Accelerator Operations involvement in project development

Minimizing exceptions and reducing the learning curve

WAO 2010

Rationale

As new projects are brought online at Fermilab, the Accelerator Operations Department continues to play a role during the project development, installation and commissioning phases. This presentation will focus on the collaborations from the Accelerator Operations Department during the development and installation phases of a project, and highlight areas of concern from the operations perspective.

Areas of Concern

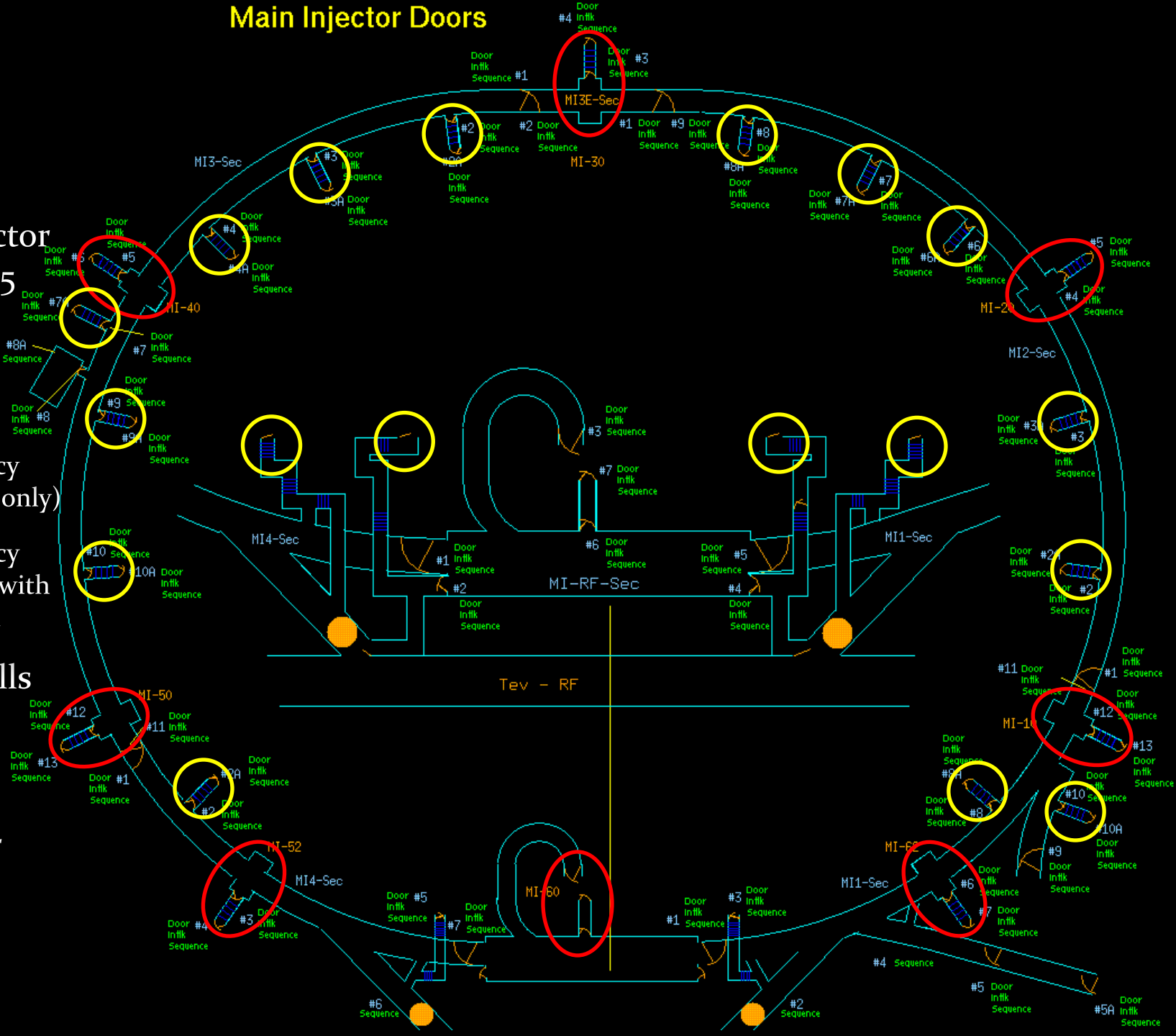
- Search and Secure Procedures
  - New enclosures : Main Injector (1998-9)
  - Modified enclosures : Muon Test Area beamline installation (MTA, 2007-8)
- Naming Conventions
  - Muon Test Area elements
  - Booster Multi-element corrector upgrade (2007, 2009)
- Integration into controls and control room environment
  - MTA enable key switch and beam switch
  - Pulse Shifter upgrade

