Lessons Learned from Decontamination and Decommissioning Projects

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IAEA-CN-211/12PR, Contributing Poster - Remediation

Nuclear Capabilities and Expertise

- More than 20 years experience in nuclear industry
  - Decommissioning and demolishing of highly radioactive facilities
  - Retrieval, characterization, treatment, packaging, storage and disposal of waste; and repository solutions
  - Nuclear remediation
  - Emergency Planning
  - Plant decommissioning services
  - Spent fuel handling, management and operations




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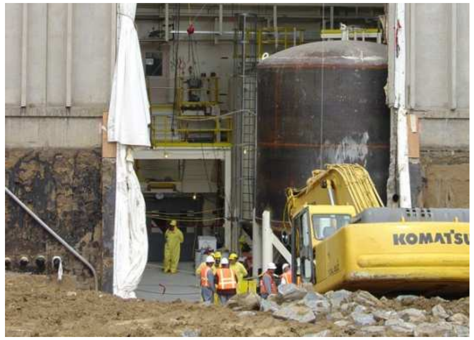
Rocky Flats Closure Project, USA

- More than 800 contaminated and non-contaminated structures
- More than 21 tons of weapons-grade nuclear materials, much of it improperly stored
- More than 30,000 liters of plutonium and enriched uranium solutions in aging tanks and pipes, some leaking
- Extensive contamination across the site
- Decontaminated and demolished five major plutonium processing facilities comprising more than 1 million square feet
- Located in the “back yard” of nearly 3 million people
- Closing the site was estimated to take 70 years and cost more than $36 billion
- Site is now a National Wildlife Refuge



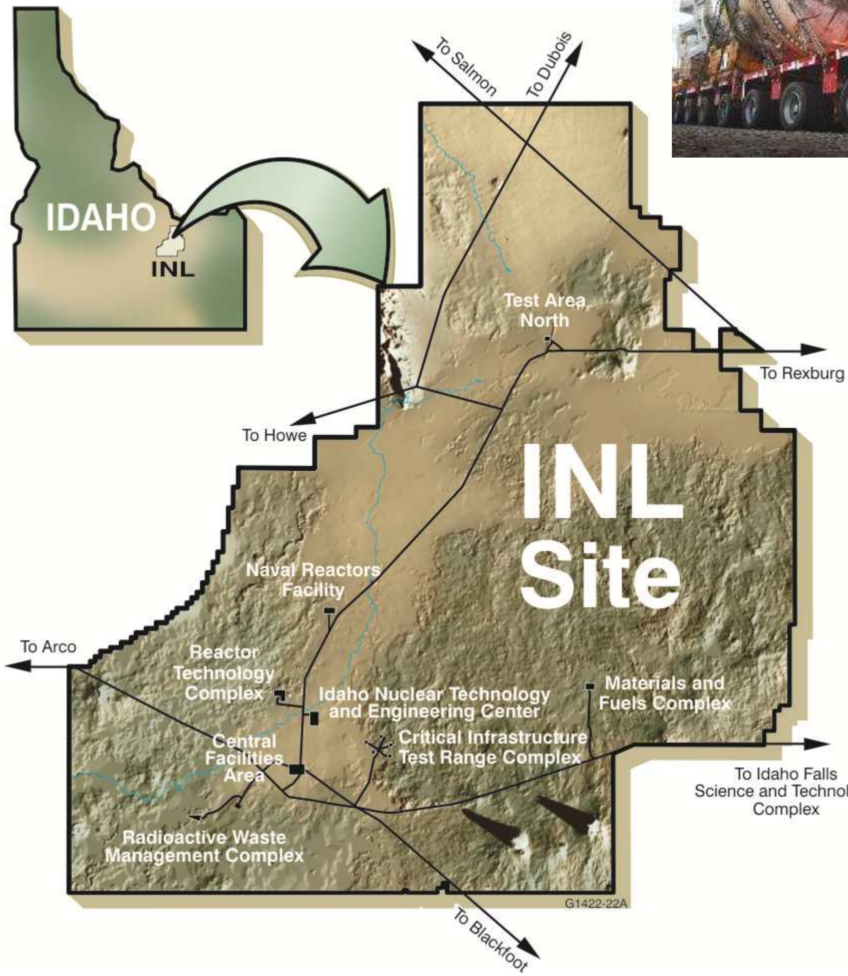
Decontaminating the Rocky Flats "Infinity Rooms"

