Neutrino Factory Mercury Flow Loop

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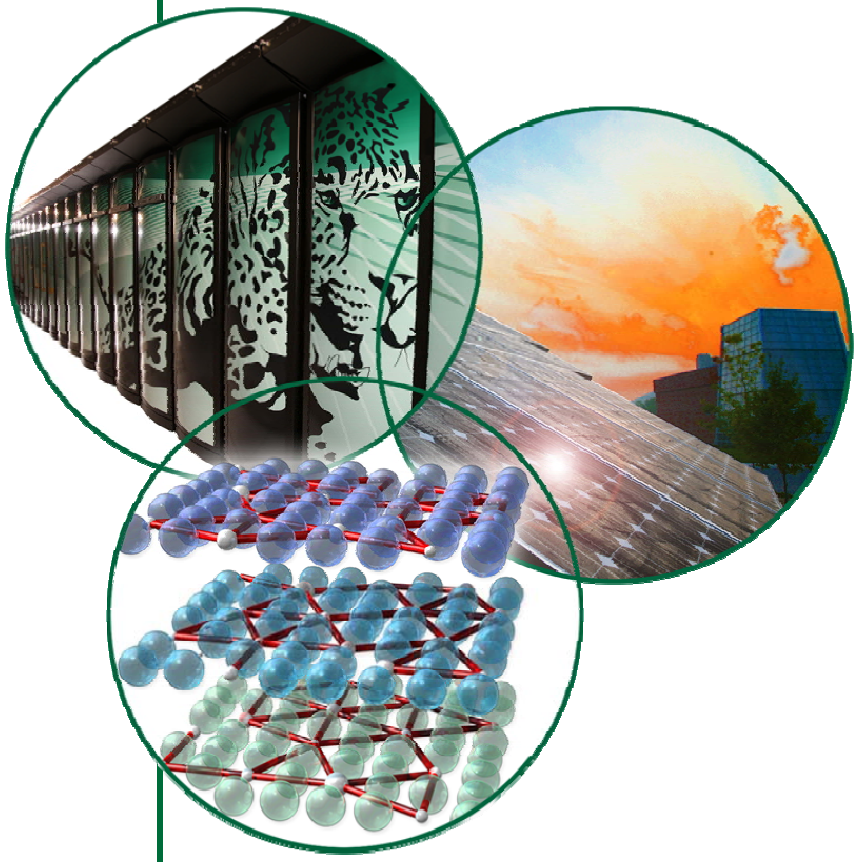

IDS-NF Videoconference

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U.S. DEPARTMENT OF ENERGY

OAK RIDGE NATIONAL LABORATORY
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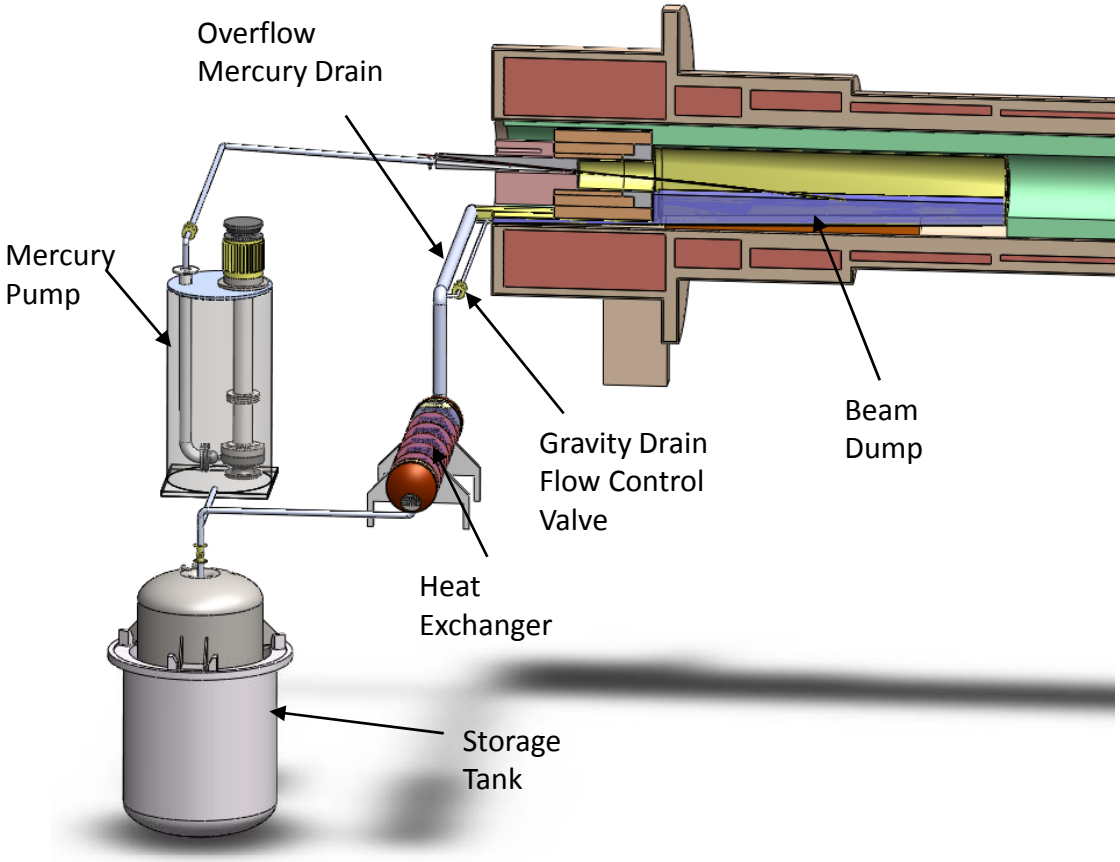
Flow Loop Review

