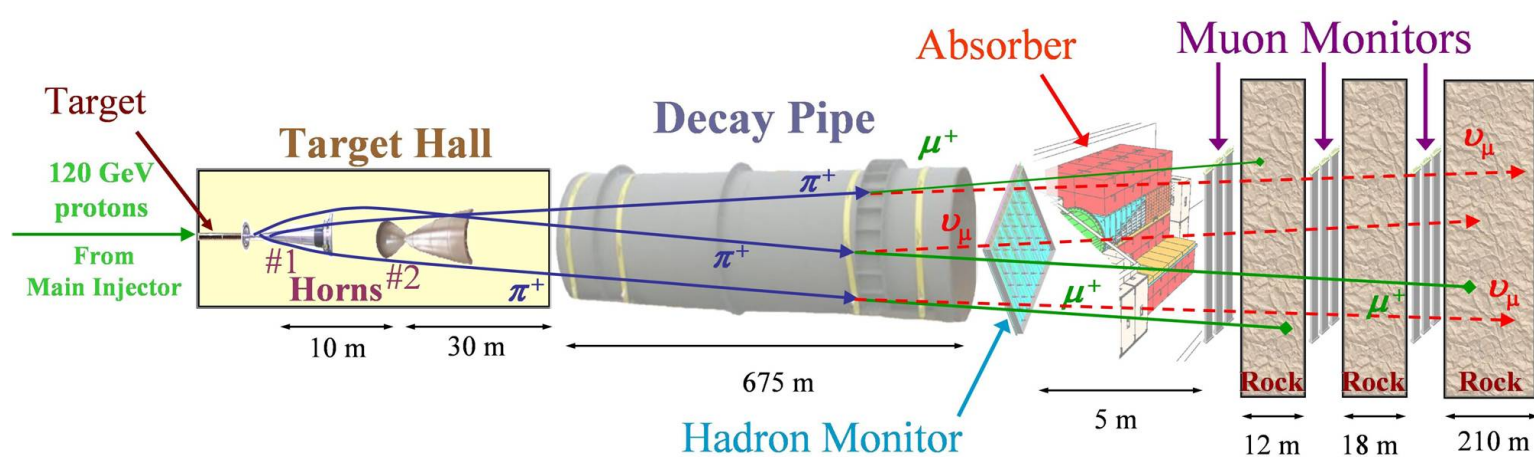


NuMI Target Systems AIP FY19 Q2 Updates

Yun He

Proton PMG / AEM Meeting, April 4, 2019



Outline

Project Plan approved Dec. 18, 2018, implementation started Jan. 3, 2019

➤ Introduction

- Project scope and issues to be addressed
- Challenges with NuMI facility
- Project milestones
- Prior to & after funds approval

➤ Project implementation

- Project organization chart and WBS
- Project schedule and phased installation
- SharePoint site for documentation and communication

➤ Project status

- Tasks for 2019 summer shutdown, shutdown job schedule
- Rest tasks not tied to 2019 summer shutdown
- Monthly project performance report March 2019

➤ Summary

➤ Introduction

- Project scope and issues to be addressed
- Challenges with NuMI facility
- Project milestones
- Prior to & after funds approval

➤ Project implementation

- Project organization chart and WBS (people & funds)
- Project schedule and phased installation (schedule)
- SharePoint site (documentation and communication)

➤ Project status

- Tasks for 2019 summer shutdown, shutdown job schedule
- Remaining tasks for 2020 summer shutdown or not involving shutdowns
- Project monthly performance March 2019

➤ Summary

Project Scope and Issues to be Addressed

Beam Power	1 MW	700 kW
Proton beam energy	120 GeV	
Protons per spill	6.5E13	4.9E13
Main injector cycle time	1.2 sec	1.33 sec
Beam pulse width	10 microsec	
Horn current/pulse width	200 kA / 2.3 msec	

- Beam acceptance capabilities
maximum beam power to target of **1 MW**
- Reliability
maintain 85% availability for HEP at full proton delivery
- Lifetime
minimally through 2025

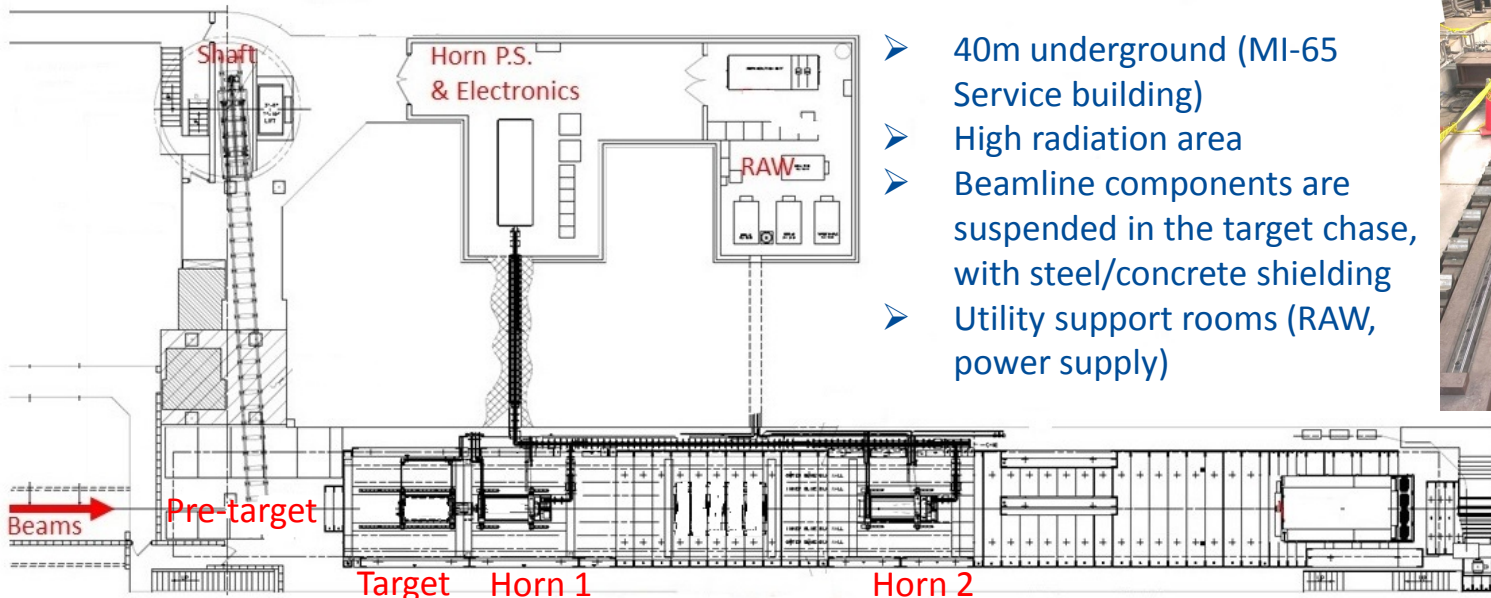
Temperatures and stresses due to beam heating	Increased radio-activation	An aging infrastructure in radiative environment
<ol style="list-style-type: none"> 1. MARS simulation 2. Pre-target beam window 3. Target core and baffle 4. Horn 1 stripline cooling 5. Radioactive water (RAW) systems 6. Target chase air handling, chiller 7. Hadron absorber temperature monitoring 	<ol style="list-style-type: none"> 8. Additional shielding to target chase 9. Tritium mitigation upgrade 10. New radiation-hard hadron Monitors 	<ol style="list-style-type: none"> 11. Decay pipe window Repair plan 12. Target/horn 1 module positioning drives

Challenges with NuMI Facility

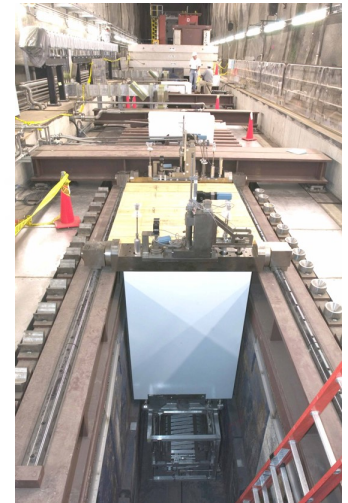
Originally designed for 400 kW, upgraded for 700 kW NOvA, now pushing for 1 MW

- Maximizes the neutrino flux while making a robust design, maintains its mechanical integrity at high temperature, withstands millions of cycling loadings
- Harsh radiative and corrosive environment
 - Radiation in humid air creates nitric acid and Ozone, which accelerate the corrosion on materials
- Precision alignment and motion control, remote handling in the event of a replacement or repair

Beamline components become radioactive once being in operation



- 40m underground (MI-65 Service building)
- High radiation area
- Beamline components are suspended in the target chase, with steel/concrete shielding
- Utility support rooms (RAW, power supply)



Project Milestones

Funds received	Dec. 2018, FY19-21
Lump sum	5.39M
Charge codes established	A1901
Project implementation started	Jan. 2019
Project completion	April 2021

Project Dates

Funds were approved in Dec. 2018
 Project started in Jan. 2019
 (two months delay)

Start
 (MMM-YY)
NOV-18

Complete
 (MMM-YY)

