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Agenda item 3. Mediterranean Offshore Guidelines and Standards
b) Common Standards and Guidance on the Disposal of Oil and Oily Mixtures and the Use and Disposal of Drilling Fluids and Cuttings

Rationale for the Common Standards and Guidance on the Disposal of Oil and Oily Mixtures and on the Use and Disposal of Drilling Fluids and Cuttings

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1. Background

1.1. Objectives

1. The purpose of this study is to establish common standards and guidelines to harmonise regional practices in the Mediterranean region as per the Mediterranean Offshore Action Plan and Offshore Protocol. This part of the study aims to develop:

- Common standards and methods for the disposal of oil and oily mixtures, the use and disposal of drilling fluids and cuttings and associated analytical measurements;
- Recommended standard for seabed sampling programmes;
- Guidance on the use and disposal of drilling fluids and cuttings;
- Guidance on the disposal of oil and oily mixtures.

1.2. Methodology

2. As mentioned above, this study follows on from the Study on International Best Practices (REMPEC/WG.35/INF.3), and particularly Sections 5.3.3 and 3.3.7 of foresaid study, which describe current best practice with regard to the disposal of oil and oily mixtures and the use and disposal of drilling fluids and cuttings, elsewhere in the world. The information contained in the International Best Practices Study has been reviewed and supplemented with additional data from publicly available literature sources, where appropriate.

3. In addition to the literature review, a questionnaire was sent to all Contracting Parties to establish a baseline of current discharge limits, monitoring requirements and practices in the region. Responses to the questionnaire have been received from the Albania, Bosnia and Herzegovina European Union, France, Israel, Italy and Morocco.

4. All collated information has been analysed and combined into a set of common offshore standards on the disposal of oil and oily mixtures, the use and disposal of drilling fluids and cuttings and analytical measurements, resulting in the draft guidance documents presented in the working document UNEP/MED WG.476/4.

1.3. Legislative Background

1.3.1. Summary of Legal Instruments and Best Practices Guidance

5. The United Nations Convention on the Law of the Sea (UNCLOS) provides a universal legal framework for the management of marine natural resources, including efforts to prevent, reduce, and control marine pollution. UNCLOS governs the delimitation of the Exclusive Economic Zone[1] (EEZ) of maritime nations.

6. The International Convention for the Prevention of Pollution from Ships, 1973, as amended by the Protocols of 1978 and 1997 relating thereto (MARPOL) and its Annexes is the main international Convention covering prevention of pollution of the marine environment by ships from operational or accidental causes. Annex I of the Convention covers prevention of pollution by oil from operational measures as well as from accidental discharges. MARPOL Annex I provides the worldwide standard for oil content of machinery space drainage from ships. The Mediterranean Sea is designated as a "Special Area" under Annex I and is subject to more stringent requirements than those that apply outside Special Areas. With the exception of Bosnia & Herzegovina (and the EU[2]), all

[1] The EEZ is the area in which the coastal state is accorded sovereign rights to conserve, manage, explore, and exploit all living and non-living resources in the water and on and under the seabed.
[2] The EU is not a full member, as IMO's founding Convention only allows for the membership of States.

Contracting Parties the Barcelona Convention and its Protocols have ratified the Annex I of MARPOL.

7. The World Bank/International Finance Corporation (IFC) guidelines (2015) provide discharge limits for oil and gas developments which are indicative of good international industry practice, as reflected in the relevant standards of various countries with recognized regulatory frameworks. The guidelines are assumed to be achievable under normal operating conditions in appropriately designed and operated facilities through the application of pollution prevention and control techniques (IFC, 2015).

8. In Northwest Europe the discharges of oil, oily mixtures, drilling fluids and cuttings are governed by the Convention for the Protection of the Marine Environment of the North-East Atlantic (OSPAR) guidance, which has been adopted and is implemented into national legislation in countries with a mature offshore oil and gas, such as the United Kingdom, Norway and the Netherlands. OSPAR guidance is recognised as good practice the world over and is often used by countries in the absence of specific local guidance.

9. In the U.S, the Clean Water Act prohibits the discharge of any pollutant into US waters from petroleum activities or other sources, unless the discharge complies with specific requirements. Separate restrictions have been set for “coastal” and “offshore” waters, with coastal discharge requirements generally being more stringent than offshore requirements (EPA, 2011).

10. In addition to this framework of international and national legislation, operational guidance is also provided by industry organisations. For example, the International Association of Oil & Gas Producers (IOGP) provides guidance on international best practice. National industry guidance is provided by organisations such as Oil & Gas UK in the United Kingdom, Nederlandse Olie en Gas Exploratie en Productie Associatie (NOGEPA) in the Netherlands and the Norwegian Oil and Gas Association (Norsk olje og gass) in Norway.

