

PIP-II Beam Instrumentation Linac Installation Deliverable List

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Document Approval

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1. Introduction

This document is a shared document between the Beam Instrumentation (BI) and the Linac Installation (LI) on the agreed upon deliverables. These deliverables are to be reviewed at an Installation Readiness Review (IRR) as shown in the PIP-II LI Plan[9]. It is determined by the BI L3M when and how much of their deliverables will be reviewed by the LI team at a time. Deliverables require finer definitions to LI, and the condition of those deliverables at hand-off milestones.

1.1. Linac Installation (LI) Scope

The scope of the LI WBS element is defined at a high level in the PIP-II WBS dictionary [1]:

"Installation and systems checkout of the PIP-II linac, from the Warm Front End through the HB650 upgrade section. This includes integration of the linac's warm units; installation work occurring after AUP of the highbay, tunnel, and gallery spaces; and system checkout required to bring installed systems to the state where they are ready to attempt beam commissioning. Installation work includes connection to utilities, but major utilities runs (fluids headers, electrical cable tray and distribution from panels) is executed by Conventional Facilities. Accelerator Controls and Safety Systems installation scope is covered by those WBS elements. This WBS also includes the procurement of shielding required for linac major access points in the HBB and penetrations in the HBB and Linac Gallery."

1.2. Beam Instrumentation (LI) Scope

The scope of the BI WBS element is defined at a high level in the PIP-II WBS dictionary [1]:

"Design, procurement, fabrication, and testing of Beam Instrumentation Systems."

While BI systems will be used in the commissioning and operation of the PIP-II complex, installation and beam commissioning activities are outside of the scope BI. Consequently, definition (procedures, conditions, quantities, etc.) of the deliverables to LI at the time of the hand-off milestones.

1.3. Purpose

The purpose of this document is to define scope and programmatic interfaces for deliverables between the BI L3M and the LI L3M at hand-off milestones.

In addition, this document also becomes a template for the data to be reviewed at the IRR for each delivery.

Key cost, schedule, technical and programmatic assumptions are provided in PIP-II Project Assumptions[2].

All technical subsystem interfaces are defined in the MCID[3] and elaborated within subsystem-specifics ISDs. BI ISDs [14][16][18][20] are upwards traceable to the associated GRD[4], Physics Requirements Documents (PRDs)[5][10], FRS[11], and TRSs [12][13][15][17][19] where applicable.

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2. Acronyms

ACCT	AC Current Transformer
AES	Allison Emittance Scanner
AMG	Alignment and Metrology Group
BCM	Beam Current Monitor
ВІ	Beam Instrumentation
BLM	Beam Loss Monitor
ВРМ	Beam Position Monitor
BProM	Beam Profile Monitor
BSM	Bunch Shaper Monitor
BTL	Booster Transfer Line
CAD	Computer Aided Design
DAQ	Data Acquisition
DCCT	DC Current Transformer
FRS	Functional Requirement Specifications
GRD	Global Requirements Documents
ICD	Interface Control Document
IRR	Installation Readiness Review
ISD	Interface Specification Document
L3	Level 3 (PIP-II Project Subsystem)
L3M	Level 3 Manager
L4M	Level 4 Manager
LI	Linac Installation WBS Element
LW	LaserWire
MICD	Master Interface Control Document
PIP2IT	PIP-II Injector Test
PIP-II	Proton Improvement Plan II
PRD	Physics Requirement Document
PRD	Physics Requirements Documents
QA	Quality Assurance
QC	Quality Control
RWCM	Resistive Wall Current Monitor
SCL	Superconducting Linac
TRS	Technical Requirement Specifications
TWS	Transverse Wire Scanner
WBS	Work Breakdown Structure

3. References

Table 3-1: PIP-II Project-Level Documentation

#	PIP-II Project Documents	Document #
1.	PIP-II WBS Dictionary	PIP-II-docDB 599
2.	PIP-II Project Assumptions	PIP-II-docDB 144
3.	PIP-II Master Interface Control Document	ED0010433
4.	PIP-II Global Requirements Document (GRD)	TC# ED001222
5.	PIP-II Parameters Physics Requirements Document (PRD)	TC# ED0010216
6.	PIP-II 121.03 Accelerator Systems Quality Assurance (QA) Plan	PIP-II-docDB 4805
7.	PIP-II Misalignment Tolerances PRD	ED0010231

