2024

ARCSAR LIVEX
Evaluation Report

INTERNATIONAL MASS RESCUE EXERCISE IN THE ARCTIC IN 2022
EDITORS

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1   Introduction

1.1   Exercise introduction

Arctic and North Atlantic Security and Emergency Preparedness Network (ARCSAR) is a project that aims to cope with the security and safety threats that result from increased commercial activity in the Arctic and North Atlantic (ANA) region. The project has received its funding from the European Union´s Horizon 2020 research and innovation programme under grant agreement No 786571.

ARCSAR focuses on increasing safety and security by improving performance amongst professionals. There has been an important discussion on how to benefit from the lessons learned, and thus, to avoid earlier mistakes. ARCSAR has helped SAR responders to prepare for emergencies in the ANA region and shown that it is essential to learn from training exercises and from practical experience as well as to share knowledge between different groups.

ARCSAR project includes both best practice and state of the art comparison of different national programs. ARCSAR has analysed and measured to what extent learning has taken place, and if systems for experience-based learning exist in regards of major incidents. In this process, ARCSAR has also made a comparison with incidents outside the region. The project analysed the total effect of the new knowledge transfer schemes in existing maritime preparedness systems among participating organisations and countries.

The project involves a wide range of professionals with tacit knowledge of marine security, SAR operations and the ANA region. It is important to make this tacit knowledge visible for wider audience and other actors in the field.

Due to the capacities, infrastructure, and good will of our consortium participants, ARCSAR consortium has been in a unique position to conduct a live exercise as part of the project events.

ARCSAR LIVEX (Live Exercise) was one of the most significant events of the ARCSAR project as it builds on the results of the work carried out thus far by the project consortium. It is part of ARCSAR's overall task 3.2 (T 3.2.). "Catastrophic incident simulations and live exercises", based on the most likely major seaborne disasters, catastrophic incidents, and security threats defined in task 3.1 (T 3.1.)

The ARCSAR LIVEX event was divided into two parts:

1. **Voyage Events and Exercises (VEEX), 28th - 30th of August:** The voyage on M/S Quest consisted of lectures on various emergency preparedness related topics, demonstrations, small exercises, and outings/landings with Zodiacs as a part of the normal expedition cruise. These events and exercises gave all participants and partners insight to how expedition cruise operators conduct safe operations in the Arctic.

2. **The live mass rescue operation (MRO) exercise, 31st of August:** The ship crew and expedition staff together with search and rescue (SAR) responders conducted a live MRO exercise including actions such as smoke diving, mass evacuation and ship-to-ship transfer of passengers. The ARCSAR partners and participants on board M/S Quest played the part of passengers that were evacuated. MRO involved organisations such as the JRCC NN, 330 squadron, the Norwegian Coast Guard, AECO, and UAS Norway among others.

MRO conducted by the consortium had the narrative of a 'Cruise Ship Catastrophe' based on a 'major fire on board' incident in the polar region. This represented a worst-case scenario for the cruise sector and the emergency and security services. Such an incident would require rapid evacuation of a large number of people in an extremely remote area in a cold climate, with significant limitations on survival time. Infrastructure, and geographic specificities of particular relevance to the ANA region had to be taken into account. Those are for example challenges in radio and satellite communication, cold and harsh climatic conditions, operations in sea ice, sparsely or non-populated areas, highly populated areas, functioning of equipment in cold climate, challenging topography on coasts (including cliffs, mountains, and fjords), islands, and other marine infrastructure and traffic operating in the region on defined routes. The rescue operation required specialised survival gear and equipment, and cooperation between practitioners across functions, borders, and countries. Local, regional, national, and international levels of SAR and emergency operations were also taken into account. Situational awareness between emergency management agencies and other emergency actors, cross sector and cross border, was assessed as well as approaches to risk assessment and decision-making. Professionals analysed vulnerabilities as well as appropriate response and decision-making policies. These were considered both in retrospective and prospective scenarios in the ANA region.

The live exercise represented an excellent way to achieve cooperation across practitioner groups, working together to highlight common capabilities and interfaces, and to expose gaps, limitations, and obstacles. Getting together for this exercise was a key tool in consolidating ARCSAR network as practitioner groups will need to work closely together. This was highly instrumental in achieving the desired project impact and sustaining the network in the longer term.

It is worth noting, that the LIVEX was the only international MRO event that took place in the Arctic in 2022 and that it involved real passengers from 30–70 years of age. Moreover, involving research and academia in the exercise has proved instrumental in maintaining the objective nature of the results as well as allowing for research to be performed from a passengers' perspective as well as take in various scientific aspects relating to movement speeds, physiological and psychological challenges and so on.

In this report, findings and recommendations gathered during the exercise and evaluation are discussed. This is not a comprehensive safety guide, but reflects on the evaluation. Recommendations might not be applicable to all situations.

1.2 Abbreviations

ACO = Aircraft Coordinator

AIS = Automatic Identification System

ANA = Arctic and North Atlantic

CE = Chief Engineer

CG = Coast Guard

CGV = Coast Guard Vessel

DISTAFF = Directing Staff

DSC = Digital Selective Calling

DV = Vessel in distress

EEBD = Emergency Escape Breathing Device

EPIRB = Emergency Position-Indicating Radio Beacon

GA = General alarm

GMDSS = Global Maritime Distress Safety System

JRCC = Joint Rescue Coordination Centre

LT= loc = Local time

MRCC = Maritime Rescue Coordination Centre

(M)RSC = (Maritime) Rescue Sub Centre

MOB = Man Overboard

MPDLS = Mobile Phone Detection and Location System

MRO = Mass Rescue Operation

MSI = Maritime Safety Information

NBDP = Narrow Band Direct Printing

NCG B = Norway Coast Guard KV Barentshav

OSC = On-Scene Coordinator

PAX = Passengers

PLB = Personal Locator Beacon

POB = Personnel On Board

R-EMCC(AMK) = Emergency Medical Communication Centre

RCC = Rescue Coordination Centre

RIB = Rigid Inflatable Boat

RU = Rescue Units

SAR= Search and Rescue

SART = SAR transmitter

SAR Tech = A Search and Rescue Technician

SITREP = Situation Report

SMC = SAR Mission Coordinator

SOLAS = International Convention for Safety of Life at Sea

SRU = SAR Responding Unit(s)

STARTEX = Start of an Exercise

UAV = Unmanned Aerial Vehicle

1.3 Participants

LIVEX included various participating organisations, with backgrounds from the academia, industry and authorities, and from several different countries.

1.3.1 Project partners in the event:

- Arctic Expeditionary Cruise Operators (AECO)
- Canadian Coast Guard
- Cork Institute of Technology
- e-Geos
- Governor of Svalbard
- Joint Rescue and Coordination Centre – Iceland (JRCC I)
- Joint Rescue and Coordination Centre – North Norway (JRCC NN)
- Lapland University of Applied Sciences
- Laurea University of Applied Sciences
- Marine Rescue and Coordination Centre Torshavn
- Maritime Forum North
- Memorial University Newfoundland
- Nord University
- Norwegian Coastal Administration
- Norwegian Coast Guard
  - o NOCG vessel Barentshav
  - o 330 Squadron (i.e. SAR Queen helicopter)
- Polar Quest
  - o M/S Quest
  - o Polar Quest home office
- The Norwegian Meteorological Institute (Norwegian Ice Service)

- United States Coast Guard Academy
- University of Portsmouth

1.3.2 Other participants:

- European Union Agency for Space Programme (EUSPA)
- Norwegian Space Agency (NOSA)
- Norwegian travel company
- Quark Expeditions
- Smith Myers
- UAS Norway

Contributing Units and Main Training Audience

These organisations contributed towards planning and conducting of the LIVEX. They had active roles in the planning meetings, contributing their own insights and knowledge of best practices and overall knowledge and expertise which was of great value for the exercise.

2   Objectives of the Exercise

2.1   Main Objectives

The main objectives for the ARCSAR LIVEX exercise were to:

1. **Enhance the understanding of ARCSAR partners on factors that affect survivability and decision-making in the Arctic and North Atlantic (ANA) region by exercising a live response to a simulated maritime incident.**

2. **Strengthen collaboration between the responding parties, including industry, and improve procedures for cooperation.**

2.2   Sub-objectives

In addition to the main objectives, several sub-objectives were defined. These were:

1. The participants (players) conducting the exercise enhance trust among each other and stakeholders by improving familiarity with:
    a. how the crew of an expedition cruise vessel operate and mitigate risk in the ANA region;
    b. how the established incident management system and participating designated rescue assets operate and mitigate risk in the ANA region;
    c. how different organisational cultures, decision-making processes, languages and terminology can affect response across different sectors.
2. Players demonstrate their ability to cooperate:
    a. while responding to a simulated fire on board an expedition cruise vessel;
    b. to evacuate passengers (role players) from an expedition cruise vessel to a place of safety (designated as a vessel of opportunity, port, or rescue vessel as applicable)
3. Gain a better understanding of the main steps and challenges associated with transferring passengers between ships at sea.
4. Players demonstrate their ability to communicate effectively throughout the exercise.
5. Players demonstrate their ability to effectively contribute to the exercise evaluation and lessons identified in order to draft recommendations for further procedures and policy.

2.3   Organisational objectives

The participating organisations also set organisational objectives for themselves. These objectives were set for them to monitor performance for further improvement of their own systems, best practices and to overall identify lessons learned.

Joint Rescue Coordination Centre North Norway (JRCC NN)
*   To test national and international warning and alarm routines as stated or indicated in relevant agreements.
*   Exercise the cooperation between the JRCC and other relevant Norwegian authorities with special focus on Rescue Sub Centre (RSC) and Emergency Medical Communication Centre (R-EMCC(AMK)).
*   Exercise coordination of SAR-operation in remote areas

- o Communication with vessel in distress, On-Scene Coordinator (OSC), vessel of opportunity, rescue helicopter and RSC.
  - o Plan and execute SAR-operation in cooperation with OSC and RSC.
  - o Plan and execute an evacuation chain of severely injured persons from remote areas to adequate medical facilities.
- Exercise coordination of an incident with victims from multiple nationalities.
- Exercise tracking of 50 different personal locator beacons (PLB) (30.08.22).

M/S Quest crew and expedition staff
- To test communications between distress vessel, home office, JRCC NN and AECO when the "accident" occurs on M/S Quest.
  - o M/S Quest calls home office and informs them about what has happened.
  - o This triggers PolarQuest internal emergency organization in Gothenburg.
  - o PolarQuest then alerts AECO, so that their internal procedures can start as well.
- To provide safe transfer of persons from the water level to the deck of the cruise ship.

Norwegian Coast Guard
EX 1 SAR OPERATION (30.08.22)
- JRCC: able to track up to 50 different PLB.
- NCG: able to track PLB by VHF tracker.
- NCG: 10 POB saved and onboard in 2 hours from STARTEX.
- NCG: able to conduct drone ops when helo in air.
- NCG: use and coverage control of SYSSELNETT as COMS equipment around Svalbard.

EX 2 LIVEX MRO (31.08.22)
- NCG: being able to solve the task as OSC efficiently with limited communication.
- NCG: establish and keep p-status and p-control during the exercise. Total number of POBs and location.
- NCG: safe air operations with several units in air (helicopters and drones).
- Effective cooperation with personnel from a civilian cruise vessel, with focus on using the resources and competence in each organisation in a good way solving a complex operation.

330 squadron
- Gain experience in helicopter AW101 in arctic operations
- Perform mobile phone disaster mode testing
- MRO multi player coordination and execution

AECO
See if JRCC and/or other responders are utilising relevant information available from AECO.

