U.S. Department of Energy
Office of Civilian Radioactive Waste Management

Engineered Barrier Drip Shield

Presented to:
Nuclear Waste Technical Review Board (NWTRB)

Presented by:
Thomas W. Doering
Department Manager
Waste Package Design

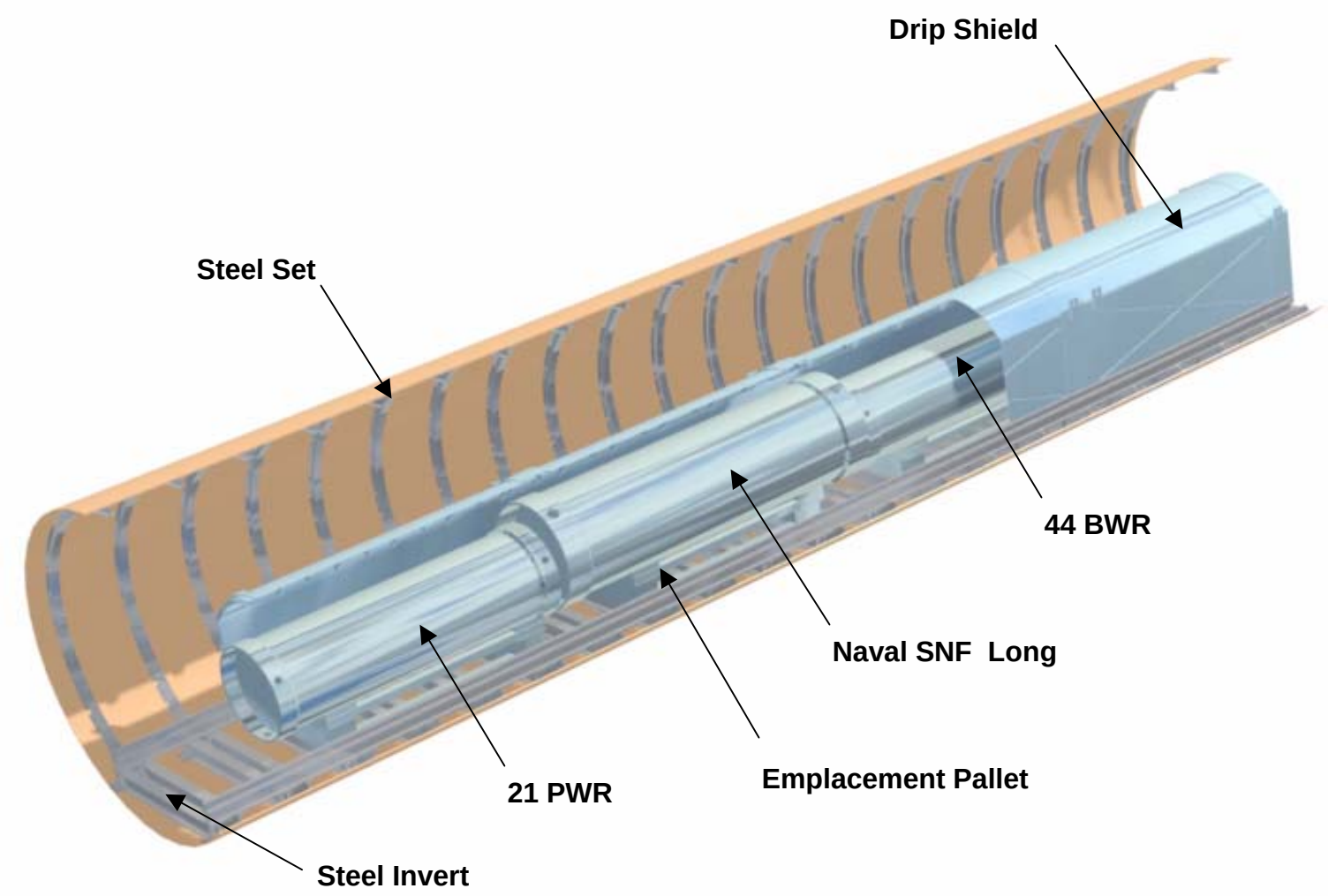
Las Vegas, Nevada
January 25-26, 2000

YUCCA MOUNTAIN PROJECT

Table of Contents

- Engineered Barrier System
- Drip Shield Goals
- Principal Factor
- Uncertainties
- Supporting data
- Future activities

