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

Subsurface and Waste Package Design Update

Presented to:
Nuclear Waste Technical Review Board

Presented by:
Paige R. Russell
Yucca Mountain Site Characterization Project

May 1, 2000

YUCCA MOUNTAIN PROJECT

Agenda

- Subsurface design changes
  - Total length of drift excavated and drift orientation
  - Removal of backfill
  - Placement of ventilation intakes
  - Drip shield emplacement gantry
- EBS design changes
  - Waste Packages
  - Drip shield
  - Emplacement Pallet

Subsurface Design Evolution

(Since 6/99 NWTRB Meeting)

- **Major Drift Changes**
  - 8 non-emplacement drifts for ventilation and operational standby placed between emplacement drifts
  - Intake shafts located within footprint of the emplacement area
  - Re-orientation of drifts to improve stability and expansion of upper block on north end to provide contingency

Emplacement Area	
70,000 tU	1,125 acres
97,000 tU	1,485 acres
115,000 tU	1,750 acres

- **Pre-closure ventilation increased from 10 to 15 m^3/s**
  - 70% net ventilation efficiency for 50-year pre-closure ventilation period

Removal of Backfill

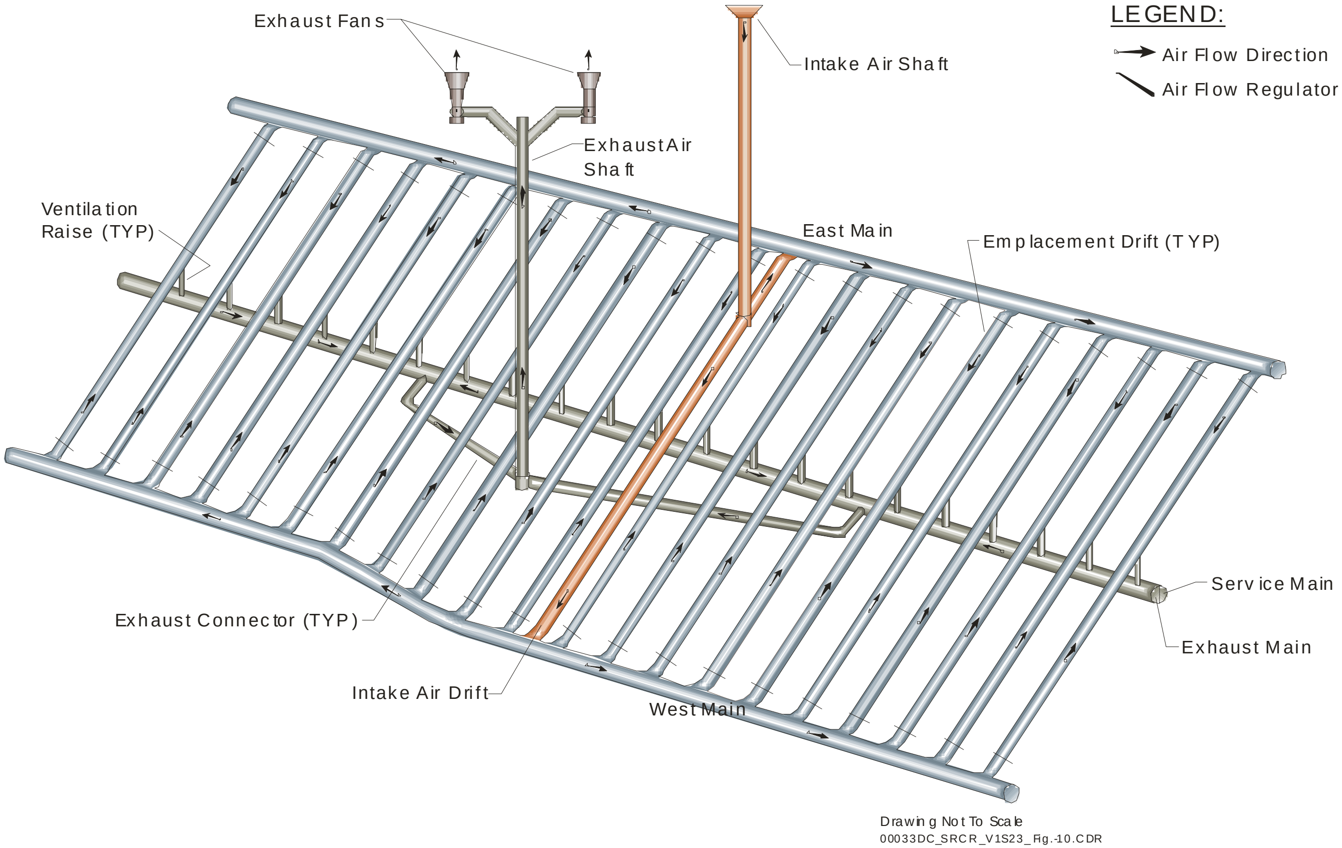
- Found candidate backfill material thermal conductivity quite low
  - LADS assumed thermal conductivities about 0.66 W/m K
  - Tests showed thermal conductivities ranging from 0.15 to 0.30 W/m K
- Cladding temperatures predicted to be above 350°C
  - No margin to creep-rupture failure screening criterion

Shafts Within the "Footprint"

- Closure of Shafts
  - Plugged at surface
  - Backfilled with mined rock below plug
- Exhaust shaft connected below emplacement level
- Intake shafts have a sump below the emplacement horizon

The goal of these design features is to preclude the entrance of surface water, and prevent man-made gravity flow paths below the shaft seals.

