CONTINUING TO IMPROVE OIL SPILL RESPONSE IN THE ARCTIC - A JOINT INDUSTRY PROGRAMME

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COLLABORATION AMONG NINE COMPANIES

- International research programme
- Builds upon decades of R&D in arctic oil spill response
- Brings together experts across industry, academia and independent research centres
- Research integrity through technical review and public dissemination of results on the website and at conferences

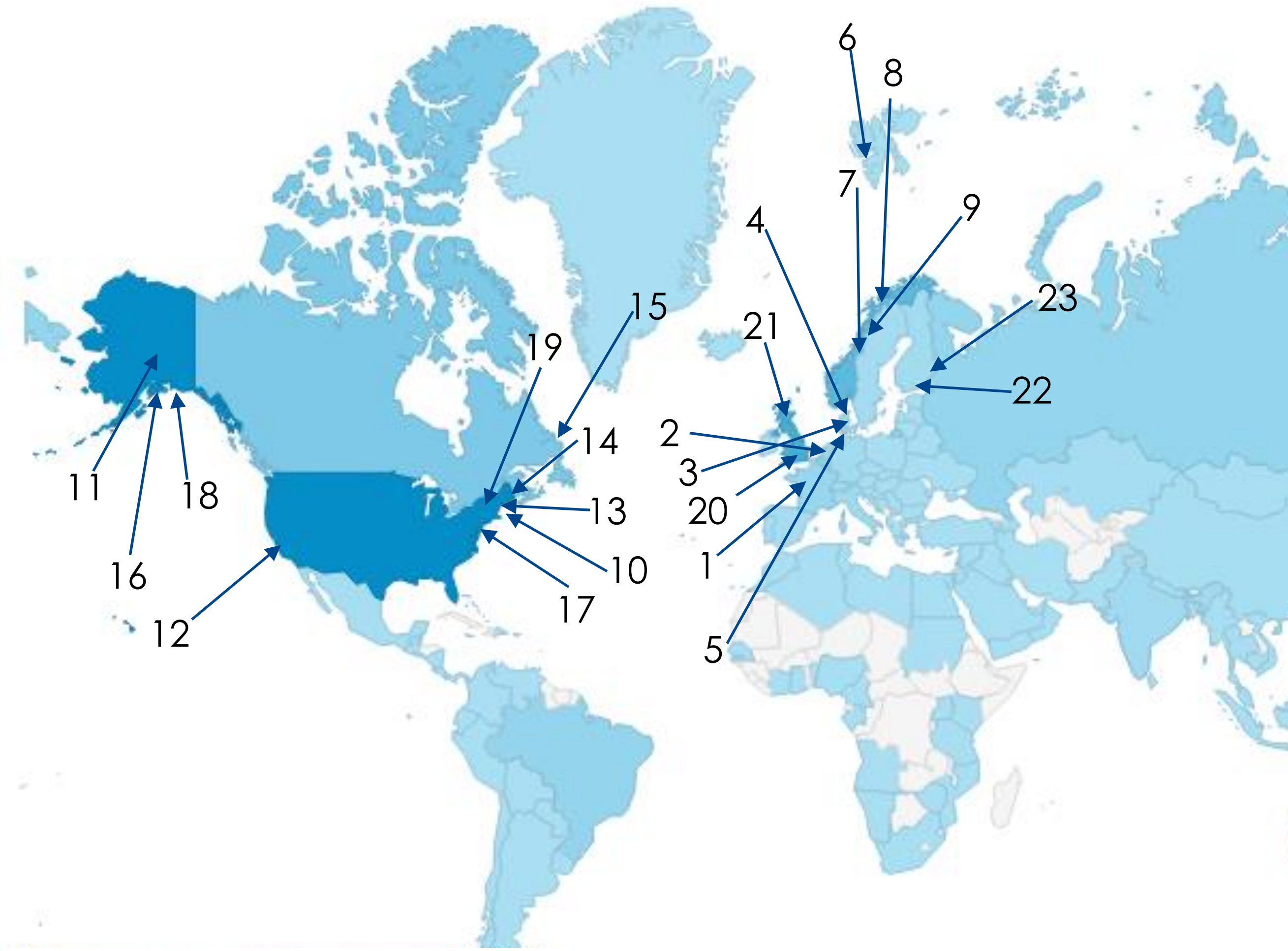
Six areas of research:

