SC&A Comments on:

Energy*Solutions* September 13th Presentation to the Waste Management and Radiation Control Board

Prepared for: UTAH DEPARTMENT of ENVIRONMENTAL QUALITY

Natural and Depleted Uranium (ES Slide 3)

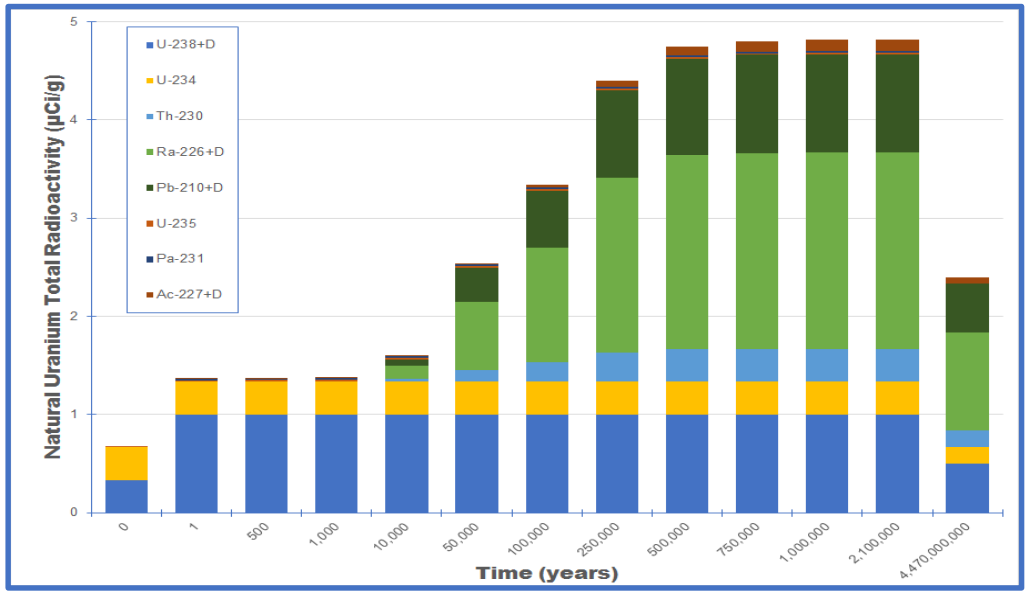
- The specific activity of depleted uranium is 58% of the specific activity of natural uranium (Reference: International Energy Atomic Agency)

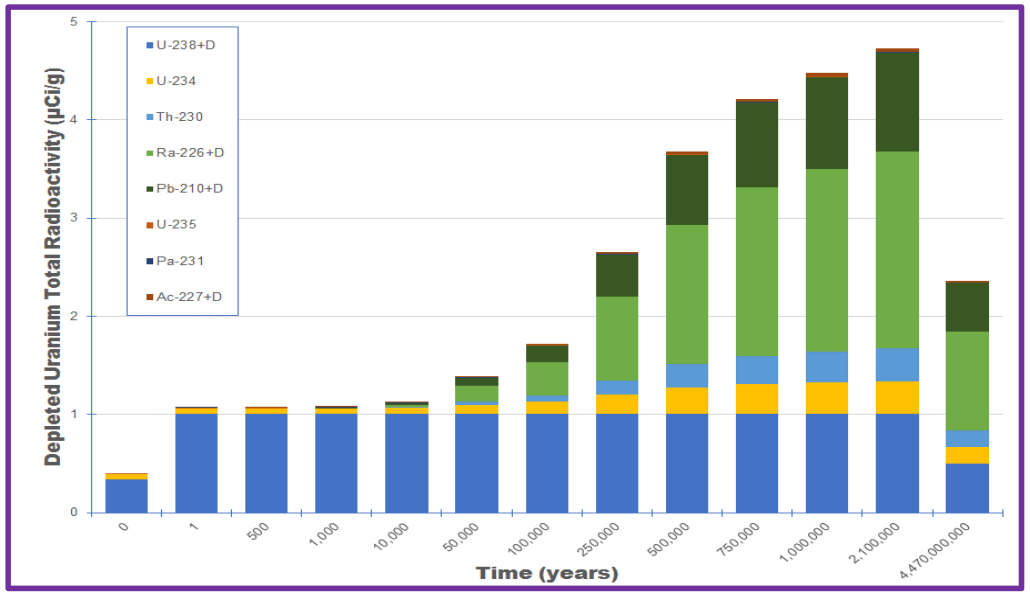
SC&A Comments:

