



Exploration & Production

GENERAL SPECIFICATION

ENVIRONMENT

GS EP ENV 112

Environmental Baseline and Monitoring Studies: Offshore and Nearshore Sites
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05	01/2012	Addition of Nearshore studies (old GS EP ENV 113), Monitoring studies and GIS requirements
04	10/2007	Sampling §5.3.5 and 7.3.2, monitoring program §10
03	10/2005	Addition of EP root to document identification
02	10/2003	Change of Group name and logo
01	03/2002	TotalFinaElf DGEP/SE
00	04/2001	Old TotalFina SP ENV 122
Rev.	Date	Notes

Owner: HSE	Managing entity: HSE
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1. Scope

The purpose of the present General Specification is to define the technical instructions for compiling a detailed Scope of Work in order to establish the reference environmental status or to carry out the environmental monitoring of an offshore or a nearshore site.

This General Specification is the minimum standard required by the Company. It should be adapted to each project in order to define a particular specification, or Scope of Work.

Additional requirements from the local authorities shall be taken into account.

This General Specification defines the content of the study and its organization, progress, content of the different phases and deliverables.

2. Reference documents

The reference documents listed below form an integral part of this General Specification. Unless otherwise stipulated, the applicable version of these documents, including relevant appendices and supplements, is the latest revision published at the EFFECTIVE DATE of the CONTRACT.

Standards

Reference	Title
Not applicable	

Professional Documents

Reference	Title
ESI	Environmental Sensitivity Index Guidelines, NOAA , version 3.0, 2002, updated 2009

Regulations

Reference	Title
Not applicable	

Codes

Reference	Title
Not applicable	



Other documents

Reference	Title
Not applicable	

Total General Specifications

Reference	Title
GS EP ENV 001	Environmental requirements for projects design and E&P activities
GS EP ENV 111	Environmental Baseline and Monitoring Studies: Onshore sites
GS EP ENV 120	Environmental Impact Assessment of E&P activities
GS EP ENV 501	GIS deliverables for HSE
GS EP SDV 101	Social Baseline Study

3. Terms and definitions

For the purpose of this document, the following definitions apply:

Coastal area refers to a distance of few hundred meters inland starting from the lowest low-tide point.

Nearshore or coastal water: in the absence of more stringent local regulations, nearshore or coastal water starts from the lowest low-tide point and extends up to 3 nautical miles towards the sea

Onshore or terrestrial means on land.

Offshore means situated at sea some distance from the shore and beyond the 3 nautical mile coastal water limit.

The **sensitivity** is the degree to which a **system** may be affected, directly or indirectly, by a perturbation (i.e. potential consequences based on its intrinsic physical, biological and socio-economic characteristics).

System includes areas with ecological or economical importance, such as protected areas or sensitive ecosystems such as mangroves, peat bogs, fishing areas, areas of tourist interest, etc.

The **vulnerability** is the degree to which a **system** (ecologic, socio-economic) is susceptible to, or unable to cope with a perturbation. The vulnerability relies on the sensitivity of the **system**, on the nature, extent, rate of the perturbation, and on the capacity of the **system** to recover from the effects of the perturbation (also known as resilience).

For other definitions or acronyms, refer to Appendix 1 and **GS EP ENV 001**.

4. Objectives of environmental baseline and monitoring studies

The objective of the Environmental Baseline Study (EBS) or reference status of an offshore or a nearshore site is to describe, before starting any new E&P project, the physic-chemical, biological, and general socio-economical characteristics of the site and highlight its main

sensitivities. Any existing contamination of the natural Environment by pollutants shall be identified and clearly assessed, in particular that which is related to oil industry activities. The EBS shall also provide an evaluation of the capacity of the disturbed environment for natural self-restoration.

The EBS includes both a bibliographic study and a field survey.

The EBS shall provide all the factual elements and parameters to support completion of an Environmental Impact Assessment (EIA) of the project to satisfy the **GS EP ENV 120** requirements.

The mapping of the sensitive areas should be used as a basis to develop an accidental spill prevention and intervention plan.

The objective of the Environmental Monitoring Study (EMoS) is to assess the site conditions at regular intervals during the operation phases or after the end of activities, and to compare to the original reference status.

According to the local context, Company may define a specific Social Baseline Study Scope of Work in accordance with **GS EP SDV 101**.