- For scenario: Automatic Identification System (AIS) is unstable and/or there is a need to check other trackers (cross check). Which sources would JRCC use (will they use the login they have to AECO's vessel tracker, will they contact AECO and ask for this information)?
- Responders would like to have information about equipment and personnel resources onboard vessels of opportunity. How do they source information about this?

- Does AECO's cruise database with vessel information provide adequate SAR information and is there need for improvement?
- Responders to source information from this database, directly or through AECO. What is missing?
- Test communications between Polar Quest home office and AECO.

e-GEOS
- Demonstrate how satellite data services can inform ship operators and response organisations in support of the safe operation of ships and emergency response in the ANA region.

Memorial University of Newfoundland
- Identify steps involved in abandoning an expedition cruise vessel and rescuing evacuees in ANA region following a simulated onboard fire.
- Measure timings associated with mustering, lifeboat boarding and recovery of evacuees to a rescue vessel for a simulated fire on an expedition cruise vessel.
- Measure timings for helicopter operations to lower a SAR Tech with equipment and lift survivors (multiple lifts).

Norwegian Space Agency
- The Norwegian Space Agency (NOSA) aims to test the use of satellite-based emergency beacons in the evacuation part of the ARCSAR livex scenario:
- Perform a live test of a personal locator beacon (PLB) integrated in (or tied to) a survival suit utilising the Galileo SAR/Cospas-Sarsat system with both forward- and return link. The test will demonstrate the scenario of a person in a survival suit using the PLB to transmit a distress signal on the 406 MHz frequency during evacuation (vessel-to-life raft/vessel-to-lifeboat/vessel-to-sea) and receiving a confirmation with the Galileo return link service that the JRCC-NN has received the distress signal.
- Perform a live stress test of the Galileo SAR/Cospas-Sarsat system by simultaneously activating several satellite-based emergency beacons (10-20-30, depending on the number of units that can be obtained). The stress test will not only determine how well the Galileo SAR/Cospas-Sarsat system can technically handle a mass evacuation scenario with multiple distress signals being emitted, but also how the JRCC NN and local rescue forces handles the situation with multiple distress signals and potentially (increasing) differences in their determined positions.

Smith Myers
- Smith Myers's goal was to test their Mobile Phone Detection and Location System (MPDLS) ARTEMIS, which can be used to locate mobile phones accurately in challenging SAR environments.
  - The main objective was to test MPDLS in the disaster mode.

3   Voyage events and exercises (VEEX)

The Voyage events and exercises on M/S Quest consisted of landings with Zodiacs, other small exercises, lectures on various emergency preparedness related topics and demonstrations.

3.1   The Evacuation Drill

Upon boarding M/S Quest, a briefing about evacuation was held, and this also included a short video about evacuation. In the briefing, it was discussed what to do from the time the alarm sounds until moving on to the lifeboats. However, it was learned that perhaps further instructions for later processes as well would have been of great value; for example, how to board the lifeboat, what to do onboard, and what would happen in case of evacuation.

In stressful situations, passengers can act irrationally and therefore, a comprehensive video guide related to the evacuation process is recommended. The information provided in the informational media/video will help passengers familiarize with the process of evacuation during an emergency, and to support the coast guards to educate their personnel about how to best help those being rescued.

During the drill, the alarm sounded as expected and guides gave clear instructions to the passengers. Proceeding to the lifeboat area happened in an orderly manner and instructions for how to put on the non-inflatable life jackets were given.

The instructions for how passengers were to conduct themselves for the landings and excursions were clear, and this was also supported by the evacuation video.

 Issues being discussed for the development of the video include for example:

- Instructions on how to board the lifeboat, what to do onboard, what to expect, and what would happen in case of evacuation. This could also be presented in the form of Do's and Don'ts. Important examples are how to fasten and unfasten the seatbelts and whether the life jackets need to be taken off before putting on the seatbelts.
- Detailed information about how the lifeboat is equipped could help to keep the people onboard calm in case of an emergency.
- Instructions on the type of clothing to wear or to bring when assembling at the muster station; or the type of protective clothing that would be provided in case of an emergency.
- Instructions on how to handle life jackets throughout different phases of the process, for example; times when life jackets can be taken off before putting on the seatbelt, locations where one can leave the life jacket in the lifeboat, in the event that one the life jacket needs to be removed; and times when the jackets are required to be put back on.
- Bulky life jackets impeded mobility. This can become a safety issue especially when considering the elderly and less-mobile people. Climbing the ladder to the rescue vessel with the life jacket for instance was difficult. It was recommended that a dedicated person should be at all times present to offer assistance to passengers boarding the rescue vessel. Various conditions, for example adverse weather, should be considered and relevant measures planned.

3.2   Zodiac Landing Exercises

3.2.1   Objectives

Altogether 4 Zodiac landing exercises were organised. The activities on each landing and the learning objectives for them are listed below. The Zodiac landings were organised in 14 Julibukta/-breen, Signehamna, Ny-Ålesund and Ossian Sars. On each landing, Zodiacs were used to demonstrate the participants the cruising and landing process. There were also additional learning objectives on each landing. For example, lectures on various safety topics were organised.

3.2.1.1   14 Julibukta/-breen

Activities in 14 Julibukta/-breen were to do a Zodiac landing and Zodiac cruise, get to know the scenery vegetation, as well as to learn about glacier fronts and glacier front's calving and safety near it.

Learning objectives were:

1. To understand the decision-making process for go/no-go and landings
2. To learn to understand different agents and participants of the exercise group and the capability of that group
3. To learn how to properly and safely conduct Zodiac cruising and landings
4. To learn about safety near glacier fronts

3.2.1.2   Signehamna

Activities in Signehamna included a Zodiac landing and learning about importance of weather reporting during World War II.

Learning objectives were:

1. To learn about polar bear safety, respect for wildlife, and group dynamics/behaviour
2. To understand the activities expedition cruise operators do with the passengers and what they explain to the passengers.

3.2.1.3   Ny-Ålesund

Activities in Ny-Ålesund included a visit to an arctic research station, learning about Svalbard's history and visiting the Norwegian Coast Guard vessel Barentshav.

Learning objectives were:

1. To visit the Norwegian Coast Guard vessel Barentshav
2. To understand Arctic research and international collaboration in Ny-Ålesund

3.2.1.4   Ossian Sars

Activities in Ossian Sars were to make a Zodiac landing and to learn about the equipment carried and brought on a landing. Also, safety in steep terrain and terrain not easily overviewed were observed.

Learning objectives were:

1. To understand how guides prepare for an accident on shore and what equipment the guides normally bring, i.e., the "safety bag".
2. To understand the decision-making process when guides are assessing whether someone requires further medical attention.
3. To learn about steep terrain challenges.

3.2.2 Findings

During the landing exercises the following observations were made:

Scouting the landing possibilities and ice bergs

- All necessary measures were taken in the landings and scouting was well done to see whether it is possible to make the landing or not. There are several security concerns to consider in the landing, for example scouting of polar bears. Guides also explained passengers the rationale to go or not to go on site.

- The observation of ice bergs was well done in order to determine if a Zodiac cruise can be done or not. More than the allowed minimum distance was kept to ice bergs. In a worst-case scenario, the Zodiacs could have been jammed to the beach line and returning to the ship could have been impossible.

Passengers' movements

- Passengers and their movements were well observed and tracked; how many, where and when.

- There was also a table on board M/S Quest for tracking passengers' movements, and the passengers were requested to sign in and out on their own. Doctor was also always present.

Zodiac safety

- Zodiacs were never overbooked during the exercises.

- Zodiacs had a safety bag, and its contents and their use were well demonstrated.

- It was well explained to the passengers that Zodiacs normally move on pairs, and that if there is a lone Zodiac it's supposed to stay close to the main vessel.

- It would be good to consider holding possible spare equipment on board the Zodiac. One of the observants described that one of the guides dropped the radio during a landing, which prevented communication with the colleagues in other Zodiacs and the vessel. Therefore, it is recommended that there is always a spare radio to prevent the loss of communications in case the radio is lost or the battery dies. Losing the means of communication could cause difficulties.

- There was a plan for each day for the Zodiac trips, which included loose schedule, destinations and activities. Weather and the environmental conditions determined whether a trip could be made or not. It's not always predictable what happens and therefore flexibility is needed in the schedule. However, a more stable schedule would help the main vessel to realise if something goes wrong with the Zodiac and communications are lost. It is good to consider how to find a balance between flexibility and stable schedule to ensure that the main vessel knows to react timely if the Zodiac is not returning as expected.

3.3 Man Overboard

In the Man Overboard exercise the aim was to test the emergency personal locator beacons (PLBs) in a man overboard rescue situation, in which two persons were rescued from the water back to the vessel. The aim with the PLB testing was specifically to test the signal timing, and this is referred to in the 3.4 Other projects and testing before/during MRO.

Observations made during the exercise included:

Two persons conducting the rescue were wearing dry suits, however, only one pair of gloves was available for the rescuers. It is recommended that enough necessary equipment should be reserved onboard for the possible rescue from water, e.g. gloves.

The rescuers were tied to the vessel by a safety line. The first person's safety line, however, had to be untied and retied on the opposite side of the gangway to allow the second person access to the water. It could also be considered to tie the safety line to a Zodiac, instead of the vessel. That way, the safety line is not blocking the gangway and the person(s) in the water could drift more safely. Also, tying the safety lines should be done in a way that they are secured. The 'round turn and two half hitches' knots which were used can be liable to slip. A bowline at each end could be used to make the safety line secured.

In the ANA region, ice can cause unexpected issues, and colliding with an iceberg can cause a severe situation for the person being rescued. During the exercise, it is noted that small pieces of drifting ice should be intercepted, in order to prevent collision with people in the water. Also, having one or two more Zodiacs in the water as support boats could make it easier to steer the drifting icebergs away and monitor the movements of the people in the water to prevent the collision with ice or the vessel. There should also be someone designated for monitoring purposes.

3.4 Other projects and testing before/during MRO

No.	Activity	When	Responsible
1	Cameras strategically placed on the ship, for measuring walking speeds and movement of passengers. Observation: • No data available	During the whole voyage During MRO	Rob Brown, Memorial University
2	Measure timings associated with mustering, lifeboat boarding and recovery of evacuees to a rescue vessel for a simulated fire on an expedition cruise vessel. Observation: • No data available	During MRO	Rob Brown, Memorial University
3	Measure timings for helicopter operations to lower a rescue swimmer with equipment and lift survivors (multiple lifts). Observation: • No data available	During MRO	Rob Brown, Memorial University
4	Perform a live test of a personal locator beacon (PLB) integrated in (or tied to) a survival suit utilising the Galileo	30th of August	Norwegian Space Agency, European Union Agency for the Space

	SAR/COSPAS-SARSAT system with both forward- and return link. Observation: • Test confirmed that the PLB works as expected.		Programme (EU-SPA)
5	Perform a live stress test of the Galileo SAR/COSPAS-SARSAT system by simultaneously activating several satellite-based emergency beacons (10-20-30, depending on the number of units that can be obtained). Observation: • Test confirmed that even in the case of several satellite-based emergency beacons being activated the expected results are gained, data flow and accuracy is reached.	30th of August	Norwegian Space Agency, European Union Agency for the Space Programme (EU-SPA)
6	Perform a cell phone search test with Artemis disaster mode for helicopter AW101 (SAR Queen). Observation: • The initial search with MPDLS on SAR Queen was to search for all/any phones within a 1nm geofenced area. 4 or 5 orbits for each Network (Telenor/Telia) was performed and 60 out of a possible 75 phones were detected within 30 mins and located inside the geofence area. This corresponds with the estimated actual number of phones turned on by the participants. This number included the 4 out of 5 International Mobile Subscriber Identity (IMSI) identifiers supplied at the start of the exercise. The location of the M/S Quest was within cellular coverage of two Norwegian operators using LTE (4G) protocols. The MPDLS test finished with a search for a specific person's phone using the GPS capability supported by this phone. The phone was immediately detected and located using the timing advance (TA) method and after about 10 seconds the GPS fix was determined. This was after an approximate 90 deg orbit, the position was stable and did not change. Once the phones had been detected and located, the SAR Queen proceeded with the rescue, documented elsewhere in this report. The MPDLS proved to rapidly detect and locate persons in distress even with or without prior knowledge of the phone identities. Recommendations for future testing: If more time had been available, and a second more remote location (no local cellular coverage) used, future tests should include:	31st of August	330 Squadron of the Norwegian Air Force