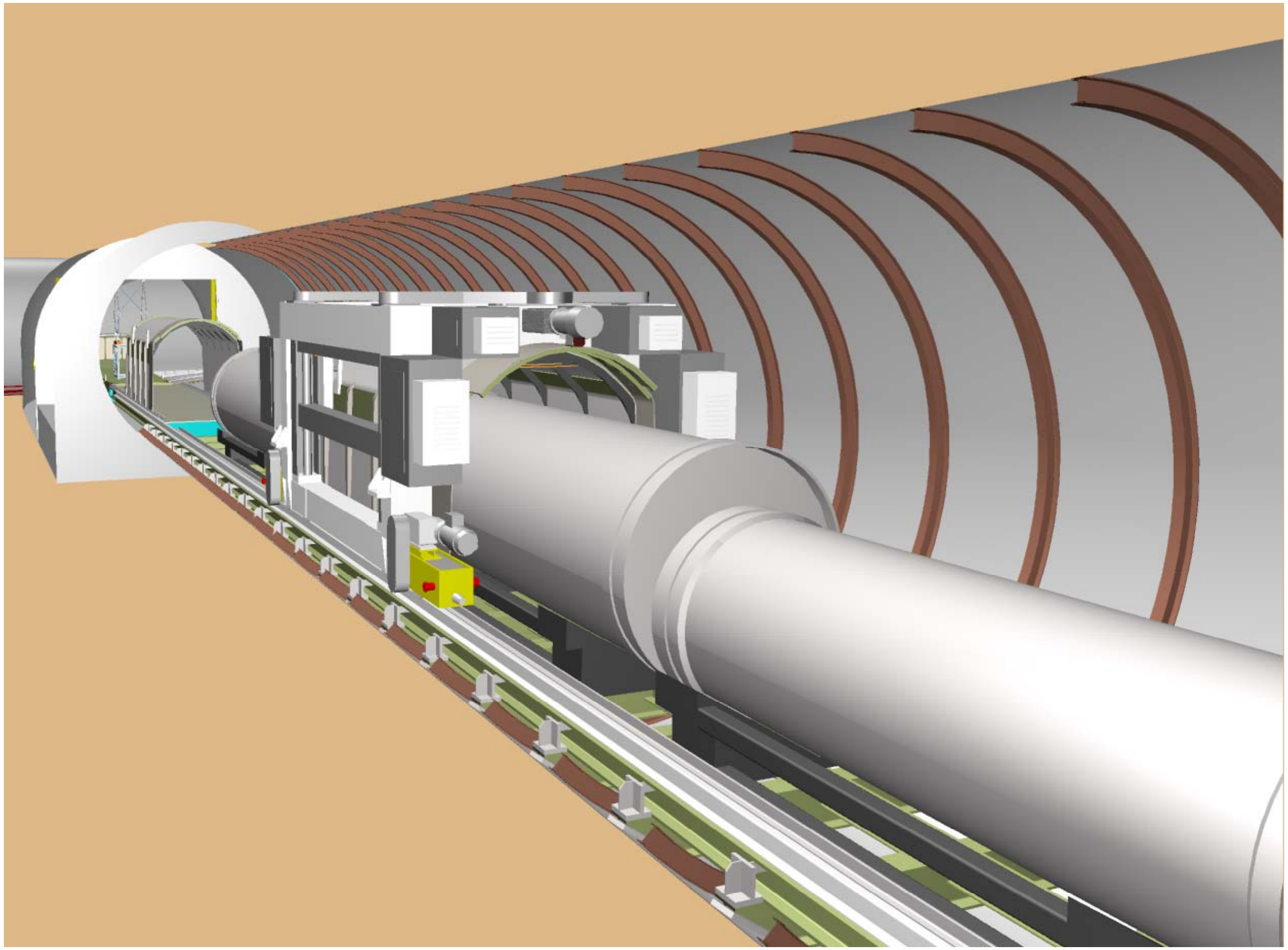
Shaft Placement



Drip Shield Placement

- The current concept calls for drip shield placement using a gantry very similar to those used to emplace the waste packages
- It will have the same redundancy for critical systems that the waste package gantry design employs

Drip Shield and Gantry



Changes to EBS
(Since 6/99 NWTRB Meeting)

