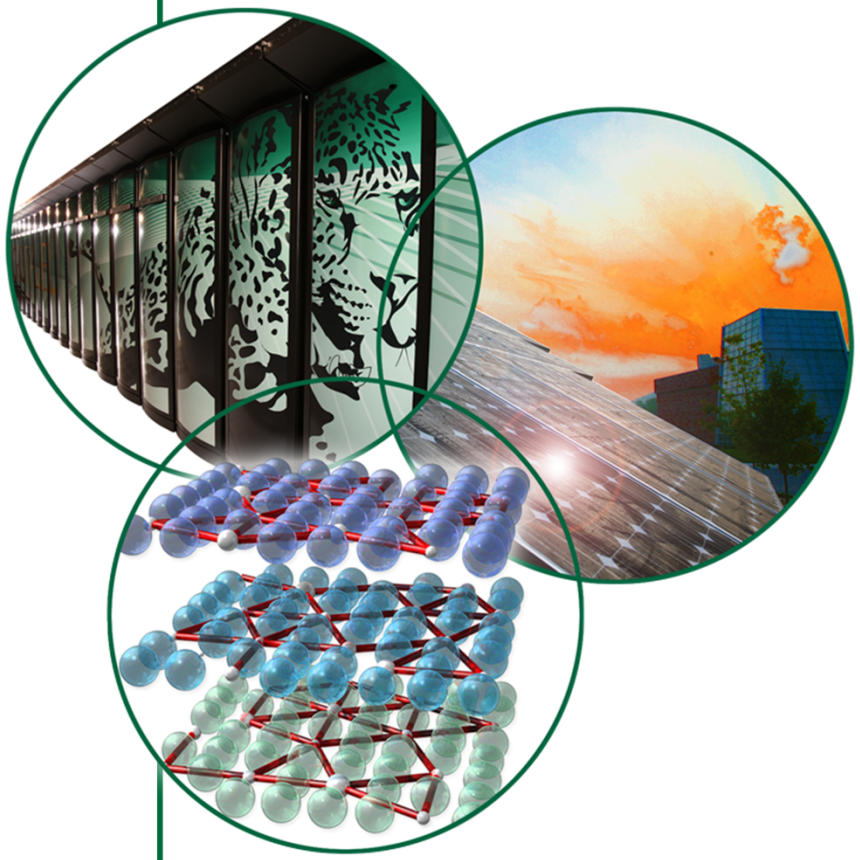
Mercury Chamber Considerations

V. Graves

IDS-NF Target Studies

July 2011



U.S. DEPARTMENT OF ENERGY

OAK RIDGE NATIONAL LABORATORY
MANAGED BY UT-BATTELLE FOR THE DEPARTMENT OF ENERGY

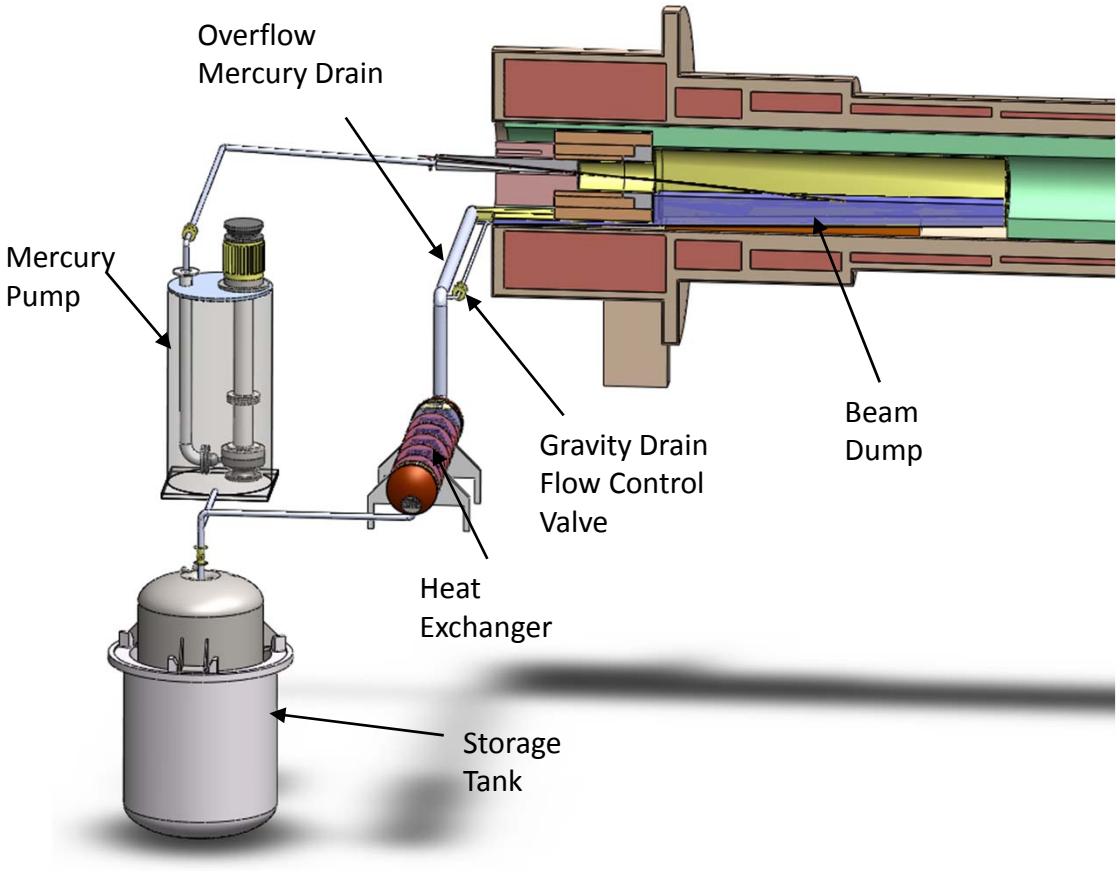
Flow Loop Review

- 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 required to produce the desired jet.
- Basic flow scheme