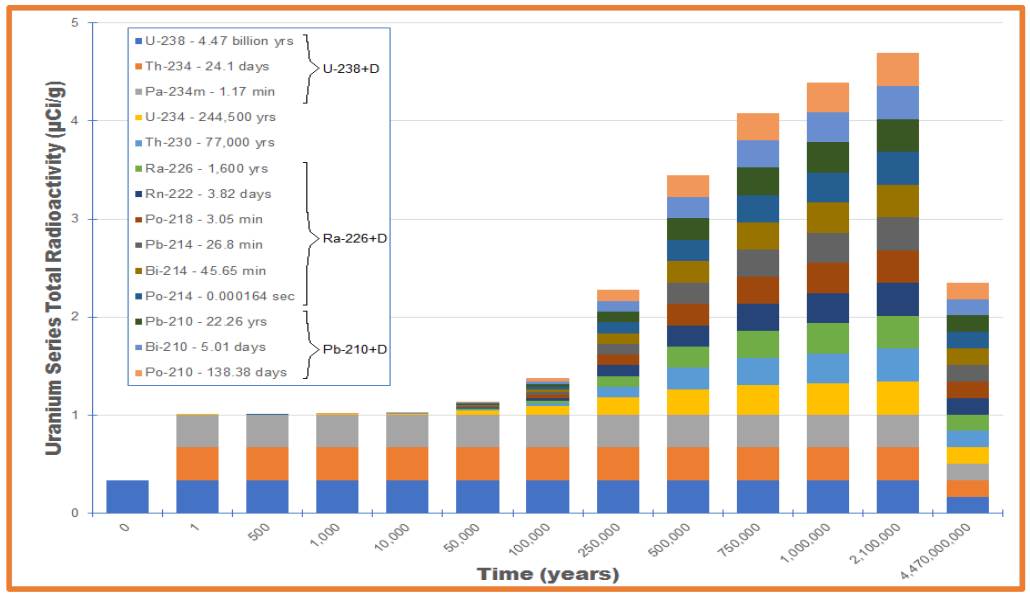
- The significance of stating that specific activity of DU is 58% of natural U is not clear.
- The initial specific activity of depleted uranium varies depending on the amount of U-234 remaining after isotopic separation.
- The specific activity of depleted uranium increases with time due to daughter in-growth reaching its peak value after about 2 million years.
- See next slide for comparison of natural uranium, depleted uranium, and U-238 buildup.

Uranium Activity Buildup

- Natural Uranium (U-235: 0.711 wt%)
- Depleted Uranium (U-235: 0.2 wt%)
- Uranium Series (U-238: 100 wt%)







