U.S. DEPARTMENT OF ENERGY
WASTE ISOLATION PILOT PLANT

WIPP is located in the Chihuahuan Desert, far from major population centers.

Openings are mined 2,150 feet underground in the ancient salt formation.

Contact Handled TRU waste permanently emplaced in the WIPP underground.

FOR MORE INFORMATION

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WHY WIPP?

WIPP has set the standard for safe, permanent disposal of long-lived radioactive defense wastes.

Transuranic, or TRU waste began accumulating in the 1940s with the beginning of the nation's nuclear defense program. As early as the 1950s, the National Academy of Sciences recommended deep disposal of long- lived TRU radioactive wastes in geologically stable formations, such as deep salt beds. Sound environmental practices and strict regulations require such wastes to be isolated to protect human health and the environment.

Bedded salt is free of fresh flowing water, easily mined, impermeable and geologically stable -- an ideal medium for permanently isolating long-lived radioactive wastes from the environment. However, its most important quality in this application is the way salt rock seals all fractures and naturally closes all openings.

Throughout the 1960s, government scientists searched for an appropriate site for radioactive waste disposal, eventually testing a remote desert area of southeastern New Mexico where, 250 million years earlier, evaporation cycles of the ancient Permian Sea had a 2,000-foot-thick salt bed.

In 1979, Congress authorized the U.S. Department of Energy's (DOE) Waste Isolation Pilot Plant (WIPP). The WIPP facility, located 26 miles southeast of Carlsbad, N.M., was constructed during the 1980s. Congress limited WIPP to the disposal of defense-generated TRU wastes. In 1998, the U.S. Environmental Protection Agency (EPA) certified WIPP for safe, long-term disposal of TRU wastes.

Generally, TRU waste consists of clothing, tools, rags, residues, debris, soil and other items contaminated with radioactive elements, mostly plutonium. These man-made elements have atomic numbers greater than uranium, thus trans-uranic, or beyond uranium on the Periodic table of Elements.

DID YOU KNOW...

WIPP'S DISPOSAL ROOMS ARE NEARLY A HALF MILE BELOW THE SURFACE LEVEL (2,150 FEET). BY COMPARISON, THE EMPIRE STATE BUILDING IS ONLY 1,454 FEET HIGH.

There are two categories of TRU waste. Contact-handled (CH) TRU waste can be safely handled by workers under controlled conditions without any shielding other than the containers itself.

CH TRU waste will make-up approximately 96 percent of the total volume of waste to be disposed at WIPP. The remaining four percent will be remote-handled TRU waste, which emits more penetrating radiation than CH TRU waste and must be handled and transported in lead-shielded casks.

Prime regulators at WIPP are the EPA and the New Mexico Environment Department. A number of other agencies, committees and panels monitor WIPP's progress and contribute to project success.

The DOE Carlsbad Field Office, which leads the nation's TRU waste disposal effort, has coordinated TRU waste cleanup at a number of generator sites around the country. Since 1999, WIPP has set the standard for safe, permanent disposal of long-lived radioactive defense wastes.

Waste Isolation Pilot Plant

. . . a critical step toward solving the nation's nuclear waste disposal problem

Transuranic Waste Transportation Containers

In 1980, the U.S. Department of Energy (DOE) committed to transporting transuranic radioactive waste to the Waste Isolation Pilot Plant (WIPP) in U.S. Nuclear Regulatory Commission (NRC)-certified Type B containers. DOE chose to have NRC approve these containers even though it is not a requirement. To obtain NRC approval, DOE must submit a safety analysis report for each transportation container, demonstrating compliance with applicable regulations.

Three Types of Containers

Container	Waste Type	Status of Certification
TRUPACT-II	Contact-Handled	Approved by NRC, August 1989
HalfPACT	Contact-Handled	Approved by NRC, November 2000
RH-72B	Remote-Handled	Approved by NRC, March 2000

Three different types of containers were proposed and approved for transporting transuranic waste to WIPP. The Transuranic Package Transporter Model 2 (TRUPACT-II) and HalfPACT were designed to carry contact-handled transuranic radioactive waste. The RH-72B will be used to facilitate remote-handled waste transportation.

TRUPACT-II

Each stainless steel TRUPACT-II is approximately eight feet in diameter, 10 feet high, and constructed with leaktight inner and outer containment vessels. The TRUPACT-II can hold up to 14 fifty-five gallon waste drums, two standard waste boxes (63 cubic feet capacity each), or one 10-drum overpack (a container designed to provide additional protection for older, deteriorating drums). The TRUPACT-II underwent extensive testing (*See page 4 for specifics*) at Sandia National Laboratories in Albuquerque, New Mexico.

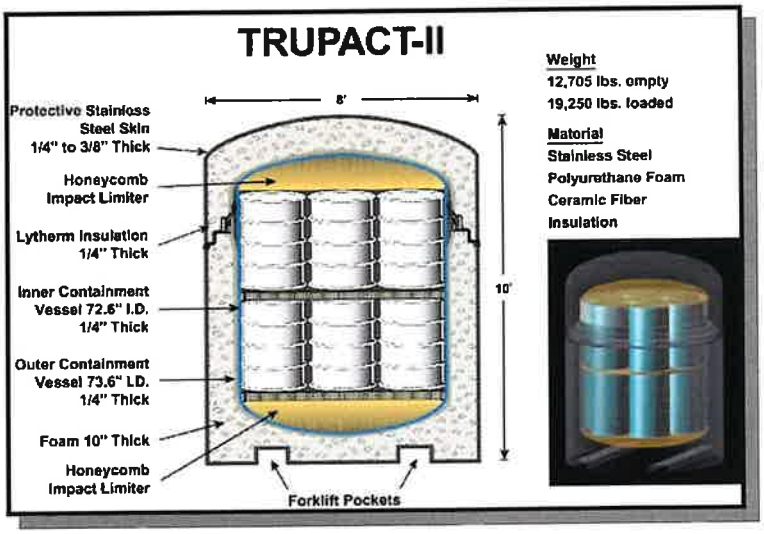
TRUPACT-II Testing 20 Times More Severe Than Average Traffic Accident