	- Voice calls from the aircraft to any of the passengers/crew phones detected. - A broadcast text message sent out to all detected phones. - A nighttime exercise could show slewing of the electro-optical/infra-red (EO/IR) camera to the MPDLS derived location and thereby providing an absolute identification of the image produced by the EO/IR sensor, making missions in Instrument Meteorological Conditions (IMC)/low visibility a viable proposition for a rapid positive outcome. - An exercise of a landing party in a remote area being lost and searched for by utilising a MPDLS. The system could be used to locate the party and to communicate with them via text or voice call. - Broadcast of text messages in a remote area, warning of an emergency. situation, polar bears, storms, mist etc. - Detection of known/unknown people (with phones) in the above emergency situation/area. - A log of number of phones switched on and summary of locations. During the exercise UAV's were flown from the cruise ship M/S Quest, illustrating that some of the above tasks could possibly be performed by UAV fitted with smaller MPLDS, and operated by the cruise ship crew. Artemis worked well at 79° North.		
7	Joint exercise with 330 squadron and the Norwegian Coast Guard in open waters: 1) Search for people (Dummies) at sea with use of drone from KV Barentshav and helicopter SAR Queen. 2) Hoisting of patient (Dummy) with a vacuum stretcher from helicopter to KV Barentshav. 3) Test of communication in remote areas. Observation No data available	30th of August	330 Squadron and Norwegian Coast Guard
8	e-GEOS: Demonstrate how satellite data services may inform ship operators and response organisations in support of the safe operation of ships and emergency response in the ANA region Observation	During the whole voyage During MRO	e-Geos in cooperation with Norwegian Ice Service

	• Demonstration highlighted that data services are accurate and can be well used in planning and to gain additional information to surveillance picture		

Some of the data from the table above has been exclusive (internal) for the organisations and hence cannot be included in this public report.

4   Description of LIVEX exercise and evaluation findings

4.1   Exercise description

The expedition vessel M/S Quest / OZ2178 is a Faroe Island registered vessel operating for the company Polar Quest, a world leading operator of small ship expedition cruises in Svalbard with its headquarters located in Sweden.

The LIVEX scenario included 54 passengers, and 25 crew members aboard M/S Quest, which is close to the vessel's full capacity. The exercise started when a fire was detected in the engine room, which escalated to an engine failure, loss of power onboard and a lot of smoke in the superstructure.

Participants strived through needs-based objectives to enhance understanding of capabilities and strengthen collaboration between parties that may be involved in and support a mass rescue operation.
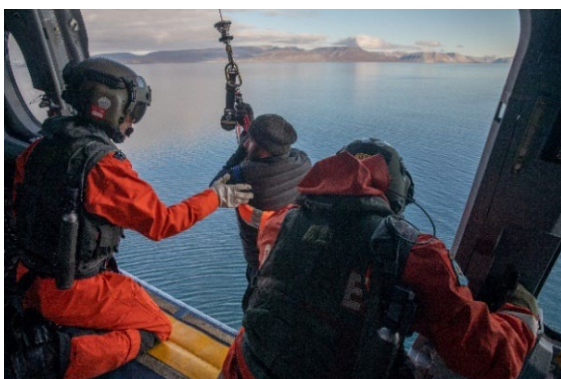

Photo 2. Participants onboard the helicopter.
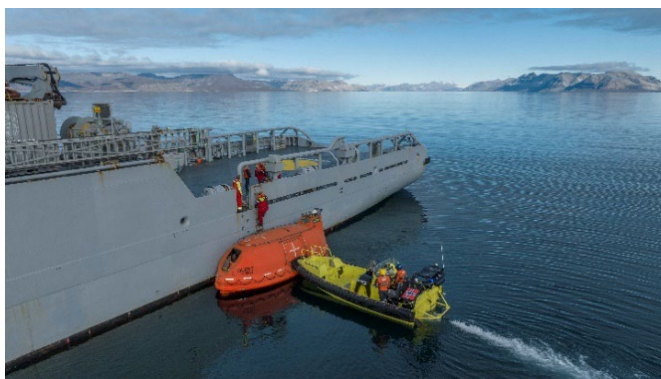
Photo 1. Participants boarding KV Barentshav.

The ship crew and expedition staff, together with SAR responders, conducted a live MRO. The scenario required actions such as smoke diving, first aid and triage, mass evacuation, and ship-to-ship transfer of passengers. The participants on board M/S Quest played the part of passengers who needed to be evacuated. Some passengers had pre-defined roles, such as being injured or sick. The simulated incident response included organisations such as the JRCC NN, 330 squadron with SAR Queen helicopter, the Norwegian Coast Guard, AECO, the Governor of Svalbard, and UAS Norway.

The exercise was played out in a fictional position in the Northern part of Svalbard. Due to safety reasons the actual position was close to Longyearbyen.

Photo 3. Location of the exercise scenario.

4.1.1 Lessons learned in connection to the exercise planning

During the planning of the exercise, there were several lessons learned identified. Those include the following:

- There is a need to attend to accessibility of digital platforms for cooperation between organisations. Increased IT security might affect the accessibility.
- It should be acknowledged, that it takes extensive time to organise an exercise in which members of the planning team come from diverse sectors.
- Different approaches and ways to achieve knowledge should be recognised. Wordy and extensive reports might not be the best way to convey new knowledge to certain groups.
- Training new personnel to handle the matters of the project takes time. It should be considered that the same person might not work on the project for all the five-year duration, and new personnel might need to be introduced and trained to handle the project.

4.2 Evaluation findings

The main goal in the LIVEX evaluation was to gather information that highlights how the objectives were met. Evaluation was planned by Evaluation Working Group, which was led by Laurea University of Applied Sciences, Finland and consisted of experts from various organisations. Evaluation findings were reported to the given, ready evaluation questions formulated by the Evaluation Working Group.

Evaluators were independent actors with expert knowledge in the field. They were trained by Laurea on how to report evaluations during an online training event. In addition, Laurea created a handbook "Evaluators Guide" and a PowerPoint presentation to be used by the evaluators to describe the setting in general and to provide practical guidance to key actions and reporting means, code of conduct etc. The "Evaluators Guide" included also reporting guidance and timetable for reporting.

The evaluators were stationed in key positions during the LIVEX, and this proved to work well. They were looking at actions at the bridges, in lifeboats, at muster stations and evacuation points, as well as actions done in regards to triage and firefighting. Some of the evaluators were located on M/S Quest, others on KV Barentshav and some were also playing a role as passenger and therefore onboard the lifeboats as well. Reporting was conducted to a ready-made excel template which included questions regarding actions in the evaluation points. Directly after the exercise, hot wash sessions were organised to collect initial feedback and to share preliminary remarks by the evaluators. Additional comments were gathered from key participants, for example expedition staff.

In the chapters below, there are listed observations and recommendations that rose from the evaluation. These highlight the best practices, either actions performed well in the exercise, or actions that left room for improvements and therefore have created a need for a best practice. Evaluation findings are considered from four points of view;

- evacuation,
- cooperation,
- decision-making and communication,
- and technology.

 When applicable, these are divided to subchapters based on the actor and action, for example M/S Quest, and Triage and First Aid.

4.2.1   Evacuation

4.2.1.1   M/S Quest

4.2.1.1.1   Triage and First Aid

Centralising casualty treatment areas

The medical team was quick to notice that the casualties should be moved together. They used available crewmembers to move all casualties to the open hallway located in midship's stairway on Deck 4. This was the largest available space to fit three casualties. However, this location had the downside of being a corridor that would soon be needed by the firefighters. It is likely that whichever location the doctor chose would have had downsides. The upper decks had only small spaces available and Decks 2 and 3 were unsuitable due to smoke risk. Furthermore, the decision to centralise the casualty treatment areas was a key to being able to monitor and treat several people with the small number of people available to assist the doctor. This may not have been possible if there were further casualties or stretchers were being used.

Recommendation

- Suitable areas for treating casualties should be planned carefully in advance.
- Centralising the casualty treatment areas enables better monitoring and treating several people at the same time.

Triage of casualties to be evacuated

The doctor decided the order of the casualties to be evacuated once they were centralised. Helicopter had limited capacity, hence deciding on the triage was important.

Recommendation

- Determining the order in which the casualties are being transferred should be done before the arrival of a helicopter or other ambulance transport.
- It's good to mark the casualties after triage, e.g. with colour tags, so that the order is clear.

Moving deceased people to a private area

As two persons were found and brought up to the doctor by the firefighting teams, they were checked, and it was clear that they were not breathing. The doctor and his team attempted CPR on one of the casualties. It became clear that there were no signs of life and the doctor declared this person to be deceased. He then prioritised the treatment and evacuation of the casualties who were alive. Due to limited space, one of the deceased persons was left in the corridor, thus getting in the way of firefighting and medical teams, as well as of passengers' evacuation route.

Recommendation

- It's recommended to give a dedicated area to the deceased casualties so that they don't block the passages or get in the way, thus causing delays for the evacuation and the work of rescuers.
- Moving deceased persons to a private area preserves their dignity and prevents other passengers from panicking.

Continuous monitoring of casualties

When the situation became busier as more casualties were found, there was a challenge for the medical team to maintain observation of the number of casualties. The two new casualties (alive) were situated on the outside of deck 4 to allow them to take fresh air. However, when the medical team went out to provide treatment, there were moments when the patient who experienced heart attack was left alone. This led to a risk of a sudden deterioration of health without someone to raise the alarm. However, the doctor noticed that the patients had been left alone and allocated a crewmember to observe several of the casualties and told the crewmember the signs they should be on the lookout for.

Recommendation

- Continuous monitoring of casualties should be ensured in all situations.

Resources to the evacuation of casualties

When the decision was taken to evacuate several casualties, either on deck 4 with the helicopter or on deck 3 with the CG rescue boat, there were probably not enough crew to move people had they been on stretchers. In similar case, the doctor could signal to the bridge should he need more crew for moving casualties.

Recommendation

- Sufficient amount of people should be allocated for possible evacuation of casualties.

Evacuating the key personnel

The Coast Guard crew were evacuating the doctor, and he entered the rescue boat only to be called back onboard. His evacuation was not checked with distress vessel's bridge and had he been evacuated at that point, it would have reduced the medical capabilities of the vessel. Sometimes, there might be a need for the doctor to evacuate together with the patients, but it needs to be considered that he might still be needed on the distress vessel.

Recommendation

- All parties should consult the bridge before evacuating key persons.

4.2.1.1.2   Lifeboat

Dividing people to lifeboats

Lifeboat 1 had 19 passengers and two crew members but a carrying capacity of 45 persons. M/S Quest has the capacity to carry 88 persons in total, including passengers, guides and crew members. If the cruise is fully booked, both lifeboats would be close to their maximum capacity. With passengers wearing survival suits and life jackets, there would have been no space to move, and access to group survival kit / personal survival kit (GSK/PSK) would have been difficult especially in darkness and / or adverse weather conditions.

Recommendation

- It should be considered how the capacity of the lifeboats and the total amount of people on board the vessel affect the division of people into lifeboats. This should be done in a way that the capacity of lifeboats is sufficient for all evacuees.

