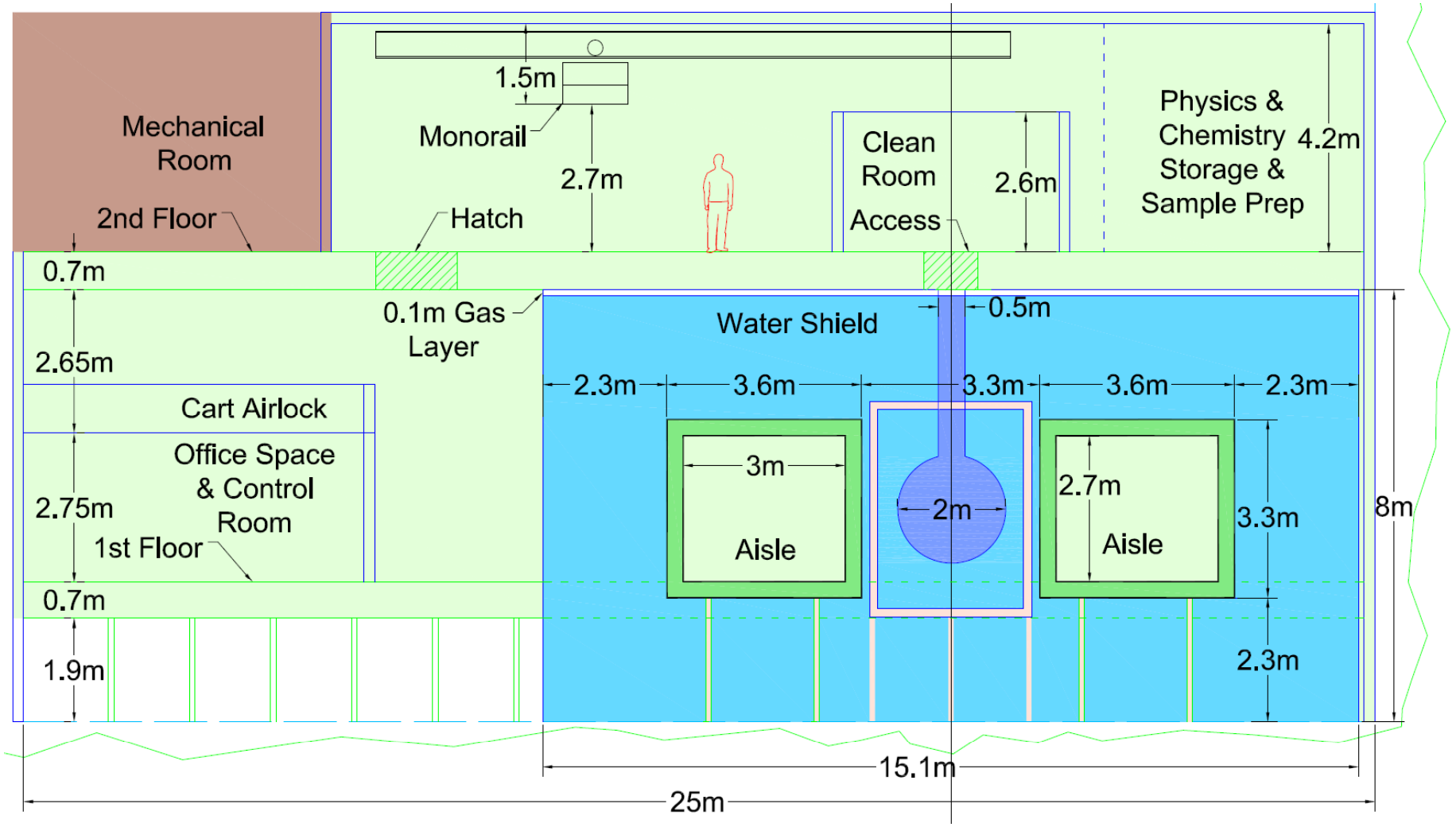
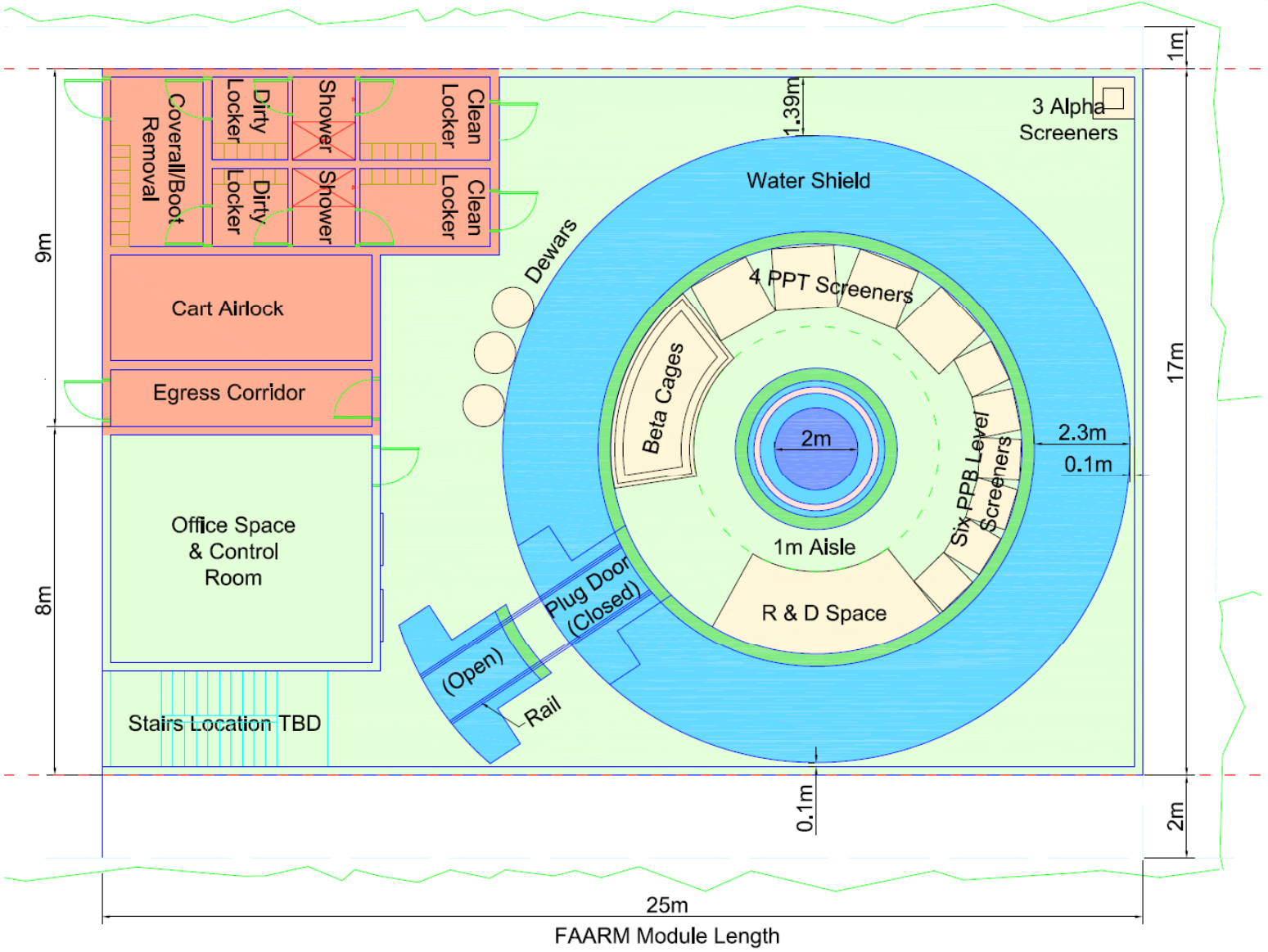
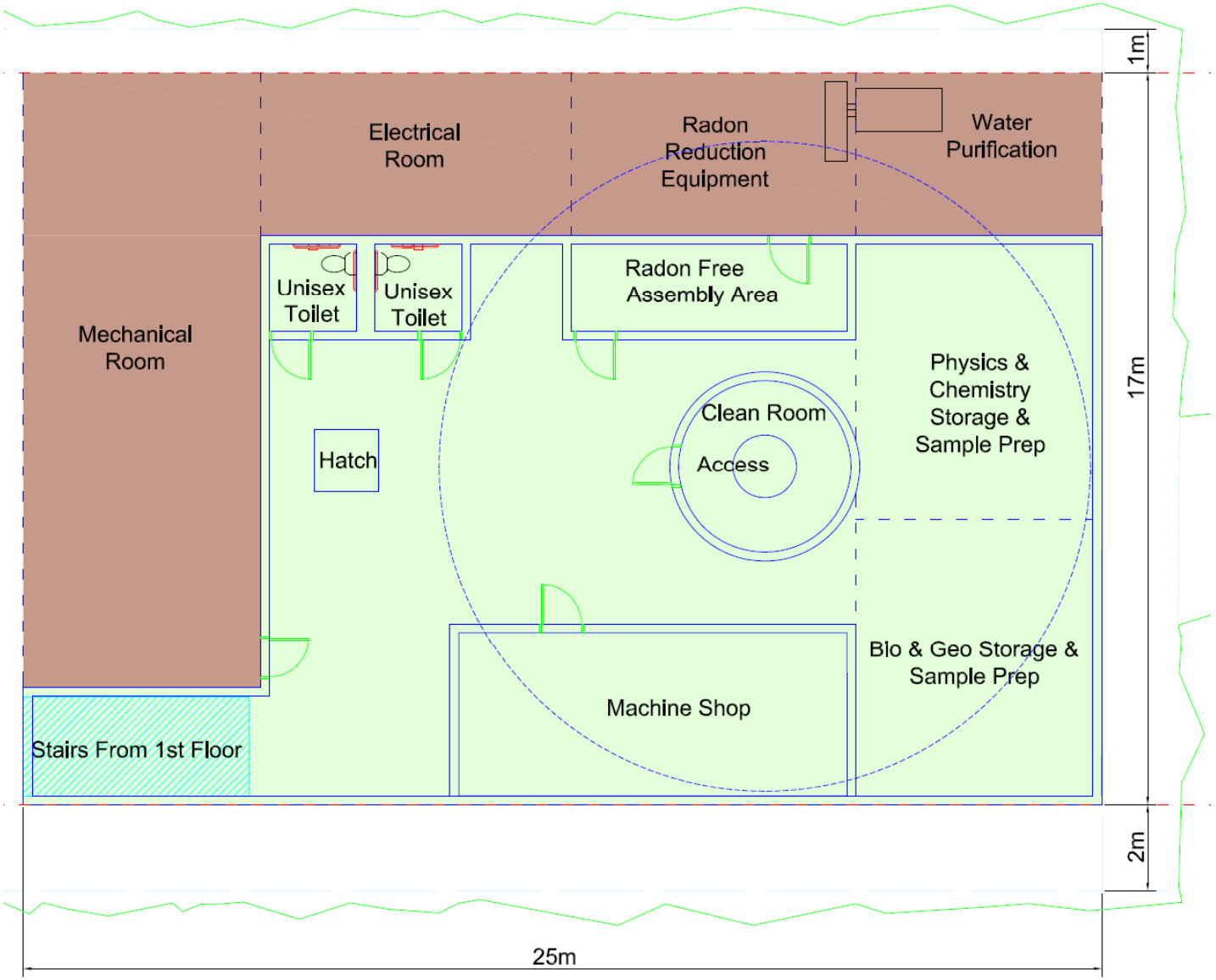
FAARM Elevation