- 13 "infinity rooms" were so contaminated that radiological monitoring equipment of the day could not measure it
- B771, Room 141 airborne radioactivity was upward of **20 million DAC -** room was sealed for 25 years
- DAC lowered to 10,000 through innovative decontamination techniques and fixative applied to interior surfaces remotely
- Entire room size reduced

Lessons Learned: methodical planning and engineered controls (fixatives, decontamination, ventilation, wet methods, fogging, wire saw cutting), and protective equipment may be slow but reduce risk.

Idaho Cleanup Project, USA

- Located in southeastern Idaho, USA, on the Snake River Plain
- 6 major facility areas across an 2,300 square km area and several laboratories 80 km east of Idaho Falls
- Extensive contamination from over 50 years of reactor testing
- Focus on risk reduction to workers, public, environment, and drinking water source for >300,000 people



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Safely Decommissioning Idaho's Reactors

- Dose rates inside of the Engineering Test Reactor (ETR) were as high as **1100 R/hr**
- **Innovation:** Engineered grout was used to provide the proper shielding so that workers could enter the reactor and perform work with general body fields of only 20 mrem/hr
- Grouting reduced the external dose rates on the reactor from ~ 100 R/hr to ~100 mrem/hr. Radiation area only extended ~10 ft from the reactor during removal

- The Experimental Breeder Reactor II broke new ground with sodium coolant, built-in fail safes, a closed fuel cycle and other innovations
  - Had not been designed to be safely dismantled
- Dose rates varied from **15 R/hr** to **3000 R/hr**
- **Innovation:** Grouted in place for safety and health
  - The lifting, transport and disposal of a fully grouted reactor vessel involved too much technical risk

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Safely Decommissioning Idaho's Reactors

- The Power Burst Facility (PBF) reactor was not grouted so that it could be removed by conventional cranes

Innovations

- To reduce dose rates above the reactor opening and in the annulus to allow for extended work the reactor was re-filled with water
- Fixative was applied to the PBF annulus to decrease the loose contamination

- The Materials Test Reactor (MTR) had dose rates of 6 R/hr
- **Innovation:** A standard, commercially available Culvert was used to shield the reactor as it was removed

