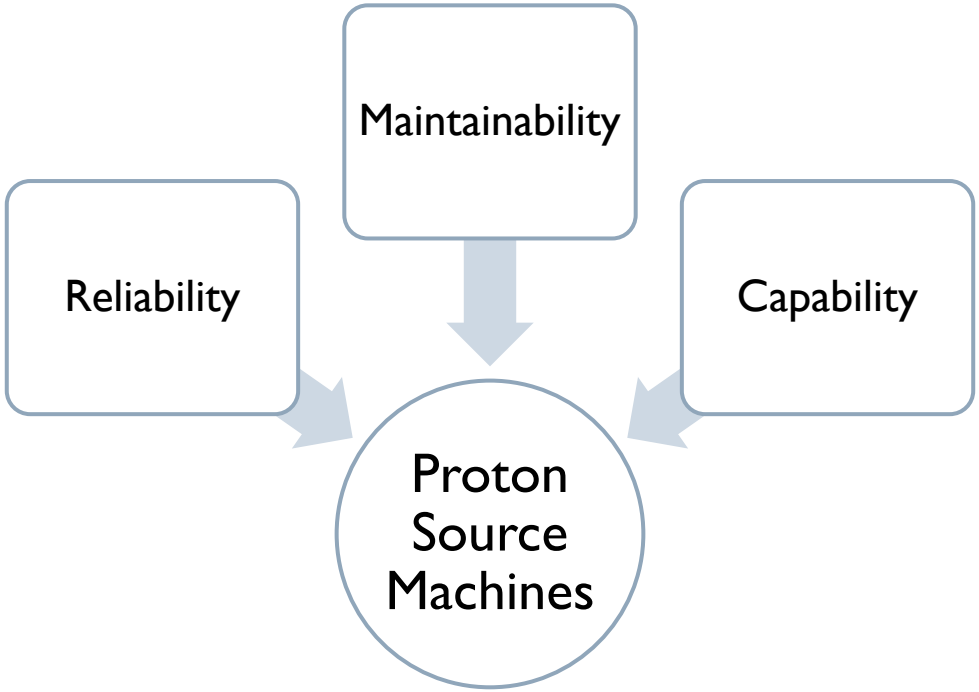
NOvA Collaboration Meeting PIP Report

Fernanda G. Garcia
on behalf of PIP team

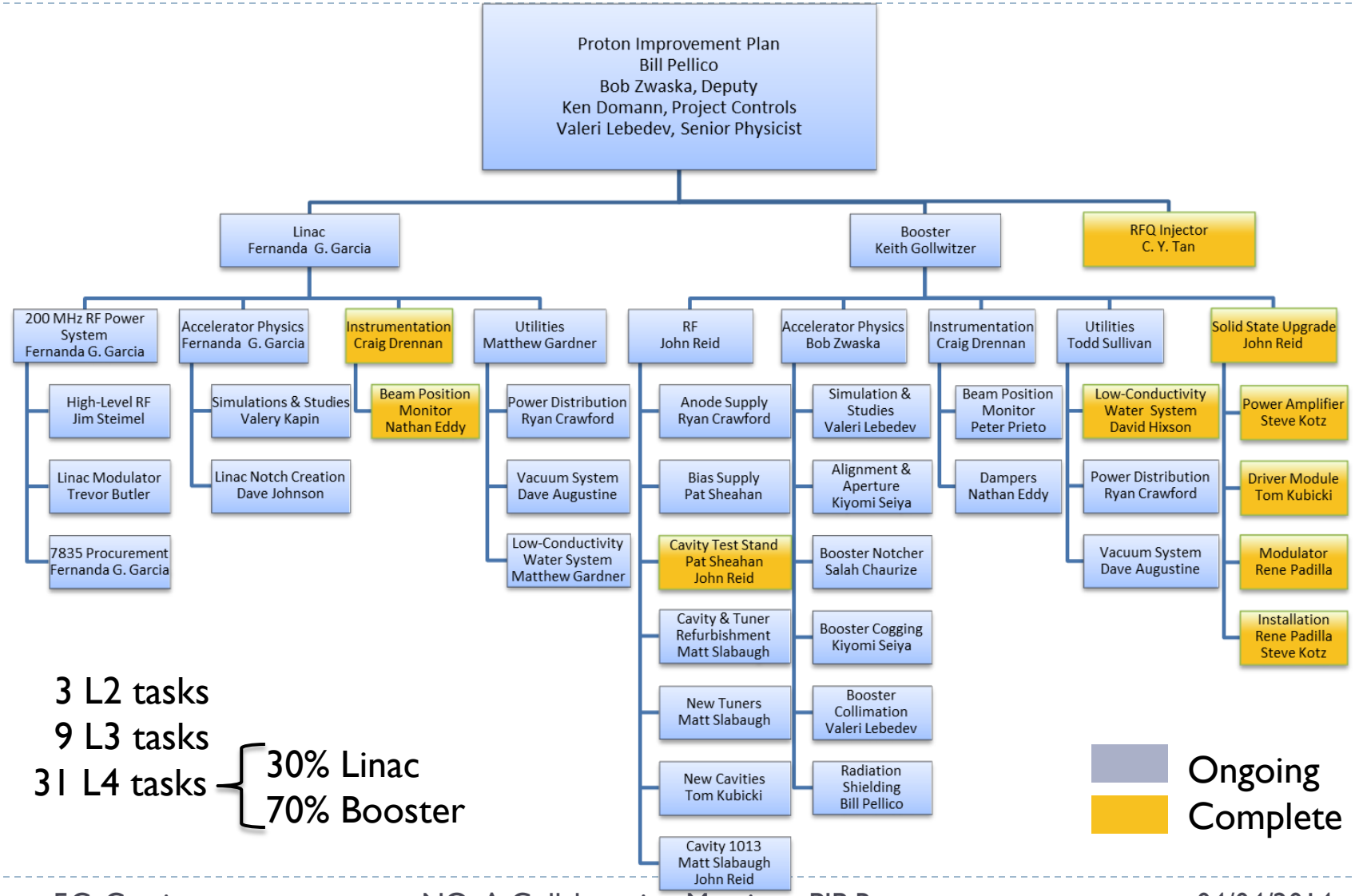
4/04/2014

Proton Improvement Plan

- Proton Improvement Plan (PIP) initiated in 2012 with the goal to update and improve the proton source machines to support the laboratory programmatic goals until middle 2020's