5. Responsibilities

The Company Representative, appointed by the Company, is responsible for coordination between the parties involved:

- Company headquarter departments (EP/HSE/ENV, EP/HSE/SUR, EP/OPS/LSO),
- The entity responsible for the Project,
- The affiliate HSE, Environment, Security and Logistics departments, and site RSES,
- The Contractor selected to carry out the study,
- Local Authorities and any International Organizations involved,
- Local community(ies) and associations.

The Company Representative is also responsible for:

- Adapting, if necessary, the scope of work or particular specification to the local conditions and to the characteristics of the project,
- Providing all in-house available information,
- Defining a tentative schedule and approving the final schedule of the study,
- Approving the choice of the logistics means, survey team and laboratory(ies) in charge of the analyses,
- Approving safety and security arrangements,
- Supervision of the field survey,
- Deciding on the final choice of survey routes and sampling locations,
- Approving methods and equipment for sampling, samples pre-treatments, storage, packaging and transport to Laboratory,
- Deciding to analyze part or all samples recovered and approving methods for analysis,

- Defining the number of copies of the reports and validation of the Contractor's deliverables.

The Contractor is responsible for:

- Propose a schedule for the study,
- Carrying out the bibliographic study,
- Proposing a preliminary sampling plan,
- Obtaining all the necessary authorizations from the Local Authorities,
- Submitting logistics, safety and security arrangements to Company for approval,
- Providing all the equipment necessary for the sampling campaign, and the certificates of conformity/calibration of the equipment,
- Carrying out the field survey,
- Ensuring at his own cost the accommodation, food, health, safety, welfare of all personnel involved in the work on the vessel,
- Selection of the accredited laboratory(ies),
- Performing the in situ and laboratory analyses and Quality Control,
- Ensuring full quality control for samples recovery, storage, equipment calibration,
- Ensuring the correct packaging and shipment of samples and that samples are received in good condition by the selected laboratory(ies),
- The interpretation of the results,
- The deliverables and results integration in a GIS (Geographic Information System).

Excessive out-sourcing should be avoided, but the Contractor may use dedicated external consultancies or scientists from institutes and specialist laboratories for detailed or special analyses with the agreement of Company.

Integration and participation of local personnel in the field team should be considered (Local Authorities representatives, scientists, experts, etc.) and the choice of participants shall be approved by the Company.

6. Organization of the study

6.1 General content of the study

The study consists of:

- **A bibliographic study** of all available documents (previous studies, maps, remote sensing studies,...) in order to identify the specific concerns of the type of environment,
- **A field survey** in order to acquire the environmental and general socio-economic data necessary for the study, including in-situ analysis, taking pictures, collecting samples of the different representative media (soil, sediments, air, water) as well as flora and fauna identification,...,
- **Laboratory analyses,**

- **An interpretation** of the results from field observations, in-situ and laboratory analyses, socio-economic data and data from the bibliographic study, ...,
- **Deliverables preparation** (production of a stand-alone document or in some cases limited to a section in the contents of the EIA).

6.2 Schedule

The Company defines a tentative schedule including:

- The date of the contract award,
- The estimated date for start-up the study,
- The time required for the acquisition of bibliographic data,
- The time necessary for personal and equipment mobilization/demobilization,
- The estimated duration of the field survey and the administrative authorization,
- The dates for deliverables issues.

The survey duration shall be adapted to the specificity of the study. In some cases, the field survey may need to be split in to several phases in order to take into consideration particular local situations (regulations, site access, climate, seasons, logistics...).

The final schedule of the study is approved by the Company Representative before starting any work. Any change in the work to be done or the time table shall also be approved by the Company Representative.

6.3 Field survey organization

The following minimum information shall be submitted by Contractor to the Company for approval, before the field survey mobilization, to help for the selection of the sampling locations and survey routes:

- A short description of the main characteristics of the concerned site (geography, bathymetry, meteorology, protected areas, sensitivities),
- Valid maps, directly usable for the field survey,
- A proposal for the site study perimeter, route and sampling locations,
- A list of bibliographical references and local contacts.

During the field survey, the surveyed locations shall be plotted on maps on a daily basis, and if possible in real time.

6.3.1 Field survey team

The personnel should include:

- Company:
 - A Company Representative or mandatory expert,
 - One or several project representatives (Optional).
- Contractor (indicative list to be adapted according to the project and the specific characteristics of the site):

- One senior Project manager,
- Experienced marine biologist(s),
- One engineer/technician specialized in marine physic-chemistry and sedimentology (who may be the same person than the marine biologist).
- One team of labourers experienced in sampling with corers and grabs.