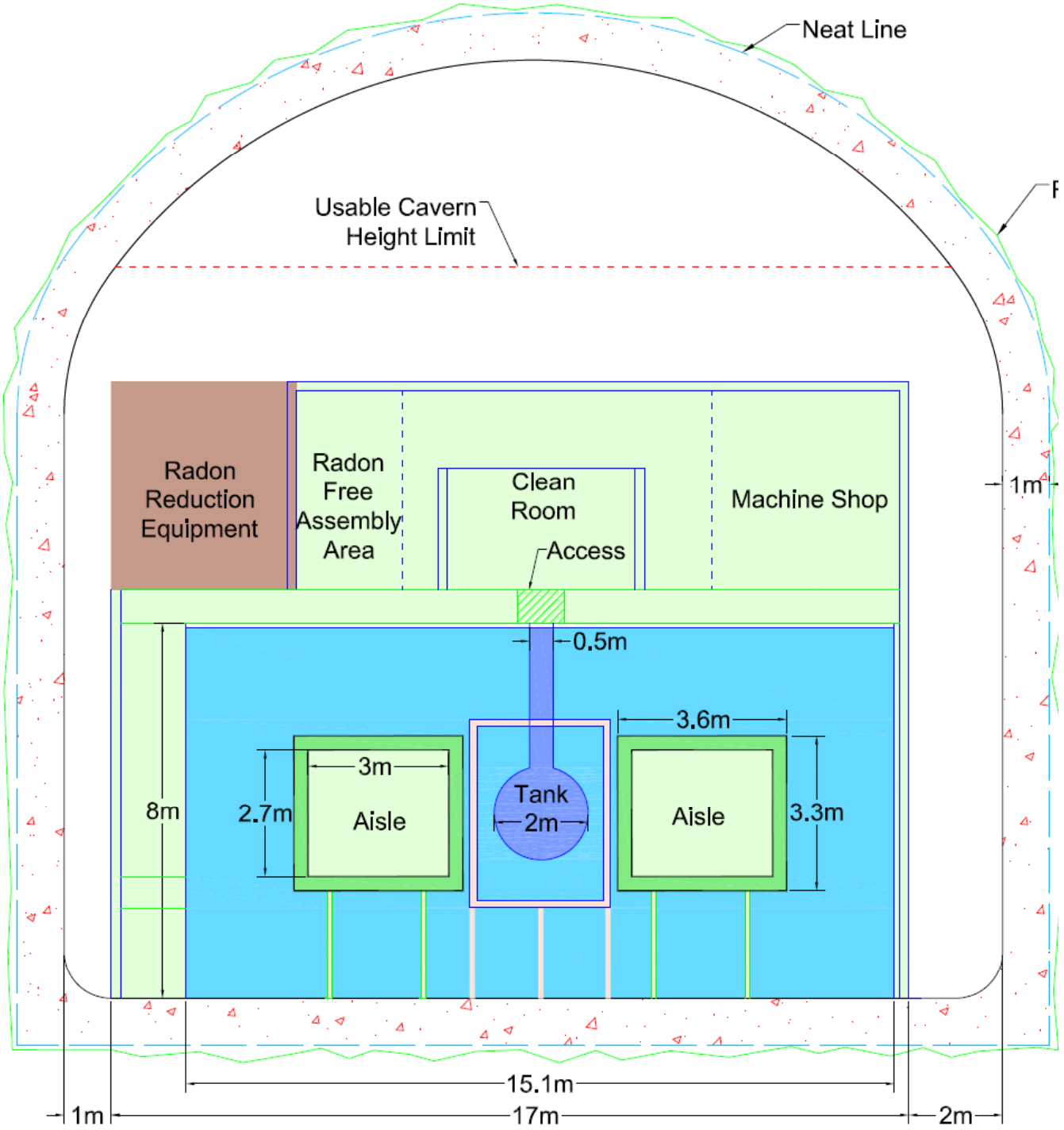
FAARM First Floor



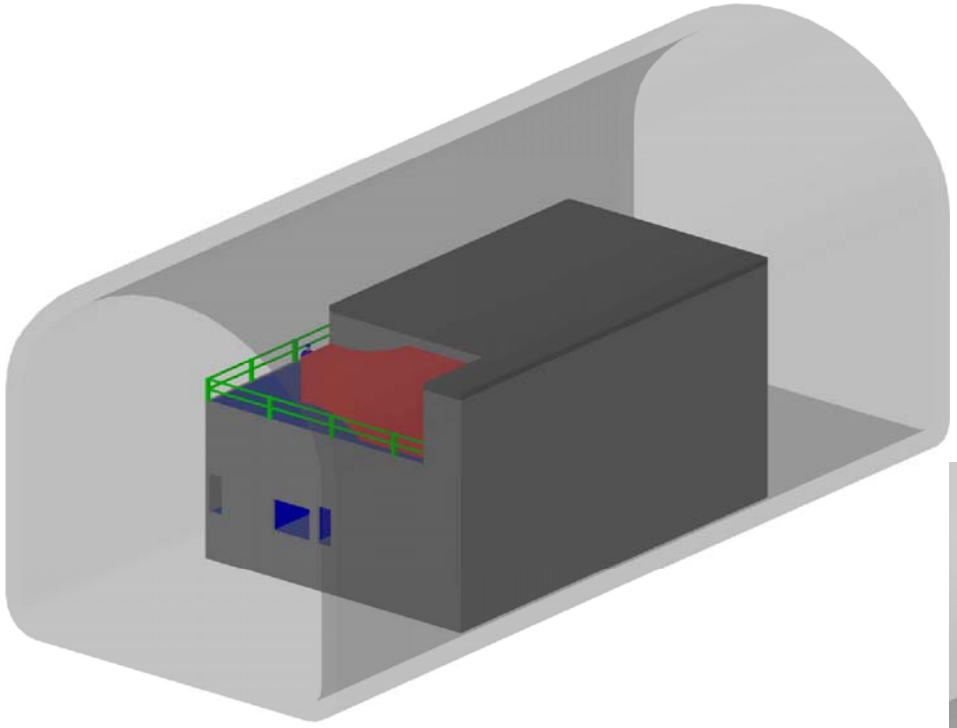
FAARM Second Floor

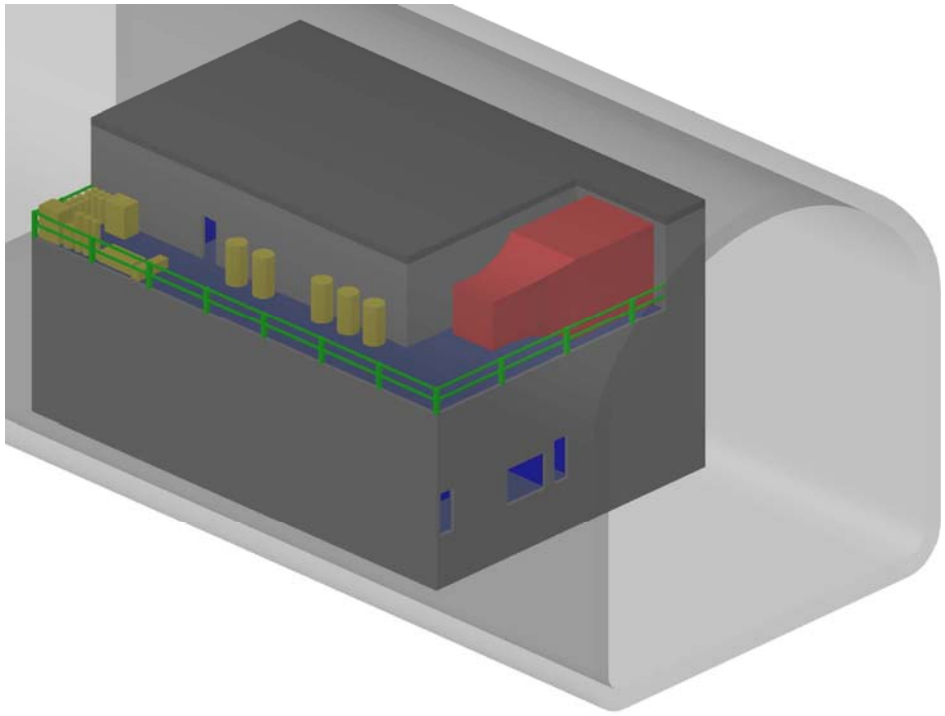


FAARM Section At Tank

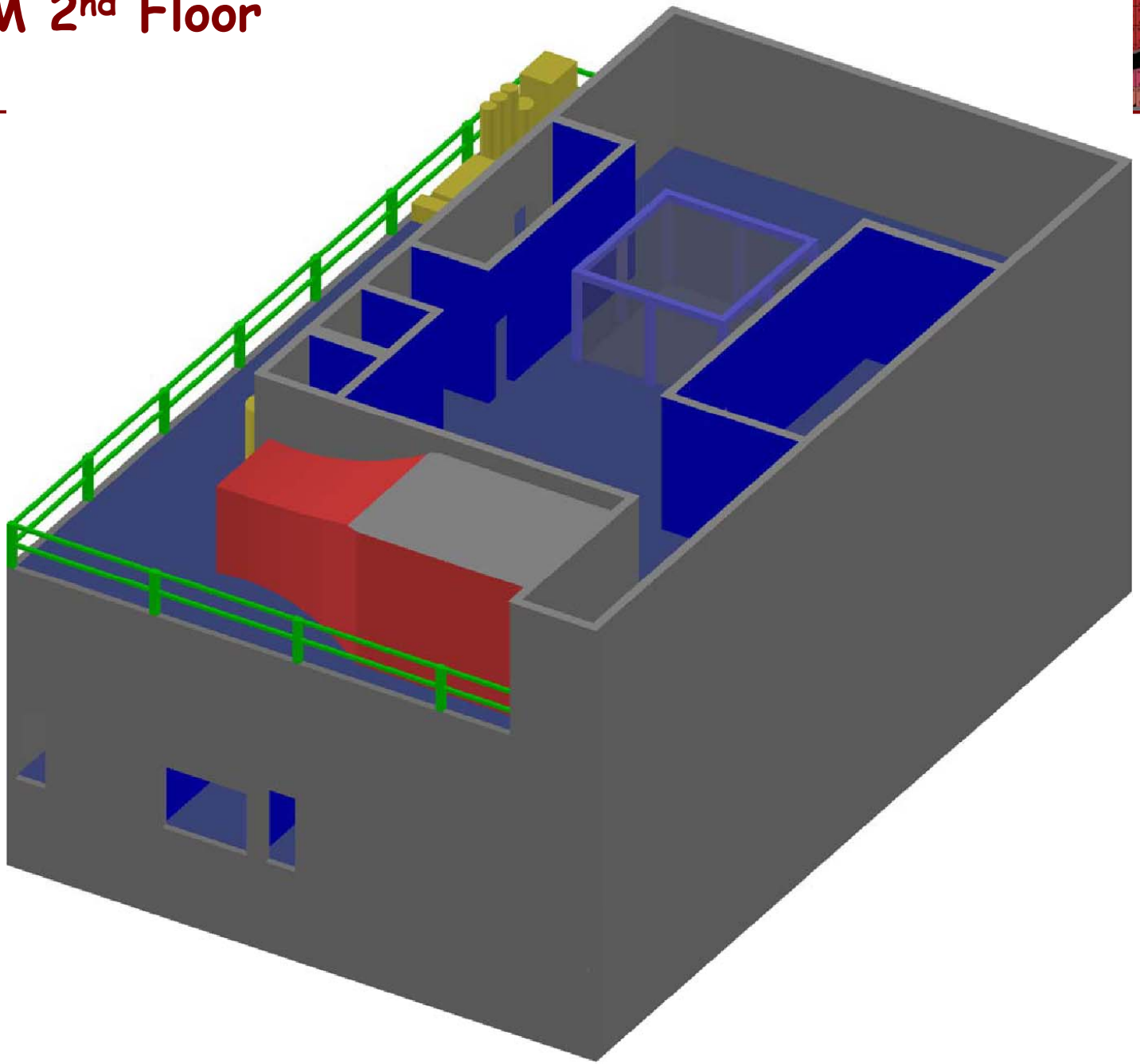


FAARM

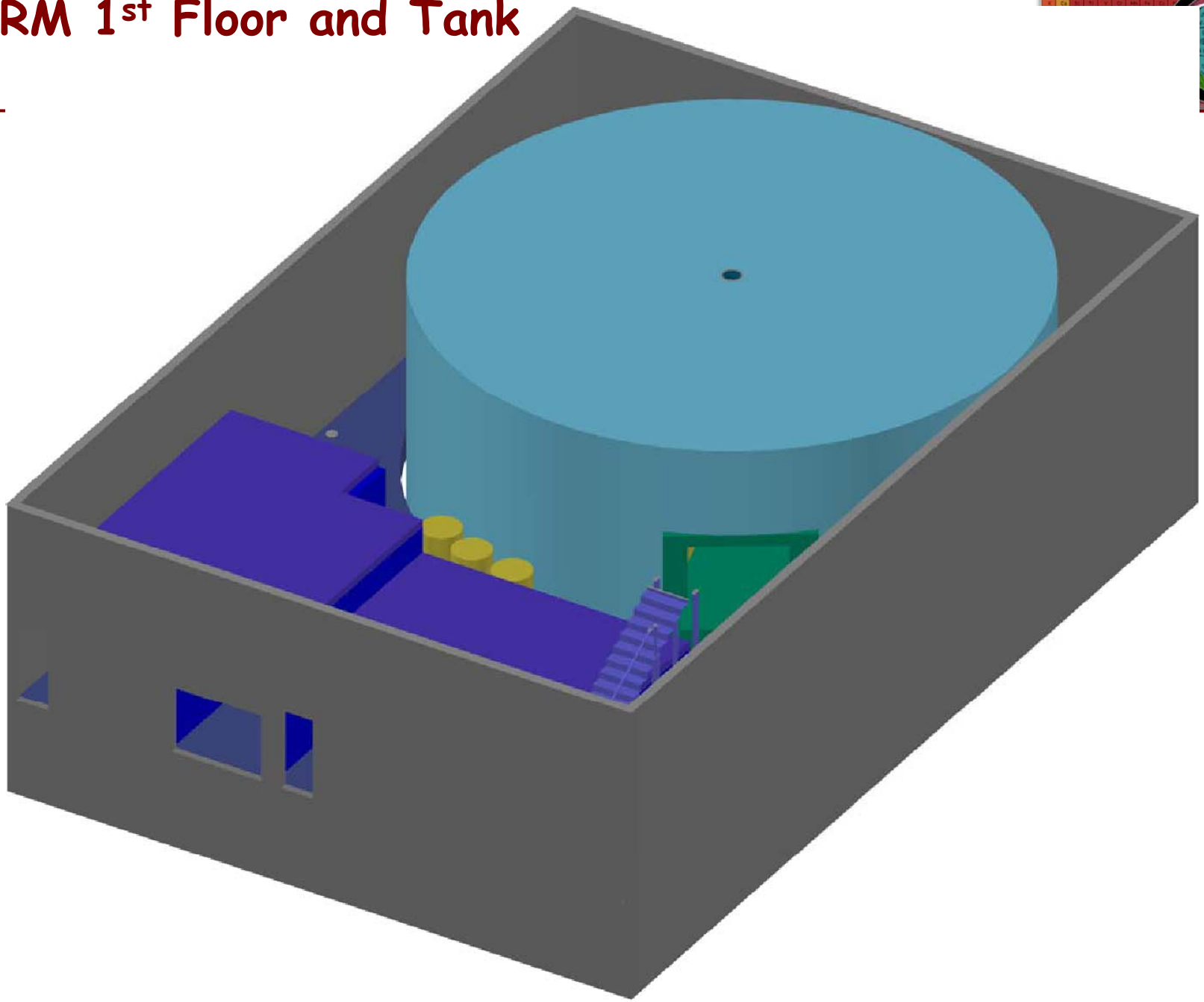




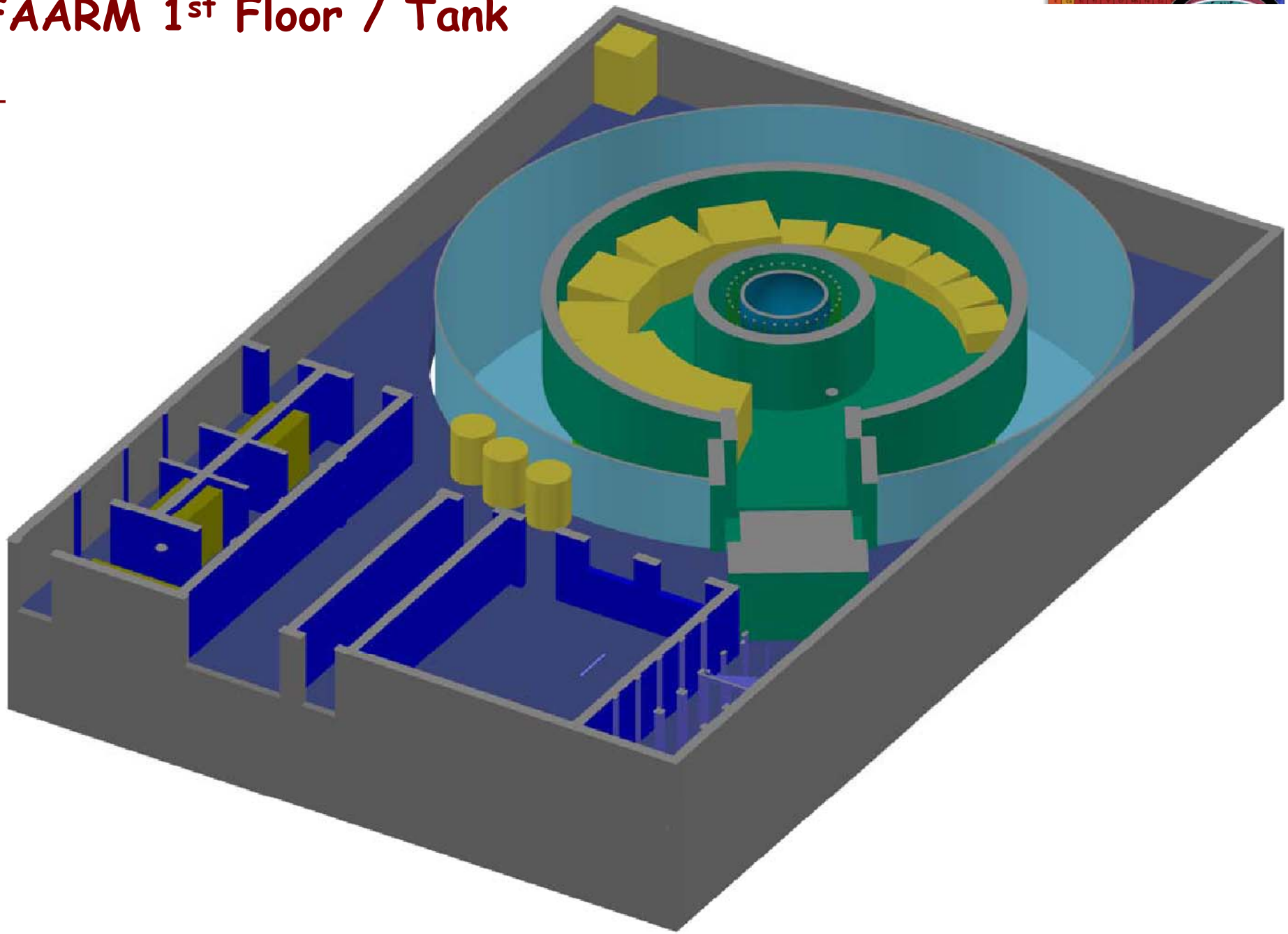
FAARM 2nd Floor



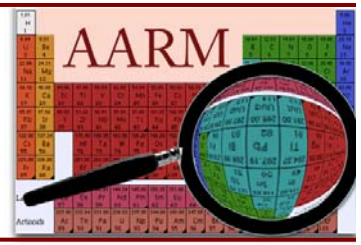
FAARM 1st Floor and Tank



FAARM 1st Floor / Tank



Depth and Location
Questions to be discussed



Key layout comments:

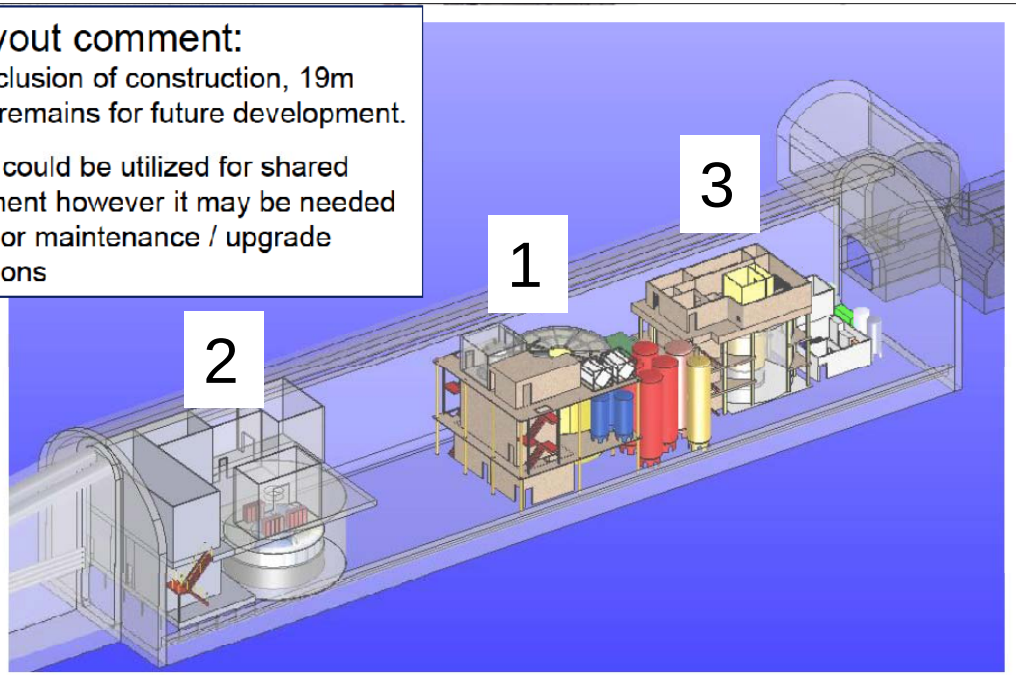
- 1st experiment is built towards module center to allow both entry drifts to remain unobstructed
- Each experiment ≤25m length
- 3m at each end of module reserved for future entry clearance

Key layout comment:

- 2nd experiment is built towards module west end to allow two lay-down areas for ongoing construction / assembly

Key layout comment:

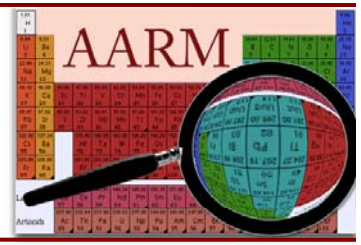
- At conclusion of construction, 19m space remains for future development.
- Space could be utilized for shared equipment however it may be needed for major maintenance / upgrade operations



Major Changes

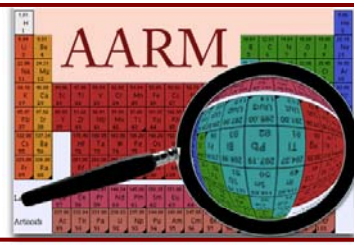
East end is a real entry
All Module-2 experiments have water tank needs
3 ISE must share space, no 3rd module.

Power Requirements



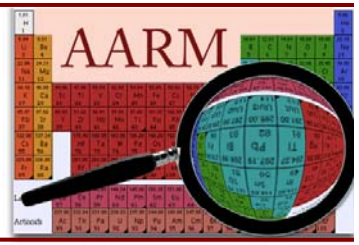
Description	Base Power Consumption (kW)	Diversity Factor	Power with Diversity Factor (kW)	Heat Sink	Comment
Clean Facility Requirements					N.A.
Water Shield	5	1	5	Air to chiller	Estimated by dlp, possible shared with others
Veto Shield		1	0	Air to chiller	Eliminated
Ultra-Sensitive Immersion Tank		1	0	Air to chiller	Eliminated