Table 3-2: PIP-II LI Documentation

#	PIP-II LI Documents	Document #
8.	Linac Installation Functional Requirements Specification (FRS)	ED0007996
9.	PIP-II Linac Installation Plan	ED0007915

Table 3-3: PIP-II BI Documentation

#	PIP-II BI Documents	Document #
10.	PIP-II BI Physics Requirement Document (PRD)	ED0010230
11.	PIP-II BI Functional Requirements Specification (FRS)	ED0008303
12.	PIP-II BI Digital Electronics Technical Requirements Specification (TRS)	ED0013715
13.	PIP-II BI BPM TRS	ED0013710
14.	PIP-II BI BPM Interface Specification Document (ISD)	ED0016037
15.	PIP-II BI BLM TRS	ED0013711
16.	PIP-II BI BLM ISD	ED0016034
17.	PIP-II BI BCM TRS	ED0013712
18.	PIP-II BI BCM ISD	ED0016033
19.	PIP-II BI Invasive BProM TRS	ED0013713
20.	PIP-II BI Invasive BProM ISD	ED0016035
21.	PIP-II BI NonInvasive BProM TRS	ED0013714
22.	PIP-II BI NonInvasive BProM ISD	ED0016036
23.	PIP-II BI Quality Control (QC) Plan	PIP-II-docDB 5520

Table 3-4: Other Reference Documentation

#	Other Relevant Documents	Document #
24.	FERMILAB Energy Control Program (LOCKOUT/ TAGOUT)	FESHM 2100
25.	PIP-II Rack Specification	PIP-II-docDB 5363
26.	PIP-II Rack Bank Power	PIP-II-docDB 5360
27.	PIP-II Cryoplant Network Relay Rack Specification	PIP-II-docDB 5511
28.	PIP-II Linac Gallery Rack Allocation	PIP-II-docDB 5390

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4. Documentation Deliverables Definitions

4.1. Assembly, Test & QC-QA

These documents define acceptance criteria for hardware, firmware, and/or software deliverables, prior to the LI handoff. Related assembly procedures, bench test procedures, and acceptance travelers are listed in the PIP-II BI QC Plan [23]. This plan is consistent with the overarching Accelerator Systems Quality Assurance (QA) Plan [6]. If inconsistencies between these two documents are discovered, Accelerator Systems QA Plan has precedence.

4.2. Transportation & Installation

These documents articulate the transfer of deliverables for LI, including information on the following:

- Starting and ending location of the deliverable as well as point of contact, if applicable
- The physical path of transport as well as any special handling requirements
- Method and resources required to install the hardware or equipment into their designated location.

These plans are generally prepared by the L4M and converted into handoff travelers, which are listed in the PIP-II BI QC Plan [23]. For Electronics Rack equipment, a Transportation and Installation Traveler is not required. However, rack locations as well as rack layouts should be documented and tracked [25][26][27][28].

4.3. Connections, ORC & Checkout Travelers

These documents describe the connections across physical interfaces and data pathway to all other L3's. These are included within the PIP-II MICD[3] as well as elaborated in the ICDs listed in Table 3-3. In addition, these documents include related test procedures as well as checkout travelers, which describe requirements and qualifications for a deliverable to obtain operational readiness. These are listed in the PIP-II BI QC Plan[23].

4.4. Interfaces MICD

L3 Interfaces are defined globally in the PIP-II MICD[3]. This document is generated prior to the IRR and elaborated through ISDs listed in Table 3-3.

4.5. TRS/FRS Checklist

The technical and functional requirements of deliverables are specified in L3 FRS and TRS documents, where are generated prior to the IRR and are listed in Table 3-3. These provide the basis for the LI's checklist to accept the deliverable for installation at the IRR.

4.6. Alignment Reference

If the hardware interacts with the beam, as in installed in the beamline, a deliverable has been referenced with its own fiducials. This exterior fiducial map is required for final alignment within the Linac enclosure. This reference ensures the LI team that a deliverable has been reviewed by the AMG team. At a minimum, PIP-II Misalignment Tolerances PRD [7] will be followed.

4.7. Control System List

This document lists the parameters that will be directly created into the controls system. It should include parameters associated with general control, readback, alarms, etc.

4.8. Cable Database

This should list the cable database entries to ensure LI that deliverables entries have been made aware for the BI team.

4.9. Operational Documentation

This documentation should provide Beam Commissioning the necessary documents to incorporate any beamline deliverable towards commissioning of the beam. This documentation will also be incorporated with a transition to operations.

