Area-based Emergency Preparedness on the Norwegian Continental Shelf

Baseline report documenting premises and technical assessments in Norwegian oil and gas 064: Recommended Guidelines for Establishment of Area-based Emergency Preparedness

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Preface

There has been an assumption in the revision of the Norwegian oil and gas 064, Guidelines for Establishing Area-based Emergency Preparedness, that the text of the guidelines should be brief and limited to the relevant requirements and terms. But there has also been a need to document the assessments and analyses that have been conducted as a basis for the revision work, hence the need arose for the current report. Considering that the work is a revision of the guidelines from 2000, there has been a need for a relatively comprehensive data and collection of experience and professional judgment, given that it still raised objections to area-based emergency preparedness in some quarters. Also reassessment of conditions and values in the guideline 064:2000 has resulted in a need for the collection and analysis of empirical data.

The report, commissioned by the Norwegian oil and gas, is released to document the basis for the evaluations in the 064:2012 guidelines, based on professional judgment, the assumptions and principles that have been applied, and experience with area-based emergency preparedness. The report covers all aspects related to the area-based emergency preparedness and associated requirements, without taking full account of the restrictions regarding themes that are applied to the update of the guidelines.

Several comments and suggestions have been received in the course of the revision work, including responses to a couple of memos which have been circulated to the working group and other stakeholders. The way that comments and inputs are reflected is through an extended discussion of the relevant issues. A detailed review of the comments is not presented.

Thanks to Kristian Lexow and colleagues at SOS International, who have analysed their data from the on-call doctor scheme in Stavanger, to extract medical statistics. It would be impossible to name everyone who have contributed; a number of people in the operating companies, unions, helicopter operators, authorities, public and private sector specialists, research institutions and consulting firms. Thanks to everyone for great benevolence and useful suggestions. The author is in any case responsible for the views expressed in the report.

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Jan Erik Vinnem
Preventor AS

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Preventor
Risk management research and development

P O Box 519, N-4341 Bryne, Norway
Tel: +47 5148 7880, Fax: +47 5148 7881

E-mail: post@preventor.no
Web: http://www.preventor.no

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This report presents supporting documentation in the form of analyses and assessments of the Norwegian oil and gas 064:2012, Guidelines for Establishing area-based emergency preparedness, commissioned by the Norwegian oil and gas. It discusses a number of aspects that are of importance to the requirements and criteria included in the guidelines, and elaborates on the principal discussions of the essential premises of the revision work, including a discussion of the relationship between the helicopter and standby vessel as emergency resources.

It presents data on the use of SAR helicopters on the Norwegian Continental Shelf since 2003 and data from the SOS International, Stavanger on-call doctor district for the period 2005–2010, and analysis of these data.

Chapters 2–4 discuss some important terms and conditions for the area-based emergency preparedness requirements. Chapters 5–12 follow the same structure as the guidelines.

Chapters 13–14 discuss other requirements for DFUs and new DFUs, while Chapter 15 is a copy of the text from the Guidelines 064:2000 which refers to the cost distribution between companies.

Index terms, English:	Norsk:
Emergency preparedness	Beredskap
SAR helicopter	SAR helikopter
Medical evacuation	Medisinsk evakuering
Rescue from sea	Redning fra sjø

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1. Introduction

1.1 Background

Norwegian Oil and Gas 064:2012, Recommended Guidelines for Establishing Area-based Emergency Preparedness, is an updated edition of the previous guideline. Part of the reason for the update was for the document to be less extensive. At the same time, there is a need to document the analyses and assessments made. This report was made in order for the guidelines to be as short as possible, while providing the necessary background information in this report.

1.2 Purpose

The purpose of the report is to document analyses and assessments made in connection with the update of the guideline. The report will not contain requirements or premises for area-based emergency preparedness, this content will be provided by the guidelines.

1.3 Preparation of the report

The report was prepared as an independent report which documents the analyses and assessments made in the work on updating the guidelines. The working group in Norwegian Oil and Gas which was responsible for the update of Guidelines 064 has provided feedback, comments and input during the update process. The report discusses all aspects related to area-based emergency preparedness and associated requirements, without taking full consideration of the thematic restrictions that were stipulated for Norwegian Oil and Gas 064: Recommended Guidelines for Establishing Area-based Emergency Preparedness. The author is responsible for the technical content of this report. The original report is in Norwegian, whereas the present report is an unofficial translation.

1.4 Report structure

Chapter **Feil! Fant ikke referansekilden.** discusses the proposal for the requirements in the guideline to apply for all facilities on the shelf.

Chapter 3 provides an overview of how area-based emergency preparedness is implemented, briefly summarises the experiences and documents and analyses empirical data for SAR helicopters, as well as data from the on-call doctor system on parts of the shelf. A considerable scope of empirical data was reported and analysed in the study ”Offshore emergency preparedness, overall evaluation, Assessment of strengths and weaknesses” (Ref. 1). This data is only modestly referenced in Chapter 3 of this report, reference is otherwise made to the report “Offshore emergency preparedness, overall evaluation”. Chapter 4**Feil! Fant ikke referansekilden.** provides an extensive basis for discussing the need to dimension for simultaneous incidents in each area with emergency preparedness cooperation, as well as a discussion of the size of the area to which the guidelines should apply, and how increased mobilisation time should be handled.

Chapters 5 through 12 follow a similar structure as in the guidelines, and provide the professional basis and the assessments made for each DFU, from DFU1 to DFU8. Chapter 5 of the baseline report corresponds to Chapter 5 in Guideline 064:2012, etc. through Chapter 12.

Chapter 13 discusses the need for stipulating other requirements for the existing DFUs. Chapter 14 discusses the need for new DFUs, followed by verification in Chapter 15. Chapter 16 cites the cost distribution model described in Guideline 064:2000, without updating this.

1.5 Definitions and abbreviations

1.5.1 Definitions

Definitions used in compliance with NORSOK Z-013, where relevant.

Emergency medicine	See thrombolytic treatment
ALARP (As Low as Reasonably Practicable)	ALARP expresses that the risk level is reduced – through a documented and systematic evaluation process – insofar that measures can no longer be identified – that do not entail a significant disproportion between costs and benefit – that can further reduce risk.
Emergency Preparedness analysis	Analysis which includes establishment of defined hazard and accident situations, including dimensioning accident situations, establishment of emergency preparedness strategies and functional requirements for emergency preparedness and identification of measures to dimension emergency preparedness.
Establishing emergency preparedness	Systematic process which involves planning and implementing suitable emergency preparedness measures for the relevant enterprise, on the basis of implemented risk and emergency preparedness analyses.
Defined hazard and accident (DFU)	A selection of possible incidents which the enterprise's emergency preparedness should be able to handle, based on the enterprise's dimensioning accidents, as well as hazard and accident situations associated with a temporary increase in risk and accident incidents with a limited scope.
Efficiency requirements for emergency preparedness	Verifiable requirements for efficiency of safety and emergency preparedness measures that will ensure safety goals, risk acceptance criteria, the authorities' minimum requirements and established norms are satisfied during engineering and operation (NORSOK's definition is "functional requirements").
Risk analysis	Analysis which includes systematic identification and description of the risk for humans, the environment and/or financial assets.
Significant wave height (H_s)	Significant wave height is the mean value of the 1/3 largest wave heights observed (measured) in a given weather situation. The 1/3 largest wave heights means the mean value of the waves that remain after including 1/3 of the total number of wave heights, according to falling wave height. It is emphasised that significant wave height is either characterised as "significant wave height" or …. m H_s. In all other cases where wave height is indicated, this must be understood as the maximum wave height.
Thrombolytic treatment	The treatment involves injection of enzymes to dissolve blood clots in the heart. It is assumed that an exact diagnosis can be made in advance through contact with a heart specialist, based on a transferred EKG. Considerable expertise is also required to stop potential life-threatening bleeding that could occur.

1.5.2 Abbreviations

ALARP	As Low as Reasonably Practicable
AMK	Emergency medical communication centre
AWSAR	All Weather Search and Rescue
BSL	Provisions for Civil Aviation
CHC	CHC Helicopter service
DFU	Defined Hazard and Accident Situations
DNV	Det Norske Veritas
EER	Escape, evacuation and rescue [of personnel]
EKG	Electrocardiogram
H_s	Significant wave height
HNO	Halten Nordland
HSS3	Helicopter Safety Study 3
HSE	[UK] Health and Safety Executive
ISO	International Standards Organization
LB	Lifeboat
LIMSAR	Limited Search and Rescue
MEDEVAC	Medical evacuation
MOB	Man-overboard
n.m.	nautical mile
NAWSAR	Norwegian All Weather Search and Rescue Helicopter
NCS	Norwegian Continental Shelf
NLA	Norwegian Air Ambulance
NORSOK	The Competitive Standing of the Offshore Sector
NRAO	Norwegian rescue responsibility area
OGP	Oil and Gas Producers
PLB	Personal Locator Beacon
POB	People on board
PSA	Petroleum Safety Authority Norway
QRA	Quantitative Risk Analysis
RNNP	Risk Level in Norwegian Petroleum Activities
RVK	Regulatory forum
SAR	«Search and Rescue»
SBV	«Standby Vessel»
TRA	Total Risk analysis

2. Should area-based emergency preparedness requirements apply for the entire shelf?

2.1 General discussions

In principle, the requirements in Guidelines 064:2000 only apply where cooperation areas have been established for emergency preparedness with a greater or lesser extent of common air and maritime resources. The requirements do not apply outside these areas. The exemption is the requirement for picking up one person that falls into the water within eight minutes following notification. This is used as an expression of the accepted industry practice. This was also the reason for including this in the guidelines.

Some of the other requirements are also largely perceived de facto as the accepted industry practice. This relates to both the requirement for picking up 21 people from a helicopter accident within 120 minutes, as well as the requirement for transporting seriously injured people and seriously ill people to a hospital within three hours. However, these requirements are not binding outside the areas.

The good solutions that are available within the defined areas are not available in other areas. In the assessment of emergency preparedness for the Petroleum Safety Authority Norway (Ref. 1), this factor is indicated as the greatest weakness of the emergency preparedness solutions on the Norwegian Continental Shelf (NCS). In order to be applied on the entire NCS, the guidelines must apply to all facilities on the NCS, regardless of whether or not they belong to an area with emergency preparedness cooperation. It will also have the advantage that there will be no ambiguity and uncertainty regarding what is the applicable practice for employees that do not permanently work on a facility. Currently, there are different requirements for whether you work on a facility inside or outside a emergency preparedness area.

Several parties have suggested that there should be common requirements for the entire shelf. Common requirements for the entire shelf could make it easier to establish more cooperation areas, where there currently is no such coverage. The map in **Feil! Fant ikke referansekilden.** shows that, in the area west of Haugesund, there are many facilities in an area without emergency preparedness cooperation. However, this area has a cooperation with BP on the UK shelf (Jigsaw) with regard to use of a SAR helicopter, a helicopter offshore[1] and a helicopter stationed on Shetland.

The Petroleum Safety Authority Norway has expressed support for making Guidelines 064:2012 apply to all facilities on the shelf. They want to avoid what are commonly called “A and B” teams, or, put another way; everyone on the shelf should have equally sound emergency preparedness solutions available. As of 1 January 2011, 88% of all employees on the shelf were covered by a SAR helicopter, when those covered by Jigsaw are included.

Area-based emergency preparedness was introduced about 10 years ago. It is considered by most to be a great success and considerable improvement. To a certain degree, it is therefore noteworthy that no new areas have been established following the original (a new area to replace Jigsaw is being assessed, see Subsection 4.1.4.4, see page 35). Goliat will also receive a emergency preparedness solution when production activity starts that satisfies all requirements in the guideline, including third generation standby vessels[2]. Otherwise, it appears no new areas are under evaluation, also not in studies of

[1] Jigsaw has a helicopter stationed on the Miller platform, which shut down production in 2007. The decommissioning plan was presented in 2010, with the first possibility for removal of facilities in 2012, but can also be postponed by BP for several years. Jigsaw’s fate following removal of Miller is unknown.
[2] Also sometimes referred to as ”fourth generation”. In relation to rescue of personnel, key factors include high cruising speed, as well as skid in stern to pick up man-overboard (MOB) boat or lifeboat.

possible development solutions for the Norwegian Sea, far from land (Vøring plateau) so they cannot be included in Halten Nordland area-based emergency preparedness.

The regulatory principle on continuous improvement indicates that, at least now after approx. ten years, it is natural to assess whether to make Norwegian Oil and Gas 064: Recommended Guidelines for Establishing Area-based Emergency Preparedness applicable for all facilities on the NCS, potentially in the northern areas (Barents Sea and areas in the Norwegian Sea far from land) as a first step. As the situation stands, it appears that field development to the north in the Norwegian Sea and in the Barents Sea (with the exception of Goliat) where there is greater vulnerability and minimal infrastructure, and which should therefore have the best solutions for safety and emergency preparedness, do not actually have this. In fact, they appear to have poorer solutions, particularly as regards emergency preparedness.

If the requirements are made applicable for all facilities (production facilities and mobile units) on the NCS, regardless of whether or not they have area-based emergency preparedness, it will be costly for those who do not have such cooperation. It should therefore spur establishment of more areas. An example of cost-benefit assessment for an assumed new, small area is shown in Subsection 2.2.

One of the most important arguments for area-based emergency preparedness in 2000 was what was believed to be a high number of seriously ill and injured people needing transport to a hospital. Empirical data from ten years has shown that the need was a factor ten times higher than predicted in 2000. The high number entails that ambulance flights with SAR helicopters on the shelf are very significant for life and health for many people each year. This also means that the costs for these helicopters are not disproportionately high in relation to the high number of people that benefit from this, see calculations in Subsection 2.2.

The assumption for making the requirements applicable for all facilities on the NCS is that it will be possible for mobile units to participate in area-based emergency preparedness schemes. This has been impossible in at least one area (Halten Nordland), based on an understanding that there had to be a maximum limit for POB (personnel on board) for the facilities that are included in an area. As far as is known, this restriction is being phased out. See also discussion in Subsection 3.6.

Multiple viewpoints on this proposal have been received through discussion and written input. This discussion is a summary of this input.

Several parties point out that making the area-based emergency preparedness requirements applicable for the entire shelf will lead to more cooperation, more areas and thus improved emergency preparedness; in addition to preventing the growth of different “industry and company practices”.

On the other hand, it is claimed that by making the requirements applicable for all facilities, the focus will move away from area-based emergency preparedness and the cooperation that is established. This appears to be based on a misunderstanding. To achieve practical solutions that are not too expensive, it must be expected that there will be more cooperation as the result of such a requirement, not less. But even with cooperation, there will still be added costs.

Some have argued that cost and benefit must always be assessed, and if the costs are disproportionately high in relation to the reduced (personnel) risk, the measure should not be implemented. But if one includes the effect of SAR helicopters placed on certain facilities to provide the possibility of rescuing people with serious illnesses that depend on rapid transport to a hospital, the number of people this relates to is so high that many measures will have an acceptable cost-benefit ratio. Subsection 2.2 presents an illustrative example.

It is noted that, rather than making the requirements applicable for all facilities, one should examine whether compensating measures can solve the same challenges. However, there are several relevant diagnoses that require rapid transport to a hospital, because vital parts of the treatment require use of equipment (for example CT scanner) that only exists in hospitals, see discussion in Subsection 11.2. Compensating measures will therefore only have a limited effect in any case. However, it will still be relevant to assess which compensating measures are relevant when there are activities (so far only a few individual facilities for exploration drilling) that take place at a great distance (300-400 km) from shore, in the Norwegian Sea (Vøring plateau) and in the Barents Sea, also Subsection 11.5 below. Furthermore, it is significant for what the emergency preparedness requirements should be for the Barents Sea, see Subsection 11.3.

It will to some extent be difficult to accept narrow arguments on finances, considering that both the authorities and the industry have ambitions for the NCS to be the best within HSE. The authorities have, for example, expressed that Norway should be world-leading within offshore HSE. Most of the companies also have a so-called zero vision as their overall HSE goal. It must be expected that such ambitions have a financial consequence, if the content is to be realistic.

In addition, as noted above, cost and benefit assessments have another and often more positive outcome than what is often experienced, because the number of employees affected by serious illness are so high. The empirical data (see Chapter 3) indicate approx. 260 cases per year for the areas that have area-based emergency preparedness cooperation with yellow and red cases of illness and injury. This equals about 4.4 cases per 100 people on board. If survival can be improved considerably for 10% of these, this will entail a possibility of justifying approx. NOK 220 million per year in increased costs with area-based emergency preparedness, for an area with total POB = 1000 people (several areas have a higher POB), if one assumes a willingness to pay of NOK 50 million per saved life (the interval used for such values is NOK 50 – 200 million per life, so the lower limit here is used to be conservative). Further highlighting of the cost-benefit factors is illustrated by the assessments of cost-benefit factors shown in the example in Subsection 2.2.

2.2 Example – cost/benefit when introducing area-based emergency preparedness

The example considers a possible new area that cannot be covered by any of the existing areas. As an example, an area far from shore off Nordland can be pictured, such as the Vøring plateau. It is assumed that it is planned as a separate area before a development solution has been chosen for the first field, so the need for hangars can be part of the development solution from day one. The potential area is assumed to consist of two fields with a facility on each field, and several subsea wells. It is assumed that five mobile drilling facilities operate in the area over a period of several years.

The area considered in the example is smaller than the other areas defined on the NCS. A small area was chosen to illustrate a possible area, for example on the Vøring plateau or in the southern Barents Sea (outside Goliat). It is also useful to illustrate the cost-benefit factors for such a small area. The cost-benefit factor only improves with more facilities. Table 1 shows the assumptions made for the relevant facilities in the area.

As regards the cost level and distribution of costs, a basis was taken in Guidelines 064:2000 (see copy in Chapter 16). The following changes were made:

- The costs of helicopters and third generation standby vessels[3] have been increased by 50% in relation to the values used in Guidelines 064:2000.

[3] See footnote 2

Table 1 Basic data used in an example study for new cooperation area for area-based emergency preparedness

Facility	POB	Flight time per month	Wells drilled per year	Production wells in operation	Production (bbls/day)
Field1	60	20	5*	8	210,000
Field 2	90	30	5*	12	250,000
5 MODUs	500	75	15		
Total	650	125	25	20	460,000

* Drilled with the mobile units

- If a emergency preparedness cooperation is not introduced, the following distribution of simpler standby vessels is assumed:
  - Field 1: 1 standby vessel
  - Field 2: 1 standby vessel
  - 5 MODUs: 2 standby vessels in total.
- The simpler standby vessels are assumed to have halved costs per year in relation to third generation standby vessels.

It is assumed that a hangar for a SAR helicopter is installed on Field 1, and that the additional investment cost is written off with NOK 50 million per year.

Table 2 shows a summary of gross and net costs per year for each facility and in total. It is noted that really only the total costs matter in a cost-benefit calculation. The details for each facility were included here to illustrate how the factors impact individual facilities.

Table 2 Gross and net costs for example study new cooperation area for area-based emergency preparedness (million NOK per year)

Facility	Helicopter	SBV joint	Write off investment	Total per unit	Annual cost field emergency preparedness	Net additional cost
Field 1	4.936	12.317	50.000	67.253	22.500	44.753
Field 2	7.404	14.274		21.677	22.500	(0.823)
Exploration drilling	33.740	18.410		52.150	45.000	7.150
Total	46.080	45.000	50.000	141.080	90.000	51.080

With the indicated POB, there will be 2.847 million working hours per year for the two production facilities and the five drilling facilities. This corresponds to 12.8 red and yellow ambulance missions, with empirical data as indicated in Subsection **Feil! Fant ikke referansekilden.**. With the same assumptions on improved survival as in Subsection 2.1, this equals 1.28 saved lives per year.

The net costs for all facilities total NOK 51 million, which entails that the write off of NOK 50 million for a hangar on one of the production facilities is the predominant annual cost. It can be noted that if one standby vessel per mobile drilling facility was assumed with field/facility emergency preparedness, there would be net savings with an area-based cooperation, no net cost. It shows that the calculation is relatively sensitive to the assumptions and preconditions stipulated, which is often the case for cost-benefit calculations.

With the chosen assumptions, the cost per saved life is NOK 40 million. Values used for the limit for willingness to pay per saved life are normally in the interval NOK 50–200 million (higher values have also been used in rare cases). A value of NOK 40 million per saved life will therefore not be considered disproportionately high, and the measure must be considered as having an acceptable cost-benefit factor.

As stated in the introduction, the number of facilities and number of people in the area is assumed to be at a relatively low level. However, the conclusion of the calculations is that there is not an unreasonable disproportion between costs and benefit. If a higher number of facilities was used, the results would be more beneficial. If a separate standby vessel had been assumed for each mobile unit, area-based emergency preparedness would, as mentioned, entail savings.

It is also notable that the POB can be lowered to 350 without cost/life exceeding NOK 75 million per saved statistical life. With the assumptions used as a basis here (Table 1), this will correspond to two production facilities and two mobile drilling facilities for drilling of exploration, appraisal and production wells.

The fact that SAR helicopters have a favourable outcome, is a result of the high frequency of red and yellow ambulance missions (green missions are not included) which the empirical data show for the existing SAR helicopters. Since this empirical data has remained relatively stable for several years, there is little uncertainty associated with this benefit.

The factor with most uncertainty is the assumption that 10% of the number of red and yellow missions is of such a degree of severity that rapid transport is vital for survival. However, the assumption is confirmed by the figures from SOS International, see Subsection 3.6.

In summary, it can be noted that a high frequency of DFU7, which provides a good effect of SAR helicopters even for areas with a low manning level, can ensure good emergency preparedness in relation to DFU2 and DFU3 in many areas on the shelf, and that the number can also increase with the new provinces that must be expected to receive production facilities in the coming ten years. Furthermore, it must be emphasised that a hangar is key, i.e. robust production facilities that have a certain back-up capacity are needed (in relation to weight and area-based use), so a hangar can be installed, preferably as an integrated part of the facility's original design. It may no longer be common practice to include such back-up capacity, as was the case 15–20 years ago (and earlier). Even floating production facilities often had such back-up capacity in the 1990s.

3. Analysis of experience and empirical data

The chapter provides a comprehensive analysis of empirical data, in relation to frequency of DFUs, empirical data from operation of SAR helicopters, as well as data from SOS International for the on-call doctor system for the fields operated out of Stavanger. A brief overview of SAR helicopters is also provided.

3.1 Frequency of DFUs

The documentation for the guideline (2000 version) contained an overview of the frequency of the relevant DFUs. In the Main Report for Guideline 064, annual frequencies for each DFU were indicated. There has not been a particular focus on statistical basis in the work on the guideline, as frequency of DFUs does not play a significant role for the emergency preparedness requirements. In the assessment of simultaneity of incidents, frequency of several of the DFUs is still included, so an updated statistical basis is presented in Subsection 4.1.2. A brief summary of the statistical picture is provided here, and further details can be found in Subsection 4.1.2.

3.1.1 DFU1 Man-overboard when working over sea

Subsection 4.1.2.1 has documented an average frequency for the entire NCS, including vessels that take part in the activity:

- Production and mobile units: 3.2 per 10^8 hours worked.

The incidents on the vessels are included in this average, and are thus normalised against the total hours worked on production facilities and mobile units on the shelf. The number of incidents on the facilities is much fewer than before, but there have been more incidents on vessels.

The frequency indicated here corresponds to an annual frequency:

- 1.3 man-overboard incidents per year on the NCS

3.1.2 DFU2 Personnel in the sea following a helicopter accident

Subsection 4.1.2.2 has documented an average frequency for the entire NCS as a prediction for the period 2010–2019:

- 0.45 per 100 000 flight hours.

This corresponds to 2.3 accidents being predicted for the period 2011–2020 for the entire NCS. This includes both fatalities and controlled emergency landings. The prediction applies for the entire transport by helicopter from onshore heliports to the facilities.

3.1.3 DFU3 Personnel in the sea following emergency evacuation

Subsection 4.1.2.3 has documented a prediction for average frequency for the entire NCS:

- Production and mobile units: $5 \cdot 10^{-4}$ per facility year.

For the NCS the updated value entails 0.5 incidents over the course of a ten-year period.

3.1.4 DFU4 Collision hazard

Subsection 4.1.2.4 has not documented a prediction for the frequency of DFU4, since measures in connection with preventing collision are not a considerable strain on area resources. A frequency of 1.5 incidents per year for the entire NCS was indicated in the baseline documentation for the guideline.

Since the guideline was prepared in 2000, efficient traffic monitoring on the NCS has been established with a basis in two traffic centres on Ekofisk H and at Sandsli (Statoil Marin). It is known that there are typically a few incidents per year involving mustering to lifeboats on the facilities, because there is a vessel on a potential collision course, with which contact cannot be established. An evacuation to sea (helicopter evacuation will normally take too long) based on a vessel on collision course has never been carried out. However, there was a precautionary evacuation in 1998 from a Norwegian production facility because a standby vessel that had lost control was drifting with a course towards the facility for a while.

The number of vessels on collision course with which contact could not be established within 25 minutes before the possible time of collision was 15 cases in 2010 (Ref. 2).

3.1.5 DFU5 Acute oil spill

Subsection 4.1.2.5 has documented a prediction for the average frequency for the entire NCS:

- Production and mobile units: 0.005 per facility year.

For the NCS, this value entails 0.5 incidents per year.

3.1.6 DFU6 Fire with need for external assistance

Subsection 4.1.2.6 has documented a few incidents (both in the 1990s) with need for external fire-fighting in the last 20 years on the NCS. Based on these incidents, the following rough calculation can be made:

- Production and mobile units: $5 \cdot 10^{-4}$ per facility year.

For the NCS, the updated value entails 0.5 incidents over the course of a ten-year period. This must be considered to be a rough, conservative prediction.

3.1.7 DFU7 Illness/injury with need for external assistance

This DFU has a considerably higher frequency than all other DFUs put together, there is extensive data material from the four areas with emergency preparedness cooperation on the NCS. Subsection 4.1.2.5 has documented a prediction for the average frequency for the entire NCS:

- Production and mobile units, red & yellow incidents: 4.5 per 10^6 hours worked

This equals approx. 185 red & yellow incidents per year for the NCS.

3.1.8 Summary

Figure 1 shows a summary of the values documented in Subsections 3.1.1–3.1.7. It is clarified that the values are partially rough prediction, and that they do not use the same emergency preparedness resources. For example, DFU7 mainly concerns the SAR helicopters, while DFU6 only concerns standby vessels.

DFU1 has a frequency of 1–3 per year for the entire shelf in total.

The last helicopter emergency landing (DFU2) was in 2002, but the pilots then found a vessel to land on. The last emergency landing on the sea on the NCS was in 1996, the last emergency landing on the sea on the UK shelf was in 2012.

The last evacuation to sea from a facility on the NCS was on Haltenbanken in October 1985 (shallow gas blowout, West Vanguard), while there was an evacuation to sea where lifeboats could not be used (most jumped in the sea in groups) from a jack-up facility being towed south from the NCS (capsizing, West Gamma) in 1990.

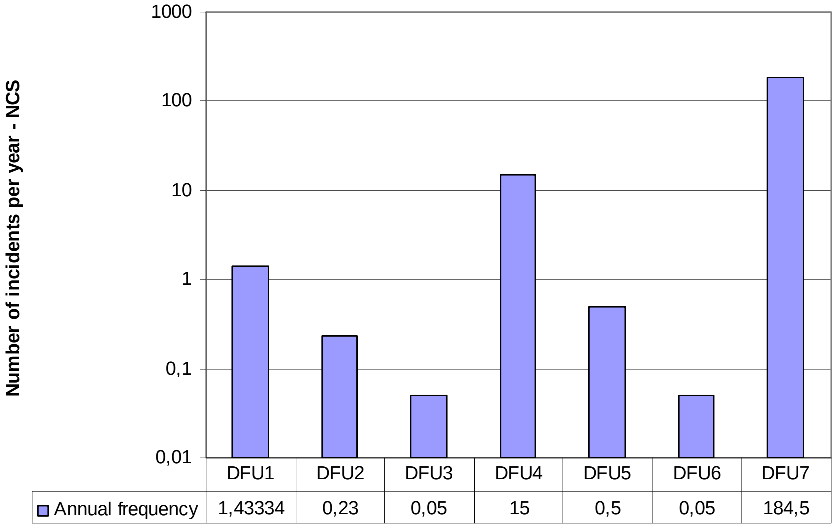


Figure 1 Typical frequencies for NCS, DFUs (logarithmic Y-axis)

3.2 Overview of SAR helicopters

The SAR helicopters are one of the most important resources in area-based emergency preparedness. SAR helicopters in the Southern Fields (Greater Ekofisk Area, Valhall, Ula, Gyda) operated by ConocoPhillips have been operational for more than 10 years, the other helicopters have been operational for seven-eight years. Historically there was also a SAR helicopter on the Frigg field for more than approximately ten years, but this was taken out of commission when the activities were reduced, and later shut down. As such, there are considerable volumes of empirical data, which are analysed in this chapter.

Coverage areas are indicated in Figure 2 for the SAR helicopters that are placed on the shelf, and that serve facilities in the North Sea and Norwegian Sea. There are four areas, three operated by Statoil and one area operated by ConocoPhillips:

- The Southern Fields (Ekofisk, Eldfisk, Valhall, Ula, Gyda)
  - Operated by: ConocoPhillips
  - Other companies that are part of the cooperation: BP, Talisman
  - Helicopter (AWSAR): Ekofisk
  - Helicopter (LIMSAR): Valhall
- Troll/Oseberg (incl. Veslefrikk, Huldra)
  - Operated by: Statoil
  - Other companies that are part of the cooperation: None
  - Helicopter (AWSAR): Oseberg field centre
- Tampen (Statfjord, Gullfaks, Snorre, Visund)
  - Operated by: Statoil
  - Other companies that are part of the cooperation: GDF Suez (Gjøa; only DFU7 with SAR helicopter)
  - Helicopter (AWSAR): Statfjord B
- Halten Nordland (Draugen, Njord, Åsgard, Heidrun, Kristin)
  - Operated by: Statoil
  - Other companies that are part of the cooperation: Shell, BP
  - Helicopter (AWSAR): Heidrun

Figure 2 does not include Hammerfest, which has an AWSAR helicopter placed on shore in Hammerfest when there is activity. As regards the Jigsaw helicopter, see Figure 3.