Gamma Counting Stations	15	1	15	Air to chiller	From FAARM documentation
Commercially available sub-ppb screeners	12	1	12	Air to chiller	Used "other alpha/beta counters"
Customized sub ppt screeners	2	1	2	Air to chiller	Used "other alpha/beta counters"
Ultrasensitive screeners	10	1	10	Air to chiller	Used "beta/alpha sensitive screeners"
Alpha screeners	0.6	1	0.6	Air to chiller	from Richard Schnee
Beta cages	5	1	5	Air to chiller	from Richard Schnee
Radon emanation chamber	1	1	1	Air to chiller	from below
Clean Machine Shop	10	0.25	2.5	Air to chiller	Estimate based on Majorana
Physics & chemistry storage & sample prep	0.93	1	0.93	Air to chiller	17 kWh/sf/yr
Physics & chemistry storage & sample prep	5.00	0.5	2.50	Air to chiller	From FAARM documentation, 20 amps at 220 v
Bio storage and sample prep	0.81	1	0.81	Air to chiller	17 kWh/sf/yr
Cryogen infrastructure					N.A.
Water purification infrastructure	10	1	10	Air to DUSEL	Estimate based on LUX
Radon reduction equipment				Air to DUSEL	Not included at this time
Electroforming					Located in another space
Intermediate Overburden Level					N.A.
Surface					N.A.
Lighting	22.7	0.7	15.9	Air to chiller	Space by space summary
Miscellaneous receptacle loads	22.7	0.2	4.5	Air to chiller	Same as lighting
Storage	0.60	1	0.6	Air to chiller	17 kWh/sf/yr
Control room and office	1.08	1	1.08	Air to chiller	17 kWh/sf/yr
Air handlers	75	1	75	Air to DUSEL	Extrapolated from LUX/MJ
Subtotal			164.4		
Chillers					By DUSEL
Total (all on)	**199.3**	**Total w/ Diversity**	**164.4 kW**		
		Heat loss to module	**85.0 kW**		
		Heat to chillers	**79.4 kW**		
		Heat to exhaust	**??? kW**		

