UT-BATTELLE

MERIT Hg System Status

V.B. Graves

P.T. Spampinato

T.A. Gabriel

Muon Collaboration Friday Meeting

March 17, 2006

OAK RIDGE NATIONAL LABORATORY
U. S. DEPARTMENT OF ENERGY

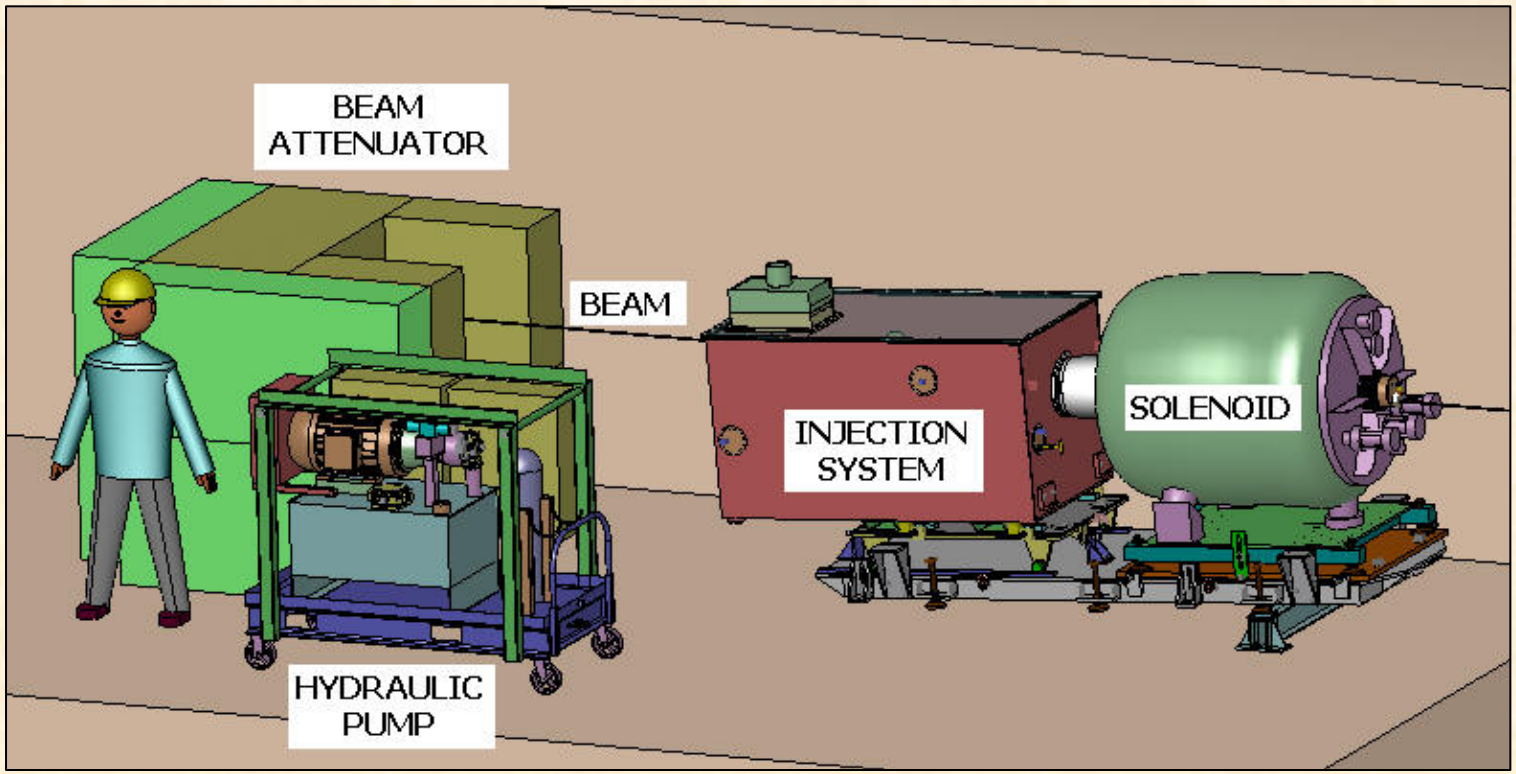
Executive Summary

- **Hg system design has been completed**
- **Syringe pump fabrication is nearly complete**
- **Drawing packages for remainder of system are either in fabrication or out for bid**
  - **Modifications being performed to target module design due to fabrication quotes being above budget**
- **System testing at ORNL scheduled to begin in May**

Now for some details...