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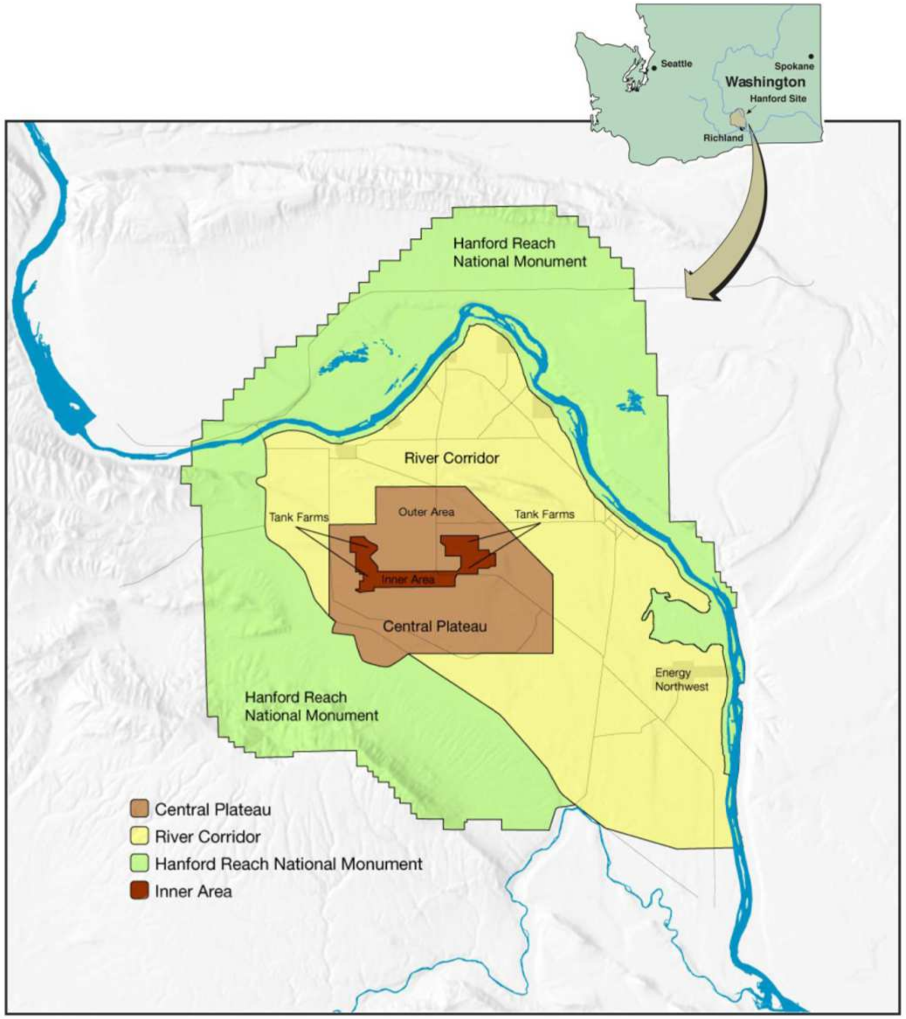