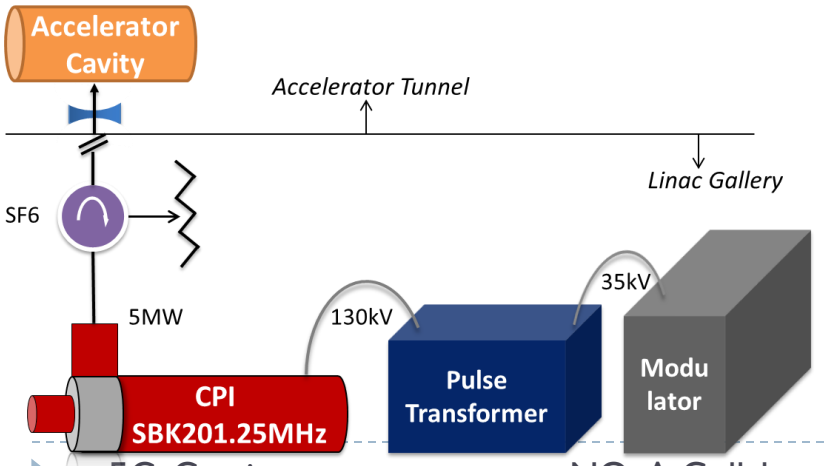
PIP Organization

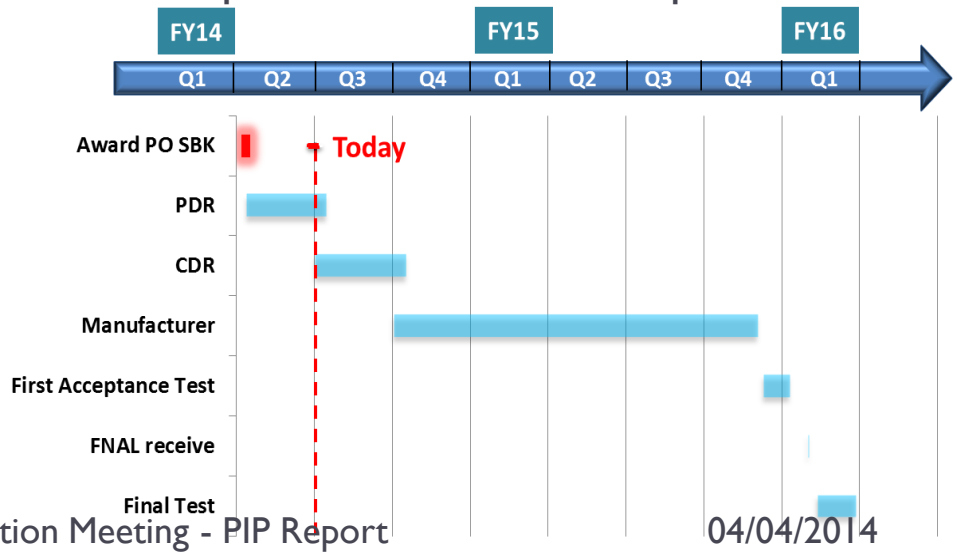


Linac

PIP - Linac
200MHz RF Power System

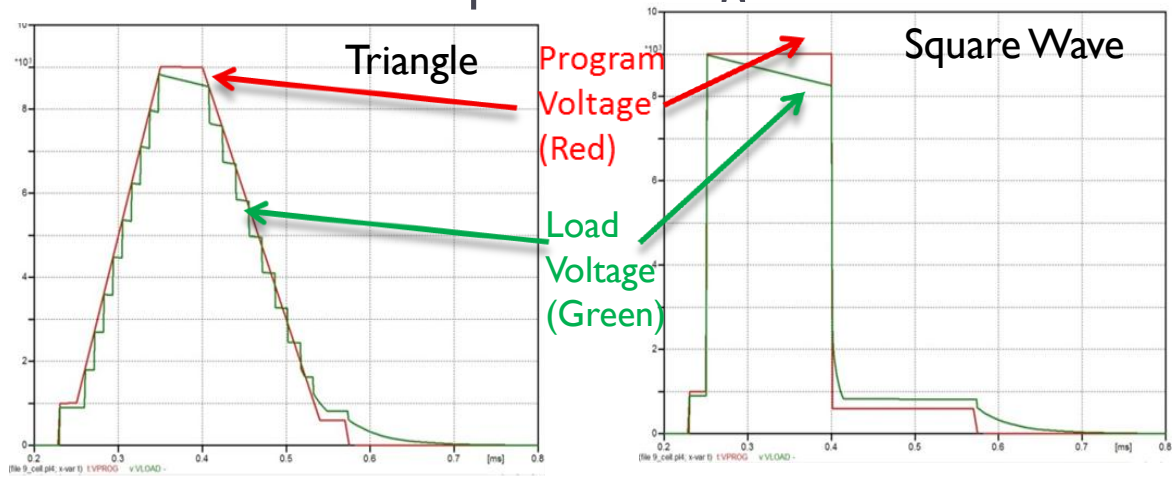
- **SBK201FERMI - 5MW pulsed klystron to operate at 201.25MHz for use as a power source for the DTL**
- The risk of retaining the current RF system is that power tubes become unobtainable to support operations until 2025
- Within PIP the plan to address this reliability issue
  - build up 4-year in-house inventory of the 7835 tubes
  - replace the high voltage modulator with present day technology
  - develop a workable plan to replace the final amplifier in case tube line production is discontinued