- Dispersants
- Environmental Effects
- Trajectory Modelling
- Mechanical Recovery
- Remote Sensing
- In Situ Burning (ISB)

bp
eni
ConocoPhillips
Chevron
ExxonMobil
Statoil
TOTAL
NCOC NORTH CASPIAN OPERATING COMPANY

ARCTIC RESPONSE TECHNOLOGY OIL SPILL PREPAREDNESS

GLOBAL EXPERTISE - CONTRACTORS



1. Cedre Brest, France
2. IMARES, The Netherlands
3. COWI, Denmark
4. DTU Byg – Department of Civil Engineering, Technical University of Denmark, Denmark
5. DCE - Danish Centre for Environment and Energy, Aarhus University, Denmark
6. University Centre in Svalbard, Norway
7. SINTEF, Trondheim, Norway
8. Akvaplan-niva, Tromsø, Norway
9. The Nansen Environmental and Remote Sensing Centre (NERSC), Bergen, Norway
10. RPS-ASA, Rhode Island, USA
11. University of Alaska, Fairbanks, Fairbanks, USA
12. RAMBOLL/ENVIRONS, Emeryville, California, USA
13. US Army Corps of Engineers Cold Regions Research and Engineering Laboratory (CRREL), New Hampshire, USA
14. Bigelow Laboratories, Maine, USA
15. C-CORE, St. Johns, Newfoundland, Canada
16. Alaska Clean Seas, Anchorage, US
17. Woods Hole Oceanographic Institute, Massachusetts, USA
18. The Prince William Sound - Oil Spill Recovery Institute (OSRI), Cordova, Alaska, USA
19. SL Ross Environmental Research Ltd., Ottawa, Canada
20. Hill and Knowlton Strategies, London, UK
21. Polar Ocean Service, Taynuit, UK
22. Aker Arctic, Helsinki, Finland
23. LAMOR, Porvoo, Finland

ARCTIC RESPONSE TECHNOLOGY
OIL SPILL PREPAREDNESS

RESEARCH: REPORTS

11 reports completed so far:

In Situ Burning (ISB)

- **State of Knowledge**
- **Technology Summary and Lessons from Key Experiments**
- **Status of Regulation in arctic and sub-arctic Countries**
- **Research summary: Herding surfactants to contract and thicken oil spills for ISB in arctic waters**

Dispersants

- **Fate of Dispersed Oil Under Ice**
- **State of Knowledge of Dispersant Testing Under Realistic Conditions**
- **Status of Regulations and Outreach Opportunities**
- **Inter-Basin Calibration**

Remote Sensing

- **Surface Remote Sensing**
- **Subsea Remote Sensing**

Mechanical Recovery

- **Recovery of Oil in Ice Feasibility Report**


ARCTIC RESPONSE TECHNOLOGY
OIL SPILL PREPAREDNESS

April 2015
SL Ross Environmental Research Ltd.
Danish Centre for Energy and the Environment