Search and Secure procedures for new or modified enclosures

- Search and Secure:
  - procedure in which a team of operators maintains visual coverage of an area as the area is searched from one control point (interlock key boxes) to the next in a specific sequence designed to maintain a secured area behind the team.
- AD Operators are responsible for conducting a search and secure of an enclosure to assure that it has been emptied of all personnel before sending beam to the enclosure.
- Operators are trained to secure 36 different enclosures at Fermilab
  - The basic principle of the search and secure is the same for all enclosures
  - 2 operators can search and secure an enclosure with well designed interlock sequence.

Main Injector Doors

- Main Injector 4k oval (2.5 mile)
  - 8 Service Buildings
  - 18 emegency exits (egress only)
  - 2 emergency exits shared with the Tevatron
- 26 stairwells to secure
  - Medical expense vs. hardware for Mini loops

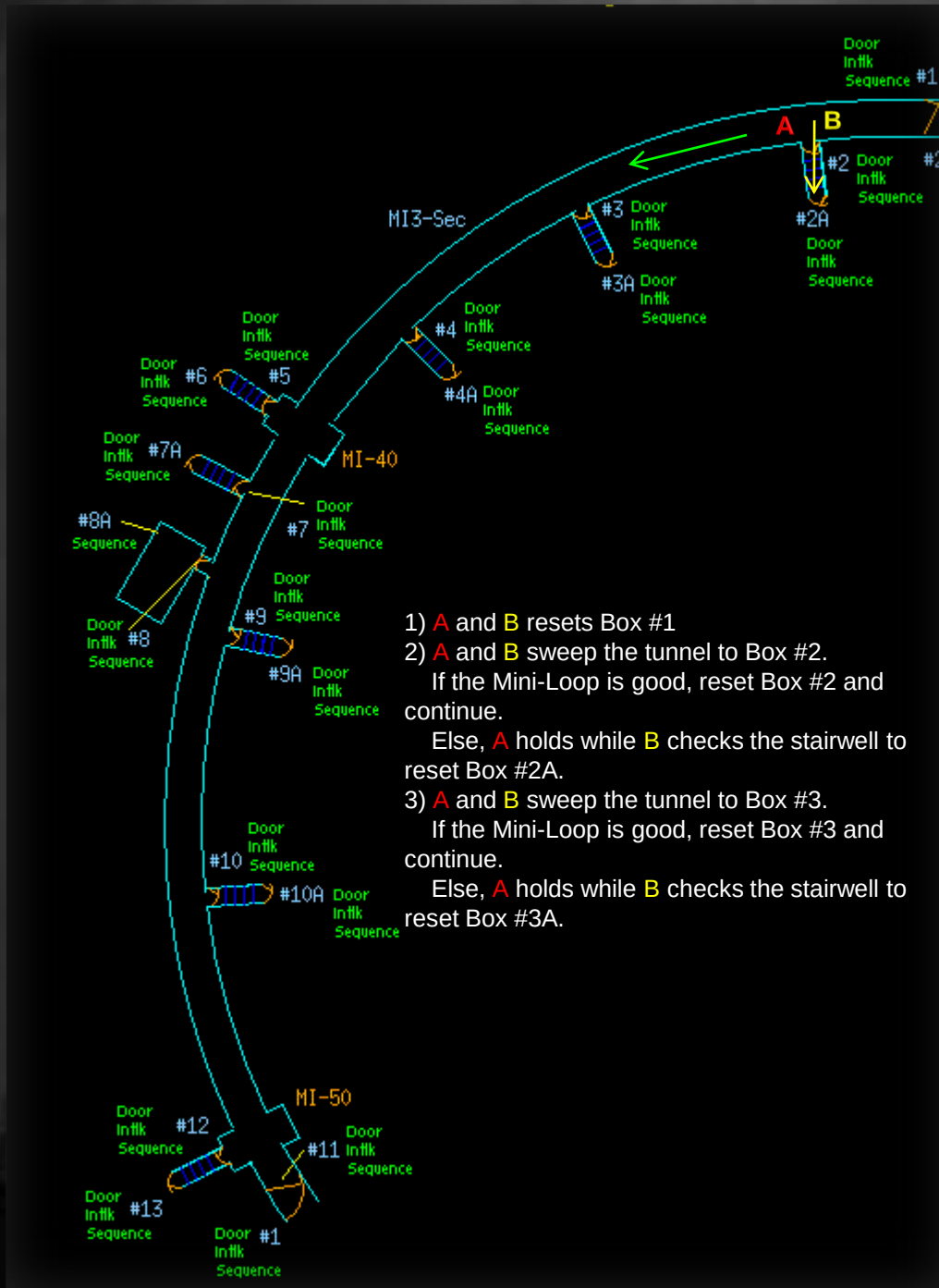


Mini-Loops

Mini-Loops are smaller interlocked areas that are summed into the main interlock system. If the Mini-Loop is not broken there is no need to secure it.

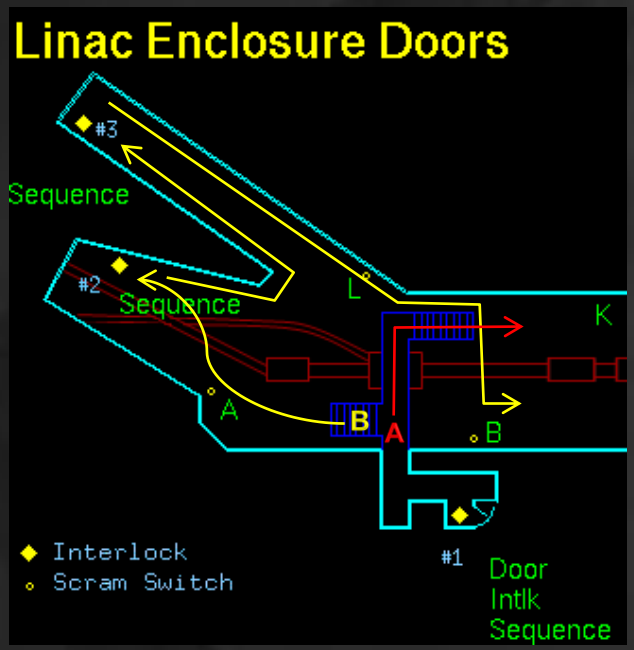
Mini-Loops were added to all of the emergency exits in Main Injector, the Absorber room, and the upstream end of the NuMI beamline eliminating the need to search 18 stairwells and 2 alcoves under “normal” circumstances.

If the Mini-Loops are secure, 2 operators can secure the Main Injector in about 2 hours vs. 3 hours if they are dropped.



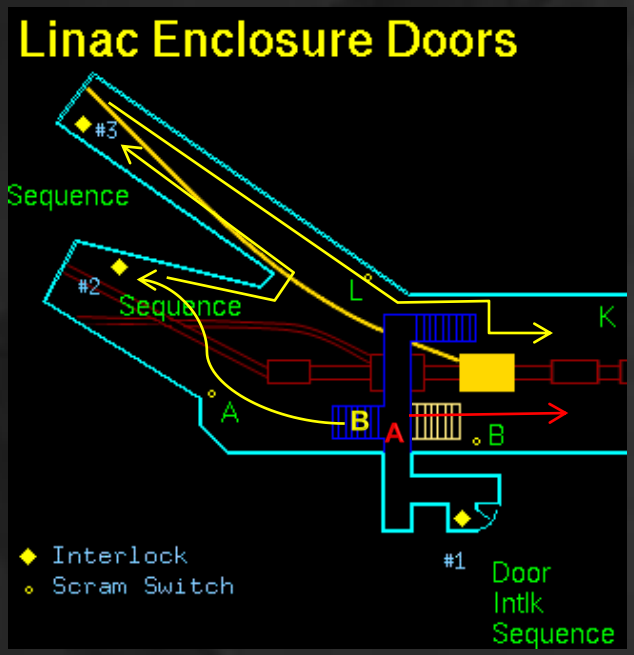
1) A and B resets Box #1
2) A and B sweep the tunnel to Box #2.
   If the Mini-Loop is good, reset Box #2 and continue.
   Else, A holds while B checks the stairwell to reset Box #2A.
3) A and B sweep the tunnel to Box #3.
   If the Mini-Loop is good, reset Box #3 and continue.
   Else, A holds while B checks the stairwell to reset Box #3A.