All of the areas have received better equipped helicopters over the past few years, some over the course of 2010. An overview of helicopter types and operators at the end of 2010 is the following:

- Southern Fields: Super Puma L1, AWSAR + LIMSAR (CHC)
- Oseberg: Super Puma EC 225 AWSAR with de-icing equipment (CHC)
- Tampen: Super Puma EC 225 AWSAR with de-icing equipment (CHC)
- Halten Nordland: Super Puma L1 AWSAR with de-icing equipment (CHC)
- Hammerfest: Super Puma EC 225 AWSAR with de-icing equipment (Bristow)

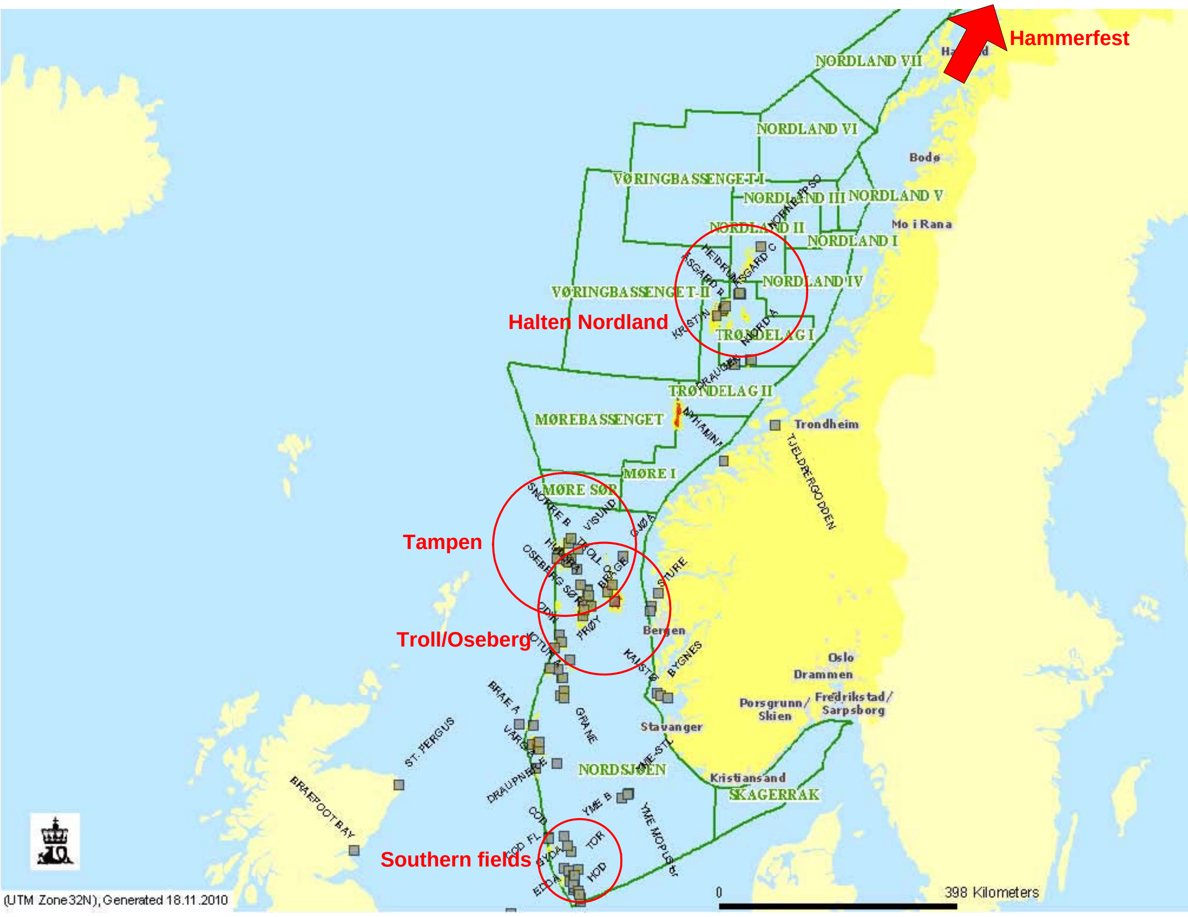
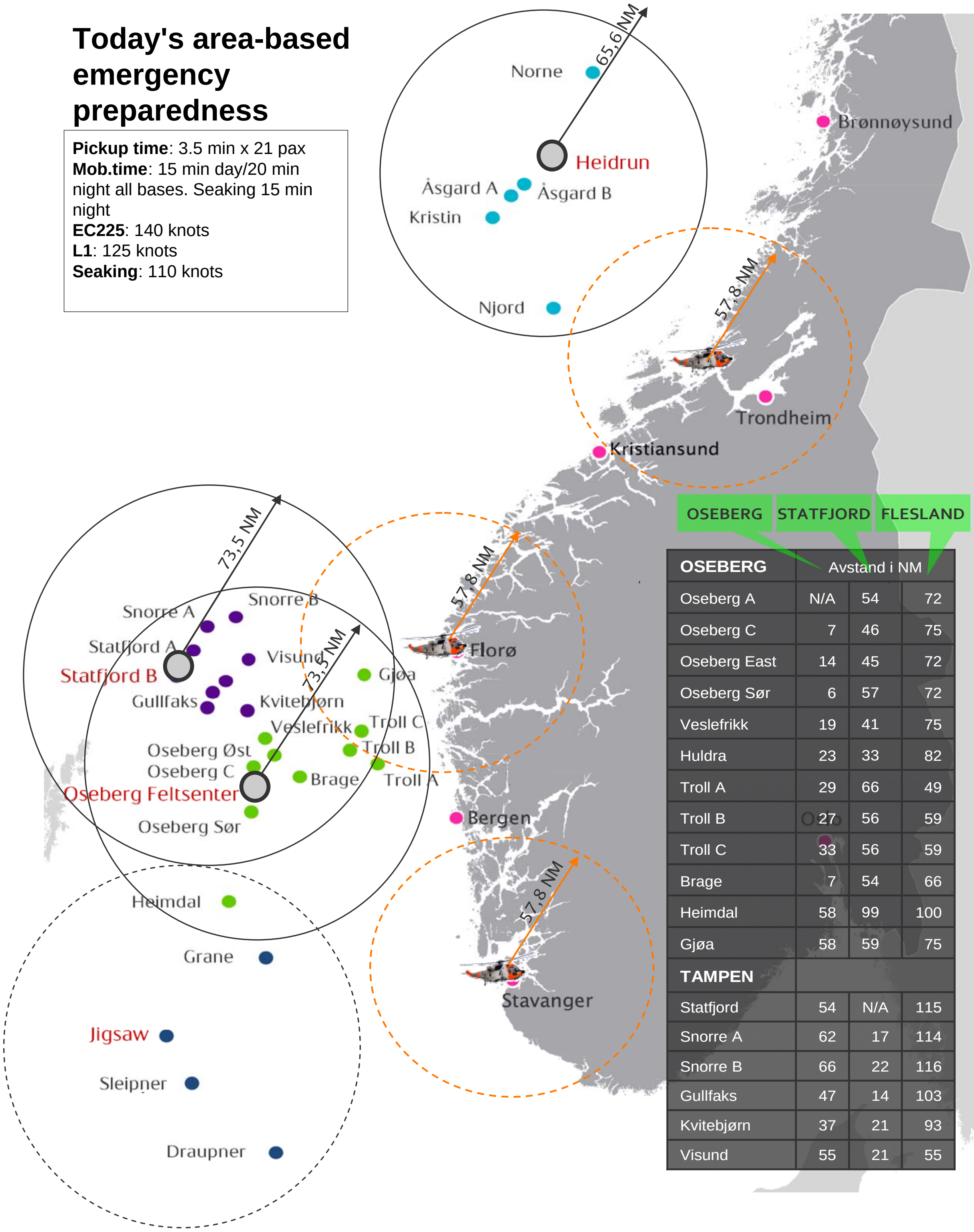


Figure 2 Overview of established areas in the North Sea and Norwegian Sea (with indicative spread)

The SAR helicopter in Hammerfest is permanently stationed onshore, and has primarily been mobilised for activity in the Barents Sea. When Goliat starts producing (and production drilling) it will be permanently operative, but still stationed onshore, as the flight time to Goliat from Hammerfest is only 20 minutes. Mobilisation times for the helicopters are shown in Table 3.

Figure 3 shows Statoil's overview of emergency preparedness areas, including Jigsaw on the UK shelf, which is also used on the NCS.



OSEBERG	Avstand i NM		
Oseberg A	N/A	54	72
Oseberg C	7	46	75
Oseberg East	14	45	72
Oseberg Sør	6	57	72
Veslefrikk	19	41	75
Huldra	23	33	82
Troll A	29	66	49
Troll B	27	56	59
Troll C	33	56	59
Brage	7	54	66
Heimdal	58	99	100
Gjøa	58	59	75
TAMPEN			
Statfjord	54	N/A	115
Snorre A	62	17	114
Snorre B	66	22	116
Gullfaks	47	14	103
Kvitebjørn	37	21	93
Visund	55	21	55

Figure 3 **Statoil's overview of their established areas on the NCS (including Jigsaw[4] on the UK shelf, source: Statoil)**

[4] The area served by the Jigsaw helicopter is sometimes called the "Southern Fields", but this term should be reserved for the area surrounding Ekofisk/Eldfisk/Valhall/Ula/Gyda, operated by ConocoPhillips, see **Feil! Fant ikke referansekilden.**.

One of the trade unions states that the SAR helicopters work well for medical evacuation, and that they are satisfied that the industry has acquired the most recent and most modern technology for such SAR machines, and that the requirements for medical and other SAR equipment are at a very high level on NCS. The same must be considered to be true for the personnel requirements on board the installations and the helicopter.

Table 3 Overview of mobilisation times for SAR helicopters

Area	Mobilisation time (min)		Comments
	Day shift	Night shift	
Southern Fields	15	30	15 minutes when there is helicopter traffic in the area and 30 minutes when there is no helicopter traffic.
Oseberg	15	20	
Tampen	15	20	10 min. conversion to SAR.
Halten	15	20	
Hammerfest	15/60	60	15 minutes with shuttle flights, 1 hour otherwise (maximum time), ENI uses 40 minutes as the design mobilisation time.

3.3 *Experience with area-based emergency preparedness*

Area emergency preparedness was introduced approximately ten years ago. The mapping shows that most agree that the experience is mainly good, but that there is still room for improvement.

The study of "Offshore emergency preparedness, comprehensive assessment, Assessment of strengths and weaknesses" (Ref. 1) proved that on all facilities on the NCS, also those included in area-based emergency preparedness, there is a clear improvement in the perception of emergency preparedness quality. This builds on the questionnaire surveys in RNNP, and is a clear improvement in the responses from 2001 and forwards. The outcome is clearly statistically significant, and is one of the strongest outcomes in the questionnaire surveys in RNNP. There is thus no basis for claiming that introduction of area-based emergency preparedness in general has weakened the trust in emergency preparedness on the facilities.

Most of the SAR helicopters have been upgraded to modern machines (EC-225 and L2, see Subsection 3.2) in recent years, and they now maintain a high standard, higher than the public rescue service with old Westland Sea King rescue helicopters. EC-225 is one of the candidates to be selected as the next generation helicopter for the public rescue service.

There are some deviations from the intentions in the implementation of area-based emergency preparedness, there is a focus on resolving this, see e.g. Subsection 4.3.

Another considerable weakness identified in the assessment of "Offshore emergency preparedness, comprehensive assessment" (Ref. 1) is that there are employees on a small part of the facilities that are not included by the solutions which area-based emergency preparedness provides. When the four Norwegian areas and Jigsaw are included, about 12% of employees work on facilities that fall outside the areas. It would be a clear improvement if most of these could be included under the solutions which area-based emergency preparedness entails.

Experience from operation of area resources, with an emphasis on SAR helicopters, is provided in the following Subsections 3.4, 3.5 and 3.6.

3.4 Empirical data from exercises, etc.

Reports have been received from 2 cooperation exercises (Level 2 exercises) in the Southern Fields in recent years, in May 2007 and in December 2010. These show the following data for picking up 21 people (dummies) from sea:

- May 2007: 50 minutes (60 minutes to confirmed POB)
- December 2010: 117 minutes (approx. 15 min. delay, waiting for other helicopter traffic)

Data has also been received from an exercise in Halten Nordland, May 2004, where 17 dummies were picked up at Njord A within 92 minutes from the notification of the SAR helicopter on Heidrun. The exercise was then interrupted because the remaining dummies had drifted underneath the facility. An MOB boat was not used, as the capacity of helicopter rescue was being tested.

A limited volume of empirical data has been available. This should not be interpreted as a problem with satisfying the requirement for 120 minutes, rather the opposite. In reality, a considerable volume of empirical data exists which indicates that picking up 21 people with a helicopter under good weather conditions within 120 minutes is not a problem. It is so unproblematic that a focus on confirming this through exercises appears to be toned down over the last ten years. This assumes the crews on SAR helicopters have good expertise that is maintained through training and exercises, as is the case for the SAR machines on the NCS, see Subsection 13.1 for more information.

3.5 SAR helicopter empirical data

3.5.1 Analysis of ambulance mission data

Data has been collected from use of SAR helicopters from the Southern Fields (two machines, only one with AWSAR properties), Troll-Oseberg, Tampen and Halten, a total of five machines. There is no systematic overview of empirical data for the SAR helicopter in Hammerfest, but this has not been in continuous operation.

Figure 4 shows an overview of the number of missions, for SAR and ambulance missions, as well as other missions classified as maritime assistance, emergency preparedness and evacuation. It emerges that the number of ambulance missions has been relatively constant, but has slowly increased from approx. 200 to nearly 300. The number of other missions has varied considerably, and was particularly high (up to 169 missions in 2006) for SAR and other types of missions.

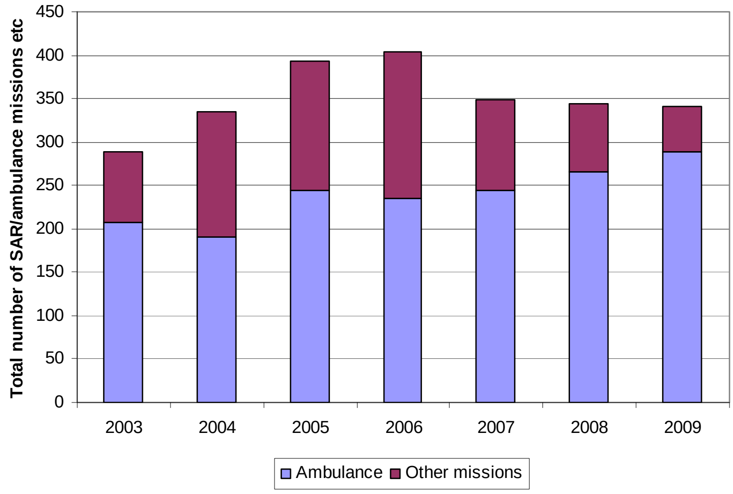


Figure 4 Overview of number of missions for all five SAR helicopters on the NCS

It can appear as if other missions increased considerably up to a peak in 2006, while there was a reduction in the period 2007–2009, down to a level approximately in line with 2003. Baseline data shows that, in particular, other missions for the helicopter on Oseberg, have been considerably reduced in recent years. It is emphasised that shuttle traffic with the helicopter on Oseberg and in the greater Ekofisk/Eldfisk area has not been included.

Figure 5 shows the number of ambulance missions distributed in four locations where SAR helicopters are stationed. The figure includes 50% of the (relatively few) missions indicated as "SAR/ambulance".

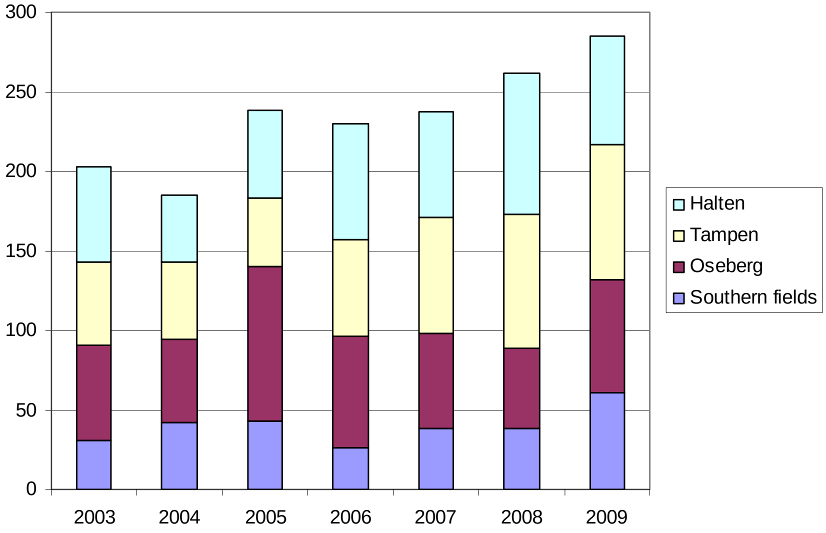


Figure 5 Overview of the number of ambulance missions for all SAR helicopters on the NCS

Figure 6 shows the average number of ambulance missions during the period 2007–2009 per 1000 employees in 2007. Production facilities, mobile units and other facilities (mainly removal) are included. Rough predictions were made for the number of mobile units, except for the Southern Fields where input from ConocoPhillips was received, and for Halten Nordland, where there is a basis from DNV's work. Vessels have not been included, despite them being included in DNV's work for Halten/Nordland.

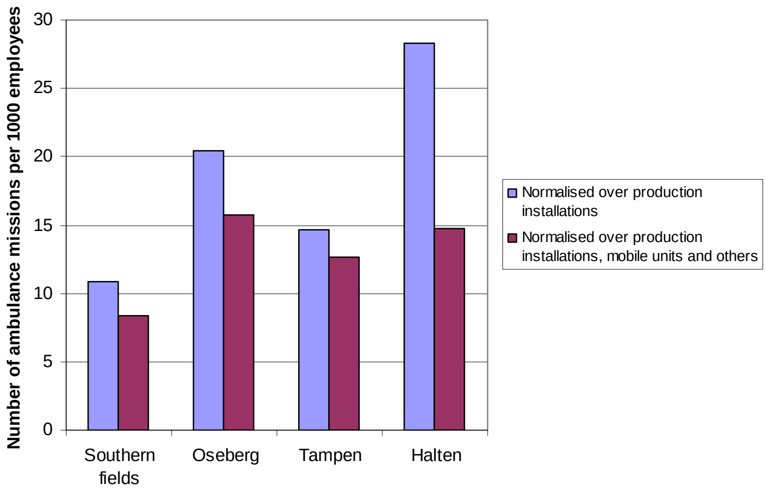


Figure 6 Number of ambulance missions per 1000 employees on facilities for all SAR helicopters on the NCS, average for the period 2007–09

There are considerable differences between the frequency of ambulance flights for the four areas with SAR helicopters, when normalising against the number of employees on the relevant facilities. There are two normalisations in Figure 6, one is in relation to the number of employees on production facilities only. However, it is known that there are considerable differences in the number of mobile drilling facilities that are included in the areas, and consideration must therefore also be given to this, even though data on the number of mobile units included is not known in detail.

Assumptions have been made in relation to typical values for the number of drilling facilities used in Figure 6. There is thus some uncertainty in relation to the exact values when normalising both against production and mobile drilling facilities, but the trends in Figure 6 should be representative. The high overabundance in Halten Nordland when only normalising against the number of employees on production facilities, disappears when also taking into account the number of employees on mobile units.

The Southern Fields are lowest regardless of the normalisation method. An explanation of why there are so relatively few missions from the Southern Fields is that there are a large number of regular flights each day from the Greater Ekofisk Area. There is therefore ample opportunity to transport ill and injured people on regular flights, if their condition allows for this. The head nurse coordinates use of SAR helicopters for ambulance purposes.

There is a better possibility for achieving transport of ill and injured people from the Southern Fields than any other area on the shelf. It is also confirmed that the transports that are ambulance flights from the Southern Fields are generally exclusively red and yellow incidents, while other locations also have some green incidents, particularly from Halten-Nordland, see Figure 7 and Figure 8[5].

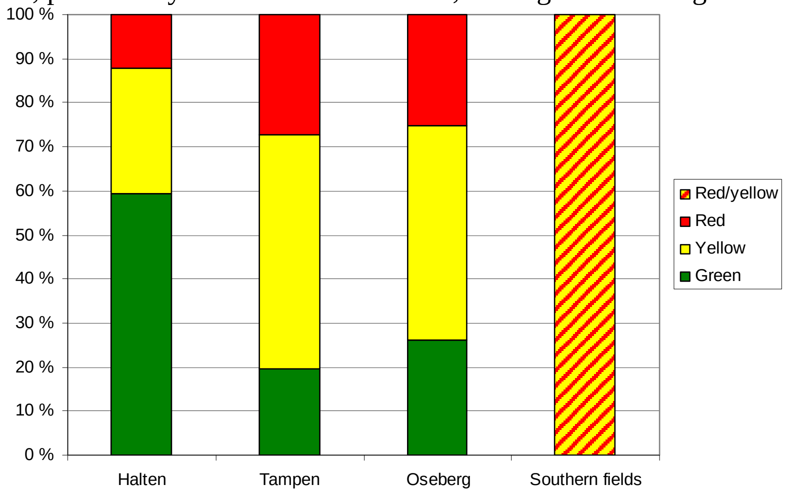


Figure 7 Percentage of missions with different criticalities for all SAR helicopters on the NCS, average 2008–2009

Red and yellow missions constitute 69%, red missions alone constitute 33%. These values correspond to 1.1 and 0.53 missions per area per month, respectively. For the four emergency preparedness areas, this is equal to just over one red or yellow ambulance mission per week, where the injury/illness is life-threatening. The definitions of the categories are as follows:

Red: life-threatening, risk of permanent injury
Green: patients that should travel onshore for an examination by a doctor, can also be sent with shuttle helicopters, but prioritise using SAR
Yellow: all others

[5] **Feil! Fant ikke referansekilden.** and **Feil! Fant ikke referansekilden.** assumes that all ambulance flights from the Southern Fields are yellow or red. It is stated that there is a very low number of green missions, but this is neglected in the figures. It is not possible to differentiate between the percentage of red and yellow.

Figure 8 shows that the percentage of green missions is decidedly highest in Halten-Nordland. Before 2007, there were many missions that were not classified in relation to green/yellow/red, so it is impossible to make a similar figure for this period. The classification is only available for Oseberg from 2008, as data was classified differently up through 2007.

3.5.2 Number of ambulance missions on the shelf

When the guideline was prepared in 2000, it was predicted based on available data that the number of ambulance missions to shore would be about 15 per year, **for the entire shelf as a whole**. However, the data basis for this prediction was very sparse. Also, only NACA 5–7 (see definitions in Table 4) were used as a basis, NACA=4 should probably also have been included.

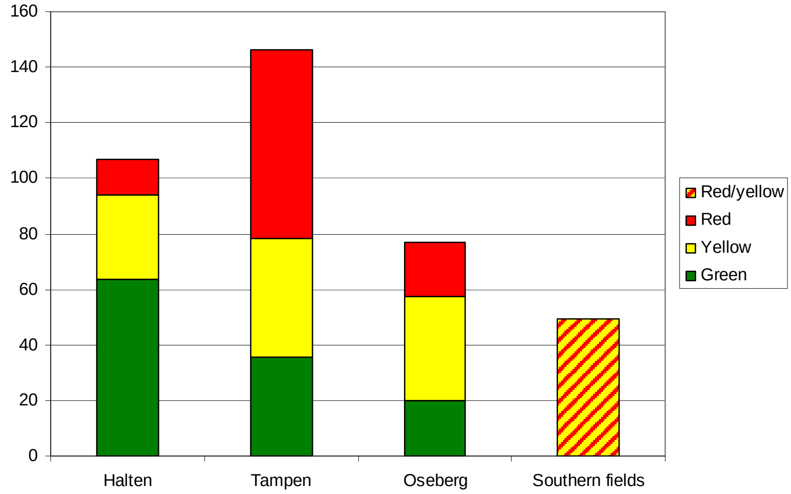


Figure 8 Number of missions with different criticalities for all SAR helicopters on the NCS, average 2008–2009

In order to obtain an prediction of critical ambulance missions for the areas that are included in area-based emergency preparedness, only data on yellow and red missions is used. As there is no data for yellow and red ambulance missions, one must make the assumption that the percentage of yellow and red ambulance missions is equal to the percentage yellow and red of total missions. With these assumptions, the number of yellow and red ambulance missions is approx. 195 per year. If all ambulance missions are included, the average will be approx. 275 per year. It is clarified that these values do not apply for the entire shelf, as the facilities between the Oseberg area and Southern Fields are not included, as well as some of the drilling activity carried out with mobile drilling facilities, when they operate for companies that are not part of the emergency preparedness cooperation.

Regardless, there is a considerably higher frequency of ambulance missions than what was predicted for the guideline in 2000. A likely part of the explanation can be found in a definition of what ambulance missions involve. In the area-based emergency preparedness guidelines, a basis was taken in the number of missions that were so critical that rapid transport to shore was absolutely crucial for survival, typically instances of cardiovascular disease and serious personal injuries. When these helicopters are actually available, there is reason to believe that ambulance missions are initiated in far more cases than when it is crucial for survival. With a preventive aim, transport to shore will likely be initiated in far more cases, with a natural precautionary attitude in allocation of ambulance flights.

3.5.3 Analysis of data regarding different types of missions

Figure 9 shows a distribution of types of missions for the Halten SAR helicopter, on average for the period 2003–2009. Together, ambulance and SAR constitute approx. 62%, followed by emergency preparedness (12%) and maritime assistance (10%). Figure 10 shows how the percentages have developed during the period 2003–2009.

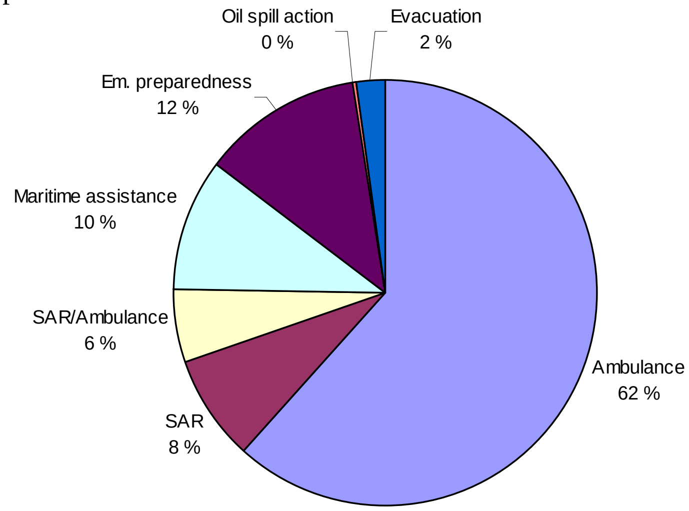


Figure 9 Distribution of type of missions on average 2003–2009, Halten SAR helicopter

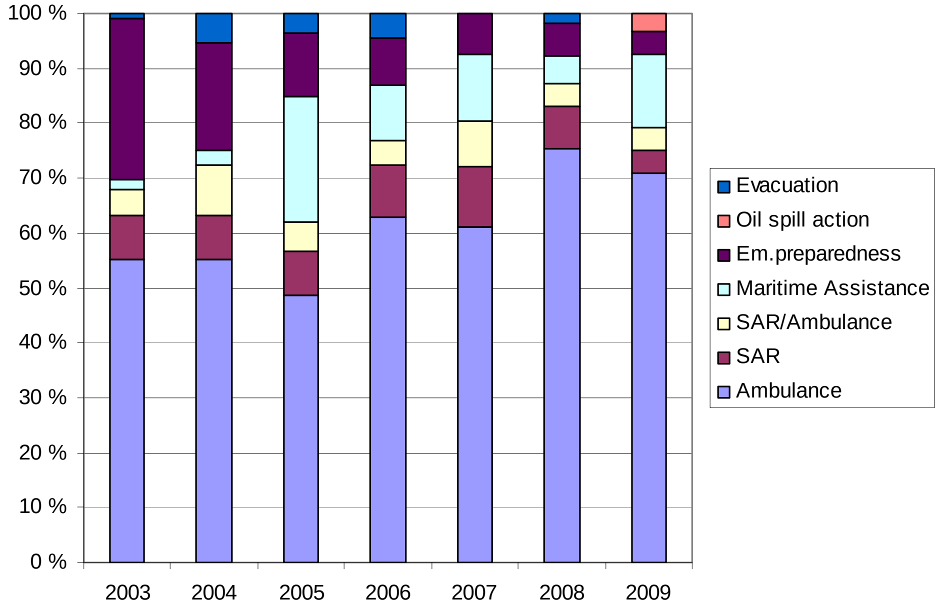


Figure 10 Development of types of missions in the period 2003–2009, Halten SAR helicopter

The number of ambulance missions for the entire NCS has been approx. 240 per year in the last three years, which corresponds to 4.5 missions per week, so just below one ambulance mission per week per helicopter on average. The number of ambulance missions is somewhat unevenly distributed, as indicated by Figure 5. In the last three years, there have been approx. 0.35 ambulance missions per week per helicopter in the Southern Fields, while the number of ambulance missions for the SAR helicopters operated by Statoil has been between 1 – 1.5 ambulance missions per week on average.

