PIP-II Naming Conventions

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Document Approval

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Revision History

Revision	Date of Release	Description of Change
-	TBD	Initial Release

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1. Purpose

This document seeks to formalize the naming conventions that will be used across the PIP-II Project for consistency when naming devices, components, documents, and locations within the PIP-II complex. The goal of the naming convention is to provide a uniform, unambiguous and flexible format that can be used by Fermilab and partnering institutions during and beyond the PIP-II Project.

This document applies specifically to the PIP-II Project but may be useful for other projects and/or organizations at Fermilab. The naming conventions described here draw from existing systems and conventions in use at Fermilab and elsewhere as much as possible to provide continuity across the Fermilab accelerator complex. Most names will be intuitively easy to understand using standardized device and location names and should adapt readily to the control system. A database will be used in conjunction with the naming convention which will aid in device tracking and management. The database will also be useful for aliasing a manufacturer's component name to the new name.

2. Scope

This policy covers Fermilab, Partner, and vendor deliverables. All components regardless of size are expected to follow this convention, but sub-assemblies and sub-components are outside of this document's scope. System/equipment owners can use their own discretion in determining what constitutes a sub-assembly or sub-component.

Note that this naming convention is intended to designate the component/device name as installed in the complex. It is not necessarily the name or serial number given to the component during fabrication and testing by Fermilab, vendor or Partner institution. This is typically the case for components such as cavity where the final location within a given class of cryomodules is not known during fabrication or single cavity testing. These names or serial numbers can be attached as additional metadata for tracking the history and documenting purposes or cross-referenced once it is determined when the final location of the component/device is known.

3. Roles and Responsibilities

3.1. PIP-II Naming Convention Working Group

Responsible for the initial rollout of the naming convention plan and documentation. Works with the various stakeholders within the PIP-II organization as well as subject matter experts inside and outside of the Project to formulate the original concept and plan. The working group will be disbanded once the initial rollout of the naming convention document has been completed.

3.2. PIP-II Integration Coordinator

Responsible for maintaining and updating this document as needed. Provides feedback and guidance regarding the naming conventions described in this document. Provides guidance and approval to exceptions and deviations from these procedures. The Integration Coordinator will work with L2Ms and L3Ms to ensure compliance and resolve naming issues that arise throughout the Project lifecycle.

3.3. PIP-II Level 2 Managers (L2Ms)

Responsible for ensuring full compliance to these conventions within their systems and subsystems within the PIP-II Project. Questions regarding implementation and/or compliance shall be brought to the attention of the Integration Coordinator.

3.4. PIP-II Level 3 Managers (L3Ms)

Responsible for ensuring full compliance to these conventions within their systems and subsystems. Questions regarding implementation and/or compliance shall be brought to the attention of their respective L2M and/or the Integration Coordinator.

3.5. PIP-II Partners

Responsible for ensuring compliance to this convention for all PIP-II Project deliverables within the framework established in the Project Planning Documents (PPD) where possible. Questions regarding implementation and/or compliance shall be brought to the attention of the PIP-II In-Kind Technical Integration Manager.

3.6. Accelerator Division

Once the PIP-II Project is completed, the operations of the facility will be transitioned to the Accelerator Division as an accelerator in the overall accelerator complex as detailed in the transfer to operations (TTO) plan. The continuation of the naming system conventions and compliance to these conventions will then reside within the Accelerator Division organizational structure. At this time, the full details have yet to be determined.

4. Naming of Components/Equipment

Figure 4-1 graphically shows the naming convention for identifying components, equipment and devices for the PIP-II complex. The convention follows a predefined number of alphanumeric characters separated by the following groupings. The groupings, further explanations and examples are given below.

Complex _ Location/System _ Device _ Identifier _ Optional

aaa _ bbbb _ cccc _ dddddd _ eeeeee

4.1. Complex Code (Variable Length with a maximum of 3 alphanumeric characters)

The Complex code distinguishes the home accelerator component/equipment/device from other accelerators in the complex such as Booster, Main Injector, etc. The alphanumeric code to be used is SCL for superconducting Linac and BTL for Beam Transfer Line. This code avoids referencing PIP-II since this is a Project designation and not the long-term accelerator name. Note that the warm front end is included under the SCL code and the beam absorber line is included under the BTL code.

