

Memorandum

Sue McGimpsey

Date: April 5, 2021
To: Matt Quinn, Senior Radiation Safety Officer
From: Sue McGimpsey, Radiation Safety Officer
Re: Summer 2020 Shutdown, Post-Shutdown Collective Dose Summary

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Message:

The Fermilab 2020 shutdown began on July 7, 2020, with Main Injector resuming beam on November 18, 2020. All planned shutdown jobs in the electronic worklist and IMPACT were reviewed by ES&H Radiation Physics Operations Department RSOs & RCTs, and jobs requiring RCT Coverage, RWP's or ALARA plans were identified prior to the start of shutdown.

Of the 239 initially planned jobs, it was anticipated that 30 jobs would need further review to determine if the job would be performed under an RWP, RCT Coverage, ALARA plan or possibly all three. Please see Table 1 below, noting that this list represents planned RWP/RCT coverage and ALARA jobs and is not inclusive of all jobs that occurred during the shutdown. Of course, jobs can and do get cancelled before any work begins due to scheduling conflicts or resources need to be allocated to other jobs. Dose estimates were conservative estimates from RPO staff and machine experts. All dose estimates for specific jobs listed in Table 1 and throughout this memo contain a 25% contingency.

Of the twenty jobs initially flagged as needing an ALARA plan, fifteen jobs were actually performed under an ALARA plan. Those are listed below. They all involve working in potentially high dose rate areas or posted contamination areas. The decon of the MI30 and MI8 collimator regions are performed every shutdown.

1. Permanently post beamline components in the collimator regions of Booster, MI8 and MI30 Contamination Areas
2. Beam loss monitor check in Booster
3. Cable pulls in MI8
4. Install HVAC duct work in the NuMI Target Hall and inside the Target Chase
5. Replace NuMI Horn #1 and #2
6. Transport NuMI Horn PH2-02 from MI65 to C0
7. Removal and replacement of the NuMI Target Hall pre-filters
8. NuMI Horn #1 module repairs
9. Restore horizontal motion control to the MI30 collimators
10. Install inserts in the beampipe of Main Injector three collimators
11. Repair bus leak at MI 307
12. Cable pulls at MI30
13. Check for vacuum leaks in the RR 900 transfer region

14. Transport NuMI Target TA-03 from MI65 to C0
15. Replace MI ion pump 301A

Since these ALARA jobs surpassed the ALARA trigger levels specified in FRCM Article 354, they also received SRSO approval prior to the shutdown. Twenty-five other jobs were performed under an RWP/RCT coverage only and are also listed in Table 1.

The initial total pre-shutdown estimated dose was:

- 4108 person-mrem for the RWP/RCT coverage & ALARA jobs
- 2651 person-mrem for other miscellaneous jobs and technical support. This includes doses from MCR Operators, RPE, HCTT, PPD etc. And may not be associated with a job in the Accelerator Division Worklist.

*Based on the actual dose received for the 2019 shutdown ALARA plan and RWP/RCT coverage jobs, and the final pocket dosimeter (PD) report, the estimated miscellaneous dose for the 2020 shutdown was 2651 person-mrem.

$$* 2020 \text{ misc. dose} = (2019 \text{ PD report} - 2019 \text{ ALARA actual dose received}) \times \left(\frac{\# \text{ weeks in 2020 shutdown}}{\# \text{ weeks in 2019 shutdown}} \right)$$

$$2020 \text{ misc. dose} = (4053 - 1960) \times \left(\frac{19 \text{ weeks}}{15 \text{ weeks}} \right)$$

$$2020 \text{ misc. dose} = 2651 \text{ person} - \text{mrem}$$

However, since the accelerators were shut down in March, this provided more cool off time resulting in lower dose rates and less dose received by personnel working in the enclosures.

The total estimated dose for the 2020 shutdown prior to the start of the shutdown was 6759 person-mrem

The actual dose received, based on Pocket Dosimeter reports from GetDose from 7/7-11/18/2020, is 4878 person-mrem.

- 3,185 person-mrem for job requiring an ALARA plan and/or RWP/RCT coverage
- 1,693 person-mrem for the other miscellaneous jobs
- The maximum individual dose received was 340 mrem, and the average individual dose received was 43 mrem.

The actual doses received were much lower than our pre-shutdown estimate. Again, this is due to the accelerators being shut down approximately three months early due to Covid-19 restrictions, and conservative job plans.

