Arctic challenges, Emergency towing
success stories and failed operations

Kay Fjørtoft,
T. E. Berg and Ø. Selvik, MARINTEK
Overview

- MARINTEK
- Introduction - Arctic Challenges
- Towing of Kulluk
- Emergency towing of F/V Kamaro
- Alarm and notification (SARiNOR)
- Conclusions
- Acknowledgements
Norwegian Marine Technology Research Institute (MARINTEK)

• Develop and verify technological solutions for the shipping and marine equipment industries, for offshore petroleum production and renewable energy.

• 205 employees from 26 countries

• Headquarters in Trondheim

• SINTEF is the largest independent research organization in Scandinavia

• Owners: SINTEF, Norwegian Shipowners's associations, DNV GL, Norwegian Maritime Directorate, Federation of Norwegian industries, Federation of shipowners
The Marine Technology Centre
Ocean Basin Laboratory

Ocean basin laboratory data:
- Length: 80 m
- Width: 50 m
- Depth: 0-10 m
Ship Model Tank

Ship Model Tank
I-III data:
- Length: 260 m
- Width: 10.5 m
- Depth: 5.6/10.0
Arctic Challenges


Source: Dr. Philip A. McGillivray, US Coast Guard
Introduction

• A large part of Arctic maritime activities takes place in waters under Norwegian jurisdiction.

Increased activity – more incidents?
Towing of KULLUK

- KULLUK took part in Shell's Alaskan drilling campaign in the 2012 summer season.
- In spite of a metocean forecast of harsh weather, the 1700 nm tow from Dutch Harbor to Seattle was started on 21st December 2012.
KULLUK towing plan

- The approved towing plan had a track close to the shore
  - Within SAR helicopter reach (pro)
  - Short drifting distance to shore line (con)
  - One towing vessel operation – Aiviq (con)
Offshore supply vessel AIVIQ

- LxBxT: 99 x 24,4 x 8,5 m
- Bollard pull: 209 Tons
- Two ducted CPP
- 1 swing down Azimuth thruster
- 4 tunnel thrusters (2 fore and 2 aft)

Photo: USCG
KULLUK towing operation (1)

Towline configuration – total tow length 1700 ft when entering Gulf of Alaska
KULLUK towing operation – Thursday 27 December 2012

- Weather are getting worse – at 6 am the following parameters were logged on Kulluk:
  - East to southeasterly wind 20-25 knots
  - Wave height 20 ft
  - Pitch angle 8 - 10 degrees
  - Roll 8- 10 degrees
  - Towing speed 3.8 knots
Analysis of "Wire Tensile Strength Overload on Tow Drum Alarms" and crew actions with respect to towline operation
KULLUK towing – 27. December

• At 11:35 am it was observed a failure in one of the shackles on the tow plate.
• An investigation showed that the 120 T shackle connecting the pennant wire to the tow plate was missing
• KULLUK was reported drifting
KULLUK positions 27-28 December

• Preparation starts to connect AIVIQ to KULLUK's emergency towing gear positioned under the helideck
• At 2.30 pm on December 27, the emergency towline was established
KULLUK positions 27-28 December

- At 11pm December 27 AIVIQ got problems with one of the main engines
- Some hours later all main engines were lost
- Power available for thrusters
Arrival of USCG vessel ALEX HEALY

• USCG ALEX HEALY arrived the scene at 1:30pm on December 28.
• It was decided that ALEX HEALY should attempt to connect a towing wire to AIVIQ
• The attempt failed when the vessel got the messenger and towline into the port propeller shaft

Photo: US Coast Guard
• Using spare parts on board, the engineers on AIVIQ were able to restart engine no. 1 to increase power delivered to thrusters

• The tug GUARDSMAN arrived and their towline were connected to AIVIQ's emergency tow point at the bow. Towing started at 3:40 pm
GUARDSMAN towing 28 December

- GUARDSMAN was unable to obtain a forward speed.
- It was slowly pulled astern, generally in a Northwesterly direction.
- An attempt to rescue the crew by helicopter was aborted due to large rig motions and an unfavorable wind direction.

Photo: Courtesy of Crowley Marine Services
GUARDSMAN towing 29 December

- Approximately at 5 am the GUARDSMAN's towline broke under harsh weather condition
- The oil spill vessel NANUQ arrives on site at 5:30 pm
- It was planned to establish a new emergency towing line to KULLUK using a mooring/anchor line connected to 1800 ft towline from NANUQ
NANUQ towing 29 December

• NANUQ's tow was established at 11:30 am
• At 11:50 the towline was tightened up
• Helicopter evacuation of crew started at 12 am and was successfully completed at 3:35 pm
KULLUK towing 29 - 30 December

• Based on spare parts delivered by helicopters to AIVIQ, the engineers were able to restart the last three main engines.
• Late morning 30 December AIVIQ reported these weather conditions:
  - Wind: South – Southwest, 40 – 50 knots
  - Wave height 20 – 25 ft, periodically 30 ft
KULLUK motion 30 December

- At 1:15 pm NANUQ's emergency towing wire broke
- Shortly after AIVIQ's emergency towing wire broke
- KULLUK was drifting once more
  - Position (56° 15.3' N, 153° 24.9' W) approximately 30 nm from shore and shallow water
Tug ALERT arrives 30 December

• The tug ALERT arrives at the drifting KULLUK 1:35 pm
• Attempts to reestablish the emergency towing line failed
• At 4:30 pm all main engines on AIVIQ were running