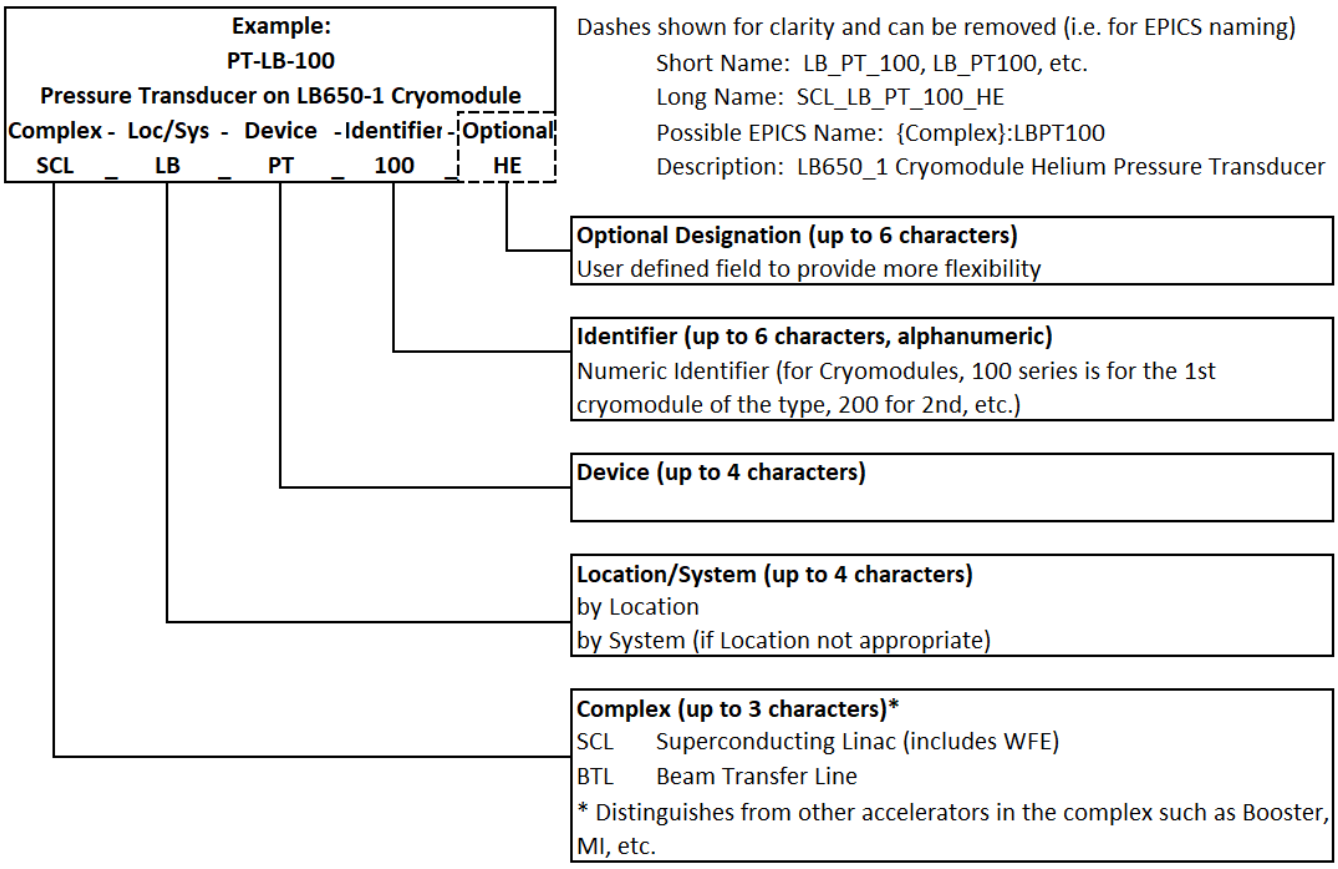


Figure 4-1. PIP-II Device and Equipment Naming Convention

4.2. Location/System Code (Variable Length with a maximum of 4 alphanumeric characters)

The Location/System code is a set of alphanumeric characters that identify the location/system of the device, component or equipment within the accelerator complex. Location codes have been identified for areas within the accelerator beam line (lattice) as well as buildings and spaces around the complex. The intent is to easily determine the general location of a device, component or piece of equipment by reading the Location code. In certain cases, devices may not pertain to a physical location such as in virtual devices and/or calculations. In these cases, a system designation is better suited and

can be used in place of the location code. A maximum of four alphanumeric characters can be used. A list of Location/System codes are shown in Appendix A. Note that the provided list of Location/System codes is not all inclusive. Should new Location/System codes be required, follow the procedure for creating new codes as outlined in Section 4.6.

