ACCELERATOR DIVISION ADMINISTRATIVE PROCEDURE

ADAP-11-0001

BEAM PERMITS, RUNNING CONDITIONS, and STARTUP

RESPONSIBLE DEPARTMENT: ES&H RPO

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ES&H Radiation Physics Operations Department Head

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AD Operations Department Head

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AD Division Head

REVISION NO. 9 REVISION ISSUE DATE 8/31/2020

Table of Contents

1.0 Purpose and Scope

The purpose of this procedure is to describe how the Accelerator Division (AD) complex is returned to an operational state after extended shutdowns or after extensive maintenance or improvement work has taken place. An extended shutdown is defined as a shutdown that is typically greater than a month long. This procedure is also used as a driver to generate Beam Permits and Running Conditions that define operational parameters. This procedure can be executed whenever it is deemed necessary to formally review a given startup or operational change. This procedure does not address the shorter, controlled shutdowns that occur during the course of a run for maintenance and repair of specific components, or improvements to a few specific subsystems.

This procedure is applicable to all machines that make up the Fermilab accelerator as outlined in the Fermilab Safety Assessment Document (SAD) and Accelerator Safety Envelope (ASE).

1.1 Policy

It is the Accelerator Division Policy that beam will not be introduced into any accelerator or beamline enclosure until:

a. equipment and components are configured in a manner to safely allow beam transport;
b. operational beam limits have been established consistent with the requirements of the Accelerator Safety Envelope (ASE) contained in the current applicable Safety Assessment Document (SAD), the appropriate SAD Chapter, and the appropriate Shielding Assessment (SA) for the area.

2.0 Responsibilities

2.1 ES&H Radiation Physics Operations (RPO) Department Head

The ES&H RPO Department Head is responsible for ensuring this document is prepared and updated on an as-needed basis.

2.2 AD Department Heads

All Department Heads are responsible for ensuring that the provisions relevant to their departments are carried out. In the event of a change in departmental procedure that affects startup, the AD Department Heads are responsible for ensuring that the AD Division Head or designee is informed in writing on the start-up sign-off document. In addition, the AD Department Heads (or their designees) are required to sign off on the relevant System Start-Up Sign-Off documents.

2.3 AD Division Head

The AD Division Head is responsible for initiating this procedure. The AD Division Head is responsible for overseeing that the provisions of this procedure are implemented. The AD Division Head is responsible for approving the System Start-Up Sign-Off, Beam Permit and Running Condition documents, and for sending the appropriate memos to the Operations Department Head to allow for the start or restart of the various accelerator systems.

2.4 Assigned Radiation Safety Officer (RSO)

The Assigned Radiation Safety Officer (RSO) will prepare and review the Beam Permit, Running Condition and the System Start-Up Sign-Off documents for compliance with the Accelerator Safety Envelope (ASE) contained in the current applicable Safety Assessment Document (SAD), the appropriate SAD Chapter, and the appropriate Shielding Assessment (SA) for the area. (See Attachments 1, 2, and 3, respectively).

3.0 Startup Procedure

3.1 Beam Permits and Running Conditions

Prior to the start of any accelerator beamline or experimental area, a Beam Permit and Running Condition shall be generated and placed in the Main Control Room (MCR) and any applicable, interfaced control room (Attachments 1 and 2). The Beam Permit and Running Condition identify ASE and Operating Limits allowed for the appropriate system within the current ASE and SA and/or SAD, and define necessary actions for the Main Control Room (MCR) and applicable, interfaced control room operations crew(s) to follow for off-normal occurrences.

Beam Permits are prepared by the Assigned RSO to ensure compliance with the current appropriate system ASE and Operating Limits. Beam Permits are reviewed by the AD Operations Department Head, applicable, interfaced operations Head, the AD Systems Department Head, the assigned RSO, and the ES&H RPO Department Head. Beam Permits are then approved by the AD Division Head.

Running Conditions provide the Main Control Room (MCR) and applicable, interfaced control room operations crew(s) with the allowed or required safety related beamline parameters, configurations, and any additional safety related restrictions on operating the beam. Running Conditions typically include:

- The Date Issued
- A Mode Identifier (some systems have multiple Running Conditions)
- The ASE intensity limit
- The Operating Intensity Limit
- Beam intensity monitoring devices
- The designated Critical Devices and enclosures protected

- Any Interlocked Radiation Detectors and monitoring channels (MUX)
- Any required special interlocks or setting types
- Devices or systems that must be disabled to allow access
- Associated Gates, Fences, or Passive Shielding Requirements
- Operational Comments such as what toroid monitors beam intensity
- Any special concerns that require approval before re-enabling the system
- Items that require documenting in the MCR electronic logs (E-Log)

Running Conditions are prepared by the Assigned Radiation Safety Officer and signed by the AD Systems Department Head, Assigned Radiation Safety Officer, AD Operations Department Head, and AD Division Head. Only the MUX channels of interlocked detectors and Operational Comments can be altered by the Assigned RSO using initials on existing documents. Any other modification to an existing Running Condition is covered by an Operating Note.