1.3.2. Relevant Articles of the Offshore Protocol – Section III Wastes and Harmful or Noxious Substances and Materials

11. Article 8 of the Offshore Protocol imposes a general obligation upon Operators to use the best available, environmentally effective and economically appropriate techniques. Operators should also observe internationally accepted standards regarding wastes, as well as for the use, storage and discharge of harmful or noxious substances and materials with a view to minimizing the risk of pollution.

12. Article 9 of the Protocol deals with the use and discharge of harmful or noxious substances and materials and sets out the following provisions for regulators and operators:

i. The use and storage of chemicals for the activities shall be approved by the Competent Authority, on the basis of the Chemical Use Plan;
ii. The Contracting Party may regulate, limit or prohibit the use of chemicals for the activities in accordance with guidelines to be adopted by the Contracting Parties;
iii. For the purpose of protecting the environment, the Parties shall ensure that each substance and material used for activities is accompanied by a compound description provided by the entity producing such substance or material;
iv. The disposal into the Protocol Area of harmful or noxious substances and materials resulting from the activities covered by this Protocol and listed in Annex I to this Protocol is prohibited;
v. The disposal into the Protocol Area of harmful or noxious substances and materials resulting from the activities covered by this Protocol and listed in Annex II to this Protocol requires, in each case, a prior special permit from the Competent Authority;

vi. The disposal into the Protocol Area of harmful or noxious substances and materials resulting from the activities covered by this Protocol and which may cause pollution requires a prior general permit from the Competent Authority;
vii. The permit referred to in paragraphs 5 and 6 above shall be issued only after careful consideration of all factors set forth in Annex III to this Protocol.

13. Article 10 of the Protocol concerns oil and oily mixtures as well as drilling fluids and cuttings. It requires to Contracting Partiers to formulate and adopt common standards for the disposal of oil and oily mixtures in the protocol area and sets out the following minimum standards:

viii. The maximum undiluted oil content of machinery space drainage discharges is 15 mg per litre;
ix. A maximum average oil content of 40 mg per litre for production water per any calendar month, not exceeding 100 mg per litre at any time.

14. Furthermore, the Contracting Parties need to determine a common method to analyse the oil content.

15. The Parties shall formulate and adopt common standards for the use and disposal of drilling fluids and drill cuttings into the Protocol Area as per to following:

x. The use of water-based drilling fluids shall be subject to the Chemical Use Plan and the provisions of Article 9 of the Protocol;
xi. The disposal of the drill cuttings shall either be made on land or into the sea in an appropriate site or area as specified by the Competent Authority;
xii. Oil-based drilling fluids shall only be used if they are of sufficiently low toxicity and only after the Operator has been issued a permit by the Competent Authority;
xiii. The disposal of oil-based drilling fluids to sea is prohibited;
xiv. The disposal of drill cuttings contaminated with oil-based mud is only permitted on condition that effective solids control equipment is installed and properly operated, that the discharge point is well below the surface of the water, and that the oil content is less than 100 grams of oil per kilogramme dry cuttings;
xv. The discharge of drill cuttings contaminated with oil-based mud in specially protected areas (SPA) is prohibited;
xvi. In case of production and development drilling, a programme of seabed sampling and analysis relating to the zone of contamination must be undertaken.
xvii. The use of diesel-based drilling fluids is prohibited. Diesel may only be added to drilling fluids under exceptional circumstances, as Contracting Parties may specify.

1.3.3. Clarifications of Terms Used in the Offshore Protocol

16. This chapter elaborates on the meaning and intent of a number of specific non-defined terms used in the Offshore Protocol. [Annexes referenced herein refer to those in the Offshore Protocol.]

1.3.4. "Acceptable Level of the Oil and Grease for Discharge" - Annex V, A.1

17. Annex V, A.1 refers to spills of high oil content in processing and platform drainage. These types of onboard spillages have to be contained, diverted and then treated as part of the product. Any remaining part of the spill that does not end up in the process stream, should end up in the open or closed drain system of the installation, and will be subject to the 'normal' machinery space drainage discharge limits (i.e. 15 ppm), as described in Section 2.2.3 below.

