PEP-II Vacuum Upgrade

Presented by: Nadine Kurita


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Outline

- Vertex Bellows Spare
- Forward Q2 Chamber
- Q1/Q2 HOM Bellows
- LER Q4/Q5 Vacuum Chambers
- HER Q4/Q5 Vacuum Chambers
- New RF Cavity Stations
- LER Bellows with HOM tiles
- HOM Straight Bellows
- LER Arc BPM’s
- IR2 BPM In-Situ Modification
- Long TSP
- Spare vertex chamber exists.
- Gold sputtering on hold for vertex bellows redesign.
  - Plan on gold sputtering the SS braze ends to reduce HOM and I^2R losses in this area.
Re-design Vertex Bellows

- TE power leaks past the RF shield and heats of the stainless steel welded bellows and inconel fingers.
- Reduce power into the stainless steel welded bellows cavity.
  - Designed small cooled AlNiSiC absorbing tiles in the bellows cavity space.
- Design complete pending final design review
  - HOM and thermal analysis completed.
Vertex Bellows Status

- Project was on hold for ~ 1 years.
  - No engineering resources.
- Effort has restarted in January.
  - Reviewing parameter changes since the last review.
    - Do not need to upgrade the SVT.
    - Decision not to rebuild the radial ion pump.
    - Decision not to upgrade the vertex bellows.
    - Upgrade to vertex without disassembling the entire support tube.
- Complete spare vertex with upgraded bellows.
- Project fully funded.
Q2R (Forward)

- Replaced Q2R with a Q2L chamber in 2002.
  - Increase BSC acceptance and reduce HOM.
  - Failed due to material flaw in the GlidCop.
- Original Q2R chamber reinstalled in 2003.
  - Clips BSC
  - No evidence that it creates increase HOMs.
- New Q2R is installed.
  - Chamber in final assembly.
  - Completed & installed in March 2006.
Suspected that arcing could be occurring at the rf contact between the AlN-SiC tile.

Redesigned the RF seal to make contact behind the tile on the copper surface.

Installed with the new Q2 chamber.
FY2003 added 4 layers of tiles per module.
Absorbing ~12 - 14 KW presently
Predict ~ 50 KW in 2007
Significant work on HOM analysis
- 50+ design solutions have been analyzed by A. Novohatski & S. Weathersby.
- A compromised solution has been found.
  - Does not absorb as much HOM as the original design.
  - Optimized absorption
    - Space
    - Suppress the monopole mode and hide the tiles from the beam behind an RF shield
    - Reduce HOM power into the tiles to 25-30 KW
Final design complete in May 2006
RFI – November 2006
Q1/Q2 HOM Bellows

- AlN-SiC Tiles
- GlidCop RF shield, ~3.4” long
- Welded Bellows
- Inconel, Spring Finger
- GlidCop Stub
**HER- Downstream, “Forward”, “Right”**

- High-Power Dump
- Frangible Link
- Q5R
- Q4R
- Q2R
- IP

**HER- Upstream, “Backward”, “Left”**

- IP
- Q2L
- Q4L
- Q5L
- Frangible “Luminosity Chamber” Collimator
- 10M
Outboard of the near IR

- **Q5 & Q4 HEB Chambers**
  - **General problems**
    - Mechanical & HOM failures in the NEG screens
    - Beam Stay Clear (BSC) & Lumi cone.
    - Thermal motion issues?
      - Magnet instabilities
      - Q4 & Q5 are rigid chambers that have minimal to no clearance to their respective magnets.
      - Load on Q2 chamber, IR support raft, magnets
    - Global alignment error between the “Bong” Collimator and Q5.
  - **Q5R (Forward End)**
    - Flange heating
    - Neg screen distorted
  - **Q5L (Backward End)**
    - Masks failed and replaced
    - Neg screen detached
  - **Q4R (Forward End)**
  - **Q4L (Backward End)**
    - Masks failed and replaced
Goals achieved

- LER: 4.5A, HER 2.2 A
- Designed between the defined BSC/luminosity cone and existing magnets
- Maintain a 2mm gap to poles and a 3mm gap to coils.
- Reduce thermal gradients
  - Aluminum clamshell design
- Added a bellows between Q4, Q5
- Added a flex flange between Q2L & Q4L
- Improve kinematics and stabilize BPMs
- Decrease the TE leakage to the pumps
  - Screen hole diameter reduced to 3 mm and depth increased to 6mm.
Status/Schedule

