INL/MIS-21-65025-Revision-0

Fuel Refabrication Prototype - Presentation for 2021 ASI Annual Webinar

November 2021

Joe Palmer

Changing the World's Energy Future

Idaho National Laboratory

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ASI Advanced Sensors and Instrumentation

Fuel Refabrication Prototype

CT-22IN070208

Advanced Sensors and Instrumentation (ASI) Annual Program Webinar

November 15 – 18, 2021

Reactor Experiment Designer: Joe palmer

Idaho National Laboratory

Project Overview

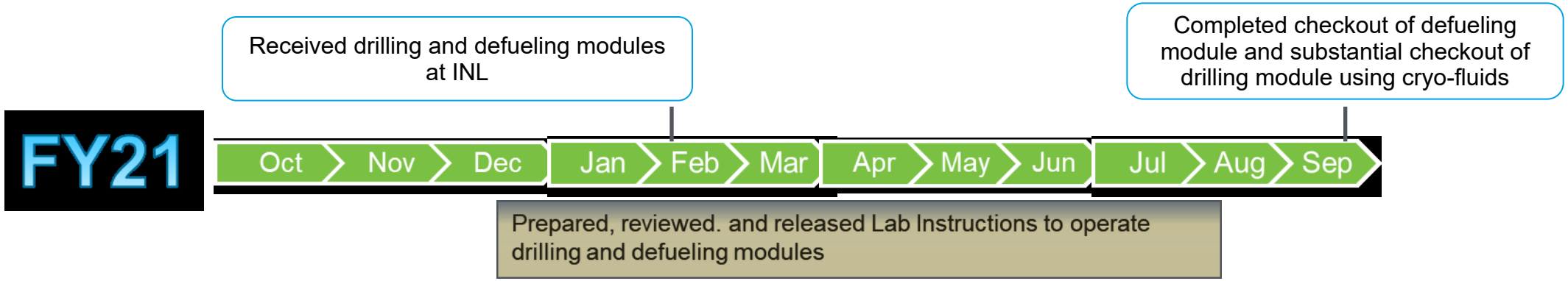
- Objective

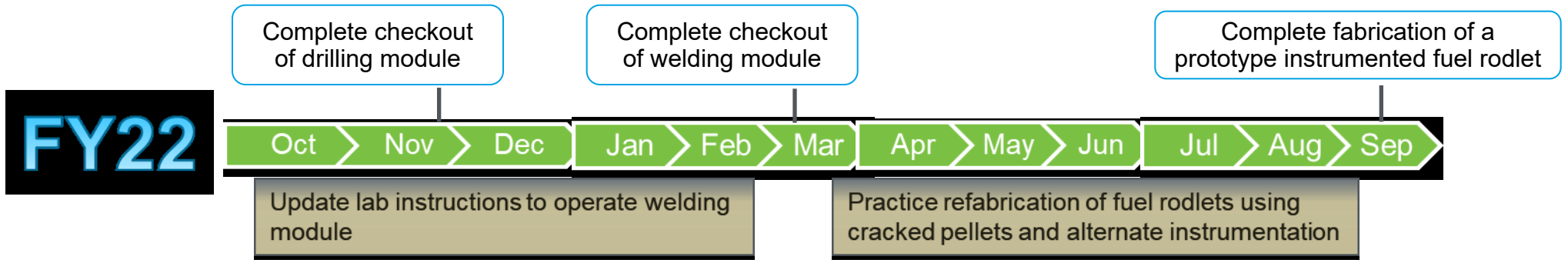
  Capture critical technology created by Institute For Energy (IFE - formerly Halden Reactor Project) to re-instrument irradiated fuel rodlets, and further this technology to enable incorporation of advanced instrumentation: fiberoptics, LVDTs, ultrasonic based sensors

- Participants
  - Joe Palmer – Project lead
  - Dr. Austin Fleming – Technical Point of Contact
  - Kory Manning – Lead technician
  - Spencer Parker – Weld engineer
  - Steinar Solstad – Project lead at IFE (Halden, Norway)

