

# Training Course for Personnel Involved in Emergency Towing Operations

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**ABSTRACT:** This paper presents development of and experience from a simulator based training course for personnel in Norwegian emergency response operations. As a response to governmental white papers on emergency preparedness and safety at sea in Norwegian waters, it was decided to develop a simulator based training course with focus on emergency towing operations. The first part of the paper describes work done by a group of subject matter experts appointed by Norwegian Coastal Administration. This group assisted Ship Manoeuvring Simulator Centre to specify the content of a three days training course for deck officers on emergency response vessels. Two test courses were run in the summer of 2006. Feedback from these courses was used to update and extend course content for the first ordinary courses that took place later that year. The second part of the paper reviews course experience and feedback from course participants. The final part of the paper describes the links between the simulator based course and the research and development activities in the R&D project “Arctic Emergency Operation” involving partners from France, Germany, Japan, Norway and United Kingdom.

## 1 INTRODUCTION

Emergency towing is a high-risk operation. In order to increase the success rate of such operations, specially designed vessels and highly trained crews ought to be employed. However, in most parts of the world, governments are not willing to spend money on dedicated vessels designed to handle worst-case scenarios. Instead, they usually opt for multi-purpose vessels that can perform a number of different tasks under normal operational conditions. For extreme operational conditions such vessels in some cases becomes “multi-useless” vessels, as they are not equipped to handle extreme situations. Nor are crews trained to handle their vessel in these situations, which may increase the risk of unsuccessful outcomes of emergency response operations under the extreme operational conditions that exist in Arctic waters.

A number of relevant papers were presented at a conference in Brest in July 2000. Capt. Charles Claden gives a good presentation of lessons learnt from the Erika disaster. During the discussion Capt. Claden said: “Regarding salvage, emphasis should

be given to improved training through more exercises and on better documenting the different emergency towline systems installed on vessels”.

Based on experience from emergency towing operations, the International Maritime Organisation (IMO) approved Resolution A535 (13) “Recommendation on Emergency Towing Requirements for Tankers”. According to the IMO regulations tankers above 20,000 DWT must be equipped with one strong point at the bow and an emergency towing system (ETS) at the stern. Larger tankers over 150,000 DWT will have 2 strong points and an ETS.

At the 35th meeting of the Maritime Safety Committee (IMO MSC 1994), the guidelines for emergency towing arrangement on tankers were approved. These state that the major components of the towing arrangement should be as listed in Table 1. These requirements are written in a functional form in order to allow for different design solutions. One commonly used design for the strongpoint is the Smit Bracket. Different manufacturers offer different designs, which may create problems in an emergency situation, especially when trying to establish a towing connection for an abandoned ship.

Table 1 Major components of emergency towing arrangements for tanker

Component	Forward of ship	Aft of ship	Strength requirements
Pick-up gear	Optional	Yes	No
Towing pennant	Optional	Yes	Yes
Chafing gear	Yes	Depending on design	Yes
Fairlead	Yes	Yes	Yes
Strongpoint	Yes	Yes	Yes
Roller pedestal	Yes	Depending on design	No

In recent years, the IMO Sub-Committee on Ship Design and Equipment has organized a correspondence group that is looking into the need for similar requirements for other types of vessels larger than 20,000 DWT. In a paper delivered at the 50th session of the Sub-Committee in 2006 (IMO 2006) it was requested that the Sub-Committee:

- Agree, in principle, to the draft Guidelines for owners/operators on the development of emergency towing procedures as developed by the correspondence group

The Guidelines have been divided into three main topics:

- Ship evaluation – The evaluation of the vessel's main characteristics (current condition) and available on-board equipment
- Emergency towing booklet (ETB)
- Developing procedures – Guidelines to help create a procedure on how to connect and be towed by another ship in an emergency situation.

INTERTANKO has also recently been working on emergency towing, with a focus on towing lines and their characteristics.

There is well-established collaboration on safety at sea among the Bonn Agreement (Bonn Agreement 1983) partners, covering shipping activities in the North Sea.

Norway and Russia have agreements regarding cooperation in cases of at-sea incidents in the Barents Sea. The initial agreement on oil pollution was signed in 1994 and the agreement on search and rescue operations in 1995. Since 2003, a joint working group with representatives of the Ministry of Transport of the Russian Federation and the Ministry of Fisheries and Coastal Affairs in Norway meet twice a year to discuss how to improve safety at sea in the Barents Sea.

