Second Peer Review for New MGI Valves for NSTX-U (Update on Valve Testing)

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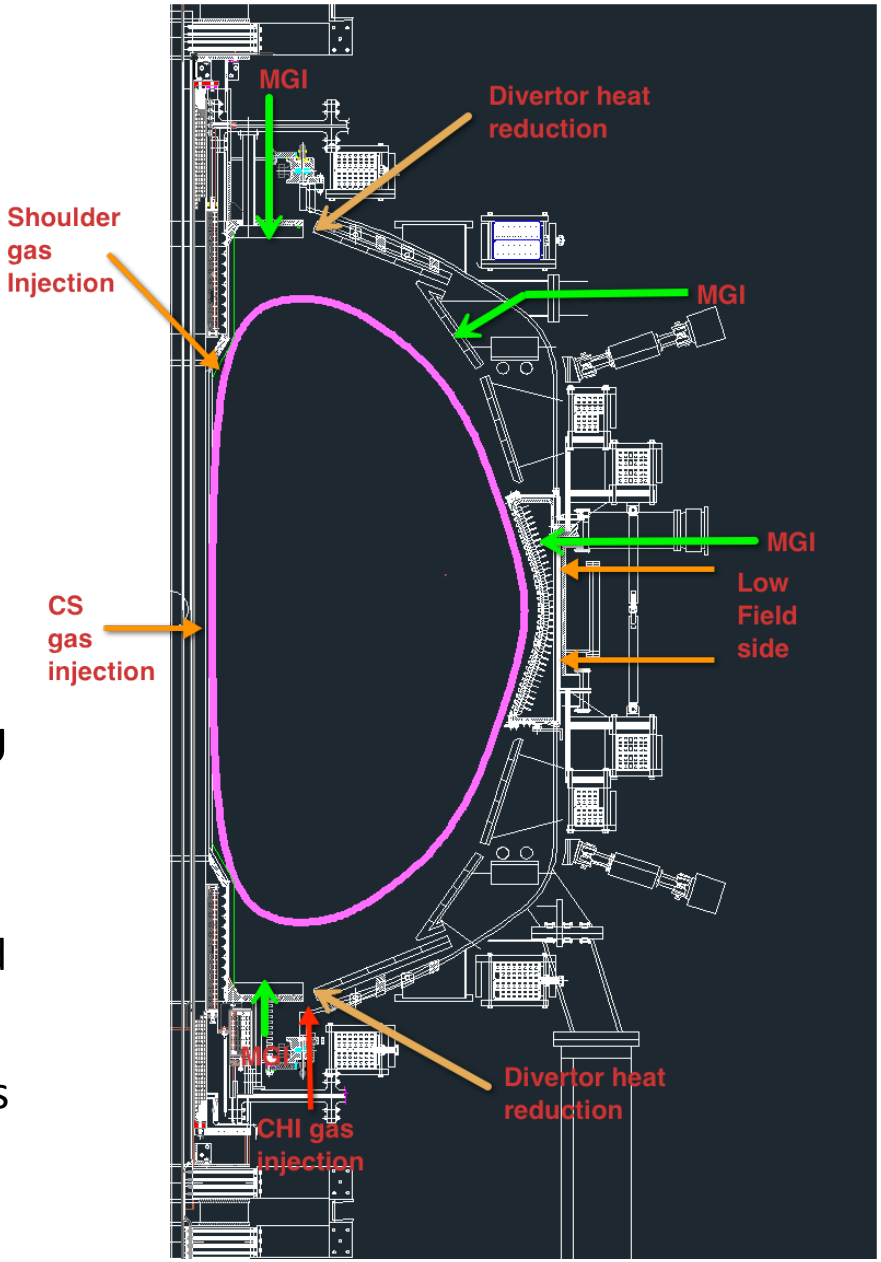
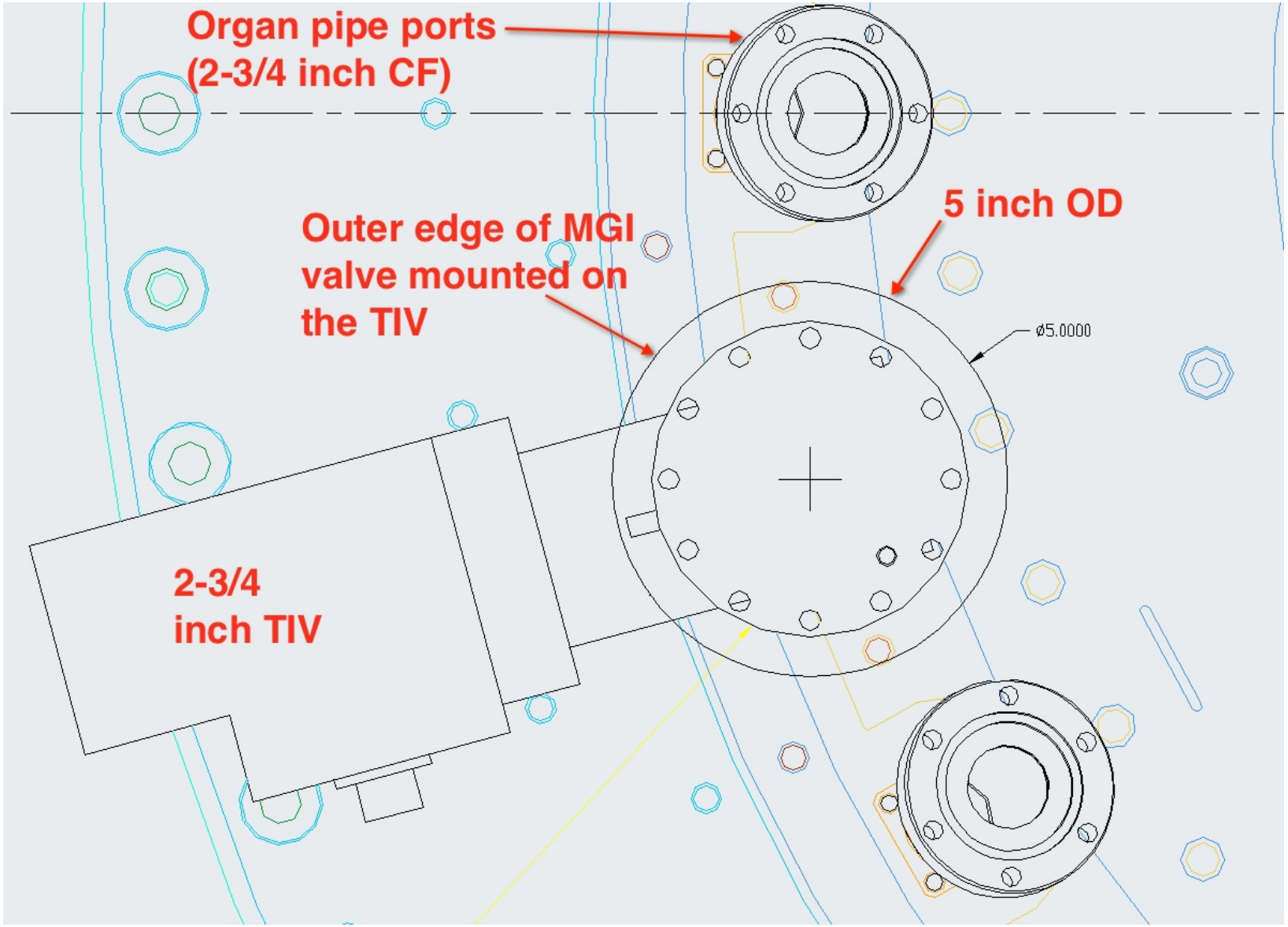
Valve & System Requirements

