Oil spill risks in Arctic waters

As the interest in the Arctic, its natural resources and its new potential fairways increases as the ice coverage decreases, the risk of severe oil spills in a sensitive and unique environment rises. The sensitivity of Arctic areas, in combination with its remoteness and the particularly harsh conditions in cold climates, increases the importance of adequate methodology for estimation of the risk. An oil spill risk assessment forms an important link in the chain of prevention, detection, control and mitigation of spills. SSPA has developed a method to provide answers to the questions; where, how often, what type of oil and the size of the oil spills that may be expected.

Research project GRACE

The EU Horizon 2020 project called "GRACE – Integrated oil spill response actions and environmental effects" was finalised in August 2019. The project focused on developing, comparing and evaluating the effectiveness and environmental effects of different oil spill response methods in a cold climate.

The results of the project are available for international organisations that plan and carry out cross-border oil spill response cooperation in the Arctic sea areas, but also for national organisations and authorities responsible for the response to, and mitigation of, oil spills. The risk assessment model for oil spills in the Arctic and sub-Arctic conditions was developed to be used in combination with the analytical tool for environmental assessment: Environment & Oil Spill Response (EOS), which also has been developed as a part of GRACE.

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Iceberg and tourist vessel in Disko Bay, Greenland.

The oil spill risk assessment methodology developed by SSPA contributes to the design of an appropriate response by taking both the probability and consequences of an oil spill into account.

Methodology

The developed spill risk assessment methodology is based on well-established principles and methods, essentially Formal Safety Assessment (FSA) methodology which is the IMO´s proactive process to be used as a tool in the rulemaking process. Efficient big data processing of AIS data and integration of data from ship databases, combined with statistics on ship accidents, enable credible predictions of accident probability, associated spill risk and its severity in terms of spill volume. Low traffic intensity, sparse empirical accident data and highly varying ice conditions, however, make Arctic predictions particularly challenging.

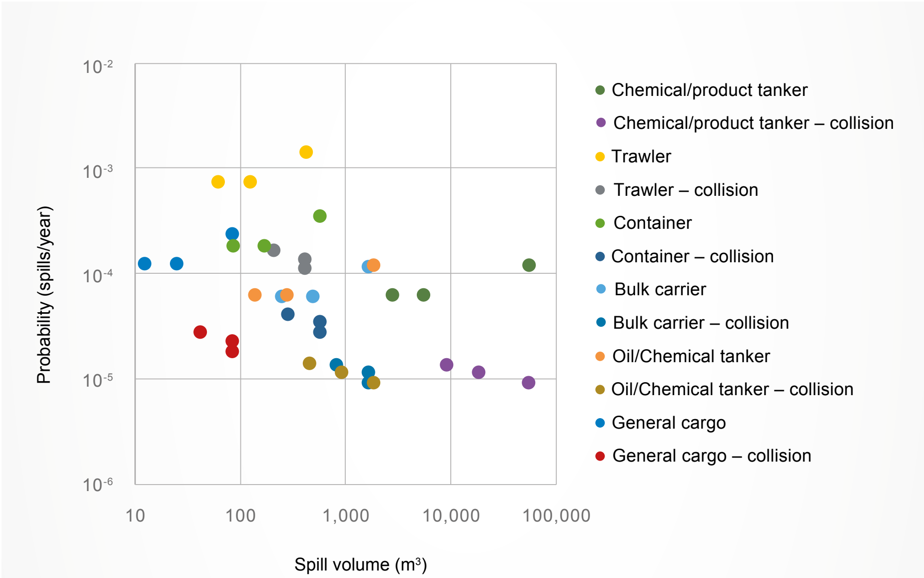
The developed methodology is applicable on a local scale, as well as on a more regional scale, to identify the worst credible scenarios and the most probable scenarios for certain areas. Adequate capacity needs and response resources can thereby be estimated. The presented spill risk assessment method was applied at a trial site, Disko Bay in West Greenland.

Seasonal variations

The presence of ice and severe Arctic conditions during a large part of the year prevent all ship traffic north of Disko Bay from January to April. A monthly accident index (AI) is calculated to show variations in accident frequency. The accident index calculated for the Arctic region correlates with traffic intensity in Disko Bay, yielding the highest values in August and September.