4.10. Potential Energy Isolation

The document identifies a deliverable's potential energy and describes how to safely isolate that potential energy for operational maintenance or repair. This documentation will be included for a transition to operations. The document should follow the guidance of Fermilab's FESHM Chapter 2100[24].

4.11. CAD Models & Drawings

Documentation of a technical deliverable includes CAD models and or drawings. These models and drawings should be produced for historical content and will be associated with documentation for a transition to operations where applicable.

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5. Deliverable and Scope Definition

5.1. Components to be integrated in the PIP-II tunnel enclosure (including the high-bay floor).

Table 5-1: BPM Components Within PIP-II Enclosure

Deliverable	Qty	Delivery/Handoff Location and Delivery trigger	Shipping/Packaging Configuration	Configuration at Handoff	Support Hardware, Labor, and Logistics	Documentation (to be presented at IRR)	Notes and Comments (to be presented at IRR)	Accepted for Installation (to be filled at IRR)
					Vacuum components		PIP-II BI QC Plan [23]	
					would need to be		PIP-II BI QC Plan [23]	
					assembled particle-free	□ Connections, ORC & Checkout	PIP-II BI QC Plan [23]	
WFE BPM Pickups				Vacuum	and then:		PIP-II MICD [3]	
		CMTF cleanroom or MEBT Unit	Set of individual	components o BPM	Leak CheckedRGA certified		PIP-II BI FRS [11] PIP-II BI BPM TRS [13]	
	11	Integration	components	housing	Low-particulate		PIP-II Misalignment Tolerances PRD [7]	
		Location		o BPM buttons	condition	☐ Control System List	See Section 5.2	
				Flanges		□ Cable Database		
				o i idiigoo	BPMs, BPMs are already assembled.	☐ Operational Documentation		
						☐ Potential Energy Isolation		
						□ CAD Models & Drawings	PIP-II BI BPM ISD [14]	
					Vacuum components		PIP-II BI QC Plan [23]	
							PIP-II BI QC Plan [23]	
		Not a deliverable				□ Connections, ORC & Checkout	PIP-II BI QC Plan [23]	
		to LI		Vacuum	would need to be		PIP-II MICD [3]	
		Will be delivered		components BPM	assembled particle-free and then:		PIP-II BI FRS [11]	
SCL BPM	18	to VAC at CMTF	Set of individual	o BPM housing	Leak Checked		PIP-II BI BPM TRS [13]	
Pickups	10	cleanroom or	components	o BPM	RGA certified		PIP-II Misalignment Tolerances PRD [7]	
		Warm Unit Integration		buttons	 Low-particulate 	☐ Control System List	See Section 5.2	
		Location		 Flanges 	condition	⊠ Cable Database		
		Loodion			 Backfilled 	☐ Operational Documentation		
						☐ Potential Energy Isolation		
						□ CAD Models & Drawings	PIP-II BI BPM ISD [14]	

Table 5-2: BLM Components Within PIP-II Enclosure

Deliverable	Qty	Delivery/Handoff Location and Delivery trigger	Shipping/Packaging Configuration	Configuration at Handoff	Support Hardware, Labor, and Logistics	Documentation (to be presented at IRR)	Notes and Comments (to be presented at IRR)	Accepted for Installation (to be filled at IRR)											
MEBT BLM Detectors							PIP-II BI QC Plan [23]												
							PIP-II BI QC Plan [23]												
						□ Connections, ORC & Checkout	PIP-II BI QC Plan [23]												
			8 PMT Loss Monitors	Self-contained		☑ Interfaces MICD	PIP-II MICD [3]												
	40	Libraha harra Daraha	and associated mounting hardware	loss-monitor units	Detectors are installed		PIP-II BI FRS [11] PIP-II BI BLM TRS [15]												
	12	High-bay Dock	 4 Neutron Loss Monitors and 	 Support stands and 80/20 	externally to beamline	☐ Alignment Reference	Installed externally to beamline												
			associated mounting	mounting		☐ Control System List	See Section 5.2												
			hardware	hardware		□ Cable Database													
				narawaro			Vendor-Provided Documentation												
									□ Potential Energy Isolation										
						□ CAD Models & Drawings	PIP-II BI BLM ISD [16]												
														40.1			⋈ Assembly, Test & QC-QA	PIP-II BI QC Plan [23]	
					 46 Ionization Loss Monitors and 														
									associated mounting			□ Connections, ORC & Checkout							
					hardware	Self-contained		☑ Interfaces MICD	PIP-II MICD [3]										
SCL BLM	128	High hay Dool	63 PMT Loss Monitors and	loss-monitor units	Detectors are installed		PIP-II BI FRS [11] PIP-II BI BLM TRS [15]												
Detectors	128	High-bay Dock	associated mounting	 Support stands and 80/20 	externally to beamline	☐ Alignment Reference	Installed externally to beamline												
			hardware	mounting		☐ Control System List	See Section 5.2												
			46 Neutron Loss	hardware		□ Cable Database													
			Monitors and				Vendor-Provided Documentation												
			associated mounting hardware			□ Potential Energy Isolation													
			Haraware			□ CAD Models & Drawings	PIP-II BI BLM ISD [16]												