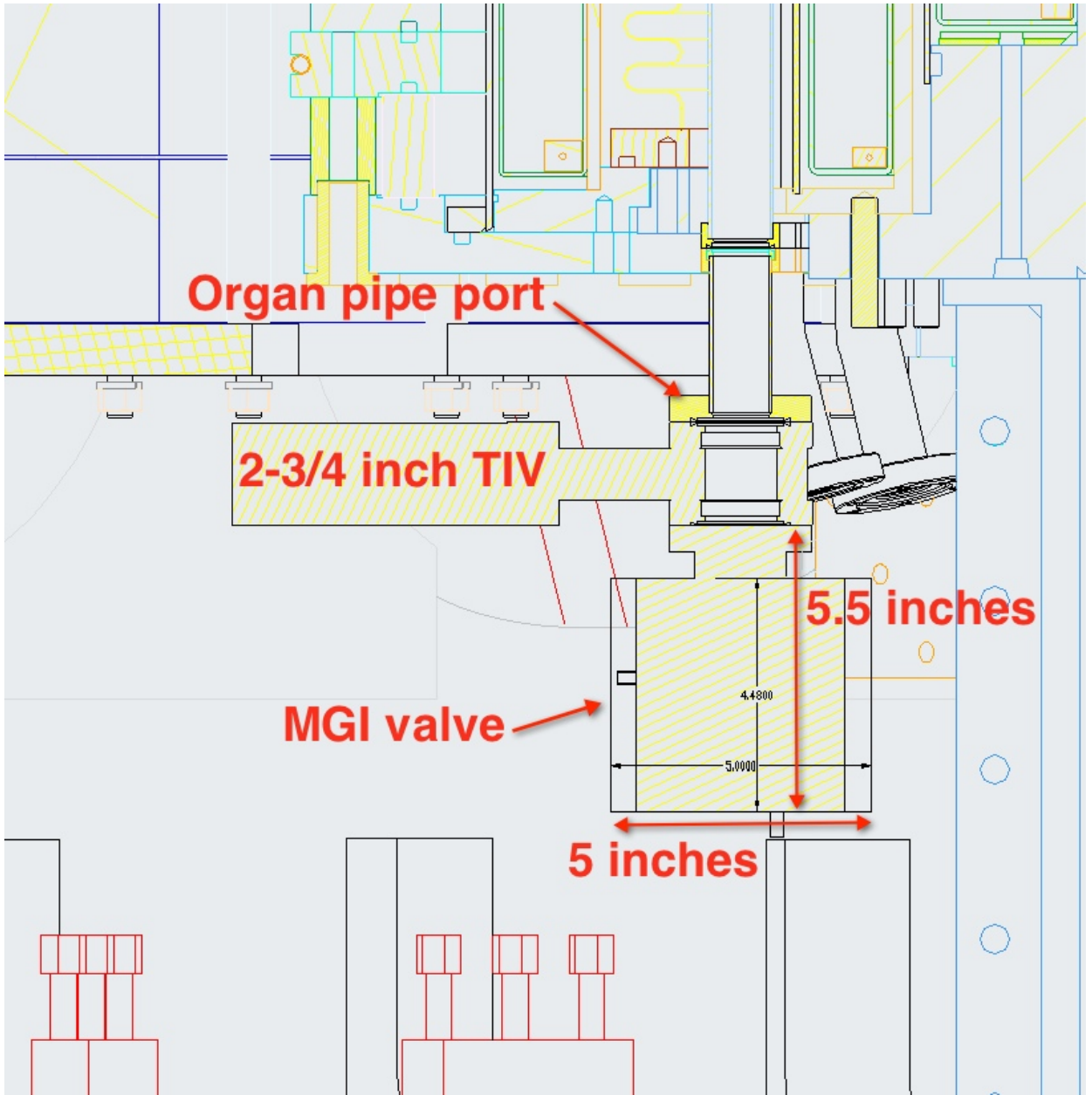
- Empty most of the plenum in <2ms after valve is triggered
  - Requires large orifice (limited by physical size limitations)
  - Rapid opening of the vacuum seal (coil voltage/current limits, PS size)
- Compatible with external magnetic fields
  - Conventional solenoid valves not suitable
- Compact in size so it can be installed on NSTX-U organ pipe flanges
- High reliability
  - Few and simpler systems for operation
- 4 – 5 identical systems needed for NSTX-U
  - Top & bottom organ pipe, 2 in mid-plane location (toroidally displaced) and one above mid-plane
  - Mid-plane valves need same diameter and length piping as organ pipe locations (one with length of tube ending at vessel & second in which the same length tube gets as close as reasonably possible to the plasma)



