LBNF Hadron Absorber

Preliminary Design Review

LBNF Hadron Absorber Costs, Schedule, and Overall Summary

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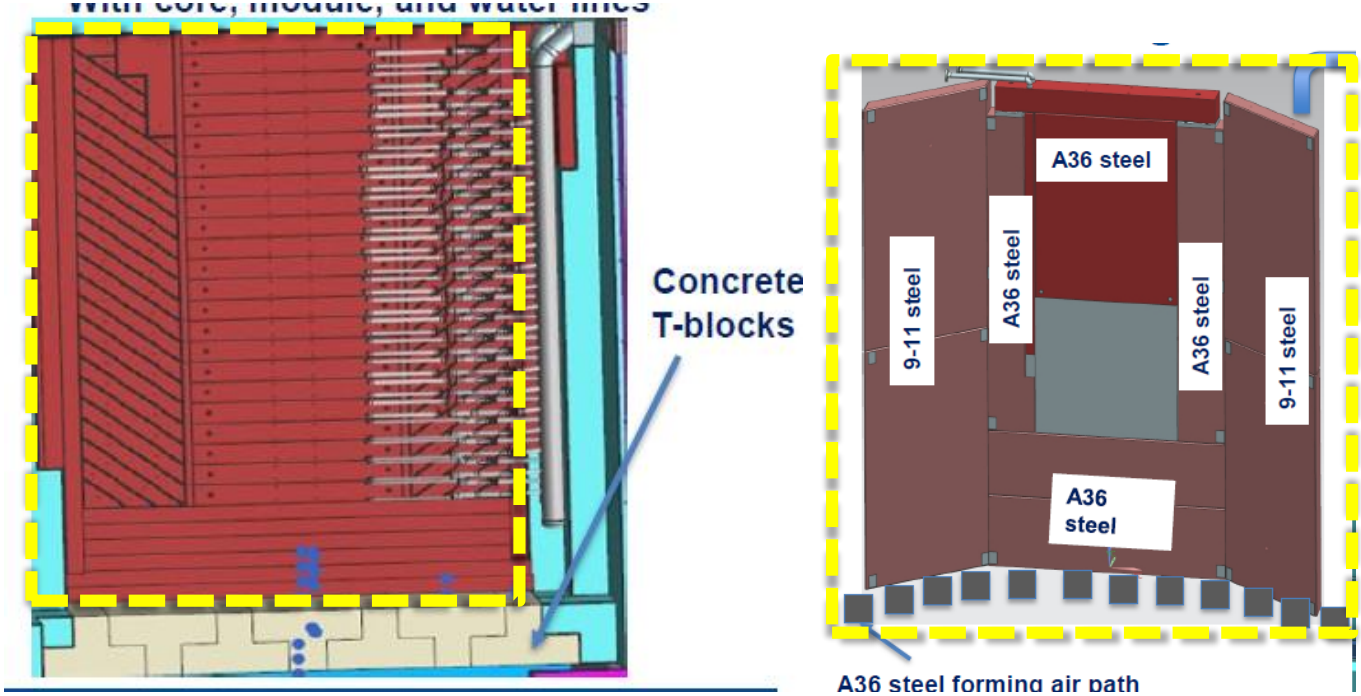
Overview

- Absorber costs
- Absorber schedule
- Overall summary wrap-up

Absorber costs

- With the help of a professional estimator, large component drawings were sent to several manufacturers for a quote.
- Have quotes for items included in yellow boxes.
- Compared quotes received with original cost estimates.