Emplacement Drift Segment



Goals for Addressing Uncertainties

- **Goals**
  - **Provide a sound technical basis for the representation of drip shield performance**
  - **Define process model uncertainties to support sensitivity studies**
  - **Provide an adequate basis to support performance assessment and design**

Why is the Drip Shield a Principal Factor?

- **General**
  - **Under expected conditions, the waste package lasts more than 100,000 years**
  - **The drip shield provides defense-in-depth, an independent barrier to the waste package barriers**
- **Chemical**
  - **In the low probability event(s) of an unanticipated early breach of a waste package, the drip shield diverts water away and minimizes the exposure of water to the spent nuclear fuel**
- **Mechanical**
  - **Helps to minimizes mechanical damage of waste package barrier**

Uncertainties is TSPA

- **Chemical**
  - **Drip shield provides a barrier between waste package and seepage**
    - **Reduces uncertainty in waste package performance by limiting water contact on waste package**
    - **Reduces sensitivity of performance to geochemical changes**
  - **In combination with the waste package, reduces the overall probability of exposure of water to the spent nuclear fuel**
    - **Helps mitigate uncertainties in water chemistry on waste package**
  - **How water is distributed in the engineered barrier system due to the drip shield, around and under waste package**
- **Mechanical**
  - **Drip shield degradation modes and performance of partially failed drip shield (e.g., gaps or cracks)**

Uncertainty Reduction

- **Chemical:**
  - **Improve process model(s)**
    - **Pilot-scale testing and EBS**
    - **Water distribution and removal model (EBS hydrology)**
    - **In-drift thermal/hydraulics/chemical (THC)(changes in EBS materials)**
  - **Testing program under service conditions and aggressive conditions**
  - **Experimental work and modeling to improve the definition of aqueous environments contacting the drip shield**
- **Mechanical**
  - **Studies of stress corrosion cracking on Titanium**
  - **Evaluation of accelerated corrosion due to stress**