Representative fleets

Based on AIS data, the most frequent and the largest dimensioning vessels of different ship types are identified and selected to constitute a representative fleet for the area. The selected vessels are used in the risk evaluation to identify the worst credible spill scenario. As the selected vessels are assumed to represent the total fleet in the area, a percentage distribution of the total fleet to each vessel is estimated based on traffic statistics. In the Disko Bay area, trawlers and fishing vessels are most frequent. Specialised icebreaking vessels to supply Greenland with necessities constitute the dominant traffic sailing in ice. The largest vessels, bulk carriers with a bunker capacity of about 3,000 m^3, only operate in the area during the summer months when the Arctic characteristics are less significant. Crude oil tankers with large quantities of oil as cargo are not present-



Risk matrix for oil spill in Disko Bay.

Name	Type	Length overall (m)	Fuel capacity (m³)	Cargo capacity – Liquid (m³)	Comment
NS Yakutia	Bulk carrier	225	DF: 260 RF: 2,310	–	Largest vessel, only during summer time
Ugale	Chemical/Product tanker	195	DF: 194 RF: 1,590	56,190	Largest tanker
Orasila	Oil/Chemical tanker	89	DF: 306	1,862	Most frequent tanker, 5th most frequent in ice
Acadienne Gale II	Trawler	71	DF: 648	–	Most frequent vessel
Ivalo Arctica	General cargo	45	DF: 130	–	Most frequent vessel in ice, Icebreaking
Irena Arctica	Container	109	DF: 84 RF: 804	–	Most frequent container vessel

Selected vessels for representative fleet in Disko Bay (DF: Destillate Fuel, RF: Residual Fuel).

ly operating in the area, which eliminates the probability of the largest types of spill.

Risk evaluation

The consequence component of the spill risk is quantified by a calculated spill volume in m³ for each specific identified accidental event and each identified dimensioning ship category. Associated probability and consequence figures are presented and compared in risk matrices to facilitate identification and prioritisation of critical spill risk events.

For the Disko Bay case, accidents (grounding, foundering or ice damage) with a product/chemical tanker are clearly indicated as a high-risk event in terms of spill risk.

Future outlook

The expected increase in future sea traffic in remote and sensitive Arctic waters calls for enhanced preparedness and tools for prioritisation of response methods, identification of risk hot spots, response capacity needs, and adequate localisation for resources. Emerging spill risks follow with the expansion of Arctic shipping and the risk profile will change dramatically with the stepwise transition from the use of HFO to distillate and hybrid fuels with lower sulphur content. New fuels and future fuel types also require revisiting the existing response technique, its efficiency and potential need for adaptation.

The combined output from technical and environmental prediction methods developed within GRACE and its different work packages will facilitate future planning processes for the sustainable utilisation and protection of Arctic resources, specifically by providing effective tools for the planning of oil spill response preparedness and for the design and selection of adequate resources.

All illustrations by SSPA.

Nelly Forsman
Project Manager, Nautical & maritime risk-, safety, & environment analyses.

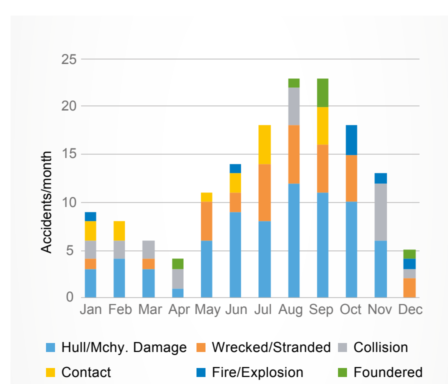
Nelly gained an MSc in Mechanical Engineering with a specialisation in Sustainable energy systems from Chalmers University of Technology in 2012. Since joining SSPA in 2014, Nelly has been active in the field of maritime safety assessment and risk analysis. Nelly also has experience and knowledge of alternative maritime fuels and the environmental impact from shipping, including oil spill risk assessment.

Contact information
E-mail: nelly.forsman@sspa.se

Björn Forsman
Senior Specialist, Nautical & maritime risk-, safety, & environment analyses.

MSc Mech. Eng. Björn joined SSPA in 1980 and has been active in areas related to the marine environment, oil spill prevention and clean-up as well as the reduction of ship emissions and alternative fuels. Currently, maritime safety and risk analysis are the main fields of expertise in his projects and in the research projects that he is engaged in. He has also been the programme manager for a number of advanced international training programmes.

Contact information
E-mail: bjorn.forsman@sspa.se



Number of accidents per month and per casualty type reported in the Arctic between 1996 and 2017. Only a few accidents are registered in the Disko Bay area, which is why no monthly statistics could be derived.