5.6.2 Monitoring

Assessment on the extent and severity of impacted environmental compartments is based on three main series of monitoring systems and operational tools:

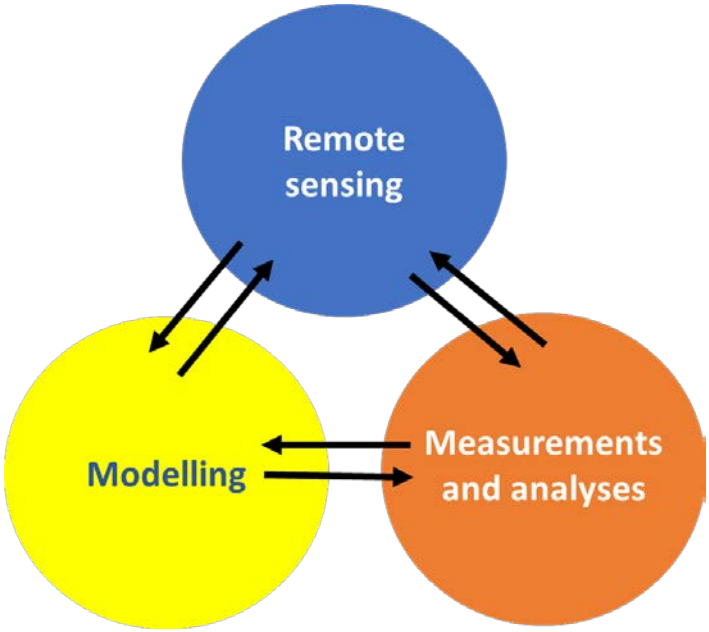

Figure X: Measurements and Analyses to in-situ data / sampling

These monitoring systems are complementary and might all need to be considered during a response. Indeed, remotely sensed data needs to be verified with in-situ data, models rely on in-situ measurements and remote sensing. The integration or consultation of environmental monitoring experts in the Incident Management Team is recommended. The objective is to help decision makers to provide information to allow for a rapid response in case of a HNS incident.

5.6.2.1 Modelling

Modelling tools are very useful systems to obtain a picture of potentially impacted areas in relative short term. However the level of relevance and reliability depends on the one hand on the capability and reliance of the modelling software (See sheet Modelling: principle and interpreting results) and on the other hand on information gathered to feed model (**See chapter 5.2**). To validate the outputs from modelling it is thus necessary to perform quantified measurements in the field, by remote sensing or measurements in the field obtained by in-situ measurements or sampling and analyse.

→ **HNS Spill Modelling**

5.6.2.2 Remote sensing

Existing remote sensors used to detect and map oil spill may be used to detect floating HNS or packages. For HNS with other behaviours, remote sensing still remains challenging, especially for HNS spreading in atmospheric or aquatic compartments. For instance the spreading kinetics of a HNS, is not technically compatible with a satellite detection. However emerging technologies, both on sensors and Remotely Piloted Aircraft System (RPAS), may be promising to improve the detection of HNS. The development of innovative and miniaturized sensors may offer the possibility to identify a wider range of HNS and, their integration on RPAS will improve the capacity of response to detect HNS avoiding a direct exposure of responders in the field, especially for explosive, flammable or toxic plumes. In the aquatic compartment, remote sensing may be possible with active sonar to detect sinker HNS or packages on the seabed, or some floating HNS.

→ Remote sensing technologies
→ Substance marking
→ Remotely Operated vehicles

5.6.2.3 Measurements and analyses

It can be noticed that both types, in-situ analyses and laboratory analyses described hereafter, can be used to duplicate measurements or obtain complementary information:

<u>- In-situ analyses</u>

They are possible thanks to equipment able to provide output value, qualitative or quantitative, in the field. It can be direct reading detectors or portable equipment able to detect or even quantify a chemical with a direct measurement, or sample and analyse in the field may be possible.

The use of portable or miniaturized detectors has been largely developed the last decades and on-going improvements should be expected in the coming years, offering more response capacity for responders and more reactivity for Incident Management Team.

Ensuring the health and safety of all responders during an incident should be the highest priority of the response. Incidents involving HNS can frequently involve the substances in a gaseous state, increasing the risk during Search and Rescue operations, entering confined spaces, or working in the vicinity of the spill. Therefore, anyone responding to the incident, especially those first on the scene, should be adequately protected **(→ PPE**) and portable gas monitors are one of the key equipment to assess that level of protection.

→ Portable gas detectors for first responders

<u>- Analyses at laboratory</u>

Sampling in the field may be required or wanted with later analysis at laboratory, for instance because:

- analysis in the field is not possible (for technical reason: inexistent portable equipment for analysis, lack of time, risky or harsh conditions in the field, etc.)

- chain of custody for liability investigations require specific procedure excluding analysis in the field,

- unknown chemical,

- etc.

