U.S. DEPARTMENT OF ENERGY | OFFICE OF ENVIRONMENTAL MANAGEMENT

DWPF/WTP Melter Design and Influence of Glass Formulation

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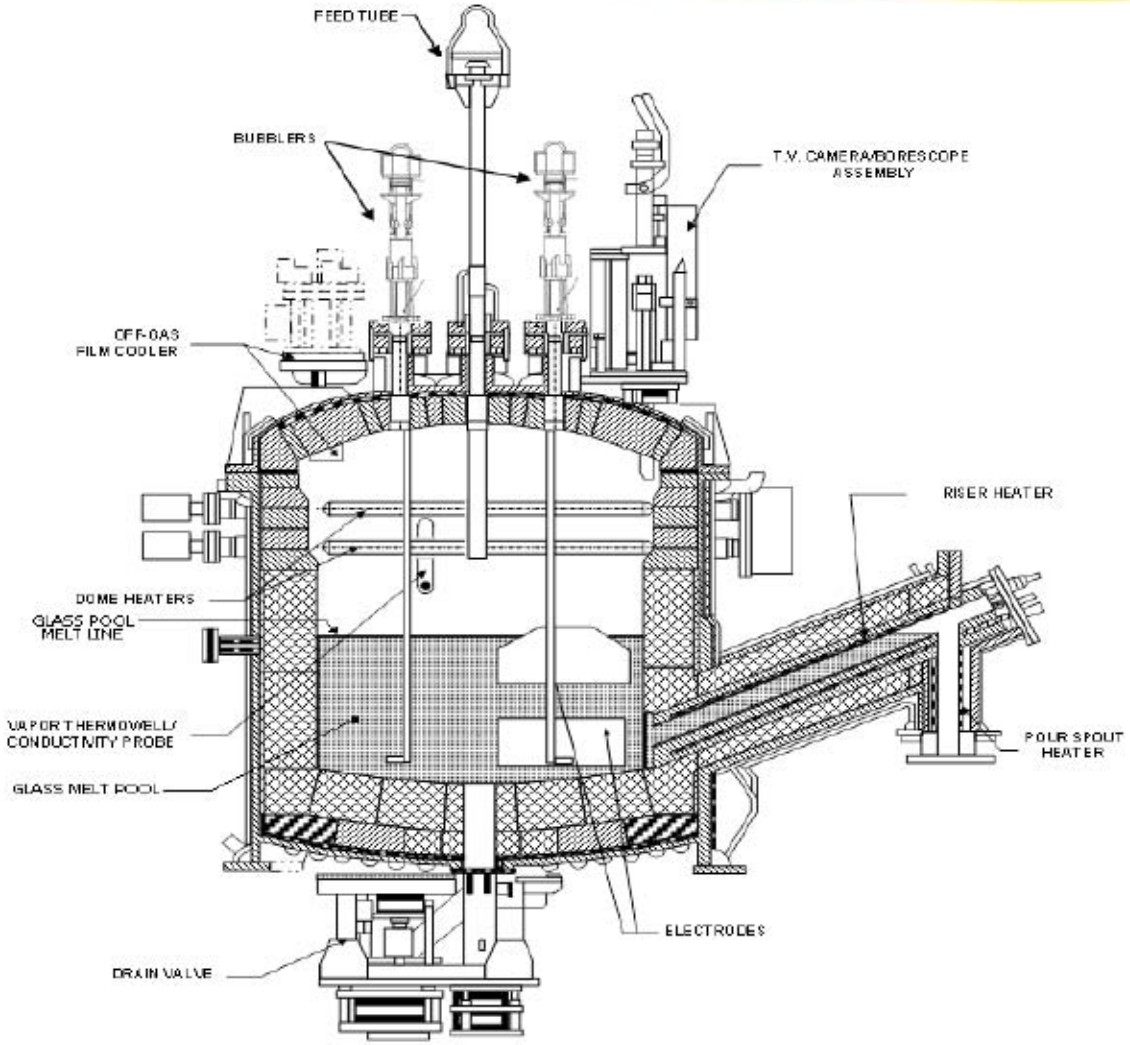
Explain the primary technical differences between the DWPF melter design and the two WTP melter designs

