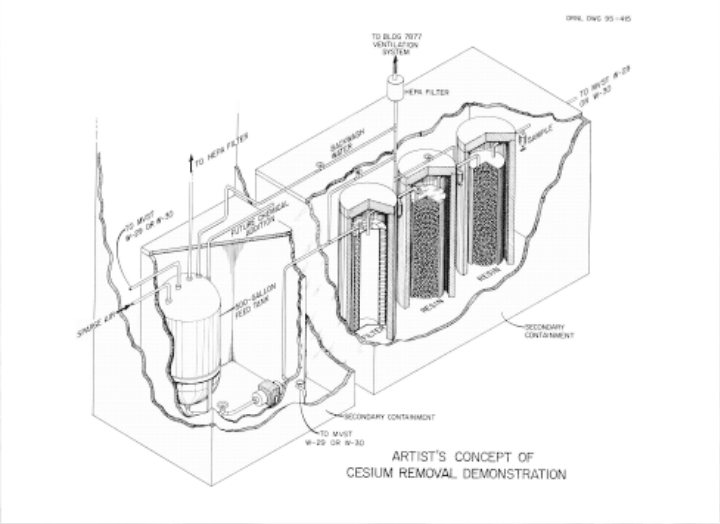
# Cesium Removal Studies



ARTIST'S CONCEPT OF
CESIUM REMOVAL DEMONSTRATION

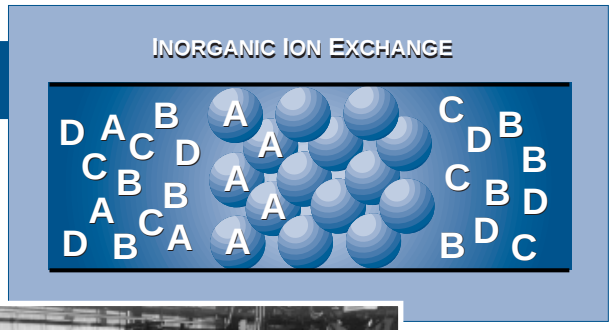
**U.S. Department of Energy**
Office of Environmental Management
Office of Science and Technology

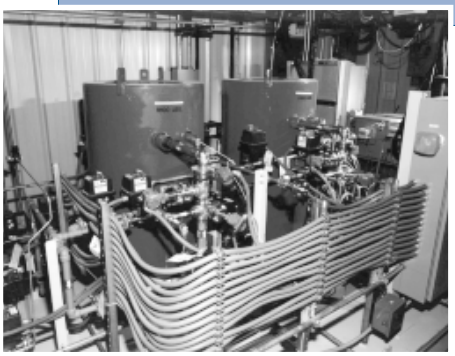
# Problem:

Approximately 100 million gallons of radioactive waste are stored in underground storage tanks at DOE's Hanford Site, Idaho National Engineering and Environmental Laboratory, Oak Ridge Reservation, and Savannah River Site. The waste contains the radioactive element cesium. Cesium emits penetrating radiation that presents health risks to workers and the public if they are exposed to the tank waste. Removing the cesium from liquid tank waste reduces the volume that must be carefully and expensively handled to prevent such exposures.

# Solution:

The Tanks Focus Area, in conjunction with the Efficient Separations Program and numerous other partners, drew upon years of experience and related research in industry, academia, and national laboratories to develop solutions to the problems posed by cesium. These groups evaluated the myriad of cesium removal technologies and provided critical data to site users on the benefits of ion-exchange for cesium removal. A number of materials were developed that remove cesium from tank waste with a minimum of secondary waste generation.



Ion exchange processes effectively remove cesium from liquid radioactive waste. In the ion-exchange process, radioactive liquid is passed through a sorbent material, which absorbs the problem elements - in this case, cesium. Depending on the concentration of cesium trapped in the sorbent, the material can be stored as low-level waste or turned into glass in a vitrification process. Durable waste forms for cesium-loaded sorbents are produced from glass formulas developed under the auspices of the Tanks Focus Area.

