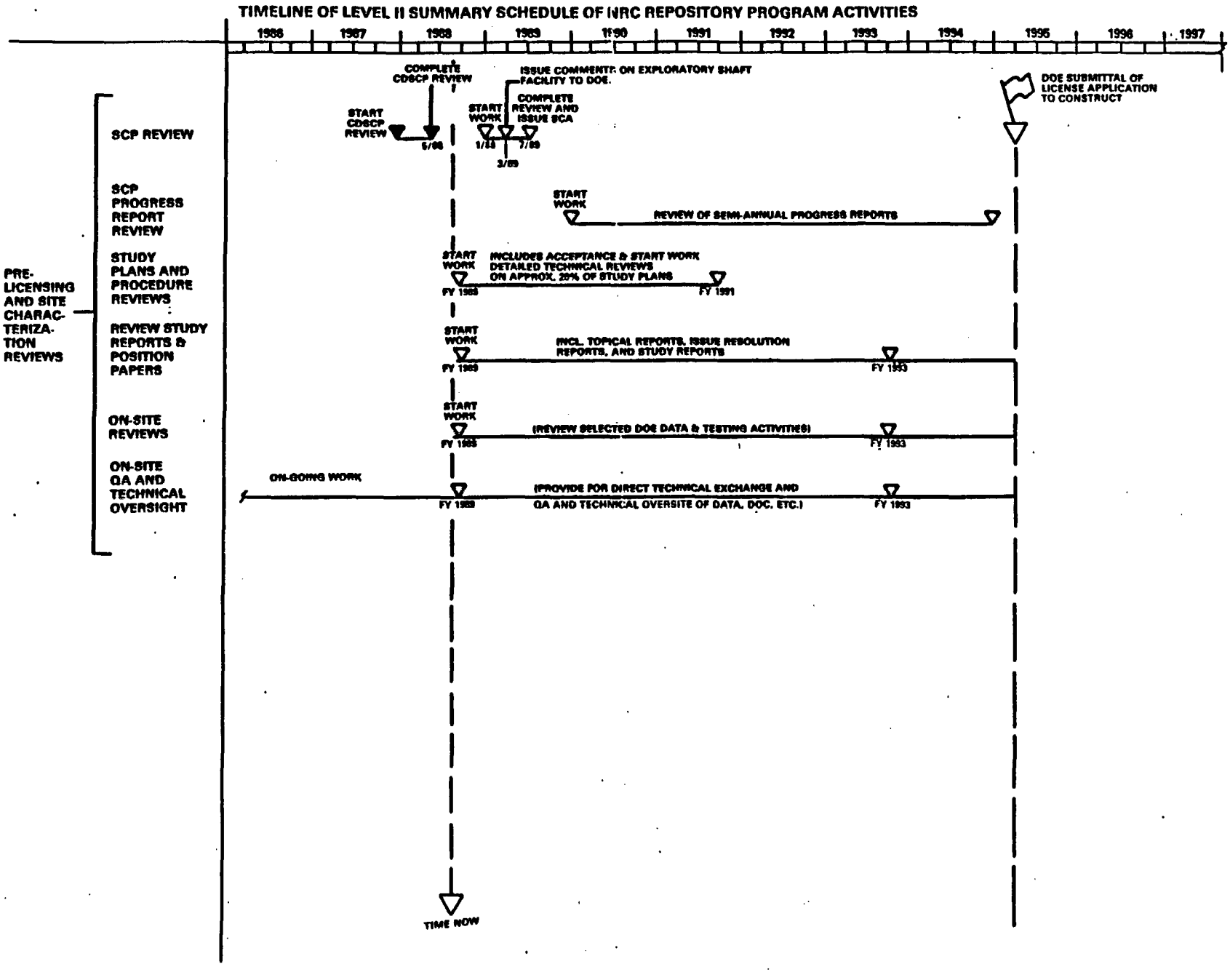


ENCLOSURE 5

TIMELINE OF LEVEL II SUMMARY SCHEDULE OF NRC REPOSITORY PROGRAM ACTIVITIES

ENCLOSURE 5

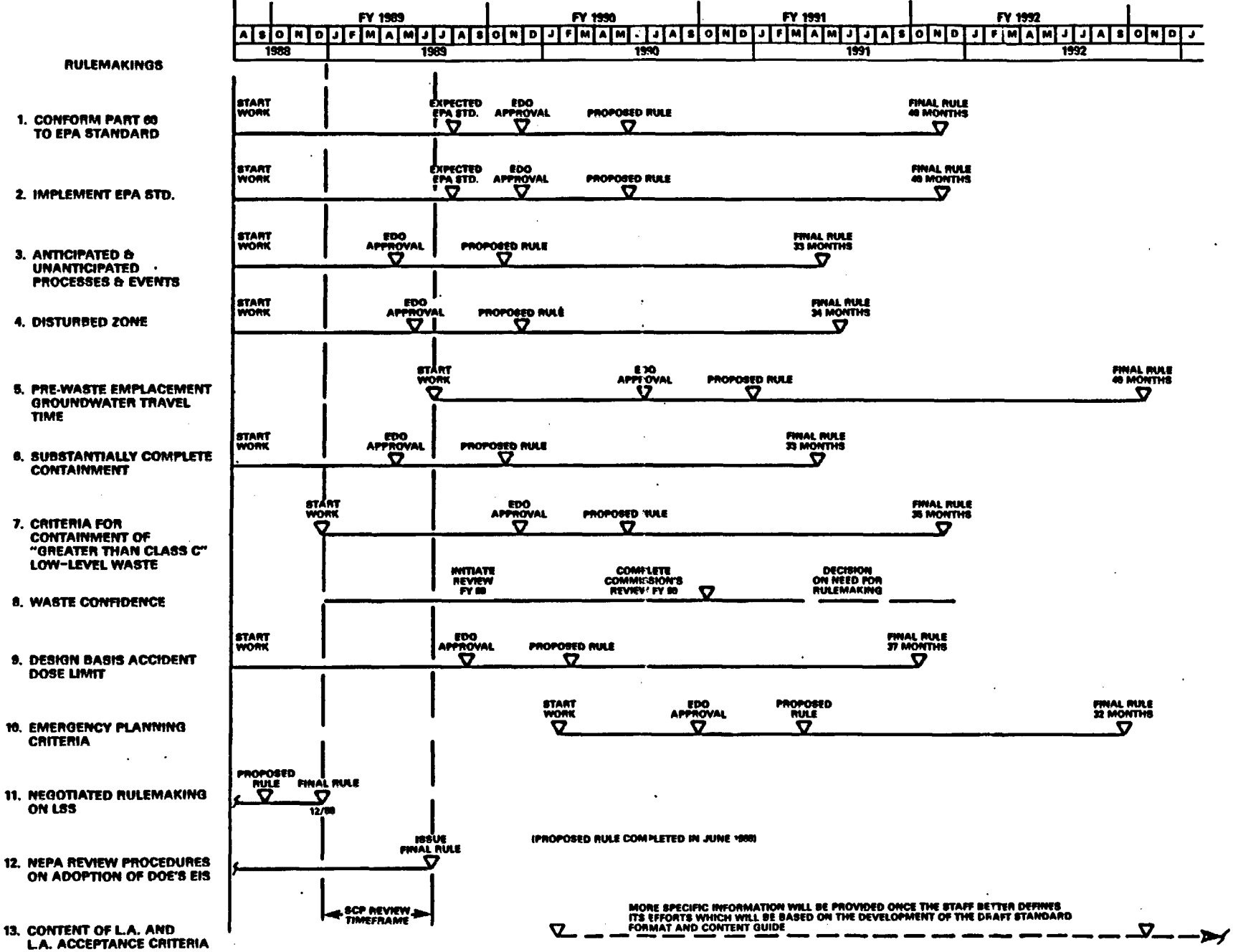



TIMELINE OF LEVEL II SUMMARY SCHEDULE OF NRC REPOSITORY PROGRAM ACTIVITIES
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
PRE-LICENSING AND SITE CHARAC-TERIZA-TION REVIEWS
SCP REVIEW
SCP PROGRESS REPORT REVIEW
STUDY PLANS AND PROCEDURE REVIEWS
REVIEW STUDY REPORTS & POSITION PAPERS
ON-SITE REVIEWS
ON-SITE QA AND TECHNICAL OVERSIGHT
START CDSCP REVIEW
COMPLETE CDSCP REVIEW
5/88
START WORK
1/88
3/89
7/89
COMPLETE REVIEW AND ISSUE SCA
ISSUE COMMENTS ON EXPLORATORY SHAFT FACILITY TO DOE.
DOE SUBMITTAL OF LICENSE APPLICATION TO CONSTRUCT
START WORK
REVIEW OF SEMI-ANNUAL PROGRESS REPORTS
START WORK
FY 1989
INCLUDES ACCEPTANCE & START WORK DETAILED TECHNICAL REVIEWS ON APPROX. 20% OF STUDY PLANS
FY 1991
START WORK
FY 1989
INCL. TOPICAL REPORTS, ISSUE RESOLUTION REPORTS, AND STUDY REPORTS
FY 1993
START WORK
FY 1989
(REVIEW SELECTED DOE DATA & TESTING ACTIVITIES)
FY 1993
ON-GOING WORK
FY 1989
(PROVIDE FOR DIRECT TECHNICAL EXCHANGE AND QA AND TECHNICAL OVERSITE OF DATA, DOC. ETC.)
FY 1993
TIME NOW