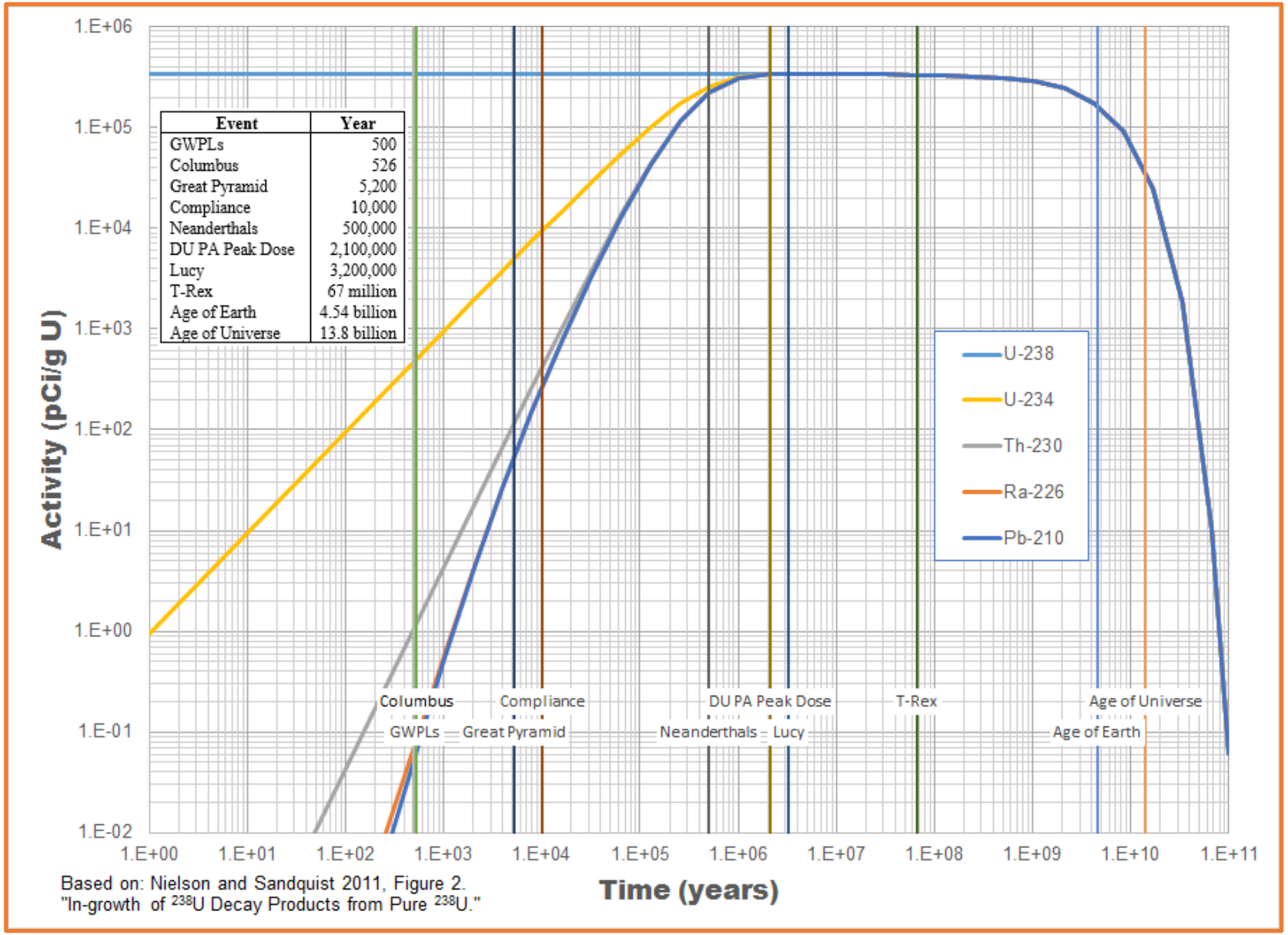
Radioactive Decay (ES slide 4)

- It takes approximately one million years for the decay products to reach their maximum activity after which they begin to decay to essentially no activity.

SC&A Comments:

- As noted in the previous comment slide, peak activity is reached in about 2 million years.
- This statement is very mis-leading since the 1/2 life of U-238 is 4.4 billion years, it will take essentially forever to reach “no activity”.
- See next slide for context.

U-238 Decay Timeline – With Perspectives



Depleted Uranium Disposal at Clive (ES Slide 7)

- Energy*Solutions* states in the graph that between 1990 and 2012 seven PA's were approved to dispose of DU.

