ACCELERATOR DIVISION ADMINISTRATIVE PROCEDURE

ADAP-11-0001

BEAM PERMITS, RUN CONDITIONS, and STARTUP

RESPONSIBLE DEPARTMENT: AD ES&H

Prepared By _____ DATE 9-24-13
AD ES&H Department Head

Reviewed By _____ DATE 9-24-13
AD Operational RSO

Reviewed By _____ DATE 9/24/13
AD Operations Department Head

Approved By _____ DATE 9-25-13
Accelerator Division Head

REVISION NO. 5 REVISION ISSUE DATE 9-25-13

SUPERSEDED

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1.0 Purpose and Scope

The purpose of this procedure is to describe how the Accelerator Division (AD) complex is turned back on 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.

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).

2.0 Responsibilities

2.1 AD ES&H Department Head

The AD ES&H 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 Division Head or designee is informed. In addition the AD Department Heads (or their designees) are required to sign off on the relevant System Start-Up Sign-Off sheets and checklists.

2.3 AD Head

The AD Head is responsible for overseeing that the provisions of this procedure are carried out. The AD Head is responsible for approving the System Start-Up Sign-off, Beam Permit, and Run 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.

The AD Head is responsible for designating a major shutdown or initiating this procedure. Such a designation is accomplished by a memo to the AD Operations Department Head rescinding authorization to introduce, accelerate, or transport beam until re-authorized in writing as described in this procedure.

2.4 AD Radiation Safety Officer

The AD Radiation Safety Officer will prepare and review the Beam Permit, Running Condition, and the System Start-Up Sign-off documents for compliance with the current Accelerator Safety Envelope (ASE) and Shielding Assessment 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 Run Condition shall be generated and placed in the Main Control Room (MCR) (Attachments 1 and 2). The Beam Permit and Running Condition identify beam power limitations, operating parameters allowed for the appropriate system within the current ASE limits, and define necessary actions for the Main Control Room operations crew to follow for off-normal occurrences.

Beam Permits are prepared and reviewed by the AD Radiation Safety Officer to ensure compliance with the current appropriate system Operating and Safety Envelope Intensity Limits defined in the ASE. Beam Permits are reviewed by the AD Operations Department Head, the AD Systems Department Head, the AD ES&H Department Head, and approved by the AD Head.

Running Conditions provide the Operations Department with the allowed or required safety related beamline parameters, configurations, and any additional safety related restrictions on operating the beam. These limits will be less than the Beam Permit. Running Conditions typically include:

- The Date Issued
- A Mode Identifier (some systems have multiple Running Conditions)
- The Beam Permit intensity limit
- The Operating Intensity Limit (an operationally determined safety factor)
- The designated Critical Devices and enclosures protected
- Any Interlocked Radiation Detectors and monitoring channels (DEMUX)
- 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

- Examples of Beam Permit and Operating Limit combinations with respect to Particles/Pulse, energy and repetition rate
- Any special concerns that require approval before re-enabling the system
- Items that require documenting in the MCE electronic logs

Running Conditions are prepared by the AD Radiation Safety Officer and signed by the AD Radiation Safety Officer, AD Operations Department Head, and AD Head. Only the DEMUX channels of interlocked detectors and Operational Comments can be altered by the AD/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 AD RSO to the Operations Department 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 AD RSO.

3.3 Sign-Offs and Checklists

Each Department Head shall sign the System Startup Sign-Off form (if applicable) indicating that all work is completed and that to their knowledge the system is ready to accept beam. In addition, the signature of the department head responsible for a particular system indicates that the radiation shielding for the system is configured as described in the current shielding assessment. The AD Radiation Safety Officer signature indicates concurrence that the radiation shielding and the Radiation Safety Interlocks are configured as described in the current shielding assessment.

3.4 System Turn-On

3.4.1 Generic Conditions

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 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.

5.0 Distribution

An electronic controlled copy of this procedure is maintained on the ES&H Department web site at: Http://www-bdnew.fnal.gov/esh/adsp/index.html

6.0 Attachment 1 - Example Beam Permit

Fermilab

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BEAM PERMIT

Linac

The maximum hourly beam power authorized through the Linac accelerator is limited to 3.54×10^{17} particles to 400 MeV in any one hour.