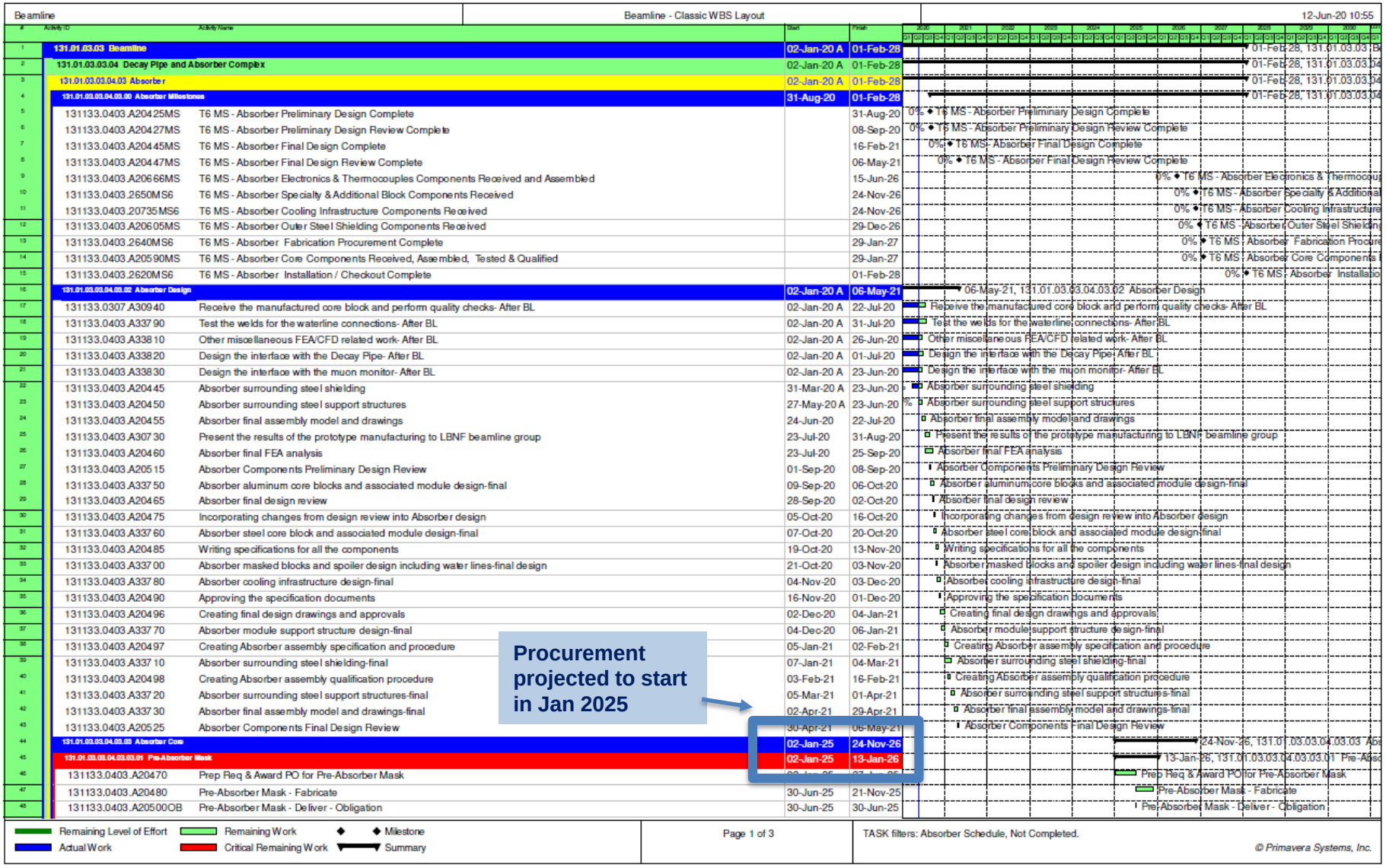
Absorber costs

- Quotes are present in Absorber section of Dune-doc-15809.