In 1993, the Copenhagen Agreement was extended to cover the Faroe Islands, Greenland and Iceland, in addition to the original participants Denmark, Sweden, Norway and Finland. In 2007, Norway and Iceland also agreed to start exchanging vessel traffic data for vessels leaving/entering these countries' EEZ.

## 2 NORWEGIAN EMERGENCY RESPONSE ORGANISATION

The Regional High Command Northern Norway initially had the responsibility for coastal contingency planning and response in Northern Norway. The command had direct access to the resources to be used, especially Norwegian Coast Guard vessels. In 2005 the Norwegian Coastal Administration's Department of Emergency Response was set up and took over the responsibility from the Regional High Command. The Norwegian Coastal Administration is responsible for the chartered emergency response vessel in Northern Norway.

The contingency planning for acute pollution has three layers; private, community and national. The Norwegian Coastal Administration is responsible for governmental contingency planning and is the executive body for handling large acute oil spills and preventing such accidents. NCA holds responsibility for the governmental towing support service in Northern Norway. Based on a study led by Det norske Veritas (DNV 2006), it was decided to use the following data when specifying the necessary towing capacity for governmental emergency response vessels working off the coast of Northern Norway:

- Hold/manoeuvre vessels up to 100,000 DWT without own power under the following environmental conditions:
  - Wind speed 20m/s
  - Current speed 1 m/s
  - Significant wave height 5 m

At present two emergency response vessels are on duty during the summer and three in the winter season. These vessels are located as shown in Figure 1.

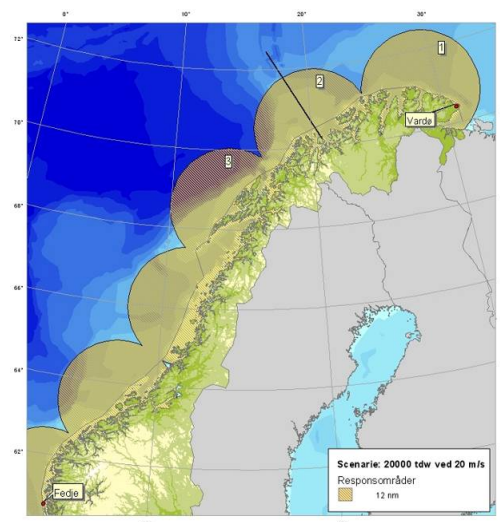


Figure 1 Operational regions for emergency response vessels

All vessels are multipurpose vessels and their performance as emergency towing vessels is limited. In a note prepared by the Norwegian Coastal Administration (NCA 2007) the following improvements to

the present contingency situation have been proposed:

- Towing vessel capacity should be raised, especially in the summer season
- Oil-spill combating equipment needs to be improved for cold climate operation/low temperatures, icing conditions)
- Training of personnel to handle situations in darkness and at low temperatures

All policy statements made by government agencies and oil companies involved in oil exploration and production off the coast of Finnmark say that “The contingency for shipping and marine operations in the Barents Sea should be the best in the world”. There is thus a need for government organisations to develop a common definition of specific objectives and action plans to implement this contingency organisation, purchase necessary equipment (including mission-adapted vessels) and train personnel who will be involved in combating maritime emergency situations.

### 3 DEVELOPMENT OF SIMULATOR BASED TRAINING COURSE

In the course of the past few years, a number of situations have arisen in which vessels in distress in harsh weather have needed the assistance of emergency towing vessels. To establish an emergency towing connection is a challenging operation, in the course of which 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. Different solutions have been selected nationally and by the major salvage companies for qualification of personnel on emergency response and towing vessels. Generally speaking, it is important to build crews with a strong degree of respect for each other's field of expertise. Companies such as Smit Salvage and Abeilles have their own in-house training program for personnel on board their emergency towing and salvage vessels.