RESEARCH SUMMARY: HERDING SURFACTANTS TO CONTRACT AND THICKEN OIL SPILLS FOR IN-SITU BURNING IN ARCTIC WATERS

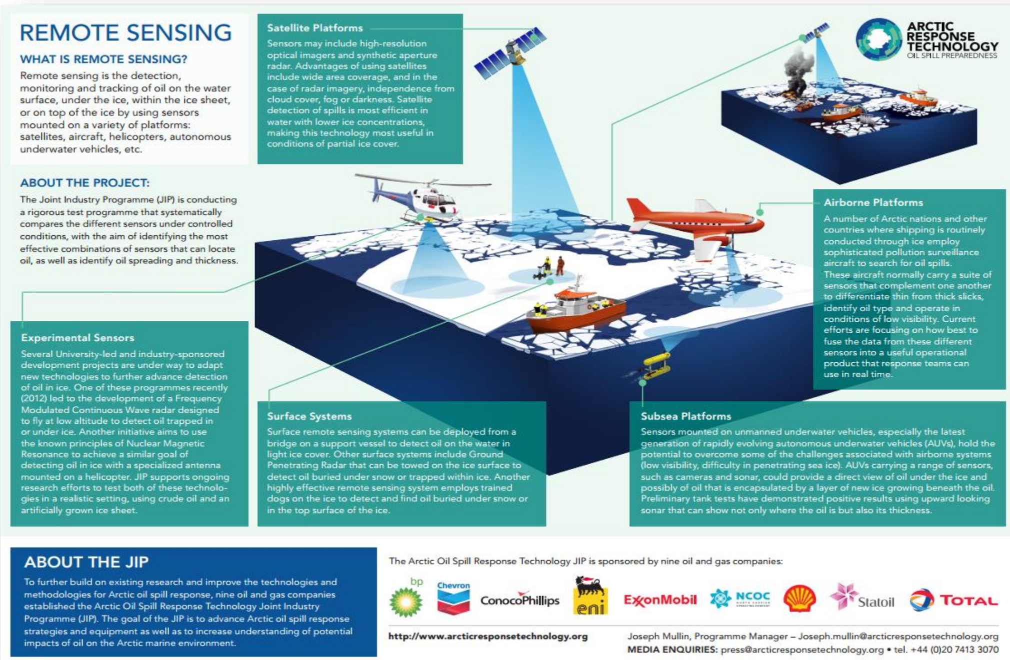
ARCTIC RESPONSE TECHNOLOGY
OIL SPILL PREPAREDNESS

CURRENT RESULT STATUS

- **Results to-date demonstrate the potential viability of multiple oil spill response technologies in arctic conditions beyond mechanical recovery – although limitations exist with each of them and more research needs to be done**
- **The release of eleven reports to date continues to build a comprehensive picture of arctic oil spill response technologies**
- **JIP has commenced laboratory, basin, and permitted field experiments of specific technologies**

Photos: Transport Canada; DF Dickins, SINTEF

CURRENT UNDERSTANDING – REMOTE SENSING



The industry has a range of airborne and surface imaging systems utilised from helicopters, fixed-wing aircraft, vessels and drilling platforms that can be used for ice conditions

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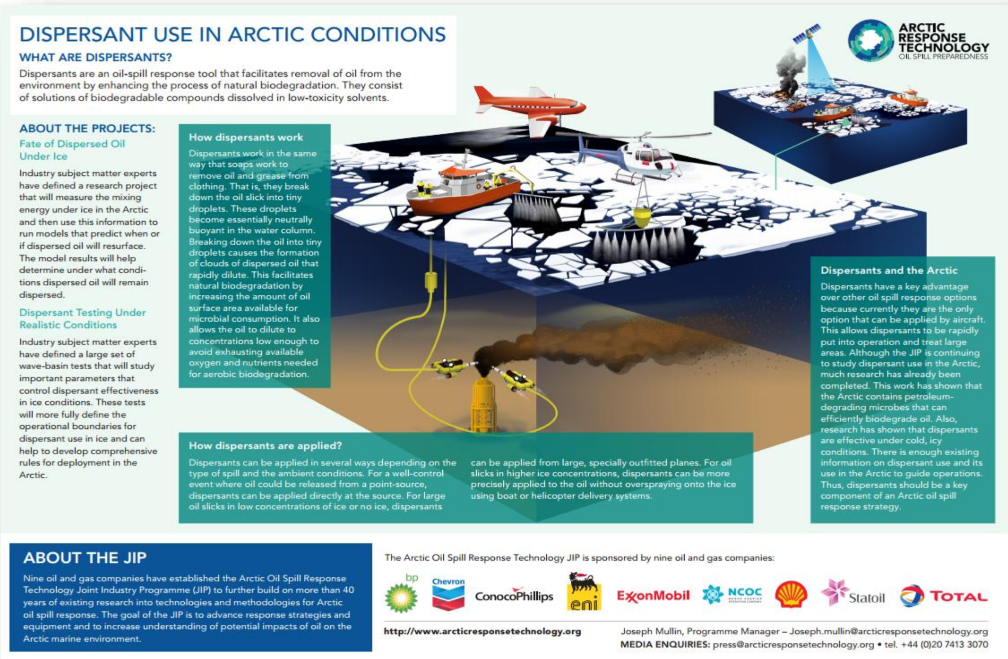
CURRENT UNDERSTANDING - DISPERSANTS