Local experts, representatives from local Authorities or project partners may be integrated in the survey team on Company request or local authorities' requirements.

The role of the various participants shall be clearly defined especially regarding:

- Sampling decisions and procedures,
- Samples treatment, preservation and transportation,
- In-situ sea water and sediments analysis.

6.3.2 Logistics

Any logistics used for personnel local transportation (helicopter, vehicles, planes,...) shall be in accordance with Company safety requirements.

The marine survey vessel is chosen according to the bathymetric, sea and weather conditions prevailing in the zone to be sampled.

Contractor shall provide all necessary navigation and survey positioning equipment.

The vessel shall have all the equipment and material on board to ensure the safety of all personnel in accordance with regulation and Company requirements. This equipment shall be checked to ensure good working order.

In the case of *Nearshore* survey, two kinds of vessels can be required for the survey:

- The principal vessel to be used as logistics base and selected according to the prevailing bathymetric, sea and weather conditions in the zone to be sampled,
- An auxiliary vessel for accessing shallow water depths and berthing for studying the terrestrial side of the shoreline.

The minimum requirement for the vessels is listed in Appendix 2, but Company reserves the right to impose modifications in the particular specification and to audit the safety on board the vessel.

A short duration **helicopter (or small plane) survey** can be proposed for a preliminary survey of *Nearshore* areas with particularly difficult access, with approved landing points for observation.

Diving, rock climbing or speleological survey details shall be submitted to Company for approval.

6.3.3 Equipment

The Contractor shall provide all survey equipment and spares required to perform the survey in good operating conditions.

Any modification or additional material shall be justified and approved by the Company.



The equipment required for the sampling campaign shall be adapted to the bathymetry and consist of:

- Sampling equipment (water, sediments, etc.),
- Material and products for treating, storage and packaging the samples,
- In-situ water and sediments measuring equipment,
- Optional: diving equipment or video camera remote system.

An indicative list of equipment is proposed in Appendix 3.

The Contractor shall make sure that the survey equipment is in good operating conditions, clean and calibrated prior to the start of the survey.

6.3.4 Samples storage and transport

The samples taken are packaged, clearly labelled and stored carefully to avoid any disturbance during transport to the laboratory where they shall be stored in appropriate conditions. To compensate for potential damage and loss of samples during transportation, spare samples shall be taken.

6.3.5 Spare samples for Quality Control

In addition, for the purpose of Quality Control requirements, Company reserves the right to take spare samples (1 out to 10) in order to compare results with those carried out by the Contractor laboratory(ies).

Spare samples shall be taken, labelled and transported to the Company laboratory specified in the particular specification, by the Contractor.

6.4 Laboratory(ies) selection

The Contractor shall provide all data concerning:

- References and certifications of the laboratory,
- Methods and norms used by the laboratory for analyses,
- Laboratory QA/QC procedures,
- Available laboratory equipment,
- Laboratory Personnel list with qualifications, specifically for detailed analyses such as benthic taxonomy...

The Company reserves the right to audit the laboratory for validation.

All the samples collected shall be kept for at least three months by the Contractor after delivery of the final report and shall not be disposed of without Company formal approval.

6.5 Deliverables

Any information shall be provided in the geodetic system specified by the Company in the particular specification.

The following deliverables shall be provided:

- **Daily report sheets,**



- A **Field Survey Report**, on completion of the field work before the demobilization of personnel and equipment,
- **Draft and Final EBS or EMoS reports** after completion of the survey and final analysis,
- A **Photo catalogue database**,
- **GIS Data and Project**.

In addition to classical paper print-out, reports, illustration, maps, photos, analytical results, etc., shall be delivered in electronic format in :

- Word® for texts,
- Excel® for analyses results, tables and charts,
- ArcGIS® (compatible with ArcGis 9.2 version from ESRI) for maps and layouts,
- Photo catalogue database compatible with ArcGIS.

Electronic models provided by the Company shall be used.

6.5.1 Field reports

Daily report sheets shall be prepared by the Contractor and based on the factual elements collected during the field survey (routes, noteworthy events, samples locations, observations, incidents, photos, videos, etc.) then checked and validated by the Company Representative.

