

Experimental Program to Address Knowledge Gaps in Phenomena Related to Severe Accident Source Terms in Small Modular Reactors

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Objectives

Investigate phenomena relevant to severe accidents High Temperature Gas-cooled Reactor (HTGR) and Integral Pressurized Water-cooled Reactor (iPWR) type SMRs:

- Initiation of bulk natural circulation of air in an air ingress accident, affecting graphite oxidation in HTGRs
- Fission product aerosol behaviours in small water-immersed containments with strong condensation effects

Federal Stakeholders

- Natural Resources Canada (NRCAN)
- Canadian Nuclear Safety Commission (CNSC)

HTGR Air Ingress Experiment

Previously:

- Prepared technical specifications document for experiment measuring air ingress into HTGR primary vessel
- Completed conceptual design of High Temperature Air Ingress Facility (HTAIF)

Progress in FY:

- Detailed Engineering design initiated and in-progress
- Commenced bulk material procurement

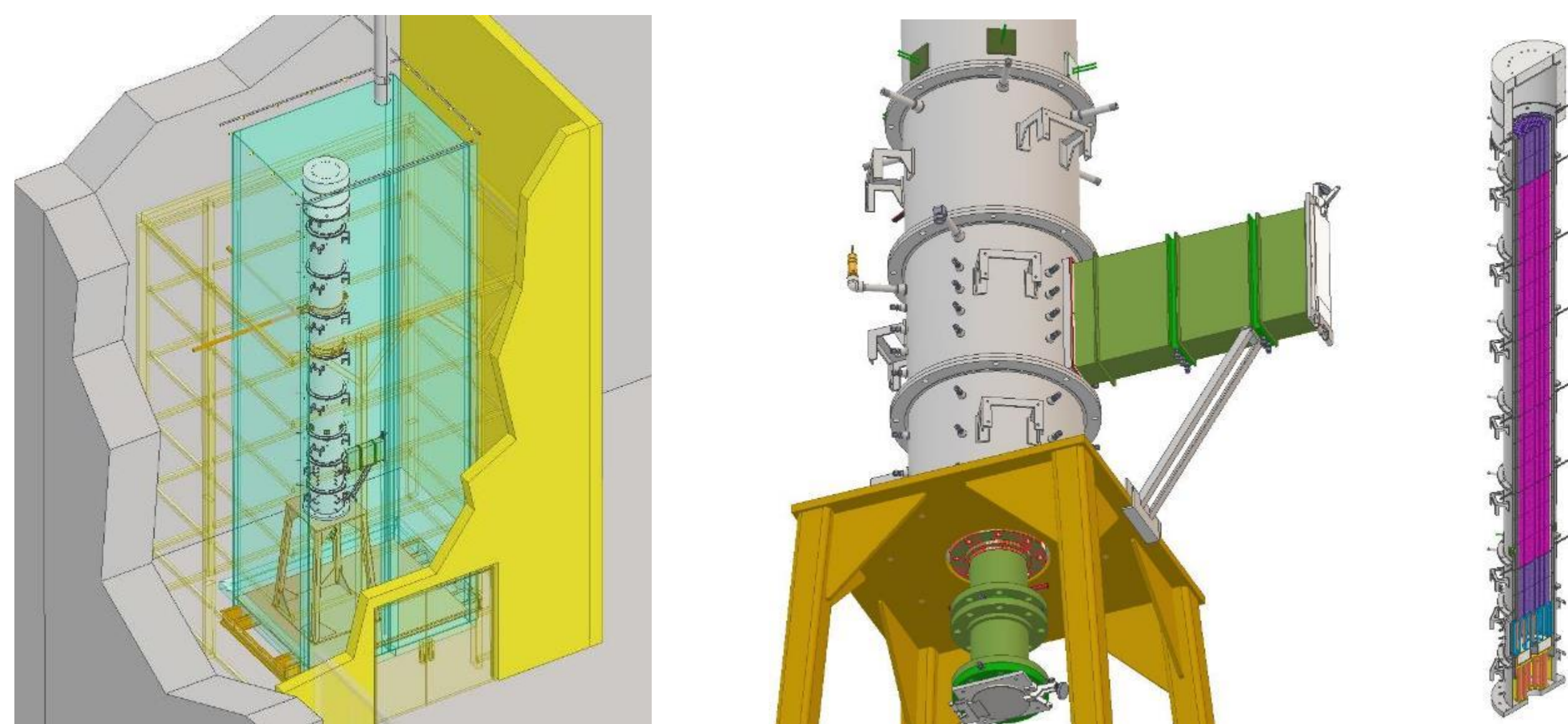


Figure: Cutaways of the HTAIF in the Large Scale Containment Facility (LSCF). The HTAIF will be full vertical scale and configurable for horizontal and vertical coaxial duct designs.