Table 5-3: BCM Components Within PIP-II Enclosure

Deliverable	Qty	Delivery/Handoff Location and Delivery trigger	Shipping/Packaging Configuration	Configuration at Handoff	Support Hardware, Labor, and Logistics	Documentation (to be presented at IRR)	Notes and Comments (to be presented at IRR)	Accepted for Installation (to be filled at IRR)		
							PIP-II BI QC Plan [23]			
							PIP-II BI QC Plan [23]			
						□ Connections, ORC & Checkout	PIP-II BI QC Plan [23]			
WFE BCM Pickups			0.4007/		Beamline assemblies		PIP-II MICD [3]			
	_	CMTF cleanroom or MEBT Unit	3 ACCT (sensor, electronics, 20m	Support stand and 80/20 mounting	need to be: • Leak Checked	□ TRS/FRS Checklist	PIP-II BI FRS [11] PIP-II BI BCM TRS [17]			
	7	Integration	cable)	hardware	 RGA certified 		PIP-II Misalignment Tolerances PRD [7]			
		Location	3 DCCT sensor1 WCM	 Assembled beamline section 	 Low-particulate 	☐ Control System List	See Section 5.2			
			J I VVCIVI	beamine section	condition	□ Cable Database				
						□ Operational Documentation	Vendor-Provided Documentation			
						☐ Potential Energy Isolation				
						□ CAD Models & Drawings	PIP-II BI BCM ISD [18]			
							PIP-II BI QC Plan [23]			
									PIP-II BI QC Plan [23]	
						□ Connections, ORC & Checkout	PIP-II BI QC Plan [23]			
				0 A COT /	_	Beamline assemblies	☑ Interfaces MICD	PIP-II MICD [3]		
		CMTF cleanroom	3 ACCT (sensor, electronics, 20m	 Support stand and 80/20 mounting 	need to be:		PIP-II BI FRS [11]			
SCL BCM	5	or Warm Unit	cable)	hardware	 Leak Checked 		PIP-II BI BCM TRS [17]			
Pickups		Integration	• 1 DCCT	Assembled	 RGA certified 		PIP-II Misalignment Tolerances PRD [7]			
		Location	• 1 WCM	beamline section	Low-particulate	☐ Control System List	See Section 5.2			
					condition	□ Cable Database □ Cable Database				
						□ Operational Documentation	Vendor-Provided Documentation			
						☐ Potential Energy Isolation				
						□ CAD Models & Drawings	PIP-II BI BCM ISD [18]			