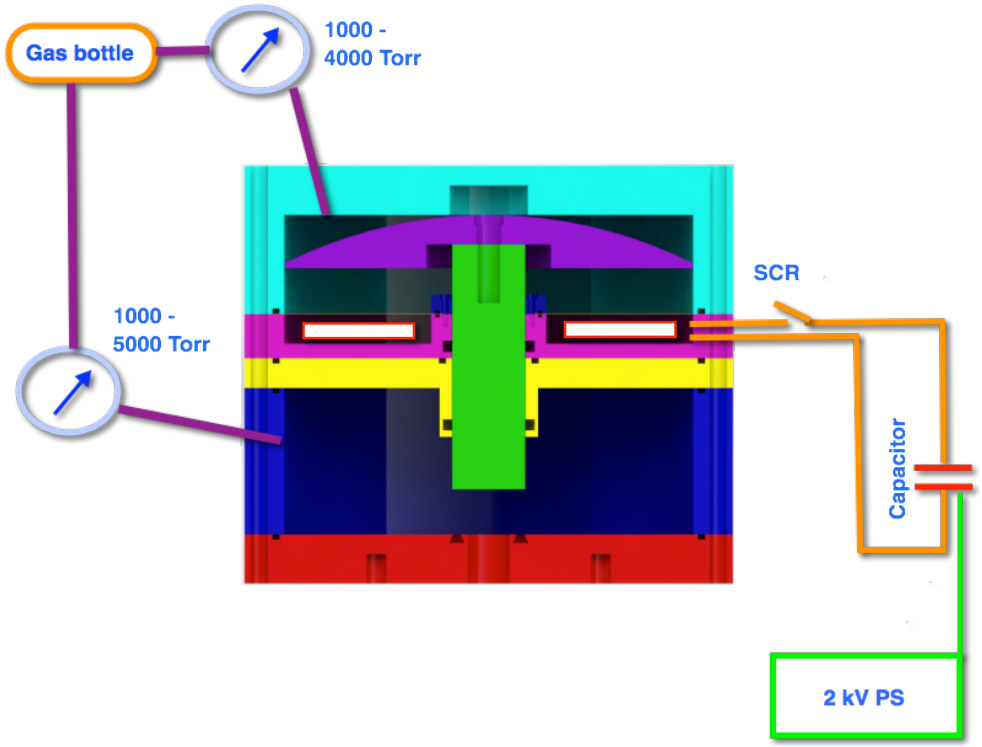
Up/Down view of MGI valve on Organ Pipe



Horizontal view of valve on Organ Pipe (Original Installation Concept)

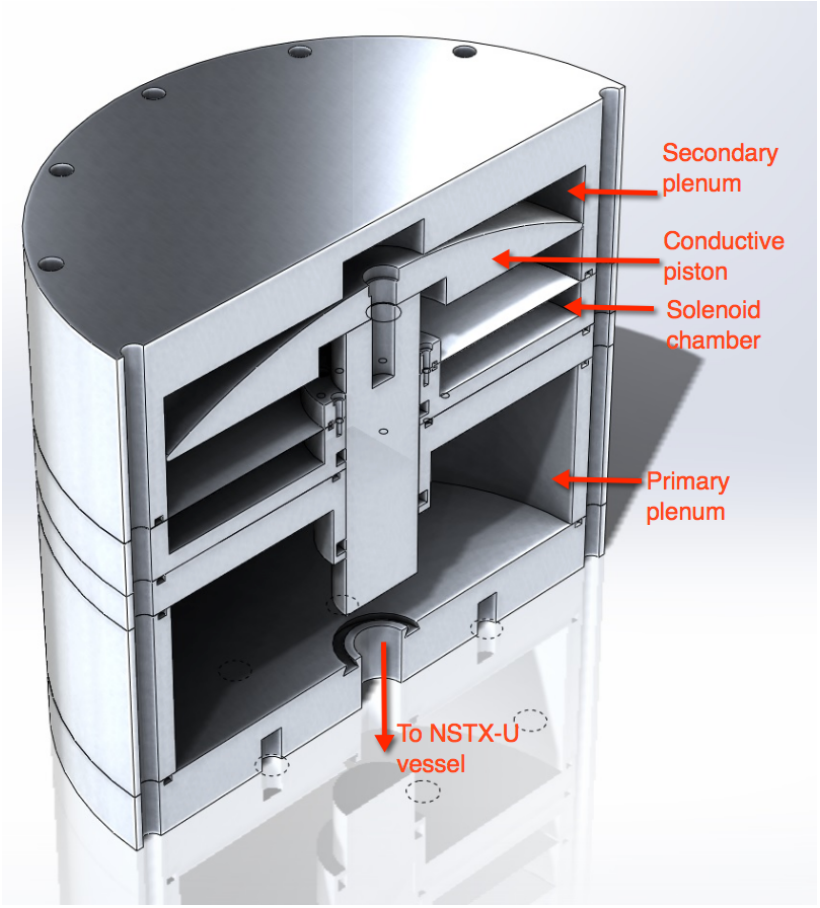


Electromagnetic Valve (similar in design to the ITER MGI valve)