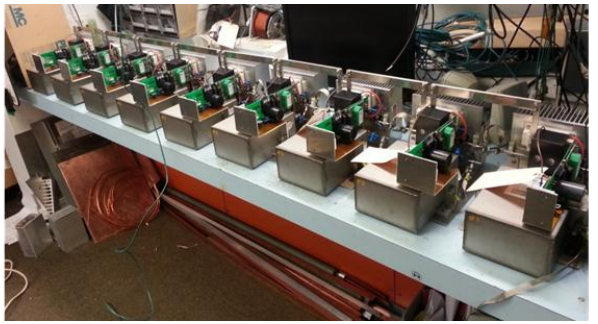


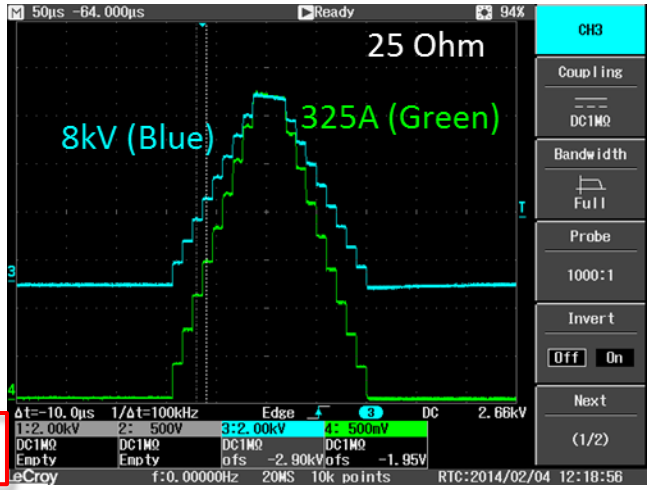


PIP - Linac
200 MHz RF Power System

- Modulator Upgrade - 35kV, Marx-topology modulator to drive triode (or SBK)
  - AD/EE complete testing with 9 cells







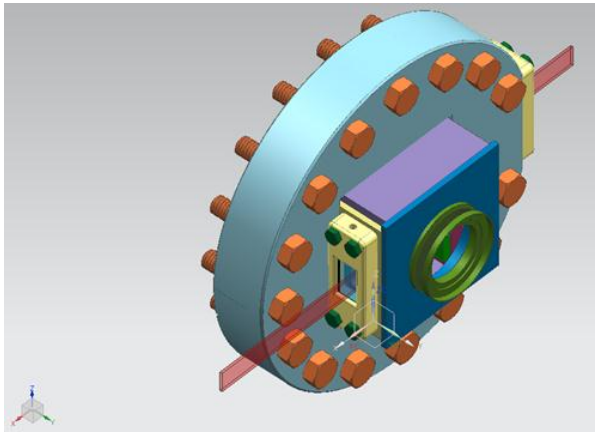
Current Status:

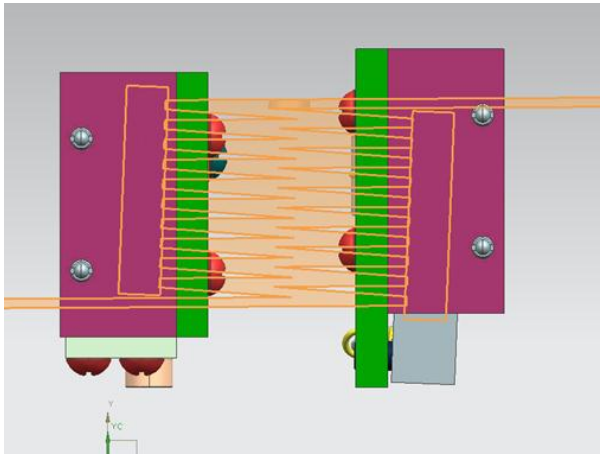
- Finish 9-cells short circuit response
- Build interleaved regulator for different stage
- Continue work on preliminary control system
- Building 25 cells modulator – capable of running LRF1