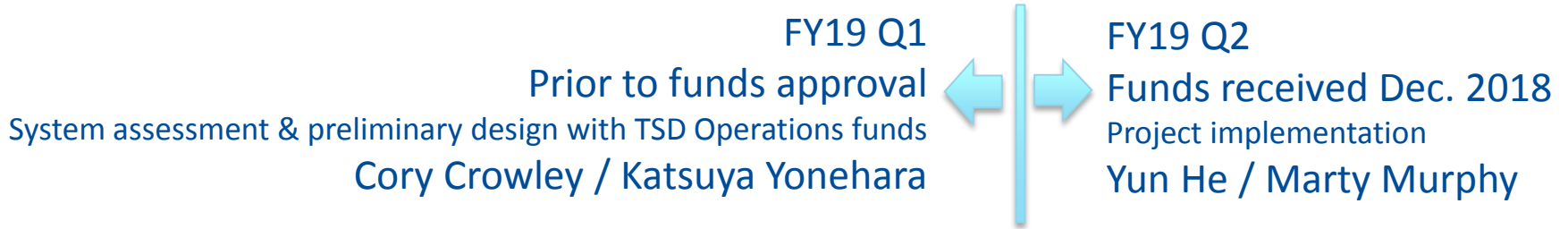
	Start (MMM-YY)	Complete (MMM-YY)
1. Project Start		
2. Horn 1 Final Design		APR-19
3. Target Fabrication		MAY-19
4. Horn 1 Fabrication		FEB-20
5. Horn Stripline, Testing		MAR-20
6. Hadron Monitor Installation		OCT-20
7. Horn 1 Stripline Installation		AUG-20
8. RAW, Target Chase Cooling, Shielding, Tritium Mitigation		OCT-19
9. Installation and Testing Complete		JAN-21

Tied to 2019 summer shutdown (July 8 to Sep. 23)

Project Completion Date incls Close Out:

APR-21 2.5 years

Prior to & After Funds Approval



Tasks identified	Status prior to re-start	Current status
MARS simulations	Preliminary simulations	Re-run for new changes
Pre-target window	Installation	Spare fabrication
Target baffle & core	Preliminary design and FEA	Final design and FEA, fabrication
Horn 1	Preliminary design and FEA	Final design and FEA, fabrication
Stripline air diverter T-block	Scope defined	Design
Target and horn 1 module drives	Preliminary design	Final design, fabrication
RAW skids	Design	Procurement
Target hall chiller/air handling	Scope defined	Procurement
Target chase shielding	Design	Fabrication
Tritium mitigation	Scope defined	Re-define scope
Decay pipe window	Preliminary design and FEA	Final design and FEA, test welding
Hadron beam monitor & absorber	Scope defined	Design

➤ Introduction

- Project scope and issues to be addressed
- Challenges with NuMI facility
- Project milestones
- Prior to & after funds approval

➤ Project implementation

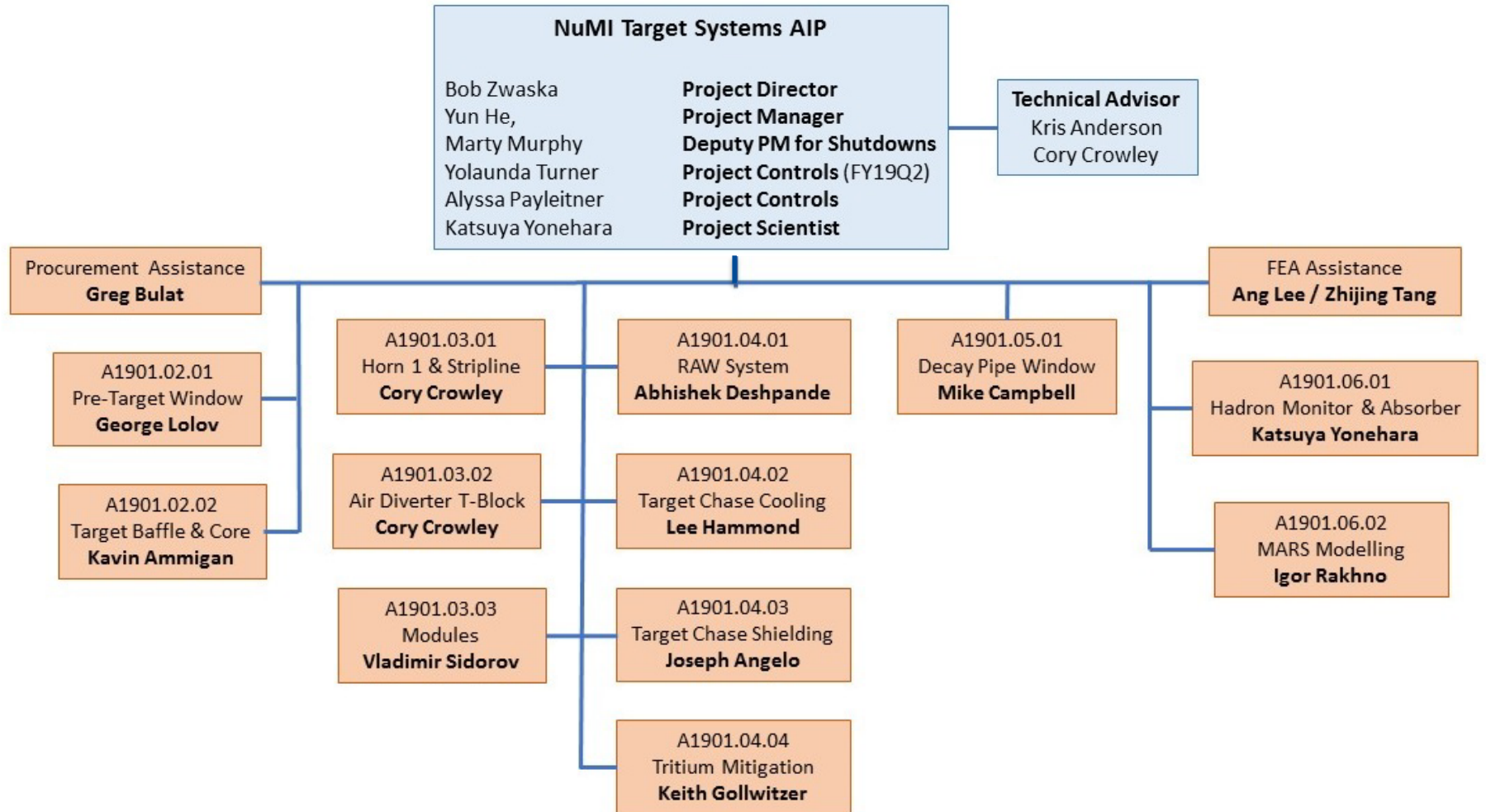
- Project organization chart and WBS (people & funds)
- Project schedule and phased installation (schedule)
- SharePoint site (documentation and communication)

➤ Project status

- Tasks for 2019 summer shutdown, shutdown job schedule
- Remaining tasks for 2020 summer shutdown or not involving shutdowns
- Project monthly performance March 2019

➤ Summary

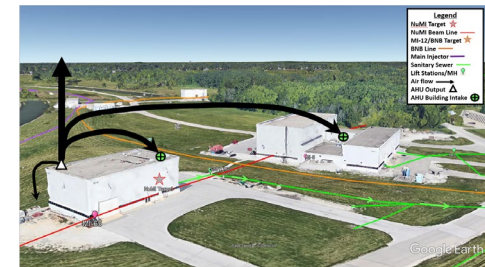
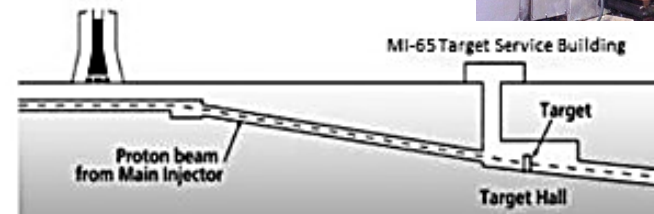
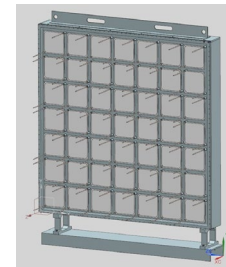
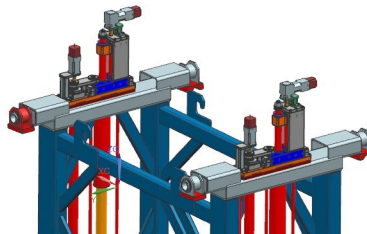
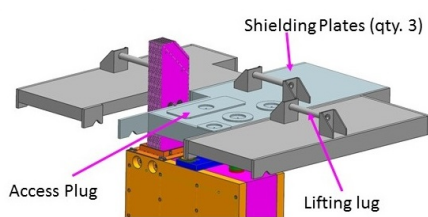
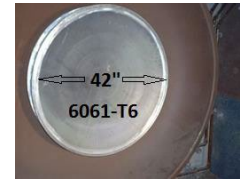
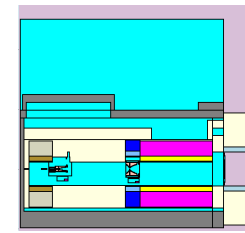
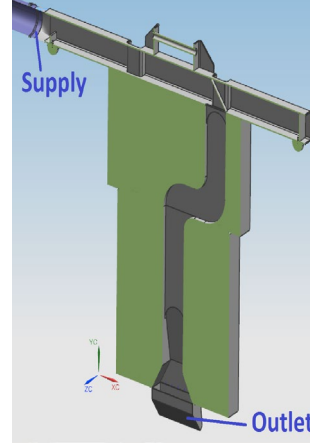
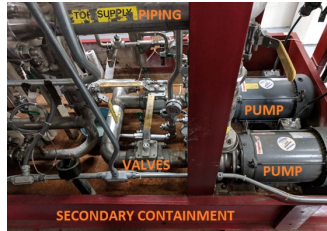
Project Organization Chart and WBS