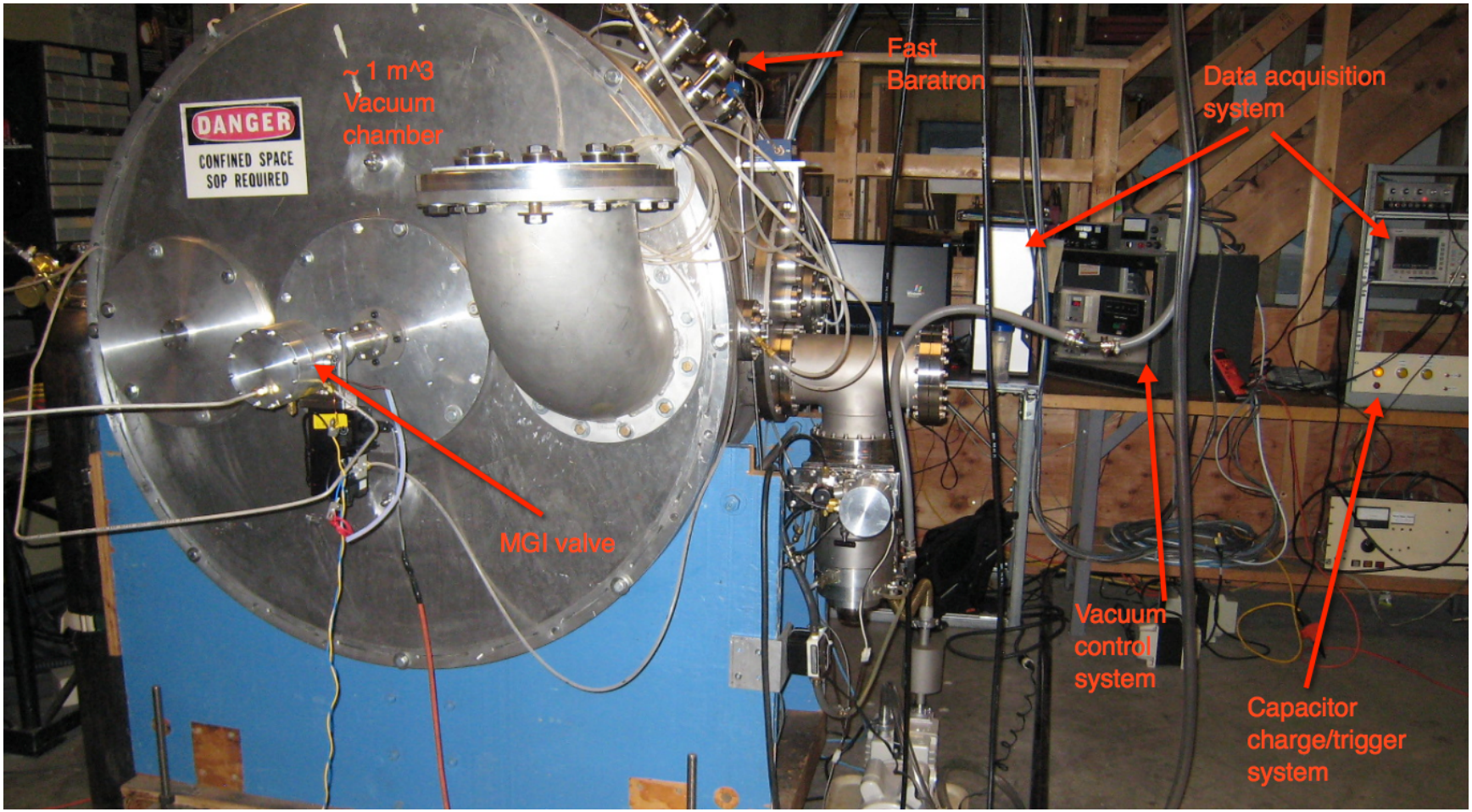
- Differential pressure across both plenums reduces load on pulsed power system
- By properly balancing pressures, the power supply requirements are nearly independent of the pressure in the primary chamber
- FY15: Max 5000 Torr (6.6 bar)
  - Consider >5000 Torr for FY16 and later
  - Requires upgrades to NSTX-U GIS

