Release of impacted building materials during Decommissioning and Demolition of the CASA Criticality Facilities

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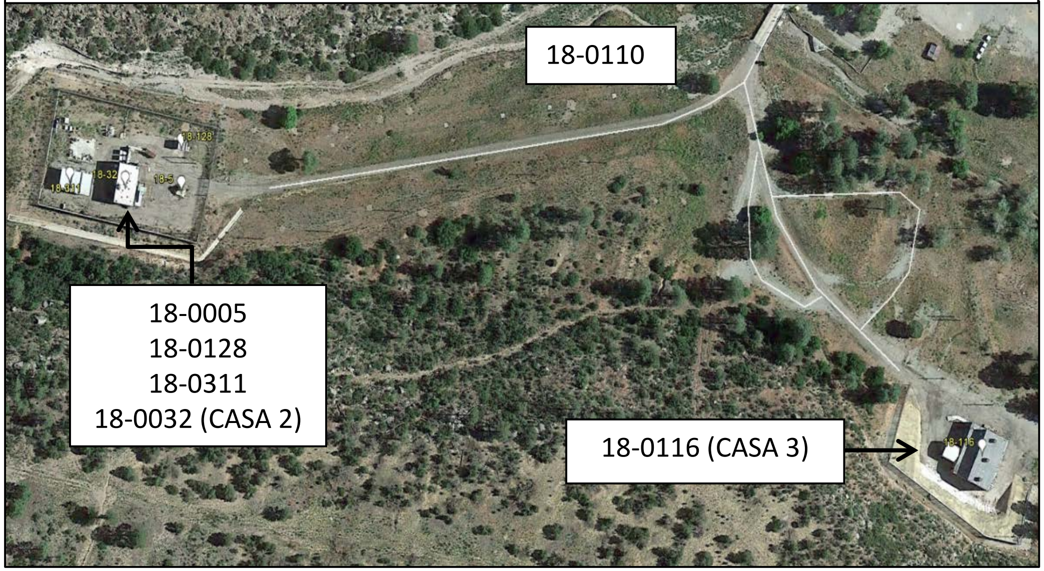
A project to D&D two Critical Assembly and Storage Areas (CASAs) at TA-18 required a decision about how to disposition the building materials- Top 10 on DOE list of D&D projects

Background

- Project Management (PM) undertook a project to decontaminate and decommission (D&D) two Critical Assembly and Storage Areas (CASAs) at TA-18, along the Pajarito Corridor.
- The CASAs housed criticality experiments, which produce neutrons. The neutrons interacted with the concrete and metal of the buildings, making the building materials radioactive (Europium-152 in the concrete and Cobalt-60 in the metal).
- The team needed to determine what to do with the building materials after demolition.
  - Option 1 was to ship the building materials as Low Level Waste (LLW).
  - Option 2 was to request an Authorized Limits approval from the Department of Energy (DOE) and reuse the materials as on-site fill.

Aerial view of TA-18



The team could ship the building materials as LLW or develop Authorized Limits for use as on-site fill

