Alpha Emitters:
Policy and Quantity for Projection

Stephen V. Musolino, PhD, CHP

Complicated History
(a conundrum)

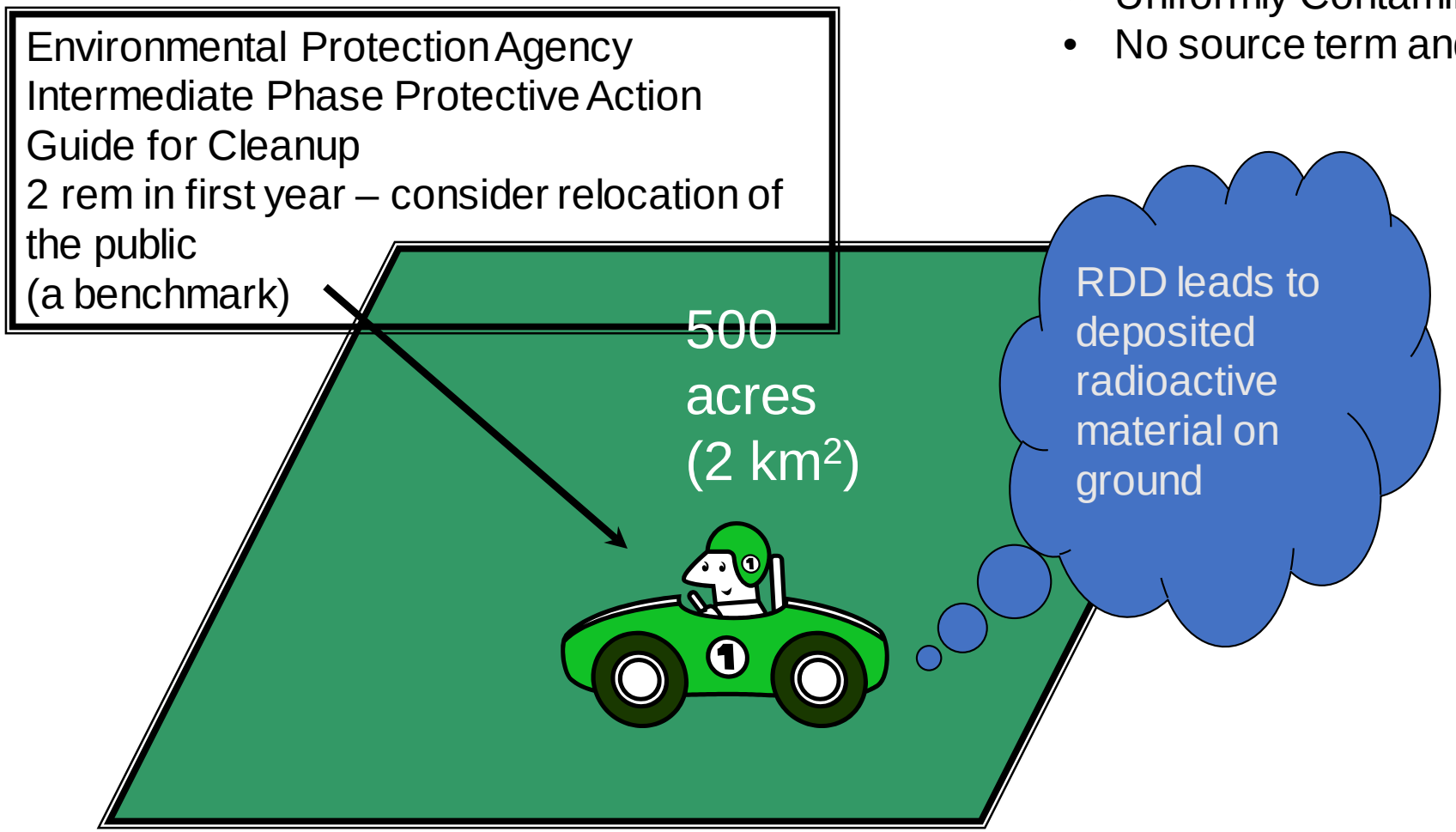
NNSA Threshold Quantity
Circa 2003

Threat Basis for Recommendation of Security Upgrades

- Intended for use as a decision basis when a team in the field encountered radioactive material in a foreign country.
  - Not a prioritized list
- Materials at or above a TQ required action ($$$) to assure security
- Applied in over 40 foreign countries