Preliminary Design Requirements

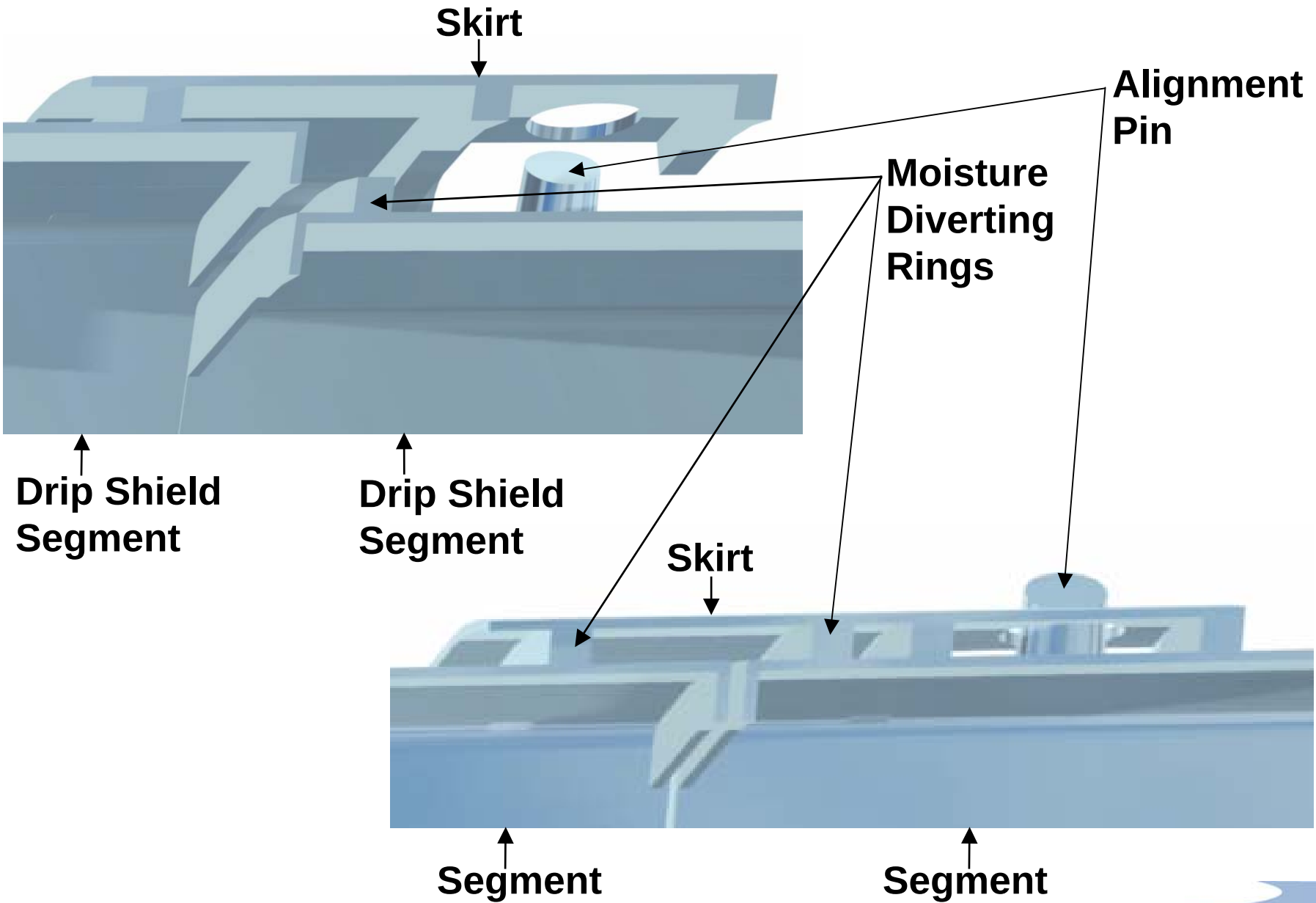
- **General**
  - **Operating life of 10,000 years**
  - **Does not detract from performance of the waste package**
- **Chemical**
  - **Divert water around the waste package to the drift invert**
  - **Increase time before water contacts spent nuclear fuel and minimize chemical deposits on waste packages due to water**
- **Mechanical**
  - **Include effects of backfill on performance of the drip shield and waste package**

Material Selection

- **Main body: Titanium Grade 7**
  - **General corrosion rate ~ 0.03 μm/year**
  - **Very resistant to crevice corrosion**
  - **Not susceptible to stress corrosion cracking (SCC) in annealed state**
- **Stiffeners: Titanium Grade 24**
  - **Higher strength alloy**
  - **Approximately same cost per pound as Titanium Grade 7**
- **Drip shield foot: Alloy 22**

Titanium Grade 7 Drip Shield

Drip Shield Connection Configuration



Evaluation Results

- **Mechanical**
  - **Engineering evaluations show maximum stress due to backfill and loose rock from the drift is less than 20% yield strength of titanium (no SCC due to static load)**
  - **Allowable rock size is being determined by transient dynamic finite element solution for rock fall on drip shield with and without backfill**
- **Chemical**
  - **General corrosion rate has been determined**
  - **Localized corrosion rates are being evaluated using anticipated environment**

Future/Ongoing Activities

- **Chemical**
  - **Performance model update**
  - **Geochemical environment/performance**
- **Mechanical**
  - **Rock fall distribution**
  - **Structural design/response**
  - **Thermal environment/performance**
- **Incorporate information into Emplacement Drift System Description document**