Table 5-4: Invasive BProM Components Within PIP-II Enclosure

Deliverable	Qty	Delivery/Handoff Location and Delivery trigger	Shipping/Packaging Configuration	Configuration at Handoff	Support Hardware, Labor, and Logistics	Documentation (to be presented at IRR)	Notes and Comments (to be presented at IRR)	Accepted for Installation (to be filled at IRR)
							PIP-II BI QC Plan [23]	(to so imod at irtit)
				Vacuum section			PIP-II BI QC Plan [23]	-
				components		□ Connections, ORC & Checkout	PIP-II BI QC Plan [23]	-
				Leak checkedRGA certified			PIP-II MICD [3]	-
WFE AES		CMTF cleanroom or MEBT Unit	Set of assembled	Subcomponents	LEBT AES are installed	☑ TRS/FRS Checklist	PIP-II BI FRS [11] PIP-II BI Invasive BProM TRS [19]	
Assemblies	6	Integration	major subcomponents	to be integrated	into ion source housings		PIP-II Misalignment Tolerances PRD [7]	
		Location		into stand and	provided by WFE.	☐ Control System List	See Section 5.2	
				supports		□ Cable Database		
				following lifting		□ Operational Documentation		_
				and assembly plans		□ Potential Energy Isolation		_
				piaris		□ CAD Models & Drawings	PIP-II BI Invasive BProM ISD [20]	
					MEBT TWS are installed into scraper housings	☑ Assembly, Test & QC-QA	PIP-II BI QC Plan [23]	
			Set of assembled	 Vacuum section components Leak checked RGA certified Subcomponents to be integrated 		☑ Transportation & Installation	PIP-II BI QC Plan [23]	
						□ Connections, ORC & Checkout	PIP-II BI QC Plan [23]	
							PIP-II MICD [3]	
MEBT TWS		CMTF cleanroom or MEBT Unit				□ TRS/FRS Checklist	PIP-II BI FRS [11] PIP-II BI Invasive BProM TRS [19]	
/acuum Assemblies	4	Integration	major subcomponents			☑ Alignment Reference	PIP-II Misalignment Tolerances PRD [7]	
Assemblies		Location		into stand and	provided by WFE	☐ Control System List	See Section 5.2	
				supports		□ Cable Database		
				following lifting		□ Operational Documentation		
				and assembly plans		□ Potential Energy Isolation		
				ριατίο		□ CAD Models & Drawings	PIP-II BI Invasive BProM ISD [20]	
							PIP-II BI QC Plan [23]	
				Vacuum section			PIP-II BI QC Plan [23]	
				components o Leak checked		□ Connections, ORC & Checkout	PIP-II BI QC Plan [23]	
3TL /				 RGA certified 	4 BTL TWS will be		PIP-II MICD [3]	
Diagnostic Cart	00	This is not a	Set of assembled	Subcomponents	initially installed in the diagnostic card during	□ TRS/FRS Checklist	PIP-II BI FRS [11] PIP-II BI Invasive BProM TRS [19]	
ΓWS		deliverable to LI	major subcomponents	to be integrated	phased commissioning. Later, these will be		PIP-II Misalignment Tolerances PRD [7]	
/acuum				into stand and	uninstalled and moved	☐ Control System List	See Section 5.2	
Assemblies				supports	into the BTL.	□ Cable Database		
				following lifting		□ Operational Documentation		
				and assembly plans		□ Potential Energy Isolation		
				ριαιίο		□ CAD Models & Drawings	PIP-II BI Invasive BProM ISD [20]	

PIP-II BI Linac Installation Deliverable List

Table 5-5: Noninvasive BProM Components Within PIP-II Enclosure

Deliverable	Qty	Delivery/Handoff Location and Delivery trigger	Shipping/Packaging Configuration	Configuration at Handoff	Support Hardware, Labor, and Logistics	Documentation (to be presented at IRR)	Notes and Comments (to be presented at IRR)	Accepted for Installation (to be filled at IRR)
				Assembled			PIP-II BI QC Plan [23]	
				vacuum section	Vacuum components		PIP-II BI QC Plan [23]	
				components		□ Connections, ORC & Checkout	PIP-II BI QC Plan [23]	
					would need to be		PIP-II MICD [3]	
MEBT		CMTF cleanroom		 Viewports 	assembled particle-free		PIP-II BI FRS [11]	
Laserwire	4	or MEBT Unit	Set of individual	protected	and then: • Leak Checked		PIP-II BI NonInvasive BProM TRS [21]	
Vacuum	1	Integration	subcomponents	- Cubaamaananta ta	 RGA certified 	☑ Alignment Reference	PIP-II Misalignment Tolerances PRD [7]	
Assembly		Location		 Subcomponents to be integrated into 	Low-particulate	☐ Control System List	See Section 5.2	
				stand and	condition	□ Cable Database		
				supports following	Backfilled			
				lifting and		☑ Potential Energy Isolation		
				assembly plans		□ CAD Models & Drawings	PIP-II BI Invasive BProM ISD [22]	
				Assembled		☑ Assembly, Test & QC-QA	PIP-II BI QC Plan [23]	
			Set of individual	vacuum section components • Viewports protected	Vacuum components would need to be assembled particle-free and then: • Leak Checked		PIP-II BI QC Plan [23]	
						□ Connections, ORC & Checkout	PIP-II BI QC Plan [23]	
							PIP-II MICD [3]	
001.1		CMTF cleanroom				☑ TRS/FRS Checklist	PIP-II BI FRS [11]	
SCL Laserwire Vacuum	11	or Warm Unit					PIP-II BI NonInvasive BProM TRS [21]	
Assemblies	' '	Integration	subcomponents	Subcomponents to	RGA certified		PIP-II Misalignment Tolerances PRD [7]	
7.00011101100		Location		 Subcomponents to be integrated into 	Low-particulate	☐ Control System List	See Section 5.2	
				stand and	condition	□ Cable Database		
				supports following	 Backfilled 	□ Operational Documentation		
				lifting and		□ Potential Energy Isolation		
				assembly plans		□ CAD Models & Drawings	PIP-II BI NonInvasive BProM ISD [22]	
						⋈ Assembly, Test & QC-QA	PIP-II BI QC Plan [23]	
							PIP-II BI QC Plan [23]	
						⊠ Connections, ORC & Checkout	PIP-II BI QC Plan [23]	
							PIP-II MICD [3]	
Warm Linit				Support stands and		☑ TRS/FRS Checklist	PIP-II BI FRS [11]	
Warm Unit Optical 11 Benches	11	High-bay Dock	Assembled Units	Support stands and 80/20 mounting			PIP-II BI NonInvasive BProM TRS [21]	
	''	I light bay book	, localition of the	hardware			PIP-II Misalignment Tolerances PRD [7]	
-						☐ Control System List	BI Electronics DAQ Database Entry	
						☐ Cable Database		
						□ Operational Documentation □ □ □ □ □ □ □ □ □ □ □ □ □ □ □ □ □		
						□ Potential Energy Isolation		
						□ CAD Models & Drawings	PIP-II BI NonInvasive BProM ISD [22]	

