23

YUCCA
MOUNTAIN
PROJECT

Studies

Reference Design for Site Recommendation

Presented to:
DOE/NRC Technical Exchange on Total System
Performance Assessment
San Antonio, Texas

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

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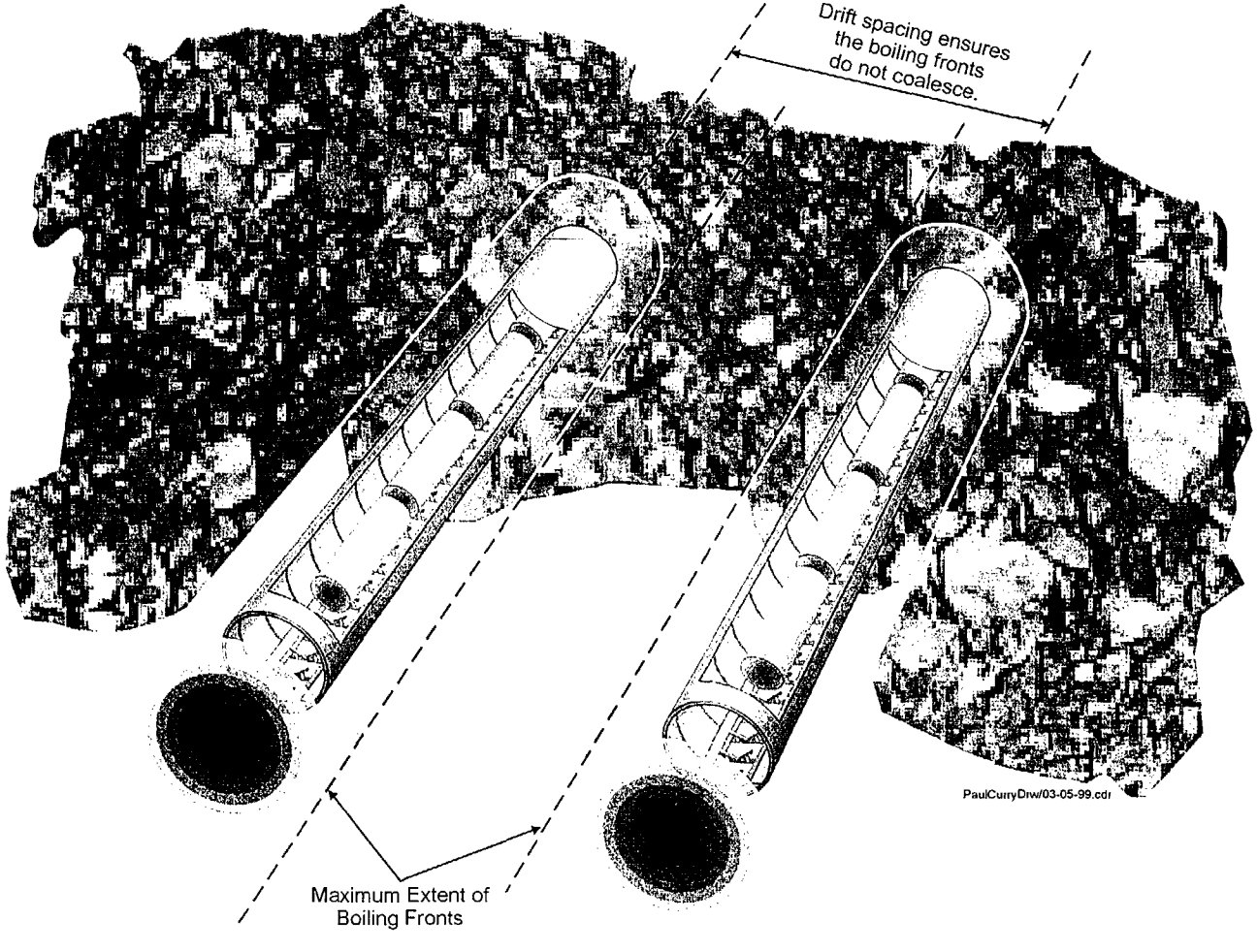
Background

- The potential to improve overall system performance was discussed in the Viability Assessment (VA)
- VA reference design included engineered barrier options that complement the natural barriers
  - Emplacement drift backfill
  - Drip shield with backfill
- The need to evaluate Design Alternatives has been identified internally and externally