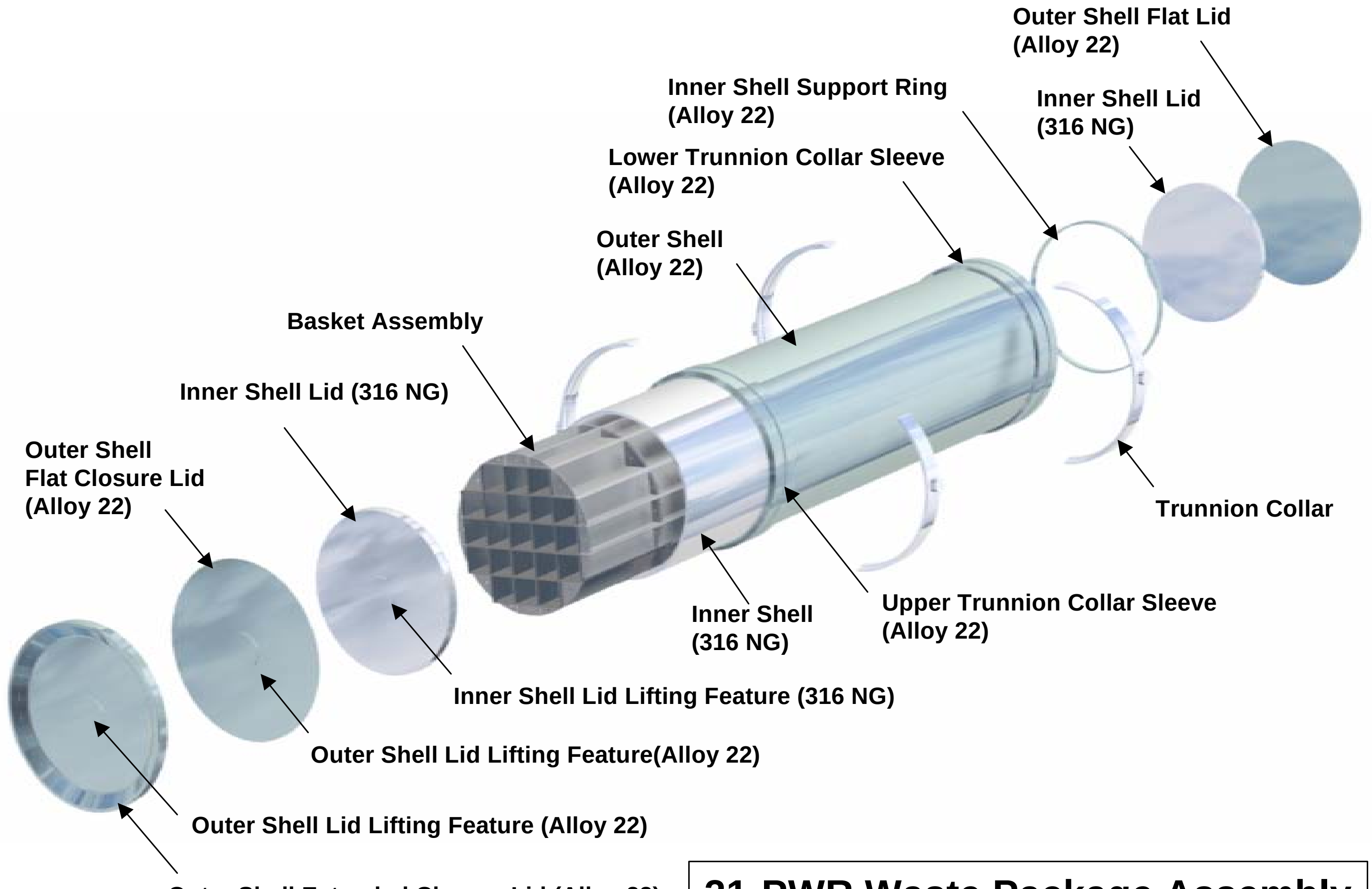
- **Changes to waste package design since EDA II**
  - Shortening of skirts to accommodate final closure weld heat treatment
  - Addition of a second alloy 22 closure lid for final closure
  - Change to lifting feature

21-PWR Waste Package Length

6/99 Design	SR Design
5.335 m	5.165 m

- **Changes to drip shield**
  - Evolution from corrugated design to smooth surface
- **Introduction of emplacement pallet**