ENCLOSURE 6

TIMELINE OF LEVEL III SCHEDULE FOR NRC RULEMAKING ACTIVITIES

ENCLOSURE 6



ENCLOSURE 7

Enclosure 7

LIST OF ISSUED RULEMAKINGS AND TECHNICAL POSITIONS APPLICABLE TO THE YUCCA MOUNTAIN SITE

Rulemaking Titles	Issue Date
1. Licensing Procedures for High-Level Waste (HLW) in Geologic Repositories	February 1981
2. Technical Criteria for HLW in Geologic Repositories	June 1983
3. Disposal of HLW within the Unsaturated Zone	July 1985
4. Site Characterization and State/Tribal Participation	July 1986

Technical Position Titles	
1. Issue-Oriented Site Technical Position (ISTP) for Nevada Nuclear Waste Storage Investigation (NNWSI) (Draft)	September 1984
2. Documentation of Computer Codes, NUREG-0856 48FR31761	June 1983
3. Determination of Radionuclide Solubility in Groundwater for Assessment of High-Level Radionuclide Waste Isolation (Final)	November 1984
4. Waste Package Reliability Analysis (Final)	December 1985
5. In-Situ Testing during Site Characterization (Final)	December 1985
6. Design Information Needs in Site Characterization	December 1985
7. Borehole and Shaft Seals (Final)	February 1986
8. Determination of Radionuclide Sorption for HLW Repositories (Final)	January 1987
9. Qualification of Existing Data for HLW Repositories (Final) (NUREG-1298 dated February 1988)	June 1987

10. Peer Review for HLW Repositories (Final) (NUREG-1297 dated February 1988)	June 1987
11. Items and Activities in the High-Level Waste Geologic Repository Program Subject to Quality Assurance Requirements (Final) (NUREG-1318)	April 1988
12. Licensing Assessment Methodology for HLW Geologic Repositories (Draft)	July 1984
13. Interpretation and Identification of the Disturbed Zone (Draft)	July 1986
14. Groundwater Travel Time (Draft)	July 1986
15. Guidance for Determination of Anticipated Processes and Events and Unanticipated Processes and Events (Draft)	February 1988

Regulatory Guide Title

1. Standard Format and Content of Site Characterization Plans for High-Level Waste Geologic Repositories (Regulatory Guide 4.17) (Revision 1)	March 1987

ENCLOSURE 8

Enclosure 8

LIST OF ONGOING AND PLANNED POTENTIAL RULEMAKINGS, TECHNICAL POSITIONS, AND REGULATORY GUIDES

Rulemakings to Reduce Regulatory Uncertainties

1. Conform Part 60 to U. S. Environmental Protection Agency (EPA) High-Level Waste (HLW) Standard (ongoing)

2. Methodology for Proving Compliance with EPA HLW Standards

3. Further Amplification of the Meaning of the Phrase "Anticipated Processes and Events and Unanticipated Processes and Events" used in 10 CFR Part 60

4. Further Amplification of the Meaning of the Phrase the "Disturbed Zone" used in 10 CFR Part 60

5. Further Amplification of the Meaning of the Phrase "Substantially Complete Containment" used in 10 CFR Part 60

6. Further Amplification of the Meaning of the Phrase "Pre-waste Emplacement Groundwater Travel Time" used in 10 CFR Part 60

7. Establishment of "Criteria for Containment of Greater-than-Class-C" Low-level Waste When It Is Disposed of in a Deep Geologic Repository

8. Definition of "Design Basis Accident Dose Limit" for Repository Operations

9. Establishment of Emergency Planning Criteria under Subpart I of 10 CFR Part 60

Rulemakings to Reduce Institutional Uncertainties

10. Review of the Commission's Findings under Its 1984 Waste Confidence Decision (high potential for not requiring a rulemaking)

11. Implementation of Nuclear Waste Policy Act (NWPA) Provisions Requiring NRC to Adopt DOE's Environmental Impact Statement (ongoing)

12. Licensing Support System (ongoing negotiated rulemaking)

13. Revisions to Content of License Application and Threshold for Acceptance of the License Application

Technical Positions to Guide DOE's Resolution of Technical Uncertainties

1. Post-closure Seals in an Unsaturated Medium
2. Extrapolation of Short-term Data to Long-term Results
3. Waste Retrievability
4. Retrieval Demonstration during Site Characterization
5. Repository Design
6. Scope for Waste Package-Engineered Barrier Testing
7. Waste Package Reliability Analysis
8. Radionuclide Transport
9. Chemical Interactions in Fractured Unsaturated Rock
10. Pre-closure Earthquake Hazard Evaluation Methods
11. Probabilistic Seismic Hazard Analysis
12. Volcanic Hazard Analysis
13. Tectonic Models under 10 CFR Part 60
14. Natural Resource Assessment Methods
15. Geologic Mapping of Shafts and Drifts
16. Geomorphic Analysis
17. Scenario Identification and Screening
18. Verification and Validation of Performance Assessment Models
19. Data and Parameter Uncertainty

20. Formal Use of Expert Judgment

21. Applicable Surface Design Regulatory Guides

22. Applicable Subsurface Design Regulatory Guides

<u>Regulatory Guide to Reduce Regulatory Uncertainty</u>

1. Format and Content of License Application