# A RISK PERSPECTIVE OF NUCLEAR WASTE REPOSITORY PERFORMANCE ASSESSMENT

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Presented to
U.S. NUCLEAR WASTE TECHNICAL REVIEW BOARD
Arlington, Virginia
January 12, 1994

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ENGINEERS ■ APPLIED SCIENTISTS ■ MANAGEMENT CONSULTANTS

# WHAT ARE THE QUESTIONS TO BE ANSWERED BY PERFORMANCE ASSESSMENT?

- WHAT WILL THE PERFORMANCE BE IF THE REPOSITORY IS UNDISTURBED?
- WHAT WILL THE PERFORMANCE BE IN REALITY, CONSIDERING THE LIKELIHOOD OF EVENTS THAT CAN DISTURB THE REPOSITORY?

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# PERFORMANCE ASSESSMENT OF WASTE REPOSITORY

- DEFINE PERFORMANCE ASSESSMENT RECOGNIZING BOTH THE UNDISTURBED AND THE VARIOUS POSSIBLE DISTURBED SCENARIOS

- DEVELOP A SYSTEMATIC SET OF OUTPUT FORMATS THAT TOGETHER EXPRESS REPOSITORY PERFORMANCE QUANTITATIVELY IN TERMS OF THE UNCERTAINTIES PRESENT

- IMMEDIATELY SUMMARIZE AND CLARIFY ANSWERS TO THE FOLLOWING QUESTIONS:

  - WHAT RADIONUCLIDES DOMINATE THE REPOSITORY RISK OVER THE TIME PERIODS OF INTEREST?

  - WHAT ARE THE UNCERTAINTIES IN THE INDIVIDUAL RADIONUCLIDE CALCULATIONS?

  - WHAT ALTERNATIVES EXIST FOR REDUCING THE DOSE BURDEN FROM THESE RADIONUCLIDES?

  - WHAT IS THE EFFECTIVENESS RANKING OF THE ALTERNATIVES?

  - WHAT ARE THE COSTS OF THE MOST ATTRACTIVE ALTERNATIVES?

- PROCEED WITH THE FULL-SCOPE PERFORMANCE ASSESSMENT FOR THE MOST ATTRACTIVE ALTERNATIVES

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# QUANTITATIVE DEFINITION OF PERFORMANCE ASSESSMENT

ADOPT THE FOLLOWING "SET OF TRIPLETS" DEFINITION OF REPOSITORY PERFORMANCE:

$$P_R \equiv \{< s_i, \ell_i, X_i >\}$$

WHERE

$s_i$ = THE Ith SCENARIO

$\ell_i$ = THE LIKELIHOOD OF THE SCENARIO

$X_i$ = THE "DAMAGE VECTOR" CONSEQUENT TO THE Ith SCENARIO

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# INTERPRETATIONS OF PERFORMANCE ASSESSMENT NOTATION

- WITHIN THE LANGUAGE OF THE TRIPLET DEFINITION OF PERFORMANCE ASSESSMENT, LET

  $s_0$ = THE "UNDISTURBED" SCENARIO
  $s_i$ = THE POSSIBLE "DISTURBED" SCENARIOS

- A DAMAGE VECTOR, X, CONSISTS OF A SET OF "COMPONENTS" THAT ARE CALLED "DAMAGE INDICES"; EXAMPLES OF THESE ARE

  $x_1(t)$ = THE DOSE RATE (REM PER YEAR) TO AN INDIVIDUAL AT THE WORST LOCATION DURING YEAR t

  $x_2(t)$ = THE CUMULATIVE INDIVIDUAL DOSE TO TIME t

  $x_3(t)$ = THE TOTAL DOSE TO THE HUMAN POPULATION IN YEAR t

  $x_4(t)$ = THE TOTAL HEALTH EFFECTS IN YEAR t

  etc.