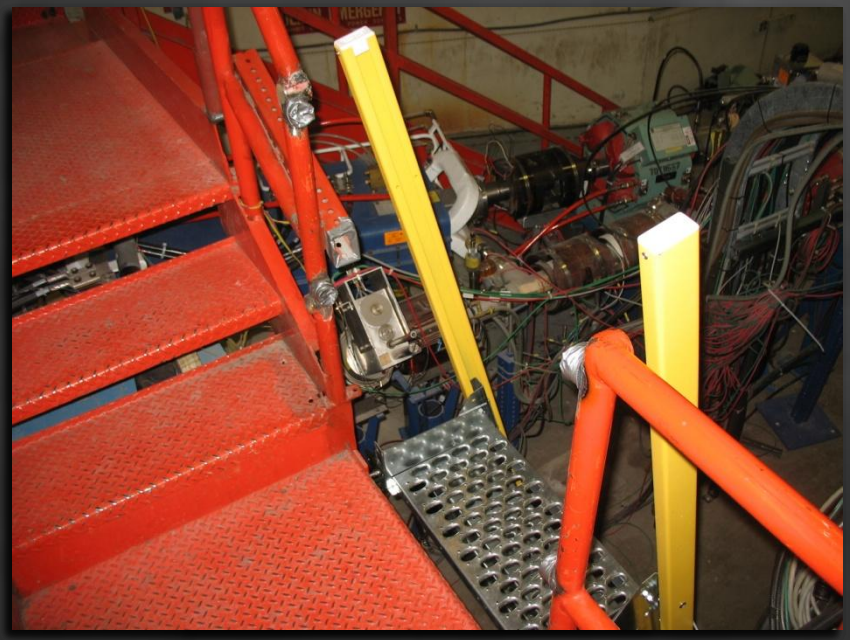
Linac Search & Secure prior MTA



1. A and B enter the downstream door.
2. A and B reset interlock box #1, and check the labyrinth to the main enclosure.
3. A holds on the bridge.
4. B walks down the stairs, checks the east side of the Spectrometer magnet.
5. B passes under the beam pipes, checks the 400 MeV area, and resets interlock box #2.
6. B continues into the spur, checking the sump pit, and resets interlock box #3.
7. B returns past the cross over, passes under the beam pipe to the east side of the klystron modules.
8. B holds while A descends the ladder to the west side of the klystron modules. Both proceed upstream.