Site Recommendation Reference Design

- Thermal Goals
  - Ensure boiling fronts from individual emplacement drifts do not coalesce
  - Maintain cladding temperatures < 350°C
- Rationale
  - Permit shedding of water in pillars during thermal pulse
  - Reduce uncertainty associated with the amount of water that enters the drifts during the thermal pulse

Site Recommendation Design - Shedding in Pillars



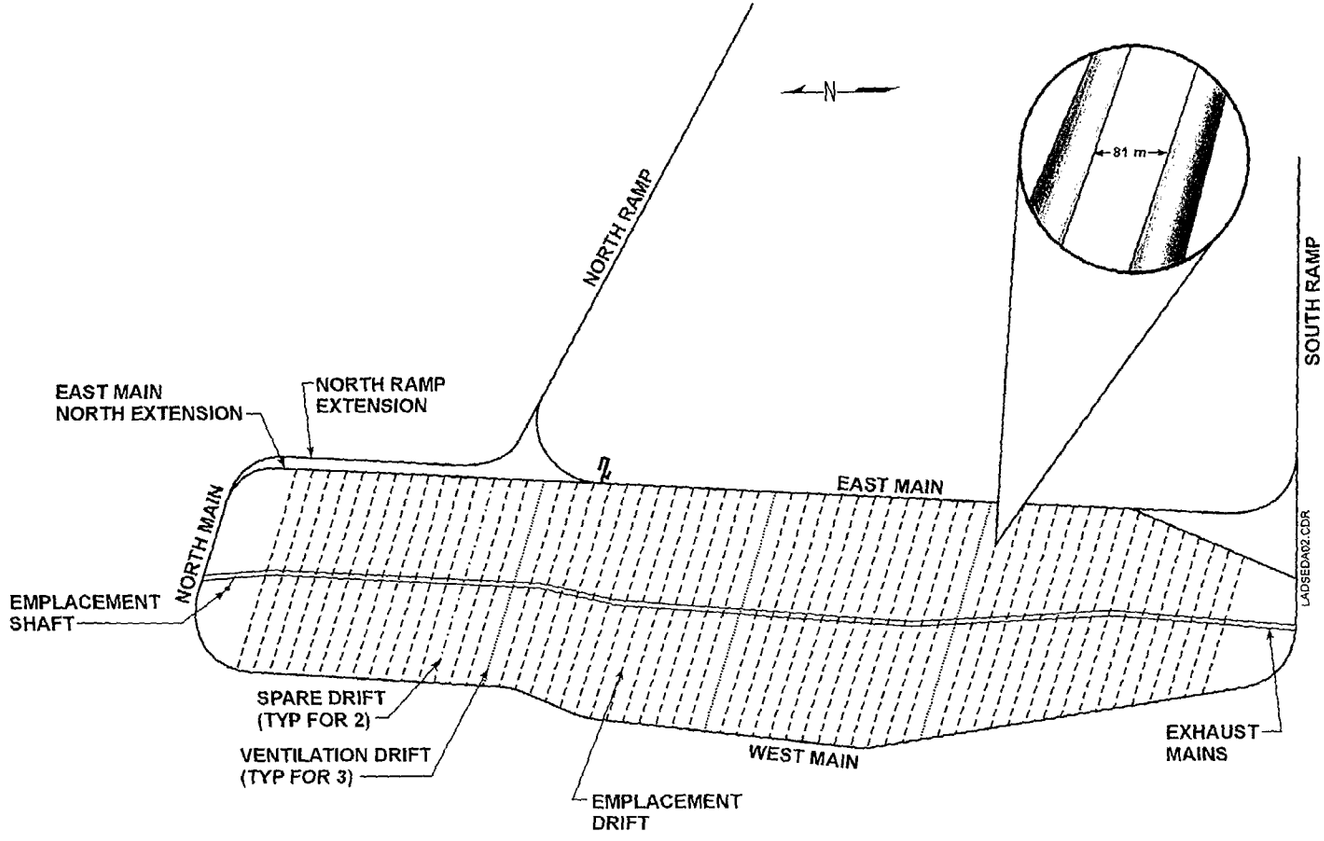
Site Recommendation Reference Design

- Design Features Include:
  - Blending of assemblies
  - Outer layer corrosion resistant material waste package
  - Pre-closure ventilation
  - Dripshields
  - Backfill

