

# PIP-II Cryogenic Plant Building Functional Requirements Specification

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**Document Approval**

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**Revision History**

<b>Revision</b>	<b>Date of Release</b>	<b>Description of Change</b>
	25 October 2017	Initial Release
Rev A	15 August 2018	Updated to Revised Format and Incorporated Comments
Rev B	17 September 2018	Routed for review/approval

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## 1. Purpose

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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.

## 2. Scope

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This FRS addresses the functional requirements of the Cryogenic Plant Building including the warm compressor station, cold box station, control room, support spaces and adjacent exterior site work.

## 3. Acronyms

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CPB	Cryogenic Plant Building
GPM	Gallons Per Minute
FESHM	Fermilab ES&H Manual
FRCM	Fermilab Radiological Control Manual
FRS	Functional Requirements Specification
ICW	Industrial Cooling Water
L2	WBS Level 2
L3	WBS Level 3
Linac	Linear Accelerator
ODH	Oxygen Deficiency Hazard
PIP-II	Proton Improvement Plan II Project
SCD	System Configuration Document
TC	TeamCenter
WBS	Work Breakdown Structure

## 4. Reference

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#	Reference	Document #
1	Conventional Facilities Engineering Process Document Management (EPDM)	ED0002857
2	Conventional Facilities System Configuration Document (SCD)	ED0008133
3	<a href="#">Fermilab Engineering Manual (FEM)</a>	-
4	<a href="#">Fermilab Environmental Safety and Health Manual (FESHM)</a>	-

5	Fermilab Radiological Control Manual (FRCM)	-
6	PIP-II Project Assumptions	PIP-II-doc-144
7	PIP-II – Fermilab Interface Document	PIP-II-doc-528

## 5. Key Assumptions

The assumptions for the Cryogenic Plant Building include:

1. The cryogenics equipment shall be provided, delivered, installed and commissioned by the Cryogenic Plant subproject;
2. The Oxygen Deficiency Hazard (ODH) system shall be designed in accordance with Fermilab policies and guidelines. The mechanical equipment (louvers, fans, ductwork) that interface with building systems shall be installed as part of the CPB work scope. The ODH analysis, design and installation of the control components, wiring, sensors and related work as well as commissioning is the responsibility of the Cryogenic Plant subproject.
3. The cryogenic warm compressors shall be cooled with Industrial Cooling Water (ICW) requiring a maximum flow of 1,400 gallons per minute (gpm) per cryogenic plant specification.

## 6. Functional Requirements

Requirement #	Requirement Statement
F-121.06.03-A001	The CPB shall provide a safe environment for employees and the public.
F-121.06.03-A002	The CPB shall provide space and infrastructure with the proper floor load rating for the warm compressors.
F-121.06.03-A003	The CPB shall provide space and infrastructure with the proper floor load rating for the cold box.
F-121.06.03-A004	The CPB shall provide space and infrastructure for unloading/loading activities
F-121.06.03-A005	The CPB shall provide exterior space for storage tanks/dewars.
F-121.06.03-A006	The CPB shall provide space for operating the cryoplant including control room space, meeting/planning space and support space.
F-121.06.03-A007	The CPB shall comply with the overall character of the PIP-II campus and applicable portions of the Fermilab Campus Plan.
F-121.06.03-A008	The CPB shall connect to existing Fermilab infrastructure. This includes electrical, domestic water, industrial cooling water, sanitary sewer, chilled water and data/communication.
F-121.06.03-A009	The CPB shall be located adjacent to the PIP-II Linac Complex such that the cryogenic distribution system feeds the front end of the Linac.
F-121.06.03-A010	The CPB shall provide foundations for gaseous helium storage tanks.
F-121.06.03-A011	The CPB shall provide foundations for a liquid helium dewar.
F-121.06.03-A012	The CPB shall provide foundations for a liquid nitrogen dewar.
F-121.06.03-A013	The CPB shall provide truck access for helium and nitrogen deliveries.

F-121.06.03-A014	The CPB shall provide space and infrastructure to support a 4.5 K cold box upgrade option
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## 7. 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:

Pressure and Cryogenic Safety
<ul style="list-style-type: none"> <li>• FESHM Chapter 5031 Pressure Vessels</li> </ul>
<ul style="list-style-type: none"> <li>• FESHM Chapter 5031.1 Piping Systems</li> </ul>
<ul style="list-style-type: none"> <li>• FESHM Chapter 5031.5 Low Pressure Vessels and Fluid Containment</li> </ul>
<ul style="list-style-type: none"> <li>• FESHM Chapter 5031.6 Dressed Niobium SRF Cavity Pressure Safety</li> </ul>
<ul style="list-style-type: none"> <li>• FESHM Chapter 5032 Cryogenic System Review</li> </ul>
<ul style="list-style-type: none"> <li>• FESHM Chapter 5033 Vacuum Vessel Safety</li> </ul>
Electrical Safety
<ul style="list-style-type: none"> <li>• FESHM Chapter 9110 Electrical Utilization Equipment Safety</li> </ul>
<ul style="list-style-type: none"> <li>• FESHM Chapter 9160 Low Voltage, High Current Power Distribution Systems</li> </ul>
<ul style="list-style-type: none"> <li>• FESHM Chapter 9190 Grounding Requirements for Electrical Distribution and Utilization Equipment</li> </ul>
Radiation Safety
<ul style="list-style-type: none"> <li>• FRCM Chapter 8 ALARA Management of Accelerator Radiation Shielding</li> </ul>
<ul style="list-style-type: none"> <li>• FRCM Chapter 10 Radiation Safety Interlock Systems</li> </ul>
<ul style="list-style-type: none"> <li>• FRCM Chapter 11 Environmental Radiation Monitoring and Control</li> </ul>
General Safety
<ul style="list-style-type: none"> <li>• FESHM Chapter 2000 Planning for Safe Operations</li> </ul>
Construction Safety
<ul style="list-style-type: none"> <li>• FESHM Chapter 7010 ES&amp;H Program for Construction</li> </ul>
<ul style="list-style-type: none"> <li>• FESHM Chapter 7030 Excavation</li> </ul>
<ul style="list-style-type: none"> <li>• FESHM Chapter 7060 Fall Protection</li> </ul>
<ul style="list-style-type: none"> <li>• FESHM Chapter 7070 Ladder &amp; Scaffold Safety</li> </ul>

Environmental Protection
<ul style="list-style-type: none"> <li>• FESHM Chapter 8011 Groundwater Protection – Excavations and Wells</li> </ul>
<ul style="list-style-type: none"> <li>• FESHM Chapter 8012 Sedimentation and Erosion Control Planning</li> </ul>
<ul style="list-style-type: none"> <li>• FESHM Chapter 8025 Wastewater Discharge to Sanitary Sewers</li> </ul>
<ul style="list-style-type: none"> <li>• FESHM Chapter 8026 Surface Water Protection</li> </ul>
<ul style="list-style-type: none"> <li>• FESHM Chapter 8050 Domestic Water Protection</li> </ul>
<ul style="list-style-type: none"> <li>• FESHM Chapter 8080 Air Emissions Control Program</li> </ul>
<ul style="list-style-type: none"> <li>• FESHM Chapter 8081 Refrigeration Management</li> </ul>
Material Handling and Transportation
<ul style="list-style-type: none"> <li>• FESHM Chapter 10100 Overhead Cranes and Hoists</li> </ul>
<ul style="list-style-type: none"> <li>• FESHM Chapter 10110 Below-the-hook Lifting Devices</li> </ul>

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:

ASME B31.3 Process Piping
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.