Any particular event, which could have an impact on the site status, shall be duly recorded and taken into account (e.g. human activities, field exploration work such as seismic surveys, drilling operations, etc.).

After completion of the field survey, the Contractor shall present the preliminary results to the Company for comments.

The Field Survey Report shall include at least:

- The schedule of the survey and list of participants,
- A full description of the equipment and methods used for sampling, positioning, etc., with the registration sheets of calibrations made on board,
- A synoptic chart of the samples taken (number, date, coordinates, description, etc.),
- A positioning map showing the sampling locations,
- A compilation of the *daily report sheets*, samples records, in-situ analytical results (attached in appendix of the Field report),
- A preliminary interpretation of the survey.

6.5.2 EBS and EMoS Reports

The EBS or EMoS report typical content is attached in Appendix 4 as information.

The report shall give a synopsis of the different phases of the study, including the bibliographical study and field survey works description, and present the analyses methods and results and their interpretation.

It shall include an executive summary-conclusion, and shall be written in a clear concise style, easily usable, with maps, charts, diagrams, graphics and significant photos.

The interpretation methods shall be clearly specified (statistical analysis, diagrams, graphics, etc.) and the results compared with regulation standards, natural background concentrations, bibliographical data and previous studies (EBS, EMoS).

Biological, sediment and water quality results should be correlated.

Any sediments or water contamination by pollutants shall be indicated, as well as the possible source of pollution.

Clear synoptic charts and thematic maps shall be provided (sampling locations, subtidal ecosystems, local constraints, general human and socio-economic aspects, etc.).

A global synoptic map shall present the **sensitive** and **vulnerable** zones to pollution using **ESI** classification.

All analyses results shall be provided using the Excel model provided by Company.

Recommendations on the following points shall be highlighted in the final report:

- Possible further investigations,
- Points to be examined in detail in the EIA,
- Relevant indicators to be taken into consideration for future site bio-monitoring (EMoS) during operations.

A draft of the final report shall be submitted to the Company for comments and approval. After receipt of the comments of the Company, the Contractor shall revise the draft report accordingly.

6.5.3 Photo catalogue database

Photos shall be taken with equipment which ensures a good quality output for future publication.

The photo catalogue database, or as a minimum an Excel file, should include the following:

- Name of the photo and site location, GPS coordinates, azimuth, owner of the photo, date, short description and key words.

6.5.4 GIS deliverables

All maps and georeferenced data (sampling locations, results, observations,...) and interpretations (thematic maps, sensitivity maps,...) shall be provided under GIS format (according to the **GS EP ENV 501** requirements).

7. Bibliographic study

The bibliographic study shall be based on the available documentation relating to the various disciplines involved and to the remote sensing studies

The bibliographical analysis of the offshore and nearshore areas investigated shall document the ecologically and economically sensitive zones, focusing in particular, but not limited to the following points:

- Study of the oceanographic and meteorological data, in particular bathymetry, currents and sediments characteristics,

- The morphology of the seabed, limits of benthic formations, seaweed patches, coral reefs, rocky or sandy zones (can be determined from geophysical survey or satellite image interpretation),
- Coastal sensitivity and geomorphology, and identification of the most exposed zones of the shoreline to Oil Spill,
- Physic-chemical and biological properties of the sediments and the water column,
- Birds, fishes and marine mammals' populations and endangered species,
- Degree of any pollution, particularly regarding hydrocarbons and heavy metals and incidents history,
- General socio-economic activity (fishing, farming and industrial areas).

The main conclusions of this bibliographic study shall be synthesized and compared to the Field survey results in the final report.

8. Field survey works

8.1 Overflight of nearshore

As an option, to identify sensitive areas or areas demanding a more direct investigation ("groundtruthing"), a helicopter flight over the coastline can give a more exact picture of the site characteristics through:

- Direct observation,
- Aerial images (photos, video film).

8.2 Choice of sampling stations

The location and number of samples shall be adapted to the sensitivity of the environment, water depth, currents direction, layout and area of scheduled installations, including subsea, described in the particular specification.

The results of the geophysical survey, when available, should guide the choice of the sampling stations locations.

Offshore, a typical standard sampling plan that covers around 100 km², generally consists of a minimum of twelve (12) stations set along two (2) orthogonal axes, centered on the planned site of the installations, to form a cross pattern. One (1) axis is orientated along the direction of the prevailing currents.