Site Recommendation Reference Design

- **Mass Loading and Footprint Design**
  - Areal mass loading: 60 MTHM/acre was 85
  - Drift spacing: 81 meters (center to center)
  - Emplacement in upper block: ~1060 acres was 740
  - Total emplacement drift length: 54,000 meters
  - Total access drift length: 33,400 meters
  - 10,039 Total Waste Packages

Site Recommendation Reference Design



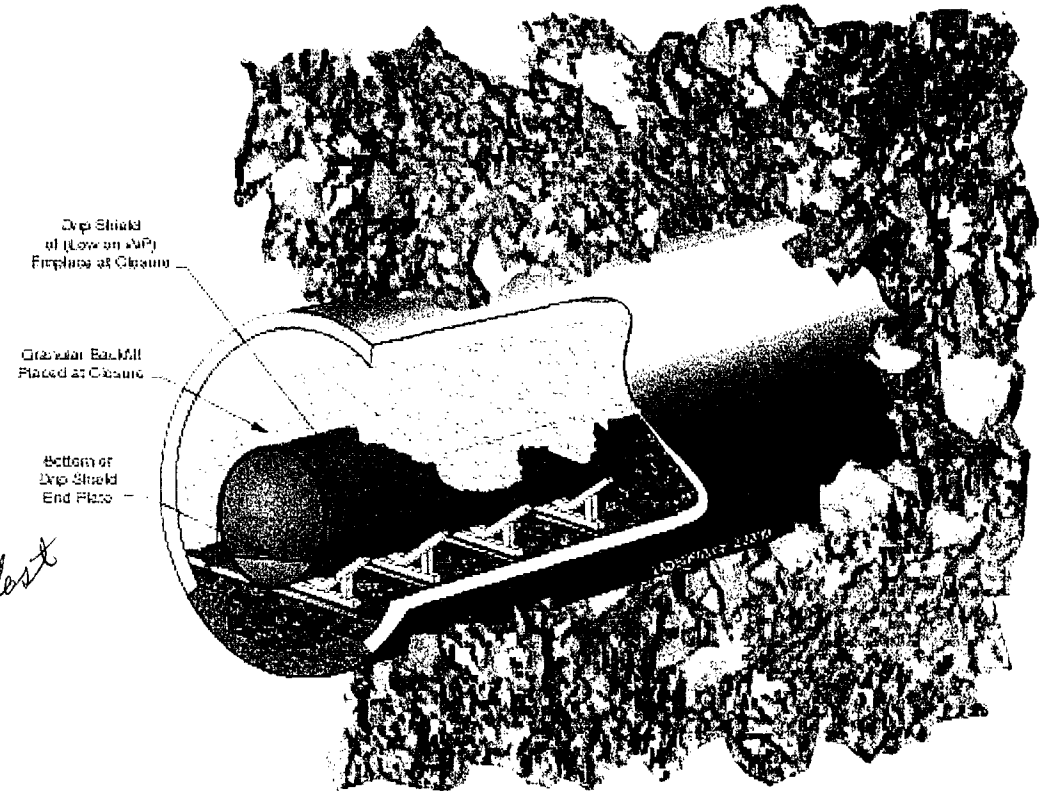
EDA 2 - 60 MTU/ACRE - 81.0 m C/C

Site Recommendation Reference Design

Drift Layout

- Line Loading
- 5.5 m diameter
- Steel sets ground support
  reduce uncertainty
- Dripshields
- Backfill

invert steel plates/ granular ballast



Site Recommendation Reference Design

- **Waste Package Design**
  - Outer layer waste package material: 2 cm Alloy 22 over 5 cm stainless steel (316NG)

    stainless steel - stronger than carbon
    won't have risk of pitting/crevicing
  - 21 PWR/44 BWR Spent Nuclear Fuel (SNF) assembly waste packages
  - Average initial waste package heat output: 9.3 kW
  - Blending ensures that maximum initial waste package heat output is within 20% of average (11.2 kW max)

Site Recommendation Reference Design

- **Thermal Management**
  - **SNF assembly blending conducted to ensure a more even distribution of heat in emplacement drifts**
  - **Pre-closure ventilation conducted to ensure that thermal goals are not violated during post-closure period**
    - » **~2-5 cubic meters per second airflow in emplacement drifts over a 50 year period**
  - **Closure possible at 50 years**

