Update on Yucca Mountain Repository and Transportation Impacts

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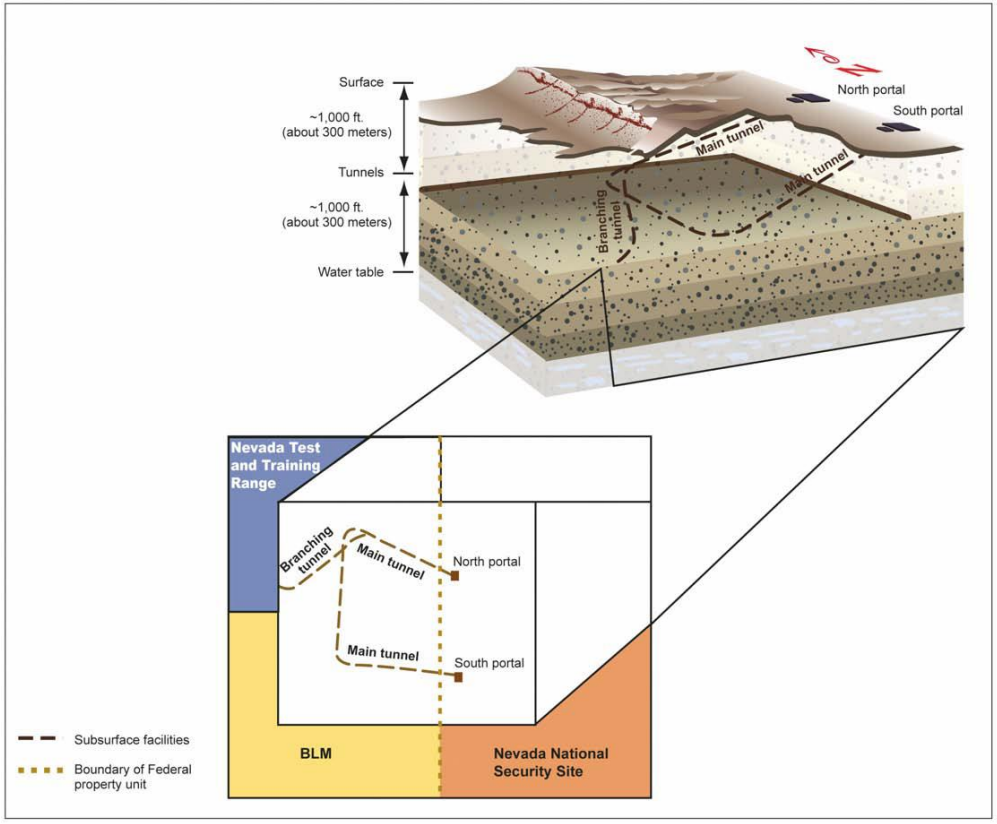
Nevada Legislature Committee on High-Level Radioactive Waste

Las Vegas, Nevada
March 20, 2018

Visit our website: http://www.state.nv.us/nucwaste/

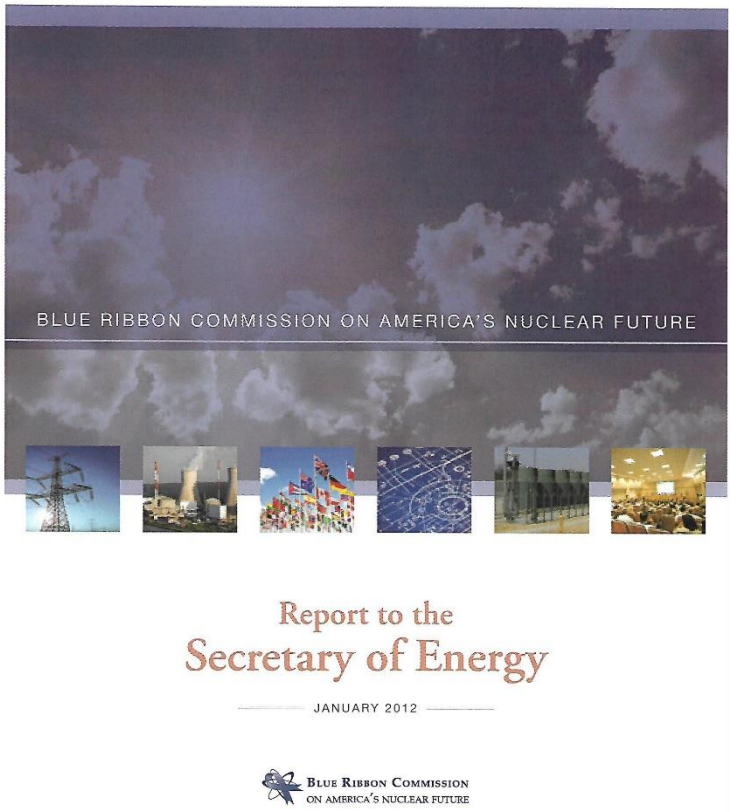
What Exists Today at Yucca Mountain Cannot be used for Waste Storage or Disposal

- 5-Mile Exploratory Tunnel
- No waste disposal tunnels (Over 40 miles needed)
- No waste handling facilities
- No state water permit
- No license (construction authorization)
- No railroad
- Expired BLM land withdrawal



Sources: GAO analysis of GAO and DOE data.

Blue Ribbon Commission (BRC) on America's Nuclear Future 2012 Report



- Bipartisan Experts
- Replace DOE
- Consent in Siting
- Interim Storage
- Nuclear Waste Fund
- Transportation
- No opinion on Yucca Mountain site suitability or resumed licensing

What Should Be Done With Nuclear Waste?

- Walk away from Yucca Mountain
- Follow Blue Ribbon Commission on America's Nuclear Future 2012 Report* Recommendations: Restructure nuclear waste program and Waste Fund, Consent-based siting, Consolidated interim storage, Improve transportation safety and security (per National Academy of Sciences study Committee 2006 Report**)
- U.S. Senate legislation (Previous S. 854 follows BRC)
- Address stakeholder concerns about at-reactor storage
- Enact Nuclear Waste Informed Consent Act introduced by Nevada Members of Congress (S. 95, H.R. 456)***

*Available on-line at: https://energy.gov/ne/downloads/blue-ribbon-commission-americas-nuclear-future-report-secretary-energy

** Free download available at: https://www.nap.edu/read/11538/chapter/1

*** Available at: https://www.congress.gov/bill/115th-congress/senate-bill/95 ; https://www.congress.gov/bill/115th-congress/house-bill/456

Nuclear Waste Informed Consent Act

- S. 95 (Heller & Cortez Masto): January 2017
- H.R. 456 (Titus, Kihuen, & Rosen): January 2017
- Written consent agreement before Nuclear Waste Fund can be used for repository construction
- Secretary of Energy and (1) Governor of the host State; (2) host unit of local government; (3)each contiguous local government affected by transportation; and (4) each affected Indian tribe

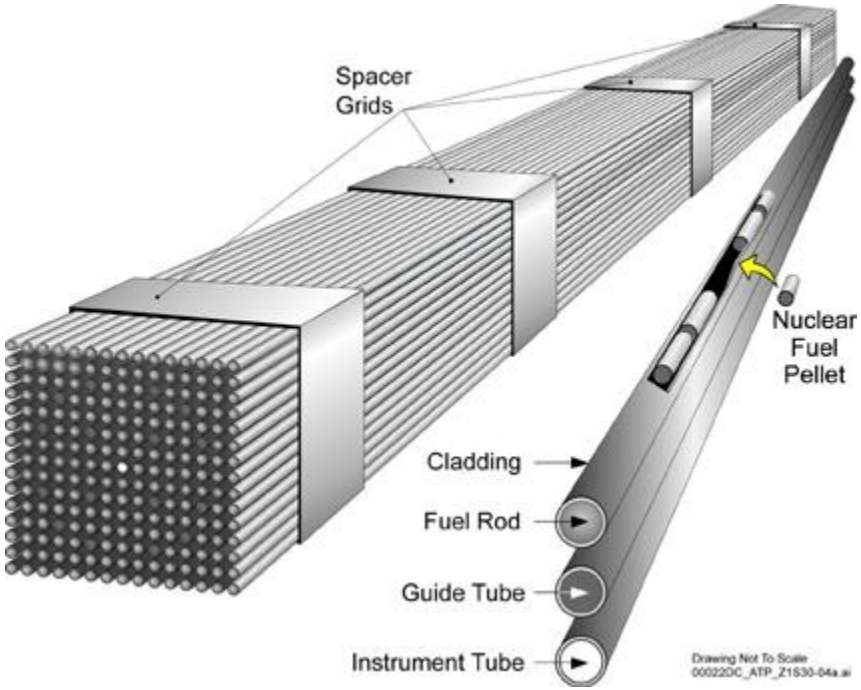
Available on-line at: https://www.congress.gov/bill/115th-congress/senate-bill/95
Available on-line: https://www.congress.gov/bill/115th-congress/house-bill/456

Developments Since March 2017

- President's FY 2018 Budget Blueprint Requested $120 million for DOE, $30 million for NRC, to restart Yucca Mountain licensing (March 2017)
- Energy Secretary Perry Visits Yucca Mountain, then meets with Gov. Sandoval (March 2017)
- GAO Report on Resumption of Yucca Mountain Licensing (April 2017)
- U.S. House Committee on Energy and Commerce, Hearings on Yucca Mountain (April 2017); Reported H.R. 3053 Nuclear Waste Policy Amendments Act of 2017 (June 2017); Floor vote expected in 2018
- U.S. Senate Appropriations Committee rejects new funding (July 2017)
- NRC directs staff to prepare for licensing restart (June 2017); LSN ARP meeting, February 2018; awaiting report on Nevada hearing venue
- FY 2019 Budget: DOE seeks $120 million, NRC $48 million (Feb. 2018)
- FY 2018 Omnibus Appropriations – new funding 3.23 - 9.30.2018???
- Licensing proceeding could resume in 2018 (cost $2 billion, 4-5 years)

