TREAT Sodium Loop: Status Update

October 7-8, 2015

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Outline

- Document Recovery
- History
- Mk-III Loop
- Key Sodium Loop Technologies
- 3D Modeling
- The Future

Document Recovery

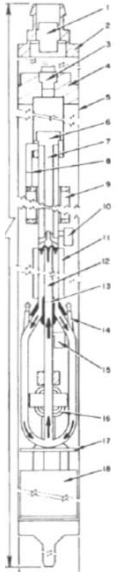
- Mk-II and especially Mk-III loops
  - Drawings
  - System Design Descriptions (SDD)
  - Operating and Maintenance Manuals (OMM)
  - Fabrication specifications
  - Design requirements documents
  - Final design disclosure documents
  - Memorandums
  - Safety Analysis Reports (SAR)
  - Experiment final reports
  - External reports (conferences etc.)

History (Mk-I onward)

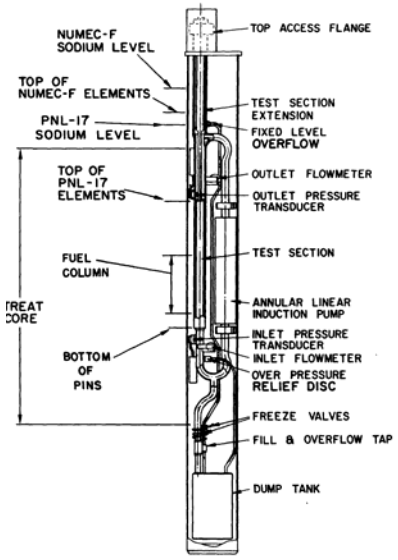
- Mk-I loop
  - One 4”x4” grid position in TREAT core
  - Annular flow path for molten sodium
  - Faraday-type conduction pump
- Mk-II loop
  - Two grid positions (4”x8”) in TREAT core
  - Flow path for molten sodium was through vertical parallel legs
  - Single annular linear induction pump (ALIP)
  - More instrumentation, a larger test section, higher operating temperature and pressure, better remote handling capabilities
  - Several Mk-II model designations, ending with Mk-IICB, whose changes were for improvements in fabricability, inspectability, and attachment of loop outfitting

History (Mk-I onward)

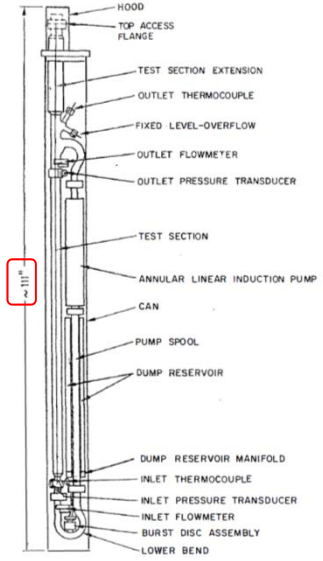
- Mk-III loop was a lengthened version of the Mk-IICB loop
  - ~37 inches longer
  - Usually two ALIPs
- Two experiment sponsors
  - ANL Reactor Analysis and Safety (RAS) Division
  - Hanford Engineering Development Laboratory (HEDL)



