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FY2025 Microreactor Transportation Activities

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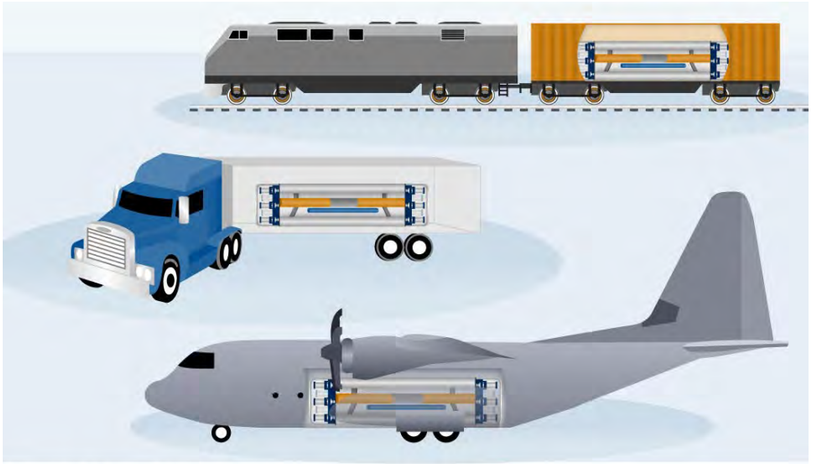
DOE-NE Microreactor Program Winter Review Meeting
March 4-5, 2025

U.S. DEPARTMENT OF ENERGY BATTELLE

PNNL is operated by Battelle for the U.S. Department of Energy

Microreactor Transportation

- Current microreactor concepts are to transport the microreactor containing its unirradiated or irradiated fuel
- A microreactor with its unirradiated or irradiated contents is unlikely to meet the entire suite of NRC regulatory requirements in 10 CFR Part 71
- A risk-informed process will likely be used for NRC transportation package approval
  - Demonstrate equivalent safety and that risk to the public is low
  - This will probably require the use of compensatory measures