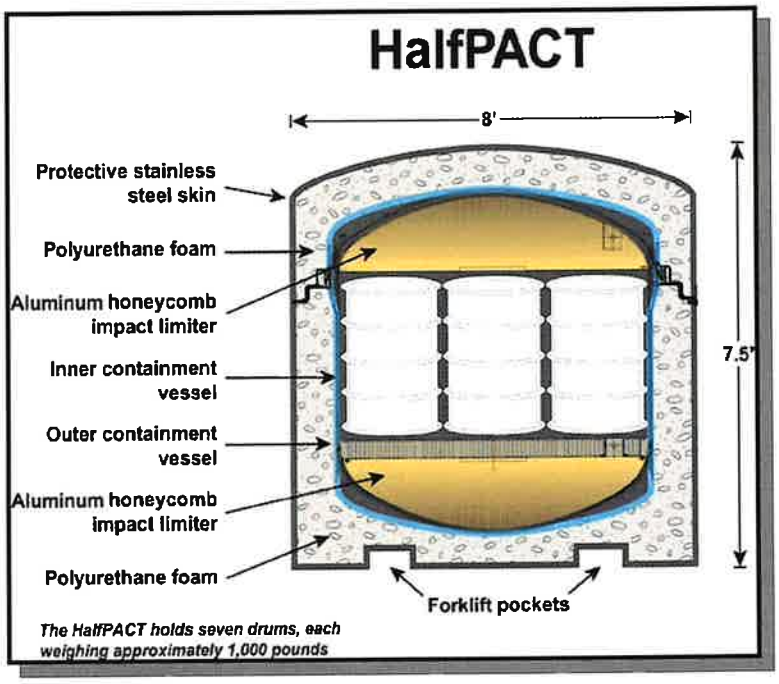
According to the Vehicle Research Center, a division of the Insurance Institute for Highway Safety, the 30-foot drop test the TRUPACT-II design withstood is more severe than any conceivable highway accident.

The amount of force the TRUPACT-II can withstand is nearly 20 times more severe than an average highway accident.

In vehicle testing, a passenger car hitting a portion of a solid barrier at 30 miles per hour creates a force of approximately 20 times greater than gravity (g).

During free-drop testing, the TRUPACT-II collision with the concrete pad generated about 385 g and remained intact.





Some shipments to WIPP will consist of 55-gallon drums of contact-handled transuranic waste weighing as much as 1,000 pounds each. Although the TRUPACT-II transportation containers are designed to hold as many as 14 drums, the total shipment (including the truck and trailer) can weigh no more than 80,000 pounds under U.S. Department of Transportation (DOT) weight restrictions. To comply with these restrictions, shippers of heavier-than-average drums of transuranic waste would have to reduce the number of drums per container below the TRUPACT-II's 14-drum capacity.

To improve shipment efficiency for heavy drums of transuranic waste, DOE designed the HalfPACT, a container for contact-handled waste that is shorter, and therefore lighter, than the TRUPACT-II. Each HalfPACT can carry up to seven 1,000-pound waste drums, and each WIPP transport truck can haul up to three HalfPACTs. Because using the HalfPACT would allow a greater volume of heavy waste to be transported in each shipment, the number of shipments necessary – and, therefore, the potential for accidents – would be reduced. The HalfPACT is expected to eliminate about 2,000 shipments of transuranic waste over the 35-year operating life of WIPP.

Each HalfPACT, like the TRUPACT-II, is leaktight and constructed with inner and outer containment vessels. It is approximately seven and one-half feet high and about eight feet in diameter. The HalfPACT is designed to hold seven 55-gallon drums, four 85-gallon drums, or one standard waste box.

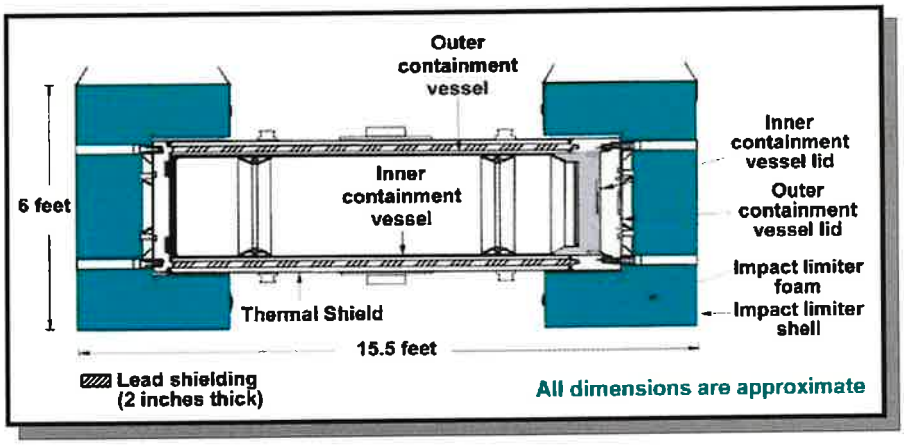
The NRC issued a certificate of compliance on November 2, 2000 for the HalfPACT transportation container.

Types of Transuranic Waste

Contact-Handled
About 96 percent of the volume of transuranic waste to be disposed of at WIPP is contact handled. This waste emits primarily alpha and beta radiation, which can be safely handled under controlled conditions without special shielding. The 55-gallon metal drums and boxes are ample protection from this kind of radiation.

Remote-Handled
Remote-handled transuranic waste emits penetrating gamma radiation that must be handled and transported in lead and steel-shielded transportation containers.

RH-72B

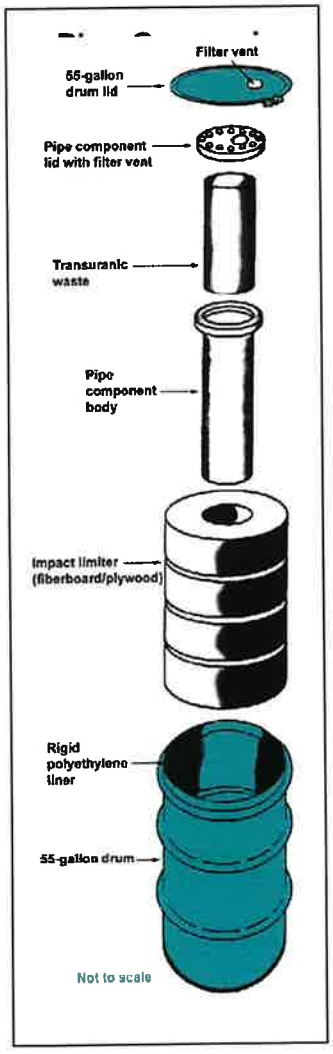


RH-72B

Some transuranic waste emits large amounts of penetrating gamma radiation. This "remote-handled" waste must be shipped in different containers that provide more shielding. The RH-72B was designed to safely transport these wastes. Like the TRUPACT-II and the HalfPACT, the RH-72B is leaktight and constructed with inner and outer containment vessels. It is a large cylinder approximately 12 feet long and about 3.5 feet in diameter. The cylinder fits into circular impact limiters, similar to shock absorbers, designed to protect the container and its contents in the event of an accident. The RH-72B has a one-and-5/8-inch-thick lead liner to shield people from gamma rays. It also has an outer thermal shield to protect the container against potential fire damage. Remote-handled shipments are expected to begin in 2002.

