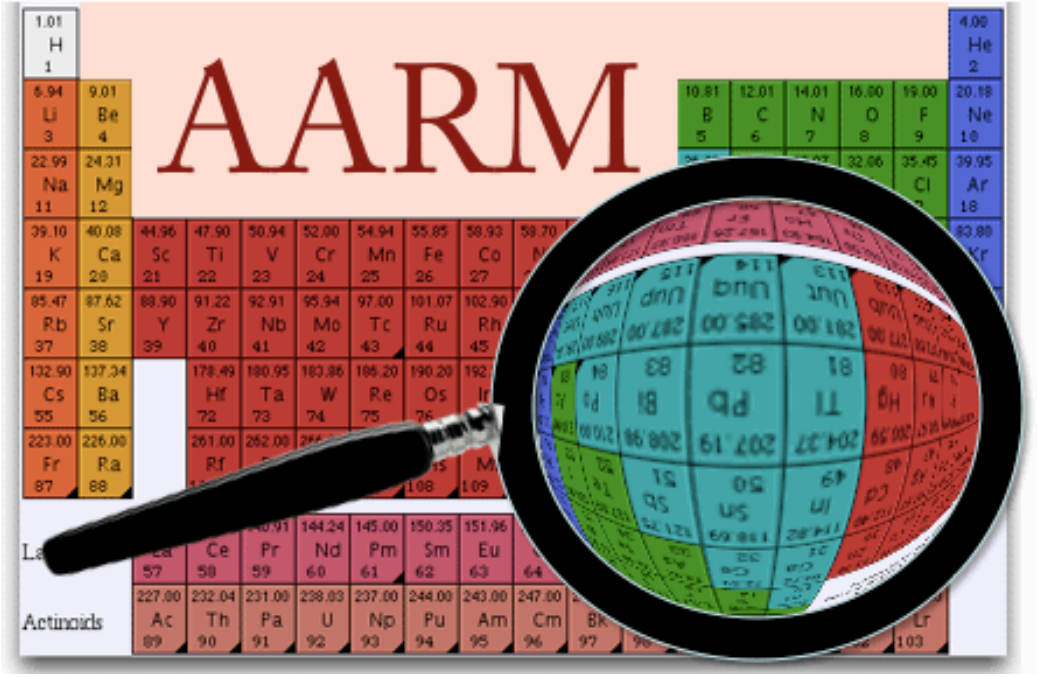
Assay and Acquisition of Radiopure Materials

Principle Investigators

Priscilla Cushman (University of Minnesota)
Dongming Mei (University of South Dakota)
Kara Keeter (Black Hills State University)
Richard Schnee (Syracuse University)

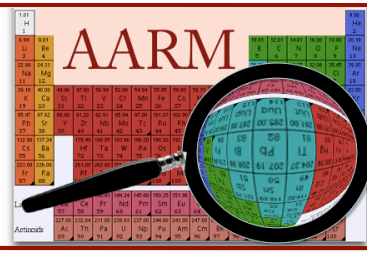
Engineering Consortium

CNA Consulting Engineers (Lee Petersen)
Dunham Associates
Miller Dunwiddie Architecture, Inc



- Characterize radon, neutron, gamma, and alpha/beta backgrounds at Homestake
- Develop a conceptual design for a common, dedicated facility for low background counting and other assay techniques.
- Assist where appropriate in the creation of common infrastructure required to perform low background experiments.
- Perform targeted R&D for ultra-sensitive screening and water shielding