Waste Package Design



21-PWR Waste Package Assembly Configuration

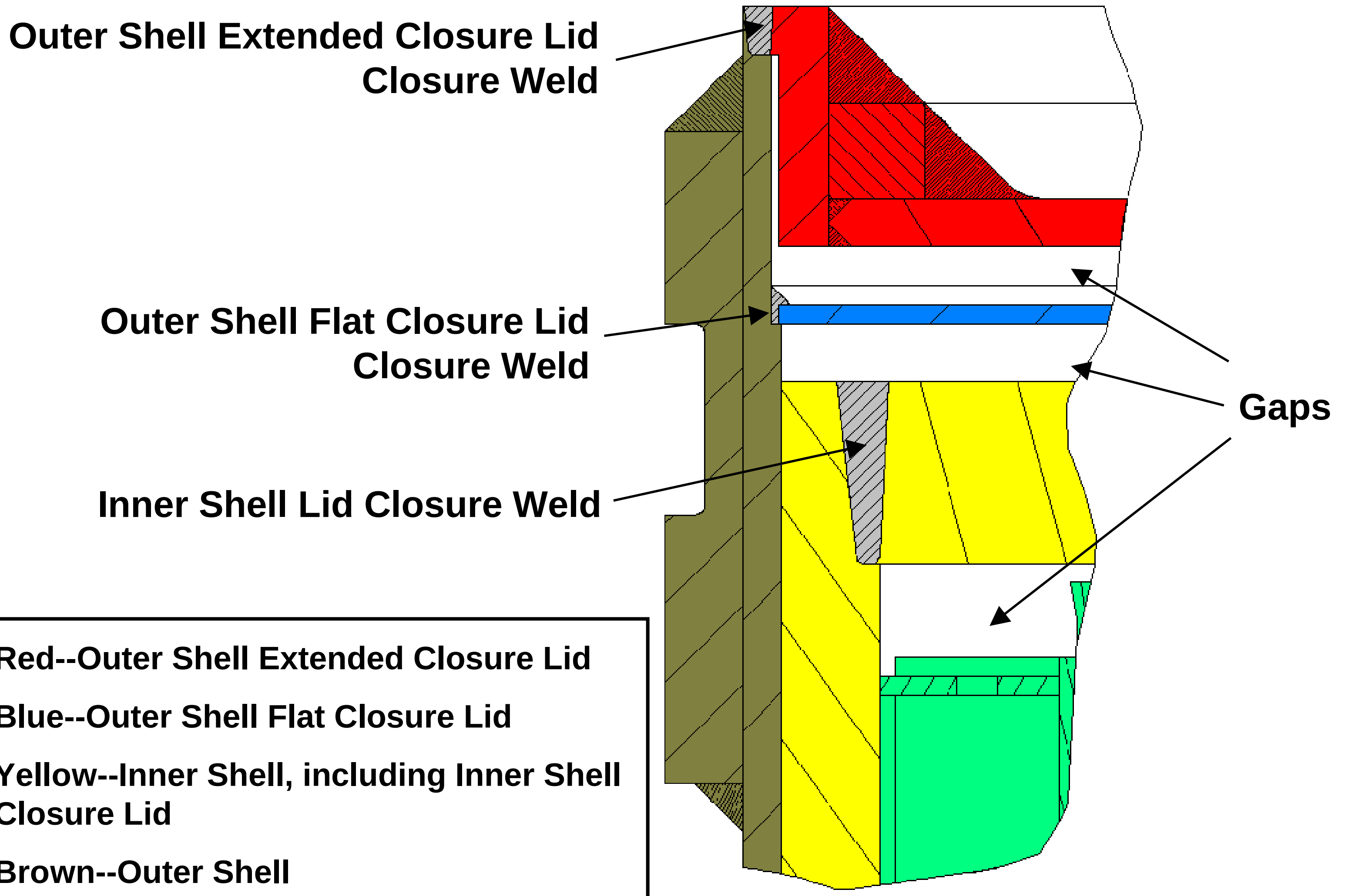
Basis for Waste Package Design Changes

- Shortening of skirts necessitated by need for closure weld final heat treatment
  - Closure welds possibly susceptible to stress corrosion cracking
  - Mitigation of residual stress in closure welds required
- Final closure weld moved to lip of waste package and second alloy 22 closure lid added
- Lifting holes replaced with trunnion collar ring

Mitigation of Stress Corrosion Cracking

- **Potential for stress corrosion cracking in final closure weld not credible for stresses < 20% of yield (in this case the hoop stress in the weld)**
- **Final weld stress reduction by a combination of induction annealing (outer alloy 22 closure lid) and laser peening (inner alloy 22 closure lid)**
- **Achievable depths are 6.5 mm for induction heating and 2-3 mm for laser peening, which prevent weld region failure for at least 10,000 years**

Final Closure Weld Configuration



Red--Outer Shell Extended Closure Lid

Blue--Outer Shell Flat Closure Lid

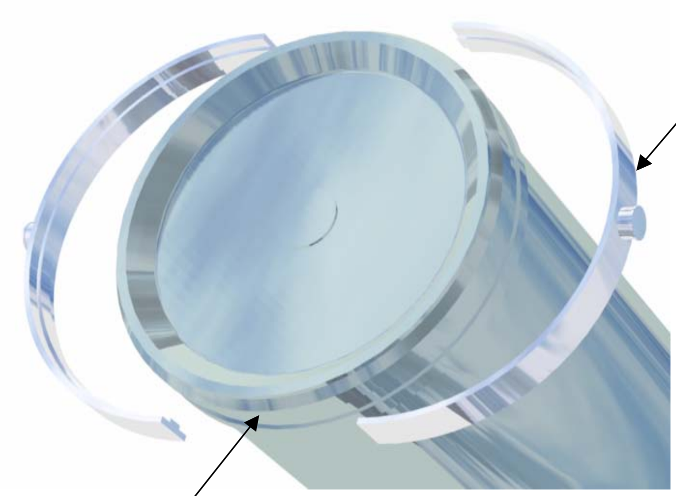
Yellow--Inner Shell, including Inner Shell Closure Lid