Nuclear Fuel Assembly

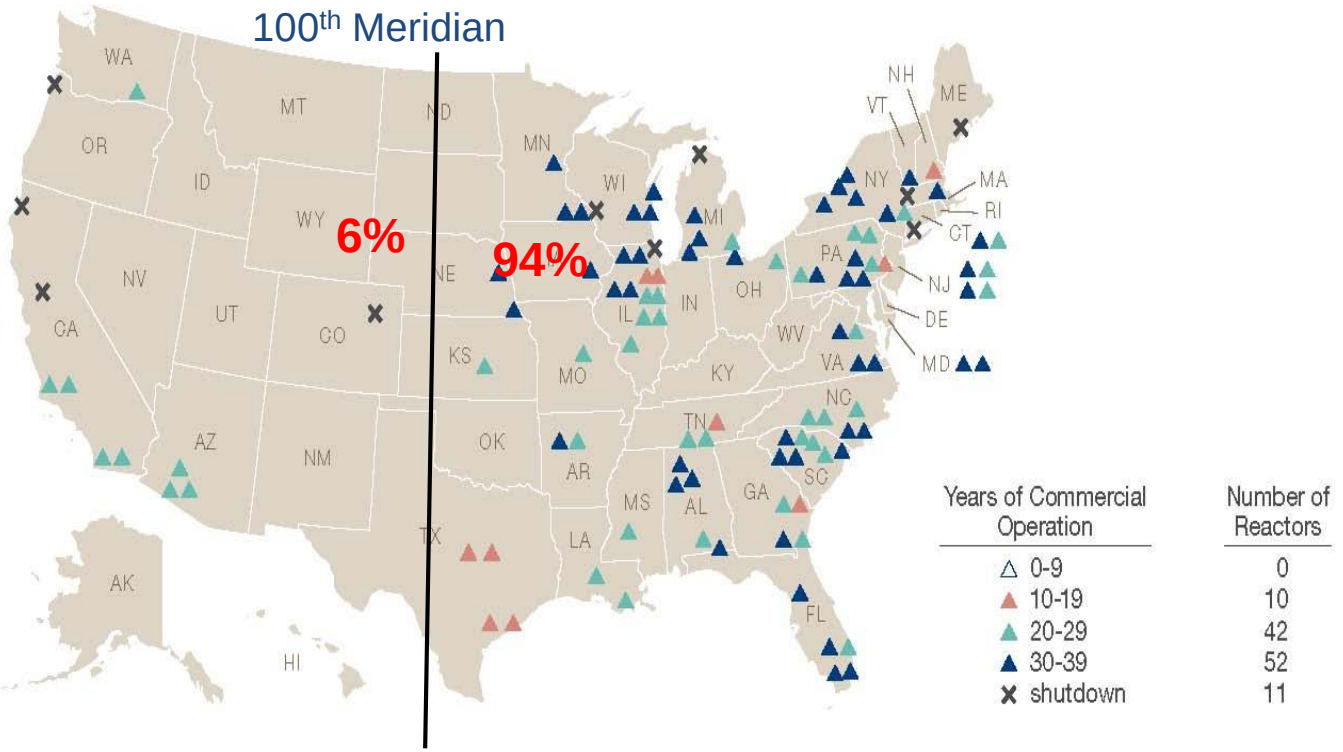
(Commercial spent fuel would be 90% of 70,000 MTHM repository limit)



Spent Fuel Removed from Reactors and Stored On-site is Highly Radioactive and Thermally Hot

Pool storage at reactors usually needed for 5-10 years, regulated by NRC

Dry Cask storage at reactors has been approved by NRC for up to 160 years



SNF in Storage: East-West Distribution (2012)

Yucca Mountain Repository Time Frames

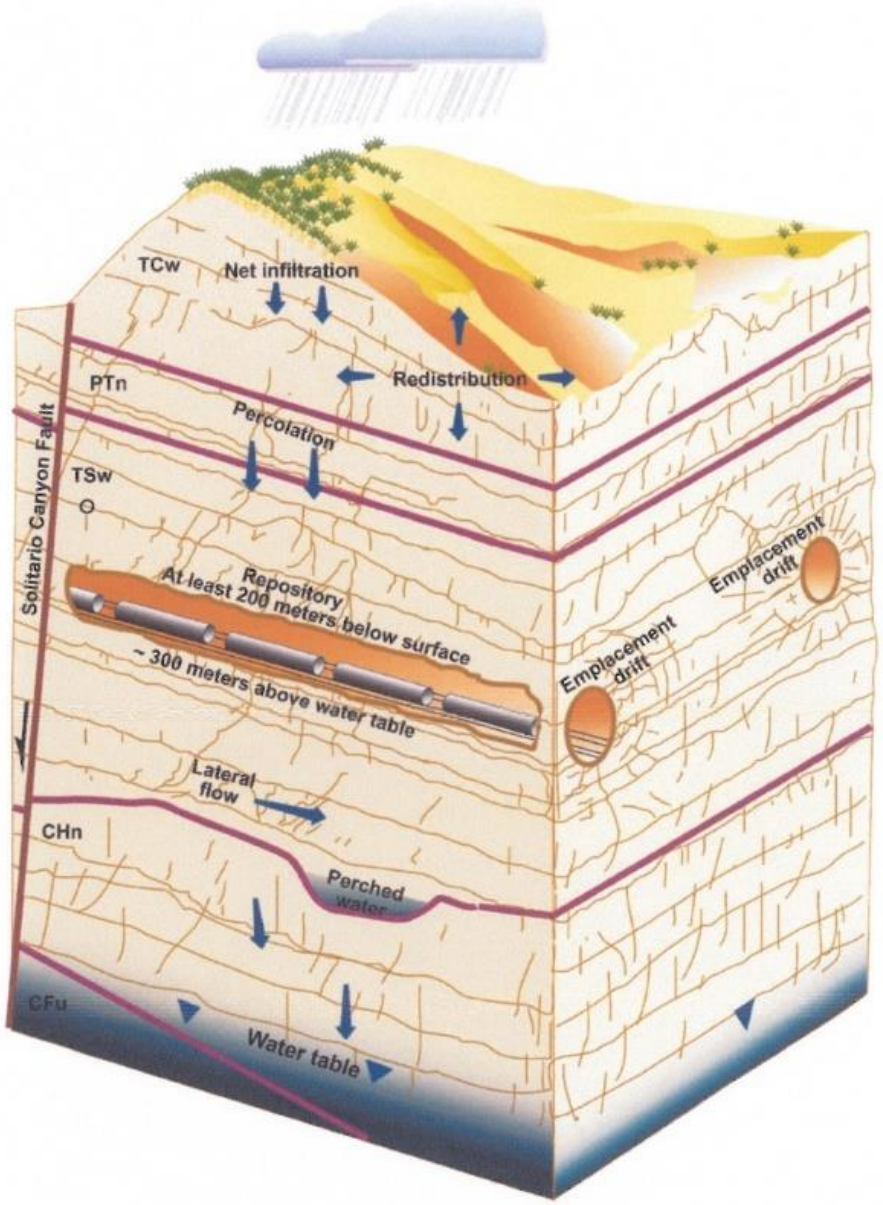
- Transportation, 50 Years or more
  - Construction of railroad
  - Shipment of 9,495 rail casks (2,800 trains) & 2,650 truck casks
  - If No 2nd Repository: 21,909 rail casks (about 6,700 trains) & 5,025 truck casks
  - Concerns include accidents, sabotage, disruption of shipments by natural events
- Preclosure Operations, 100 Years or more
  - Construction of surface facilities, underground tunnels and drifts
  - Emplacement of 11,200 waste packages, and 11,500 drip shields (90 years later)
  - If No 2nd Repository: 25,900 waste packages and 26,200 drip shields
  - Concerns include human factors, military aircraft crashes into surface facilities, earthquake induced accidents in surface facilities and rock falls in drifts
- Postclosure Performance, One Million Years
  - Repository closure, surface restoration, monitoring, and retrieval of waste if necessary
  - Concerns include groundwater contamination, human intrusion, erosion, volcanism

If Yucca Mountain Licensing Resumes…

- State of Nevada will fully adjudicate 218 admitted contentions in opposition to DOE license application (LA) and submit 30-50 new contentions based on new information and NRC EIS Supplement
- Nevada estimates over 400 hearing days would be needed to adjudicate 250 contentions, plus time for discovery, motions and appeals, so legally mandated proceeding could require 4-5 years, and cost DOE $1.66 billion, NRC $330 million, Nevada $50 million
- Nevada contentions challenge all aspects of DOE LA and EISs – Postclosure Safety, Preclosure Safety, NEPA Transportation

