BWX Technologies, Inc.

October 13, 2022

Docket No. 99901469
BANR-LTR-22-0521

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
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11555 Rockville Pike
Rockville, MD 20852-2738

Subject: BWXT Advanced Technologies, LLC (BWXT AT) October 20, 2022 Meeting Public Presentation

This letter provides the BWXT AT presentation for the open portion of the October 20, 2022 meeting.

This letter and the enclosure make no regulatory commitments nor do they make any revisions to existing regulatory commitments.

If you have any questions or need further information, please contact me at (434) 363-7517 or swschilthelm@bwxt.com.

Sincerely,

Steve Schilthelm Digitally signed by Steve Schilthelm
Date: 2022.10.13 16:14:01 -04'00'

Steve Schilthelm
Director, Regulatory and Mission Assurance
BWXT Advanced Technologies, LLC

CC:
Michael Orenak, NRC
Greg Oberson, NRC

Enclosure: Presentation - BANR Licensing Activities, NRC Kick-Off Meeting

BWX Technologies, Inc.

BANR Licensing Activities
NRC Kick-Off Meeting

Steve Schilthelm, Director, Regulatory & Mission Assurance
Erik Nygaard, Director, Product Development
Mike Haggerty, ARDP Project Manager
Steve Pope, Licensing Engineer (ISL)

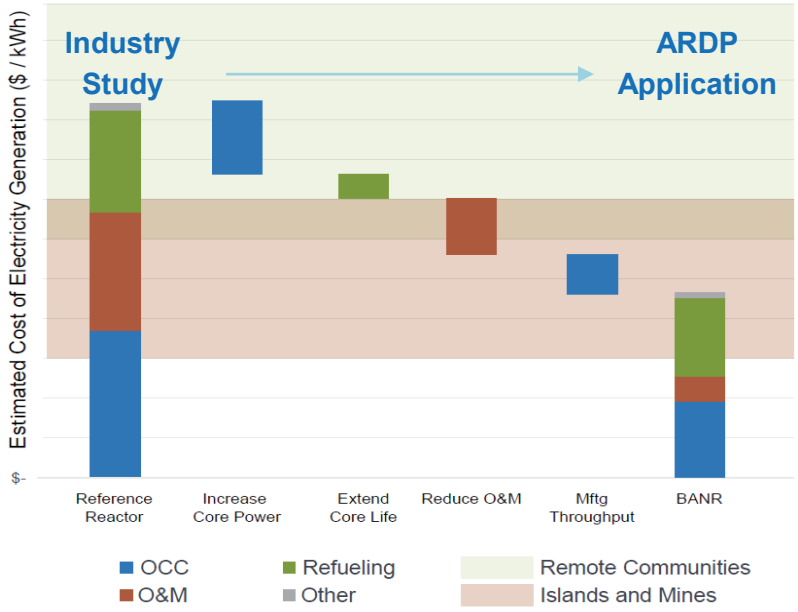
October 20, 2022

Agenda

- Introductions/Opening Remarks
- BWXT ARDP Program Goals
- Partners
- Timeline
- BANR Technology
- NRC Engagement
- Questions

BWXT ARDP Program Goals

ARDP: Seven year cost share program to facilitate development of U.S. private industry advanced nuclear demonstrations for designs that are: reliable, cost effective, licensable, and commercially viable.



Cost Reductions Improve Market Penetration

- Increasing core power reduces the number of reactors required
- Extending core life reduces life time refueling costs
- Reducing operations and maintain cost directly reduces cost per kWhr
- Improving manufacturing through-put reduces initial capital cost and refueling cost

Target Markets:

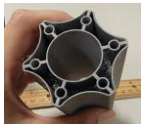
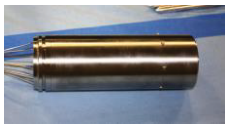
- Mining / Oil sands
- Remote communities
- Industrial process heat
- Secure off-grid power sources

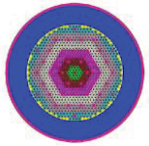
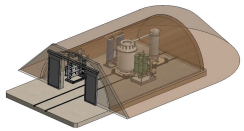
BANR ARDP - PARTNERS

- BWXT Advanced Technologies (AT)
  - Engineering design, advanced manufacturing development and BWXT contracting entity
- BWXT Nuclear Operations Group (NOG)
  - UN TRISO fabrication development
  - UN TRISO and fuel element fabrication development, laboratory services
- ORNL
  - TCR modeling and advanced manufacturing knowledge transfer, TRISO development, material characterizations and HFIR irradiation, non-fuel irradiation testing, PIE, fuel safety testing
- INL
  - ATR fuel irradiation, modeling & simulation, instrumentation development, PIE, fuel safety testing