Valve Fabrication and Testing Update



- Primary plenum operated to 3500 Torr
- Secondary plenum at 2000 Torr
- 850 V, 500μF, coil current 2.3kA, 400μs pulse (200μs, FWHM)
- 100 Torr.L N_2 injected
- FY15 NSTX-U Experiments will use 50-100 Torr.L neon for poloidal comparison experiments (based on recent DIII-D experiments that used 60-90 Torr.L neon)

Present Test Set-up



Next Steps (1)

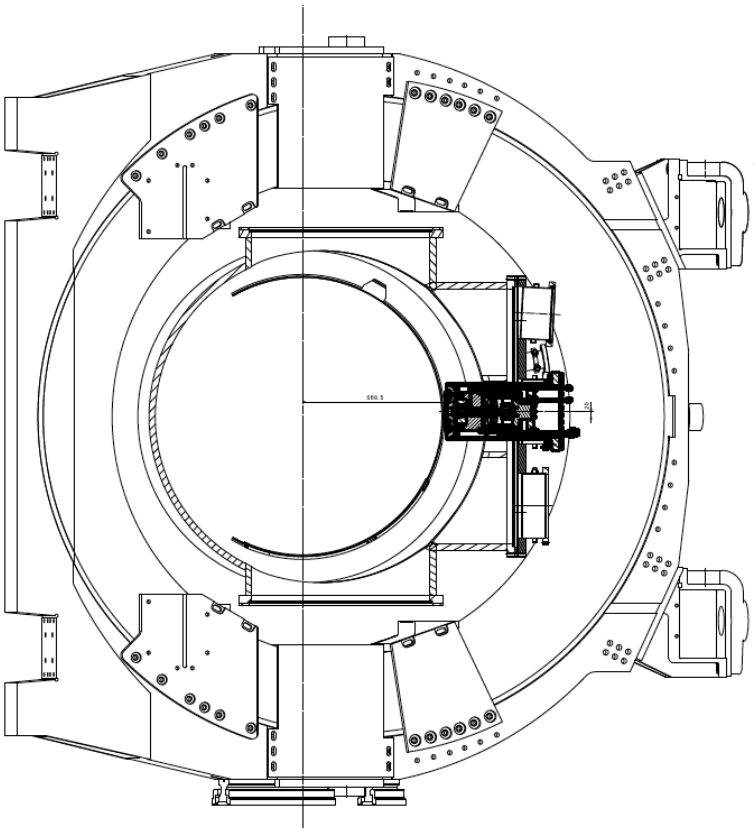
- Move test set-up to a different room
  - Operate power system from an adjacent room, after adding door interlocks
  - Increase pressure to 5000 Torr in primary chamber
  - Increase charging voltage to the 1.5 to 2kV range
  - Collect fast baratron data of pressure pulse inside vessel
- Finish Characterizing valve operating parameters for this first valve design (upto 1000 Torr.L)

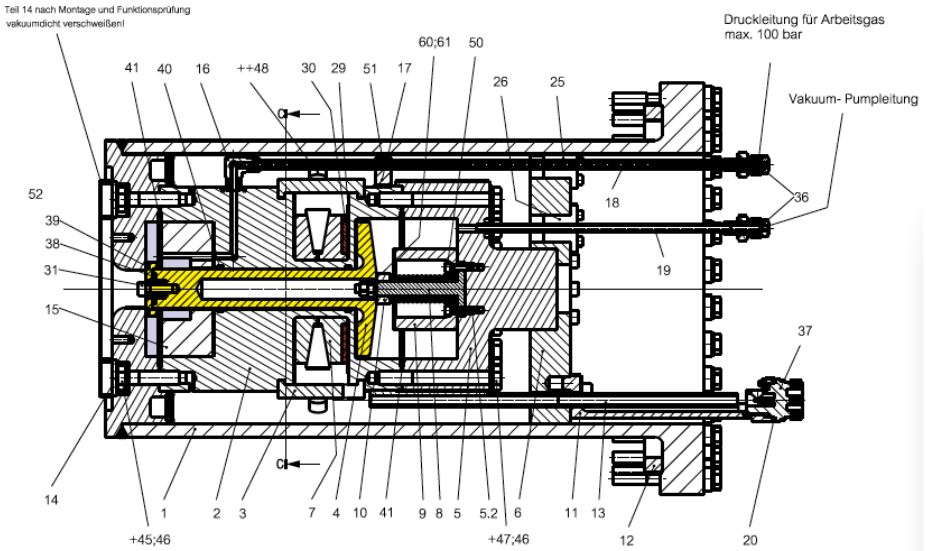
TEXTOR Valve Operated at 2T Radial Fields

