FERMILAB
Accelerator Division
ES&H Department

HINS Linac Critical Device Justification

Area Information

Area/s or Enclosures Protected	HINS Beam Line Enclosure (located in SE corner of Meson Detector Building)
Beam Type and Source	Proton and H- beam
Beam Energy	Up to 10 MeV
Beam Intensity	4.8E14 Protons/pulse, a maximum of 5.6E18 protons/hr

Critical Device 1

Device Name	H:ISBST1
Device Type	50 keV Beamstop #1
Device Location	Between ion source and RFQ of HINS beam line in HINS LEBT
Critical Device Controller	HINS beamline access keytree
CDC Location	HINS control room (located immediately south of ME7 entrance)
Method of Operation	Motor driven or pneumatic control, atmospheric pressure forces stop in.

Critical Device 2

Device Name	H:ISBST2
Device Type	50 keV Beamstop #2
Device Location	Between ion source and RFQ of HINS beam line in HINS LEBT
Critical Device Controller	HINS beamline access keytree
CDC Location	HINS control room (located immediately south of ME7 entrance)
Method of Operation	Pneumatic control, atmospheric pressure forces stop in.

Failure Mode Backup

Backup System	Ion Source High Voltage
Backup Device Name	H:HVPSV
Location	South end of HINS linac beam line enclosure

Failure Analysis

Is there an unsafe failure mode? (If yes please explain)	None Identified At This Time
Is there a common failure mode between Device 1 and 2? (If yes, please explain)	None Identified At This Time

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Department: MDB Facilities

Reviewed By: ______________________________   Date: __________________
AD Interlock Engineer

Reviewed By: ______________________________   Date: __________________
AD RSO

Description and Explanation:

The scope of the HINS Linac is a linear proton/H^- ion accelerator with beam energies up to 10 MeV. It will operate to test and demonstrate accelerator components, technologies, and beam chopping methods and to facilitate the development and testing of beam instrumentation and diagnostic methods and devices.

The HINS Linac has a potential capability of 25mA beam current in a three-millisecond pulse at a 1% duty cycle for a maximum beam intensity of 5.6E18 protons or H^- ions per hour. Typical operation will be half that hourly rate or less. The HINS Linac is expected to operate less than 6 hrs/day, 4 days/week/, and 30 weeks per year. Assuming these rates, the HINS Linac will produce no more than 2.0E21 protons at 10 MeV per year.

Facilities for the HINS Linac are installed and operated in the east side of the Meson Detector Building (MDB). The HINS Linac beam line is housed within the HINS Linac enclosure, a concrete structure built for radiation shielding, shown in Figure 1.

The HINS Linac comprises a 50 keV proton or H^- ion source, a Radio Frequency Quadrupole (RFQ), a 2.5 MeV Medium Energy Beam Transport (MEBT) line including beam choppers and absorbers, and an acceleration section to produce a final beam energy of up to 10MeV. Beam diagnostics sections and suitable beam absorbers are located within the Linac enclosure downstream of the accelerating sections. No beam is transported outside the HINS Linac enclosure that is shown in Figure 1.

Ancillary power supplies, controls and diagnostics equipment, and other accelerator support equipment are located outside the Linac enclosure. A 325 MHz, pulsed radio frequency (RF) power source consisting of a 2.5 MW klystron and modulator occupies the Klystron and Modulator Area shown in Figure 1 and provides pulsed power for the RF cavities of the HINS Linac.

