Oil Spill Response Research Program

Karen Stone
Oil Spill Response Engineer
Oil Spill Preparedness Division
February 17, 2017

“To promote safety, protect the environment and conserve resources offshore through vigorous regulatory oversight and enforcement.”
Oil Spill Response Research (OSRR)

- Results from more than 200 research projects conducted over the past 25 years can be found on the BSEE.gov website.
- The major focus of the program is to improve the methods and technologies used for oil spill detection, containment, treatment, recovery and cleanup.
- The OSRR program is a cooperative effort bringing together funding and expertise from research partners in government agencies, industry and the international community.
Ohmsett - National Oil Spill Response Test Facility

- Largest outdoor saltwater wave/tow tank facility in North America
- Allows full scale oil spill response testing, training and research with oil in a realistic marine environment
- Website www.ohmsett.com
Research Overview

- Mechanical Containment/Recovery
- Remote Sensing
- *In Situ* Burn
- Dispersants
- Herding
- Ohmsett
- Decision-Making Strategies
Where We Research

- Ohmsett—(BSEE)  Dispersants, Mechanical
- JMTF (USCG/NRL)  ISB
- CRREL—(USACE)  Arctic ISB
- National Labs (DOE)
  - PNNL
  - NETL
- Academia
- Research Entities
Decision-Making Support Tools
Geographic Referencing Identification (GRID) Tag/ Tagging of Oil Under Ice

OSRR # 1050/#1051 AECOM
(formerly URS)
PI: Ben Schreib
Decision-Making Support Tools

Equipping GRIDs with Accelerometers to Measure Wave Characteristics

OSRR#1080 AECOM
PI: Ben Schreib
Estimated Completion Date: September 30, 2017

Objective: 1) Equip GRID and tags with 3-axis accelerometers to measure wave height, wave length, wave period; 2) use enhanced GRID tags to equip and test skimming units for wave characterization 3) achieve satellite communication to transmit data for operational awareness; and 4) create a user-friendly operator interface for skimmer operator.
Objective: To establish a uniform and objective means to determine the level of maturity of a new technology, and when it is ready for use in the field.

### BSEE Oil Spill Response TRL Summary

<table>
<thead>
<tr>
<th>TRL</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>BASIC TECHNOLOGY RESEARCH</strong></td>
<td></td>
</tr>
<tr>
<td>TRL 1</td>
<td>Basic principles observed or reported</td>
</tr>
<tr>
<td>TRL 2</td>
<td>Concept and speculative application formulated</td>
</tr>
<tr>
<td>TRL 3</td>
<td>Proof of concept demonstrated</td>
</tr>
<tr>
<td><strong>TECHNOLOGY ADVANCEMENT/Demonstration</strong></td>
<td></td>
</tr>
<tr>
<td>TRL 4</td>
<td>Prototype demonstrated in lab environment or model scenario</td>
</tr>
<tr>
<td>TRL 5</td>
<td>Prototype tested in relevant environment</td>
</tr>
<tr>
<td>TRL 6</td>
<td>Full-scale prototype tested in relevant environment</td>
</tr>
<tr>
<td><strong>TECHNOLOGY IMPLEMENTATION IN OPERATIONAL ENVIRONMENT</strong></td>
<td></td>
</tr>
<tr>
<td>TRL 7</td>
<td>Integrated technology tested on large scale or in open water</td>
</tr>
<tr>
<td>TRL 8</td>
<td>Final integrated system test in real or relevant environment</td>
</tr>
<tr>
<td><strong>TECHNOLOGY DEPLOYMENT IN REAL SPILL ENVIRONMENT</strong></td>
<td></td>
</tr>
<tr>
<td>TRL 9</td>
<td>Final integrated system deployed in real spill environment</td>
</tr>
</tbody>
</table>
Decision–Making Support Tools

Estimating an Oil Spill Response Gap for the U.S. Arctic Ocean

OSRR # 1022  Nuka Research and Planning Group
PI: Tim Robertson and Sierra Fletcher
Complete

Objective: To conduct an oil spill response gap analysis for three areas in the U.S. Arctic Beaufort and Chukchi Seas.

- Quantified the frequency that oil spill response may not be feasible due to weather or environmental conditions
- Consider wind, sea state, temperature, ice coverage, and visibility
- Response options included mechanical recovery, *in situ* burn, and use of dispersants
Objectives: To conduct an oil spill response viability analysis (and develop a model) for the U.S. Outer Continental Shelf GOM exclusive economic zone.

• Quantify the frequency and duration that a specific oil spill response strategy may not be feasible or ‘unduly’ impacted.

• Consider: wind, sea state, salinity, and visibility, using available hindcast environmental data.

