ACCELERATOR DIVISION ADMINISTRATIVE PROCEDURE

ADAP-11-0001

BEAM PERMITS, RUN CONDITIONS, and STARTUP

RESPONSIBLE DEPARTMENT: AD ES&H

Prepared By _____ DATE 3-14-14
AD ES&H Department Head

Reviewed By Gary Lauten DATE 3/14/14
AD Operational RSO

Reviewed By _____ DATE 3/21/14
AD Operations Department Head

Approved By S Nagaitsev 11291 DATE 3/25/14
Accelerator Division Head

REVISION NO. 6 REVISION ISSUE DATE 3-25-14

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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) and *Accelerator Division Administrative Procedure ADAP-11-0003, Approved Accelerator Beam Intensity Operating Limits*.

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), ADAP-11-0003, 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 ASE and Operating Limits allowed for the appropriate system within the current ASE, ADAP-11-0003 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 ASE and Operating Limits. 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 ASE intensity limit
- The Operating Intensity Limit
- 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 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 Systems Department Head, 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://ad-esh.fnal.gov/ad_adap.html

6.0 Attachment 1 - Example Beam Permit

Fermilab

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BEAM PERMIT

Main Injector Accelerator Safety Envelope (ASE) Limit

The maximum hourly beam power transmitted through the Main Injector accelerator is limited to:
7.45×10^{17} protons at 8 GeV
7.45×10^{17} protons at 120 GeV
6.23×10^{17} protons at 150 GeV

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

Main Injector Operating Limit

The maximum charge transmitted through the Main Injector is limited to:
1.39×10^{17} protons per hour at 8 GeV
1.39×10^{17} protons per hour at 120 GeV
1.16×10^{17} protons per hour at 150 GeV

Examples: Charge/ hr = number of pulses/ hr x number of protons/ pulse

#1 1200 pulses per hour at 1.16×10^{14} protons per pulse = 1.39×10^{17} protons per hour at 8 GeV

#2 2700 pulses per hour at 5.15×10^{13} protons per pulse = 1.39×10^{17} protons per hour at 120 GeV

#3 2400 pulses per hour at 4.83×10^{13} protons per pulse = 1.16×10^{17} protons per hour at 150 GeV

Special conditions and comments:

NOTE: Although energy scaling of the 8 GeV intensity could be substantially higher, there is no need for higher intensity at 8 GeV and the limit is chosen to match the 120 GeV intensity limit.

Reviewed by_____
Operations Department Head/Date and Main Injector 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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3/11/14

7.0 Attachment 2 - Example Run Condition

Running Condition
Main Injector

March 11, 2014

R.S.O. Gary Lauten

Mode Identifier	Full Operation	
ASE Limit	**Operational Limit**	Exp. #
7.45 E17 protons/hr at 8 GeV	1.39 E17 protons/hr at 8 GeV*	N/A
7.45 E17 protons/hr at 120 GeV	1.39 E17 protons/hr at 120 GeV	
6.23 E17 protons/hr at 150 GeV	1.16 E17 protons/hr at 150 GeV **	
Critical Devices	**B:MH1 and B:LAM**	
Enclosures Protected	8 GeV, MI, TeV F-Sector, MI/TeV Crossovers, P-Bar Transport, MI-12A	

Interlocked Radiation Detectors

Detector Type	Detector Trips	Demux	Location
See Page 2	All Detectors Trip B:MH1 and B:Lam	See Page 2	See Page 2

Other Requirements

Special Interlocks:
The "CDC" Inputs required to obtain a "Beam Permit", may be found on the "Safety System Status" pages.

INFO: Coasting Beam critical Devices are **I:BV619 & I:BV622**. "Open" achieves coasting Beam.

Access Devices: Either B:MH1 and B:Lam must be disabled in order to access the enclosures protected, or Booster must be in the "Dump Mode" of operation.

Special Concerns: Access to the MI-40 Absorber room requires **prior** RSO approval.
Any work performed on Critical Devices requires RSO approval before re-establishing beam.

Gates, Fencing, and Passive Shielding Requirements:
There is no access to radiologically fenced areas or MI berms during beam operation without prior RSO approval.

The A150 & P150 ODH barrier gates have been locked in the open position since the shielding physically provides the barrier and isolates the Tevatron from the Main Injector. Shielding removal requires prior RSO approval.

"Operational Comments"

The operational intensity is monitored by **I:TOR852 via $BF** for Booster to MI, **and R:TOR905 via $F3 event** for RR to MI. It is important that we minimize losses on the MI 40 abort Lambertson by monitoring losses on the Lambertson via the acknowledgeable alarm.

