

**Summary of Hg Jet Target Meeting  
September 1, 2004  
Oak Ridge National Laboratory**

Introduction

This write up summarizes highlights of the presentations and discussions from the mercury target design meeting, and lists the action items that resulted. The action items are shown in the text adjacent to the bullets. Please respond to each of the meeting attendees when resolving an action.

1) At the recent meeting of the CERN Research Board, the Board indicated that it does not have sufficient information to make a decision regarding the Hg jet target experiment at CERN. More specific information is needed about the impact on CERN, and the scientific value of this experiment. In addition, memoranda will be needed from each of the CERN safety experts establishing requirements, and we should respond to those memoranda.

- This group, under the direction of Harold and Adrian, should consider writing an addendum to the April, 2004 proposal document to address the Board's request regarding "impact" and "value." The addendum should also present a preliminary plan that addresses safety (i.e. responses to the safety experts' memoranda) and for dismantling/disposal of the test equipment.

2) The magnet has a great deal of operating flexibility built into the design; eddy current stresses will be seen in the Hg target tube within the bore of the magnet. The 15-cm bore remains unchanged during cool down and operation because of a heater in the cryostat bore that maintains room temperature. However, there will be a "tipping" of the bore axis when the magnet is cooled. The magnet contains 300-liters of liquid N<sub>2</sub> during cool down; the magnet/cryostat weighs approximately 4-tonnes; the length of the cryostat is ~ 1-meter and the electrical leads will require approximately 50-cm.

- Harold will provide a plot of stray magnetic fields; the internal field plots generated by Peter Titus will be sufficient to use for the fields in the vicinity of the magnet, i.e. for the Hg pump and the flow of mercury.
- Peter will provide a) the "tipping" dimensional change, b) the axial change of the bore for cool down, and c) a layout of the bus connections to the coil with dimensions.

3) Target design/operation: the beam stop will be about 2-meters downstream of the target window; the target system will operate with 1-atmosphere of helium; the pump should be velocity controlled and will likely operate for only a few minutes per hour due to heating; the jet may have to be adjustable for a zero-field test and testing in the full magnetic field (a 20-30% velocity reduction should be expected according to Jacques); the pump must be able to maintain the same velocity under all operating conditions; the nozzle should be "fixed" for tests at CERN, however it will be tested at the ORNL/TTF

where it will be manually adjusted as needed; the magnet and Hg target system should be mounted on a common base support for rail movement into and out of the beam line; at the end of testing, the target assembly remains intact and after some cool down period, is moved to Lab A for disassembly, Hg removal, and preparation for shipping.

3) Optical diagnostics may be difficult to fit into the target tube. The tube inside-diameter is ~145-mm.

- Thomas, Harold, and Kirk, establish how many views are needed for the optics (two will be the minimum), and where to look at the beam profile; determine whether a “pixel detector” could be a better diagnostic.

4) The Hg target jet tests at BNL used double windows with interstitial pumping to determine if a window cracked; the window diagnostic was interlocked to the control system; windows were designed to a safety factor of 4.

- Nick, Jacques, Harold, think about whether a double window design with interstitial pumping will be required. Considering that we will have a secondary containment, it may not be necessary. In addition, none of the windows tested at BNL (E951 tests) failed and there is actual data that can be scaled to the proposed CERN test.
- Nick, draft a brief paper that documents the E951 experience, including the “George Greene” tests.

5) The schedule for the target jet test program needs to be updated based on discussions at the meeting. BNL will design the diagnostics so they can be integrated into the target system, but procurement for the target system will include the diagnostics.

- PTS, provide Harold with a “guesstimate” of the cost to fabricate the target system.
- PTS, add time in the schedule to install the target diagnostics.
- Add CERN installation/assembly activities to the schedule based on input from Adrian and Jacques, i.e. installing cryo system, power supply, controls, etc.

6) The dose rate on the cryostat is ~1 mrad/h after 1 month, based on 200 pulses; the activation in the Hg is 2.5 Ci at 1 second, and  $4.9E-4$  Ci after 1 year. The remote control location will be ~50-meters from the test location in another tunnel area. The beam attenuator will be an iron core surrounded by concrete, and could be 160-cm thick. In the tunnel layout, the beam attenuator will replace the dipole and quadrupole magnets downstream of the target.

- Harold, estimate the dose rate of a function of time after shutdown at the beam attenuator.

7) The magnet and target should share a common base support structure designed by Van Graves (ORNL) and a rail system compatible with the TT2A tunnel, but installed by CERN.

8) A preliminary decommissioning and disposal plan needs to be started and discussed with the various CERN safety experts.

- Phil, update the D&D table by adding the power supply to the component list that was presented, and remove the liquid nitrogen component.

9) The orientation of the magnet axis relative to the proton beam must be established within the next week. Case Zero is for the beam line and B-axis to be coincident; Case One is for the B-axis to be rotated 66 milliradians relative to the beam line. The second option kicks the beam line 12.5-cm horizontally at ~10-meters downstream.

- Harold, distribute a sketches to the Collaboration that show each option; discuss at the teleconference on Thursday, Sept. 9 (8:00 a.m. EDT).

*One item that I believe should have been discussed in more detail deals with the nozzle tests that were originally scheduled to be done at Princeton University. There seems to have been a consensus that these tests may not be needed if the “nozzle” is simply a clean-cut tube end. If that is the case, then those funds could be applied elsewhere in the target design. But if confirmation testing is needed, that could be done at the ORNL Target Test Facility. I recommend that this be added to the discussion topics for the Thursday teleconference.*

prepared by Phil Spampinato  
[spampinatop@ornl.gov](mailto:spampinatop@ornl.gov)  
tel 865 576-5267  
Sept. 5, 2004