Heat Balance



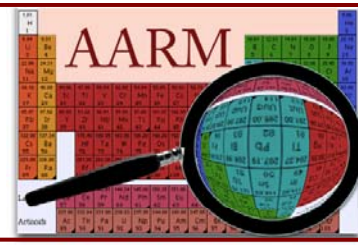
- Three categories of heat sink for FAARM
  - Into the module air
  - Into the chilled water system
  - Into the FAARM exhaust air stream
- All heat will ultimately be in the exhaust air up the ventilation shafts
- Assumptions
  - 100 percent of the electrical power consumption of the air handlers, radon system, and water system goes to the module air
  - Design is not mature enough to estimate the (small) portion of the heat that would be lost to the air exhaust

Ventilation: Clean room and Civil Engineering



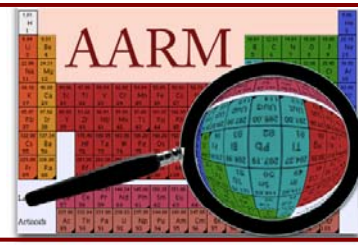
- One approach:
  - Follow ASHRAE design codes (classified clean room)
  - Based on extensive experience
  - Produce designs with large mechanical systems
  - Many air changes per hour
  - Result is a very reliable system that will produce the desire cleanliness
- Another approach:
  - Follow the experience of SNO, etc.
  - Far fewer air changes per hour
  - Achieve cleanliness with protocols and cleaning
  - Reduces capital cost, increases operating costs (labor)
  - Increases risk
  - LUX/Majorana for Davis Campus is 15 ach

Resource Loaded Schedule



- We used MS Project, 356 tasks, 150 resources
- WBS task identification
- Capital costs are MS Project “materials”
- Labor costs are MS Project “work”
- Conventional construction tasks/costs are “materials”
- Costs distinguish ten “color of money” categories
  - S4
  - Post S4
  - Other
  - CDMS
  - DULBCF
  - DUSEL
  - DUSEL R&D
  - FAARM
  - FAARM Ops
  - BGE

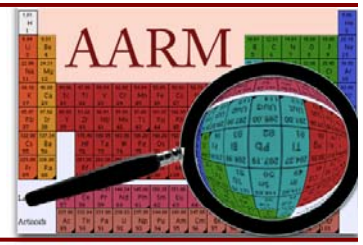
Resource Table



- 3 percent escalation on labor

ID		Resource Name	Type	Mate Labe	Initial	Group	Max. Units	Std. Rate	Ovt. Rate
155		Architect (FAARM)	Work			FAARM	100%	$154.50/h	$0.00/h
84		Architect (post S4)	Work			Post S4	100%	$154.50/h	$0.00/h
83		Architect (S4)	Work			S4	100%	$154.50/h	$0.00/h
85		Beta cage-gas handling (DULBCF)	Material			DULBCF		$10,000.00	
110		Beta cage-gas handling (DUSEL R&D)	Material			DUSEL R&D		$10,000.00	
86		Beta cage-high voltage (DULBCF)	Material			DULBCF		$5,000.00	
111		Beta cage-high voltage (DUSEL R&D)	Material			DUSEL R&D		$5,000.00	
90		Beta cage-load/lock hardware (DULBCF)	Material			DULBCF		$7,000.00	
112		Beta cage-load/lock hardware (DUSEL R&D)	Material			DUSEL R&D		$7,000.00	
82		Beta cage-MWPC grids/frames/shapers (DULBCF)	Material			DULBCF		$25,000.00	
113		Beta cage-MWPC grids/frames/shapers (DUSEL R&D)	Material			DUSEL R&D		$25,000.00	
91		Beta cage-radon purge (DULBCF)	Material			DULBCF		$3,000.00	
114		Beta cage-radon purge (DUSEL R&D)	Material			DUSEL R&D		$3,000.00	
87		Beta cage-readout electronics (DULBCF)	Material			DULBCF		$50,000.00	
115		Beta cage-readout electronics (DUSEL R&D)	Material			DUSEL R&D		$50,000.00	
88		Beta cage-shielding (DULBCF)	Material			DULBCF		$15,000.00	
116		Beta cage-shielding (DUSEL R&D)	Material			DUSEL R&D		$15,000.00	
81		Beta cage-vacuum chamber with HV feed-throughs (DULBCF)	Material			DULBCF		$20,000.00	
117		Beta cage-vacuum chamber with HV feed-throughs (DUSEL R&D)	Material			DUSEL R&D		$20,000.00	
118		BGE-cabinet storage with lead shielding – 1 m^3	Material			BGE		$95,276.00	
109		BGE-HEPA filtered laminar flow through hood	Material			BGE		$15,000.00	
65		BGE-wet bench for nucleic acid extraction	Material			BGE		$39,000.00	
134		CDMS staff	Work			CDMS	200%	$50.00/h	$0.00/h
120		Civil-Concrete	Material		C	FAARM		$0.00	
126		Civil-Doors and Windows	Material			FAARM		$29,000.00	
129		Civil-Equipment including material handling	Material		C	FAARM		$20,000.00	
127		Civil-Finishes	Material			FAARM		$159,000.00	
130		Civil-Furnishings	Material		C	FAARM		$0.00	
122		Civil-General metals	Material			FAARM		$26,000.00	
121		Civil-Masonry	Material			FAARM		$303,900.00	
119		Civil-Site Preparation	Material		C	FAARM		$0.00	
131		Civil-Special Construction	Material		C	FAARM		$0.00	
128		Civil-Specialties	Material			FAARM		$26,000.00	
123		Civil-Structural steel decks	Material			FAARM		$1,073,000.00	
125		Civil-Thermal and Moisture	Material			FAARM		$32,000.00	
124		Civil-Wood and Plastics	Material			FAARM		$9,000.00	
76		CLOVER-deployment system	Material			DULBCF		$10,000.00	
75		CLOVER-with electroformed copper cryostat	Material			DULBCF		$350,000.00	
66		Computer systems	Material			FAARM		$10,000.00	

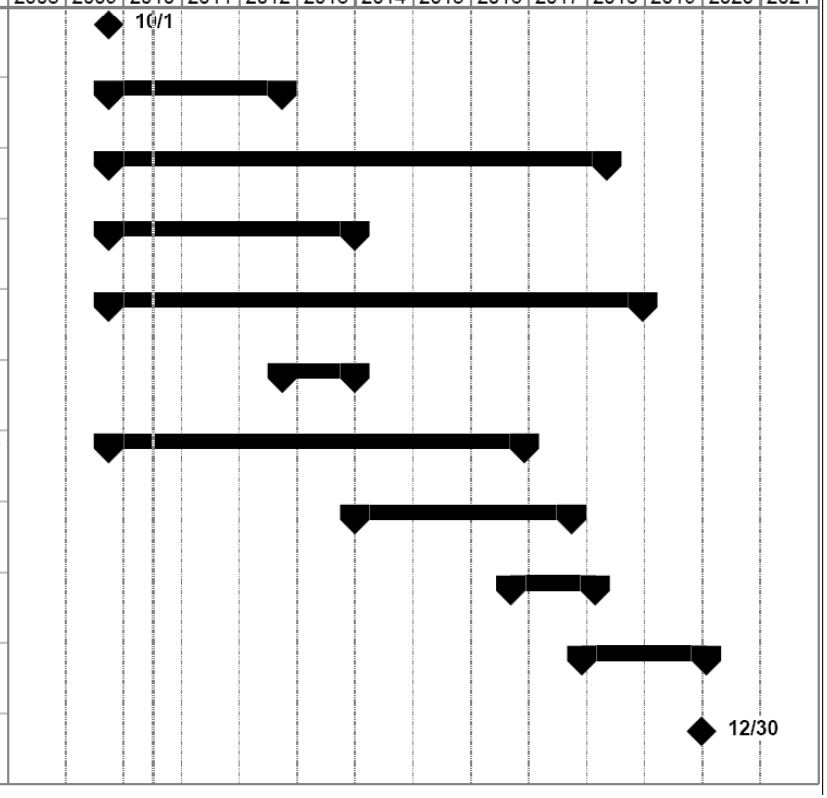
WBS Level 1 Items



1 Low Background Counting (start)
2 S4 Science Operations
3 Homestake Characterization
4 Shielding and Simulation Studies
5 Early Screening Activities
6 Post S4 Scientific Operations
7 FAARM Design Phases
8 FAARM Scientific Elements
9 FAARM Conventional Construction
10 FAARM Installation & Commissioning
11 End of schedule

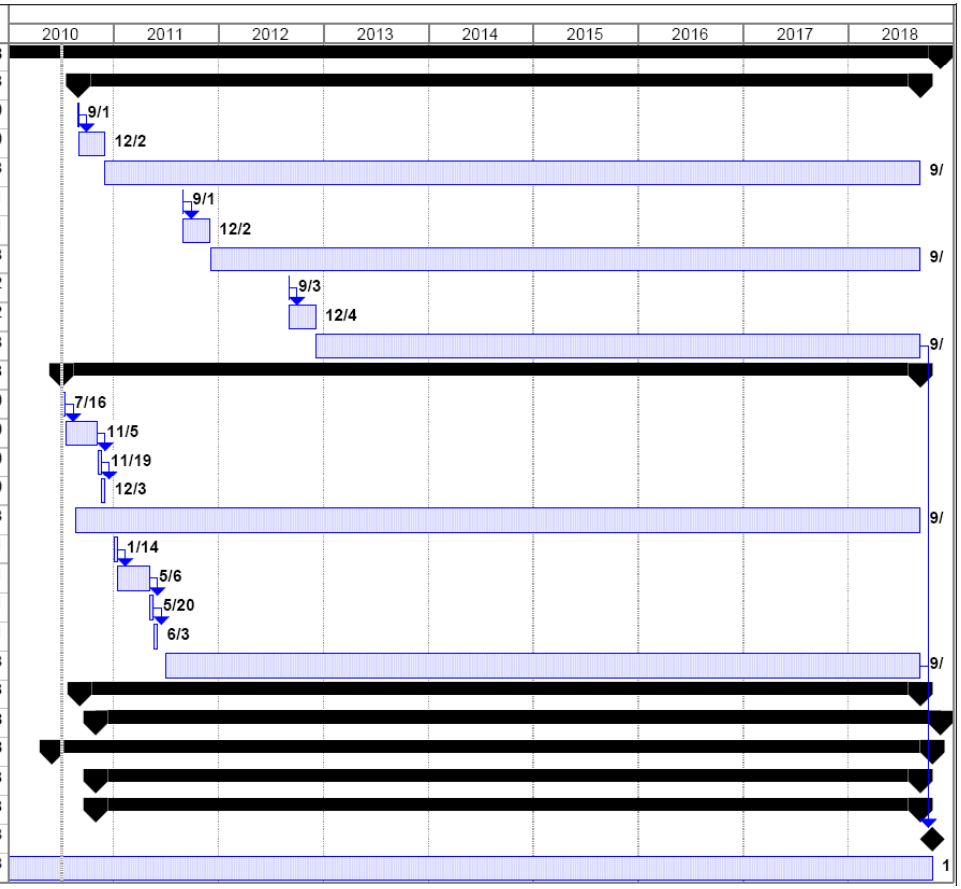
All Tasks Rolled Up

ID	WBS	Task Name	Duration	Start	Finish
1	**1**	**Low Background Counting**	**0 d**	**Thu 10/1/09**	**Thu 10/1/09**
3	**2**	**S4 Science Operations**	**782 d?**	**Thu 10/1/09**	**Fri 9/28/12**
5	**3**	**Homestake Characterization**	**2245 d**	**Thu 10/1/09**	**Wed 5/9/18**
31	**4**	**Shielding and Simulation Studies**	**1109 d**	**Thu 10/1/09**	**Tue 12/31/13**
47	**5**	**Early Screening Activities**	**2407 d?**	**Thu 10/1/09**	**Fri 12/21/18**
181	**6**	**Post S4 Scientific Operations**	**327 d**	**Mon 10/1/12**	**Tue 12/31/13**
183	**7**	**FAARM Design Phases**	**1872 d**	**Thu 10/1/09**	**Mon 12/5/16**
210	**8**	**FAARM Scientific Elements**	**978 d**	**Wed 1/1/14**	**Fri 9/29/17**
239	**9**	**FAARM Conventional Construction**	**381 d?**	**Mon 9/12/16**	**Mon 2/26/18**
302	**10**	**FAARM Installation & Commissioning**	**561 d**	**Mon 12/4/17**	**Mon 1/27/20**
378	11	End of schedule	0 d	Mon 12/30/19	Mon 12/30/19



