High Power Hg Target Conceptual Design Review

Hg Target Interface with Solenoid

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Outline

• Target module insertion
• Solenoid thermal insulation
• Solenoid operational cycle
• Solenoid orientation changes
• Field plots
• Solenoid / target base support structures
**Target Module Insertion**

- Primary and secondary containment mechanically fastened (weight ~ 160 lbs)
- Flexible metal hoses probably already attached
- Can be inserted either before magnet aligned to beam or after
Solenoid Thermal Insulation

- Original solenoid design incorporated insulating bore tube (G-10)
- Removal of G-10 tube provided more room for target module components
- Insulation replaced by addition of flexible foil heater (silicone or kapton) 0.007" – 0.060" thick outside the secondary tube
- May only need on one end of secondary containment tube
- Requires controllable power supply
Magnet Operational Cycle

Parameters of Pulse Coil Precooled to 69 K and Energized at 600 V to 7200 A

Bob Weggel’s 10-14 analysis of the LN2 magnet operation
Magnet Positional Changes During Max Field

Peter Titus - MIT
Consequences of Magnet Movement

• Vertical movement summary
  – Upbeam end: -3 mm
  – Downbeam end: +1.2 mm
  – Z=0 position: -0.9 mm
  – 3.5mrad tilt over assumed 1200mm length
  – Position of zero vertical movement at Z=+257mm

• No compensation in design (nozzle position) for Z=0 movement

• Actual movements to be measured during solenoid testing
Design Alternatives

- Magnet movement must be accommodated by target system
  - Target can float within magnet or be small enough that movement does not produce contact

- Space constraints within target secondary containment push toward maximizing secondary diameter and floating with magnet
  - Tilt changes accommodated by flex metal hoses
Magnet Field Plot

Magnetic field distribution: the axes are in meters; the rectangle is one half of the solenoid.

- The volume within the conductor is > 9.7 T (red), > 6.1 T (orange).
- The field at Z=0, R=0.6 is >0.6 T, at R=1.0 (base support structure), B> ~0.1 T (1000 G).
- The field at Z=-2.5, R=0.4 (pump motor) is 0.03<B<0.07 T (300-700 G).
Fields with Solenoid

>2.5T  >1.0T  >0.41T  >0.17T  >0.07T  >0.03T

>3.9T

>6.1T

>9.7T

>1.6T  >0.68T  >0.26T  >0.11T  >0.04T

221in (563cm)
Field Near Equipment
Issues

• Position hydraulic pump to minimize field effects
• Max field at cylinders between 0.17T & 0.26T
• Need steel cover plates for magnetic shielding over cylinders?
• Remote valve or sensor concerns?
Magnet & Target Base Supports

- Flexible metal hoses somewhat decouple the target module from the delivery system
- Only the magnet & target module must be precisely positioned relative to beam
  - Hg delivery system does not have to tilt or be exactly in line with magnet
  - Downbeam window on secondary containment should be oversized to accommodate delivery system misalignment
- Base material will be carbon steel or aluminum, depending on cost
Base Supports

- Magnet & Hg system will have independent mobility and leveling features
- Independent base supports should make equipment installation less complex
Recommendations

- Change from a common base support to independent supports for solenoid and Hg delivery systems
- Both should incorporate mobility and tilt/leveling features
- Increase size of secondary downbeam window to accommodate Hg system misalignment