On each axis, the stations are placed at regular distance defined in the particular specification (in general, every 250 m, 500 m, 1000 m and 2000 m).

In the case where the survey area incorporates a number of installations in close proximity, a grid like pattern can be applied to the selection of sampling positions. Sample positions should be selected to ensure data is collected from across the survey area taking in to account water depth, historical discharges, seabed sediments and presence of sensitive organisms or assemblages.

If a pipeline route construction is planned, the particular specification evaluates the necessity of scheduling stations at regular intervals along the route: a minimum of five (5) stations should be

provided for a 300 km offshore route, with extra stations in sensitive zones, and according to the heterogeneity of the environment.

Nearshore, the position of sampling stations can be determined following a preliminary investigation of the site using a side-scan sonar or a diving campaign along several transects running parallel or perpendicular to the coast depending on the coastal currents and tides.

Usually three to five transects are defined up to some 2 km on either side of the zone of interest.

Between three and five stations are chosen on each transect depending of the sensitivity and homogeneity of the environment.

Along the shore, inland, sediment samples shall be taken in locations set along a transect running parallel to the tide line according to **GS EP ENV 111** methodology.

A reference station, as a minimum, is selected at a distance of more than 3,000 m away from the site, in the opposite direction to that of the strongest currents, and having characteristics similar to those on the site.

If installations already exist close to the site, the number of stations is to be increased in their vicinity, close to the discharge points and on the axis of the resultant currents.

The monitoring study shall consider as far as possible the same sampling locations, analysis program and laboratory(ies).

8.3 Positioning – Geographic coordinates system

Sampling locations, routes coordinates and altitudes shall be measured, with an accuracy of approximately 15 m, using, as a minimum, a portable GPS. Coordinates are expressed in the WGS 84 system even if the Company official coordinate system for engineering is different in the area of interest. Before measuring the geographic coordinates (longitude, latitude), GPS receiver parameters shall be checked by the Contractor and approved by the Company.

8.4 Parameters to be measured

As a minimum, and in accordance with the local context and regulation, the following parameters (indicative list) shall be measured on each sample, unless otherwise specified by Company.

8.4.1 Water column

- Temperature,
- Conductivity/Salinity,
- PH,
- Dissolved oxygen,
- Turbidity,
- Content in chlorophyll pigments and/or phaeopigments,
- Nitrites, Nitrates,
- Ortho Phosphates,
- Suspended matter,

- Total Petroleum Hydrocarbons (TPH),
- Polycyclic Aromatic Hydrocarbon (PAH)- if TPH measurement is > detection limit,
- Mono Aromatic hydrocarbons (Benzene, Toluene, Ethyl-benzene, Xylene) - if TPH measurement is > detection limit,
- Aliphatic hydrocarbons if TPH measurement is > detection limit,
- Heavy metals (if the measurements performed in the sediments are significant).

8.4.2 Sediments

8.4.2.1 Physico-chemical characteristics

- Visual description (colour, homogeneity, bioturbation, texture, stratification),
- Smell,
- Grain size,
- Redox potential,
- Water content,
- Total Organic Matter (TOM),
- Total Organic Carbon (TOC),
- Total Nitrogen content,
- Total Phosphorous content,
- Total Petroleum Hydrocarbons (TPH),
- Aliphatic hydrocarbons if TPH measurement is > detection limit,
- Mono Aromatic hydrocarbons (BTEX) if TPH measurement is > detection limit,
- Polycyclic Aromatic Hydrocarbons (16 PAH from the EPA list) if TPH measurement is > detection limit,
- Heavy metals: Ba, Cd, Cu, Pb, Zn, Hg, Co, Ni, Cr, Sn, As, Se, V, Al, Sb, Ag, Be, Mn, Mo, Tl (if necessary, the list is adapted in a particular specification),
- Benthic characteristics,
- Number of species (flora/fauna),
- Number of individuals per species,
- Biomass,
- Diversity index.

8.4.3 Ecotoxicity test on benthic fish

Depending on specific environmental characteristics, an ecotoxicological study may be necessary (for example if there is a suspicion of Hg contamination). When relevant, the Company defines the requirements in a particular specification.

8.5 Sampling and in situ analysis

8.5.1 Water column

One (1) to two (2) location(s) and a reference station shall be selected for measuring each parameter listed in section 8.4.1.

For monitoring studies, in addition, measures shall be carried out and samples taken at significant installation discharge points.

