Overview

-Nuclear transient testing often requires purpose-built transient test reactors
-But depending on event duration, steady state reactors can be better suited to some transient scenarios
-The Advanced Test Reactor (ATR) has a rich history of transient testing, particularly for power cycling
-ATR’s unique design would also allow accident simulations
  1) Transient overpower
  2) Loss of flow
  3) Loss of coolant

Intro to ATR

-Constructed in 1967 and still considered advanced in 2017
-Unique serpentine shape creates nine high intensity flux traps
-Up to nine (currently five) in-pile tubes for pressurized water loops in flux traps
  1) Discrete control over flowrate, chemistry, and inlet temperature
  2) Other positions (flux trap and reflector) for drop-in or instrumented lead-out tests

ATR Transient Testing Capabilities
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ATR could be used for slower transient overpower testing
  1) Control drums allow ~3:1 power tilt in corner lobe powers
  2) ~30 sec minimum “comfortable” period in manual mode

Leadout tests enable temperature adjustment via cover gas blend (Ar:He blend)
  1) Could be used for temperature transients (with or without varying reactor power)
  2) Leadout and loop type tests can monitor real time for fission product release

Powered Axial Locater Mechanism (PALM) drives experiments into and out of core
  1) Max PALM speed 0.15 m/s (6 in/s)
  2) Ideal for simulating load following, power demand cycles, etc.

ATR will trip on low flow signal from loops
  1) Could simulate SCRAM-protected loss of flow
  2) Safety constraints prevent intentional loop blowdown
  3) Depressurization via blow down of thermosiphon in reflector
  4) Sync with planned SCRAM for a decay heat-driven LOCA test

Experiments discharged to storage during outage can undergo non-destructive exams
  1) Project underway to expand in-channel exam capabilities
  2) Experiment can be returned to reactor for further testing

References