In 2003, the Norwegian Coastal Administration started a project that had two main objectives. The first was to prepare a set of functional requirements for vessels to be used in the authorities' emergency preparedness system. The second was to specify a list of competences needed by senior personnel on emergency response vessels. With this list in hand, NCA reviewed existing training offers in Norway and concluded that these were unable to deliver what they required. They then decided to fund the devel-

opment of a specific training course to improve the competence level of personnel involved in tasks specified in the National Emergency Towing Contingency Plan. In 2005, SMS was invited to take part in the development of a simulator-based training course as one element of a competence enhancement plan for personnel on emergency response vessels. The Norwegian Coastal Administration appointed an expert group to help SMS to develop a simulator-based training course. It had representatives from:

- The Norwegian Coastal Administration
- The Regional High Command Northern Norway
- The Norwegian Coast Guard
- Tanker operators

The expert group was asked to specify course objectives, evaluate the need for necessary extensions of simulator software and hardware and specify the 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 onboard vessels scheduled to form part of the National Emergency Towing Service.
- Shore-based personnel with tasks in the National Emergency Response plan relating to handling disabled vessels.
- The types of training objectives for this course have been divided into the following categories:
- Basic knowledge and understanding of the physics of towing operations
- Towline characteristics
- Handling of the tug when preparing the towline connection
- Procedure training
- Team work and Bridge Team Management

On the recommendation of 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 the Norwegian Maritime Directorate, the Norwegian Coastal Administration and the Regional High Command Northern Norway will be discussed on the course. Parts of the DNV rules for Marine Operations will also be highlighted in some exercises.

For the towing operation the training objectives are related to

- Arrival at 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/cable
- Tension in towing cable
- High-risk elements during towing

Some of the aspects to be reviewed when the towing connection has been established will be :

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

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 perform some additional force and visual modelling of the towing arrangement, towing gear and towing winch. Figure 2 shows an early visual model of the aft deck of the Coast Guard vessel KV Harstad and the towing line for a calm-water towing operation in confined waters.

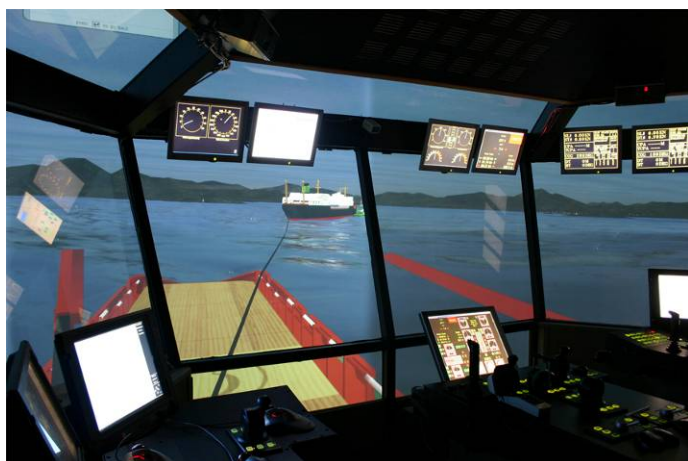


Figure 2: KV Harstad towing a simulated disabled vessel

The simulator exercises have been developed to enable the trainees to learn more about:

- External forces (wind, current, swell and waves)
- Manoeuvring close to a disabled vessel
- Maintaining disabled vessel in position
- Turning and stopping the drift of a disabled vessel
- Arrival at coastline/Port of refuge
- Towing with assistant tug(s)

Locations for training scenarios were selected so as to represent traffic patterns and for sites where the consequences of an oil spill from a grounding or grounded tanker would be serious. The simulator instructor has the option of changing weather conditions during an exercise. The expert group has prepared a list of failures that can be introduced during simulation runs.

Initially, two test courses with eight participants on each were held, one in May and the other in September 2006. The objective of the test courses was to collect feedback from trainees on course design, course material, exercises and simulator fidelity. Participants were nominated by the Norwegian Coastal Administration. Course participants represented:

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

The topics of the three-day test courses can be divided into three main items:

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

In addition to the oral debriefing 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 2 shows some of the responses of the participants. Only the top three score levels are shown in the table as there were no items where the two lowest levels were used by the trainees. As can be seen the course was well received by the trainees, who made a number of suggestions on ways to improve the outcome of the course. The written learning material was updated on the basis of feedback from the participants. The briefing and debriefing activities were modified to increase trainee participation.

Table 2: Evaluation scores of 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	

The results of the evaluation was used to update course content and written learning material as well as to improve simulator software and adapt the visual system to include important cues used by experi-

enced tug masters. The participants recommended that the course should be extended by at least one day.