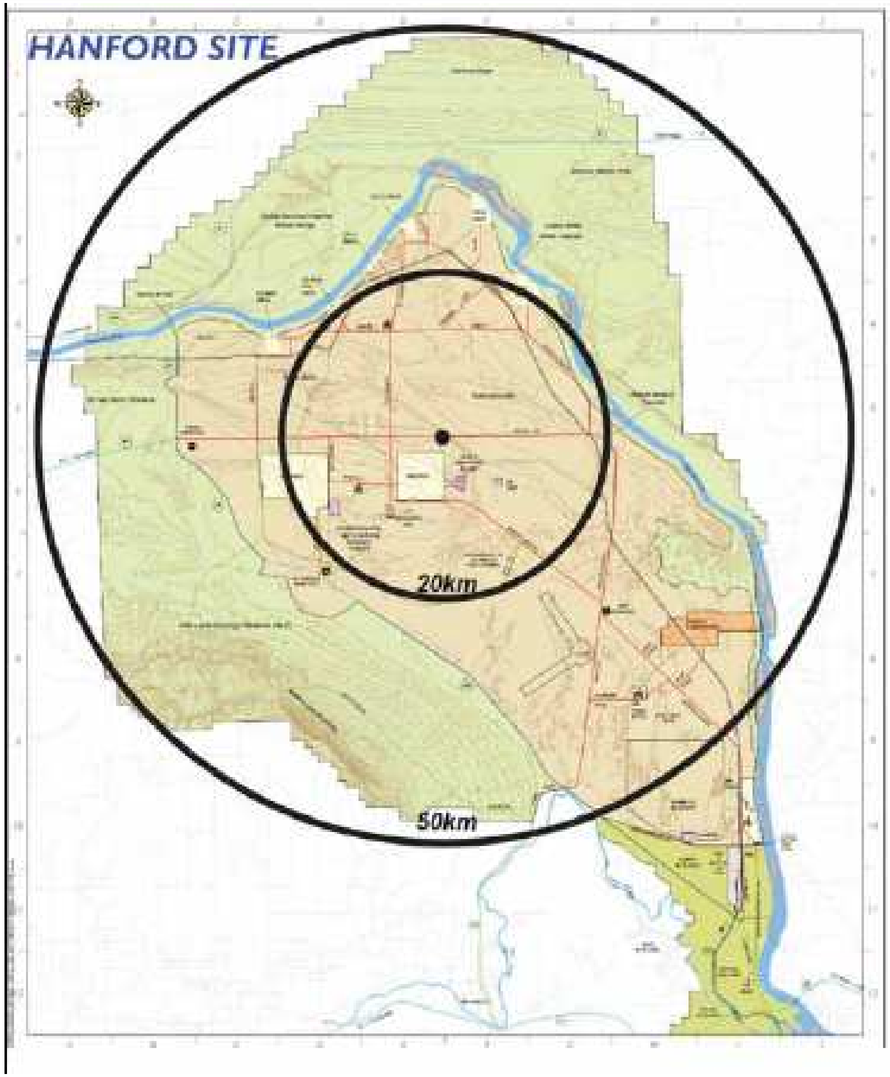
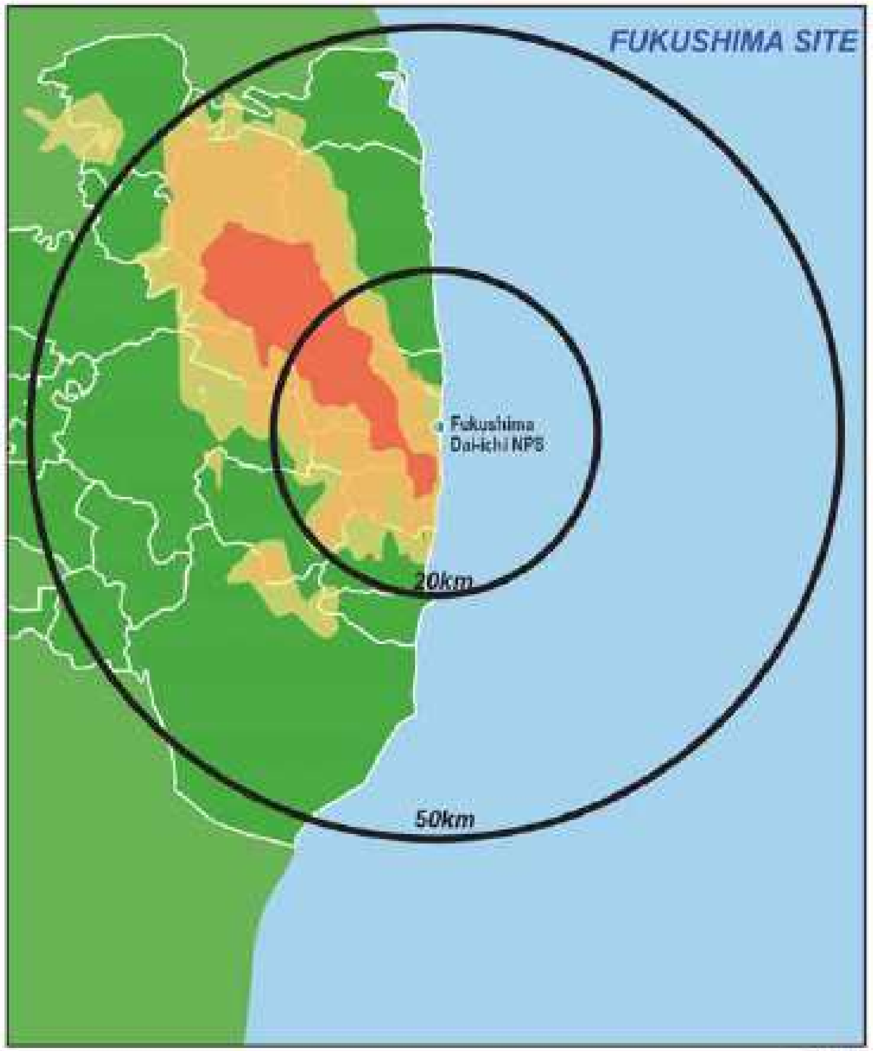
Hanford Plateau Remediation Project, USA