→ **Sampling Techniques and Protocols**
→ **HNS detection and analyses methods**

5.6.2.4 Implementation of monitoring

5.6.2.4.1 Why and what for perform monitoring?

Monitoring must be implemented as soon as possible after notification and will last all along emergency response phase and will last even during post-spill monitoring. The following figure shows the reasons for monitoring at different phases during the incident management:

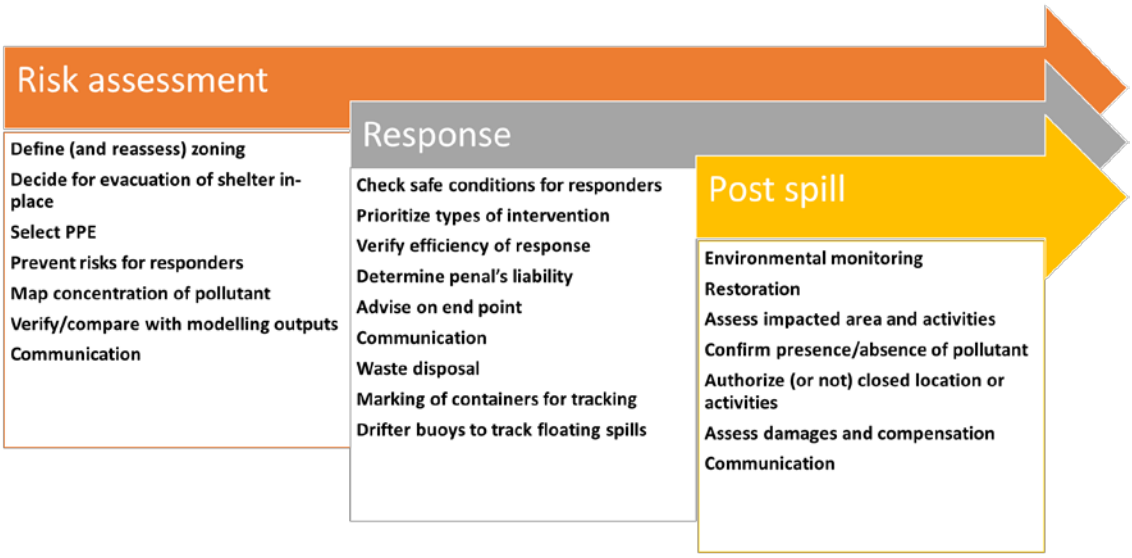

Figure X: Objectives of monitoring for different phases of the response

From OSPAR commission, one of the approaches to determining good environmental status, setting of environmental targets and selecting indicators for Marine Strategy is to get knowledge on occurrence, origin, extent of significant acute pollution events (e.g. slicks from oil and oil products) and their impact on biota physically affected by this pollution.

5.6.2.4.2 Who is responsible for monitoring?

The objectives of monitoring mentioned earlier must be prioritized and integrated in a coordinated monitoring programme to avoid duplication of work, as well as to avoid missing chances of important measurement. The strategy must be led by a Monitoring Coordinator and should be built in a collaborative effort between experts and with advisory opinion of possible third parties. It must be accepted that the strategy of survey can last after the response phase and goes during long term

cleanup or environmental follow-up. The Environmental Monitoring Coordinator should continue its activity during the whole period, including post spill. The objective is to join information from potentially multiple sources or various locations over a period of time to obtain a better / more accurate overview of the situation.

To conduct the monitoring strategy, different duties fall under the responsibility of the Environmental Monitoring Coordinator, among them:

1. Establish a plan for documentation of the work and introduce a “chain of custody”.

2. Make arrangements for appropriate monitoring if health risks are liable to occur.

3. Make sure that necessary measurements can be done concerning extent, severity and accuracy of both spill and contaminated items as well as suspected sources.

4. Judge if special examinations of the spill are needed to facilitate spill response measures.

5. Judge if short term and/or long term environmental impact may be expected. In such a case, contact appropriate agencies.

6. Judge if special examinations and analyses are needed when providing for general and specific needs for information.

7. Contact responsible bodies for transport and disposal. Check what special information is needed in this context and make arrangements for relevant analyses.

5.6.2.4.3 Where perform monitoring?

As explained in chapter 3, HNS can cover one or several major behaviours and their fate will affect differently and more or less environmental compartments between atmosphere, water surface, water column, benthos or shoreline. In addition to the behaviour of the chemical and its toxicological data, the location of accident and corresponding ecosystem can affect specifically biota or fauna. Thus monitoring can be performed in these environmental compartments or some indicators will have to be selected.

Figure X: environmental compartments and corresponding objectives of measurement

From the location of the incident, the short term behaviour of the chemical (SEBC), the forecast modelling outputs or the expected fate, a sampling strategy may be d. It will detail the number and location of analyses to be performed for each parameter to monitor (chemical, temperature, etc.) allowing to compare values of the same unit at the same time. It allows the creation of iso-concentration curves that will indicate the evolution of a pollutant in space and time.

5.6.2.4.4 Preparation of monitoring campaign

Depending on the objective and behaviour of chemical, select proper method for sampling or analysing.

Monitoring in case of HNS spill can be done in various manners depending on the objective defined and on the moment in the response phase or post spill phase. It is essential to select the type of measurement: what must be monitored with what type of detection? It can be the chemical spilled

or other chemical or biological indicators deemed relevant. It may be more secure not to try to determine accurate concentration with an uncontrolled method than to use a less accurate method, but controlled or more easy to use, that will bring acceptable results. For instance, instead of sampling biota, analytical chemistry can be very useful to microbiology by providing methods for the rapid identification of microorganisms, characterization of microbial products and constituents, and trace detection of microbial chemicals.

Field data can be collected either by in-situ analyses or by sampling followed by analyses at laboratory. During the response phase it is urgent to perform measurements to have a picture of the reality and decide on adapted counter-measures.

However it is important to have identified, within the contingency plan or at least during the planning stage, resources able to perform analyses, for instance with sampling protocols, guidelines, contacts of experts, etc. To assess impact on the environment, sampling should be done quickly but it may be possible to preserve samples (for instance by freezing them) before determining a parameter to be measured at a later stage.

Selection of type of detection

- → **Sampling and monitoring**
- → **HNS detection and analyses methods**
- → **Portable gas detectors for first responders**
- → **Remote sensing technologies**