

Radiation Risk & Cleanup Standards

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EPA and 0.15 mSv (15 mrem/y)

- EPA has historically supported 0.15 mSv/y (15 mrem/y) as a cleanup standard that is “fully protective of human health and the environment”
 - 40CFR196, “EPA Radiation Site Cleanup Regulation” Draft. May 1994. Subsequently withdrawn
 - EPA Memorandum, OSWER 9200.4-18. “Establishment of Cleanup Levels for CERCLA Sites with Radioactive Contamination.” August, 1997

EPA OSWER 9200.4-18

“Establishment of Cleanup Levels for CERCLA Sites with Radioactive Contamination.” August 22, 1997

- "If a dose assessment is conducted at the site, then 15 millirem per year (mrem/yr) effective dose equivalent (EDE) should generally be the maximum dose limit for humans. This level equates to approximately 3×10^{-4} increased lifetime risk and is consistent with levels generally considered protective in other governmental actions, particularly regulations and guidance developed by EPA in other radiation control programs."

EPA OSWER 9200.4-18 (Cont.)

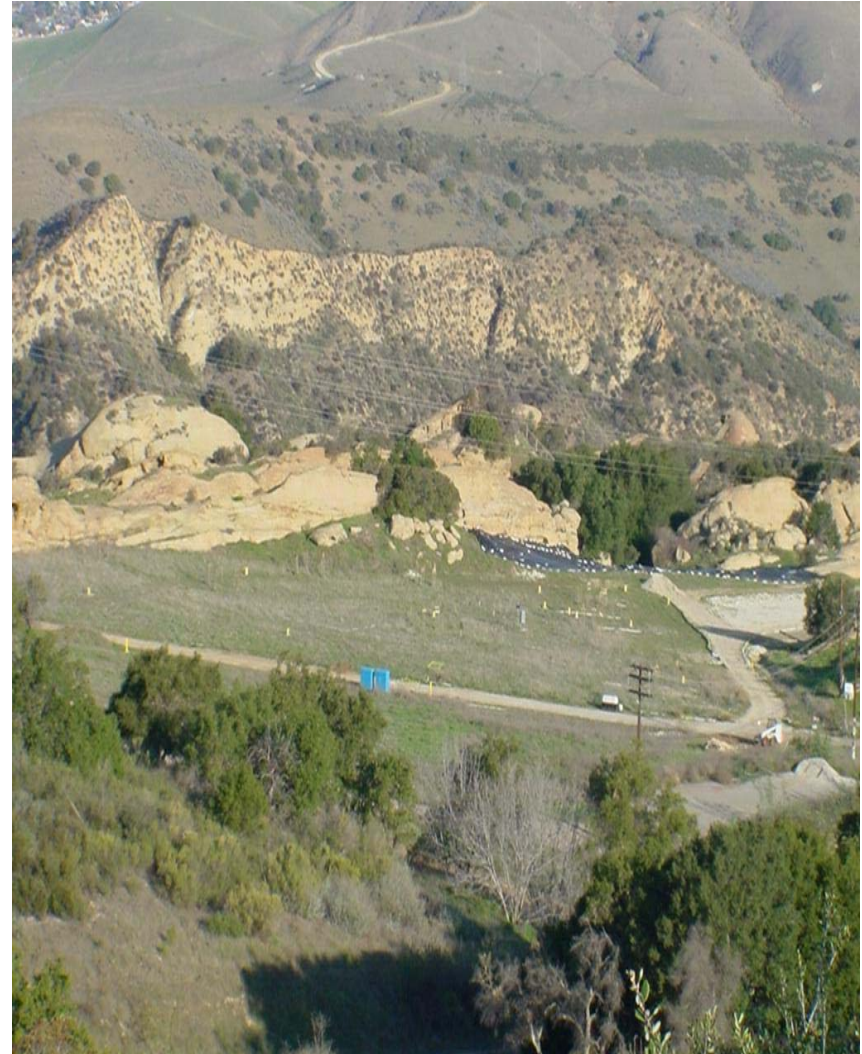
- "Protectiveness for carcinogens under CERCLA is generally determined with reference to a cancer risk range of 10^{-4} to 10^{-6} deemed acceptable by EPA. Consistent with this range, EPA has considered cancer risk from radiation in a number of different contexts, and has consistently concluded that levels of 15 mrem/yr (which equate to approximately 3×10^{-4} cancer risk or less) are protective and achievable."