Pipe Overpack

In some cases, another container called a "pipe overpack" is used within the TRUPACT-II or HalfPACT to contain wastes contaminated with higher concentrations of plutonium and americium (*see drawing at right*). The filled pipe overpack is placed inside a 55-gallon drum, which, in turn, is placed inside the TRUPACT-II. The pipe overpack has three key functions:

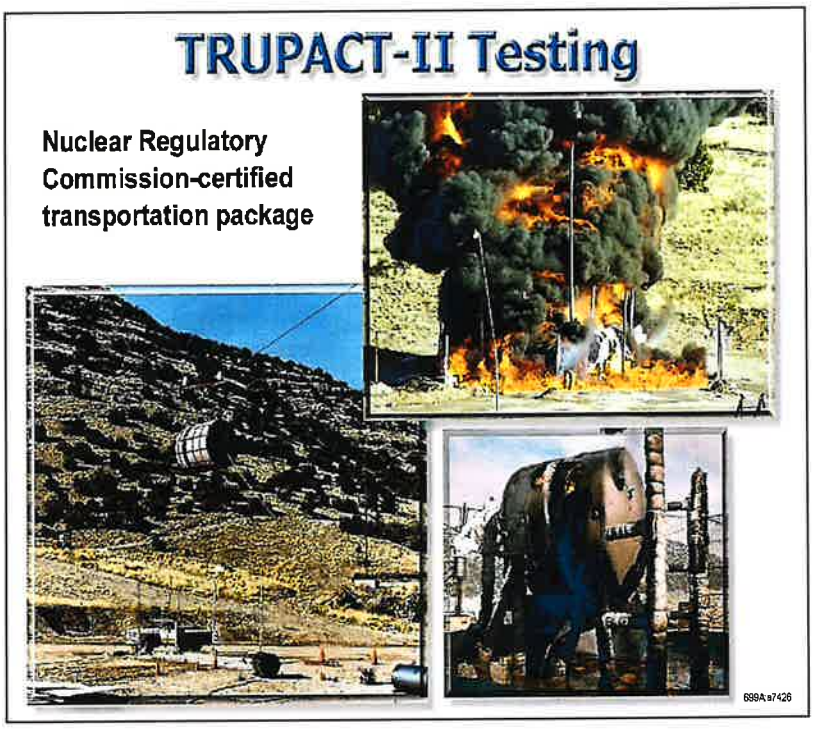


- To maintain separation of fissile material (materials whose atomic nucleus has the ability to split into two or more nuclei, releasing large amounts of energy) to prevent an inadvertent uncontrolled nuclear chain reaction from occurring;
- To provide shielding from radiation; and
- To immobilize fine particulate waste material.

DOE estimates the pipe overpack will be used in less than five percent of contact-handled transuranic waste shipments.

NRC approved the use of pipe overpack as part of the TRUPACT-II. Pipe overpacks cannot be used to transport transuranic waste unless they are inside TRUPACT-IIs or HalfPACTs.

Pipe overpack testing at Sandia National Laboratories included a top-impact drop test, a side-impact drop test, and a leak test. There was no loss of container contents during these tests.



Testing and Certification

The TRUPACT-II, the HalfPACT, and the RH-72B are all known as Type B transportation containers. Type B transportation containers are double containment packages and must meet NRC design, fabrication, operation, and maintenance requirements. Designs for Type B transportation containers must withstand normal transportation conditions, such as exposure to high and low temperatures ranging from 100 degrees Fahrenheit to minus 40 degrees Fahrenheit, varying external pressure, vibration, heavy rainfall, drops during handling, drops onto each corner of the transportation container, compression of approximately five times the weight of the transportation container for 24 hours, and impact from debris.

In addition, NRC certification requires each Type B transportation container to withstand a series of hypothetical accidents to demonstrate its ability to withstand extreme conditions without breaking open or releasing radiation. The NRC regulations (10 Code of Federal Regulations Part 71) allow computer-simulated, scale-model, or full-scale model testing to demonstrate a transportation container's suitability for certification. A combination of these methods is commonly used. To gauge their cumulative effects on transportation container designs that are candidates for Type B certification, several tests, or analyses, are performed in the following sequence:

- Free-Drop Test. The transportation container is dropped from 30 feet onto a flat, unyielding surface (such as a steel-reinforced concrete pad), striking the surface at the container's weakest point.
- Puncture Test. Next, the transportation container is subjected to a 40-inch free drop onto a six-inch diameter steel bar at least eight inches long.
- Burn Test. The transportation container is drenched with jet fuel and ignited, subjecting it to a temperature of 1,475 degrees Fahrenheit for 30 minutes.
- Immersion Test. Using specialized analyses, a separate transportation container of the same design is subjected to external pressure equivalent to being immersed under 50 feet of water.

When all the requirements for design and testing are met, NRC issues a Certificate of Compliance for the design of the transportation container. The certificate specifies procedures for the manufacture, operation, and maintenance of the transportation container. It also defines the container's authorized contents. The certificate is valid for five years. At the end of this period, DOE may apply to renew a container's certification.

For More Information on WIPP:

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Internet: http://www.wipp.ws

U.S. DEPARTMENT OF ENERGY

WASTE ISOLATION PILOT PLANT

TRANSPORTATION

WIPP drivers must pass stringent safety and emergency response examinations and maintain good driving records.

TRUPACT-II

Three shipping casks, the TRUPACT-II, HalfPACT and TRUPACT-III, are designed for hauling contact-handled (CH) TRU waste, while the RH72-B is used to transport remote-handled (RH) TRU waste. All four casks meet Nuclear Regulatory Commission and U.S. Department of Transportation radiation limits for public safety.

HalfPACT

The U.S. Department of Energy employs a professional trucking firm that offers an excellent safety record and years of experience in transporting hazardous materials.

Drivers work in pairs to assure that the truck and payload are attended at all times and that drivers are rested when it is their turn to drive.

The waste is transported in four shipping casks approved for use by the U.S. Nuclear Regulatory Commission (NRC).

Three shipping casks, the TRUPACT-II, HalfPACT and TRUPACT-III, are designed for hauling contact-handled (CH) TRU waste, while the RH72-B is used to transport remote-handled (RH) TRU waste. All four casks meet NRC and U.S. Department of Transportation radiation limits for public safety.

TRUPACT-II
Each stainless steel TRUPACT-II is approximately eight feet in diameter, 10 feet high, and constructed with leak-tight inner and outer containment vessels. The TRUPACT-II can hold up to 14 fifty-five gallon waste drums, 8 eighty-five gallon drums, six one hundred gallon drums, two standard waste boxes or one 10-drum overpack.

The TRUPACT-II underwent extensive testing at Sandia National Laboratories in Albuquerque, New Mexico. A single WIPP shipment can consist of a maximum of three TRUPACT-II's, or a combination of TRUPACT-II's and HalfPACT's.