SC&A Comment:

- The 1990 analysis determined the potential worker exposures from a large number of sources including DU; a DU activity limit of 110,000 pCi/g was established based on the worker inhalation dose. This DU activity limit was incorporated into the license, but has since been removed.
- The 2012 analysis was designed to support an amendment to the Groundwater Permit, not the Radioactive Material License.
- See additional comments on EnergySolutions (ES) Slide 10, below.

Exemption Request – Key Facts (ES Slide 8)

- Disposal of these DU Penetrators does not result in an unanalyzed condition.
- Energy*Solutions* supported this contention in its September 11 letter to DWMC stating that "NRC included depleted uranium in the original analysis that serves as the basis for the 1981 promulgation of the 10 CFR 61.55 waste classification system." (NUREG-0782, Vol. 1, Section 6.4, page 42).

SC&A Comment: DU was omitted from the final 10 CFR 61 rule. As recently stated by the NRC: *The original development of 10 CFR 61.55 did not explicitly consider the impacts resulting from the disposal of unique waste streams such as significant quantities of depleted uranium from the operation of a commercial uranium enrichment facility. When 10 CFR Part 61, "Licensing Requirements for Land Disposal of Radioactive Waste," was initially developed, there were no commercial facilities generating significant quantities of depleted uranium waste streams. As a result the analysis only considered the types of uranium-bearing waste streams being typically disposed of by licensees at the time. Additionally,* ***the nature of the radiological hazards associated with DU presents challenges to the estimation of long-term effects from its disposal – namely that its radiological hazard gradually increases due to the ingrowth of decay products****, eventually peaking after 1 million years, rather than decreasing significantly over a few hundred years like that of typical LLW.* [emphasis added]

Source: https://www.nrc.gov/reading-rm/doc-collections/cfr/part061/part061-0055.html

Disposal of this Type of Waste has Been Previously Analyzed (ES Slide 10)

- Energy*Solutions* completed an updated PA and renewed their license in 1998 to manage Class A radioactive waste (including depleted uranium). Four other updates to the PA model were completed and approved from 1998 to 2012. The PA was again updated (and included depleted uranium) and approved in 2012 for creation of the Class A West embankment.

SC&A Comments:

- The cited 2012 site-specific PA did not consider DU. It was for blended wastes, "the 2012 site specific performance assessment … was not prepared as the basis for the Class A West License Amendment …" (Energy*Solutions* letter to DEQ, CD18-0168 , September 13).

Disposal of this Type of Waste has Been Previously Analyzed (Con't)

SC&A Comments:

- The 2011 analysis cited by Energy*Solutions* (Whetstone 2011) was, in fact, not a formal PA but instead documented flow and transport modeling of a large number of radionuclides in support of amending the Clive groundwater permit. It did not meet NRC requirements for PAs as specified in NUREG-1573.
- See the next two slides for a comparison of the reports Energy*Solutions* identified as DU PAs.

SC&A Comparison of Previous Analyses

	Report	Embankment Analyzed	Top Slope Infiltration (cm/yr)	Uranium Kd (mL/g)	Waste Density (g/cm^3)	Max U-238 Source (pCi/g)	Exposure Pathways	U-238 in Aquifer		Sensitivity/ Uncertainty
								Exceeds GWPL	Peak Conc*	
1)	Rogers and Associates Engineering, June 1990	LARW	0.124	40	1.6	28,000 (calculated)	Intruder (3)+ Offsite Individual Onsite Worker	Not calculated	Not calculated	None
2)	Rogers and Associates Engineering, August 1990	N.A.	N.A.	N.A.	N.A.	110,000 (calculated)	Onsite Worker	N.A.	N.A.	None
3)	Adrian Brown Consultants, February 12, 1998	LARW	0.198	6	1.8	330,000	Rather than the exposure of individuals, concentrations in the aquifer and the compliance well were calculated and compared to the GWPLs.	>2,000	>20,000 2,000	Vertical dispersivity Hydraulic parameters Container life
4)	Whetstone Associates, July 19, 2000	LARW/Class A	0.265	6	1.8	336,260		>1,000	>10,000 2,000	None
5)	Whetstone Associates, August 1, 2000	Class A, B, and C	0.066	6	1.11	336,260		>1,000	>10,000 2,000	
6)	Whetstone Associates, May 2006	Class A Combined	0.244	6	1.8	336,260		>1,000	>10,000 1,000	
7)	Whetstone Associates, December 7, 2007	Class A South	0.276	6	1.8	336,260		>1,000	>10,000 1,000	
8)	Whetstone Associates, October 30, 2009	Class A, Class A North, Class A South	0.364	6	1.8	336,260		6,700	18,903 (2.51E+7 pCi/L)	
9)	Whetstone Associates, April 19, 2011	Class A West	0.238	6	1.8	3.36E+5		>1,000	>10,000 1,000	
10)	Whetstone Associates, May 2012	Class A West	0.106	6	1.8	336,260		Not provided	>10,000 1,000	

