Chapter 13: Unplanned Events

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13.1 Introduction

Unplanned events are episodes that are not expected to occur during the Project's normal construction and operational phase activities, such as accidents. The Project follows safety and engineering design criteria that aim to reduce the probability and consequences of unplanned events that could lead to adverse environmental, socio-economic or health and safety impacts.

This chapter provides an assessment of the potential environmental and socio-economic risks and impacts from unplanned offshore events that could occur during the Construction and Pre-Commissioning, and Operational Phases of the Project so that design controls and mitigation measures can be put in place. The approach to unplanned event management during the Decommissioning Phase is also presented herein. Project risks and impacts associated with worker occupational health and safety (OH&S) are considered in Appendix 9.2: Occupational Health and Safety.

The assessment considers both the likelihood of unplanned event occurrence as well as the potential consequences of such events.

13.2 Scope and Approach

The Project Area (is defined as 470 km in length and 2 km in width, extending along an east west orientation across the north of the Turkish EEZ from the Russia and Turkey EEZ boundary to the Turkey and Bulgaria EEZ boundary. Information on the Project Area is given in **Chapter 1 Introduction**.

Locations and areas of activity (e.g. shipping routes) in the wider Project Area of Influence that could be affected by unplanned events are also considered.

This chapter focuses on those unplanned events considered to be of most relevance to the Project given the nature of the construction activities, the operational requirements of the pipelines and the geographic location of the Project. In order to assist the unplanned event identification process, South Stream Transport has undertaken an Emergency Threat Analysis[1] for the Project that determines the risks posed by potential emergencies and the need for an Emergency Preparedness and Response Plan and related contingency arrangements. The unplanned events considered within this chapter have been identified via the Emergency Threat Analysis.

Where available, information on the likelihood of occurrence of unplanned events has been drawn from statistics from industry organisations. Data on the frequency of shipping incidents

[1] Involves use of an emergency risk analysis spreadsheet that assigns risk ratings against potential unplanned events taking account of event likelihood and consequences. In August 2013, South Stream Transport undertook an internal Emergency Threat Analysis workshop involving relevant specialists.

has been taken from statistics published by recognised industry bodies, including the International Association of Oil and Gas Producers and European Maritime Safety Agency.

Given the inherent uncertain nature of potential unplanned events, the potential variability of such events in terms of geographic location and coverage, and limitations of directly relevant event statistics, a qualitative assessment methodology has been adopted herein. This methodology has entailed the following tasks:

- Screening of unplanned events to identify those which are carried forward for further consideration;
- Identifying the range of activities that could lead to the occurrence of a potential unplanned event during the Construction and Pre-Commissioning and Operational Phases of the Project;
- If possible, determining the likelihood of occurrence of such events;
- Defining and describing the geographic range of occurrence of potential unplanned events;
- For each unplanned event, estimation of the potential resultant impacts in relation to potentially affected receptors; and
- Definition of appropriate risk management measures to reduce the likelihood of occurrence of each unplanned event and reduce the residual consequences so that the resultant risk is acceptable.

When determining the potential consequences of unplanned events, the resultant impacts have been assessed in relation to categories of receptors as follows:

- Environmental receptors; and
- Socio-economic receptors.

OH&S impacts associated with unplanned events are not considered in this chapter. However, South Stream Transport will implement internationally recognised procedures to assure the OH&S of the workforce (including during unplanned events) along with the necessary equipment and training to make these effective. OH&S measures will be included in a Health, Safety, Security and Environmental Integrated Management System (HSSE-IMS) which will form an important part of the corporate management system (**Chapter 16 Environmental and Social Management**).

In order to support the unplanned events assessment as reported herein, the following additional assessments have been undertaken:

- *Maritime Risk Assessment* (Appendix 13.1): which considers the risks of vessel accidents occurring and the potential for consequential oil spillages;
- *Oil spill modelling* (Ref. 13.1 and Appendix 13.1): undertaken as part of the maritime risk assessment to investigate the fate and behaviour of various oil spill scenarios that may occur following an unplanned marine event (as identified by the maritime risk assessment); and

- *Marine geohazard evaluation* (Appendix 13.2): which highlights the potential geohazards present along the pipeline alignment, and the actions that have been undertaken to manage risks to pipeline integrity.

