

Training of personnel on Norwegian emergency response vessels

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Abstract

This paper gives a brief presentation of the ongoing research project “Emergency Operations in Arctic Waters”. Focus will be on the work package that considers towing operations in harsh environments. Norwegian Coastal Administration – Troms and Finnmark has organized approximately 15 training exercises where one or more of the three nominated emergency response vessels for northern Norway take part in a simulated emergency towing operation. Experience from these exercises will be summarized. The final part of the presentation will review the content of the simulator-based training course, discuss the feedback from course participants and present the initiative taken by Norwegian Coastal Administration to start sharing experience between governmental bodies responsible for emergency preparedness in Northern Europe (Bonn Agreement countries).

Keywords

Contingency planning; emergency response vessel; towing; on-board training, simulator-based training.

1. Introduction

Recently there have been a number of incidents with drifting ships and offshore structures in the North Sea. Examples are the lay barge “LB200”, the drilling rig “Bredford Dolphin” and the cargo vessels “Marte”, “Gitta Kosan”, “Vindo” and “Server”. The expected increase in ship traffic in northern waters related to oil and gas activities provides the background for a research project initiated by Ship Manoeuvring Simulator Centre (SMS) and Norwegian Marine Technology Research Institute (MARINTEK). Based on a pre-project completed in 2005 involving representatives from Norwegian Coastal Administration (NCA), Norwegian Coast Guard, oil and shipping companies a main project proposal has been developed. This proposal for a three-year research and development project was approved by the Research Council of Norway (NFR) in December 2005. A brief description of this project is given in

Section 2.

Parallel to the pre-project work, the Norwegian Coastal Administration worked on a new strategy for emergency response to disabled vessels in the Norwegian territorial waters off northern Norway. The increasing frequency of harsh weather conditions combined with an observed lack of operational experience from cold climate operations amongst most ship crews, were some of the arguments for defining a new response strategy. One part of this strategy was the decision to charter dedicated emergency response vessels. In the winter season three emergency response vessels are located in different geographic sectors along the coast of northern Norway. In cooperation with shipping and oil companies NCA has organized a number of training exercises to test the operability of emergency towing systems under different weather conditions. Field test planning, preparation and lessons learned are described in Section 3. Work done to develop a simulator-based training course for senior officers on emergency preparedness vessels are summarized in Section 4. Experience from the first training courses run at Ship Manoeuvring Simulator in Trondheim is presented in Section 5, while Section 6 gives a brief review of topics discussed in a series of project workshops on emergency towing. Section 7 presents the conclusions and outcomes from the work to develop a holistic training system for personnel involved in response to maritime emergencies in Norwegian waters.

2. The “Arctic Emergency Operations” project

2.1 Description of Arctic Emergency Operations project

Arctic Emergency Operations (AEO) is a three-year research and development project supported by the Research Council of Norway as a part of the MAROFF programme (Research Council of Norway, 2006). The project has been one the outcomes of MARUT (Norwegian Ministry of Trade, 2005) “Cold Climate Specialist” pre-project “Drifting tankers under extreme weather conditions”. This pre-project identified knowledge gaps with respect to motion of disabled tankers, safe methods

to reduce risk for oil spills when tankers have structural integrity problems and emergency towing operations. The main objective of the project is to reduce risk of major oil spill due to accidents involving ship operating in Arctic waters. The project has six thematic work packages:

- Mathematical models for drifting vessels
- Motion response of disabled vessels in a sea-way
- Open sea emergency lightering – extreme conditions
- Best practice - Towing disabled vessels in harsh conditions
- Emergency offloading – tanker in ice
- Collision scenario – passenger and bulk carrier at Svalbard

Work on the first four work packages started in 2006 while the last two will start mid-2007. In total there are close to 20 partners in the project representing governmental bodies, oil companies, shipping companies (tankers and tugs), marine insurance companies, training centres and research companies. In addition to Norwegian partners the project has participants from France, Germany, Japan and the Russian Federation. More information about this project can be found at the project web site (SMS, 2007).