Dispersants can work in the Arctic and will, under certain conditions, be more effective in the presence of ice than in open water

The presence of ice can increase the time window within which dispersants can be used effectively

There is need for a discussion around potential obstacles to achieve permission to conduct dispersant operation in ice-prone regions

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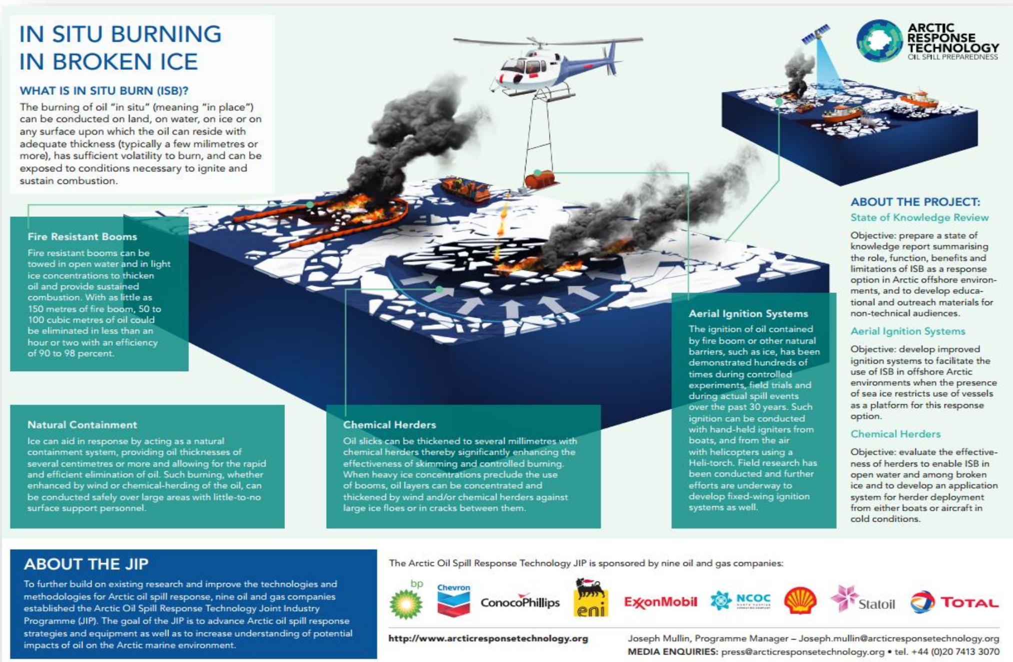
OIL SPILL PREPAREDNESS

CURRENT UNDERSTANDING – IN SITU BURN (ISB)



Technology exists to conduct controlled ISB of oil spilled in a wide variety of ice conditions

ISB is one of the response techniques with the highest potential for oil spill removal in arctic conditions and the industry should consider regulation that will support its use