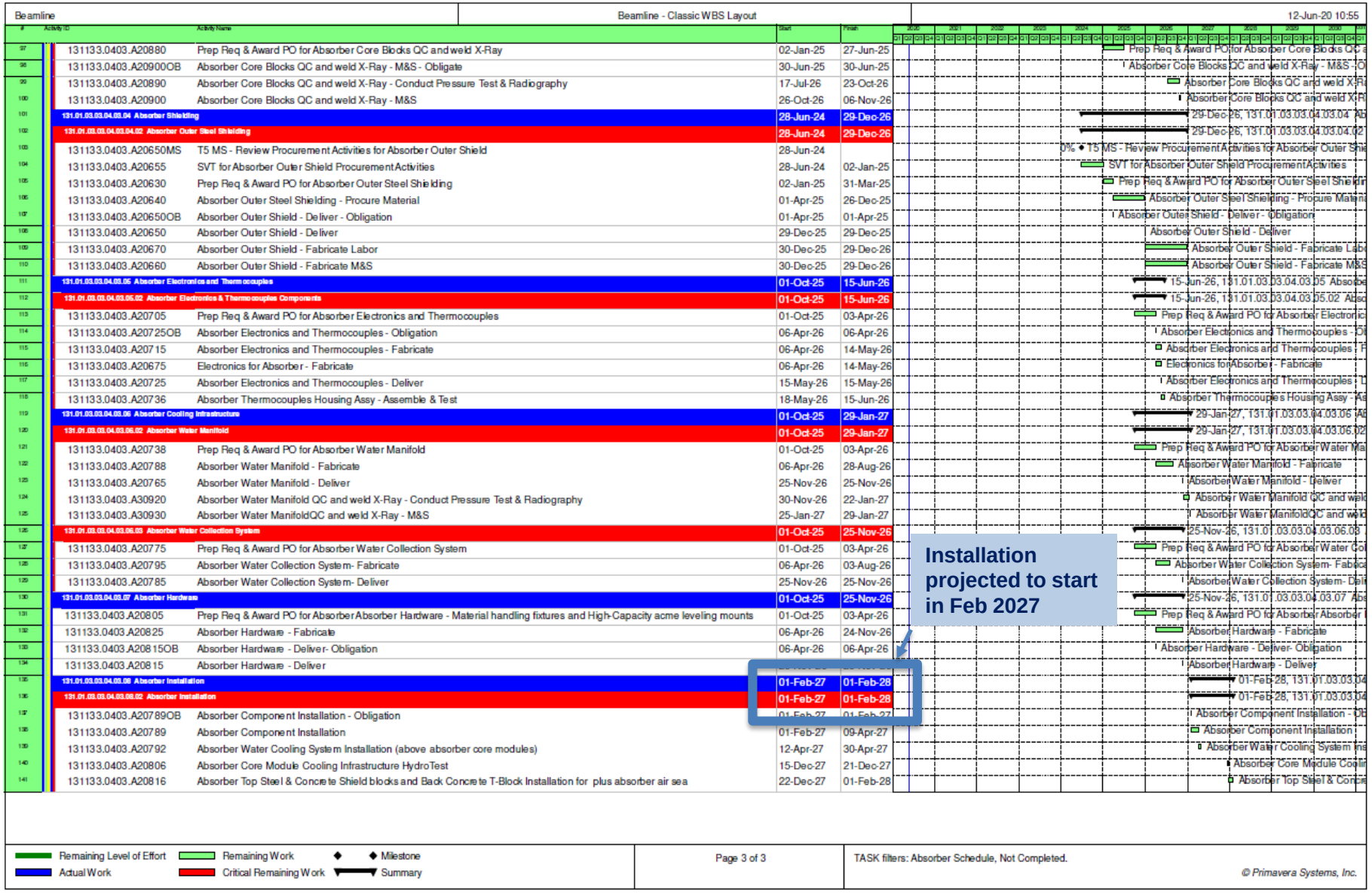
- Comparison between estimated and vendor costs is shown below:

Cost Breakdown Summary for the LBNF Absorber Compared to Estimates from Vendors						
Major components	Estimated cost (2018)	Vendor cost (2019-20)	Difference between vendor cost (2019-20) and estimated cost (2018)	Fermi hours estimated (2018)	Hours absorbed by the vendor (2019-20)	Notes/comments
Absorber core	$1,014,233.06	$975,339.00	-$38,894.06	1746	0	Spoiler (1), Mask (4), Core-Aluminum (13), Sore-Steel (4)
Absorber core support and surrounding steel	$1,250,569.88	$2,643,045.00	$1,392,475.12	0	0	This includes the core support modules and the steel immediately surrounding the absorber core. This is all the A36 steel
Water cooling infrastructure	$94,885.35	$78,108.00	-$16,777.35	520	520	
Steel shielding 9-11 steel	$1,847,582.16	$1,283,043.17	-$564,538.99	3264	0	Assuming cost per pound is $0.25
Steel for the air channels	NA	$279,811.00	$279,811.00	0	0	Air channels at the bottom of the absorber pile were never costed in the original (2015) and the later version (2018) schedule.
Misc. items	$60,482.10	Not available	-$60,482.10	0	0	SS water collection pan, material handling hardware, and thermocouple array
Total---------->	$4,287,752.55	$5,259,346.17	$991,593.62	5530	520	