12 Control accounts, personnel from AD/TSD, AD/MSD, FESS, PPD
The work presented here are team work from people in this org chart

Project Schedule and Phased Installation

2019 summer shutdown	2020 summer shutdown	Tasks not involving summer shutdowns
1 MW target installation	1 MW horn 1 installation	MARS simulations
Target & Horn 1 RAW upgrade	Stripline air diverter T-block	Pre-target window spares
Target chase cooling / air upgrade	Target and horn 1 module drives	Decay pipe window
Target chase supplemental shielding	Hadron beam monitor & absorber	Tritium mitigation



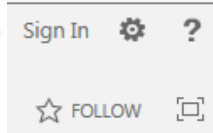
SharePoint for documentation and communication

<https://web.fnal.gov/project/TargetSystems/NuMI-AIP/>

(An example)
(A1901.02.02)

Target Baffle and Target Core

With your Fermilab Service account password →



- NuMI TS AIP Home
- Project Management
- Org Chart
- Project Plan
- Resource-cost-schedule
- Project Controls
- CAM eToolbox
- Finance WebQueries
- AD WebReq Instruction
- Pre-target Beam Window
- Target Baffle / Target Core

A190.02.02, Task Scope

- Redesign the core and baffle to accommodate larger fins for the larger beam spot size (**Completed**).
- Fabricate and install new target core and baffle.

Status / Schedule

Drawing in TeamCenter

Analysis report in Beams DocDB

Tasks for target baffle	Resources (Hours)	Schedule	References
FEA of preliminary design	Budgeted resource	Completed	Dwg. No. F10041831 , Mar. 30, 2018
Final design / drawing package		Completed	Baffle analysis , Beams-DocDB-6147, Kavin Ammigan, Feb. 27, 2018
Design review		Completed	Target Baffle Design Review Comments / Recommendations , Beams-DocDB-225, Mar. 19, 2018
Procurement and fabrication	Engineer / Physicist / Techs / Fab. specialist (40 /8 /80 /40)	Jan. 2 - June 27, 19	50K ← Budgeted M&S cost Order placed with Magna Machine to produce spare 1MW baffles TET-05. Spare baffles ordered for MET-06,07, 08 and 09

Break-down activities

Tasks for target core	Resources	Schedule	References
FEA of preliminary design		Completed	Target core preliminary analysis , Beams-DocDB-6835, Kavin Ammigan, Nov. 7, 2018
Final design	Engineer / Physicist / Designer (200 /32 /200)	Jan. 2 -May 22, 19	F10115609 (Winged fins at US, final version) <ul style="list-style-type: none"> • Fin width increase to 9.0mm from 7.4mm. • 4 winged fins added. • Information has provided for MARS modeling Winged Fin Position Desision Briefing , TSD-Briefing-2019-002, Cory Crowley, Jan. 22, 2019 F10109309 (Winged fins at DS, Obsolete)
Design review	Engineer / Physicist (16 /24)	May 23 -29, 19	Review comments & recommendations , Dec. 10, 2018
Procurement and fabrication	Engineer / Physicist / Techs / Fab. specialist (40 /8 /120 /8)	Jan. 2 - June 27, 19	60K Req#293190 / PO#653400, Target Rail Support / Brackets , Qty. 4, Jan. 29, 2019, \$3368.79, Delivery date Feb. 06, 2019 WebReq#29990, Target Graphite Fins , approved Feb. 5, 2019, Village Machine Shop, for Qty. 6, with the 1st set MET-05 delivered by Mar. 29, 2019, 92.7K

Procurement Req# / PO#, Delivery date

- Horn-1
- Stripline Air Diverter
- T-Block
- Modules Drive Mechanism
- Radioactive Water System
- Target Chase Chiller and Air Handling Unit
- Target Chase Shielding
- Tritium Mitigation
- Decay Pipe and Windows
- Hadron Absorber
- Instrumentation and Beam Monitoring
- MARS Modeling
- Shielding Assessment
- TSD SharePoint Home
- ✎ EDIT LINKS



➤ Introduction

- Project scope and issues to be addressed
- Challenges with NuMI facility
- Project milestones
- Prior to & after funds approval

➤ Project implementation

- Project organization chart and WBS (people & funds)
- Project schedule and phased installation (schedule)
- SharePoint site (documentation and communication)

➤ Project status

- Tasks for 2019 summer shutdown, shutdown job schedule
- Rest tasks not tied to 2019 summer shutdown
- Monthly project performance report March 2019

➤ Summary

Status of Tasks for 2019 Summer Shutdown

4 tasks. All are on track:

- Procurement delay on Pipefitter T&M contracts for A1901.04.01 & A1901.04.02
- Finally they were approved!

#	Tasks	Activities	Complete %
1	1 MW target installation 1a) Target baffle & core 1b) Target DS Be window (new) Target canister and carrier are on hand	Fabrication of baffle and core parts	50%
		Assembly drawing package and documentation	30%
		FEA, pending final review	80%
		Assembling to be started in late April	
2	Target & Horn 1 RAW upgrade	Pipefitter T&M procurement	100%
3	Target chase cooling / air handling	Pipefitter T&M procurement	90%
		Pump PO	100%
		Cooling coil specification to be done April 12	
4	Target chase supplemental shielding	Procurement	100%
		Fabrication	Delivery May 1st

2019 Shutdown NuMI-AIP Job Schedule

Cool down time before
target chase can be opened



Job/Week	1	2	3	4	5	6	7	8	9	10	11	12
Tar/H1 RAW skid work - Des												
Horn-1 Target Pile RAW Fitters. - Des												
Mez fitting work. Lee Hammond												
Mez Chiller HX Clean Lee Hammond												
Mez Chiller PM - Prism Lee Hammond												
Chase Cooling HVAC/Fitting Lee Hammond												
Transfer MET-02 to C0												
Install MET-05 Crowley & Lolov						MET-03 to Morgue						Install MET-05
Replace Stipline Hardware												



Pipefitter T&M Contract includes labor & materials, all piping / valves
Fermilab provides pump assemblies and cooling coils

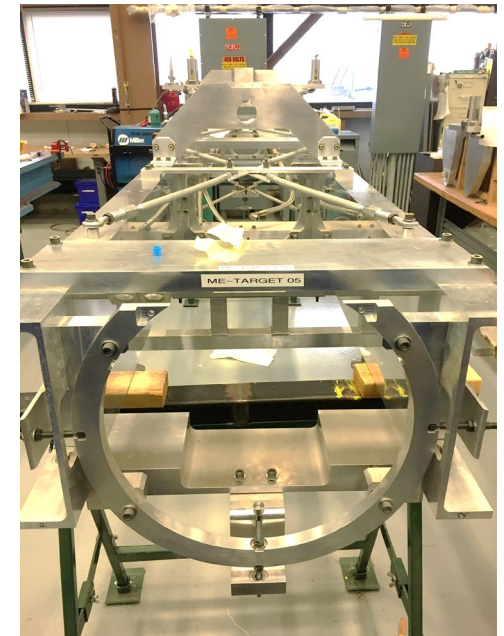
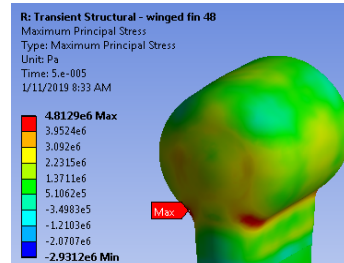
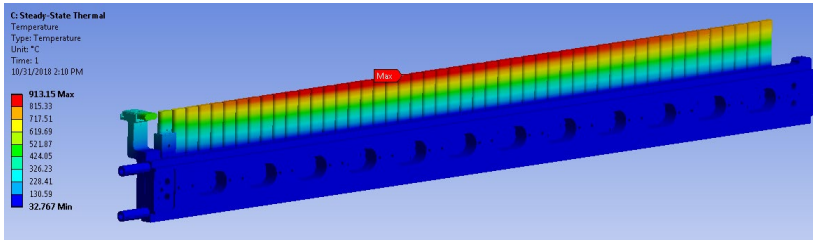
Target installation

Next 4 slides will cover these 4 tasks with more technical details

1a). 1 MW Target (A1901.02.02)

Redesigned per increased beam size

Design & FEA completed	Fabrication status	Plans for next quarter
<ul style="list-style-type: none">• Addition of U.S. winged fins provide protection per mis-steered beam• Extensive FEA performed• Additional cooling to DS Be window (next slide)	<ul style="list-style-type: none">• Target canister and carrier are ready• Baffle to be shipped next week• Fabrication of target core parts are 50% complete	<ul style="list-style-type: none">• Inspect baffle straightness• Bake graphite fins in vacuum oven• Start assembling process in late April