- Located in southeast Washington State, USA
- 1,500 square kilometer site
- Significant contamination including 12 groundwater plumes threatening the Columbia River
- Today, undergoing reactor decommissioning, demolition and environmental remediation



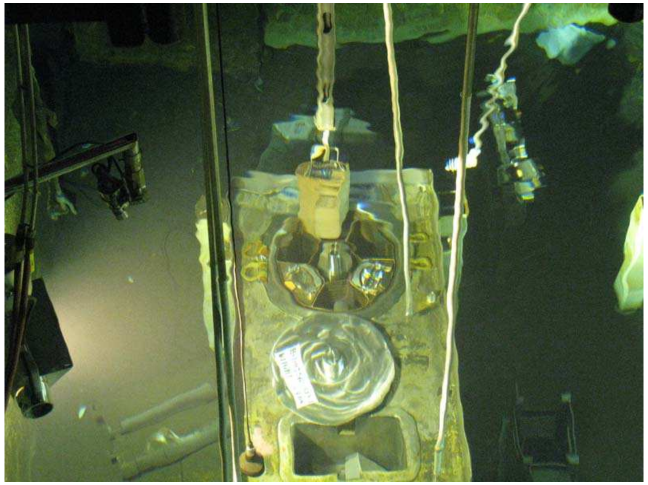
Decontamination Area Perspective





Hanford Sludge Treatment Project

- The Sludge Treatment Project was one of DOE's top national cleanup priorities.
- Stored 17 feet under water in a large concrete basin adjacent to Hanford's K-West Reactor for more than 30 years
- Using long-handled tools, workers processed the material under water, transferring it to copper inserts and then into stainless steel structures