Boarding the lifeboats

Instructions regarding how and when to board the lifeboat, and procedures after boarding, could have reduced confusion among passengers and made the boarding more efficient. Attention should be paid that also the lifeboat crewmen are dressed according to the conditions.

Recommendation

- Passengers should be instructed how to act and what to do in a lifeboat. A comprehensive information package i.e. evacuation video, paper materials and so on should include instructions from 'what to do when you hear the alarm' all the way to 'what to expect if you have to board another vessel during the rescue'. The video and its main points should be included in an extended safety briefing at the outset of the voyage as well as on board the vessel. It should be accessible also during the voyage.
- Regular exercising should also include boarding the lifeboat and advising the passengers about the rescue on lifeboats, as well as training crowd management.
- Lifeboat crewmen should be dressed according to the conditions.

Seat belts on the lifeboat

Once the evacuees had entered the lifeboats, they were told to fasten the seat belts. These are four-point seat belts with a relatively complicated buckle mechanism. Less experienced passengers were unsure how to fasten them. For some the fastening process took several minutes, some simply gave up and tied the buckle in a knot or left them unfastened. This had to be done independently or with the help of other passengers. It would have been challenging in a full lifeboat, in darkness or in adverse sea state to request assistance from others.

> Evaluator's comments:

>> *"On the lifeboat, there was confusion about whether we should remove the life jackets, until one lifeboat crewman told us to do so. It turned out that we needed to put on seat belts, which we did not know beforehand, and the life jackets would be in the way of that, so we were figuring it out as we went along anyway. But the confusion could have been avoided."*

> Recommendation

> - Instructions for how to fasten the seat belts could be included in the evacuation video (information package) shown to the passengers or in the safety briefing in the beginning of the voyage.

Driving the lifeboats

The lifeboat crew seemed well-trained to drive the lifeboats and to handle them in general.

> Recommendation

> - It is important that the crew is well-trained to drive the lifeboats.

Location of the lifeboats after lowering them

After lowering the lifeboats, they were taken for test drive and ventured far from the vessel in distress. In the event of an urgent need for abandoning the vessel, it would have taken several minutes for them to arrive back to the vessel.

> Recommendation

> - The lifeboats should stay relatively close to the vessel also during testing.
> - Letting passengers know that the lifeboats are being tested is important in avoiding misunderstandings as passengers can see the lifeboats leaving without them.
> - Lifeboats should be tested and maintained regularly in accordance with the applicable regulations to make sure they are in working order.

4.2.1.1.3   Firefighting

Search for missing persons

The Chief Engineer (CE) informed the bridge of two missing persons from the engine department. It was not possible to use CO2 for firefighting. There was a large amount of smoke, and a fire team got ready to enter the engine room to get an overview of the damages.

A firefighter without smoke diving gear attempted to search Deck 3 for persons who may have been trapped inside, which was a smoke area. He couldn't enter all the way to check the cabins. Instead called out "Is anyone here" through the area. Afterwards, a firefighter with smoke diving gear was able to search Deck 3 including cabins and two crew members who had inhaled smoke were found. They were evacuated with emergency escape breathing device (EEBD) and were brought to the ship's doctor for treatment, given oxygen masks and possibility for fresh air on an open deck.

Recommendation

- It is good to exercise firefighting and rescuing persons thoroughly with proper scenario planning, briefing and debriefing. Drills should not be only a technical performance.
- Firefighters who are searching an area, should search the facilities thoroughly, especially as people who have inhaled smoke might not be able to speak up.
- Areas confirmed to be empty should be marked with an agreed sign, such as drawing on the door with a marker.
- Accessing smoke areas without smoke diving gear causes a serious risk and therefore it should be ensured that firefighters are equipped accordingly.

Observations about firefighting

A fireteam on Deck 3 entered through the engine control room. The team was properly dressed and equipped. The team entered through the watertight door to the workshop (fire area) after cooling it first. They retrieved an injured person (motorman, burnt face and arm). The team left the workshop after orders from the Exercise's Directing Staff. The team regrouped and another firefighting team was sent to the workshop after cooling the surface. As the fire got out of control, the firefighting team retreated through the Engine Control Room.

Fireteam Leader CGV and Deck officer Quest coordinated actions properly following the Fire Safety Plan for Situational Awareness. Two firefighters evacuated a person from the workshop and searched the engine department for persons.

Recommendation

- It's important that coordination works well with the officer from the distress vessel and the responding firefighting teams, and in accordance with the Fire Safety Plan.

4.2.1.1.4 Bridge

Rescue plan

The bridge had a well-designed rescue plan for various situations. The plan also included a reporting table. In an emergency, the plan supports prompt actions and situation control.

Recommendation

- Well-designed rescue plan for different situations in the bridge supports rapid and prompt actions. The plan should also be reviewed regularly.
- Thorough exercises should be conducted with proper scenario planning, briefing and debriefing. Drills should not be only a technical performance.

Role and responsibilities of the expedition staff onboard

It appears that expedition staff's role onboard the cruise ships is unclear. This varies greatly from ship to ship. For example, M/S Quest expedition staff were instructed beforehand on their responsibility to "help hotel management take care of passengers" in case of an emergency. In practise, their responsibilities encompassed a wide range of activities including, for example, gathering passengers to the muster station and to lifeboats, counting passengers, finding missing passengers, taking care of panicking passengers, and assisting the coast guards as soon as all passengers were onboard at the coast guard vessel. The expedition team leader needed also to coordinate the actions of their team. The responsibilities of "helping hotel management take care of passengers" and "taking responsibility for passengers' safety and getting them to the lifeboats" differed significantly. This mismatch between theory and practise, according to the expedition staff, is not specific to this vessel, but common in the area.

According to the expedition staff, the practices on different vessels as well as the training of the guides vary considerably, which can cause confusion in emergency situations. Responsibilities for expedition staff outside the vessel i.e. landings and Zodiac operations are well-established through operational protocols, but the role onboard the vessel can vary significantly from ship to ship and between companies. On some vessels they are signed on as passengers, and on others as crew members. Sometimes they are not fully aware of how they are signed on, as crew or passenger. The vessel's safety officer usually gives a ship safety demonstration before departure or shortly thereafter, but the demonstration is relatively brief and basic. Experience and training among expedition staff members also varies. Some guides have STCW Basic Safety Training, and Crowd Management Certificate, but others may not have relevant training.

Recommendation

- There is a need for a general standard and clear practice for responsibilities and role of expedition staff members onboard the vessels in emergency situations. If the expedition staff are assigned as passengers, their level of responsibilities can be appropriately assigned, while still being able to assist the crew members. If they are crew members, they can have designated tasks in an emergency, and the tasks are based on the muster list. If a person is not signed in the muster list, they can't be responsible for actions.
- All personnel assigned to shipboard duties in a passenger ship engaged in international voyages, shall have adequate familiarisation and training. If applicable, in accordance with STCW (Standard for Training Certification and Watchkeeping for Seafarers), they shall have Passenger ship crowd management training (STCW A-V/2-1) and Crisis management and human behaviour training STCW A-V/2-2). Trainings can be considered also for other personnel.
- Basic Safety Training (STCW A-VI/2-1) and Survival craft and rescue boats other than fast rescue boats training (STCW A-VI/2-1) and possibly Fast rescue boat training (STCW A-VI/2-2) should be considered.

- Even if the role of expedition staff is defined as passengers, they could still benefit from the above-mentioned trainings and regular safety drills and onboard trainings.

Alarm and information to the passengers

The mass rescue operation started with an alarm, which differed from what passengers were briefed beforehand or which was stated on the information sheet on the cabin door. In the safety briefing passengers were instructed to listen for further information after the alarm. However, there was no information given over the loudspeakers, which caused confusion whether to take warm clothes, life jackets and personal medications from the cabins or not. During the following hours, various alarms were heard without further guidance. Despite the confusion, the operation went well and passengers assembled quickly to the muster station.

Recommendation

- Sample scripts for communicating with passengers can make the communication easier, and help to ensure that all necessary information is passed on to the passengers. Messages need to be short, clear, authoritative and reassuring – while preparing passengers for possible worst-case scenarios. Sample scripts can be found for example in IMO resolution A.918(22) IMO Standard Marine Communication phrases (SMCP), especially in the section B4 Passenger care.
- Alarm should be clear and correct to the situation. Information given over loudspeakers after the alarm would clarify the situation to the passengers and help them to know whether to, for example, obtain warm clothing from the cabins or not.
- Alarms should be tested regularly, in accordance with regulations.

Instructions on the use of life jackets for passengers being hoisted to the helicopter

Some of the passengers needed to be hoisted to the helicopter for evacuation. There was some uncertainty about whether those being hoisted should wear a life jacket and which life jackets should be used. Onboard M/S Quest, there were two types of life jackets. The passenger had to ask for a crew member to get a life jacket from the cabin.

Recommendation

- Instructions and practises on the use of life jackets should be clear and regularly exercised.

- When medical evacuation by helicopter is the best option, IAMSAR Vol III section 4 and the action card in annex F gives easily readable guidance. Some points to highlight from the action card is to:
  - Have the patient wear a lifejacket and attach all medical information and other important records, and passport along with a record of medications that have been administered (no luggage).
  - The action card can be printed out and be readily available on the bridge and in the triage location.

Instructions on the clothing

Choosing proper clothing caused some confusion among the passengers during the exercise. When the first alarm went off, passengers were dressed in outdoor clothes, because they knew about the exercise beforehand. In addition to this, exercise's safety leader instructed everyone to pick up and to wear survival suits just before the evacuation. Therefore, participants had the safest possible dressing. In a real life scenario, the actions depend on how urgent the situation is. In the worst case scenario passengers may have to leave their cabins in underwear only able to pick up the life jacket with them. As one of the observers pointed out, in a real situation it might not be possible to obtain warm clothing from the cabin, but it is not appropriate to simulate this in training.

Some thought should be given to the details of the process to be followed during a real emergency. There are competing needs: the immediate need to get everyone up to a safe area; versus the eventual need to evacuate people that are suitably clothed and protected. For future solutions, it could be considered which storage locations of the survival suits and life jackets work best and should the regulations be revised.

Recommendation

- It needs to be clearly defined and communicated, how and where passengers get life jackets and survival suits, and whether they need to or can fetch warm clothes from the cabins.

Man overboard

A man fell overboard, while the crew was already overwhelmed with urgent activities. As the bridge crew was informed by an eyewitness, other crew members on the deck weren´t aware of the incident. Inherently, this resulted to delays in rescue actions to be initiated. On M/S Quest, the lifeboats are certified to be used if someone falls overboard. However, the M/S Quest crew explained that the ship´s Zodiacs might be handier for the task and faster to deploy. Zodiacs were used in the rescue.

Recommendation

- Some of the recommended initial actions mentioned in IAMSAR Vol III, when a person falls overboard, are to:
    - Mark and note position and time from GNSS.
    - Throw a life-ring over the side as close to the person as possible.
    - Sound three prolonged blasts of ship's whistle; hail "man overboard".
    - Post lookouts to keep the person in sight.
    - See also the Man Overboard action card in annex F of IAMSAR Vol III.
- It's important that the crew is informed of the situation and a man overboard alarm is issued.
- It is good to regularly practice the procedures with proper scenario planning, briefing and debriefing.
- IAMSAR recommends all surface SRUs to be equipped to lift survivors from the water without help from the survivors, as they may be injured, exhausted, or suffering from hypothermia. This key recommendation is hereby conveyed to the reader. Such tools are often called recovery cradles or rescue nets.