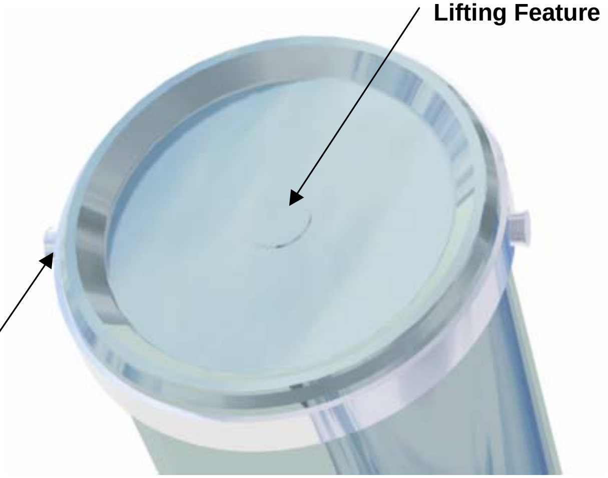
Brown--Outer Shell

Green--Internals

Trunnion Handling Approach

Waste Package Configuration Before Trunnion Collar Emplacement





Waste Package Configuration After Trunnion Collar Emplacement

Note: Attachment Method is Under Development

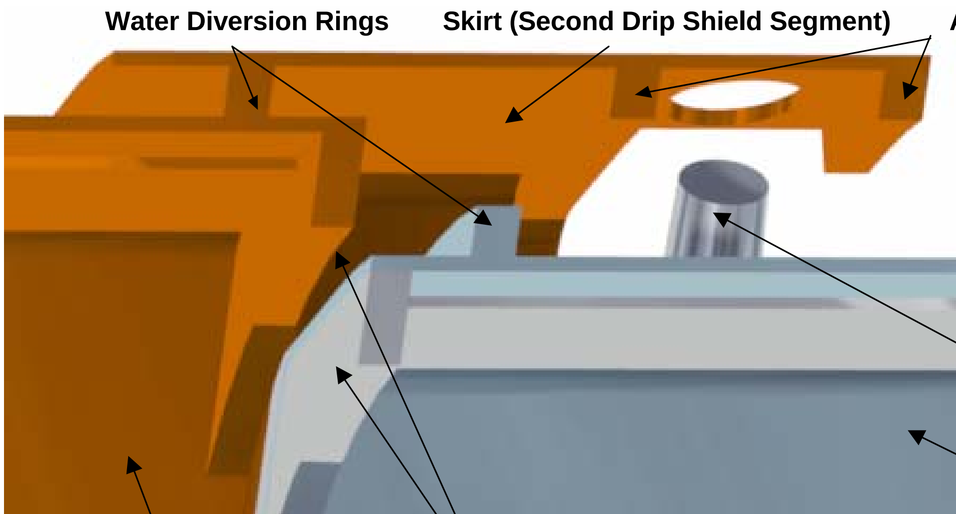
Basis for Drip Shield Design Changes

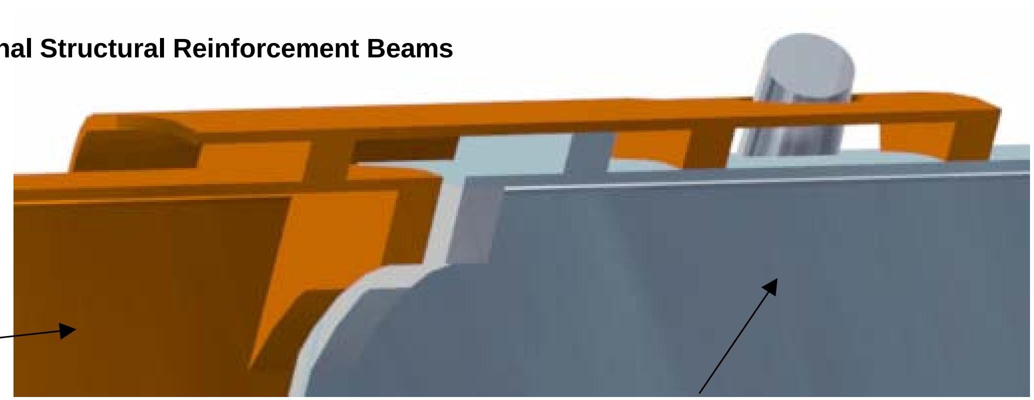
- **Ensure drip shields will not separate during seismic events (evaluation proceeding)**
- **Provide overlap at drip shield junctions and alternate flow paths**
- **Reduce titanium usage by reducing thickness (to 15 mm from 20 mm)**
  - **Removal of corrugations**
  - **Drip shield capable of protecting waste package from a 13 t Rock**