Figure 11 and Figure 12 show corresponding data for use of the Tampen SAR helicopter. It emerges that the percentage of ambulance missions is considerably lower than for Halten (45% compared with 60%). Oil spill response/control and SAR are considerably higher, and maritime assistance is considerably lower.

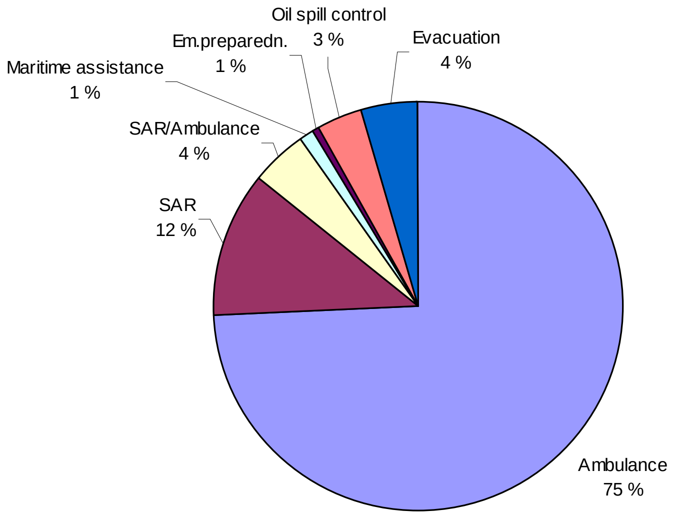


Figure 11 Distribution of type of missions on average 2003–2009, Tampen SAR helicopter

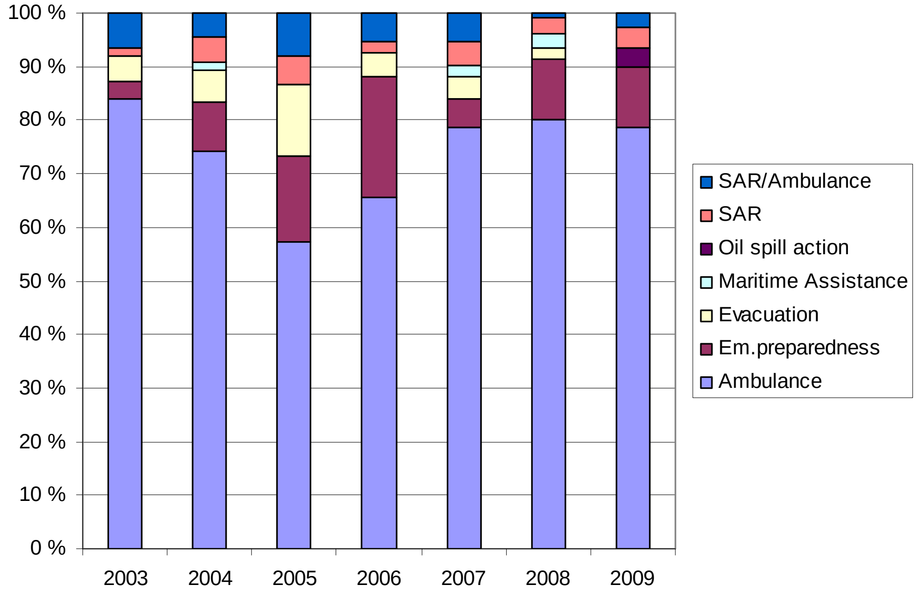


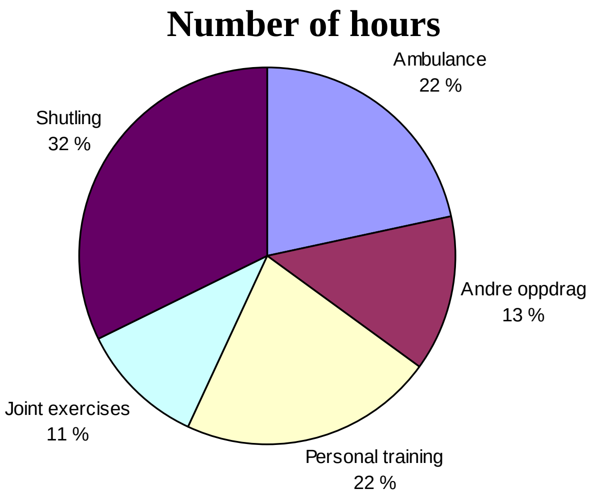
Figure 12 Distribution of type of missions in the period 2003–2009, Tampen SAR helicopter

3.5.4 Duration of missions

For the time being, this subsection is based on figures for the period 2003–2007, as data for flight times have not been available for 2008–2009. Figure 13 shows a distribution of time spent for the Oseberg/Troll SAR helicopter, where detailed time spent is stated. On average, the helicopter has been operational for 470 hours per year, and 495 missions per year.

The following is the average duration for the different types of missions with the Oseberg/Troll SAR helicopter:

- Ambulance 90 minutes
- Other missions 60 minutes
- Own training 85 minutes
- Joint exercises 63 minutes
- Shuttling 37 minutes



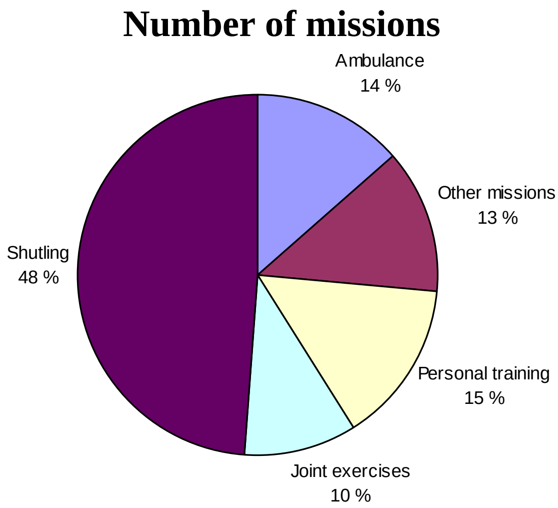


Figure 13 Distribution of number of hours and missions for the Oseberg/Troll SAR helicopter, average 2003–2007

Figure 14 shows the distribution of clients for the Halten SAR helicopter as an average over the period 2003–2007. Shell has a facility in the area as the operator of Draugen, and has an average of nine missions per year during the period. The number of missions for companies that do not operate a production facility in the area is 17.5% on average over the period. There are no dominating clients in this group, assistance to drilling rigs accounts for just 1.6%.

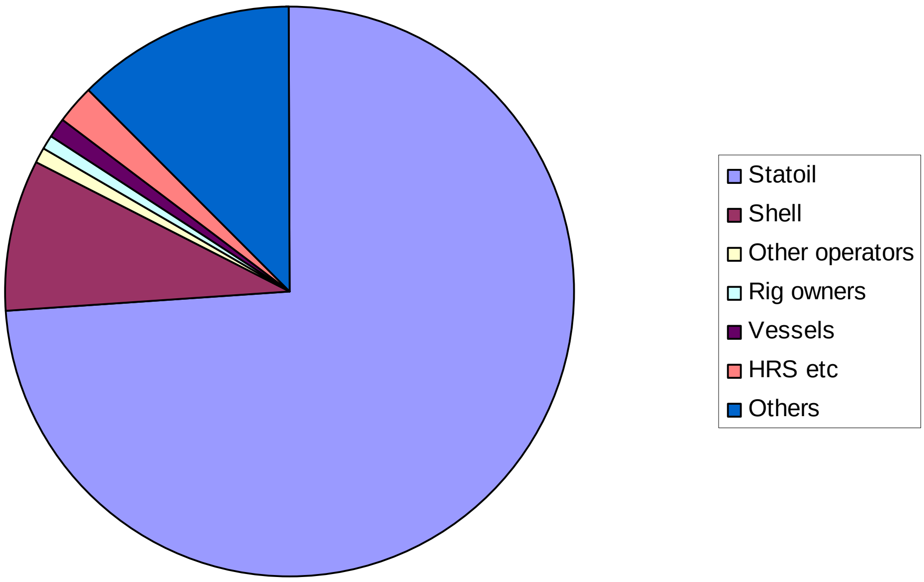


Figure 14 Distribution of clients on average 2003–07, Halten SAR helicopter

As regards the duration of ambulance missions, the following typical times are indicated:

- Southern Fields: 83 minutes
- Troll/Oseberg: 90 minutes
- Tampen: 107 minutes
- Halten: 144 minutes

For Tampen and Halten, the values are average durations for all missions, not just ambulance missions.

3.6 Empirical data from SOS International

SOS International has contributed an analysis of baseline data from its on-call doctor system for facilities that are operated out of the Stavanger area (Ref. 3). The data basis used is what was registered electronically with a basis in the service from Stavanger from 2005 through 2010. Reporting from Hammerfest, Brønnøysund, Kristiansund and Bergen is excluded. Some reports from 2010 are missing, but the remainder of the data basis is complete. The reporting uses the NACA scale with categories as shown in **Feil! Fant ikke referansekilden.**.

Table 4 NACA codes and their explanation (Ref. 3)

NACA	Explanation
0	**No illness or injury.**
1	**Minor injury or illness that does not need medical treatment**. Example: Temporary hypotension, minor cut. Patient fully treated and discharged from hospital.
2	**Minor injury or illness which requires medical treatment, but not necessarily hospital admission.** Example: Moderate soft tissue injury, burns. Normal birth. Patient fully treated and transferred to another hospital for care.
3	**Injury or illness that requires hospital treatment, but that is not life-threatening.** Example: Minor concussion, fractures, burns comprising 15–20% of body surface area, major wounds, minor asthmatic attack, cancer without organ failure. Unresolved chest pain, angina pectoris.
4	**Injury or illness that is potentially life-threatening.** Example: Suspected myocardial infarction, unstable angina, fractures of major bones, burns comprising 20-30% of body surface area.
5	**Life-threatening injury or illness, immediate treatment necessary.** Example: Brain contusion, suspected raised intracranial pressure (cerebral haemorrhage, cerebral oedema). Larger and complicated fractures, pelvic fracture, multiple rib fractures. Suspected rupture of viscera with circulatory impairment. Airway obstruction. Heart attack complicated with arrhythmia, hypotension or cardiac failure. Lung oedema. Loss of consciousness. Burns > 30% of body surface area.
6	**Serious injuries or illness with manifest failure of vital functions.** Example: CNS injury with respiratory/circulatory impairment. Thorax injuries and multiple fractures. Respiration and/or circulation failure.
7	**Dead on site or within the time for which the service was responsible for treatment, including death after resuscitation attempts.**

Figure 15 shows the total number of inquiries to the on-call doctor in Stavanger, distributed by illness and injury for the period 2005–2010. On average, the number of injuries accounts for 12.6% of the total inquiries.

Figure 16 shows the distribution between the most critical cases of illness and injury for the period 2005–2010, distributed by NACA category and year. The cause of the decline in 2009 and 2010 is not known, this could be circumstantial.

There are five NACA 4 injuries during the period, out of 78 total NACA 4 cases. There are no NACA 5-7 injuries in the period for Stavanger. This indicates that the percentage of injuries is approx. 5% of the total for illness and injuries, when only the most serious cases are considered. The low percentage also indicates that the decline in 2009 and 2010 cannot only be caused by a decline in injuries.

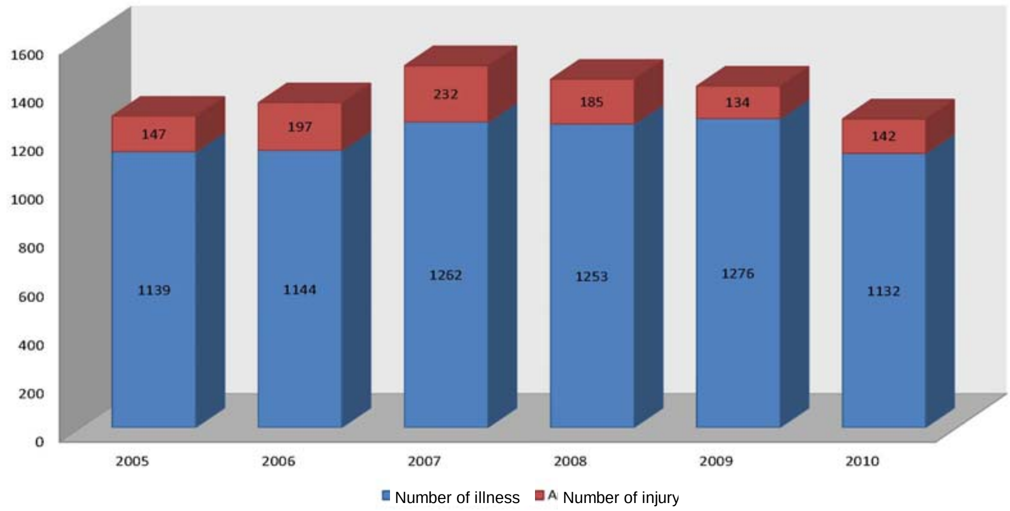


Figure 15 Total number of inquiries to the on-call doctor in Stavanger distributed by illness and injury, respectively (source: SOS International)

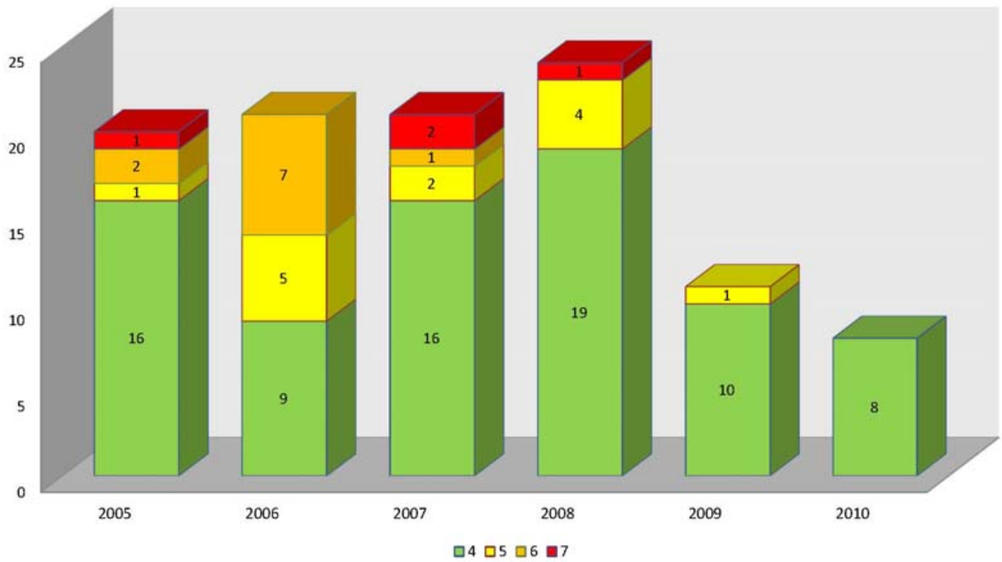


Figure 16 Number and distribution between NACA 4, NACA, 5, NACA 6 and NACA 7 (source: SOS International)

Feil! Fant ikke referansekilden. shows the most serious cases (NACA 4–7) distributed by cause and year, which shows that, on average, heart-related disease is responsible for 67%, cerebral for 13%, abdominal and stomach ailments 9%, and others as well as injuries about 5% each. **Feil! Fant ikke referansekilden.** shows that, in particular, heart-related cases have declined considerably in 2009 and 2010. There is no obvious reason for the decline, it is most likely caused by random variations.

Feil! Fant ikke referansekilden. provides the opportunity to give an independent prediction for the number of cases of serious injuries and illness on the NCS. On average, 0.67 serious injuries (NACA 4–7) are registered in the Stavanger on-call doctor area. In order for this to be comparable with the Petroleum Safety Authority Norway's definition of serious personal injuries, NACA=3 must also be included. Including NACA=3, there are an average of 17.2 injuries per year in the Stavanger on-call doctor area. For the shelf, this is about 45 serious personal injuries per year, which is roughly equivalent to the average for serious personal injuries reported to the PSA, which is 35 per year on average for the period 2005–2010, in accordance with RNNP (Ref. **Feil! Bokmerke er ikke definert.**). This assessment uses an assessment of the number of people on the shelf including in the Stavanger on-call doctor area carried out by SOS International, which indicates that this constitutes 38.5% of the total hours worked for all people working on the NCS.

Feil! Fant ikke referansekilden. provides an average for serious injuries and illness (NACA 4–7) for the Stavanger on-call doctor area of 17 cases per year, for the period 2005–2010. The values for NACA=3 are not available for illnesses, but a prediction based on the total number, as well as total number of injuries, is 119 cases per year, on average. For the shelf as a whole, this corresponds to a value of 310 cases per year. This value is 50% higher than the number of yellow and red missions for the SAR helicopters. The explanation is likely that a considerable part of NACA=3 is not flown as yellow or red missions. On the other hand, the companies also include some social causes in the basis for mobilisation of SAR helicopters, there will be some cases in addition that are flown as yellow missions. The four helicopters currently do not cover all facilities on the shelf, the Jigsaw helicopter covers several, the helicopter in Hammerfest covers a few and some are completely left out. But within an uncertainty margin that must be expected for such figures, there is a fair accordance between the two sets of values.

This means that the values from the companies' SAR helicopters and SOS International can both be used to assess the effect of ambulance flights and SAR missions.

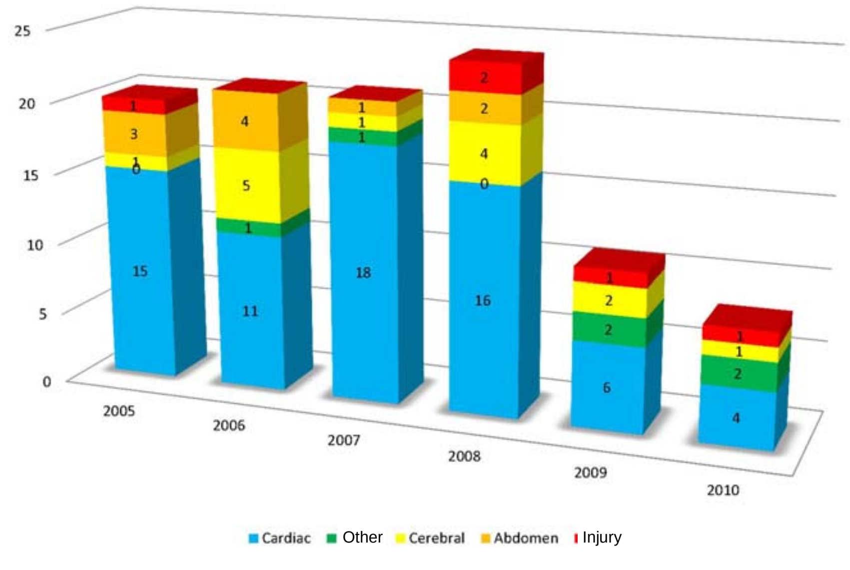


Figure 17 The number of serious conditions (NACA 4–7) each year and their causes (source: SOS International)

Feil! Fant ikke referansekilden. also provides the possibility for predicting the most serious cases, and their scope. The number of cases of NACA=5–7 during the period 2005–2010 which the on-call doctors in Stavanger cover is 27, which corresponds to 4.5 per year for this part of the shelf, and 12 cases per year for the entire shelf. NACA greater than 4 has barely been registered for the Stavanger on-call doctor area for 2009 and 2010, and if these two years are therefore ignored, the number is 18 per year for the entire shelf. This indicates that there are about 20 people per year with such serious illnesses and injuries that rapid transport to a hospital is crucial to their survival, potentially their quality of life if they survive. This corresponds to about 10% of the number of yellow and red ambulance missions on the shelf. Reference can also be made to an analysis of DFU7 which was made as a basis for the guideline in 2000, where the scope of people with life-threatening illness or injury was predicted at approx. 15 cases per year for the NCS. The values correspond to each other relatively well.

Feil! Fant ikke referansekilden. shows the number of transport missions to shore with ordinary and extra flights, and the latter will largely be the SAR helicopter in the Southern Fields and the Jigsaw helicopter on Miller. The average number of extraordinary transport missions to shore is 60 per year, i.e. 1.2 per week, which complies with the empirical numbers from the SAR service.

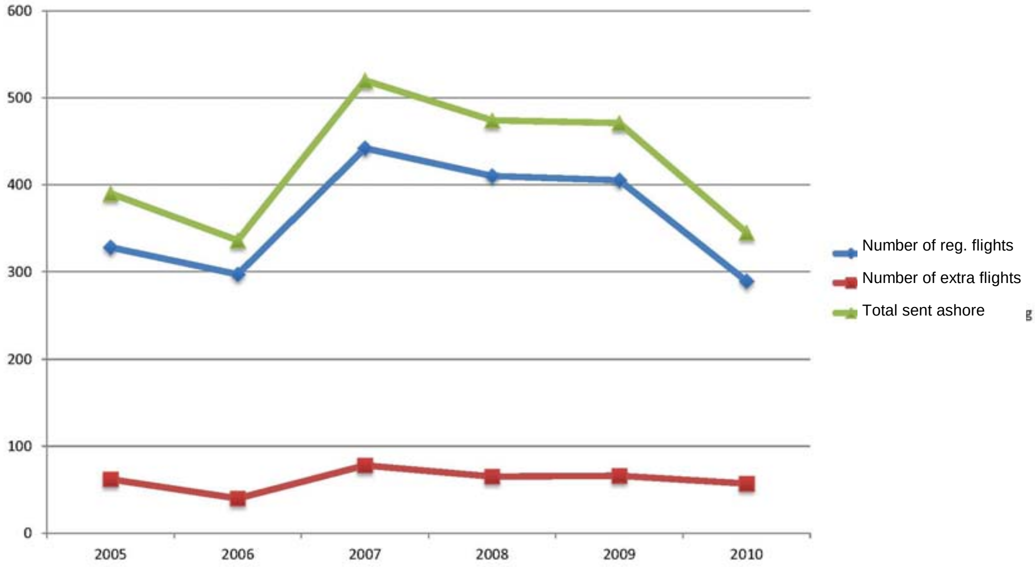


Figure 18 Number of cases of transport to shore with a helicopter due to illness or injury (source: SOS International)

Feil! Fant ikke referansekilden. shows causes of transport to shore for the most serious cases. Following three categories are divided into illness and injury, respectively "ICPC-A " (General and unspecified), "ICPC-L" (Musculoskeletal system) and "ICPC- S" (Skin).

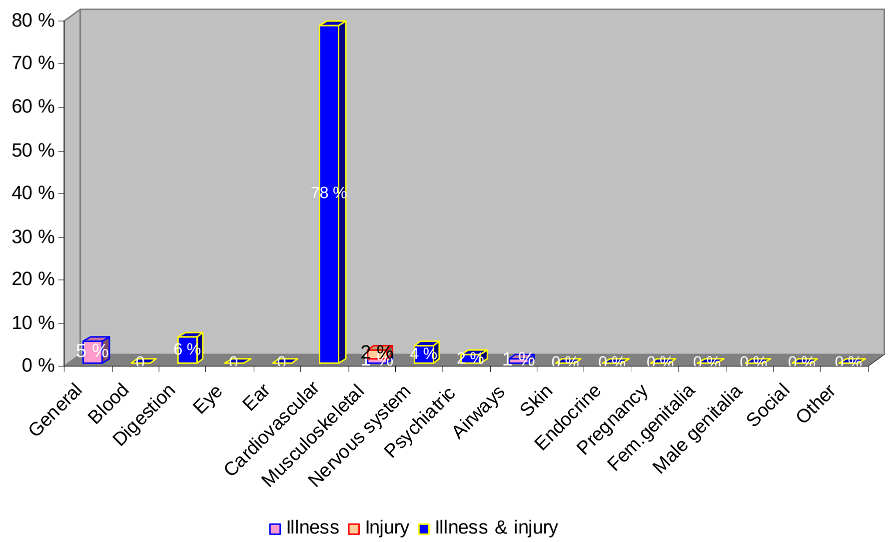


Figure 19 Percentage causes of transport to shore for serious causes (NACA 4–7). 'ICPC-A' (General and unspecified), 'ICPC-L' (Musculoskeletal system) and 'ICPC-S' (Skin) are divided into illness and injury, respectively (source: SOS International)

4. Restrictions when defining an area

4.1 Coincidence of DFUs

There has been a considerable focus on potential missions that were not delivered because the helicopter was busy on another mission. When the assessment on Comprehensive emergency preparedness (Ref. 1) was carried out for the PSA in 2008, no such missions were reported, and it was concluded that coincidence was not a relevant issue.

Since then, Halten-Nordland has reported the following:

- Period 2007–2009: One case of coinciding green missions

The two simultaneous missions were solved by being flown to land in the same helicopter, so both missions were thus delivered. A further elaboration on coincidence, based on Statoil's assessment on the same topic, is documented in this Subsection.

In the guidelines from 2000, a founding principle relating to only one DFU being dimensioned at a time was used as a basis. Statoil's practice on Halten Nordland (HNO) has to a certain extent challenged this, as there are restrictions on the number of facilities based on a possibility for coinciding incidents. There is therefore reason to assess whether the principle on the DFU should still be maintained. As a step towards this, it is necessary to carry out an assessment of the calculations which Statoil in HNO has built upon.

For some years in the Halten Nordland area-based emergency preparedness, there has been a cap on the number of POB (personnel on board) on the production facilities, mobile units and vessels that can be included in area-based emergency preparedness. The cap was introduced as a result of an audit by the Petroleum Safety Authority Norway, where the PSA asked how missions were prioritised for the SAR helicopters. As a reaction to this, DNV conducted an analysis which took a basis in the number of POB inside the area at the relevant time, 1626 for production facilities, mobile units and vessels on the field. Subsequently, this number was developed as an upper limit for POB, 1626 people.

Another element related to prioritisation of use of SAR helicopters is the ratio between red, yellow and green missions flown to shore. In Halten Nordland, more green missions have been flown to shore than what is normal in the other areas, see Ref. 12.

Production facilities that are part of area-based emergency preparedness for Halten Nordland constitute nearly half of the cap of 1626 people. About the same number of people can be included from mobile units and vessels that operate for Statoil, Shell (Draugen) and BP (Skarv FPSO installed in Q2/2011) in the area. Other operators are prioritised after these as regards mobile units and vessels.

Only Halten Nordland has had a cap on the number of people on the facilities that are part of area-based emergency preparedness. None of the other areas with cooperation in Statoil or area-based emergency preparedness in the Southern Fields on the NCS that are operated by ConocoPhillips have a similar cap. The need for a focus on such issues is related to risk of coinciding incidents.

In connection with the assessment of coordination of area-based emergency preparedness which was carried out by Statoil in autumn 2010, a decision was made to not continue the cap which Halten Nordland has used. This appears to be in line with the general perception that it is unnatural to have a cap on the number of people that can be included in area-based emergency preparedness.

Since there still is documentation of this, the documentation was reviewed. This Subsection presents a brief discussion of DNV's documentation of the cap of 1626 people, as well as proposed updated values (Subsection 4.1.1), while there is a general discussion of the need to dimension for coinciding incidents (Subsection 4.1.4).

4.1.1 Documentation of POB maximum limit

Statoil's documentation for setting limits on POB are mainly based on a DNV report (Ref. 4) 2004–0879, which was updated a few times in subsequent years. The report analyses the situation in Halten Nordland in 2004, with a basis in empirical data from 2003. The report has quantified the frequency of coinciding incidents for use of area-based standby vessels and for use of SAR helicopters.

The report is clear and sound, by explicitly documenting the preconditions and assumptions it builds upon (Appendix A), as well as showing empirical data from Halten Nordland (Appendix B) and calculations (Appendix C). However, the report has some interpretations that help push the frequency upwards, as well as some weaknesses that should not be ignored:

1. Accident statistics
   The values used for accident statistics for several of the DFUs are too conservative, see Subsection **Feil! Fant ikke referansekilden.**.

2. Scope of activity
   The analysis includes production facilities, mobile units, as well as vessels on the fields (POB = 171). It can be discussed whether vessels should be included in the dimensioning of area-based emergency preparedness, even though they will obviously also assist in the event of incidents.

3. Helicopter shuttle service
   Includes frequency of helicopter accidents in the entire phase for shuttle helicopters, even though the responsibility is only within the 500 m zone.

4. Update of empirical data
   The data basis which the report is based on is 2003 (Appendix B). Updates have not considered data and assumptions in relation to empirical data from more recent years.

5. Illness/injury on vessels
   For vessels, it is assumed that all illness/injury will lead to use of a SAR helicopter, because there is no helideck and therefore no other manner of transport. The report is too conservative here. Considerable time will be saved picking up people from vessels to Heidrun with a helicopter in the event of green incidents on vessels, and then sending them with a crew change service helicopter from there (obviously does not apply for yellow/red incidents).

4.1.2 Corrected DFU frequencies

Table 5 on page 28 shows a summary of the data used by DNV (Ref. 4). Some of the frequencies used by DNV have unrealistic values if applied to the entire NCS. It is therefore necessary to correct these, so the values are more realistic.