* The top line shows what is given in the text and/or tables, while the bottom is the maximum shown in the PATHRAE files.
\+ The three intruder scenarios were: Construction, Agriculture, and Explorer

NUREG-1573 PA Essential Elements

The essential elements of a performance assessment for an LLW disposal site are:

(a) a description of the site and engineered system; - provided

(b) an understanding of events likely to affect long-term facility performance; - not provided

(c) a description of processes controlling the movement of radionuclides from LLW disposal units to the general environment; - groundwater only

(d) a computation of doses to members of the general population; - not provided

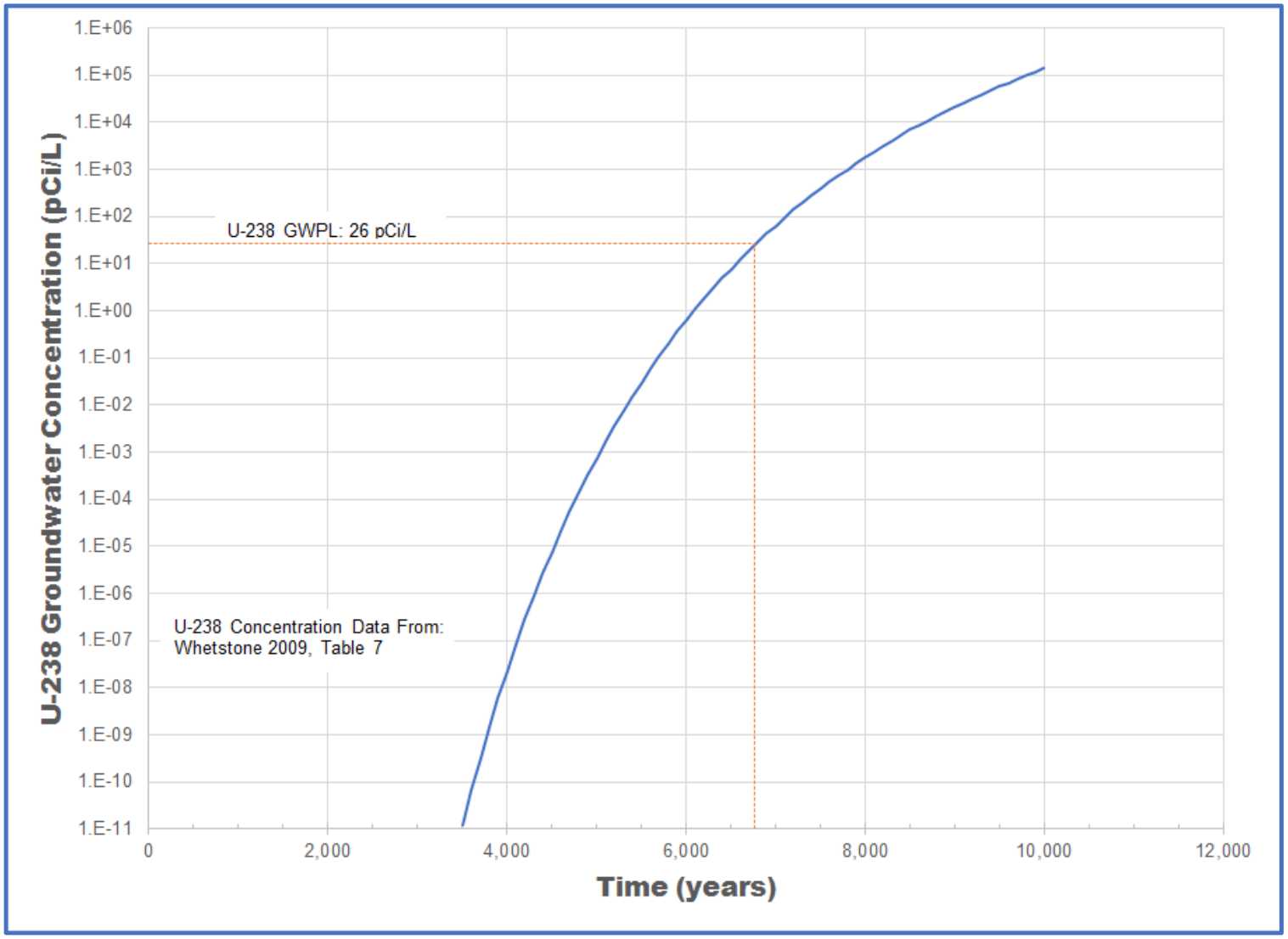
and

(e) an evaluation of uncertainties in the computational results. - not provided

Quantitative estimates of LLW site performance are matched to need: deterministic, bounding analyses for simple problems; and probabilistic analyses for more complex problems, with large uncertainties.

Source: NUREG-1573, "A Performance Assessment Methodology for Low-Level Radioactive Waste Disposal Facilities, Recommendations of NRC's Performance Assessment Working Group," October 2000.

Whetstone 2009 U-238 Aquifer Model Results



Disposal of DU Penetrators at Clive (ES Slide 13)

- The receipt of the U.S. Army depleted uranium at Clive will be less than one percent of the annual volume received for disposal.

SC&A comments:

- R313-25-9(5)(a) defines “significant quantity” in terms of mass (i.e., >1 MT), not the site landfill volume/capacity.