Set-up of the new valve (installed March 2011)

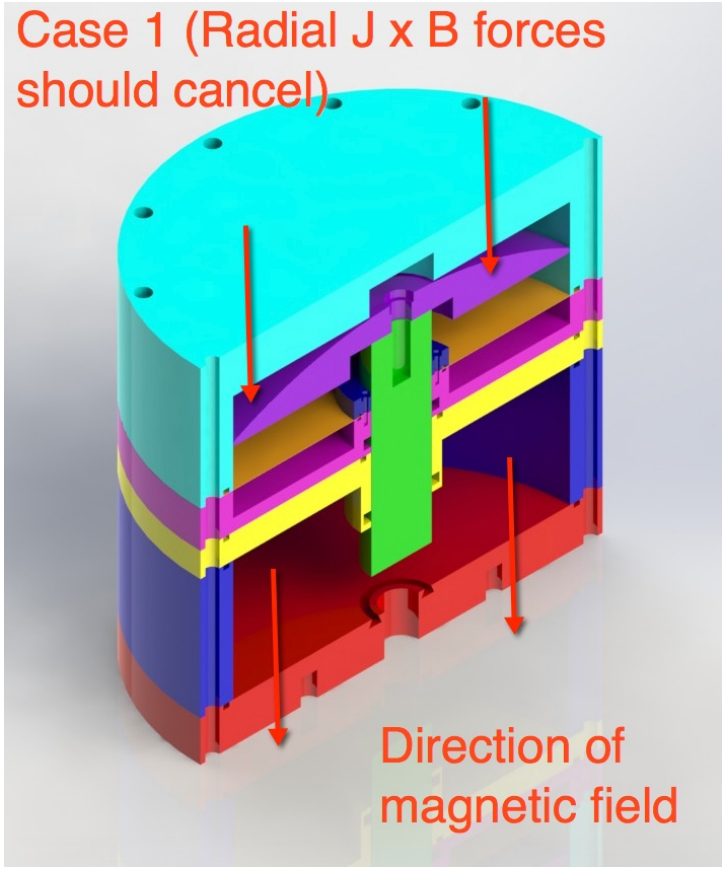
main features

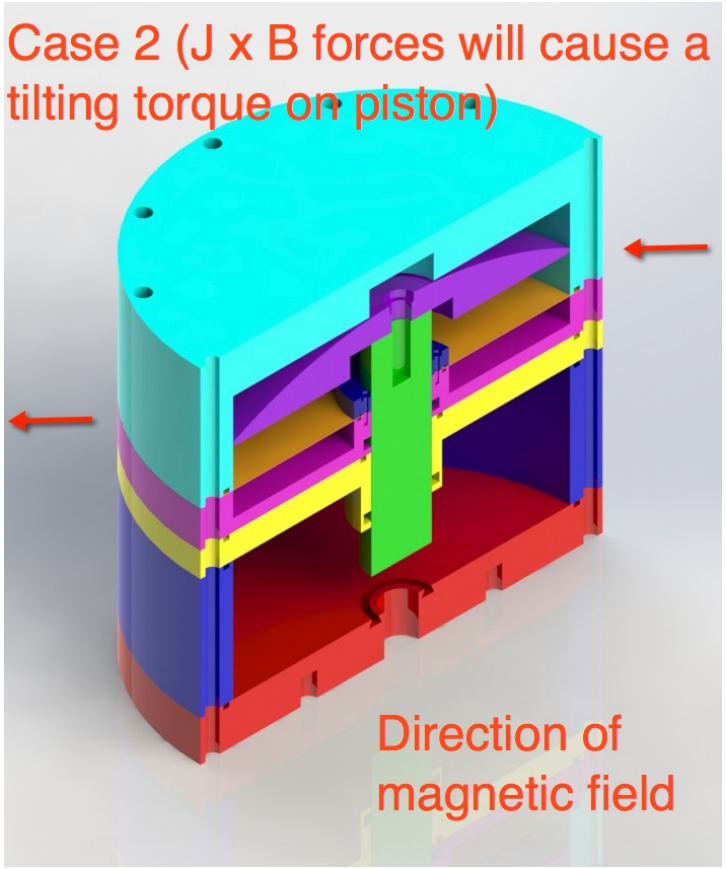
- short distance to plasma ~ 0.1m
- high pressure up to 100 bar **(15 X NSTX-U valve)**
- operation inside toroidal field (~2T)
- large orifice (d=30mm)