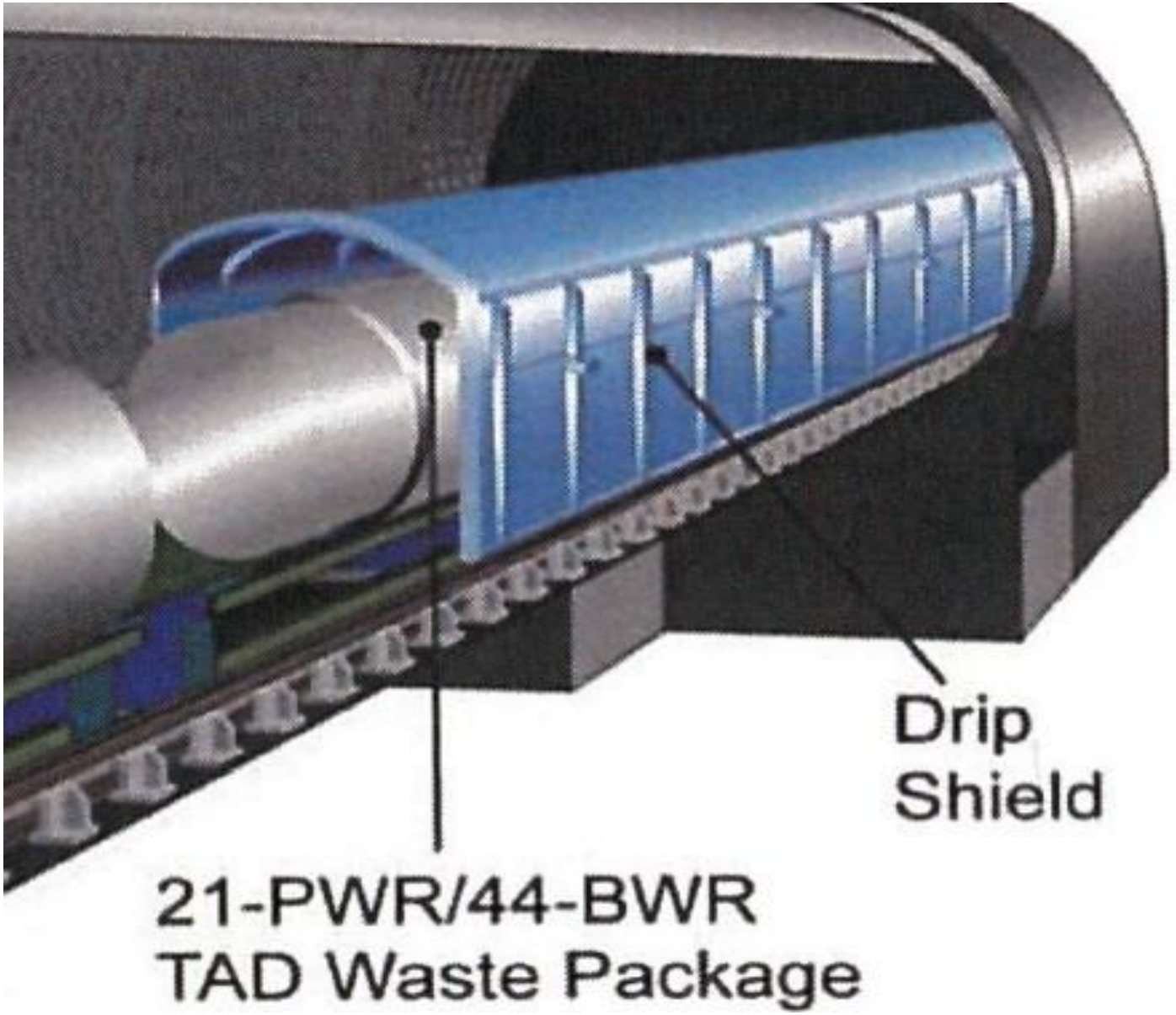
Contentions Challenge Site Suitability

Fractured rock, oxidizing groundwater, above water table



Titanium Drip Shields

(as Proposed by DOE)



Contentions Challenge Hot Repository Concept

DOE says drifts will remain above water boiling point for about 1,000 years

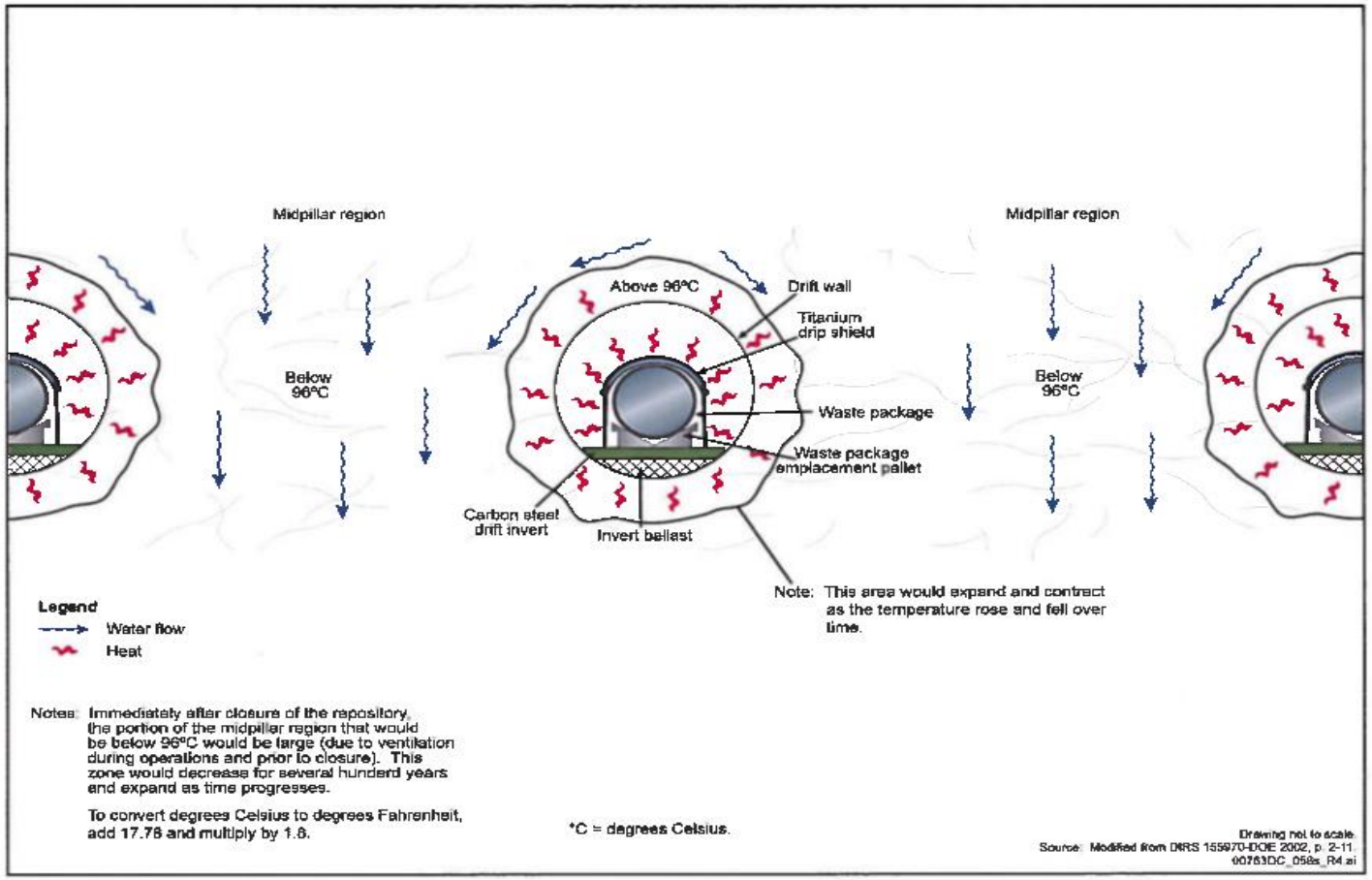
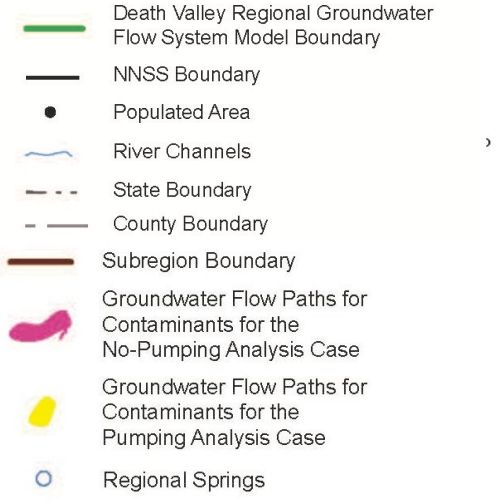
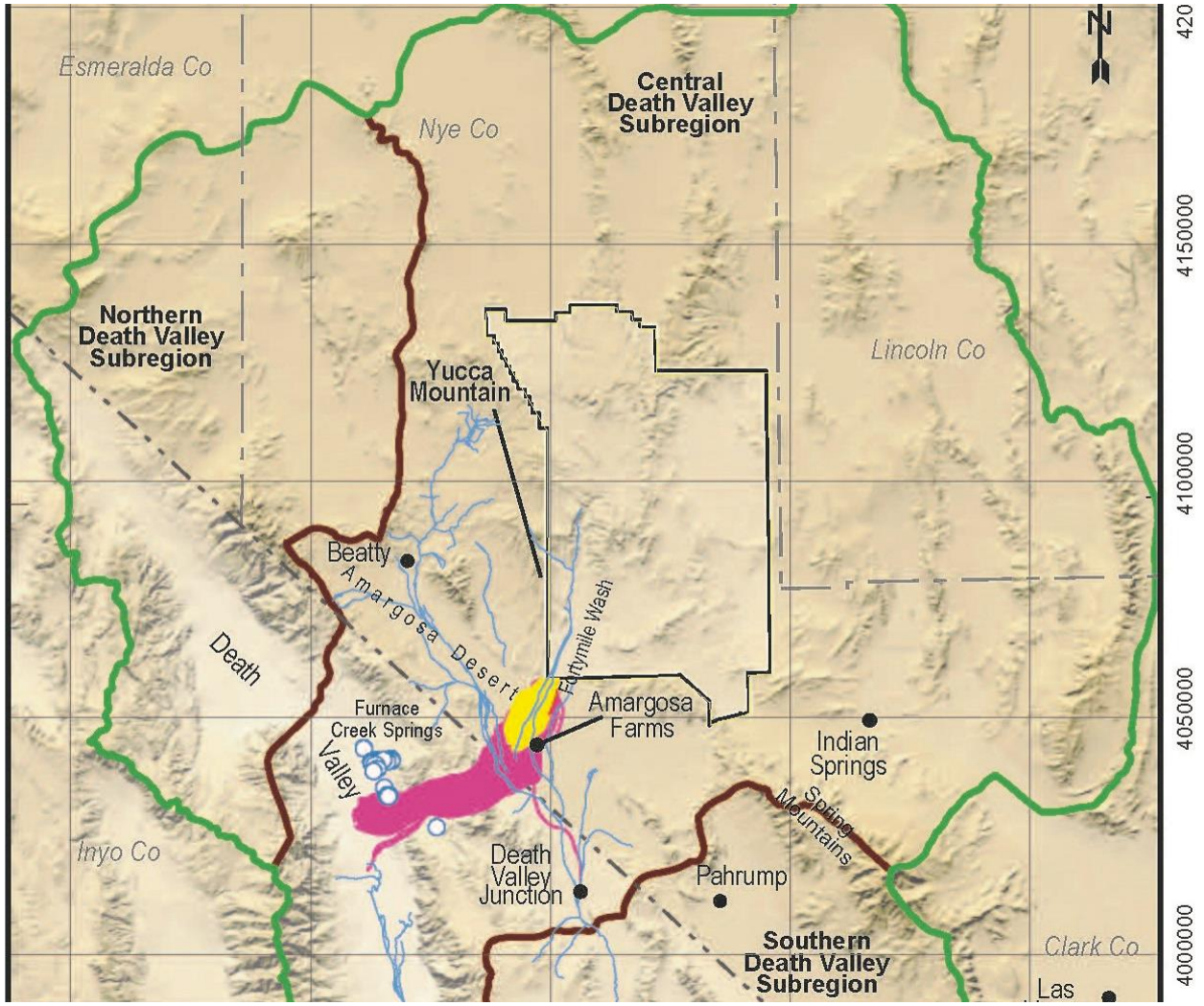


Figure S-8. Management of waste package emplacement using thermal energy density (artist's concept).