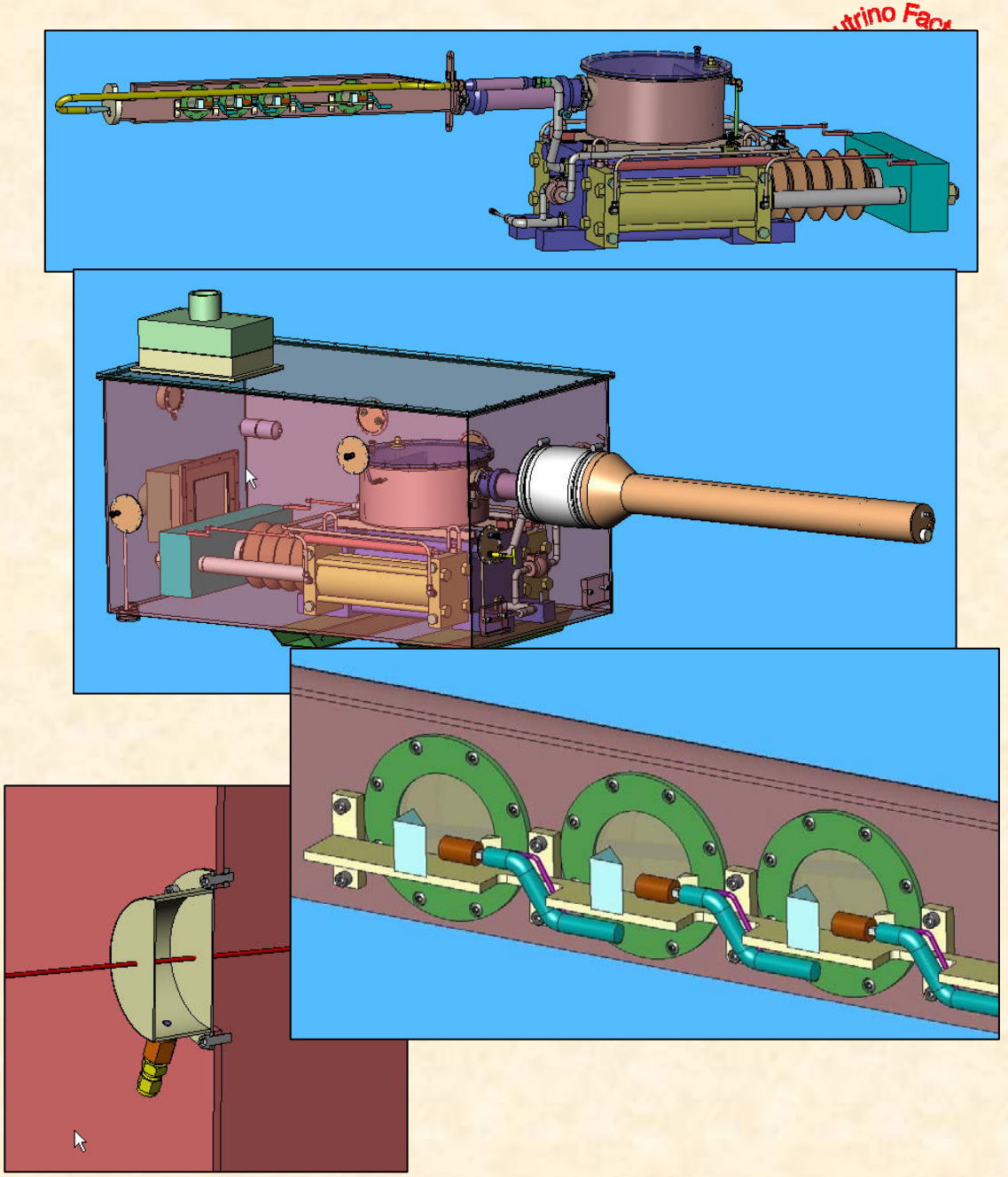
Experiment Layout

- **Hg target is a self-contained module inserted into the magnet bore**
- **Two containment barriers between the Hg and the tunnel environment**
- **Hydraulic pump will be in adjacent tunnel, personnel in remote control room**