Direct measurement of the **Temperature, Turbidity, Conductivity/Salinity, pH, dissolved oxygen** is profiled on the water column using a multi-parameter probe, from sea surface to bottom.

Samples shall be taken from a 5 litres water sampler (Niskin® type) at the sea surface, an intermediate depth and sea bottom. Sampling depth shall be adapted to water depth.

Volumes sampled for **Hydrocarbons, Suspended matter, Heavy metals, nitrites, nitrates and orthophosphates** shall be adequate to allow the subsequent laboratory analyses in good conditions.

Samples are pre-treated and stored according to approved methodology (best practice). Glass bottles shall be used for hydrocarbon analysis, suspended matter and nutrient analysis, and plastic bottles for nitrogen and heavy metals.

Chlorophyll pigments and phaeopigments are gathered immediately by filtering (0.45 µm) water samples. The filters are then frozen for conveyance to the laboratory(ies).

Sample pre-treatment shall be carried out according to approved methodology (best practice) and kept in cool conditions (-4°C).

8.5.2 Sediments

Samples are taken on each station to analyze the parameters listed in section 8.4.2.

- For **shallow water and water depths less than 200m**, samples are taken using Van Veen®, Smith MacIntyre® or Day types Grabs.

0.1m² of bottom sediments shall be collected for physicochemical analyses and a minimum of 0.3m² (3x0.1m²) for benthos analyses. Each biological replicate shall be analyzed separately.

In areas of strong currents the grab system being deployed shall be fitted with a relative positioning system (USBL® beacon transponder or equivalent).

- For **deeper waters**, a box corer shall be used.

If a box corer of 0.25 m² is used, a minimum of 2 samples should be recovered in order to have a 0.3 m² for biological analyses and 0.1 m² for physicochemical analyses.

In deep waters, the box corer and any camera equipment or other items being deployed shall be fitted with a relative positioning system (USBL® beacon transponder or equivalent).

A description of **sediments appearance, photos** and the **Redox potential** measurement (at 4 cm depth) are carried out on board immediately after sampling.

From each 0.1 m² replicate, sub-samples (minimum 250 ml each) are taken for **heavy metals, particle size** analyses (collected in plastic bottles), and **hydrocarbons analyses** (collected in glass bottles).



Samples quantities shall be adequate to allow subsequent analyses in laboratory in good conditions.

Sample pre-treatment shall be carried out according to approved methodology (best practice) and kept in cool conditions (-4°C).

Sample pre-treatment and storage methodology shall be clearly described and submitted to Company for approval.

For **benthos** analyses, all the sampled sediments are washed carefully with sea water on site, then sieved.

The size of the grid depends on the sediment granulometry and water depth. It is defined in a particular specification.

For deep water surveys, the grid should be 500 microns or smaller in size. In shallow water the grid size is maximum 1 mm.

Following sieving the biological sample is fixed and coloured using a solution of Formalin and Rose Bengal before packaging in plastic bags or containers for transport and laboratory analyses.

8.5.3 Sea bottom study

The morphology of the sea beds, limits of benthic formations, seaweed patches, coral reefs, rocky or sandy zones can be described using a lateral sweep sonar or be based on geophysical survey results.

Nearshore, a diving survey can be implemented as necessary and in accordance with Company requirements.

9. Laboratory analyses and method

The standard methods in force for physic-chemical analyses (ISO, CEN, AFNOR, BS, ASTM, etc.) or required by the local regulation shall be implemented.

The number and type of analyses to be carried out shall be adapted according to the sensitivity of the site characteristics, in particular regarding heavy metals, nitrates, phosphates and hydrocarbons and approved by the Company.

9.1 Water column analyses

Analysis	Method (indicative)
Total Petroleum Hydrocarbons (TPH)	Infra Red Spectrometry
Aliphatic Hydrocarbons (if TPH > detection limit)	Gas chromatography
Mono Aromatic Hydrocarbons (BTEX) (if TPH > detection limit)	Gas chromatography
Polycyclic Aromatic Hydrocarbons (PAH) (if TPH > detection limit)	Gas chromatography
Chlorophyll pigments and phaeopigments	Extraction then spectrophotometry or fluorescence
Suspended matters	Filtering then weighing Centrifugation
Nitrates, nitrites, orthophosphates	Ionic chromatography
Heavy metals (if relevant) - Ba, Cd, Cu, Pb, Zn, Co, Ni, Cr, Sn* - Hg	Extraction, then - Inductively coupled plasma atomic emission spectrometer, or - Spectrometry

9.2 Sediments physical analyses

Physical analyses	Method (indicative)
Colour, Type of sediment	Munsell Soil Classification Colour Chart System
Grain size distribution	Sedimentometry/Granulometry Grain size 2 µm to 10 mm

* Total reserves the right to modify the list of heavy metals to be analysed depending on the environmental context.