New Contentions Challenge NRC Groundwater Evaluation and Failure to Address Native American Cultural Impacts (NRC EIS Supplement NUREG-2184)

Figure 2-5, Groundwater Flow Paths for Contaminants for the Pumping (Yellow) and No Pumping (Fuchsia) Analysis Cases





DOE Proposed Yucca Mountain Transportation System (2008 FSEIS)

- Ship 9,495 rail casks (2,800 trains) & 2,650 truck casks over 50 years [p.6-8]
- If No 2nd Repository: 21,909 rail casks (about 6,700 trains) & 5,025 truck casks [p.8-41]
- Average 1-3 trains & 1-2 trucks per week
- Every day, for 50 years, one or more loaded casks on rail or road, from 76 shipping sites
- Cities would be heavily impacted by shipments
- Urban infrastructure impacts must be assessed

Yucca Mountain Shipments (New Casks) Compared to Past Shipments

- 40 Times More SNF Shipped Per Year
- 8 - 38 Times More Casks Per Year
- 5 - 40 Times More Shipments Per Year
- 443% Increase In Average Rail Miles
- 280% Increase In Average Truck Miles
- Western Route Conditions
- Potential Heavy Haul Trucks and Barges

Source: Halstead & Dilger, "How Many Did You Say? Historical and Projected Spent Nuclear Fuel Shipments in the United States, 1964-2048," Waste Management'03 Conference, February 25, 2003, Tucson, AZ

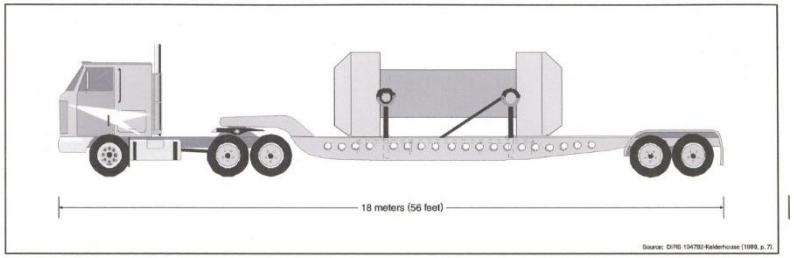


Figure J-3. Artist's conception of a truck cask on a legal-weight tractor-trailer truck.

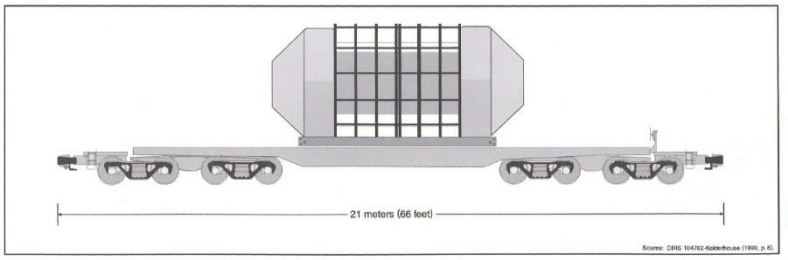


Figure J-4. Artist's conception of a large rail cask on a railcar.

Transportation Radiological Impacts

- **Routine exposures to members of the public residing near or traveling on transportation routes**
  Up to 0.016 rem to a person in a gridlock traffic jam [Pp.6-20, 6-21, 8-41]
- **Routine exposures to transportation workers**
  Escorts, truck drivers, & inspectors (by administrative controls, DOE would limit individual doses to 0.5 rem per year; the allowable occupational dose is 5 rem per year) [Pp.6-21, 8-41]
- **Release of radioactive material as a result of severe transportation accident involving long-duration fire**
  Probability about 5 in one million per year, involving a fully engulfing fire, 34 rem dose to the maximally exposed individual, 16,000 person-rem population dose and 9.4 latent cancer fatalities in an urban area, and cleanup-costs of $300,000 to $10 billion; [Pp.6-15, 6-24, G-56]
- **Release of radioactive material following a successful act of sabotage or terrorism**
  Attack using a high-energy density device, resulting in 27-43 rem dose to the maximally exposed individual, 32,000-47,000 person-rem population dose and 19-28 latent cancer fatalities in an urban area, and cleanup costs similar to a severe transportation accident. [Pp.6-27, CR-467]

Source: Halstead and Dilger, ANS IHLRWMC 2011, Albuquerque, NM, April 10-14, 2011, Pp. 410-411, Based on DOE 2008 FSEIS

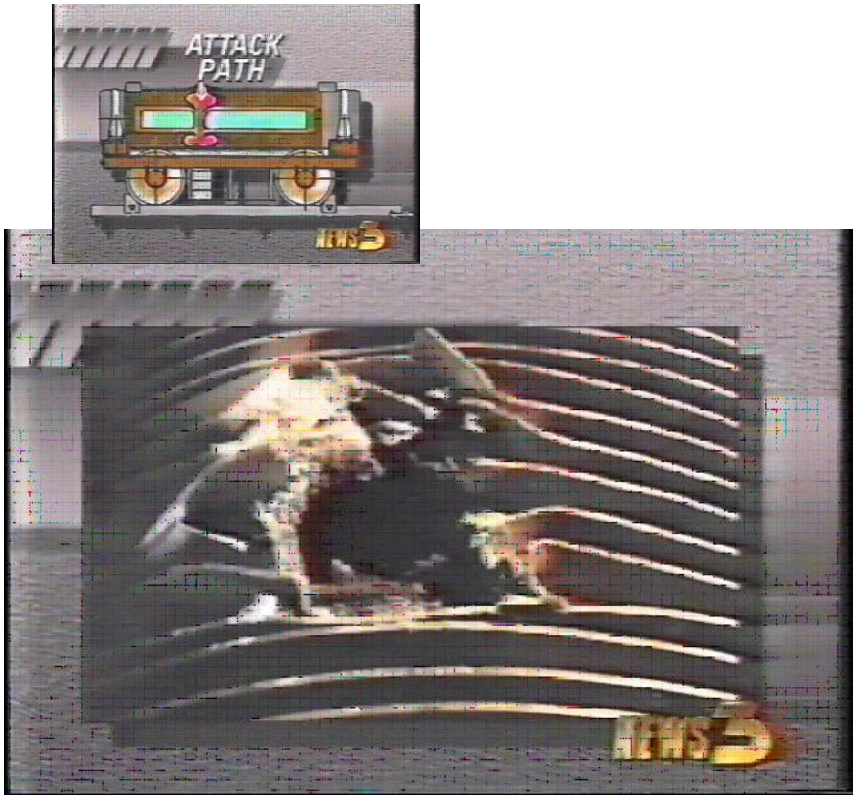
Shipping Cask Vulnerability in Severe Accident Fires – Ongoing Debate