EPA-NRC Memorandum of Understanding

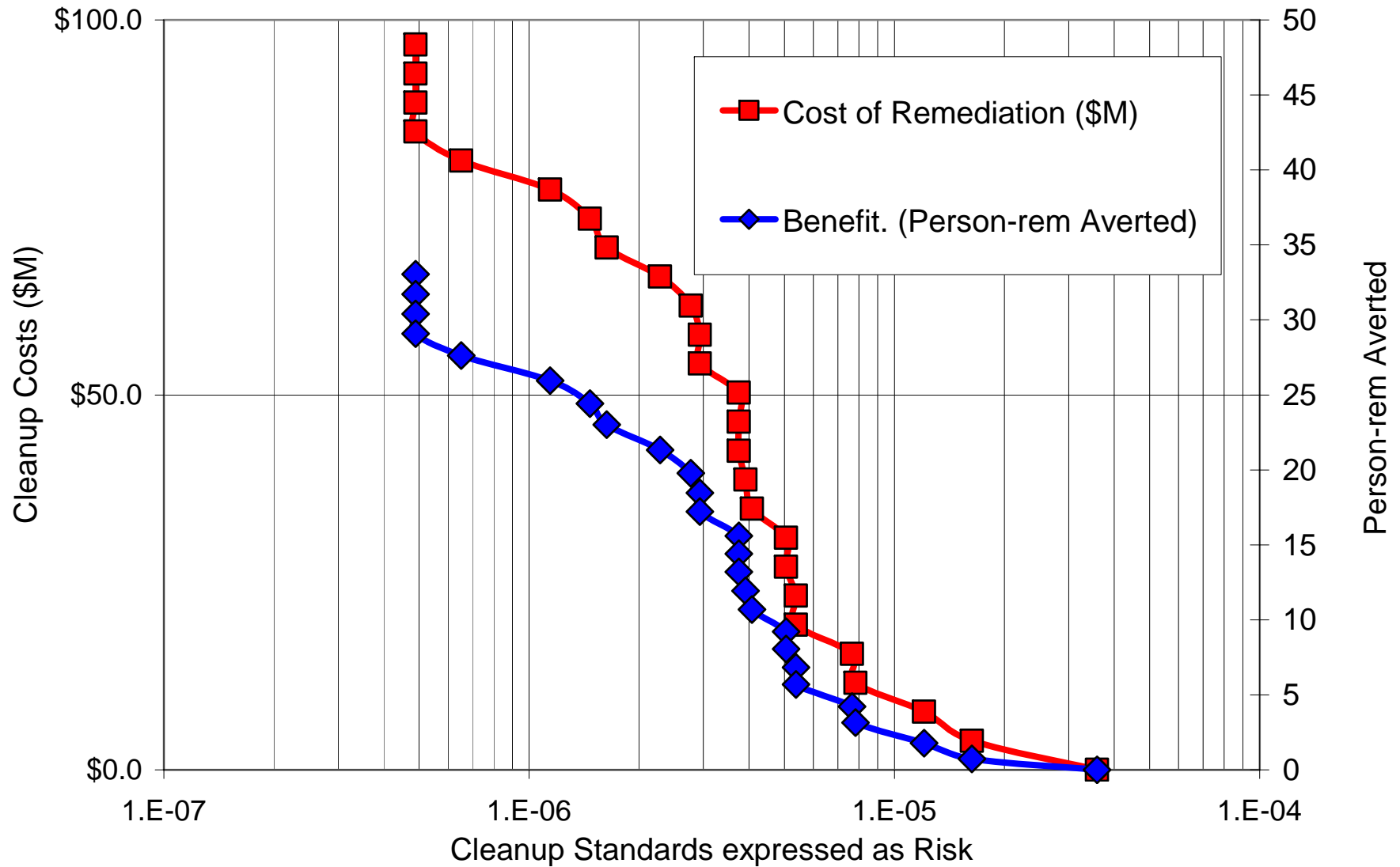
- NRC and EPA have signed a MOU setting guidelines for limiting, though not eliminating, EPA's CERCLA authority over the decommissioning of current or former NRC-licensed facilities (some facilities in Area IV were NRC licensed)
- EPA will not exert its CERCLA authority over NRC-licensed facilities if
 - Groundwater meets drinking water MCLs
 - Soil meets specified EPA 10^{-4} risk level for a reasonably anticipated land use (residential not agricultural)
 - Facility is not released for restricted use