13.3 Legal Context

Relevant legislation in Turkey is listed below. It reinforces the prevention and elimination of accidents and promulgates the need for emergency management plans:

- Law Pertaining to Principles of Emergency Response and Compensation for Damages in Pollution of Marine Environment by Oil and Other Harmful Substances, No. 5312, and associated regulations (Official Gazette Date: 21 October 2006 and No: 26326); and
- Regulation on the Control of Major Industrial Accidents (Official Gazette Date: 18 August 2010 and No: 27676).

13.4 Emergency Preparedness and Response Plan

Chapter 16 Environmental and Social Management highlights that South Stream Transport will prepare an over-arching Emergency Preparedness and Response Plan for the overall South Stream Offshore Pipeline (i.e. covering the Russian, Turkish and Bulgarian sectors) in line with the International Finance Corporation (IFC) Environmental, Health and Safety (EHS) Guidelines. The plan will be part of the HSSE-IMS as defined in **Chapter 16 Environmental and Social Management**. South Stream Transport's Emergency Preparedness and Response Plan will be prepared in coordination with the relevant Turkish authorities to ensure it is fit for purpose.

This plan will define response actions for material unplanned events or risks that have been identified by the Emergency Threat Analysis. The plan will cover all Project phases and will include details as suggested by the IFC EHS Guidelines such as the following:

- Purpose and scope;
- Emergency response management strategy;
- Emergency risk analysis, Emergency Preparedness and Response Plan and definition of the relationships with Contractors Emergency Response Plans;
- Roles and responsibilities;
- Communication requirements;
- Emergency drill requirements (including examinations, inspections and testing); and
- Review processes.

South Stream Transport's construction contractors will be responsible for preparing their own Emergency Response Plans for their work activities, and specifically those events identified by the Emergency Threat Analysis. Contractors are expected to apply Good International Industry Practices (GIIP) and applicable recognized industry standards when preparing their Emergency Response Plans.

The preparation of contractors Emergency Response Plans will be a requirement of the applicable works contract, and will be available prior to the start of construction activities and will be subject to South Stream Transport review and approval. South Stream Transport will ensure that contractors plans are integrated with other Project response plans, including South Stream Transport's overarching Emergency Preparedness and Response Plan.

The Project will also submit an Emergency Response Plan and Risk Assessment Report to the Turkish authorities according to specific regulatory requirements[2] prior to construction works taking place.

13.5 Construction and Pre-Commissioning Phase

13.5.1 Events Identification

During the Construction and Pre-Commissioning Phase of the Project, unplanned events in the Turkish EEZ may occur as a result of offshore construction activities, use of maritime vessels and as a result of maritime vessel accidents.

Table 13.1 lists the main activities that could result in an unplanned event, a description of the unplanned event, and the receptors which could be affected.

Table 13.1 Marine Activities Potentially Resulting in an Unplanned Event (Construction and Pre-Commissioning Phase)

Activity	Event	Receptors	
		Environmental	Socio-Economic
Offshore construction activities and associated use of maritime vessels	Maritime accidents or collisions leading to oil spills (including during bunkering)	✓	✓
	Introduction of invasive species by marine vessels	✓	✓

Table 13.1 indicates that during the Construction and Pre-Commissioning Phase, there is a risk of maritime vessel accidents and collisions. These events have the potential to impact upon socio-economic and human health receptors. Such maritime vessel accidents and collisions can also result in oil spillages which can have resultant impacts upon environmental, as well as socio-economic and human health receptors. Table 13.1 also indicates the risks associated with the introduction of invasive species by maritime vessels.

[2] Regulation on Pertaining to Principles of Emergency Response and Compensation for Damages in Pollution of Marine Environment by Oil and Other Harmful Substances (Official Gazette Date: 21 October 2006 and No: 26326); Law Pertaining to Principles of Emergency Response and Compensation for Damages in Pollution of Marine Environment by Oil and Other Harmful Substances, No. 5312, (Official Gazette Date: 21 October 2006 and No: 26326).

In order to assist in defining the risks and potential secondary environmental or socio-economic impacts associated with maritime accidents and associated oil spills, a maritime risk assessment has been undertaken which has included modelling of marine oil spills that are considered most likely to occur due to accidental collisions of marine vessels or during vessel bunkering (refuelling). The risk assessment assists in defining risk management activities. Details of the maritime risk assessment are presented in Appendix 13.1: Maritime Risk Assessment and Oil Spill Modelling, which highlights the potential likelihood of accidents occurring. Appendix 13.1 also presents results from oil spill modelling which has been used to assess the implications and risk management activities as related to environmental, socio-economic and human health receptors.