MacArthur Maze - 2007

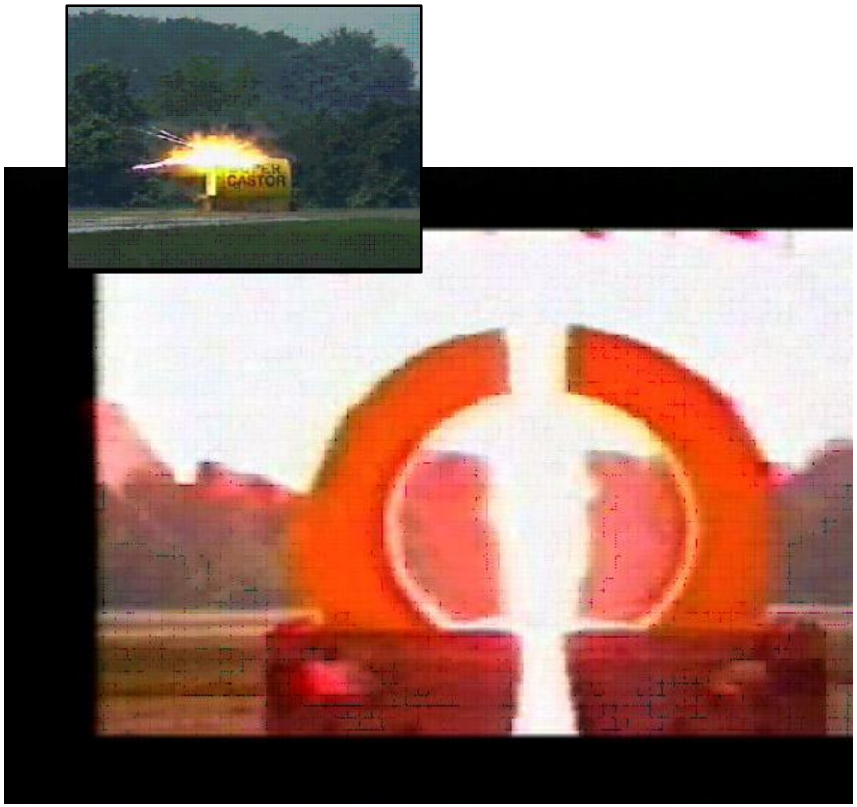
Baltimore Rail Tunnel - 2001

Shipping Casks Are Vulnerable to Terrorist Attacks

Truck Cask Test, 1982



Rail Cask Test, 1998

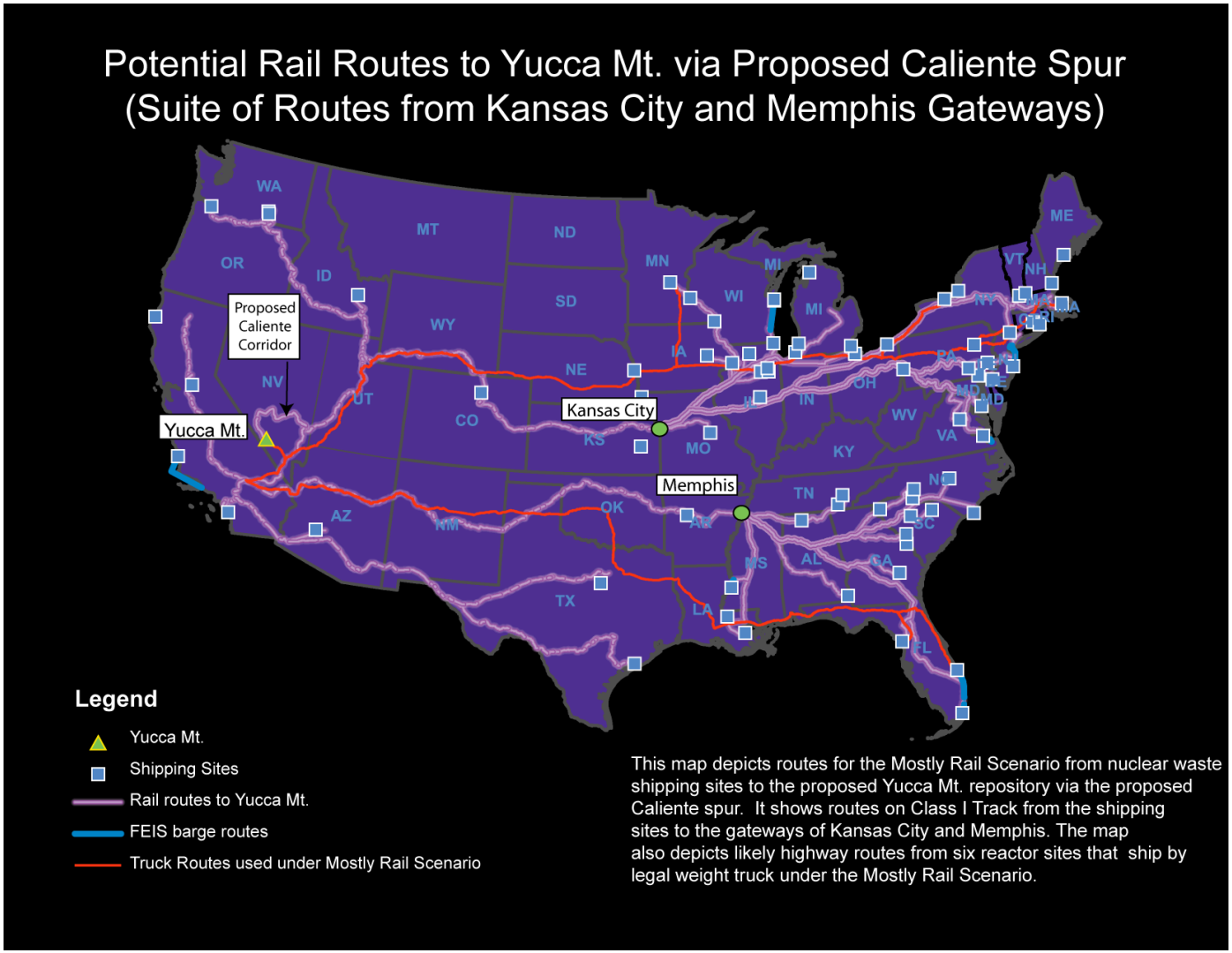


DOE 2008 Representative Transportation Routes to Yucca Mountain

The representative routes identified in the SEIS would traverse 955 counties with a 2010 Census population of 177 million persons, about 56% of the US total.

Alternative Rail Routing Using Caliente Corridor
Las Vegas Midrange Impact Scenario

35 - 50 Percent of Rail Shipments to Caliente Through Las Vegas
(Nevada Suite of Routes Analysis, 2007)

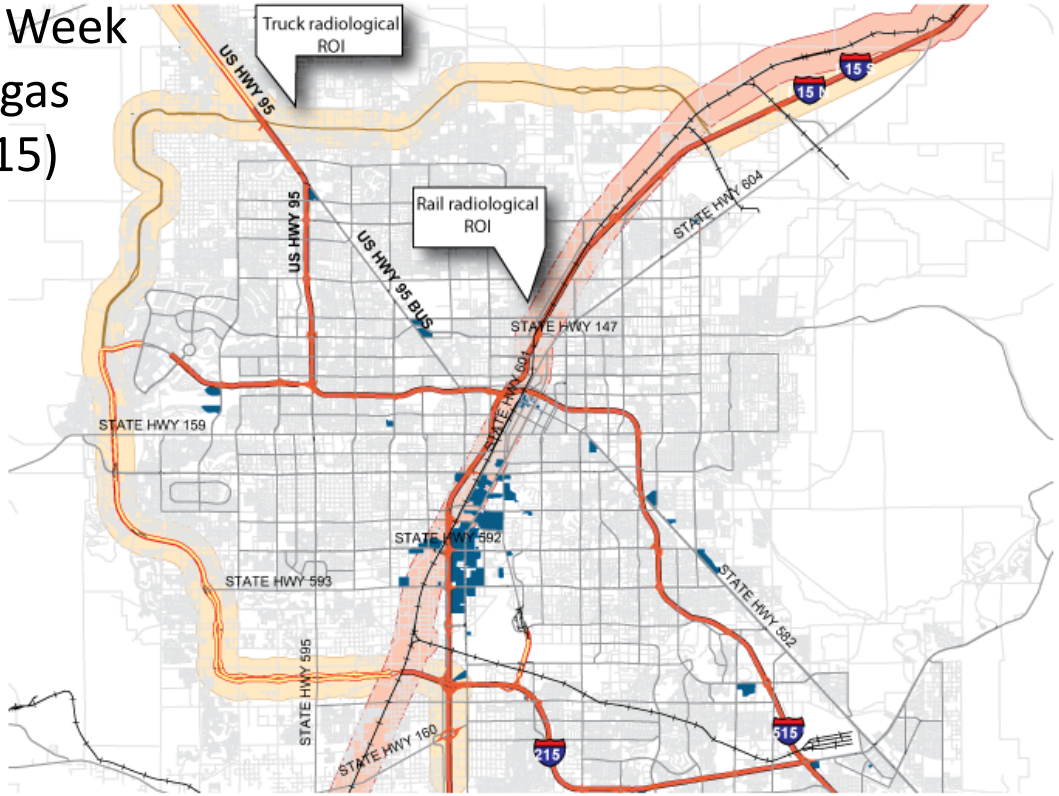


Black Mountain Research fcd5@cox.net

Estimated Las Vegas Impacts, DOE Mostly Rail Scenario, Caliente Rail Corridor, No Second Repository, For DOE Base Case & Nevada Alternative Routing Scenarios

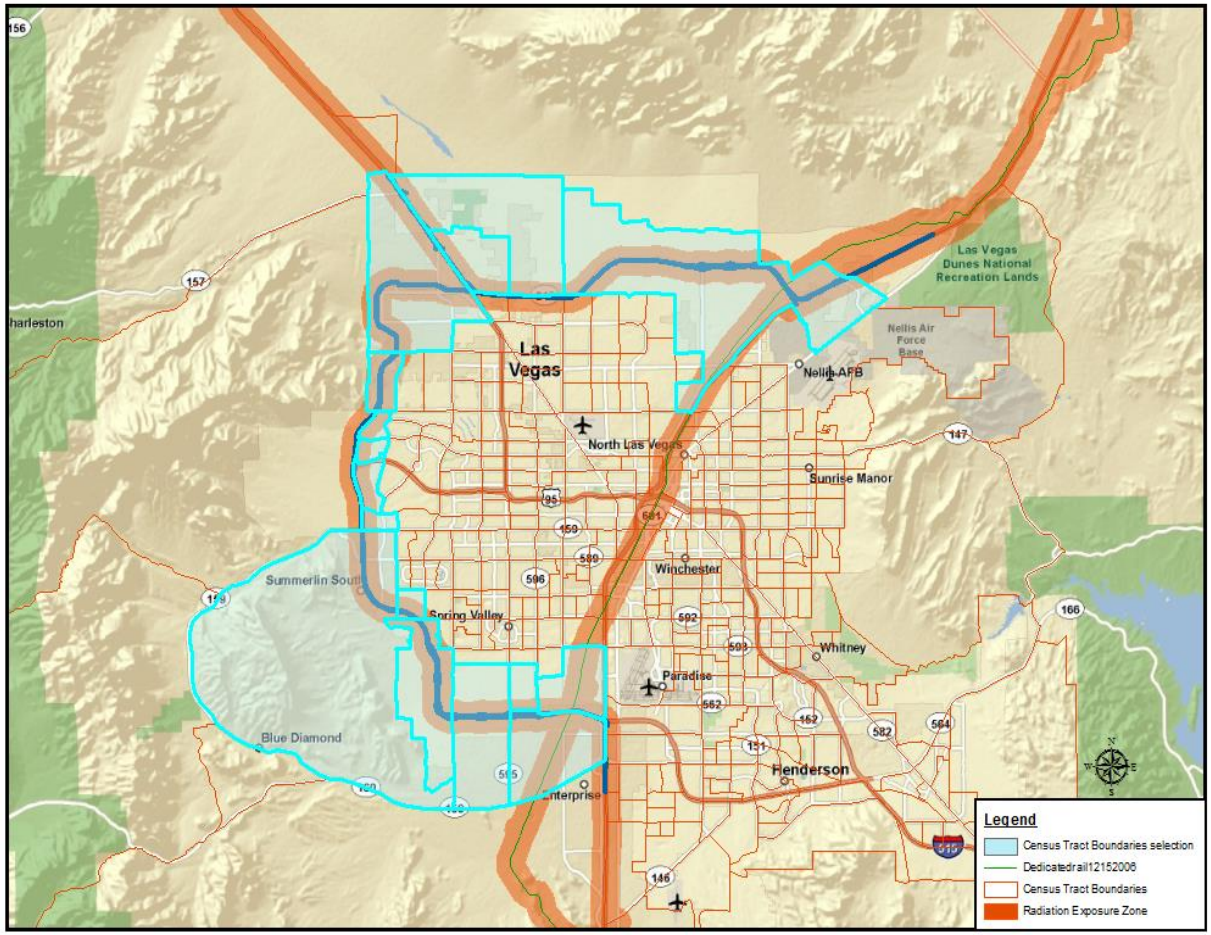
Minimum: 12 Trains per Year (8%)
Low Midrange: 48 Trains per Year (36%)
Maximum: 100 Trains per Year (75%)
Through Downtown for 50 Years