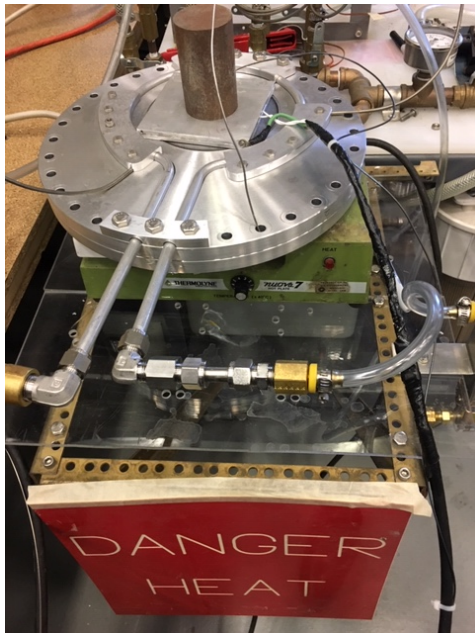
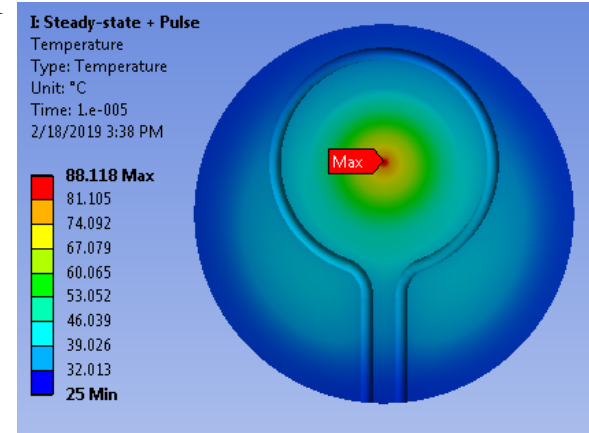
1b). Target Downstream Beryllium Window (new in A1901.02.02)

FEA results indicated D.S Be window temperatures and stresses were higher than originally envisioned and were marginal to the material allowable strength

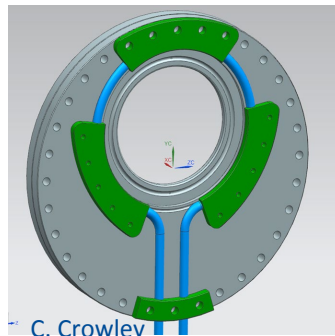
- Additional cooling loop was **designed and tested**.

With cooling loop:

Internal pressure (psig)	T_{\max} (°C)	Internal surf. $\sigma_{\text{equiv, max}}$ (MPa)	External surf. $\sigma_{\text{equiv, max}}$ (MPa)
5	88	164	132
10	88	197	192



- Fabrication is not an issue, Loop fitment is good
- Temperature measurements, average heat transfer coefficient from 3 tests: **2550 W/m².C**



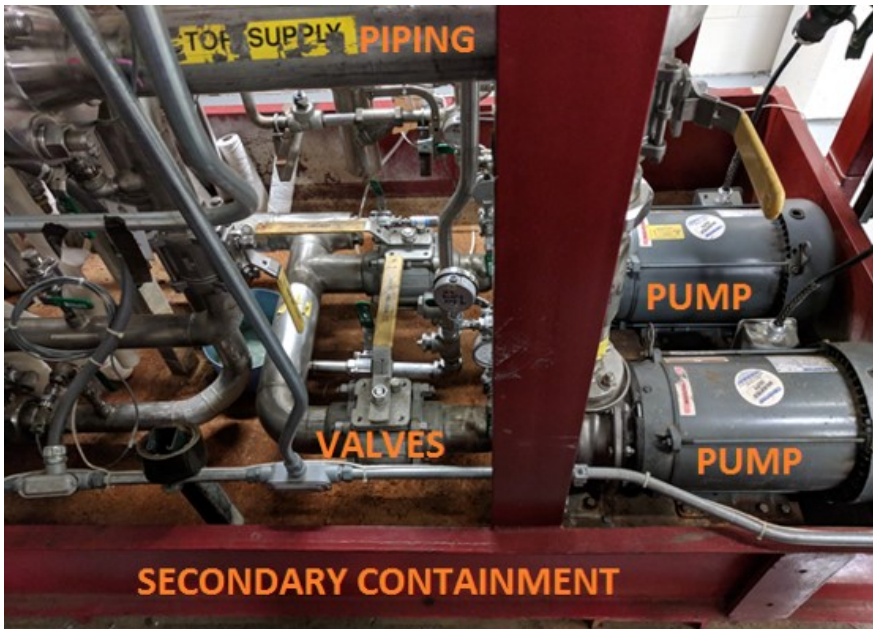
- Cooling loop does not require additional target RAW skid revisions.
- Effectively reduces maximum window temperature and stresses to within acceptable limits.
- **Modification to real window and water line revisions to Target assembly started**
- Can be accommodated in overall target schedule

2). Target & Horn 1 RAW System Upgrade (A1901.04.01)

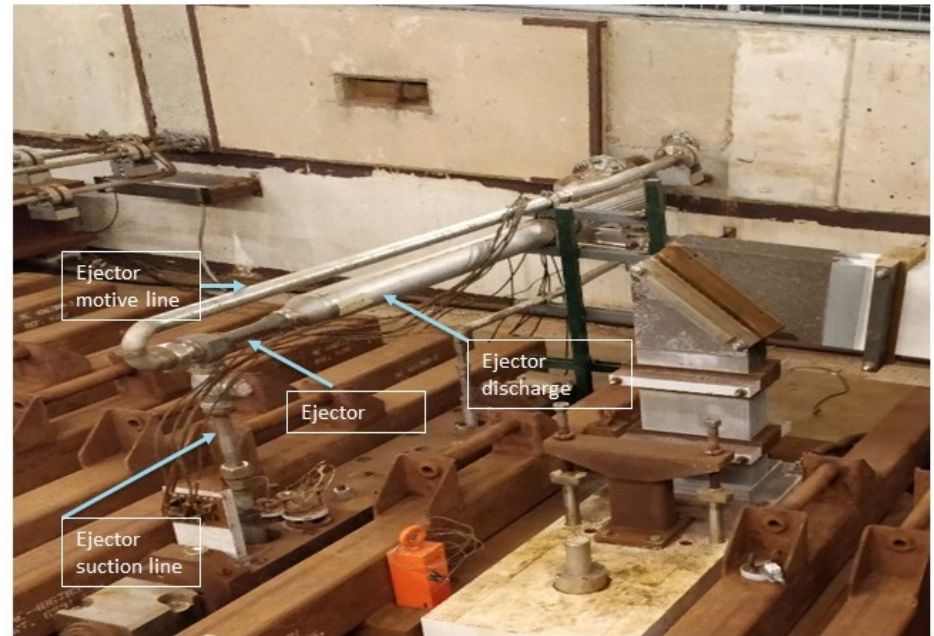
Upgrade RAW pumps, heat exchangers, piping and instrumentation, to handle extra cooling required

- Heat exchangers, centrifugal pumps, valves and instrumentation parts are on hands
- PO for Horn 1 RAW ejector pump is complete
- Pipefitter T&M requisitions were approved – two jobs
- Contractor's teams have experiences working on site with Fermilab team

Modifications in RAW room



Piping modifications in Target Hall

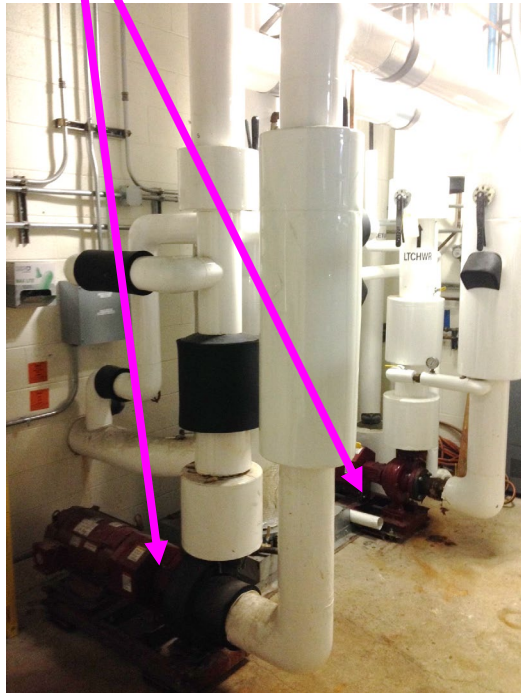


3). Target Chase Cooling & Air Handling Upgrade (A1901.04.02)

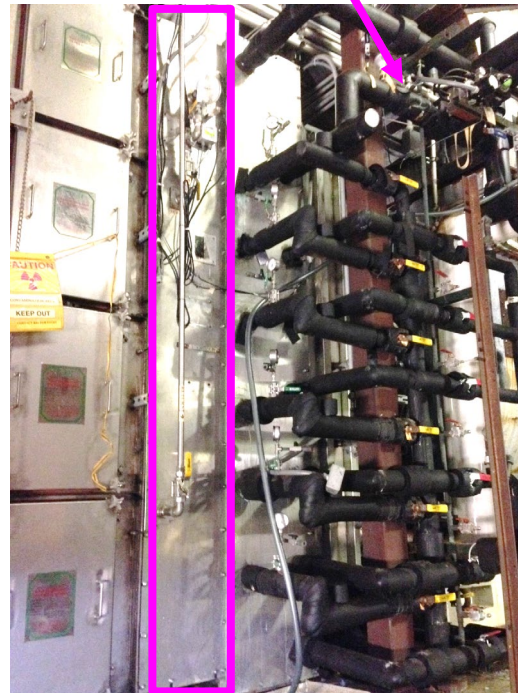
Upgrade pumps, add 3 cooling coils to the target chase cooling circuit