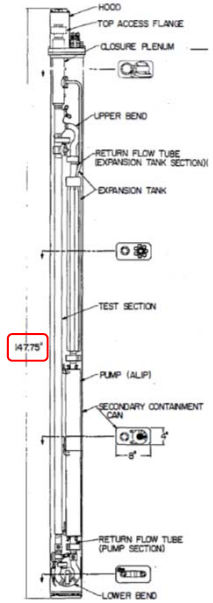
Mk-I



Mk-IIA



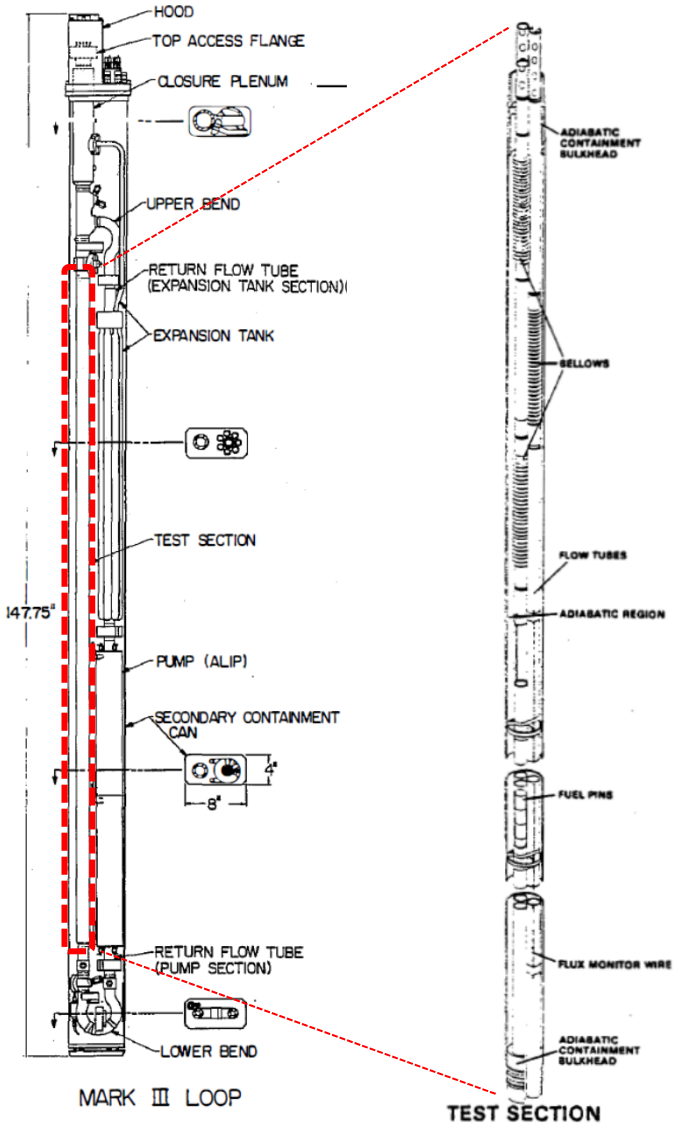
Mk-IIC



Mk-III

Mk-III Loop

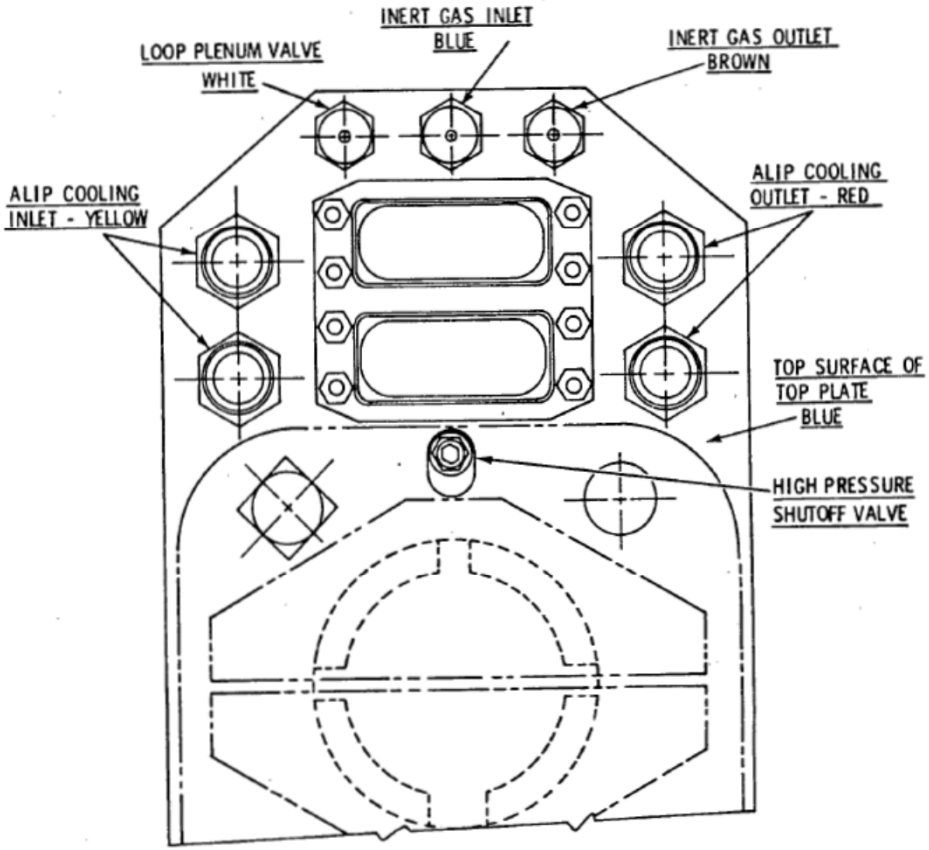
- Three Mk-III model designations
- Mk-IIIA, Mk-IIIB, Mk-IIIC
  - Differed only in the capacity and/or dimensional size of their test sections
  - The bulk of the Mk III loop structure was common to all three loops