Drip Shield Design

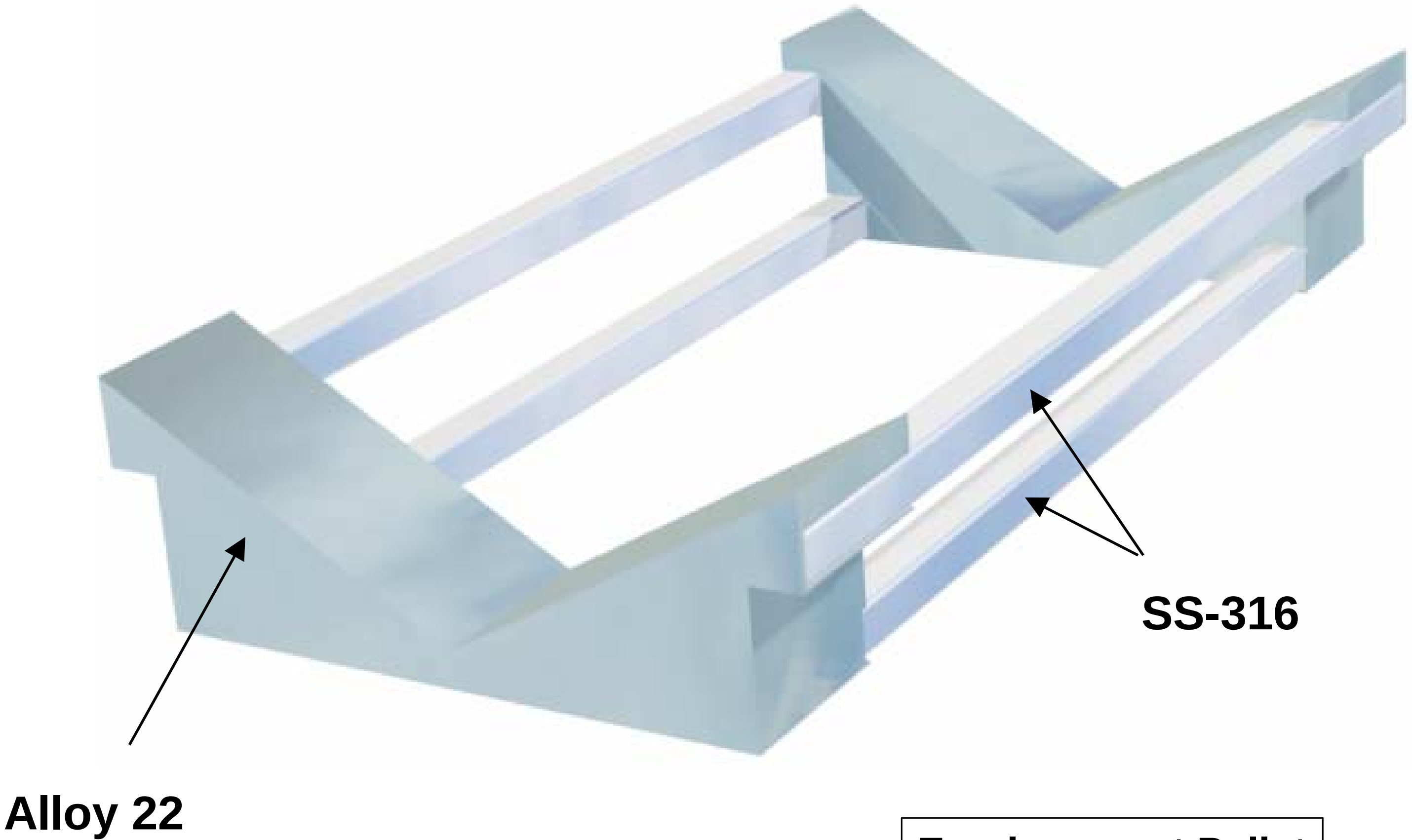
Drip Shield

Drip Shield Connection



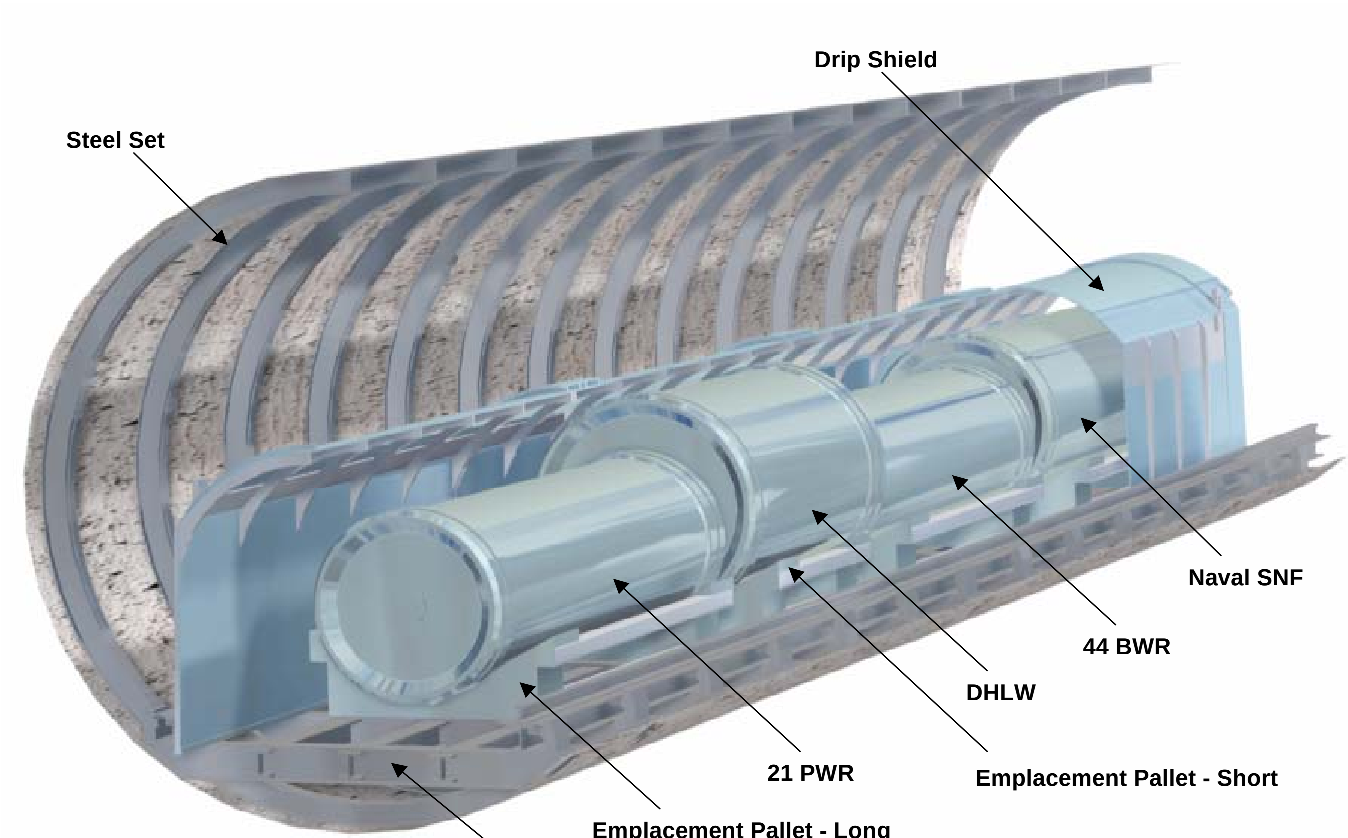


Emplacement Pallet



Emplacement Pallet

Waste Packages Loaded in Drift



Emplacement Drift Segment for Site Recommendation

Note: Granular Ballast in Invert Section not Shown

Cost Differential (TSLCC)

Component	June 1999 Design ($B)	Site Recom-mendation Design ($B)	Δ ($B)
Waste Package	5.8	6.9	1.1
Drip Shield	6.2	4.3	-1.9
