

ADVANCED REACTOR SAFEGUARDS

University Advanced Reactor Activity Assessment

PRESENTED BY

Azaree Lintereur (Collin McDowell)

Los Alamos National Laboratory

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LA-UR-24-24217

Background

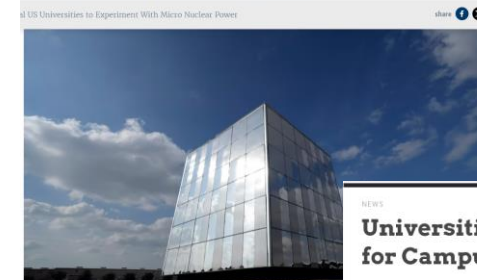


- Advanced reactor/microreactor technology is gaining interest for an increasing variety of applications.

- Local power
- Remote locations
- Isotope production

- Universities in the United States represent a growing user base exploring the feasibility of siting advanced/microreactors on college campuses.

Several US Universities to Experiment With Micro Nuclear Power



Universities Consider for Campus Power

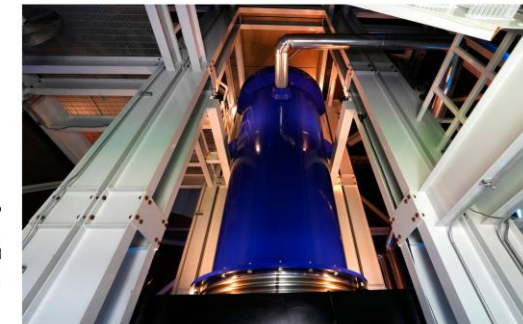
March 01, 2023 by Claire Turvill

A new generation of micro nuclear provide a decarbonized electricity a

Tiny nuclear reactors that produce one-hundredth the size of a large nuclear reactor are being developed. Some universities are interested in.

Micro-Nuclear Power On College Campuses

Thursday, February 9 2023 by JENNIFER McDERMOTT Associated Press



AP/David J. Phillip A cross-section of a prototype reactor is shown inside Los Alamos National Laboratory's microreactor demonstration unit.

If your image of nuclear power is giant, cylindrical concrete cooling towers pouring out steam on a site that takes up hundreds of acres of land, soon there will be an alternative: tiny nuclear reactors that produce only one-hundredth the electricity and can even be delivered on a truck.

Small but meaningful amounts of electricity — nearly enough to run a small campus, a hospital or a military complex, for example — will pulse from a new generation of microreactors. Now, some universities are taking interest.



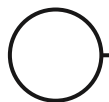
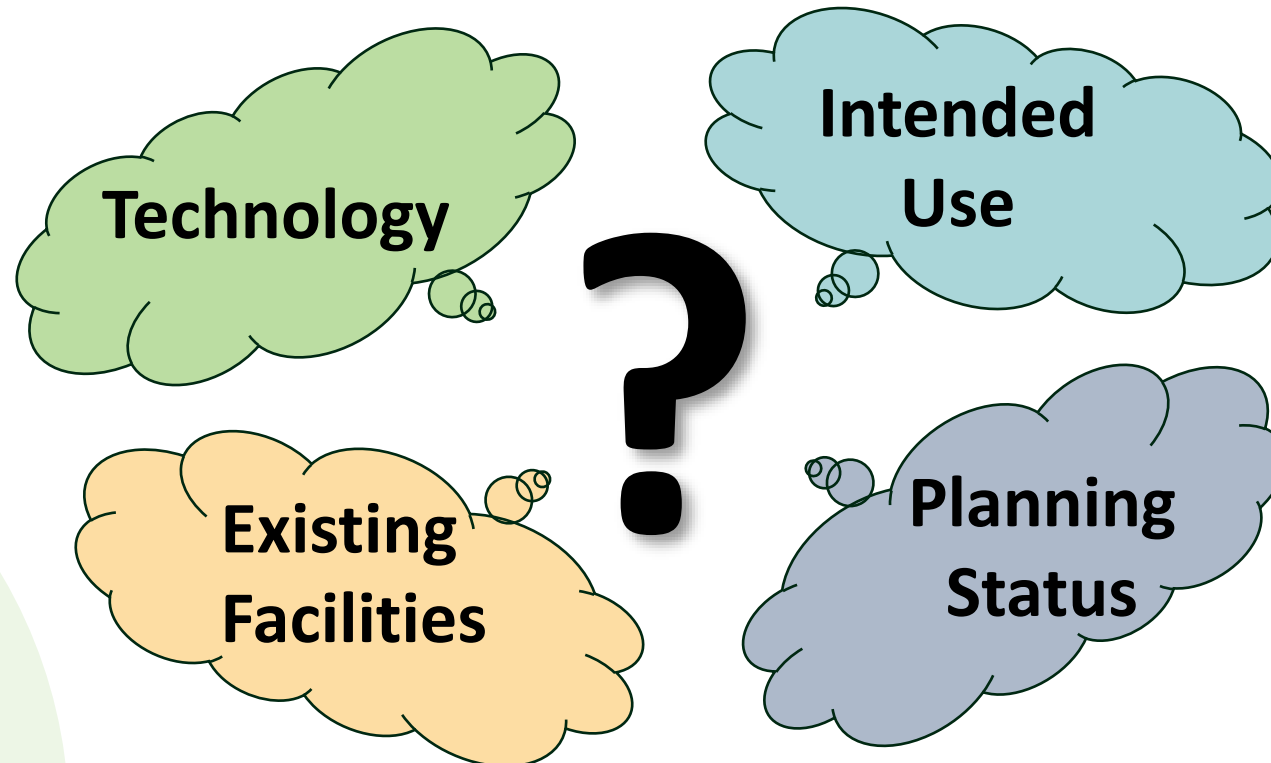
A nuclear power plant. Image used courtesy of Pixabay.