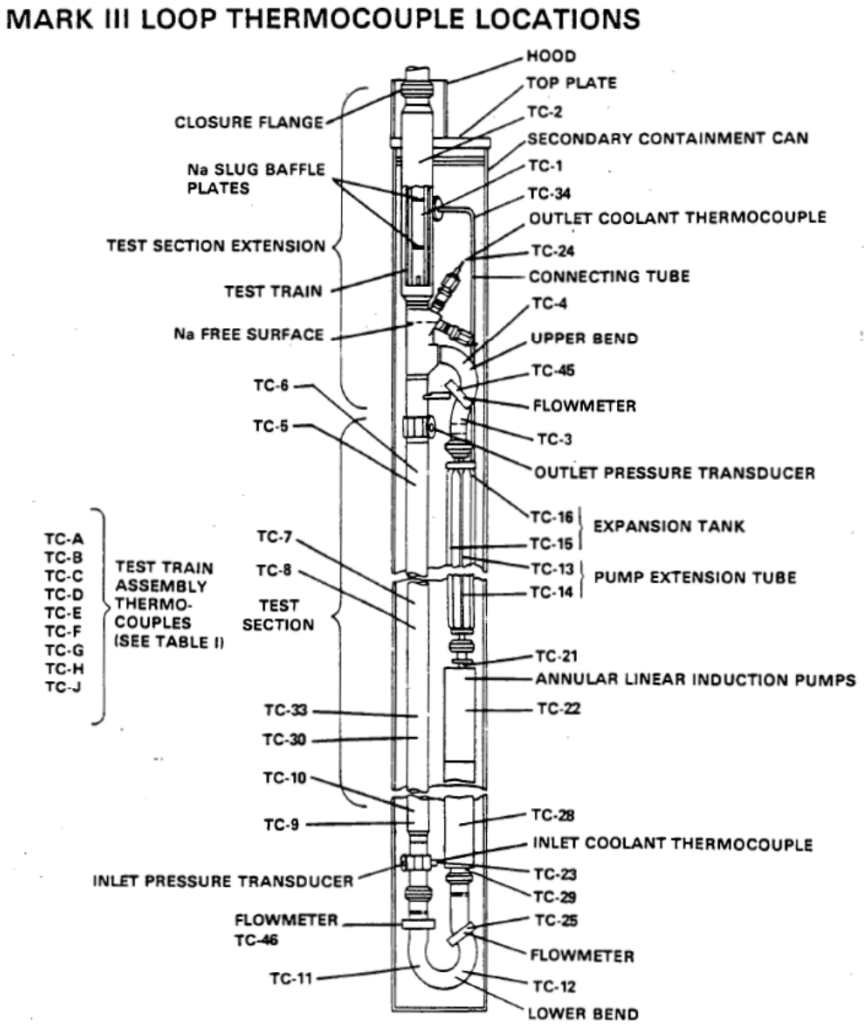


Mk-III Design Features & Characteristics

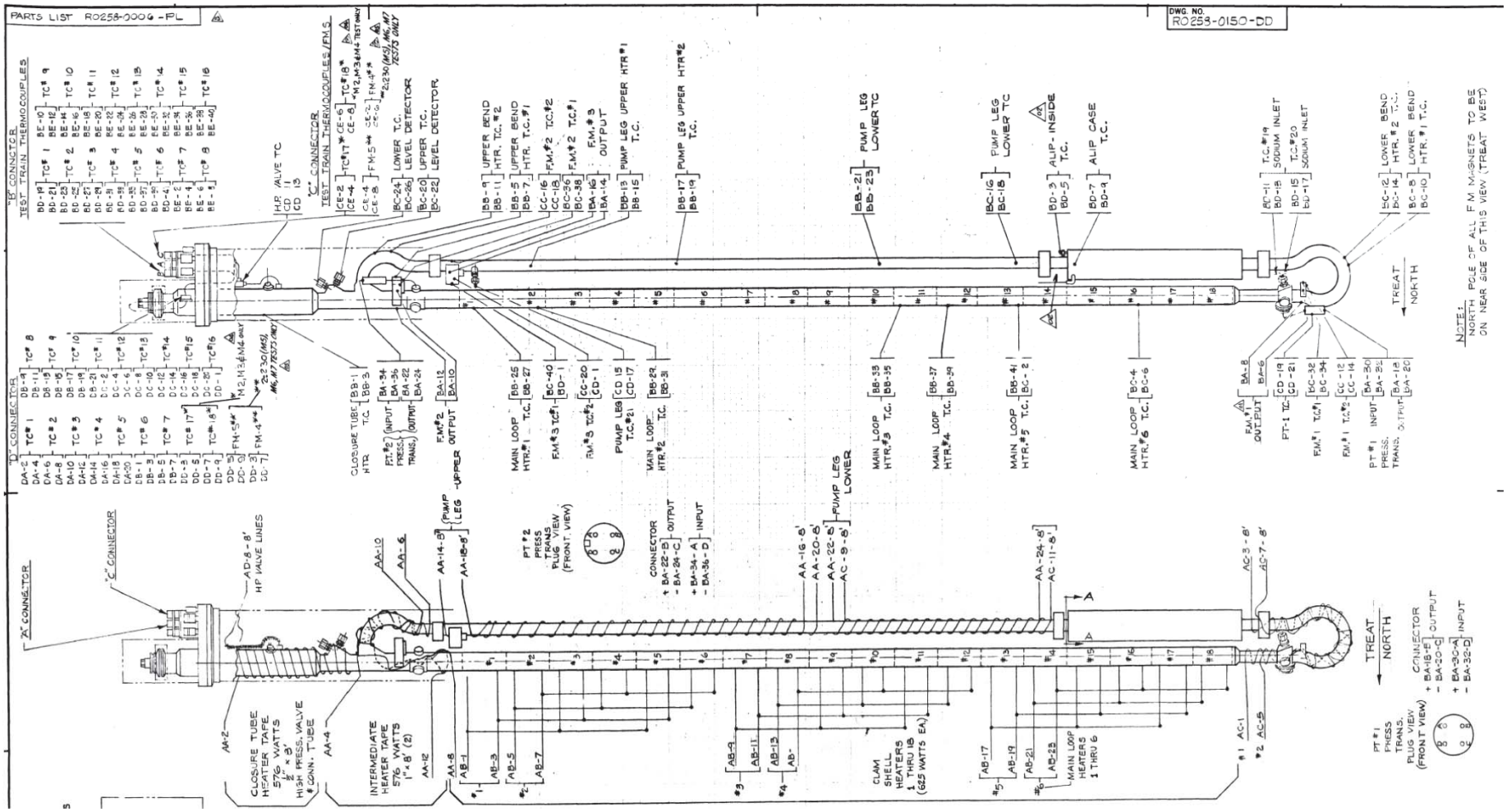
Parameter	Value
Design pressure at temperature	34.5 MPa at 538°C (5000 psi at 1000°F)
Initial pressure proof test	43.1 MPa at 538°C (6250 psi at 1000°F)
Static pressure (pre-transient)	≤ 710 kPa (103 psi) abs, at temperature
Test section inlet temperature (pre-transient)	≤ 400°C (752°F)
Volume of sodium	≈ 2 liters
Mass of sodium	≈ 1.25 kg
Sodium flow velocity	≤ 7 m/s (23 ft/s)
Sodium flow rate	≤ 1.2 liter/s (19.4 gal/min)
Burst disc design pressure (P)	30% ≤ P ≤ 90% of loop rated pressure (± 5%) (1500 ≤ P ≤ 4500 psi) (at ≤ 500°F)
Mass of loop	115 kg (253 lb)