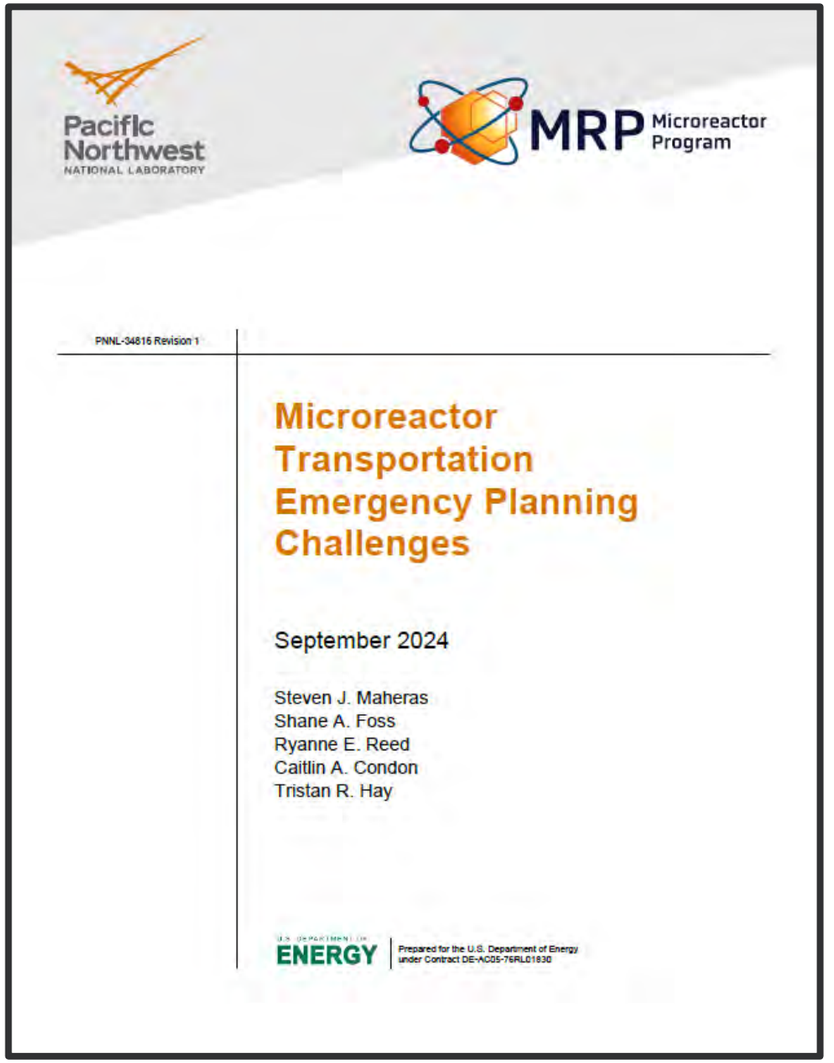
Source: GAO. | GAO-20-380SP

Current Transportation Approach

- The microreactor shipment would be a commercial shipment and would receive transportation package approval from the NRC using a risk-informed process
- Strategy is Crawl-Walk-Run
  - Concentrate on highway transport first
  - Then other surface modes (rail and barge/ship) – evaluation of transport by vessel has just started
  - Finally air transport
- The microreactor containing its irradiated fuel would contain a highway route-controlled quantity of radioactive material (i.e., > 3000 A_2)
  - For truck shipments this means that a Commercial Vehicle Safety Alliance (CVSA) Level VI inspection and safety permit would be required (see 49 CFR 385 and 49 CFR 397)
  - For rail shipments this means that the transportation planning requirements in 49 CFR 172.820 would apply
- The microreactor would be fueled by LEU or HALEU (not HEU)
- For rail shipments, transport would be via Association of American Railroads (AAR) Standard S-2043 railcars

Microreactor Transportation Accomplishments

- Revised Microreactor Transportation Emergency Planning Challenges – September 2024
  - Funded by carryover from 2023
  - Added section on the uranium lung absorption category for uranium carbide (potentially important for TRISO-fueled microreactors)
  - Added section on lessons learned from 2024 Naval Spent Nuclear Fuel Transportation Accident Demonstration with the Shoshone-Bannock Tribes and the State of Idaho
  - Revised maritime concept of operations with additional information on transport by vessel



Collaboration Activities

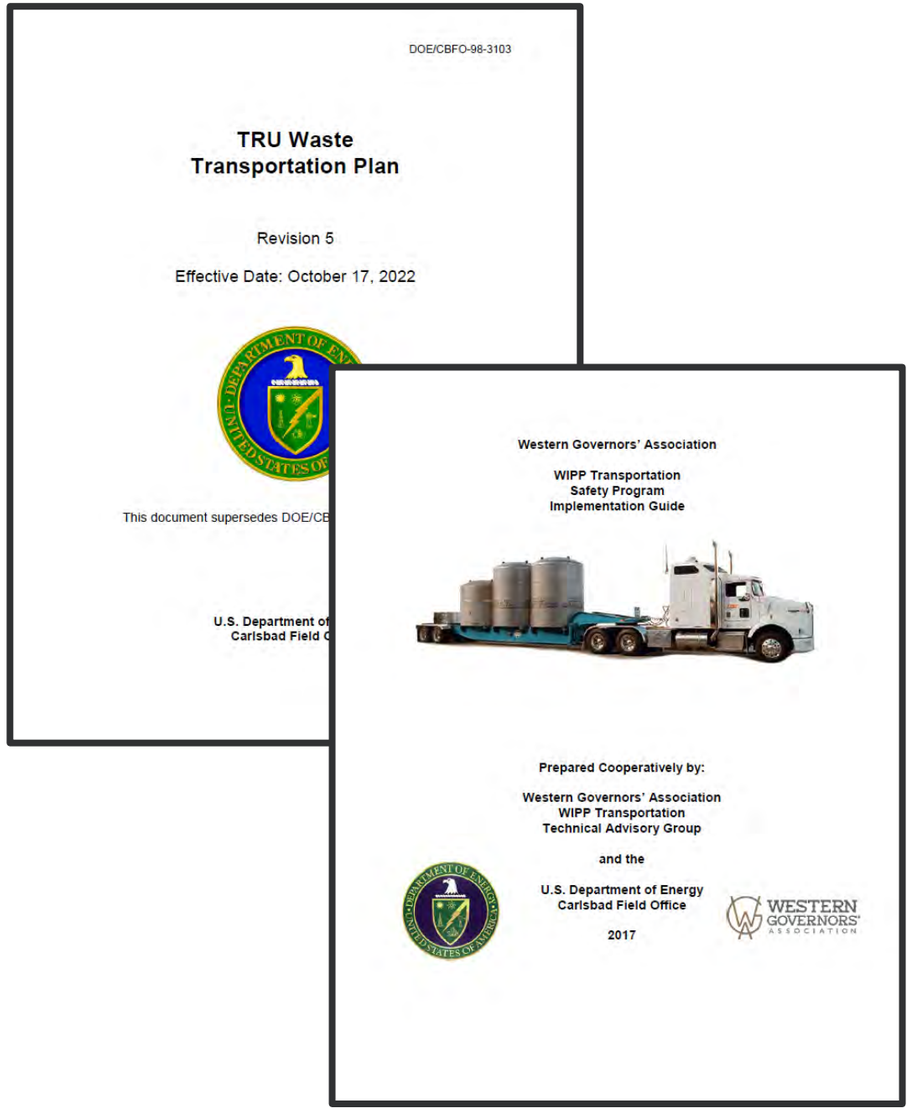
- Working closely with the U.S. Department of Defense (DoD) Strategic Capabilities Office (SCO), PNNL developed a risk-informed transportation package approval methodology for highway transport and presented it to the U.S. Nuclear Regulatory Commission (NRC) Advisory Committee on Reactor Safeguards (ACRS)
  - ACRS Subcommittee – November 17, 2023
  - Full ACRS – December 6, 2023
- This methodology was endorsed by the NRC on October 7, 2024 (ML24271A054)
- PNNL is now working closely with SCO and the U.S. Army Office of the Chief of Engineers (OCE), Nuclear Power Branch to extend the risk-informed methodology to maritime transport
  - Maritime transport work has also been funded by the National Reactor Innovation Center (NRIC)