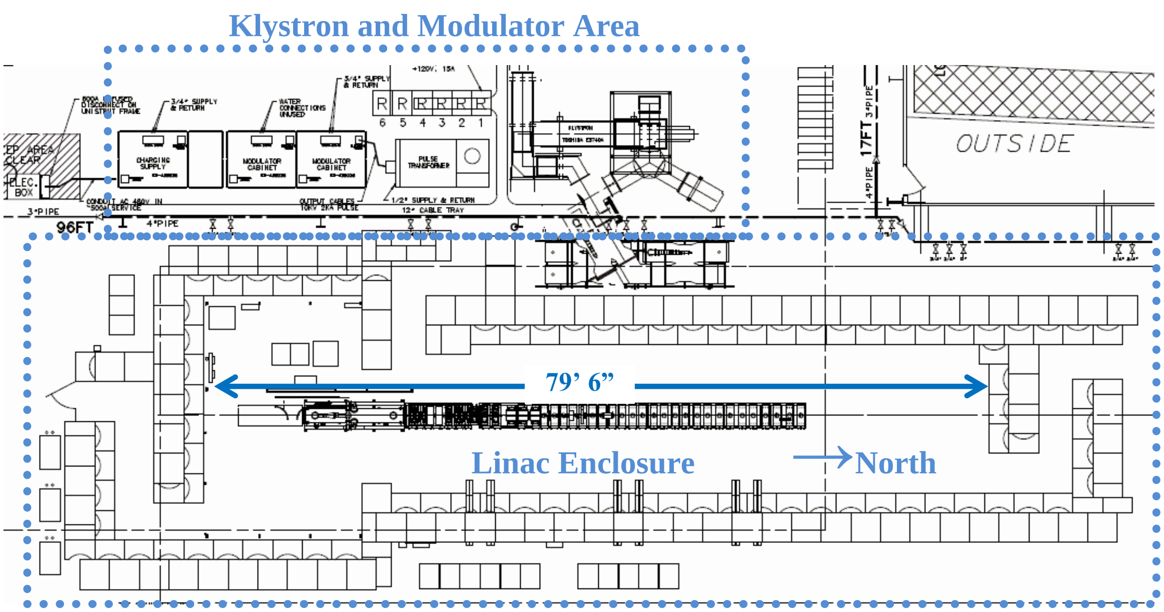

Figure 1: Layout of HINS Linac enclosure, beam line and support equipment in the east side of MDB.

HINS Beamline Critical Devices and Accident Modes

The primary function of the HINS beamline critical devices is to prevent personnel exposure to high energy (>50keV) beam operations. This is performed by two, independent beam stops. These stops intercept beam prior to entering the RFQ accelerating structure.

Critical Device: Beam Stops

The HINS linac beam stops are located in the center of the Low Energy Beam Transport (LEBT) section of the linac. Figure 2 shows a diagram of the ion source and LEBT. The LEBT system is equipped with two beam stops made of ¼" aluminum plates sufficiently large in cross-section to fully occlude the downstream beam pipe aperture. The primary purpose of these stops is to provide a definitive, verifiable and redundant means of stopping the beam at 50 keV. The stop controls are configured for insertion either manually by the HINS operator or automatically by the Safety Interlock System and for retraction only with Safety Interlock System permit.