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

Linac Beam Operating Limits

The operational limit for beam transmitted through the Linac in any one hour is 3.34×10^{17} particles.

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

#1 33 mA of beam with a pulse length of 30 μsec at 15 pulses/sec for one hour
33 mA x 30 μsec x 54000 pulses/hr x $6.25 \times 10^{9} = 3.34 \times 10^{17}$

#2 50 mA of beam with a pulse length of 30 μsec at 5 pulses/sec for one hour
50 mA x 30 μsec x 18000 pulses/hr x $6.25 \times 10^{9} = 1.69 \times 10^{17}$

Special conditions and comments:

Reviewed by_____
Operations Department Head/Date and Proton Source Department Head/Date

Reviewed by_____
Accelerator Division ES&H Dept Head/Date

Reviewed by_____
Accelerator Division Radiation Safety Officer/Date

Approved by_____
Accelerator Division Head/Date

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7.0 Attachment 2 - Example Run Condition

Running Condition
Linac

September 3, 2013

R.S.O. Gary Lauten

Mode Identifier	Full Operation	
Beam Permit Limit	3.54 E17 particles/hour	Exp. #
Operational Limit	3.34 E17 particles/hour	N/A
Critical Devices	**L:LVV and RFQ Low Level Amplifier 24 volt DC PS**	
Enclosures Protected	Linac and all areas downstream	

Interlocked Radiation Detectors

Detector Type	Detector Trips	Demux	Location
See Attached List	LEBT Vacuum Valve L:LVV	See Attached List	See Attached List
	RFQ Low Level RF Amplifier 24 volt DC PS		

Other Requirements

Special Interlocks:
The "CDC" Inputs required to obtain a Linac "Beam Permit" may all be found on the "Safety System Status" pages. The status of the RFQ Low Level Amplifier 24 DC PS is monitored on L:RFQDS1.

The Backup Devices are the Ion Source Extractor PS AC Contactor L:AEXTSV and L:BEXTSV

Access Devices: L:LVV must be closed and RFQ Low Level Amplifier 24 volt DC PS must be OFF to access Linac.

Special Concerns: 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:
No outdoor fencing is required for Linac. The area between the Pre-Acc enclosures and the Linac enclosure must be posted as a Radiation Area and locked (AC-4 cored lock) to prevent access by non-Radiological Worker Qualified personnel. Routine access to the Radiation Area between the Pre-Acc enclosures and the Linac enclosure, during operations, by Radiological Worker trained personnel, is permitted. (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" must be covered and locked with a PAD 118 cored padlock. There is no access to radiologically fenced areas without prior RSO approval.

"Operational Comment"

The maximum beam energy is limited to 400 MeV. The maximum charge transmitted through the Linac is limited to 3.34 E17 protons/hour at 400 MeV kinetic energy.

As an Example:
33 mA of beam with a pulse length of 30 μsec at 15 Hz for 1 hour gives you 3.34 E17 protons/hour.
33 mA x 30 μsec x 54000 pulses/hr x 6.25 E9 = 3.34 E17 protons/hour

50 mA of beam with a pulse length of 30 μsec at 5 Hz for 1 hour gives you:
50 mA x 30 μsec x 18000 pulses/hr x 6.25 E9 = 1.69 E17 protons/hour

R.S.O. approval also signifies that all necessary Interlock Tests have been completed and Removable Shielding is installed.