Table 5 Frequencies and response time for each DFU (source: DNV)

DFU	Frequency	Response time	
		Area standby vessel	AWSAR
DFU01 Man-overboard when working over sea	Production facilities: 2.7 per 100 mill. hours worked /6/ Mobile units: 4.3 per 100 mill. hours worked /6/	-	In 10% of man-overboard incidents: 120 min. + transport to hospital + return to Heidrun + 1 hour
DFU02 Personnel in the sea as the result of a helicopter accident	Obtained from each facility's risk analysis	24 hrs.	120 min. + transport to hospital + return to Heidrun + 1 hour
DFU03 Personnel in the sea during emergency evacuation	0.003 per installation per year	24 hrs.	120 min. + transport to hospital + return to Heidrun + 1 hour
DFU04 Collision hazard	100* the frequency for actual collision which is obtained from each facility's risk analysis	-	50 min. + return time to origo
DFU05 Acute oil spill	0.0023 per installation per year	24 hrs.	Mobilisation + 15 min.
DFU06 Fire with need for external assistance	-	-	-
DFU07 Illness/injury with need for external assistance	Permanent and mobile installations: One case per 84 000 hours worked Vessels: One case per 50 000 hours worked	-	Mobilisation time + transport from Heidrun to patient + transport to hospital + return to Heidrun + 1 hour

4.1.2.1 DFU1 Man-overboard when working over sear

DNV uses the following values with a basis in Guideline 064:2000:

- Production facilities: 2.7 per 10^8 hours worked
- Mobile facilities: 4.3 per 10^8 hours worked

Through RNNP (Ref. 2), there are statistics available for the period 1990–2010. It is not considered necessary to differentiate between production facilities and mobile units, as most incidents in recent years have taken place from vessels that are associated with the activity. As an average value for the entire shelf, the following can be used, based on 1990–2010:

- Production and mobile units: 3.5 per 10^8 hours worked.

This average includes the incidents on vessels, and is thus normalised against the total number of hours worked on production facilities and mobile units on the shelf. The number of incidents on offshore installations is much lower than before, but there have been more incidents on vessels. As regards the frequency of these incidents there is a flat trend.

4.1.2.2 DFU2 Personnel in the sea as the result of a helicopter accident

DNV (Ref. 4) uses the following values with regard to frequency of helicopter accidents:

- Production facilities: 0.52 per 100 000 flight hours[6]
- Mobile units: 1.2 per 100 000 flight hours

Each facilities' quantitative risk analyses are stated as sources for these values. However, they appear as generic frequencies, joint for all production facilities, but separate value for mobile units. There is no explanation for why there should be a separate value for mobile units.

It is difficult to see that there should be a difference between production facilities and mobile drilling units. Technical arguments (in relation to landing on a moving deck) could be envisaged for a difference between facilities resting on the seabed and floating units, but this has not been considered further. In any case, it is unlikely that there would be enough statistical data to find such a difference.

There is an insufficient basis for differentiating between various types of facilities, and it is considered most realistic to indicate a common value for all types of facilities.

DNV has used frequencies that correspond to the entire transport from shore to the facilities, even though the formal responsibility is limited to the safety zone surrounding the facilities. This approach is continued here, though it is conservative.

There is reason to clarify that the frequency included here must encompass fatal accidents as well as controlled emergency landings. Incidents similar to the controlled emergency landing on sea near the ETAP platform on the UK shelf on 18 February 2009 are then included, where everyone survived and was picked up. This is one of the most important scenarios for a SAR helicopter. Similarly, there was a controlled emergency landing at sea with a helicopter travelling to Ula/Gyda, 41 nm from Sola, on 18 January 1996. (Everyone was rescued from a raft). There was also a controlled emergency landing on 5 November 2002, but the helicopter was able to reach the helicopter deck on a nearby tanker, so rescue from sea was not necessary. It is therefore insufficient to look at the number of fatal accidents. This entails that it is not an evidently "correct" figure which can be indicated.

If one uses the values used by DNV (0.52 and 1.2 per 100 000 flight hours for production installations and mobile units, respectively) and combine these with the official number of flight hours from RNNP (2009), the result will be an annual frequency of 0.35 for the entire NCS. As there were only three incidents on the NCS in the last 20 years (emergency landings in 1996 and 2002, as well as the fatality in 1997), 0.35 is obviously a too high value, this could be shown to be statistically significantly too high with standard statistical tests. Even if four incidents had been included in the North Sea in 1988 (two on the NCS, two on the UK shelf), an annual frequency of 0.35 is not justified.

The most updated source for helicopter risk is HSS3 (Ref. 5). For the period 1990–2009 on the NCS, 0.9 fatalities per million person flight hours and 0.38 accidents (fatal and non-fatal) per million person flight hours are indicated. The data basis is then the number of incidents classified as "aviation accidents" in BSL A 1-3 (Ref. 6), respectively, while "aviation incident" and "serious aviation incident" are not included. The emergency landing in 2002 is classified as an "aviation accident".

For the period 2010–2019, a 23% reduction is indicated in relation to the period 1999–2009 on the NCS, while a reduction of 16% is stated for the period 2000–2009 compared with 1990–1999, based on expert assessments carried out by HSS3. If we here assume a 30% reduction for the period 2010–

[6] The term "hours" is used. Through checking calculations, it has been determined that flight time was used.

2019 compared with 1990–2009 on the NCS, we have a prediction of 0.63 fatalities per million person flight hours and 0.27 accidents per million person flight hours. In the period 1999–2009, there has been an average of 16.85 person flight hours per flight hour (i.e. 16.85 passengers per trip) on the NCS. The accident frequency expressed per flight hour is then as a prediction for the period 2010–2019:

- 0.45 per 100 000 flight hours.

These values correspond well with the predictions of risk values, including helicopter transport, made in Ref. 7.

The predicted value only applies for the NCS, and is based on five incidents during the period 1990–2009. If the UK shelf was included, the number of incidents would be 27. However, in the last 20 years, the frequencies have been significantly higher on the UK shelf, so the predicted value would be too high if the UK shelf is included. The number of accidents per million person flight hours on the UK shelf is 1.33 for the period 1990–2009, compared with 0.38 for the NCS. The number of fatalities per million person flight hours on the UK shelf for the period 1990–2009 is 3.1 compared with 0.90 for the NCS.

For the entire NCS, this corresponds to predicting 2.3 accidents for the period 2011–2020, if we assume that the number of flight hours develops in the next ten years as the number of person flight hours has done in the last ten years. This includes both fatalities and controlled emergency landings.

It is noted that the predicted number of accidents applies for the entire helicopter transport from shore to the facilities. If only the percentage within the safety zone were indicated, this would be a just a few per cent.

The value 0.45 per 100 000 flight hours is not significantly different from the value used by DNV, the difference is that this value is an average for all facilities on the NCS, while DNV has implicitly used an average of 0.73 per 100 000 flight hours, when weighting with the number of production installations and mobile units. The value corresponds to 0.31 accidents for Halten Nordland over the course of a ten-year period 2011–2020. This value can be compared with 0.06 incidents per year stated in the DNV report for HNO.

4.1.2.3 DFU3 Personnel in the sea during emergency evacuation

DNV has used an average frequency of 0.003 emergency evacuations per installation year. This is based on all emergency evacuations on the NCS since 1975 (excluding Deep Sea Driller which was being towed along the coast when it grounded in 1976). It is documented in Ref. 8 that such a value is much too conservative.

Based on various sources, an average value has been conservatively predicted at $5 \cdot 10^{-4}$ in Ref. 8, as regards major accidents on facilities. As this is a conservative value, it is assumed that this also includes the cases of emergency evacuation that are implemented even if the accident does not develop into a major accident (for example as with the Ekofisk Bravo blowout in 1977 when emergency evacuation was carried out, though it eventually emerged that the blowout was not ignited). This entails an annual frequency of 0.0065 for NHO, while DNV’s value is 0.040.

For the NCS the updated value entails 0.5 incidents over the course of a ten-year period. They entail that the total number of incidents with emergency evacuation or helicopter accidents on the NCS during the period 2011–2020 equals 2.8 incidents.

4.1.2.4 DFU4 Collision hazard

DNV (Ref. **Feil! Bokmerke er ikke definert.**) has indicated a basis for a frequency such as: "100 x frequency of actual collision" which is obtained from each facility's risk analysis. The value is predicted at 0.034 per year for HNO.
In RNNP, several hundred vessels on potential collision courses have been reported in the last ten years. Of these, some are vessels with which contact was never established, but none of them have collided over the course of the period. The collisions that have taken place on the NCS in the last ten years, have included field-related traffic, also supply vessels, shuttle tankers or other vessels with permission to navigate on the field within the safety zones. During this period, there have been some cases where the crew mustered into lifeboats while waiting for contact to be established with the vessel on a potential collision course. It has so far not been necessary to implement evacuation.

Empirical data [limited number of incidents] indicate that it will be difficult to determine whether a vessel on a potential collision course will collide or not before the vessel is quite close. Therefore it could be envisaged that emergency evacuation would be implemented in some cases where the vessel does not end up colliding. This could indicate that there should be an addition to the calculated collision frequencies that emerge from QRA/TRA.

However, since measures in connection with preventing collision do not particularly strain area resources, the emergency preparedness is not sensitive to potential increased frequencies of DFU4.

4.1.2.5 DFU5 Acute oil spill

DNV uses the value 0.0023 per installation year as an average for production facilities and mobile units. This is based on four incidents over the course of the period 1977–2004.

More up-to-date statistics can be found in RNNP acute spills (Ref. 9), which particularly covers the period 2000–2009. If a frequency of spills > 100 m^3 is used, the frequency is 0.005 per installation year.

This corresponds to approximately one incident every other year for the NCS overall, or 0.065 for HNO overall. This is about twice as high as DNV's value. However, since measures in connection with oil spill response actions do not place much strain on area resources, the emergency preparedness is not sensitive to a potential increased frequency of DFU5.

4.1.2.6 DFU6 Fire with need for external assistance

There are no facilities in HNO where there is a need for external assistance for necessary cooling of a fire on the facility, frequency is not calculated by DNV. As far as we know, there is only one facility on the NCS (Tampen) with such a need. This facility has its own standby vessel for this reason.

There have been a few major fires in unclassified areas on the NCS, where external fire-fighting was required, as there was an insufficient number of automatic and/or manual systems installed. A few such incidents in the last 20 years are the following:

- West Alpha, 13 Jan. 1993, fire in engine room
- Frigg TCP2 10 Nov. 1992, methanol fire in shaft

The fact that fire cannons on standby vessels were used in these two cases do not necessary indicate that the facilities could not have accomplished fire-fighting with their own systems.

4.1.2.7 DFU7 Illness/injury with need for external assistance

The following values were used by DNV based on ambulance missions in HNO for 2003:

- Production installations and mobile units: One case per 84 000 hours worked
- Vessel: One case per 50 000 hours worked

If averages for 2008–2009 are used as a basis, and restrictions for red and yellow incidents are set, both for facilities and vessels, the following values emerge:

- Production installations and mobile units, red & yellow incidents: 4.5 per 10^6 hours worked (one case per 220 000 hours worked)
- Vessels, red & yellow incidents: 8 per 10^6 hours worked (one case per 125 000 hours worked).

It is also relevant to look at the following empirical data from Statoil in 2009:

- Approx. 30% of emergency medical cases are injuries, the rest are illness.

Figure 20 (Ref. 10) shows the distribution of approx. 600 emergency medical cases. Heart ailments constitute about 50%.

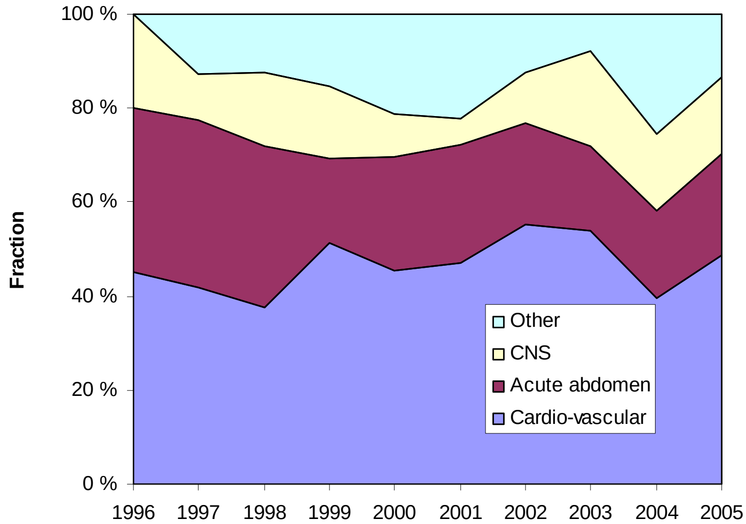


Figure 20 Distribution of emergency medical cases

Figure 20**Feil! Fant ikke referansekilden.** is not only limited to the most serious cases. The data from SOS International (Subsection 3.6) provides a more nuanced picture for a part of the shelf. There is reason to assume that this is representative for the entire shelf. This shows that injuries constitute a smaller percentage of the most serious cases (NACA 4–7) than for all cases.

4.1.3 DNV's calculation of coincidence of need for SAR helicopters

DNV rapport 2004–0879 has calculated the number of cases when there is a coinciding need for AWSAR helicopters and area standby vessels. The likelihood for a coinciding need for area standby vessels is at a very low level, and has not been assessed further.

The DNV report has calculated the number of cases with a coinciding need for AWSAR helicopters as 4.2 times per year. However, this is also based on use for green incidents. This is a practice which Statoil is about to abandon, which will be completely abandoned from 2011. Without green incidents, the frequency of cases with a coinciding need is 1.23 per year according to DNV's calculations.

DNV has updated the calculations with Skarv FPSO, Kristin FPU, has taken into consideration a higher activity level for rigs, as well as nuanced the model to a limited extent (Ref. 11), and has presented the following results:

- Number of cases with coinciding need with Skarv and six rigs (as before): 4.5 per year
- Number of cases with coinciding need with Skarv and ten rigs: 7.2 per year

The data basis which the frequencies are based on has also significantly changed since 2004, as documented in this chapter. An updated calculation is presented in Subsection 4.1.4.3.

4.1.4 Discussion of dimensioning for coincidence of DFUs

In principle, coincidence of DFUs concern both SAR helicopters and area standby vessels. However, the likelihood of two coinciding missions for area standby vessels is so low that, in practice, it is only a discussion of coinciding incidents that SAR helicopters can experience.

4.1.4.1 Principles, regulations, etc.

It is a recognised principle in Norwegian petroleum regulations that it is not necessary to dimension emergency preparedness for two coinciding DFUs. This was also adopted in the guideline in 2000, one does not dimension the resources within an area for two coinciding incidents.

This principle has to some extent been challenged through Statoil's restriction on the number of POB on the facilities and vessels in HNO that could have belonged to area-based emergency preparedness. This has been explained based on the possibility for coinciding incidents that affect an area's capacity, in practice only the helicopter's capacity for SAR and ambulance missions.

Statoil has carried out studies that show about five incidents per year in HNO, where capacity restrictions can entail that not all missions are delivered as assumed. This is strongly influenced by the prevailing practice in HNO, where several green [ambulance] missions have been flown with SAR helicopters. In all other areas such cases wait for ordinary flights to shore. In its studies Statoil has shown that the number is reduced to about 1 incident per year in HNO, if SAR helicopters are not used for green missions.

ConocoPhillips administers area-based emergency preparedness for the Southern Fields on the NCS. Here all green missions are flown with normal crew change helicopters. There has never been a coincidence of two incidents that have affected the system's capacity, but it must be considered that there are two SAR helicopters located offshore, one AWSAR on Ekofisk and one LIMSAR placed on Valhall. On the other hand, the helicopters are used for shuttling in the Southern Fields to a considerable extent.

Statoil's study (Ref. **Feil! Bokmerke er ikke definert.**) also proves that in Norway, on average, there are about 8 600 people per emergency medical resource unit (ambulance, helicopter, aircraft). Prioritisation and coordination of these resources is done daily by the AMK centres. Coincidence of incidents is not an unknown phenomenon, in more areas there are multiple resources available, and there is also the public rescue service (330 squadron) as an additional resource (which should not be included in plans). On the shelf there are fewer people per resource unit (helicopter), but there are also fewer resources to mobilise, so flexibility is reduced. The baseline data show that approx. 20 000 people work on the facilities included under area-based emergency preparedness on the NCS (Jigsaw facilities and the Hammerfest base not included). These approx. 20.000 people spend one-third of the calendar year on the facilities, so there are always approx. 6 700 people covered in the four areas.

4.1.4.2 Experience from practice

As mentioned, there has never been a case of coinciding incidents that affect the capacity in the Southern Fields on the NCS. Statoil's study (Ref. 4) contains an appendix which shows detailed illness and injury data for 2003 (Appendix B). Here it emerges that there were five coinciding incidents in 2003 as regards ambulance traffic and illness/fatalities in families. There was one coinciding incident in 2003 for other types of missions. However, it emerges that the majority of the incidents were green.

For the period 2007–09, one incident was documented (Ref. 12) with coinciding needs, this is a considerably lower level than what was documented for 2003. It is proven that in this period, a considerable number of green missions were still flown. This entails that the cause of the marked reduction is not an absence of green missions.

Experience from practice also underlines that, to some extent, there might be a need for having clear criteria for classification of emergency medical cases that thus provide a basis for prioritisation and handling. It is claimed that, to some degree, there is experience that indicates that this could be a considerable challenge for contracted medical expertise for sub-contractors and service providers. For the operating companies, with permanently employed doctors or service contractors on long-term contracts, this is not as challenging. However, the non-medical criteria are likely far more varied. There are clear criteria for land-based ambulance services for classification of emergency medical cases (Ref. 13).

4.1.4.3 Main contribution, likelihood

In Statoil study (Ref. 4), it is demonstrated that 96.5% of the contributions to mission frequency of SAR helicopters in HNO come from ambulance flights to shore. The updated calculations presented here are therefore done exclusively for such missions.

In 2004, a Statoil study (Ref. 4) calculated between four and five missions per year with coinciding incidents where capacity restrictions would determine the response. In an update (Ref. 11) the number was increased to between seven and eight missions per year, when including Kristin and Skarv, as well as a higher activity level with up to ten mobile units at the same time.

It is documented in Subsection 4.1.2 that some of DNVs frequencies are too conservative. Consideration was also given to the fact that green missions should normally not be flown. When changed data and preconditions are added, and DNV's calculation method is reproduced (based on Appendix C in Ref. 4), with these changes, the following frequency of coinciding incidents (without green missions) is achieved:

- 0.93 incidents per year for HNO

This figure can be compared with the value of between seven and eight that was calculated by DNV with updated preconditions, which is accounted for. This corresponds to just over 2 100 people (POB) on production and mobile units, as well as vessels (number does not increase proportionally with increase in mobile units).

4.1.4.4 Dimensioning for coincidence of DFUs

Updated values for HNO show that when green ambulance missions are not flown, the scope of potential problems with coinciding incidents is reduced to about one incident per year.

However, the number of red and yellow missions in HNO is still no more than barely one mission per week on average. This corresponds to the typical level on the entire shelf, according to what was documented in the PSA's study (Ref. 1) in 2008.

Empirical data for HNO is one incident over the course of the three-year period 2007–2009, which is an even lower level, however, this does not mean that coincidence can be excluded.

The question is still whether to dimension for such a possibility for coinciding incidents? If the conclusion for HNO is that this is required, this will necessitate a corresponding review for all areas on the shelf.

However, it can still be emphasised that HNO is the most exposed area. The Southern Fields have two SAR helicopters placed on Ekofisk and Valhall, respectively. As regards Tampen and Oseberg, there is considerable overlap between the areas, so potential coinciding incidents can likely be solved through cooperation. In Halten Nordland, there is only one AWSAR helicopter located offshore, though there is a LIMSAR helicopter located on Kvernberget in Kristiansund.

In the long term, it could be relevant to have two offshore SAR helicopters outside Central Norway/Nordland, if there will be more developments on the Vøring Plateau (e.g. Aasta Hansteen). Most prospects are located 300-400 km from shore, and 150–200 km from Heidrun, so it is outside the SAR helicopter's coverage area. It could be natural to have a SAR helicopter on Aasta Hansteen for example, when it is developed with a production facility.

In its project for coordination of area-based emergency preparedness on the NCS (not including the Southern Fields), Statoil has assumed that there should be no restrictions on POB within an area, this implicitly entails that one accepts a certain degree of coincidence. At the same time, it was clarified that use of SAR helicopters for green missions should be avoided.

It can be noted that the onshore ambulance and rescue system is not dimensioned so coincidence is always avoided, coincidence is resolved through prioritisation and coordination when it occurs, but the flexibility in the system is higher than on the shelf.

The practice on the shelf of not dimensioning for two DFUs at the same time thus reflects society's prioritisations on shore. The possibility of coinciding incidents cannot be excluded, but is assumed to be at a low level. When it eventually occurs, it is a question of prioritisation and coordination.

Based on assessments repeated here, it is not found appropriate to dimension specially for coincidence of incidents in HNO. This also entails that it is not natural to dimension for coincidence of incidents in any location on the shelf. This is also the same standpoint which Statoil appears to arrive at in its project for coordination of emergency preparedness (Ref. 12).

Statoil's project for coordination of emergency preparedness has also identified a need for a coordinating function for area-based emergency preparedness resources, and Statoil Marine at Sandsli is suggested. This could be a role that can contribute to improved resource coordination and that could play an important part if coinciding needs should arise. Furthermore, it is intended to evaluate the possibility for a new area that will cover Sleipner, Grane, Jotun, Alvheim, etc.

4.1.5 Conclusion

The updated calculation that is documented in this Subsection, confirms that the scope of potential coinciding incidents should be at a low level in Halten Nordland, which is the most exposed area.

Furthermore, it appears to be in line with the established practice in society in general and on the shelf in general that one should not dimension emergency preparedness on the shelf to handle coincidence of DFUs, including potential needs for simultaneous ambulance flights to shore.

During the period 2007–2009, one case of coinciding needs for ambulance flights to shore was registered. This is ten times lower than what was calculated by DNV, and also lower than the updated calculation in this Subsection.

On this basis, we concluded that one does not need to plan for coinciding incidents.

4.2 Should rescue of personnel in the sea be limited to the safety zone?

In Norwegian Oil and Gas 064:2000: Recommended guidelines for Establishing Area-Based Emergency Preparedness, the responsibility for rescue of personnel in the sea is limited to the safety zone, i.e. 500 m surrounding the facilities. The basis for this restriction set in 2000 was, in part, regulatory requirements, which limit the operators' responsibility to what takes place inside the safety zone. There have been questions as regards continuing this restriction in connection with the revision.

It is obvious that, with a SAR helicopter, one can rescue 21 people in the sea in a much larger area, corresponding to the areas defined for the coverage of area-based emergency preparedness, up to 75 nm from the facility where the SAR helicopter is located.

For the facilities that do not have coverage with a SAR helicopter, the emergency preparedness for rescuing people in the sea in the event of a helicopter accident and emergency evacuation is based on using an MOB boat as long as the sea state allows for this (normally <4.5 m H_s). When the wave height exceeds 4.5 m H_s operational restrictions banning helicopter flight must be established.

When an MOB boat is the only emergency preparedness resource for rescuing personnel in the sea, the range will be considerably shorter than with a helicopter, both due to lower speed, and the need to transfer the rescued people to a vessel or facility, due to limited capacity. If a Daughter Craft is used, one will avoid the time spent on transferring people to a vessel/facility before all 21 people are rescued. However, the range will be limited to the cruising speed of the Daughter Craft, and its location in relation to the accident.

Regulatory requirements for the companies are limited to the safety zone. The update of the guideline therefore assumes that the requirements only apply within the safety zone around the facilities.

4.3 Capacity restrictions with increased mobilisation time and increased flight time

In some cases, the normal practice involved implementing operational restrictions in relation to the rescue capacity one has in a given situation, but this is a topic which has not received considerable attention.

Statoil is developing a tool for planning helicopter flights, which takes into consideration the changes of operational factors that apply:

- Changes in mobilisation time (for example when transferring a helicopter to shore)
- Changes in flight time (also when transferring to shore)
- Changes in flight speed (headwind) which impact flight time
- Changes in average pick up time due to inclement weather and/or darkness

Changes can entail that it takes shorter or longer than 120 minutes to pick up the dimensioning number of people from sea (21 people, if DFU2 is dimensioning). In connection with planning the helicopter shuttle service, this can be taken into consideration, with the need to reduce the number of passengers on board, so there is capacity to pick up the number which one has real capacity to pick up.

Use of PLB must also be noted in this context. If PLB is not used for helicopter shuttle service, a considerable increase (50% or more) of time for rescue in the dark and inclement weather must be added, so there are significant capacity restrictions under such conditions.

Such a system could also provide important documentation that one has maintained emergency preparedness, also under the factors that represent restrictions in the response.

5. DFU1: Man-overboard when working over sea

No new work was done with this DFU. The requirement (8 minutes) is continued without changes. As regards baseline data, reference can be made to data from RNNP, repeated in Figure 21**.**

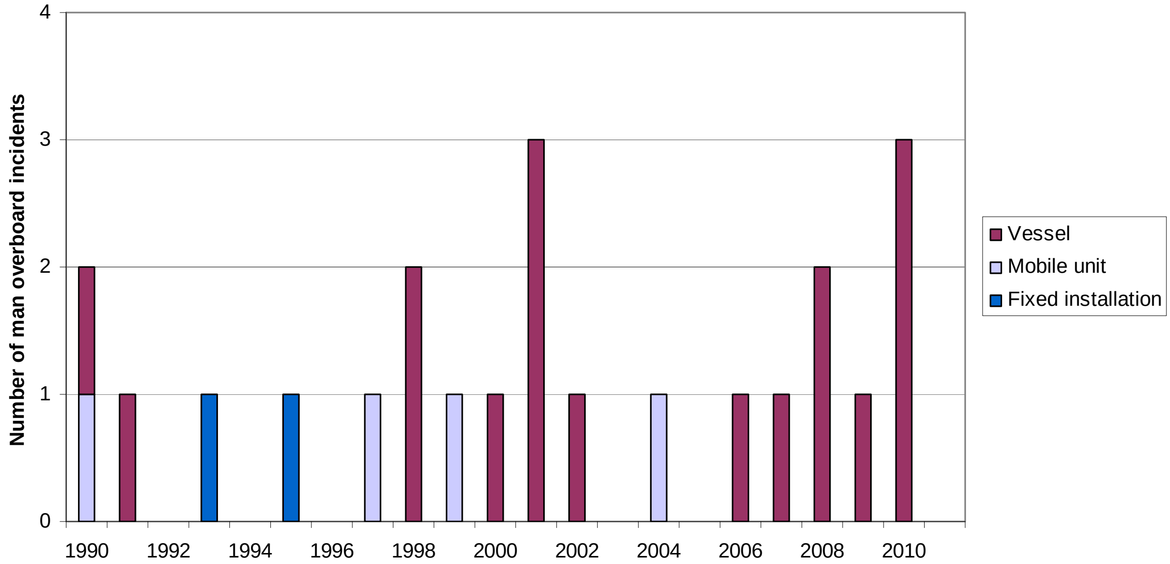


Figure 21 Number of man-overboard incidents, 1990–2011

Figure 21 indicates that there was a period at the end of the 1990s and just after 2000 with multiple incidents. The number of incidents per year in the last ten years appears to be at a stable level up to 2007, and has apparently increased somewhat during the period 2008–2010. If one looks at trends over the period, there is no statistically significant trend.

In the last ten years, 12 out of 13 incidents took place from a vessel. This is a significant trend, fewer incidents on production facilities and mobile units, more incidents on vessels involved in the petroleum activity.

6. DFU2: Personnel in the sea as a result of helicopter accident

This chapter discusses basic questions related to rescuing personnel in the sea. These aspects are, in part, common to both DFU2 and DFU3, and some only apply for either DFU2 or DFU3. In any event, we have chosen to discuss these aspects as one.

In spite of the fact that area-based emergency preparedness has been in operation for nearly ten years, there are still some fundamental objections to the concept. We have therefore found it necessary to discuss, on a general basis, the strengths and weaknesses of standby vessels and helicopters in relation to rescuing personnel in general, as well as specifically in relation to smoke, heat generation and the spread of gas in and around an installation.

6.1 Premises for evacuation and emergency preparedness

6.1.1 Premises for rescuing personnel in the sea

One of the premises for the guidelines is that rescue of personnel in the sea will be carried out with SAR helicopters, if available. The reason is that this is both a safer method of rescuing personnel in the sea, and it is also less exposed to the weather, i.e. more robust.

However, this does not prevent standby vessels from also playing a role if weather and wave conditions permit. The standby vessel could be on site faster, and can start rescue operations before the helicopter arrives.

The other premise used as a basis is that the emergency preparedness primarily focuses on the need to protect against hypothermia, as well as drowning. It is not correct to say that the focus has been exclusively on hypothermia.

What is measurable, and what can thus be subject to specific requirements, is the ability of the suits to provide protection against loss of body heat (core temperature). There is a great deal of data available in this area, and tests are conducted (e.g. under the auspices of SINTEF) of the properties of new survival suits, as well as of existing suits in relation to new temperature requirements. Survival suits on the Norwegian Shelf must be approved pursuant to Norwegian Oil and Gas Guideline 094, recommended guidelines for requirement specifications for rescue and survival suits for use on the Norwegian Continental Shelf, which in turn refers to ISO tests, see Subsection 6.3, and must provide protection for six hours in relation to standard testing conditions.

SINTEF tested survival suits for the Barents Sea in 2010, with quite different weather conditions than those prescribed in standard tests. It was found that cooling of fingers and toes was more significant than previously believed. However, SINTEF emphasises that this type of cooling is not life-threatening. It can lead to discomfort and reduced vigour, but it does not directly impact survival.

The ability of the suits to protect against drowning is more difficult to measure specifically. Norwegian Oil and Gas' project to test survival suits in the early 2000s revealed that drowning was a greater challenge than had previously been identified.

Following the suit project under the direction of Norwegian Oil and Gas in the early 2000s, a face shield requirement was also introduced in order to protect against sea spray in the face, as well as the associated possibility of drowning in high seas. Icing and dew have proven to be a problem, but these are also issues that do not impact survival.

