Nuclear Information and Resource Service
For a Nuclear-Free, Carbon-Free World

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HOT CARGOS

RADIOACTIVE WASTE on our Roads, Rails, Waterways for Decades to Come

Nuclear power reactors make energy by creating nuclear waste. For every watt of electricity from nuclear power, there are hundreds of kinds of radioactive atoms formed when uranium-235 (U-235) atoms split into smaller radioactive atoms. U-238 atoms absorb neutrons to make bigger radioactive atoms, like plutonium (which can be used to make nuclear weapons). All of these atoms are formed inside fuel pellets that are stacked like poker chips in long thin metal tubes which are held together in assemblies. Hundreds of fuel assemblies are in each nuclear power reactor core.

Each time a uranium atom breaks into smaller radioactive atoms it gives off the binding energy that held it together. That energy heats the water, turns the turbines and makes electricity, but that electricity is fleeting—used or wasted right away—while the radioactive elements formed last for minutes up to literally millions of years, posing radioactive dangers for generations.

The **"irradiated" fuel** that comes out of the nuclear reactor core, also referred to as "spent" or "used" fuel, is **high level radioactive waste** and is **millions of times more radioactive than the fresh uranium fuel** that went into the reactor. Unshielded the irradiated fuel can give a **lethal radiation dose in seconds to minutes**, so must be stored under water and cooled for years before it can be moved to dry storage. In recent decades, reactors have used more concentrated U-235 and kept the fuel in the core longer, resulting in **"high burn-up"** fuel which is **even more radioactive and thermally hot** than the fuel from the 1970s. Fuel at all "burn-up" levels is dangerous and challenging but recent research has shown how much **more stress high burn-up places on the cladding, assembly structures and the containers in which it is stored.**

High level radioactive waste was made at 83 nuclear power sites across the country and continues to be generated as long as they operate. After a few years in the reactor core, irradiated fuel/high level waste is removed by remote control to 40-foot deep water-filled pools where it is shielded and cooled--thermally and radioactively for a few to over 20 years.

As the fuel pools fill, nuclear utilities move older fuel into dry storage. The higher the "burn-up," the longer the fuel must stay in the pool before moved to dry storage, which in US means into sealed thin-walled canisters and concrete cylindrical overpacks at each reactor site. Thicker casks are used internationally.

As a temporary fix, nuclear utilities, the Department of Energy (DOE) and some in the US Congress are promoting one or more consolidated 'interim' storage sites. In the past such proposals targeted Native American lands; now they are directed at largely Hispanic communities which already have multiple hazardous industries.

For now, the waste remains at nuclear power sites, but **if a consolidated site opens, the nuclear transport flood gates would open.** Thousands of truck, train and barge shipments would move dangerous radioactive waste across the country, through everyone's backyard and over rivers, lakes and oceans. Transportation routes would likely go through as many as 43 states and the District of Columbia, through 87% of the Congressional districts in the US, potentially impacting huge areas and most of the US population. Department of Transportation regulations require highway shipments of nuclear waste to take the most direct Interstate routes, even if these routes traverse densely populated metropolitan areas. **Every day for more than 50 years at least one nuclear shipment would be on the rails or highways.**

SHIPPING CONTAINERS: THEY'RE BIG. THEY'RE STRONG. THEY'RE VULNERABLE.

A shipping cask is a cylindrical metal container, made up of steel and lead or uranium. In the 1990's each truck shipping cask weighed 25 tons: rail casks weighed up to 125 tons.

Industry has been pushing the size larger. Holtec canisters are moved from concrete overpacks into transfer casks and then transferred into transportation casks. The massive Holtec rail cask weighs 209 tons, much heavier than earlier rail casks. The flat bed carriage weighs an additional 55 to 93 tons. This weight is an important transportation safety concern on deteriorating infrastructure.

Many bridges are far higher than 30 feet above ground surface; **casks must be designed to withstand a 30 foot drop.** The fuel assemblies are remotely loaded into the casks. A typical (PWR) pressurized water nuclear power reactor uses 60 fuel assemblies, or 30 tons of fuel, every 1½ years. Each truck cask contains 1 or 4 PWR fuel assemblies. Each rail cask holds from 24 to 37 fuel assemblies. **Each fuel assembly contains over 10 times the long-lasting radioactivity released by the Hiroshima bomb.**

The more severe an accident, the more likely that radioactive material would be released to the environment. Further, high burn-up fuel (up to 72 GWd/MTU*) has more brittle and thinner fuel tubing or cladding. A low speed highway accident could unseat a valve or damage a seal, releasing radioactive particulates to the environment. The same event could crack the brittle metal tubing about the fuel. According to the American Petroleum Institute, heavy truck accidents occur about 6 times each million miles traveled. With thousands of truck shipments, **at least 15 accidents are expected each year.**

Shipping containers are designed to withstand a crash into an immovable object at 30 miles per hour. Obviously Interstate trucks travel much faster than 30 mph. Impact into a bridge abutment or a fall off a bridge **could easily exceed the design limits of the container.**

A fire associated with a truck or rail accident increases the likelihood that radioactivity will be released. Fires occur in 1.6% of all truck and 1% of all train accidents. Shipping containers are designed to withstand a 1/2- hour fire at a temperature of 1475 ^{o}F. But rail fires could burn for hours, sometimes for days, at temperatures considerably hotter. Diesel fuel burns at 1850 ^{o}F or more. Some materials burn twice as hot. The heat could vaporize some radioactive materials, such as cesium-137, and sweep them up into the air. Persons downwind could inhale radioactive particulates and later develop cancer, genetic effects or ischemic heart disease. Children and females suffer more harm than an adult male given the same exposure.

None of the container designs presently used on highways and rails has been physically tested. Some containers were designed and built in the 1960's and '70's. Waste containers used now have only been tested by computer or hand calculators. Before the flood gates open on nuclear shipments, DOE should at least require shipping containers presently proposed be physically tested, but the Department has no such plans.

ARE YOU READY?

Even if a small percentage of radioactive waste is released from a shipping container, the number of health effects and the impact on a local community could be disastrous. A 1980 study by the Nuclear Regulatory Commission estimates economic consequences in an urban area on the order of $2 billion. A more recent study by DOE contractors estimates economic costs on the order of $460 million, and a period greater than 1 year to clean up the radioactive residue. Who would be first on the accident scene? Local fire, police and emergency personnel, who are neither trained nor equipped to cope with emergencies of this magnitude. It is important that fire companies extinguish a fire within a half hour, yet it is often unclear who has authority and responsibility for cleanup and protecting the public health in an emergency.

WHAT TO DO?

High-level waste containers should be designed to withstand all real highway, rail and nautical accidents. The standards need to be raised. Waste containers should be physically tested to withstand realistic and credible accidents. Local community emergency personnel should be trained and equipped to handle radiation-related accidents. No nuclear fuel should move until these basic safety conditions are met.

*GWd/MTU=gigawatt days/metric ton uranium; unit of measure of amount of fissioning irradiated fuel has undergone.

Updated April 2018 HOT CARGOs prepared by collaboration of Dr. Marvin Resnikoff, Radioactive Waste Management Associates, www.rwma.com and Nuclear Information and Resource Service, www.nirs.org.