Soil Excavation from Former Sodium Disposal Facility (FSDF) at SSFL

- Collective dose averted = 0.12 person-Sv (12 person-rem)
- Total actual cost of FSDF remediation to save 0.014 theoretical statistical radiation induced cancer = \$10,000,000
- Equivalent cost of FSDF remediation to save one theoretical statistical radiation induced cancer incidence = \$700,000,000
- EEOICPA payout for one DOE radiation induced cancer = \$150,000



Site Cleanup Costs of Person-rem Averted



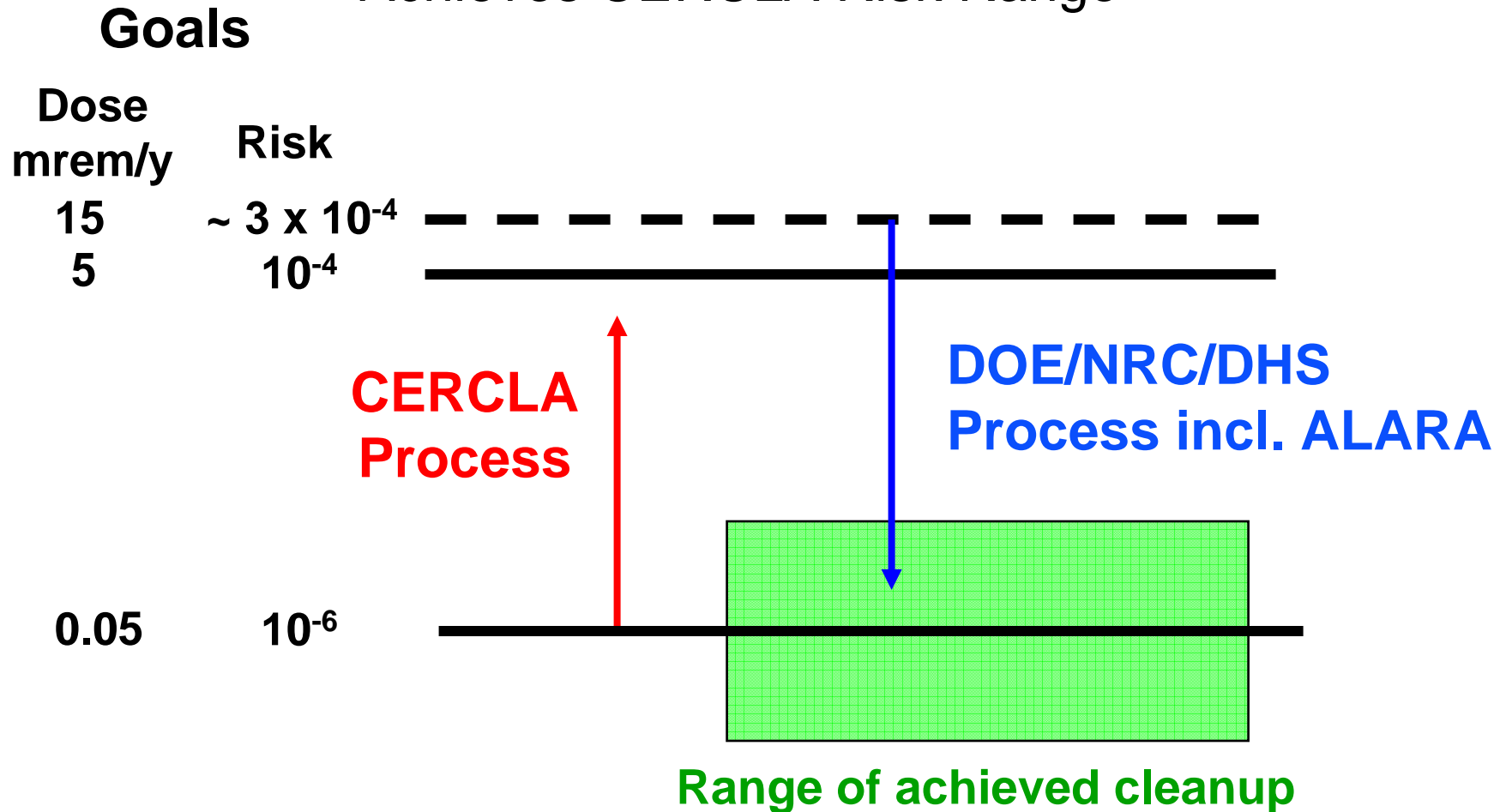
Fallacy of the Geometric Scale of Safety