4.2.1.1.5   Muster station

Transfers from muster station to lifeboats

After a break in the exercise (NOPLAY), passengers started returning to muster station A (lounge deck) to don the survival suits, but an announcement from the bridge ordered them to go to the lifeboat station (muster station B). This led to confusion and the guides had to shepherd passengers back to muster station A, while some of the passengers had forgotten which muster station and lifeboat they belonged to. Once the order had been given to evacuate the ship, lifeboat 1 passengers followed the guide to the lifeboat station (muster station B), received and donned life jackets without delay or issues and followed the orders of the guides, following them into the lifeboat.

One of the observants described the need for passengers' supervision during transfer and while waiting for the boarding to the lifeboat:

> *"Our group 'experimented' by one person 'wandering away' while waiting to go down to the lifeboat, to test the observation and management of the group at the muster station. There was a period of about 10-15 minutes during which no-one from the crew noticed the absence of this person from the group."*

Recommendation

- Assigning clear roles for crew for minding passengers helps to keep an order, especially during transfers to muster stations and to the lifeboats. Also, it is important that the crew understands the possible need for adapting the assigned roles if there are casualties among the crew.
- It should be considered that during the evacuation there is adequate supervision of the passengers.
- It could also be considered to replay the evacuation video in the muster station. It would help passengers to become mentally prepared as well as remind them of the procedures and what to expect, and to repeat instructions from time to time during the evacuation.
- It is good to regularly practice the evacuation procedures with proper scenario planning, briefing and debriefing.

Allowing passengers to go outside to the deck

Due to the evacuees dressed with warm clothing and due to the muster station being full of people, it got relatively hot inside. Opening doors to get ventilation helped partially, but for the comfort of the passengers, they were allowed to go outside during the break in the exercise. However, the whole exercise had not been stopped, so the helicopter operations were ongoing when people went outside to the deck. The idea was probably to give the people the opportunity to observe the helicopter in action, but it was seen as a safety hazard.

An observer, who was present at the muster station A, considered it dangerous to let people outside to watch the helicopter. They suggested a possibility to allow people to go out for air in smaller groups of 10 for 10 minutes, and to consider that the helicopter operations are not happening during that time.

Recommendation

- Consideration should be given to allowing passengers to refresh themselves on deck in an organised manner.
- In a real situation, passengers should not be left unattended even for a moment. Some may try to evacuate too early and disturb the helicopter's evacuation operations.

Locating panicked passengers

Passengers were divided into two evacuation groups in the same room. Panicking passengers were in the same room as others, which caused stress among the group and the guides. A few of the passengers took the most attention of the staff, creating further distraction and for example persons suffering from silent panic may not be noticed.

Recommendation

- Panicking passengers can cause issues for other passengers and crew. Possible courses of action should be planned in advance, to be prepared should any of the passengers start to panic.
- Crowd management training, in accordance with STCW, is important for the crew members responsible for the crowd control.

Equipment at the muster stations

Coffee, water and apples were available for evacuees at the muster station. Emergency equipment and basic medications could have been useful at muster station. Passenger manifest with clear sign-in and sign-out boxes makes tracking the whereabouts of the passengers easier. Expedition staff faced issues getting inside the cabins since they were locked, and they would have needed a master key. Passengers expressed needs for food, restroom facilities, briefings, and preparation for what might come at the assembling station.

Recommendation

- It is recommended for muster stations to be equipped with emergency kit, that includes:
    - Colourful and/or clearly marked vests for expedition staff and passengers able to assist.
    - Seasickness medication, other basic medications and sea sickness bags stored according to the legislation and regulations.
    - Passenger manifest with room number and, if available, voluntarily given information about medical conditions or needs for special care or assistance in emergency situations.
    - Defibrillator in case of a heart attack.
- There should be several copies of the passenger manifest available at the muster station A, along with a pencil, eraser, and sign-in and sign-out boxes on the sheet so the crew can easily see which passengers are missing and which ones went in and out.
- Technical solutions could be developed for passenger tracking, and this could help for example when there are large amounts of passengers. Tracking solution could include a possibility to search for or sort useful information, for example special skills or reported medical information.
- A master key needs to be available for the staff whose task may require entering the cabins. This needs to be considered when designating the tasks.

- An issue that was noted by the expedition staff is that it should be decided whether the rifles are brought into the lifeboats.
- Passengers should be informed to take off their glasses before putting on or taking off the life jacket.
- In an emergency, the crew members could request if there are anybody capable to help if needed, for example with a background of medicine, military, or coast guard. This could also be a voluntary question during the registration to the cruise.

Role of the expedition staff at the muster station

As some of the passengers started panicking, they became difficult to control and keep calm by the crew. The other crew members had their hands full controlling the fire, preparing for boarding teams, and preparing the lifeboats for a possible evacuation. Thus a reserve army of two expedition guides were enrolled to look after the passengers at the muster station. The guides were highly trusted by the passengers but possibly a mandatory crowd and crisis management course could have provided them with more tools in the situation.

An observer stationed at muster station A, emphasizes the importance of crowd control. In the exercise, the guides managed to control the passengers with a less active approach, which might not have been enough in a real situation. At the same time it must be noted that the guides did not receive information, that would have supported them in their task.

An observer states:

> *"I think there would be a more widespread panic and/or frustration being expressed by the group. This means there would be far greater challenges for the staff. The critical requirement would be for control and calm to be maintained, so that passengers do not decide to act on their own opinions e.g. to head for the lifeboats too soon, or to return to their cabins for clothes, luggage, etc. If the staff 'lose the crowd' there would be a much more dangerous situation. So, early and clear communication with the passengers is crucial. Passengers should be informed regularly to keep them updated and calm."*

Recommendation

- The roles of the different crew teams need to be clearly defined. Also, if the expedition staff is expected to play a very active role in managing the passengers during an emergency, it should be defined in advance to clarify their role. It would be good to tell the passengers in the initial briefing what the different crew teams will be doing in an emergency and who is going to take care of them.
- All expedition staff assigned to safety duties should have appropriate training according to STCW.

Counting and tracking passengers

Counting and tracking of passengers proved challenging for both crew of distress vessel and assisting assets. Headcount was done twice on muster station A (lounge). The expedition staff member at the muster station was not given the correct list for the play which caused some confusion. There was no headcount on muster station B (outside, next to life jackets) when passengers arrived or left. While transiting from one station to

another, it might have been possible that someone would have escaped the group. There was also no crowd control at the muster station after life jackets were equipped. This is however something that exercise's directing staff should have considered, as the crew itself is already small with 25 people, and 4 important crew members were taken out by injury. This could also happen in real life, and therefore it could be important to utilise the expedition staff the best way possible.

Recommendation

- The roles and responsibilities between the crew and the expedition staff need to be clearly defined. Also, training together is a good idea to improve efficiency and cooperation in general.
- All expedition staff assigned to safety duties should have appropriate training according to STCW.
- It should be ensured that the correct passenger list is available at muster stations.
- Discuss, exercise, and develop standardised solutions for passenger and triage tracking.

4.2.1.2   KV Barentshav (Evacuation)

4.2.1.2.1   Triage and First Aid

No data available.

4.2.1.2.2   Lifeboat

Boarding the rescue vessel

Passengers were transported in lifeboats to the coast guard vessel KV Barentshav. The only way to board the vessel was to climb up the rope ladder, which was challenging to some evacuees. It may be that the reason for choosing a rope ladder for embarkation was due to the known capabilities of passengers arriving. One of the observers described that they weren't assisted in climbing around the top of the ladder through the railing. For example, someone grasping the survival suit by the shoulder or taking evacuee's hand in sailor's grip would help especially older and less mobile passengers getting onboard the rescue vessel. One of the observers found this part of the exercise relatively risky.

It should be noted that some life jackets were left in the lifeboat upon boarding. While the embarkation from M/S Quest to lifeboat 1 was done safely wearing survival suits and life jackets, passengers were given the option to take off life jackets to climb up the pilot ladder to KV Barentshav as they are bulky and make climbing more difficult. Although survival suits provide some buoyancy, they do not replace life jackets and climbing pilot ladders always carries a risk of slipping or being crushed between lifeboat and hull. This could be a safety issue, especially at night or in adverse weather conditions. Abandoning life jackets in the lifeboat means consequently that passengers would no longer have their life jackets for subsequent transfers. The vessel was equipped with a hoist, which was not used during the exercise. Option to use the hoist was mentioned earlier, during the familiarisation visit.

Recommendation

- Safe boarding of the rescue vessel needs to be ensured, and alternative options for boarding the vessel should be available instead of only the rope ladders.
- Life jackets should be worn when boarding the rescue vessel.

Controlling passengers

Despite some observants not being aided at the top of the ladder, the rest reported that there were one or two persons present, and to some of the evacuees, help was offered to board the vessel. The novice crew members taking care of the evacuees had some challenges in controlling the situation. For example, their task was to register the people coming on board, but the process was slightly slow due to the little experience of foreign names. Immediately after boarding the vessel, a panicked evacuee was able to wander around the deck for a while. A gathering place was designated outside in the deck, and thus unprotected from the weather. Health issues concerned mainly one panicking passenger, but more attention could have been paid on the health status of the evacuees. Sometimes the supervising was entrusted to fellow passengers, which worked quite well. After some time, evacuees were guided inside, where it was possible to have water, coffee, tea and biscuits. The evacuees were not supervised inside.

Recommendation

- It is important that the passengers are minded all times, also in the rescue vessel. Experienced personnel can support the novice in controlling the passengers and calm and capable passengers can be used as help.
- There should be one or two persons helping the passengers to board the rescue vessel.

4.2.1.2.3   Firefighting

No data available.

4.2.1.2.4   Bridge

No data available.

4.2.1.2.5   Muster station

Counting and tracking passengers

Counting and tracking of passengers proved challenging for both crew of distress vessel and assisting assets. There was also confusion regarding the evacuee and role player lists.

Recommendation

- Make sure that total amount of people (the number of crew members and passengers) onboard is available.
- Taking a head count should be dedicated to a crew member if possible in the situation. If it is clearly dedicated to someone or is part of a certain role, it supports the process and fast proceeding. If the activity is not properly organised, someone can be left on board during evacuation.
- While taking the head count, it is important to consider that there are also rescuers who are entering the distress vessel and may be going back and forth more than once.
- Discuss, exercise, and develop standardised solutions for passenger and triage tracking.

- Also during exercise, it's important to have correct evacuee lists available.

4.2.2   Cooperation

4.2.2.1   M/S Quest

4.2.2.1.1   Triage and First Aid

Planning medevac

The doctor rightly ordered his patients in priority of medevac. However, during the planning, communication faced challenges. The doctor didn't know how many patients could be evacuated by the helicopter until the aircrew were on the deck. It would have been important to know how many and which patients could be going in the helicopter so that each of them could be prepared according to the evacuation method. For example, the winch operations took place on the fore part of Deck 4, but the rescue boat was carrying out evacuations on the gangway at Deck 3. Moving the casualties would have been a difficult, slow and potentially dangerous procedure (particularly as they would have been on stretchers and being moved back down towards the fire on Deck 3 where the gangway was located).

Recommendation

- It needs to be ensured that all relevant information is shared between the bridge, the OSC, the helicopter, and the person responsible for the first aid (in this case the doctor).

4.2.2.1.2   Lifeboat

No data available.

4.2.2.1.3   Firefighting

No data available.

4.2.2.1.4   Bridge

Role of search and rescue unit as On-Scene Coordinator

When the emergency worsened, captain briefed the approaching coast guard vessel about the situation. This designated search and rescue unit (SRU) provided excellent means for rescuing and communication and took on the task as On-Scene Coordinator (OSC) as well as Aircraft Coordinator (ACO) for the expected rescue helicopter. The OSC briefed the JRCC with progress reports, taking some weight off the shoulders of the captain of the distress vessel.