4.3. Device Code (Variable Length with a maximum of 4 alphanumeric characters)

The Device code is a set of alphanumeric characters that identify the type of device, component or equipment. Device types have been characterized into different classes such as Instrumentation, Equipment-General, Equipment-Valves, Equipment-Linac, etc. The Device code consists of a maximum of four alphanumeric characters and the list is not intended to be a comprehensive list of all possible devices. A list of Device codes is shown in Appendix B. Should new Device codes be required follow the procedure for creating new codes in Section 4.6.

4.4. Identifier Code (Variable Length with a maximum of 6 alphanumeric characters)

The Identifier code is a set of six alphanumeric characters used to further distinguish between devices, components or equipment. In the case of cryomodules, the 100 series of numbers are used to designate devices associated with the first cryomodule of a given type. The 200 series of numbers are for the second cryomodule and so forth. For greater flexibility, letters are also allowed.

4.5. Optional Code (Variable Length with a maximum of 6 alphanumeric characters)

The Optional code is a user defined alphanumeric set of characters used for further defining the device or component as needed. In one instance it is used to define the type of fluid for devices and components that involve process fluids. It can also be used for directional devices such as BPMs (BPM in the X director has an X). A maximum of six alphanumeric characters can be used.

4.6. Procedure for Creating New Codes

Stakeholders can propose new Device and Location/System codes related to their respective equipment and systems. Any proposed addition needs to be brought to the attention of the PIP-II Integration Coordinator for approval to ensure consistency and compliance to this naming standard. Approved changes will be added to the naming convention documentation and database.

4.7. Use of Short, Long and EPICS Names

Instead of using the full names of devices, components and equipment according to this naming convention, the name can be truncated in various ways depending on how it is used and displayed. Below are some possible examples:

Description: LB650-1 Cryomodule Helium Pressure Transducer
Long Name (full path): SCL_LB_PT_100_HE
Short Name (remove the Complex and Optional codes): LB_PT_100, LB_PT100, etc.
Possible EPICS Name (short name with dashes removed): {complex}: LBPT100

4.8. Example Cases

The following are representative examples using this naming convention:

Description: SSR1-2 Cryomodule Temperature
Long Name: SCL_SSR1_TX_201_HE
Short Name: SSR1_TX_201, SSR1_TX201, etc.
Possible EPICS Name: {complex}: SSR1TX201

Description: Air Compressor Outlet Pressure
Long Name: SCL_UP_PT_100_IA
Short Name: UP_PT_100, UP_PT100, etc.
Possible EPICS Name: {complex}: UPPT100

Description: Oil Manifold Valve on Compressor #1
Long Name: SCL_CMP_MV_101_OIL
Short Name: CMP_MV_101, CMP_MV_101_OIL, CMP_MV101_OIL, etc.
EPICS Name: NA (not read back in control system)

Description: Linac Gallery Relay Rack #120
Long Name: SCL_LG_RR_120
Short Name: LG_RR_120, LG_RR120, etc.
EPICS Name: NA (not read back in control system)

Description: SSR2 Cryomodule #7
Long Name: SCL_SSR2_CM_700
Short Name: SSR2_CM_700, SSR2_CM700, etc.
EPICS Name: NA (not read back in control system)

Description: HWR Cryomodule #1 Solenoid #5
Long Name: SCL_HWR_SOL_105
Short Name: HWR_SOL_105, HWR_SOL105, etc.
EPICS Name: NA (not read back in control system)

Description: HB Cryomodule #2 Coupler #3
Long Name: SCL_HB_CPLR_203
Short Name: HB_CPLR_203, HB_CPLR203, etc.
EPICS Name: NA (not read back in control system)

Description: LB 650 MHz Cryomodule #2 Cavity #2
Long Name*: SCL_LB_CAV_202

Short Name: LB_CAV_202, LB_CAV202, etc.
EPICS Name: NA (not read back in control system)

Description: LB 650 MHz Cryomodule #3 Warm Quad #1
Long Name**: SCL_LB_QUAD_301
Short Name: LB_QUAD_301, LB_QUAD301, etc.
EPICS Name: NA (not read back in control system)

*Note this cavity name is intended to designate the cavity as located in the Linac. It is not the name or serial number given to the cavity during fabrication and testing by the vendor or institution. The vendor designation can be attached as additional metadata for tracking the history and documentation purposes or cross-referenced once it is determined which cryomodule and location within a cryomodule the cavity will be placed. A similar process can be followed for other components that have similar characteristics.