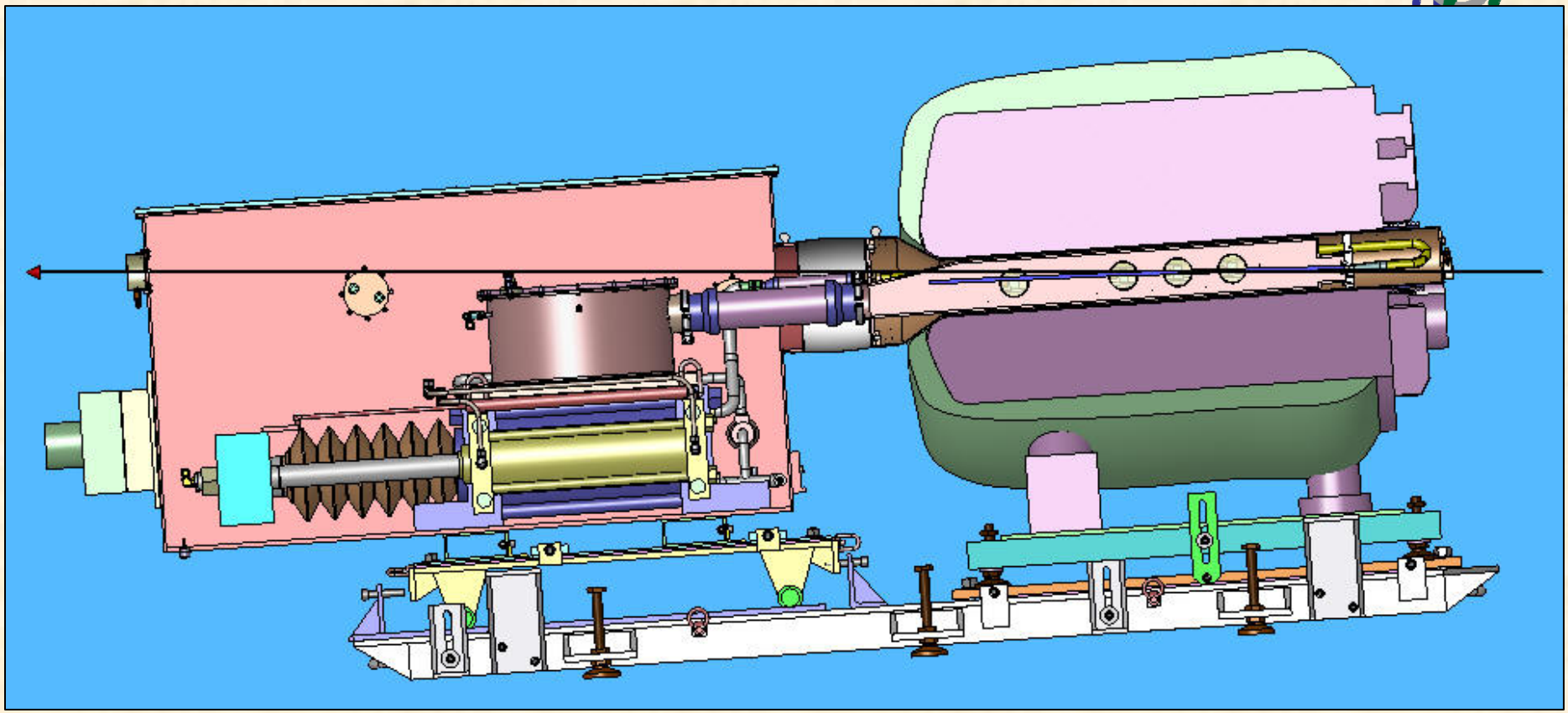


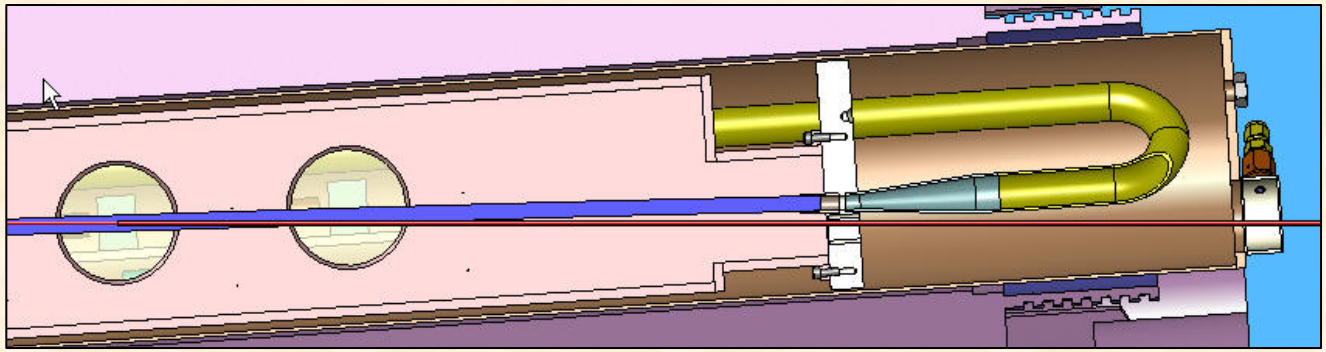
Hg Delivery System

- **Primary containment**
  - **Hg-wetted components**
  - **Capacity 23liters Hg (~760 lbs)**
  - **Jet duration up to 12 sec**
- **Secondary containment**
  - **Hg leak/vapor containment**
  - **Ports for instruments, Hg fill/drain, hydraulics**
- **Optical diagnostic components**
  - **Passive optics**
  - **Shadow photography**
- **Beam Windows**
  - **Ti alloy components that directly interact with beam**
  - **Single windows on primary, double windows on secondary**



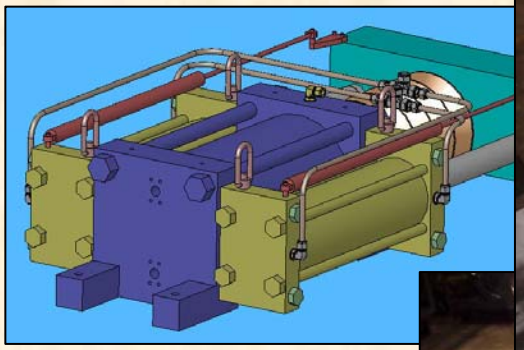
MERIT Side View

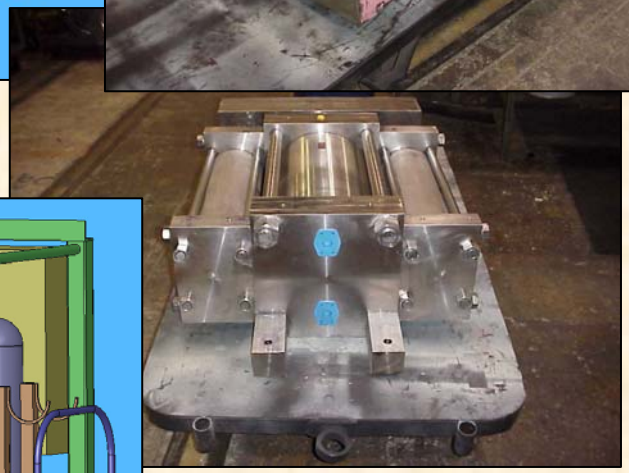


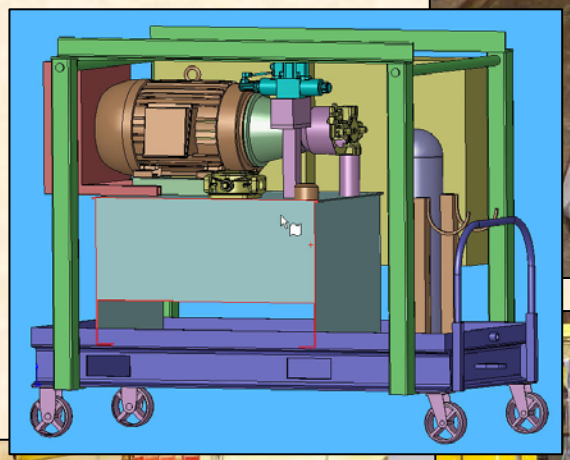


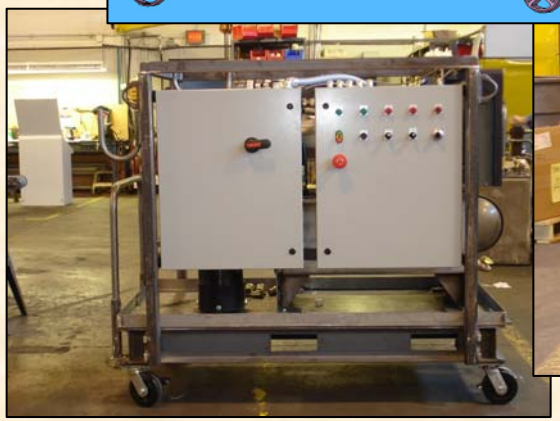
Syringe Status

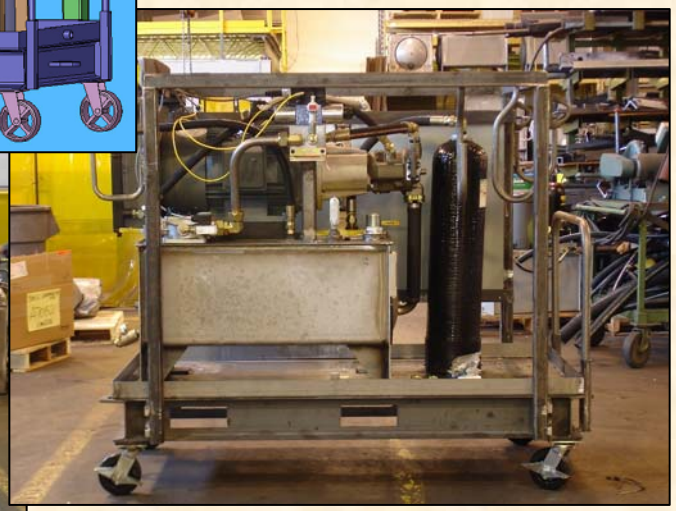
- **Syringe vendor Airline Hydraulics Corp (AHC)**
  - **Bensalem, PA**
- **AHC provided system design based on functional requirements specification**
- **System consists of all syringe pump components**
- **Status**
  - **Integration of cylinders & control system starting this week**
  - **System factory acceptance testing March 30**