Project Overview

Timelines of Project Activities FY-21 and F-Y22





Milestones

FY-21, FY-22 Milestones

Milestone	Due Date	Status
Receive welding module for the re-instrumentation facility procured from the Institute For Energy - Halden, Norway	9/30/2021	Slipped to 11/30/2021
Complete system checkout testing of the re-instrumentation facility procured from the Institute For Energy - Halden, Norway	12/31/2021	Slipped to 3/31/2022
Complete fabrication of an instrumented fuel rodlet prototype using ceramic surrogate pellets in place of UO2	9/30/2022	On schedule

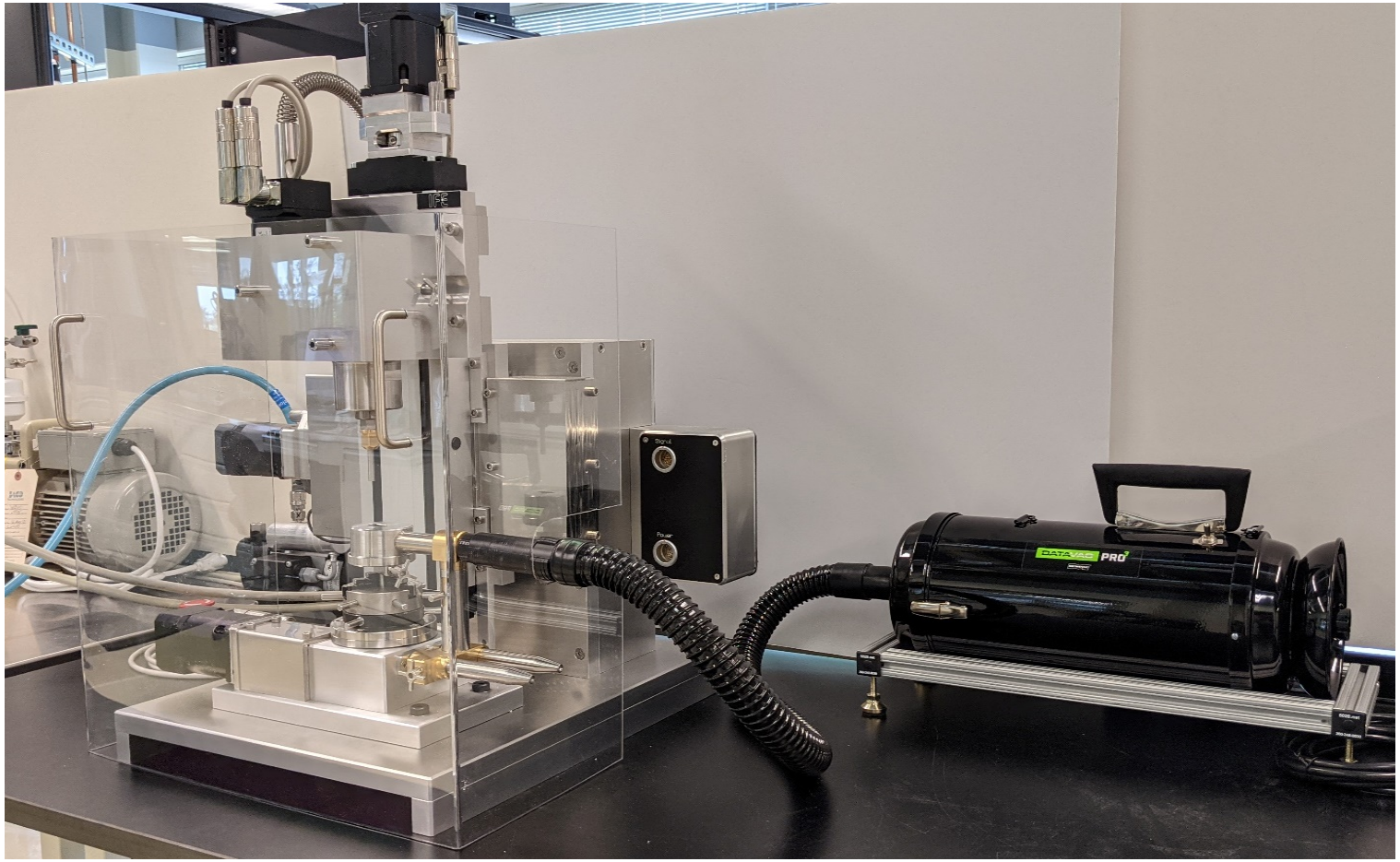
Technology Impact

- For decades, the Halden Boiling Water Reactor (HBWR) in Norway was a key resource for assessing nuclear fuels and materials behavior to address performance issues and answer regulatory questions.