- PO for pump complete
- Pipefitter T&M requisitions were approved -- two jobs
- Contractor's teams have experiences working on site
- Remaining: cooling coil procurement mid-April

Pump to be replaced

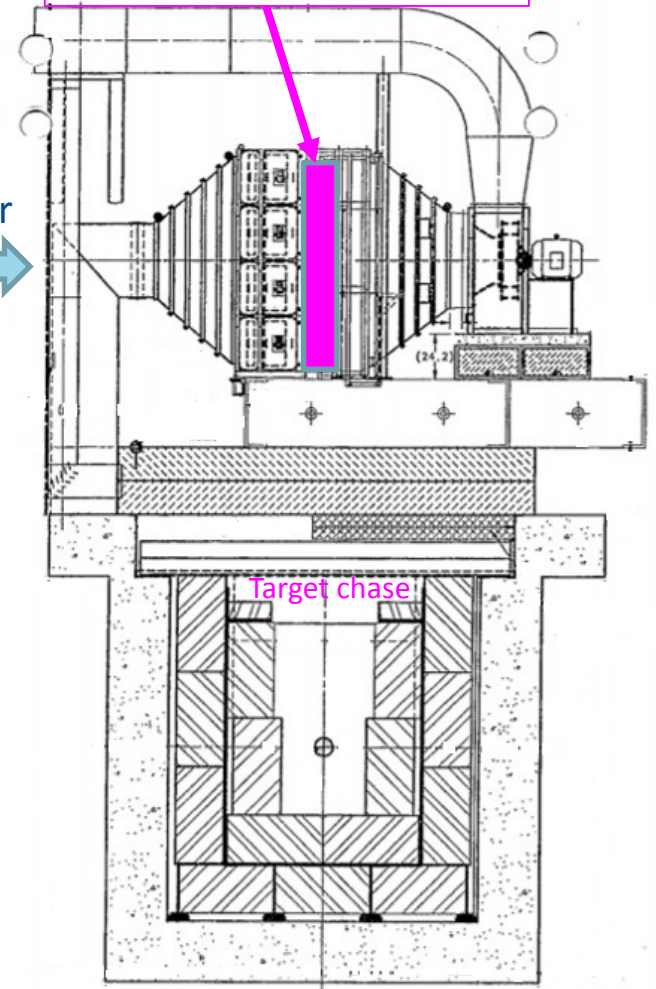


Existing piping of 3-sets of cooling coils



New coils to be inserted

Air

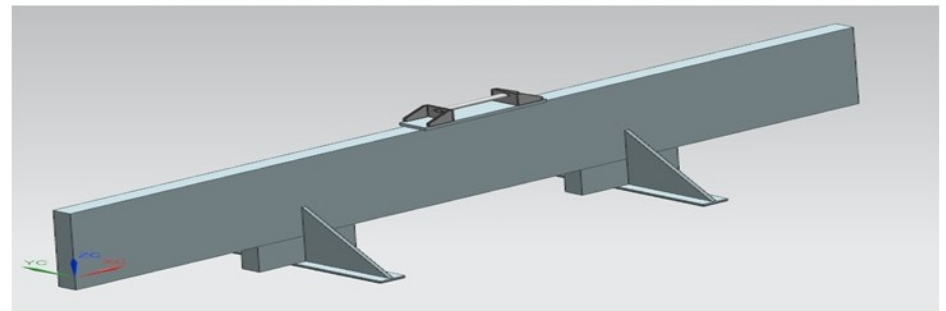
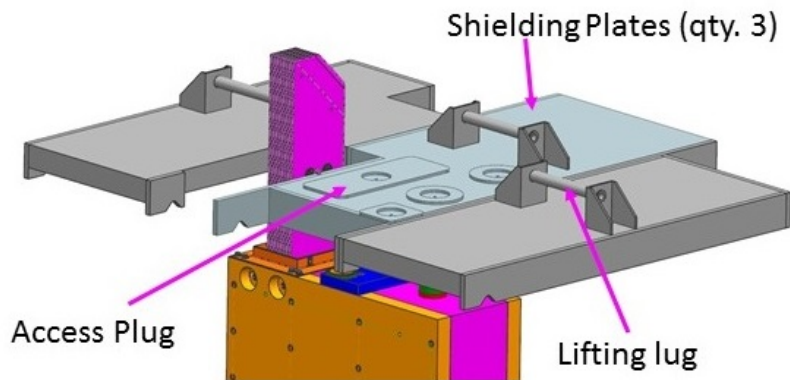


4). Target Chase Supplemental Shielding (A1901.04.03)

Increases in residual radiation due to higher beam power will significantly increase the cool-down time needed before maintenance or changeout activities can start

- Supplemental shielding for Horn 2 stripline block
- Shield curtain between the steel shield pile and the concrete cap downstream of Horn 1

Procurement complete, delivery date May 1st



Status of Rest Tasks (not Tied to 2019 Summer Shutdown)

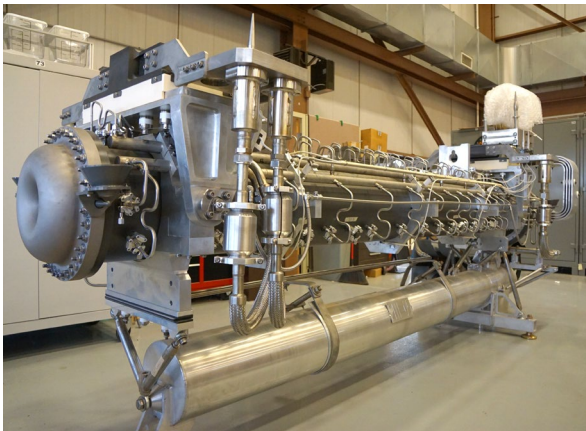
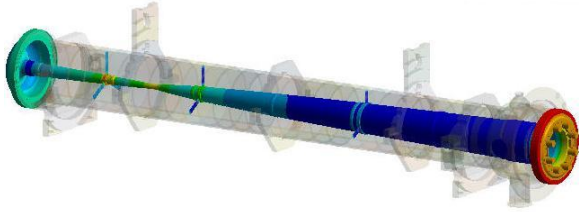
Major activities: review preliminary design, finalize design and generate drawing package

#	Tasks	Activities	Complete %
5	1 MW horn 1 5a) Horn 1 conductors PH1-05 ready and tested 5b) Horn 1 stripline	Wind tunnel test	100%
		FEA of conductors & stripline	100%
		Stripline fabrication	60%
		Air diverter fabrication	90%
		Design review planned for week April 8	
6	Stripline air diverter T-block	Design and drawing package	60%
7	Target & Horn 1 module drive mechanism	Design and drawing package	50%
8	Hadron beam monitor & absorber	R&D, prototyping	70%
		Design	30%
9	MARS modelling	Additional information provided, re-run	
10	Pre-target window	Spare fabrication	40%
11	Decay pipe window	Test welding gets started	
12	Tritium mitigation	Redefine scope due to recent new findings	

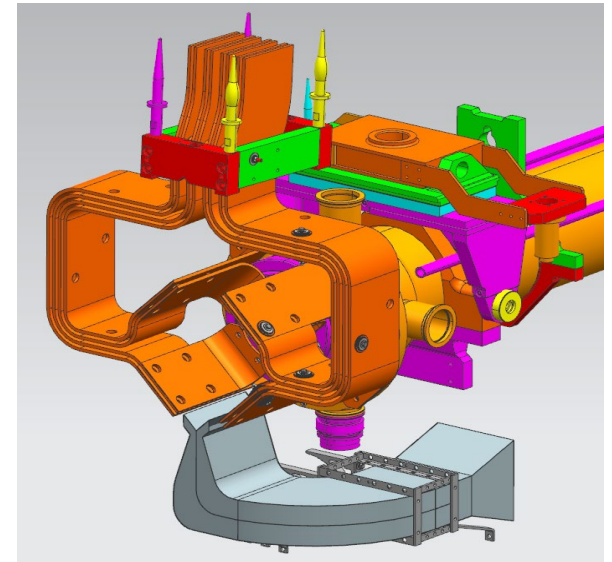
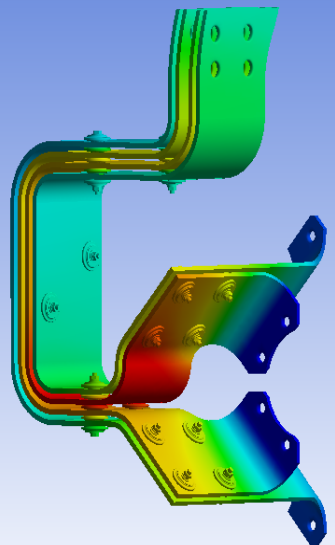
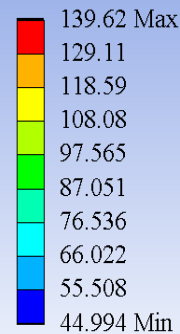
Next a few slides will cover these tasks with more technical details

5). Horn 1 Conductors & Stripline (A1901.03.01)

Design & FEA completed	Fabrication status	Plans for next quarter
<ul style="list-style-type: none"> Cooling improvement to Horn 1 inner conductor Design improvements to stripline (w/ air diverter) Wind tunnel test Extensive FEA 	<ul style="list-style-type: none"> PH1-05 ready and tested Stripline fabrication 50% Air diverter fabrication 90% 	<ul style="list-style-type: none"> Final design review April 11 or 12 Continue stripline fabrication Test air diverter with Horn 1