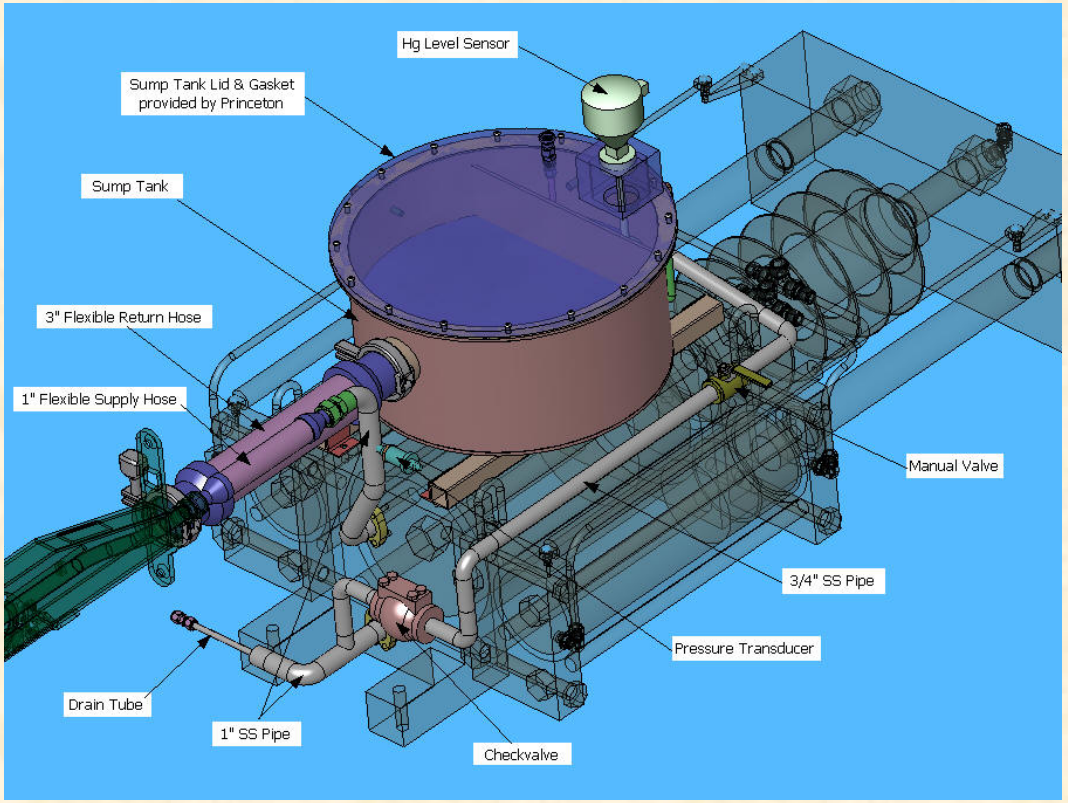




OAK RIDGE National Laboratory

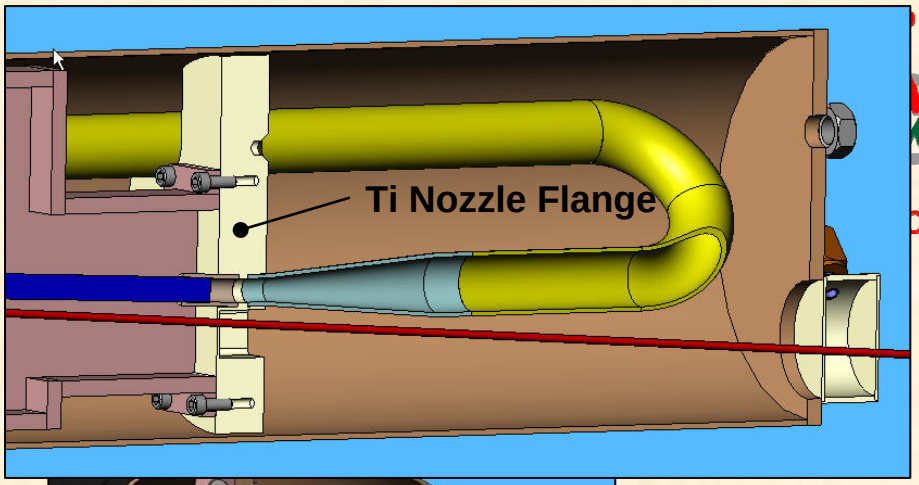
Additional Syringe Work

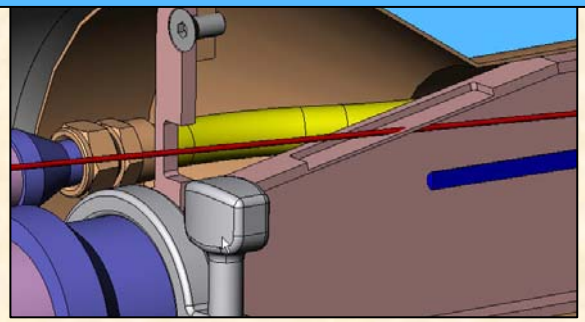
- **Syringe procurement initiated Sept '05 due to anticipated long delivery of cylinders**
- **Fabrication dwgs for remainder of system not completed at that time**
  - **Dwg pkg now complete**
- **Prefer to award to syringe pump vendor**
- **Being coordinated by BNL Procurement**