- The HBWR was shut down in 2018. In order to avoid the loss of the unique experimental techniques developed at Halden, INL is procuring equipment modules designed to re-instrument sections of LWR fuel rods prior to irradiation in a test reactor.
- This is part of a broader effort to transfer the expertise developed at Halden to other relative facilities such as TREAT and ATR.
- This fuel testing is key to advancing and qualifying new light water reactor technologies.

Accomplishments

Defueling Module Setup

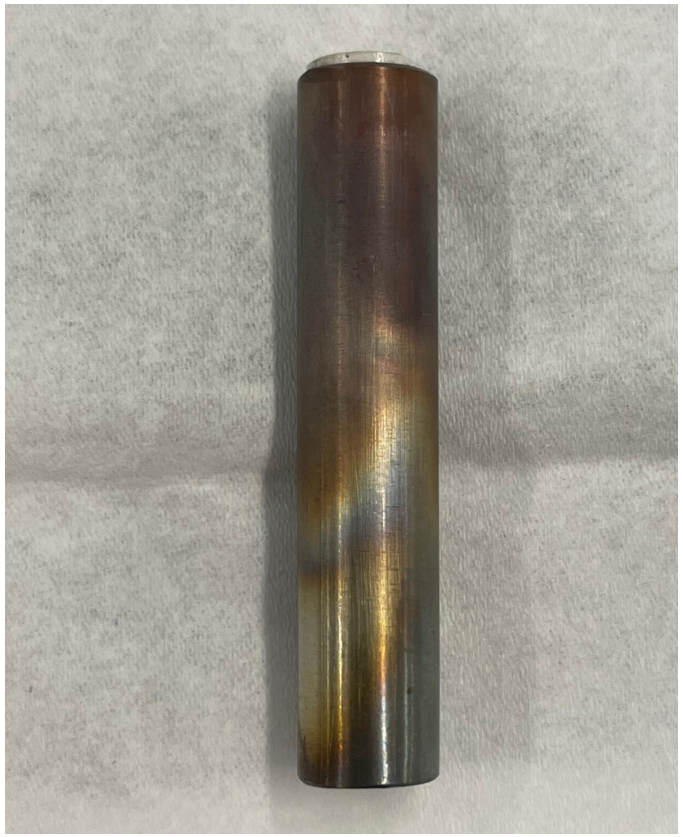
- **Received Defueling Module**
  - Installed transparent personnel protection shield
  - Incorporated vacuum to collect fines
  - Practiced “defueling” a surrogate rodlet