The motivation for this project is the increasing interest in oil and gas exploration in waters off northern Norway and in the Barents Sea. This interest pushed the Norwegian authorities to focus on the marine ecosystems in Northern waters and how they would be influenced by increasing oil and gas activities and ship traffic. A specialist group was appointed to obtain background knowledge and understanding of the present state of the art of ecosystems in these regions. This group had representatives from a number of governmental agencies and some government sponsored research institutions. Their main objective was to map existing knowledge and pinpoint areas where knowledge and understanding were missing. Their findings are presented in a government White Paper (Ministry of Environment, 2006). Prior to that work another governmental group had reviewed the Norwegian policy on sea safety and oil spill preparedness. Norwegian consultancy and research companies such as DNV, SINTEF and Dovre Safetec ran different types of risk analysis to quantify risk levels for different parts of the Norwegian coastline. The studies included the present traffic pattern and some possible scenarios for traffic development for the year 2015. The results of these studies are included in another White Paper that was public in 2005 (Department of Environment, 2005).

2.2 Work package on “Emergency Towing Vessels”

Work package no. 4 looks at emergency towing operations. The main objectives are to

- Improve competence related to emergency towing operations

- Develop new training offers for senior officers on emergency towing vessels/nominated contingency vessels

MARINTEK and SMS decided to arrange a number of workshops to involve project partners in knowledge-sharing activities on emergency towing operations and design of vessels to be used for such operations. More information on these workshops is given in Section 6.1.

3. Towing exercises using emergency response vessels

3.1 Norwegian Coastal Administration’s initiative for testing of emergency towing systems

Based on experience from incidents in Norwegian waters and lessons learned by other countries, in 2003 the Norwegian authorities initiated work related to an evaluation of present emergency preparedness plans and the short and long-term needs for improvements. Amongst others DNV and SINTEF were commissioned to do some background studies on traffic statistics, reported incidents and risk levels for Norwegian waters. The outcome of these studies was part of the background documents used to develop the governmental White Paper no. 14, 2004-2005 (Department of Environment, 2005). It discusses the risk for sudden spills from ship traffic, petroleum activities and considers actions to prevent future ship accidents. Section 6 of the White Paper presents material related to contingency plans and activities connected to incidents and accidents at sea. Based on selected cases it was found that to obtain a satisfactory emergency response capability there was a need to establish dedicated emergency response vessels along the coast of northern Norway. For the winter season three vessels are involved in this service, while only two are necessary in the summer season.

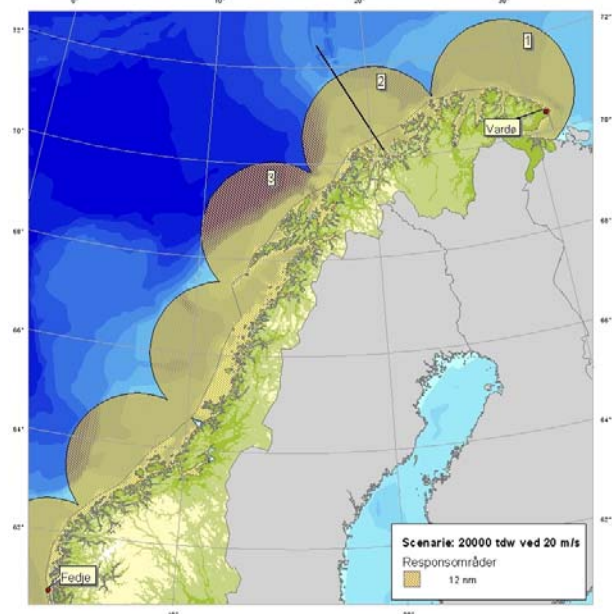


Fig.1: Distribution of emergency response vessels in northern Norway (winter season)

Figure 1 shows the nominal location of the vessels during the winter season. The vessels in sectors 1 and 3 are anchor handling tugs, while the vessel in sector 2 is the Norwegian Coast Guard vessel “KV Harstad”.