**Note this quadrupole is located in the warm region between the third and fourth Low Beta 650 MHz cryomodules. The Location/System and Identifier refer to the immediate upstream cryomodule. A similar process can be followed for other components in these warm regions.

4.9. Vendor and Partner Supplied Equipment

Vendor and Partner supplied equipment may have their own naming conventions and, in many cases, it may not be practical to impose the PIP-II naming convention to these situations. One example is the Cryogenic Plant where the vendor has an established naming convention that cannot be easily changed. In these instances, a cross-reference document may be needed to show how a vendor or Partner name translates to the PIP-II name. Once delivered, Fermilab may choose to rename the component-equipment or adopt as is using the device database.

5. Document Naming

Consistent document naming for all PIP-II Project documents is essential for better tracking and organization of documents across the Project. How files and documents are organized and named will have a big impact on the ability to find those documents later and understand what they contain. Furthermore, depending on the type, documents can be located in different repositories and databases making consistent and descriptive naming even more essential.

The naming of documents within PIP-II follows the PIP-II – PM – Document Management and Control Procedure, PIP-II-doc-2946 [1]. Reference this procedure for more details on the PIP-II document naming convention.

6. Infrastructure Naming Convention

6.1. Electrical Infrastructure Naming Convention

The naming of electrical distribution equipment such as panel boards, transformers, breakers, etc. for PIP-II shall follow the Fermilab standard as described in Standard Conventions for the Fermilab Electrical AC Power Distribution System (FESHM 9120) [2]. This standard provides uniformity across all electrical distribution systems at Fermilab and is mandated by FESHM.

Using the FESHM standard, equipment within the PIP-II complex will use the location abbreviations presented in Table 6-1.

Table 6-1. Electrical Equipment Location Abbreviations

Location	Description
LG	Superconducting Linac Gallery
LT	Superconducting Linac Tunnel
BTL	Beam Transfer Line
SAD	Straight Ahead Dump
BAL	Booster Absorber Line
F3	F3 Service Building
F35	F3.5 Service Building

7. Cables

Cables will be tracked using the PIP-II cable database (a services account is required for access) [3]. Each cable will have a unique cable number that will be used in place of the aforementioned naming scheme. Each cable label must contain the following information:

1st Row: Cable Type/Cable Number/Function
2nd Row: Origin
3rd Row: Destination

8. EPICS Control System Device Naming

At this time, EPICS naming for control system devices shall follow the naming convention outlined in Section 4. As more information regarding the EPICS implementation and rollout is provided, the EPICS naming scheme may further evolve.

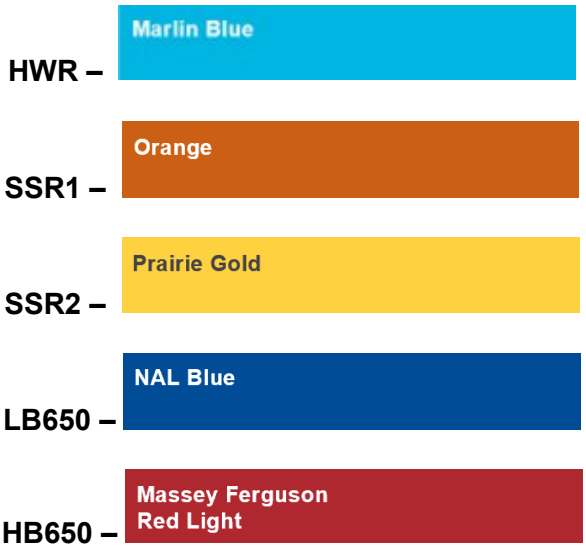
9. Color Coding Convention

Like the device and equipment naming convention, a color coding convention has been adopted for certain systems and subsystems within the PIP-II Project. The color coding convention draws from existing conventions in use at Fermilab. The chosen color schemes follow Fermilab's core color palette as described in the Graphics Standards at Fermilab which can be found at the following link: https://www.fnal.gov/faw/designstandards/color-palette.html [4].