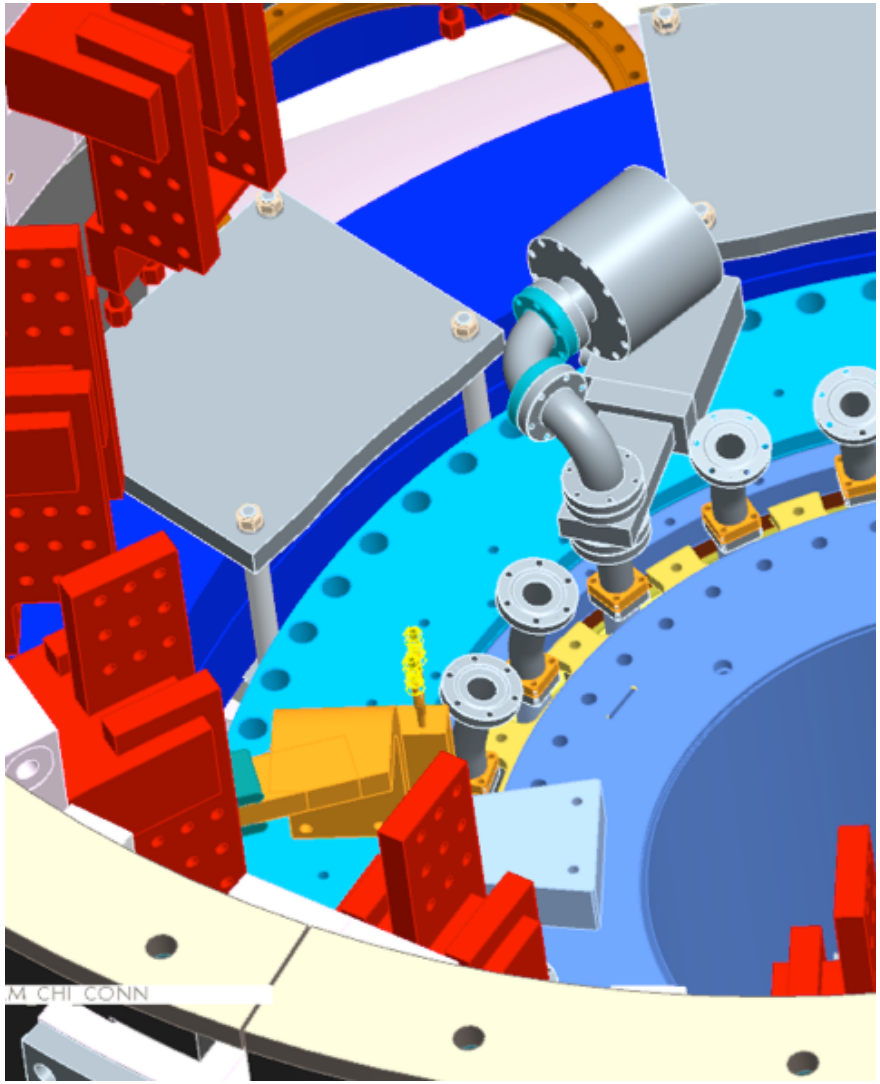
Next Steps (2)





- Test with magnets installed near the valve body
  - 6 inch x 3 inch x 1 inch magnets with surface field of ~1-1.3T (neodymium magnets to be used)
  - Higher forces can be simulated by increasing coil current above normal operating levels

Next Steps (3) & Modified Installation on NSTX-U (CASE 1)



- Strengthen internal valve components
  - Possibly use 15-20 mm orifice size, dependent on Valve 1 results
- Characterize this valve upto 1000 Torr.L
- Describe results in Peer Review (Jan, 2014) – Then fabricate NSTX-U valves
- Revised installation arrangement also avoids issue of lithium getting trapped near O-ring seals
  - Need to consider how to support current leads from the valve (2-5kA current, coax or twisted pair)
  - Additional support for external valve body
  - Valve will be electrically isolated from vessel by a suitable insulating (non-ceramic) spacer (0.5 inch thick), and insulated bolt sleeves