A screenshot of a World Nuclear News article. The main headline is 'US university plans to build microreactor' dated 29 June 2021. The article text states: 'The University of Illinois at Urbana-Champaign (UIUC) has informed the US Nuclear Regulatory Commission (NRC) that it intends to construct an Ultra-Safe Nuclear Corporation (USNC) Micro Modular Reactor on its campus. The university said the submission of the letter of intent is the first step in the NRC's two-step process to license the new research and test reactor facility.' Below the text is an image of a microreactor unit with the USNC logo. A sidebar on the right lists 'Most read' articles, including 'UK SMEs embrace carbon', 'Saudi Arabia reiterates plans for nuclear energy', and 'E.ON eyes SMR deployment in Italy'. At the bottom, there is a 'World Nuclear Association' logo and a 'FREE for our members' offer.

Project Overview



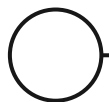
- The goal of the proposed effort is to perform a preliminary scoping study of domestic universities' advanced/microreactor activities.



Project Overview



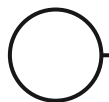
- Project Status
 - Started September 2023
- Tasks
 - University Engagement
 - Preliminary assessment
 - Questions/topics for engagement
 - Outreach
 - Regulation Overview
 - Review regulations
 - Future Planning
 - Identify potential future activities
 - Reports; Focused workshops; Individual engagements; etc.



University Overview



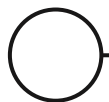
- University nuclear department and program overview (visual example only!)



University Overview



- University nuclear department and program overview (visual example only!)



University Overview – Advanced/Micro Reactors



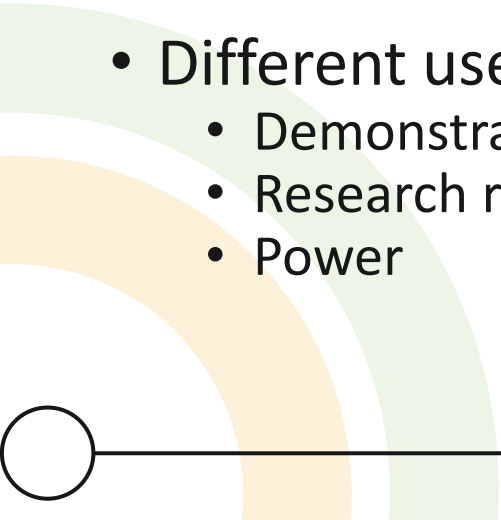
- Universities interested in advanced reactors are not limited to those with nuclear programs