A work group on national towing preparedness was set up by Norwegian Coastal Administration in 2005. This group consisting of members from Norwegian Coastal Administration and Norwegian Coast Guard prepared a summary document early 2006 (Norwegian Coastal Administration, 2006). Some of the group’s work was based on contract work done by Det Norske Veritas (DNV) related to the following topics:

- Evaluation of threats today and in the future
- Describe a dimensioning incident and analyse necessary towing capacity for this incident
- Calculation of drift of floating bodies
- Description of methods for handling a drifting vessel
- Prepare a list of usable towing vessels along the Norwegian coast
- Discuss findings and propose ways of obtaining access to necessary towing force along the Norwegian coast

When planning the existing emergency response regime for northern Norway, the expected future traffic situation was used as a baseline when writing the specification documents to be used for selecting the 3 vessels that are hired as emergency response vessels in the winter time. The following cases were used to describe as dimensioning cases for towing capacity requirements:

- Bulk carrier of 150 000 dwt
- Tank vessels of 20 000, 50 000 and 100 000 dwt respectively

For all vessels both laden and ballast conditions were investigated. Calculations to find necessary towline force to control vessels without own power was done by DNV. Calculations were made using these environmental parameters:

- Wind speed 20 m/s
- Current speed 1 m/s
- Significant wave height 5 m

where all parameters are working in the same direction so that the vessel drifts the shortest way towards the coastline. The necessary towing force were calculated for four different cases; laden – wind 0 and 15 degrees on the bow, ballasted – wind 0 and 15 degrees on the bow. For all conditions the highest force was needed to handle the laden bulk carrier, varying from 96.4 tons to 151.2 tons. For a vessel that has been drifting for some time, the vessel will probably be drifting with a large angle against the wind and waves. The ability of tugs to turn a drifting vessel up against the wind is not discussed in the paper. The final specification prepared by Norwegian Coastal Administration in 2005 stated that the emergency response vessel should be able to:

- Hold/manoeuvre vessels up to 100 000 dwt without own power under the following envi-

ronmental conditions:

- Wind speed 20m/s
- Current speed 1 m/s
- Significant wave height 5 m/s

It was early decided that on-the-job training would be one of the ways of developing skills needed for an emergency towing operation. The Norwegian Coastal Administration approached shipowners and asked for their support to make vessels available for towing exercises. So far more approximately 15 training exercises have taken place off the Troms and Finnmark coastline.

One of the exercises involved the VLCC Belokamenka which is now serving as a floating storage and offloading unit in Murmansk. Other exercises have been made using tankers involved in ship-to-ship transfer operations of gas condensate in the Finnmark fjords. As an example Figure 2 shows one of the exercises involving the Norwegian Coast Guard vessel KV Harstad.



Fig. 2: Tightening the towing line during an exercise with KV Harstad.

3.2 Preparation for an emergency towing exercise

Prior to the exercise the NCA makes a formal request for cooperation with a selected shipping company. The company forwards information on the towing arrangement for their vessel, communicates the participation to the master of this vessel and discusses the training scenario objectives with NCA representatives. NCA prepares a draft training scenario which is presented for the ship-owner and a final version is agreed. The final version is distributed to the emergency response vessels and the vessel acting as the disabled vessel. Before the exercise starts a member of the exercise planning team embarks the disabled vessel to observe and record the way the exercise develops.

Even though many exercises have taken place in the winter season, the weather conditions during these exercises have been fairly reasonable. Thus it has not been necessary to abort planned exercises due to risks for personnel or property damage.

3.3 Lessons learned

It should be noted that it had not been possible to run these exercises without the excellent support and cooperation from shipowners and operators. They have really seen the benefit in this – and contributed to create a win-win situation.

On one of the vessels to be assisted it was experienced that the Emergency Towing System messenger line was drifting into the ship's side. The same happened when the vessel was turned. This made it difficult for the crew on the towing vessel to pick it up.

Design of a strong point varies and makes it difficult to plan how to make fast the towing gear. As a consequence, the Norwegian authorities ask for information on strong point arrangements as part of the questionnaire faxed to vessels with dangerous cargos when entering the waters off northern Norway. The lack of a strong point on large bulk carriers is seen as a possible problem for stopping a drifting vessel without creating structural damage to it when it is towed in harsh weather conditions.

For the Coast Guard vessel it was shown that in some cases it was difficult to obtain a preferred towing arrangement. This was mainly due to lack of a towline stopper on the aft bulwark of the Coast Guard vessel. This vessel also lacked a meter for the relevant force in the towline and it was without a rendering function on the winch that reduced the possibility of having snatch loads breaking the towing wire.