HalfPACT
Some shipments will consist of CH TRU waste drums that weigh as much as 1,000 pounds each. The total weight of the shipment (including

DID YOU KNOW...

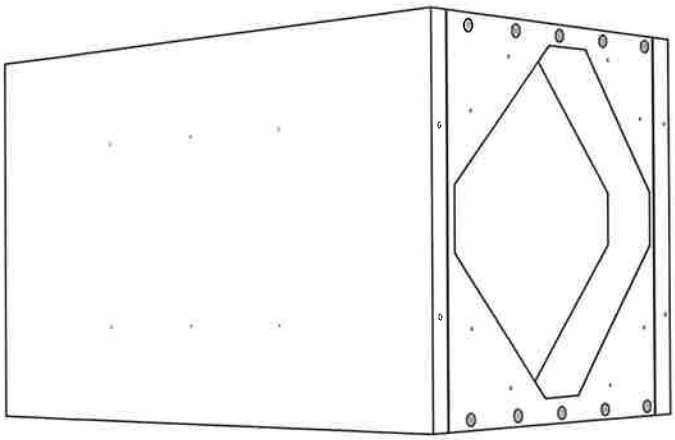
IN ORDER TO MEET DEPARTMENT OF TRANSPORTATION (DOT) REGULATIONS, A FULLY LOADED TRUCK CANNOT WEIGH MORE THAN 80,000 POUNDS. THIS INCLUDES THE WEIGHT OF THE TRACTOR AND TRAILER.

Shipping Routes

U.S. Department of Transportation regulations require radioactive materials to be shipped on the interstate highway system unless states designate other routes. WIPP shipment protocols were developed through cooperative efforts with the states, tribal governments and the U.S. Department of Energy.

the truck and trailer) can weigh no more than 80,000 pounds under U.S. Department of Transportation requirements.

To meet these requirements, DOE designed the HalfPACT, a cask for contact-handled waste that is shorter, and therefore lighter, than the TRUPACT-II. Each HalfPACT can carry up to seven fifty-five gallon drums, four eighty-five gallon drums, or three one hundred gallon drums.



TRUPACT-III

A single WIPP shipment can consist of a maximum of three HalfPACT's or a combination of HalfPACT's and TRUPACT-II's. The HalfPACT is expected to eliminate about 2,000 shipments of TRU waste over the 35-year operating life of WIPP.

TRUPACT-III

Large CH TRU waste containers known as Standard Large Box 2!s (SLB2!s) are too big to fit inside either the TRUPACT-II or HalfPACT. In an effort to accommodate these SLB2!s, DOE designed a third CH TRU waste shipping cask.

TRUPACT-III is a large rectangular cask used to transport the SLB2. The cask is comprised of inner and outer stainless steel plates and polyurethane foam to protect against potential punctures and fire danger.

DID YOU KNOW...

SOME SHIPMENTS WILL CONSIST OF CH TRU WASTE DRUMS THAT WEIGH AS MUCH AS 1,000 POUNDS EACH

One TRUPACT-III is transported on a custom designed trailer. The maximum allowable weight of a TRUPACT-III cask can be up to 55,116 pounds making a fully loaded TRUPACT-III shipment 84,096 pounds.

A TRUPACT-III shipment is a non-divisible load, meaning parts of the shipment cannot be removed to lessen the weight. Therefore, overweight shipping permits can be obtained for shipments to WIPP.

Vehicles

WIPP uses conventional diesel tractors and specially designed trailers. The trailers can carry a total of three TRUPACT-II's or HalfPACTs, one TRUPACT-III or one RH-72B per shipment.

Features in the tractor cab include:

- A computer keyboard linking the vehicle with a satellite tracking system
- Continuous tracking by a central control room at the WIPP site
- Redundant two-way communication systems

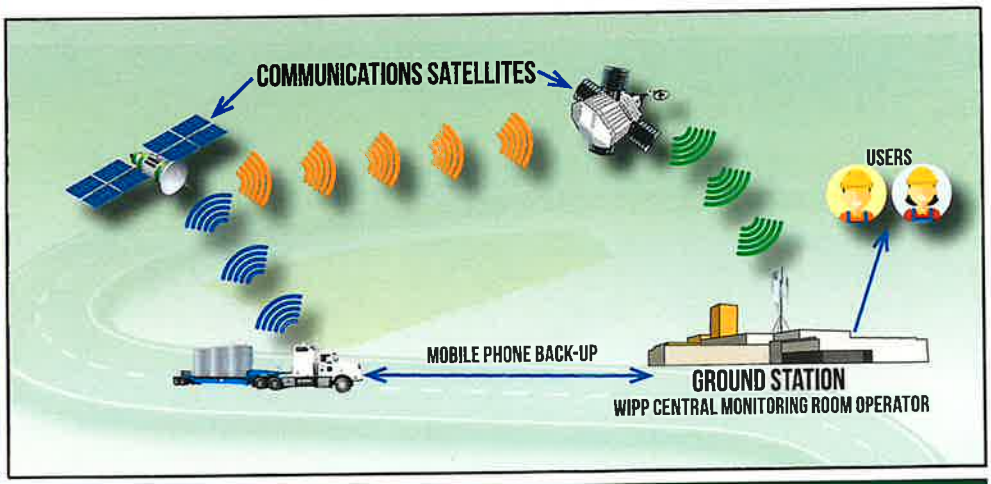
Each shipment is inspected to the Commercial Vehicle Safety Alliance Level VI standards, the industry's highest level, prior to departing a TRU waste generator site.

WIPP drivers are required to stop and check their trucks and payload every 150 miles or three hours en route. The trucks are also subject to inspection at state ports of entry.

Other transportation safeguards include:

- Designated safe parking areas along all routes for use in inclement weather or off-normal conditions
- The ability to replace or repair tractors en route within eight hours

Satellite Monitoring System



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U.S. DEPARTMENT OF ENERGY
WASTE ISOLATION PILOT PLANT

REMOTE-HANDLED TRANSURANIC WASTE

After 5,000 safe shipments of contact-handled transuranic waste, WIPP started receiving remote-handled transuranic waste.

In October 2006, the New Mexico Environment Department (NMED) approved the U.S. Department of Energy's plans for disposal of remote handled (RH) transuranic (TRU) waste at the Waste Isolation Pilot plant (WIPP). The Environmental Protection Agency (EPA) gave its approval in 2004.

Located in the remote desert of southeastern New Mexico, WIPP permanently isolates barrels and boxes of TRU waste from the nation's nuclear weapons program 2,150 feet underground in an ancient salt bed.