Example



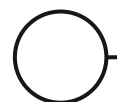
Activity Overview



- Different stages of planning
 - Assessment
 - Memorandum of Understanding
 - Preparing for license application
 - Current application
 - Different technologies
 - Different use cases
 - Demonstration
 - Research reactor
 - Power
- 

Approach

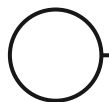
- NEDHO
- TRTR
- University Consortia
- Professional Societies and Conferences
- Direct Engagement



University Assessment and Engagement



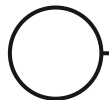
- Universities were contacted directly to gain increased awareness of their current activities and planning status
 - Topics
 - Advanced/microreactor technology that is being pursued
 - Proposed use
 - Current stage of planning
 - License pathway
 - Status of security planning
 - Status of safeguards (MC&A) planning



University Overview – Advanced/Micro Reactors



Example



Abilene Christian University (ACU)

- Technology
 - Liquid fueled molten salt (1 MWth)
 - Online feed and removal
 - Onsite analytical lab
 - Vendor: NATURA
- Status
 - Construction permit submitted
- Licensing Pathway
 - Research reactor (Class 104(c))
- Safeguards and Security
 - Engaged with:
 - Sandia National Laboratories
 - Oak Ridge National Laboratory
 - NRC



University of Illinois Urbana Champaign (UIUC)

- Technology
 - High-temperature gas-cooled reactor
 - Vendor: Ultra Safe Nuclear Corporation
- Status
 - Preapplication materials submitted
- Licensing Pathway
 - Research reactor (Class 104(c))
- Safeguards and Security
 - Safeguards Information Protection Plan



The background of the slide features a glowing blue microreactor diagram. On the left, the Westinghouse logo is visible, consisting of a crown inside a circle and the word "Westinghouse" in a stylized font. The microreactor diagram shows a central core with multiple fuel elements, surrounded by a moderator and coolant system, all enclosed in a cylindrical vessel with various ports and connections.

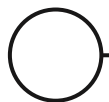
Penn State University (PSU)

- Technology
 - Heat pipe microreactor (eVinci)
 - Vendor: Westinghouse
- Status
 - Preparing for license application
- Licensing Pathway
 - Research reactor
- Safeguards and Security
 - To be determined

University Activity Summary



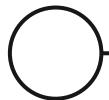
- Three universities moving forward with licensing
- Three different technologies
- Licensing as research reactors
 - One university is pursuing licensing a research reactor sited in an existing multipurpose facility, as allowed for in 10 CFR 50(a)(2)(x)
 - One university has an existing research reactor
 - One university previously had a research reactor



Regulations



- 10 CFR 50
 - Class 104
- Others?
 - 10 CFR 73
 - 10 CFR 74
 - 10 CFR 20
 - 10 CFR 51
 - 10 CFR 52
 - ~~10 CFR 53~~
 - NUREGs
 - SECY-22-0072
 - SECY-23-0021
 - Regulatory Guide 1.233



NRC Discussions

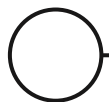
- Engage early
- RTRs: "Potential Scenarios"
 - Microreactors: MHA vs DBA
- Application of 10 CFR 53
 - RTRs will stay under 10 CFR 50
- Part 73.55a7 (alternative security measures)
- Consequence evaluation
- Part 74:
 - FNMC Plan + NMMSS



Regulatory Considerations



- Assumptions vs requirements
- HALEU (category)
 - Material attractiveness in fuel form
- Security "education"
- Law enforcement training
 - MOUs
 - Alarm Response Training through ORS
- Non-power production utilization facility
- Comparison to medical isotope facilities



Initial Recommendations and Requests



- One-on-one meetings
 - Developing MC&A processes
 - Establishing physical security procedures
 - Physical and cyber security support
 - Dedicated task force to explore the domestic-international safeguards interface
 - Workshops
 - Faculty – laboratory staff exchange program
 - Research opportunities
 - Course support
 - Cyber security
 - Physical protection
 - Instrumentation
 - Training
-
-
- A decorative graphic in the bottom left corner consists of a white circle with a black outline, connected to a horizontal line that extends across the page. Below this line are several overlapping, semi-transparent curved shapes in shades of green and yellow, mirroring the design of the logo in the top right.

Next Steps

Write final report...





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