



# PIP-II WBS 121.04 Risk Overview

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Risk Workshop  
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In partnership with:  
India/DAE  
Italy/INFN  
UK/STFC  
France/CEA/Irfu, CNRS/IN2P3

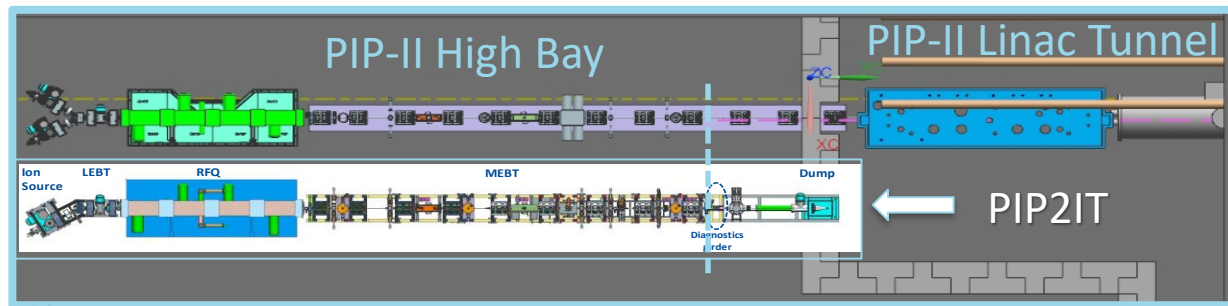
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# Outline

- Scope Overview
- Critical Technology Elements
- Interfaces
- Cost and Schedule
- Risk categories

# Scope Overview

# WBS 121.04



## WBS 121.04 Installation and Commissioning

121.04.02  
Warm Front End

L. Prost

121.04.03  
Test Infrastructure

J. Leibfritz

121.04.04  
Building Infrastructure

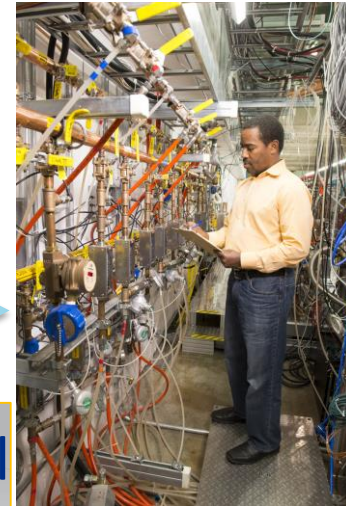
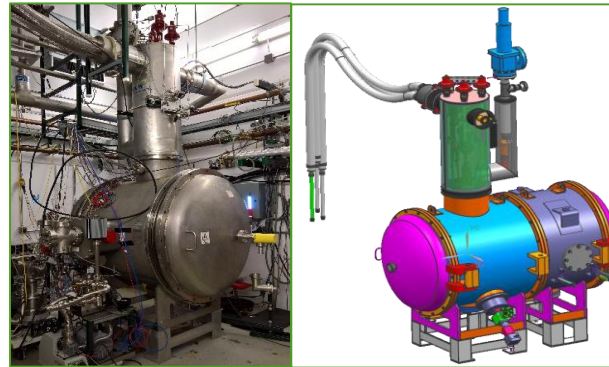
J. Hunt

121.04.05  
Installation

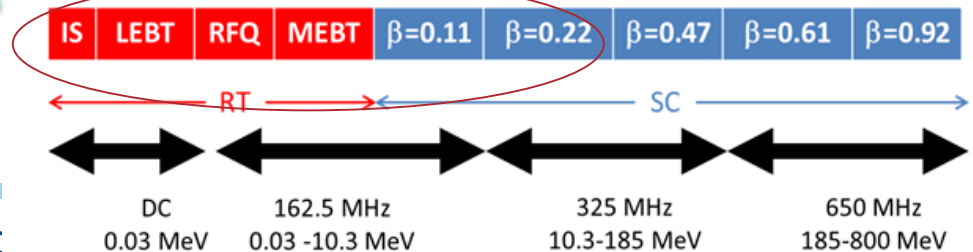
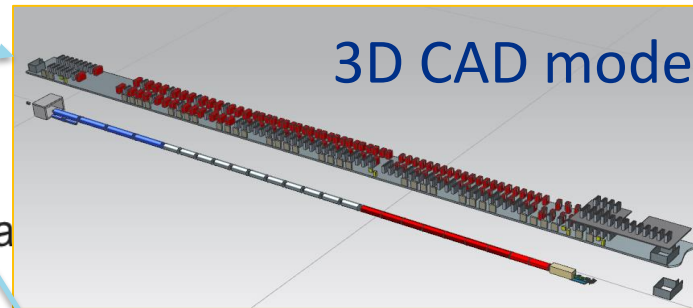
C. Baffes