- 1 cm dia nozzle, 20 m/s jet requires 1.57 liter/sec mercury flow (94.2 liter/min, 24.9 gpm).
- MERIT experiment showed that a pump discharge pressure of ~40 bar gauge required to produce the desired jet.
  - Reference: SNS nominal flow 1440 liter/min (380 gpm), 7 bar gauge pump discharge pressure, ~1400 liters total Hg inventory
- Basic flow scheme

  Pump → Nozzle → Jet/Beam Dump → Heat Exchanger → Pump

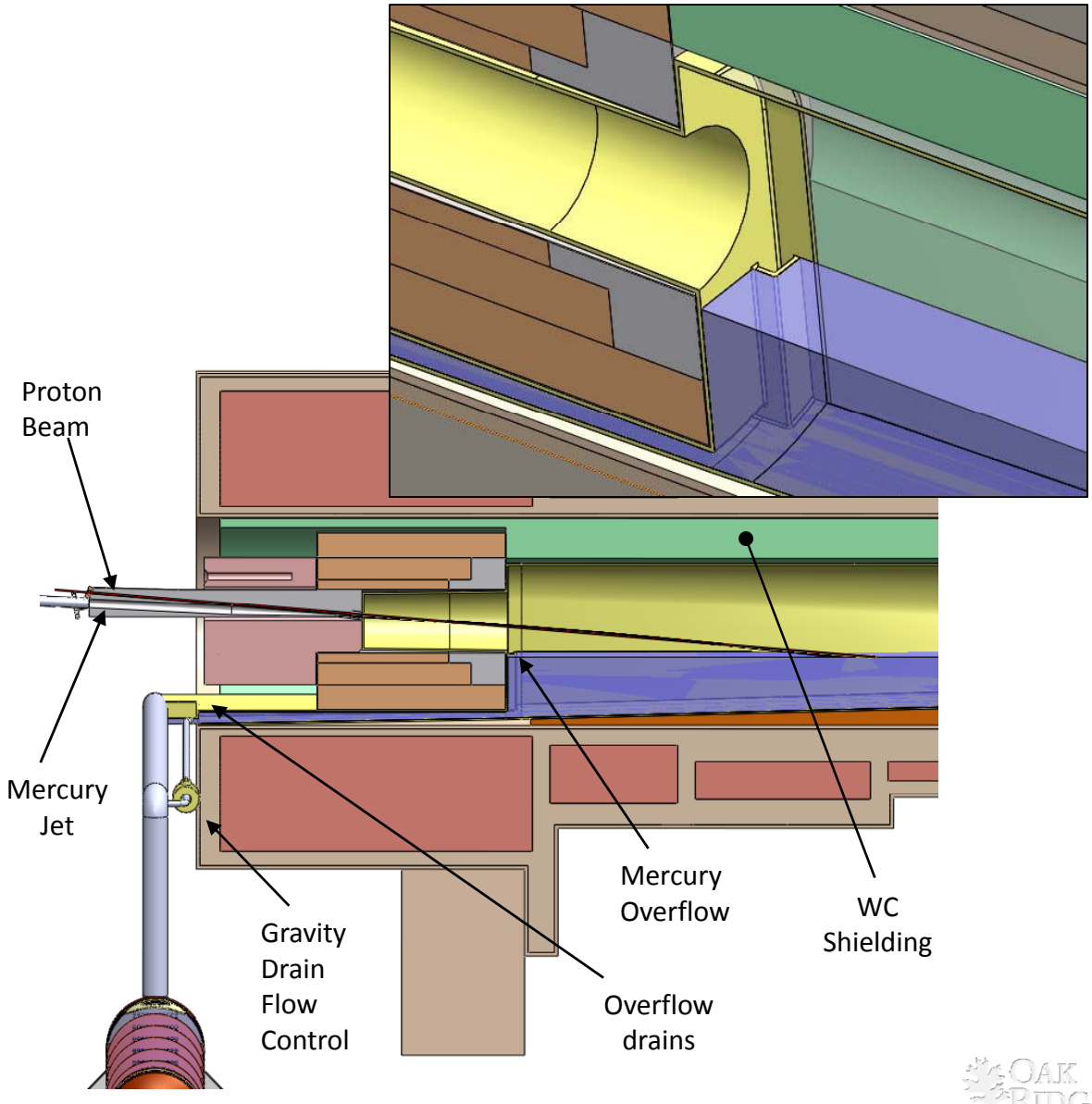
Hg Flow

- Minimize pressure drops through piping by increasing diameter
  - 2" nozzle supply piping transitioning to 1 cm nozzle
- Actual NF Hg inventory may reach SNS volumes
  - ~500 liters in the half-length beam dump shown