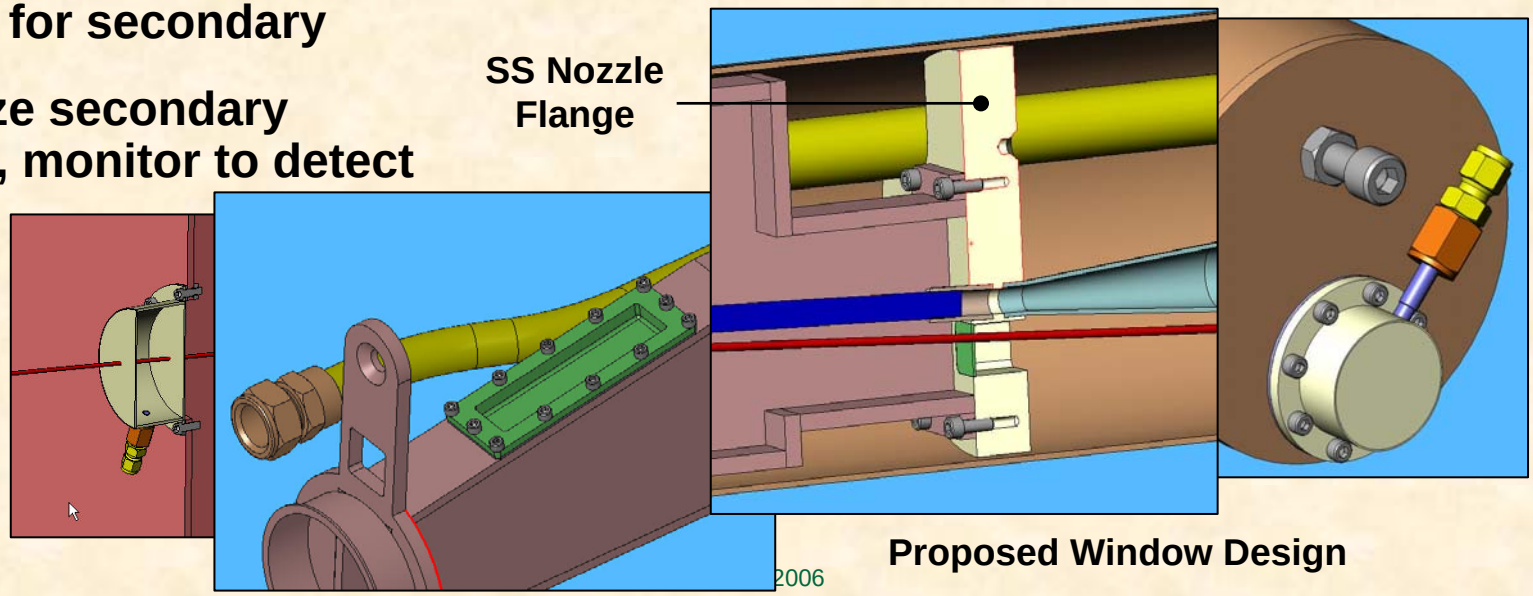
Beam Windows

- **Windows fabricated from Ti6Al4V alloy**
- **Welded attachments provide more usable space for beam**
  - **Currently performing a re-design to mechanically attach windows where possible**
- **Single windows for primary containment, double windows for secondary**
- **Pressurize secondary windows, monitor to detect failure**





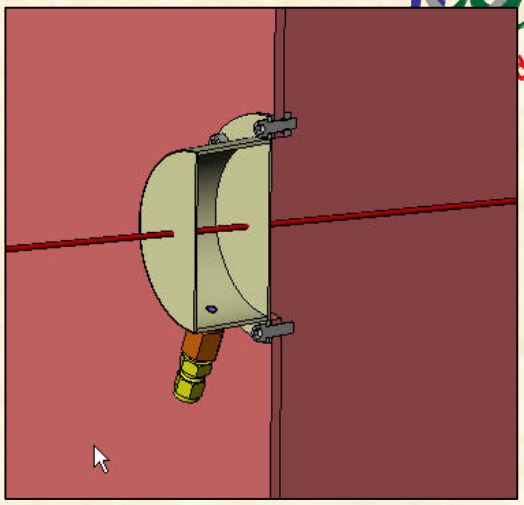
Current Window Design

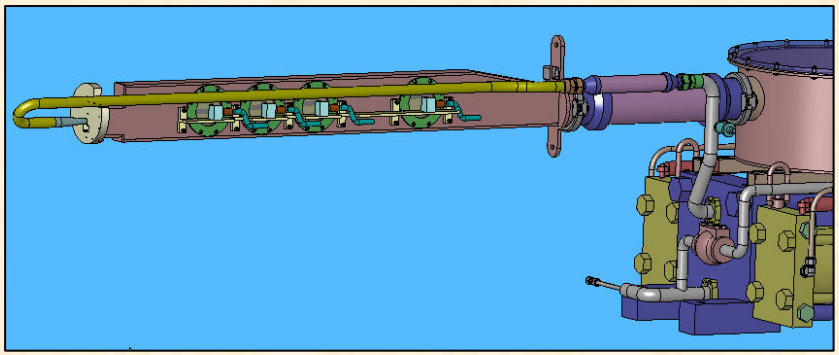


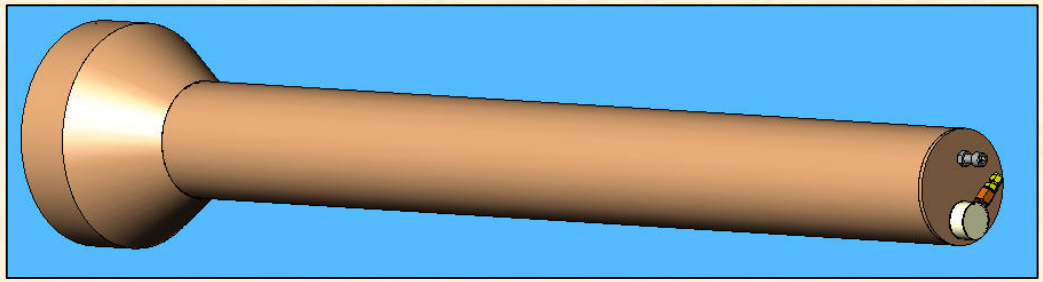
Proposed Window Design

Target Module

- **Current design of primary/secondary containment modules inserted into magnet utilizes Ti or Ti alloys**
  - **Alleviates issues with welding dissimilar metals**
- **Material for 2 spare nozzle assemblies will also be procured**
- **Drawing package currently out for bid**
  - **Will be coordinated by Princeton Procurement**
  - **Procurement direction to be decided on cost/schedule considerations**
- **Vendor quotes indicate an all-Ti fabrication is beyond our budget, so drawings being modified for SS target module**
  - **Brazing Ti to SS appears feasible**

