

YUCCA
MOUNTAIN
PROJECT

Studies

Human Intrusion Analyses for Future TSPAs

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Total System Performance Assessment
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Waste Management

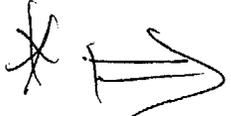
May 25-27, 1999

Legacy/maim-201

Outline

- **Philosophy of human-intrusion analyses**
- **Proposed 10 CFR 63 Human Intrusion Scenario**
- **TSPA-VA Human Intrusion Scenario**
- **Potential Scenarios Considered for TSPA-SR**

Background

- **Human intrusion is a “special case” in proposed 10 CFR 63 regulation**
 - **Analyses should test the resilience of the repository to a stylized drilling incident**
 - **Much of the drilling scenario is specified in the proposed regulations**
- *  **» Analyses are largely deterministic**
- **Areas where regulation is silent leads to ambiguities in modeling details**

Philosophy in Proposed 10 CFR 63 that Influences Human Intrusion Scenarios

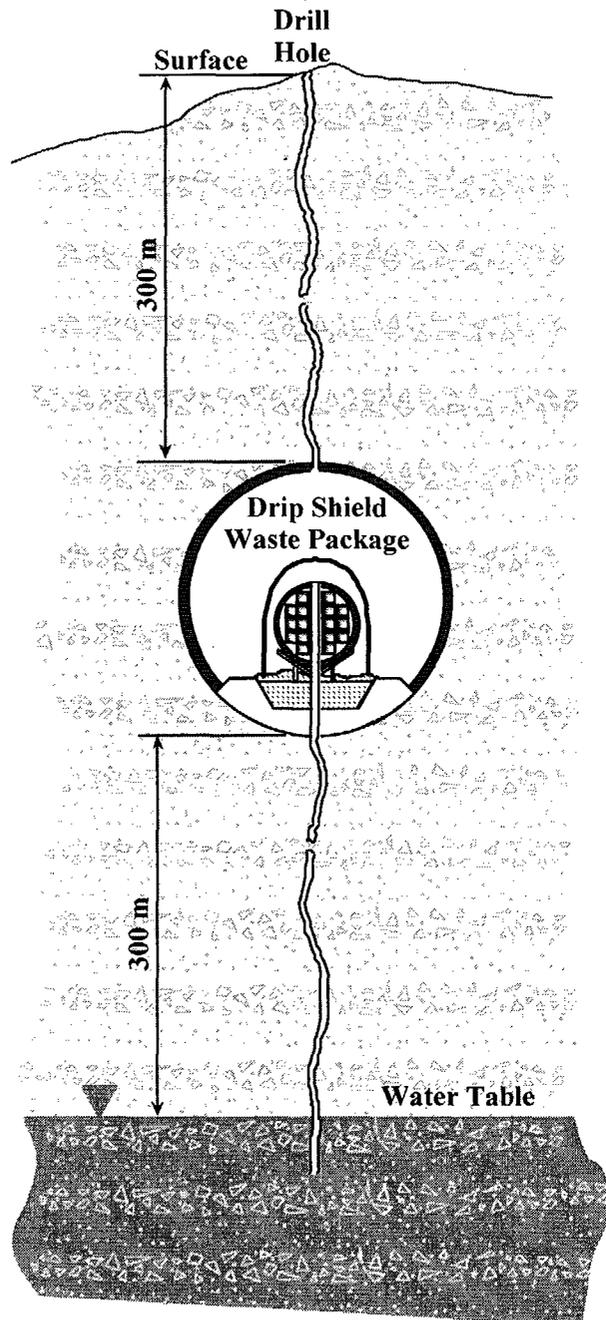
- **Intent of analyses is to “... show that the repository exhibits some resilience to a breach of engineered and geologic barriers ...”**
- **Current drilling practices and equipment typical of resource exploration are to be assumed**
 - **Avoids making speculative assumptions about future human technology and social structures**

Philosophy of Proposed 10 CFR 63

(Continued)

- **A stylized intrusion scenario removes from consideration many imponderables**
 - **Probability of penetrating the waste package**
 - **Probability of detection and remediation**
 - **Effectiveness of institutional controls**
- **Performance measure is the same as for TSPA base case, except:**
 - **Probability of occurrence is not applied to consequences**

Scenario Specifications in Proposed 10 CFR 63



- **Assumptions**

- Event occurs 100 years post-closure
- Current drilling practices
- Single, nearly vertical borehole through one drip shield and waste package to water table
- Borehole not adequately sealed