Absorber schedule



Absorber schedule



#	Activity ID	Activity Name	Start	Finish
97	131133.0403.A20880	Prep Req & Award PO for Absorber Core Blocks QC and weld X-Ray	02-Jan-25	27-Jun-25
98	131133.0403.A20900OB	Absorber Core Blocks QC and weld X-Ray - M&S - Obligate	30-Jun-25	30-Jun-25
99	131133.0403.A20890	Absorber Core Blocks QC and weld X-Ray - Conduct Pressure Test & Radiography	17-Jul-26	23-Oct-26
100	131133.0403.A20900	Absorber Core Blocks QC and weld X-Ray - M&S	26-Oct-26	06-Nov-26
101	131.01.03.03.04.03.04	Absorber Shielding	28-Jun-24	29-Dec-26
102	131.01.03.03.04.03.04.02	Absorber Outer Steel Shielding	28-Jun-24	29-Dec-26
103	131133.0403.A20650MS	T5 MS - Review Procurement Activities for Absorber Outer Shield	28-Jun-24	
104	131133.0403.A20655	SVT for Absorber Outer Shield Procurement Activities	28-Jun-24	02-Jan-25
105	131133.0403.A20630	Prep Req & Award PO for Absorber Outer Steel Shielding	02-Jan-25	31-Mar-25
106	131133.0403.A20640	Absorber Outer Steel Shielding - Procure Material	01-Apr-25	26-Dec-25
107	131133.0403.A20650OB	Absorber Outer Shield - Deliver - Obligation	01-Apr-25	01-Apr-25
108	131133.0403.A20650	Absorber Outer Shield - Deliver	29-Dec-25	29-Dec-25
109	131133.0403.A20670	Absorber Outer Shield - Fabricate Labor	30-Dec-25	29-Dec-26
110	131133.0403.A20660	Absorber Outer Shield - Fabricate M&S	30-Dec-25	29-Dec-26
111	131.01.03.03.04.03.05	Absorber Electronics and Thermocouples	01-Oct-25	15-Jun-26
112	131.01.03.03.04.03.05.02	Absorber Electronics & Thermocouples Components	01-Oct-25	15-Jun-26
113	131133.0403.A20705	Prep Req & Award PO for Absorber Electronics and Thermocouples	01-Oct-25	03-Apr-26
114	131133.0403.A20725OB	Absorber Electronics and Thermocouples - Obligation	06-Apr-26	06-Apr-26
115	131133.0403.A20715	Absorber Electronics and Thermocouples - Fabricate	06-Apr-26	14-May-26
116	131133.0403.A20675	Electronics for Absorber - Fabricate	06-Apr-26	14-May-26
117	131133.0403.A20725	Absorber Electronics and Thermocouples - Deliver	15-May-26	15-May-26
118	131133.0403.A20736	Absorber Thermocouples Housing Assy - Assemble & Test	18-May-26	15-Jun-26
119	131.01.03.03.04.03.06	Absorber Cooling Infrastructure	01-Oct-25	29-Jan-27
120	131.01.03.03.04.03.06.02	Absorber Water Manifold	01-Oct-25	29-Jan-27
121	131133.0403.A20738	Prep Req & Award PO for Absorber Water Manifold	01-Oct-25	03-Apr-26
122	131133.0403.A20788	Absorber Water Manifold - Fabricate	06-Apr-26	28-Aug-26
123	131133.0403.A20765	Absorber Water Manifold - Deliver	25-Nov-26	25-Nov-26
124	131133.0403.A30920	Absorber Water Manifold QC and weld X-Ray - Conduct Pressure Test & Radiography	30-Nov-26	22-Jan-27
125	131133.0403.A30930	Absorber Water ManifoldQC and weld X-Ray - M&S	25-Jan-27	29-Jan-27
126	131.01.03.03.04.03.06.03	Absorber Water Collection System	01-Oct-25	25-Nov-26
127	131133.0403.A20775	Prep Req & Award PO for Absorber Water Collection System	01-Oct-25	03-Apr-26
128	131133.0403.A20795	Absorber Water Collection System- Fabricate	06-Apr-26	03-Aug-26
129	131133.0403.A20785	Absorber Water Collection System- Deliver	25-Nov-26	25-Nov-26
130	131.01.03.03.04.03.07	Absorber Hardware	01-Oct-25	25-Nov-26
131	131133.0403.A20805	Prep Req & Award PO for Absorber Absorber Hardware - Material handling fixtures and High-Capacity acme leveling mounts	01-Oct-25	03-Apr-26
132	131133.0403.A20825	Absorber Hardware - Fabricate	06-Apr-26	24-Nov-26
133	131133.0403.A20815OB	Absorber Hardware - Deliver- Obligation	06-Apr-26	06-Apr-26
134	131133.0403.A20815	Absorber Hardware - Deliver		
135	131.01.03.03.04.03.08	Absorber Installation	01-Feb-27	01-Feb-28
136	131.01.03.03.04.03.08.02	Absorber Installation	01-Feb-27	01-Feb-28
137	131133.0403.A20789OB	Absorber Component Installation - Obligation		
138	131133.0403.A20789	Absorber Component Installation	01-Feb-27	09-Apr-27
139	131133.0403.A20792	Absorber Water Cooling System Installation (above absorber core modules)	12-Apr-27	30-Apr-27
140	131133.0403.A20806	Absorber Core Module Cooling Infrastructure HydroTest	15-Dec-27	21-Dec-27
141	131133.0403.A20816	Absorber Top Steel & Concrete Shield blocks and Back Concrete T-Block Installation for plus absorber air sea	22-Dec-27	01-Feb-28