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Table 1. 2020 Shutdown jobs needing RWP, RCT coverage and ALARA Plan

Shutdown Job	Pre-Shutdown Dose Estimate person-mrem (If estimated)	ALARA Plan and/or RWP/RCT Coverage	RWP #	Pre-Job Estimate (mrem)	Actual Dose Received (mrem)	Comments
Decon MI8 and MI30 at the end of Shutdown		ALARA Plan	AD-20-147	87	47	This job is part of every shutdown
Decon MI8 and MI30 at the beginning of the Shutdown		ALARA Plan	AD-20-096	87	50	This job is part of every shutdown
Repair Quad 110 Magnet in MI		RWP/RCT Coverage	AD-20-108		14	
Install Ion Pumps in MI		RWP/RCT Coverage	AD-20-109		31	
Alignment Survey in Booster		RWP/RCT Coverage	AD-20-110		22	
Replace NuMI Target Hall Pre-Filters	65	RWP/RCT Coverage	AD-20-112	65	8	
Transport NuMI Target TA-03 from MI65 to C0	21	ALARA Plan	AD-20-113	10	8	
Replace NuMI Horn #1	1076	ALARA Plan	AD-20-114	870	935	It took several attempts to get the new horn in the correct position
NuMI Horn #1 Module Repair	371	ALARA Plan	AD-20-115	483	577	Higher dose resulted due to the difficulty in removing corroded rods and bkgd. dose underestimated for moving R & T blocks
Move Horn PH1-04 C0 into the "big room" long term storage.		RWP/RCT Coverage	AD-20-116		0	
Repair sump and well discharge piping for MI-12		RWP/RCT Coverage	AD-20-117		0	
Repair Water Line on MI RF Cavities		RWP/RCT Coverage	AD-20-118		17	

Shutdown Job	Pre-Shutdown Dose Estimate person-mrem (If estimated)	ALARA Plan and/or RWP/RCT Coverage	RWP #	Pre-Job Estimate (mrem)	Actual Dose Received (mrem)	Comments
Replace the F24 Quad Magnet		RWP/RCT Coverage	AD-20-119		0	
Investigate Vacuum Leak in Booster at L3 and L6		RWP/RCT Coverage	AD-20-120		5	
Girder Capacitor Adjustment in Booster	5	RWP/RCT Coverage	AD-20-121	5	87	
BLM Check in Booster	13	ALARA Plan	AD-20-121	128	81	
Take some pictures of beamline components in the posted contamination area in Booster		RWP/RCT Coverage	AD-20-125		0	
Posting Beamline as Contamination Area	42	ALARA Plan	AD-20-123	34	23	
Take measurements of the collimators in the MI30 region		RWP/RCT Coverage	AD-20-128		0	
ISA trim magnet installation in the Delivery Ring		RWP/RCT Coverage	AD-20-129		0	
Fix water leak in Transfer Hall LCW system		RWP/RCT Coverage	AD-20-130		0	
Repair Bus Leak at 307	Not Available	ALARA Plan	AD-20-131	189	140	
Replace NuMI Horn #2	Not Available	ALARA Plan	AD-20-132	325	375	
Transport NuMI Horn PH2-02 from MI65 to C0		ALARA Plan	AD-20-134	10	6	
NuMI HVAC Work		ALARA Plan	AD-20-135	88	66	
Inspect the LVDTs at each collimator		RWP/RCT Coverage	AD-20-136		0	
Water Clean Up in MI at 307		RWP/RCT Coverage	AD-20-137	Not in pre-shutdown list	4	
Cable Pulls in MI8	126	ALARA Plan	AD-20-138	126	19	

Shutdown Job	Pre-Shutdown Dose Estimate person-mrem (If estimated)	ALARA Plan and/or RWP/RCT Coverage	RWP #	Pre-Job Estimate (mrem)	Actual Dose Received (mrem)	Comments
Pull abort sump monitoring cables through the MI abort room		RWP/RCT Coverage	AD-20-139		0	
Restore Horizontal Motion Control in MI30 Collimators	791	ALARA Plan	AD-20-140	883	154	
Install Collimator Inserts in Beampipe at MI30 Collimators	1547	ALARA Plan	AD-20-140	756	136	
Repair MI40 Abort Skid Motor		RWP/RCT Coverage	AD-20-141		7	
Cable Pulls at MI30	Not Available	ALARA Plan	AD-20-144	82	177	A few issues arose with having the wrong connectors and labeling of connections. It was also noted that the electricians used were not familiar with making these connections
Replace Fans in Booster		RWP/RCT Coverage	AD-20-145		5	
Investigate Vacuum Leak in RR 900 Section		ALARA Plan	AD-20-146	276	124	
HEPA Filter Change out in APO		RWP/RCT Coverage	AD-20-148		9	
Retrieve Loss monitors from Booster		RWP/RCT Coverage	AD-20-152		11	
Replace MI Ion Pump 301A		ALARA Plan	AD-20-153	110	37	

Shutdown Job	Pre-Shutdown Dose Estimate person-mrem (If estimated)	ALARA Plan and/or RWP/RCT Coverage	RWP #	Pre-Job Estimate (mrem)	Actual Dose Received (mrem)	Comments
LCW Hose Inspections	Not Available	RWP/RCT Coverage	AD-20-157		4	
Inspect Two RR Magnets		RWP/RCT Coverage	AD-20-156		4	
Modify extraction kicker around 201/202 section in the middle of the D30 straight section in the Delivery Rig		RWP/RCT Coverage	AD-20-155		0	
Remove and replace EPDM hoses at MI30 for fiber optic test	Not Available	RWP/RCT Coverage	AD-20-151		2	This job was not able to be completed
Replace Drift Tube #2 in Linac		RWP/RCT Coverage	AD-20-107		0	