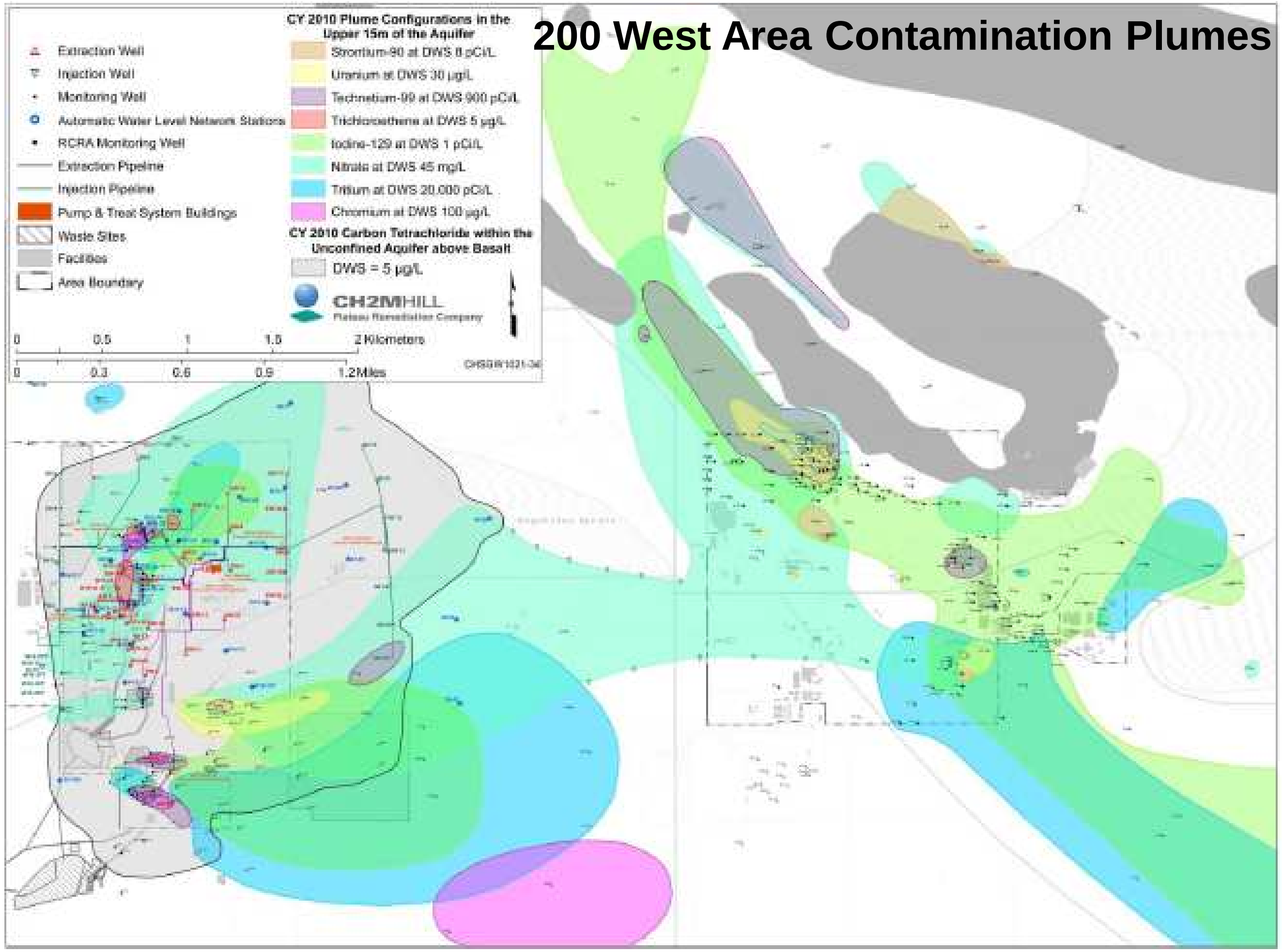


Lessons Learned

- A mock-up of the reactor basin was constructed to create a non-radiological site where workers could master the retrieval tools and processes.
  - Full-scale test and training setup increased worker safety while reducing cost and schedule

Hanford Groundwater Treatment

- Approximately 80 square miles of groundwater beneath the Hanford Site were contaminated above the drinking water standard from past nuclear processing activities



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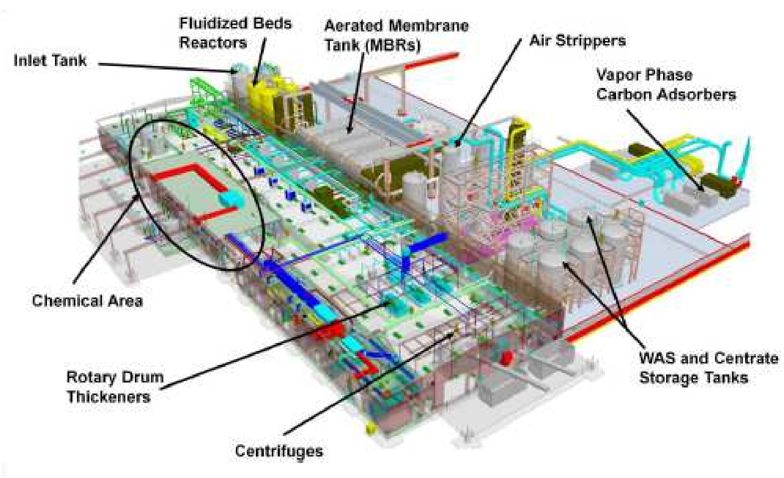
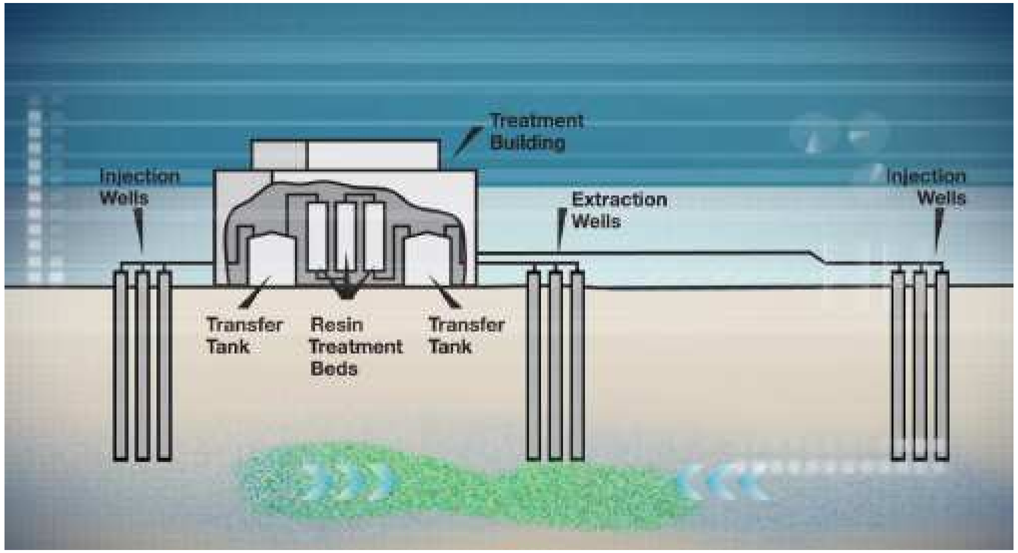
Hanford Groundwater Treatment