1.3.5. The Minimum Standard for "all the Necessary Precautions" - Annex V, A.3 and A.4

18. Annex V, A.3 states "All the necessary precautions shall be taken to minimise losses of oil into the sea from oil collected or flared from well testing". In this context, a minimum standard of "All the necessary precautions" should be defined as any flare burner used shall be specifically designed to prevent any hydrocarbon fallout. Features that prevent hydrocarbon fall out include atomising of oil droplets to increase combustion efficiency, enhanced air ingestion, and automatic shut-off valves to prevent oil spillages.

19. Annex V, A4 states "All the necessary precautions shall be taken to ensure that any gas resulting from oil activities should be flared or used in an appropriate manner". In this context, a minimum standard of "All the necessary precautions" should be defined as utilising any produced gas other than from well testing operations, wherever possible.

20. All produced gas shall either be sold to market, used for power generation onboard the production installation or re-injected to maintain reservoir pressure. Only as a last resort any (remaining) gas should be flared off. Where required for safety reasons, a pilot flare may be lit at all times.

21. Any gas produced as part of a well test, shall either be collected to be sold to market, or shall be flared off. When flaring, a burner should be used that is specifically designed to prevent any hydrocarbon fallout and provides smokeless combustion.

1.3.6. Clarification of Parameters Determining "Sufficiently Low Toxicity" - Annex V, B.2(a)

22. The term "sufficiently Low Toxicity" in this context refers to low toxicity non-aqueous drilling fluids (NADF), which are regularly used to drill the deeper sections of wells when using NADF is considered advantageous over drilling with WBM as it can provide faster drilling rates, increased stability in water-sensitive rock formations and is more effective for drilling deviated, deep, high temperature wells.

23. Low toxicity oil-based muds (LTOBMs) are the second generation (Group II) of non-aqueous drilling fluids with medium aromatic content which were developed in the 1980s to replace the diesel and conventional oil-based drilling fluids to address the concerns over the potential toxicity of diesel-based fluids.

24. LTOBMs are developed from refining crude oil, but the distillation process is controlled to the extent that total aromatic hydrocarbon concentrations between 0.5 and 5% and PAH content is less than 0.35% but greater than 0.001% (OGP, 2003).

25. The third generation (Group III) of non-aqueous drilling fluids with low to negligible aromatic content is characterised by PAH contents less than 0.001% and total aromatic contents less than 0.5%. Group III drilling fluids include synthetic based fluids which are produced by chemical reactions of relatively pure compounds and can include synthetic hydrocarbons (olefins, paraffins, and esters). Base fluids derived from highly processed mineral oils using special refining and/or separation processes (paraffins, enhanced mineral oil-based fluid (EMBF), etc) are also included. In some cases, fluids are blended to attain particular drilling performance conditions (OGP, 2003).

26. Therefore, for the purposes of the Offshore Protocol the term "sufficiently Low Toxicity" refers to any Group II or III fluid, i.e. total aromatic hydrocarbon content is < 5% and PAH content is less than 0.35%.

2. Suggested Common Standards and Methods

2.1. Suggested Common Standard on the Disposal of Drill Cuttings and Drilling Fluids

27. The discharge of drill cuttings and drilling fluids is subject to certain well-defined conditions set out in Annex V (B) of the Offshore Protocol.

28. These conditions are broadly in line with other internationally recognised conditions that are regarded as good industry practice, such as those developed by OSPAR, US and the World Bank/IFC, as reviewed in the Study on International Best Practices (REMPEC, 2013).

29. Therefore, the conditions outlined in the Offshore Protocol can be applied directly as the suggested common standard for the disposal of drill cuttings and drilling fluids, with the following two amendments.

30. Although the term OBM is used in the Offshore Protocol, it is suggested to apply the conditions referring to OBM to all non-aqueous drilling fluids (NADF), i.e. including those fluids derived from synthetic hydrocarbons. This will bring the definition in line with countries such as the UK, Norway and the Netherlands where the discharge of mineral and synthetic oil-based drilling fluids (i.e. all NADF) are subject to the same restrictions (i.e. no discharge to sea). This also agrees with the questionnaire responses from Italy, Israel and Morocco, where the discharge of NADF is prohibited.

31. The second Offshore Protocol standard that is different from current best industry practice adopted in other geographic regions, is the threshold of 100 grams oil per kilogramme dry cuttings for the disposal of drill cuttings contaminated with oil-based mud. For example, the OSPAR threshold for this type of cuttings is 1%, i.e. 10 grams of oil per kilogramme dry cuttings. Experience from offshore thermal treatment of drill cuttings contaminated with oil-based mud (OBM cuttings) on the UKCS shows the resulting average oil content adhering to the cuttings 0.4 g/kg dry matter (Blytt et al, 2014). Therefore, it is suggested to adjust the current threshold to 10 grams oil per kilogramme dry cuttings for the disposal of drill cuttings contaminated with oil-based mud, in line with the OSPAR threshold.