WIPP was designed to dispose of both contact handled (CH)- and RH-TRU waste, as addressed in WIPP's first environmental impact statement in 1980 and the 1992 federal WIPP Land Withdrawal Act.

DID YOU KNOW...

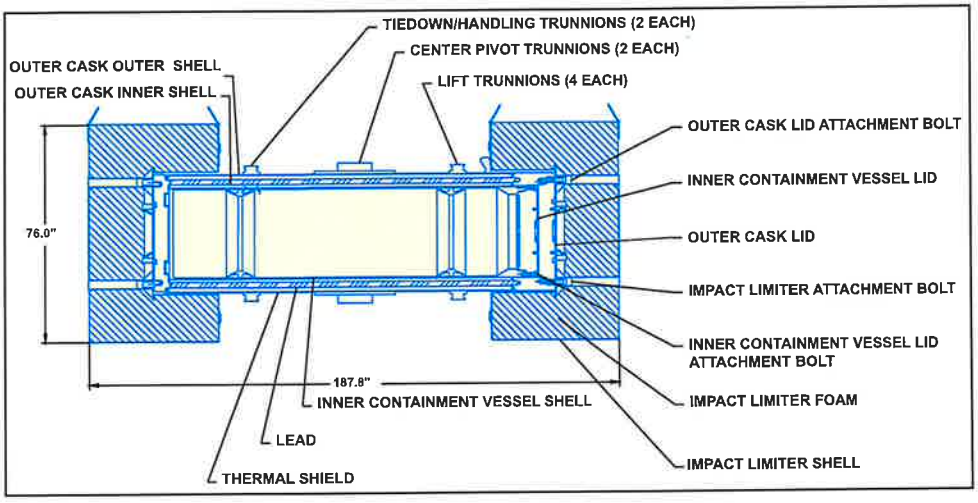
AS WITH CH-TRU WASTE, ALL RH-TRU SHIPMENTS UNDERGO A COMMERCIAL VEHICLE SAFETY ALLIANCE LEVEL VI INSPECTION, THE MOST RIGOROUS IN THE SHIPPING INDUSTRY.

The specially designed RH-72B cask is constructed of steel, shielded by lead and protected by sturdy impact limiters at both ends. The RH-72B holds up to three 55-gallon drums or a single cylindrical canister of waste.

Only about 4 percent - or 7,080 cubic meters - of the total volume of waste received at WIPP is expected to be RH-TRU, according to a 1981 Department of Energy record of decision and a 1988 agreement with the State of New Mexico. The total volume of waste anticipated at WIPP is 175,570 cubic meters, as stipulated by the Land Withdrawal Act.

While RH-TRU waste will be a small percentage of the total amount of waste at WIPP, its disposal is essential to addressing the environmental legacy of the Cold War.

Just like CH-TRU waste, RH-TRU waste disposed of at WIPP consists of tools, rags, protective clothing, sludges, soil and other materials contaminated with radioactive elements that



have atomic numbers greater than uranium (transuranic).

When transported, RH- and CH-TRU waste have the same dose rate limit on the outside of the shipping casks.

RH-TRU waste is disposed in the walls of the disposal rooms using shielded horizontal emplacement equipment.

Before any waste generator site ships RH-TRU waste to WIPP, the EPA and NMED must approve the site's procedures for characterization, determining the physical and chemical characteristics of the waste, to ensure it is suitable for disposal at WIPP.

Transportation

RH-TRU waste is transported to WIPP primarily ii the RH-72B. The shipping cask has also been used to safely ship RH-TRU waste between waste generator sites.

The Nuclear Regulatory Commission has certified the cask, following rigorous safety testing to ensure it would remain leak tight, even in a severe accident.

The RH-72B cask is constructed of steel and capped with impact limiters, which are designed to act as shock absorbers. The RH-72B holds up to three 55-gallon drums or a single cylindrical canister of waste. Because of the weight of lead shielding, only one RH cask is loaded per trailer, compared to up to three TRUPACT-IIs and HalfPACTs used for CH-TRU waste.

Transportation routes to WIPP for RH- and CH-TRU waste are the same. Routes are designated in cooperation with states and tribal nations. Shipments are tracked by satellite from a secure, around-the-clock control center.

As with CH-TRU waste, all RH-TRU shipments undergo a Commercial Vehicle Safety Alliance Level VI inspection, the most rigorous in the shipping industry, and drivers must also stop and perform an inspection every three hours or 150 miles. Truck drivers must meet stringent requirements to be qualified to transport waste to WIPP.

Since 1998, more than 25,000 emergency responders along WIPP routes have received free training.

At WIPP

RH-TRU waste canisters are primarily placed in boreholes drilled into the walls of WIPP's underground disposal rooms. CH-TRU waste barrels and boxes are then stacked in rows on the floor of the same rooms.

In an RH-72B, waste or drums of waste are inside of a cylindrical canister, which is loaded into a facility cask at WIPP. Once underground, a forklift moves the facility cask to horizontal emplacement equipment, which pushes the canister out of the facility cask and into a borehole, and then inserts a concrete shield plug.

FOR MORE INFORMATION

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United States Naval Nuclear Propulsion Program

OPERATING NAVAL NUCLEAR PROPULSION PLANTS AND SHIPPING (RAIL) NAVAL SPENT FUEL SAFELY FOR OVER 60 YEARS

USS WASHINGTON (SSN 787)

USS GEORGE H.W. BUSH (CVN 77)

M-140 Naval Spent Fuel Shipping Container
(14" solid stainless steel)

September 2017

Naval Spent Nuclear Fuel Shipments

- Since 1957, the Naval Nuclear Propulsion Program (NNPP) has made over 870 container shipments of naval spent nuclear fuel to the Idaho National Laboratory (INL). These shipments are subject to rigorous health and safety requirements. The result is that all of the U.S. Navy's spent nuclear fuel shipments have been done safely without any release of radioactivity or injury to workers or the public.

- These spent nuclear fuel shipments are essential to maintaining and improving the U.S. Navy's nuclear-powered warships, which are key to the Navy's mission of protecting the nation.

- Upon refueling/defueling of reactors, all naval spent nuclear fuel is transported to the Naval Reactors Facility (located at the INL) for examination to confirm performance of current fuel and to improve the design of fuel for future ships. For example, the first nuclear-powered submarine, USS NAUTILUS (SSN 571), was refueled after her first two years of operation having steamed about 62,000 miles. Today's nuclear-powered attack submarine will not require refueling during its 33-year life and will steam over one million miles.

- Military advantages of nuclear-powered aircraft carriers and submarines include endurance at high speeds, independence from underway refueling, strategic and tactical flexibility, higher state of readiness upon arrival at destination, and submarine stealth at any speed. Today's nuclear fleet consists of:

  - 11 aircraft carriers (2 more under construction);
  - 70 submarines (3 more under construction);

  *More than 45 percent of the U.S. Navy's warships are nuclear-powered.

