PIP-II BTLBA Beam Absorbers

Technical Requirements Specification

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**Document Approval**

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Revision History

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# Purpose

A TRS describes the technical characteristics, performance requirements, and requested behavior of a system or component. TRS requirements may be derived from higher-level requirements in an FRS or ICD or recommended from the design process. TRS requirements may be specific to a particular design concept.

# Scope

Deliver a permanent 25 KW beamline Absorber and a 2 KW portable beam Absorber for the PIP II Linac beam.

# Acronyms

|  |  |
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| CAD | Computer Aided Design |
| FESHM | Fermilab ES&H Manual |
| FRCM | Fermilab Radiological Control Manual |
| FRS | Functional Requirements Specification |
| TC | Teamcenter |
| WBS | Work Breakdown Structure |
| RF | Radio Frequency |
| MI | Main Injector |
| AccU | Accelerator Upgrade |

# Key Assumptions

The following key assumptions are relevant to these requirements:

* The maximum PIP II Linac beam energy is 1 GeV.
* The max integrated beam per year on the 25 KW absorber is expected to be 2.1E19.
* Max number of beam pulses per year on the 25 KW absorber is 3.1E6.
* The max integrated beam per year on the 2 KW absorber at his permanent location is expected to be 4.2E18.
* The 25 KW Absorber is going to be permanently installed at the end of the Absorber Line.
* The 2 KW portable Absorbers is going to be used during the PIP II Linac commissioning at the 177 MeV location.

# Technical Requirements

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| **Requirement #** | **Requirement Statement** |
| **Configuration** | |
| T-121.05.02.03-A001 | Both absorbers shall operate for at least 10 years. |
| T-121.05.02.03-A002 | The 25 KW absorber shall have enough redundancy to minimize downtime due to water leaks. |
| T-121.05.02.03-A003 | The 25 KW absorber shall provide easy access to water cooling lines for repairs. |
| T-121.05.02.03-A004 | The 2 KW portable Absorber shall be able to operate without active beam sweeping and water cooling. |
| T-121.05.02.03-A005 | Both absorbers shall provide enough shielding to prevent surface and ground water contamination. |
| T-121.05.02.03-A006 | Both absorbers shall provide enough shielding to minimize the residual radiation. |
| T-121.05.02.03-A007 | Shall provide removal capability of the permanent 25 KW Absorber. |
| T-121.05.02.03-A008 | The 25 KW absorber shall be able to absorb the full power of the Booster beam (22KW) for 1 hr. |
| T-121.05.02.03-A009 | The 25 KW absorber shall be safely exposed to 2.1E19 H- at 1 GeV per year. |
| T-121.05.02.03-A010 | The 2 KW absorber shall be able to absorb up to 1.13 KW of 1 GeV linac beam for 4 hrs. |
| T-121.05.02.03-A011 | The 2 KW absorber shall be safely exposed to 4.2E18 H-/year at its final location. |
| T-121.05.02.03-A012 | The 2 KW absorber shall be safely exposed to 2.0E18 H- at the 177 MeV location |
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| **Capabilities and Performance** | |
| T-121.05.02.03-B001 | Able to absorb 1 GeV H- at 25 KW average power (permanent Absorber)  Able to absorb 1 GeV H- at 2 KW average power (portable Absorber) |
| **User Interface and Safety** | |
| T-121.03.08.03-C001 | Interface with Radiation Safety Interlock Systems |

# Standard 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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| Electrical Safety |
| * 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 |

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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| NEPA 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.

# Reference

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| **#** | **Reference** | **Document #** |
| 1 | The PIP-II Preliminary Design Report | PIP-II-doc-2261 |
| 2 | PIP-II Transfer Line and Beam Absorber FRS | ED0008140 |
| 3 | PIP-II Master ICD | ED0007705 |
| 4 | [Fermilab Engineering Manual](http://directorate-docdb.fnal.gov/cgi-bin/RetrieveFile?docid=34) | - |
| 5 | [Fermilab Environmental Safety and Health Manual](http://eshq.fnal.gov/manuals/feshm/) | - |
| 6 | Fermilab Radiological Control Manual | - |