121.04.06  
Commissioning

F.G. Garcia



PIP2IT LEBT  
LCW Manifold



# WBS 121.04

WBS L3	Scope	Assumptions Scope/Design
.02 Warm-Front End	Provides a beam of H <sup>-</sup> ions, accelerates up to 2.1 MeV and transport to the first SRF cryomodule. In addition, it provides the bunch structure for injection into Booster ring.	All necessary 'utilities' are provided by the facility Focusing and steering elements for MEBT are in-kind contributions from BARC
.03 Test Facility	Includes the design, preparation, installation and commissioning of two Test Facilities (STC and PIP2IT) to perform PIP-II cavity and cryomodule testing <ul style="list-style-type: none"> <li>• STC (Spoke Test Cryostat): will test cavities for SSR1, SSR2 &amp; HB650 CMs</li> <li>• PIP2IT: will be converted to a cryomodule test stand for LB650, HB650 &amp; SSR CMs (w/o beam)</li> </ul>	Testing of the components (cavities and cryomodules) is not part of this WBS and is captured in the SRF WBS The scope of this WBS is complete once modifications are completed and systems are commissioned
.04 Building Infrastructure	Provides cooling water infrastructure, compressed gas distribution, RAW system, AC power distribution, electronic rack layout, cable trays and cable routing of the accelerator components. Connects to the main service lines into the building to the sub-system equipment owners	Conventional Facility delivers heat exchange fluid for LCW system RAW system assumed to heat exchange with LCW Water distribution skid is re-used from PIP2IT



## WBS 121.04

WBS L3	Scope	Assumptions Scope / Design
.05 Installation	Provides the 3D CAD model of the accelerator; design, build and install the cryomodule stands; provides in-tunnel cryomodule mover; removal and relocation of PIP2IT components; provides the planning and execution of all components to be installed in the PIP-II Linac Complex buildings; provides ORC and hardware check of all components	Delivering L3s will prepare and deliver complete installation documentation (models, drawings, certifications, procedures, etc.) Assume minimal subsystem design/redesign during installation
.06 Commissioning	Provides creation and execution of the beam commissioning plan; primary deliverable is a fully-commissioned accelerator turning over to Operations	Hardware commissioning and ORC granted within Installation WBS

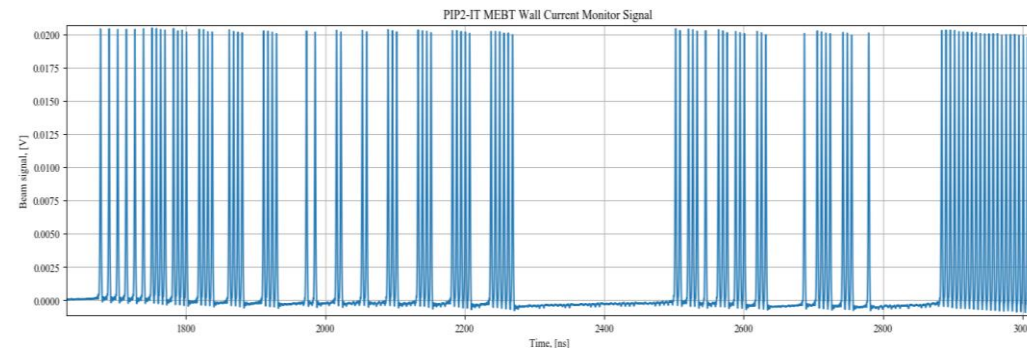
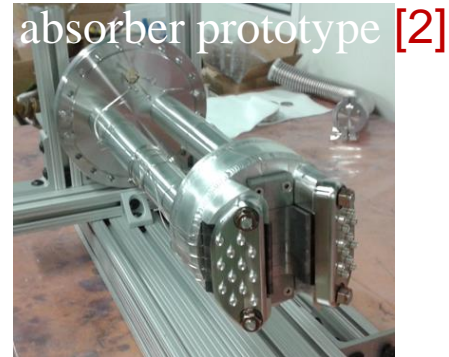
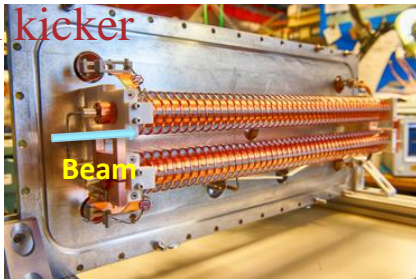
# Critical Technology Elements