- As a matter of public record, the U.S. Navy's nuclear-powered ships have collectively steamed over 162 million miles and accumulated over 6,900 reactor-years of operating experience without a reactor accident or adverse impact on the public or the environment. The U.S. Navy operates these ships and conducts shipments of spent nuclear fuel with a strong commitment to safety and environmental protection.

USS GEORGIA (SSGN 729)

USS RONALD REAGAN (CVN 76)

Naval Spent Fuel Shipping Containers

- Naval spent nuclear fuel is packaged for shipment in formidable containers that meet or exceed all requirements of the Naval Nuclear Propulsion Program, the Nuclear Regulatory Commission, and the Department of Transportation.

- Collectively, these robust containers have traveled safely over 1.7 million miles throughout the United States loaded with spent nuclear fuel.

- Conservative engineering analysis, detailed calculations, scale model testing, and computer modeling demonstrate that the containers are designed to withstand severe real world accidents and remain safe. The regulatory accident performance standards that the container must withstand are:

    - 30-foot drop onto an unyielding surface;
    - 40-inch drop onto a 6-inch diameter vertical metal rod;
    - Fully-engulfing 1475 degree Fahrenheit fire for at least 30 minutes;
    - Immersion in 50 feet of water.

    *Including combinations of these events

- Radiation levels outside the shipping container are extremely low and are not a threat to human health. Typical radiation levels on the outside of loaded Naval spent fuel shipping containers are about 100 times less than the Department of Transportation safety limits.

M-290 Naval Spent Fuel Shipping Container
(10-11" solid stainless steel)

Naval Spent Fuel Characteristics

- In addition to the robust nature of the shipping containers, the contents — naval spent nuclear fuel — are also extremely rugged.
    - Naval fuel is solid metal.
    - Naval fuel contains no flammable, explosive, or corrosive materials.
    - Naval fuel is designed to protect the warship's crew by fully containing the uranium fuel and all of its radioactive fission products produced during operation.
    - Naval fuel is built to withstand combat battle shock forces well in excess of 50 times the force of gravity (more than 100 times the force of a severe earthquake).
- The same characteristics of naval nuclear fuel that make reactor operations safe, with a warship's crew living in close proximity and under combat conditions, make it safe to transport in a robust shipping container.

Naval Spent Fuel Shipping Practices

- The following shipping practices are used for naval spent fuel shipments:
    - Shipments are escorted by specially trained and armed NNPP shipment couriers who maintain constant surveillance of the shipments. These couriers would act as on-board first responders in the event of a transportation incident.
    - Shipments are dry – no water in container during transit.
    - Shipment location and status are constantly monitored by the same tracking center used for nuclear weapons shipments.
    - Government-owned railcars are strictly inspected and regularly maintained.
    - Shipments are coordinated in advance with railroad police and operations personnel.
- Since 1996, the NNPP has conducted shipment accident exercises at the following locations: Bremerton, WA; Norfolk, VA; Idaho Falls, ID; Portsmouth, NH; Topeka, KS; Kenova, WV; Denver, CO; Vancouver, WA; Fort Wayne, IN; Granger, WY and Mechanicville, NY. These periodic exercises have been very well received by the states that have hosted them. Objectives of the NNPP's accident exercises include:
    - Regional outreach with the host state;
    - Opportunity to familiarize civilian emergency services personnel and interested political leaders with naval spent fuel shipments;
    - Opportunity for civilian emergency personnel to interact with shipment couriers;
    - Opportunity to train personnel and practice emergency actions, including communications and public affairs, in response to an accident scenario.

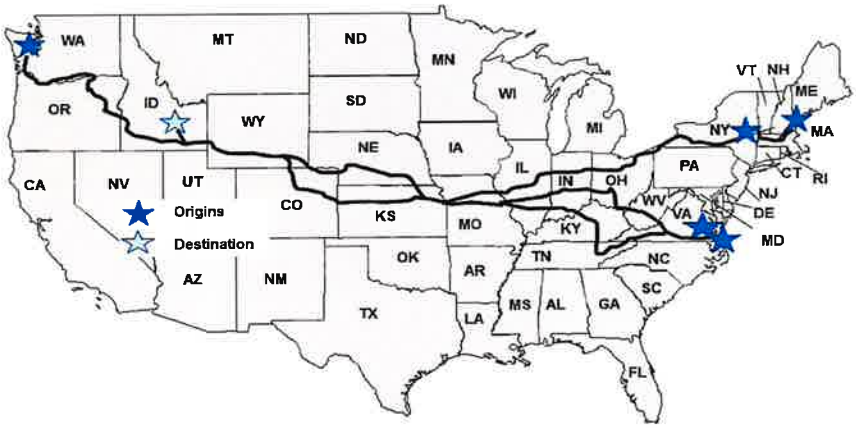
    The key takeaway from these exercises is that a coordinated, collaborative response amongst the shipper (NNPP), carrier (railroad), and civilian authorities (state, tribal, local) is crucial.

NNPP Shipment Couriers Integrate into Unified Command during the 2017 Accident Exercise in Mechanicville, NY

Conclusion

- The formidable construction of naval spent fuel shipping containers and the rugged nature of the fuel, along with the precautions taken during transit, have been successful in ensuring every shipment over the last 60 years has been conducted safely.

TYPICAL NAVAL SPENT FUEL SHIPPING ROUTES



24/7 Shipment Emergency Number: 412-476-5000 (Bettis Laboratory)

For questions, please call the Naval Spent Fuel Transportation Office: 412-476-7277.

For more information about the Naval Nuclear Propulsion Program, please visit:
http://nnsa.energy.gov/ourmission/poweringnavy

Version 2, Revised July 9, 2025

NTSF HBURC Shipment Ad Hoc Working Group

Work Plan

Background: The High Burnup Research Cask (HBURC) Project is a research project that the U.S. Department of Energy (DOE) has been conducting in collaboration with the Electric Power Research Institute (EPRI) since 2013. The purpose of the project is to investigate whether higher burnup spent nuclear fuel (SNF) performs similarly to lower burnup SNF after being removed from the reactor and placed in dry storage containers. In 2017, high burnup SNF was placed in a storage cask at the North Anna Power Station in Virginia, and this loaded cask is referred to as the HBURC. DOE is currently developing plans to relocate the HBURC from Virginia to Idaho National Laboratory for further research. The cask will travel by train on DOE's Atlas railcar, a 12-axle railcar specially designed to safely transport SNF. The HBURC shipment is a single research shipment of SNF, shipped according to DOE's authority under the Atomic Energy Act and DOE Order 460.2B, "*Departmental Materials Transportation Management*," and is not a Nuclear Waste Policy Act (NWPA) shipment. Therefore, this shipment will have important differences and will be distinct from future DOE SNF shipment campaigns to NWPA storage and disposal facilities. However, the HBURC shipment will provide an opportunity to operationalize and evaluate some of the same plans, tools, and resources that have been developed for future DOE large-scale rail transport activities, including public outreach and communication approaches, emergency response training with rail-specific modules, the Rail Consist Safety Inspection Protocol, and TRANSCOM tracking for rail shipments. Additional background resources on the HBURC Shipment project can be found at https://curie.pnnl.gov/HBURC-Transport.