2 Trucks per Week
Using Las Vegas
Beltway (I-215)
To US 95
For 50 Years

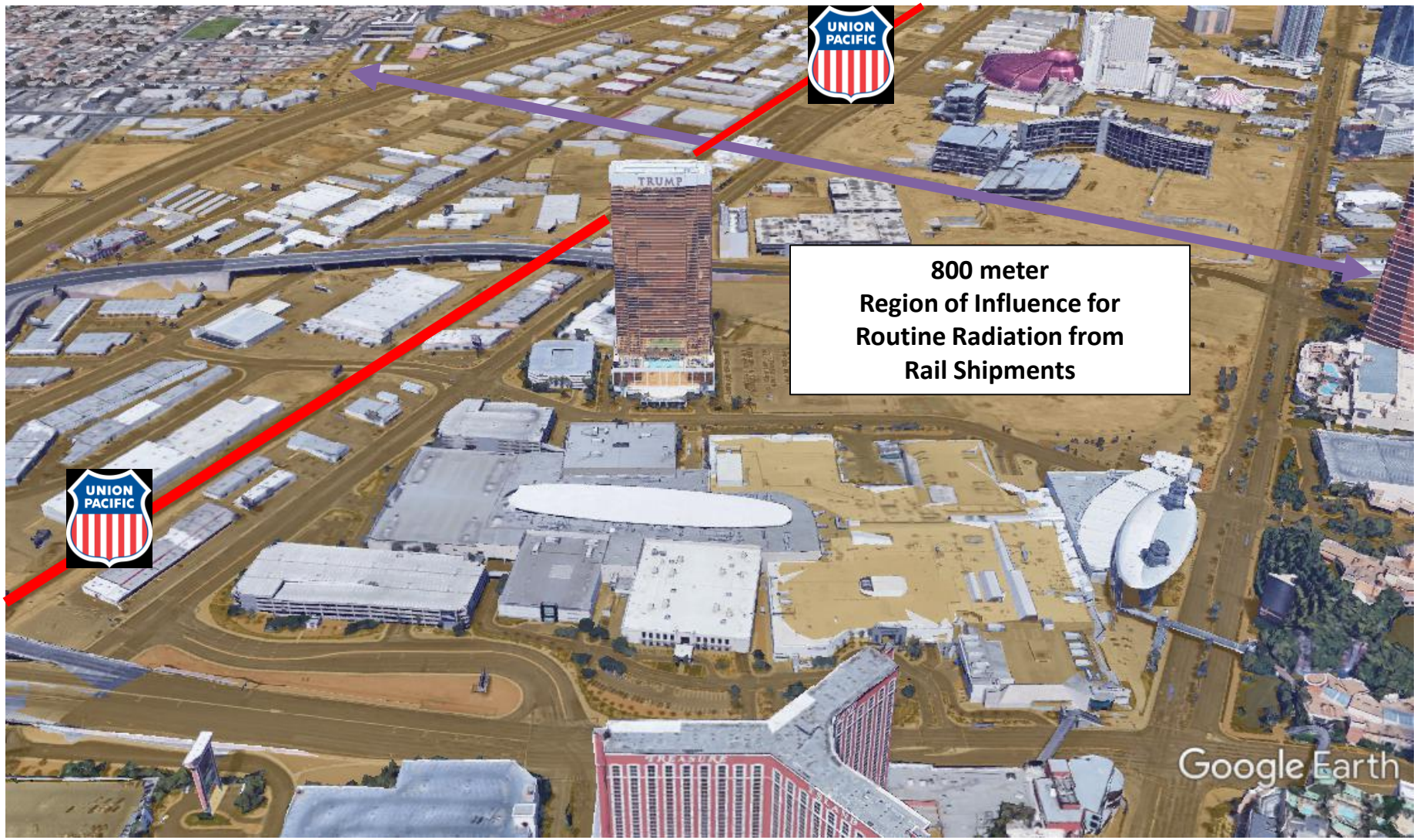


Las Vegas Rail & Truck Routes Region of Influence (ROI)

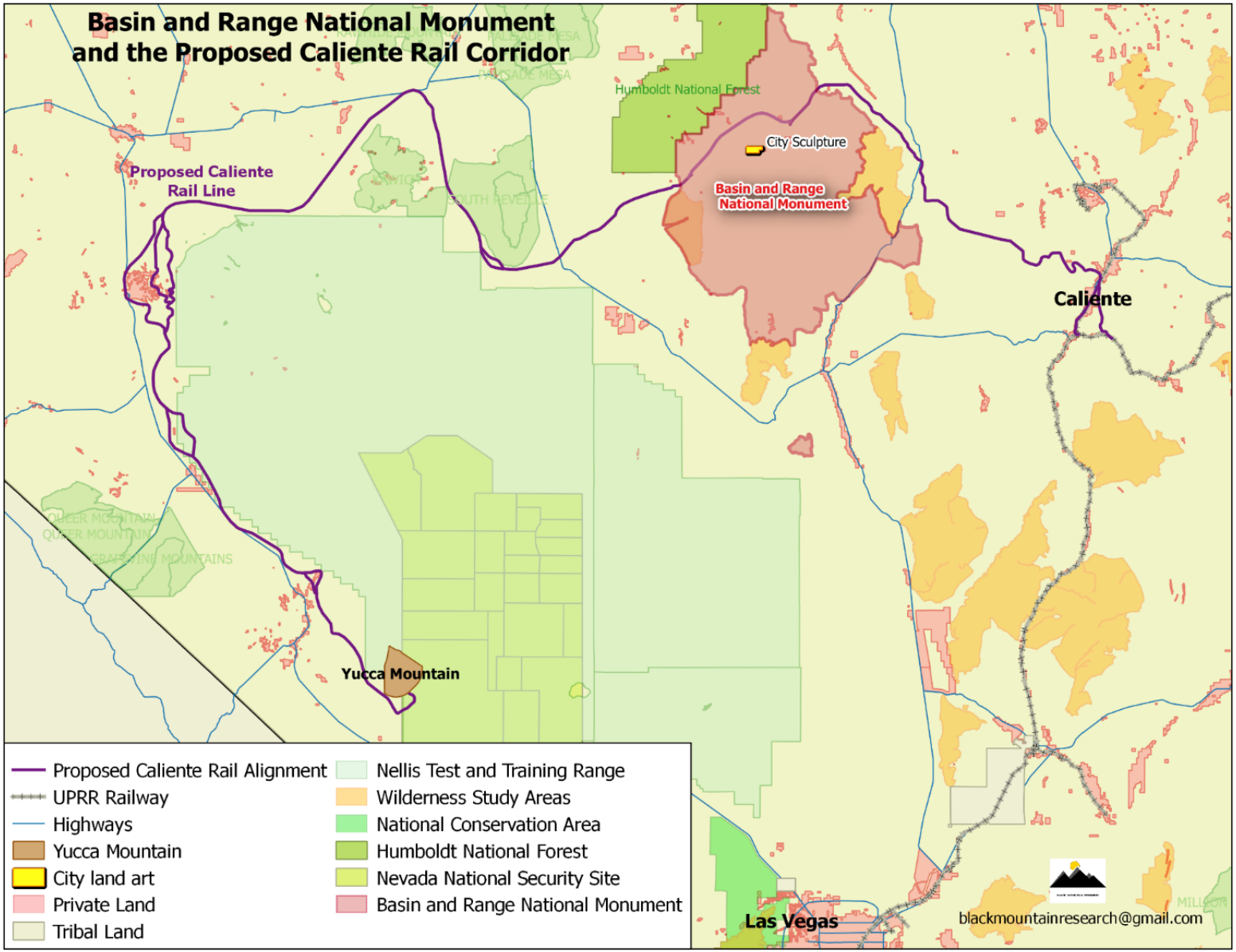
2010 US Census Analysis



In Clark County, 220,225 residents (about 11 percent of the total county population) live within the ROI for incident-free rail and truck transportation, within 0.5 miles of a rail or truck route to Yucca Mountain.