Points of Contact, Meeting Summary



We have filled out the docs contact form

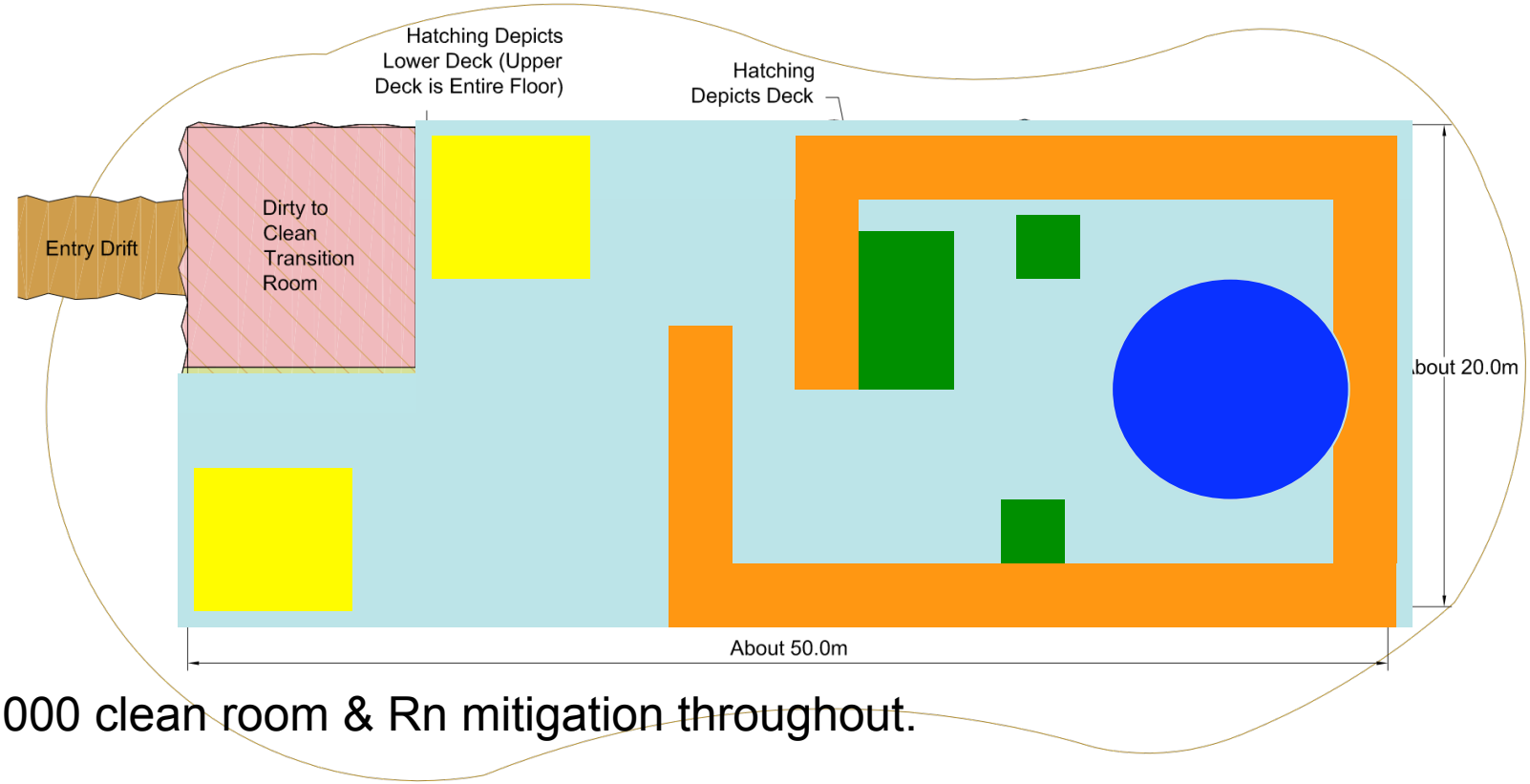
Spokesperson: P. Cushman
AARM Engineer: L. Petersen
EH&S Contact: K. Keeter
E&O Coordinator: C. Keller

Liaison Engineer: S. Marks
Liaison Scientist: Y-D Chan

Met with about 10 members of the AARM Scientific Collaboration
plus Dave Plate and Steve Marks

Firmed up plans for FAARM design and determined location
Discussed interface between AARM, Facilities, and the Experiments
New floor plan will be distributed in 2 weeks, need feedback in a month
Recast our “Program Infrastructure” spreadsheet into official docs form (2 weeks)