3.2 Operating Notes

Operating Notes may be issued by the Assigned RSO to the Main Control Room (MCR) and applicable, interfaced control room operations crew(s) that temporarily modifies an existing Running Condition to allow for special operating conditions that do not contradict shielding assessments. Typically, Operating Notes require intensities lower than the Running Condition allows. Operating Notes may include, but are not limited to: reduced intensities for commissioning beam, reduced intensities for temporary conditions that result in special concerns of a radiological nature, or special runs for beam studies. Operating Notes allow for an equivalent or more conservative modification to beam operations or intensities than the existing Running Condition. Operating Notes are in effect until they are rescinded by the Assigned RSO.

3.3 System Start-Up Sign-Off Document

The Assigned RSO is responsible for providing the System Start-Up Sign-Off document to each System Department Head with the appropriate “System Being Signed Off” designated and the appropriate Shielding Assessment noted on the form.

Each System Department Head is then responsible for ensuring that support Departments that have performed work on the system sign the System Start-Up Sign-Off Sheet, otherwise indicate “N/A” for support Departments that did not perform work.

Support Department(s) Signatures indicate that, unless noted in the comments section, their relevant systems are ready for the start of beam operation. If there is any remaining work on their relevant systems that would affect the restart of beam operations, descriptions of the remaining work should be made in the comments section.

Department Head Signatures indicate that all work is completed in the relevant support Departments and that to their knowledge the system is ready to accept beam, or that any

remaining work indicated in the comments section has been acknowledged and will be evaluated to ensure safe restart of beam operations. In addition, the signature also indicates that the radiation shielding for the system is configured as described in the current shielding assessment.

The Assigned Radiation Safety Officer signature indicates concurrence that the radiation shielding and that the Radiation Safety Interlocks are configured as described in the current shielding assessment, and that all items in the relevant system's configuration control log have been closed out.

The AD Division Head signature acknowledges their review of the system readiness for safe restart of beam operations.

3.4 System Turn-On

A valid Beam Permit, Running Condition and System Start-Up Sign-Off (see Attachments 1, 2, 3) are required to be completed before a given beamline system may accept and/or accelerate beam.

System operation is initiated by a memo that is sent by the AD Division Head to the AD Operations Department Head, and applicable, interfaced operators, indicating that a system is ready for beam transport.

4.0 Documentation

Copies of all Beam Permits, Running Conditions, and System Start-Up Sign-Off forms will be retained by AD Headquarters. Active Beam Permits, Running Conditions, and Operating Notes (if applicable) for all accelerator systems will be viewable in the Main Control Room and any applicable, interfaced control room.

5.0 Distribution

An electronic controlled copy of this procedure is maintained on the Beams DocDB:
http://beamdocs.fnal.gov/AD-public/DocDB//ShowDocument?docid=4975

6.0 Attachment 1 - Example Beam Permit

Fermilab

ADAP-11-0001 Rev. 8

BEAM PERMIT
09/03/2018

LINAC Accelerator Safety Envelope (ASE) Limit

The maximum beam intensity transmitted through the LINAC Beamline is limited to:
1.77×10^{19} protons/hr at 400 MeV

No accelerator or beam line will transmit beam without an operational beam interlock safety system.

LINAC Beamline Operating Limits

The maximum beam intensity transmitted through the LINAC Beamline is limited to:
3.54×10^{17} protons/hr at 400 MeV

Examples: Particles/hr = current (mA) × pulse length (μsec) × number of pulses/hr × 6.25×10^{9}

#1 35 mA of beam with a pulse length of 30 μsec at 15 Hz for one hour yields 3.54×10^{17} protons/hour
(35 mA × 30 μsec × 54,000 pulses/hr × 6.25×10^{9} = 3.54×10^{17} protons/hour)

#2 50 mA of beam with a pulse length of 30 μsec at 5 Hz for one hour yields 1.69×10^{17} protons/hour
(50 mA × 30 μsec × 18,000 pulses/hr × 6.25×10^{9} = 1.69×10^{17} protons/hour)

Special conditions and comments:

