Resumption of Transient Testing Program

TREAT Startup Update

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Facility Location

[Map showing the location of the Idaho National Laboratory with labels for different areas and complexes, including Alberta, Montana, Idaho, and Nevada.]

[Treat facility image and Materials and Fuels Complex image with specific locations marked on the map.]
Nuclear fuel tends to fracture during use or when exposed to a power burst, it is important for the fuel to retain reasonable structural integrity.

During a transient test, fuel is exposed to a power to cooling mismatch, driving the fuel to high temperatures.

Transient testing fuel and crash testing cars have a lot in common: Design and test for high safety standards.
TREAT Reactor

- Designed to conduct transient testing of fuels and structural materials.
- Reactor has performed 6604 reactor startups, 2884 transient irradiations.
- Major refurbishment completed in the late 1980's, and upgraded reactor ran from 1989 to 1994.
- Reactor remained fully fueled during standby from 1994 to now, plant left in excellent condition with all required surveillance and maintenance activities performed.

- Over 20 GW Peak Transient Power (120 kW Steady-state power).
- Core: 4 ft. high x roughly 6 ft. dia.; surrounded by 2 ft. graphite reflector.
- Fuel: 19 x 19 array (approximately 360 fuel elements) of 4 in. X 4 in. fuel and reflector assemblies.
- LEU conversion work initiated.
TREAT Configuration and Unique Features

• No decay heat mitigation actions required
  – Negligible decay heat
  – Low fission product inventory
  – No emergency cooling or residual heat removal required
  – No emergency power required

• Self-limiting
  – Near instantaneous large negative temperature coefficient – safely shuts the reactor down, inherently safe
  – Reactor Trip System is not required to prevent fuel damage

• Reactivity Control and Operation
  – Prompt critical operation – normal mode
  – Air cooling system has a non-safety-related function – operated during steady-state operations or to prepare for next transient
  – Three independent Control Rod Drive types
  – Transients performed from remote Control Room
  – Self-contained experiments
RTTP Recap and Highlights

- Managed as a reactor being returned to service following an extended outage.
- Relied on operations and maintenance history and experienced operating personnel.
- Required activities completed for restart include:
  - Systematic approach used to return facility systems and equipment to service.
  - Procedures and processes revised to current standards.
  - Hired and trained full operating staff.
  - Thoroughly tested and exercised all equipment and systems supporting reactor operations.
- Extremely good safety record with no significant injuries.
- Resumption of Transient Testing Program (RTTP) was completed August 31, 2017, more than twelve months ahead of the baseline schedule of September 2018 and for about $20M less than the baseline cost estimate of $75M.
- On November 14, 2017 the Reactor critical operations resumed after over two decades of standby.
TREAT Restart Timeline

2011: Mission need approved for transient testing

2014: In February NEPA process completed and FONSI approved, TREAT selected as the reactor to perform transient testing

2014: After February initiated assembling restart team, initiated infrastructure items such as facility cleanout, roof replacement, initiated system walkdowns

2015: Revised and implemented SAR and TS to allow control rod and in core activities, DOE RA performed, system testing initiated, facility repairs and refurbishment under way

2016: Poisoned core and validated, replaced Transient Rod shock absorbers, completed plant significant modifications, initiated integrated plant simulated operations

2017: Completed all personnel, plant, and process preparations, initiated and completed review processes, low power testing initiated

2018: Physics testing, completion of restart plan, initiate experimental operations ~ March 2018
Equipment Readiness Journey
**Future of TREAT Operations**

- The Reactor will continue to be operated through 2017 at low power for startup testing.
- Experiments and testing of new cutting edge instruments is expected to commence in calendar year 2018.
- There is great interest in use of TREAT, anticipated customers and research are under development.
- Dan Wachs is giving a Transient Testing experiment presentation later in the meeting.
**Fuel Assembly**

- **Standard Fuel Assembly**
  - Central uranium oxide-bearing Fuel Section
  - Upper and lower Graphite Reflector Sections
- **Fuel Section**
  - Standard is 4 feet long, contains six 8 inch long fuel blocks, specialized use less fuel
  - 1 part HE UO₂ to 10,000 parts carbon/graphite
  - 37g HE UO₂ per fuel element
  - Clad in Zr-3, under vacuum
- **Carbon and Graphite Urania Fuel**
  - High heat-absorption capability provides heat sink for transient heat without cooling dependence.
  - Homogeneity of fuel and moderator provides near instantaneous large, negative temperature coefficient.
  - Excellent thermal shock resistance sustain high rates of heat input during transient operation.
  - Less than 0.3% burnup on existing fuel, indicating remaining fuel life well in excess of the 40 year programmatic projected need.
- **Graphite Reflector Sections**
  - 2 feet long each