BANR ARDP – TIMELINE NOTE: PICTURES AT TOP HAVE NOT BEEN CLEARED FOR PUBLIC RELEASE



2021-2022	2023 - 2026	2026 - 2028	2028+
Fuel Development	**Demonstration**	**Fuel Qualification**	**Production**
○ Reactor design and manufacturing of fuel test specimens	○ Irradiation testing and in-process analysis of fuel integrity	○ Post irradiation examination ○ Development of licensing basis	○ Demonstration decision ○ Commercial implementation

Risk Reduction Program Scope

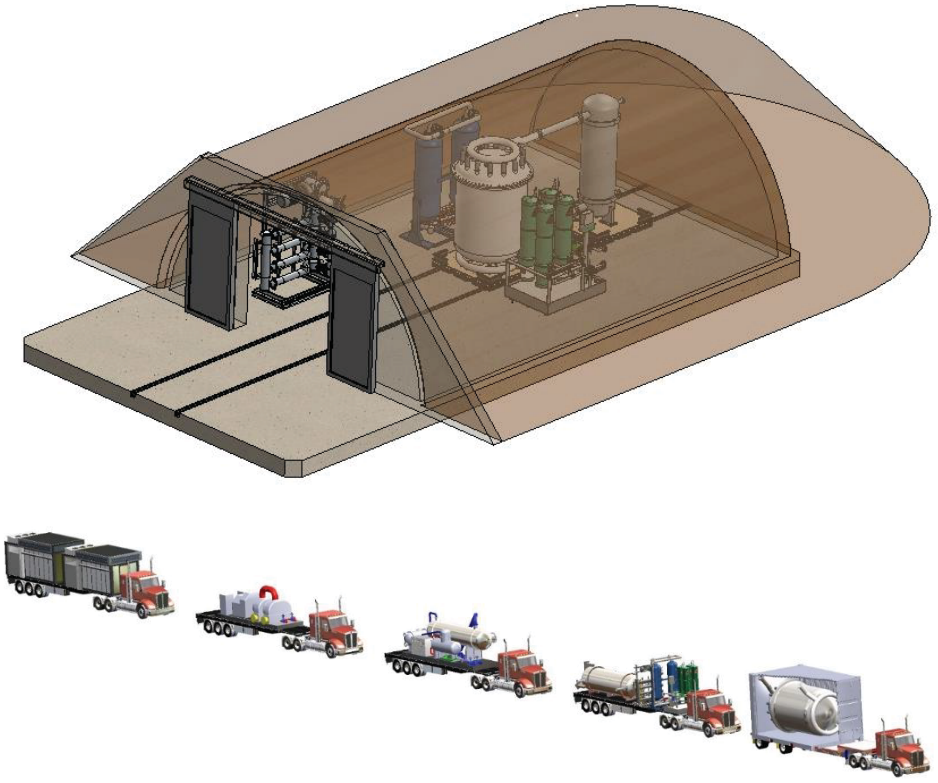
- Mature design and manufacturing technologies, improving commercial viability
- Demonstrate advanced technology applications to reduce manufacturing costs
- Develop and demonstrate high-power density TRISO fuel form for microreactors
- Focus on reactor skid: fuel system, core design, reactivity control, passive cooling, I&C