#### 4 EXPERIENCE FROM ORDINARY COURSES

After the test courses, four ordinary courses were held in 2006. Based on feedback from the test courses the final course length was increased to four days. Participants on the ordinary courses have included representatives of on-board and on-shore management involved in emergency response operations in northern Norway. Table 3 shows the results of the written questionnaire for these courses. For all topics the feedback is more positive than for the test courses shown in Table 2. It can be seen that instructor performance has been improved, training goals made more relevant to real-life operations and the briefing and debriefing sessions made more interesting.

Table 3: 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

In 2007, 6 courses were run with a total number of 42 participants. The total score showed that course got a mean score of 4.0 on a 1-5 score list (where 5 is top score – or excellent).

In 2008, 5 courses took place with a total of 45 participants. The mean score on the feedback form was slightly higher then for 2007.

##### 4.1 Improving ship models

The participants 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 important differences in the manoeuvring and sea-keeping performance of these vessels. Due to limited personnel resources at SMS the development of ship-specific models will be limited to only one of the emergency response vessels. KV Harstad was selected as a case vessel for the development of a new mathematical model. Part of this work has been done at MARINTEK using the 3 degrees of freedom (DOF) model employed in MARINTEK’s SIMAN software (MARINTEK 2005), which is based on:

- Numerical calculation of added mass using VERES
- Empirical expressions for linear damping terms
- Crossflow drag formulation for non-linear damping terms
- Empirical formulae or manufacturers' data for rudder forces
- Empirical formulae or manufacturers' data for propellers and thrusters
- Empirical corrections for hull-rudder-propeller interactions

Empirical models of wind forces.

To validate the model, MARINTEK has access to model tests for the UT-512 design, which is the basic design for KV Harstad, as well as calm-water manoeuvring tests. As the shipyard delivery tests are very sparse on vessel manoeuvrability, it was necessary to run additional sea tests with the actual vessel. Calm-water standard manoeuvring tests according to IMO recommendations (IMO 2002) were done late October 2006. These measurements were used to tune MARINTEK’s calm-water model.

However, emergency response operations will usually take place in a harsh weather conditions. It is thus necessary to develop a complete 6 DOF model for emergency response vessels operating in rough seas. This work is currently under way at MARINTEK. To validate the 6 DOF model a new set of manoeuvring tests was done in relatively harsh seas late November 2008.

##### 4.2 Other requests for simulator model improvements

The course participants also asked for more realistic representation of the wave field on the lee side of a disabled vessel. This improvement will eventually be made by manipulating the visual database for the sea surface. There will be no calculations of the actual wave field for a multibody situation. It will not be possible to implement this modification within the time-frame of the ongoing “Arctic Emergency Operations” project. It has also been requested that the visual presentation of the towing line during a towing operation in harsh weather should be made more realistic. Experienced masters will be asked to take part in a face validation of possible solutions to make the visual representation of the towline more realistic. These modifications may be based on simplified mathematical models of the towing line.

#### 5 FIELD EXERCISES

In addition to the simulator based training course deck officers on the chartered emergency response vessels in Northern Norway are performing regular



field training exercises to practice the steps of an emergency towing operation. When planning such exercises the Norwegian authorities have paid special attention to drifting tankers due to the increased number of oil tankers operating in or passing close to Norwegian waters. For disabled tankers the challenges presented by an emergency response operation can be divided into three main areas:

- Establishing a towline between the disabled tanker and the support vessel
- Controlling the drifting vessel after towline connection
- Reducing/stopping or removing an oil spill around a disabled tanker.

In general NCA runs about 6-8 field exercises involving commercial vessels annually. The objectives of these training exercises are threefold:

- To train the emergency response vessel crews
- To train the land-based part of the emergency response organization on co-operation, surveillance, alerting and response
- To train the complete emergency response organization to prepare to strand the vessel or assist it to a port of refuge.

In additions to training with merchant vessels, the emergency response vessels run a large number of exercises in which other Coast Guard vessels are simulating the vessel in distress.