- We question the emphasis on waste volume when assessing the impact of DU metal disposal at Clive, as opposed to weight or activity
- As shown on the next slide, on an activity basis, the DU metal will contribute about 12% of the annual total activity from waste disposal

Disposal of DU Penetrators at Clive (Con't)

Volume (yd^3)	Annual		Notes:
Site Total	120,000	[a]	[a] 2016 volume from ES (Shrum) 2017.
Penetrators	1,000	[b]	[b] From ES (Orton), Sept 11, 2018.
P/ST Ratio	0.8%		[c] Volume × 0.605 Ci/m^3, from Whetstone 2011, Table 24.
Uranium Activity (Ci)			[d] Volume × 370,000 pCi/g × 19 g/cm^3 × 0.8 packing efficiency.
Site Total	42,754	[c]	
Penetrators	5,347	[d]	
P/ST Ratio	12.5%		

Proven and Authorized Disposal of DU (ES Slide 14)

- Energy*Solutions* has proven expertise and an embankment specifically designed to isolate and safely dispose of the DU penetrators.

SC&A Comments:

- The Class A West cell was not specifically designed to isolate and safely dispose of DU penetrators. It was designed to handle a broad spectrum of wastes.
- Energy*Solutions* arguments address what has been accomplished over a few years. There is no focused analysis on long-term effects.

Summary of SC&A's Review

- Utah regulation R313-25-(5)(a) is very clear. A performance assessment is required for disposal of more than 1 metric ton of depleted uranium.
- The "PAs" that Energy*Solutions* refers to are not considered to be site-specific DU performance assessments.
- Energy*Solutions* has not demonstrated that an exemption from this regulation will not result in undue hazard to public health and safety or result in undue hazard to the environment.

Thank you.

Questions?