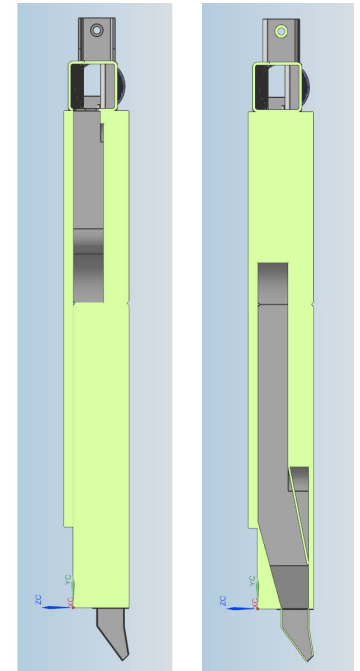
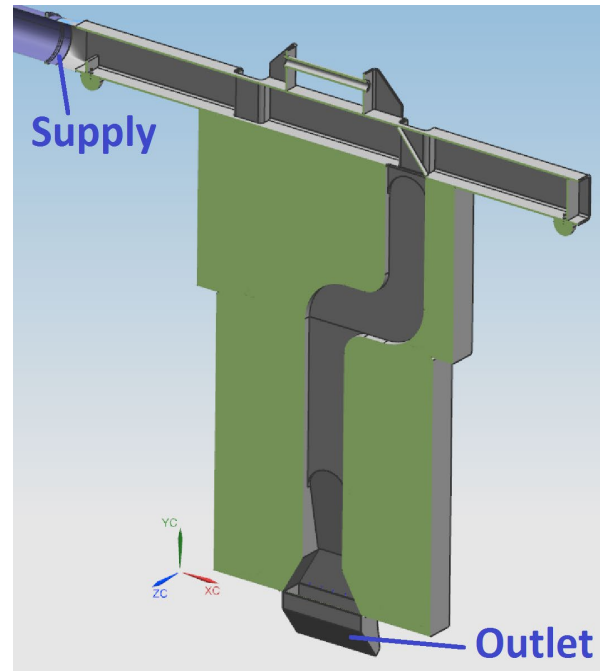
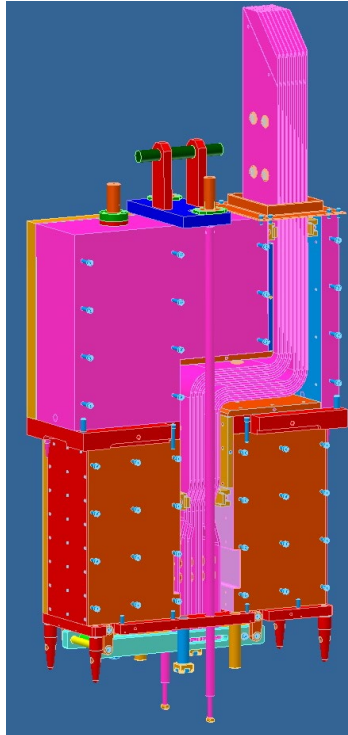
A: Thermal-Electric
 Temperature
 Type: Temperature
 Unit: °C
 Time: 1
 3/19/2018 9:19 AM



6). Stripline Air Diverter T-block (A1901.03.02)

Dedicated air cooling to upper end of Horn 1 electrical bus stripline

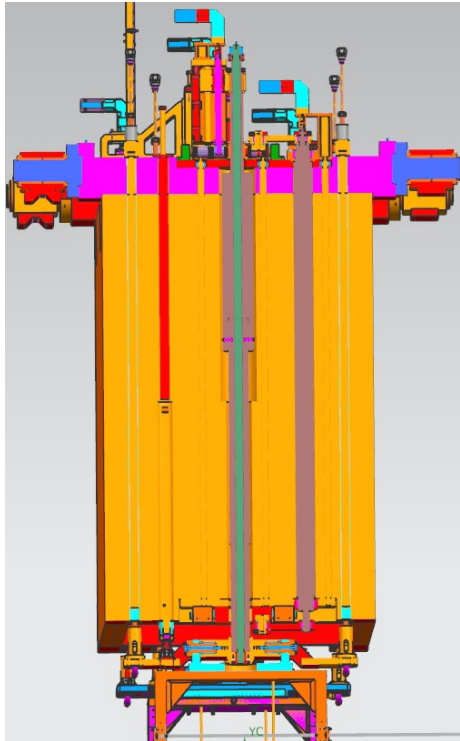
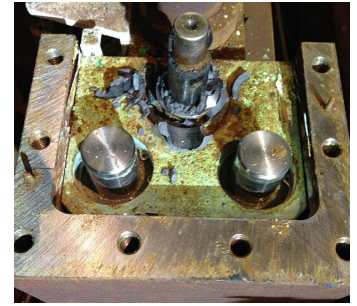
- through an adjacent shielding block with new air supply installation through battlement
- Design and drawing package 60%



7). Target & Horn 1 Module Drive Mechanism (A1901.03.03)

Module are corroded, motion control on Target & Horn 1 is failing

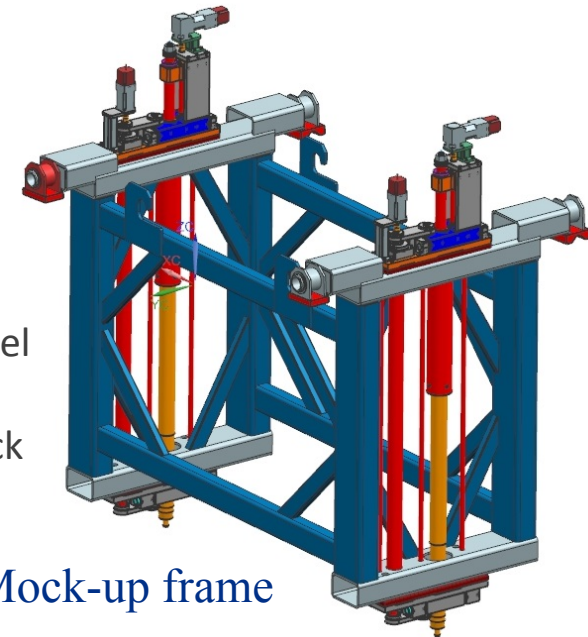
- Target horizontal motion is frozen
- Redesigned drives and linkages with corrosion resistant materials SS
 - Drawings of Target module drive released in 2018, now under review and revision.
 - Horn 1 module drive mechanism is similar with less motion requirements
 - Fabrication of mock-up frame at Fermilab's MAB



Modules	Vertical motion	Horizontal motion
Target	+8 mm to -200 mm	+/- 8mm
Horn 1	+/- 3 mm	+/- 3 mm

Modifications:

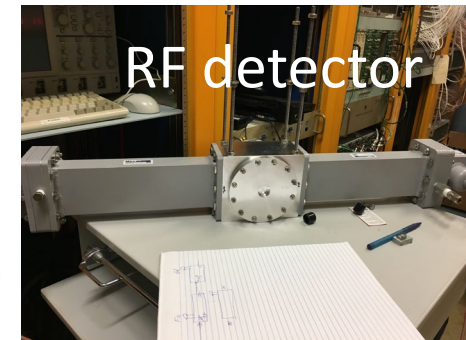
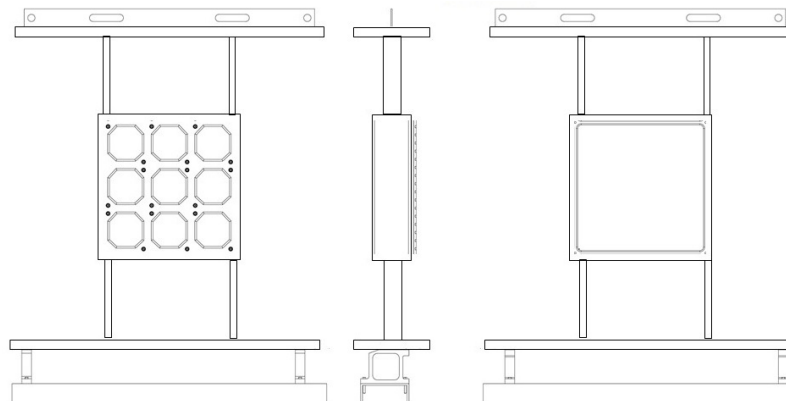
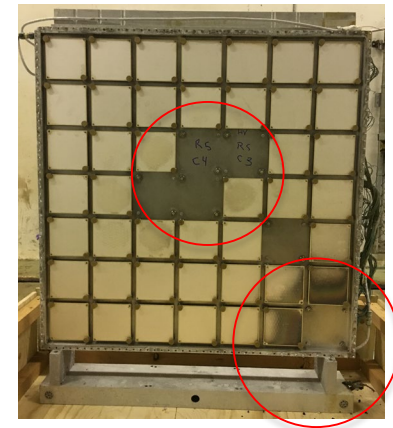
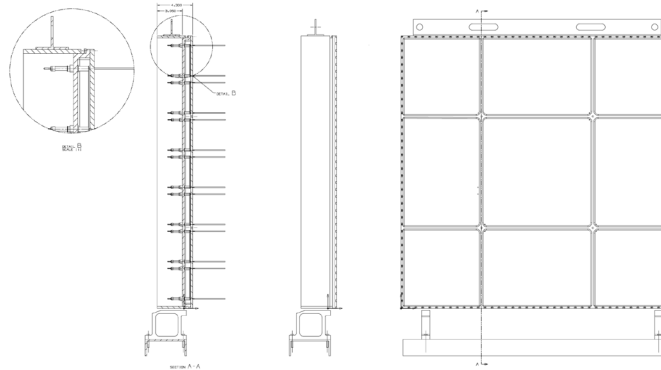
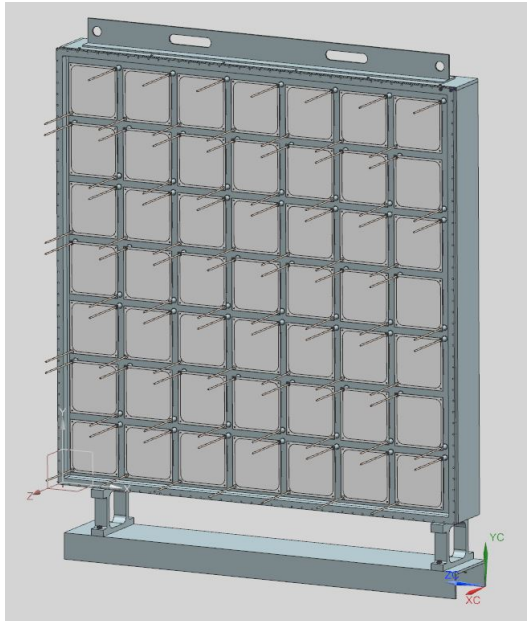
- Graphalloy bushings and washers
- More powerful motors with stainless steel gear box
- Al anodized bushings in lower linear block
- Transverse link shaft design
- Vertical shaft support block
- Module mock-up frame