It is noted that there is a risk of encountering geohazards along the Pipeline route. Geohazards associated with the offshore environment include seismic activity, soft sediments, and gas seeps. Appendix 13.2: Maritime Risk Marine Geohazards presents details of potential marine geohazards and the resultant pipeline design responses.

Some unplanned events have been excluded from the assessment as they are not expected to lead to significant environmental or socio-economic impacts. Unplanned events that have been excluded from discussion are:

- *Grounding*: Grounding of marine vessels is not considered given that such vessels will not pass through Turkish nearshore areas;
- *Spillages and discharge of potentially hazardous materials other than fuel or oil*: Spillage of relatively small quantities of potentially hazardous chemicals (discharges of sewage, garbage, bilge and oily water) from marine vessels can be readily managed through ensuring that vessels operate in accordance with the International Convention for the Prevention of Pollution From Ships (MARPOL), The Convention on the Protection of the Black Sea Against Pollution (Bucharest Convention) and national regulations. All contractors and operators of vessels working on behalf of South Stream Transport will be required to prepare Shipboard Marine Pollution Emergency Plans (SMPEP) as applicable for each vessel. Effective implementation of the SMPEP will mean that the implications of any such events will be sufficiently small not to warrant a detailed discussion of these events herein;
- *Unexploded ordnance (UXO) Clearance*: A UXO survey will be carried out along each pipeline route well in advance of pipe-laying. A UXO clearance plan (if required) will be developed by South Stream Transport in close conjunction with the relevant authorities at the appropriate time. In the event that UXO requires clearance (controlled detonation) in close proximity to an as yet unidentified Cultural Heritage Object (CHO), the possibility that the CHO might be damaged or lost cannot be discounted. **Chapter 10 Cultural Heritage** discusses this issue further noting that the likelihood of such an event is considered remote. UXO clearance via a controlled detonation also has the potential to result in behavioural disturbances to marine fish and/or mammals over several kilometres; and
- *Impacts of unplanned pipeline construction events*: During the Construction and Pre-Commissioning Phase a range of unplanned construction events may be encountered, including wet buckle events (whereby the submerged pipeline floods which can result in pipeline buckling). Such events have the potential to result in significant construction delays and associated costs. It is considered that the environmental implications of such events,

such as, pipeline recovery, disposal, relaying, would be similar to the environmental impacts as associated with routine construction activities as reported within this Environmental and Social Impact Assessment (ESIA) Report. Under such circumstances, remedial activities will be undertaken in accordance with GIIP which will limit the potential for significant environmental impacts.

13.5.2 Maritime Risk Assessment

13.5.2.1 Maritime Collisions and Oil Spillages

A maritime vessel collision could conceivably occur at any location along the Pipeline route, although the likelihood of such a collision occurring is considered to be very low. The likelihood that such an incident would result in an oil spill is even lower, as a high-energy collision would be required to damage a vessel to such an extent that marine diesel was spilled into the sea.