Reviewed by_____
Operations Department Head

Reviewed by_____
Systems Department Head

Reviewed by_____
Assigned RSO

Reviewed by_____
ESH&Q Radiation Physics Operations Department Head

Approved by_____
Accelerator Division Head

Page 1 of 1

7.0 Attachment 2 - Example Running Condition

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Running Condition
Linac

August 16, 2018

Area RSO Maddie Wolter and Sue McGimpsey

Mode of Operation Full Operation

Beam Limits	**Beam Energy**	**ASE Limit**	**Operating Limit**
	400 MeV	1.77 E19 protons/hr	3.54 E17 protons/hr

Critical Devices L:LVV and RFQ Low Level RF

L:LVV is a Vacuum Gate Valve

Enclosures Protected Linac and all areas downstream

Preferred Monitoring Devices* Intensity is monitored via L:RF3INT

*Other methods of monitoring intensity may be used.

Requirements

Access Devices L:LVV must be closed and RFQ Low Level RF must be OFF to access Linac.

Cool Off Period none

Special Interlocks The CDC Inputs including failure mode devices may all be found on the Safety System Status pages.

The status of the RFQ Low Level RF is monitored on L:RFQDS1.
The backup devices are the Ion Source Extractor PS AC Contactor L:AEXTSV and L:BEXTSV.

Special Concerns Any work performed on Critical Devices and/or obtaining a Critical Device key requires prior RSO approval. No access to the Linac enclosure while the high energy (Klystron) gradients are energized, and access is not allowed unless the Low Energy Gradients are below 50% nominal gradient.

Gates, Fencing and Passive Shielding Requirements There is no access to radiologically fenced areas without prior RSO approval.
The RFQ, ion source, (and former I- Cockroft-Walton) area directly north of the Linac enclosure is posted as a Radiation Area and is locked (AC-4 cored lock) to prevent access by non-Radiological Worker trained personnel. Routine access to this Radiation Area by Radiological Worker trained personnel is permitted during beam operations. (27) Lower Level penetrations must be locked with a LIN C cored padlock prior to operation. (8) penetrations on top of the Linac Berm must be locked with PAD 118 and LIN E cored padlocks. The downstream portion of the Booster Chute (on the Booster side) must be covered and locked with a PAD 118 and LIN C cored padlocks.

Assigned RSO approval also signifies that all necessary Interlock Tests have been completed and Removable Shielding is installed.

Ops. Dept. Head Approval _____ **Assigned RSO Approval** _____

Sys. Dept. Head Approval _____ **AD Head Approval** _____

Page 1 of 4 ADAP-11-0001

Fermilab

Running Condition
Linac

August 16, 2018

Area RSO Maddie Wolter and Sue McGimpsey

Operational Comments

No additional comments.

Fermilab

Running Condition
Linac

August 16, 2018

Area RSO Maddie Wolter and Sue McGimpsey

Instrument Information

Interlocked detectors are limited to 10 trips per hour. RSO approval is required if there are more than 10 interlocked detector trips in an hour. All interlocked detector trips and RSO approvals to reset, if required, shall be documented in the MCR E-log.

MUX	Type	Location	QF	R/I Mode	Trip Level	CDC	Device(s) Tripped
2-027	Chipmunk	Linac Dump #1 Berm US	5	Rate	2.5 mrem/hr	L:CRDEV	L:LVV & RFQ Low Level RF
2-028	Chipmunk	Linac Dump #1 Berm DS	5	Rate	2.5 mrem/hr	L:CRDEV	L:LVV & RFQ Low Level RF
2-031	Chipmunk	Linac Enclosure Tank #1	5	Rate	50 mrem/hr	L:CRDEV	L:LVV & RFQ Low Level RF
2-032	Chipmunk	Linac Gallery Tank #2	5	Rate	50 mrem/hr	L:CRDEV	L:LVV & RFQ Low Level RF
2-033	Chipmunk	Linac Gallery Tank #3	5	Rate	50 mrem/hr	L:CRDEV	L:LVV & RFQ Low Level RF
2-034	Chipmunk	Linac Gallery Tank #4	5	Rate	50 mrem/hr	L:CRDEV	L:LVV & RFQ Low Level RF
2-035	Chipmunk	Linac Gallery Tank #5	5	Rate	50 mrem/hr	L:CRDEV	L:LVV & RFQ Low Level RF
2-036	Chipmunk	Linac Gallery Tank #6	5	Rate	10 mrem/hr	L:CRDEV	L:LVV & RFQ Low Level RF
2-037	Chipmunk	Linac Gallery Tank #7	5	Rate	10 mrem/hr	L:CRDEV	L:LVV & RFQ Low Level RF
2-038	Chipmunk	Linac Gallery Tank #8	5	Rate	10 mrem/hr	L:CRDEV	L:LVV & RFQ Low Level RF
2-039	Chipmunk	Linac Gallery Tank #9	5	Rate	10 mrem/hr	L:CRDEV	L:LVV & RFQ Low Level RF
2-040	Scarecrow	Linac Enclosure 400 MeV Labyrinth		Rate	300 mrem/hr	L:CRDEV	L:LVV & RFQ Low Level RF
2-042	Scarecrow	Linac Enclosure Tank #3		Rate	3,500 mrem/hr	L:CRDEV	L:LVV & RFQ Low Level RF
2-044	Chipmunk	Booster Chute	5	Rate	50 mrem/hr	L:CRDEV	L:LVV & RFQ Low Level RF
2-053	Chipmunk	Booster Tunnel Dump #1	5	Rate	50 mrem/hr	L:CRDEV	L:LVV & RFQ Low Level RF

