Pacific Northwest
NATIONAL LABORATORY

Proudly Operated by Battelle *Since 1965*

Pacific Northwest National Laboratory: Oil Spill Research at the Extremes

The ever-changing and uncertain global climate of the 21st century requires innovative research and strategic planning to address challenges related to climate change, extreme events, energy exploration and generation, and environmental protection. Catastrophic events like the 2010 Deepwater Horizon event in the Gulf of Mexico, along with new oil exploration in the Arctic, drive the need for enhanced research and modeling tools to support oil spill response in under-studied conditions (e.g., high pressure and low temperature), oil and dispersant tracking, and prioritization of coastal areas for cleanup.

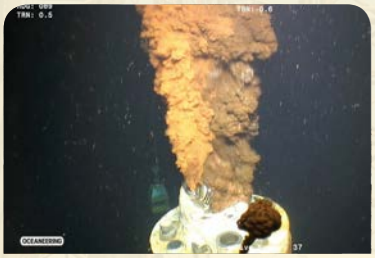
To help address these challenges and assist stakeholders in implementing their strategic plans, Pacific Northwest National Laboratory (PNNL) is engaging in cutting-edge research for oil spill response. As one of the only research institutions with the capability to investigate both extreme temperature and pressure, PNNL manages worldclass research facilities, for bench- to mid-scale studies investigating oil chemistry, detection, and cleanup methods with a 320-square–foot freezer laboratory and hyperbaric laboratory.

PNNL is committed to engaging in innovative research that helps our nation tackle the most complex environmental challenges. PNNL collaborates with other leading research institutions, including the National Energy Technology Laboratory (NETL), to ensure the best minds and capabilities are being put to use addressing these issues for the Bureau of Safety and Environmental Enforcement (BSEE) and others.

DISTINGUISHING CAPABILITIES

PNNL's Marine Science Laboratory is situated on 145 acres of shoreline in Washington State. High-capacity unfiltered and filtered seawater and non-chlorinated well water resources enable the simulation of saline environments. The facility includes a comprehensive 250 gpm wastewater treatment facility designed to support oil research, and Washington State-issued permits allow outdoor burning of crude oil. Biotechnology, geochemistry, and ecology labs support effects, bioremediation, and habitat restoration research across molecular, organism, and ecological scales. PNNL stewards the scientific and engineering underpinnings necessary to enable four distinguishing capabilities and foundational, multidisciplinary scientific and technical expertise critical to resolving challenges associated with oil spill response:

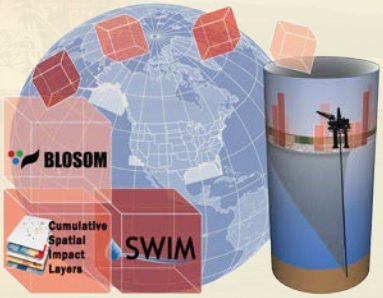
Hyperbaric Research – Simulate the deep ocean environment of the Outer Continental Shelf.



Ice and Hydrodynamic Research – Simulate ice formation dynamics coupled with wave energy and shore break to understand dispersed oil behavior.

Technology Development – Develop new sensors and novel herding technologies.

Modeling and Simulation – Custom tools for analyses to inform oil spill response planning.



U.S. DEPARTMENT OF
ENERGY

Hyperbaric Research – PNNL scientists are conducting research to determine how subsea conditions, including extreme pressure and pressure drop, affect the effectiveness of dispersants. Our hyperbaric laboratory includes:

- six Parr reactors rated to 3000 psi (2 km depth)
- custom cooling system
- Teledyne syringe pumps
- biological and chemical safety hoods.

Ice and Hydrodynamic Research – PNNL maintains several research facilities that simulate arctic hydrodynamic conditions. Our meso-scale wave tank and 320-square-foot refrigeration laboratory can generate ice using seawater taken directly from the Puget Sound. The refrigeration unit controls air and water temperatures to -15°C and can generate waves and currents.

Technology Development – Our facilities are also used to develop new methods and technologies to support oil spill response. Specifically, our scientists develop novel methods of detecting, quantifying, and tracking oil, along with new technologies for oil spill cleanup, including chemicals herders, oil-water separation, microbial bioremediation, and in situ burning.

Modeling and Simulation – PNNL collaborates with NETL to build and improve decision-making support tools for oil spill response planning, e.g., with BSEE. NETL's modeling tools simuate oil spills resulting from ultra-deep/deepwater well blow-outs to evaluate the fate of the hydrocarbons through the water column. Collaborations with PNNL include validating models, coupling with hydrodynamic models, inclusion of decision analysis tools, and integrating experimental results with model updates. The results of our collaborations will be available to the public through EDX (https://edx.netl.doe.gov/).

Project Spotlight - Biodegradation Following Dispersant Usage in a Cold, Stratified, Deep Sea Setting– PNNL is conducting experiments on seawater-oil and seawater-oil-dispersant mixtures to assess the independent and combined effects of features such as pressure and temperature on oil biodegradation. Our NETL partners will use the resulting data to enhance spill models. The results of our collaborations will be available to the public through the BSEE website at https://www.bsee.gov/what-we-do/oil-spillpreparedness/oil-spill-response-research.

For more information, contact:

Jill Brandenberger
Battelle Seattle Research Laboratory
(206) 528-3407 | jill.brandenberger@pnnl.gov