Photo: Courtesy of Crowley Marine Services
KULLUK towing 31 December

• At 1:10 am ALERT succeeded to connect its towing gear to the end of KULLUK's emergency towing line
• AIVIQ was able to connect to KULLUK's mooring line at 05:10 am
• Both vessels headed for Port Hobron, a safe port on the Northeastern side of Sitkalidak Island
KULLUK grounding

• Due to harsher weather, AIVIQs pennant wire broke at 4:30 pm
• At full power, ALERT was pulled astern
  – ALERT's task was changed – influence the drifting path to help grounding the rig at an acceptable position
  – Oceans Bay was selected
KULLUK grounding – 31 December

• At 8 pm ALERT was instructed by Unified Command to release the tow due to safety of the tug’s crew
• At 8:10 pm ALERT reported that they had released KULLUK 3 nm from the coast line
• KULLUK grounded at 8:55 pm
For more information on the KULLUK towing operation:
Towing of fishing vessel KAMARO – late October 2012

• Engine problems – close to Bear Island
• Initially assisted by another fishing vessel
  – Towing towards Norwegian mainland was started
• Norwegian Coast Guard asked to take over the tow
Preparation on board NCG vessel HARSTAD

- The crew on NCG HARSTAD started planning the towing operation during the transit from Norwegian mainland to Bear Island.
- They used experience from a similar situation as the baseline for their planning.
- There had been a major change of crew since then.
Establishing the tow

Crowfoot (Dextron)

Dextron (42mm)

Shackle

Towing wire

Grommet
Preparing towline connection on KAMARO
KV HARSTAD – Initial towing observations

- Observations:
  - Weather conditions – wave height 4 m
  - Towed vessel was fishtailing
  - Towline length adjusted to reduce fishtailing
  - Stability of towed vessel
  - Towing speed 4.2 knots
25 October – tow underway

• Inspection of the tow
• Observation of weather and evaluation of forecast
• KV HARSTAD asks for assistance
• Weather gets worse – 12 m high waves
26 October – crisis situation

- Inspection of the tow
- Cable locker on Kamaro loosens
- Alarm sent to RCC Bodø
- Preparation for helicopter evacuation
26 October – rescue of crew

- SAR helicopter arrives, operated for ENI
- Attempt to lift crew members from the deck fails
- Crew has to jump overboard to be picked up from the sea by the SAR helicopter
- All crew members rescued
- Towline breaks
On behalf of the Maritime Forum North and the SARiNOR project MARINTEK, SINTEF Fisheries and Aquaculture and SINTEF ICT completed work package 2 (WP2): Alerting and Notification. The focus of the work package was on how accidents reports today, analyses of requirements, technology and gaps within alerting and notification for "Search and Rescue" (SAR) services in the Norwegian sector.

The methodology behind this work consists of three main steps:

1. Collection of data on alerting and notification, including empirical knowledge from users, information technology and statistics about incidents
2. Any data collected is analysed to identify gaps and challenges with current systems and technology, and it is simultaneously made an assessment of risks related to notification and alerting
3. The results of the analysis are used to recommend measures, identify requirements for future systems, and to prioritize research and development tasks
Data analysis

- Basic map
- Radio stations and coverage
  - VHF/MF/HF public
  - DSC watch VHF/MF/HF
  - Coverage DSC VHF/MF
- Navigational aids
  - LORAN-C transmitters
  - CHAYKA transmitters
  - NAVTEX transmitters
- Vessel density
  - Month, type, zone
- Vessel accidents
  - Type, zone
- Combination
- Reports
Recommendations: Alerting and Notification

Technological recommendations

- Easier functionality on emergency equipment, less information, standardization is important
- Too many different system (integration of systems, use of daily systems such as the chart plotter also for alarm and notification)
- Receipt back to the sender of received alarm
- Position data as standard integrated in emergency equipment (suits, lifeboats, rafts, etc.)
- Higher focus on mobile equipment, also recommended regulated in to GMDSS
- New and better procedures for technical maintenances on equipment such as the emergency beacons
- Better procedures for maintenance of safety equipment, in order to avoid false alarms (in some contexts this counts for more than 90% of the alarms)

Organization and human recommendations

- Use of 120-number, a service number, should be investigated. Frequently used within the leisure fleet in Norway
- Better knowledge on communication limitations, should be part of the SAR-training courses.
- Better understanding of cultural differences as well as organizational barriers
- Establish procedures for vessels sailing in the northern waters, that not have the expertise on board
- Establish back-up resources regarding interpretation services
Conclusions

- Better knowledge on arctic challenges
- Towing masters should have area specific metocean knowledge, preferably combined with previous area specific operational experience
- Safety recommendation no. 7 in the USCG "KULLUK" report states that:
  - Shipping companies should establish levels of competencies and formal training requirements for masters and deck officers engaged in towing. This should involve the use of simulators in order to provide realistic training.
- Onboard training to establish emergency towing systems should be a regular activity for vessels selected to deliver harsh weather emergency towing services.
- To prevent emergency towline parting, towline tension should be monitored and data presented in real time on the bridge.
- Vessels dedicated for emergency towing operations should be equipped with an automatic rendering winch to reduce the towline tension and thus prevent snapping loads on the towing wire.
Conclusions

• There is a need for strong points for connection of emergency towing lines on all vessels operating in Arctic waters
Acknowledgements

• The authors thank:
  – Norwegian Ministry of Foreign Affairs for financial support through their Barents 2020 program
  – Norwegian Coast Guard for illustrations from the Kamaro towing and rescue operation
  – Maritim Forum Nord – the SARiNOR project

• Contact: Kay.fjortoft@marintek.sintef.no