Materials and Quantities that Represent a Threat to US National Security Interests

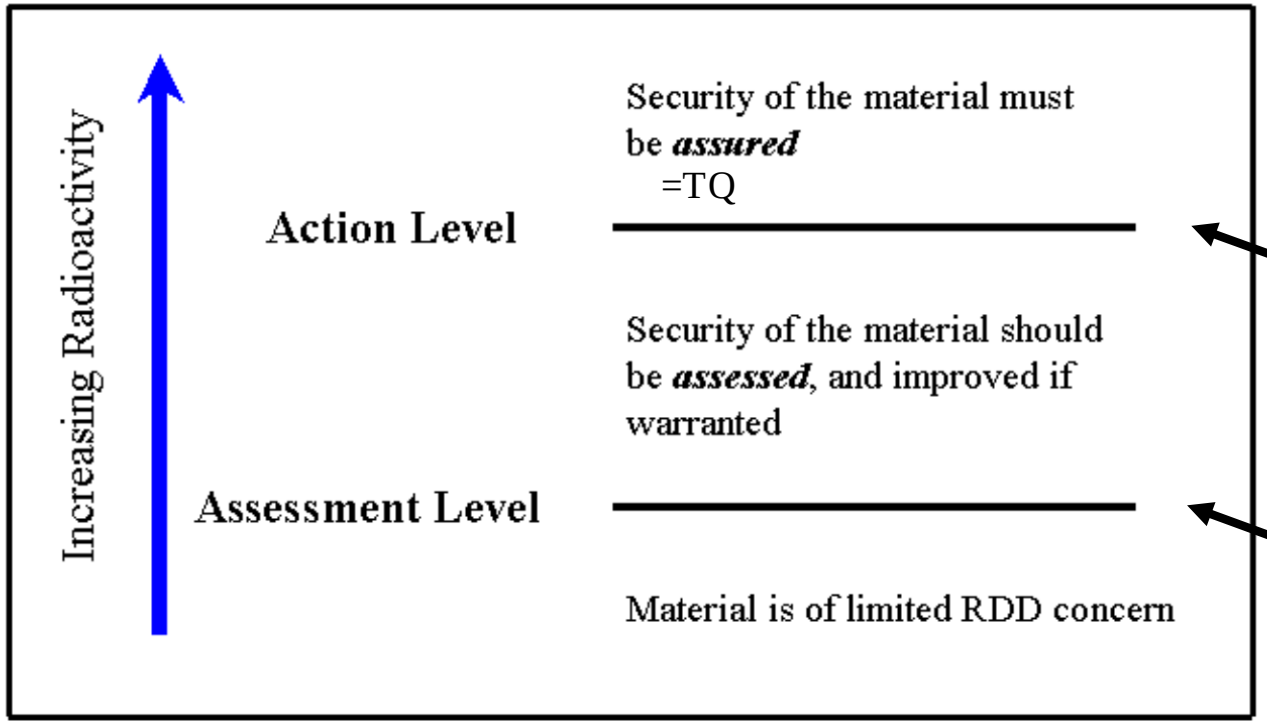
- Uniformly Contaminated
- No source term and transport



Threshold Quantity and Actual Values

Material	TQ (Ci)	Calculated (Ci)
^{241}Am	10	1.9
^{252}Cf	10	8.6
^{238}Pu	10	14
^{192}Ir	1000	220
^{60}Co	1000	76
^{137}Cs	1000	120
^{90}Sr	1000	570
^{226}Ra	100*	110