UNION PACIFIC
UNION PACIFIC
TRUMP
800 meter
Region of Influence for
Routine Radiation from
Rail Shipments
Google Earth

Contentions Challenge Caliente Rail Impacts



Caliente Corridor Impact Issues

Mountains = Cuts, Fills, Grades, Curves

Land Use Conflicts

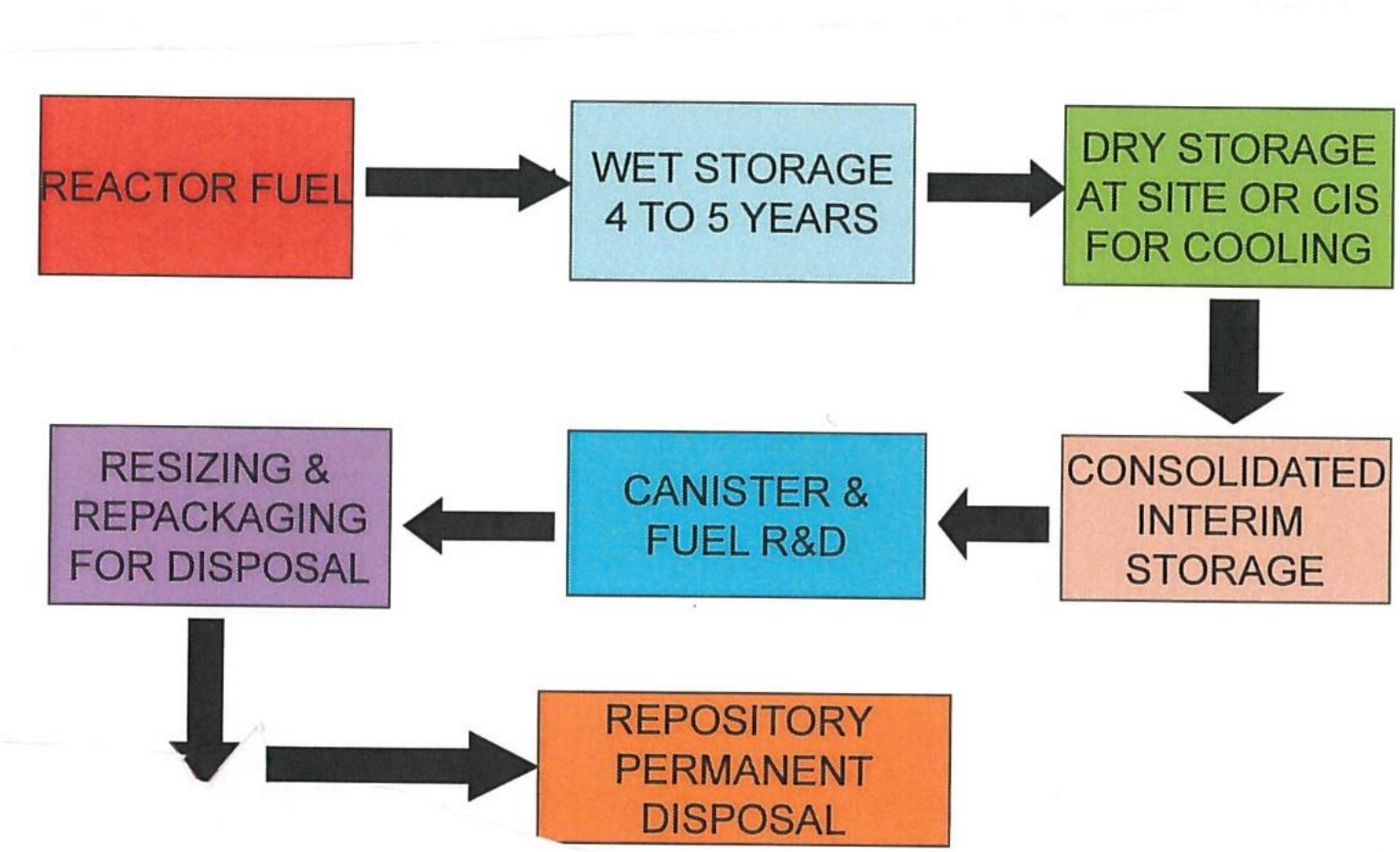
Bridges & Flood Hazards

Limited Economic Benefits

Selected References

- Report and Recommendations of the Nevada Commission on Nuclear Projects, January 2017 http://www.state.nv.us/nucwaste/news2017/pdf/nv2017comm_report_final.pdf
- DOE Budget Justification Fiscal Year 2018, Vol. 3, Pp. 658-680 (Yucca Mountain) https://www.energy.gov/sites/prod/files/2017/05/f34/FY2018BudgetVolume3_0.pdf
- GAO, Commercial Nuclear Waste: Resuming Licensing of the Yucca Mountain Repository would require Rebuilding Capacity at DOE and NRC, Among Other Key Steps, (GAO-17-340) April 2017 https://www.gao.gov/assets/690/684327.pdf
- Nuclear Waste Policy Amendments Act of 2017, H.R. 3053, Committee Report, October 2017 http://www.state.nv.us/nucwaste/news2018/pdf/CRPT-115hrpt355-pt1.pdf
- R. Halstead, Comments on Nuclear Waste Policy Amendments Act of 2017, H.R. 3053, January 2018 https://titus.house.gov/sites/titus.house.gov/files/wysiwyg_uploaded/NV%20NWPAA%20Final%20Comments.pdf
- R. Halstead, A. Mushkatel, K. Thomas, Remaking the US Nuclear Waste Program: A Window of Opportunity for Change? Waste Management Conference, March, 2015 http://www.state.nv.us/nucwaste/news2016/pdf/WM2015_RemakingWasteProgram.pdf
- M. Thorne, Is Yucca Mountain a long-term solution for disposing of US spent nuclear fuel and high-level radioactive waste? Journal of Radiological Protection, 2012 http://www.state.nv.us/nucwaste/news2018/pdf/Thorne_2012.pdf
- R. Halstead, F. Dilger, Repository Transportation Planning, Risk Management, and Public Acceptance: Lessons Learned, ANS IHLRWM Conference, April 2011 http://www.state.nv.us/nucwaste/news2011/pdf/ANS2011halstead.pdf
- NRC ASLB Memorandum and Order Identifying Participants and Admitted Contentions, May 2009 http://www.state.nv.us/nucwaste/licensing/nrc090511contentions.pdf
- State of Nevada's Petition to Intervene as a Full Party (Contentions Submitted to NRC Licensing Proceeding), December 2008 http://www.state.nv.us/nucwaste/licensing/Contentions_NV.pdf

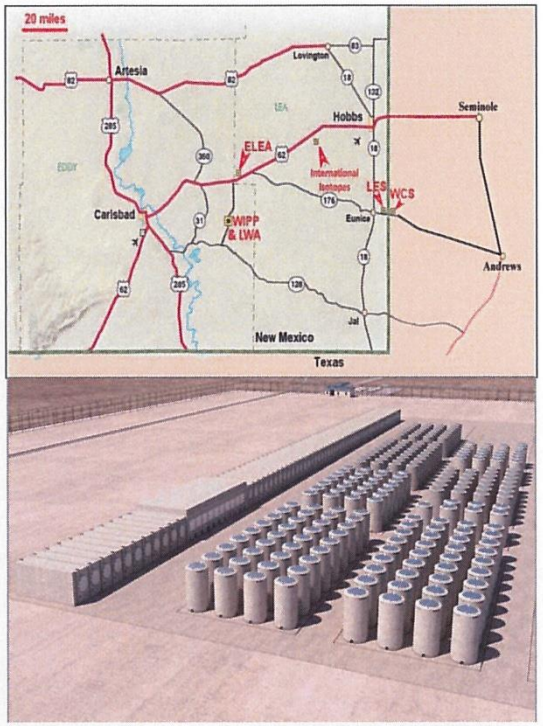
Consolidated Interim Storage



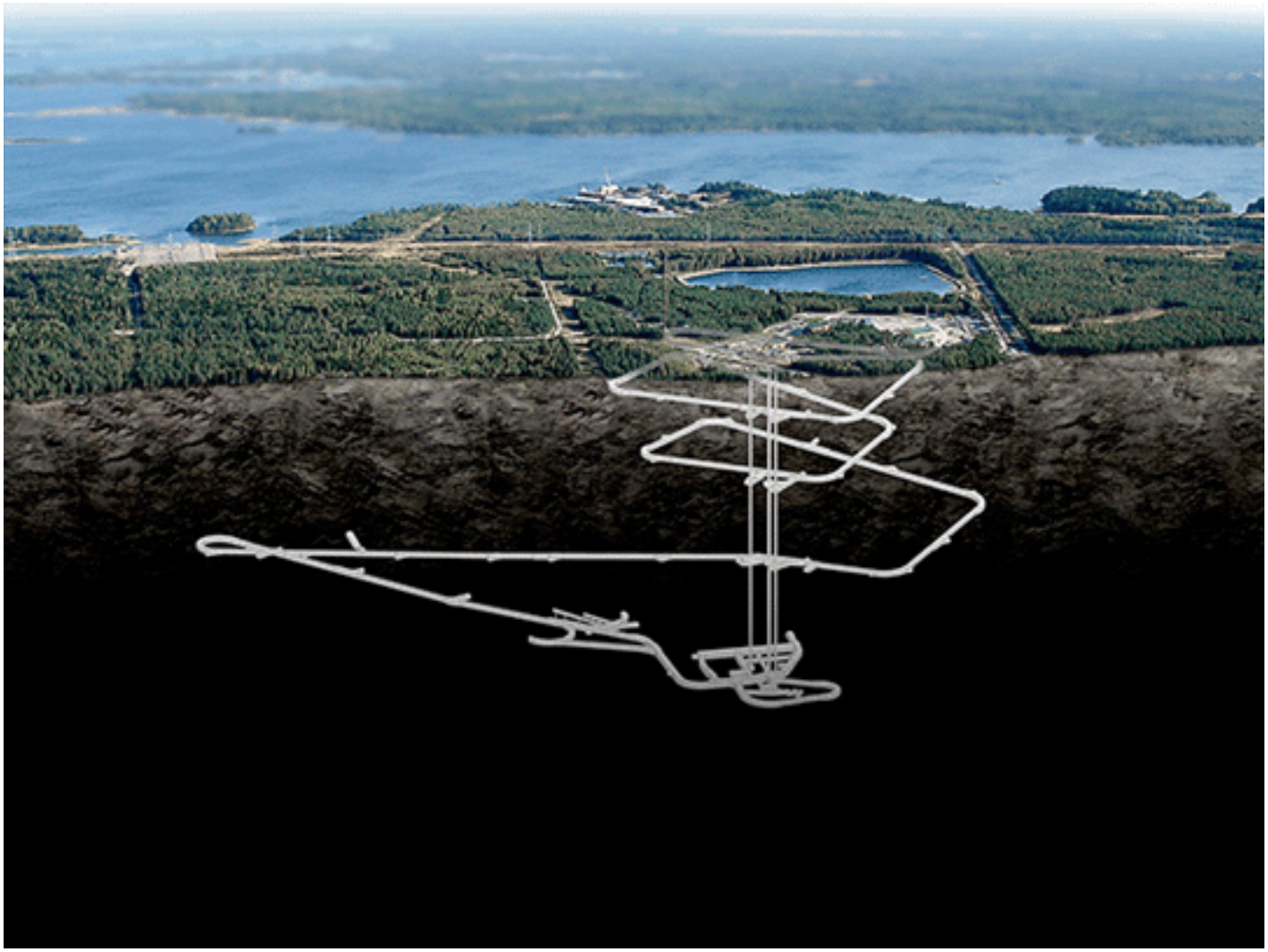
CIS Proposals in NM & TX

New CISF Proposed in Texas and New Mexico

- Both Holtec International and Waste Control Specialists LLC (WCS) have submitted license applications to construct and operate a CISF to the NRC.
- Both local communities strongly support the construction and operation of a CISF.
- Both locations have been extensively studied by federal agencies and located in arid and geologically stable lands.
- Each location is accessible by rail.