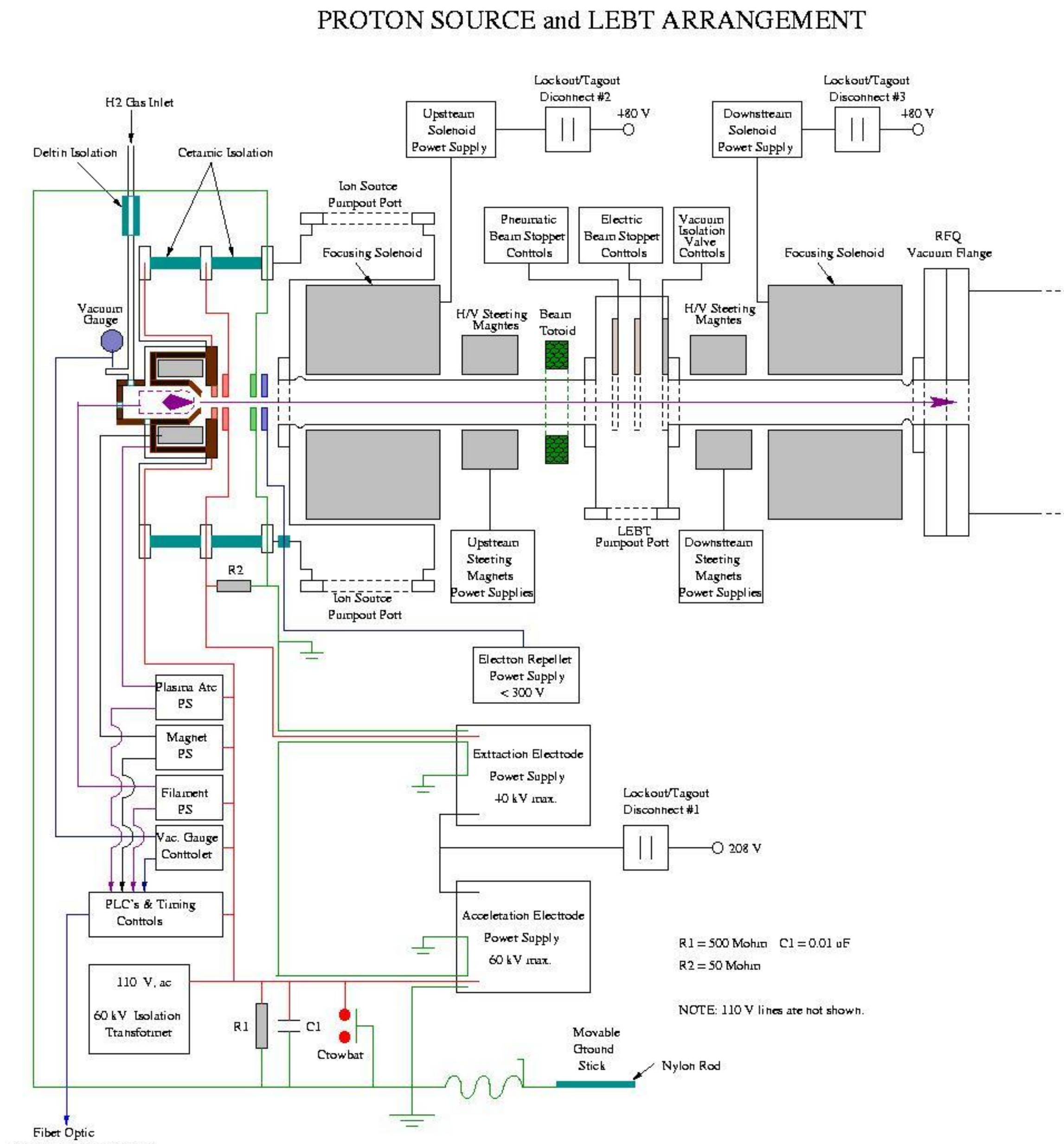

Figure 2: Schematic view of HINS proton source and LEBT

These beam stop drive mechanisms are designed to actively overcome the pressure differential between atmosphere and beam line vacuum when the stops are pulled out. When power is interrupted to the beam stop drive, the force of the pressure differential will push the stops into the beam line. Presently, one of the stops is driven pneumatically and one stop is motor driven. We plan to replace the motor driven stop with another pneumatically driven stop for greater speed and reliability. A close-up of the beam stop mechanism is shown in Figure 3.

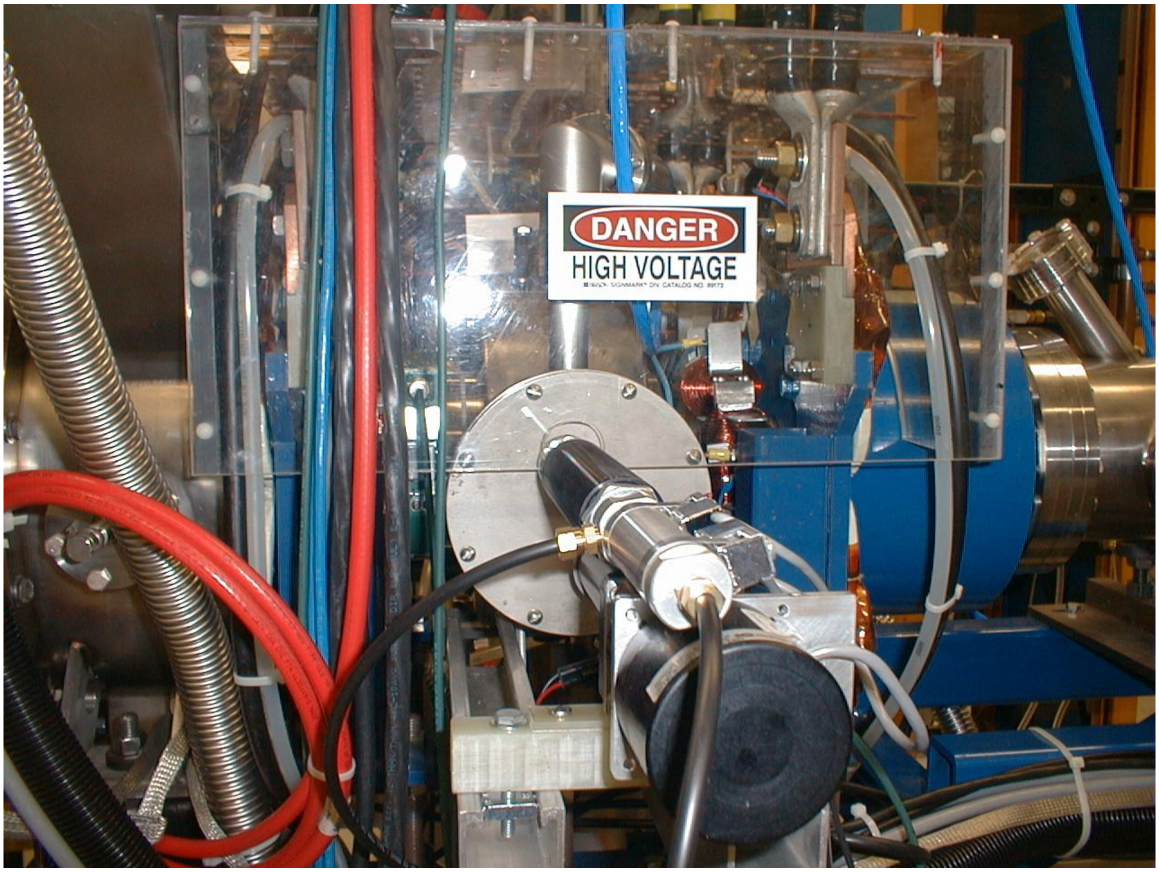

Figure 3: A close-up view of the beam stop mechanisms.

Backup Device: Ion Source High Voltage

In the event that the Safety Interlock System detects that a beam stop has not successfully deployed, the system will disable permits to the ion source high voltage supplies. This will disable beam from exiting the accelerator column. This is not a desirable interlock method, because it disrupts the thermal stability of the ion source, and could take hours or a day to recover. It is a reliable backup.