Ops. Department Approval **R.S.O. Approval** **Division Head Approval**

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Running Condition
Linac

September 3, 2013

R.S.O. Gary Lauten

Note: Interlocked detectors are limited to 10 trips per hour. RSO approval is required if there are more than ten 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 Quad/Add	Name/Location	Quality Factor	Detector Type
2-027	Linac Dump #1 Berm US	Nu	Chipmunk
2-028	Linac Dump #1 Berm DS	Nu	Chipmunk
2-031	Linac Enclosure TL #1	Nu	Chipmunk
2-032	Linac LL Gallery TL #2	Nu	Chipmunk
2-033	Linac LL Gallery TL #3	Nu	Chipmunk
2-034	Linac LL Gallery TL #4	Nu	Chipmunk
2-035	Linac LL Gallery TL #5	Nu	Chipmunk
2-036	Linac LL Gallery TL #6	Nu	Chipmunk
2-037	Linac LL Gallery TL #7	Nu	Chipmunk
2-038	Linac LL Gallery TL #8	Nu	Chipmunk
2-039	Linac LL Gallery TL #9	Nu	Chipmunk
2-040	400 MeV Labyrinth Leg #2	4	Scarecrow
2-042	Linac Enclosure TL #3	4	Scarecrow
2-044	Booster Chute	Nu	Chipmunk
2-053	Booster Tunnel Dump #1	Nu	Chipmunk

R.S.O. approval also signifies that all necessary Interlock Tests have been completed and Removable Shielding is installed.

Ops. Department Approval **R.S.O. Approval** **Division Head Approval**

8.0 Attachment 3 - Example System Sign-Off

Fermilab

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SYSTEM SIGN-OFF

The signatures below indicate that work done on the system since the last period of operation has been completed and that the systems are ready for restart of beam operation. Signatures that are N/A should be initialed by the appropriate Department Head.

SYSTEM BEING SIGNED OFF: (Circle One) **Linac, NTF, MuCOOL, Booster, Main Injector, Recycler, BNB, NuMI, Muon, Switchyard, Fixed Target: MT, MC, NM**

DEPARTMENT	DATE	SIGNATURE (Department Head/Designee)
Controls		
Cryogenics		
E/E Support		
ES&H		
External Beamlines		
Instrumentation		
Main Injector		
Mechanical Support		
Muon		
Operations		
Proton Source		
RF		
SRF Electron Linac		
SRF Proton Linac		

The _____ radiation shielding meets the requirements documented in the _____ shielding assessment.

Approved by _____ _____
Department Head Date

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Comments and special conditions:

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FINAL APPROVALS

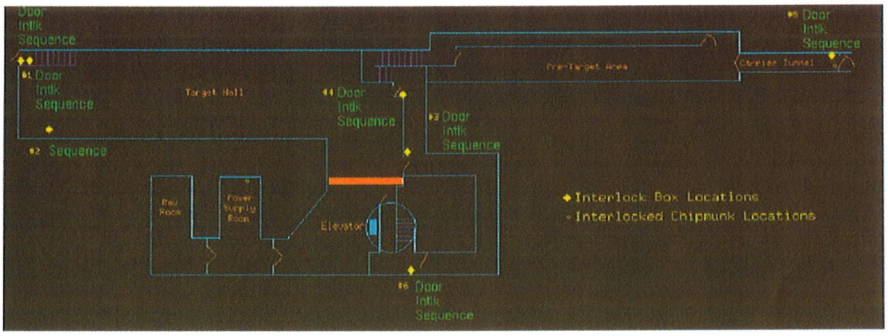
Department Head _____ Date _____

Radiation Safety Officer _____ Date _____

Accelerator Division Head _____ Date _____

9.0 Attachment 4 - Example Operating Note

Operating Note
NuMI
Low Intensity Target Scans
September 2, 2013



The current Running Condition for NuMI HEP operation is modified as follows:

Low intensity scans will be conducted to verify target position. The intensity must be temporarily reduced to low intensity (no more than 1.2 E12 Proton/pulse, no faster than 10 seconds between pulses) at 120 GeV because the "R-blocks" are not sealed. Intensity limit is as follows:

4.32 E14 protons/hr
1.2 E12 protons per pulse, 360 pulses per hour

Special Concerns: The purpose of this Operating Note is to conduct low intensity target scans in order to adjust and verify its position. The T-blocks are in chase, concrete R-block covers are on, and target hall shield wall door is closed.

NuMI "R-Blocks" are in place, however they are not sealed against air leaks. It is acceptable to run beam at low intensity as stated above during the time when the "R-blocks" are not sealed.

This Operating Note is in effect from September 2, 2013 until it is rescinded by the AD RSO. NuMI HEP operations may NOT resume until approved by the AD RSO.

G. Lauten