Future of high-level waste disposal rests on research

When the first canisters of Hanford's highly radioactive tank waste are shipped to the proposed repository inside Nevada's Yucca Mountain later this century, the event will be heralded as a major achievement, due in no small part to research taking place today inside the Radiochemical Processing Laboratory in Hanford's 300 Area.

The RPL, sometimes referred to as the 325 Building, houses state-of-the-art research equipment and an expert staff seeking to answer questions about the long-term performance of the repository. The research being done here will aid in the Department of Energy's application to the Nuclear Regulatory Commission for authorization to construct the proposed repository and to receive and hold the waste when that time comes.

"Our task is to understand if there is a real-world possibility of waste escaping the repository — and, if so, how it could occur," said Brady Hanson, Pacific Northwest National Laboratory project manager who is leading a team studying four specific aspects of waste migration. They will use their data to develop computer models that will show the degree of risk the radioactive materials could pose to public health and safety and the environment if the containers are eventually breached.

"Historically, we've always looked at worst-case scenarios," Hanson said. "Now we are looking at realistic scenarios to understand what would really happen, not what *might* happen."

Hanson's team of scientists in PNNL's Radiomaterials Chemistry organization is building computer models that will simulate scenarios involving a variety of radioactive materials such as N Reactor fuel, mixed oxide fuel and other spent nuclear fuel forms, as well as vitrified high-level waste, which would be put in the repository.

The first issue the scientists are examining is referred to as Waste Form Oxidation. The study involves what happens to the waste material if a hole opens in the sealed double-shell container known as a waste package. Researchers will study the corrosion rates of the fuel and other waste forms under both relatively dry and moister conditions.

A second examination will look at how fast the waste would dissolve if exposed to water and how quickly it would escape the container. The third study looks at colloid formation — in other words, how radioactive materials adhere to microscopic particles that could be carried along by groundwater. The fourth area of study focuses on which radioactive materials will actually dissolve, how readily they will dissolve, and how the movement of groundwater could transport them.

Results of the research are to be completed before DOE submits the license application in December 2004.

"All of this information is essential to understanding the natural processes that could occur in and around the repository, which could impact the ability of the repository to get a license," Hanson said. "And, without a license, no waste will leave Hanford or anywhere else in the country."

PNNL is conducting the research in conjunction with Argonne National Laboratory in Chicago. Other laboratories across the country are looking at other aspects of the repository licensing requirements. ■