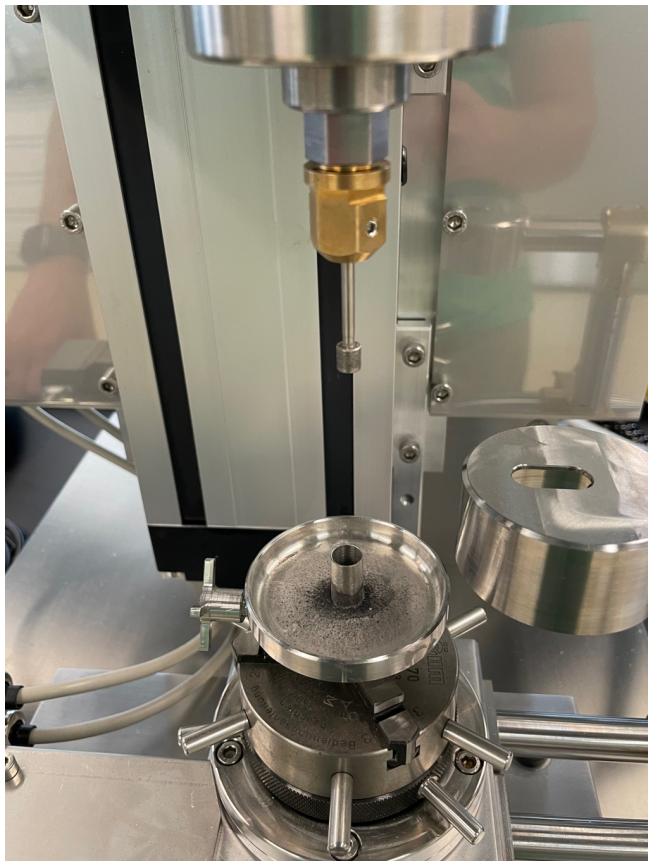
“Defueling” module

Accomplishments

Defueling Practice



Mullite pellets glued inside oxidized (sst) cladding



Top pellet removed and oxidation cleaned from inner and outer surfaces of the cladding (this is prep for welding)

Accomplishments

Drilling Module Setup

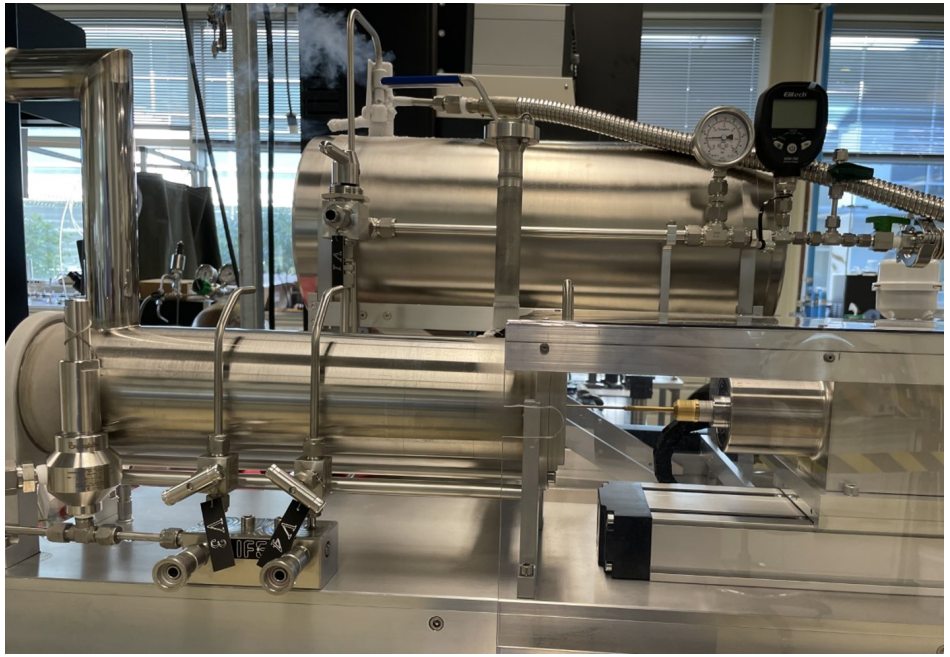
- **Received Drilling Module**
  - Installed transparent personnel protection shield
  - Incorporated two vacuum systems: 1) to collect fines and 2) to establish vacuum jacket for dewar
  - Practiced drilling with cryo-system active