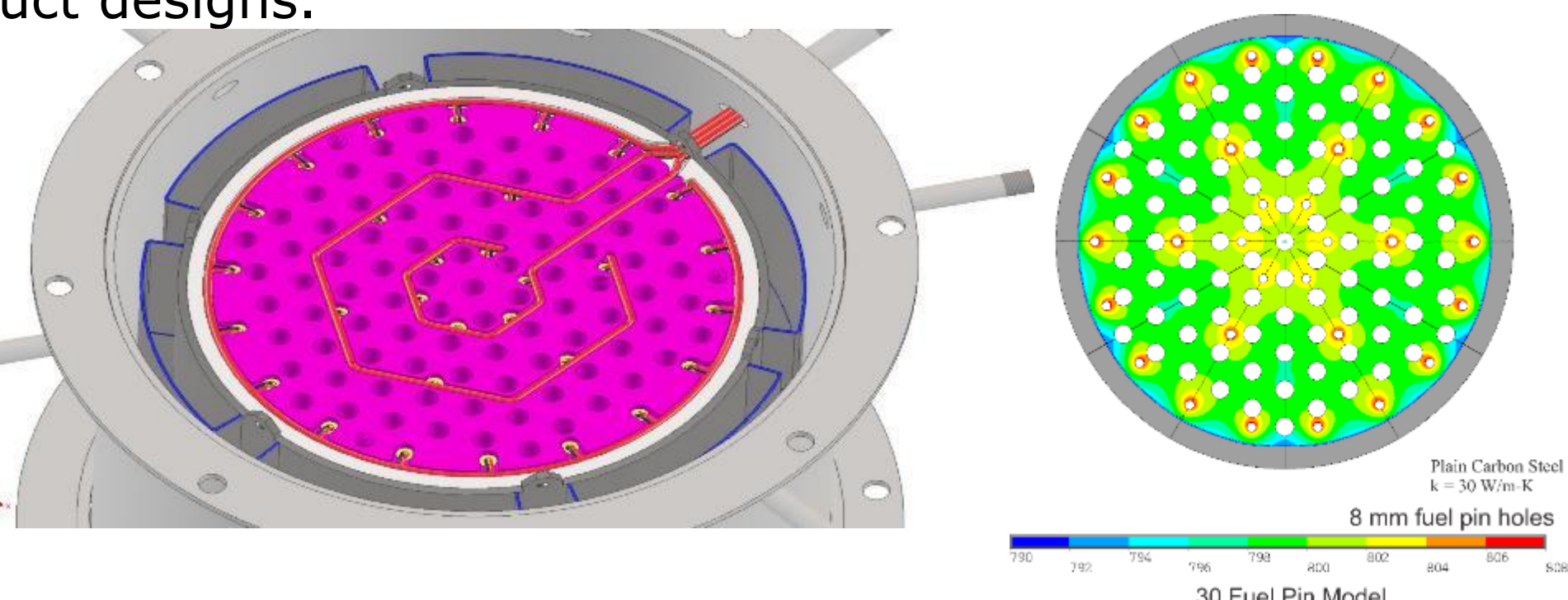


Figure: Steel core blocks will be heated to 700°C under helium before opening the duct to air. Initiation of bulk natural circulation can be determined via the gas temperatures.

Future work:

- Material procurement, construction and commissioning
- First test campaign, after scheduled construction completion

Expected outcomes:

- Experimental data on the timing of initiation of bulk natural circulation of air in a scaled (full-height) HTGR vessel. Data will be needed to benchmark model predictions of air ingress and graphite oxidation in HTGR severe accident analysis.

iPWR Aerosol Behavior Modelling and Experiment

Previously:

- Prepared test plan for measuring aerosol behavior in iPWR containment conditions
- Created preliminary MELCOR model of generic iPWR
- Detailed design of the Strong Condensation Containment Apparatus (SCCA)