Linac Search & Secure post MTA



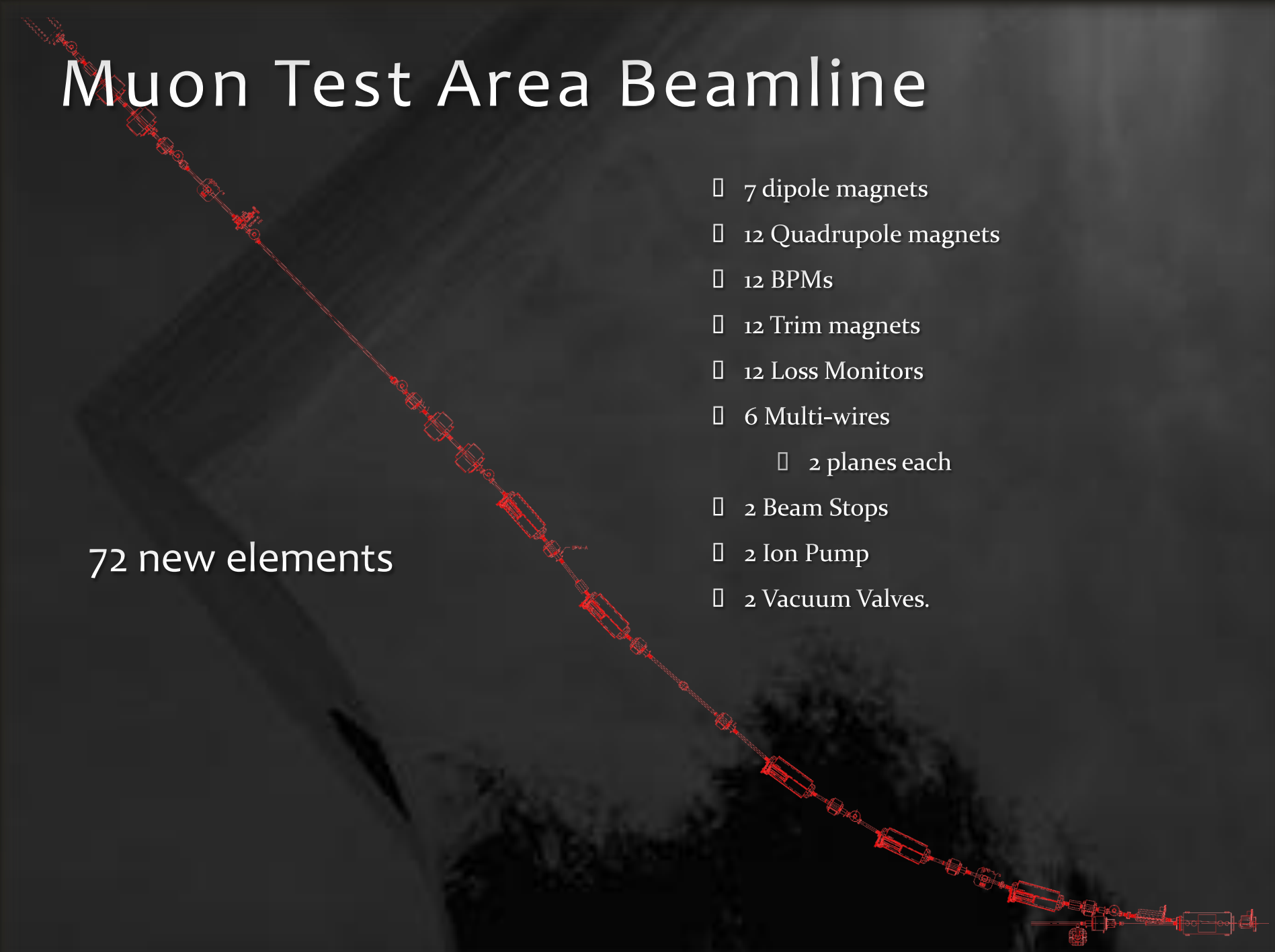


1. A and B enter the downstream door.
2. A and B reset interlock box #1, and check the labyrinth to the main enclosure.
3. A holds on the bridge.
4. B walks down the stairs, checks the east side of the Spectrometer magnet.
5. B passes under the beam pipes, checks the 400 MeV area, and resets interlock box #2.
6. B continues into the spur, checking the sump pit, and resets interlock box #3.
7. B returns past the cross over.
8. B holds while A descends the ladder to the east side of the klystron modules. Both proceed upstream.

Naming Conventions: What's in a name?

- New projects have new devices
  - Devices include magnet power supplies, beamline instrumentation and control elements
  - Each device has a database name
- Good Naming Conventions
  - Can help locate new elements in the gallery, and in the tunnel
  - Can reduce the learning curve to identify new elements if they fit a familiar pattern

Muon Test Area Beamline



72 new elements

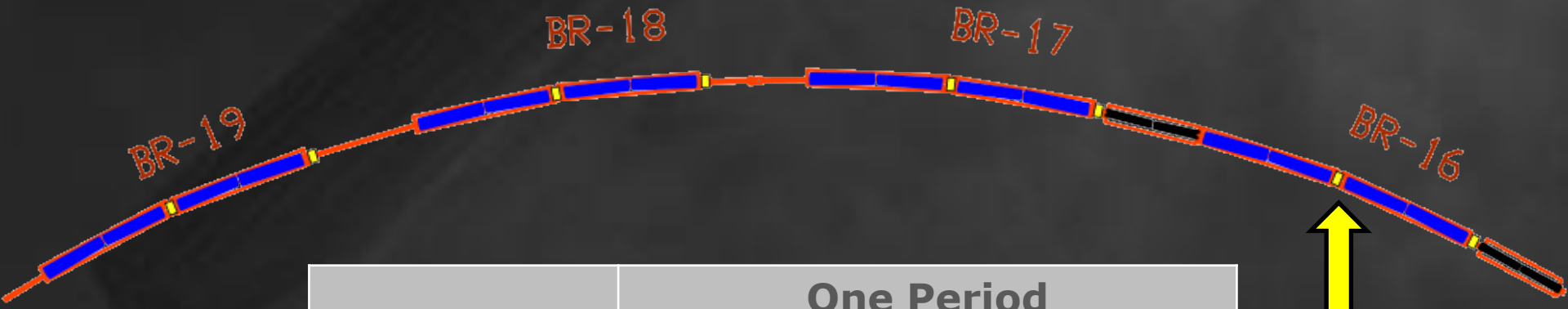
- 7 dipole magnets
- 12 Quadrupole magnets
- 12 BPMs
- 12 Trim magnets
- 12 Loss Monitors
- 6 Multi-wires
  - 2 planes each
- 2 Beam Stops
- 2 Ion Pump
- 2 Vacuum Valves.