Pallets	1.1	1.0	-0.1
Total	**13.1**	**12.2**	**-0.9**

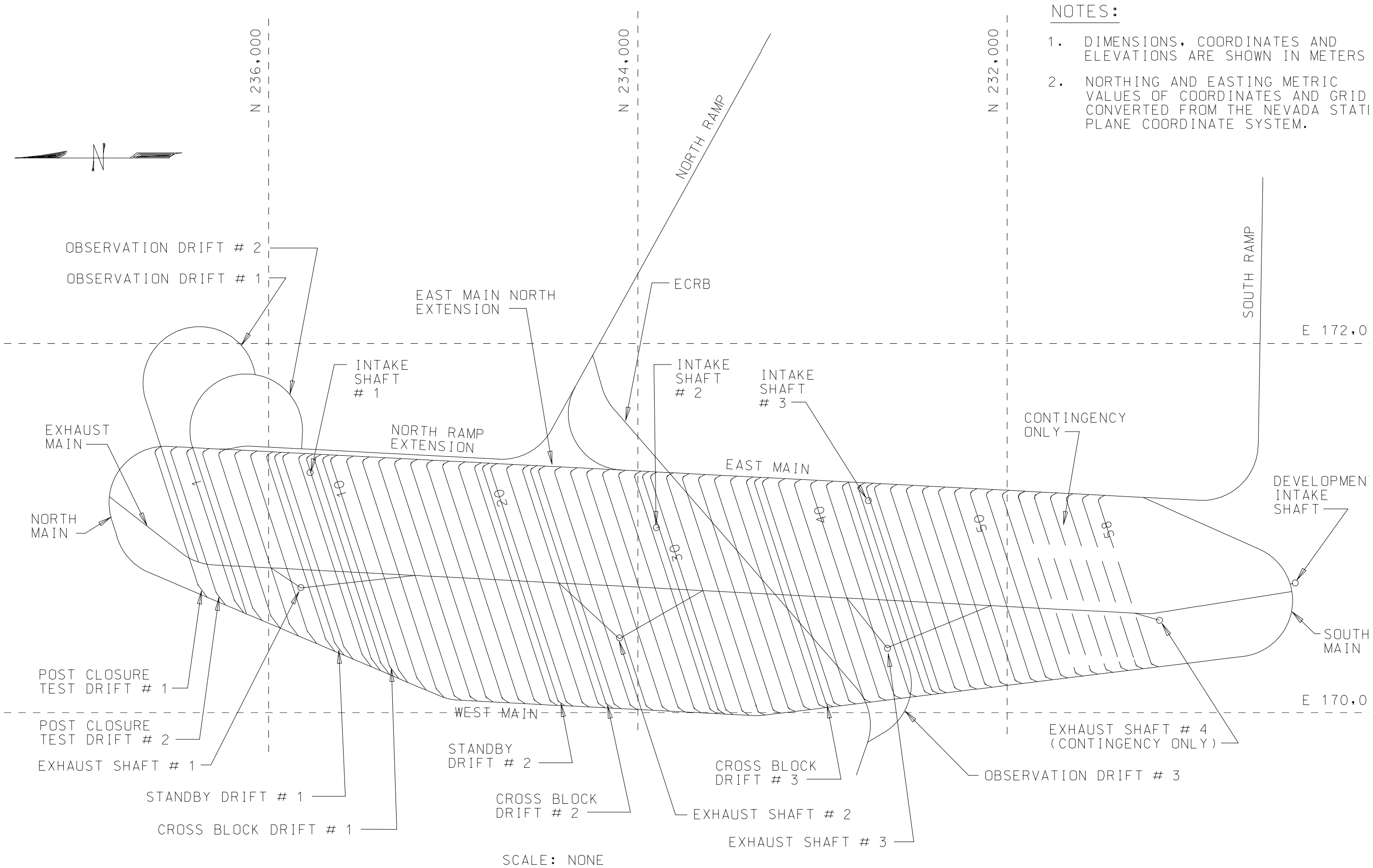
Summary

- **Sub-surface Changes**
  - **Changes to Drift Orientation and Placement of Shafts**
    - **Reduces cost and complexity of construction**
    - **Reduces size of design basis rock**
  - **Removal of Backfill**
    - **Creates margin to cladding temperature limit**
    - **Simplifies closure operations**
  - **Definition of Drip Shield Emplacement Gantry**