9.3 Sediments chemical analyses

Chemical analyses	Method (indicative)
Total Organic Matter	Loss on firing (550°C)
Total Organic Carbon	Sulfochromic oxidation or combustion after carbonate elimination
Total Nitrogen Content (modified Kjeldhal method)	Titration
Total Phosphorous Content	Spectrophotometry
Water content	Gravimetric method
Heavy metal content: - Ba, Cd, Cu, Pb, Zn, Co, Ni, Cr, Sn, As, Se, V, Al, Sb, Ag, Be, Mn, Mo, Tl - Hg	Extraction, then - Inductively coupled plasma atomic emission spectrometer, or - Spectrometry
Total Petroleum Hydrocarbons (TPH)	Infra Red Spectrometry or equivalent
Aliphatic hydrocarbons (if TPH > detection limit)	Gas chromatography
Mono Aromatic hydrocarbons (BTEX) (if TPH > detection limit)	Gas chromatography
Polycyclic Aromatic Hydrocarbons (PAH) (if TPH > detection limit)	High Performance Liquid Chromatography (HPLC)

9.4 Biological analyses

Analysis	Method (indicative)
Benthic organisms: Associations	Sieving, identification and classification of species (for each replicate), counting individuals, biomass of each species
Ecotoxicity (fish)	To be defined

Biological analyses are interpreted statistically (abundance of species, frequency, association, diversity index and fidelity) and synthesized with the purpose of giving an overall image of the ecosystem studied and of its sensitivity (interpretation maps, diversity, etc.).



Bibliography

IMO/IPIECA	Guide for Oil Spill Sensitivity Mapping and its Integration into Preparedness and Response Systems in the West and Central Africa Region - GIWACAF (2008)
IMO/MARPOL 73/78	International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978 relating thereto (MARPOL) and subsequent amendments (2008)
IPIECA	Volume 1: Sensitivity Mapping for Oil Spill Response (1994)
OSPAR	Guidelines for monitoring methods to be used in the vicinity of platforms in the North sea – 1988. Guidelines for Monitoring the Environment Impact of Offshore Oil and Gas Activities – Ref 2004-11
Rio Convention	Convention on Biological Diversity (United Nations, 1992)
WCMC/UNEP	World Database on Protected Areas (WDPA) (permanent update)



Appendix 1 Acronyms

BOD	Biological Oxygen Demand
BTEX	Benzene, Toluene, Ethylbenzene, Xylenes
COD	Chemical Oxygen Demand
EBS	Environmental Baseline Study
EIA	Environmental Impact Assessment
EMoS	Environmental Monitoring Study
GIS	Geographic Information System
IUCN	The World Conservation Union
NORM	Naturally Occurring Radioactive Material
OSCP	Oil Spill Contingency Plan
PAH	Polycyclic Aromatic Hydrocarbon
PID	Portable Photoionisation Detector
PCB	Polychlorinated Biphenyls
TOC	Total Organic Content
TPH	Total Petroleum Hydrocarbon
TSS	Total Suspended Solids
UV	Ultraviolet
VOC	Volatile Organic Compounds
WHO	World Health Organisation

Appendix 2 Specifications concerning the survey vessels

The type of vessel is selected according to the weather conditions, distance from coast, and water depth. In all cases the vessel being considered is subject to Company approval.

1. Technical characteristics of the offshore survey vessel

The survey vessel is fitted with:

- A platform of approximately 1 m² overhanging the water and fitted with protection chains (sampling),
- An electric pulley fitted with a cable the length of which is adapted to the sampling depth:
 - At the stern of the vessel to handle the sampling grabs,
 - On either side of the vessel for implementation of the hydrological bottles and CTD probe.
- Fixing point on the bridge for anchoring survey equipment (containers, grabs, etc.),
- Adequate electric power supply for the various items of equipment to be able to operate simultaneously (pulley engine, freezer equipment, etc.),
- A Global Positioning System (GPS). Optional : DGPS surface navigation system, capable of fixing the vessel position at sampling stations to an accuracy of ± 10 m,
- Option: a relative positioning system (USBL® beacon transponder or equivalent) to be installed on the grab or on the box corer.