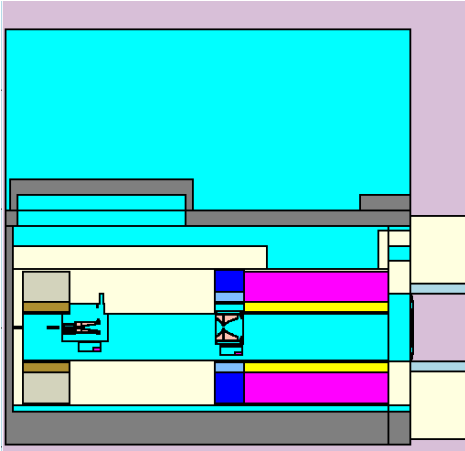
Mock-up frame

8) Hadron Beam Monitor

- Experiencing pixel failure from radiation damage
- Inspected 1st and 2nd retired hadron beam monitors
 - Found two types of discoloration at beam center and near gas exhaust line, heavily corroded
 - Performed dimensional measurements and reproduce drawings
- Design simplified robust hadron monitor (3x3 array) with radiation hard materials
- R&D alternative detectors
 - RF detector
 - SEM



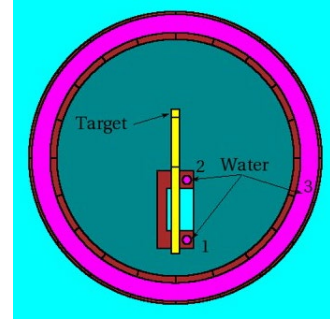
9). MARS Simulations



Calculated distributions of star density, hadron flux, prompt and residual dose, and energy deposition for:

- Target chase
- Decay pipe
- Absorber Hall and Muon Alcoves

- Shielding and environmental assessments
- Preliminary FEA thermal and structural analysis

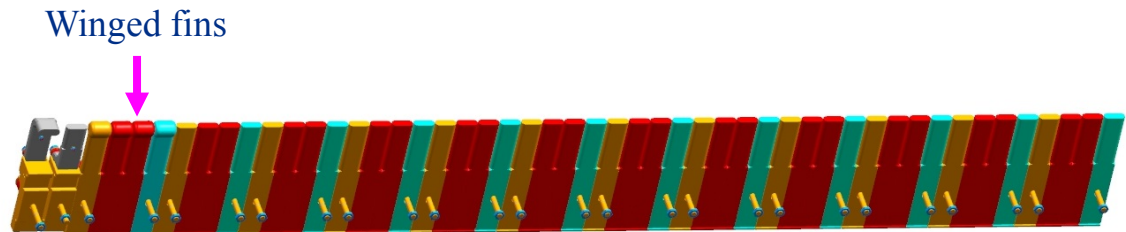


The following information were provided for MARS model updates:

- New target core changes with winged fins placed upstream
- Target DS window cooling loop
- Decay pipe repair patch

MARS re-run for:

- Target DS Be window
- Decay pipe window
- Hadron absorber
- Normal operation, and accident condition with a 6mm beam offset.



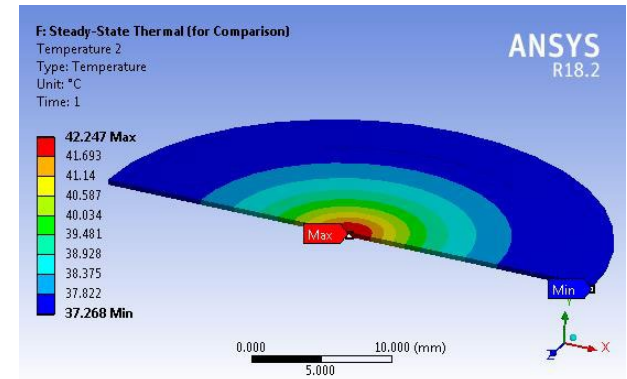
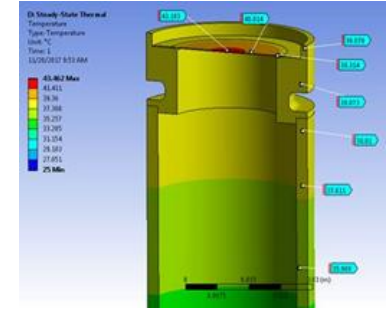
10) Pre-target Vacuum Pipe with Beryllium window

Pre-target vacuum pipe with improved Beryllium window was installed in summer 2018

- Pre-target Be window
 - Slightly domed and thicker
 - Improved brazing joint design
 - Thermal-structural analysis

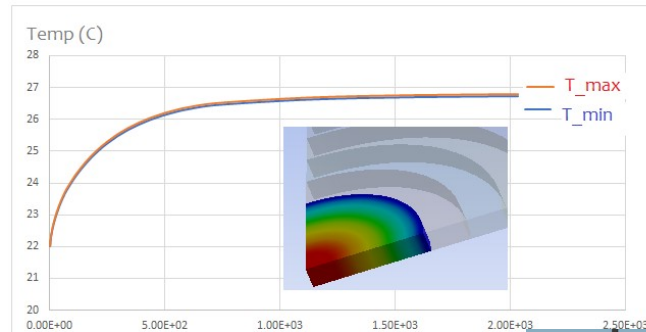
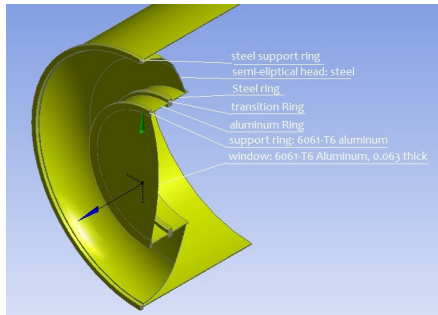
Fabrication of pre-target vacuum pipe spares (qty. 3)

- 80% parts on hand
- EB-welding
- Assembly welding

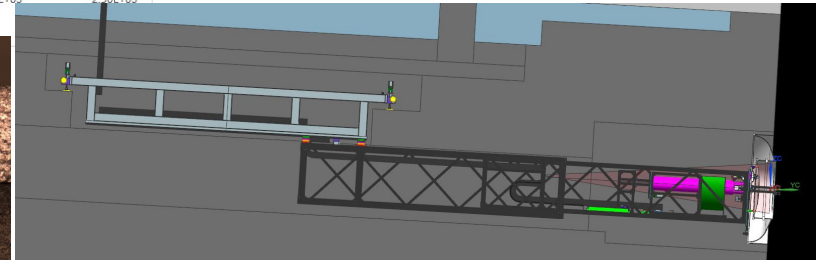
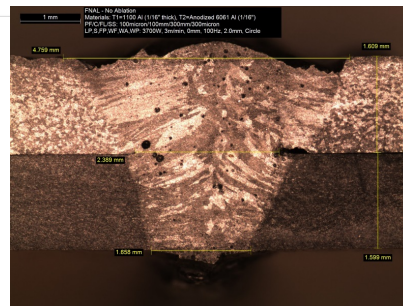
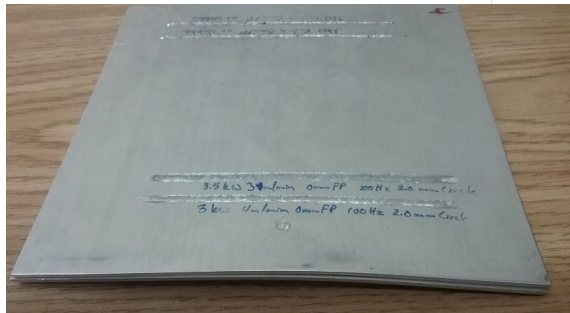


11) Decay Pipe Window

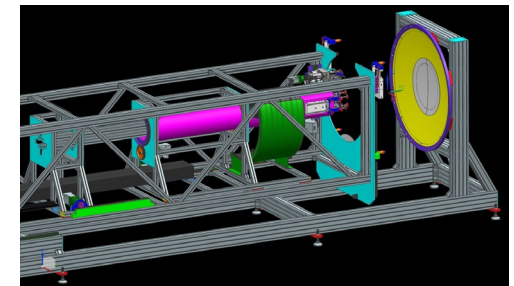
- Evaluation and possible solutions in event window needs to be replaced
 - Preliminary FEA analysis
 - Weld repair patch (Al 5083 or 5052) over failed section (Al 6061)
 - Repair mechanism concept developed



Suspected corrosion was found on the window at beam spot center in 2007 (heat or corrosion?)