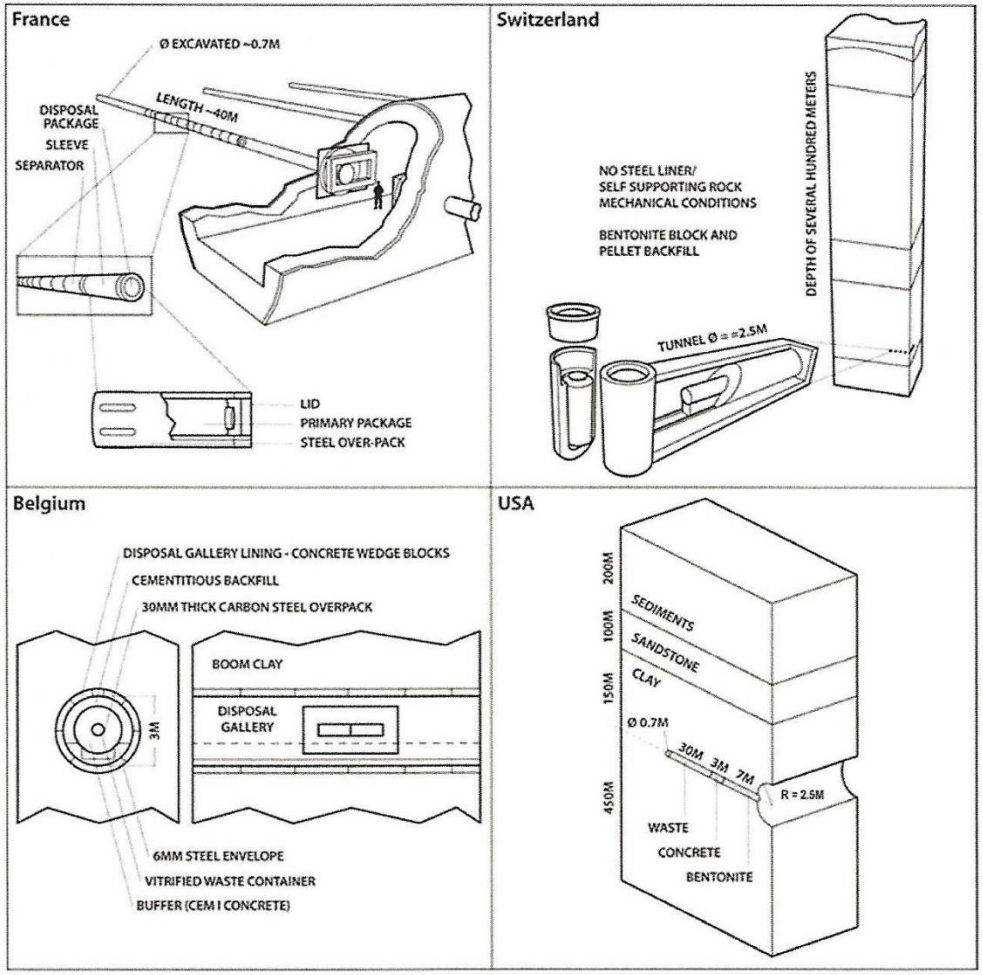


Finland Repository Under Construction in Crystalline Rock



Clay/Shale Repository Concepts

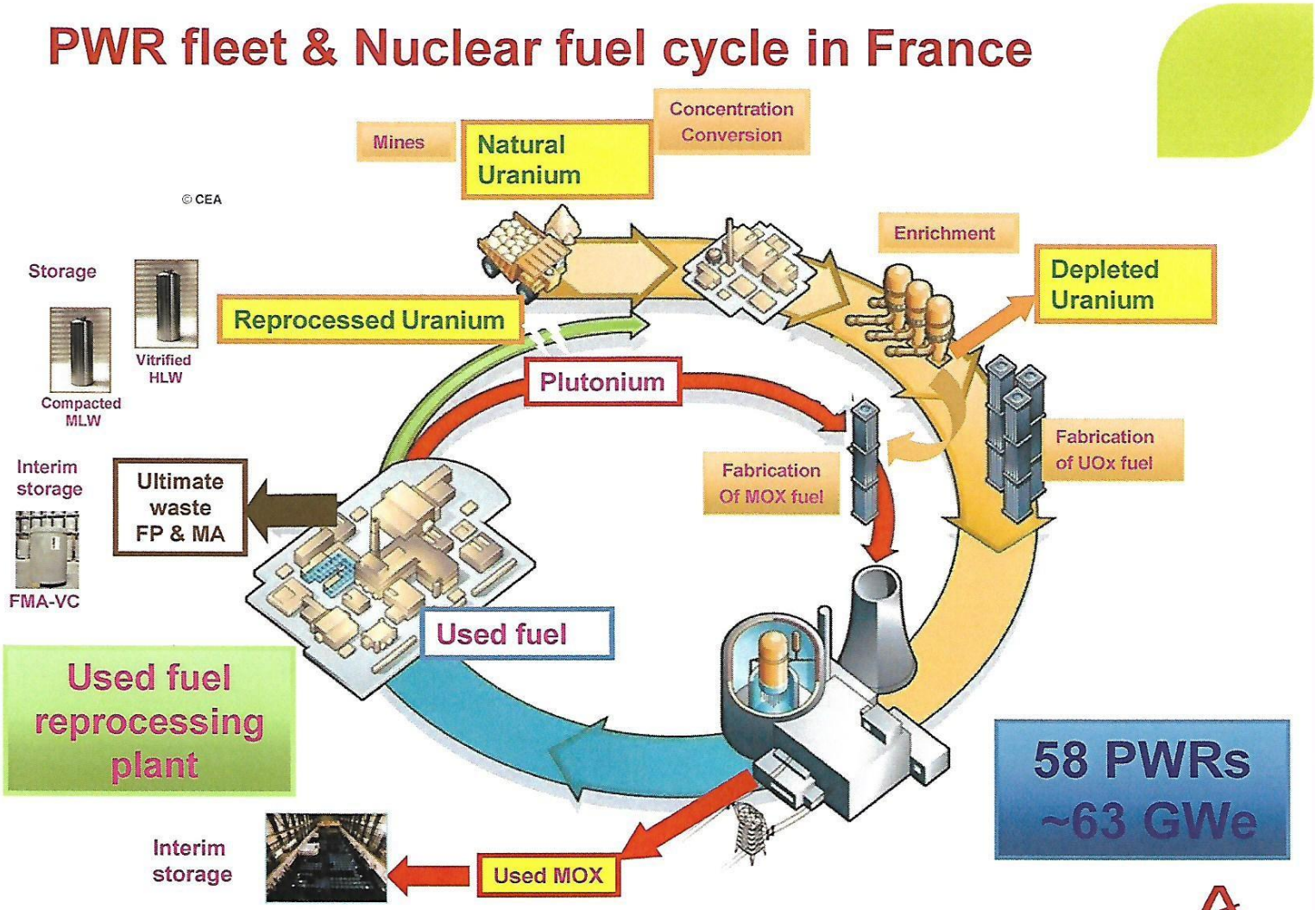
France, Belgium, Switzerland, U.S.



Sources: France: www.andra.fr; Switzerland: www.nagra.ch; Belgium: www.sckcen.be.

Figure 2.1-1 Schematic of Clay/Shale Disposal Concepts

French Reprocessing Fuel Cycle



AREVA

World Commercial Reprocessing Capacity 2016 (World Nuclear Association)

(tonnes per year)		
LWR fuel	France, La Hague	1700
	UK, Sellafield (THORP)	600
	Russia, Ozersk (Mayak)	400
	Japan (Rokkasho)	800*
	Total LWR (approx)	3500
Other nuclear fuels	UK, Sellafield (Magnox)	1500
	India (PHWR, 4 plants)	330
	Japan, Tokai MOX	40
	Total other (approx)	1870
Total civil capacity		5370

** now expected to start operation in 2018*

Reprocessing Pro & Con

- Fuel recovery and reuse in reactors
- Isotopes for non-fuel uses
- Reduced volume, hazard, and cost of radioactive waste requiring geologic disposal
- National security technology considerations
- Capital cost for facilities and product cost compared to other sources of uranium
- Process hazards and environmental impacts
- Increased volume of total radioactive waste
- Proliferation of weapons and weapons technology

Yucca Mountain Site Unsuitable for Reprocessing

- No Rail Access – Reprocessing facility would require about 2,900 truck shipments per year, using routes through Las Vegas metro area; trucks would likely be required for shipping out recovered uranium/plutonium and/or new MOX fuel
- Inadequate Water Resources – Reprocessing facility would require thousands of acre/feet per year; water resources would also constrain collocation of new fuel fabrication facilities
- Seismic Hazards to Surface Facilities – Major concern for NRC licensing and operation: 2008 USGS maps show moderate to high ground acceleration area; 10 miles from Little Skull Mountain (5.6 magnitude) earthquake epicenter; 10 – 30 miles from 3 active faults with potential earthquake magnitude of 6.5-7.9
- Lack of previous reprocessing experience - U.S. sites with past reprocessing experience would almost certainly compete for new facilities and be selected over Yucca Mountain