Muon Test Area names

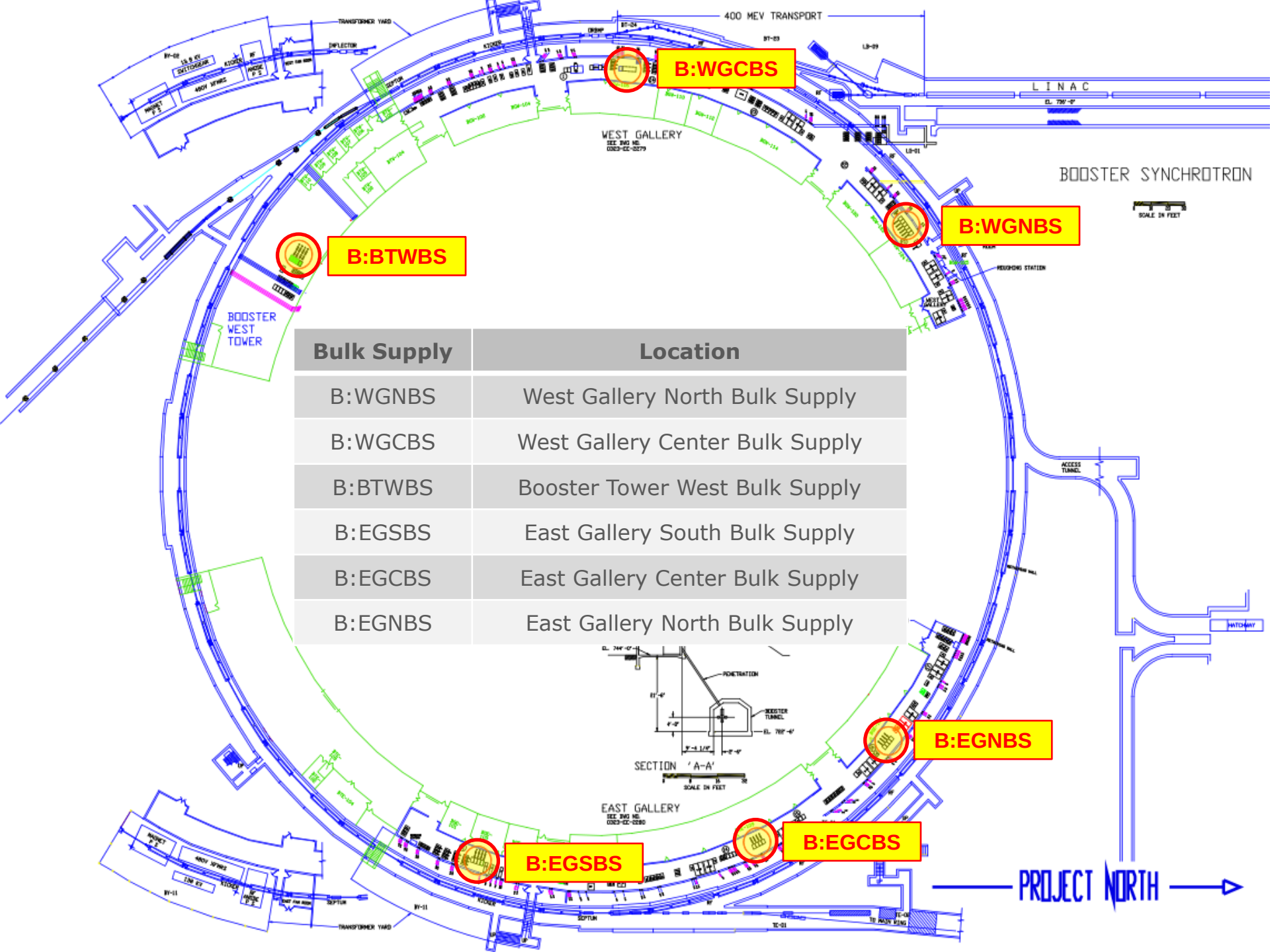
- Database allows for 8 characters including the semicolon

- First Character indicates machine or experimental area
  - L=Linac, B=Booster, T= Tevatron …E= External Beamline
    - MTA is an External beamline
- Second character commonly denotes what beamline
  - MTA is idenitfied by U (MiniBoone uses M)
- The remaining characters identify the element type
  - Q=quad, HB=Horiz Bend, VB=Vertical Bend, LM=loss monitor
- And location in the beamline
  - E:ULMQ10 is the loss monitor next to 10th quadrupole