- Weld testing (Robot laser ablation welding)
 - Material selection
 - Samples, welding, testing & characterize properties
- MARS and FEA with new parameters and beam accident conditions



12) Tritium Mitigation

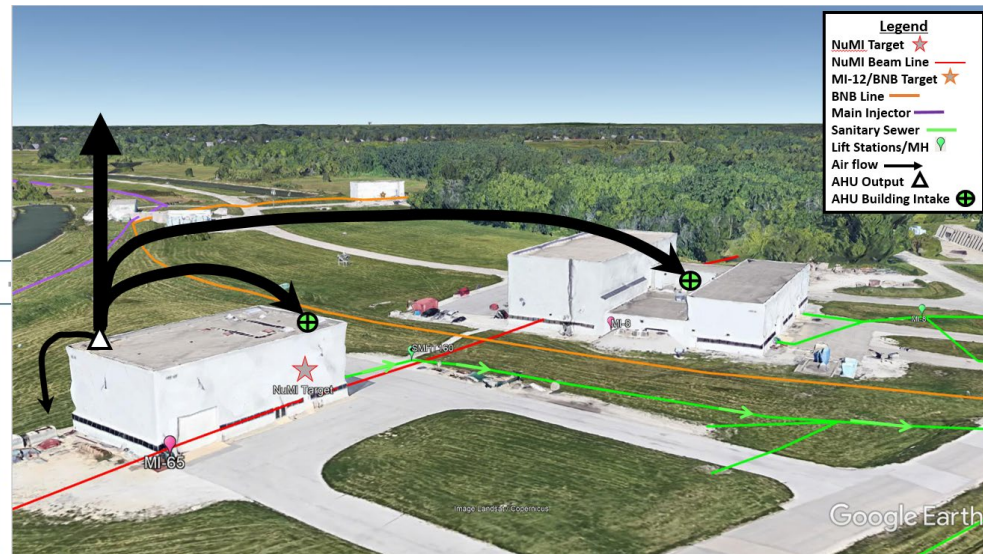
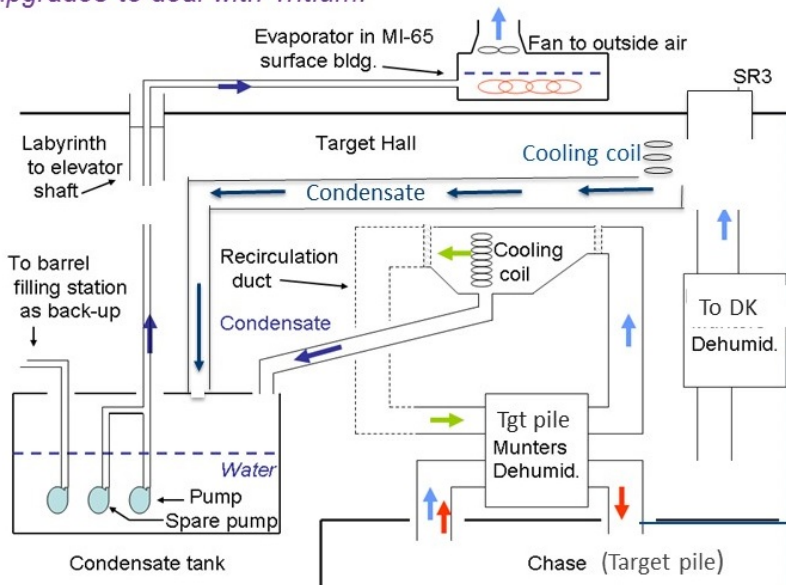
Tritium is nearly all produced by spallation in the shielding, increases exponentially with beam power

- Baseline scope: extend chimney stack for an improved evaporative disbursement
- Recent measurements:
 - spikes in sewer higher than expected after rain
 - under investigation
- It is an operational issue that Tritium Task Force is working on

Schematic of main NuMI Tritium release path

Takes target hall HTO humidity, condenses it, then evaporates it from roof

All of this dehumidification and evaporation equipment was added to NuMI as upgrades to deal with Tritium.



Monthly Project Performance Report – March 2019

CONTRACT PERFORMANCE REPORT FORMAT 1 - WORK BREAKDOWN STRUCTURE											DOLLARS IN Dollars		
1. CONTRACTOR				2. CONTRACT				3. PROGRAM			4. REPORT PERIOD		
a. NAME Fermi National Accelerator Laboratory				a. NAME				a. NAME NuMI AIP Project with February 2019 Status			a. FROM (YYYYMMDD) 2019 / 03 / 01 b. TO (YYYYMMDD) 2019 / 03 / 31		
B. PERFORMANCE DATA													
Cntrl Acct (2) Cntrl Acct Work Package.CTC (3) ITEM (1)	CURRENT PERIOD					CUMULATIVE TO DATE					AT COMPLETION		
	BUDGETED COST		ACTUAL	VARIANCE		BUDGETED COST		ACTUAL	VARIANCE		BUDGETED	ESTIMATED	VARIANCE
	WORK SCHEDULED (2)	WORK PERFORMED (3)	COST WORK PERFORMED (4)	SCHEDULE (5)	COST (6)	WORK SCHEDULED (7)	WORK PERFORMED (8)	COST WORK PERFORMED (9)	SCHEDULE (10)	COST (11)	(14)	(15)	(16)
A1901.01.01 Project Management	18,544	18,544	18,947	0	(404)	54,748	54,748	67,761	0	(13,013)	674,142	748,384	(74,242)
A1901.02.01 Pre-Target Window	7,770	7,474	7,342	(296)	132	25,006	17,014	16,209	(7,992)	806	39,435	55,644	(16,209)
A1901.02.02 Target Baffle & Core	46,410	12,718	46,733	(33,692)	(34,015)	136,658	128,209	95,815	(8,449)	32,394	315,907	298,490	17,418
A1901.03.01 Horn 1	30,613	48,913	21,266	18,300	27,647	64,836	145,101	57,940	80,264	87,161	267,284	314,038	(46,754)
A1901.03.02 Air Diverter T-Block	19,934	4,183	173	(15,751)	4,010	52,737	35,940	17,042	(16,797)	18,898	262,011	268,829	(6,818)
A1901.03.03 Modules	19,715	3,908	13,576	(15,808)	(9,669)	63,052	19,131	17,027	(43,921)	2,104	625,140	642,167	(17,027)
A1901.04.01 RAW	0	0	6,256	0	(6,256)	0	0	12,111	0	(12,111)	457,254	469,365	(12,111)
A1901.04.02 Target Chase Cooling	8,543	42,970	9,108	34,427	33,862	25,080	42,970	16,431	17,890	26,539	347,466	362,415	(14,948)
A1901.04.03 Target Chase Shielding	31,382	0	1,869	(31,382)	(1,869)	99,101	74,326	1,869	(24,775)	72,457	113,347	40,891	72,457
A1901.04.04 Tritium Mitigation	0	0	1,229	0	(1,229)	47,487	23,743	1,229	(23,743)	22,515	143,925	121,410	22,515
A1901.05.01 Decay Pipe Window	24,776	15,305	2,097	(9,470)	13,209	126,094	15,305	6,290	(110,789)	9,015	244,531	250,821	(6,290)
A1901.06.01 Hadron Monitor & Absorber	60,100	34,555	25,184	(25,546)	9,370	149,877	95,184	25,184	(54,694)	69,999	577,937	603,735	(25,797)
A1901.06.02 MAS Modeling	17,183	0	0	(17,183)	0	52,367	671	726	(51,696)	(56)	67,096	67,151	(56)
d. UNDISTRIBUTED BUDGET											0	0	0
e. SUBTOTAL	284,969	188,569	153,779	(96,401)	34,789	897,044	652,343	335,634	(244,701)	316,708	4,135,475	4,243,339	(107,864)
f. MANAGEMENT RESERVE											0		
g. TOTAL	284,969	188,569	153,779	(96,401)	34,789	897,044	652,343	335,634	(244,701)	316,708	4,135,475		

Most tasks are on schedule

- Schedule variances were due to transition process of project re-start

Summary

➤ Most tasks are on schedule

- Effective team work from scope defining, design, to procurement and fabrication
- Procurement delay for Pipefitter T&M requisitions for A1901.04.01 & A1901.04.02, but finally they were approved with the team work among several CAMs!
- 1 MW target fabrication, requires alignments during shutdown time, but it is scheduled to be installed in the last week of summer shutdown. It is expected to be on schedule with work planning and coordination
- Task scope for tritium mitigation (A1901.04.04) needs to be redefined due to recent spikes in tritium measurements, but TTF is actively working on this issue
- DS Be window additional cooling is an extra activity In Target Core A1901.02.02, it is addressed and on schedule

➤ Next quarter will be busy – preparing for summer shutdown