Dealing with the Risks of Radioactive Waste

"Should It Stay or Should It Go"

I've spent a lot of time riding the highways in my mom's Honda Odyssey. My two brothers, sister, and I call it the Gunship. It's taken us to countless soccer tournaments across the country and to many family vacations up north. In fact, in less than nine years, we have logged close to 300,000 miles in that dark grey metallic van. That's a crazy amount of miles for a van, but what's even crazier is the type of cargo I've seen being hauled by eighteen wheelers traveling the interstates. I've seen oversized process tanks, huge structural supports, and chemicals of all kinds, but the loads that really grab my attention are the ones bearing the hallmarks of radioactive material, the infamous three-bladed black and yellow symbol. When we pass these trucks, my mom puts the pedal to the metal to put some distance between us. And I'm pretty sure our Gunship is not the only vehicle to take this sort of evasive action. So it begs a question, is that even a rational action to take? Or more to the point, why is radioactive waste being transported on our highways in the first place? To answer this requires an understanding of the risks associated with transporting radioactive material on our roads, rails, or waterways versus the risks of storing radioactive waste at the facility where it was generated.

There are a number of types of radioactive waste that require a disposal path (e.g. low-level waste, intermediate-level waste, high-level waste, and transuranic waste). Many long-term waste management options already exist for disposing of low-level radioactive waste (LLW) not only in the United States, but around the world. However, since LLW makes up 90% of volume but has only 1% of the radioactivity of all radioactive waste, the risks of shipping it for disposal or storing it are very small.[1] The real challenge is to safely manage the transportation or storage of high-level waste (HLW) which is comprised predominately of used fuel rods, waste from reprocessing used fuel, or defense nuclear waste from old weapons production sites.

In the United States, the closest our country came to obtaining a permanent repository for HLW was the Yucca Mountain project. Sadly, or thankfully, depending on your perspective, this project was cancelled by the Obama administration in 2009. Hence, the only option available in the U.S. for HLW is on-site storage. While a few countries in Europe are making progress towards opening a repository, reactor owners really have no choice but to keep spent fuel at the reactor sites. The good news is that on-site storage of radioactive waste has been demonstrated to be safe over decades as long as there is active surveillance and maintenance.[2] In addition,

since there are only about 100 operating reactors in the U.S. and 440 operating reactor worldwide, the volume of HLW is a relatively small quantity and still quite manageable.

At a reactor site, spent fuel is kept in pools of water to keep them at a safe temperature, whereby the fuel cladding encasing the uranium stays intact. If the water were to drain from the cooling pool, the result could be a catastrophic fire and release of radioactive substances such as cesium-137 to the environment.[3] However, the probability of this happening is very low considering the four major risks of storing radioactive waste on-site are from natural disasters, human error, equipment failure, and terrorism. The nuclear industry has done its job managing these risks with engineering controls, procedures, trained personnel, and technologies. Terrorism, though, continues to be an ever evolving risk which makes on-site storage less attractive as a long-term solution for some countries or acceptable to the public. One successful terrorist attack could devastate an entire community. It's estimated that the cost to an economy, to public health, and to cleanup a release from a spent fuel pool disaster could be billions of dollars. An alternative to avoid these risks would be moving the spent fuel in storage pools to dry casks where decay heat can safely be removed by the natural convection of air flow after about five years.[4] Dry casks are a viable solution to further reduce onsite storage risks and offer long-term benefits to society. It would take an extraordinary effort for someone to breach a steel and concrete dry cask holding radioactive waste. Also, dry casks can be spaced above ground or underground such that the consequences of a deliberate plane crash would be reduced. Until all options for long-term storage or disposal of HLW have been explored, the best action may be to have it remain where companies can monitor the condition of the containers and can have access in the event a new technology renders radioactive waste usable or less hazardous.

Yet, the safest option for radioactive waste could be to ship and consolidate it at an interim long-term storage or reprocessing facility until governments decide on a permanent repository. Some countries already have programs similar to this or have agreements in place for a repository. In 2015, after thirty years of studies, Finland's government was the first to approve the construction of a deep underground repository for HLW.[5] Eventually, other countries may follow Finland's lead or the International Community will agree to a technology allowing for International repositories. A centralized facility for disposal of HLW has many advantages in terms of cost, safety, security, and non-proliferation since many countries do not have the needed

geological conditions for disposal.[6] These solutions, however, will require the shipment of radioactive waste which is often met with much opposition.

Most people don't realize that all sorts of radioactive waste have been shipped safely around the world and in the U.S. for years. In fact, the U.S. has over 40 years of experience shipping radioactive waste. We routinely ship over 250,000 packages containing radioactive waste from nuclear power plants each year. Anywhere from 25 to 100 of these are considered used fuel and are packaged in Type B casks and shipped by rail.[7] Type B casks are extremely safe and secure. They range in size from a drum to a truck and can be very expensive due to the engineering involved to withstand extreme environmental conditions. The Nuclear Regulatory Commission also imposes design requirements on these type casks such as a 30 foot drop onto a hard surface, immersion tests, and being engulfed in fire at 1470 degrees for 30 minutes. There are over 150 Type B casks designs and some are able to store HLW safely for over 100 years.[8]

So how do the potential risks from shipping radioactive material really differ from those of storing radioactive waste? Once again, natural disasters, accidents, equipment failures, and terrorism are the most significant risks to contend with during shipments. However, the safety record for radioactive waste shipments says it all. Over the course of several decades, there has never been a release of harmful contamination, public radiation exposure, or environmental damage when shipping used reactor fuel. In fact, a 2006 study by the National Research Council found that there were "no fundamental technical barriers to the safe transport of spent nuclear fuel and high level waste in the United States".[9] While some might argue that there is a greater health risk (i.e. additional cancer deaths) to the workers who have to handle radioactive waste or to citizens on the transportation route, there are good controls in place such as cask shielding, use of approved routes, and GPS monitoring of the shipment along the route to alleviate this concern.[10] Also, as new technologies like driverless vehicles emerge, the risk of accidents will decrease too.

The nuclear industry has done a very good job protecting the public and environment from the risks associated with storing radioactive waste at a generating facility and the risks involved when transporting radioactive material. Both storing and shipping of radioactive waste has proven to be safe and are part of the solution until permanent repositories are constructed. However, better security is needed to reduce the risk of terrorism until then. Recall the story of the nun who broke into a nuclear weapons plant in 2014 to make a political statement. Security

failures like this need to be addressed immediately with new technology to ensure public confidence that storing or shipping radioactive waste is safe.

I realize now that most of the radioactive materials that I have witnessed on highways over the years were probably LLW on their way to a licensed disposal facility. While I may have seen some Type B casks, one thing is for sure, I did not appreciate the robustness of these containers. Personally, I've come to learn that the transportation and storage risks that should concern me most are the toxic chemicals and wastes being hauled on the roads and through our communities every day. Maybe that's the risk we should all take time to better understand.

Sources:

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