Action and Assessment Levels



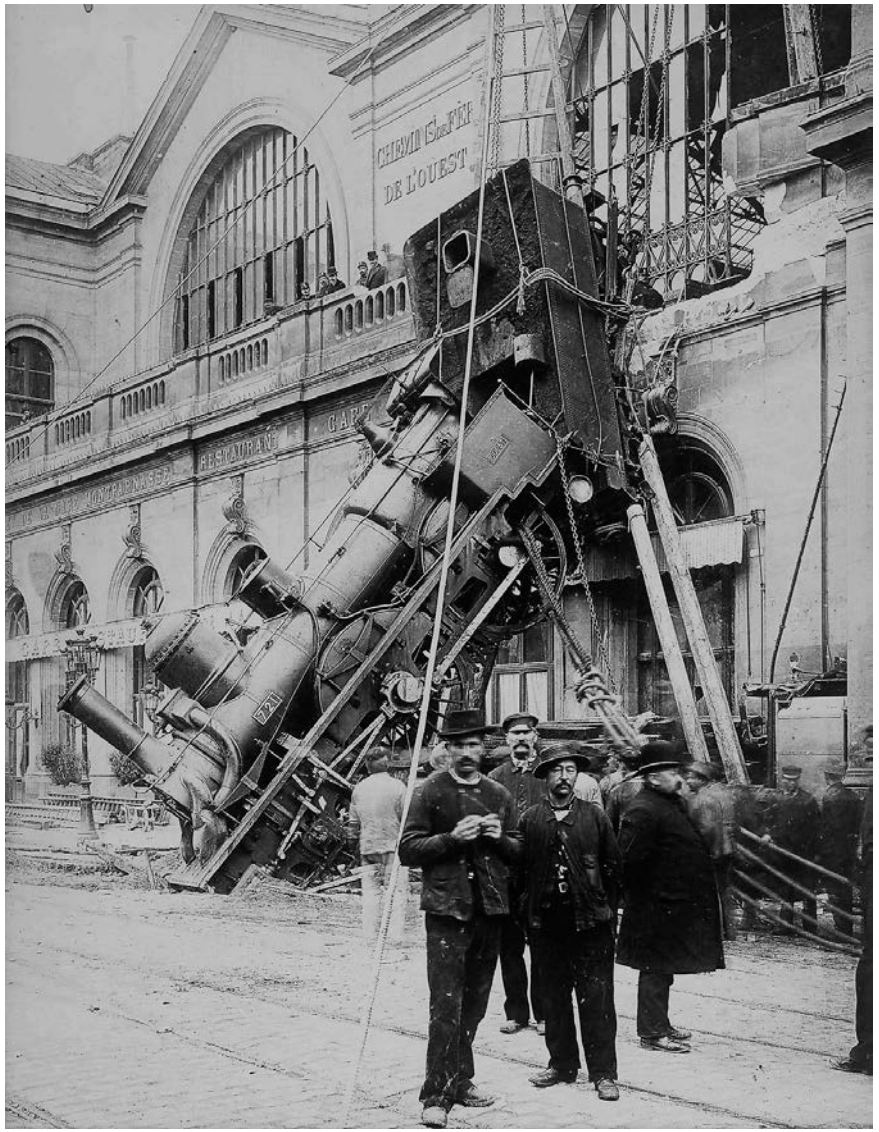
Action Level Based on the FRMAC Model and was compared to the IAEA Model for Transport Security

Assessment Level 1/10 of Action Level

$^{241}Am \rightarrow 1$ Ci

NRC Increased Controls
Circa 2005

But there was a problem…



“Conflict” with Increased Controls

Material	Threshold Quantity (Ci)	TQ (Ci)	IAEA Category
^{241}Am	1.9	10	3
^{252}Cf	8.6	10	2
^{238}Pu	14	10	3
^{192}Ir	220	1000	2
^{60}Co	76	1000	2
^{137}Cs	120	1000	2
^{90}Sr	570	1000	2
^{226}Ra	110	100	2

Threshold Quantity and Actual Values - Conundrum

Material	TQ	IAEA CoC	IAEA Cat
	(Ci)	(Ci)	
^{241}Am	1.9 [10]	16	3
^{241}Am circa 2020 (NCRP 1999)	1.1 [?]	?	?