2.2. Suggested Common Standard on the Disposal of Oil and Oily Mixtures

2.2.1. Production Water

32. Article 10 and Annex V of the Offshore Protocol set out minimum requirements for the disposal of oil and oily mixtures. For production (or produced) water, Article 10 defines a maximum content of 40 mg of oil per litre as an average in any calendar month and not exceeding 100 mg per litre, at any time. Article 10 of the Protocol also stipulates the requirement to develop a common method to analyse the oil content.

33. Table 1 provides an overview of the methods currently in use by the Contracting Parties that have responded to the questionnaire to date.

Table 1. Analytical Method for Oil in Water

Country	Method	Comments
EU	None specified	--
Israel	EPA FTIR 1664A	--
Italy	APAT IRSA-CNR 5160B2 MAN 29 2003	--

	UNI EN ISO 9377-2:2000	
Morocco	MN 03.7.074-2006 Gas Chromatography for concentrations greater than 0.1 mg/l. Solvent extraction method and GC-mass spectrometry.	Partner laboratory proposes to measure oil in water according to NF ISO 9733 standard procedure.

34. The Study on International Best Practices (REMPEC, 2013) identified two main sets of best practices as sources of guidance for development of common standards for the treatment and discharge of production (or produced) water. These are from the OSPAR maritime area and the U.S. Gulf of Mexico, both of which have extensive oil and gas production within well-developed regulatory frameworks. Of these two, the OSPAR Recommendation appears 2001/1 to be most appropriate for adaptation to the Offshore Protocol, as the OSPAR standards are already aligned with existing standards of a number Contracting Parties.

35. As such, the following common standard on the disposal of produced water is suggested:

- **Discharge Limits**
  For production water, a maximum oil content of 30 mg per litre[3] as an average in any calendar month; the content shall not at any time exceed 100 mg per litre.

  The dilution of treated or untreated produced water for the purpose of lowering the average concentration of oil or achieving compliance with the performance standard is prohibited.

- **Sampling**
  For offshore installations which discharge continuously, the determination of the quantity of dispersed oil discharged should be based on the results of at least 16 samples per month. Samples should be taken at equal time intervals.

  The sampling point should be immediately after the last item of treatment equipment in, or downstream of, a turbulent region, and in any case before any subsequent dilution.

2.2.2. Oily Waste and Sludges from Separation Processes

36. Most of the liquid hydrocarbons recovered during the separation process will be directed back into the process stream, where they will end up as part of the product. Any remaining oily waste and sludges from separation processes that cannot be returned into process stream shall be transported to shore, in line with the stipulations set out in Annex V (A.2) of the Offshore Protocol.

2.2.3. Machinery Space Drainage Discharges

37. Article 10 of the Protocol prescribes a maximum oil content of 15 mg per litre for machinery space drainage, which is in line with the requirements of MARPOL.

38. Because the MARPOL Annex I standards for machinery space drainage are already implemented worldwide, most authorisations for oil and gas exploration and exploitation generally do not specify any additional requirements for drainage from drilling rigs and platforms.

[3] It is noted that at present, the proposed amendment to Annex I of the List of Pollutants Document (UNEP(DEPI)/MED WG.434/3, for oil & grease is to change the discharge limit to 42 mg/l in any one day with the average of daily values for 30 consecutive days not exceeding 29 mg/l. These discharge limits are based on the current World Bank guidelines, which in turn are based on the US EPA requirements. As explained above, it is advised to adopt the OSPAR limit instead as the OSPAR standards are already aligned with existing standards of a number Contracting Parties.

39. Regulations 12 and 14 of MARPOL Annex I specify that the drilling rig or platform must be equipped “as far as practicable” with the oil filtration equipment specified in, and the discharge of oil or oily mixtures from machinery drainage spaces is prohibited unless the oil content does not exceed 15 ppm. These facilities are also required to keep a record of all operations involving oil or oily mixture discharges.

40. Incidentally, this is also in line with definition of what is classified as a harmful quantity of oil in the U.S, i.e. “an oil discharge that can “cause a file of sheen upon, or a discoloration of, the surface of the water” or a discharge that can cause a sludge or emulsion to be deposited beneath the surface of the water or upon adjoining shorelines; more specifically, an oily waste having an average oil content greater than 15 ppm” (EPA, 2017).