Facility for AARM (FAARM)
Staged approach to cleanliness and shielding



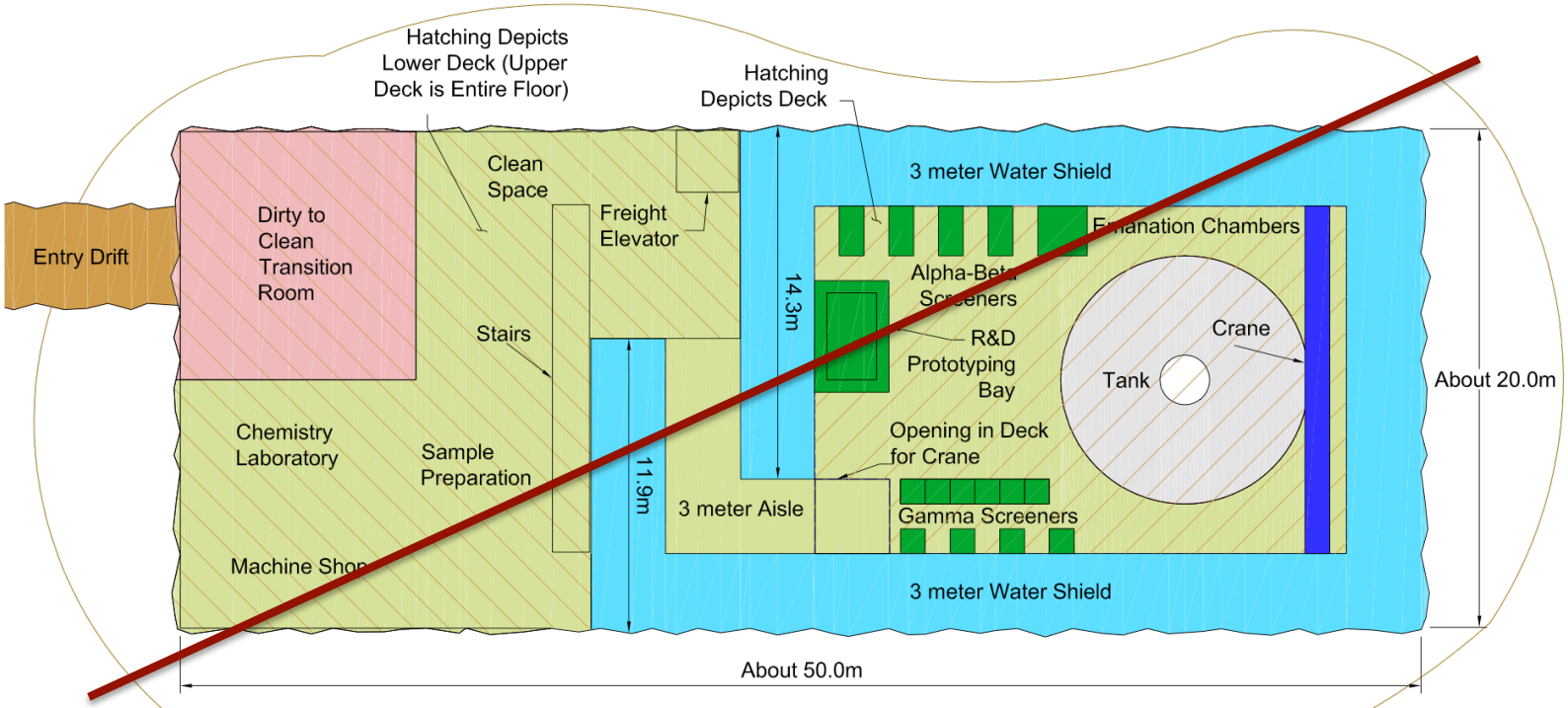
Class 2000 clean room & Rn mitigation throughout.