FY2025 Activities (1)

- Develop the elements of a prototype microreactor transportation safety program that describes what should be contained in a vendor-developed microreactor transportation safety program, identifying the unique elements associated with microreactor transport
  - Report builds on Microreactor Transportation Emergency Planning Challenges
  - Draft report (M4) – 03/31/2025
  - Final report (M2) – 09/30/2025

Microreactor Transportation Safety Program Based on Successful Transportation Programs

- Waste Isolation Pilot Plant (WIPP) TRU Waste Transportation Plan
- WIPP Transportation Safety Program Implementation Guide (PIG)
- Domestic and Foreign Research Reactor Shipments
- DOE Transportation Emergency Preparedness Program (TEPP)
- Commercial Vehicle Safety Alliance (CVSA) Level VI inspection procedures
- Defense Transportation Regulations (DTR 4500.9-R)
- U.S. Department of Transportation (DOT), U.S. Nuclear Regulatory Commission (NRC), and U.S. Department of Energy (DOE) regulations, orders, manuals, guidance, etc.



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Contents

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- Public Information
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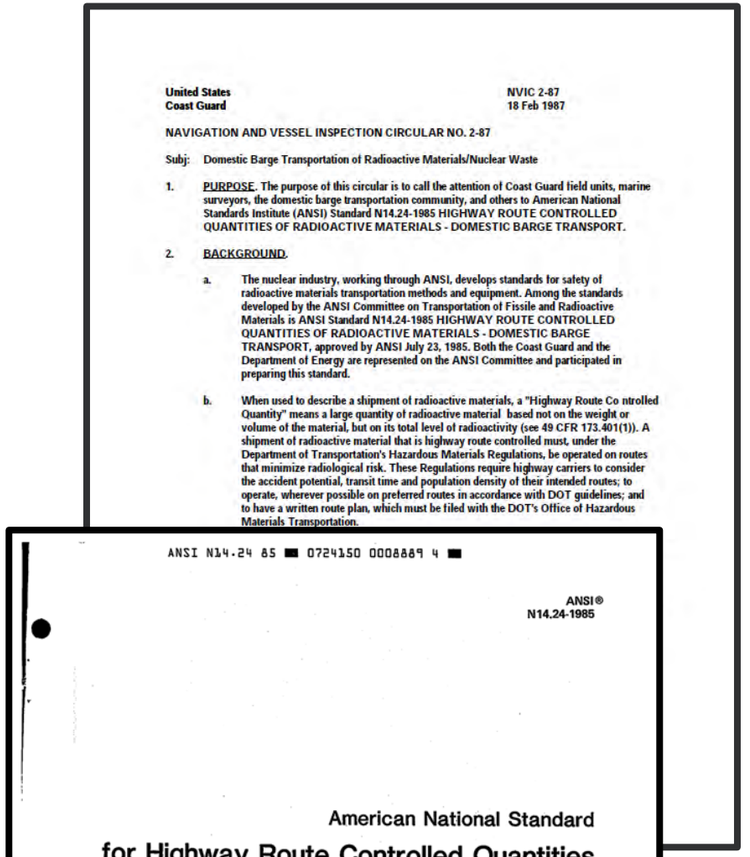
- Inspections
- Security
- Safe Parking
- Shipment Tracking
- Weather and Road Conditions
- Medical Preparedness
- Training and Exercises
- Program Evaluation
- Training and Qualification Program

FY2025 Activities (2)