Contributions to Cancer Risk	Radiation Exposure (mSv/year)	Theoretical individual cancer incidence risk*	Incremental population cancer risk (cancer incidence)	Total population cancer risk (cancer incidence)
U.S. average cancer incidence	N/A	0.42	336	336
U.S. average natural background exposure (75 y)	3	0.026	21	336
Average background exposure from soil (75 y)	0.3	0.0026	2	336
NRC license termination dose (30 y)	0.25	0.0009	0.7	336.7
DOE/SSFL cleanup standard (30 y)	0.15	0.0005	0.4	336.4
Upper EPA CERCLA risk range (1 in 10,000)	-	0.0001	0.08	336.08
Geometrical mean of CERCLA risk range (1 in 100,000)	-	0.00001	0.008	336.008
Lower EPA CERCLA risk range (1 in 1,000,000)	-	0.000001	0.0008	336.0008
Zero risk level	0	0	0	336

* Using the BEIR VII cancer incidence risk of $1.14E-04$ per mSv

Two Cleanup Processes with the Same Goal

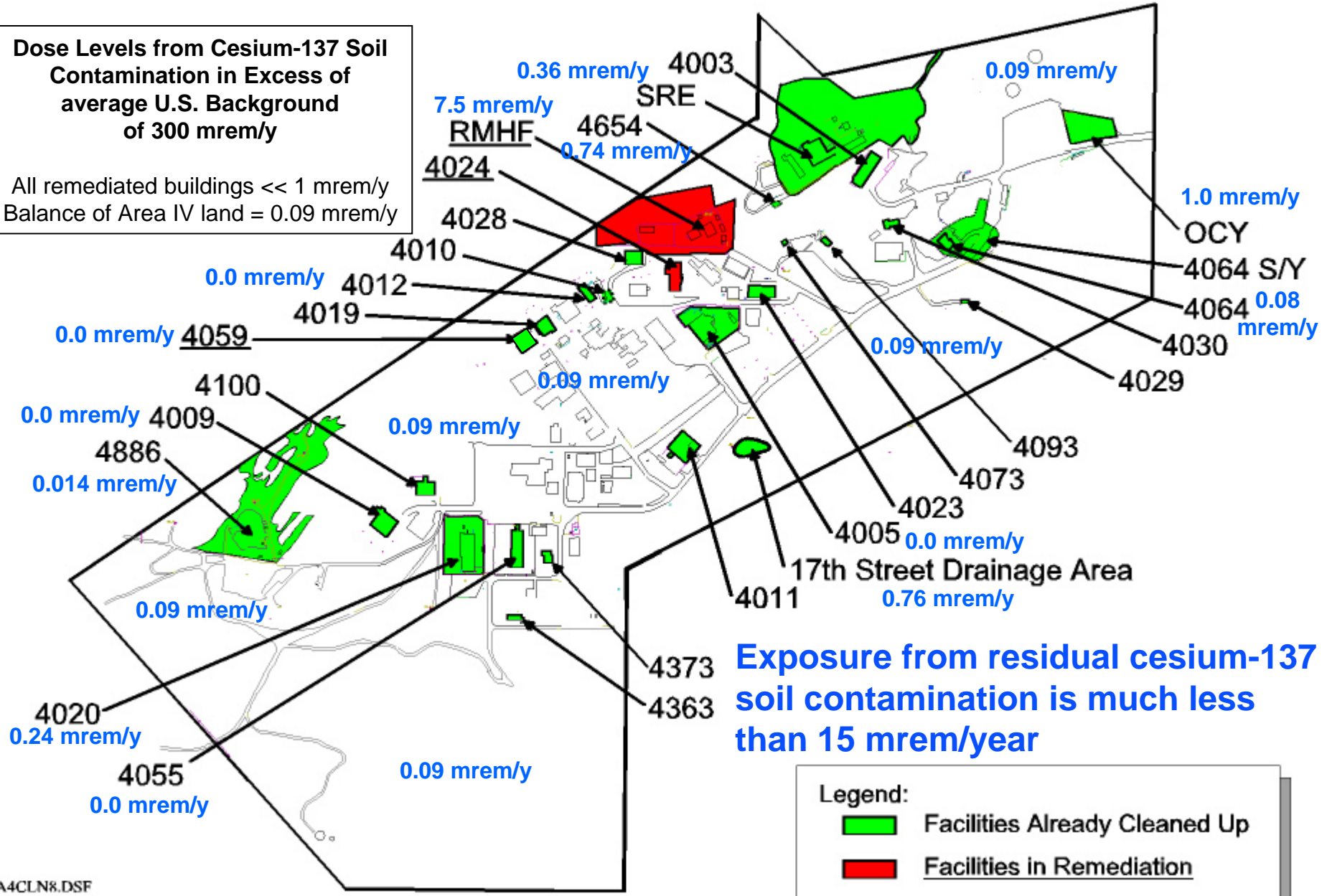
DOE Radiological Cleanup Process
Achieves CERCLA Risk Range



Radiation Exposure Map of Area IV of SSFL

Dose Levels from Cesium-137 Soil Contamination in Excess of average U.S. Background of 300 mrem/y