New Booster Correctors names



Field	One Period	
	Long (LX)	Short (SX)
Horiz Dipole	**B:HL**X	**B:HS**X
Vert Dipole	**B:VL**X	**B:VS**X
Quadrupole	**B:QL**X	**B:QS**X
Skew Quad	**B:SQL**X	**B:SQS**16
Sextupole	**B:SXL**X	**B:SXS**X
Skew Sext	**B:SSL**X	**B:SSS**X
	X = **1,2,3,4, …24**	

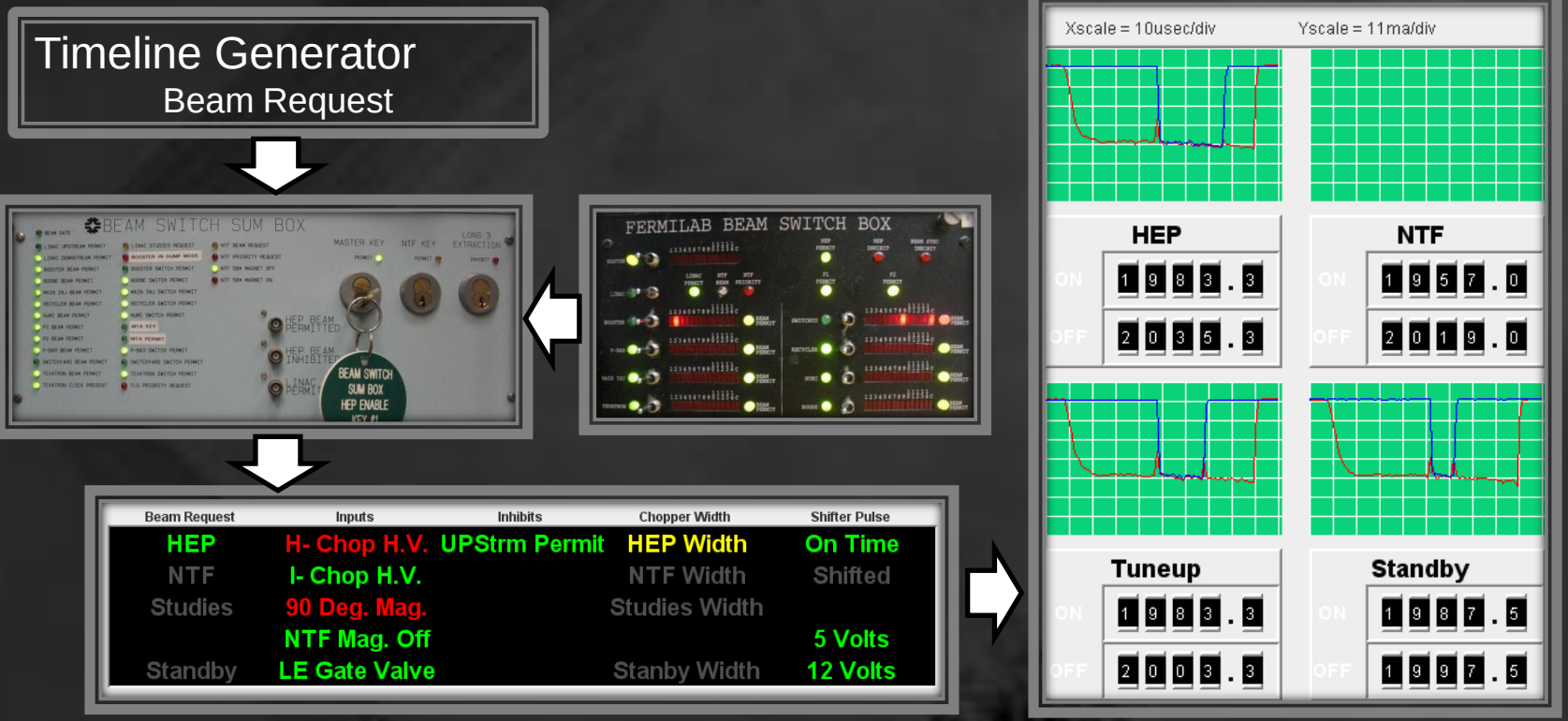


Bulk Supply	Location
B:WGNBS	West Gallery North Bulk Supply
B:WGCBS	West Gallery Center Bulk Supply
B:BTWBS	Booster Tower West Bulk Supply
B:EGSBS	East Gallery South Bulk Supply
B:EGCBS	East Gallery Center Bulk Supply
B:EGNBS	East Gallery North Bulk Supply