Additional Assumptions Required for Modeling Human Intrusion Scenarios

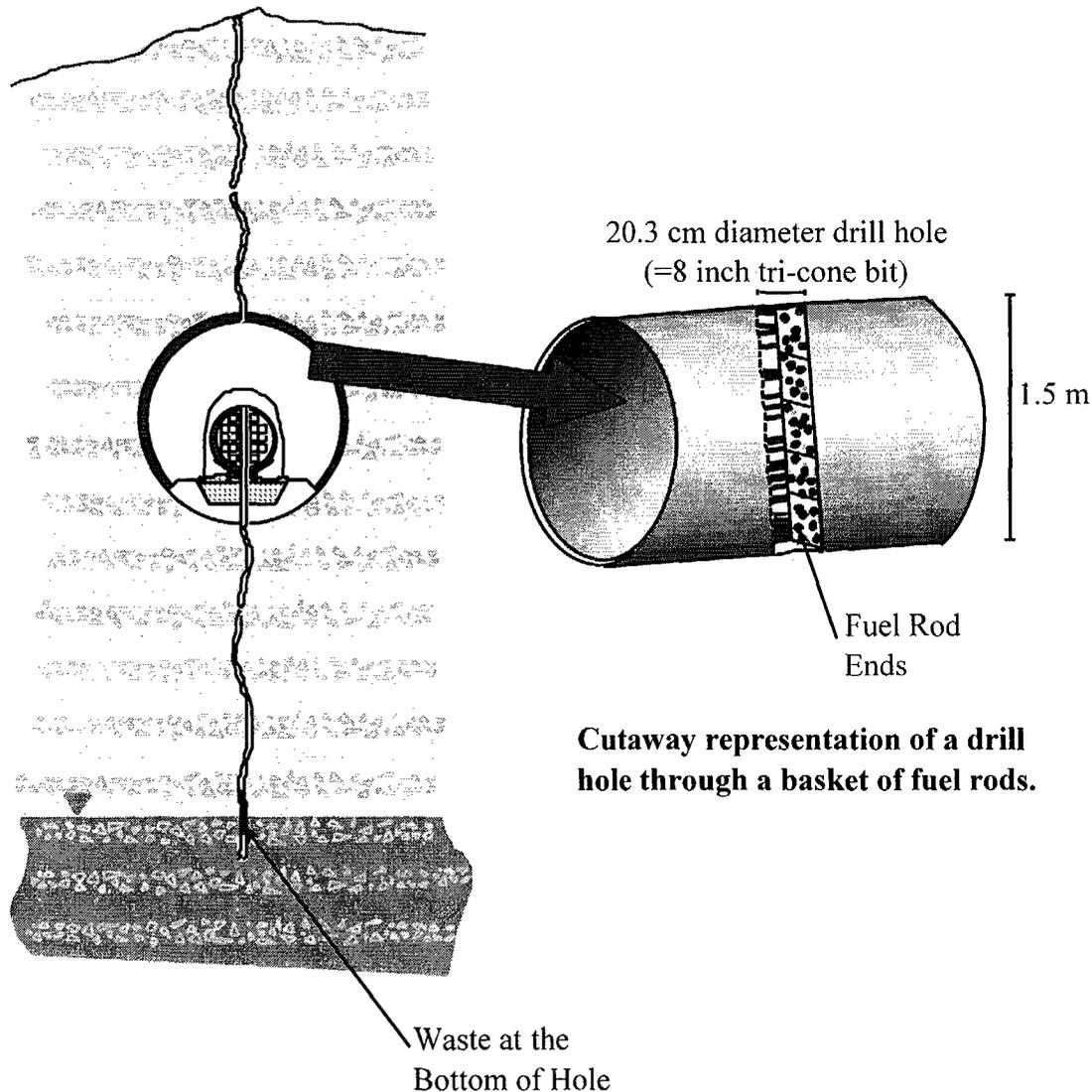
- **Size of borehole**
- **Area/volume of waste exposed**
- **Thermal conditions near waste package**
- **Seepage conditions into drift**
- **Permeability of borehole**
- **Waste mobilization and transport processes**

Possible Human Intrusion Scenarios Identified by DOE

- 1) Waste in solid form reaches saturated zone
(TSPA-VA human intrusion scenario)
- 2) Advective flow into and through waste package
- 3) Diffusive mobilization of waste from package

- **Note: Scenarios are listed in:**
 - Expected decreasing level of consequence
 - Expected increasing degree of plausibility