In some exercises one of the tugs transferred an exercise observer to the simulated disabled vessel. This was shown to be of great value, both for setting up a good communication system during the exercise as well as for getting a first-hand information and knowledge of problems met when handling towline shackles through the Panama gat. Even though most of the exercises have been performed in reasonably calm weather and with a fully crewed vessel, the problem of embarking an abandoned vessel in harsh weather in the wintertime with total darkness may be a significant problem. In such cases the rescue team have to be airlifted to the disabled vessel. Helicopter characteristics and availability may slow down the work to set up the emergency towing system. Low effective air temperatures may also be a limiting factor for rescue team members preparing the emergency towing connection.

The training exercises gave valuable knowledge, understanding and skills for personnel on emergency response vessels. However, they cannot train in situations that may endanger lives or property. Thus it is necessary to develop an alternative safe training system for abnormal and extreme cases with simulated disabled vessels handled by emergency response vessels. The development of a simulator-based training programme is described in the next section.

Until January 2007, the Regional High Command Northern Norway collected information on relevant characteristics of vessels with dangerous cargos passing the coast of northern Norway. This task has now been transferred to Vardø Vessel Traffic Service as they

become operational on 1 January 2007. Vardø VTS has the responsibility of monitoring AIS data for the coastline from Rørvik to the Russian border. The introduction of a new vessel traffic separation schemes off the coast of Norway from Vardø to Røst was approved by IMO at the December 2006 meeting of the Maritime Safety Committee (IMO 2006). Tankers of all sizes, including gas and chemical tankers, and all other cargo ships of 5 000 gross tonnage and upwards engaged in international voyages should follow the routing system. It consists of a series of traffic separation schemes joined by recommended routes off the coast. The motion of the tracks further off the coast may result in vessels disappearing from the AIS map as they are out of reach of the shore-based AIS stations.

4. Developing a simulator-based training course for personnel on emergency preparedness vessels

4.1 Background

In 2003, the Norwegian Coastal Administration started a project to improve the competence level of personnel involved tasks specified in the National Emergency Towing Contingency Plan. In 2005, SMS was invited to take part in development of a simulator-based training course as one element of a competence enhancement plan for personnel on emergency response vessels.

During the last few years a number of situations have emerged where vessels in distress in harsh weather have needed the assistance of emergency towing vessels. To establish an emergency towing connection is a challenging operation where the emergency response vessel has to manoeuvre close to the disabled vessel. A highly skilled and experienced master is needed for such an operation. How to train masters for such vessels is a challenge as emergency towing in harsh weather is a rare event for personnel on other vessels than dedicated emergency towing vessels.

4.2 Selection of personnel to a course specification group

Early in 2005, MARINTEK and Ship Manoeuvring Simulator Centre in Trondheim prepared a pre-project proposal in the Norwegian Innovation Programme MA-RUT. The proposal was focusing on emergency operations involving large vessels in waters off the coast of northern Norway. The proposal was approved and the pre-project was started in May 2005. During the initial phase of the pre-project the Norwegian Coastal Administration asked if it was possible to use an expert group appointed by the partners in the pre-project to help SMS to develop a simulator-based training course. The pre-project partners agreed to appoint members to this expert group. It had representatives from:

- Norwegian Coastal Administration
- Regional High Command Northern Norway

- Norwegian Coast Guard
- Tanker operators

A separate contract was made between NCA and SMS for specification, development and running of two test courses. The objective of the test courses was to collect feedback from trainees on course design, course material, exercises and simulator fidelity.

4.3 Specification of course objectives

The expert group had a number of meetings at SMS to discuss course objectives, evaluate the need for necessary extensions of simulator software and hardware and specify instructor qualifications needed for this highly specific simulator-based training course. At an early stage it was decided that the target group of trainees should be

- Management and deck operators serving on-board vessels scheduled to be a part of the National Emergency Towing Service.
- Shore-based personnel with tasks in the National Emergency Response plan relating to handling of disabled vessels.