Overall summary wrap-up

Requirement	Description	Comment
Absorber - radiation protection	The absorber shall provide radiation protection to people, in compliance with the FRCM.	*This has been addressed.*
Absorber - energy absorption	The absorber shall absorb the energy of the particles exiting the decay pipe and transfer this energy away using an active cooling system.	*It was shown during the review that energy deposited in the Absorber was effectively transferred to the core water cooling system and the shielding air cooling system.*
Absorber - lifetime	The absorber shall keep its operational ability for the life of the LBNF experiment. Near Site Conventional Facility (NSCF or CF) life is 30-years. And, the LBNF/DUNE experiment life is 20-years.	*Fatigue loading and effects of creep on Aluminum were addressed. Prototyping of critical component has been done. A remote handling system facilitates quick turn around in case of component failures.*
Absorber - accident conditions	The absorber shall sustain the beam energy deposition under all accident situations that may occur with some reasonable probability.	*It was shown that all core components can survive after 2- accident pulses. In addition to this, a beam interlock system was described that will prevent more than 1 accident pulse.*
AC - Absorber Bunker Liner	Beamline shall provide a 24 inch high, leak tight stainless steel pan liner at the bottom of the Absorber bunker	*A pan design was described. Its interface with CF infrastructure has also been captured.*

Overall summary wrap-up

Specification	Description	Comment
Absorber - accident pulses	The absorber shall include an Interlock system that limits the accident pulses to 2.	*It was shown that all core components can survive after 2- accident pulses. In addition to this, a beam interlock system will prevent more than 1 accident pulse.*
Absorber - dose rate	The absorber shall have a residual dose at 1 foot (measured from outside the absorber shielding) after 100 day irradiation and 4 hr. cooling that does not exceed 20 mrem/hr.	*This was addressed in the energy deposition presentation. It was shown that shielding is appropriate to prevent dose rates from exceeding allowable values.*
Cooling System - heat removal	The cooling system shall remove 473 kW of dissipated heat during normal operation. 233 kW using water cooling and 240 kW using forced air/gas ventilation system. This assumes a 1.5-m RAL Target at 2.4-MW beam operations.	*The RAW cooling system has gone through its own preliminary design review. It is oversized for the 1.5-m RAL target case. There is room for value engineering here.*
Absorber - accident pulses	The absorber shall sustain at least 2 successive accident beam pulses without damage to components or loss of functional ability.	*Engineering analysis shows that 2-accident pulses will not have a detrimental effect on Absorber operations.*

Thank you!