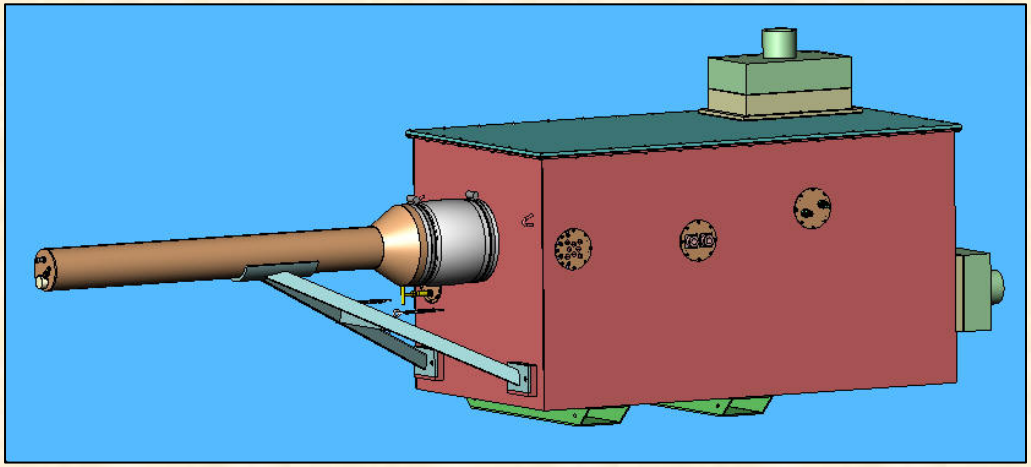






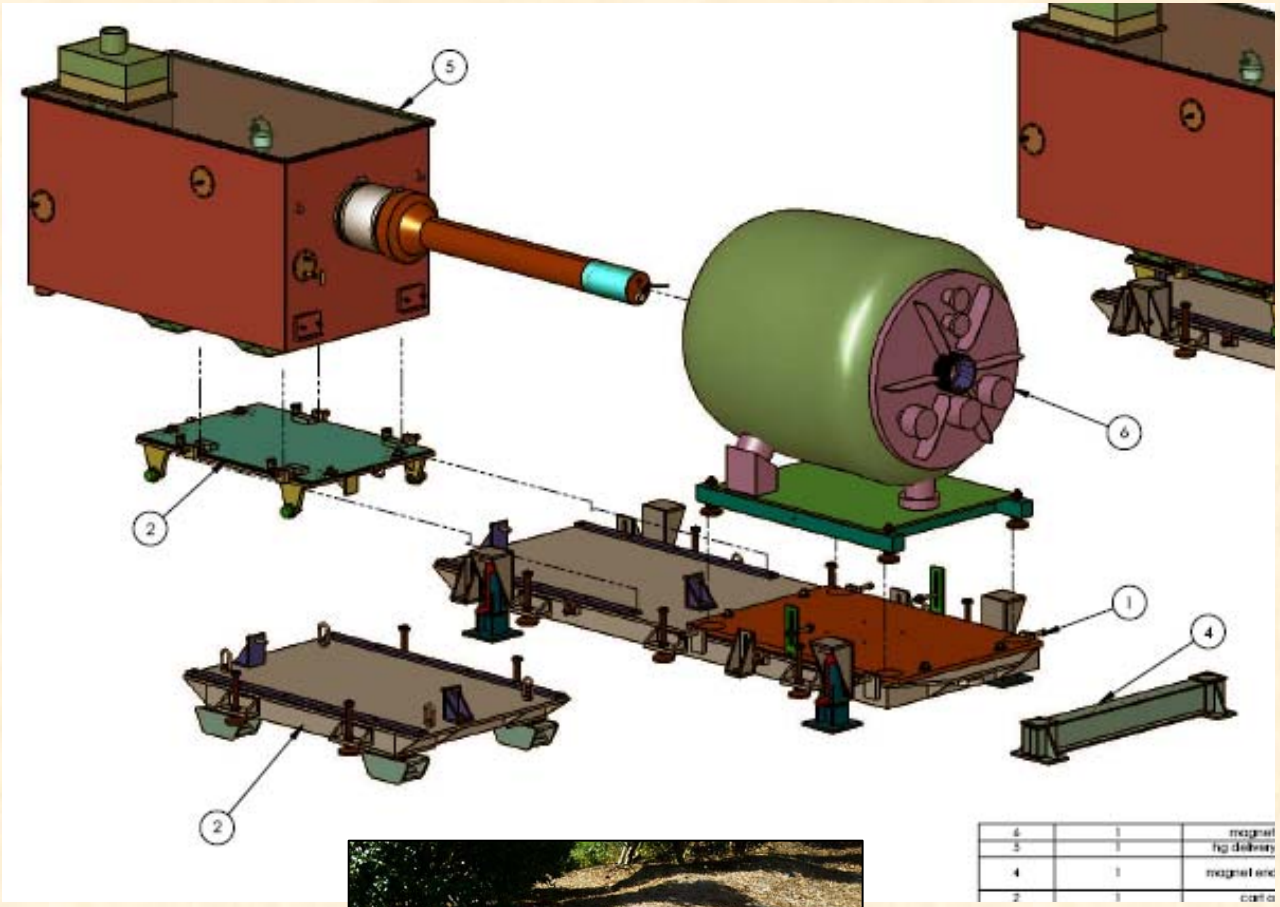
Secondary Containment

- **SS304L/316L 1/2" bottom plate, 1/4" sides**
- **SS flexible sleeve**
- **SS cylindrical sleeve**
- **Lexan top**
- **Ports**
  - **Optical diagnostics**
  - **Instrumentation**
  - **Hydraulics**
  - **Hg drain & fill (without opening secondary)**
  - **Hg extraction (in event of major leak in primary containment)**
  - **Passive filtration**
- **Fabrication of box underway at Princeton**