- HER Q5 Backward Chamber & Q4/Q5 Bellows
  - Installed Fall 2005

- HER Q5 Forward Chamber
  - RFI 2/06

- HER Q4 Forward Chamber
  - RFI 3/06

- HER Q4 Backward Chamber
  - Assembly complete 4/06
  - RFI 5/06

- On original AIP budget and ready for ’06 downtime.
HER Q5 Forward Chamber

Vacuum System p.14
HER Q5 Forward Chamber

- **New RF screen**
  - 3mm holes, 6mm deep
  - NEGs are no longer getting hot from HOMs.
Q4/Q5 Bellows with Absorber

- Completed & installed 1 unit.
- 2nd unit damaged during assembly. Repair and use as spare.
- Replacement unit complete in July 2006.
LER Q4/Q5 Chambers

- Two major issues led to redesign
  - NEG heating problem
  - Thermal motion of the backward raft/magnets.
- New design for Q4 and Q5 chambers underway
  - Improve RF screens
  - Adding bellows, improving mask cooling and adding additional cooling.
Q4/Q5 LER Chambers

Manufacturing Status
- 143 of 176 component parts have been manufactured (82%)
- 22 of 34 sub-assemblies are complete (64%)
- 0 of 4 assemblies are complete
- NEG pumps have been assembled
- Chamber screens are being manufactured by OV, due in next week.
- BPM’s are being manufactured by Meggett, due early July.
- Machining of chamber extrusions is complete.
- May ’06 – Start assembly and welding
- August ’06 – all four chambers RFI
New RF Cavity Station

- HER
  - Remove 156” long drift chamber from Beam Line;
  - Install two cavities.
  - Install additional 220L/sec Ion Pump between cavities
  - Fabricate new drift chambers & straight bellows
RF Cavity – Vacuum Status

- All drawing completed
- Fabrication underway
  - Fabrication of the new 5 drift chambers and anchor systems;
  - Straight Sections Bellows assembly RFI;
  - 220 l/sec vacuum pump refurbish, RFI;
  - HER Pump Tee - existed, ready for Bake Out.
  - Modifications of the LER raft supports in the tunnel;
  - Supports for LER Trans./Vat/Pump and Quad QDP8;
  - HER Cavities “I” support plates, Pump Tee support Assy, etc.
  - Remainder of parts here by May ‘06
  - Installation – October ‘06
Goal – to create a HOM absorber in a defined modular space.

- HOM absorber will damp and absorb the power to prevent neighboring components from seeing excessive HOM power.
  - Valves, NEG

Design was optimized with MAFIA simulations.

Complete 1st prototype in May ‘06.
- Rh plating
- Final Assembly
- Bake

Improving tile brazement tooling.

Complete 3 units in August ‘06.
HOM Straight Bellows

- Inconel Spring Finger
- GlidCop Stub
- GlidCop RF Shield Finger
- Welded Bellows

Beam Direction

AlNSiC Tiles

2.75” long by .24” wide HOM Trapping Slots

Bellows Cavity

Modes that leak past the RF shield finger and are trapped in this area still see the absorber
Two areas are of major concern due to the high current and BPM position relative to beam.

- LER arc BPM’s
- IR2 BPM’s

LER Arc BPM’s

- Flanged in so they can be modified.
- Investigating several options
  - Remove button only, φ.056” pin as button
  - Remove button, attach new φ7mm button & insert
  - New BPM’s
    - Saint Gobain
    - Meggit
    - Times Microwave

- Placed prototype order with Times
- If removing button works this is the most cost effective solution
  - Calculations for signal strength and HOM underway
  - Final decision next month.
IR2 – In Situ BPM Puller

- IR2 – In situ BPM puller
- 29 BPM sets
  - Solution is to leave the .090” diameter pin as the button
- One chamber last downtime has this configuration.
- The puller was designed to utilize the 4” of space taken up by a bellows module.
- The concept was tested and the collet survived 310lbs.
  - Expected load 20 – 100 lbs.
- Boroscope utilized for positioning the collet.
Long TSP

- Designed to replace NEGs that are overheating.
- Testing of the unit underway.
- Locations are being investigated.
- HOM heating of the TSP unit?
Summary

- Funded AIP projects will be ready for the 2006 downtime.

  - Critical Path Projects
    - Q2 Bellows – needs solution
    - LER Q4/Q5 chamber
    - LER arc BPM’s

  - In-situ BPM button removal has significant technical risk.
    - Full concept will be tested in May ’06.
    - Contingency is to remove the chambers and use the puller in the lab.