Recommendation

- Depending on whether the vessel responding to the emergency has the capabilities (e.g. technology, training), they could be ordered to take the role as the OSC.

Communication between JRCC NN, OSC and M/S Quest

OSC/SMC/ACO roles seemed unclear in the beginning because JRCC NN activity seemed low and only 2-3 calls via Iridium were made during the exercise. Furthermore, there were two calls to the cruise company. It gave the impression that Polar Quest was left alone. JRCC NN's decision seemed to be to communicate with the Norwegian Coast Guard only. In a real situation the distress vessel should be well included in the communication of the rescue actions.

Recommendation

- Even in exercises, communication measures are recommended to be conducted as close as possible to real situation because the experience will then support the cooperation in the future.

4.2.2.1.5   Muster station
No data available.

4.2.2.2   KV Barentshav (cooperation)
4.2.2.2.1   Triage
No data available.

4.2.2.2.2   Lifeboat
No data available.

4.2.2.2.3   Firefighting
No data available.

4.2.2.2.4   Bridge
The role of OSC

The OSC role was delegated to KV Barentshav from JRCC. Based on this mandate, KV Barentshav initiated all necessary activities in the rescue operation throughout its whole duration. As the operation was led by the OSC, they took the relevant measures and initiated activities during the operation.

Recommendation

- When the roles are clear and the actors have strong expertise to carry on their work, everything works according to plan and expectations. This highlights the importance of expert personnel and the role of training and exercises. Trainings and exercises provide a fruitful arena to practice skills and to maintain them as well for the future real rescue operations.

The finding and recommendation is the same as mentioned in chapter 4.2.3.2.4 Decision making & Communication/KV Barentshav.

OSC maintaining communication

In rescue operations, it is important that there has been established and maintained reliable communications via the assigned frequency between Rescue Units (RU) and OSC. In addition, it is crucial that OSC maintains communication with all RU's and the SMC. In the exercise OSC maintained communication with all relevant RU's, but due to vessel's location, limited access to various means of communication made it complicated/few assets were available.

Recommendation

- Future solutions that deliver well-working means of communication among various and different types of users are much needed. Innovative solutions to cover this challenge are much looked forward to.
- It is highly important to have exercises and trainings in which rescue operations and communication are arranged based on limited means of communication. This ensures that in a real situation the limited possibilities will not cause extra challenges for the rescue.

The finding is the same as mentioned in chapter 4.2.3.2.4. Decision making& Communication/KV Barentshav and chapter 4.2.4.2.4. Technology/KV Barentshav.

Communication about rescue team's arrival

Boarding through sheltered gangway was agreed over radio prior to boarding by SAR team as this was considered the safest option.

Recommendation

- As boarding another vessel can be risky, especially if the weather is unfavourable, prior assessment and explicit communication about how to board is key to keeping the boarding team safe.

4.2.2.2.5   Muster station

Updating the exact number of crew and passengers

As in rescue operations in general, also in an exercise it is important to deliver precise head count of crew and passengers to be mustered to the OSC so that OSC could provide the information further for other actors involved in the rescue operation. The total number of crew and passengers to be evacuated was established in the early phases of the operations and most of the information obtained was from the crew of KV Barentshav onboard M/S Quest. This was further confirmed/supplemented with information from the captain (M/S Quest). M/S Quest relayed all relevant and essential information (i.e. POB was reconfirmed or updated when relevant) to the OSC via VHF.

Recommendation

- The exact number of crew and passengers to be mustered is critical in every rescue operation. Therefore, during the exercises, it is important to test that the vessels internal procedures to gain exact information of the number of crew and passengers head count to be mustered is clear. It is also important to have clear communication between captain and crew, alike captain

and OSC, on the head count number without delays. If changes in the head count numbers occur, it must be well communicated between captain, crew and OSC. If challenges occur, it is a valuable lesson learned for the actors in questions to focus on future improvements e.g. to see that the internal procedures are precise enough to support the flow of information between all actors.

- Include the bridge of distress vessel to the VHF.

Clarifying expedition staff's role on the rescue vessel

Cooperation between coast guards and expedition staff was a good learning opportunity, and something that could be considered for future MRO procedures. Some of the guides were asked to do tasks on the rescue vessel, but they were not instructed properly, which caused confusion. It would be important to give the expedition staff clear instructions on what they can do to help and give them specific tasks to assist. If they are not needed for help, it should be clearly stated that their tasks are now over.

Recommendation

- A rescue vessel should give clear instructions for the staff members of the distress vessel when they come onboard, whether their help is needed or not.

4.2.3 Decision Making and Communication

4.2.3.1 M/S Quest (decision making)

4.2.3.1.1 Triage and First Aid

Communication method with the doctor

The doctor of the cruise ship had to monitor ship's busy radio channel and to reply to non-clinical questions. The doctor could not fully focus on treating patients because he had to filter through all communications in case something was for him. Another team member could have been better suited to reply to messages such as the location of the casualties/medical team. This was one of the instances in which the doctor became overloaded.

The doctor was treating casualties and giving instructions to the medical team in a noisy environment. Several crew members of the engine department and firefighting crew were standing around a patient. It could have been beneficial if they had moved elsewhere to talk about the other elements of the situation (such as the firefighting) and doing so reduced the stress of the environment. The situation is stressful for the doctor anyway, so reducing stress and workload allows the doctor to do his job more efficiently.

Recommendation

- Organising communications and facilities in the best possible way, without unnecessary distractions, could reduce the workload of the doctor and therefore contribute to the most efficient care for casualties.

Communication between bridge and the medical team

The doctor made a radio call to the captain to inform of the casualties and that further medical assistance would be needed. Given the intensity of the workload on the doctor, this was made at the earliest opportunity upon discovering the most seriously injured patient. Reporting this early was critical to ensure that JRCC could arrange appropriate external medical resources. The captain and doctor clarified the medical situation again several minutes later, presumably to ensure the most accurate information was being fed to the OSC. Another medical update was provided later which meant the bridge had up to date information on the casualties.

In general, the medical team worked well in the situation. They prioritised the casualties and gave initial treatment to all who required it. They ensured that the casualties were evacuated, and as such achieved the objective of effective triage. The areas for improvement revolved around communication. At times, the doctor did not receive much information from the bridge. It is important that operators and crews are prepared and rehearsed for this kind of situation. Having a communication process for onboard multi-casualty scenarios would ensure constant updates to and from the doctor. For example, the doctor should easily be able to request more crew for assistance, or to get updates on the RCC's plan for medevac.

Recommendation

- Regular exercises for the crew in multi-casualty scenarios could be arranged in the form of treating multiple fake injuries, moving people on the ship, and giving CPR. This does not demand much time but would mean more of the crew have practised. Knowing that the team could be depended on for basic tasks without constant oversight would reduce the doctor's workload and allow greater concentration. It is in the best interest of the operators to ensure their crew's preparedness, beyond minimum requirements.
- Bridge needs to be informed of casualties in short order and relay the information to the OSC. Updates should be provided when necessary.

Marking casualties

During the exercise the casualties were discussed amongst the crew several times, in person or via the radio. Every time they were mentioned, they were referred to by their symptoms which lead to some confusion.

Recommendation

- The casualties should be marked clearly and distinguishably, for example by numbers. This could be done by marker pen on the skin, or with a large visible tag attached to them. The assigned numbers and the symptoms could be given to the bridge (and therefore OSC) on a check card so when referring to someone on the radio they only need to be referred to as e.g. 'casualty 1.'. In this way, an order to 'move casualty 2 to Deck 5' doesn't leave room for confusion. This technique, used by some military forces, would potentially avoid confusion especially in cases that have higher number of casualties or there are many casualties with similar injuries. There may also be alternative options for operators/planners to consider.

4.2.3.1.2 Lifeboat

No data available.

4.2.3.1.3   Firefighting

No data available.

4.2.3.1.4   Bridge

Recap on the safety onboard

There was a detailed safety briefing during the first evening of the cruise. This safety briefing is a good practice, but the problem is that passengers soon forget the information.

Recommendation

- A short exercise on safety onboard the ship could be arranged after 3 - 5 days.

Call for assistance

The decision to call for assistance (mayday) was made as soon as the crew experienced difficulties with the fire. However, it took some tries for the captain to get through on the satellite line and an uneasiness was sensed by the people present on the bridge. The JRCC controller finally answered, allowing the JRCC to gain awareness about the situation. A coast guard vessel in vicinity had difficulties gaining the same awareness as a mountain obstructed the radio waves.

Recommendation

- In the ANA region, it can be uncertain how the communications technology is functioning. Due to challenging environment and long distances, to get assistance to remote areas, call for assistance or mayday should be launched earlier than in other areas. At this latitude, the mayday call can't be launched via satellite communications. Instead, HF radios can be used.

Talking to passengers

In practise, expedition staff were responsible for supervising a muster station. Their role was to keep passengers in muster station, which was a panorama lounge of the ship. They fulfilled their tasks well in that respect that they kept the passengers in place. Lack of information and clear status made their work difficult. The passengers were informed by the bridge only two times in four hours, which is a low amount of communication.

The visible activities outside the ship, lifeboats floating at sea and a helicopter flying nearby, aroused the passengers' interest. The activities also caused confusion because they were not explained to the passengers. They could also hear messages about fire, casualties etc., which caused uneasiness.

Hotel manager was present and could at least in principle (the radio connection did not work) communicate with bridge there and expedition staff was able to get information via hotel manager. Passengers waited a long time in a muster station, some of them in panic, and no situational leader was introduced to them. Expedition staff, who were passengers themselves, took care of others. Seeing the captain or hearing his voice could have calmed down the passengers – especially, when some of them were speculating, that the captain has left the ship.

Recommendation

- The roles in the emergency need to be clear and in accordance with the muster list. Crew members responsible in any task in case of emergency need to be trained and familiarised with their task. Well-trained crew has the authority and capability to keep the situation in control.
- PA system could be utilised to communicate more easily to the passengers and to increase the flow of information, which reduces passengers' confusion.
- It is good to regularly practice the evacuation procedures with proper scenario planning, briefing and debriefing.

Communication between muster station and bridge

Expedition staff in muster station could not communicate directly with the bridge. According to the emergency plan, all expedition staff's communication should go via the hotel manager. The problem was that hotel management could not correspond with the bridge either due to high activity on the channel. Hotel manager also frequently left the muster station, and then the communication channel to the bridge was lost.

Recommendation

- Roles for the crew members need to be clear and defined.
- Crew member responsible for the muster station needs to be able to communicate with the bridge and to be present in the muster station.
- Emergency plan needs to ensure clear communication procedures, and it needs to be exercised regularly.

Communication tasks between the captain and the chief officer

Division of tasks between the captain and the chief officer was exemplary and clearly made so that the captain took care of external communication and the chief officer internal – this supported prompt proceeding and having everything well under control. Communication to the crew could have been clearer, but it seemed to work well enough.

Recommendation

- Regular and prompt updates to crew support keeping the situation under control in the whole vessel.

4.2.3.1.5   Muster station

Communication between distress vessel, OSC/ACO and helicopters

It was unclear to M/S Quest of the helicopter communication how many passengers will be eventually hoisted. This could derive from the exercise setting itself. However, in order to have lessons from the exercise to the future possible emergencies the communication between helicopter and M/S Quest could have been more detailed.

Recommendation

- Communication measures between the distress vessel and OSC/ACO and helicopters are important part of trainings and exercises for future possible cooperation in a real rescue operation.

4.2.3.2 KV Barentshav (decision making)

4.2.3.2.1 Triage

No data available.

4.2.3.2.2 Lifeboat

No data available.

4.2.3.2.3 Firefighting

Radio communication

Coast Guard firefighting personnel reported to the M/S Quest bridge face to face and via radio.