Cryo-drilling unit with vacuum pumps and guards in place

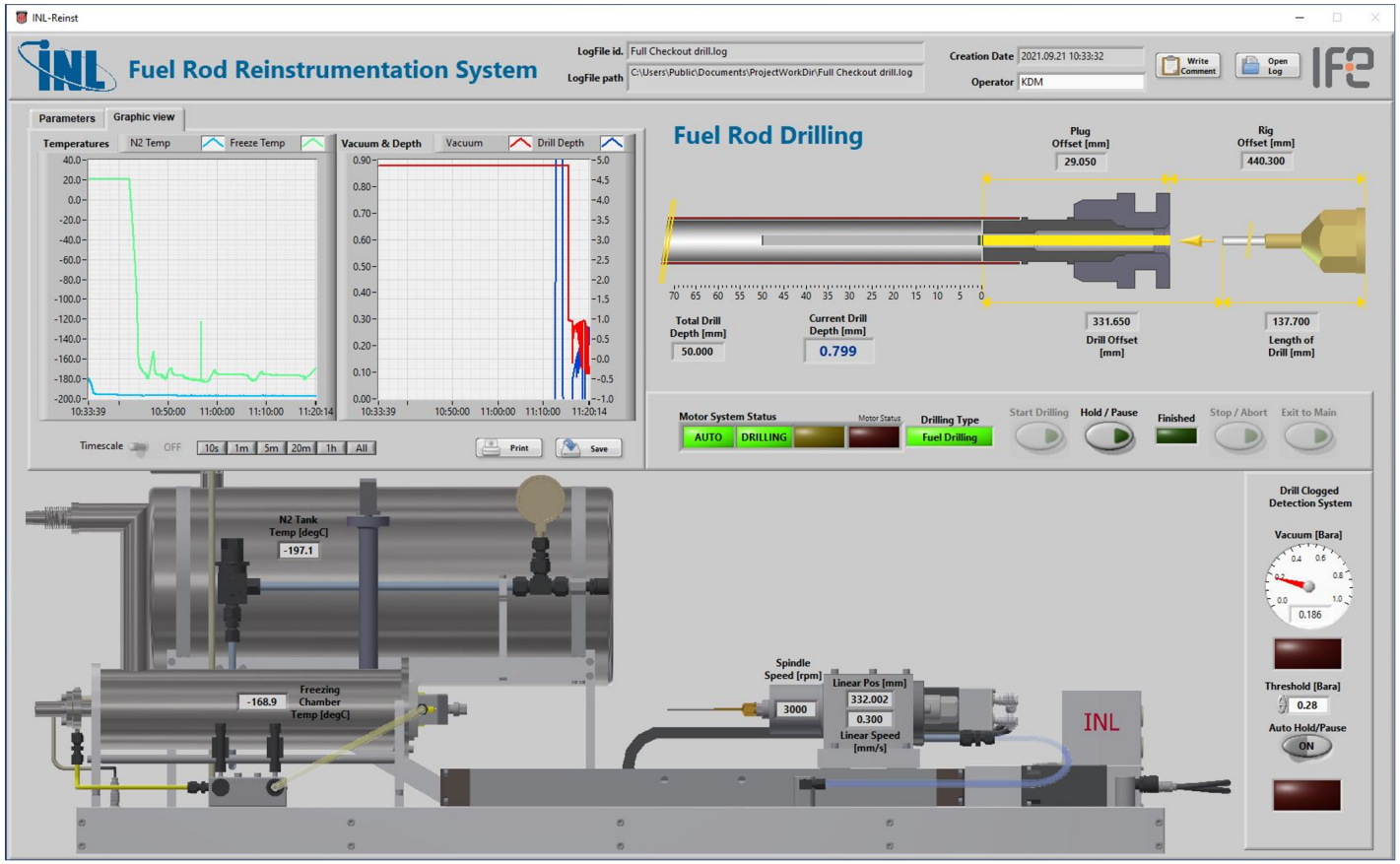
Accomplishments

Drilling Practice

Several practice runs – still learning how to not break diamond bits during drilling