The drowning aspect is, however, indirectly taken care of through existing requirements in the guidelines, through the 50% safety factor that was used to arrive at the 120-minute time requirement for rescue from sea. Although the suits were designed to protect against hypothermia for 180 minutes, the maximum response time for saving the design number of people at sea was set at 120 minutes. The Norwegian Oil and Gas requirement for suits, which is now six hours, entails a much higher safety factor (200%).

In connection with revisions of the guideline, the safety factor of 50% has, to some extent, been challenged, probably because 180 minutes would be a straightforward requirement to comply with in connection with activity further from the coastline. If six hours is used as a basis, the 50% safety factor would indicate a pick-up requirement within four hours.

However, there is little to indicate that one could accept a pick-up requirement in excess of 120 minutes, on an expert basis, as the requirement must also take into account factors that are difficult to measure, such as the risk of drowning, etc. Other factors of significance, and which are not reflected in tests, are waves, sea spray, air temperature, icing (combined effect of waves, cold, wind), seasickness (can lead to temperature regulation problems in the body which causes faster cool-down), the ability to look after oneself (which can be affected by chilling of fingers and toes), the person's size, physical condition, food and stimulant consumption (Ref. 14).

Could all tests be revisited, so that the focus was shifted from hypothermia to drowning? No, this is not a good solution. For people who do not drown in the first 5–10 minutes due to the cold shock or involuntary submersion, a drop in body temperature will be one of the few measurable factors that can be used to quantify the effectiveness requirements. Other survival criteria (exhaustion, physical stamina) are much more difficult to measure objectively, and must be incorporated into safety margins when the effectiveness requirements are established. It is also difficult to imagine an opportunity to carry out realistic tests of drowning with live subjects, based on research ethics considerations. Hypothermia is also used as a basis in a number of international standards.

Reference can also be made in general to the work on replacing public SAR helicopters, see Subsection 6.2.

6.1.2 Premises for evacuation to sea

The discussion in this subsection focuses on evacuation to sea. This entails that the facilities that can be evacuated via gangways to a safe area on another facility are not covered under this discussion.

Helicopters can also be used for evacuation, and NORSOK S-001 describes them as primary means of evacuation where evacuation via gangway is not available. Helicopters can normally always be used for precautionary evacuation, in other words, when non-essential personnel are removed as a precaution, in the event of temporarily heightened risk.

Generally speaking, however, helicopters cannot be the primary means of evacuation, if there is time pressure necessitating that evacuation occurs quickly, and when there is gas, fire or smoke on the facility. Under such conditions, evacuation to sea is the only robust solution, if there is no gangway connection available. With one exception (precautionary evacuation), all incidents in Table 9 (see Page 57) are carried out without a helicopter as means of evacuation.

Helicopters will not normally be a relevant solution if it is important to carry out evacuation as quickly as possible. In the great majority of cases, several trips would be needed to evacuate all of the people on a facility by helicopter, due to the limited capacity. The time aspect would thus be what precludes the use of helicopters. Evacuation to sea using lifeboats will be the most robust solution. Moreover, it will be impossible to use helicopters for evacuating personnel if there is heat, smoke or gas near or on the helicopter deck.

When evacuation must be carried out as quickly as possible, it is normally because the accident incident is developing rapidly and out of control. The evacuations from Alexander Kielland, from Piper Alpha and West Vanguard (ignited shallow gas blowout, Haltenbanken, 1985) are examples of such evacuations.

It is emphasised that the evacuation discussed herein is "the fastest possible organised evacuation to sea", and cannot be characterised as "panic evacuation", where procedures are not followed and everyone tries to save themselves as best they can. Such "panic evacuation" can, in part, describe the evacuation from Ekofisk Alpha following the riser fire in 1975, the evacuation from Alexander L. Kielland in 1980, as well as some of the incidents in Table 9.

The evacuation of Deepwater Horizon (Ref. 15) can be highlighted as an example of the fastest possible organised evacuation to sea. The evacuation was largely carried out in an organised manner, even considering the significant time pressure and the extreme accidental loads that the rig and crew were exposed to, and with a number of injured people in the lifeboats. Several other emergency response functions were not successful, but the actual evacuation of personnel itself took place in a largely organised and proper manner.

In order to ensure a robust solution for evacuation under all types of conditions, it is therefore required that lifeboats are the primary means of evacuation. This is also the assumption for the work on updating the guideline. The petroleum regulatory requirements for lifeboats are focused on use of free-fall lifeboats, which are considered to have far superior likelihood of successful launching, also in bad weather.

It has been asserted that experience gained from the lifeboat project, Snorre A, Gullfaks C and Deepwater Horizon incidents, as well as new experience with survival suits, show that the theoretical models do not sufficiently well take care of the intention of the legislation. As regards measures aimed at preventing accidents, there is probably quite a bit of truth in this assertion. Preventive measures to prevent accidents and near-misses from occurring have fundamentally failed in several of these cases, not least in the Deepwater Horizon accident.

However, the claim cannot be entirely correct as regards emergency preparedness. The Deepwater Horizon is, not least, a clear example of a case where parts of the emergency preparedness functioned as intended. The Report (Ref. 15) from the Presidential Commission clearly documents that, based on the preconditions that developed over the course of the accident, parts of the emergency preparedness functioned as well as possible. Those who died in the accident were on the drill floor when the explosion occurred, and probably had no chance of survival. All of the others, of which 17 were injured (some seriously), were evacuated and brought to safety.

If the preventive measures had worked, then the blowout need not have happened. But, even if the gas flow on the drill floor occurred, a different attitude and different decisions on the part of the crew could have entailed that all personnel were evacuated from the drill floor immediately, and the number of fatalities could have been considerably lower. In other words, parts of the emergency preparedness failed, while other parts functioned as intended.

Nevertheless, it cannot be denied that some of the emergency preparedness measures through accidents and near-misses have revealed weaknesses, which theoretical studies have been unable to uncover. This illustrates a challenge in relation to emergency preparedness situations; that it is not easy to get empirical data from realistic conditions during training and drills. Realistic data is only available for some aspects during actual accidents and near-misses.

6.1.3 Strengths and weaknesses associated with helicopters used for evacuation

6.1.3.1 Strengths associated with using helicopters for evacuation

Helicopters represent a good way of carrying out a precautionary evacuation. The time pressure is not normally extreme, and multiple helicopters can often be mobilised to carry out a precautionary evacuation. If several helicopters can be mobilised, a precautionary evacuation can be carried out in a reasonable amount of time. The gas blowout on Snorre A in November 2004 can illustrate this. Preparations for a precautionary evacuation started at 20.30 hours on 28 November 2004. A helicopter evacuation was carried out between 20.58 and 22.05 hours and the manning was reduced from 216 to 75 people. Two helicopters, from Statfjord B and Oseberg, were used for this purpose. The wind direction was favourable in relation to gas entering the helicopter deck, which meant that helicopters could be used safely.

6.1.3.2 Weaknesses associated with using helicopters for evacuation

There are two factors which can rule out use of helicopters for evacuation:

- The evacuation must take place quickly based on the development of the accident situation
- If gas, fire or smoke on the facility, due to wind direction, make it impossible to use the helicopter deck.

If it is important to carry out the evacuation as quickly as possible, helicopters will not normally be the appropriate solution. In most cases, several trips would be needed to evacuate all of the people on a facility with helicopters, due to the limited capacity. The time issue would thus preclude the use of helicopters.

The gas blowout on Snorre A in 2004 can be used to illustrate the time aspect. As emerges from Subsection 6.1.3.1, it took 95 minutes to lift 141 people. It would have taken an additional 45 minutes if all of the people were to be evacuated. If the gas blowout had developed such that a maximum of one hour was available for evacuation, using helicopters would not have been possible. Evacuation to sea with lifeboats will be the most robust solution.

It will not be possible to use helicopters if gas, fire or smoke on the facility exposes the helideck due to wind direction. Piper A illustrates such a scenario. Most of the crew on board gathered in the living quarters directly below the helicopter deck to wait for evacuation by helicopter, which could not land because smoke was blowing toward the helideck. Those who did not jump into the sea on their own initiative perished due to smoke poisoning in the living quarters module, or when the living quarters module fell into the sea.

6.1.4 Strengths and weaknesses associated with SAR helicopters

This subsection discusses the use of SAR helicopters, i.e. the use of helicopters in a emergency preparedness context in an area solution, where one (potentially two) helicopter(s) serves many facilities, possibly also including vessels. It is assumed that the helicopter has AWSAR properties (All Weather SAR), as all emergency preparedness areas have at least one helicopter with AWSAR (equipped for operations in the dark) and de-icing equipment, see Subsection 3.2.

6.1.4.1 Strengths associated with using SAR helicopters

SAR helicopters are without parallel when it comes to rescuing people in the sea. They can accomplish this quickly and without significant restrictions, if the helicopter can take off from the helideck/-landing site where it is located. The performance of SAR helicopters for search and rescue operations is confirmed, not least, by the public rescue service (the 330 squadron) with its Westland Sea King rescue helicopters. The performance of the helicopters has been demonstrated time and time again by the Sea King aircrafts, with numerous rescue campaigns both at sea and on land. It is assumed here that the private SAR helicopters have comparable expertise in search and rescue operations as the Sea King squadron has.

As long as it has managed to take off, an AWSAR helicopter has practically no restrictions when it comes to rescuing personnel in the sea or in rafts. Experience from the public rescue service has confirmed this. Experience shows that rescues in poor weather and dark conditions take somewhat longer, but can still be carried out effectively. Following a helicopter accident (DFU2), personnel in the sea (or in rafts) will all be equipped with personal locator beacons (PLBs), and it should be possible to rescue such personnel faster than is indicated by the empirical data from the 330 squadron.

There is no empirical data from the private SAR helicopters (i.e. stationed offshore) as regards search and rescue missions in connection with evacuation or helicopter incidents. Therefore, the data from the 330 squadron is the most relevant empirical data available.

A SAR helicopter has significant range, and can reach around 100 km in about half an hour. The newest SAR helicopters have a cruising speed of approx. 150 knots (277 km/h). This means that it may also be effective for rescuing personnel in the sea following a helicopter accident about halfway between land and a facility, even though the companies' responsibility under the petroleum legislation does not cover this section.

Lifeboats are the primary and preferred means of evacuation in the event of smoke and heat or gas clouds around the facility, see Subsection 6.1.3.2. When the lifeboats are launched, SAR helicopters can be used to pick up personnel in lifeboats who need medical attention due to injury or illness, when necessary.

A SAR helicopter is also effective for attracting attention from the crew on vessels on collision courses without bridge control, assuming that it is close enough to reach the vessel in time. Some of the SAR helicopters have their own external loudspeakers, which makes them best suited for such tasks. Some empirical data is available here, but there have been few instances when helicopters have been used for vessels on a collision course.

SAR helicopters are very effective in connection with serious injury and illness, both in relation to providing rapid emergency medical expertise and equipment on the facility and then, if needed, transporting the ill or injured person(s) to hospitals on land. an extensive experience basis exists here from today's helicopters over a number of years (see Subsection 3.5). The helicopters are very well-suited to this, and no other alternative is available.

6.1.4.2 Weaknesses associated with SAR helicopters

The most important limitation in the use of helicopters is if weather conditions prevent the helicopter from taking off from the facility where it is parked, particularly as regards high wind speeds (perhaps combined with unfavourable wind direction) or poor visibility. It is often common practice that the helicopter is taken to land if weather forecasts indicate that the helicopter will not be able to take off from the facility later.

Fog can also prevent helicopters from taking off from the facility, but then the helicopter transport service will also not be in normal operation, so that DFU2 is not relevant under such conditions. DFU3, however, is still relevant.

Heat and smoke or gas clouds around facilities can also prevent the helicopter from taking off, if such events occur on the facility where the helicopter is parked. However, since there are many other facilities in an area (often more than ten facilities), there is limited likelihood that fire or gas clouds would affect precisely the facility where the helicopter is parked.

As regards exposure of all facilities in an area, this scenario (fire or gas cloud on the facility where the helicopter is parked) has limited likelihood. However, it cannot be ruled out that precisely the facility where the helicopter has its hangar will be affected. This would probably result in the helicopter being unavailable for that incident, and helicopters from other areas or the 330 squadron would have to be used. This is obviously a factor associated with helicopters placed on the facilities that cannot be avoided. The alternative is that all helicopters are located on land which, in many cases, would mean increased response time, which is considered to be a greater disadvantage (particularly since the frequency of DFU7 is more than 600 times higher than DFU2 and DFU3).

It is important to emphasise that this limitation only applies to evacuation (DFU3) from facilities on which the helicopters are parked. For all other DFUs and for DFU3 on other facilities that are part of emergency preparedness areas, such limitations do not apply. Lifeboat evacuation has not occurred on the Norwegian Shelf after 1985 and, as such, is one of the rarest DFUs.

If there is no fire or gas cloud on the facility where the helicopter is parked, the SAR helicopter can be used in an emergency preparedness context, as it is extremely unlikely that two accident scenarios would arise at the same time on two different facilities, and this eventuality can be disregarded in practice. It must be expected that lifeboat evacuation is carried out from the facility where the accident incident takes place. When the lifeboats have moved a few hundred metres away from the facility, the SAR helicopter can contribute to transferring any injured or seriously ill personnel in lifeboats. In practice, this is approximately equivalent to what took place as a consequence of the Deepwater Horizon blowout, in connection with evacuation of injured and uninjured personnel.

6.1.5 Strengths and weaknesses associated with standby vessels

The standby vessels discussed herein are presumed to be “standard” standby vessels dedicated to a facility, in a solution without area-based cooperation, and thus without a SAR helicopter. Typical cruising speed of 14 knots and equipped with 1–2 man-overboard boats, including crews and launching arrangements, hospital equipment and capacity, equipment for rescuing personnel in the sea, possibly also oil spill response equipment, fire extinguishing equipment, etc.

The standby vessels discussed herein are not presumed to be the latest generation of standby vessels with high cruising speeds as well as stern-mounted slides for picking up man-overboard boats or lifeboats. These are standby vessels that, so far, have only been contracted as part of an area-based emergency preparedness solution together with SAR helicopters without a dedicated standby vessel at each facility.

6.1.5.1 Strengths associated with dedicated standby vessels

A standby vessel can, in nearly all incidents, operate regardless of accident scenario. It will not be significantly hampered by heat, smoke and gas on a facility.

The standby vessel can be used as a safe place for personnel in lifeboats, but this is not required unless the lifeboats are damaged. In bad weather, it will normally be safer for personnel in intact lifeboats if they do not attempt to move to a standby vessel. The Ocean Ranger accident (off Newfoundland, 1982) showed what could happen if such transfers are attempted in poor weather. A lifeboat tried to come alongside the vessel on the field, was destroyed in a collision with the vessel, capsized and drifted away from the vessel, causing everyone on board to drown. Their bodies were never recovered.

In the event of a vessel on collision course, the standby vessel can sail towards the vessel and possibly use lights and/or water cannons to achieve contact. It was previously thought that physical contact could also be used, but this idea has been abandoned following an incident many years ago when a standby vessel attempted such a manoeuvre, and ended up being liable for the damage.

For mobile units (and in part also for production facilities), it may be relevant for the standby vessel to cover all or parts of the facility's responsibility for man-overboard emergency preparedness. The standby vessel will often be the best-qualified resource to handle this responsibility. The standby vessel also entails available crew with good maritime expertise, which may be in short supply on a facility.

It is often asserted that the standby vessel represents a high degree of perceived safety for personnel on the facilities. In the study the author carried out for the Petroleum Safety Authority (PSA) in 2008 regarding Comprehensive Emergency Preparedness (Ref. 1), this was studied by analysing the development of responses to a single question in the four RNNP questionnaire surveys during the period from 2001 to 2007. A clear improvement was proven during this period in the perception of how good the emergency preparedness was, measured among those who work on the facilities. This perception was equally pronounced on the facilities which, during the period, had area-based emergency preparedness implemented, as on the facilities that still have dedicated standby vessels (because they do not have area-based emergency preparedness). This strong positive development was even more noteworthy in light of the fact that the problems associated with free-fall lifeboats were discovered during the course of the analysed period.

There is therefore no basis for using the Comprehensive Emergency Preparedness analysis to assert that the perception of safety among the employees is worse on the facilities that do not have dedicated standby vessels.

6.1.5.2 Weaknesses associated with dedicated standby vessel

Use of standby vessels to rescue a number of people in the sea presumes that man-overboard boats are normally used for this circumstance. The operational limitations that apply for use of MOB boats (often H_s = 4.5 m) apply for this emergency preparedness. This normally leads to setting operational restrictions, where flights (crew change traffic) must cease when wave heights exceed this limit. Some vessels have qualified their solutions for up to 7 m H_s, and thus have fewer operational restrictions.

The standby vessel, with the applicable operational restrictions, can rescue personnel in the sea within the safety zone, where the companies have a clear responsibility for rescue. The standby vessel has a much more limited range due to cruising speed, and will therefore be far less effective for helicopter accidents far from the facility.

As discussed above, the standby vessel has significant weather limitations as regards transferring personnel from lifeboats to vessels in poor weather, as demonstrated by the Ocean Ranger accident.

In the event of extreme weather, a standby vessel will be significantly impacted as regards cruising speed and ability to manoeuvre, which can also have a negative impact on the vessel's function.

6.2 Conceptual study for new rescue helicopters, NAWSARH

The following document is an important background document for the revision work: Preparatory study for new rescue helicopter capacity[7], Sub-Document 1 of 5, Needs Assessment (Ref. 16). In Subsection 5.3, Conclusion Survival Ability, you can find the following table, which sums up the require-

[7] It is emphasised that the study is included here to provide background documentation. None of the scenarios includes an assumption where the national rescue helicopter service contributes capacity.

ments discussed in relation to how quickly the effort must be in place in order to ensure good survival ability.

Table 6 Response time requirements for NAWSARH needs analysis (Ref. 16)

#	Scenario	Immediate resp.	Response within 30 min	Response within 1 hr	Response within 2 hrs	Response within 3 hrs	Response within 6 hrs	Response within 12 hrs	Response within 24 hrs	Response within 48 hrs
1	Unprotected in water	+	+/-	+/-	+/-	-	-	-	-	-
2	Protected in water	+	+	+	+	+/-	+/-	+/-	-	-
3	Unprotected in raft	+	+	+	+	+	+/-	+/-	-	-
4	Protected in raft	+	+	+	+	+	+	+	+/-	+/-
5	Child in terrain	+	+	+	+	+	+/-	+/-	-	-
6	Adult in terrain	+	+	+	+	+	+	+	+/-	+/-
7	Child in mountains	+	+	+	+/-	+/-	+/-	-	-	-
8	Adult in mountains	+	+	+	+	+	+	+/-	+/-	-
9	In avalanche	+	+/-	+/-	+/-	-	-	-	-	-
10	Acute heat attack	+	+	+/-	+/-	+/-	-	-	-	-
11	Acute stroke	+	+	+/-	+/-	+/-	-	-	-	-

"Protected in water" means persons wearing survival suits in water. The green zone means rescue response within two hours; within three hours is the yellow zone. Darkness and poor weather reduce this to one hour.

Based on the needs and a detailed review of relevant scenarios, conclusions have been drawn regarding the level of ambition for the rescue service.

The following conclusion regarding rescue ambition level is found in Sub-Document 2, Chapter 10, Paramount strategy document (Ref. 17):

The following is recommended for rescue ambition:

- In a single operation following notification, be able to aid 20 people in distress at any point 150 nautical miles straight out from the baseline, within 2 hours[8].
- To be able to carry out MEDEVAC for two persons in distress out to the outermost boundary of NRAO (Norwegian rescue responsibility area), up to 400 nautical miles from the baseline.
- To be able to aid those in distress at any point along the coastline and throughout the entire land area, and to bring those in distress to a safe location.

This entails that the ambition level for the public rescue service is more or less at the same level, but slightly lower than the ambition level for the guideline. The latter presumes that aid efforts are carried out in the course of 2 hours, while the public rescue service shall start relief efforts during the course of 2 hours.

6.3 Summary – required pick-up times

In the guidelines from 2000, the requirements for rescuing personnel in the sea as the result of a helicopter accident (DFU2) and emergency evacuation (DFU3) were set at 120 minutes, based on a safety factor of 50%. The premises for this consideration have now changed somewhat, thus making it relevant to consider whether the time requirement should be amended up or down.

To some extent, input has been received from two trade unions to the effect that the time must be reduced, because it has been proven that drowning is more significant than one was previously aware

[8] The NAWSARH project has commented that, while it says 20 persons, this should be understood such that it covers a full helicopter with two pilots, a total of 21 people. It is not common practice to operate with a precision level beyond 20 people in such a document.

of, and that the 120-minute requirement was set exclusively in relation to hypothermia. This was discussed in Subsection 6.1.1. Input has also been received from the largest trade union that both hypothermia and drowning have been addressed to the extent necessary, and that the 120-minute requirement is at an appropriate level.

Other elements that must be taken into account when stipulating pick-up time requirements:

- Pursuant to NS-EN ISO 15027–1, survival suits must be tested in relation to cooling for six hours at 2°C (Ref. 18).
- Test requirements from Norwegian Oil and Gas also cover six hours, as well as refer to the ISO requirement (Ref. 19).
- If one only looks at deep core temperature and cool-down, the 6-hour requirement and 50% safety factor would entail an increase to four hours.
- Requirement specification for the new rescue helicopters (NAWSARH project) uses 120 minutes + time for pick-up as a basis, for all locations within 150 nm out from the baseline (Ref. 20).
- Survival suit test for Goliat (more extreme conditions than assumed by ISO) shows the impact of other factors; waves, sea spray, air temperature, icing (combined effect of waves, cold, wind), seasickness (can cause temperature regulation problems in the body which leads to more rapid cool-down, Ref. 14).
- Survival suit test for Goliat was planned to last for 3 hours, but had to be halted after 2 hours due to cooling of fingers and toes (not life-threatening, Ref. 14). The test was run with more realistic conditions than in standard tests, the suits are approved for six hours based on standard tests.
- PLB and survival suits with face shields are new improvements introduced after 2000.

As regards the Barents Sea, one solution could be to have stricter requirements than otherwise on the NCS. However, several parties have stated that it is not desirable to have different requirements for different parts of the NCS. It is therefore assumed that the requirement for rescue from sea should be the same everywhere on the NCS.

PLB and survival suits with face shields compensate to a significant extent for the elements that some believe should lead to shorter available rescue times. It is not correct to say that only hypothermia was emphasised when the 120-minute requirement was set in the guideline in 2000. Other factors in addition to hypothermia were indirectly taken into account through the 50% safety factor that was applied when stipulating the 120-minute requirement. Without this safety factor, the requirement would have been 180 minutes.

It is very significant that the NAWSARH project has used 120 minutes, with the addition of 30 minutes to rescue about 20 people from the sea. This confirms that the guideline assumes a reasonable ambition level. It would also be extremely unnatural to increase the time for rescue, which would be a weakening of the assumed standard, and would also mean that the petroleum industry would adopt a poorer standard than the public rescue service.

Nor is it obvious that the requirement should be stricter. Survival suit requirements have become stricter, so that retaining the same requirement for rescue from sea would entail greater robustness in relation to hypothermia. Moreover, PLB and suits with face shields were introduced after 2000, both to protect against drowning due to sea spray in the face, and to improve the possibility of finding persons who have drifted away from other persons faster.

Overall, continuing the 120-minute requirement is considered to be reasonable and balanced, in the light of all factors.

6.4 Design time for rescue from sea

Rescue from sea can be carried out with SAR helicopters and MOB boats or Daughter Craft from facilities or vessels. In an area where the SAR helicopter is the primary means, and the resource that one relies on in bad weather, it will therefore be the design basis. The discussion below is therefore limited to rescuing personnel in the sea (or in lifeboats/rafts) with helicopters. Weather permitting, rescue with MOB boats can often start earlier, so that a combination is the optimal solution.

The extent of the areas that can be covered by a SAR helicopter is largely limited by the pick-up time used as a basis. This was addressed in the guideline in 2000, but lacked a clear recommendation as to which value should be assumed. The indicated value in the guideline was 3–3.5 minutes, which was also meant to cover the worst weather conditions. The new edition of the guideline will clarify which basis to use with regard to pick-up from sea.

Using 3 minutes per person, it will take 63 minutes to pick up 21 people. Using 3.5 minutes per person, the corresponding figure will be 73.5 minutes for 21 people. This means an acceptable flight time to the outermost border of the area will be 10.5 minutes shorter, with the consequences this entails for the extent of the area.

The following is an overview of the times used (Ref 21):

- BP, UK Shelf (Jigsaw), based on 770 exercises
    - 2 minutes per person for rescue
    - 2.5 minutes in bad weather
- CHC
    - 3 minutes
- 330 Squadron (Sea King)
    - 2.5 minutes
- NAWSARH project
    - 1.5 minutes

It emerges from the values here that 2.5–3 minutes are the longest times used. A somewhat conservative approach was not unnatural in 2000 when there was no experience from private rescue services, but this is not the case now when we have more than ten years of experience. While it is true that there have not been any rescue operations involving a large number of people, there have been exercises and drills.

BP's data from SAR helicopter tests (Ref. 22) covers tests up to 5.5 m H_s, with a stated average time per person for $3.2 < mH_s < 5.5$. The following results are reported:

- $0 < mH_s < 5.5$: 1:33
- $3.2 < mH_s < 5.5$: 2:10
- About 20% of the exercises were carried out in the dark, without noticeable impact on the average rescue time

This means that the average time for tests with wave height < 3.2 mH_s can be predicted at a little less than 1:30, and the addition from the average in the category $0 < mH_s < 5.5$ to $3.2 < mH_s < 5.5$ will be 50%. The times indicated here include time for rescue, hoisting personnel up and transporting them to the nearest helicopter deck on the facility.

In its emergency preparedness analysis for Lunde (block 7120/12), SINTEF has indicated the following values, based in part on OF064:2000, as shown in Table 7.

The values in Table 7 are in the range of 2–3 minutes, consistent with guideline 064:2000, with the exception of the values for pick-up in waves higher than 6 m H_s, and darkness. SINTEF has commented that guideline 064:2000 does not differentiate between different wave conditions and daylight/-darkness, but, as mentioned, that is a misunderstanding.

Table 7 Recommended rescue time values from SINTEF (Ref. 23)

Rescue resource	Weather conditions	Rescue rates (min/person)		Comments
		Daylight	Dark	
MOB boat	Good	1	2	
	Waves < 4.5 m (Hs)	2.5	6	N/A for MOB boat on rig
Helicopter	Waves < 6 m (Hs)	2	3	
	Waves > 6 m (Hs)	3	6	

The data forming the basis for the guidelines in 2000 contain the following data for personnel rescue in rough seas and darkness performed with a Sea King (330 squadron):

- 23 December 1991, west of Frøya, 0345-0420 hours, full hurricane, 20 m waves rescue of 17 people with 2 helicopters (if both arrived at the same time, this corresponds to an average of 4 min 7 sec)
- 1 March 1993, 30 nm south of Lista, 0015-0045 hours, NE gale, rough seas, rescue of 6 people, 5 min 49 sec on average per person
- 4 October 1999, unknown location, 0345-0409 hours, 6-8-metre waves, rescue of 6 people, 4 min on average per person

On this basis, the average time per person in the dark and rough seas is 4 min 35 sec as a conservative average. One important difference between the 330 squadron's empirical data and personnel in the water in the event of a helicopter accident is that all passengers in transport helicopters have personal emergency beacons on their suits. On this basis it appears that SINTEF's value of 6 minutes for rough seas and darkness is far too conservative.

The emphasis to be placed on the dark is questionable; helicopter transport primarily takes place during the daytime, but will of course, particularly in the Norwegian Sea and Barents Sea, take place in partial darkness during the winter months. According to Ref. 24, emergency evacuation is considerably more unlikely.

The following is a summary of data from drills in recent years:

ConocoPhillips, HAVARI drill, 9 May 2007:

- The objective of the drill was to test the company's ability to handle a significant accident in connection with a helicopter crash within a platform's safety zone, while also testing the area-based emergency preparedness' ability to pull 21 people out of the sea within 2 hours after testing the alarm.
- All personnel were picked up within 50 min. The count was confirmed after 60 min.
- Weather and sea conditions do not appear to have been logged.

ConocoPhillips, Bold Mercy NATO drill, 6 May 2008:

- The objective was to practice and develop inter-regional and cross-boundary cooperation and coordination between joint rescue coordination centres in NATO's northern region and between each partner nation which shares SAR regions with NATO.
- The scenario was a vessel on collision course with the Eldfisk complex, with evacuation of non-essential personnel on the Eldfisk complex, subsequent collision risk for Eldfisk B and evacuation of Eldfisk B and from vessels.
- The report is not specific, but concludes that all objectives were achieved.
- Weather and sea conditions do not appear to have been logged.

ConocoPhillips, COPNO drill, week 49, 2011:

- The objective of the drill was to check the emergency preparedness organisation's ability to ensure that the plans can be followed in relation to a large accident in connection with a helicopter crash within a platform's safety zone, while also testing the area-based emergency preparedness' ability to pull 21 people out of the sea within 2 hours after testing the alarm.
- All personnel were picked up within 117 min. (The SAR helicopter had to wait 10–15 minutes for other traffic)
- Weather and sea conditions do not appear to have been logged.

Statoil has carried out a considerable number of drills involving rescuing dummies from the sea, and all are stated to be within the criteria with a significant margin. The following is stated as an example:

- Verification drill at Njord A, 5 May 2004
- 17 minutes from when the SAR helicopter was notified until take-off, 33 minutes flight time.
- 17 dummies picked up within 40 minutes (2 min 21 sec on average per dummy), after which the drill was halted, as the dummies had drifted under the facility.
- Weather and sea conditions do not appear to have been logged.
- The pilots comment that other aspects (e.g. interaction between different parties) of the drill should receive more focus than the purely "mechanical" picking up of dummies, perhaps also the use of live markers.