✓ Possible Shutdown'14

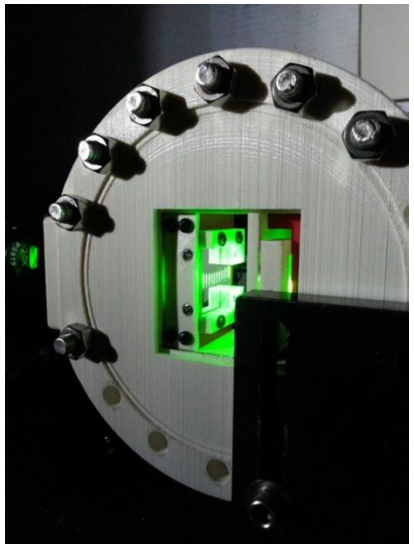
PIP - Linac
Laser Notcher System

- R&D project to build a laser system to create the notch within a linac beam pulse @ 750 keV
  - remove the notch creation outside Booster tunnel reducing activation
- 3D model of optical cavity to test design





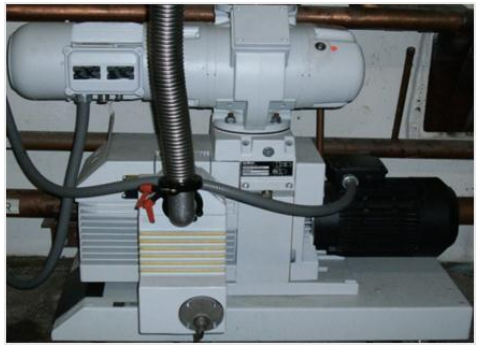
Optical cavity to be installed during shutdown 2014 ✓



PIP - Linac Utilities

- Power Distribution
  - Power distribution system is old and has obsolete parts ✓
  - Difficult installation
    - Existing transformer resides inside the Linac lower gallery – building was built around it….

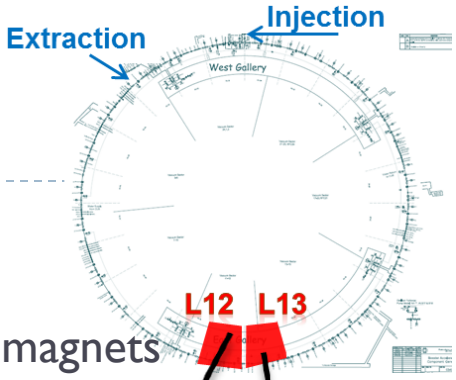
- Vacuum System
  - Finish installation of the last roughing pump for the DTL region ✓



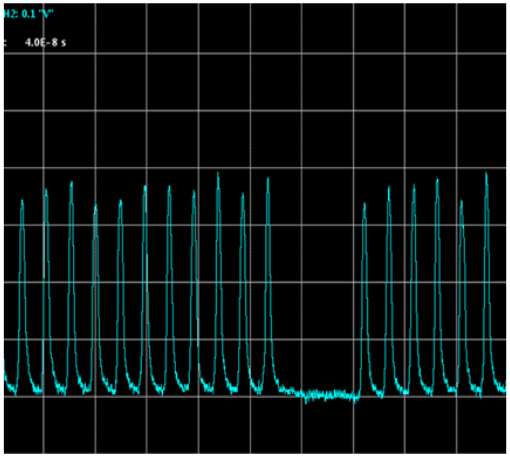
- Utility Water System
  - Measurements of pipe wall thickness revealed several other similar spots to this eruption
  - Replace dual temp water lines ✓