Most of the perceived risks associated with burning oil are able to be mitigated

ARCTIC RESPONSE TECHNOLOGY OIL SPILL PREPAREDNESS

A CLOSER LOOK AT THE PROJECTS

Environmental impacts

AIM: To improve the knowledge base for conducting arctic Net Environmental Benefit Analysis (NEBA)

- **The comprehensive Phase 1 review is complete and shows there is an extensive existing science base for Arctic NEBAs**
- **NEBA Tool - Information resource the collects the available research results and information required for NEBA in one place.**
- **It is a fully searchable report and literature database that contains 960 citations**
- **The tool is hosted on a dedicated microsite, accessible from the Arctic JIP website and openly available to all other audiences. http://neba.arcticresponsetechnology.org/**

Photo: Caspian International Seal Survey

Photo: Aker Arctic

ARCTIC RESPONSE TECHNOLOGY OIL SPILL PREPAREDNESS

CURRENT UNDERSTANDING - ENVIRONMENTAL EFFECTS

- **There is an extensive existing science base for Arctic NEBAs.**
- **Arctic species are not more sensitive to dispersed oil than non-arctic species and that they react to dispersed oil exposure in the same way as temperate species do.**
- **Certified dispersants and oils treated with dispersants are not more toxic than the oil itself.**
- **Biodegradation of oil in the Arctic does occur and that certified dispersants do not reduce the ability of microbes to degrade oil.**

Photo: ENVIRON

Photo: Akvaplan-niva

ARCTIC RESPONSE TECHNOLOGY
OIL SPILL PREPAREDNESS

A CLOSER LOOK AT THE PROJECTS

Environmental impacts

AIM: To improve the knowledge base for conducting arctic Net Environmental Benefit Analysis (NEBA)

- **Phase 2 is conducting research activities to improve and advance Arctic NEBA's**
- **Four research projects underway**
- **Two projects involve field work using crude oil, dispersants and in situ burn residue**
- **The JIP received permit from Governor of Svalbard to conduct oil in ice experiments at Svea, Norway**
- **Experiments are in progress**