Additional separate Class 100 (or 500) clean rooms (sample handling, assembly)

Shielded room with easy access

Additional shielding for screeners, Special water shield for sensitive applications.
Veto shield for the most sensitive applications and for Prototypes (e.g. dark matter)

Facility for AARM (FAARM)
Refinement of Design

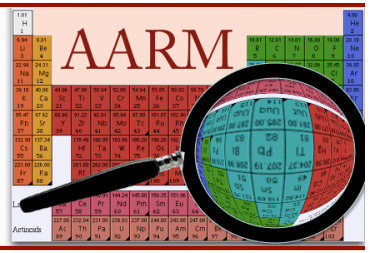


New plan will be drawn, including first pass at sensitivities for each screener

Distribute to AARM Collaboration and all S4 PI

- which labeled screeners will you use and for how long?
- Typical use of clean room, storage needs, machining needs
- Protoyping? Ultra-sensitive screening type, size, sensitivity.

Confirmed 4850 level



4850-ft level

- deep enough for ultra sensitive screening and dark matter prototype testing
- close to experiments for easy access (drive in large items)
- share water purification and cryogen infrastructure

Open Questions tend to be about duplication with facilities or experiments

Location and commonality of Water Purification and Cryogen system

Nitrogen liquifier and distribution system?

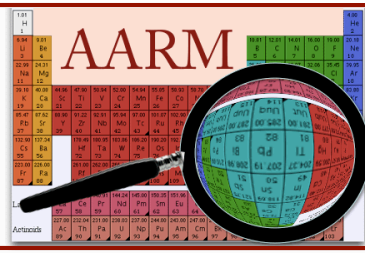
!st stage of water purification for shield

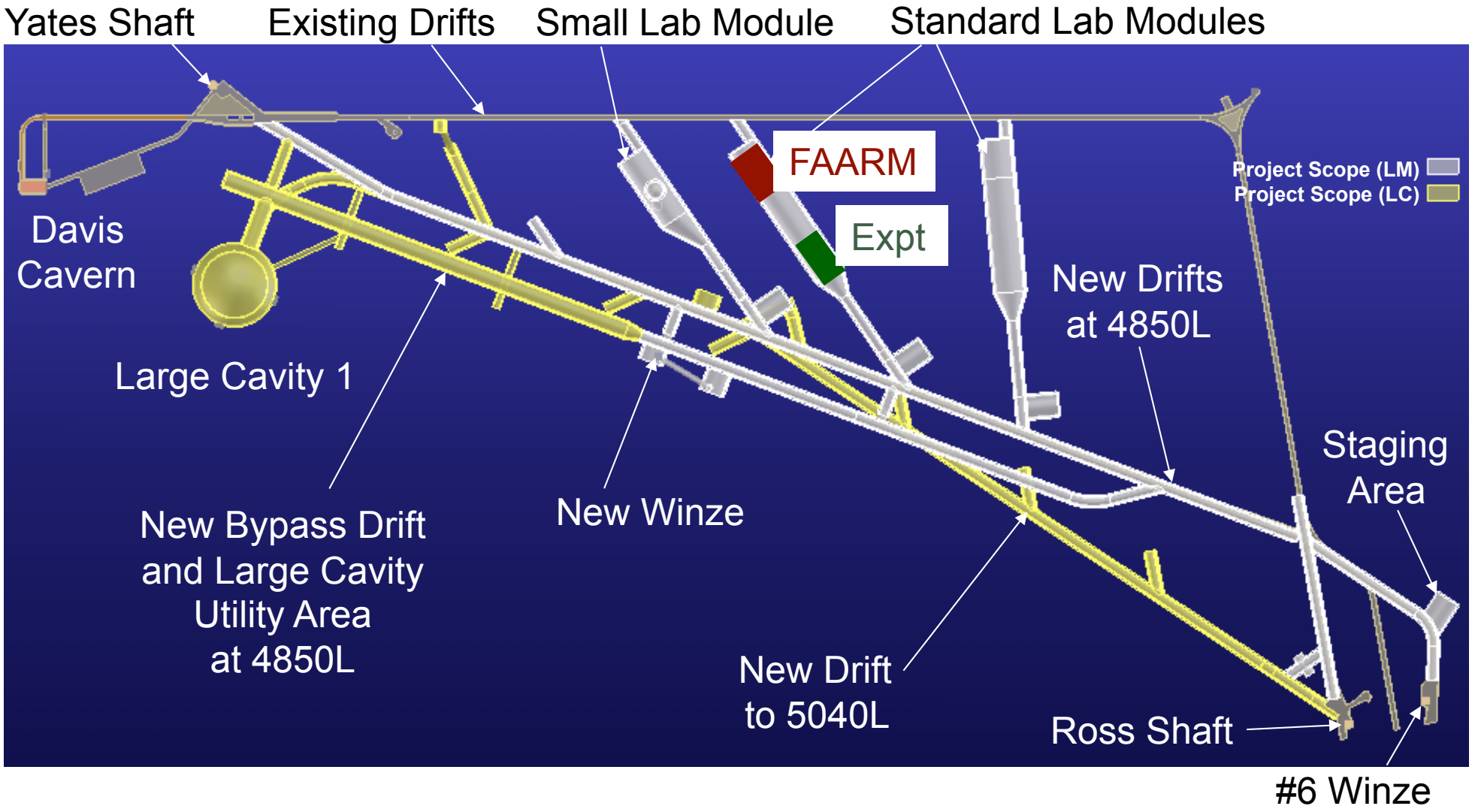
Radon mitigation for the whole lab or just for us?