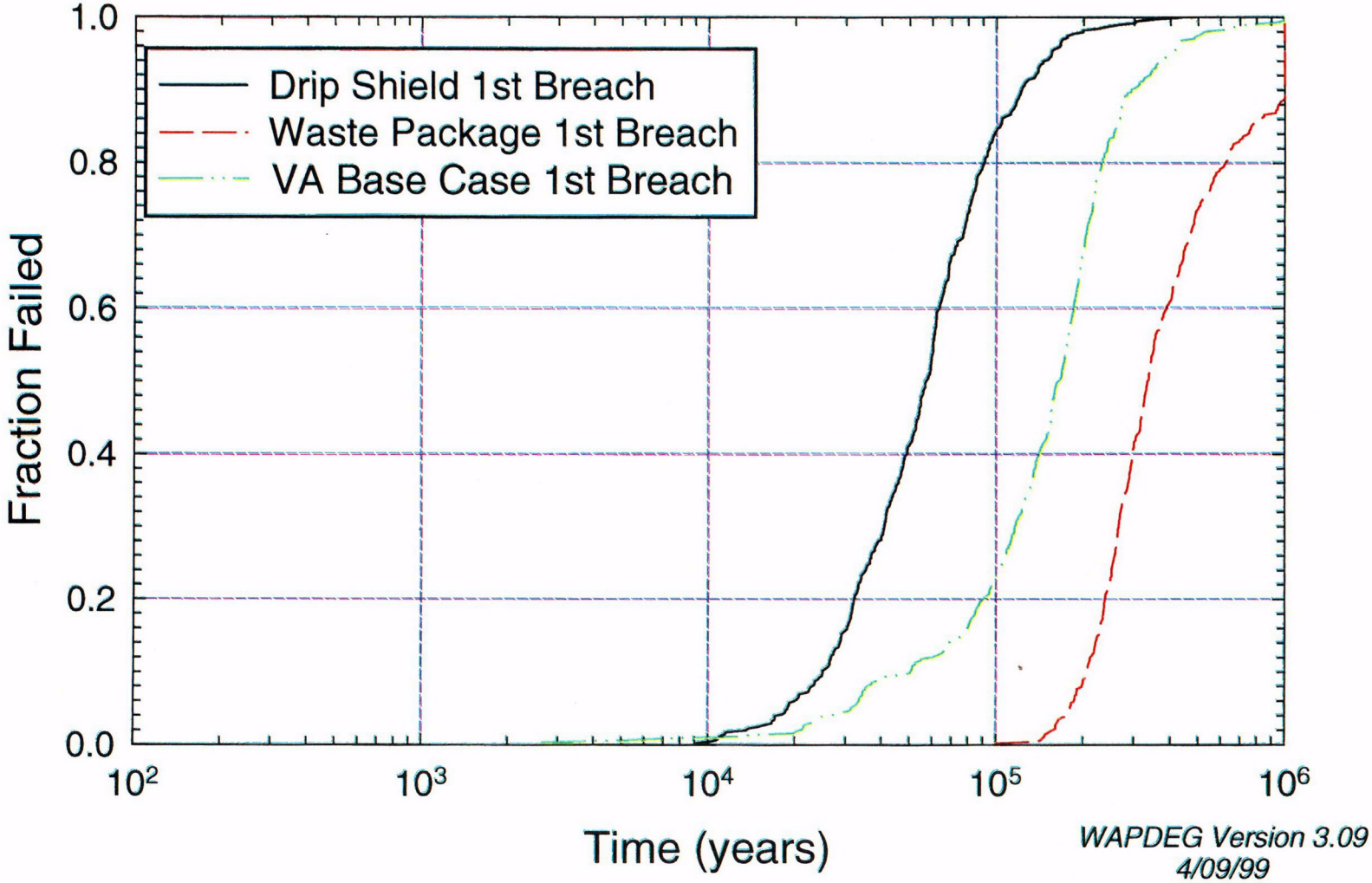
flow rates to be optimized 2-5 m^3/s
2-10 m^3/s

radiolysis
predosure radiation

Climax – ~~what do with~~ radiolysis on steel sets
WP design people don't feel it is our issue