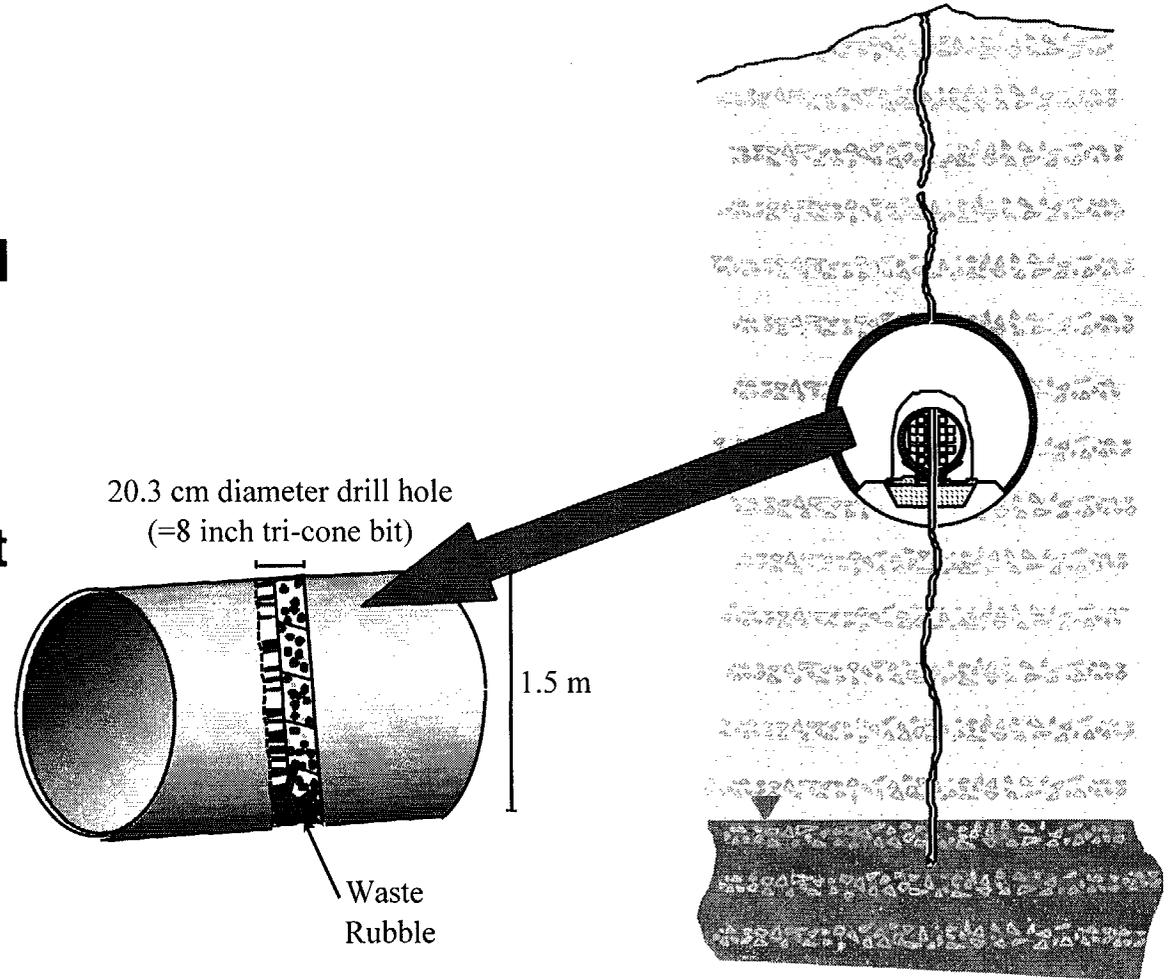
Scenario 1: Solid Waste at SZ (TSPA-VA Scenario)



- Volume of waste removed ~ 0.05 m³
 - ~500 kg of CSNF
- Travel time to SZ is “instantaneous”
 - Waste dissolves and is transported in SZ from time of incident for 10,000 years
- Extremely low probability
 - will not be investigated further