• Response strategy options including mechanical recovery, in situ burn, and the surface applications of dispersants (aerial and vessel deployed)

Rule to establish response viability:
If:
A. Any single environmental factor is red then response is Not Favorable (red)
B. All environmental factors are green then response is Favorable (green)
C. If the environmental factors are not A or B then response is Marginal (yellow)
Decision-Making Tools/Dispersents

Development of a Real-time Monitoring Protocol for Assessing VOC Impacts on Response and Cleanup Workers' Safety During Dispersant Operations

OSRR # 1006 Louisiana State University
PI: Edward Overton
Complete

Objective: The objective of the proposed research was to develop real-time and passive monitoring protocols to effectively determine the impact of dispersant use and VOC release, in both surface and subsurface applications, on oil spill response worker safety.
Dispersants

Developing an Innovative Dispersant Spray Drift Model

OSRR #1077: Nuka Research & Planning Group, LLC
PI: Sierra Fletcher
Estimated Completion Date: September 22, 2017

Objective: This project developed a CFD model of the forces acting on dispersant as it is sprayed from four commonly used aircraft models.

There was a need to improve upon existing tools to enable application to the equipment and missions typical of oil spill dispersant spraying missions rather than agricultural equipment and missions.

Drift Pattern
Project Objectives:
1) Evaluate the influence of salinity on dispersant effectiveness for select oils and dispersants, from 10-125 psu salinity, using the Baffled Flask Test which provides a broad range of sufficient mixing energy including those observed in field conditions.

2) Characterize dispersant effectiveness during wave/flume tank simulations of high-velocity subsea releases of oil injected with dispersant at high salinities and subsequent mixing of plume to capture relative changes in dispersant effectiveness.
Dispersants

Analysis of How Environmental Conditions Affect Dispersant Performance During Deep Ocean Applications

OSRR # 1066  Pacific Northwest National Laboratory
PI: George Bonheyo
Estimated Completion: April 2017

This project will determine how subsea conditions of pressure, pressure drop, temperature, solution gas-oil ratio (GOR), dispersant-to-oil ratio (DOR), sediment, and hydrates affect the effectiveness of dispersants.

• Ambient water pressure and the pressure drop expected at a blowout

• Temperature differentials between oil, dispersant, and surrounding seawater

• Sediments

• Relationship between dispersant activity and hydrate crystal formation

Remote Sensing

Development of Acoustic Methods to Measure Oil Droplet Size and Slick Thickness using ROV and AUV Platforms

OSRR # 1065 Applied Research Associates (ARA), Inc.
Pl: Dr. Paul Panetta
Estimated Completion: May 31, 2017

Objective: To develop and test acoustic techniques and sensors mounted in free-swimming platforms [Remotely Operated Vehicles and Autonomous Underwater Vehicles] for field applications to measure: (a) slick thickness on the surface of the water, and (b) oil droplet size distribution at the well head for subsurface releases of crude oil and dispersants in the presence of natural gas.

Seabotix ROV and Slocum Glider
Remote Sensing

**Oil Leak Detections with a Combined Fluorescence Polarization Instrument and a Wide Band MultiBeam Sonar**

OSRR # 1039 EIC Laboratories, Inc. and Norbit US, Ltd.
PI: Dr. Job Bello
Estimated Completion Date: Complete

Objective: This project was to develop and test a prototype sensor that integrates two partial solutions (fluorescence and sonar) with a goal of operating at a suitable standoff distance and interrogating a wide area, while providing real-time data feed from the subsea environment.
Remote Sensing

Enhanced Oil Spill Detection Sensors in Low-light Environments

OSRR # 1013 US Army Research Development and Engineering Command
PI: Edward Overton
Estimated Completion: October 31, 2017

Objective: To enhance the methods currently in place to detect oil in a low-light marine environment. The methods currently in place rely heavily on time-delayed aerial remote sensing technologies, or visual observation. This project will leverage the knowledge and expertise of RDECOM to identify and document existing capability gaps; identify and assess technology gaps; test and evaluate potential new or alternative hardware; and if necessary, support the design, development and demonstration of new technologies to meet identified needs.
Remote Sensing

Oil Spill Detection and Slick Thickness Measurement using Spaceborne and Airborne Sensors

OSRR # 1079 NOAA
PI: George Graettinger
Estimated Completion: September 30, 2017

Objective: To provide BSEE and NOAA the needed methodology and operational tools to assess future oil spills and the ability to monitor and measure more accurately the thickness of surface oil slicks in the marine environment using a suite of satellite and aerial sensors. Comprehensive analysis of the capabilities and limitations of each sensor will be conducted.
In Situ Burn