41. Regulation 14 of MARPOL Annex I specifies that oil filtering equipment must be of a design approved by the Administration, must be provided with an alarm arrangement to indicate when the 15 ppm level cannot be maintained, and must ensure that any discharge of oily mixtures is automatically stopped when the oil content exceeds 15 ppm. For further information, the Revised Guidelines and Specifications for Pollution Prevention Equipment for Machinery Space Bilges of Ships are contained in resolution MEPC.107(49). The IMO maintains a list of approved oil filtering equipment.

42. Therefore, it is suggested to use the MARPOL Annex I as the suggested common standard for the disposal of oil machinery space drainage discharges.

2.2.4. Hydrocarbon Drop-out During Flaring

43. Annex (A.4) of the Offshore Protocol states that all the necessary precautions shall be taken to minimise losses of oil into the sea from oil collected or flared from well testing. As illustrated in Section 1.3.5 above, modern flare burners are designed to prevent hydrocarbon drop-out, and therefore the suggested common standard for any hydrocarbon drop-out resulting from flaring would be to treat these instances as an oil spillage, rather than a permitted operational discharge.

2.3. Suggested Common Method to Analyse Oil Content

44. There are various methods available to analyse oil content in produced water. However, the analytical results from these various methods differ significantly and are therefore not comparable without the specification and calibration results of the analytical method used to measure the oil content. Similarly, it will be impractical to work to the same discharge limits, using different analytical methods. Therefore, it is important to adopt a common method to analyse oil content.

45. OSPAR Recommendation 2001/1 (as amended by OSPAR Recommendation 2006/4) is recommended to be adopted as the common method to analyse oil content.

46. The amount of ‘oil’ present in the produced water should be determined as the sum of the dispersed oil and the BTEX content (i.e. Benzene, Toluene, Ethylbenzene, Orthoxylene, Metaxylene and Paraxylene).

2.3.1. Dispersed Oil Content

47. The reference method for the determination of the dispersed oil content in produced water by means of gas chromatography and flame ionisation detection (GC-FID) is described in OSPAR Agreement 2005/15. This method is designed for produced water and other types of waste water discharged from gas, condensate and oil platforms and allows the determination of the dispersed oil content in concentrations above 0.1 mg/l.

48. The OSPAR produced water analysis reference method is a modified version of the ISO 9377-2 method in order to include the determination of certain hydrocarbons with boiling points between 98 and 174°C. This method is to be used only for the determination of dispersed oil in produced water. This method is not to be used for the determination of oil in other discharges for oil on sand, drains discharges, etc. Details of this sample analysis method are published in: 'Oil in Produced Water Analysis – Revised Guideline on Criteria for Alternative Methods Acceptance and General Guidelines on Sample Taking and Handling – OSPAR Agreement 2006-6'.

49. For certain instances, there may be scope to use a simpler analysis method offshore if that has already been correlated against the OSPAR Reference Method in an onshore laboratory. Therefore, a suitable Infra-red (IR) analysis method (or other analysis methods) may be accepted as an 'alternative' analysis method, but only if it is correlated against the OSPAR Reference Method.

50. Additional guidance on alternative sampling methods can be found in a guidance document published by the UK Department of Energy and Climate Change: Methodology for the Sampling and Analysis of Produced Water and Other Hydrocarbon Discharges (DECC, 2014).

Box 1 Comparison of Analytical Methods for Determining Oil in Water Content

It is noted that Israel currently uses the EPA method 1664A from the United States Environmental Protection Agency, which is gravimetric method which is inherently different from the recommended OSPAR methodology which is based on gas chromatography.

Gravimetric methods require a very stable working environment (which is very hard to achieve on an offshore installation) and are therefore susceptible to high levels of measurement uncertainty, particularly at the low levels of oil that would be expected in produced water. Therefore, the OSPAR GC-FID method or a suitable correlated IR analysis method are preferred over the EPA gravimetric method. The US equivalent to the GC-FID method ISO 9377-2 is EPA method 8015D, which is very similar, and could also be used instead.

Italy and Morocco both use gas chromatography methods.

It should be noted that gravimetric and gas chromatography methods will provide different analytical results, which are not readily comparable. Therefore, in order to be able to observe and monitor compliance to a defined discharge limit, the required analytical method must be specified. As such, it is strongly recommended for all Contracting Parties to adopt a single method.

2.3.2. BTEX Content

51. The 'BTEX content' should be determined by taking the sum of the levels of BTEX obtained by the application of the static headspace method described in ISO 11423-1, using gas chromatography - mass spectrometry (GC-MS) or another method that produces equivalent results. The amount of BTEX should be calculated on the basis of the quantity of water per year (m3) and the yearly flow-weighted average values of BTEX analysed in the produced water discharged into the sea.