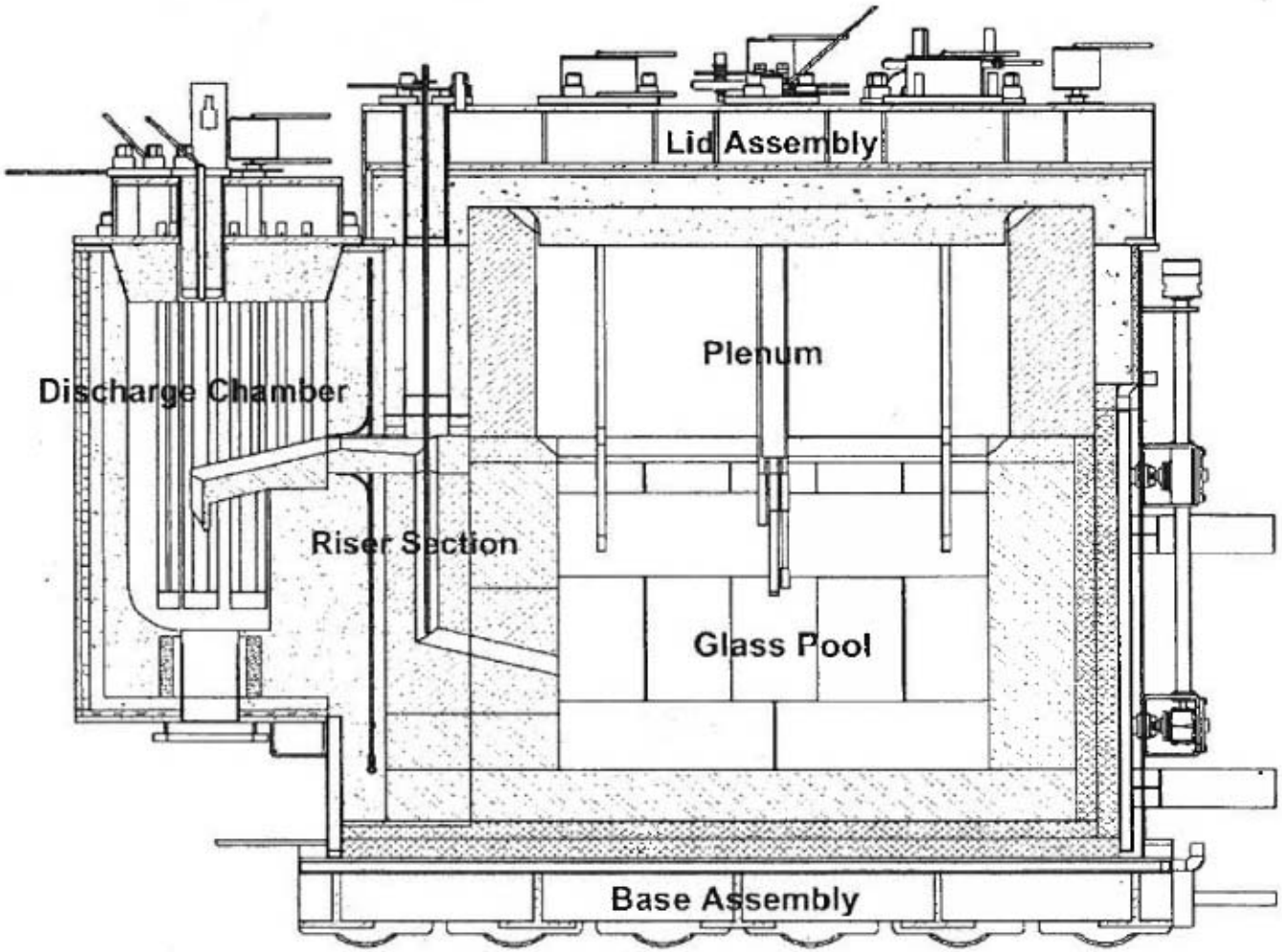
DWPF and WTP Melters

- Similarities
  - Monofrax K-3 glass contact refractory
  - Joule heated melt pool, 1150 °C
  - Inconel 690 electrodes
  - Water cooled shell
  - Bubbler driven glass stirring
  - Slurry Feed
  - Similar Borosilicate Glass
- Differences
  - Size
  - Shape
  - Design philosophy
  - Plenum heat
  - Glass pouring method
  - Draining method
  - Electrode layout
  - Bubbler gas
  - Offgas treatment system
  - Glass former introduction
  - Canister