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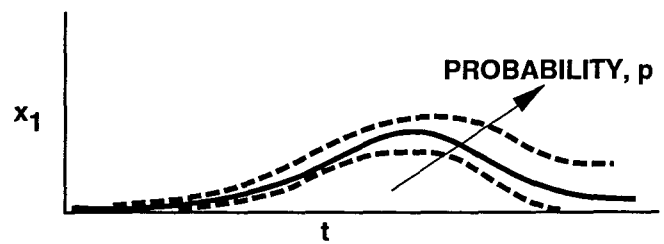
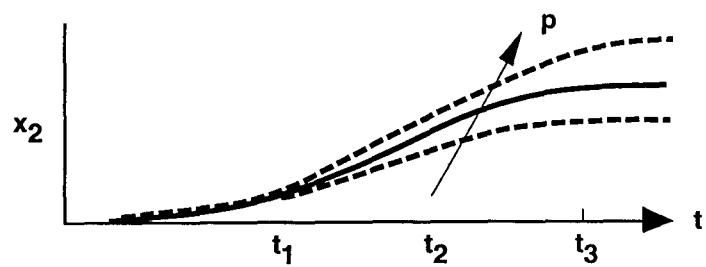
# FORM OF THE RESULTS

## INDIVIDUAL DOSE RATE



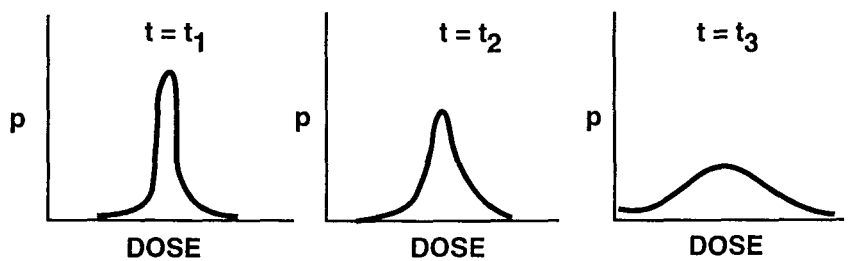

(YEARS AFTER CLOSURE)

## CUMULATIVE INDIVIDUAL DOSE

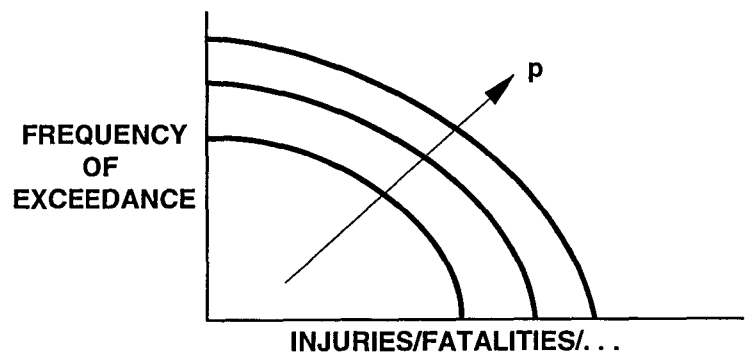



(YEARS AFTER CLOSURE)

## DOSE AT DISCRETE TIMES




## HEALTH EFFECTS

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# SEABROOK STATION RISK RESULTS