Booster

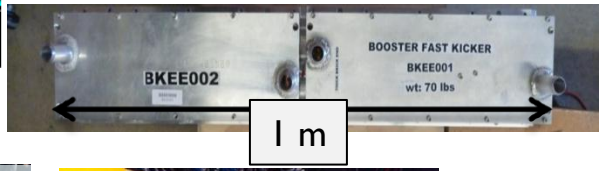
PIP - Booster Notcher & Absorber

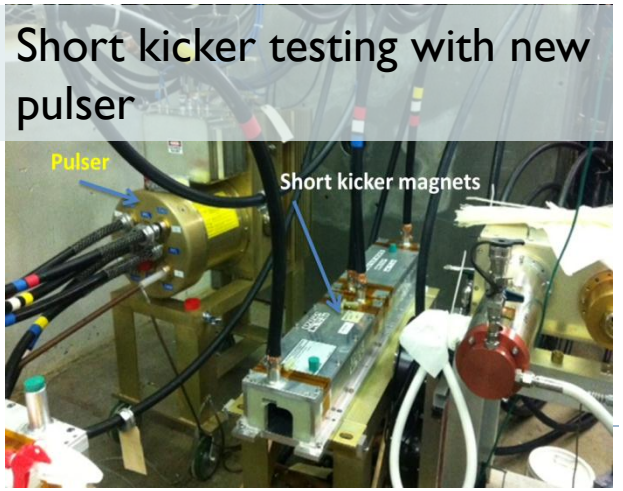


Bucket spacing at extraction energy ~ 19 nsec



- PHASE I: complete
  - Abort gap created using 3 long kicker magnets
    - Beam kicked in absorber @ L13
- PHASE II:
  - convert 3 long kickers to 6 short kickers

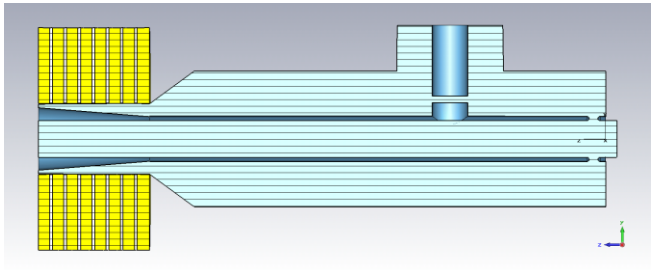




New pulser control rack and power supply installed
Ready for testing

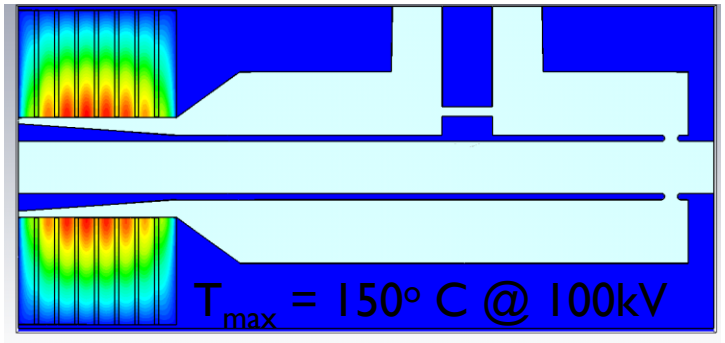
PIP - Booster
RF system – New Cavities

- New cavities
  - Efforts continue on developing a model of the existing Booster cavity
    - Full 3D model with most of the details incorporated
    - 3D EM simulations
      - Identified weak points of max electric field in air and vacuum
  - A modified/improved design has been under development
    - PIP plan is to build 3 more cavities



Main parameters:
Frequency range: 37.8 53 MHz
Aperture: 3.25”
Voltage: 60kV
Rep Rate: 15 HZ