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Table 5-6 : Other BI Components Within PIP-II Enclosure

Deliverable	Qty	Delivery/Handoff Location and Delivery trigger	Shipping/Packaging Configuration	Configuration at Handoff	Support Hardware, Labor, and Logistics	Documentation (to be presented at IRR)	Notes and Comments (to be presented at IRR)	Accepted for Installation (to be filled at IRR)
Lifting Fixture	1	High-bay Dock		Note released and legal	Delivering L3 provides			
for warm unit				for use at FNAL.	interface fasteners	☐ Assembly, Test & QC-QA	PIP-II BI QC Plan [23]	
laser wire optical							PIP-II BI QC Plan [23]	
benches						□ Connections, ORC & Checkout	PIP-II BI QC Plan [23]	
DOTTOTION							PIP-II MICD [3]	
						□ TRS/FRS Checklist	PIP-II BI FRS [11] PIP-II BI NonInvasive BProM TRS [21]	
						☐ Alignment Reference		
						☐ Control System List		
						☐ Cable Database		
						□ Operational Documentation		
						☑ Potential Energy Isolation		
						☐ CAD Models & Drawings		
						☐ Assembly, Test & QC-QA	PIP-II BI QC Plan [23]	
						☑ Transportation & Installation	PIP-II BI QC Plan [23]	
						□ Connections, ORC & Checkout	PIP-II BI QC Plan [23]	
Specialty						☐ Interfaces MICD		
tooling, fixtures			Lab equipment and	N		☐ TRS/FRS Checklist		
or test	TBD	High-bay Dock	various assembled	Note released and legal for use at FNAL.	Anything non-standard must be provided by BI	☐ Alignment Reference		
equipment for			units	101 use at FINAL.	be provided by Bi	☐ Control System List		
BI						☐ Cable Database		
						□ Operational Documentation		
						□ CAD Models & Drawings		

						☐ Assembly, Test & QC-QA	PIP-II LI QC Plan
							PIP-II BI QC Plan [23]
						□ Connections, ORC & Checkout	PIP-II BI QC Plan [23]
							PIP-II MICD [3]
						☐ TRS/FRS Checklist	
Warm Unit					LI provides girders and	☐ Alignment Reference	
girders and				Support stand kits and	interface fasteners	☐ Control System List	
adjustable	25	High-bay Dock	Palletized	80/20 mounting	instrumentation-to-stand	☐ Cable Database	
stands				hardware	interface	☐ Operational Documentation	
						☐ Potential Energy Isolation	
						□ CAD Models & Drawings	PIP-BI BPM ISD[14]
							PIP-BI BLM ISD[16]
							PIP-BI BCM ISD[18]
							PIP-BI Invasive BProM ISD[20]
							PIP-BI NonInvasive BProM ISD[22]