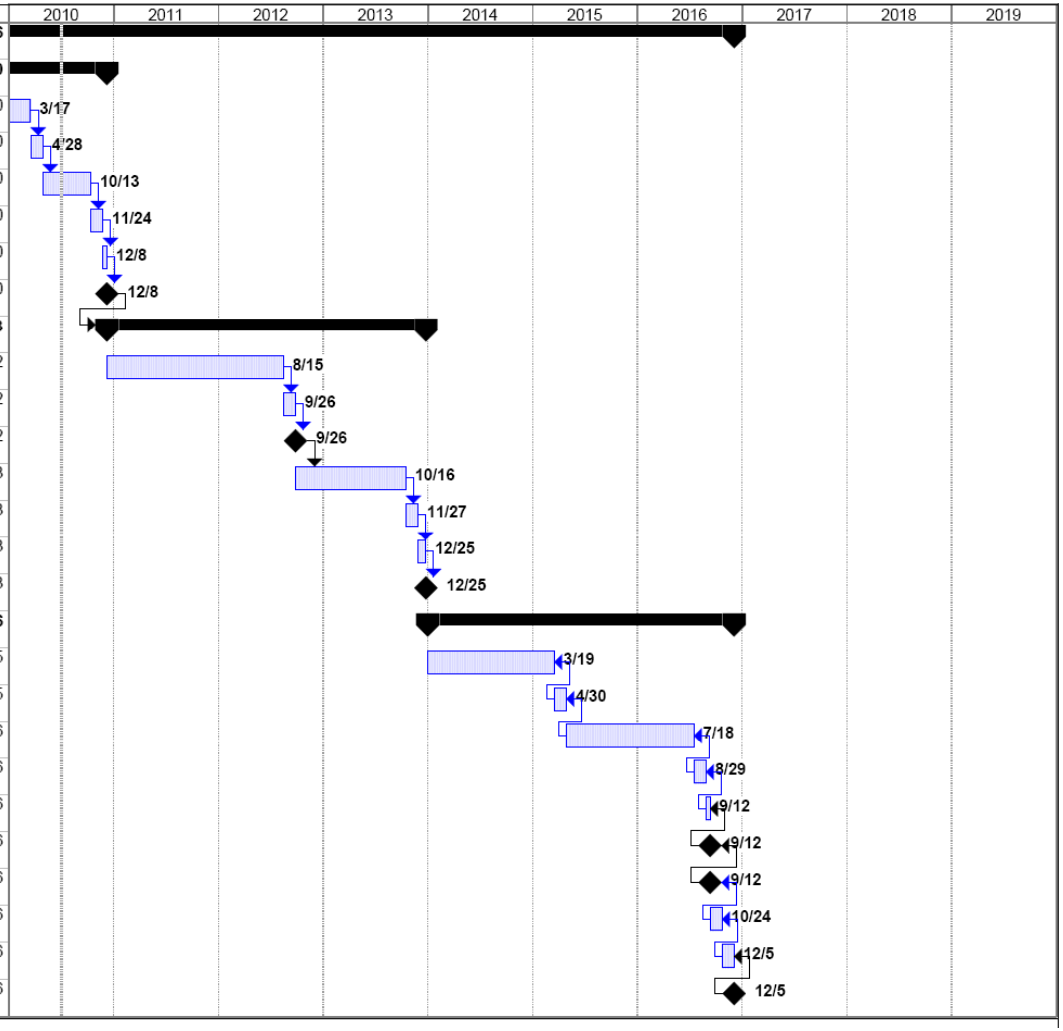
Early Screening Activities

ID	WBS	Task Name	Duration	Start	Finish
47	**5**	**Early Screening Activities**	**2382 d?**	**Thu 10/1/09**	**Mon 11/19/18**
48	5.1	Alpha screening	2093 d	Wed 9/1/10	Mon 9/10/18
49	5.1.1	Procure first XIA screener	1 d	Wed 9/1/10	Wed 9/1/10
50	5.1.2	Install and commission first XIA screener at Soudan	66 d	Thu 9/2/10	Thu 12/2/10
51	5.1.3	Conduct CDMS screening at Soudan	2026 d	Fri 12/3/10	Mon 9/10/18
52	5.1.4	Procure second XIA screener	1 d	Thu 9/1/11	Thu 9/1/11
53	5.1.5	Install and commission second XIA screener at Souc	66 d	Fri 9/2/11	Fri 12/2/11
54	5.1.6	Conduct CDMS screening at Soudan	1765 d	Mon 12/5/11	Mon 9/10/18
55	5.1.7	Procure third XIA screener	1 d	Mon 9/3/12	Mon 9/3/12
56	5.1.8	Install and commission third XIA screener at Soudar	66 d	Tue 9/4/12	Tue 12/4/12
57	5.1.9	Conduct screening at Soudan	1503 d	Wed 12/5/12	Mon 9/10/18
58	**5.2**	**Neutron detectors**	**2135 d**	**Mon 7/5/10**	**Mon 9/10/18**
59	5.2.1	Purchase components for neutron detectors	10 d	Mon 7/5/10	Fri 7/16/10
60	5.2.2	Fabricate neutron detectors	80 d	Mon 7/19/10	Fri 11/5/10
61	5.2.3	Install neutron detectors at Soudan	10 d	Mon 11/8/10	Fri 11/19/10
62	5.2.4	Integrate neutron detectors with shield	10 d	Mon 11/22/10	Fri 12/3/10
63	5.2.5	Run detectors	2100 d	Mon 8/23/10	Mon 9/10/18
64	5.2.6	Purchase components for neutron detectors	10 d	Mon 1/3/11	Fri 1/14/11
65	5.2.7	Fabricate neutron detectors	80 d	Mon 1/17/11	Fri 5/6/11
66	5.2.8	Install neutron detectors at Davis	10 d	Mon 5/9/11	Fri 5/20/11
67	5.2.9	Integrate neutron detectors with shield	10 d	Mon 5/23/11	Fri 6/3/11
68	5.2.10	Run detectors	1875 d	Mon 7/4/11	Mon 9/10/18
69	**5.3**	**GeMPI screeners**	**2090 d**	**Mon 9/6/10**	**Mon 9/10/18**
104	**5.4**	**HPGe screeners**	**2100 d**	**Mon 11/1/10**	**Mon 11/19/18**
147	**5.5**	**Beta screeners**	**2189 d**	**Tue 6/1/10**	**Mon 10/22/18**
163	**5.6**	**Other Gamma Screeners**	**2050 d**	**Mon 11/1/10**	**Mon 9/10/18**
171	**5.7**	**Radon Emanation Chamber**	**2050 d**	**Mon 11/1/10**	**Mon 9/10/18**
179	5.8	End of early screening tasks	0 d	Mon 10/22/18	Mon 10/22/18
180	5.9	DULBCF Activities (hammock task)	2362 d?	Thu 10/1/09	Mon 10/22/18



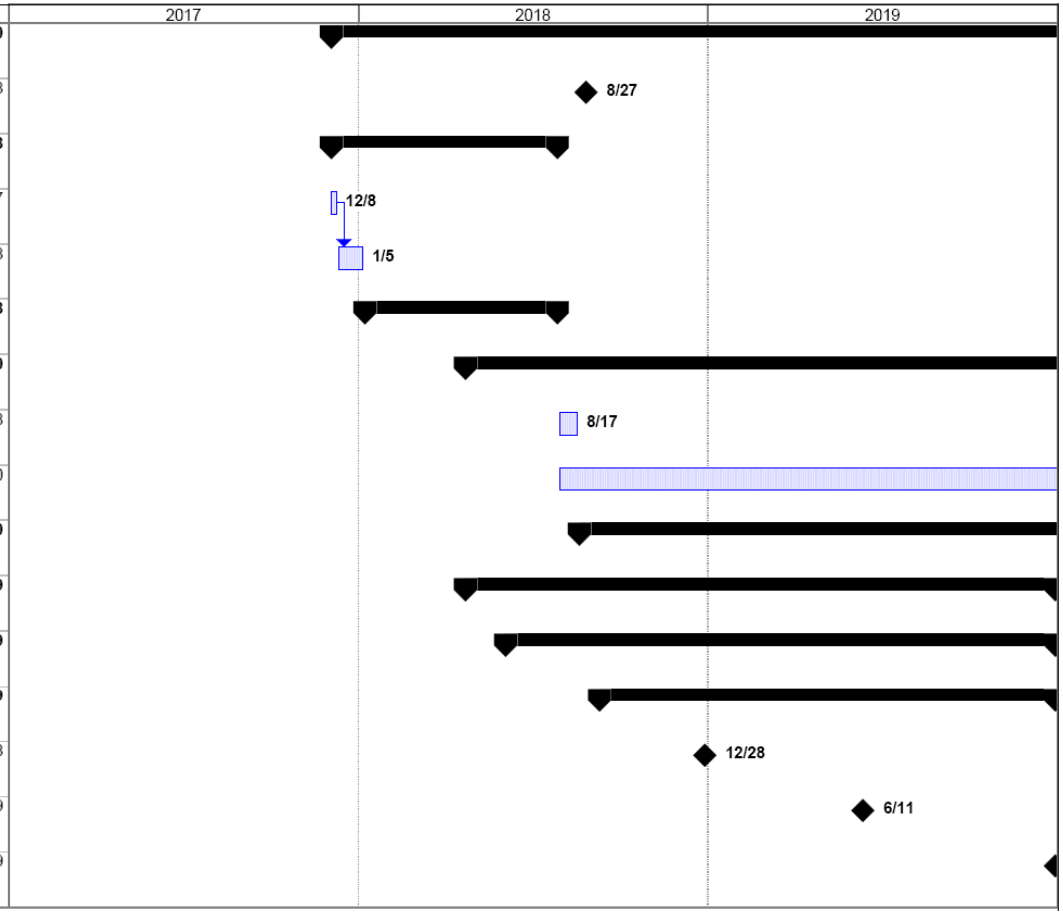
Design Phases

ID	WBS	Task Name	Duration	Start	Finish
183	**7**	**FAARM Design Phases**	**1872 d**	**Thu 10/1/09**	**Mon 12/5/16**
184	**7.1**	**FAARM Conceptual Design**	**310 d**	**Thu 10/1/09**	**Wed 12/8/10**
185	7.1.1	Conceptual design phase 1	120 d	Thu 10/1/09	Wed 3/17/10
186	7.1.2	Design review	30 d	Thu 3/18/10	Wed 4/28/10
187	7.1.3	Conceptual design phase 2	120 d	Thu 4/29/10	Wed 10/13/10
188	7.1.4	Design review	30 d	Thu 10/14/10	Wed 11/24/10
189	7.1.5	Conceptual design updates from design revi	10 d	Thu 11/25/10	Wed 12/8/10
190	7.1.6	Conceptual design complete	0 d	Wed 12/8/10	Wed 12/8/10
191	**7.2**	**FAARM Preliminary Design**	**795 d**	**Thu 12/9/10**	**Wed 12/25/13**
192	7.2.1	Preliminary design phase 1	440 d	Thu 12/9/10	Wed 8/15/12
193	7.2.2	Design review	30 d	Thu 8/16/12	Wed 9/26/12
194	7.2.3	Completion of preliminary design with S4 fur	0 d	Wed 9/26/12	Wed 9/26/12
195	7.2.4	Preliminary design phase 2	275 d	Thu 9/27/12	Wed 10/16/13
196	7.2.5	Design review	30 d	Thu 10/17/13	Wed 11/27/13
197	7.2.6	Preliminary design updates from design revi	20 d	Thu 11/28/13	Wed 12/25/13
198	7.2.7	Preliminary design complete	0 d	Wed 12/25/13	Wed 12/25/13
199	**7.3**	**FAARM Final Design**	**763 d**	**Wed 1/1/14**	**Mon 12/5/16**
200	7.3.1	Final design phase 1	316 d	Wed 1/1/14	Thu 3/19/15
201	7.3.2	Design review	30 d	Thu 3/19/15	Thu 4/30/15
202	7.3.3	Final design phase 2	317 d	Thu 4/30/15	Mon 7/18/16
203	7.3.4	Design review	30 d	Mon 7/18/16	Mon 8/29/16
204	7.3.5	Final design updates from design review	10 d	Mon 8/29/16	Mon 9/12/16
205	7.3.6	Documents ready for procurement	0 d	Mon 9/12/16	Mon 9/12/16
206	7.3.7	Procurement approved, funding authorized	0 d	Mon 9/12/16	Mon 9/12/16
207	7.3.8	Bidding phase	30 d	Mon 9/12/16	Mon 10/24/16
208	7.3.9	Contracting phase	30 d	Mon 10/24/16	Mon 12/5/16
209	7.3.10	FAARM Notice to Proceed	0 d	Mon 12/5/16	Mon 12/5/16