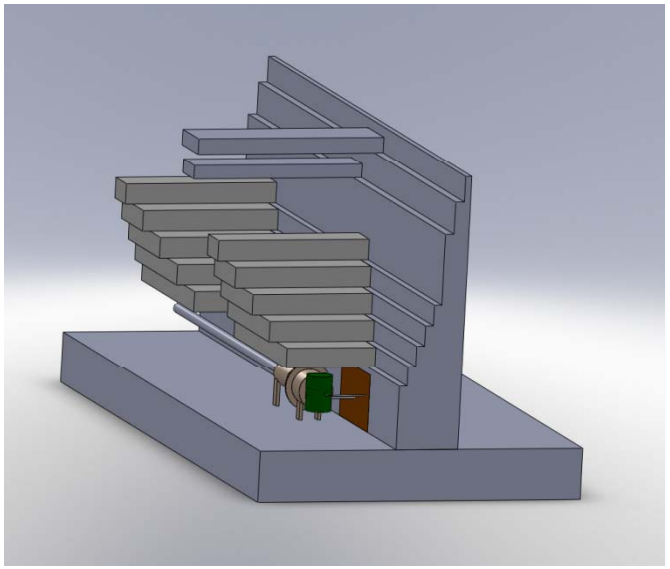
Gravity Drain Requires Flow Control

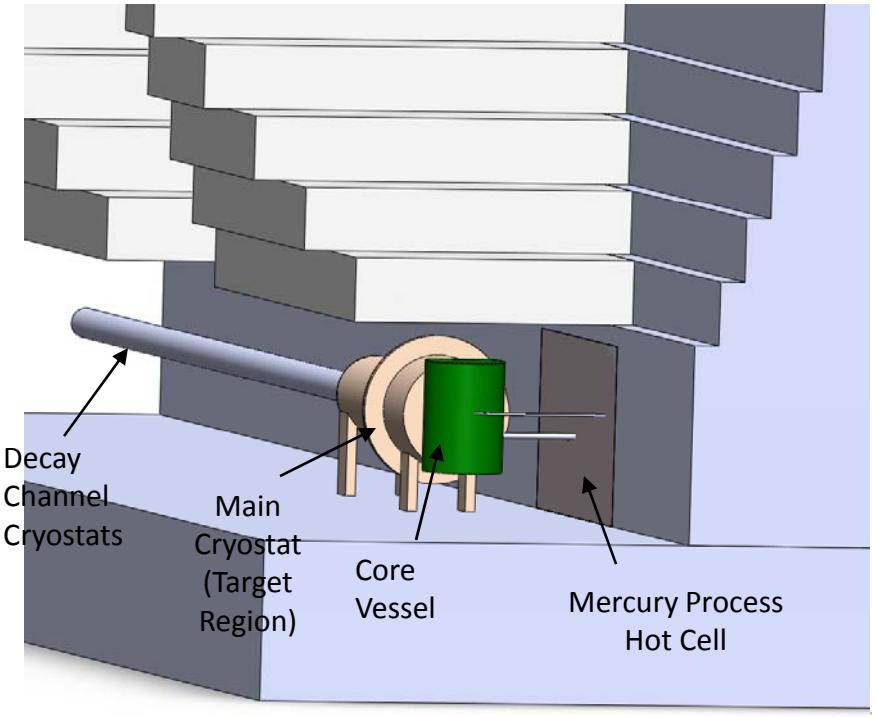
- Bulk flow exits dump via overflow drains
- Gravity drain intended to remain closed until end-of run, but this liquid becomes static
- Decay heating requires gravity drain to have flow control



Target Building

- Based on Study 2 concept
- Mercury loop "hot cell" will probably extend into magnet chase
  - Could require double containment of mercury
  - Chase will certainly have a drain back into hot cell





Heat Removal

Element/Compound	Density (g/cm^3)
Hg	13.5
W	19.3
WC	15.8

- From Study 2, the mercury jet/pool receive < 10% of beam energy; bulk goes into WC shielding
  - Currently assumed to be WC spheres cooled by water
  - Much larger heat exchanger needed to cool shielding
- Considering that both W and WC must be water-cooled, their effective densities will approach that of Hg.
- Consequently, IF a Hg target is selected, the infrastructure will be in place to support use of Hg as a solenoid shield.
  - Would probably be a separate loop due to vastly different flow/pressure requirements, but could share a storage tank

Future Work

- Continue development of Target Building infrastructure conceptual design
- Look further into the mechanics of the region upstream of the nozzle
  - Remote maintenance / assembly / disassembly
  - Mercury flow