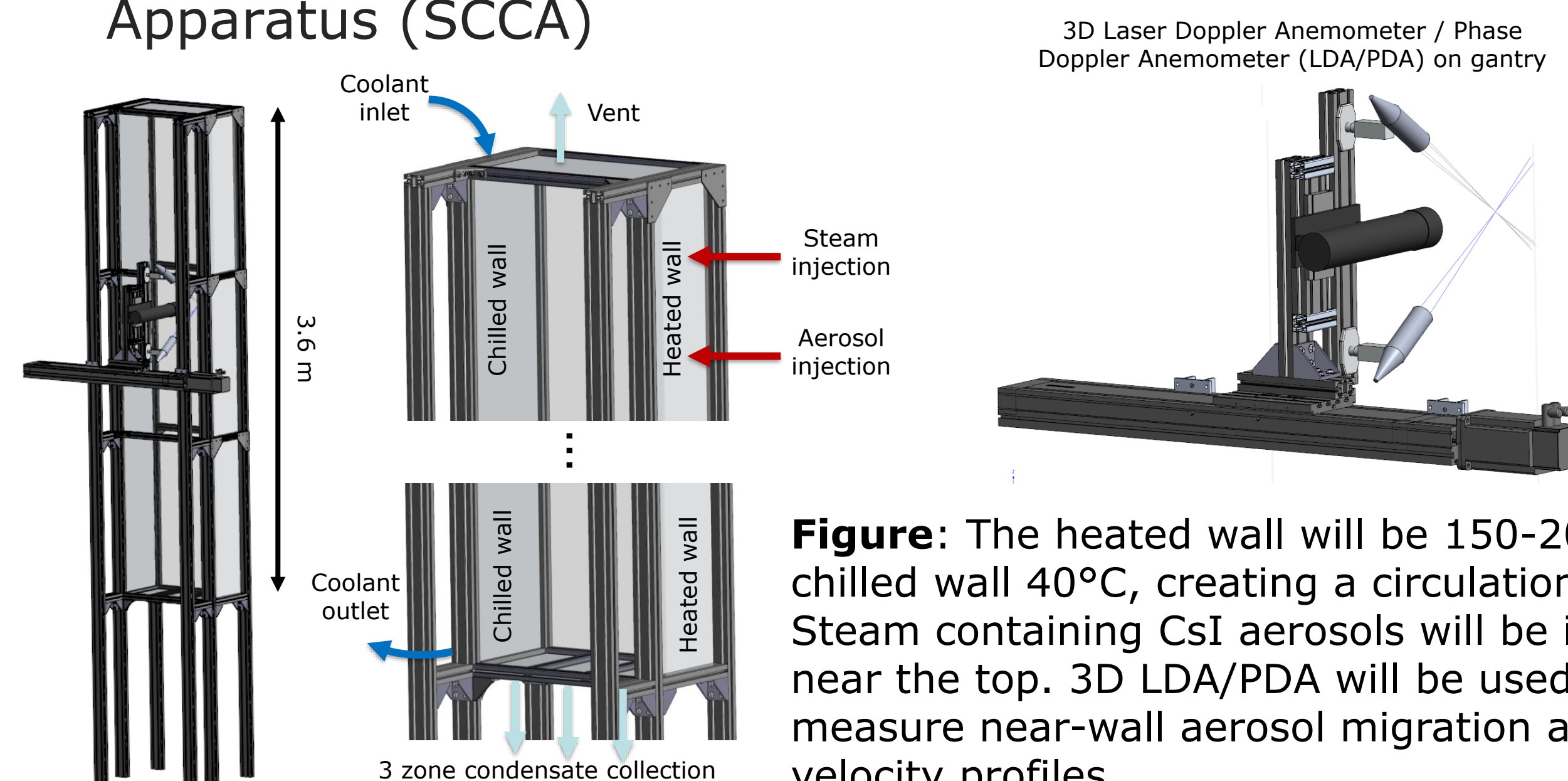


Figure: The heated wall will be 150-200°C, the chilled wall 40°C, creating a circulation current. Steam containing CsI aerosols will be injected near the top. 3D LDA/PDA will be used to measure near-wall aerosol migration and bulk velocity profiles.