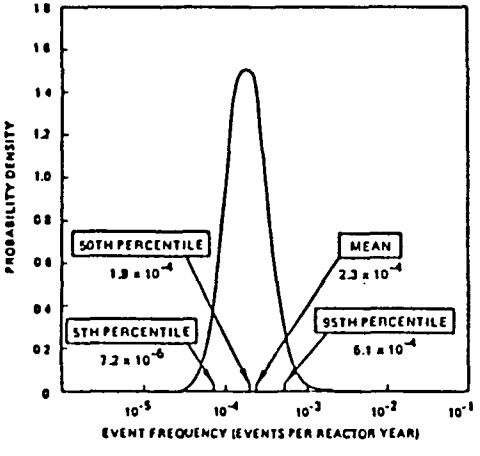
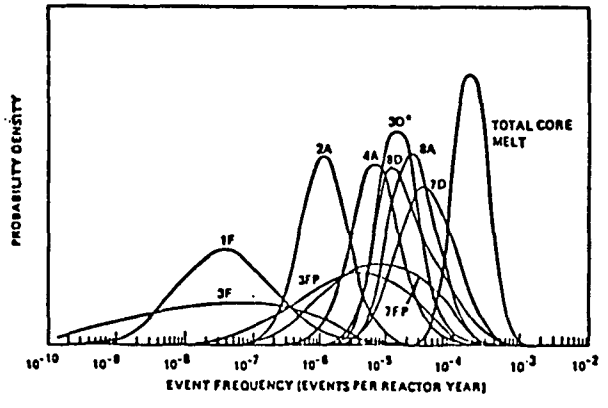
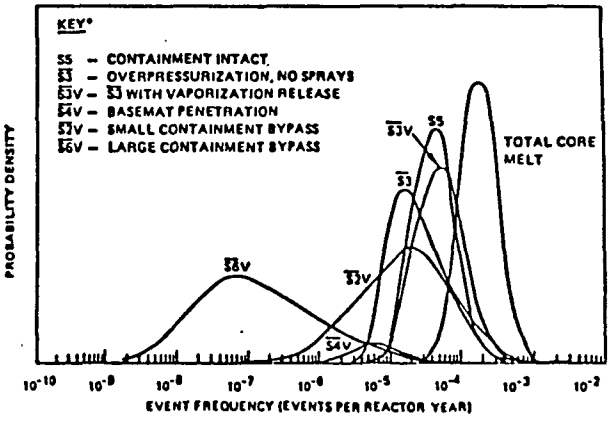



FIGURE 1-2a. UNCERTAINTY DISTRIBUTION FOR CORE MELT FREQUENCY EVALUATED FOR SEABROOK STATION - SINGLE UNIT OPERATION




*PLANT DAMAGE STATES ARE DEFINED IN TABLE 2-2.

FIGURE 1-2b. UNCERTAINTY DISTRIBUTION FOR PLANT DAMAGE STATES MAKING SIGNIFICANT CONTRIBUTIONS TO CORE MELT FREQUENCY AND RISK




*COMPLETE DEFINITIONS OF RELEASE CATEGORIES ARE PRESENTED IN TABLE 2-3.

FIGURE 1-2c. UNCERTAINTY DISTRIBUTIONS FOR THE FREQUENCIES OF RISK SIGNIFICANT RELEASE CATEGORIES AND CORE MELT

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# SEABROOK STATION RISK RESULTS