3. Recommended Strategy for a Seabed Sampling Program (Annex V, B.2 (e))

52. The environmental effects of discharges to the sea from offshore oil and gas operations are difficult to measure, as the local currents and wave action will quickly dilute and disperse any discharges to sea. Furthermore, most receptors in the water column are (highly) mobile, making it hard to attribute any effects on locally sampled specimens to any specific operation. Monitoring

changes in seabed biota is more straightforward however, as many benthic species living in or on soft sediments are sedentary, and therefore any changes in macrobenthic assemblages can often be directly related to local impacts. Therefore, seabed sampling programmes are an important tool for monitoring offshore oil and gas operations.

53. Annex V, B.2 of the Offshore Protocol states that a programme of seabed sampling and analysis relating to the zone of contamination must be undertaken for production and development drilling.

54. It is strongly recommended for the Contracting Parties to adopt a regional and pragmatic approach to seabed sampling programmes, taking account of the required timing and duration, available analytical expertise and overall cost, to ensure sufficient information is collected to adequately assess any environmental effects, but without unduly hampering commercial viability and timelines of planned development projects.

55. This chapter provides information of a number of seabed sampling strategies that may be adopted during the various stages of an offshore development.

Box 2 Relevance of Offshore Oil and Gas Monitoring to IMAP Indicators

Seabed sampling programmes for the oil and gas industry can also be used to contribute to the overall body of data that will need to be collected for the IMAP quality indicators. Of particular relevance to the oil and gas industry activities are:

- Common Indicator 1: Habitat distributional range, to also consider habitat extent as a relevant attribute (EO1);
- Common Indicator 2: Condition of the habitat’s typical species and communities (EO1).

3.1. Environmental Survey Strategy for Exploration/Appraisal Operations

56. Before any exploration or appraisal drilling operations can take place, it is essential to collect good quality baseline data of the drilling location and its immediate vicinity (i.e. a few hundred metres from the drilling location), as this is where the main effects on the seabed are anticipated. Various sample strategies can be used, including the popular cruciform survey design around the anticipated well location. However, it should be noted that this design is indiscriminate of potential variability in local seabed conditions and will only be valid to the (limited) area covered by the sample stations (i.e. if the well location changes after the survey, the collected baseline data may no longer be representative.

57. As part of the Offshore Strategic Environmental Assessments of the United Kingdom Continental Shelf, which have been undertaken since 1999, an ‘intelligent sampling strategy’ was adopted, and this method proved very effective for areas with no or limited baseline data available, and where the exact location of the activity is still to be determined. As such, this method is very relevant to exploration/appraisal drilling operations, where the actual well location is often susceptible to change late in the well planning phase.

58. Intelligent survey design makes use of geophysical data collected (i.e. side scan sonar and multibeam) before the seabed sampling survey. This analysis can either take place onshore, or on the survey vessel itself. Typically, an area of 3 × 3 km to 6 × 6 km of geophysical survey data is analysed and potential seabed habitats and features of interests are identified (a typical site survey for a jack-up drilling rig is 3 × 3 km, whereas for anchored semi-submersible drilling rigs this area may 4 × 4, 5 × 5 or 6 × 6 km, depending on water depth and length of anchor lines). Habitats can be delineated by changes in sediment composition and/or water depth, for example. A stratified random sampling

design is then applied for each potential habitat to determine the sample locations within the survey area. At least three to four samples should be taken for each habitat identified. In areas with very homogeneous seabed sediments and water depth, additional samples (i.e. more than three or four) should be taken to ensure good coverage of the entire survey area is achieved. Any features of potential interest (i.e. potential reefs, large boulders or other objects, pockmarks, large sponge aggregations, etc.) are investigated by stills photography and/or video. This sampling strategy will provide a good overview of all habitat types present in the entire survey area, and thus, the drilling location remains flexible. Therefore, it is recommended to adopt an intelligent survey design for survey strategy for exploration/appraisal operations.

3.2. Environmental Survey Strategy During Production/Development Phase

59. Field-specific stations for a baseline survey before production drilling should preferably be established using radial transect design that is expected to be permanent for subsequent monitoring surveys of the field. The stations are to be placed at increasing distances from the discharge point (according to the geometric series 250 m, 500 m, 1000 m, etc.). Transect length with increasing distance from the discharge point should be decided upon on a case-to-case basis. Stations less than 250 m from the installations should be established, if practically possible and acceptable in terms of safety (NEA, 2015).