It appears that the drills which have been carried out to an extensive degree, and which entail showing that one can pick dummies out of the water during a stated maximum time, have limited value, in that they are always successful. More emphasis should perhaps be put on different parties training together, potentially with the use of live markers, as well as potentially training on other aspects, such as rescue from a damaged raft or lifeboat.

Even though weather and sea conditions were not logged in all drills, it is assumed that weather conditions are always good when the drills are carried out. Thus, only the BP data and the data from the 330 squadron provide information on the effects of weather, sea conditions and light conditions. In conclusion, one can observe the following:

- Up to 5.5 m Hs, the dark does not appear to have a significant effect on the pick-up time.
- A 50% increase in the pick-up time in adverse weather is confirmed by the BP data.
- The NAWSARH project presumes two people per lift, 3 min per lift, to rescue 20 people over 30 minutes.

It is most likely not possible to have a realistic drill on the effect of people (dummies) drifting apart, and what effect darkness and adverse weather has on this. On the other hand, the effect of a personal emergency beacon is not included in either the drills or the data from the 330 squadron.

The data from the 330 squadron indicates between 4 and nearly 6 minutes per person in very bad weather and darkness. These data must be adjusted with the anticipated impact of the personal emergency beacon. The presumed values for the effect of darkness stated in Table 7 are therefore presumed to be too conservative.

The following data in Table 8 appears to be a reasonably conservative compromise between all considerations.

Table 8 Recommended rescue time values

Rescue resource	Weather condition	Average rescue time (min/person)	
		Daylight	Dark
Helicopter	Wave height < 6 m (H_S)	2	2
	Wave height > 6 m (H_S)	3	4

Personnel transport by helicopter mainly takes place during the day, but will still partially take place in the dark during the winter months. Emergency evacuation may occur at any time, but is still less likely than a helicopter accident.

The values in Table 8 do not take into account the opportunity to hoist two people per lift, and can thus be said to have an extra conservative element. Therefore, 3 minutes is recommended for planning purposes.

To define the extent of an area, we need one value to relate to. On the basis of the available data, it is most appropriate to use the following pick-up time from the water as a basis for designating the area (used for all conditions):

- 3 minutes per person.

6.5 Interpretation of the 120-minute requirement

6.5.1 Situation with 1 SAR helicopter

Figure 22 shows how the maximum response time of 120 minutes is to be understood from when the accident is reported until rescue of the designed number of people is complete. The time period starts when the accident has been reported (confirmed DFU). The figure also allows for different mobilisation times during the day and night.

If the helicopter has the capacity to have all rescued persons on board until the rescue operations are complete, the 120-minute time requirement is in effect until the last person is brought on board. If there is not sufficient capacity to have everyone on board, time must potentially be included for transfer to the facility, vessel, etc.

If the MOB boat from the facility or vessel will take part to satisfy the requirement for picking up a number of people within T_{max} = 120 minutes, Figure 22 also applies for the combined pick-up with helicopter and MOB boat.

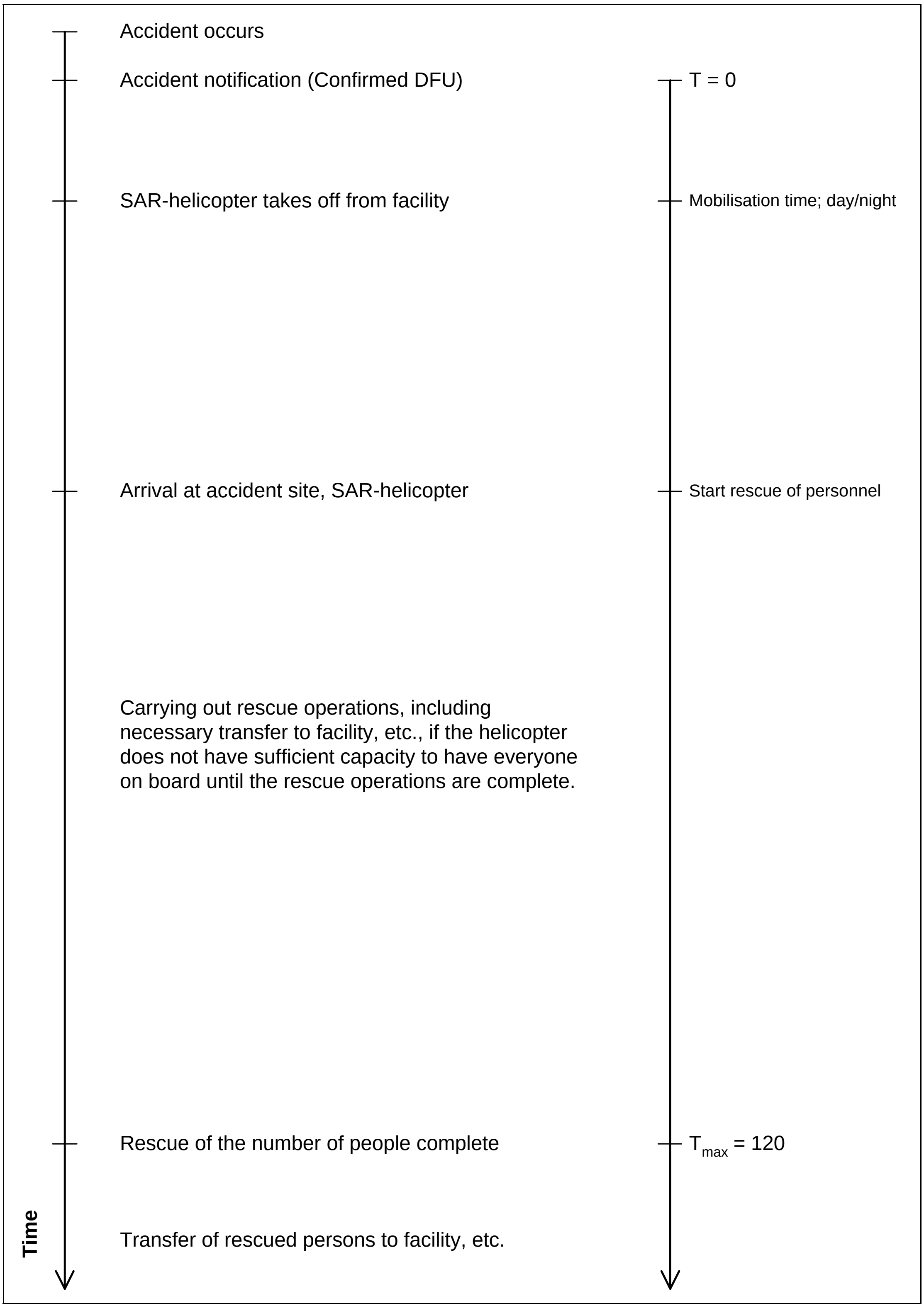


Figure 22 Interpretation of the 120-minute maximum response time (DFU2 and DFU3)

As regards mobilisation time, there are some differences in how this is practiced, with a background in differences in how the helicopters are disposed:

Statoil:	Halten Nordland, Oseberg: Tampen:	15 minutes during the day, 20 at night 10 min conversion to SAR
ConocoPhillips:	15 minutes with helicopter traffic in the area and 30 min when there is no helicopter traffic	
ENI/Statoil:	15 minutes when there is a transport flight, 1 hour otherwise (max time), ENI uses 40 minutes as a dimensioning mobilisation time	

As a point of departure, the mobilisation time is set at 30 min after 2100 hours. This is because maintaining 15 min in the evening has consequences for the pilots' breaks. The tower controls air traffic in such a way that, in the event of late flights, available standby vessels are ordered to cover for the 30-minute requirement. If the weather is unfavourable for such a solution, the tower will consider cancelling the flight or maintaining the 15-min mobilisation time for the SAR helicopter and accepting a delay in shuttle traffic until the pilots have completed their breaks. An overview of SAR helicopter types as of the end of 2010 can be found in Subsection 3.2.

BP's helicopter on the Miller platform on the UK shelf (Jigsaw) is also used by some facilities that fall outside existing areas on the NCS in the area around Sleipner. This is a Super Puma L2 AWSAR machine without a hangar.

6.5.2 Situation with 2 SAR helicopters

When there is combined pick-up with two helicopters rescuing people in the same area, one must consider aviation restrictions for concurrent flights, if those who are to be rescued are close enough together that the two machines will be operating in the same area (typically 2D, where D=19.4 m for EC-225).

One assumes this is relevant in connection with DFU2, where many people could be close together in a small area. In the event of emergency evacuation (DFU3), it is assumed that those who require rescue will come from different rescue means, or have potentially jumped over board, and will thus cover a significantly larger area.

As regards DFU2, the following argument is used as a basis. It is assumed to be unlikely that 21 people will be lined up, holding each others' arms, for example, they could be on two sides of the helicopter, could come via a raft, etc. It is assumed that there could be one or two groups, as well as some people floating alone. The helicopter that arrives first will then naturally start with a group. While waiting for the second helicopter, the scenario will develop continuously. When the second helicopter arrives, it can start with those who are floating alone. Eventually, the two helicopters could get fairly close to each other, but only in the event of hoisting closer than 2D (about 40 m) will they have to stop simultaneous operations. It is unlikely that this will last for a long period of time, but to be conservative it has been assumed that the efficiency of the second helicopter is set at 50% during the period when both helicopters are running parallel rescue operations in the same area.

If all the people are in a perfect group, there will be a total conflict between two helicopters. Then 3 minutes per person will be highly conservative under most conditions.

Figure 23 shows how this is to be interpreted, including the period when both helicopters are running parallel rescue operations, and when one of the helicopters leaves the area to drop off rescued people.

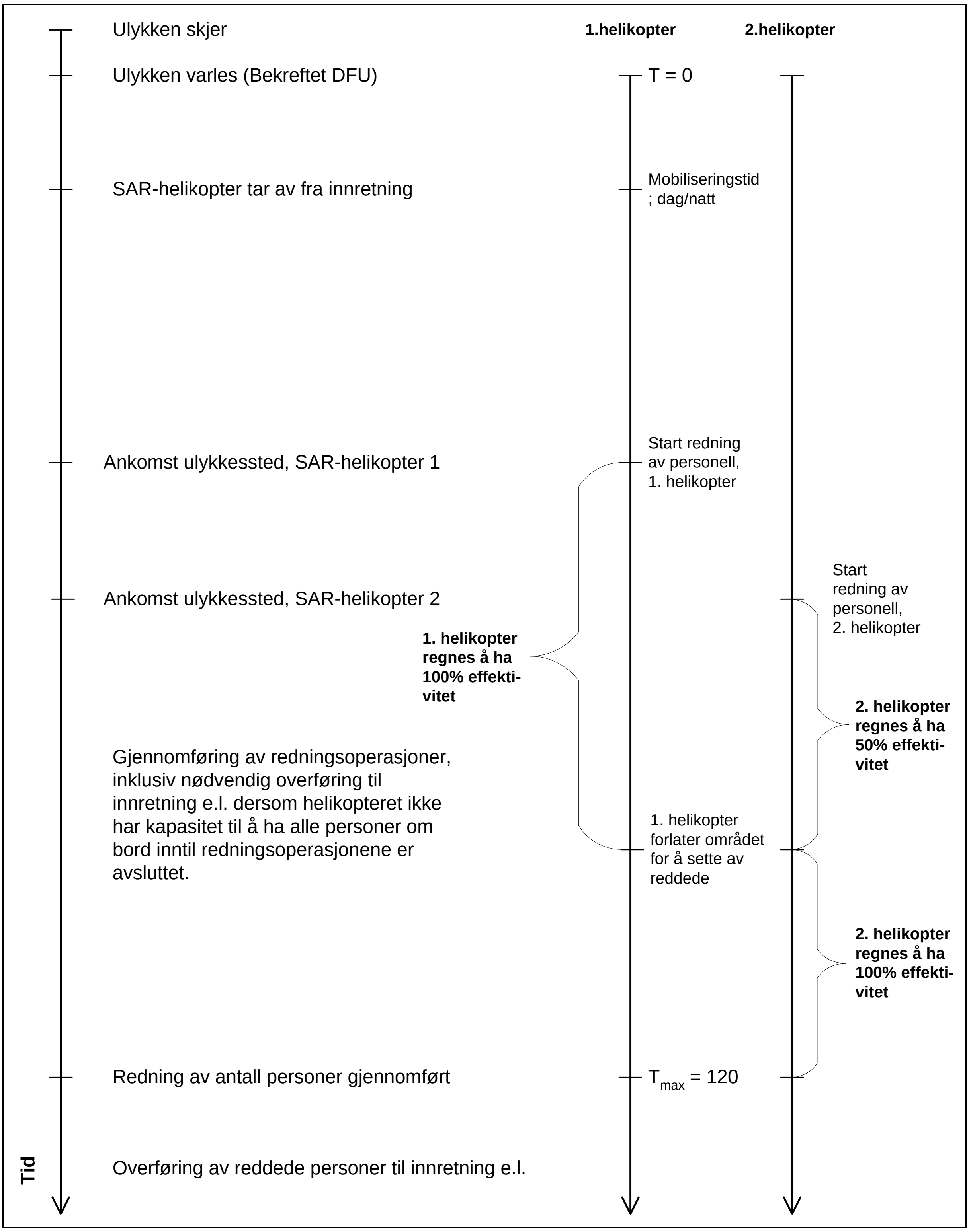


Figure 23 Interpretation of max response time and efficiency assumptions for 2 helicopters (DFU2)

6.6 Operational restrictions

It has been common to set operational restrictions for helicopter transport services when an MOB boat is the primary rescue means in the event of a helicopter accident within the safety zone. A significant wave height of 4.5 m H_S is a common restriction.

Statoil has taken the initiative for an operational routine associated with planning helicopter flights, which will set restrictions on the number of passengers on board on the basis of operational restrictions for the SAR helicopter service. An agreement has been entered into with an external supplier for developing a program that automatically provides such data, e.g. based on weather data, see Subsection 4.3.

There has been a corresponding situation for helicopters, where one cancels flights when the SAR helicopter cannot take off, from the helideck or from shore (if it has been moved onshore). The restrictions have been “on/off”, i.e. one either flies or one doesn’t. Statoil’s objective is that flights with a limited number of passengers may be allowed, based on the available rescue capacity, when the following is taken into consideration:

- Increased mobilisation time, for example when the SAR helicopter has been taken onshore, and the crew is sleeping at a hotel in the nearest town
- Changed flight time based on the helicopter’s location on land
- Increased flight time based on wind conditions (direction and strength), etc.

If the sum of the mobilisation time and flight time increases by e.g. 35 minutes in relation to what has been assumed for normal emergency preparedness, this corresponds to an 11–12 person reduction in the number of people who can be rescued. If normal emergency preparedness indicates that 21 people can be rescued within 120 minutes, such an increase will reduce this to 10 people, and the flight can be carried out with only 8 passengers.

There has not been complete awareness surrounding these circumstances previously, so this type of operational restriction is often disregarded. One company, however, has focused on this for quite some time. An increased awareness which entails that everyone is aware of such circumstances therefore develops and increases the quality of the emergency preparedness.

7. DFU3: Personnel in the sea during emergency evacuation

Much of what is documented in Chapter 6 for DFU2 also applies for DFU3. This chapter therefore only documents what is unique for DFU3.

7.1 Simplified dimensioning basis for rescue capacity for DFU3

The simplified approach in accordance with the guideline from 2000 for determining the number of people the rescue capacity must be dimensioned for indicates:

- 5% with emergency evacuation from independent facilities that have free-fall lifeboats
- 25% with emergency evacuation from independent facilities with conventional lifeboats[9]
- 0% with emergency evacuation from facilities connected by bridges, regardless of lifeboat type.

Conventional lifeboats can be found on production facilities on the Ekofisk and Veslefrikk fields, as well as on a number of mobile drilling units. It has been questioned what the basis for the criteria is, particularly the criteria for conventional lifeboats, as this entails a larger number of people than one helicopter (21 people) as the dimensioning basis, with a manning level higher than 85 people. For free-fall lifeboats, a manning level over 420 people is needed before 5% will result in a higher dimensioning basis that what comes from helicopter accidents.

There has not been an emergency evacuation to sea since 1985 on the NCS, see also Subsection 3.1. There have been multiple emergency evacuations to sea on a global basis in the last ten years (Ref 8):

- Brazil P-36, 2001 11 fatalities, fire and explosion, none during evacuation/rescue
- Brazil P-34, 2002, strong list, no fatalities
- Egypt Temsah, 2004, ignited blowout, no fatalities
- Bombay High North, India, 2005, riser fire, 22 fatalities, unknown how many during evacuation/rescue
- Usumacinta, Mexico, 2007, blowout, 22 fatalities, all during evacuation/rescue
- Montara, 21 Aug. 2009, Australia, blowout, no fatalities
- Macondo, 20 Apr. 2010, US GoM, 11 fatalities, ignited blowout, everyone on facility, none during evacuation/rescue
- Alban Pearl, 13 May 2010, Venezuela, capsizing, no fatalities
- Vermillion 380 platform 2 Sept. 2010, US GoM, ignited gas leak, no fatalities

Not all of these incidents have been organised emergency evacuations with lifeboat/capsules, several of the incidents have been "panic evacuations" where the crew jumped over board, for example the P-34 production vessel (FPSO) that experienced strong list in 2002. All of these incidents have resulted in a considerable number of people needing rescue from sea, from rafts, damaged lifeboats, etc. All of these incidents took place in waters with pleasant sea temperatures, so the time factor was not as critical based on hypothermia concerns, but could be critical in other ways.

In order to arrive at the best possible prediction for the percentage of people who need rescue from sea, an expanded search was carried out for incidents involving evacuation of facilities on a global basis. Table 9 shows the incidents found.

[9] In 064:2000 there was also a limit of 20% for independent concrete facilities with conventional lifeboats. This is no longer applicable, as there are no such facilities on the NCS.

Table 9 Evacuation and rescue of personnel offshore, on a global basis, 2001–2011

Facility	Country	Year	Means of evacuation	Weather conditions	POB	Number that needed rescue	Percentage rescue	Source
P-36	Brazil	2001	Crane, helicopter	Good	175	0	0%	Investigation report
P-34	Brazil	2002	Jump over board	Good	67	25	37%	Upstream
Temsah	Egypt	2004	Precautionary evacuation (not relevant)					Upstream
Mumbai High North	India	2005	Conv.LB, rafts	Poor	360	>180?	50%	HSE presentation
Usumacinta	Mexico	2007	Conv.LB	Extremely poor	73	73	100%	Investigation report
Montara	Australia	2009	Conv.LB	Good	69	0	0%	Investigation report
Macondo	US GoM	2010	Conv.LB, raft	Good	126	22	17%	Investigation report
Aban Pearl	Venezuela	2010	Conv.LB, jump over board	Good(?)	95	3	3%	Upstream
Vermillion 380	US GoM	2010	Jump over board	Good	13	13	100%	Upstream
Jupiter (living quarters facility)	Mexico	2011	Jump over board	Good	713	100	14%	Upstream
Total					**1691**	**416**	**24.6%**	

The following comments can be linked with the most uncertain values with regard to the number that needed rescue in these incidents:

- Mumbai High North, 360 people on board the complex before the accident, only a few lifeboats and 1 raft launched successfully, indicates that a high number needed rescue from sea (180 assumed).
- Usumacinta, approx. 80 people on board before the accident, both lifeboats capsized, all people on board required rescue from sea/lifeboats.
- Macondo, 126 people on board before the accident, five required rescue from sea, as well as 17 injured people in lifeboats.
- Alban Pearl, 95 people on board before the accident, everyone apart from three people that remained on the facility evacuated in lifeboats, those three needed rescue from sea.
- Vermillion 380 platform, 13 people on board before the accident, everyone jumped over board and needed rescue from sea.

For purposes of illustration, we can mention the following data from the two last incidents on the NCS where rescue of personnel in the sea in connection with emergency evacuation was relevant.

- West Vanguard, 1985, ignited shallow gas blowout, 77 out of 80 evacuated with two conventional lifeboats, one not found (killed in the explosion?), two people remained to release anchors, climbed down along a column and started swimming towards the standby vessel, and then needed rescue from sea.

- West Gamma, 1990, capsizing while being towed in the German sector, all 49 jumped into sea, when lifeboats and helicopters could not be used, all 49 were rescued from sea using an MOB boat from Esvakt (Danish sea rescue service) in gale-force winds.

In most of these incidents there was a need for rescue of from 13 up to more than one hundred people, which constitutes between 0 and 100% of the people on board. There were conventional lifeboats on all of these facilities, but lifeboats have not been used in all of the incidents. In five of the ten incidents, less than 25% needed rescue from sea/lifeboats/rafts. The average for all incidents is 25% that needed rescue from sea/lifeboats/rafts.

The major accidents on the NCS took place so long ago that they have limited relevance. There was obviously a very high percentage that needed rescue in the Alexander Kielland accident in 1980, while two out of approx. 80 people needed rescue from sea in the West Vanguard accident in 1985.

Many of the major accidents that have occurred on a global basis can give a basis for predicting of a relatively high percentage of personnel on board that could require rescue from sea or lifeboat/raft, if the accident development is particularly challenging.

However, based on data reported here, it can be claimed that 25% of the number of people on board is not a particularly conservative prediction for the number of people that could need rescue. Furthermore, it can be argued that the number of people that needed rescue in several of the accidents would likely be just as high, even if free-fall lifeboats had been installed.

On the other hand, there have been no major accidents on the NCS since 1985[10]. It is therefore not representative to use all accidents in other waters as representative for the NCS. There are stricter regulations on the NCS, with an expected effect on the likelihood of successful evacuation operations.

Nevertheless, the emergency preparedness arrangements need to be reasonable and defensible, even though major accidents on the NCS have become very rare. In this case, a low frequency has less significance.

It is not a relevant argument that it could be challenging and costly to fulfil the requirements when drilling exploration wells in the Barents Sea or the Norwegian Sea far (400-500 km) from shore. If mobile units for such drilling operations have free-fall lifeboats, it will not be dimensioning. It does not appear to be an unreasonable precondition that exploration drilling under such conditions takes place with the mobile units with the best evacuation solutions. Thus, the requirements could possibly contribute to such facilities being chosen. In summary, one can conclude the following factors in relation to the percentage of people that could need rescue from sea/lifeboats/rafts:

- The average number of people that needed rescue on a global basis in the last ten years is 25% for facilities with conventional lifeboats and rafts. The data basis is not insignificant. The empirical value is identical to the value used in the guideline in 2000.
- There are many significant differences between facilities on the NCS and other waters, which ideally should be taken into consideration, if extensive data was available. There is not enough data available to make the differentiations that would be desirable to reflect differences between facilities on the NCS and other waters.

[10] It is uncertain whether the Snorre Alpha blowout in 2004 should be included as a major accident. It was an uncontrolled blowout lasting a few hours, but with no fatalities. Also, emergency evacuation with lifeboats was not implemented, only precautionary evacuation with helicopters, see Subsection 6.1.3.1. The PSA's investigation report says that it was not a major accident.

- Some of the incidents could very well have happened on the NCS, for example the Macondo blowout, with 17% that needed rescue.
- There is no data available from incidents with free-fall lifeboats. Some of the incidents would not have been affected by different lifeboat concepts, while others would have been considerably affected by the type of lifeboat. It is therefore natural that the percentage of people that need rescue from sea/lifeboats/rafts is significantly lower using free-fall lifeboats.
- As a balanced assessment, it is most appropriate to continue the evaluation used as a basis for the assessment in 2000, and continue the basis for dimensioning of the number of people that need rescue in connection with emergency evacuation, so long as the deterministic (prescriptive) approach is used for dimensioning of the number of people that need rescue.

As an alternative to the prescriptive solution for determining the dimensioning basis, the guidelines from 2000 indicated a risk-based approach, which is discussed in the following subsections.

7.2 Risk-based dimensioning of rescue capacity

7.2.1 Can risk-based dimensioning of rescue capacity during emergency evacuation be used?

In the guideline from 2000, two possibilities for dimensioning rescue capacity during emergency evacuation, either risk-based or using the simplified rules (prescriptive approach) are discussed in Subsection 7.1. As far as we know, the risk-based approach has never been used, only the simplified, deterministic approach. As a helicopter accident will virtually always be dimensioning, when the free-fall lifeboats are installed, it is natural that this is the outcome. Only in cases with conventional lifeboats is there a benefit of using a risk-based dimensioning.

The principle for risk-based dimensioning can be summarised as follows. To carry out a risk-based dimensioning of rescue capacity, the following steps are taken:

1. Assumptions, preconditions and results from quantitative risk analysis are reviewed to determine the need for rescue of personnel that is required to fulfil the risk acceptance criteria.
2. The highest number of people that come out of the scenarios in Step 1, is the minimum capacity for rescue of people in the sea.
3. In addition, a probable number of people that could need rescue is established based on a classification of the facilities, with regard to escape routes and means of evacuation.
4. If the number of people in Step 3 is higher than the minimum capacity from Step 2, the number from Step 3 will be dimensioning, or the number from Step 2 is used.

It is a fact that few QRA studies are so detailed that they can be used for risk-based dimensioning as described in the guidelines. This particularly applies for mobile drilling facilities, where QRA often has a relatively limited work scope. It could be necessary to carry out a separate escape, evacuation and rescue study to get the necessary details. Use of the risk-based approach is discussed in the remainder of Subsection **Feil! Fant ikke referansekilden.**. It would be expected that use of the risk-based approach is most relevant for facilities with conventional lifeboats, otherwise it will be most relevant to use the simplified approach.

It is claimed that the Petroleum Safety Authority Norway does not accept risk-based dimensioning. This has been discussed with the PSA. The PSA says this is possible, but shares the perception that the quality of risk analyses for mobile units will often be an obstacle for implementing this in practice. The PSA assumes that the letter from November 2007 relating to misuse of risk analyses could have been interpreted to indicate that such use is not accepted in this case, this is a too strict interpretation of the letter relating to misuse of risk analyses.

PSA in collaboration with the Regulatory Forum (RVK) in the first half of 2012, published an intention to strengthen the regulatory requirements for means of evacuation (free-fall and conventional lifeboats). Furthermore, extensive studies were implemented and improvement measures were proposed for means of evacuation, since the weaknesses of free-fall lifeboats were discovered in 2005. These issues are considered in designated forums, and are not included in this Subsection.

7.2.2 Approach for risk-based dimensioning of rescue capacity

The approach for risk-based dimensioning of rescue capacity is indicated in Items 1-4 in Subsection 7.2.1, as well as Figure 1 in the guidelines. Items 1–3 represent two alternative dimensioning bases. It is clarified that use of both methods is not always required, but at least one of them must be used for the dimensioning to be risk-based. If Steps 1 and 2 are not implemented, it is assumed that the implementation of Step 3 is done based on a risk analysis that is sufficiently detailed with regard to escape and evacuation scenarios.

The following Subsections elaborate on the content of Steps 1-4 as indicated above. It is not indicated how this can be analysed in risk analyses to illustrate the aforementioned factors.

7.2.3 Preconditions in the risk analysis

The risk analysis will often have preconditions and/or intermediate results that show details in the evacuation and rescue of personnel. These preconditions are used in the calculation of personnel risk (FAR, IR, etc.), and form part of the basis for satisfying the acceptance criteria. When these preconditions are fulfilled, the risk will be acceptable in relation to the acceptance criteria. Such follow-up takes place in parallel with barrier management.

The preconditions included here, are normally the following scenarios:

- Groups of people that do not reach primary means of evacuation
  - Number of people in such groups
  - Percentage of people that end up in the water or rafts
- Groups of people that reach primary means of evacuation, but end up in the sea, in rafts or in damaged means of evacuation:
  - Number of people in such groups
  - Percentage that presumably is rescued in accordance with the risk analysis

These preconditions must not be assessed in relation to probability. They are preconditions from the quantitative risk analysis that must be fulfilled for the risk to comply with the results from the risk analysis. Then the risk is normally also acceptable.

If the escape routes are well-protected and logically organised, it is possible that there are no such scenarios that imply requirements for rescue following use of secondary (potentially tertiary) means of evacuation.

In some cases, the risk analyses have made direct assumptions relating to people that die during the lifeboat evacuation. This relates to people who are, for example, injured in some way and that must be rescued relatively quickly to try to save their life. Such preconditions therefore provide a direct basis for dimensioning of emergency preparedness capacity. Risk-based dimensioning could be unnecessary in such cases.

For people that do not reach primary means of evacuation, it is assumed that rescue capacity should be based on everyone that ends up in the sea or in rafts, regardless of whether they are assumed to be saved or dead in the risk analysis. This is based on the fact that, for these people, it will be impossible to determine who should be saved before one has attempted to rescue them, so the entire number of people that end up in the sea must be dimensioning for the rescue capacity. Such calculations have been carried out with conservative assumptions. This can entail that one assumes a lower number than all people that, in accordance with the analysis, do not reach primary means of evacuation. Such potential non-conformances must be documented extensively.

Preconditions that must be fulfilled:

- All people that are in lifeboats, rafts or that are forced to jump into the water are wearing survival suits.
- The survival suits must be placed such that the potential groups that could be prevented from reaching mustering stations in the risk analysis, can access survival suits.

7.2.4 Robustness of facilities

This paragraph discusses technical differences between different types of production facilities that are significant for dimensioning of rescue capacity, in relation to:

- People that do not reach primary means of evacuation
- People that could be injured during evacuation with lifeboats or other means.

The first aspect mainly concerns escape routes on the facility, the other aspect is related to the actual evacuation.