Progress in FY:

- Created MAAP-CANDU model of US DOE/EPRI iPWR aerosol experiments for benchmarking
- Construction and commissioning of experimental apparatus

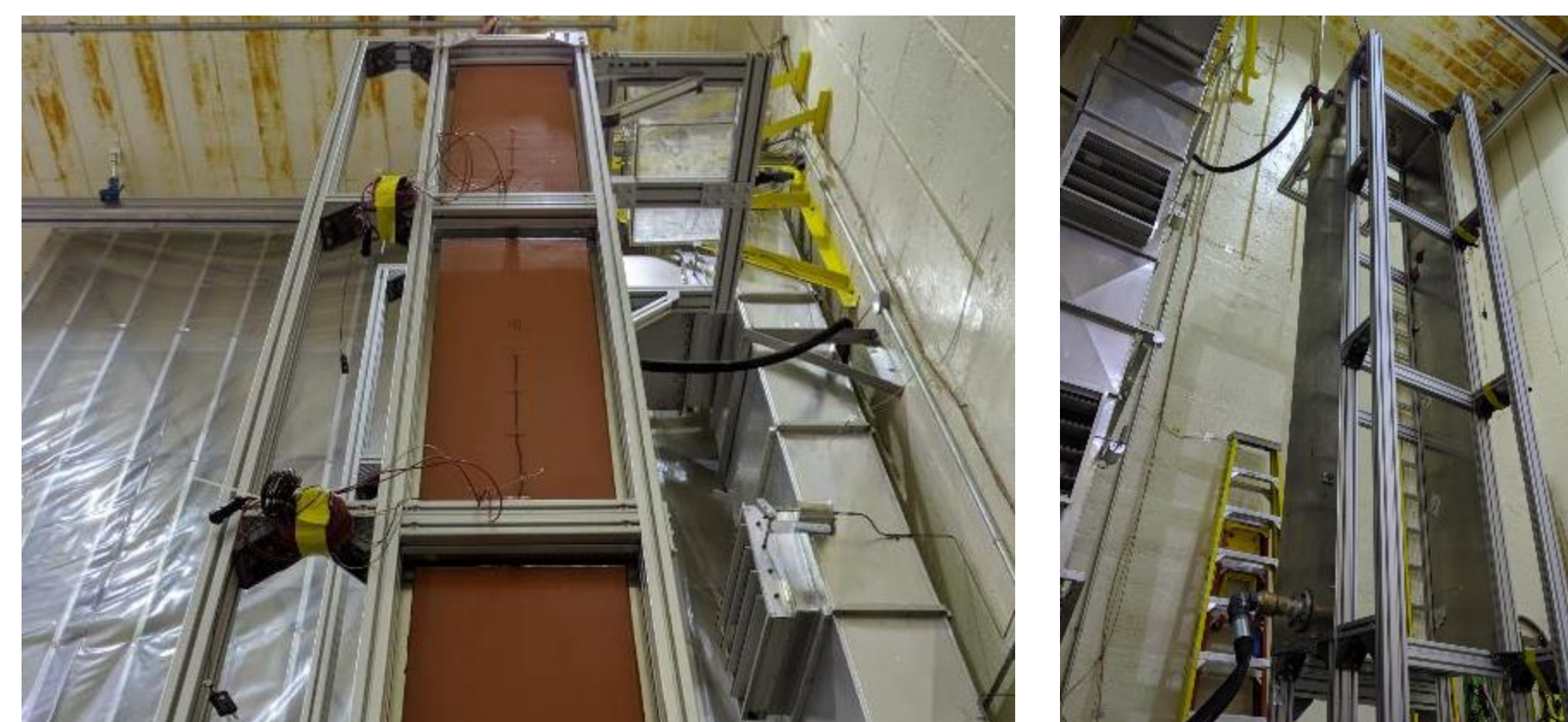


Figure: The SCCA has been constructed within the LSCF (Building 137 Room 109). Silicone rubber heaters warm the heated wall (left). Facility water cools the chilled wall (right). Wall surfaces have been instrumented with thermocouples.

Future Work:

- First test campaign of aerosol behavior using the SCCA

Expected outcomes:

- Data on fission product aerosol behaviours in iPWR containment conditions. Data will be used to evaluate high source term retention predictions in iPWR accident analysis.

Canadian Leadership in SMRs

Previously:

- Technical program chair for G4SR-1 conference

Progress in FY:

- SMR track chair at Canadian Nuclear Society conference
- Participated in US DOE workshop on Licensing Base Events for Molten Salt Reactors
- Coordination meeting for IAEA Collaborative Research Project (CRP) on SMR Emergency Planning Zones (EPZs)

Future work:

- Technical program chair for G4SR-2 conference

Collaborations

- IAEA CRP on technical basis for SMR EPZs
- US-Canada Action Plan