Temperature distribution



PIP - Booster
RF system – Anode and Bias Power Supply

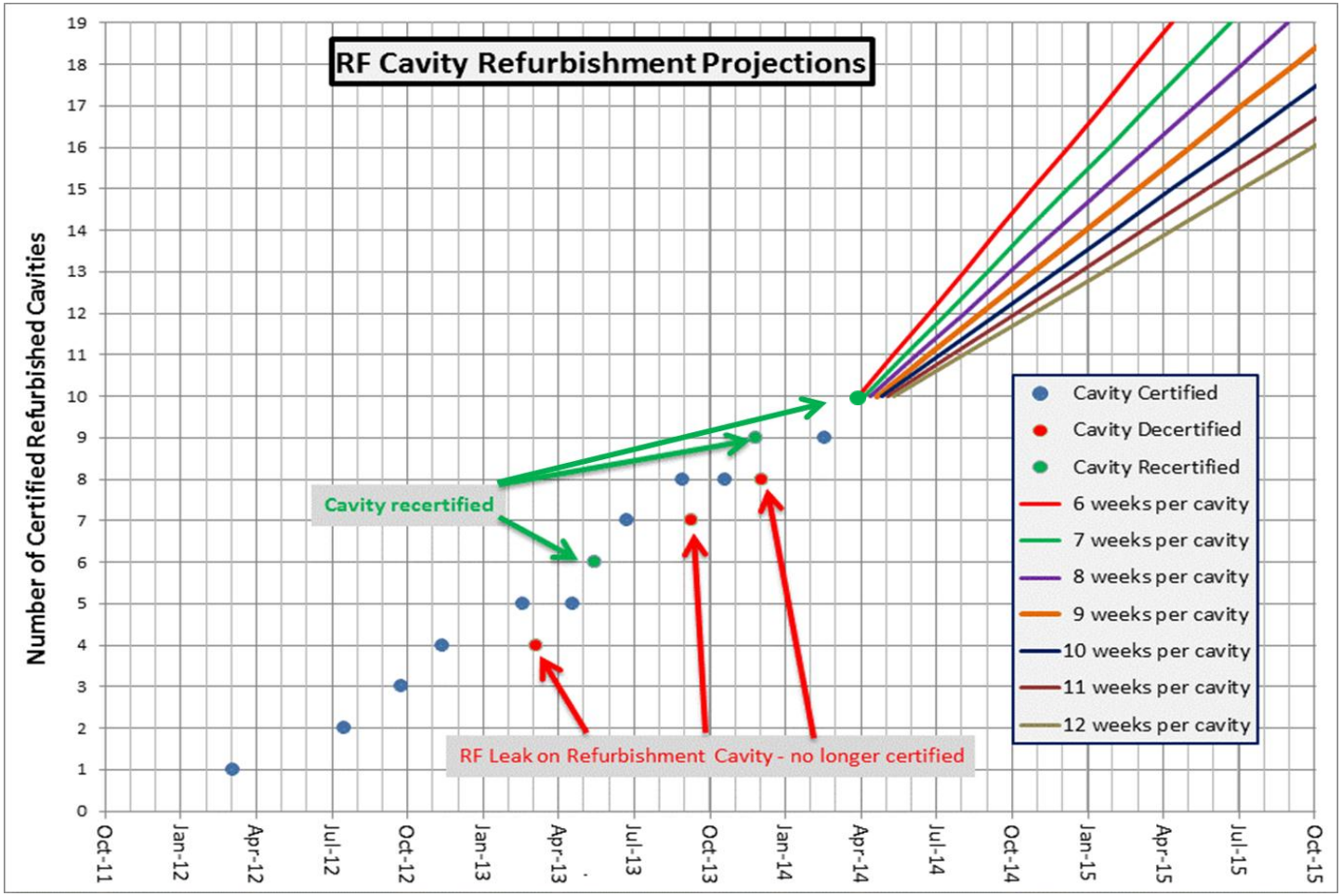
- Anode Bias Supply
  - Design specifications complete
  - Hardware ordered and bid process ongoing
  - Plan: install both supplies during shutdown 2014 ✓
- Bias Power Supply
  - Slow start on first supply, complete Mar'14
    - Labor limitation, delay with materials, consensus on final layout
  - Ongoing work on update of transformers, heat sink & SCRs
  - Intensive labor work
    - Addition of 2 techs expedited the process
  - Expect to complete in FY15