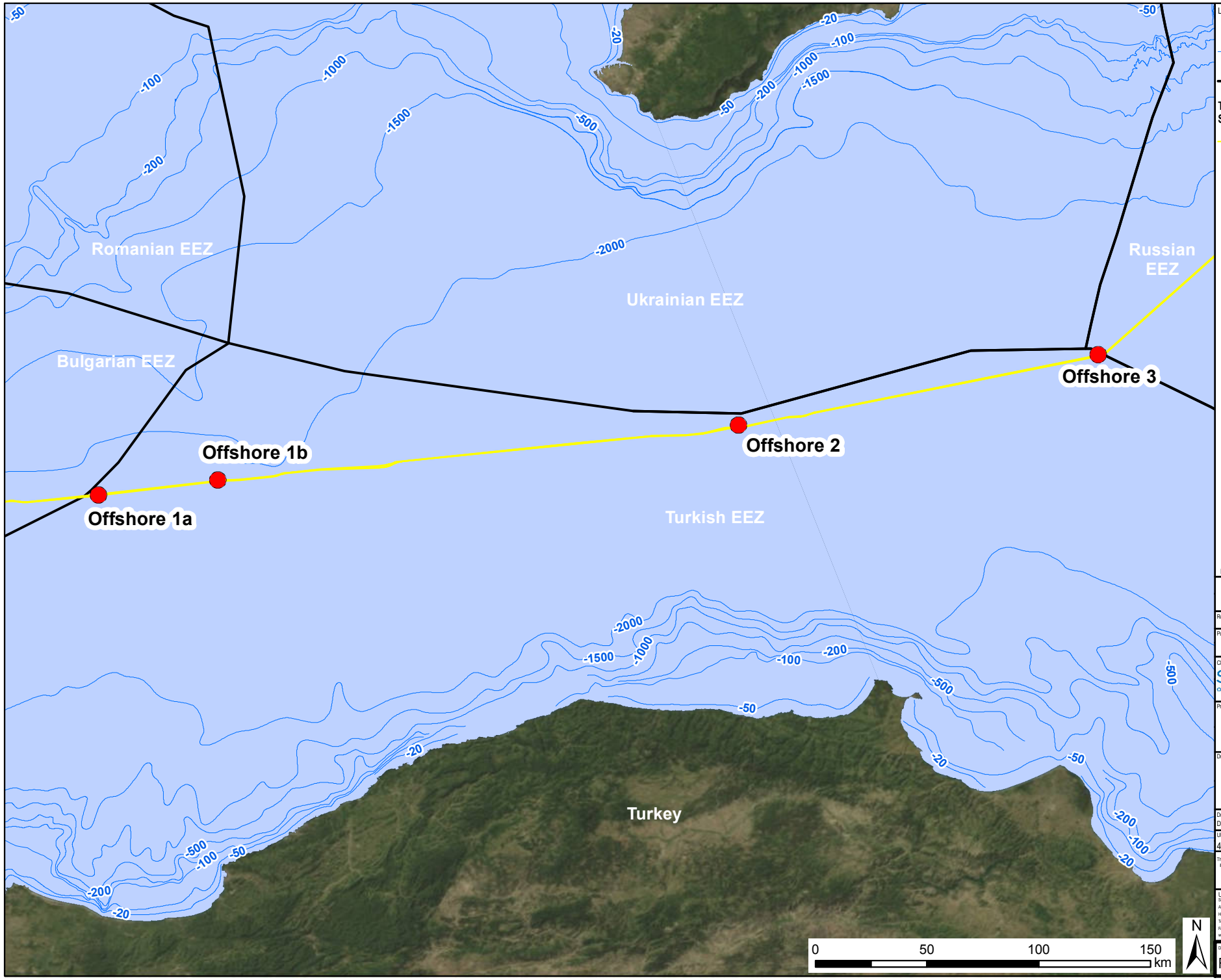
Appendix 13.1 presents details of maritime risk assessment which has entailed the following:

- Estimate the likelihood of an oil spill occurring following a maritime collision (based on available historical information), and rank these into categories;
- Estimate the severity of the potential consequences of any oil spill that could occur and rank these severities into categories;
- Construct a risk matrix of likelihood and consequence severity; and
- Assess various oil spill scenarios and determine their overall risk rating.

Following an evaluation of potential unplanned collision events, the oil spill scenarios (involving marine diesel oil – MDO[3]) as detailed in Table 13.2 were defined, together with details of potential resultant oil spillages. The maritime risk assessment and oil spill modelling (Appendix 13.1) goes on to indicate that such unplanned collision events do not present a major risk of oil spills and that overall risk ratings are considered to be acceptable.

On the basis of the scenarios above, oil spill modelling has been undertaken for the offshore oil spillage of 2,000 m^3 of MDO. Figure 13.1 illustrates the oil spillage locations that have been modelled. Details of the modelling undertaken and the results obtained are included in Appendix 13.1.

[3] Where practical, Project vessels deployed in the Project Area will use marine gas oil (MGO) or MDO, commonly referred to as 'marine diesel' and conforming to ISO-8217:2010 Marine Distillate Fuel Grades DMA, DMB or DMZ (rather than persistent oils such as most crude oils and Heavy Fuel Oil (HFO).