The types of training objectives for this course have been divided into the following categories

- Basic knowledge and understanding of the physics involved in towing operations
- Towline characteristics
- Handling of the tug when preparing the towline connection
- Procedure training
- Team work Bridge Team Management

4.4 Specification and development of training exercises

Based on the recommendation from the expert group the following items were included in the course programme

- National and International Regulations
- Towing Vessels and Towing Equipment
- Towing Manual and Standard Procedures
- Preparing for the Towing Operation
- The Towing Operation
- Forces acting on Disabled Vessel
- Towing Connection and Towing Vessel
- Arrival Port of Refuge
- Simulator Exercises

Relevant chapters from SOLAS and MARPOL as well as national regulations from Norwegian Maritime Directorate, Norwegian Coastal Administration, Regional High Command Northern Norway will be discussed in the course. In addition sections from DNV rules for Marine Operations are highlighted in some exercises.

For the towing operation the training objectives are related to

- Arrival disabled vessel
- Pick up of emergency towing equipment
- High risk elements during manoeuvring close to the disabled vessel
- Connection of towing equipment
- Operation of towing winch/wire
- Tension in towing wire
- High risk elements during towing

Some of the aspects that are reviewed when the towing connection has been established are

- Towing Speed
- Towing Wire Length
- Arrival Coastline/Port of Refuge
- Towing in Shallow Water
- Towing in Narrow Water
- Towing without Assistant Tug(s)

For this course it was found necessary to develop new mathematical models for the vessels taking part in the emergency preparedness organization for northern Norway. MARINTEK took some field measurements of manoeuvring performance in calm water for the Norwegian Coast Guard vessel KV Harstad in October 2006. These measurements were used to tune the mathematical model used for the SMS simulators. It is planned to do parallel field tests in rough weather later this year to obtain manoeuvring performance data in more realistic operational conditions for vessels involved in emergency towing in harsh weather conditions. To be able to start training as early as possible it was decided to start courses using existing simulator models for anchor handling and platform supply vessels. For these vessels it was necessary to do some additional modelling of the towing arrangement, towing gear and towing winch. Figure 3 shows the aft deck on the Coast Guard vessel KV Harstad and the towing line for a calm water towing operation in confined waters.

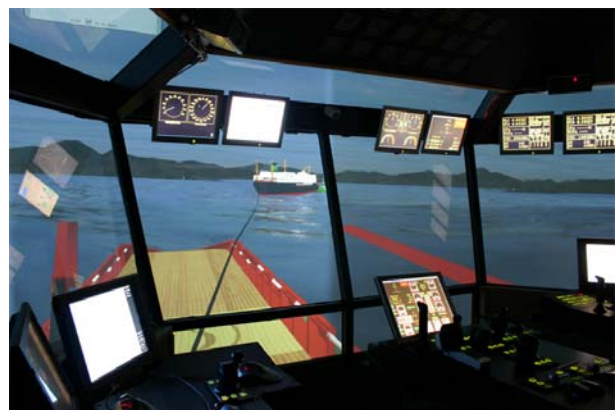


Fig. 3: KV Harstad towing a simulated disabled vessel

The simulator exercises are developed to give the trainees the possibility to learn more about

- External Forces (wind, current, swell and waves)

- Manoeuvring close to a disabled vessel
- Maintain disabled vessel in position
- Turning and stopping the drift of a disabled vessel
- Arrival coastline/Port of Refuge
- Towing with assistant tug(s)

Selection of locations for training scenarios has been made to represent traffic patterns and for sites where there is a severe consequence of a possible oil spill from a grounding or grounded tanker. The simulator instructor has the option to change weather conditions during an exercise. The expert group has prepared a list of failures that can be introduced during simulation runs.

4.5 Instructor qualifications

For all simulator-based training courses the instructor qualifications are important for transfer of training taking place. Experience from actual operations will always be an important part of the instructor's qualification. Some of the instructors at SMS are qualified to act as instructors for this type of course.

5. Experience from the first training courses

5.1 Test course description and feedback from participants

Initially two test courses with 8 participants on each of them were conducted, one in May and the other one in September 2006. Nomination of participants was done by representatives of Norwegian Coastal Administration. Course participants represented

- Norwegian Coastal Administration
- Norwegian Coast Guard
- Regional High Command Northern Norway
- Tug operator

The topics included in the 3 day long test courses can be divided in three main items:

- Introduction to rules and regulations
- Study of previous cases
- Training in the simulator

(see section 4.4 for more details). In addition to the oral debrief at the end of these courses, SMS used a one page written questionnaire. For most of the questions a five level score form were used. Table 1 shows some of the responses given by test course participants. Only the top three score levels are shown in the table as there were no items where the two lower score levels were used by the test course trainees. As can be seen the course was well received by the trainees. They made a number of suggestions on ways to improve the outcome of the course. The written learning material was updated based on feedback from the participants. The briefing and debriefing activities were modified to create stronger participation from the trainees.