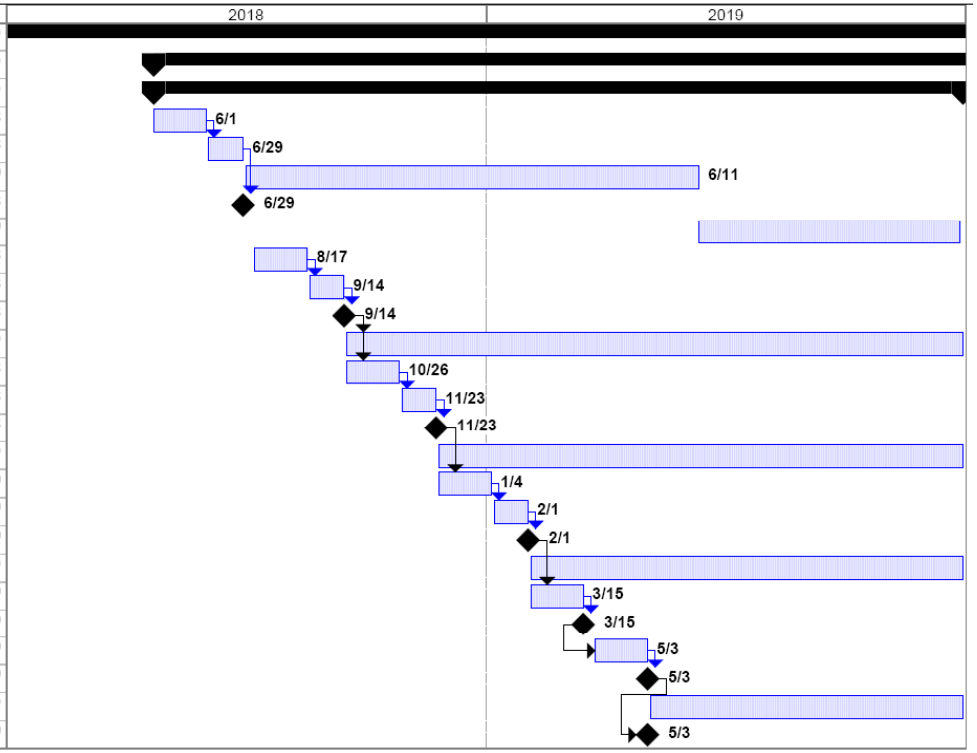
FAARM Installation & Commissioning

ID	WBS	Task Name	Duration	Start	Finish
302	**10**	**FAARM Installation & Commissioning**	**561 d**	**Mon 12/4/17**	**Mon 1/27/20**
303	10.1	FAARM screening starts 1	0 d	Mon 8/27/18	Mon 8/27/18
304	**10.2**	**Phase 1: Moderate Cleanliness**	**170 d**	**Mon 12/4/17**	**Fri 7/27/18**
305	10.2.1	Establish moderate cleanliness protocols	5 d	Mon 12/4/17	Fri 12/8/17
306	10.2.2	Clean entire FAARM	20 d	Mon 12/11/17	Fri 1/5/18
307	**10.2.3**	**Water Shield Commissioning**	**145 d**	**Mon 1/8/18**	**Fri 7/27/18**
317	**10.3**	**Phase 2: Tight Cleanliness**	**461 d**	**Mon 4/23/18**	**Mon 1/27/20**
318	10.3.1	Establish tight cleanliness protocols	15 d	Mon 7/30/18	Fri 8/17/18
319	10.3.2	Monitor particulate level and radon	391 d	Mon 7/30/18	Mon 1/27/20
320	**10.3.3**	**Immersion Tank Commissioning**	**376 d**	**Mon 8/20/18**	**Mon 1/27/20**
333	**10.3.4**	**Gamma screener installation and commis**	**440 d**	**Mon 4/23/18**	**Mon 12/30/19**
357	**10.3.5**	**Beta Screener Installation and Commissi**	**410 d**	**Mon 6/4/18**	**Mon 12/30/19**
371	**10.3.6**	**Alpha Screener Installation and Commiss**	**340 d**	**Mon 9/10/18**	**Mon 12/30/19**
376	10.4	Decommission Soudan LBCF	0 d	Fri 12/28/18	Fri 12/28/18
377	10.5	FAARM Fully Operational	0 d	Tue 6/11/19	Tue 6/11/19
378	11	End of schedule	0 d	Mon 12/30/19	Mon 12/30/19

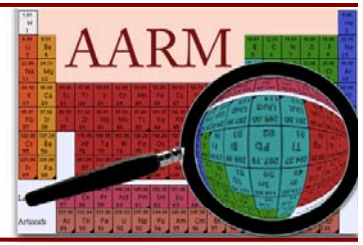


FAARM Installation & Commissioning (detail)

ID	WBS	Task Name	Duration	Start	Finish
302	**10**	**FAARM Installation & Commissioning**	**561 d**	**Mon 12/4/17**	**Mon 1/27/20**
317	**10.3**	**Phase 2: Tight Cleanliness**	**461 d**	**Mon 4/23/18**	**Mon 1/27/20**
333	**10.3.4**	**Gamma screener installation and commissioning**	**440 d**	**Mon 4/23/18**	**Mon 12/30/19**
334	10.3.4.1	Move GeMPI-1 from Soudan to FAARM	30 d	Mon 4/23/18	Fri 6/1/18
335	10.3.4.2	Commission GeMPI-1	20 d	Mon 6/4/18	Fri 6/29/18
336	10.3.4.3	Run GeMPI-1 as Monitor	247 d	Mon 7/2/18	Tue 6/11/19
337	10.3.4.4	GeMPI-1 Screening begins at FAARM	0 d	Fri 6/29/18	Fri 6/29/18
338	10.3.4.5	GeMPI-1 Screening	143 d	Wed 6/12/19	Fri 12/27/19
339	10.3.4.6	Move GeMPI-2 from Soudan to FAARM	30 d	Mon 7/9/18	Fri 8/17/18
340	10.3.4.7	Commission GeMPI-2	20 d	Mon 8/20/18	Fri 9/14/18
341	10.3.4.8	GeMPI-2 Screening begins at FAARM	0 d	Fri 9/14/18	Fri 9/14/18
342	10.3.4.9	GeMPI-2 Screening	335 d	Mon 9/17/18	Mon 12/30/19
343	10.3.4.10	Move GeMPI-3 from Soudan to FAARM	30 d	Mon 9/17/18	Fri 10/26/18
344	10.3.4.11	Commission GeMPI-3	20 d	Mon 10/29/18	Fri 11/23/18
345	10.3.4.12	GeMPI-3 Screening begins at FAARM	0 d	Fri 11/23/18	Fri 11/23/18
346	10.3.4.13	GeMPI-3 Screening	285 d	Mon 11/26/18	Mon 12/30/19
347	10.3.4.14	Move GeMPI-4 from Soudan to FAARM	30 d	Mon 11/26/18	Fri 1/4/19
348	10.3.4.15	Commission GeMPI-4	20 d	Mon 1/7/19	Fri 2/1/19
349	10.3.4.16	GeMPI-4 Screening begins at FAARM	0 d	Fri 2/1/19	Fri 2/1/19
350	10.3.4.17	GeMPI-4 Screening	235 d	Mon 2/4/19	Mon 12/30/19
351	10.3.4.18	Move conventional HPGe's from Davis to FAAF	30 d	Mon 2/4/19	Fri 3/15/19
352	10.3.4.19	Davis LBCF available for other exper.	0 d	Fri 3/15/19	Fri 3/15/19
353	10.3.4.20	Commission HPGe's	30 d	Mon 3/25/19	Fri 5/3/19
354	10.3.4.21	HPGe screening begins at FAARM	0 d	Fri 5/3/19	Fri 5/3/19
355	10.3.4.22	HPGe Screening	170 d	Mon 5/6/19	Mon 12/30/19
356	10.3.4.23	All gamma screening at FAARM	0 d	Fri 5/3/19	Fri 5/3/19



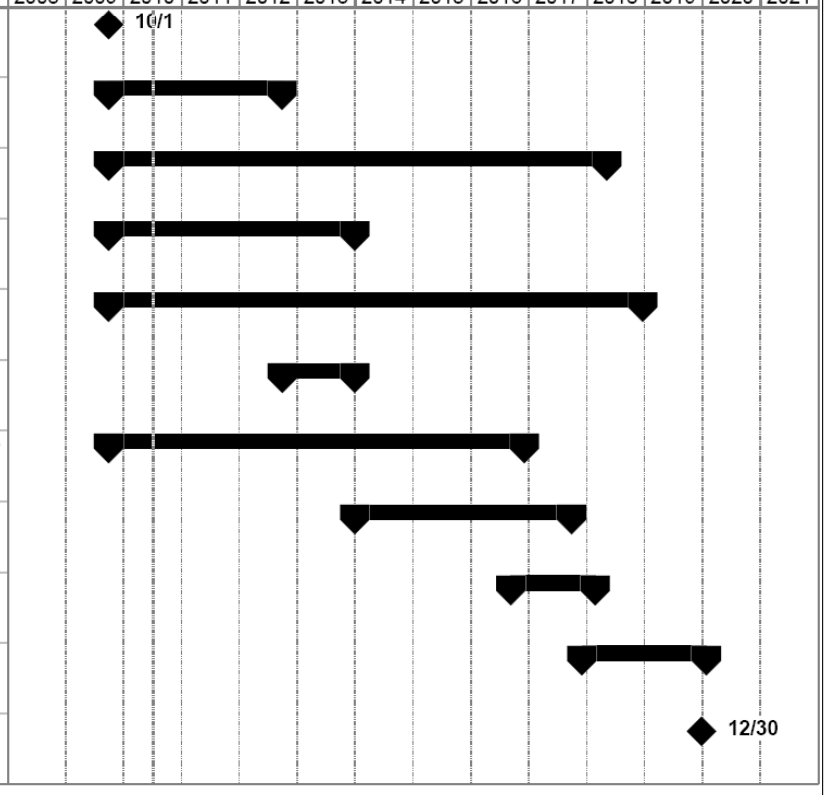
WBS Level 1 Items



1 Low Background Counting (start)
2 S4 Science Operations
3 Homestake Characterization
4 Shielding and Simulation Studies
5 Early Screening Activities
6 Post S4 Scientific Operations
7 FAARM Design Phases
8 FAARM Scientific Elements
9 FAARM Conventional Construction
10 FAARM Installation & Commissioning
11 End of schedule

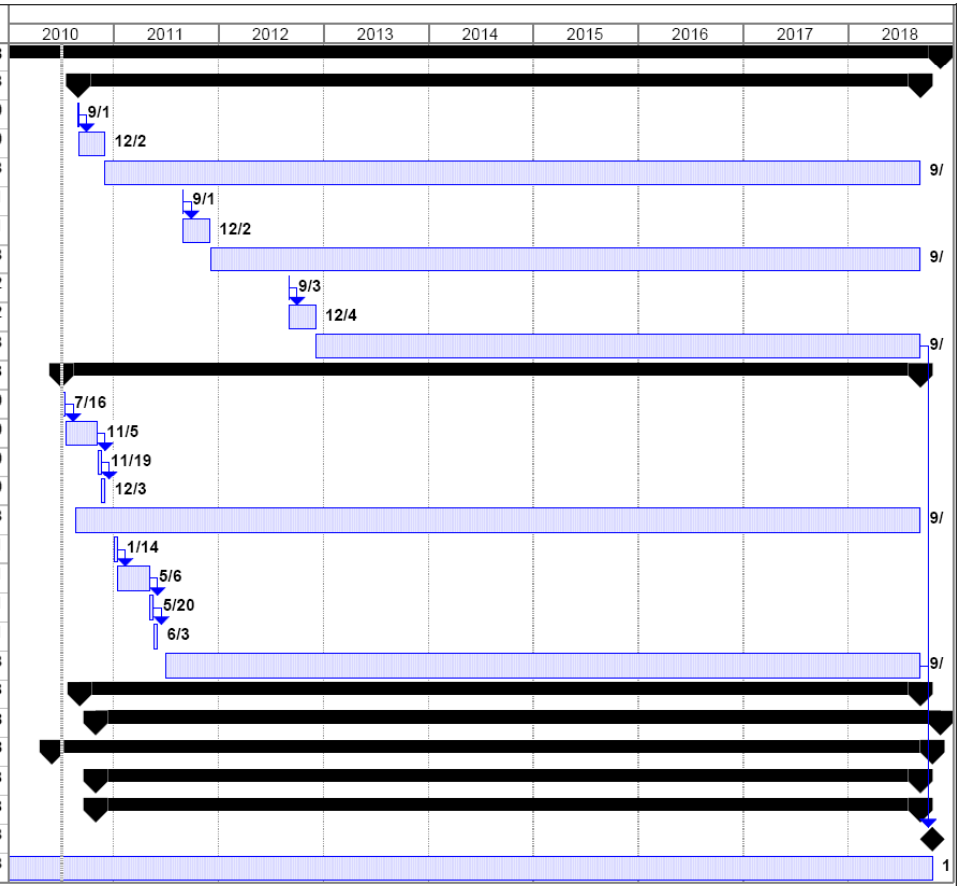
All Tasks Rolled Up

ID	WBS	Task Name	Duration	Start	Finish
1	**1**	**Low Background Counting**	**0 d**	**Thu 10/1/09**	**Thu 10/1/09**
3	**2**	**S4 Science Operations**	**782 d?**	**Thu 10/1/09**	**Fri 9/28/12**
5	**3**	**Homestake Characterization**	**2245 d**	**Thu 10/1/09**	**Wed 5/9/18**
31	**4**	**Shielding and Simulation Studies**	**1109 d**	**Thu 10/1/09**	**Tue 12/31/13**
47	**5**	**Early Screening Activities**	**2407 d?**	**Thu 10/1/09**	**Fri 12/21/18**
181	**6**	**Post S4 Scientific Operations**	**327 d**	**Mon 10/1/12**	**Tue 12/31/13**
183	**7**	**FAARM Design Phases**	**1872 d**	**Thu 10/1/09**	**Mon 12/5/16**
210	**8**	**FAARM Scientific Elements**	**978 d**	**Wed 1/1/14**	**Fri 9/29/17**
239	**9**	**FAARM Conventional Construction**	**381 d?**	**Mon 9/12/16**	**Mon 2/26/18**
302	**10**	**FAARM Installation & Commissioning**	**561 d**	**Mon 12/4/17**	**Mon 1/27/20**
378	11	End of schedule	0 d	Mon 12/30/19	Mon 12/30/19