Additional Cu Electroforming probably required

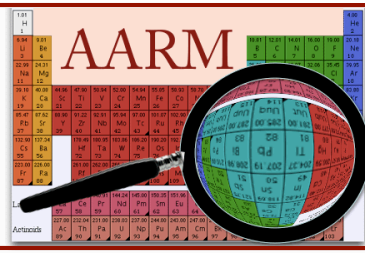
timescale of handing over the Majorana facility

Confirmed 4850 level
Define overall size and location

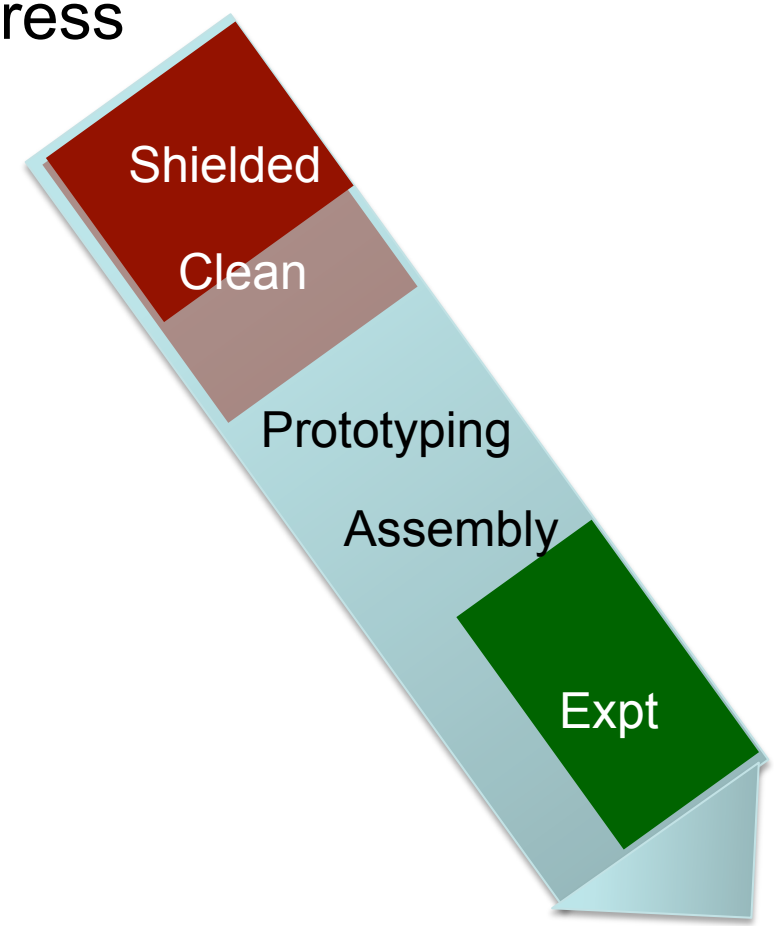




Confirmed 4850 level
Located at back of Module 2

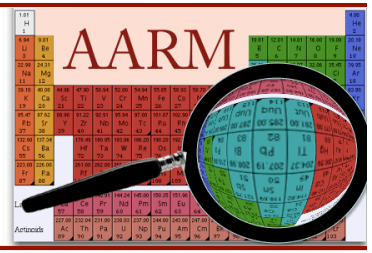


Emergency Egress



Main Entrance

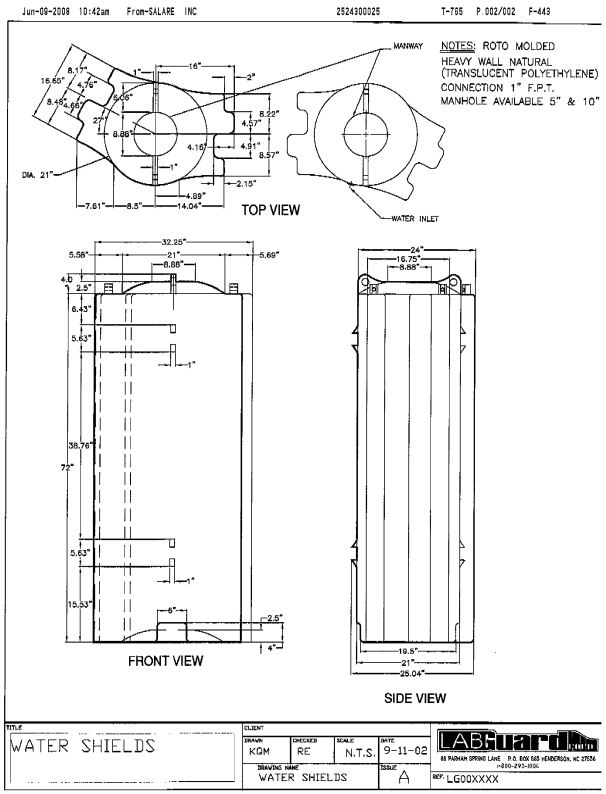
Water Shield Design



Modular, stackable containers vs Steel frame support vs custom wall
We will move ahead quickly on vendor quotes

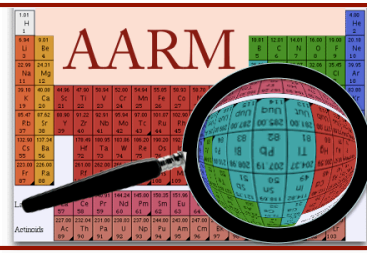
Simulation of thickness and sensitivity requirements
still needs to be done properly, but

General consensus that we go for the gamma reduction
as well as the rock radioactivity ➔ 3 m water



e.g. commercial vendor
Dufrane Nucear Shieding

Outstanding Questions: Ultra-sensitive Immersion Tank



Identity Crisis

I. A very pure water shield into which we put several high sensitivity screeners
or even whole prototype experiments (e.g. high pressure Xe or …?)

or

II. A Sensitive Detector into which we dip large items that need whole body counting

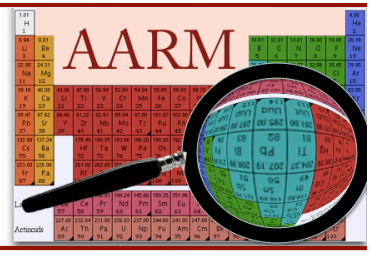
LUX water tank may be available for purpose I at the right timescale
but we need to plan our requirements – let Facilities integrate

