PIP-II Booster Connection

Functional Requirements Specification

Document number: ED0006794, Rev. A

**Document Approval**

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Revision History

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| Revision | Date of Release | Description of Change |
|  | 25 October 2017 | Initial Release |
| Rev A | 19 June 2018 | Updated to Revised Format |
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# Purpose

An FRS describes the programmatic or project needs and/or requested behavior of a system or component. The document typically outlines what is needed by the end user as well as the requirements and requested properties of inputs and outputs. The FRS specifies the functions that a system or component must perform and establishes consensus among stakeholders on what the system is expected to provide.

# Scope

This FRS addresses the functional requirements of the Booster Connection conventional construction to provide below grade shielded enclosures required to support assembly, installation and operation of the PIP-II accelerator components from the Beam Transfer Line portion of the Linac Complex to the existing Booster beamline enclosure.

# Acronyms

|  |  |
| --- | --- |
| BC | Booster Connection |
| FESHM | Fermilab ES&H Manual |
| FRCM | Fermilab Radiological Control Manual |
| FRS | Functional Requirements Specification |
| L2 | WBS Level 2 |
| L3 | WBS Level 3 |
| ODH | Oxygen Deficiency Hazard |
| PIP-II | Proton Improvement Plan II Project |
| SCD | System Configuration Document |
| TC | Teamcenter |
| WBS | Work Breakdown Structure |

# Reference

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| **#** | **Reference** | **Document #** |
| 1 | Conventional Facilities Engineering Process Document Management | ED0002857 |
| 2 | Conventional Facilities System Configuration Document (SCD) | ED000xxxx |
| 3 | [Fermilab Engineering Manual](http://directorate-docdb.fnal.gov/cgi-bin/RetrieveFile?docid=34) | NA |
| 4 | [Fermilab Environmental Safety and Health Manual](http://eshq.fnal.gov/manuals/feshm/) | NA |
| 5 | Fermilab Radiological Control Manual | NA |
| 6 | PIP-II Project Assumptions | PIP-II-doc-144 |
| 7 | PIP-II – Fermilab Interface Document | PIP-II-doc-528 |

# Key Assumptions

The assumptions for the Booster Connection include:

1. The area does not contain cryogenics equipment and will not require Oxygen Deficiency Hazard (ODH) systems.

# Functional Requirements

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| --- | --- |
| **Requirement #** | **Requirement Statement** |
| F-121.06.06-001 | The BC shall provide a safe environment for employees. |
| F-121.06.06-002 | The BC shall provide space and infrastructure for the conventional beamline components. |
| F-121.06.06-003 | The BC shall provide radiation shielding. |
| F-121.06.06-004 | The BC shall be located adjacent to the Beam Transfer Line portion of the Linac Complex |
| F-121.06.06-005 | The BC shall be located adjacent to the existing Booster enclosure. |
| F-121.06.06-006 | The BC shall provide for a future beamline to the Muon Campus |

# Safety Requirements

The system shall abide by all Fermilab ES&H (FESHM) and all Fermilab Radiological Control Manual (FRCM) requirements including but not limited to:

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| Pressure and Cryogenic Safety |
| * FESHM Chapter 5031 Pressure Vessels |
| * FESHM Chapter 5031.1 Piping Systems |
| * FESHM Chapter 5031.5 Low Pressure Vessels and Fluid Containment |
| * FESHM Chapter 5031.6 Dressed Niobium SRF Cavity Pressure Safety |
| * FESHM Chapter 5032 Cryogenic System Review |
| * FESHM Chapter 5033 Vacuum Vessel Safety |
| Electrical Safety |
| * FESHM Chapter 9110 Electrical Utilization Equipment Safety |
| * FESHM Chapter 9160 Low Voltage, High Current Power Distribution Systems |
| * FESHM Chapter 9190 Grounding Requirements for Electrical Distribution and Utilization Equipment |
| Radiation Safety ANSI ASC A14.3  -2000  Safety Requirements for Fixed Ladders |
| * FRCM Chapter 8 ALARA Management of Accelerator Radiation Shielding |
| * FRCM Chapter 10 Radiation Safety Interlock Systems |
| * FRCM Chapter 11 Environmental Radiation Monitoring and Control |
| General Safety |
| * FESHM Chapter 2000 Planning for Safe Operations |
| Construction Safety |
| * FESHM Chapter 7010 ES&H Program for Construction |
| * FESHM Chapter 7030 Excavation |
| * FESHM Chapter 7060 Fall Protection |
| * FESHM Chapter 7070 Ladder & Scaffold Safety |
| Environmental Protection |
| * FESHM Chapter 8011 Groundwater Protection – Excavations and Wells |
| * FESHM Chapter 8012 Sedimentation and Erosion Control Planning |
| * FESHM Chapter 8026 Surface Water Protection |

Any changes in the applicability or adherence to these standards and requirements require the approval and authorization of the PIP-II Technical Director or designee.

In addition, the following codes and standards in their latest edition shall be applied to the engineering, design, fabrication, assembly and tests of the given system:

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| ASME B31.3 Process Piping ANSI ASC A14.3  -2000  Safety Requirements for Fixed Ladders |
| ASME Boiler and Pressure Vessel Code (BPVC) |
| CGA S-1.3 Pressure Relief Standards |
| NFPA 70 – National Electrical Code |
| IEC Standards for Electrical Components |

In cases where International Codes and Standards are used the system shall follow FESHM Chapter 2110 Ensuring Equivalent Safety Performance when Using International Codes and Standards and requires the approval and authorization of the PIP-II Technical Director or designee.

Additional Safety Requirements that are not listed in the general list above shall be included in the Requirements table in the Functional Requirements section.