Photo: ENVIRON

Photo: ENVIRON

ARCTIC RESPONSE TECHNOLOGY
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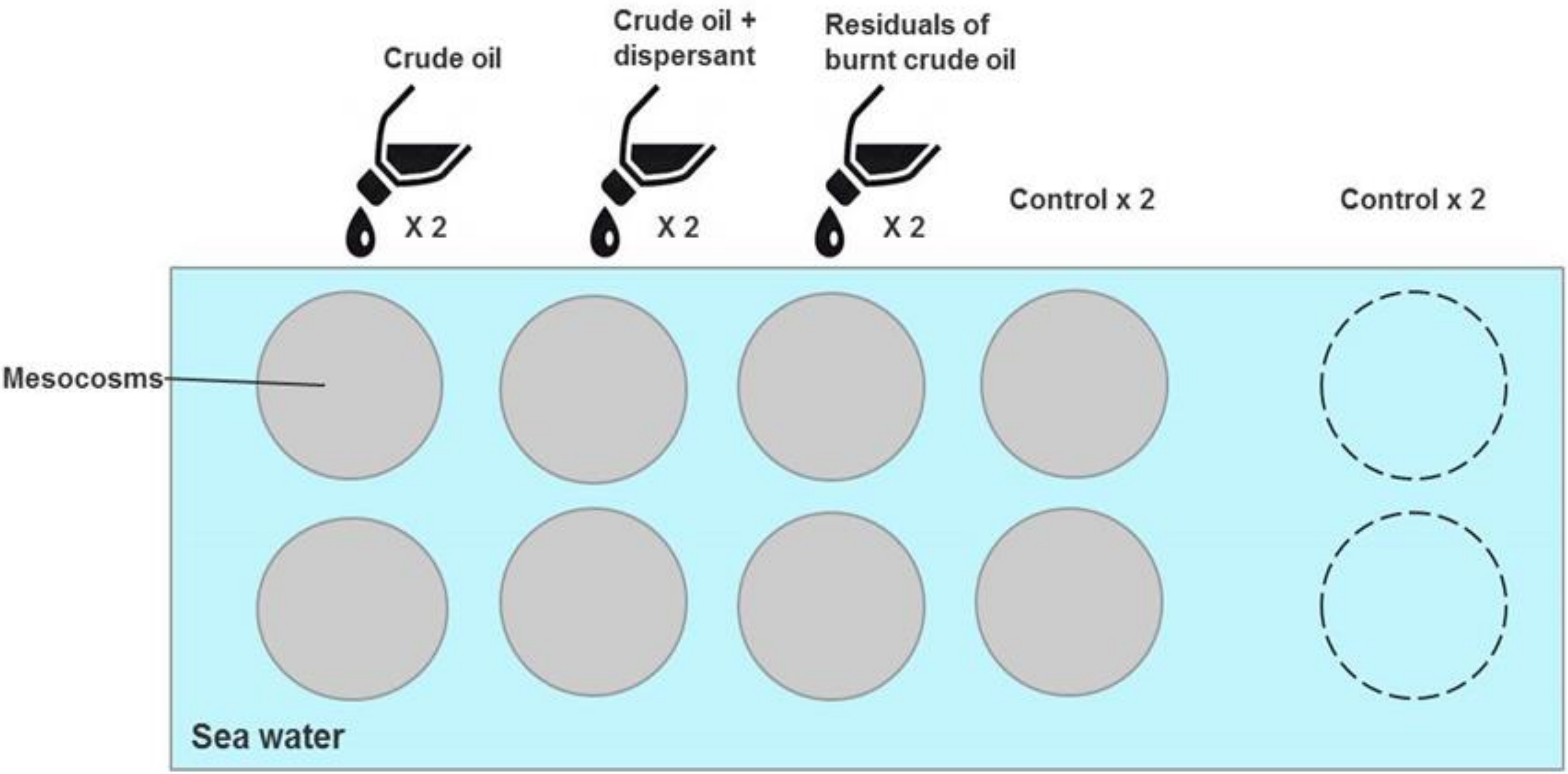
In Situ Mesocosms

Mesocosms to be Employed in the Svea, Norway Field Campaign. Length: 3 m, Diameter: 1.6 m, Weight: 325Kg

Mesocosm Buoyancy Testing at Cedre

Four Conical Shape Floats Held Together by a Protective Metal Framework Keep the Mesocosm at the Surface as the Ice Forms

TREATMENTS



Crude oil
X 2
Crude oil +
dispersant
X 2
Residuals of
burnt crude oil
X 2
Control x 2
Control x 2
Mesocosms
Sea water

Final Sampling - July 2015

A: Oil

B: Oil

C: Oil + Dispersant

D: Oil + Dispersant

E: In Situ Burn Residue

ARCTIC RESPONSE TECHNOLOGY
OIL SPILL PREPAREDNESS

Final Sampling - July 2015

Towing back at Svea harbor

Retrieval for cleaning and decommissioning

ARCTIC RESPONSE TECHNOLOGY
OIL SPILL PREPAREDNESS

SUMMARY

- **Results to-date demonstrate the potential viability of multiple oil spill response technologies in arctic conditions beyond mechanical recovery**
- **Over the coming year dispersant effectiveness experiments will be conducted using**
  - **Natural mixing energy**
  - **Mixing energy from the propeller wash of ice breaker**
  - **After oil or oil-dispersant mixtures have been frozen in ice**
- **Flume tank studies in the UK and field research experiments at Svea, Norway in 2016 will provide data for dispersant modelling project**
- **Development an integrated herder delivery and ignition system for in situ burn (ISB) operations**
- **Development of an aerial ignition system to facilitate the use of ISB in offshore Arctic environments, including situations when severe ice conditions and/or safety concerns may preclude the use of vessels as a nearby base for helicopter operations**

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Visit the programme website at: www.arcticresponsetechnology.org