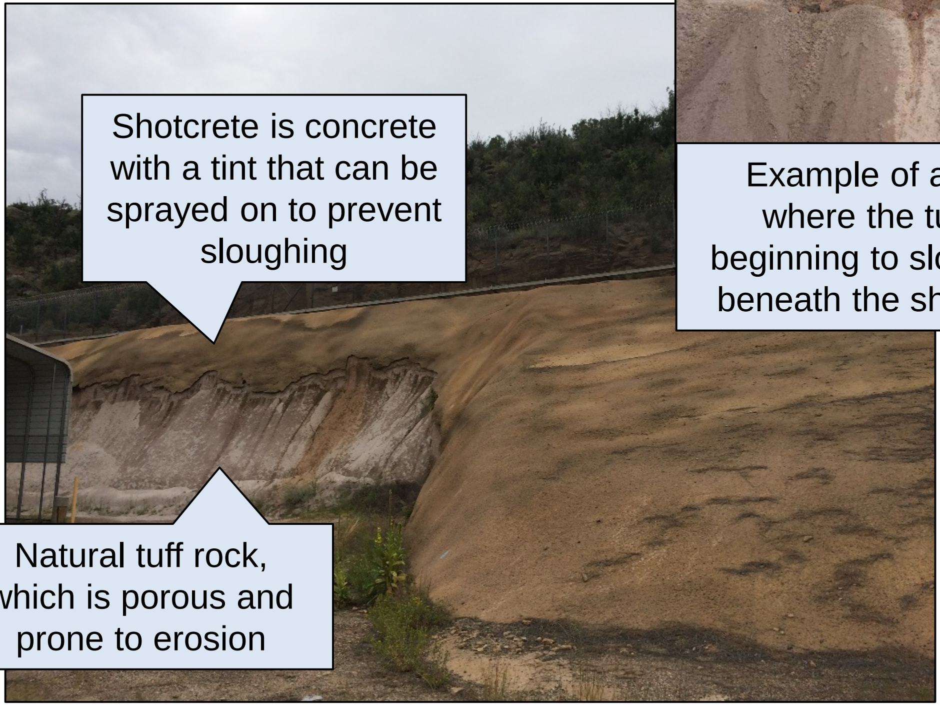
Activation Measurement Results

- Concrete samples sent for gamma spectral analysis found Eu-152
- In-situ gamma spectral measurements showed measureable Co-60, with stronger signals from inside metal doors.
  - Eu-152 concentration 1 pCi/g
  - Co-60 concentration in metal 0.8 pCi/g (~200,000 lbs of rebar)

Regulatory Environment

- DOE regulates release of personal property to the public, which includes release of materials for recycling or to commercial landfills
- DOE provides release criteria for materials with residual radioactive surface contamination, but not for volumetrically-activated materials
- Criteria for release of neutron-activated concrete and metal was “Indistinguishable from Background,” or IFB
- ANSI N 13.12 “Surface and Volume Radioactivity Standards for Clearance.” Issued, but not seen as implemented by DOE

Physical Environment: CASAs located in steep canyon with significant erosion



Problem: How to dispose the activated concrete and metal given the regulations and programmatic drivers (i.e., cost and schedule):

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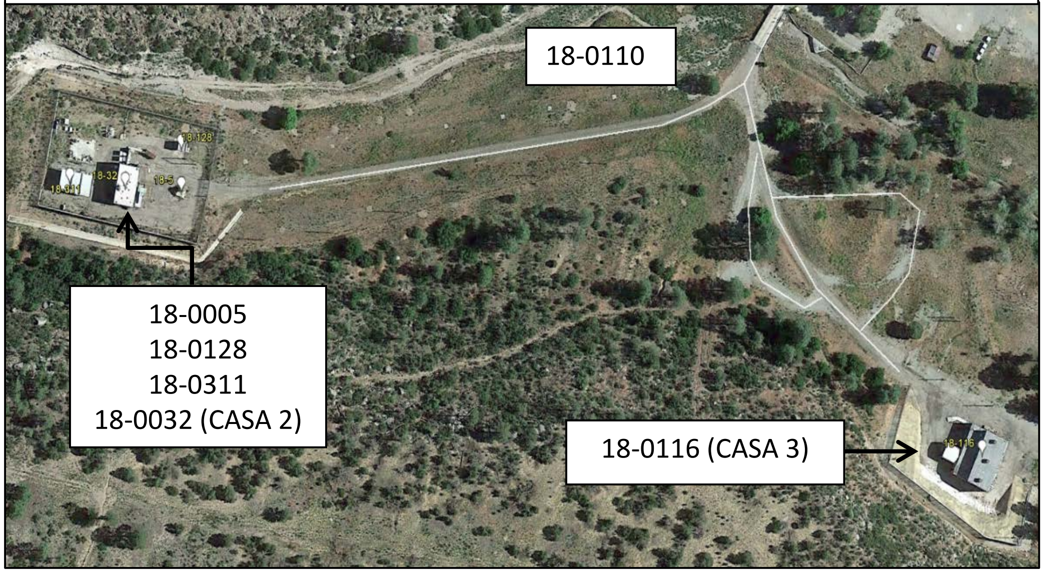

The team considered impacts of the two approaches to determine the path forward

In each case, Authorized Limits has better outcomes

Item to Consider	LLW Approach	Authorized Limits Approach
Ability to complete project	Could not be completed with current budget. • This jeopardizes LANL's ability to address one of DOE's top 10 priorities to demolish the CASAs. • Leaving the buildings standing increases surveillance and maintenance costs for the Laboratory.	Project can be completed within cost and schedule. LANL can D&D a top priority. • Allows the Laboratory to D&D one of DOE's top priorities. • Project completion reduces surveillance and maintenance costs.
ALARA Risk / Benefit Analysis	The risks of shipping as LLW are greater than the benefits of keeping the materials on-site as fill.	The Authorized Limits approach makes sense scientifically and financially.
Opportunities to recycle and reuse	Shipping the waste does not allow for recycling or reuse of the material.	The Authorized Limits approach allows the project to reuse the material as fill to cover up a legacy scar in the hillside to stabilize the canyon and improve the aesthetics (which, among other things, benefits the Manhattan Project National Historical Park).
Carbon footprint	Shipping as LLW increases the number of truckloads shipped to Nevada.	This approach does not require trucks to ship waste out of state.
Space in waste storage facility	Shipping as LLW takes up valuable space in a waste storage facility for waste that will decay away within 10-20 years.	The Authorized Limits approach frees space in waste storage facilities for other waste.
Cost	$2.2M in addition to the project's $1M subcontract award amount.	Original $1M subcontract award amount is maintained.
Future benefits of the approach	None.	This project sets a precedence for requesting DOE approval for Authorized Limits, which benefits future projects.