Summary
(continued)

- **Waste Package Changes**
  - Introduction of closure lid post-weld heat treatment and peening
    - Extends life of the waste package
  - Use of Trunnion Ring
    - Facilitates close emplacement in drifts and permits post-weld heat treatment
  - Smooth Surface Drip Shield
    - Enhances resistance to shield-to-shield separation
  - Emplacement Pallet
    - Facilitates close emplacement in drifts

Back Up

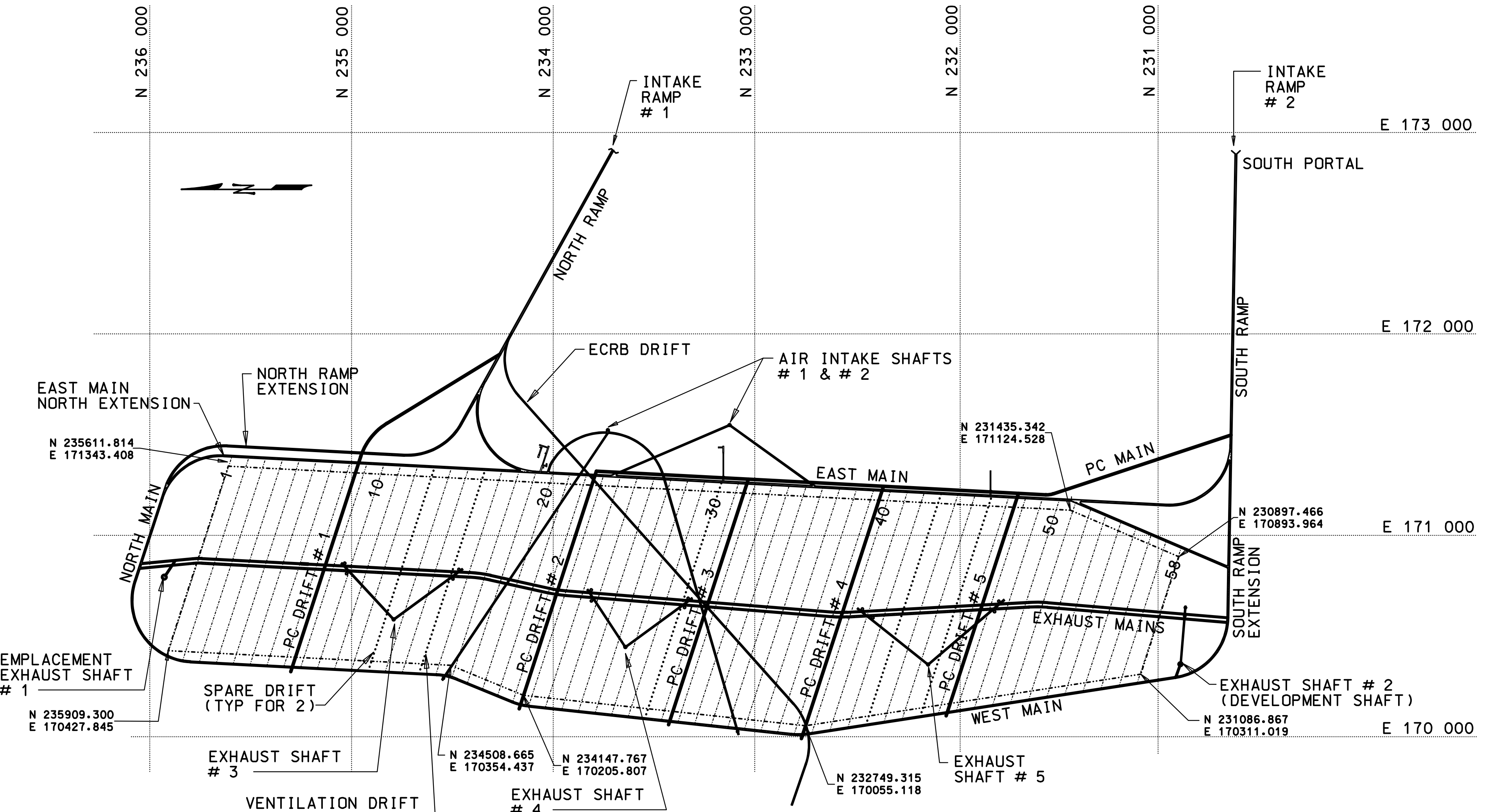


70,000 MTU

PLAN

CAD FILE: 70case.fig

SCALE: NONE



NOTES:

1. 60 MTU/ACRE.
2. SPACING OF EMPLACEMENT DRIFTS = 81 m.
3. NUMBER OF EMPLACEMENT DRIFTS = 53.

EDA II – LAYOUT
10 m³/S EMPLACEMENT VENTILATION