Fuel-Specific Scope

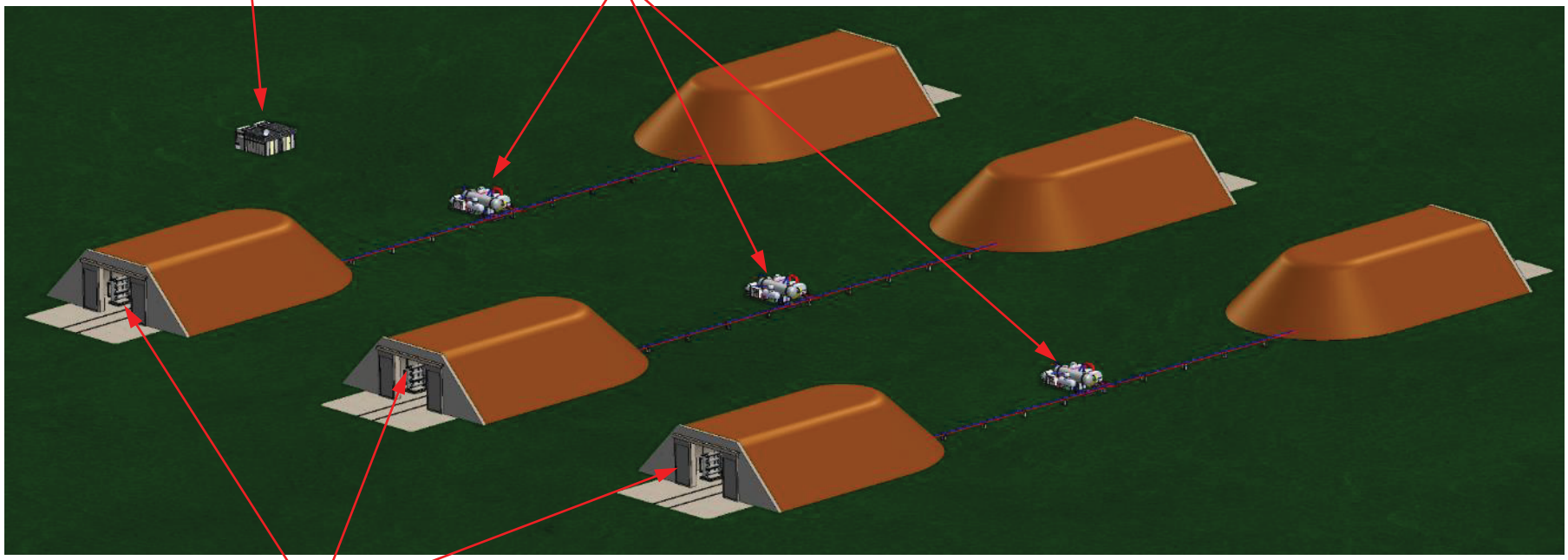
- HALEU fuel acquisition; TRISO fuel production
- Knowledge transfer from INL's AGR program and ORNL's TCR program
- Iterative manufacturing and testing of fuel elements, e.g. AM using CVI densification, element testing and characterization
- Irradiation (INL) and examination (ORNL) to advance UN fuel performance
- **Licensing activities to advance fuel form regulatory case**

BANR – Technology

- High temperature gas (HTGR) coolant technology proven since the 1950's
- 50 MW_{th} per reactor provides scalable solution to meet site specific power needs
- High power density fuel fabricated by BWXT enables 5 year refueling cycles
- Five modules, each meets standard road and rail shipping requirements
- Flexible power conversion to provide process heat, electricity, or co-generation
- Passive, inherent safety
- Rapid modular installation and refueling
- High TRL technologies