LEGEND

- Oil spill modelling locations
- Isobaths
- Exclusive Economic Zone boundary

Turkish Sector of South Stream Offshore Pipeline

- Proposed offshore pipelines

Projection: Lambert Conformal Conic

Revision Details	By / Check	Check Date	Suffix

Purpose of Issue: For Information

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URS Infrastructure & Environment UK Limited
Scott House
Alencon Link, Basingstoke
Hampshire, RG21 7PP
Telephone (01256) 310200
Fax (01256) 310201
www.ursglobal.com

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Table 13.2 Potential Oil Spill Scenarios in the Marine Environment

Location	Event Description	Assumption
Black Sea Offshore	Grounding	Not possible.
Black Sea Offshore	Collision of the pipe-lay vessel with third party	MDO spillage of 2,000 m^3 (loss of fuel over six hours). *Estimate based on the loss of 25% of the fuel capacity of the Saipem 7000. Given the vessel size this was considered a credible volume for both collision and sinking scenarios.*
	Collision with Project vessel	MDO spillage of 750 m^3 (loss of fuel over six hours). *This represents the loss of one full fuel tank from a supply vessel or similar type vessel during a collision.*
	Bunkering incident	MDO spillage of 10 m^3. *Given normal industry safety measures (e.g. break away coupling) this was considered a credible spill volume in the event of incident during bunkering.*
	Sinking	MDO spillage of 2,000 m^3 (loss of fuel over six hours). *As above.*

13.5.2.2 Oil Spillage Risk Factors

The severity of the consequences of an oil spill depends on several factors including (a) type of oil spilled, (b) the amount of oil spilled and, perhaps most importantly, (c) the proximity of the oil spill to oil-sensitive resources. These issues are considered in the sections below.

a) Type of Oil Spilled

Maritime vessels typically use the following types of fuel oil:

- Marine gas oil (MGO): Consisting of only distillates from oil-refining. This fuel is used in the small diesel engines of boats and smaller ships and can be used in auxiliary equipment such as generators and compressors;
- Marine diesel oil (MDO): A blend of heavy gas oil that may contain small amounts of black refinery feed stocks. This is used as fuel by the medium-speed diesel engines of smaller ships and can also be used in auxiliary equipment such as generators and compressors; and
- Intermediate fuel oils (IFO): Blends in varying proportion of gas oil and residues from crude oil distillation. This includes IFO-380 or heavy fuel oil (HFO) consisting almost entirely of residues. HFO is used to power the slow-speed cross-head diesel engines used in most large ships and requires heating and purification when stored and used.

Oils have been classified by the International Oil Pollution Compensation Funds, the body

involved with compensation for oil spills from tankers, into two groups; 'persistent' oils and 'non-persistent' oils:

- Persistent oils include most crude oils and HFO. When spilled on the open sea these oils progressively 'weather' to produce high-viscosity, water-in-oil emulsions that are very persistent on the sea surface and which contaminate shorelines when they drift ashore; and
- Non-persistent oils are mainly distillate fuels such as gasoline and diesel fuel. When spilled in the open sea these oils evaporate to some degree and are rapidly dispersed and dissipated by the prevailing wave action. MGO and MDO are classified as being non-persistent.

Taking into account the above, where practicable vessels deployed in the Project Area will use MDO. As such, the oil spill modelling undertaken as detailed in Appendix 13.1 only considers oil spill scenarios that involve MDO.

b) Amount of Oil Spilled

The amount of oil spilled from an incident influences the area which is potentially affected.

c) Proximity of the Oil Spill to Oil-Sensitive Resources

Oil spills in the open ocean are generally dispersed and dissipated by the effects of wind, waves and currents which reduce their ability to reach coastal sites. Spills to the surface in open water environments tend only to have an immediate effect on receptors on the sea surface and in the water column immediately beneath the spill. Seabirds and some fishing activities may be adversely affected. In addition, some scattered tar balls can be found along coastlines which are evidence of past oil spills of crude oil and HFO, or caused by operational activities such as tank-washing.

13.5.3 Potential Impacts to Environmental Receptors

Typically ecological impacts are more severe when oil spills occur in shallower nearshore waters where spilled oil can affect the shoreline or be naturally dispersed into shallow water by wave action. Different organisms have different sensitivities to the toxic and physical effects of spilled oils. A spill of a relatively small amount of oil close to particularly sensitive coastal sites such as mud-flats and salt marshes can cause more ecological damage than a larger oil spill further from such sensitive sites. Spilled oil that becomes naturally dispersed by wave action through the water column to reach benthic habitats in shallow water can cause adverse effects to habitats such as fish nurseries.