7.2.4.1 Escape on the facility

If the escape routes are well-protected and logically organised, it is realistic to expect that personnel are not "caught" without the possibility to reach mustering areas/stations. In such cases, there could be results from risk analyses which indicate that scenarios that set requirements for rescue or use of secondary (potentially tertiary) means of evacuation have not been identified. In practice, one cannot exclude that this can still happen in very rare cases, even though the analyses might not be sufficiently nuanced to identify it. Considerable variations between the facilities are likely on this point.

Assessments of these aspects should, to the extent possible, be founded in detailed risk analyses focusing on EER.

7.2.4.2 Lifeboat evacuation

Generally, one has considered conventional lifeboats as being exposed to damage through impact against a facility or against the sea during deployment. This is mainly a difference between conventional lifeboats in relation to free-fall lifeboats and skid type free-fall lifeboats.

Free-fall lifeboats (drop type) are the most common on fixed production facilities, while skid launched types are more widely used on floating production facilities. It is normally assumed that the likelihood of damage from impact with the sea is very low with such lifeboats[11]. Furthermore, they have an initial velocity away from the facility, so the probability of drifting back and becoming damaged is considered to be substantially less. Still, it must be noted that all experiences with deploying such lifeboats

[11] As mentioned, the issues associated with free-fall lifeboats that were discovered in 2005 are not included here. The assumption relating to low damage probability will most likely apply, if the lifeboats fulfil the regulatory requirements at all times.

come from deployment during drills, there have been no actual incidents where free-fall lifeboats have been involved.

Most conventional lifeboats have been improved in relation to becoming damaged by the sea when deployed, e.g. by the hooks that may be released even if they are not load free. The main problem for conventional lifeboats is therefore often considered to be the risk of damage to lifeboats when colliding with the facility, if the motor cannot be started. This concerns fixed as well as floating structures. It must therefore be assumed that with conventional lifeboats, damage to the lifeboat cannot be excluded, so allowance is needed for a number of people in the sea (or in damaged lifeboats) that need quick assistance and rescue.

Facilities connected by bridges will normally have a very low probability of evacuation with lifeboats being required at all. Normally, this probability is so low that it can be ignored. However, there could be cases where personnel cannot find protected escape routes to a shelter area, so they escape to sea or a raft, and will thus depend on rescue.

7.2.5 Principles

To determine the risk-based capacity for rescue of personnel in the sea during emergency evacuation, the basis is in principle taken in each facility's probability for having a certain number of people that need quick rescue, after an emergency evacuation. The relevant causes that can trigger such needs will include:

- People that end up in the sea because the means of evacuation (lifeboats) are damaged during deployment.
- People that are injured in an intact lifeboat, e.g. because it is damaged through impact against the facility or some people are not sufficiently buckled up during the fall with free-fall lifeboats.

Generally, one has considered conventional lifeboats as exposed to damage through impact against the facility or waves during deployment, as indicated above.

There are considerable differences between each facility as regards the probability for personnel in the sea, and the potential number of personnel. In most areas, there will therefore be differences between the facilities included.

For each facility, one must determine the correlation between the number of people in the sea during emergency evacuation and the associated probability. A principal illustration of such a correlation is shown in Figure 24, for three hypothetical facilities, with the following evacuation possibilities:

- Stand-alone platform, with conventional lifeboats
- Stand-alone platform, with free-fall lifeboats
- Platforms connected by bridge, regardless of lifeboat type

Note that this figure is only made to illustrate principal correlations, which is why it shows three curves in the same figure. Only one curve will apply for a facility. There is also no reason to expect that curves for an actual facility are as "smooth" as shown in Figure 24.

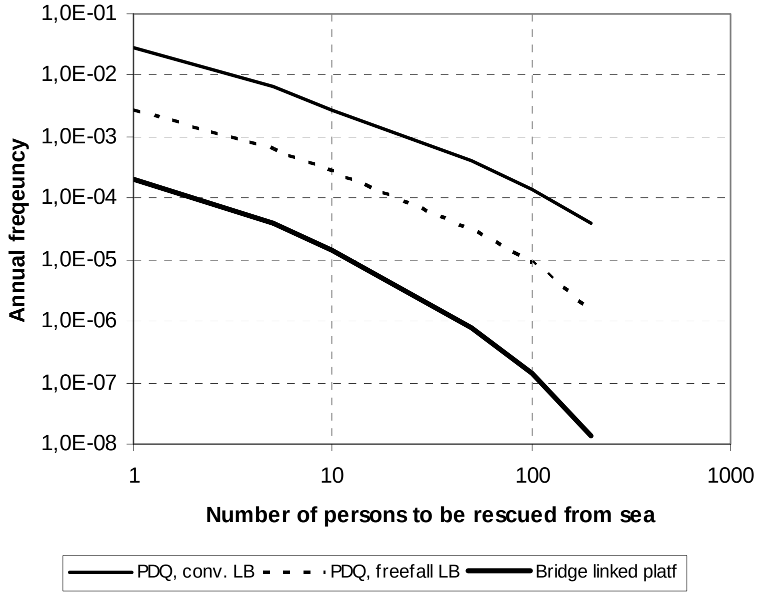


Figure 24 Correlation between number of people in the sea and cumulative frequency (idealised example)

The figure shows the cumulative frequency, i.e. when the frequency for ten people in the water is $1.2 \cdot 10^{-5}$ per year (the curve for platforms connected by bridge), this entails that the frequency of all accident scenarios that result in ten or more people in the water during emergency evacuation, is $1.2 \cdot 10^{-5}$ per year. Correspondingly, there is a frequency of $2 \cdot 10^{-4}$ per year for platforms connected by bridge for accidents with one or more people in the water. This entails that the frequency of accidents from 1 to 9 people in the water is $1.88 \cdot 10^{-4}$ per year.

The following data must be obtained to implement the planned mapping of accident probability, for each of the facilities covered:

- Frequency for the different evacuation scenarios
- Extent of personnel consequences of evacuation scenarios

7.2.6 Probability limit for selecting dimensioning scenarios

There are no acceptance limits for which probability to be used as a basis for dimensioning the capacity of the emergency preparedness system. In some cases, limits of about 10^{-4} per year have been used in emergency preparedness analyses, without there being a clear logic for selecting such limits.

It is emphasised that, for the rescue which the risk analysis has assumed, these preconditions must be completely fulfilled, without a probability evaluation, see Subsection 7.2.3. The assessments discussed here are therefore not necessary to fulfil risk acceptance criteria, but come in addition. As one is thus dealing with a emergency preparedness function that comes in addition to the primary requirements from the risk analysis, it is considered acceptable to determine the necessary capacity based on a probability assessment.

Subsection 3.1.8 shows an overview of the total frequencies for the different DFUs for the entire NCS. The overview shows that the scenarios that involve rescue of personnel generally have a frequency totalling 0.1 per year. For some of the scenarios, one must be aware that the incidents took place a long time ago (e.g. emergency evacuation), so the real frequency is likely lower for facilities dimensioned according to the current practice.

On this basis, it can be claimed that there is in implicit limit for which incidents are used as a basis for dimensioning emergency preparedness, equalling 0.1 per year for the entire NCS.

It must be acknowledged that risk analyses and statistics can never be comprehensive, analyses will have considerable limitations in which incidents are analysed, and statistics for rare incidents are normally lacking. The limit for when choosing not to dimension for a certain scenario should therefore be somewhat lower.

There are approx. 60 manned facilities on the NCS, when a platform complex is considered one facility, and mobile units are included.

If the value 10^{-3} per installation year is used to define the limit for which incidents to disregard, this is equal to about 0.06 per year overall for the NCS for the accidents which one does not dimension rescue emergency preparedness against. This is then approximately in line with (potentially somewhat lower than) the value approx. 0.1 per year, which emerges from empirical data discussed in Subsection 3.1.8.

It may be questionable whether the limit of 10^{-3} per installation year for the scenarios disregarded during the establishment of emergency preparedness requirements is "correct", or if 10^{-4} per platform per year would be a more suitable limit. The limit of 10^{-4} per installation year is often used in other contexts to select, for example, dimensioning accidental loads. However, when this is assessed, it must be assumed that the scenarios considered represent risk for personnel that is, generally, acceptable. The incidents used as a basis must be prevented to a sufficient extent through probability-reducing and/or consequence-reducing measures, so the remaining risk is acceptable. These incidents also represent faults in emergency preparedness systems.

It will therefore be equally unreasonable to set equally strict requirements for establishment of emergency preparedness for these incidents, which generally already have an acceptable risk. It is also relevant to note that the preconditions established in the analyses for the risk level to be acceptable, must apply directly as emergency preparedness requirements without any form of probability assessment. However, a case specific of which limit to use must be made, based on the following areas:

- Frequency = 10^{-3} per year — Highest frequency that can be used to establish dimensioning capacity
- Frequency in the interval 10^{-4}–10^{-3} per year — Specific assessment to be made based on specific factors to determine the highest frequency that can be used to establish dimensioning capacity
- Frequency = 10^{-4} per year — Lowest frequency that can be used to establish dimensioning capacity

7.3 Interpretation of the 120-minute requirement

7.3.1 Situation with 1 SAR helicopter

The situation with one SAR helicopter corresponds to what is described in Subsection 6.5.1 (incl. **Feil! Fant ikke referansekilden.**).

7.3.2 Situation with 2 SAR helicopters

The situation with two SAR helicopters is, as described in Subsection 6.5.2, that one can expect that the survivors that need rescue from sea and/or rafts/lifeboats are spread over a larger area, so both SAR helicopters can be expected to have 100% efficiency.

8. DFU4: Collision hazard

There are no changes as regards vessels on collision courses or drifting vessels that have significance for area-based emergency preparedness. However, it has been considered whether requirements for notification and potential implementation of evacuation should be changed. This is discussed in the following subsection.

8.1 Is the notification time for vessels on collision courses too short for facilities with a high manning level?

The requirements for notification of vessels on a collision course (50 minutes) is set based on the possibility for making a decision regarding evacuation 25 minutes before the potential collision time, and that this should provide the opportunity to evacuate with lifeboats before the possible collision, with a certain time margin.

However, information has emerged indicating that this is not sufficient for some facilities with a high number of people on board, and several free-fall lifeboats installed in parallel next to each other. In such cases, there must be a time separation between launching the lifeboats so one can ensure the previous boat has left the vicinity of the facility before the next boat is launched, to ensure a collision between them is avoided in connection with deployment, or immediately thereafter.

If evacuation takes place with 1–2 lifeboats, or multiple lifeboats that point in different directions, this is not considered a relevant problem. With two lifeboats, it should in any case be possible to launch these two boats within approx. 15 minutes. This is likely to apply for most facilities. There are probably less than ten facilities on the NCS with such a high manning level (and thus so many life-boats) that substantially longer than 15 minutes are required.

It does therefore not appear appropriate to increase the general notification time requirement for vessels on a collision course beyond what is stipulated in the guideline. But if there are many lifeboats with parallel headings, this must be checked in each case.

It will, regardless, be each facility's responsibility to ensure the performance requirements for emergency preparedness solutions are relevant based on the facility's risk picture and facility-specific conditions, and potentially adjust the emergency preparedness requirements if necessary.

9. DFU5: Acute oil spill

Dimensioning of emergency preparedness against acute oil spills is not included in Norwegian Oil and Gas 064: Recommended Guidelines for Establishing Area-based Emergency Preparedness.

10. DFU6: Fire with need for external assistance

The capacity of external cooling in the event of a fire on a platform must be dimensioned in line with preconditions made in the risk analysis. No changes have been assessed for this DFU in connection with the revision of the guideline. When determining Norwegian Oil and Gas 064:2012: Recommended Guidelines for Establishing Area-based Emergency Preparedness, there is only one production facility on the NCS according to risk analyses that requires external fire-fighting out of consideration for personnel safety.

11. DFU7: Personal injury/illness with need for external assistance

This Subsection discusses factors concerning emergency medical emergency preparedness, in connection with criteria for emergency medical response in general, as well as relevant measures of an emergency medical nature for expanding the activity to the north in the Barents Sea, as well the Vøring Plateau.

Emergency medical topics are one of the key aspects of area-based emergency preparedness. It is also one of the areas where the scope of empirical data is most extensive. It is also one of the topics where existing requirements in the guideline have been challenged.

The requirement for transport to hospital within three hours is considered by many to be the best practice which should also be used outside the established areas. On the other hand, it is known that a company with drilling operations so far from shore that it was not possible to satisfy the three-hour requirement with existing resources, established a requirement for four hours with the basis in this being an internal company requirement.

When the activities are expanded to the north in the Barents Sea as well as on the Vøring Plateau, emergency medicine is one of the two topics (the other is survival at sea for those who are waiting for helicopter rescue) that must mainly be considered very thoroughly. Discussion of these topics is therefore crucial.

This chapter therefore contains both a review of potential needs to change existing criteria, as well as an assessment of relevant measures when expanding the activity.

11.1 Time requirement – emergency medical response on the facility

The time requirement stated in the guideline from 2000 was one hour for emergency medical response on the facility. This entails thrombolytic equipment and expertise. Some facilities have permanent equipment. If the nurse also has sufficient expertise for safe use of the equipment, the one-hour requirement will not be relevant.

It is not relevant to consider a defibrillator in this context, all facilities have this.

The ambition level on shore is that it should be possible to reach 90% of the population within 45 minutes (Ref 25). In practice this means a helicopter (air ambulance).

In the most serious cases, transport to hospital will to an increasing extent involve “driving past” the local hospital, and going directly to a hospital with specialist expertise based on the diagnosis made. This also means greater dependency on helicopters. Treatment of the most serious cardiovascular and brain diseases is done at a limited number of specialised hospitals.

In summary, there is nothing to indicate that the requirements should be less strict in this area. It is not relevant to change the requirement for emergency medical response on the facility, this must be covered either with thrombolytic equipment and expertise on the facility, or by a SAR helicopter bringing this capacity to the facility within one hour.

The users have emphasised that it is not enough to have equipment in place, one must also ensure the expertise for safe use is fully present, and that practical arrangements for, for example, communication of the EKGs to a hospital or telemedicine has been tested in practice. This will e.g. require regular testing, and practical maintenance of emergency preparedness. Experience has show that this is much easier to achieve in practice on production facilities, than mobile units that relate to new hospitals all the time, and where medical services are often contracted from project to project.

11.2 Time requirement – transport of seriously injured and ill people to a hospital

11.2.1 Emergency medical criteria

A somewhat different practice has been documented in the various areas with regard to classification and prioritisation of emergency medical cases for transport to shore. Statoil has realised a need for stronger coordination and will establish a position as resource coordinator at Statoil Marine at Sandsli.

On Ekofisk, the head nurse has a coordination role in relation to prioritisation for mobilisation of SAR helicopters for emergency medical transport to shore. Thus, emergency medical expertise is a coordination resource.

There has also been discussion regarding the need to assess the possibilities for solving emergency medical challenges with drilling so far north in the Barents Sea that a helicopter in Hammerfest cannot deliver the emergency medical response time in accordance with the requirements in the guideline.

A measure to achieve better coordinated emergency medical response is to develop general criteria for classifying emergency medical cases, as the basis for the most identical practice possible between the areas. There is a norm published by the Norwegian Medical Association for onshore-based emergency medicine:

- Norwegian index for medical emergency assistance (Ref. 13)

There is feedback indicating that the challenges associated with a unified practice on the shelf do not involve the medical aspect, but what is called the "service level" in connection with transport to shore, in other words, the non-medical criteria which one has, over time, become accustomed to justifying use of a SAR helicopter. There are clear indications that this is practiced differently for each area.

It will not be possible to affect such criteria by developing more precise medical criteria. It is therefore not certain that a measure to develop general criteria for classification of emergency medical cases will have a notable effect to achieve the most identical practice possible.

11.2.2 Potential change in time requirements

The time requirement stated in the guideline from 2000 was three hours for transport to a hospital. It has been noted that there is no clear medical reasoning for the three hours. It has also been expressed that increasing the requirement to four hours would be a desirable scenario, based on the possibility to satisfy the requirement when the activity eventually moves further from land to Vøring and in the Barents Sea. A new assessment has been made of the basis for identifying a possible need for changes, and potential need for stricter or less strict requirements. On one hand, new equipment on the facilities could help enable expansion of the requirement. While on the other hand, other guidelines could lead to making the requirement stricter, because society's expectations for quick response may have increased. The illness scenario may have changed, or new treatment has been developed which requires a certain response.

In order to gain the broadest possible basis for considering whether to introduce changes, the demands and criteria have been discussed with multiple authorities and people, including the Rogaland County Medical Office (Ref 26), Norwegian Air Ambulance (Ref 25), and MD Kristian Lexow, Stavanger University Hospital/Global Medical Support/SOS International (Ref 27), who is a recognised capacity within emergency medicine.

As the basis for a requirement for transport time to a hospital, it would be natural to take a basis in the municipal health service in a remote rural area. A reasonable requirement for maximum time for transport to a hospital in such a situation is 90–120 minutes (when air ambulance is not available). Such an assessment is supported by Kristian Lexow.

Another parallel which can be referenced is that all ambulances that could have a longer transport time to a hospital than 90 minutes have thrombolytic treatment capacity (equipment and expertise) to result in an increased time window in the event of a heart attack. This corresponds to the time requirement for DFU7 offshore, external assistance with thrombolytic capacity within one hour. This way, there is an overlap between the situation onshore and offshore. Pre-hospital thrombolytic treatment improves survival and will be an important compensating measure in the event of long transport time to the hospital.

Following through with the remote rural area analogy, this would ideally indicate that the three-hour requirement for DFU7 should be lowered to 90–120 minutes. However, taking into consideration that thrombolytic capacity should be available within 60 minutes, one can exceed the 90–120 minutes, and still comply with the situation onshore to a reasonable extent. To a certain degree, this assessment also contains a pragmatic attitude that, if the three-hour requirement was lowered to two hours, it would be nearly impossible to fulfil in several locations, so one would end up with several exemption applications.

Treatment capacity for strokes has been developed at some major hospitals after the guidelines were published in 2000. This treatment requires what is referenced as a “narrow window of time”, up to 3.5–4 hours from when the stroke occurs until treatment at a hospital must start. Strokes mainly affect older people, but there are also some cases involving 50-year-olds, which is one of the major age groups on the NCS. In order to reach this from a facility, the time to a hospital from when the decision is made cannot exceed three hours.

The assessments do not contain anything to indicate a change that resulted in extending the time requirement, a longer period than three hours is not considered relevant based on a professional assessment, with reference to the analogy with remote rural areas. If any change were to be made, it would be relevant to reduce the requirement to less than three hours.

It would also conflict with the general development in society, and the prevailing expectations, to make the requirements for rapid transport to a hospital less strict.

Major trauma is an important example of injuries where survival depends on rapid transport to shore and where it will take a long time before alternative measures (telemedicine) could compensate for this. On the other hand, for major trauma, it will be impossible to set a lower deadline that is “short enough”. Serious trauma or spontaneous bleeding from the abdomen/major chest artery requires surgical intervention within minutes, and it will be impossible to dimension emergency preparedness in relation to this.

It would be difficult to satisfy a requirement that is reduced to less than three hours in many locations, for those facilities that are located furthest away from the facility where the helicopter is stationed. It would be less relevant to consider the requirement as a universal requirement on the NCS (even though the requirement is not implemented as universal outside areas, it is already used by many as an informal expression of a universal standard with which they want to comply). With a pragmatic view, one can therefore conclude that it appears best to keep three hours as the requirement, and prioritise that this has a function as a universal requirement rather than attempting to make the time requirement even stricter.

11.3 Should there be special emergency preparedness requirements for the Barents Sea?

It is considered that ENI, through drilling production wells on Goliat and the subsequent production phase, will set a standard for all fields with permanently manned facilities in the Barents Sea to have a emergency preparedness standard, as a minimum, corresponding to area-based emergency preparedness. It would be desirable to add such a premise in the guideline, but this has not been possible. Norwegian Oil and Gas considers discussion of such aspects to be outside the defined mandate.

The area opened for exploration drilling is the Southern Barents Sea, with a maximum area of approx. 500 km north from Hammerfest, but blocks have not been awarded so far more than 300 km north of Hammerfest.

ENI is testing survival suits for the Goliat field, limited to the area with dimensioning minimum temperature ÷20ºC, and considers that a survival suit, potentially in combination with requirements for undergarments, can satisfy the requirement for temperature drop for survival for up to 180 minutes. For research ethics reasons, the tests in 2010 were stopped after 120 minutes due to severe cool-down of fingers and toes, but the plan was to run them for 180 minutes. Everything indicates that the tests could have been run until 180 minutes without the deep core temperature being a problem (Ref. 14). This temperature deals with hypothermic survival.

It must be emphasised that the suits must have acceptable temperature protection for 180 minutes in order to be used in an area with a 120-minute requirement for rescue, when using the same safety factor of 1.5 which was used when determining the requirement for 120 minutes in the 064:2000 guidelines, and which is the same as used by HSE for the UK shelf (see discussion of safety factor below).

It is expected that the requirement for suits can be considerably more extreme, if dimensioning against minimum temperature ÷30ºC or ÷40ºC.

On the other hand, some are expressing scepticism to ending up with several suit types, which will substantially complicate logistics. It is much more robust and simple administratively if there is only one suit type everywhere. Additional requirements must then be fixed with requirements for undergarments.

The results from ENIs tests will be essential before one can make a conclusion in this question. On the other hand, it is likely unimaginable to use a “standard” suit with additional undergarments for satisfying requirements in those areas where they are dimensioning against minimum temperature ÷30ºC or ÷40ºC. A precondition for the same type of suit for the entire shelf will therefore cease regardless, when the petroleum activity moves north and east in the Barents Sea.

There are plans underway to further develop the suits to improve insulation of fingers and toes. Whether this will be introduced on all suits remains to be seen.

ENI will have a SAR helicopter stationed onshore in Hammerfest (20 min. flight time), with one hour mobilisation time 24/7, but with 15 min. mobilisation time for all shuttle flights. With one hour mobilisation time, it will not be possible to satisfy the requirement for external emergency medical assistance within 60 min., but arrival at a hospital within three hours is possible. ENI assumes that, in practice, mobilisation will be possible within 40 minutes, and that they will thus fulfil the requirement for external emergency medical assistance within 60 minutes. Compensating measures are also being assessed (Ref. 28).

In 2011, there was exploration drilling up to approx. 300 km from shore in the Barents Sea. This entails that a SAR helicopter located in Hammerfest cannot satisfy requirements related to medical evacuation, neither a response time of one hour for external emergency medical assistance nor patient to a hospital within three hours. This entails that compensating measures as discussed below in Subsection 11.5 are relevant.

With 300 km from Hammerfest, speed of 135 knots, 15 min. mobilisation time for shuttle flights, the helicopter can be at the facility within 87 minutes, if there is a helicopter accident inside the safety zone, and if the weather conditions are such that an MOB boat cannot start earlier. Then there are 33 minutes left to rescue people in the sea, which is nine people (three minutes per person, see Subsection 6.4). If waves do not exceed 4.5 m H_s, the MOB boat may already have rescued many people before the helicopter arrives. However, if waves exceed 4.5 m H_s, the number of people in the helicopter must be limited to nine (or the flight must be postponed).

It must be noted that 87 minutes is a long time to wait for a SAR helicopter, which will require good psychological and physical fitness, particularly for those that cannot get on a raft. The personal locator beacon will be absolutely crucial in such cases, and it must be expected that people in the sea will drift somewhat over such a long time.

When a helicopter conducted an emergency landing at sea in January 1996 on the way from Sola to Gyda, passengers had to wait approx. 60 minutes to be rescued. However, all passengers and the crew were in a raft, so the conditions for survival were as good as possible, despite winter temperatures both in the air and sea.

If it is possible to implement measures that increase the probability of people in the sea getting onto a raft, this will have a very good effect on the probability of surviving for a longer period. Such measures could be good ALARP measures.

It is documented above that it could be relevant to have special requirements for survival suits including undergarments in order for them to fulfil the same requirements in the Barents Sea as for the rest of the shelf.

It has been indicated that with drilling very far from shore (400–500 km), which is relevant in the Barents Sea and in the Norwegian Sea (Vøring Basin) it could be appropriate to increase the time available to rescue people in the sea beyond 120 minutes, if survival suits could be qualified for extra long protection. In this connection it is noted that when determining 120 minutes in the guideline in 2000, a safety factor of 1.5 was used. The safety factor will e.g. take into account all of the factors that will affect the possibility of survival, and which it is not practically possible to incorporate in simulated tests of suits in pools. This means that to achieve a 150-minute “window” for rescue of people at sea, one needs qualified suits for withstanding 225 minutes in the dimensioning temperature (air and sea). Standard tests according to the Requirements from Norwegian Oil and Gas indicate six hours, but this is not with a realistic temperature for the Barents Sea.

There will be more challenges than just the temperature so far north in the Barents Sea, such as sea spray and icing. These will be very isolated areas, it will be dark for large parts of the day outside the summer season. Experience from fishing up north is that gull birds will attack the eyes of people floating in the sea, without any possibility of defending themselves (for example due to fatigue or hypothermia). The eyes must therefore be protected to a considerable extent.

There are strong objections against permitting increased time for rescue from sea beyond 120 minutes, even though suits that can withstand sea and air temperature, wind/icing, etc. can be acquired.

It is considered to be a reasonable requirement that all producing fields in the Barents Sea with permanent facilities have a emergency preparedness standard corresponding to area-based emergency preparedness as a minimum. It is not considered reasonable to introduce even stricter requirements than what applies on the rest of the shelf.

It will likely also be a reasonable requirement that exploration drilling in the Barents Sea has a emergency preparedness standard corresponding to area-based emergency preparedness, but it is more natural to accept compensating measures for exploration drilling.

The examples above show that 300 km is the longest distance where, in practice, it is possible to rescue people in the sea on time, with a land-based helicopter. The same calculation with 400 km results in the rescue of only three people within 120 minutes.

With locations so far from the closest airport, consideration must be given to stationing an AWSAR helicopter on a facility or vessel. Then one must likely carry out coordinated drilling campaigns, so several mobile drilling facilities drill at the same time, and can share the costs of the AWSAR helicopter placed in the area. The placement of the hanger is most likely the greatest challenge.

11.4 Emergency medical emergency preparedness with operations far from shore

In connection with the update of the guideline, the need for establishing a subgroup to consider more in detail the emergency medical measures that can be used to compensate for the long distances that can occur from Hammerfest to the northern Barents Sea (400–500 km) was voiced. The work group could e.g. initiate contact with the Navy, to discuss the possibility of cooperation on stationing a frigate (see below) as a station en route.

A possible measure that emerged in conversations involves using Navy vessels (frigates) as stations en route to facilities that are drilling far north in the Barents Sea. The frigates will have helicopters on board when the NH90 helicopters are delivered. They have a doctor on board, but not on a general basis, only for certain missions. In this case, an agreement must be entered into between the Navy and Norwegian Oil and Gas, and there must probably be compensation for the obligations entailed by the agreement. It cannot be necessary for the vessel to be in the same position, it must be able to move within a certain area, so long as it is within a pre-determined sector which allows for reaching drilling facilities as soon as necessary. Others express doubt that it will be possible to achieve such an agreement with the Armed Forces.

If it is not realistic to use helicopters from the Navy, helicopters placed on a facility (or vessel) must be considered. A helicopter has never been placed on a mobile drilling unit, but perhaps it is a reasonable measure as drilling starts far north in the Barents Sea?

When Shtokman was drilled a few years ago with a helicopter base on Novaja Zemlja, a civilian vessel was used at a halfway position between the Finnmark coast and Novaja Zemlja, in order to provide refuelling facilities for helicopters. As far as we know, this was not with regard to achieving emergency preparedness requirements, only for helicopters to fly the long distance.

11.5 Compensating measures when requirements for medical evacuation cannot be fulfilled

In the Norwegian Sea, there has already been exploration drilling up to approx. 400 km from the nearest airport (for example drilling on Dalsnuten, block 6603/5, autumn 2010). In 2011, there was drilling of exploration wells approx. 300 km from Hammerfest in the Barents Sea. As referenced in Subsection 11.3, it will not be possible to satisfy the emergency preparedness requirements related to medical evacuation.

If it is assumed that the area-based emergency preparedness requirements are made applicable for the Barents Sea, compensating measures must be introduced for these projects. It is recommended that compensating measures are limited to the period with drilling before production activity has been established.

Relevant compensating measures that can be considered (most proposed measures have been implemented at least once) in relation to not meeting the medical evacuation requirements (60 min. and three hours, respectively):

- Increase the medical expertise on board (doctor on facility, two nurses on board, of which one has special expertise)
- Additional equipment on board (monitoring equipment, medication inventory, intensive-medical equipment) in combination with increased expertise
- Utilisation of the possibilities for telemedicine (requires high-speed data connection, as well as considerable preparations in relation to compatibility, encryption and other practical factors)
- SAR helicopter in the area, on facility or vessel (complete measure, not compensating)

These measures can be considered a “menu”, they have varying effects in relation to the emergency preparedness requirements, and have different cost levels.

Subsection 11.3 argues against reducing the requirements if the emergency preparedness requirements from area-based emergency preparedness are not achieved. There was at least one case with drilling far from shore in the Norwegian Sea, where the requirement for medical evacuation was reduced from the standard for area-based emergency preparedness, because it was not possible to satisfy the general requirement. The internal company requirement had a longer time until arrival at a hospital.

12. DFU8: Helicopter accident on the facility

12.1 Scope of injured people

For a long time it has been the established practice in many companies to use seven severely injured people as a basis for a helicopter crash on the helideck on the facilities. This has been based in the so-called "7/7/7 rule", i.e. seven fatalities, seven severely injured, seven with minor injuries. The basis for this rule was, with somewhat simplified assumptions, made in a emergency preparedness analysis at the end of the 1990s. If seven severely injured people were continued as the dimensioning basis, this would be significant with regard to how many severely injured people it would have to be possible to transport to a hospital with a SAR helicopter.