Recommendation

- Exercises provide an arena to consider future use of various radio channels for a specific communication needs e.g. firefighters to support their own internal communication in a dedicated channel. Radio communication should reduce the need to provide face to face updates to the bridge.

4.2.3.2.4 Bridge

Solution to establish common situational awareness

The only reporting method between OSC and JRCC was via Iridium and this seemed to complicate establishing common situational awareness.

Observation

- Future novel solutions would be welcomed to enable establishing situational awareness picture that could be accessed by all necessary actors. The solution should be such that it may well work also in the arctic latitudes.

The finding is the same as mentioned in chapter 4.2.4.2.4. Technology/KV Barentshav.

The role of OSC

The OSC role was delegated to KV Barentshav from JRCC. Based on this mandate, KV Barentshav initiated all necessary activities in the rescue operation throughout its whole duration. As the operation was led by the OSC, they took the relevant measures and initiated activities during the operation.

Recommendation

- When the roles are clear and the actors have strong expertise to carry on their work, everything works according to plan and expectations. This highlights the importance of expert personnel and the role of training and exercises. Trainings and exercises provide a fruitful arena to practice skills and to maintain them as well for the future real rescue operations.

The finding is the same as mentioned in chapter 4.2.2.2.4 Cooperation/KV Barentshav

OSC maintaining communications

In rescue operations, it is important that there has been established and maintained reliable communications via the assigned frequency between Rescue Units (RU) and OSC. In addition, it is crucial that OSC maintains communication with all RU's and the SMC. In the exercise OSC maintained communication with all relevant RU's, but due to vessel's location limited access to various means of communication made it complicated/few assets were available.

Recommendation

- Future solutions that deliver well-working means of communication among various and different types of users are much needed. Innovative solutions to cover this challenge are much looked forward to.
- It is highly important to have exercises and trainings in which rescue operations and communication are arranged based on limited means of communication. This ensures that in a real situation the limited possibilities will not cause extra challenges for the rescue.

The finding is the same as mentioned in chapter 4.2.2.2.4 Cooperation/KV Barentshav, 4.2.4.2.4 Technology/KV Barentshav.

AECO's database

AECO has a database that provides information on cruise vessels. When a cruise vessel is in distress, the database may support the rescue operation. During the exercise, KV Barentshav had access to the database through JRCC, but not directly due to limited communication access/infrastructure. However, it is not known how much information from the database was obtained by JRCC in their analysis and used to create situational awareness to support the rescue operation.

Recommendation

- AECO's database could be tested in the future exercises more thoroughly to study its usability and possible needs for novel features, also when there is limited communication access.

4.2.3.2.5   Muster station

Communication between distress vessel, OSC/ACO and helicopter

It was unclear to M/S Quest from the helicopter communication how many passengers will be eventually hoisted. This could derive from the exercise setting itself. However, in order to have lessons from the

exercise to the future possible emergencies the communication between helicopter and M/S Quest could have been more detailed.

Recommendation

- Communication measures between the distress vessel and OSC/ACO and helicopters are important part of trainings and exercises for future possible cooperation in a real rescue operation.

4.2.4   Technology

4.2.4.1   M/S Quest

4.2.4.1.1   Triage

No data available.

4.2.4.1.2   Lifeboat

Lowering the lifeboats

Crew of the lifeboats communicated with the bridge with handheld VHF-radios. Both lifeboats were lowered within five minutes as per SOLAS requirements. Lifeboat 1 (starboard side) was lowered within 4.5 minutes and lifeboat 2 (port side) within 1 minute. However, there was a delay in the lowering of lifeboat 2 due to the use of the port side embarkation hatch to transfer personnel and casualties by the RIBs of KV Barentshav. Once the area was clear, lifeboat 2 was lowered and launched within 60 seconds.

Recommendation

- It should be ensured that lifeboats can be lowered within SOLAS requirements.
- Lowering the lifeboats should be exercised regularly.
- Lifeboats and davits need to be tested and maintained regularly, in accordance with the applicable regulations.

Lifeboat innovations

Group survival kit / personal survival kits (GSK/PSK) were stowed in dedicated hatches in the forward centre part of the lifeboat and easily accessible with a half-filled lifeboat. However, access would have been extremely difficult had the lifeboat been filled to maximum capacity, especially in darkness and / or adverse weather conditions. One of the observers noted that the fixed position for the pilot in the lifeboat was designed for a taller person, which caused difficulties for the shorter pilot

> *"The pilot's position in the lifeboat appeared to be designed for a person of c. 1.8-2m height, whereas our pilot was much shorter. To see out the hatch, and to be able to steer, he stood on a 2-step 'hop-up' set of wooden steps. These were not fixed in position but were able to slide around in the place where they were balanced on a ledge of the boat. They could have fallen off the ledge and the pilot could have been injured in the process, especially if we had any kind of waves."*

Recommendation

- Future innovations for the lifeboats could look for a solution to adjust the cockpit for pilots of different sizes.
- There might be a need to deviate from the tasks assigned in the muster list if there is a physically more suitable person to do that task.
- Future solutions for lifeboats could take into account an easy access to GSK/PSK storage, moving in the lifeboat and that both, life jackets and survival suits, could be worn when seat belts are on.

4.2.4.1.3   Firefighting

Communication method

During the firefight, firefighters were at times reporting via face to face that did not support rapid communication.

Recommendation

- Using the radios should be the first choice of communication methods for firefighters.
- All technological solutions that may carry on fast, prompt, reliable and easy communication measures among the relevant actors in the rescue operations are welcomed for future development.

4.2.4.1.4   Bridge

Alarm malfunction

The alarm system malfunctioned during the exercise, and therefore the alarm was not the expected pattern. This led to confusion for the passengers how to proceed and what to do because the message of the alarm was unclear.

Recommendation

- To avoid alarm system malfunctions it is important to test it regularly, and on SOLAS vessels it should be done in accordance with the SOLAS regulations. In a real situation, additional information is recommended to be provided through the loudspeakers to the passengers. In short, back-up system needs to be available and taken into use in case the system malfunctions.

4.2.4.1.5   Muster station

Labels on vests

Vests that Coast Guard personnel used had the texts in Norwegian. However, it is not clear to foreigners (e.g. passengers and perhaps also to vessel crew) what the labels such as texts and signs in the vests are, and this might prevent rescue and might cause some interference.

Recommendation

- Rescue teams boarding a vessel in distress should be well distinguishable. E.g., who is the medical/doctor and who is team leader or local incident coordinator.
- Authorities should have recognisable uniform and/or sign so that they can be recognised also over language barriers.

4.2.4.2   KV Barentshav

4.2.4.2.1   Triage

No data available.

4.2.4.2.2   Lifeboat

No data available.

4.2.4.2.3   Firefighting

No data available.

4.2.4.2.4   Bridge

Solution to establish common situational awareness

The only reporting method between OSC and JRCC was via Iridium and this seemed to complicate generation of establishing common situational awareness.

Observation

- Future novel solutions would be welcomed to enable establishing situational awareness picture that could be accessed by all necessary actors. The solution should be such that it may well work also in the arctic latitudes.

The finding is the same as mentioned in chapter 4.2.3.2.4. Decision making& Communication/KV Barentshav.

OSC maintaining communication

In rescue operations, it is important that there has been established and maintained reliable communications via the assigned frequency between Rescue Units (RU) and OSC. In addition, it is crucial that OSC maintains communication with all RU's and the SMC. In the exercise OSC maintained communication with all relevant RU's, but due to vessel's location, limited access to various means of communication made it complicated/few assets were available.

Recommendation

- Future solutions that deliver well-working means of communication among various and different types of users are much needed. Innovative solutions to cover this challenge are much looked forward to.

- It is highly important to have exercises and trainings in which rescue operations and communication are arranged based on limited means of communication. This ensures that in a real situation the limited possibilities will not cause extra challenges for the rescue.

The finding is the same as mentioned in chapter 4.2.2.2.4. Cooperation/KV Barentshav and chapter 4.2.3.2.4 Decision making& Communication/KV Barentshav.

Situational Reports

The SITREP (Situational Report) regime was set after the initial phase. The SITREPs were initiated by the JRCC or the OSC. The SITREPs were mainly the OSC reporting status to JRCC since they did not have many resources to introduce to the operation. All SITREPs were conducted by Iridium, and JRCC did not have access to KV Barentshav's NORSIS log due to simulated lack of data coverage. Access to the NORSIS log would reduce the workload on the OSC and contribute to efficient and accurate sharing of information.

Recommendation

- Communicating the log via Iridium could be a future option as it requires fairly limited bandwidth.

4.2.4.2.5   Muster station

No data available.

4.2.5   General findings

Common safety

Safety in the processes of the mass rescue operation can be examined and developed. During LIVEX, weather was favourable and extra safety measures were taken due to the exercise. In adverse weather conditions the operation would have been more challenging. Even when the conditions are good, when working on places in which there are risks of falling overboard, such as at gangways in open sea, it could be recommended that a life jacket and a safety lanyard are used.

Critical parts of the rescue operation can be, for example, as observed during the exercise, transferring to the lifeboat and from lifeboat to the vessel of opportunity, process of donning the life jackets and buckling the seat belts on the lifeboat as well as climbing the ladder to the vessel of opportunity.

One example of the regular check-ups of the equipment conditions could be to inspect the condition of the embarkation ladders regularly and thoroughly. Bear in mind that natural fibres are susceptible to dry rot and mildew and that natural rope may self-abrade from inside.

Commonly developed risk assessment, communication plan, and air space separation procedures together with professional air coordination supported safe air operations throughout the MRO event. Two drones were safely and successfully used to document events during the exercise, also during helicopter operations.

During an exercise, it is important that a correct list of evacuees is available and clearly distinguished from the evacuee list of the play.

Recommendation

- Exercise and evaluate safe transfer of persons from the water level (lifeboat) to the deck of a vessel of opportunity such as a cruise ship.
- Regular inspections and maintenance of the equipment are needed in the cruise ships.
- Discuss, exercise, and develop guidelines on how to safely evacuate persons in a mass rescue operation.

Communication to the media

Communication to the media was not simulated in the exercise, except a role player calling to the cruise company as journalist asking questions. It should be noted, that in a real situation, such messages from passengers as "there are dead people, captain has left the ship, the lifeboat is drifting away, etc." could have quickly spread to the media.

Recommendation

- Organisation which is responsible for the search and rescue operation is primarily responsible for the communication to the media. Shipping company communicates in cooperation with the search and rescue organisation according to their own crisis communication plan.
- If the accident happens in the mobile phone network area, the passengers can be recommended not to use their phones, so that they are not blocking the network and to avoid them communicating to the media.
- It could be considered to include external communication to the exercise, for example simulating a press release.

5   Conclusion

Meeting the objectives

ARCSAR LIVEX provided an excellent opportunity for various actors to train and work together in establishing common understanding and procedures, finding new solutions and learning from each other. This exercise brought together organisations across national borders and offered also a platform to test new technologies in a live exercise setting.

LIVEX' first main objective was *to enhance the understanding of ARCSAR partners on factors that affect survivability and decision-making in the Arctic and North Atlantic (ANA) region by exercising a live response to a simulated maritime incident*. The exercise provided valuable information to the partners on this matter. It can be concluded that for example the importance of defined roles and responsibilities, well-planned communication, and the need for continuous training were factors that were discussed.

The second main objective was *to strengthen collaboration between the responding parties, including industry, and improve procedures for cooperation*. Well-working collaboration is seen as a valuable goal by all partners. The exercise provided a unique opportunity to bring together various operators, responding

parties and industry to work on the collaboration and to enhance the procedures. Exercising in a live setting creates a possibility to learn in practise how things are done and how the other partners work. If a real-life incident happens, it is then easier to work together.