- The successful commercial deployment and redeployment of microreactors may require transport by barge or ship.
  - Deployment and redeployment of microreactors to Alaska would likely require transport by sea from the west coast of the US to a port such as Anchorage, Alaska
- The ANSI Standard for barge transport of spent nuclear fuel (N14.24) has not been updated since 1985 and is significantly out-of-date, and does not include consideration of microreactor transport
  - For example, the classes of barges discussed in N14.24 are no longer available, and significant advances in maritime technology have taken place in the nearly 40 years since 1985
- In addition, the U.S. Coast Guard Navigation and Vessel Inspection Circular for Domestic Barge Transport of Radioactive Materials/Nuclear Waste (NVIC 2-87) has not been revised since 1987
- The objective of this work is to develop recommendations for the revision of N14.24 that will be transmitted to the ANSI N14 Committee
  - Barge consultant subcontracted to assist
  - M3 report due 07/31/2025



United States Coast Guard

NVIC 2-87
18 Feb 1987

NAVIGATION AND VESSEL INSPECTION CIRCULAR NO. 2-87

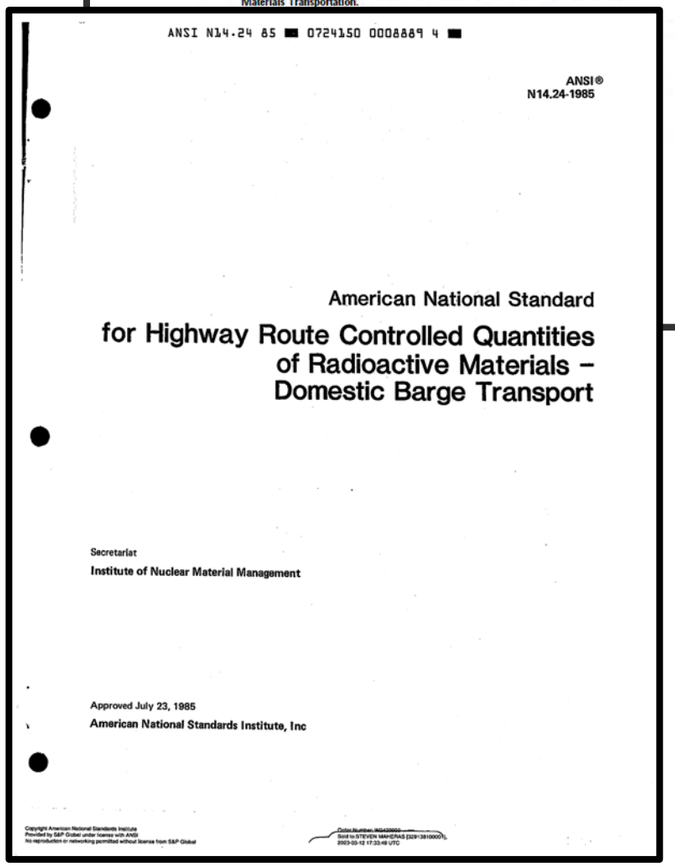
Subj: Domestic Barge Transportation of Radioactive Materials/Nuclear Waste

1. PURPOSE. The purpose of this circular is to call the attention of Coast Guard field units, marine surveyors, the domestic barge transportation community, and others to American National Standards Institute (ANSI) Standard N14.24-1985 HIGHWAY ROUTE CONTROLLED QUANTITIES OF RADIOACTIVE MATERIALS - DOMESTIC BARGE TRANSPORT.

2. BACKGROUND.

a. The nuclear industry, working through ANSI, develops standards for safety of radioactive materials transportation methods and equipment. Among the standards developed by the ANSI Committee on Transportation of Fissile and Radioactive Materials is ANSI Standard N14.24-1985 HIGHWAY ROUTE CONTROLLED QUANTITIES OF RADIOACTIVE MATERIALS - DOMESTIC BARGE TRANSPORT, approved by ANSI July 23, 1985. Both the Coast Guard and the Department of Energy are represented on the ANSI Committee and participated in preparing this standard.

b. When used to describe a shipment of radioactive materials, a "Highway Route Co ntrolled Quantity" means a large quantity of radioactive material based not on the weight or volume of the material, but on its total level of radioactivity (see 49 CFR 173.401(1)). A shipment of radioactive material that is highway route controlled must, under the Department of Transportation's Hazardous Materials Regulations, be operated on routes that minimize radiological risk. These Regulations require highway carriers to consider the accident potential, transit time and population density of their intended routes; to operate, wherever possible on preferred routes in accordance with DOT guidelines; and to have a written route plan, which must be filed with the DOT's Office of Hazardous Materials Transportation.



ANSI N14.24 85 ■ 0724150 0008889 4 ■

ANSI®
N14.24-1985

American National Standard

for Highway Route Controlled Quantities of Radioactive Materials – Domestic Barge Transport

Secretariat
Institute of Nuclear Material Management

Approved July 23, 1985
American National Standards Institute, Inc

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Thank you