60. Sample locations should be selected on the basis of bottom topography, sediment characteristics, current conditions and other relevant parameters. Areas with high fractions of silt/clay sediments, where contaminants are likely to accumulate, deserve particular attention (OSPAR, 2017). It is important for monitoring surveys to be repeatable. Therefore, sample locations should be selected in locations that will remain accessible over the life of field (as far as can be foreseen at the time), so that the same sample locations can be revisited on subsequent monitoring surveys.

61. The main transect axis should be orientated along the predominant local residual current direction. Monitoring frequency will depend on water depths and seabed conditions, where shallow areas with a dynamic (sandy) seabed will generally warrant more frequent monitoring (i.e. survey frequency < 5 years) than deeper less dynamic (muddy) areas where sediment transport is much lower (i.e. survey frequency between 5 and 10 years).

62. At least four replicate grab samples should be taken at each sample location (i.e. one grab sample for physico-chemical analysis, and three replicate benthic ecology samples).

63. The physico-chemical grab sample may be sub-sampled for different analytes as follows:

- Two (2) subsamples for particle size analysis (500 grams each, from the top 0 cm to 5 cm of the grab sample);
- Two (2) subsamples for hydrocarbons (125 grams each, from the top 0 cm to 2 cm of the grab sample);
- Two (2) subsamples for heavy metals (200 grams each, from the top 0 cm to 2 cm of the grab sample);
- If radionuclides are required as well, these may be taken from the hydrocarbon sub-sample, as only a very small amount will be required (i.e. 20 grams dry weight).

64. For field specific monitoring, a minimum of three (3) reference stations should be selected. The conditions at each reference station should be as similar as possible to those at the other sampling points (i.e. similar depth and sediment type), whilst at the same time, the reference stations must be far enough away to be unaffected by discharges from the offshore oil and gas operations (OSPAR, 2017).

3.3. Recommended Standards for Sample Acquisition, Processing and Analysis

65. Analysis of macrofaunal communities in soft-bottom sediments is an integral part of marine environmental assessment. The faunal composition, in terms of both the species present and their relative abundance, reflects integrated environmental conditions in the survey area over a period of time. The composition and structure of soft-bottom macrofaunal communities therefore can be used to characterize environmental conditions and estimate the extent of environmental impact. In addition to the macrofaunal data, it is essential to monitor a number of physico-chemical parameters as well, which will show the physical and chemical extent of the impacts, which generally extends beyond the area in which direct ecological impacts are observed.

66. Seabed samples for faunal, sediment and chemical analysis are generally acquired using grab sampling equipment. A number of different types of grabs exist (e.g. van Veen, Day, Shipek, etc.) which allow effective acquisition of sediment samples and associated faunal communities across a full range of different substrata (i.e. mud, sand, coarse and mixed sediments). Each device has advantages and disadvantages depending upon the seafloor composition, the type of sample required and the required sample volume. The appropriate sampling device should be selected to allow for optimum sample quality, whereby due consideration should be given to seabed material, water depth and type of sample required. For example, for physico-chemical sampling, where it is important to preserve sediment stratigraphy, the use of a Hamon grab is not recommended.

67. ISO 16665:2013 provides guidance for quantitative sampling and sample processing of marine soft-bottom macrofauna. The ISO 16665:2013 guidance describes the processes for sample taking, fixing, storing, processing and analysing, as well as for appropriate and quality assurance and control. It is recommended for all Contracting Parties to adopt these guidelines as good practice guidance.

68. For seabed sampling surveys of soft-bottom habitats, appropriate quantitative sampling equipment should be selected that can be used for the collection of both biological and chemical samples. The equipment must sample a minimum area of 0.1m2. Having a standardised sampling area ensures that a consistent sampling effort can be maintained, allowing quantitative comparisons.

69. ISO 5667-19:2004 provides guidance for the sampling of sediments in marine areas for analyses of their physical and chemical properties for monitoring purposes and environmental assessments. It encompasses sampling strategy, requirements for sampling devices, observations made and information obtained during sampling, handling sediment samples, and packaging and storage of sediment samples.

70. Physico-chemical grab samples require approximately 0.1 m2 of sediment to a depth of 10 cm per sample, whereas analyses of macrofaunal generally require a larger sample size, e.g. 0.3 to 0.5 m2 to a depth of 10 cm (i.e. a grab type with a benthos fauna sampling area of 0.1 m2 should be used in the majority of surveys, taking 3 to 5 replicate samples at each sample location), in order to ensure that sufficient biomass of organisms is collected to provide the basis for a representative count (OGP, 2012).