# WBS 121.04 Critical Technology Elements (CTEs)

## Critical Technology Element (CTE)

- WFE - MEBT chopping system [1]
- Part of the risk mitigation
  - Developed 2 concepts for the MEBT kickers - “50-Ohm” and “200-Ohm”
  - Both prototype were tested at PIP2IT: **200 Ohm kicker version demonstrated all capabilities required for PIP-II operation** with bucket-to-bucket injection to Booster.

200 Ohm kicker



Randomly generated bunch pattern recorded with RWCM.

[1] RT-121-03-04-001

[2] RT-121-03-04-003



# Cost and Schedule

**Disclaimer:** Costs presented are from CD-1 review (fully burden + Esc)

# WBS 121.04 Cost and Schedule

## .02 Warm Front-End

- **Cost: \$6.6M**
  - Cost driver is labor
- Schedule/Milestone:
  - PIP2IT WFE : ends in FY19 with the delivery of MEBT and HEBT to support beam commissioning of HWR/SSR1
  - PIP-II WFE: ends in FY22 with the delivery of 2<sup>nd</sup> IS and 2<sup>nd</sup> leg of LEBT
- Assumptions:
  - Most components used (and paid for) at PIP2IT are expected to be transferred to the PIP-II High-Bay
    - Other components: mostly duplicates of existing ones or more in-kind contributions (BARC will provide additional 3 LQ + 6SQ for PPI-II MEBT)
  - Some estimates from previous work done on prototype
  - Schedule mostly dictated by constraints from other WBS and long term procurement items (ion source, bunching cavities)

**Disclaimer:** Costs presented are from CD-1 review (fully burdern + Esc)

## WBS 121.04 Cost and Schedule

### .03 Test Infrastructure

- **Cost \$8.5M**
  - Cost Driver is labor
- Schedule/Milestone:
  - STC - complete by Dec'18 (ready to test HB650 Cavities)
  - PIP2IT
    - CTL install and commissioning (Apr'18 – Feb'19)
    - Prep. for HWR and SSR1 (Apr'18 – Mar'19)
    - Operate HWR and SSR1 (end Apr'21)
    - Modify PIP2IT to test 650 MHz CM's (Apr'21- Sept'21)
    - Ready to test HB650 pCM (Oct'21)
- Assumptions:
  - The estimates are based on similar work that was done previously
  - The schedule of each phase of TI is driven by the availability of the test stand and/or the readiness of the component (cavity or CM) to be tested

# WBS 121.04 Cost and Schedule

**Disclaimer:** Costs presented are from CD-1 review (fully burden + Esc)

## .04 Building Infrastructure

- **Cost \$7M**
  - Cost is basically equally split between labor and M&S – labor is for design and documentation efforts, M&S is material and equipment purchase
- **Schedule/Milestone:**
  - Current revising the RLS – below are our main
    - Cable Database available (FY20)
    - Cables/racks/connectors/ hardware ready for installation (FY21)
    - RAW system for BTL/BAL ready for installation (FY23)
- **Assumptions:**
  - Installation starts near the beginning of the PIP-II installation window
  - **CD-1 cost estimate did not include cables and connectors. Being added now**