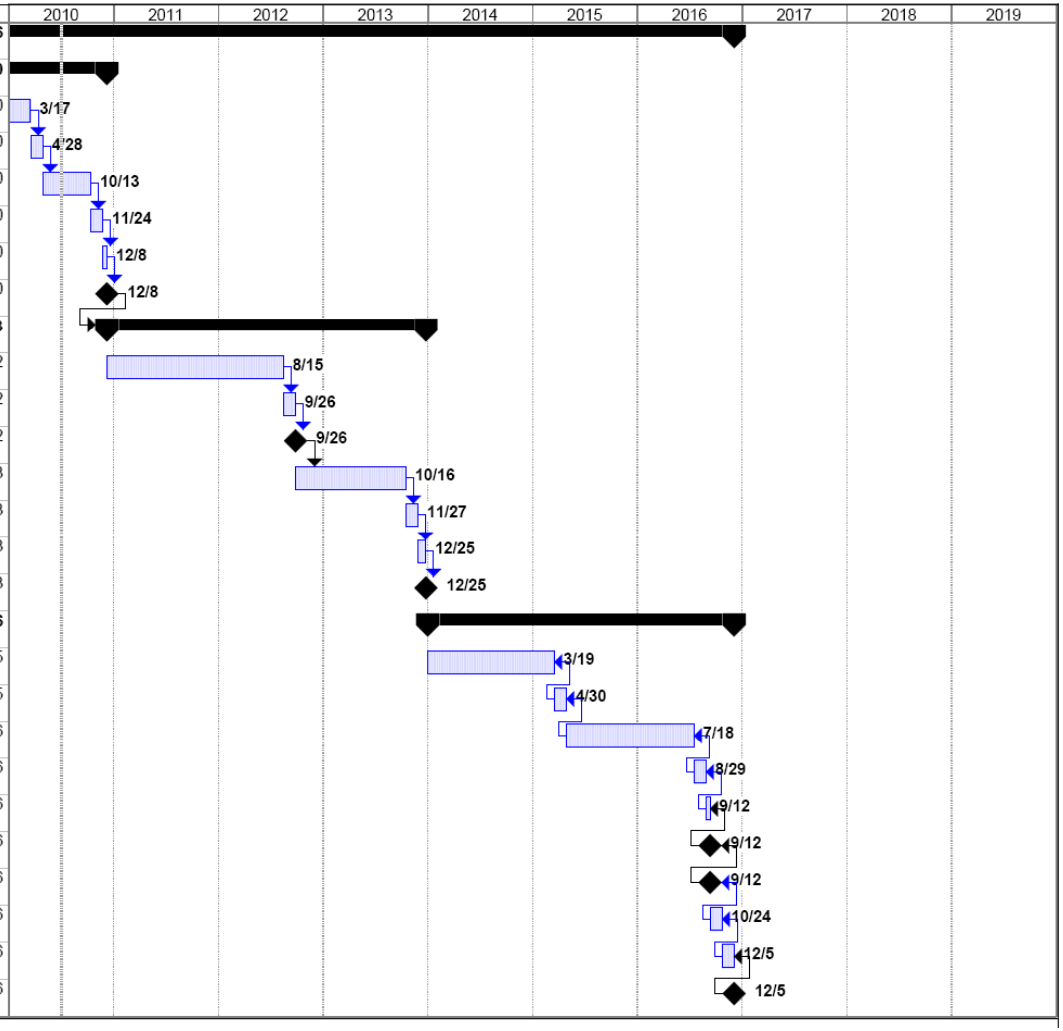
Early Screening Activities

ID	WBS	Task Name	Duration	Start	Finish
47	**5**	**Early Screening Activities**	**2382 d?**	**Thu 10/1/09**	**Mon 11/19/18**
48	5.1	Alpha screening	2093 d	Wed 9/1/10	Mon 9/10/18
49	5.1.1	Procure first XIA screener	1 d	Wed 9/1/10	Wed 9/1/10
50	5.1.2	Install and commission first XIA screener at Soudan	66 d	Thu 9/2/10	Thu 12/2/10
51	5.1.3	Conduct CDMS screening at Soudan	2026 d	Fri 12/3/10	Mon 9/10/18
52	5.1.4	Procure second XIA screener	1 d	Thu 9/1/11	Thu 9/1/11
53	5.1.5	Install and commission second XIA screener at Souc	66 d	Fri 9/2/11	Fri 12/2/11
54	5.1.6	Conduct CDMS screening at Soudan	1765 d	Mon 12/5/11	Mon 9/10/18
55	5.1.7	Procure third XIA screener	1 d	Mon 9/3/12	Mon 9/3/12
56	5.1.8	Install and commission third XIA screener at Soudar	66 d	Tue 9/4/12	Tue 12/4/12
57	5.1.9	Conduct screening at Soudan	1503 d	Wed 12/5/12	Mon 9/10/18
58	**5.2**	**Neutron detectors**	**2135 d**	**Mon 7/5/10**	**Mon 9/10/18**
59	5.2.1	Purchase components for neutron detectors	10 d	Mon 7/5/10	Fri 7/16/10
60	5.2.2	Fabricate neutron detectors	80 d	Mon 7/19/10	Fri 11/5/10
61	5.2.3	Install neutron detectors at Soudan	10 d	Mon 11/8/10	Fri 11/19/10
62	5.2.4	Integrate neutron detectors with shield	10 d	Mon 11/22/10	Fri 12/3/10
63	5.2.5	Run detectors	2100 d	Mon 8/23/10	Mon 9/10/18
64	5.2.6	Purchase components for neutron detectors	10 d	Mon 1/3/11	Fri 1/14/11
65	5.2.7	Fabricate neutron detectors	80 d	Mon 1/17/11	Fri 5/6/11
66	5.2.8	Install neutron detectors at Davis	10 d	Mon 5/9/11	Fri 5/20/11
67	5.2.9	Integrate neutron detectors with shield	10 d	Mon 5/23/11	Fri 6/3/11
68	5.2.10	Run detectors	1875 d	Mon 7/4/11	Mon 9/10/18
69	**5.3**	**GeMPI screeners**	**2090 d**	**Mon 9/6/10**	**Mon 9/10/18**
104	**5.4**	**HPGe screeners**	**2100 d**	**Mon 11/1/10**	**Mon 11/19/18**
147	**5.5**	**Beta screeners**	**2189 d**	**Tue 6/1/10**	**Mon 10/22/18**
163	**5.6**	**Other Gamma Screeners**	**2050 d**	**Mon 11/1/10**	**Mon 9/10/18**
171	**5.7**	**Radon Emanation Chamber**	**2050 d**	**Mon 11/1/10**	**Mon 9/10/18**
179	5.8	End of early screening tasks	0 d	Mon 10/22/18	Mon 10/22/18
180	5.9	DULBCF Activities (hammock task)	2362 d?	Thu 10/1/09	Mon 10/22/18



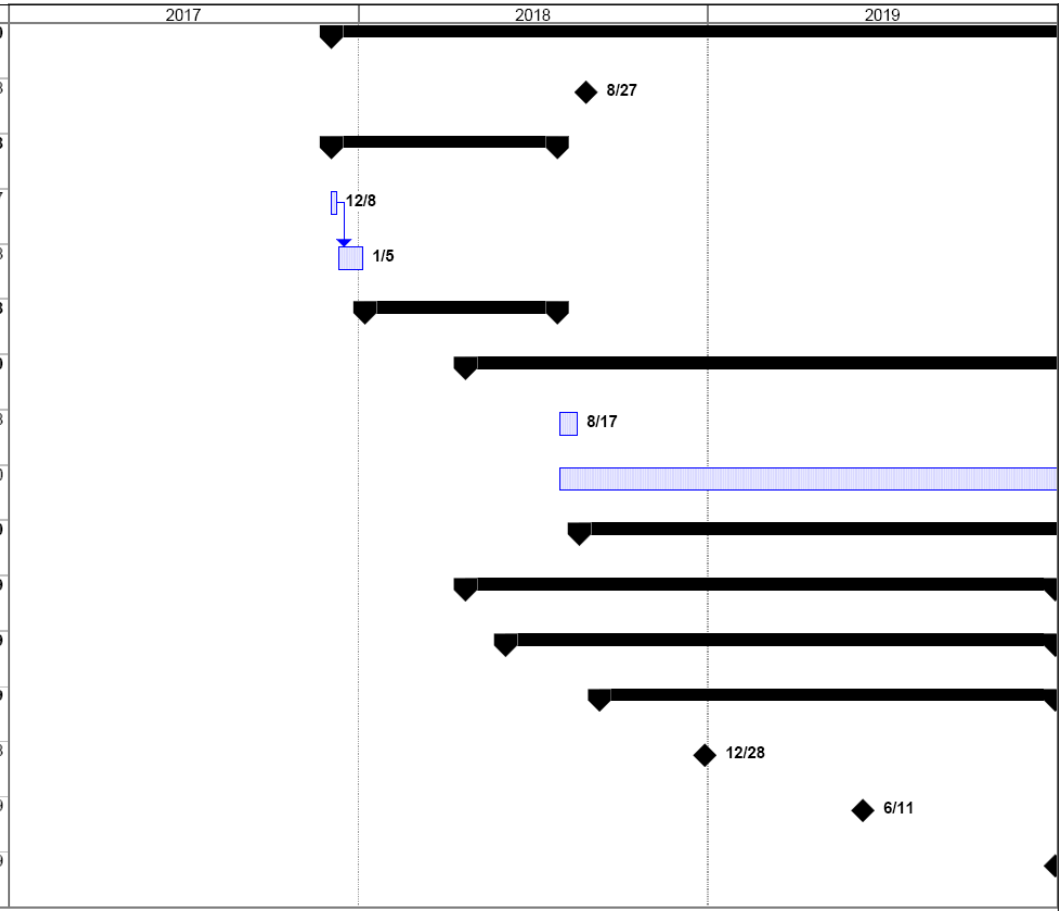
Design Phases

ID	WBS	Task Name	Duration	Start	Finish
183	**7**	**FAARM Design Phases**	**1872 d**	**Thu 10/1/09**	**Mon 12/5/16**
184	**7.1**	**FAARM Conceptual Design**	**310 d**	**Thu 10/1/09**	**Wed 12/8/10**
185	7.1.1	Conceptual design phase 1	120 d	Thu 10/1/09	Wed 3/17/10
186	7.1.2	Design review	30 d	Thu 3/18/10	Wed 4/28/10
187	7.1.3	Conceptual design phase 2	120 d	Thu 4/29/10	Wed 10/13/10
188	7.1.4	Design review	30 d	Thu 10/14/10	Wed 11/24/10
189	7.1.5	Conceptual design updates from design revi	10 d	Thu 11/25/10	Wed 12/8/10
190	7.1.6	Conceptual design complete	0 d	Wed 12/8/10	Wed 12/8/10
191	**7.2**	**FAARM Preliminary Design**	**795 d**	**Thu 12/9/10**	**Wed 12/25/13**
192	7.2.1	Preliminary design phase 1	440 d	Thu 12/9/10	Wed 8/15/12
193	7.2.2	Design review	30 d	Thu 8/16/12	Wed 9/26/12
194	7.2.3	Completion of preliminary design with S4 fur	0 d	Wed 9/26/12	Wed 9/26/12
195	7.2.4	Preliminary design phase 2	275 d	Thu 9/27/12	Wed 10/16/13
196	7.2.5	Design review	30 d	Thu 10/17/13	Wed 11/27/13
197	7.2.6	Preliminary design updates from design revi	20 d	Thu 11/28/13	Wed 12/25/13
198	7.2.7	Preliminary design complete	0 d	Wed 12/25/13	Wed 12/25/13
199	**7.3**	**FAARM Final Design**	**763 d**	**Wed 1/1/14**	**Mon 12/5/16**
200	7.3.1	Final design phase 1	316 d	Wed 1/1/14	Thu 3/19/15
201	7.3.2	Design review	30 d	Thu 3/19/15	Thu 4/30/15
202	7.3.3	Final design phase 2	317 d	Thu 4/30/15	Mon 7/18/16
203	7.3.4	Design review	30 d	Mon 7/18/16	Mon 8/29/16
204	7.3.5	Final design updates from design review	10 d	Mon 8/29/16	Mon 9/12/16
205	7.3.6	Documents ready for procurement	0 d	Mon 9/12/16	Mon 9/12/16
206	7.3.7	Procurement approved, funding authorized	0 d	Mon 9/12/16	Mon 9/12/16
207	7.3.8	Bidding phase	30 d	Mon 9/12/16	Mon 10/24/16
208	7.3.9	Contracting phase	30 d	Mon 10/24/16	Mon 12/5/16
209	7.3.10	FAARM Notice to Proceed	0 d	Mon 12/5/16	Mon 12/5/16