Baseplates

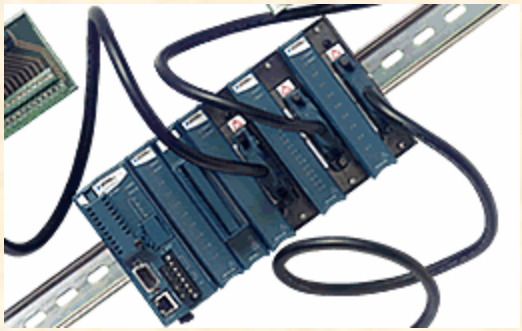
- **Multiple baseplates required for transport, assembly, and equipment support**
- **Primarily fabricated from Al 6061-T6**
- **Fabrication underway at University of Mississippi**



OAK RIDGE National Laboratory

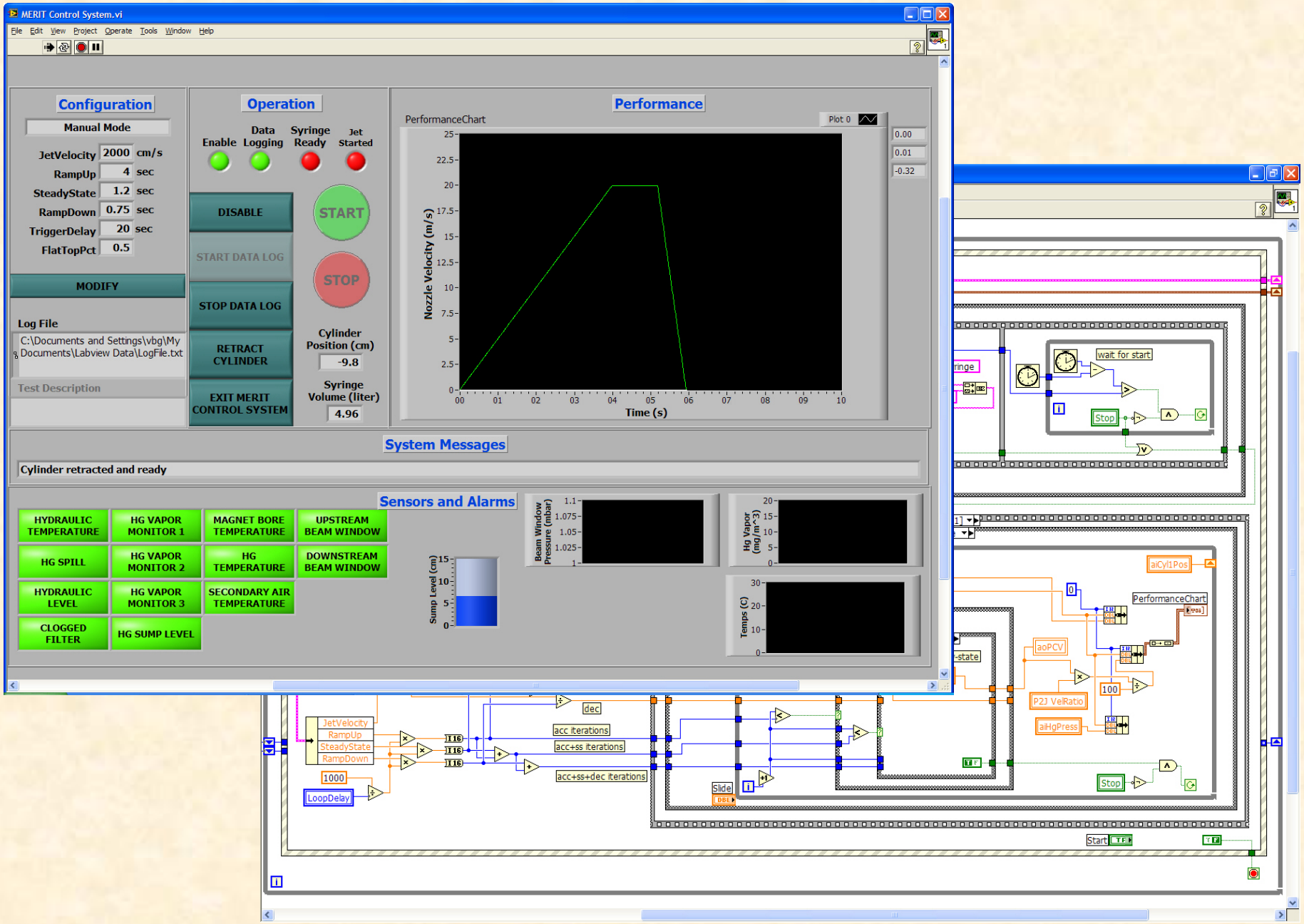
LabView-Based Control System

- **Remote control over long distance limited control choices**
- **LabView on laptop computer was chosen as system controller**
  - **CompactPCI I/O modules at syringe pump control station**
  - **Communicates to laptop via EtherNet cable**
  - **Should allow straightforward integration with other MERIT control systems**



Labview hardware

Hg Syringe Control System Development Underway

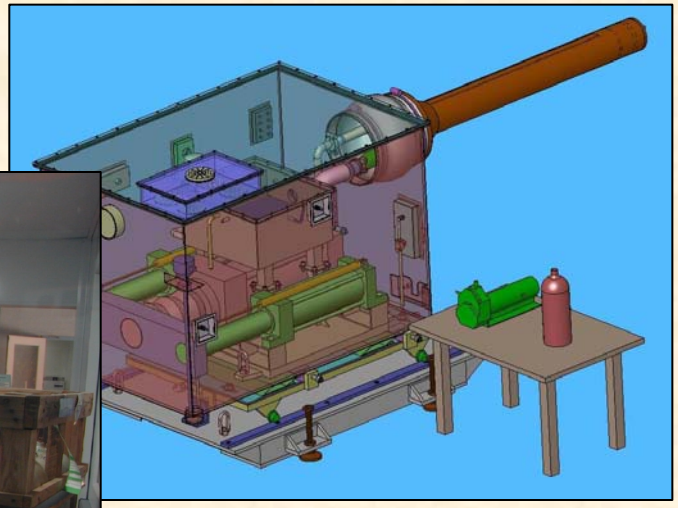


Mercury Containers/Shipping

- **Standard flask is 2.5 liters**
- **Flask + Hg weighs ~35 kg**
- **Shipping requirements coordinated by ORNL Transportation Group**
- **MERIT will require a short (20ft) Sealand container for transport to CERN**
  - **Ship magnet with Hg system**

