# Lithium systems design for LTX

Dick Majeski
PPPL

# LTX lithium systems

- CDX/LTX experiments have run 12 years without an accident or near-miss
- CDX was the first U.S. tokamak to incorporate liquid lithium PFCs
  - Very extensive safety designs prior to starting experiments
- Developed extensive engineering controls for lithium systems
  - Example: secondary stand-by vacuum system consisting of a Roots blower + backing pump to maintain reduced pressure in LTX, even if a vacuum window cracks
    - » Valved automatically to LTX if main (turbo+cryo) gate valves close
    - » System activation is required whenever heaters are activated (liquid lithium is present in LTX)
  - Heaters are interlocked to the main gate valves
  - Vulnerable windows are quartz, fitted with quartz “sacrificial” blank flats on the vacuum side
  - **ALL** windows are mounted on gate valves, and all can be changed if compromised, without breaking main vessel vacuum
  - Very comprehensive venting procedure to eliminate airborne LiH

# LTX lithium systems

- We do not employ direct water cooling of the vacuum boundary
  - Only provision for in-vessel cooling in LTX is with helium
- We do not use argon pressurization, or any other gas pressurization in combination with liquid lithium
  - Recently developed a gravity-actuated tungsten piston lithium delivery system to avoid argon pressurized lithium delivery to lower shells
- We do not use lithium containment systems with demountable joints
  - Difficult/impossible to effectively leak check once in service
  - Liquid lithium containment employs welded or formed stainless steel or tungsten structures
- !Vacuum boundary is NOT heated above the melting point of lithium!
  - Lithium will freeze out on the wall. No possibility of liquid egress though the vacuum boundary into air.
- Most lithium fires have involved jointed, argon pressurized liquid lithium systems, with a liquid leak into air and resulting fire