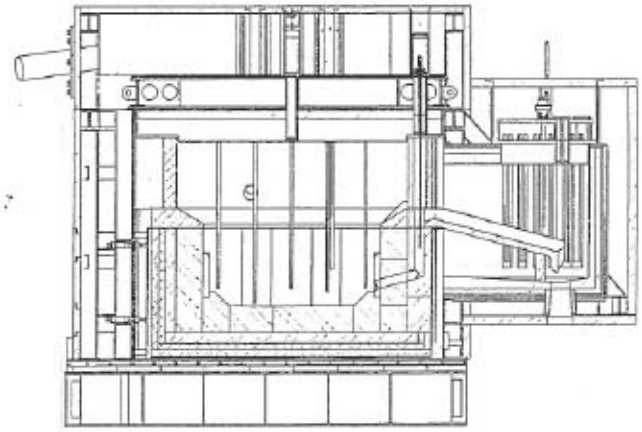
DWPF Melter

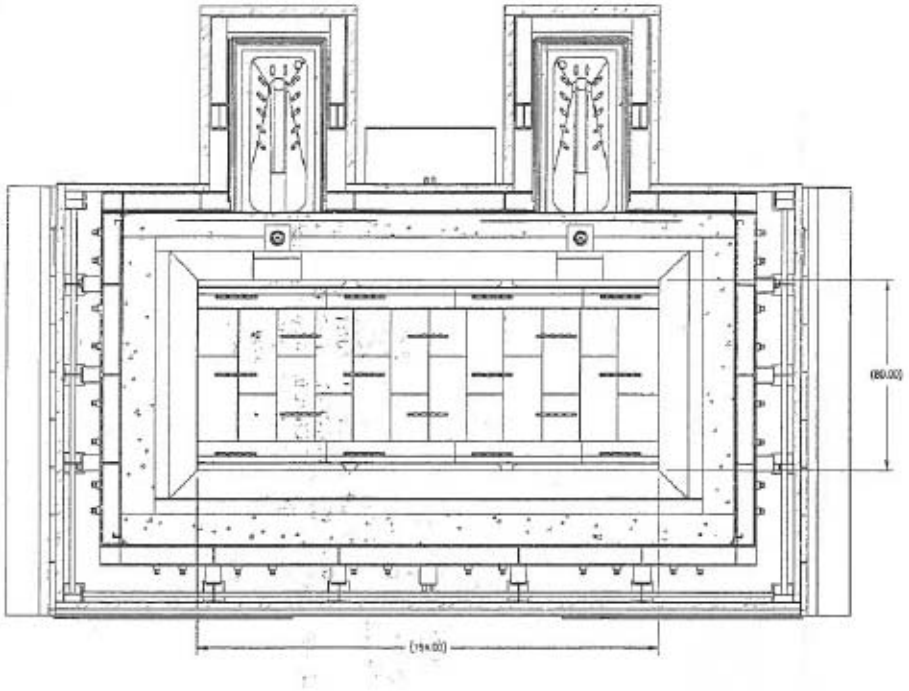

FEED TUBE
BUBBLERS
T.V. CAMERA/BORESCOPE ASSEMBLY
OFF-GAS FILM COOLER
RISER HEATER
DOME HEATERS
GLASS POOL MELT LINE
VAPOR THERMOWELL/ CONDUCTIVITY PROBE
POUR SPOUT HEATER
GLASS MELT POOL
ELECTRODES
DRAIN VALVE

WTP HLW Melter



WTP LAW Melter





DWPF and WTP Melters

- **Size: melt surface area**
  - DWPF: 2.6 m^2
  - HLW: 3.75 m^2
  - LAW: 10 m^2
- **Shape**
  - DWPF: cylindrical heavy wall vessel, complex wedge/curved refractory shapes
  - WTP HLW & LAW: rectangular structure, simple refractory shapes
- **Design philosophy**
  - DWPF: Refractories in compression, locked within water cooled rigid outer vessel. Incorporates compressible materials to accommodate refractory thermal expansion.
  - WTP HLW & LAW: Similar to commercial glass furnace design approach. External cooling panels and adjustable jack screws to retain refractories. "Gas Barrier" shell for offgas control. Incorporate castable backup refractory layers

DWPF and WTP Melters

- **Plenum Heat**
  - DWPF: Lid resistance heaters used during normal operation.
  - HLW & LAW: Lid resistance heaters used for start-up only.
- **Glass Pouring Method**
  - DWPF: Continuous overflow pouring. Pouring initiated and terminated via pressure differential control between melter plenum and canister.
  - WTP HLW & LAW: Batch pouring. Air-lift pumping action within riser channel then gravity flow through pouring trough.
- **Glass draining method**
  - DWPF: Bottom drain valve. Draining initiated via heating of drain valve assembly and raising drain probe into melter.
  - WTP HLW & LAW: Air-lift pumping action via normal path followed by use of evacuated canister.

DWPF and WTP Melters

- **Electrode Layout**
  - DWPF: Two pairs of opposed plate electrodes (upper & lower)
  - WTP HLW: Three electrodes
  - WTP LAW: Six electrodes, Three opposed pairs
- **Bubbler Gas**
  - DWPF: Argon
  - WTP HLW & LAW: Air
- **Offgas Treatment System**
  - DWPF: Redundant systems. Film cooler, quencher, steam atomized scrubber, condenser, mist eliminator, heater, HEPA, exhauster
  - WTP HLW & LAW: Film cooler, submerged bed scrubber, wet electrostatic precipitator, mist eliminator, heater, HEPA, caustic scrubber, thermal catalytic oxidizer. Three LAW melters share common system.

DWPF and WTP Melters

- **Glass Former Introduction**
  - DWPF: Glass frit (powder)
  - WTP HLW & LAW: Glass forming chemicals

- **Canister**
  - DWPF: 2' diameter, 10' tall
  - WTP HLW: 2' diameter, 15' tall
  - WTP LAW: 4' diameter, 7' tall

How have developments and changes in the DWPF glass formulation influenced the design of the WTP melters?

DWPF Glass Formulation Influence ?

- DWPF Glass formulation changes have not directly influenced WTP glass melter design
- DWPF glass formulation is governed by DWPF defined performance and processing constraints
  - Durability, Viscosity, Resistivity, Liquidus, Waste loading
  - Constraints defined based on repository requirements, melter design, operational risk, safety basis
  - Proposed glass formulations must meet all constraints
- WTP melters have a similar set of constraints that govern glass formulation