Fraction of Waste Packages Failed vs. Time

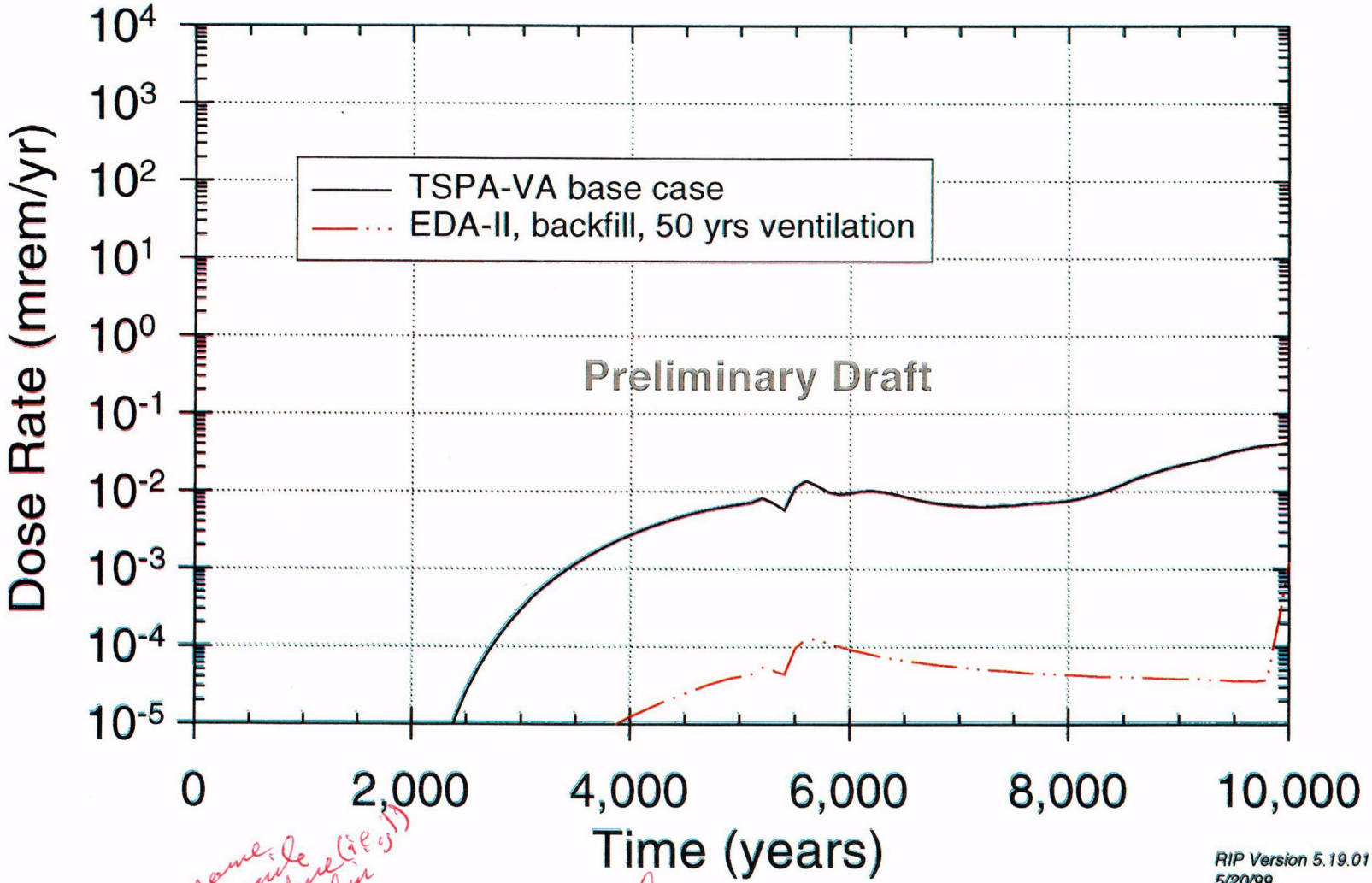
LADS - EDA2-2, 50 Yr. Ventilation, Always Drip