The Authorized Limits approach is scientifically supported, financially beneficial, and more environmentally sustainable

Components of Authorized Limit Request under DOE Order 458.1

- Scope of request- Reuse as fill material onsite
- Specific ALs - 3 pCi/g for both Eu-152 and Co-60, matching ANSI 13.12 values
- Potential radiation doses- individual and collective, for actual and future land use scenarios- RESRAD dose assessment model
- ALARA assessment- 1) LLW, 2) reuse as fill, and 3) recycle

Key aspects of ALARA Evaluation

- Dose for LLW disposition assumed to be 0
- Dose for reuse as fill- Recreational user hiking for 1 hr/d and 3000 hikers/yr. Site has 30 cm of clean soil covering 2 m of contaminated fill. Worst case, 30,000 hikers/year
- Dose for Recycle
  - Used for house- Dilution factor (DF) of 0.1, occupancy factor (OF) 0.8, family of 4 in 100 individual houses. Worst case, DF=1, OF=1

Evaluated at both $2000 and $20,000 per person-rem

Estimated Costs and Doses for Disposition Options

Costs

- LLW disposal = $2.2 Million
- Cost for recycle = $100,000
- Cost for reuse as fill = $0

Dose

- LLW disposal = 0 person-rem
- Cost for recycle = 1.8 E-3 person-rem
- Cost for reuse as fill = 5.9 person-rem

General Formula for ALARA Optimization Calculations

$$C_{TotA} = P_A + \beta D_A \times V$$

Where: C_{TotA}= total cost of alternative A ($)

P_A = Production costs of alternative A ($)

β = Beta factor, political and social cost of alternative A (assumed equal to 1)

D_A = Collective radiation dose for alternative A (person-rem)

V = value for radiation dose avoidance (range $2000 to $20,000 per person-rem)

Results of ALARA Optimization

	Eu-152	Co-60	Sum
Measured Concentration (pCi/g)	0.77	1	
Fill/Recreational Individual Dose (mrem/yr)	1.23E-05	4.76E-05	6.00E-05
Recycle Individual Dose (mrem/yr)	0.725	0.198	9.23E-01
Collective Dose Calculation			
	Eu-152	Co-60	Sum
Radionuclide half life (yr)	12.7	5.27	
Integration time (yr)- half life/ln(2)	18	8	
Fill/Recreational Collective Dose (person-rem) assuming 3000 people/yr usage	6.8E-04	1.1E-03	1.76E-03
Recycle Collective Dose (person-rem) for 4 people and 100 homes	5.32E+00	6.02E-01	5.92E+00
Cost Comparison ($)			
	$2k/person-rem		$20k/person-rem
Fill Option (No change in cost)	4		35
Recycle Option ($100,000)	111836		218362
Low Level Waste Option ($2.2 million)	2200000		2200000

Comparison between recreational user dose from activated materials to dose from naturally occurring radionuclides

		NORM Materials			
	U-238	Th-232	K-40	Sum	Compare Fill/NORM
Measured Concentration (pCi/g)	1.22	1.43	30		
Recreational Individual Dose (mrem/yr) for 1 user, 1 hour per year	2 E-05	1 E-04	3 E-03	3 E-03	2%
Recreational Collective Dose (person-rem) assuming 3000 people-hr/yr usage	1 E-2	6 E-2	2 E+00	2 E+00	0.09%

DOE Approved the AL request

Benefits and Cost Savings
The team received approval from DOE on May 3, 2016, which could achieve the benefits described below.

- Save the project $2.2M in costs.
- Reduce surveillance and maintenance costs by ensuring the D&D of the buildings.
- Achieve a desirable balance between risks and benefits.
- Provide fill to reuse material to cover up a legacy scar and stabilize the canyon.
- Reduce carbon footprint by reducing the number of truckloads required to ship LLW off-site.
- Establish a precedence for using the Authorized Limits approach.

The picture below shows the scar that will be improved with the fill. The lower section will be filled, improving the appearance and stability of the scar.

This approach has potential to save $2.2M and allow opportunities to recycle and reuse material

Approved, but potential risks still existed

- Use of radioactive material as fill could result in creation of a waste burial site and be regulated-Perception issue more than regulatory?
- Additional non-radioactive (e.g., RCRA constituents) need assessment prior to use as fill (Pb, PCBs, etc.)

Final Status:

- PCBs were found in some of the paint samples, and so RCRA requirements trumped the radionuclide regulations. Building debris could not be used as fill in canyon wall
- However, given the thorough characterization of the radioactivity in the materials and ALARA analysis, the material met criteria for fill at an onsite material disposal area rather than being disposed of as LLW.

Thanks for your attention!