71. Operators for monitoring programmes should use laboratories that have ISO 17025 accreditation for the methods they use. The certification should be awarded by the certified accreditation body in their country or region, as applicable. If no official accreditation scheme is available in a particular area, depending on the type of analyses involved, Operators should document their own quality assurance routines for undertaking laboratory analysis testing. The operating companies' reports to the Competent Authorities must confirm that the requirements above are fulfilled, with reference to the qualification system, certificates and approval date. All accreditations and certifications must be kept up-to-date by Operators.

3.4. Habitat Assessments

72. A habitat assessment using video/still photography is a non-destructive method which can be used to identify and assess habitats within and around the activity location. This method is particularly suitable for surveying hard substrata which are difficult or impossible to sample with a grab, sensitive and/or protected habitats, and to record mobile (larger) epifauna, which may otherwise avoid capture by grab.

73. Still photographs can be used to classify sediment type and to record any identifiable epifauna. Similarly, video photography data, noting the locations (relative to a surveyed route) can be used to observe any changes in sediment type and/or associated faunal communities. Particular attention should be paid to any observed habitats of conservation importance. Appropriate sampling locations should be chosen to allow for good spatial coverage and should use prior knowledge of the location or seabed material to select assessment locations.

74. Sampling locations should be selected in order to provide representative data of the sediment types observed from the geophysical data, bathymetric highs/lows and any features that may represent a sensitive habitat. Depending on the features observed, the sample locations could either be selected as drop-down video locations or video transects, with sediment sampling stations either matching the drop-down locations or positioned along a transect, as required.

75. It is recommended to use additional sampling locations in areas where multiple habitats are identified, or potentially sensitive habitats such as reefs are present, to ensure sufficient data is collected to identify all the different habitats present in order to create a robust environmental baseline data set.

3.5. Decommissioning Surveys

76. If relatively recent survey data does not already exist, a pre-decommission survey should be undertaken to establish the current condition of the seabed before any decommissioning operations commence. In most cases, it is unlikely that a new survey would be required if a relevant survey has been undertaken in the last 5 years.

77. Precise survey requirements will differ according to individual conditions and must be agreed between the Operator and Component Authority, before any survey commences.

78. If drill cuttings piles are present at the site, then specific effort should be made to map and characterise the size and composition of the cuttings pile using geophysical data (i.e. side scan sonar and multibeam) and by taking core samples. Core samples may be taken from a survey vessel, the platform/installation itself, by ROV, or by any combination of these. Depending on the size of the cuttings pile, the Operator should aim to obtain maximum penetration, to obtain representative samples throughout the depth cuttings pile. Cuttings pile penetration will be very dependent on the cuttings pile characteristics and the sampling equipment used.

79. The use of ROV-operated coring devices (push corers) is recommended for sampling cuttings piles, as they provide access to challenging sampling locations where existing infrastructure is in place. When using ROV-operated push corers it is advised to collect samples of at least 20 to 50 cm long from 5 to 10 locations for a small to medium-sized pile. The number of sampling locations should be adjusted in line with the size of the pile and the purpose of the survey. Core samples should be sectioned and analysed for standard parameters, such as THC, PAH, metals, grain size and TOC (NOROG, 2016).

80. Gravity, piston or vibro-corers may be used to obtain larger and deeper samples (up to 5 to 6 m) from the cuttings pile. The purpose of deeper core sampling is to acquire better knowledge of the

characteristics inside the pile with regard to both chemical content and geotechnical conditions. It will potentially reveal more information about historic drilling discharges and establish the contamination status in deeper and central sections of the pile (NOROG, 2016; OSPAR, 2017).

81. If any protected species, such as coral is present on the installation which is to be returned to shore, the Operator and Competent Authority will need to agree how this will be managed under the requirements of the Convention on International Trade in Endangered Species (CITES) to which all Contracting Parties are signatories to.

82. Upon completion of each decommissioning operation, appropriate surveys should be undertaken to identify and recover any debris located on the seabed which has arisen from the decommissioning operation or from past development and production activity. The area to be covered will depend on the circumstances of each case. However, the minimum required will be a radius of 500 metres from the location of an installation and up to 100 metres either side of a decommissioned pipeline.

83. In addition to debris surveys, a post-decommissioning environmental seabed sampling survey should be undertaken to monitor levels of hydrocarbons, heavy metals and other contaminants in sediment and biota. Any further subsequent post-decommissioning survey requirements will depend upon the results of earlier work and the circumstances of each case.

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