C-01

10,000-yr Expected-Value Total Dose-Rate History

All Pathways, 20 km



RIP Version 5.19.01
5/20/99
case0ee4;eda2e4p

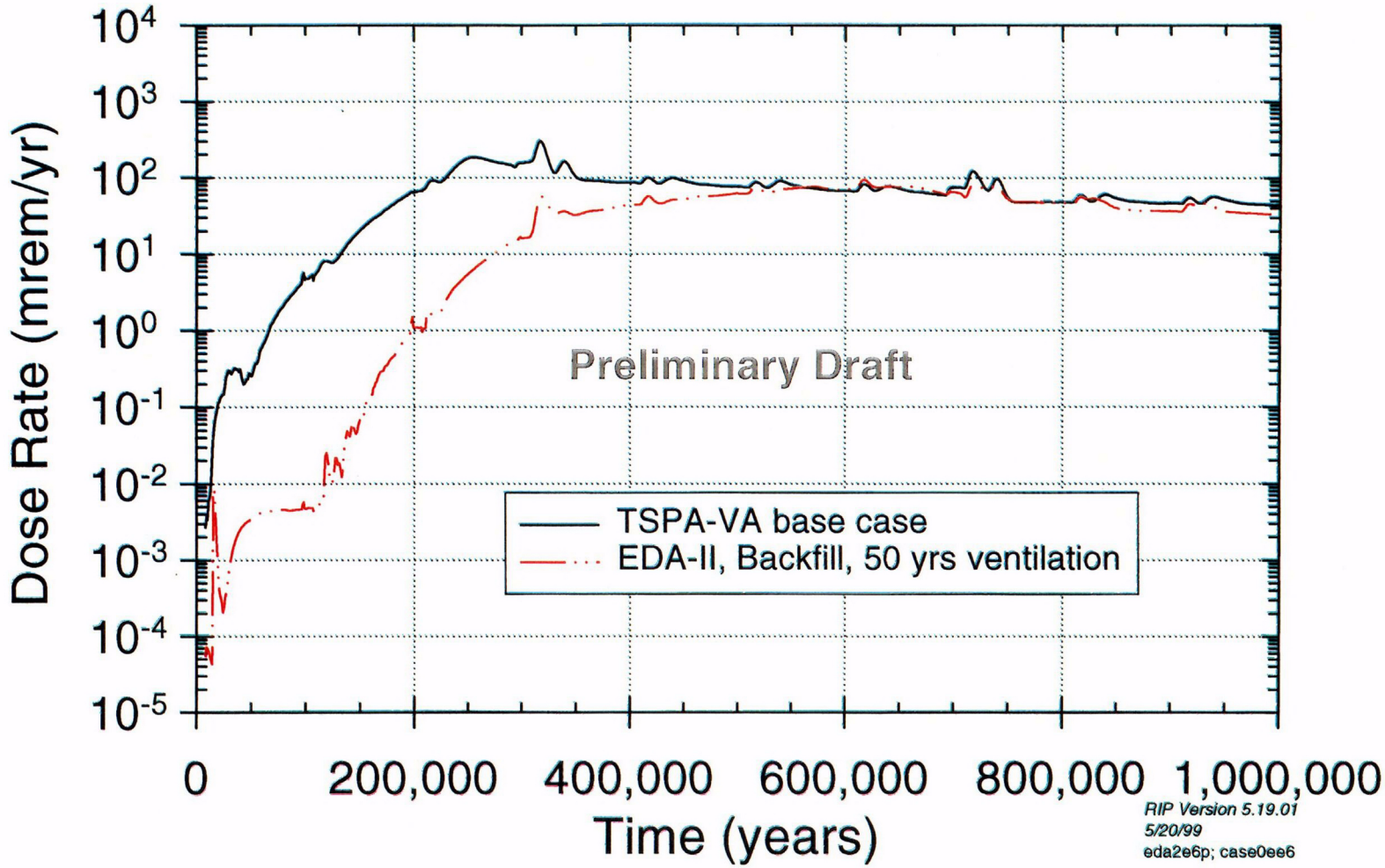
C-02

some juvenile WP failure (i.e.) assumed in VA

assumed 5% ~~capillary~~ saturation in quartz sand "invert"

1,000,000-yr Expected-Value Total Dose-Rate History

All Pathways, 20 km



C-03

Comparison of Enhanced Design Alternative II to VA Design

Design Characteristics	EDA II	Viability Assessment Design
Areal Mass Loading	60 MTU/acre	85 MTU/acre
Drift Spacing	81 m	28 m
Drift Diameter	5.5 m	5.5 m
Invert	Steel with sand or gravel ballast	Concrete lining
Number of waste packages	10,039	10,500
Length of emplacement drifts	54 km	107 km
Waste Package Materials	2 cm Alloy-22 over 5 cm stainless steel 316L	10 cm carbon steel over 2 cm Alloy-22
Maximum Waste Package	21 PWR assemblies	21 PWR assemblies
Peak Waste Package Power (blending)	20% above average PWR waste package power	95% above average PWR waste package power
Drip Shield	2 cm Ti-7	None
Backfill	Yes (may become an option)	None
Preclosure period	50 yrs	50 yrs
Preclosure ventilation rate	2-10 m^3/s	0.1 m^3/s