Development of a Low-Emission Spray Combustor for Emulsified Crude Oil

OSRR # 1061 Naval Research Laboratory (NRL)
PI: Dr. Steve Tuttle
Estimated Completion: October 31, 2016

Objective: This project builds off of the proof-of-concept project previously completed and further advances the development of a low-emission, low pressure atomization and combustion process for emulsified crude oil by developing and refining the performance of a quarter and half-scale flow blurring atomizer spray burner.
Objectives: The objective of this proof-of-concept study is to develop and test methods to directly measure the volume of oil burned and the burn rate in real time during ISB by integrating the direct thickness measurements using acoustic methods and surface area measurements derived from visible and infrared images.
In Situ Burn

Quantitative Measurement of *In Situ* Burn (ISB) Efficiency and Burn Rate
Mechanical Recovery

Development of an Autonomous Oil Skimmer (AOS)

OSRR # 1037 Alion Science and Technology Corp.
PI: Dr. Gregory Johnson
Completed

Objective: Develop a navigation, sensor, and computer control system to direct a variety of commercial off the shelf (COTS) skimmers and vessels to autonomously maneuver and skim the oil from a given area with automatic tracking and reporting of progress and performance.
Ohmsett Panoramic

Oil spill response equipment testing at the Ohmssett facility. This photo depicts the Ohmssett staff measuring the oil recovery rate for an oleophilic drum skimmer when placed in a 1/2 inch thick oil slick on the water.
Ohmsett Panoramic

Oil spill response equipment testing at the Ohmsett facility. This photo depicts the Ohmsett staff measuring the oil recovery rate for an oleophilic drum skimmer when placed in a 1/2 inch thick oil slick on the water.
Oil Spill Response Research (OSRR)

For more than 25 years, BSEE (Bureau of Safety and Environmental Enforcement) has aggressively maintained a comprehensive, long-term research program dedicated to improving oil spill response success. The major focus of the program is to improve the methods and technologies used for oil spill detection, containment, treatment, recovery and cleanup. The OSRR program is a cooperative effort bringing together funding and expertise from research partners in government agencies, industry, and the international community.

OSRR’s Response Research Branch (RRB) manages the funding for numerous research projects chosen based on selected major topics each year. While RPs and research proposals are solicited through a Broad Agency Announcement, project coordination is conducted by the National Research Appeal Branch at BSEE. OSRR's RRB also manages Ohrmsett, the National Oil Spill Response Research Test Facility, located in Leonardo, New Jersey. Ohrmsett is the latest outdoor, wave/flow test facility in North America. Ohrmsett allows full-scale oil spill response testing, training and research with oil in a realistic marine environment. For more information visit the Ohrmsett website.

Click on the categories below to bring up more information on our efforts in the subject area:

- Arctic Oil Spill Response
- Behavior of Oil
- Chemical Treating Agents
- Decision-Making Support Tools
- In Situ Burning of Oil
- Mechanical Containment
- Ohrmsett
- Remote Sensing

Master List of Oil Spill Response Research (OSRR) Projects

For more information on the Bureau of Spill Response Research or to SRRP Program email us here.
<table>
<thead>
<tr>
<th>Project No.</th>
<th>Subject</th>
<th>Performing Activity (Researcher)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1085</td>
<td>In-Situ Burn Testing of California Crude Oils</td>
<td>Naval Research Laboratory (NRL)</td>
</tr>
<tr>
<td>1082</td>
<td>Methods to Enhance Mechanical Recovery in Arctic Conditions</td>
<td>Cold Regions Research and Engineering Laboratory (CRREL)</td>
</tr>
<tr>
<td>1081</td>
<td>Advancing ICEHORSE proof-of-concept to make it more useful in an operational environment</td>
<td>Alion Science and Technology Corporation</td>
</tr>
<tr>
<td>1080</td>
<td>Equip GRID and GRIDSAT Tags with Accelerometers to Measure Ocean Waves</td>
<td>AECOM</td>
</tr>
<tr>
<td>1079</td>
<td>Deepwater Horizon Lessons Learned - Methodology and Operational Tools to Assess Future Oil Spills</td>
<td>NOAA</td>
</tr>
<tr>
<td>1077</td>
<td>Gulf of Mexico Oil Spill Response Viability Analysis</td>
<td>Nuka Research and Planning Group, LLC</td>
</tr>
</tbody>
</table>
To promote safety, protect the environment and conserve resources offshore through vigorous regulatory oversight and enforcement.

BSEE Website:  www.bsee.gov

@BSEEgov

BSEEgov

Bureau of Safety and Environmental Enforcement

BSEEgov

“To promote safety, protect the environment and conserve resources offshore through vigorous regulatory oversight and enforcement.”