Need both applications eventually

Explore a double tank or concentric tank solution
more real estate required…

Milestones for the AARM Cooperative Agreement

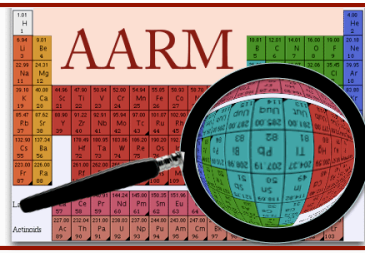
Site Characterization and Simulation Studies



12 month Milestones	24 month Milestones	36 month Milestones
Collate previous measurements, (radon variations, neutron and gamma fluxes and rock radioisotope information) Prepare site characterization database and begin targeted measurements.	Characterize site: Measure radon, n,γ at all accessible levels Host ILIAS measurement team and cross correlate with their measurements Determine minimum acceptable radon levels for screening, storage, and experiments.	Finish site characterization Establish joint backgrounds working group with new European infrastructures organization. Conceptual plan for radon mitigation
Setup site-specific n,γ GEANT4 MC of water shield and rock (SD and UM)	Optimize external water shield thickness, radiopurity of structural members (SD and UM)	Conceptual design of the surrounding water shield
Study immersion tank parameters Optical properties, H2O and LS purity (BHSU)	Define immersion tank properties decide between H2O and LS, active vs passive, size and number of ports	Conceptual design of the ultra-sensitive immersion tank

Milestones for the AARM Cooperative Agreement

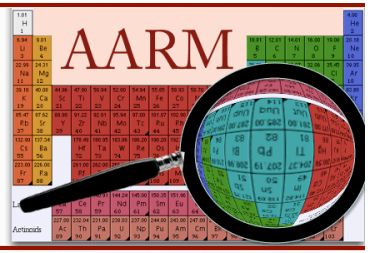
Determining the parameters of the FAARM



12 month Milestones	24 month Milestones	36 month Milestones
Determine experimental needs and sensitivities of S4 groups as well as possible synergies from outside physics	Decide on number, type and sensitivity of screeners to be located inside the FAARM Preliminary simulations of backgrounds for beta screening. Define type and amount of additional shielding needed for individual screeners based on simulations and requirements Determine footprint of auxiliary services, such as a clean machine shop, material storage, the water purification plant, sample preparation and wet chemistry labs	Determine placement of the alpha, beta, and gamma screeners within the FAARM Finish simulations of backgrounds for beta screening Design of additional shielding configurations for screeners based on the sensitivities required for each screener. Conceptual design of the FAARM infrastructure

Milestones for the AARM Cooperative Agreement

Translating this into a Conceptual Design



WBS	Task	3 months	6 months	12 months	24 months	30 months	36 months
2.1	Develop conventional facilities WBS						
	2.1.1 Draft WBS	X					
	2.1.2 Updated WBS			X			
	2.1.3 Updated WBS				X		
	2.1.4 CDR WBS						X
2.2	Develop facility program and design criteria						
	2.2.1 Initial Program and Design Criteria		X				
	2.2.2 Revised Program & Design Criteria			X			
2.3	Develop conceptual design of surface and underground facilities						
	2.3.1 Develop floor plans, sections, profiles		X				
	2.3.2 Develop excavation requirements and systems concepts			X			
	2.3.3 Update layouts and systems concepts				X		
	2.3.4 Update layouts and systems concepts					X	
	2.3.5 Prepare final layouts and system conceptual designs						X
2.4	Address critical requirements						
	2.4.1 Identify critical requirements		X	X			
	2.4.2 Develop solutions for critical requirements				X		
	2.4.3 Develop final solutions for critical requirements					X	
2.5	Develop design and construction schedules						
	2.5.1 Initial Schedule			X			
	2.5.2 Updated Schedule				X		
	2.5.3 CDR Schedule						X
2.6	Develop cost estimates for WBS items						
	2.6.1 Initial Cost Estimate			X			
	2.6.2 Updated Cost Estimate				X		
	2.6.3 CDR Cost Estimate						X
2.7	Prepare Conceptual Design Report						
	2.7.1 Draft CDR					X	
	2.7.2 Final CDR						X

Priscilla Cushman
University of Minnesota