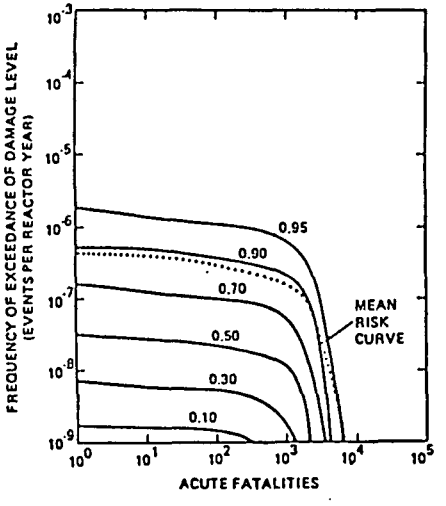


FIGURE 1-1a. RISK OF EARLY FATALITIES

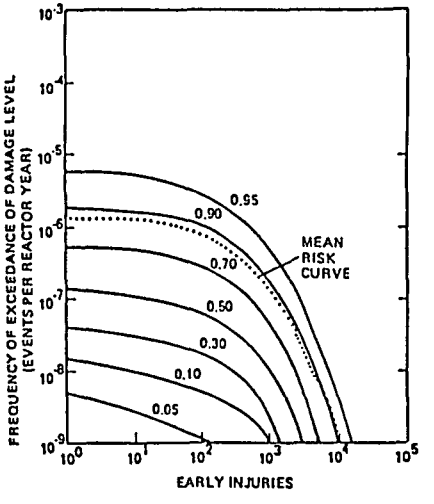


FIGURE 1-1b. RISK OF INJURIES

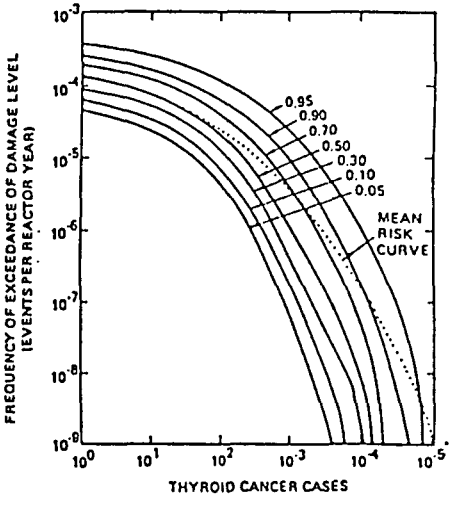


FIGURE 1-1c. RISK OF THYROID CANCER CASES

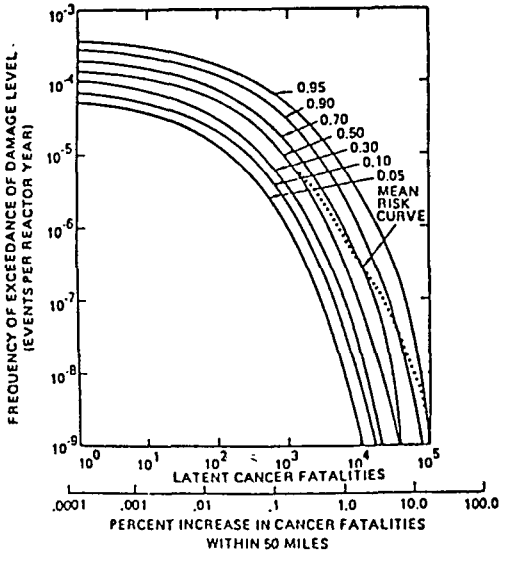


FIGURE 1-1d. RISK OF LATENT CANCER FATALITIES (OTHER THAN FATAL THYROID CANCERS)