In particular, the color convention is applied to two major subsystems, Cryomodules and Warm Magnets and described in detail below. Other systems that may benefit from an established color coding scheme shall use the official Fermilab color palette as the basis for the convention.

9.1. Cryomodule Color Code

Cryomodule external vacuum jackets shall be painted using the following color codes. The intent is to differentiate the different cryomodule types by a given color which will also provide consistency and uniformity. There are five different classes/types of cryomodules. Each cryomodule has been designated a color based on the Fermilab color palette as shown below:



9.2. Warm Magnet Color Code

Warm Magnets throughout the Fermilab complex have used an established color convention to differentiate between magnet types for many years. The color convention for warm magnets for the PIP-II complex will follow these existing conventions as much as possible. Note that across the Fermilab complex there are exceptions to this convention and in certain instances components may not be painted at all.

Quadrupoles – 

The quadrupole color scheme shown above applies to main quadrupoles and quadrupole correction elements. This convention is currently followed by Main Injector, Main Ring and parts of Muon Campus. Exceptions to this scheme include the permanent magnet quads in the Recycler and the 8-GeV line where they are painted gold and in External Beams where they are painted orange. Also, for Muon/Pbar, the large aperture quadrupoles are painted red and the small aperture quadrupoles are painted orange. Note that in some cases the magnets are not painted such as in the case of the MEBT quadrupoles.

Dipoles – 

The dipole color scheme show above applies to standard dipoles. Different shades of blue are used to distinguish between different types of dipoles. Exceptions are the dipole correction elements in the Main Injector, 8 GeV line and NuMi beam line which are painted black.

Sextupoles – 

The sextupole color scheme shown above applies to sextupoles and trims. This convention is currently followed by Main Ring, Main Injector and Recycler.

Combined Function Magnets – 

The above color scheme applies to combined function magnets. One exception is in the Booster where they have an unpainted stainless steel outer jacket.

10. QR Codes

In addition to the naming conventions described in this document, the PIP-II project is also planning on identifying physical components using QR codes (barcodes) similar to how Fermilab identifies and tracks sensitive equipment. QR codes will allow for tracking of operational and spare components and can also be used to document maintenance activities.

11. Device Database

A device database will be used throughout the Project to manage each unique piece of equipment. This database will capture the following:

Table 11-1. Device Database Field Requirements

Entry Identifier	Description	Mandatory
Device Type	Enter shorthand and detailed information related to the device type: BPM-Beam Position Monitor, CV-Control valve, etc.	Yes
Manufacturer	Who produced the device	No
Vendor ID	Serial Number, Name, etc.	No
Production Date	When was the device made	No
Device Name	Enter a name that conforms to this document	Yes
System Owner	Who is responsible for this device	Yes
Installed or Stored Location	Where is the device currently	Yes
Current Status	Spare, In-Use, Obsolete, etc.	Yes

The device database will also be the primary means of managing the naming of devices. The database will verify that each device name is unique and fits within the standards of this document. The database will alert users to issues and provide a means to contact the Integration Coordinator for naming issue resolution if necessary. The Device Database is currently under construction and a link will be provided shortly [5].

12. Reference Documents

#	Reference	Document #
1	PIP-II Project Document Management and Control Procedure	PIP-II-doc-2946

2	Standard Conventions for the Fermilab Electrical AC Power Distribution System	FESHM 9120
3	PIP-II Cable Database, https://ad.fnal.gov/cgi-bin/cable/cableIndex.pl?areaID=19	-
4	Graphic Standards are Fermilab, https://www.fnal.gov/faw/designstandards/color-palette.html	-
5	PIP-II Device Database	TBD

13. Appendix A – Location/System List

Table 13-1 lists the current Location/System abbreviations for the PIP-II naming convention. Note that this list is not all inclusive. Additional abbreviations will be added as they are identified. User may create new abbreviations not listed in the table as long as the four character maximum requirement is satisfied, and it does not duplicate an existing abbreviation.