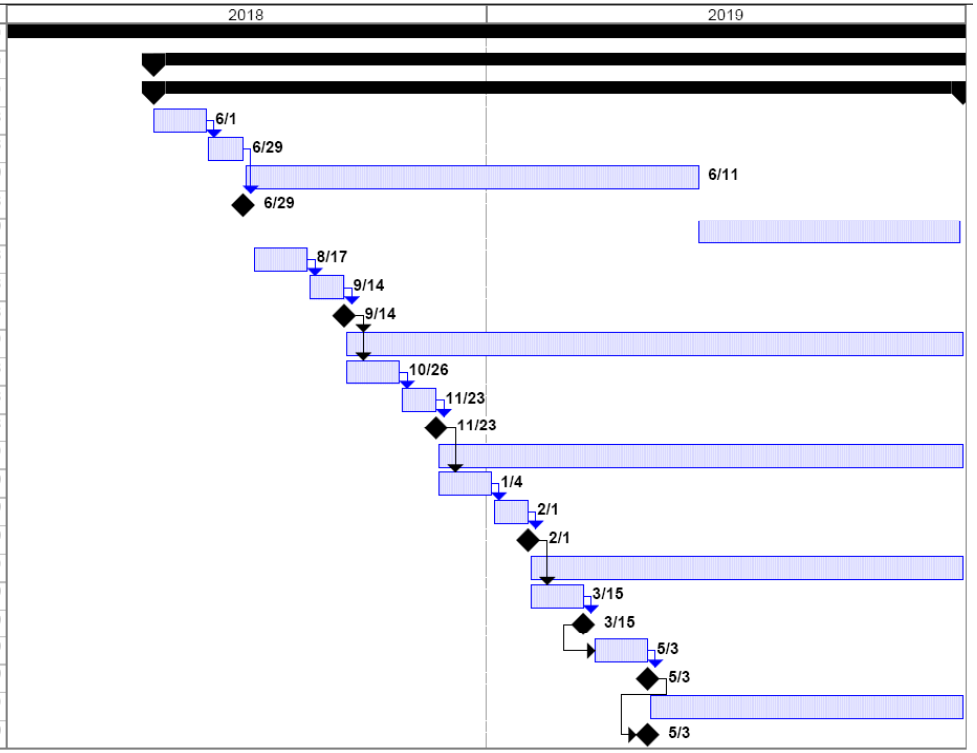
FAARM Installation & Commissioning

ID	WBS	Task Name	Duration	Start	Finish
302	**10**	**FAARM Installation & Commissioning**	**561 d**	**Mon 12/4/17**	**Mon 1/27/20**
303	10.1	FAARM screening starts 1	0 d	Mon 8/27/18	Mon 8/27/18
304	**10.2**	**Phase 1: Moderate Cleanliness**	**170 d**	**Mon 12/4/17**	**Fri 7/27/18**
305	10.2.1	Establish moderate cleanliness protocols	5 d	Mon 12/4/17	Fri 12/8/17
306	10.2.2	Clean entire FAARM	20 d	Mon 12/11/17	Fri 1/5/18
307	**10.2.3**	**Water Shield Commissioning**	**145 d**	**Mon 1/8/18**	**Fri 7/27/18**
317	**10.3**	**Phase 2: Tight Cleanliness**	**461 d**	**Mon 4/23/18**	**Mon 1/27/20**
318	10.3.1	Establish tight cleanliness protocols	15 d	Mon 7/30/18	Fri 8/17/18
319	10.3.2	Monitor particulate level and radon	391 d	Mon 7/30/18	Mon 1/27/20
320	**10.3.3**	**Immersion Tank Commissioning**	**376 d**	**Mon 8/20/18**	**Mon 1/27/20**
333	**10.3.4**	**Gamma screener installation and commis**	**440 d**	**Mon 4/23/18**	**Mon 12/30/19**
357	**10.3.5**	**Beta Screener Installation and Commissi**	**410 d**	**Mon 6/4/18**	**Mon 12/30/19**
371	**10.3.6**	**Alpha Screener Installation and Commiss**	**340 d**	**Mon 9/10/18**	**Mon 12/30/19**
376	10.4	Decommission Soudan LBCF	0 d	Fri 12/28/18	Fri 12/28/18
377	10.5	FAARM Fully Operational	0 d	Tue 6/11/19	Tue 6/11/19
378	11	End of schedule	0 d	Mon 12/30/19	Mon 12/30/19



FAARM Installation & Commissioning (detail)

ID	WBS	Task Name	Duration	Start	Finish
302	**10**	**FAARM Installation & Commissioning**	**561 d**	**Mon 12/4/17**	**Mon 1/27/20**
317	**10.3**	**Phase 2: Tight Cleanliness**	**461 d**	**Mon 4/23/18**	**Mon 1/27/20**
333	**10.3.4**	**Gamma screener installation and commissioning**	**440 d**	**Mon 4/23/18**	**Mon 12/30/19**
334	10.3.4.1	Move GeMPI-1 from Soudan to FAARM	30 d	Mon 4/23/18	Fri 6/1/18
335	10.3.4.2	Commission GeMPI-1	20 d	Mon 6/4/18	Fri 6/29/18
336	10.3.4.3	Run GeMPI-1 as Monitor	247 d	Mon 7/2/18	Tue 6/11/19
337	10.3.4.4	GeMPI-1 Screening begins at FAARM	0 d	Fri 6/29/18	Fri 6/29/18
338	10.3.4.5	GeMPI-1 Screening	143 d	Wed 6/12/19	Fri 12/27/19
339	10.3.4.6	Move GeMPI-2 from Soudan to FAARM	30 d	Mon 7/9/18	Fri 8/17/18
340	10.3.4.7	Commission GeMPI-2	20 d	Mon 8/20/18	Fri 9/14/18
341	10.3.4.8	GeMPI-2 Screening begins at FAARM	0 d	Fri 9/14/18	Fri 9/14/18
342	10.3.4.9	GeMPI-2 Screening	335 d	Mon 9/17/18	Mon 12/30/19
343	10.3.4.10	Move GeMPI-3 from Soudan to FAARM	30 d	Mon 9/17/18	Fri 10/26/18
344	10.3.4.11	Commission GeMPI-3	20 d	Mon 10/29/18	Fri 11/23/18
345	10.3.4.12	GeMPI-3 Screening begins at FAARM	0 d	Fri 11/23/18	Fri 11/23/18
346	10.3.4.13	GeMPI-3 Screening	285 d	Mon 11/26/18	Mon 12/30/19
347	10.3.4.14	Move GeMPI-4 from Soudan to FAARM	30 d	Mon 11/26/18	Fri 1/4/19
348	10.3.4.15	Commission GeMPI-4	20 d	Mon 1/7/19	Fri 2/1/19
349	10.3.4.16	GeMPI-4 Screening begins at FAARM	0 d	Fri 2/1/19	Fri 2/1/19
350	10.3.4.17	GeMPI-4 Screening	235 d	Mon 2/4/19	Mon 12/30/19
351	10.3.4.18	Move conventional HPGe's from Davis to FAAF	30 d	Mon 2/4/19	Fri 3/15/19
352	10.3.4.19	Davis LBCF available for other exper.	0 d	Fri 3/15/19	Fri 3/15/19
353	10.3.4.20	Commission HPGe's	30 d	Mon 3/25/19	Fri 5/3/19
354	10.3.4.21	HPGe screening begins at FAARM	0 d	Fri 5/3/19	Fri 5/3/19
355	10.3.4.22	HPGe Screening	170 d	Mon 5/6/19	Mon 12/30/19
356	10.3.4.23	All gamma screening at FAARM	0 d	Fri 5/3/19	Fri 5/3/19



Hazards & Risk Analysis (EHS)

- Fire
  - Inside water shield
  - In first floor common space
  - In machine shop
  - In chemistry laboratory
  - In transition space
  - In office/control room
  - In mechanical, electrical, radon control space
- Hazardous materials
  - Chemicals
  - Cryogens (burns, etc.)
  - Cryogens (ODH)
  - Lead
  - Liquid Scintillator (LAB)
- Radiation
  - Calibration sources
  - Welding
  - Other
- Structural failure
  - Deck structure
  - False floor
  - Lifting devices
- Water shield leak
  - Minor leak
  - Major leak
- Immersion tank leak
  - Minor leak
  - Major leak
- Falls
- Electrocution
- Material Handling
  - Crushing hazards
  - Tripping hazards
  - Lifting hazards
  - Pinch-point hazards
- Machine Shop
  - Eye hazards
  - Wounds
  - Particulates
  - Tripping hazards
  - Snagged clothing
  - Audio hazards
  - Lifting hazards

Liquid Scintillator MSDS: 1,100 gallons (21 barrels) LAB

PETRESA CANADA

MATERIAL SAFETY DATA SHEET

LINEAR ALKYLBENZENE

PETRELAB® 500-Q (P 500-Q)

DESCRIPTION AND USES

Petrelab® 500-Q is a linear alkylbenzene containing side alkyl chains of 10-13 carbon atoms, averaging 11.3 atoms. This high purity product is used primarily for the production of biodegradable synthetic detergents. Its relatively low molecular weight is especially suitable for the manufacturing of liquid detergents.

SULFONATION PROPERTIES

Petrelab® 500-Q alkylate can be sulfonated exceptionally well with either sulphur trioxide or fuming sulphuric acid to yield high quality sulfonic acid or sulfonate slurries.

BIODEGRADABILITY

Sulfonate derivatives of Petrelab® 500-Q are highly biodegradable (97% or greater), according to O.E.C.D.'s official method described on E.E.C. Directive, 82/243.

PRODUCTION

Petrelab® 500-Q is produced by Petresa Canada Inc. (PCI), a CEPSA Group Company, at its manufacturing facilities in Becancour (Québec), Canada.

® Petrelab 500-Q is a registered trademark of Petresa Canada Inc. (PCI)

PETRESA CANADA

MATERIAL SAFETY DATA SHEET

1. PRODUCT IDENTIFICATION AND USE

Trade name:	PETRELAB® 500-Q (P 500-Q)
Synonyms:	Linear Alkylbenzene, LAB
CAS number:	68648-87-3
EINECS number:	Not available.
Product use:	This high purity product is used primarily for the production of biodegradable synthetic detergents. Its relatively low molecular weight is especially suitable for the manufacturing of liquid detergents.
Manufacturer's name: **Address:**	Petresa Canada Inc. (PCI) 5250 Bécancour Boulevard Bécancour (Québec) G9H 3X3, CANADA
	Tel.: 1-819-294-1414
Emergency telephone number (24 hr) Canutec:	Tel.: 1-613-996-6666
Chemtrec:	Tel.: 1-800-424-9300

2. HAZARDOUS COMPOSITION / COMPONENT INFORMATION

COMPONENT	CAS NUMBER	WEIGHT %
Benzene, C_{10}-C_{16} alkyl derivatives	68648-87-3	100 %

3. PHYSICAL AND CHEMICAL DATA

Boiling Range (°C):	275 - 307
Melting Point (°C):	< -50
Vapor Pressure (mmHg):	< 0.1 mmHg @ 20°C (68°F)
Vapor density (Air = 1):	8.1
Solubility in water:	Insoluble
Molecular weight:	233 à 237 g/mol
pH:	Not applicable
Viscosity:	5 - 10 cps @ 20°C
Evaporation Rate (water = 1):	Not available