Note: QF only included for chipmunks

Fermilab

Running Condition
Linac

August 16, 2018

Area RSO Maddie Wolter and Sue McGimpsey

Operator Signatures

Crew Chiefs

Crew A

Crew B

Crew C

Crew D

Crew E

Other

8.0 Attachment 3 - Example System Sign-Off

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ADAP-11-0001
REV. 9

SYSTEM START-UP SIGN-OFF

The signatures below, unless noted in the comments section, indicate that the relevant systems are ready for the restart of beam operation. Indicate in the comments section any remaining work that would affect the restart of beam operations. Indicate N/A for departments that did not do any work on the system.

SYSTEM BEING SIGNED OFF: (Circle as Applicable)
Linac NIF MTA Booster [8-GeV Line-MI-10 Region]
[MI-20-MI-62/Recycler] BNB NuMI P1-P2 Muon P3-Switchyard
Meson Primary MT MC NM FAST _____

DEPARTMENT	DATE	SIGNATURE (Department Head/Designee)
1. Controls		
2. Cryogenics		
3. E/E Support		
4. RPO Manager		
5. LSO		
6. External Beamlines		
7. Instrumentation		
8. Interlocks		
9. Main Injector		
10. Mechanical Support		
11. Muon		
12. Operations		
13. Proton Source		
14. RF		
15. ENG Support		
16. Target Systems		
17. Shutdown Coordinator		

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Comments and special conditions (please mark comment with department # to connect comment with appropriate department):

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The _____ radiation shielding meets the requirements documented in the

_____

_____ shielding assessment.

FINAL APPROVALS

System Department Head _____ Date _____

Assigned RSO _____ Date _____

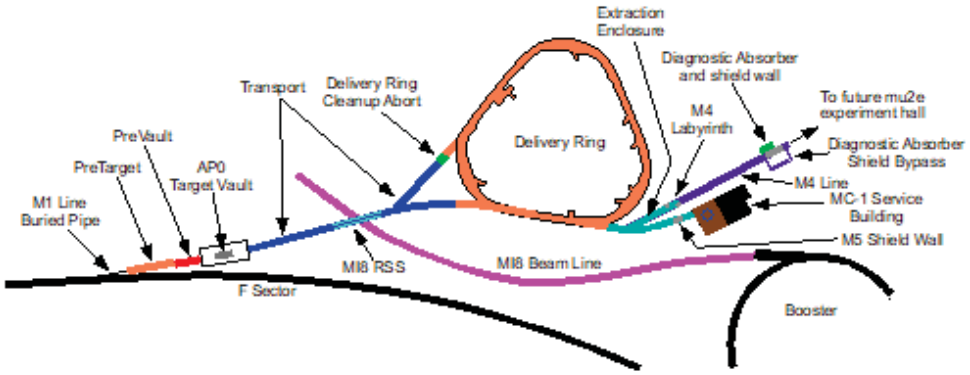
AD Division Head _____ Date _____

9.0 Attachment 4 - Example Operating Note

Muon Campus Operating Note

March 19, 2018

Muon Campus ACIS Boundaries



Based on the changes of the accelerator operations, AP0 South Vault Wall Chipmunk (2-069) radiation trip limit had been changed to 10mrem/h on Jan 16, 2018 and then to 15 mrem/h on January 26, 2018.

Since then there have been chipmunk studies going on at AP0 to monitor radiation levels around the Vault. Currently there are few shield blocks placed around the South and West wall of the Vault. No more radiation trip limit change is expected for 2-069, however it might be moved around (on top or to the side of the shield block) to allow the shield block placed at the right location.

This operating note is in effect from March 19, 2018 until it is rescinded by the area RSO.

Nino Chelidze