5.2. Components to be integrated in the PIP-II electronic galleries (including those in xxx)

Deliverable	Qty	Delivery/Handoff Location and Delivery trigger	Shipping/Packaging Configuration	Configuration at Handoff	Support Hardware, Labor, and Logistics	Documentation (to be presented at IRR)	Notes and Comments (to be presented at IRR)	Accepted for Installation (to be filled at IRR)
						☑ Assembly, Test & QC-QA	PIP-II BI QC Plan [23]	
							PIP-II Linac Gallery Rack Allocation[28]	
						□ Connections, ORC & Checkout	PIP-II BI QC Plan [23]	
				Vendor-assembled rack-wide chassis,			PIP-II MICD [3] PIP-II BI BCM ISD[18]	
Bergoz DCCT Electronics	3	Gallery Dock	Individual Units	which is uniquely matched to a specific interconnect cable	BI will handle the installation of the electronics into the	□ TRS/FRS Checklist	PIP-II BI FRS [11] PIP-II BI Electronics TRS[12] PIP-II BI BCM TRS [17]	
Electionics				and pickup into the	pre-allocated relay racks.	☐ Alignment Reference		
				tunnel.		☐ Control System List	See DAQ Electronics for BCM Systems	
						□ Cable Database		
						□ Operational Documentation	Vendor Provided Documentation	
						☐ Potential Energy Isolation		
						☐ CAD Models & Drawings		
Bergoz	8	Gallery Dock	Individual Units	Wall-/girder-/cable	BI will handle the		PIP-II BI QC Plan [23]	
ACCT				tray- mountable	installation of the		PIP-II Linac Gallery Rack Allocation[28]	
Electronics				electronics enclosure	electronics near gallery	□ Connections, ORC & Checkout	PIP-II BI QC Plan [23]	
				box, containing vendor-assembled module. Each module	penetrations, due		PIP-II MICD [3] PIP-II BI BCM ISD[18]	
				is uniquely matched to a specific	cable length restriction.	□ TRS/FRS Checklist	PIP-II BI FRS [11] PIP-II BI Electronics TRS[12] PIP-II BI BCM TRS [17]	

				interconnect cable		☐ Alignment Reference		
				and pickup into the		☐ Control System List	See DAQ Electronics for BCM Systems	
				tunnel.		☐ Cable Database	Coo Brig Electronice for Bellin Systems	
						□ Operational Documentation	Vendor Provided Documentation	
						☐ Potential Energy Isolation	Vollage Frontage Dogumentation	
						☐ CAD Models & Drawings		
						□ SAS Models & Blawings □ Assembly, Test & QC-QA	PIP-II BI QC Plan [23]	
						☐ Transportation & Installation	PIP-II Linac Gallery Rack Allocation[28]	
						□ Connections, ORC & Checkout	PIP-II BI QC Plan [23]	
							PIP-II MICD [3]	
						MINICIACES WIIOD	PIP-II BI BCM ISD[18]	
DAQ				Rack-mounted crate,	BI will handle the		PIP-II BI FRS [11]	
Electronics			Set of Individual	patch panels,	installation of the	- Tree, res ensemble	PIP-II BI Electronics TRS[12]	
for MEBT	4	Gallery Dock	Units	transition boards	electronics into the		PIP-II BI BCM TRS [17]	
Scrappers				,,	pre-allocated relay	☐ Alignment Reference	- , ,	
					racks.	⊠ Control System List	DAQ Readout/Control Database Device Entries	
						⊠ Cable Database		
						□ Operational Documentation		
						□ Potential Energy Isolation		
					☐ CAD Models & Drawings			
							PIP-II BI QC Plan [23]	
				 Rack-mounted electronics, HV power supplies, motion control, programmable 	BI will handle the installation of the	☐ Transportation & Installation	PIP-II Linac Gallery Rack Allocation[28]	
						□ Connections, ORC & Checkout	PIP-II BI QC Plan [23]	
							PIP-II MICD [3]	
							PIP-II BI Invasive BProM ISD[20]	
DAQ			Set of Individual			☑ TRS/FRS Checklist	PIP-II BI FRS [11]	
Electronics for							PIP-II BI Electronics TRS[12]	
MEBT / BTL	4	High-bay Dock	Units	digitizer cards	electronics into the		PIP-II BI Invasive BProM TRS [19]	
TWS			O'illo	Associated	pre-allocated relay	☐ Alignment Reference		
systems				components such	racks.	□ Control System List	Motion System and Measurement DAQ	
				as patch panels, controller cards,		∇ Oakla Databasa	Readout/Control Database Device Entries	
				timing cards		☐ Cable Database		
						☐ Operational Documentation		
						☑ Potential Energy Isolation		
				Da-1 (!		☐ CAD Models & Drawings	DID II DI OC Dion [22]	
				 Rack-mounted electronics, HV 			PIP-II BI QC Plan [23]	
				power supplies,		☐ Transportation & Installation	PIP-II Linac Gallery Rack Allocation[28]	
DAQ				PC, motion	BI will handle the	☐ Connections, ORC & Checkout	PIP-II BI QC Plan [23]	
Electronics	1	High hay Dook	Set of Individual	control	installation of the electronics into the		PIP-II MICD [3]	
for WFE AES	I	High-bay Dock	Units	 Associated 	pre-allocated relay	▼ TDC/CDC Chapting	PIP-II BI Invasive BProM ISD[20]	
Systems				components such	racks.	□ TRS/FRS Checklist	PIP-II BI FRS [11] PIP-II BI Electronics TRS[12]	
				as patch panels,			PIP-II BI Electronics TRS[12] PIP-II BI Invasive BProM TRS [19]	
				controller cards, timing cards		☐ Alignment Reference	ן אוטו ווע סאואסאווי וע די וווער ווע אווויער וויער	