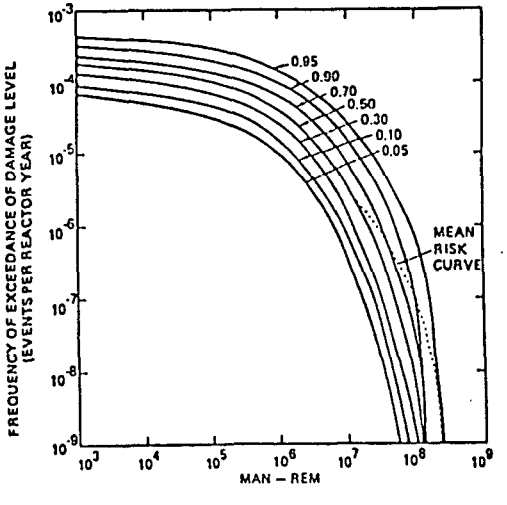


FIGURE 1-1e. RISK OF MAN-REM

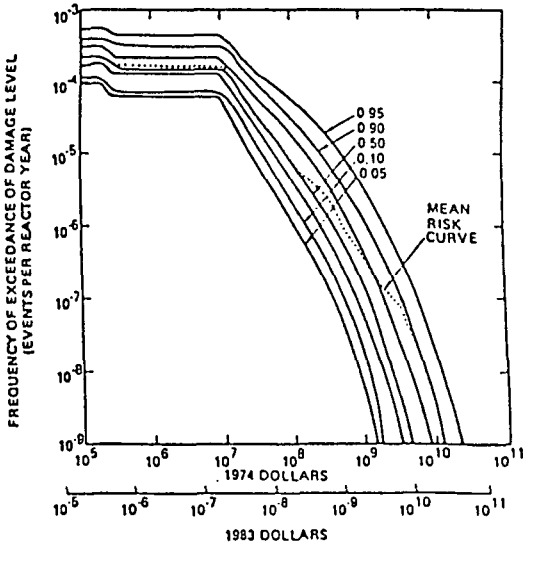


FIGURE 1-1f. RISK OF PROPERTY DAMAGE AND EVACUATION COSTS

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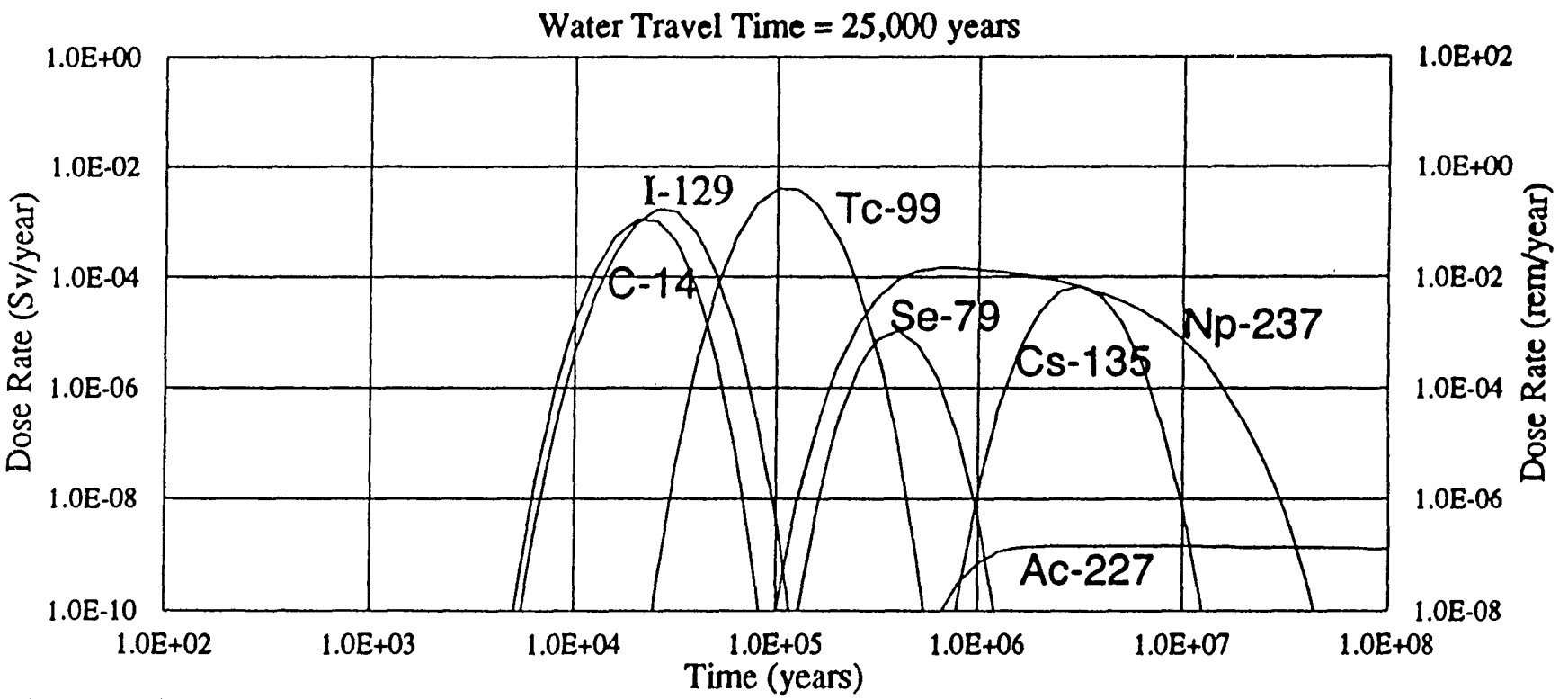