**Disclaimer:** Costs presented are from  
CD-1 review (fully burdern + Esc)

## WBS 121.04 Cost and Schedule

### 05 Installation

- **Cost \$38.5M**
  - Cost driver - labor
  - M&S costs are driven by sub-contractors installation and T&M
- Schedule/Milestone:
  - Installation plan ready before BO of High Bay Building (Jun'21)
  - Installation starts with WFE after BO if HBB (Jun'22)
- Assumptions:
  - Installation sequence is intended to offer flexibility and tight integrated with Conv. Facility work and hardware delivery schedule

### .06 Commissioning

- **Cost \$10M**
  - Cost driver - labor
  - M&S costs are driven by consumables (cryogenes for supporting beam commissioning, for instance)
- Schedule/Milestone:
  - PIP2IT operations in CMTF - Apr'21
  - Removal and relocation of PIP2IT to the High Bay Area – Jun'22
- Assumptions:
  - Additional beam commissioning can be done in the PIP-II tunnel

# Interfaces



# WBS 121.04 Interface

IC must interface  
with nearly all  
PIP-II L2

– WBS 121.01  
Proj. Management

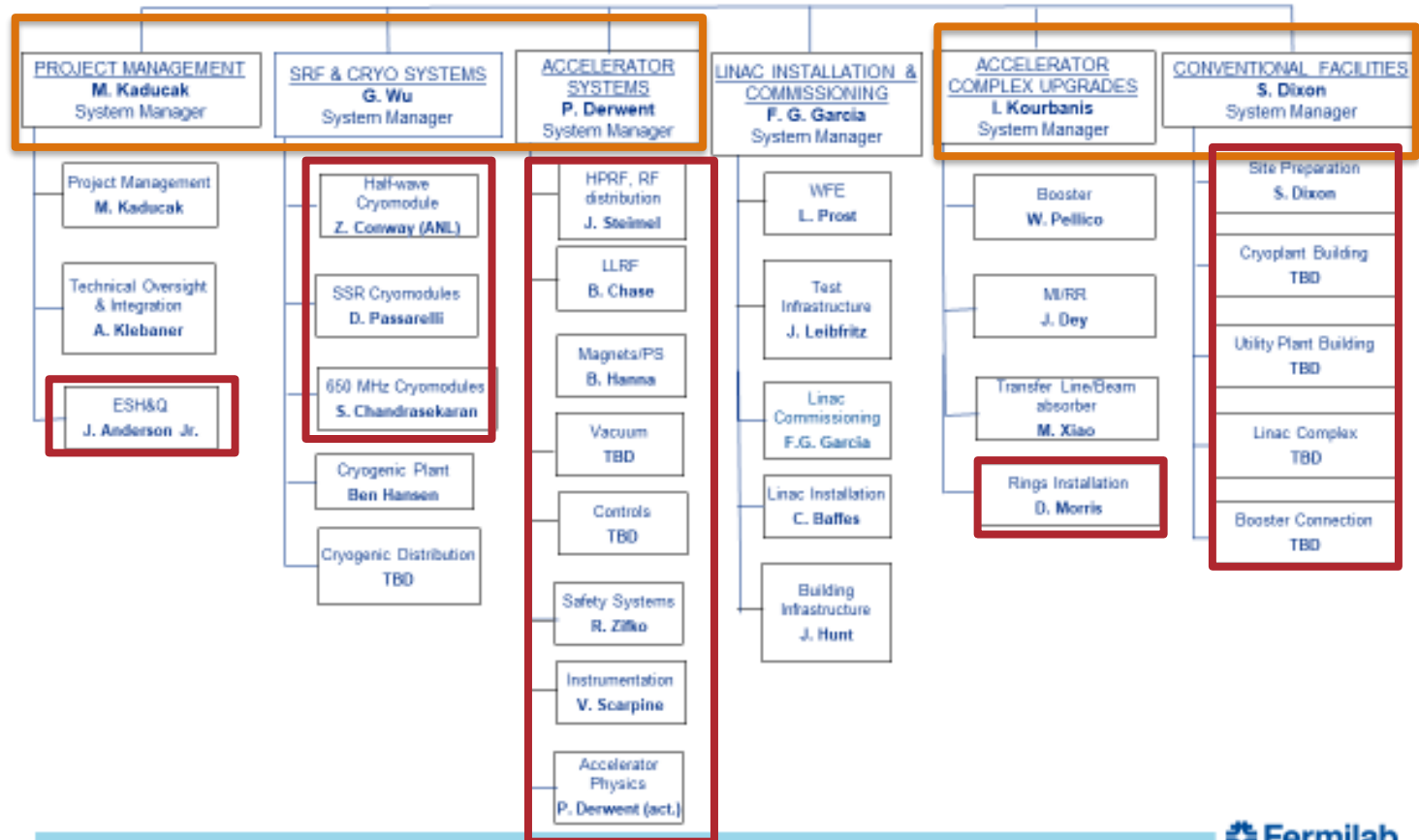
– WBS 121.02  
SRF & Cryo

– WBS 121.03  
Accel. Systems

– WBS 121.05  
Rings Upgrade

– WBS 121.06  
Conventional  
Facility

## Level 3 Systems & Managers



# WBS 121.04.XX Interface

## .02 Warm Front-End

- Key interfaces within L3's are:
  - **Controls (MPS)**
  - LLRF (RFQ, bunch cav., resonance control, choppers synch., wave form generator)
  - Safety Systems (personnel protection, controlled access, radiation protection)
  - All interfaces related with beam operations: Controls, Vacuum, Accelerator Physics, Instrumentation, Linac Installation, Commissioning

## .03 Test Infrastructure

- All of the Test Infrastructure facilities rely upon services provided by other WBSs in order to provide full functionality for testing
  - CM Integration/Assembly; PIP2IT Cryo Transfer Line