□ Control System List	Motion System and Measurement DAQ
•	Readout/Control Database Device Entries
□ Cable Database	
□ Potential Energy Isolation	
☐ CAD Models & Drawings	

Deliverable	Qty	Delivery/Handoff Location and Delivery trigger	Shipping/Packaging Configuration	Configuration at Handoff	Support Hardware, Labor, and Logistics	Documentation (to be presented at IRR)	Notes and Comments (to be presented at IRR)	Accepted for Installation (to be filled at IRR)
DAQ	2	High-bay Dock	Set of Individual		 Rack-mounted 	BI will handle the		PIP-II BI QC Plan [23]
Electronics for			Units		electronics, HV power supplies,	installation of the electronics into	☐ Transportation & Installation	PIP-II Linac Gallery Rack Allocation[28]
MEBT/ SCL Laserwire					motion control, programmable	the pre-allocated relay racks.	□ Connections, ORC & Checkout	PIP-II BI QC Plan [23]
systems					digitizer cardsAssociated			PIP-II MICD [3] PIP-II BI NonInvasive BProM ISD[22]
	components such as patch panels, controller			PIP-II BI FRS [11] PIP-II BI Electronics TRS[12] PIP-II BI NonInvasive BProM TRS [21]				
					cards, timing		☐ Alignment Reference	
					cards		□ Control System List	Motion System and Measurement DAQ Readout/Control Database Device Entries
							□ Cable Database	
							Documentation	
							☐ Potential Energy Isolation	
							☐ CAD Models & Drawings	
								PIP-II BI QC Plan [23]
							☐ Transportation & Installation	PIP-II Linac Gallery Rack Allocation[28]
DAG					METH based		□ Connections, ORC & Checkout	PIP-II BI QC Plan [23]
DAQ Electronics for					MFTU-based system consisting of rack-mounted			PIP-II MICD [3] Multiple PIP-II BI ISDs [14][16][18]
WFE / SCL / BTL / BAL	10	High-bay Dock or Gallery Dock	Sets of individual assembled		crate with RTM cards, AMC cards,		☑ TRS/FRS Checklist	PIP-II BI FRS [11] Multiple PIP-II BI TRSs[12][13][15][17]
			components		and MTCA.4		☐ Alignment Reference	
Multiple BI					modules		☐ Control System List	
Systems							⊠ Cable Database	
							□ Operational	
							Documentation	
							☑ Potential Energy Isolation	
							☐ CAD Models & Drawings	

					PIP-II BI QC Plan [23]
				☐ Transportation & Installation	PIP-II Linac Gallery Rack Allocation[28]
				□ Connections, ORC & Checkout	PIP-II BI QC Plan [23]
					PIP-II MICD [3] PIP-II BI BPM / BLM / BCM ISD[14][16][18]
DAQ Servers for	2 High-bay Dock	Sets of individual assembled	Rack-wide servers and installation	□ TRS/FRS Checklist	PIP-II BI FRS [11] PIP-II BI Electronics TRS[12]
BI Systems		components	supports	☐ Alignment Reference	
				□ Control System List	Network Identification and DAQ Readout/Control Database Device Entries via BI Front End Interface
				□ Cable Database	
				Documentation	
				□ Potential Energy Isolation	
				☐ CAD Models & Drawings	