Purpose: The HBURC Shipment Ad Hoc Working Group (AHWG) of the NTSF has been established to (1) facilitate a dialogue among Federal staff from DOE (Offices of Nuclear Energy and Environmental Management), Tribal and State governments associated with designated transportation route(s), the Federal Railroad Administration (FRA), and other Federal agencies, as applicable; (2) to coordinate training plans, technical assistance needs, transportation plans, and public communication resources for the shipment; (3) to build capacity, gather lessons learned in real time, and develop a common understanding about how future DOE rail shipments of spent nuclear fuel could operate in a safe and routine manner; and (4) to review lessons learned post-shipment and/or emerging questions to resolve in advance of commencing future DOE shipping campaigns. An additional goal of the AHWG is to identify key issues relating to the HBURC transport from the NTSF community perspective, address those issues, and systematically document work done through white papers and other media to make that work available to the NTSF community.

Start Date: May 2025

Finish Date: Spring 2028

AHWG Membership: One to two representatives from State governments (e.g., State officials) along the potential HBURC transportation routes, supported by State Regional Group (SRG) staff; Tribal government representatives from Tribes with reservation lands or treaty protected areas along the

potential HBURC transportation routes, supported by Northwind staff; federal staff from DOE and FRA, and designated national laboratory staff supporting DOE. Previous Rail/Routing AHWG members are also welcome to join as members to finalize the Rail Consist Safety Inspection Protocol. Other NTSF members are welcome to participate as observers.

Co-Chairs: (TBD) – Volunteers welcome

DOE Leads: Erica Bickford (US Dept. of Energy/Nuclear Energy) and Sara Hogan (US Dept. of Energy/Nuclear Energy)

DOE National Laboratory Support: Miriam Juckett (Pacific Northwest National Laboratory, lead); Steven Maheras (Pacific Northwest National Laboratory, Rail Consist Safety Inspection Protocol lead)

Meetings: The working group will convene virtual meetings or conference calls approximately monthly, or as needed; and will target 3-4 face-to-face meetings per year, or as practicable. One of the in-person meetings will occur at the NTSF Annual Meeting, and others may be held in conjunction with DOE-NE's Transportation Core Group meetings or SRG/TRMTC fall/winter meetings.

Work Products:

The AHWG will:

- Develop a work plan for the group and revisit/revise every 6-12 months
- Complete a final round of comments and revisions to carry forward the NTSF Rail/Routing AHWG's work on the Rail Consist Safety Inspection Protocol and finalize it (NTSF Rail/Routing AHWG will be sunset in May 2025).
- Identify and discuss topics related to preparation and planning along the transportation route for the HBURC shipment and identify differences between the HBURC shipment and future DOE NWPA shipments
- Identify emergency response training needs and capacity along the route and coordinate with DOE's Transportation Emergency Preparedness Program (TEPP) to plan and schedule trainings to meet the needs of Tribes and States.
- Identify Tribal and State technical assistance needs from DOE
- Review and provide feedback on parts of DOE's HBURC Transportation Plan, when available
- Develop or provide feedback on products such as communication plans and FAQs for use with Tribal or State leadership
- Identify one or more individuals to take the lead or co-facilitate addressing each issue or topical area, where needed
- Provide feedback on engagement and outreach plans or materials as needed, such as the potential whistle-stop tour plans, interactive events, and communication materials
- Document investigation and discussion of issues and appropriate action items or conclusions in white papers, collaborating with AHWG members and evaluating and integrating input from relevant subject matter experts
- Post white papers to the Working Group Google Drive, and present to NTSF community as appropriate

- Coordinate informational webinars for the benefit of the AHWG, and/or the NTSF community, as needed
- Organize and facilitate sessions at NTSF and other forums, as appropriate.

AHWG Priority Issues:

- Complete Rail Consist Safety Inspection Protocol
- Identify and coordinate emergency response training needs and/or information sharing through DOE EM/TEPP
- Identify technical assistance needs for Tribes/States along HBURC route
- Identify differences between the HBURC shipment and future DOE NWPA shipments
- Share DOE's HBURC transportation plan and other activities consistent with DOE Order 460.2B

Schedule of Activities:

Task	Due Date	Lead & Participants	Status/Comments
Initiate AHWG; present draft work plan at NTSF	May 20, 2025	Erica Bickford; Miriam Juckett	Completed, May 20, 2025
Revise Dec. 2024 draft of Rail Consist Safety Inspection Protocol to incorporate DOE comments	May 20, 2025	Maheras (lead)/Bickford/Juckett	DOE comments received 05/06/2025
Brief revised Rail Consist Safety Inspection Protocol to HBURC AHWG at NTSF Annual Meeting	May 20, 2025	Maheras/Bickford/Juckett	Completed, May 20, 2025
NTSF Webinar on HBURC Shipment Project	June 18, 2025	DOE/CSG-MW	Completed, June 18, 2025
Comments on AHWG work plan, seek volunteers to Co-Chair AHWG	June 30, 2025	All; Bickford/Juckett	Comments received; evaluated for discussion at July AHWG meeting.
Begin monthly virtual AHWG meetings	July 2025	All	First meeting July 9, 2025.
Review and resolve comments/finalize initial AHWG work plan	July 29, 2025	Bickford/Juckett; All	
HBURC AHWG comment period	September 19, 2025	All	

on Rail Consist Safety Inspection Protocol			
Confirm final transportation route and plan TEPP training along route	Fall 2025	All	
Revise Rail Consist Safety Inspection Protocol	December 19, 2025	Maheras	
DOE review of revised Rail Consist Safety Inspection Protocol; iterations to complete	January 31, 2025	Bickford/Maheras	
Release revised Rail Consist Safety Inspection Protocol	February 2026	Bickford	
Conduct webinar to roll out Rail Consist Safety Inspection Protocol	February/March 2026	Maheras/Bickford	
Start planning and subcontracting for test and use of Rail Consist Safety Inspection Protocol during TN-32B dry run	March 2026	Maheras/Bickford	
HBURC shipment Dry-Run	Spring 2027	All	
HBURC whistle-stop tour	Spring/Summer 2027	All	
HBURC shipment	Fall 2027	All	
Post-shipment summary and lessons learned discussions	Winter 2027/Spring 2028	All	

Reference: U.S. Department of Energy. DOE Order 460.2B, "*Departmental Materials Transportation Management*." Jun, 2022.