  - RF: SSA infrastructure (floor space, water, electrical), and RF distribution (waveguide routing and support)
  - LLRF, Controls: (rack space, cable routing)
  - Safety Systems: (ODH and RF Interlocks)

# WBS 121.04.XX Interface

## .04 Building Infrastructure

- **Strong interface with Conv. Facility** and large portion of the L3 sub-systems within Accelerator Systems WBS

## .05 Installation

- CAD, schedule, and **scope interfaces to all systems**
- This WBS is considered as the *integrator* for many interfaces

## .06 Commissioning

- Interfaces with all accelerator systems related with beam operations : Accelerator Physics, Instrumentation, Vacuum, SRF, Controls, LLRF

# Risks

# WBS 121.04.XX Risks

## .02 Warm Front-End

PIP2IT: a platform to retire risks

- Effect of bend in LEBT on emittance (retired)
- MEBT magnets design verification (retired)
- **MEBT chopping system** RT-121-03-04-001
- **Vacuum management** RT-121-03-04-002

## .03 Test Infrastructure

There are no identified direct risks associated with this WBS

## .04 Building Infrastructure

Risk related to inadequate requirements for cooling, AC power distribution from sub systems

## .05 Installation

Risks related to component problems/failures during or after installation, schedule changes

## .06 Commissioning

Risk related to inadequate machine performance

### • Risk in the Registry

#### Tech/Reliability or Performance

IS: RO-121-03-02-001

RT-121-03-02-003

RFQ: RT-121-03-03-001

MEBT: RT-121-03-04-001 (kicker)  
RT-121-03-04-002 \* (vacuum)

RT-121-03-04-003 (absorber)

RT-121-03-04-004 (scrapers)

\* Only valid risk with the 1.1% duty factor

LCW inaccurate req. RT-121-03-21-002

LCW temp. reg. RT-121-03-21-003

Schedule change RT-121-03-24-001

Component problem/ RT-121-03-24-002  
failure after inst.

Storage needed RT-121-03-24-003

Machine RT-121-03-24-005

# Provisional Unofficial Schedule – IC components