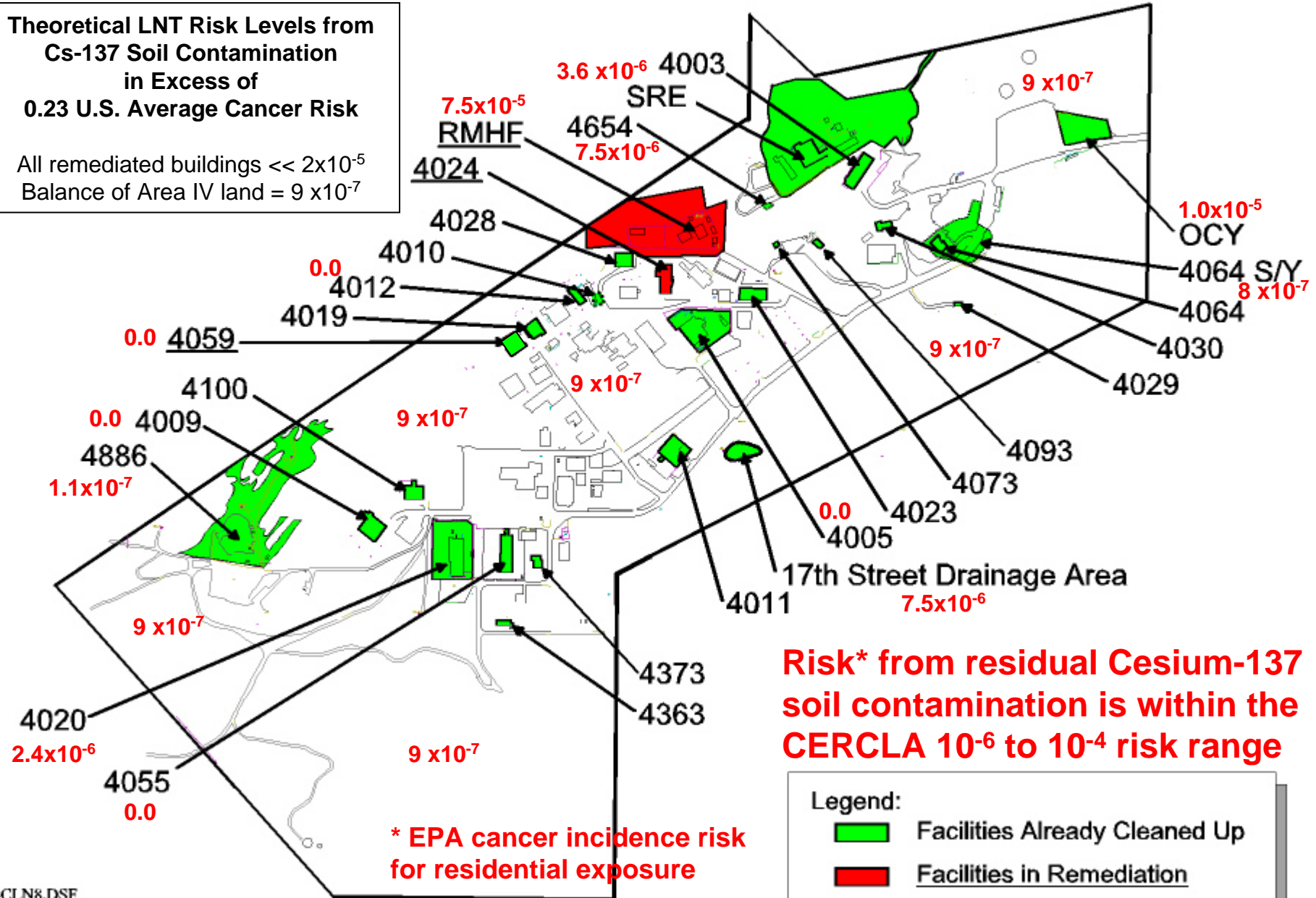
All remediated buildings << 1 mrem/y
Balance of Area IV land = 0.09 mrem/y



Theoretical Risk* Map of Area IV of SSFL

Theoretical LNT Risk Levels from Cs-137 Soil Contamination in Excess of 0.23 U.S. Average Cancer Risk

All remediated buildings $\ll 2 \times 10^{-5}$
 Balance of Area IV land = 9×10^{-7}



* EPA cancer incidence risk for residential exposure

Legend:

- █ Facilities Already Cleaned Up
- █ Facilities in Remediation

Conclusion

- Radiation cleanup standards of 15 mrem/y for SSFL have been approved by the DOE and the California DHS
- The approved cleanup standards, in use at Rocketdyne, are based on, and consistent with, standards in use in the rest of the US, including those used by DOE, NRC and EPA
- Post remedial sampling confirms that the CERCLA risk range of 10^{-6} to 10^{-4} is achieved because of the ALARA process