# Benefits:

- Removing cesium from the tank waste reduces processing costs and risks to the worker
- Ion exchange does not introduce additional hazardous chemicals into the waste stream
- By removing cesium, large volumes of tank waste can be disposed as low-level waste, which is much cheaper than high-level waste disposal in an offsite geologic repository

*Oak Ridge Reservation has 89 underground storage tanks, however 34 of these tanks contain the bulk of the liquid radioactive waste.*

## Oak Ridge

OST Reference # 21, 182, 2006

At Oak Ridge, the Tank Focus Area's Cesium Removal System was developed, demonstrated, and transferred to the users. Over the course of eight months, the Cesium Removal System processed more than 30,000 gallons of waste, efficiently removing more than 1000 curies of cesium. The system works by flowing liquid tank waste through a column packed with sorbent, in this case, crystalline silicotitanate. The compact, modular design allows the system to be transported from tank farm to tank farm. Thus, the costs of constructing a large, stationary facility and the risk of moving the waste to such a facility are eliminated. Efforts are underway to combine the Cesium Removal System with a mobile evaporator developed by the Tanks Focus Area.

### Benefits:

- By removing the cesium, radioactive tank waste can be treated and disposed of as low-level waste resulting in significant cost savings over treatment and disposal as transuranic waste
- Potential cost savings at Oak Ridge from cesium removal is more than $60 million

## Hanford

OST Reference ID # 21

Performance data on cesium removal studies conducted through the Tank Focus Area enabled a successful negotiation for privatized treatment and immobilization of Hanford's tank waste. British Nuclear Fuels Limited, Inc.'s multibillion dollar contract with DOE's Richland Operations Office contains stringent specifications for waste processing and the final waste product. Technical results and discussions with the Tank Focus Area and have provided British Nuclear Fuels Limited, Inc. with data to better evaluate materials for removal of cesium from Hanford's tank waste.

### Benefit:

- Potential cost savings for cesium removal at Hanford from using new ion exchange materials is estimated to be $1 billion

*Hanford houses 177 underground storage tanks containing 54 million gallons of tank waste.*

*The Idaho National Environmental and Engineering Laboratory stores 1.4 million gallons of highly acidic liquid waste in eleven tanks. Seven bin sets store one million more gallons of dry radioactive waste in the form of calcine.*

## Idaho

OST Reference # 204, 206, 347, 1438

Ion-exchange had not been used on waste with the high acid content of Idaho National Engineering and Environmental Laboratory's, so it was important to find a sorbent material that worked with their particular waste chemistry. Scientists at the Remote Analytical Laboratory tested three ion-exchange sorbents with simulated and actual waste. The Idaho National Engineering and Environmental Laboratory collaborated with Russia to develop and evaluate materials for the treatment of acidic high-level radioactive wastes. Comparative data compiled on the performance of the materials is being used by the site in flowsheet development and evaluating treatment alternatives for cesium removal as part of their Environmental Impact Statement and waste disposition planning. A demonstration of technology for removing cesium and other radionuclides from dissolved calcine is also being discussed.

### Benefits:

- Removing radionuclides from tank waste at Idaho will save $2 billion
- After radionuclide removal, the resulting high-level waste volume is significantly less resulting in lower facility and processing costs

## Savannah River Site

OST Reference # 21, 204, 245

With technical assistance provided by the Tanks Focus Area, the Savannah River Site is evaluating alternative methods for processing their cesium-laden wastes. Their current process was suspended because of safety concerns. Approximately 140 possible cesium disposition alternatives were evaluated and refined to a list of four. Two of the four alternatives are products of DOE's Office of Science and Technology. Savannnah River Site will further test and evaluate several cesium removal options and make a final downselect after pilot-scale testing is complete. In addition, Savannah River Site is planning a system that includes cesium removal to decontaminate a condensate stream from the Defense Waste Processing Facility.

### Benefits:

- A safer alternative will be provided for cesium removal for tank wastes
- Alternative cesium removal methods are available that result in minimal secondary waste production and use existing treatment equipment, saving dollars in capital costs and subsequent vitrification activities

*Savannah River Site's 49 waste storage tanks contain 34 million gallons of waste.*

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