Table 1: Evaluation scores from test course participants

Activity	Topic	Good	Very good	Excellent
Theory	Content	11	5	
	Presentation method	11	5	
	Instructor	6	10	
Exercises	Training goal	6	9	1
	Briefing	10	6	
	Personal challenge	9	6	1
	Debriefing	9	7	

Based on the outcomes from the test courses it was decided to make some modifications to the course. The participants asked for an extension of the course with at least one additional day.

5.2 Summary of feedback from additional courses

After the test courses there has been 4 additional courses in 2006. Based on feedback from the test courses the final course length was increased to 4 days. Participants on these courses have been representatives from on-board and on-shore management involved in emergency response operations in northern Norway. Table 2 shows results from the written questionnaire for these courses. For all topics the feedback is more positive than for the test courses shown in Table 1. It can be seen that the instructor performance has been improved, training goals made more relevant to real life operations and the briefing and debriefing sessions made more interesting.

Table 2: Evaluation scores from course participants

Activity	Topic	Good	Very good	Excellent
Theory	Content	13	16	
	Presentation method	10	18	1
	Instructor	1	26	2
Exercises	Training goal	7	21	1
	Briefing	10	19	
	Personal challenge	9	19	1
	Debriefing	11	16	2

The participants play an active role in an interactive process to improve the quality of the course by proposing new training scenarios. They also ask for simulation studies of ways to improve their emergency towing gear and what is the optimum way to operate their vessel when handling a large drifting vessel in heavy seas and strong winds.

5.3 Input to further improvement of training course

An NCA representative (pilot master) has taken part in

all of the simulator courses. He has made notes and improvement proposals during and after each course. His findings and proposals have been discussed with course participants under the course and especially at the final course debriefing session.

The participants have asked for updated mathematical simulator models representing the three vessels that are part of the emergency response system for the winter season in northern Norway. This is due to the large variation in manoeuvring and sea-keeping performance of these vessels. They have also asked for more realistic representation of the wavefield on the lee side of a disabled vessel and the visual presentation of the towing line during a towing operation in harsh weather.

6. Workshops on emergency towing

6.1 Project workshops on emergency towing operations

The Norwegian Coastal Administration Troms and Finnmark hosted this first project workshop. Some 25 representatives took part. Presentations included a project overview, contingency plans for northern Norway, experience from training exercises arranged by Norwegian Coastal Administration and experience from selected real life cases. The Norwegian Coast Guard vessel KV Harstad was located in Honningsvåg during the meeting. A thorough walkthrough of the vessel was one of the items on the workshop schedule. MARINTEK has produced and distributed a DVD with material presented at the workshop.

The second workshop on "Emergency Towing Operations" was arranged in Brest in October 2006. Ifremer took care of the organization as it was held in connection with the Search and Rescue seminar under the SeaTechWeek in Brest. Topics discussed included ERIKA experience (Commandant Charles Claden), wreck removal (Captain Bert Kleijwegt) and transfer of emergency towing equipment by helicopter to an abandoned ship. MARINTEK has collected the presentation material and produced a CD which has been distributed to project partners.

The third workshop was held in Glasgow in March 2007. The main topic for this workshop was requirements for vessels to be used for emergency towing. Views on this topic were presented by representatives from Iceland, France, Germany and Norway. In addition to technical requirements with respect to vessel motion characteristics and towing equipment it was stated that competence of the vessels crew is the most important factor for successful emergency rescue operations. MARINTEK has collected the presentations from the workshop on a CD which will be distributed to the project partners by the end of April 2007.

6.2 Workshop for experience sharing between Bonn Agreement partners

In December 2006 the Norwegian Coastal Administra-

tion – Troms and Finnmark arranged an experience-sharing workshop for national governmental bodies responsible for emergency response under the Bonn Agreement (Bonn Agreement, 2007). Representatives from Sweden, Denmark, Germany, the Netherlands, Belgium, France, the United Kingdom and Norway took part. In addition, representatives of the Iceland Coast Guard and the European Maritime Safety Agency (EMSA) participated. Presentations of present and planned emergency response organizations were given. The participants were observers on a field training towing exercise involving two of the emergency response vessels for northern Norway. First KV Harstad acted as the disabled vessel and the other emergency response vessel rigged their towing gear to the anchor chain of KV Harstad. Later on the other vessel was the disabled vessel and KV Harstad made a normal towing connection with the disabled vessel.