The principal areas of ecological concern with respect to oil spills are:

- Impacts on seabirds on the sea surface caused by oil contaminating the plumage of seabirds leading to the loss of insulation and subsequent hypothermia; and
- Impacts on coastal habitats and marine species including benthic species in shallow areas.

Chapter 8 Biological Environment describes the marine habitats and species known to be present within the Project Area. The chapter describes the seafloor habitat as a fairly uniform expanse of muddy seabed. Although very little is known about the offshore deep water seabed

of the Black Sea abyssal plain, it is an area that is devoid of meiofaunal and macrofaunal life. Plankton and fish species are known to be present within the Project Area, but are only recorded in low numbers; as a result, fisheries are largely absent from the central Black Sea. The migration route of the European anchovy, a commercially important species, crosses the Project Area and fish numbers within the Project Area are higher during the seasonal migration period. Sea birds are also found in low numbers within the Project Area, particularly during the seasonal migration periods for anchovy. Marine mammals, namely common dolphin and bottlenose dolphin, are also known to be present within the Project Area. More information on fish mortality is provided in Section 13.5.5.2 with regards to impacts on fisheries.

13.5.4 Oil Spill Design Controls

Given the presence of the sensitive marine species as indicated in the section above, an oil spill of sufficient size could have significant adverse consequences. It is therefore a key objective of the Project to minimise the likelihood of occurrence of an oil spill and to develop Oil Spill Prevention and Response Plans that would effectively minimise the potential for adverse impacts on potentially impacted marine species and habitats. Mitigation measures to be applied include the following:

- Where practicable vessels deployed in the Project Area will use MGO or MDO and, therefore, any accidental spill of fuel will have less adverse consequences than a spill that involves heavier fuels;
- All contractors and operators of marine vessels working on behalf of South Stream Transport will be required to develop and implement an Oil Spill Prevention and Response Plan. South Stream Transport will ensure that contractor Oil Spill Prevention and Response Plans are appropriately aligned with the Black Sea Contingency Plan (Ref. 13.2). The Oil Spill Prevention and Response Plans will specifically target the prevention of potential oil spillage incidents as detailed in Table 13.2;
- The contractor will develop and implement standard operational procedures (SOPs) which will define procedures that involve the handling of fuels/oils that aim to minimise the potential for spillages;
- Contractors and operators of vessels working on behalf of South Stream Transport will operate in compliance with MARPOL regulations on oil spill prevention and response and are required to prepare Shipboard Oil Pollution Emergency Plans (SOPEP) and Shipboard Marine Pollution Emergency Plans (SMPEP) as applicable for each vessel (Ref. 13.3 and Ref. 13.4). The SOPEPs will specify the control and response measures that have to be available on-board every vessel to respond to a spill that does not require external intervention; and
- All marine vessel crews will have the appropriate training, qualification and certification to undertake the tasks required during the construction of the pipelines.

The mitigation measures indicated above will minimise the probability of an oil spill occurring, and thus reduce the potential adverse impacts to marine habitats in the event of a spill.

13.5.5 Potential Impacts to Socio-Economic Receptors

13.5.5.1 Beach Users and Tourism

The mitigation measures highlighted in Section 13.5.4 minimise the risk of an oil spill occurring. In addition, the oil spill modelling results described within Appendix 13.1 indicate that the most likely oil spill scenarios that may occur during the Construction and Pre-Commissioning Phase are not expected to have a significant impact on any beach users or tourism along the Turkish coastline, as the oil would likely arrive in a highly weathered and dispersed state across a wide area of coastline, and would not be visible in the water column.

13.5.5.2 Fisheries

Oil spills would have the potential to affect fishery resources in a number of ways as described in the sections below.