TTF Operations – Hg Filling

- **A peristaltic pump for transferring Hg was successfully tested**
  - **This is the preferred approach for filling & draining MERIT**
  - **System designed to fill/drain without opening secondary containment**
- **Hg handling requires multiple spill/drip precautions and ventilation equipment**



Mercury Vapors – Filtering & Monitoring

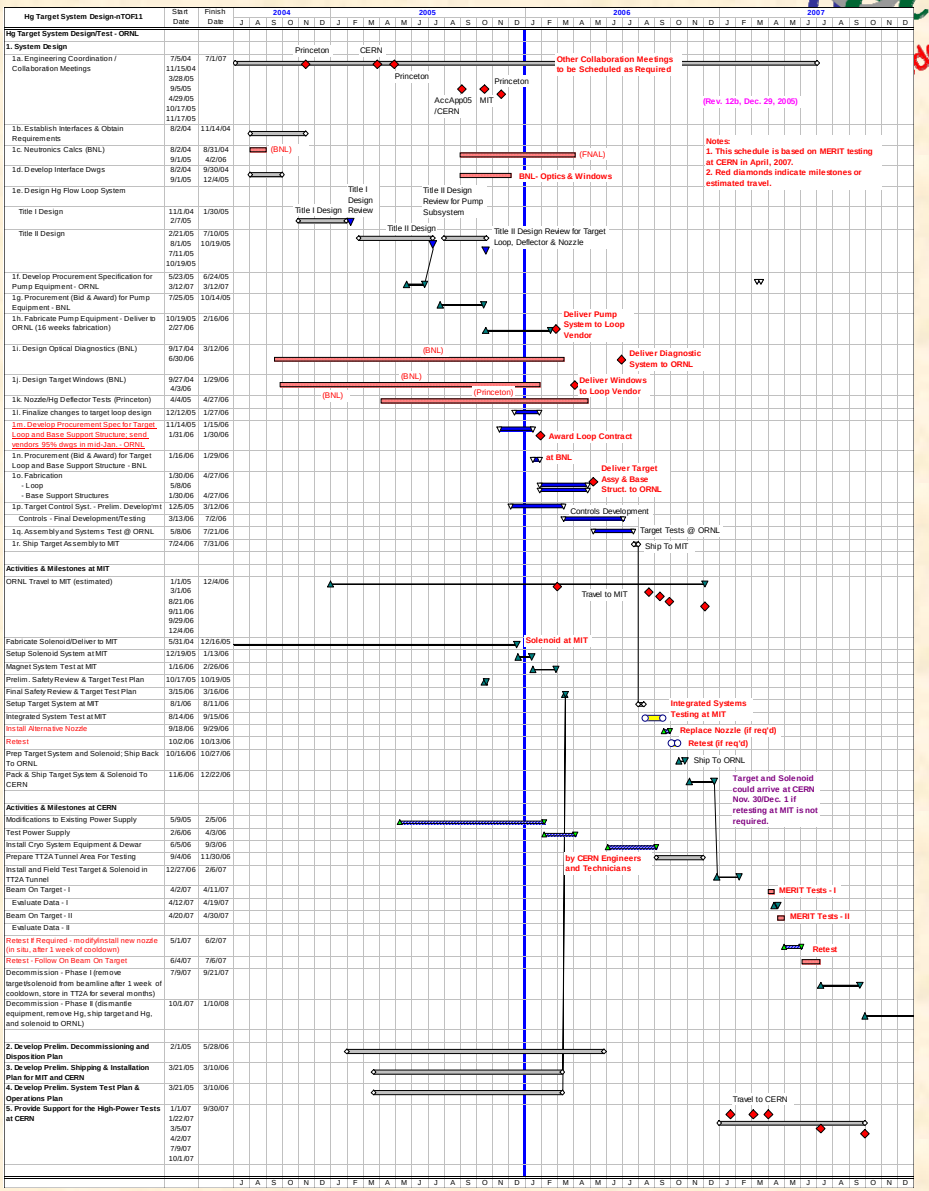
- **Two vapor monitors to be used**
  - **One for secondary volume, one for tunnel environment**
  - **Will communicate with control system**
- **Scavenger portable ventilation system will be used**
  - **Can be used as stand-alone system or connected to secondary containment**
  - **Already procured by Princeton**
- **Passive filtration on secondary containment**
  - **Sulphur-impregnated charcoal & HEPA filtration**

MERIT at MIT and CERN

- **Dialogue with CERN & MIT Safety Engineering Group has begun**
  - **Presentation/discussion with CERN in August ’05**
  - **Presentation/discussion with MIT at the October Collaboration Meeting**
- **Formal safety reviews and test/operation plans to be presented to MIT and CERN during summer 2006**

Schedule – Major Milestones

- **Target Tests at ORNL May-Jul '06**
  - **Integrated with optical diagnostics system**
- **Integrated Tests at MIT Aug-Sep '06**
  - **Retest Oct '06 if nozzle reconfiguration needed**
- **Ship MERIT equipment to CERN Nov-Dec '06**
- **Beam Tests at CERN Apr '07**
  - **Retest Jun '07, if needed**



Conclusions

- **Syringe pump system fabrication nearly complete, integration to begin this week**
  - **Factory acceptance testing March 30**
- **Final design details & fabrication dwgs of Hg system have been completed**
  - **Initial nozzle configuration determined**
  - **Fabrication is underway on baseplates & secondary containment**
  - **Sump tank assy pkg should be awarded soon**
  - **Target module drawings being revised, should go out for bid by end of March**
- **Control system development started, need guidance regarding integration with supervisory experiment control system**
- **Hg system testing at ORNL will begin as soon as equipment becomes available**
  - **Water testing followed by Hg**