- The 200 West Pump and Treat system was designed and constructed by CH2M HILL to remove the contamination and slow the movement of the contamination toward the Columbia River
- The treatment system combines several technologies to address multiple contaminates in the groundwater
- Capability of removing more types of radioactive and chemical contaminants than any other systems of its kind in the DOE Environmental Management complex





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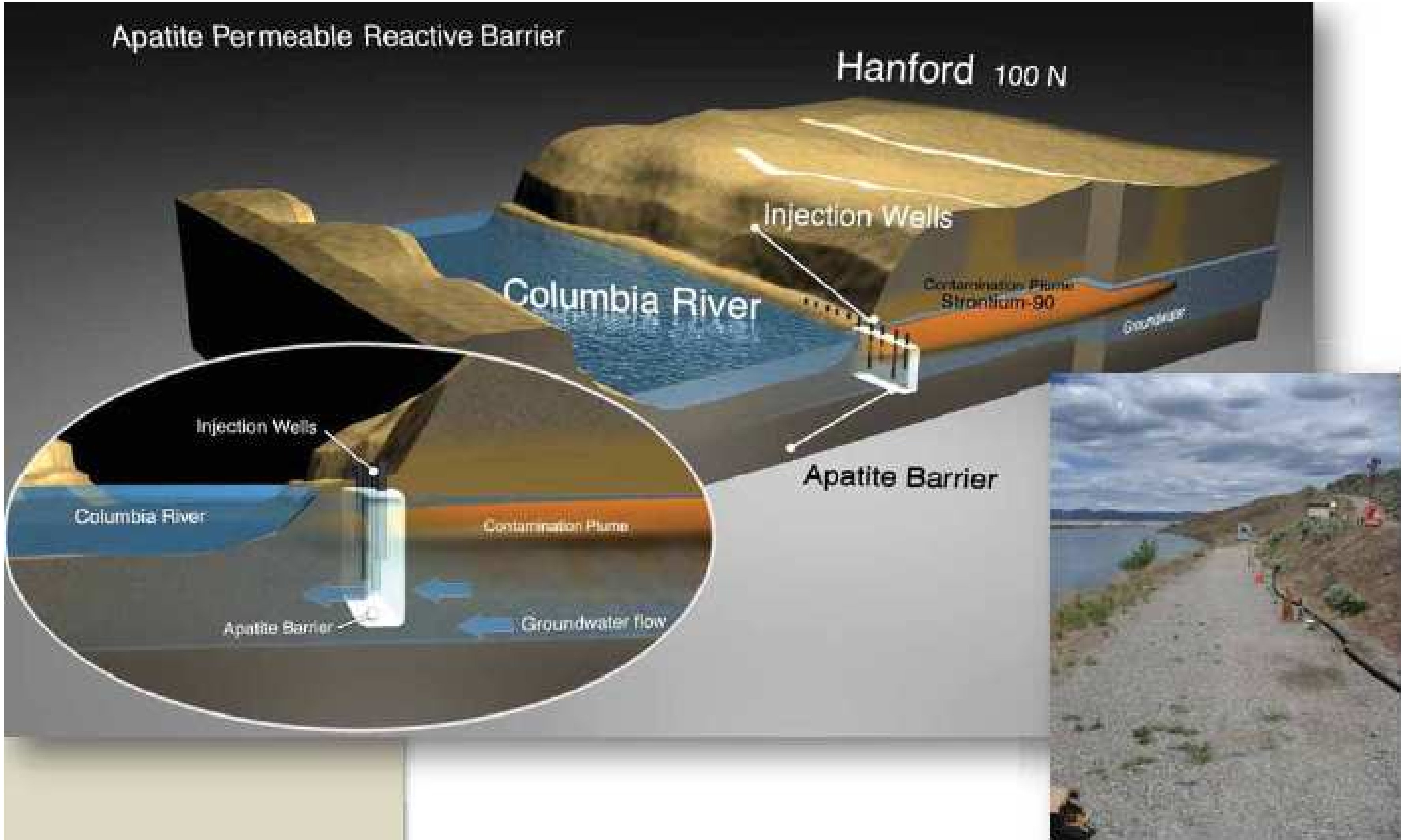
Conceptual Illustration of the Emplaced Apatite Permeable Barrier System