Scenario 2: Advective Flow into Package

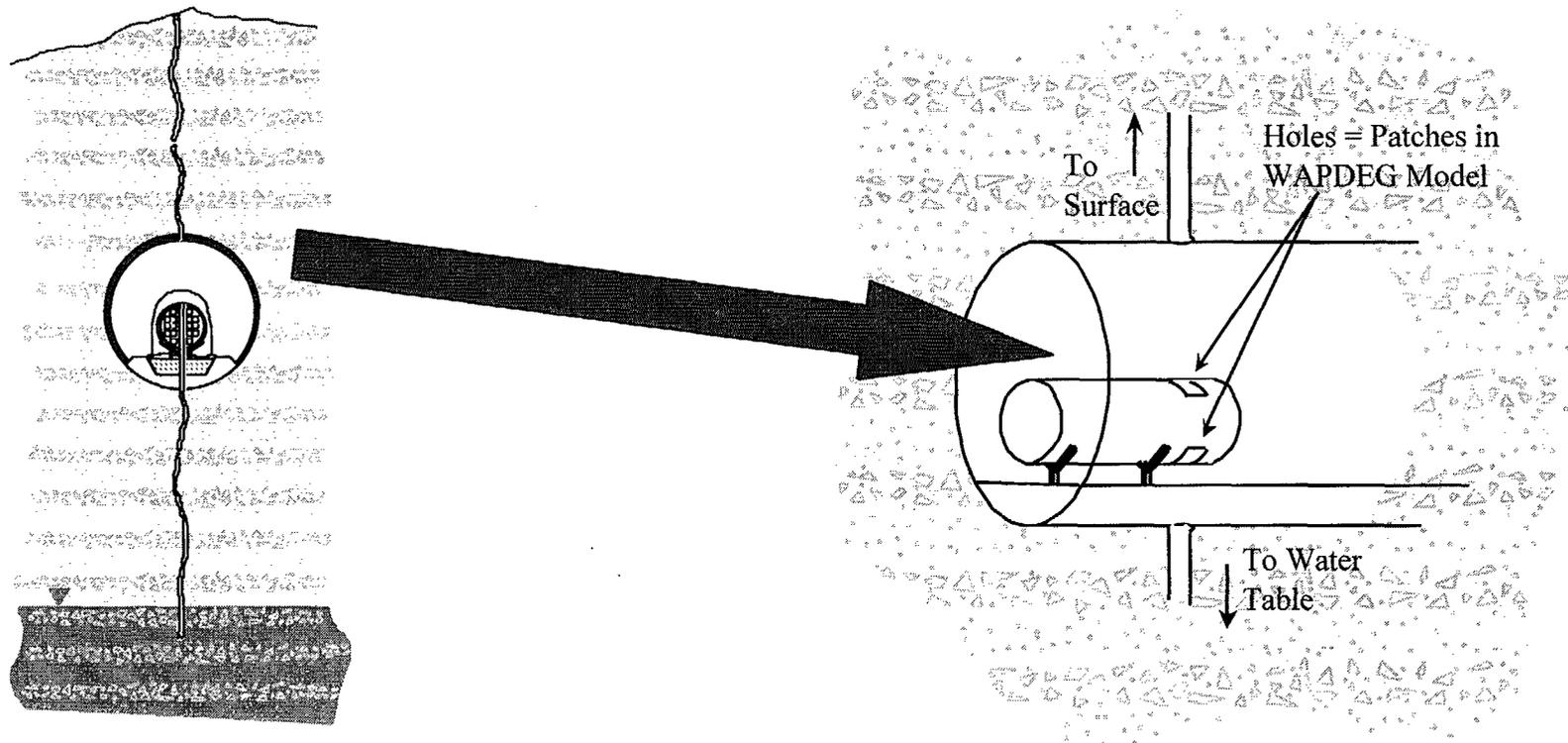
- Liquid water from improperly sealed borehole enters waste package
- Waste dissolves and is transported through UZ and SZ
 - Dissolution and advective transport calculated in RIP, bypassing WP model
 - Borehole in UZ is fast path
 - Assume no travel time in UZ



Cutaway representation of a drill hole through a basket of fuel rods.

Scenario 3: Diffusive Processes Mobilize Waste

- Similar to juvenile failure modeled in TSPA-VA
- Waste-form mobilization calculated in RIP as diffusion
- Drilled hole is equivalent to two “patches” (top and bottom) as modeled in WAPDEG



Effects on Performance

- **Except for the damaged package, repository system is not compromised by borehole**
- **Scenario 1**
 - **Not considered realistic nor meeting proposed 10CFR63 objectives**
 - **Only SZ transport influences performance**
- **Scenarios 2 and 3 test attributes of repository systems (e.g., waste dissolution, thermal conditions, hydrologic conditions, isolation of packages, geologic barrier)**

Summary

*feel
consider
and 3rd
scenarios*

- **Alternative human-intrusion scenarios presented follow specifications in proposed 10 CFR 63**
 - Analyses will make reasonably bounding assumptions for key properties of the stylized scenarios
- **Resilience of potential repository systems to human intrusion can be investigated in a limited fashion**
 - Model parameters can be chosen specific to the Yucca Mountain site
 - Model parameters are within ranges used in base-case analyses