Mk-III Loop Instrumentation



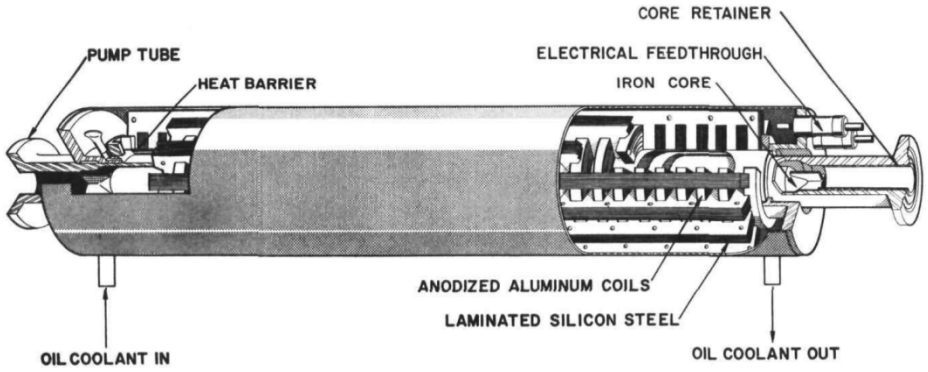


Mk-III Loop Instrumentation

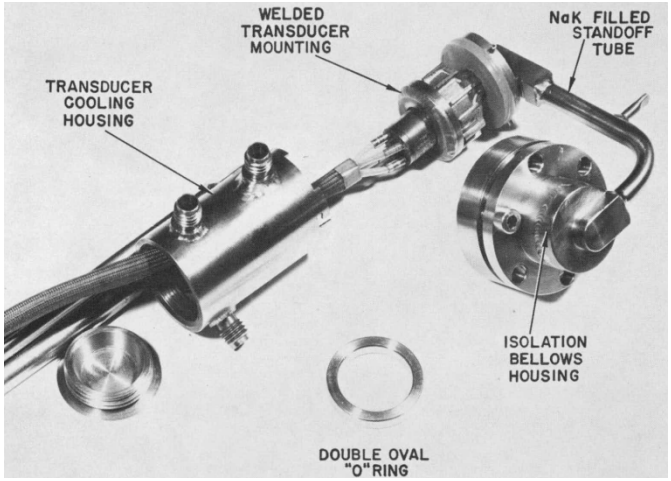


Key Sodium Loop Technologies

- Annular Linear Induction Pump (ALIP)



- Pressure Transducer



- Permanent Magnet Flowmeter

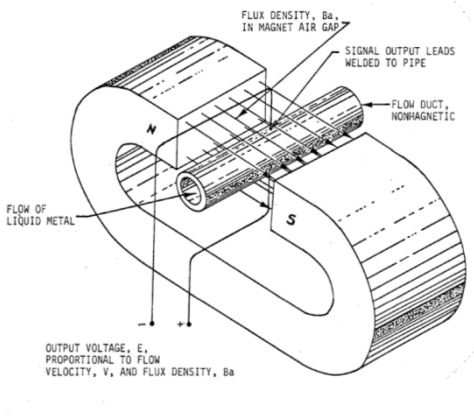


FIGURE A.5. Typical Permanent Magnet Flowmeter Configuration.

3D Modeling (Mk-IIIA Loop)

The Future

- Design of Mk-IV loop should be based upon the Mk-III loop
- Room for advancement – materials, fabrication techniques, instrumentation
- Maintain compatibility with legacy equipment and the TREAT core
- More demanding design requirements are likely – increased temperature, flow rate, length, etc.
- Disposition pathway for sodium should be considered during the design phase

Questions and Answers (Open Forum)