Integration into controls and control room environment

- Muon Test Area beamline expectations
  - 50mA beam current
  - 50 μS pulse width
  - Minimum beam repetition rate of 1/sec.
    - After future shielding upgrade
  - Using Linac Studies pulse to generate beam

Beam Request

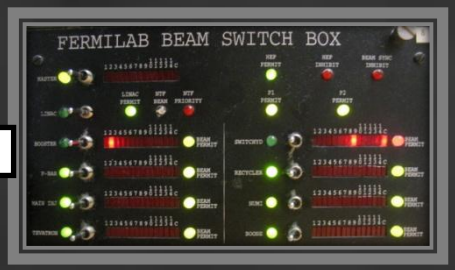


1. TimeLine Generator sends Beam Request to Beam Switch Sum Box (BSSB)
2. BSSB verifies permits for pulse shift scenarios
    1. Inputs from Enable Key and Beam Switches
3. Passes beam request to Pre Accelerator pulse shifter
4. Pulse shifter allows the source to deliver requested beam type to Linac

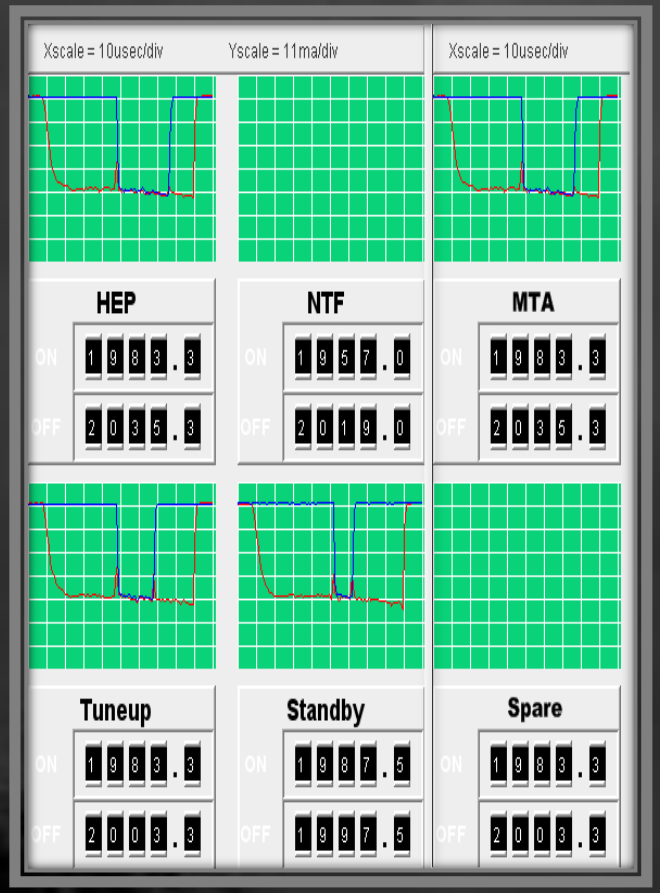
Integration into Controls and control room environment

- Challenges with 50mA/50μS @ 1/sec & Linac Study Pulse
  - Linac Study pulse nominal is 34mA beam current
  - Linac Study pulsewidth is 20 μS
  - Used daily by operators and Linac experts for tuning at repetition rates of 3 to 15 hz
- Solutions to 2 of 3.
  - 50 mA beam current is unresolved at this time
  - Upgrade pulse shifter to provide separate beam pulse
    - Variable width and TLG dependent
  - Beam enable key and beam switch installed for operator control

Beam Request with MTA



Beam Request	Inputs	Inhibits	Chopper Width	Shifter Pulse
HEP	H- Chop H.V.	UPStrm Permit	HEP Width	On Time
NTF	I- Chop H.V.		NTF Width	Shifted
Studies	90 Deg. Mag.		Studies Width	
	NTF Mag. Off			5 Volts
Standby	LE Gate Valve		Stanby Width	12 Volts



- The new pulse shifter/enable chassis can provide 6 types of beam requests
  - One will be dedicated to MTA & generated by TLG
- The operators have a direct intervention beam switch to inhibit beam.

Conclusion

- Operations Department collaboration with a new project from the onset can yield benefits for both groups.
  - Better assure a smooth transition into the commissioning and operational stages.
  - Allows Operations Department to limit exceptions and reduce the learning curve.

Fin

- Obrigado

Multi-element correctors