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

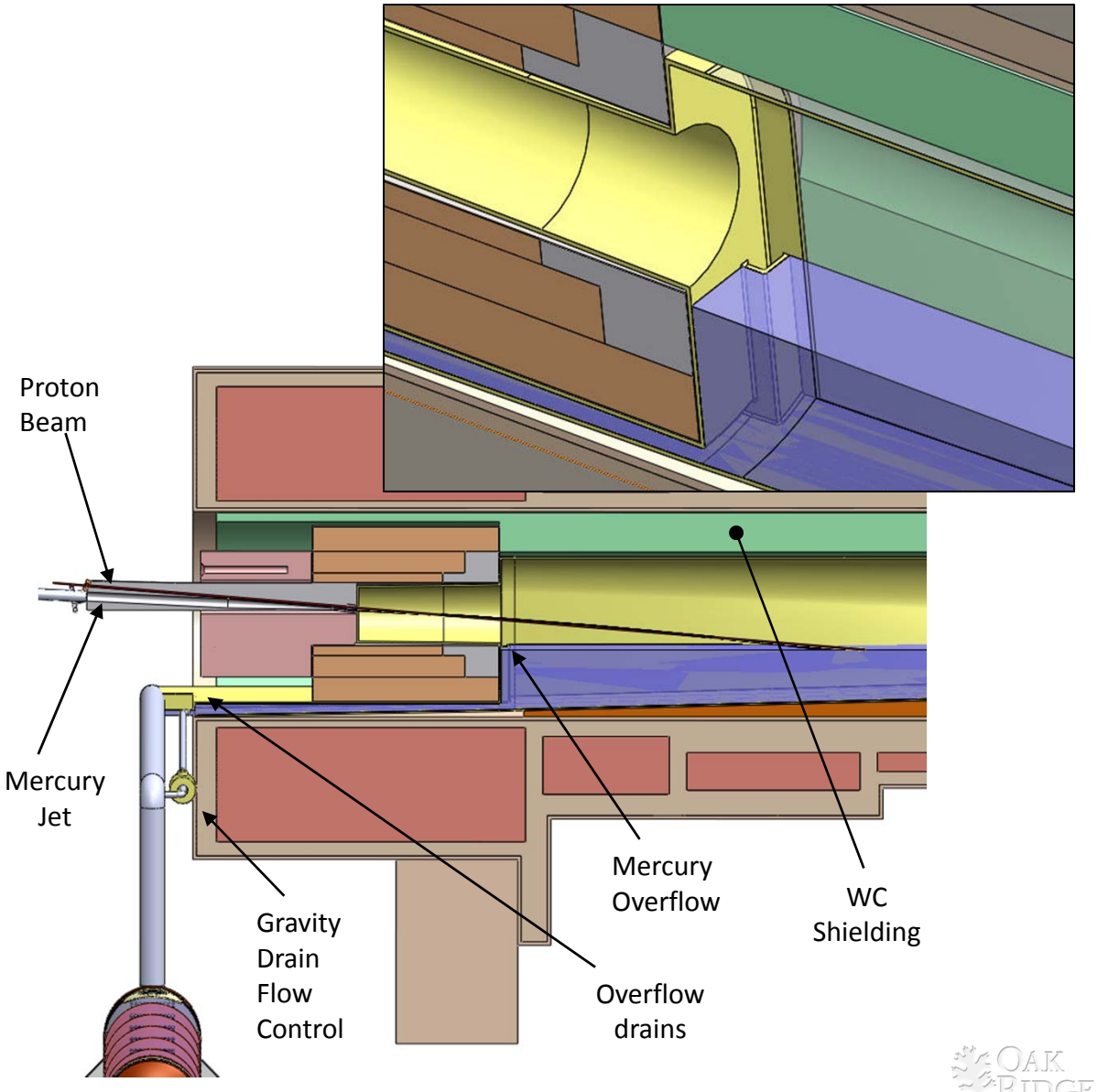
Hg Flow

- Minimize pressure drops through piping by increasing diameter
  - 2" nozzle supply piping transitioning to 1 cm nozzle



Gravity Drain Requires Flow Control

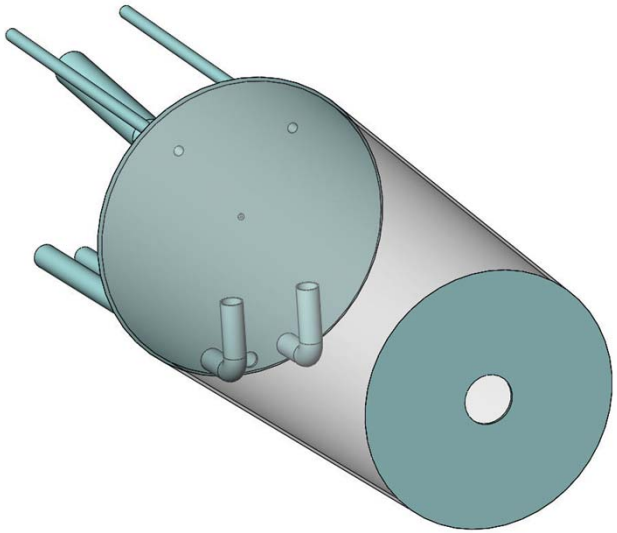
- Bulk flow exits dump via overflow drains
- Gravity drain intended to remain closed until end-of run, but this liquid becomes static
- Decay heating requires gravity drain to have flow control