6.3 Using workshop outcomes to improve simulator - based training course

The experience from real life emergency towing operations presented at the workshops has been used to specify simulator training scenarios. Special focus has been given to handling of the response vessel close to the disabled vessel when setting up the towing connection.

The need for high fidelity mathematical models and realistic visual models have been stated by workshop participants as well as subject matter experts taking part in the first two test courses at SMS.

At present the Norwegian authorities do not require that dedicated emergency towing vessels should be available at short notice in Norwegian waters. Thus the chartered emergency response vessels have to act as emergency towing vessels when necessary. Emergency towing operations are complex marine operations with a high risk potential. Partners coming from different stakeholders of the maritime industry have taken part in a number of workshops aimed at sharing knowledge, understanding and experience on emergency towing operations. Experienced operational personnel have been invited to present cases they have been involved in such as the Prestige and Erika. From these workshops the need has been identified for increased international collaboration to share experience related to the handling of disabled vessels in harsh weather situations and operation of emergency response vessels close to a drifting vessel.

7. Conclusions

Training will always be needed to build a high quality emergency response service. It is important that personnel in all levels of the emergency response organization are able to perform their own tasks well and that they have a good understanding of the tasks of the other parties. The Norwegian Coastal Administration has seen a significant improvement in the way field tests of towing operations have been planned and performed since

the first tests back in 2004. Shipping companies have become very positive to enable their vessels to be part of these towing exercises. In addition to the improvement of competence of personnel on the emergency response vessels there has been enhancement of skills for personnel on the merchant vessels as well. However, operational training in harsh weather will not be done due to the risk for personnel and vessels involved. Such conditions must be trained in the risk-free environment found in ship handling simulators.

The new simulator-based training course for personnel involved in marine emergency response organizations developed at SMS in Trondheim, Norway, gives a risk-free training environment. Here all parties in the emergency response organization will be given the opportunity to increase the knowledge, understanding and skills needed for performing well in complex emergency response operations. Based on the course evaluation forms completed by participants at two test courses, the Norwegian Coastal Administration asked SMS to increase the course length from 3 to 4 days to be able to add more training scenarios and to improve the understanding of tasks performed by the other levels of the emergency response organizations. In collaboration with the Norwegian Coast Guard and MARINTEK, SMS will develop new and improved mathematical models for the Coast Guard vessel chartered for emergency response activities in northern Norway.

As part of the ongoing "Arctic Emergency Operations" project there will be more workshops arranged to enhance experience-sharing between personnel on emergency response vessels and work with functional requirements for emergency towing vessels to be used in Arctic conditions. The next workshop will be arranged by Central Command for Maritime Emergencies Germany in September 2007.

Sharing of information related to development of functional specifications for a new generation of vessels suited for emergency towing operations in harsh environmental conditions will be beneficial. The characteristics of Arctic waters make it even more important to share knowledge and to develop robust emergency response systems. Lack of available infrastructure, lack of suitable air support combined with the low air and sea temperatures reduces the survival time for ship's crew. Availability of emergency response vessels designed to operate under cold climate conditions is a must for an Arctic emergency response organization.

8. Acknowledgements

On behalf of the Norwegian Coastal Administration, we would like to thank the shipping companies for making vessels available for this type of training exercises. The Research Council of Norway is acknowledged for their financial support to the project "Arctic Emergency Op-

erations" under their MAROFF programme. Their support has made it possible to run a number of international workshops on emergency towing operations to investigate functional specifications of emergency towing vessels, operation of such vessels and training of personnel on emergency rescue vessels. The authors express their gratitude to the experienced masters Bert Kleijwegt (Smit International) and Charles Claden (Les Abeilles International) for their workshop presentations based on operational experience from emergency towing operations. Finally we will thank participants on SMS training courses for their valuable input to continuously improve the training course for personnel in the northern Norway emergency response organization.

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