Bringing industry onboard the exercises offers them a valuable possibility to learn about field's needs and for the operators to gain understanding about new possible technological solutions. This creates a platform to innovate together based on the needs and the possibilities.

Participants reported that the exercise helped them to familiarise with each others' procedures and ways of working. Understanding the different steps other operators take is important as it enables operators to prepare actions in a way that procedures run smoothly. For example, industry and authorities have different ways of working and conducting operations, so to understand each other and training together is vital.

One of the sub-objectives were to gain a better understanding of the main steps and challenges associated with transferring passengers between ships at sea. This concluded, for example, in realising the challenges the bulky life jackets create on getting to the vessel of opportunity. Climbing the ladder to the vessel of opportunity is a critical step in the rescue operation, and if the evacuees are not in the best physical shape, climbing the ladder with the life jacket might be challenging.

Effective communication is crucial in all rescue operations and one of the sub-objectives were to test communications in an emergency. It is important to consider the communication practises as well as the methods that make communication possible. Successful communication practises include all relevant parties making the rescue operation possible. Also, communication to the passengers onboard the vessel is important. They need to get relevant information and instructions to be prepared for the evacuation. Communication to the passengers reduces confusion about the situation.

LIVEX brought uniquely many operators together to exercise mass rescue operation. This offered a possibility to work on cooperation with multiple operators.

This report answers to the final sub-objective of *players demonstrate their ability to effectively contribute to the exercise evaluation and lessons identified in order to draft recommendation for further procedures and policy*. The evaluation was conducted by professionals from many organisations and their recommendations are mentioned in this report.

Exercise conclusions

Exercises are artificial, but highly important for future improvements in many respects. As they are artificial some observations need to be seen from that point of view. However, without exercises basic measures wouldn't be tested and improved, so the importance of exercises can't be undermined either. It is good to remember that continuous exercising enables developing exercises, their evaluation and therefore improving the basic measures.

An essential feature of the expedition cruises in the ANA region is **the expedition staff** onboard. According to the findings in this exercise, the role of the expedition staff was well-established in the Zodiac cruises and landings in the LIVEX cruise. However, it looks like the role of the expedition staff, and therefore their responsibilities, during an emergency onboard is not as clear. This seems to be common in the ANA region. Regardless, in the LIVEX cruise, expedition staff did well. On some ships, the expedition staff are signed on as

passengers and on others as crew, which creates confusion onboard. They have various backgrounds and some are more educated in the safety issues onboard than others. These variables make it difficult to establish a common procedure. However, it draws attention to that there should be a common standard on what is their role. If they are crew members, there are regulations to be followed regarding trainings and education, as well as regarding duties and rights. Being crew members gives them possibility to be responsible for safety actions onboard. If they are regarded as passengers, how can they function as the best possible help for the crew and still not be responsible for safety actions? How then should the work be organised between crew and expedition staff?

One issue that always craves more attention is communication. In the ANA region it is even more crucial, and more limited than in areas with more connections and services. There are, however, also aspects that can be considered in the communication practises. If an expedition staff member is responsible for the passengers, they should have a way to communicate with the bridge. In the exercise this was to be done through the hotel manager, but they were not present at the muster station all times. It is important that the one who is responsible for the passengers has a way to communicate with the bridge and is also familiar with the communication practises onboard.

The importance of regular exercising can't be emphasised enough. Exercise should never be a technical performance only, but taken as an essential part of everyday work. This can make a huge impact in an actual emergency. If the expedition staff are considered as crew members and given a more active role onboard in the safety tasks, the common exercises for the crew and the expedition staff together are much needed as well. If expedition staff are considered as passengers, training together with the crew and getting trained on crowd management and safety onboard could still be beneficial for them. Training together also offers a possibility for the crew to see in which actions expedition staff could be most useful as help.

LIVEX offered a unique possibility to test **communication practises** in the remote areas and to simulate an incident in which the access to communication methods is limited or failed. This setting requires testing the limited access in an exercise scenario so that in the real situation it is not a surprise how communication works or doesn't work. Also, new innovations in this area are looked forward to.

Vessel's own procedures for the communication with passengers can be practised and developed. It is important to realise passengers' needs for information and clear instructions. For example, as passengers are told to listen for further instructions after an alarm, it is important that they get that clarifying information. They should be informed on the course of action they need to take, for example, whether they should e.g., go get warm clothes, life jackets and personal medications. During the emergency, the instructions might need to be repeated to the passengers as they may be too focused on the emergency and not hear or understand the instructions. Hearing from the bridge can also have a reassuring and calming effect and should not be undermined.

The communication procedures should be well-established as how they work with the OSC, distress vessel and JRCC. It is crucial that the distress vessel's bridge is included in the communication and therefore gets all relevant information. This can then be relayed in the vessel to the relevant parties, for example to the doctor responsible for the medical evacuation.

Medical care and evacuation needs to be planned and organised carefully. The location in which casualties would be treated is defined in the vessel's safety plan. However, in an emergency, there might be a need to deviate from the original plan, for example due to the location of the fire. Therefore, it is good to be aware of all possible locations spacious enough to host several casualties and the medical team. Centralising the

casualty treatment areas is one of the keys to successful triage and requires less crew members to watch over casualties as compared to multiple locations.

Communication is a crucial part of medevac, and the person responsible for medevac should get information regarding evacuation possibilities; for example, whether and when a helicopter is coming and how many passengers it can take. Knowing this will help the person responsible for medevac to plan how and where to transfer the casualties, as it can be that some of them are transported by different means off the ship.

Also, marking the casualties for example by numbers, as is done in military contexts, could simplify communication regarding casualties. There can be several casualties with similar injuries and referring to them by numbers which are written on a card on bridge, and on the persons themselves, could reduce the risk of confusion and mistakes.

One of the most important improvements that has already been taken up by operators is creating a new, more comprehensive **evacuation video**. This can be shown to the passengers in the safety briefing in the beginning of the cruise. It will guide passengers through the whole process of being evacuated. The video can easily be replayed during the cruise to remind passengers of the safety features. Evacuation video could be a recommended action on many vessels.

The technical issues raised in the exercise emphasise the need for regular maintenance and check-ups of the technical systems and equipment. Also, the alarm system malfunction reminded to think about the back-up plans, which in this case would have been to use the loudspeakers to explain the passengers what is happening. This should be done anyway after the alarm, but it could be used as a back-up if the alarm system malfunctions.

It is noted that new technological solutions tested in the exercise would be of great help in the SAR operations. For example, Artemis MPDLS was successfully tested, and it worked in the ANA region.

New technological solutions would be welcomed to make it possible for pilots of different sizes to drive the lifeboat safely and practically. Also, adverse weather conditions and darkness make it more challenging to operate in lifeboats. Therefore, solutions to make lifeboats more practical in various situations would be greatly valued.

Lessons learned

Organising a live exercise with multiple partners in the ANA region is a huge operation and this would not have been possible without funding from Horizon2020 and close collaboration with partners and stakeholders.

LIVEX included many stakeholders, which made the planning complex. It should be clear for everyone who is the leading the process and the respective roles of those involved, and how to communicate and interact with each other. For smooth proceeding, establishing sub-working groups with clear responsibilities early in the planning process can be recommended. The exercise planning process can also be seen as a valuable learning opportunity for less experienced staff to participate in.

The planning process was supported by an exercise directive document which was accessible to all planners. It was challenging to find a right platform for the document, as it should have been practical to work with and easily accessed by all partners. To develop GDPR policy, safety instructions, safety risk

assessment, and other key policies, assessments and documents was also a useful learning opportunity for the planning staff.

Involvement of various industry stakeholders in SAR and MRO exercises provides valuable multi-lateral training and better understanding of how a response will unfold. Therefore, it can be encouraged to invite industry and industry associations to participate in planning, conducting, and evaluation of exercises. A specific recommendation discovered during the planning phase was to exercise the role of a vessel of opportunity assisting in a mass rescue operation. For the future exercises, it could also be useful to invite relevant voluntary organisations to participate in, as such will often represent indispensable resources with specialised and local knowledge.

Involvement of academia in the exercises provides a second and trained set of eyes on research and education matters and might bring extra resources for data collection and dissemination. This can provide useful information to those educating the future professionals for the field. It is then useful to continue to work with academia in planning, conducting, and evaluating exercises.

Liaison with SAR service providers, specifically meteorologic office staff and satellite service providers, before, during, and after the exercise gave highly specialised input about technical solutions to be potentially used in SAR operations. The involved SAR service providers showed great interest in participation and future involvement.

Having real passengers onboard was seen very valuable for the exercise. It is not common for the authorities to be training with real passengers. However, it offers insight into the passengers' point of view and in the need of crowd management and reminds that not all passengers are familiar with the procedures. Involving real passengers causes extra work and there are regulations on the exercises with civilians.

Evaluation creates added value by enabling learning, developing practises and procedures, and identifying challenges and best practises. In LIVEX, evaluation was done by independent evaluators with expert knowledge in the field. They were stationed in key positions onboard, and this proved to work out well. Evaluator's Guide which was created for the LIVEX was considered as an important tool for the evaluators.

6   ANNEX

6.1   Guiding for evaluation reporting

The LIVEX evaluation results are reported according to chosen themes that are in-line with main and sub-objectives. The themes and their reporting codes in the excel are following:

- Evacuation Methods - Questions in **brown**
- Cooperation - Questions in **purple**
- Decision making & Communication - Questions in **blue**
- Technological solutions - Questions in **grey**
- Additional questions - Questions in **black**

The rationale for the selected main evaluation themes is following what comes to the coverage of objectives:

	Evacuation methods	Cooperation	Decision making/ communication	technology
Main objective 1. Enhance the understanding of ARCSAR partners on factors that *affect survivability* and *decision-making* in the Arctic and North-Atlantic (ANA) region by exercising a live response to a simulated maritime incident.	x	x	x	(x)
Main objective 2. *Strengthen collaboration* between the responding parties, including industry, and improve procedures for cooperation		x		(x)
Sub-objective 1. The participants (players) conducting the exercise enhance trust among each other and stakeholders by improving familiarity with: a. how the crew of an expedition cruise vessel operate and mitigate risk in the ANA region; b. how the established incident management system and participating designated rescue assets operate and mitigate risk in the ANA region; c. how different organizational cultures, decision-making processes, languages and terminology can affect response across different sectors.	x	x	x	(x?)

Sub-objective 2. Players demonstrate their ability to cooperate:
 	
   a. while responding to a simulated fire on board an expedition cruise vessel;
   b. to evacuate passengers (role players) from an expedition cruise vessel to a place of safety (designated as a vessel of opportunity, port, or rescue vessel as applicable)
	x	x	x	

Sub-objective 3. Gain a better understanding of the main steps/challenges (coordination) associated with transferring passengers (evacuation) between ships at sea, for example:
 	
   1. Healthy, young to middle-aged passengers
   2. Injured, young to middle-aged passengers
   3. Considering challenges associated with older passengers
	x	x		

Sub-objective 4. Players demonstrate their ability to communicate effectively throughout the exercise			x	
Sub-objective 5. Players demonstrate their ability to effectively contribute to the exercise evaluation and lessons identified in order to draft recommendation for further procedures and policy				x

The evaluation questions in excel were requested to be answered with a colour code so as to ease reporting and to have a possibility easily to see the level of measures taken. The colour codes are following:

- **Green**. Activity is done on time/ Activity is done as expected and agreed on
- **Yellow**. Activity is done partly on time or delayed in some amount/ Activity is partly conducted as expected and agreed on but something is missing or not as it should be
- **Red.** Activity is not done on time or badly delayed/ Activity is not conducted as it should have been and is agreed on
- **Grey**. No possibility to report/ Additional own questions/ Additional important remark

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