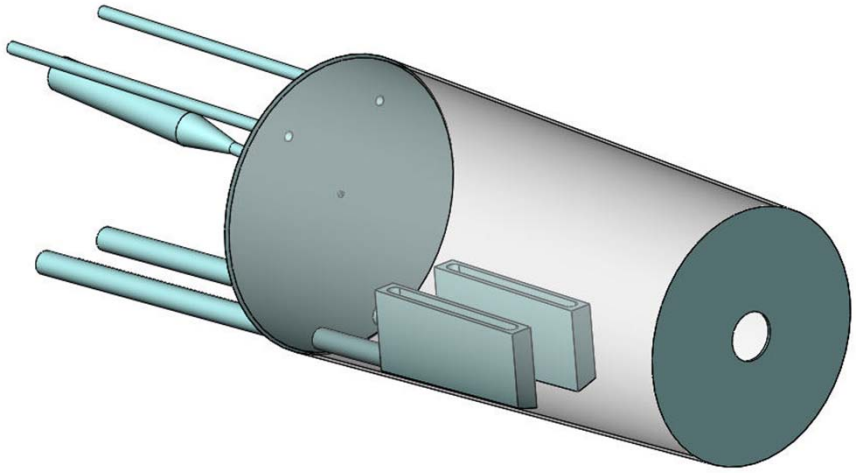
Mercury Chamber Basics

- Chamber serves as both jet and beam dumps
  - Chamber must encompass the nozzle tip
- No openings into chamber during operation
  - Mercury flows in a closed loop
  - Likely will be double-walled for mercury containment, possibly water cooled
- No embedded sensors
- Gravity drain of mercury required
- Penetrations (ports) into chamber
  - Nozzle
  - Hg drains (overflow and maintenance)
  - Vents (in and out)
  - Beam windows (upstream and downstream)
  - Cooling?