A 2022 NTSF webinar with information about DOE Order 460.2B can be found here: https://www.ntsf.info/webinars#h.luesskso7san

Revision History:

Initial Draft for Comment (Rev 1): June 10, 2025

Rev 2, Final Work Plan: July 9, 2025

Likely Rail Route for the U.S. Department of Energy's High Burnup Research Cask Spent Nuclear Fuel Shipment

LEGEND

☆ Origin/destination

▬ Route

September 2025

U.S. DEPARTMENT of ENERGY | Office of Nuclear Energy

Spent Fuel and High-Level Waste Disposition

ATLAS RAILCAR

The U.S. Department of Energy (DOE) has developed special railcars for future large-scale DOE transport of spent nuclear fuel (SNF) from nuclear power plants. The designs include the Atlas railcar (designed to transport SNF containers), new buffer railcars, and a new escort railcar for security personnel that was developed in collaboration with the U.S. Navy.

RAILCAR DESIGN PROCESS

Atlas is a 12-axle railcar designed to carry 23 different SNF transportation packages (also known as "casks") weighing between 82 tons and 210 tons. The design process included extensive dynamic computer modeling to simulate how the railcar would perform with various railcar components, attachment mechanisms, and container weights.

SAFETY STANDARDS AND TESTING

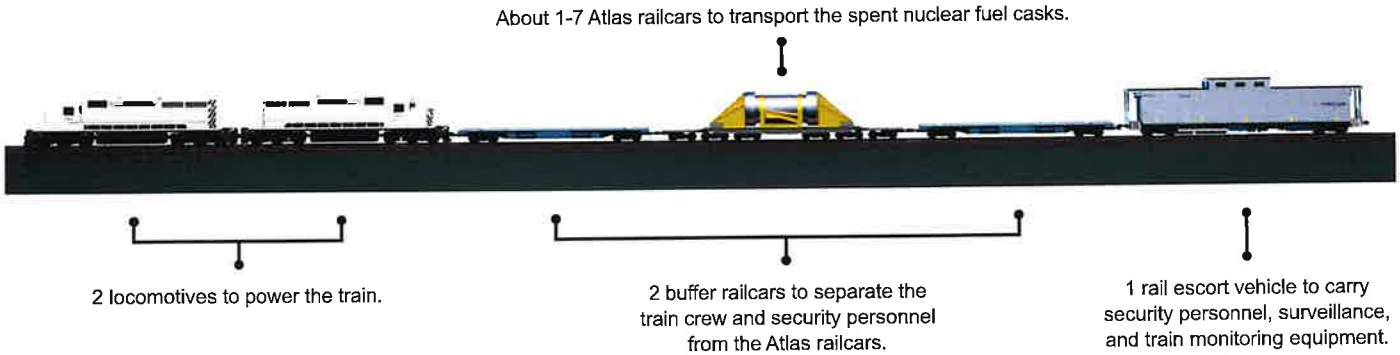
The Association of American Railroads (AAR) is the standard-setting organization for North America's freight railroads. In May 2024, DOE's three railcar designs were officially approved under AAR's S-2043 standard, which is specific to railcars used to transport high-level radioactive material such as SNF.

To gain AAR approval under the rigorous S-2043 standard, railcars must undergo individual testing and multiple-railcar testing as part of a full train with other S-2043 railcars. The Atlas railcar took 10 years of development and testing to meet AAR standards.

TRANSPORTING SNF BY RAIL

DOE transport of SNF by rail will look similar to the graphic below, with flat-deck buffer railcars providing physical separation from radioactive materials in the cask-carrying Atlas railcar(s). A rail escort vehicle (REV) will transport armed escorts along with security and safety monitoring equipment for each shipment. DOE and the U.S. Navy collaborated on the design and testing of the REV.

For more information, contact **AskSNF@nuclear.energy.gov**



U.S. DEPARTMENT of ENERGY | Office of Nuclear Energy
Spent Fuel and High-Level Waste Disposition

June 2025

Rail Escort Vehicle

Jointly Prepared and Presented by the U.S. Department of Energy and the U.S. Department of the Navy

The U.S. Navy's Naval Nuclear Propulsion Program (NNPP) transports classified, high-value U.S. Navy ship components by rail, including naval spent nuclear fuel (SNF). Meanwhile, the U.S. Department of Energy Office of Nuclear Energy (DOE NE) is preparing for future large-scale transport of commercial SNF from nuclear power plants using much of the same rail infrastructure and similar railcars. The current fleet of NNPP escort vehicles will soon reach the end of their service life. To leverage resources and share best practices, the NNPP and DOE NE jointly designed the new rail escort vehicle (REV).

Both programs require 24/7 monitoring and surveillance of their SNF shipments by specially trained security personnel on-board the transport train. At least one REV will be included in every train along with the railcars that carry SNF. The REV will transport the security personnel during these shipments, providing a comfortable living and working environment.

NNPP Rail Escort Vehicle
(Identified by "DODX" reporting mark)

DOE Rail Escort Vehicle
(Identified by "IDOX" reporting mark)

Rail Escort Vehicle General Characteristics	
Manufacturer	Vigor Works LLC. - Portland, Oregon
Truck Design	Two Truck Sets *(four axles per railcar)* Amsted Rail 100 Ton Swing-Motion™ Custom Spring Package with Vertical Dampers 36" Wheel Diameter
Overall Length	68' 10-9/16" Over Pulling Faces
Overall Width	10' 4-25/32" Maximum
Clearance Diagram	Meets Plate E Equipment Diagram (AAR Standard S-2031)
Maximum Weight	185,000 Pounds

The REV is designed in accordance with Association of American Railroads (AAR) Standard S-2043 for trains used to transport SNF and high-level radioactive waste. The REV has undergone thorough structural and performance testing at both the manufacturer and testing facility in accordance with AAR Standard S-2043.

The NNPP will operate a fleet of five REVs which will provide enhanced security, communication, and surveillance capabilities compared to the existing NNPP escort vehicles. DOE's REV is available for use on future shipments or railcar testing, and DOE may procure additional REVs as it prepares for large-scale transportation of commercial SNF.

To maintain operational security, further details regarding REV capabilities and specifications are not publicly releasable.

Additional Resources:

For more information about the Naval Nuclear Propulsion Program, please visit:
www.energy.gov/nnsa/missions/powering-navy

For more information about the U.S. Department of Energy Office of Nuclear Energy and the DOE Railcar Projects, please visit:
www.energy.gov/ne/spent-fuel-and-waste-disposition