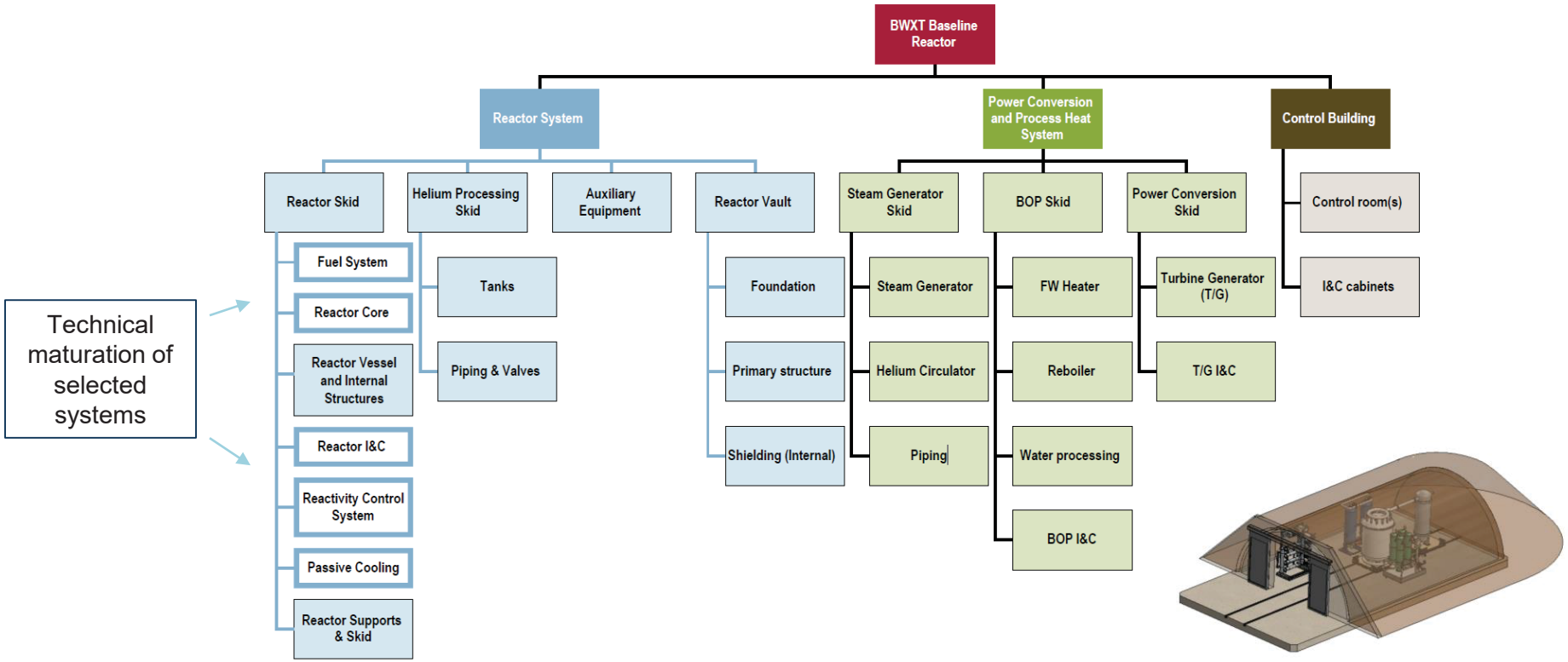


BANR – Technology – Design Site Concept



Separate modules/skids permit factory assembly, ready shipping and flexible configuration for a multitude of applications

BANR – Technology – System Breakdown Structure



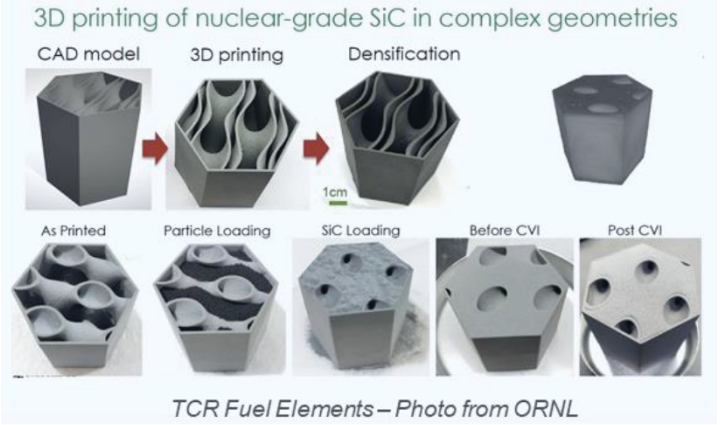
Focus on reactor skid … balance of plant out of scope

BANR – Technology – Fuel System Technology History

Advanced Gas Reactor (AGR)
UCO TRISO Fuel

- UCO fuel kernel coated with multiple layers of pyrocarbon (PyC) and Silicon Carbide (SiC)
- Can withstand extreme temperatures well beyond the threshold of current nuclear fuels
- Each particle acts as its own containment, retaining fission products under all conditions

BANR upgraded to higher density
UN TRISO Fuel



- UN fuel kernels packed in fuel shell
- UN fuel kernel provides ~ 2X fuel density compared to UCO or UO_2 … increasing power and extending core life
- Advanced manufacturing optimizes design, reduces cost & improves throughput
- Commercializes existing DOE development work

BANR – NRC Engagement – Milestones / Submittals

- 8/31/2022: Regulatory Engagement Plan
- 4Q 2022: QA Topical Report
- 4Q 2023: Fuel Qualification Plan Technical Report
- Q4 2028: Fuel Qualification Topical Report

BANR Licensing Activities – Submittals

- Regulatory Engagement Plan
  - Purpose: Establish and enhance communications between BWXT AT and NRC with the intent to increase regulatory certainty on topical and technical reports
  - Contents: Identifies the planned regulatory approach and tentative licensing submittal schedule, and defines interactions, roles and responsibilities to enhance communications.

BANR Licensing Activities – Submittals

- QA Topical Report
  - Purpose: Establishes the quality assurance policy and assigns major functional responsibilities for BANR activities conducted by or for BWXT AT.
  - Contents: Applies to BANR activities affecting the quality and performance of safety-related structures, systems, and components including, but not limited to designing, procuring, fabricating, inspecting, handling, testing, and training.

BANR Licensing Activities – Submittals

- Fuel Qualification Plan Technical Report
  - Purpose: Describe the fuel qualification approach and the manufacturing and testing program
  - Contents: Includes the UN TRISO development, the Advanced Test Reactor test, the binder jet process, the CT scanner, CVI process, and data engineering plan

BANR Licensing Activities – Submittals

- AM Licensing Technical Report
  - Purpose: Describe advanced manufacturing processes used in fuel development and fabrication
  - Contents: Contents are not yet determined as we are currently moving through development activities

BANR Licensing Activities – Submittals

- Fuel Qualification Results Topical Report
  - Purpose: Present fuel qualification topical report
  - Contents: Fuel performance modeling, ATR test results, PIE, etc. (Consistent with NUREG 2246 and similar to EPRI TRISO Topical Report)

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Questions?