Simple Chamber – Overflow Drain Options

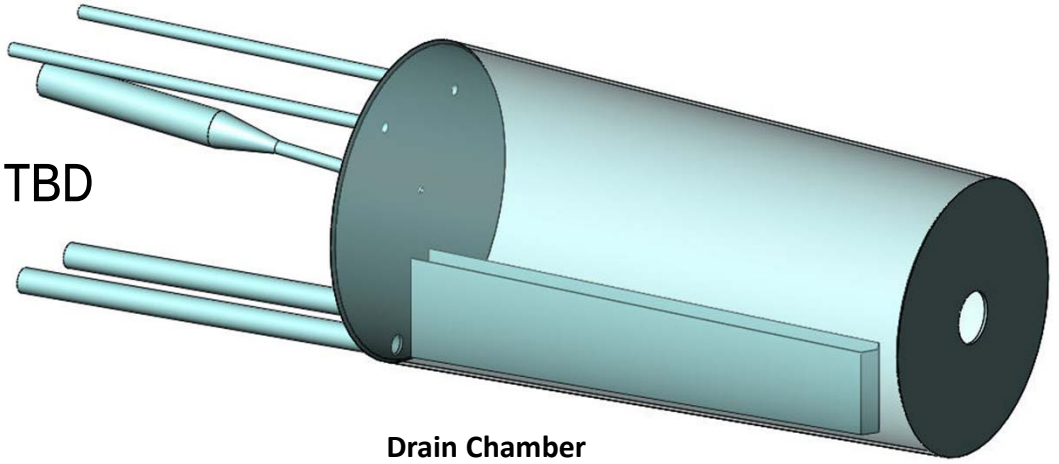


Drain Pipes



Drain Slots

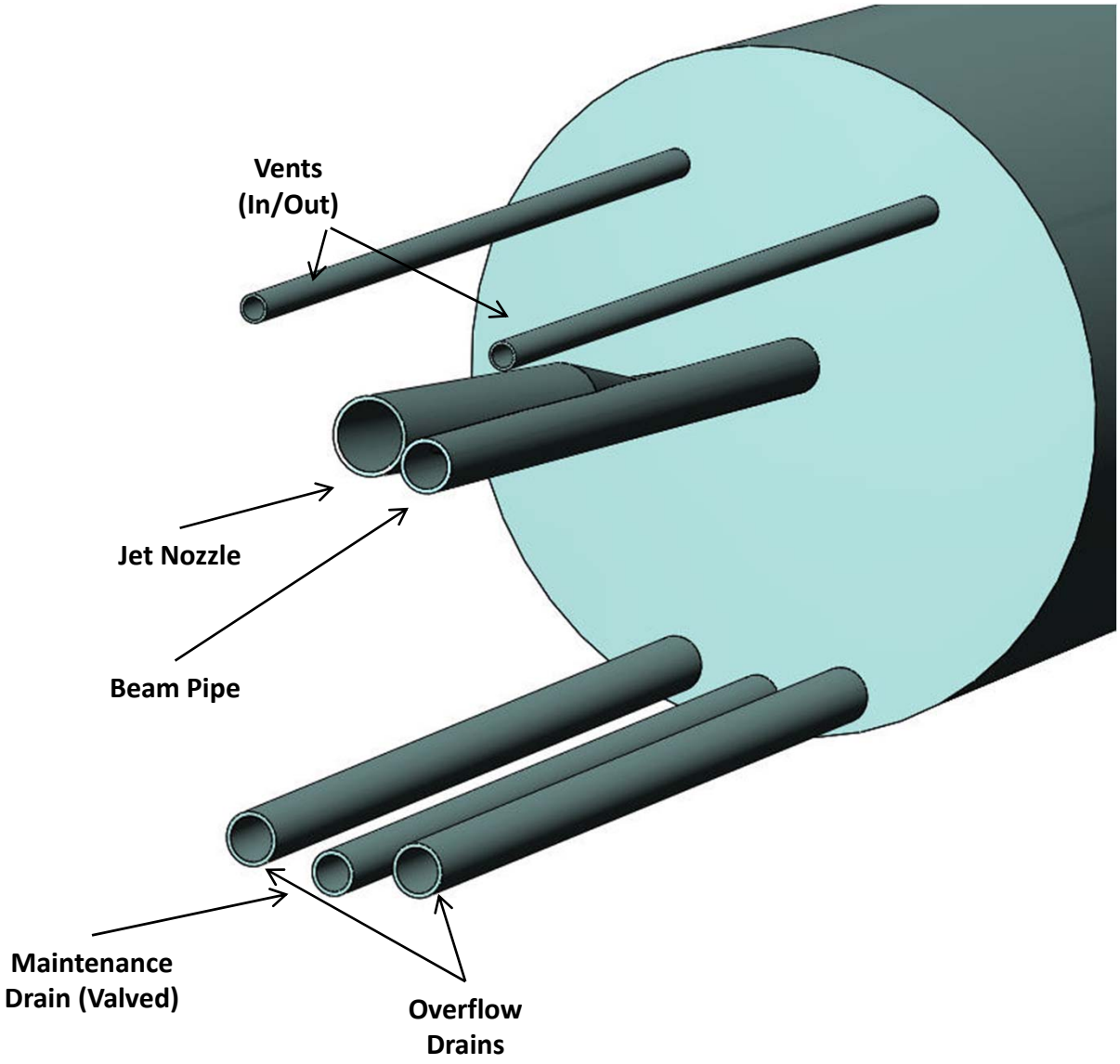
- Splash mitigation not shown
- Size of drainage system outlets TBD