The vessel has sufficient autonomy to carry out a complete campaign without having to berth to take on fuel.

The good working order of all equipment needed for the sampling campaign is checked before the vessel sets sail.

2. Technical characteristics of the ancillary vessel

A second boat, some 5 metres long and with a shallow draft for navigating in shallow water and berthing, equipped with:

- two engines.
- means of communication between this boat and the main vessel (e.g. portable VHF).
- a portable GPS system .

3. Necessary equipment to ensure safety on board the survey vessel

- Safety jackets and harness,
- Life boat: standard non-inflatable boat, life raft or puncture proof dinghy, depending on the sea conditions prevailing during the survey and on the number of people on board the vessel,
- Distress flares, with light and smoke signals, and projector (ALDIS type),
- HF and VHF equipment: to ensure liaison between land and the vessel,
- Walkie-talkies: for communication between operators and crew,
- First aid medical and reanimation (oxygen) equipment,



- Sling/stretcher for taking off by helicopter,
- Fire protection system: alarm, extinguisher, fire pump system.

Some items of equipment, as for radio equipment is duplicated for greater safety.

Special equipment may be needed (e.g.: suits for insulation against cold for North Sea surveys).

The description of this extra material is defined in the particular specification.

Appendix 3 Equipment for a sampling campaign

To avoid any technical failure stopping the survey campaign, some items of equipment are duplicated.

Minimum equipments list required for an offshore survey

- Van Veen® Grab or Smith Mac Intyre® grab or equivalent or Box corer (1 unit + 1 spare) - minimum size 0.1 m²
- Freeze drier 10 litres capacity minimum - or freezer (1 unit)
- Large capacity fridge (1 unit)
- Large diameter sieve (40 cm) - 1mm mesh or 0.5mm for deep waters (1 unit + 1 spare)
- Large plastic bins -to be used for sifting tasks- 70 to 90 litres (10 units)
- Small plastic shovels (5 units)
- Strong plastic bags - Food quality - 15 to 20 litres (500 units)
- Plastics drums - Large neck - Tight closing - 50 litres (10 units)
- Formalin (5 litres) and MSDS
- Rose Bengal and MSDS
- Alcohol (5 litres)
- Minimum two pH calibration solutions (probe calibration)
- Flasks and wash glasses - 1 litre (5 units each)
- Redox electrodes (2 sets)
- Multi parameters probe (pH, turbidity, dissolved oxygen, temperature, conductivity/salinity, depth profiles) - (1 unit + 1 spare)
- Filters (chlorophyll)
- Fluorimeter (1 unit)
- Niskin® (or equivalent) bottles with equipment for two or three simultaneous samplings (1 set + complementary bottles)

Optional equipment required for a offshore survey:

- Video camera remote observation system

Optional for an ecotoxicological study

- Fishes pots and/or nets

Minimum equipment required for a coastal survey:

- PVC corer: 20 cm long and 4 cm diameter with 5 mm diameter holes every 2 cm (2)
- Wide necked plastic bottles (1 litre)
- Portable GPS



Optional equipment required for a coastal survey:

- Loco-diver or sub-sea scooter (2)
- Complete diving equipment (3) (+1 extra)
- Compressor (1 on the main vessel)
- Sub-marine photographic equipment
- Observation camera/video remote system

Appendix 4 EBS or EMoS Report content

The Study Report contains the following:

1. Detailed Executive Summary giving an overview of the characteristics of the concerned environment and the main conclusions including a proposal for a future site monitoring

2. General Presentation of the study

- Survey Description
- Equipments and methods
- Bibliographic study synthesis.

3. Survey Results

Laboratory and in situ analyses methods and results described in sub-sections:

- The water column study
- The sediments study
- Biological study.

4. Interpretation

Results are systematically interpreted and replaced in the environmental context.

Regional and local main sensitivities are summarized (sensitivity map).

The methods used to interpret results are described:

- Biological indices
- Statistical analyses
- Correlation studies, etc.

5. Proposal for a monitoring programme

Appendices:

- Tables and numerical results of the analyses on the sampling
- Details of the analysis methods
- Bibliographical references.