Dounreay Decommissioning Program, UK

- £1.6 billion environmental cleanup through 2022-25
- radioactive waste to be placed into a condition that is safe for long-term storage or disposal

Shaft and Silo

- Licensed as a disposal facility for radioactive wastes and routinely used for the disposal of unconditioned intermediate level waste (ILW) until 1970
- Anexplosion occurred in 1977 at the shaft which caused severe damage to the superstructure
- Currently developing concept designs for waste retrieval, treatment and storage facilities
- A number of innovative approaches have been introduced to accelerate the decommissioning and reduce the cost

Lessons Learned: use of proven, commercially available off-the-shelf technology and equipment such as industrial grabs and robotic mechanisms reduces cost and risk

Broader Lessons Learned - Stakeholders

- Empathy and execution are required
- Stakeholder collaboration is critical
- Successful clean up is an evolution
- Integration and coordination at all levels

Sharing Lessons Learned from the Hanford Groundwater Treatment Program with Japanese delegations.

Demonstrating reactor component removal to the public using a mock-up of the reactor

Dounreay End State Public Consultation

Decontamination and Decommissioning Technology Applicability

- Proper application of a wide range of technologies will:
  - Allow personnel to work in an efficient manner
  - Minimize waste generation
  - Reduce cost and time
  - Safely achieve the project goals
  - Minimize personnel exposure
- To summarize, there is no single answer or technology to nuclear decommissioning and decontamination—it is the approach and correct application of multiple technologies
- Successfully decontaminating and decommissioning highly contaminated facilities and reactors is achieved by correctly applying multiple technologies

Summary of Critical Success Factors

- Simplicity and reliability of technology/equipment for Decontamination - Easy to say but most difficult to achieve!
  - Remote operated equipment
  - Novel and First of A Kind
  - High Potential for Rapidly Escalated Costs
- Cultural transition from operations or generating organization to a project-based decommissioning organization
- Effective regulatory/stakeholder interaction and involvement is key to regaining trust and acceptance.
- Training/reskilling of the workforce to the unique challenges and skills required of the nuclear decontamination and decommissioning industry is paramount –
  - Worker involvement in planning, implementation and feedback essential

Discussion