Drain Chamber

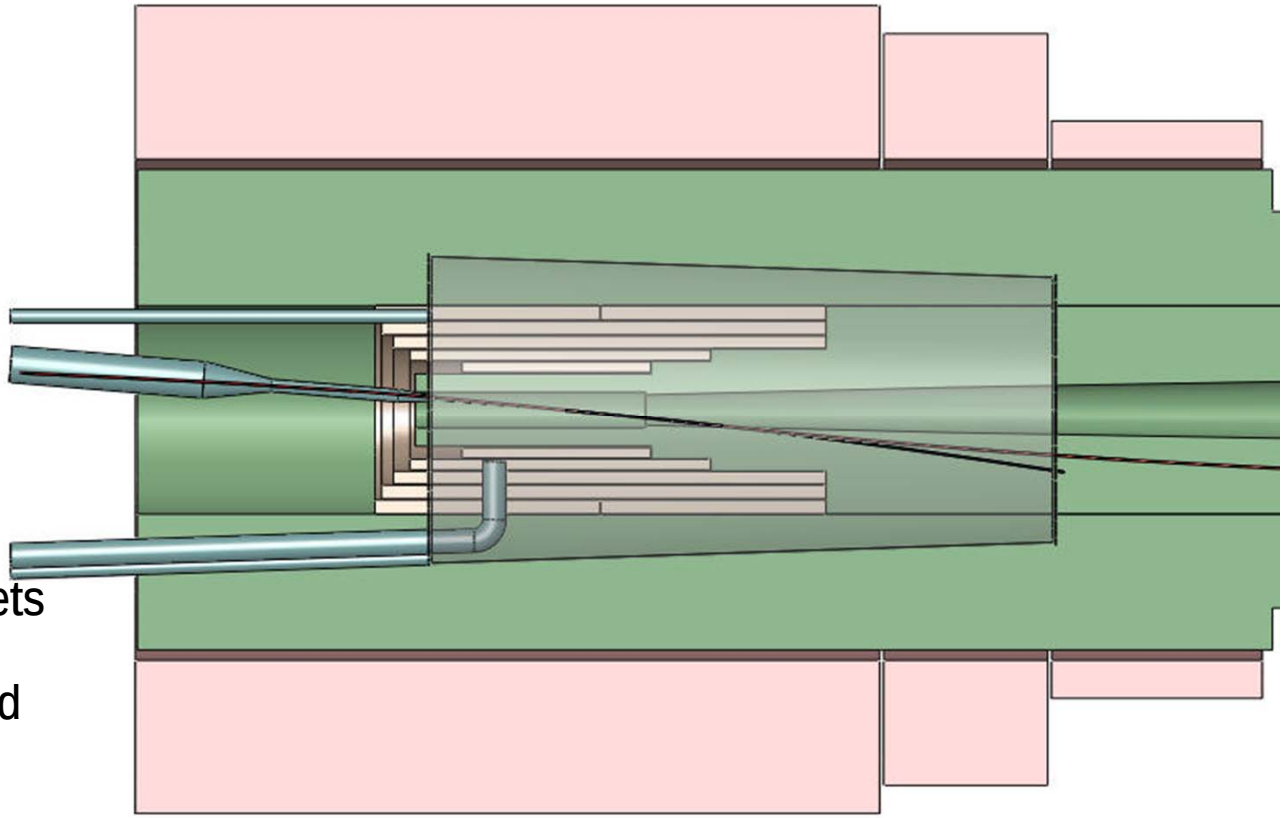
Mercury Chamber Ports

- Chamber requires several ports
- Sizes likely to increase due to remote handling requirements



Chamber Relative to Existing Coils

- Sized to locate drain pipes below resistive magnets
- No beam pipe shown
- Severely impacts tungsten shielding
- Chamber shape requires significant increase in complexity
- Integrating resistive magnets and chamber into a single module likely to be required



Upstream Solenoids Affect Design

- Long piping required
- Remote removal / insertion more difficult
- Beam trajectory impacted
  - Dictates the location of upstream accelerator
  - Ramifications of inaccurate field map?
- More utility connections interfere with beam path