- This is lower than the regulatory limit, but not from a source term, transport, and deposition
- TQ not intended to use in a regulatory manner

National Council on Radiological Protection and Measurements. Recommended screening limits for contaminated surface soil and review of factors relevant to site-specific studies. NCRP Report 129, National Council on Radiological Protection and Measurements, 1999.

Why the difference?

- CoC Based on TECDOC-1344
  - D-Values developed for transportation security
  - Has consideration for dispersal

- Not reproducible from first principles
  - Assumptions not published

Why the difference?

Topic	IAEA CoC	NNSA TQ
Purpose	To identify sealed radioactive sources that warrant regulation…"minimize the likelihood of accidents" (safety) and "prevent unauthorized access…loss, theft or unauthorized transfer" (security).	To provide guidance on security upgrades at foreign facilities by identifying radioactive material (sealed and unsealed) that could be used in an RDD...
Exposure scenarios	Dispersion due to accidents and "hand/pocket/room" exposures and other close distance scenarios;	Airborne dispersion over an area of 500 acres
Dose basis	Deterministic (acute) effects high doses and close exposure	Dislocation/relocation, area denial - 2 rem in a year low dose and exposure to highly dispersed material (low concentration)

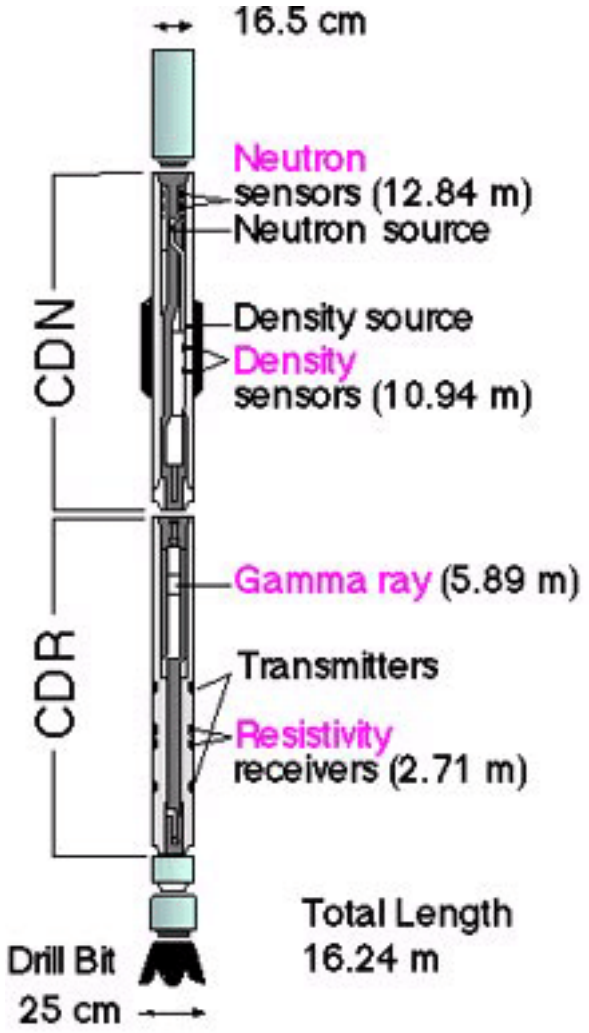
Compromise

- GTRI changed the TQ to 20 Ci
- Did not affect the program
- Decision would still be at the optional Assessment Level – 2 Ci

Neutron Howitzer

5 Ci

Well Logger



10 Ci

^{241}Am not regulated

NNSA Protection Criteria & Sustainability Circa 2010

“Power to Contaminate” Criterion

- Assumed 1 km^2 affected
- 14 materials + spent fuel
- Considered alpha emitters > 0.1 Ci
- Based on source term and dispersal, 78 Ci for ^{241}Am
- Then, NNSA chose 10 Ci for all radioactive materials

1 km²

Epilogue

- Almost 20 years since 911 when radiological terrorism became a priority
- No attack anywhere in the world
- ISIS controlled the city of Mosel
  - Access to high activity radioactive material
  - Did nothing
  - Did not offer it to other groups
- Are we mirror-imaging the problem?
- Is there really a problem?
- Did Increased Controls solve the problem?