Operating Intensity Limits and Examples:
1200 pulses/hour at 1.16 E14 protons/pulse --> 1.39 E17 protons/hour at 8 GeV*
2700 pulses/hour at 5.15 E13 protons/pulse --> 1.39 E17 protons/hour at 120 GeV
2400 pulses/hour at 4.83 E13 protons/pulse --> 1.16 E17 protons/hour at 150 GeV**

* Although energy scaling of the 8 GeV intensity could be substantially higher, there is no need for higher intensity at 8 GeV and the limit is chosen to match the 120 GeV intensity limit.

** 150 GeV beam operation for MI studies only. Beam aborted to MI-40 Abort.

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

Ops. Dept. Head Approval _____ **R.S.O. Approval** _____

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

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Running Condition
Main Injector

March 11, 2014

R.S.O. Gary Lauten

Defense-in-Depth Controls

The Main Injector and Recycler rings utilize defense-in-depth controls to reduce the probability, duration, and likelihood of beam loss accident conditions. These consist of Beam Loss Monitors, Vacuum Interlocks, and Power Supply Regulation and Permit Interlocks connected to the Beam Permit System, LCW radiation monitors, Beam Switch Sum Box (BSSB), Time Line Generator (TLG), MI/Recycler Transfer Permit, MI/Recycler Orbit Controls and software Alarms and Limits.

The Beam Permit System, Beam Switch Sum Box (BSSB), Time Line Generator (TLG), Main Injector / Recycler Transfer Permit, and the LCW Chipmunk Detectors are required to be operational when the MI or Recycler rings are transporting or accelerating beam.

Individual inputs to the beam permit system from the Beam Loss Monitors, Vacuum Interlocks, and Power Supply Regulation and Permit Interlocks may be masked on an as needed basis under the direction of the MI Department. Any inputs masked from these three systems and any administrative controls directed by the MI Department are required to be logged in the MCR e-log.

Interlocked Detectors

Interlocked detectors are in integrate mode. Interlocked detector trips may be reset as the safety system allows. Interlocked detector trips shall be documented in the MCR E-log. Detectors in "Integrate" mode that trip will not allow a safety system reset until sufficient time has passed to keep the hourly dose rate equal to or below the trip point setting.

MUX	Location	Quality Factor	Type	Integrate/Rate Mode
1-136	MI-10 SB LCW	1	Chipmunk	Integrate
1-160	MI-20 SB LCW	1	Chipmunk	Integrate
1-169	MI-30 SB LCW	1	Chipmunk	Integrate
1-186	MI-40 SB LCW	1	Chipmunk	Integrate
1-192	MI-50 SB LCW	1	Chipmunk	Integrate
1-200	MI-52 SB LCW	1	Chipmunk	Integrate
1-216	MI-62 SB LCW	1	Chipmunk	Integrate
1-208	MI-60 South Rm 117 Pipe and BUS pens	5	Chipmunk	Integrate
1-209	MI-60 South Rm 110 LCW Pens RF Gal	5	Chipmunk	Integrate
1-210	MI-60 North Rm 110 LCW Pens RF Gal	5	Chipmunk	Integrate
1-211	MI-60 North Rm 118 LCW Pen	5	Chipmunk	Integrate
1-212	MI-60 North Rm 118 Pen	5	Chipmunk	Integrate

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

Ops. Dept. Head Approval _____ **R.S.O. Approval** _____

Sys. Dept. Head Approval _____ **AD 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

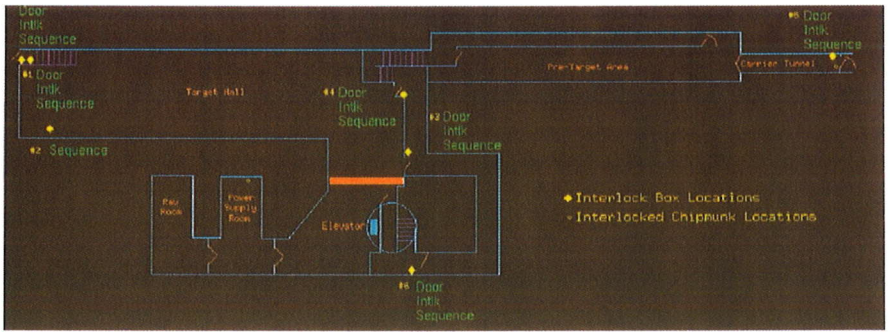
Department Head _____ Date _____

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