### 5.1 *Special challenges for emergency operations in Northern regions*

For exercises during the winter, sea spray icing may introduce additional challenges. The aft working deck may be slippery and removing ice from equipment may be a dangerous task in a rough sea. Figure 3 shows deck equipment on one of the emergency response vessels prior to starting a field exercise. Low temperatures combined with wind chill restrict the working time for persons on deck. Lack of daylight in the wintertime is an additional constraint to be considered when planning and performing an emergency towing operation. To reduce the workload for deck personnel it is common to head the stern into the waves so that the sea water wash out the ice on deck prior starting the transfer of the towing gear from the Coast Guard vessel to the disabled vessel.

### 5.2 *Lessons learned from field training exercises*

Field exercises have illustrated some of the problems one can encounter when trying to establish the towing connection. Examples of operational problems include the drifting pattern of released emergency towing gear, large drifting speed of the disabled vessel, mismatch of connecting shackles and lack of in-

formation regarding towline force. The following statements are taken from debriefing discussions after field exercises:

- Rigging a towing connection to a drifting vessel is a complex task even under good weather conditions. Manoeuvring an emergency response vessel close to a large drifting vessel is a complex task even for a vessel with high-quality manoeuvring performance.
- Towing large vessels in heavy weather conditions requires good manoeuvring performance of the towing vessel and a towing arrangement designed for ocean towing.
- Drifting of the messenger line for a released ETS depends on weather and current conditions. Handling of the emergency response vessel to get in a position to pick up the messenger line can be difficult, especially at night and with reduced visibility
- Shackles delivered from the emergency response vessel may be too large to fit bulwark openings on vessels built before IMO ETS requirements were approved. There are a number of different arrangements for strong points, ETS and ways of arranging an emergency towing connection. NCA has therefore developed a questionnaire that is forwarded to all vessels entering the control zone for Vardø VTS. Ships are requested to forward drawings and procedures for establishing emergency towing connections. NCA has developed a database for ETS and strongpoint arrangements on vessels in regular oil and gas traffic in Norwegian Exclusive Economic Zone areas.
- Qualification of personnel on emergency rescue vessels must include training in emergency towing operations.



Figure 3 Removing ice on the aft deck prior to a field training exercise

## 6 USING R&D RESULTS FROM “ARCTIC EMERGENCY OPERATION” TO IMPROVE TRAINING OF DECK OFFICERS ON NORWEGIAN EMERGENCY RESPONSE VESSELS

Since 2006, the Ship Manoeuvring Simulator Centre has managed an international research and development project on Arctic emergency operations. More information on this project can be found on the project website <http://www.arcemop.no>. One of the work packages is investigating best practice for emergency towing operations. An important activity has been to arrange workshops for sharing operational experience on emergency towing operations. Experienced tug masters have been invited to present real-life cases in which they have been involved. Representatives of emergency response organizations in a number of European countries and Japan have taken part in the seven workshops arranged by the project.

The field tests with KV Harstad described in section 4 have been a part of this project. The Norwegian Coast Guard has made the vessel available for field testing throughout the project period. In May 2008 a special towing test took place where KV Harstad established an emergency towing connection and towed a 70.000 dwt tanker at low speed in confined waters. The outcome of this test has been used in validation studies of a new version of the Japanese software tool “Optimum Towing Support System” developed by National Maritime Research Institute (T. Koruda & S.Hara, 2007).

## 7 CONCLUSIONS

Based on information from project partners and external contributors, the following conclusions have been drawn:

- There is no internationally accepted functional specification of an emergency towing vessel
- Most countries specify parameters such as necessary bollard pull, speed in calm water and draught.
- It is proposed that more effort should be put into operational characteristics such as speed, manoeuvrability and motion characteristics in rough seas, towing gear, etc.
- From an economic point of view most nations prefer multipurpose vessels as emergency response vessels
- Salvage operations will be carried out by professional salvage companies using their best available rescue tugs

To handle large disabled vessels in harsh weather situations, dedicated ETVs will have a higher proba-

bility of a successful operation than multipurpose vessels. The professional skill of the ETV crew is a critical success factor in establishing a towing connection in harsh weather and to prevent the towing wire from breaking in heavy-weather towing.

On the basis of the conclusions listed above, it is recommended that a potential follow-up project should focus on these topics:

- Specifying the necessary equipment on an ETV in order to simplify different ways of hooking up to a drifting vessel
- Specifying a range of tactics to be used when handling a disabled vessel in a heavy-weather situation
- Improving the ability to position the ETV close to the casualty
- Transnational sharing of emergency towing experience and training of crew members on emergency response vessels.

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