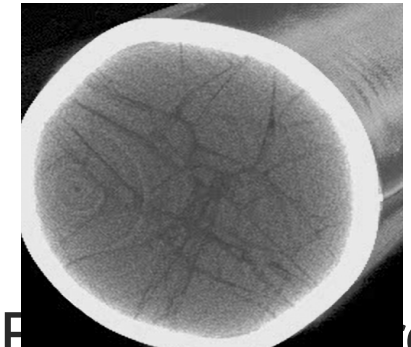
Start of a cryo-drilling practice run

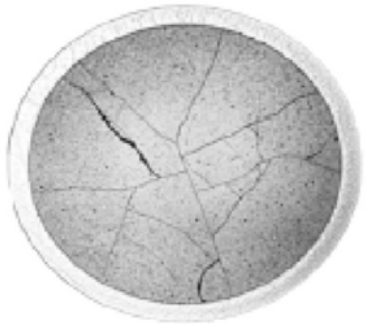


Control system display during drilling process

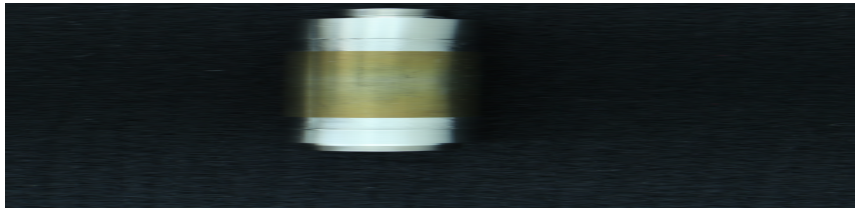
Outlook for FY-22

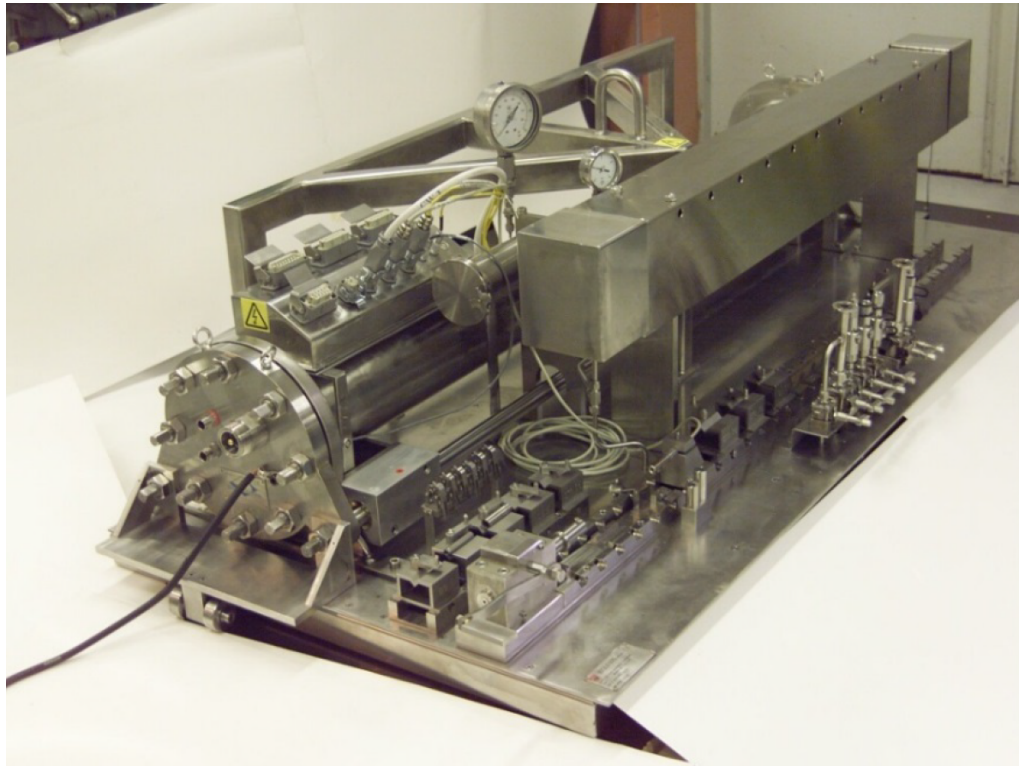
- Receive welding module and perform checkouts (practice welding)
- Prepare rodlets with both cracked and uncracked pellet stacks





- Finally, prepare a complete instrumented rodlet using all three equipment modules





Halden welding module with drying and leak check chambers

Conclusion

- INL is capturing critical technology developed at IFE in Halden, Norway by procuring three equipment modules, which are designed to take sections of commercial fuel rods and prep the ends for welding (defueling module), drill a hole in the fuel pellet stack (drilling module), and weld end plugs on each with accompanying instrumentation (welding module).
- The defueling and drilling modules were received in FY-21 and substantial experience was gained with them.
- The welding module is expected to arrive at INL early in FY-22.
- By the end of FY-22 the project will produce a fully instrumented prototypical fuel rodlet (using surrogate ceramics in the place of UO2).

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Questions?