PIP - Booster RF system

- Lots of press release related with PIP and cavity refurbishment…

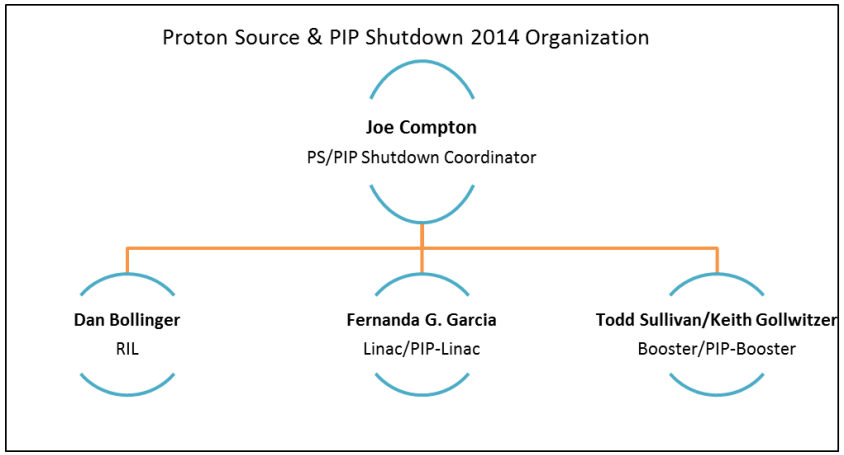
PIP - Booster
RF system – Cavity Refurbishment

- 10 of 19 cavities have been refurbished



Courtesy: K. Gollwitzer

PIP
During Shutdown 2014



Machine shutdown'14:

6 weeks of work

2 weeks start-up/commissioning

PIP Shutdown Tasks	Coordinator	Shutdown Work Priorities	Comments	Alignment
Linac	**Fernanda G. Garcia**			
Linac Modulator		Middle	25-cell test in LRF1 if ready and resources allow (Linac personnel & EE support)	
Linac Notch Creation		Middle	Notcher cavity - linked with MEBT beam valve installation	Yes
Power Distribution		Middle-High	Push to install the transformer. Mainly T&M for resources, with EE support help	
Linac LCW System		Middle-High	Dual Temp System: Finalizing the options. Some prep work will occur prior the shutdown. CUB 55LCW pump installation: Most of the work can be done prior the shutdown.	
Vacuum System		High	1 rough pump & four 400MeV turbo installation (Linac side)	
Booster	**Todd Sullivan/Keith Gollwitzer**			
Anode Supply		High	Want to do 2 - big job - requires they be procured, built, and tested ahead of time	
Bias Supply		Low	not coupled	
Cavity & Tuner Refurbishment		Low	Mostly decoupled, unless new tuners are really coming in	Yes
New Tuners		Low	Only connect to refurb	
New Cavities		Middle	Prep for Station 20 - recon 21 & 22 - need to understand priority	Yes
Cavity 1013		Low	New Tuner dependent	
Booster Notcher		Low	Kickers should be done, but spill-over here if needed. S12 and L13 DS modifications - Removemarble steel support straps (Salah /	Yes
Booster Collimation		Low	Probably not ready	
Radiation Shielding		Unkown	TLMs may require additional cables pulled.	
Power Distribution		Low-Middle	Two transformers - affects house power - two separate weekends	
Vacuum System		Middle	22 pumps - draining 4 penetrations, like to do quadrants - negotiate with Ben & Kent - limited by time - would need >~ 60 working days for all. Cables can all be pulled. Need three electricians for possibly 8 days for cable pulls. Booster electrical and control will be completed for all turbo locations. Still have to decide which sectors for actual turbo installation since not all will be installed this shutdown. Install new sector vacuum valves, we still need	

Summary

- PIP has made and continue to make significant progress
- Lots of attention has been devoted to the cavity refurbishment
  - NOvA ramping up and
  - Imminent beam start-up for MicroBooNE
- PIP continues to address the limited resources and budget modifications
  - New AD Division Head has been very supportive of PIP
  - Working close with PIP management to address issues
- PIP greatly appreciate the support and recognition that we've gotten from the experiments
  - With the constant rebalancing of resources & budgets, we appreciate the experiments keeping laboratory management aware of the importance of reaching PIP goals
  - It doesn't go unnoticed when PIP managers talk to lab management