As indicated in Subsection 12.1 in the guidelines, the purpose of including DFU8 in the guideline is so it contributes to achieving a uniform practice on the NCS. The requirement applies for all facilities, including vessels that fall under the petroleum regulations and with helicopter decks, see Subsection 12.1 in Norwegian Oil and Gas 064:2012: Recommended Guidelines for Establishing Area-based Emergency Preparedness.

Statoil has changed its practice from 2011, and is now using a damage scenario with three severely injured people and four people with minor injuries, which corresponds to a dimensioning damage scenario with a toppled helicopter on deck without, or potentially with subsequent fire (same number of injured people with and without fire, with fire there is one fatality in addition)[12]. The basis is a risk analysis performed for Statoil in 2006, which has been updated for three facilities in 2009. The reports were reviewed with regard to suitability for use as a basis for changing the general requirements that were used for the NCS. With the exception of Statoil's basis for selecting a dimensioning incident, which is discussed below, it was found to be a suitable approach, mainly realistic assumptions, relevant data and a suitable degree of robustness/conservatism in the analysis. Both reports consider "new" (S-92) and "old" (Super Puma L2) helicopter models. Even though mainly only new helicopter models (EC-225 Super Puma & S-92) are used on the NCS in 2011, this is not expected to significantly change the results.

In the last few years, a system for monitoring helicopter decks for floating facilities was introduced. The system measures, among other things, speed and acceleration of the deck (Ref. 29). Previously, such information has only been based on manual observation, so measurements and automatic transfer of these parameters provide far safer (and earlier) information to the pilots, and reduce the risk of landing under conditions that are not prudent. The probability for incidents during landing on floating facilities has been reduced to the level for permanent facilities, as a result of this system. The system was introduced following the last update (in 2009) of Statoil's reports.

The analysis has looked at a number of scenarios with a basis in uncontrolled landing, and has assessed factors such as toppling on the deck, fall from helideck down to the facility and in the sea, as well as the possibility of a fire occurring. The resulting damage scenarios range from the most serious with 21 fatalities, to the most limited damage, which is considered to be two people with minor injuries.

Only one damage scenario is provided for each accident scenario. This should be perceived as the expected damage scenario given the individual accident scenario. The basis for these distributions has been accident statistics from offshore helicopter accidents on a global basis, combined with technical assessments from medical and technical helicopter professionals. Table 10 shows a summary of the data basis used in Statoil's risk analysis of a helicopter accident on the facilities. Note that for the worldwide data (based on data reported by Oil and Gas Producers – OGP), the number of people (also

[12] Baseline documentation for this requirement has been fully available for the work on revising 064, but the report has not been published beyond this. The values on this and the next page are excerpts from the report.

unharmed people) is not indicated, so there are two alternative calculations with different assumptions, for an average of 12 and 15 people, respectively, in the helicopter when the accident occurs.

Table 10 Overview of baseline data used in the risk analysis of a helicopter accident on deck

Sector	Period	Number	Percentage			Number per accident		
			Fatalities	Injured	Unharmed	Fatalities	Injured	Unharmed
Norway	1990–2005	3	0	0	0	0	0	0
UK	1976–2002	5	66%	1.6%	33%	8.4	0.2	4.2
Worldwide*	2000–2004	28	6.5%	9,5%	84%	0.8	1.1	10
Worldwide**	2000–2004	28	5.2%	7.6%	87%	0.8	1.1	13

* Based on assumed average of 12 people in helicopter during accident
** Based on assumed average of 15 people in helicopter during accident

Table 10 shows that there have been no relevant incidents on the NCS, not after 1990 which the table shows, and not before if the period was expanded. There have been five incidents on the UK shelf in the period after 1976. Only accidents that are relevant in connection with a crash on the deck or in the sea near the facility have been included in data from the UK shelf and data from OGP on a global basis. Both on the UK shelf and on a global basis there has generally been a very small number of injured people in connection with such accidents, the percentage of fatalities has been high on the UK shelf. In all five accidents there was at least one fatality, and up to all fatalities in the event of a crash into the sea. There have only been injured people in one incident (one person). The accidents on a worldwide basis generally have few fatalities, few injured people, and a much higher percentage of unharmed people. Details on these accidents are not available, so there is no data to explain this difference. OGP data from the period after 2004 has been reviewed to find potential representative incidents.

Even from helicopter operations on a global basis it is difficult to find incidents with a crash on a facility with a considerable number of injured people, but there are several incidents with a crash/emergency landing on sea with a number of injured people. On 6 September 2005, there was a partially controlled emergency landing at sea approx. 15 minutes flight time from a platform in the Gulf of Mexico. Everyone got out of the helicopter before it sank, five people (incl. two pilots) with serious injuries, seven with minor injuries. They were located and picked up by a rescue helicopter after approx. six hours (time entails that what is called “serious injuries” has not been life-threatening injuries, as everyone survived nearly six hours in the sea). On 29 December 2007, there was an uncontrolled landing in the sea near a platform in the Gulf of Mexico, everyone got out of the helicopter, one fatality, one person with serious injuries and two people with minor injuries. Two people were rescued by vessels after about 2.5 hours, the last survivor was rescued by vessels after four hours, and there was one fatality due to hypothermia/drowning.

The complete overview of scenarios and damage pictures that are analysed in the risk analysis, are (summarised in Ref. 30):

- Fall into the sea: 21/0/0 fatalities/severely injured/minor injuries[13]
- Fall to lower level, fire: 8/12/1 ” - - - - - ” - - - ” - - - - - ”
- Fall to lower level, no fire: 2/11/8 ” - - - - - ” - - - ” - - - - - ”
- Toppling on helideck, fire: 1/3/4 ” - - - - - ” - - - ” - - - - - ”
- Toppling on helideck, no fire: 0/3/4 ” - - - - - ” - - - ” - - - - - ”
- No toppling, fire: 0/1/2 ” - - - - - ” - - - ” - - - - - ”
- No toppling, no fire: 0/0/2 ” - - - - - ” - - - ” - - - - - ”

Differences between various facility types which Statoil has and various helicopter types have also been assessed, but the latter has proven to have a minimal influence on the results. There is a greater

[13] It is assumed that there are 21 people (including two pilots) in the helicopter. It is indicated that the same percentage distributions can be used if there are fewer people in the helicopter.

difference, but still limited differences between facility types. Some of the reason for limited differences relates to the system for monitoring movements of the helideck, as discussed on page 73.

Statoil has chosen to base selection of the dimensioning damage scenario on the probability of accidents, which entails that the dimensioning damage scenario is a function e.g. of the scope of helicopter traffic. The probability will also depend on other operational parameters, as well as the helicopter model. If changes are made in such parameters, in principle, the basis for emergency preparedness should be updated and potentially changed, this is inexpedient and unrealistic in practice.

The practice on the NCS also does not entail that the level of emergency preparedness is done directly depending on the probability of accident scenarios. If such a principle had been implemented on a broad basis, no standby vessels would likely have fire-extinguishing capacity. One could also reference the practice on the UK shelf, where it is stated that there should be emergency preparedness against all scenarios that have a non-negligible probability of occurring. The limit for what is negligible, must then be expected to be considerably lower than a frequency of $1 \cdot 10^{-4}$ per year.

If Statoil's approach was used by all companies, there would be very different emergency preparedness levels on different facilities. Facilities with a low manning level could risk ending up without a dimensioning scenario. This is considered unreasonable.

For each helicopter passenger that is exposed to an accident, how often helicopters land on the facility is insignificant. The risk of a helicopter accident is a joint risk factor for everyone working on facilities, and everyone should be entitled to the same emergency preparedness level. There should therefore be a level of emergency preparedness which is independent of the scope of helicopter traffic.

Statoil has only considered the facilities they own, i.e. production facilities, with a few exceptions (Glitne, etc.). Requirements established in the guideline in this area must also be valid for mobile drilling units, for there to be a general requirement for all facilities on the NCS. The operational factors can vary to a greater extent for mobile units.

Statoil has the following principle: The *dimensioning damage scenario* is chosen based on the principle that all of the damage scenarios that are more serious should have an overall annual probability lower than $1 \cdot 10^{-4}$. For the most unfavourable combination of facility type and helicopter type, this gives the following dimensioning scenario:

- Helicopter that topples on helideck with subsequent fire

The other combinations of facility type and helicopter type result in scenarios that are similar to this, with the exception that fire is not dimensioning. According to Statoil's study, this constitutes the difference between one fatality and zero fatalities, while the damage scenario is the same. It was commented that if Statoil should have an equal dimensioning scenario for all facilities, the above-mentioned scenario will be dimensioning, with the following damage scenario:

- One fatality, three severely injured, and four with minor injuries

The guideline therefore chose to partially use Statoil's principles for dimensioning emergency preparedness associated with a helicopter crash on the facility, as regards arriving at a dimensioning scenario for the facilities that have the highest volume of helicopter traffic. But then Statoil's principles are abandoned, by indicating that all facilities should have the same emergency preparedness level, regardless of the scope of helicopter traffic. With this use of Statoil's approach, the following scenario will be dimensioning:

- Helicopter that topples on the helideck with subsequent fire
- One fatality, three severely injured and four with minor injuries

When these values are compared with empirical data from accidents, see Table 10, the number of injured people is generally at a low level. Figure 25 shows a distribution of the number of injured people for the UK shelf and worldwide, based on data in Statoil's risk analysis. Available data provides no possibility for differentiating between serious and minor injuries. 22 out of 33 accidents have no fatalities, in two cases there are more than four injured people, in five out of 33 cases there are more than three injured people.

It is therefore natural to note that even though the number of injured people is considerably reduced in relation to what was previously assumed, there is still a significant degree of conservatism in the dimensioning values indicated here (three severely injured, four with minor injuries), when held up against data from relevant accident and incidents from the North Sea and worldwide.

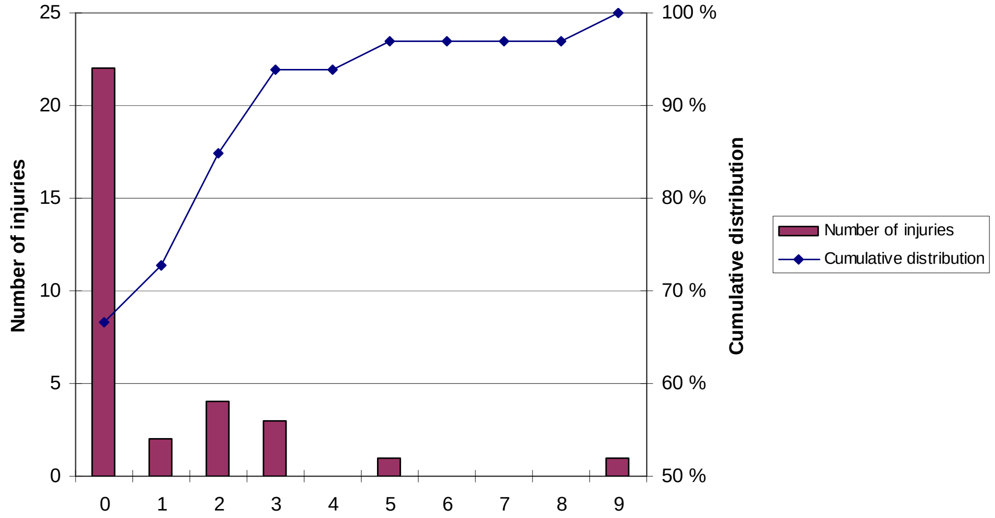


Figure 25 Distribution of number of injured people in a helicopter accident in connection with the helideck, based on data in Statoil's risk analysis

For dimensioning of emergency preparedness, the injured people receive the primary focus, but for the first phase of the rescue work on the damage site (helideck) it should be assumed that there are four severely injured people, of which one is so severely injured that it could be impossible to save him/her.

Statoil's dimensioning of emergency preparedness for such a scenario focuses on capacity for taking care of the injured people on the facility. In relation to the guideline, the need for transporting severely injured people to a hospital is the primary objective. With three severely injured people with survival potential, one could see a need for two or three people that need to be transported to a hospital with a SAR helicopter. The modern SAR machines (EC-225, as well as L2) have capacity for up to four stretchers transported to shore.

12.2 Time requirement in the event of a helicopter accident on the facility?

No specific time requirement is made in connection with medical treatment of injured people in the event of a helicopter accident on the facility. Primarily the facility's own emergency preparedness resources must handle the immediate treatment of injured people.

There is therefore no special time requirement for DFU8.

Furthermore, it is assumed that a potential need for sending the severely injured people to shore will be possible with the solutions from DFU7, even though a winch may have to be used to load the stretchers, as it must be expected that a damaged helicopter would block normal use of the helideck.

13. Other requirements for existing DFUs?

The chapter provides a brief overview of the additional requirements considered for existing DFUs.

13.1 Expertise and training SAR crews

SAR service suppliers expect that it will be possible to fulfil requirements for pilots to have a SAR background for captains. But they are of the opinion that a dialogue relating to requirements for a SAR background for co-pilots should be established. If there is still a requirement for SAR background for co-pilots, one must expect that a considerable degree of exemptions will be granted, as it is not possible to recruit co-pilots externally that have such backgrounds.

SAR service suppliers are concerned that, when simulator requirements are made, (8 hours crew time, approx. 4 hours joystick time) per six months, one must set a requirement for at least two of these hours to be SAR-specific training for the SAR crew.

13.2 Ship on collision course

Subsection 8.1 discusses a possible need for increasing the time requirement for notification of vessels on a possible collision course, if full evacuation requires there to be many free-fall lifeboats with the same heading to be dropped. Changing the general requirement has not been proposed, but the facilities with more than three free-fall lifeboats with the same heading must consider this need in particular. More information is provided in Subsection 8.1.

13.3 Standby vessel requirements

The Norwegian Maritime Authority is working on a revision of the regulations for standby vessels. Requirements for vessels must be adapted to the revised regulations for standby vessels.

The development of new concepts for such vessels has resulted in far better performances for the ability to operate in high seas. One of the trade unions emphasises that not all such vessels perform equally. The limits for how high the seas can be to deploy and pick up the rescue boat (MOB) vary too much. Depending on the content of the revised regulations for standby vessels, it could be relevant to formulate additional requirements to express the “best practice”.

13.4 Injured people in the event of a helicopter crash on the facility

This is not a new requirement, but a premise which applies to emergency preparedness on the facility, but which is also significant for area-based emergency preparedness. More information is provided in Chapter 12.

14. New DFUs?

The chapter provides a brief overview of the assessments made of potential DFUs in addition to the seven provided in the guidelines from 2000.

14.1 DFU8: Helicopter accident on the facility

DFU8 must normally be handled with the facility's own emergency preparedness resources. Norwegian Oil and Gas 064:2012: Recommended Guidelines for Establishing Area-based Emergency Preparedness include ensuring that there are joint and realistic requirements in the industry, see Chapter 12.

14.2 Ash clouds as DFU?

When the ash clouds stopped air traffic in large parts of Europe and the helicopter traffic on the NCS during spring in 2010 (Eyjafjöll eruption), the PSA referenced the same paragraphs in the regulations that relate to operation of the facilities in connection with cancelled flights due to fog. The duration of the shutdown during spring 2010 was also not significantly longer than the most of the longer periods of shutdown due to fog.

It can be noted that fog is not treated as a separate DFU.

There is also no practice for facilitating alternative personnel transport solutions with brief shutdowns due to fog. However, use of vessels has been considered when fog conditions last for several days. The focus is then often on transfer with a personnel basket, which should be voluntary. There are also a few known cases where ill people are sent to shore by boat.

There are therefore strong precedents for considering short-term ash problems as the same as fog problems. However, one can imagine ash emissions that last for several months. If one considered the last 6-7000 years, there have been three incidents with considerable ash precipitation in Southern Norway (and then often also in larger parts of Europe), so a longer duration must be expected, (Ref. 31). Such incidents have also had a strongly varying frequency from 40 to 250 years between each time. The last serious ash incident was in 1918 (approx. 20 times larger volume of ash emission than the Eyjafjöll eruption in 2010), and it can therefore not be excluded that a new serious occurrence could happen over the course of the near future. (However, the largest volcano eruptions on Iceland have had a 500–1000 year recurrence interval). How should such aspects be considered?

It should also be mentioned that as long as ash clouds stop SAR helicopter flights, all other helicopter traffic will also be stopped. So rescue of personnel from the sea in the event of a helicopter accident is not relevant. But emergency evacuation cannot be excluded.

It has therefore been assessed whether there are factors in connection with emergency evacuation that would indicate a need for special measures, for example in relation to the facilities that have so-called "red seats" when the weather conditions and wave heights are not favourable.

With the help of the Norwegian Meteorological Institute (Ref 32), we have investigated which correlation can be expected between ash clouds that stop flights and high winds (that also create large wave heights). Major pressure differences, that cause strong winds, will entail good stirring and considerable vertical movement, according to the meteorologists. It will normally lead to a low ash concentration in the air. This entails that the combination of bad weather and a high ash concentration is unlikely. There would therefore be no reason to expect that while helicopter flights are stopped due to ash clouds, there will be an emergency evacuation with an insufficient number of lifeboat seats due to the so-called "red lifeboat seats".

Ambulance flights to shore are also stopped by ash clouds and fog. Under such conditions, alternative transport to shore will take place using standby or similar vessels, with a considerably longer transport time to shore. Consideration has been given with regard to setting time requirements when use of helicopters is not possible due to fog or ash clouds. Such a time requirement would need a much longer horizon, as it could take 12–15 hours to reach shore with a boat.

However, the time requirement is set based on emergency medical factors, and not what is possible to achieve. It is therefore not relevant to set a separate time requirement for transport with a vessel. The requirement is the same, three hours, but factors that prevent use of helicopters must be treated as extraordinary situations, where one must find alternative solutions that are as good as possible based on the patient's condition, what it is possible to achieve, etc.

It is therefore considered that, from a emergency preparedness viewpoint, long-term ash clouds should not be a DFU. But such a condition would entail a need to operate the facilities in another manner, which would indirectly also have an effect on area-based emergency preparedness.

14.3 Other DFUs?

We have considered whether there have been incidents or other types of experiences that indicate a need for new DFUs that are relevant in relation to area-based emergency preparedness, with a basis in experiences from the NCS during the period following 2000. When preparing the guideline in 2000, certain other potential incidents were considered (Chapter 10 in the guidelines from 2000):

- Drifting shuttle tanker
- Loss of stability
- Loss of position
- Extensive structural damage

None of these incidents were made applicable as DFUs in the guideline in 2000. There have been no incidents or other empirical data in the period following 2000 which indicates that other conclusions for these potential DFUs are relevant in 2011. We also have not identified other incidents or experiences that would indicate a need for new DFUs.

15. Verification that requirements are met

All DFUs in connection with area-based emergency preparedness (with the exception of DFU7) are rare incidents, and verification through incidents that occurred is much too random and insufficient. Verification must therefore be done through exercises and to some degree analyses. Each facility is responsible for verification.

When planning training and exercises there are two overall considerations that must be maintained; which have impact on the planning of training and exercises in separate ways. To provide the best possible qualifications for the crews, it is desirable for training and exercises to take place under the most realistic conditions possible. However, it is an established principle on the NCS that one cannot expose crews and live markers to unnecessary risk during training and exercises. This sets clear restrictions on how realistic the conditions can be.

To avoid unnecessary risk exposure, weather restrictions are often used during training and exercises that are stronger than the weather conditions they assume the emergency preparedness resources can operate efficiently under. If the gap is too large, the training will not have the correct effect and verification through exercises will not be real. If the gap is small, the risk exposure will be unnecessarily high.

The principle relating to not exposing crews and live markers to unnecessary risk, thus entails important restrictions. The Danish company Esvagt is responsible for the most known illustration of an alternative approach. Crew changes on the company's standby vessels (also on the NCS) take place using an MOB boat during prevailing weather conditions. This entails that the crews are trained in manoeuvring MOB boats and implementing personnel transfers under realistic weather conditions, not just in relatively good weather conditions. This may entail a certain risk, but it is expected to result in considerable advantages if a rescue action will be carried out in bad weather. In this connection, reference is often made to the rescue of the crew on West Gamma which all had to jump into the sea during very bad weather, when the facility wrecked while being towed in the southern North Sea in 1990. The Norwegian vessel was not able to rescue the personnel in the sea, but the crew from Esvagt (which happened to be nearby) were able to rescue everyone.

As regards rescue of personnel in the sea, it is important to focus on verification of requirements during marginal conditions. It is also essential that exercises are carried out during marginal conditions. This includes wave conditions, wind strength, sea temperature, daylight/dark, etc. During the most marginal conditions, it will not be prudent to use live markers. Verification that requirements can be met must be done both where a SAR helicopter is the primary emergency preparedness resource, as well as where a standby vessel is either the primary resource or the only available resource under certain conditions.

It is important that exercises are planned so they can be used to verify that area-based emergency preparedness requirements can be met under all conditions under which the requirements apply.

Training and exercises in connection with man-overboard emergency preparedness are addressed in separate guidelines, see Norwegian Oil and Gas Guidelines 096, Recommended Guidelines for Man-overboard Emergency Preparedness (Ref 33).

16. Cost distribution model

The text in Subsection 16.1 is a direct copy of the text with the same title which was presented in Subsection 13.4 of the guideline in 2000, without being edited in any way (beyond changing the table caption numbers). Cost distribution has not been a topic in the update of the guideline in 2012.

16.1 Cost distribution

16.1.1 Principles

The cost distribution must be based on all parties carrying their share of the costs for the common emergency preparedness in the area.

If one of the resources is used by one party only, this party will cover the direct accrued costs.

A cost pool will be administered by one of the parties in the pool. The pool administration will distribute net costs for all the participants in the pool. An annual calculation of the monthly costs must be made in February of each year for the previous year.

16.1.1.1 Helicopter costs

The helicopter costs will be distributed in accordance with the number of people on board the installations in the area, and the direct use of the helicopter.

The average POB on each installation over the course of a month will be aggregated up to a total (average) POB for the area.

The fixed cost of having one/two helicopters in the area will then be distributed in line with the percentage share of the average POB for the month.

The cost of using the helicopter, i.e. technical flight time, will be charged directly per hour (or part of hour) to the party using the helicopter.

If the helicopter is used by other parties that do not participate in the pool, such parties must pay a price which covers both fixed expenses and technical flight time. The price for these is set at NOK 25 000 per hour. All such income goes to the pool and will reduce the fixed monthly fee for all parties.

16.1.1.2 Standby vessel costs

The standby vessels' costs will be distributed in relation to the number of production wells drilled, the number of exploration wells drilled, and oil production in the area. Oil production means both oil and condensate.

Fifty per cent of the costs over the course of the month will be distributed by the number of wells drilled. Exploration wells must be weighted three times that of a production well.

Fifty per cent of the costs must be charged based on the percentage of production which each participant has of the total oil production in the area.

If one of the parties uses the vessel for emergency towing or special missions, this activity must be fully charged to this party. An hourly rate must be agreed for this. The income from these activities will go to the pool and net pool costs will be charged in accordance with these principles.

16.1.2 Distribution formula

16.1.2.1 Helicopter costs

The calculation formula takes a basis in costs per month, and summarises over 12 months to determine annual costs. The following formula expresses the distribution principles as indicated in paragraph **Feil! Fant ikke referansekilden.**:

$$C_A^H tot = \sum_{i=1}^{12} \left(\frac{POB_{A,i}}{\sum POB_i} \bullet C_{Fast}^H + H_{A,i}^H \bullet C_{Time}^H \right)$$

The following notations are used here:

$C^H_A tot$ = Total annual cost of helicopter for Facility *A*

$POB_{A,i}$ = Average monthly POB for Facility A and month *i*

C^H_{Fast} = Fixed monthly costs of helicopter

$H^H_{A,i}$ = Number of flight hours per month for Facility A and month *i*

C^H_{Time} = Costs of helicopter per flight hour

16.1.2.2 Standby vessel costs

The calculation formula takes a basis in costs per month, and summarises over 12 months to determine annual costs. The following formula expresses the distribution principles as indicated in paragraph **Feil! Fant ikke referansekilden.**:

$$C_A^B tot = \sum_{i=1}^{12} \left(\left(0{,}5 \bullet \frac{3 \bullet B_{Ai}^L + B_{Ai}^P}{\sum 3 \bullet B_{Ai}^L + B_{Ai}^P} + 0{,}5 \bullet \frac{M_{Ai}^O}{\sum M_{Ai}^O} \right) \bullet C_{Fast}^B + H_{A,i}^B \bullet C_{Time}^B \right)$$

The following notations are used here:

$C^B_A tot$ = Total annual cost of standby vessel for Facility *A*

B^L_{Ai} = Number of exploration wells drilled for Facility A in month *i*

B^P_{Ai} = Number of production wells drilled for Facility A in month *i*

M^O_{Ai} = Volume of oil and condensate produced on Facility A in month *i*

C^B_{Fast} = Fixed monthly costs of standby vessels, after correction for income from special missions

$H^B_{A,i}$ = Number of hours use of standby vessel for special missions for Facility A and month *i*

C^B_{Time} = Costs of special missions for standby vessel per hour

16.1.3 Examples – Helicopter costs

16.1.3.1 Example 1 - Haltenbanken

An example has been prepared of distribution of costs of helicopter use on Haltenbanken, with the following facilities:

- Draugen
- Heidrun
- Njord A, B
- Åsgard A
- Norne

Data basis for the example, as well as calculation of cost components are provided in the table below.

Table 11 Calculation example, annual distribution of costs of SAR helicopter

Facility	*POB*	*% POB*	*Share fixed costs*	*Flight time per month*	*Share costs of flight time*	*Cost per month*	*Cost per year*
Draugen	60	10.26	205 128.21	20	70 000.00	275 128.21	3 301 538.46
Heidrun	206	35.21	704 273.50	30	105 000.00	809 273.50	9 711 282.05
Njord	120	20.51	410 256.41	30	105 000.00	515 256.41	6 183 076.92
Åsgard	80	13.68	273 504.27	40	140 000.00	413 504.27	4 962 051.28
Norne	119	20.34	406 837.61	40	140 000.00	546 837.61	6 562 051.28
Total	585	100.00	2 000 000.00	160	560 000.00	2 560 000.00	30 720 000.00

16.1.3.2 Example 2 – the Southern Fields

An example has been prepared for distribution of costs of helicopter use on the Southern Fields, with the following facilities:

- Ula
- Gyda
- Valhall
- Hod
- Ekofisk

Data basis for the example, as well as calculation of cost components are provided in the table below.

Table 12 Calculation example, annual distribution of costs of SAR helicopter

Facility	*POB*	*% POB*	*Share fixed costs*	*Flight time per month*	*Share costs of flight time*	*Cost per month*	*Cost per year*
Ula	40	3.91	133 072.41	10	35 000.00	168 072.41	2 016 868.88
Gyda	40	3.91	133 072.41	15	52 500.00	185 572.41	2 226 868.88
Valhall	140	13.70	465 753.42	20	70 000.00	535 753.42	6 429 041.10
Hod	2	0.20	6 653.62	40	140 000.00	146 653.62	1 759 843.44
Ekofisk	800	78.28	2 661 448.14	120	420 000.00	3 081 448.14	36 977 377.69
Total	1022	100.00	3 400 000.00	205	717 500.00	4 117 500.00	49 410 000.00

16.1.4 Examples –standby vessel costs

16.1.4.1 Example 3 - Haltenbanken

An example has been prepared for distribution of costs of use of standby vessels on Haltenbanken, with the following facilities:

- Draugen
- Heidrun
- Njord A, B
- Åsgard A
- Norne

Data basis for the example, as well as calculation of cost components are provided in the table below.

Table 13 Calculation example, distribution of costs of standby vessel

	Exploration wells	%	Cost exploration wells	Production wells	%	Cost production wells	Production	%	Cost exploration wells	Total monthly cost	Annual cost
Draugen	1	3.49	43 604	8	9.30	116 279	210 000	31.82	397 727	557 610	6 691 331
Heidrun	2	6.98	87 209	10	11.63	145 348	150 000	22.73	284 090	516 649	6 199 788
Njord	2	6.98	87 209	7	8.14	101 744	80 000	12.12	151 515	340 468	4 085 623
Åsgard	4	13.95	174 418	16	18.60	232 558	100 000	15.15	189 393	596 370	7 156 448
Norne	1	3.49	43 604	15	17.44	218 023	120 000	18.18	227 272	488 900	5 866 807
Total	10	34.88	436 046	56	65.12	813 953	660 000	100.00	1 250 000	2 500 000	30 000 000

16.1.4.2 Example 4 – the Southern Fields

An example has been prepared for distribution of costs of use of standby vessels on the Southern Fields, with the following facilities:

- Ula
- Gyda
- Valhall
- Hod
- Ekofisk

Data basis for the example, as well as calculation of cost components are provided in the table below.

Table 14 Calculation example, distribution of costs of standby vessel

	Ex-ploration wells	%		Produc-tion wells	%		Production	%		Total monthly cost	Annual cost
Ula	0	0.00	0	5	6.85	85 616	35 000	7.37	92 105	177 721	2 132 660
Gyda	2	8.22	102 739	7	9.59	119 863	35 000	7.37	92 105	314 708	3 776 496
Valhall	1	4.11	51 369	10	13.70	171 232	100 000	21.05	263 157	485 760	5 829 127
Hod	0	0.00	0	1	1.37	17 123	5 000	1.05	13 157	30 281	363 374
Ekofisk	2	8.22	102 739	35	47.95	599 315	300 000	63.16	789 473	1 491 528	17 898 341
Total	5	20.55	256 849	58	79.45	993 150	475 000	100.00	1 250 000	2 500 000	30 000 000

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