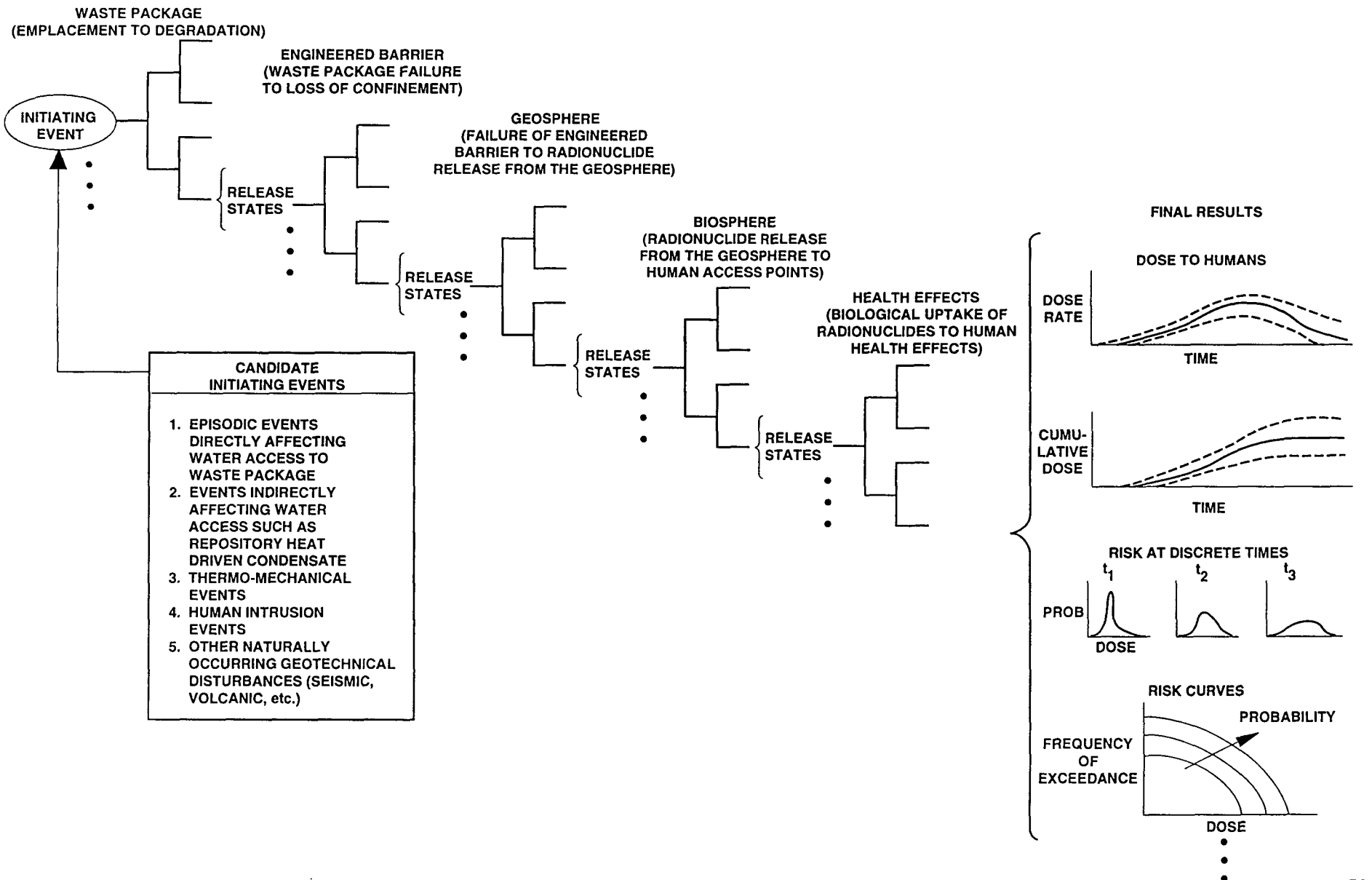
# INDIVIDUAL DOSE RATE (UCBNE-41)
# (Baseline Case)




Distance = 5,000 meters
FUEL AGE = 30 YEARS

R. W. Andrews
Intera, Inc.

# MODELING STAGES FOR QUANTITATIVE PERFORMANCE ASSESSMENT

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