Table 13-1. Location/System List

By Location	Abbreviation	By System	Abbreviation
Ion Source	IONS	Accelerator Physics	AP
Low Energy Beam Transport	LEBT	Beam Instrumentation	BI
Medium Energy Beam Transport	MEBT	Beam Transfer Line Installation	BTLI
Warm Front End	WFE	Building Infrastructure	BLDI
Half Wave Resonator CM	HWR	Commissioning	COMM
Single Spoke Resonator 1 CM	SSR1	Controls	CNTR
Single Spoke Resonator 2 CM	SSR2	Cryogenic Plant	CP
Low Beta 650 MHz CM	LB	Cryogenic Distribution System	CDS
High Beta 650 MHz CM	HB	High Power RF	HPRF
Straight Ahead Beam Dump	SAD	Linac Installation	LINS
Beam Abs Line/25 kW Beam Dump	BAL	Low Level RF	LLRF
BTL Arch 1	ARC1	Machine Protection System	MPS
BTL Straight Section	STRS	Magnets	MAG
BTL Arch 2	ARC2	Main Injector	MI
Upper High Bay	UHBY	Power Supplies	PS
Lower High Bay	LHBY	Recycler Ring	RR
Linac Gallery	LG	Safety Systems	SS
F3 Service Building	F3	Test Infrastructure	TI
F37 Service Building	F37	Vacuum	VAC
Cryogenic Plant Coldbox	CB	Warm Front End	WFE
Cryogenic Distribution	CDS		
Helium Inventory	INV		
Warm Compressor System	WCS		
Utility Plant	UP		
Virtual Device	VD		
* Note, this list is not all inclusive. Additional abbreviations will be added as they are identified.			

14. Appendix B – Device List

Table 14-1 lists the current Device abbreviations for the PIP-II naming convention. Note that this list is not all inclusive. Additional abbreviations will be added as they are identified. User may create new abbreviations not listed in the table as long as the four character maximum requirement is satisfied, and it does not duplicate an existing abbreviation.

Table 14-1. Device List

Device Type		Device Type		Device Type	
General Instrumentation		**Equipment - General**		**Equipment - Linac**	
Contamination Transmitter	CT	Bellows	BLS	Absorber	ABS
Differential Pressure Switch	DPS	Chiller	CH	Beam Stop	BSTP
Diff. Pressure Transducer	DPT	Compressor	CMPR	Cavity	CAV
Flow Indicator	FI	Filter	F	Chopper	CHOP
Flow Switch	FS	Heat Exchanger	HX	Collimator	COL
Flow Transmitter	FT	Instrument Air Compressor	IA	Coupler Electron Probe	CEP
Heater	HTR	Ion Pump	IP	Coupler	CPLR
Level Indicator	LI	Ion Pump Controller	IPC	Cryomodule	CM
Level Switch	LS	Rupture Disk	RD	Differential Pumping Insert	DPI
Level Transducer	LT	Strainer	STR	Faraday Cup	FC
Moisture Transmitter	MT	Tank	TNK	Fast Faraday Cup	FFC
Pressure Indicator	PI	Roughing Pump	RP	Field Probe	FP
Pressure Switch	PS	Turbo Molecular Pump	TMP	Flux Gate	FG
Pressure Transducer	PT	Valve Box	VB	HALO Ring	HALO
Speed Switch	SS	Relay Rack	RR	Kicker	KICK
Speed Transmitter	ST			Magnet Quadrupole	QUAD
Diode Temperature Sensor	TD	**Equipment - Valves**		Magnet Skew Quadrupole	QSKW
Temperature Indicator	TI	Beam Valve	BV	Magnet Dipole	DPL
TVO Temperature Sensor	TO	Check Valve	CV	Piezo	PZ
Platinum Temp. Sensor	TP	Solenoid/Electric Valve	EV	Power Supply	PS
Temperature Switch	TS	Fast Acting Valve	FAV	RF Amplifier	RFA
Temperature Transducer	TT	Manual Valve	MV	Ring Pick-Up	RPU
Cernox Temperature Sensor	TX	Pressure Reducing Valve	PRV	Solenoid	SOL
Vibration Transmitter	VT	On/Off and Control Valve	PV	Scraper	SCRP
		Safety Valve	SV	Three-Way Septum	3WS
Beam Instrumentation		Generic Valve	V	Corrector – X direction	XCOR
AC Current Transformer	ACCT	Three-Way Valve	3WV	Corrector – Y direction	YCOR
Allison Scanner	ASCN	Four-Way Valve	4WV		
Beam Loss Monitor	BLM				
Beam Position Monitor	BPM				
Beam Position Monitor	BPM				
Bunch Length Monitor	BNLM				
DC Current Transformer	DCCT				
Laser Profile Monitor	LPM				
Res. Wall Current Monitor	RWCM				

Wire Profile Monitor	WPM				

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