Fish Mortality

Despite the susceptibility of juvenile stages of fish to relatively low concentrations of oil in the water column, adult free swimming fish and wild stocks of commercially important species will tend to swim away after detecting oil in the water column, thus it is unlikely that a spill will cause serious mortalities in any wild stocks. In general juvenile fish and eggs are significantly more susceptible to oil pollutants than adults, and thus oil spillages can result in localised mortalities. Following a spillage, the reproductive success of unaffected fish, as well as the influx of eggs, juveniles and adults from unaffected areas leads the recovery of stock numbers. Given that many marine species produce vast numbers of eggs and larvae that are widely distributed by tidal currents means that species can recover from any mortality events as a result of short-term unfavourable conditions. Thus, the depletion of adult stocks is very rarely recorded following spillages as marine organisms can generally adapt to high mortalities though production of large numbers of eggs and replacement from outside the affected area.

The impacts of an oil spill will depend upon the type of oil used and duration of the exposure to the components in the oil. Non-persistent oil such as MGO and MDO, when spilled in the open sea, evaporate to some degree and are rapidly dispersed and dissipated by wave action.

Economic Potential of Fisheries (Including in Coastal Waters)

Significant fishing activity does not occur within the central Black Sea. The Turkish fishing fleet in the Black Sea is mostly comprised of small vessels with limited range which concentrate their fishing efforts in waters relatively close to the Turkish coast and at least 100 km from the Project Area.

The number of fish species present within the Black Sea sharply decreases with water depth, with waters becoming anoxic below a depth of approximately 150 m. The low numbers and productivity of plankton further restricts the distribution of organisms in the deeper offshore waters of the Black Sea. Within the Project Area, fish species are predominantly pelagic, of which the most important (in terms of fisheries resource) are European anchovy, sprat, Black Sea horse mackerel and Atlantic bonito. The European anchovy is of particular importance to

Turkish fisheries as it accounts for over 60% of the total catch in the Turkish waters of the Black Sea.

The oil spill modelling results described within Appendix 13.1 indicate that the most likely oil spill scenarios that may occur during the Construction and Pre-Commissioning Phase are not expected to have a significant impact on Turkish coastal waters, as the oil would likely arrive in a highly weathered and dispersed state across a wide area of coastline, and would not be visible in the water column. Appendix 13.1 also states that oil spillages in the Project Area are not anticipated to have a significant impact upon coastal fishing areas and in turn any commercial or artisanal Turkish fisheries.

Damage to Fishing Gear

It is considered that the risks of damage and contamination to fishing gear is very low as fishing activity is concentrated in Turkish coastal waters, MGO or MDO spillages are expected to be rapidly dispersed, and that following a spillage, any affected areas would likely be avoided by fishing vessels.

Fisheries – Mitigation

Appendix 13.1 has established that Project construction activities do not present a major risk of oil spills and that the fuels in question, if spilt, would evaporate to a significant degree with the remainder being naturally dispersed in the water column by wave action within a few days of being spilled. This reduces the potential for adverse impacts upon fisheries and the Turkish Black Sea fisheries industry. The oil spill design control measures presented in Section 0, further limits the potential for adverse impacts upon fisheries and the Turkish Black Sea fisheries industry.

Although significant impacts on fishers and fishing activities from unplanned events are not anticipated, in the unlikely event that an impact occurs, fishers and fisheries will have access to recourse through the Grievance Procedure and Compensation Management Framework. Further information regarding these measures is included in **Chapter 9 Socio-Economics**.

13.5.6 Invasive Species Risk Assessment

Vessel operations have the potential to inadvertently introduce invasive alien species, either in ballast water, on the biofilm inside ballast tanks or carried as fouling organisms on the vessel hull. Historically, some introductions of alien species have had extreme ecological consequences, either directly through the introduction of benthic predators such as *Rapana venosa* or through system wide perturbations as exemplified by the invasion of the planktonic ctenophore *Mnemiopsis leidyi.* In other instances, such as the introduction of the bivalve *Anadara inaequivalvis*, the effects have been less severe and in the case of *Beroe ovata*, have in fact served to redress some of the ecological perturbations caused by *M.leidyi*. See **Chapter 8 Biological Environment** for more information.

13.5.6.1 Potential Impacts to Environmental Receptors

Despite its low likelihood of occurrence, there is the possibility of population or community-wide effects on the entire ecology of the Black Sea should invasive alien species be inadvertently introduced. Introduced invasive planktonic species can out compete native plankton species and cause changes to the marine food web. As such, introduction of invasive species can lead to the decrease in populations of pelagic fish that are the main food of most cetaceans or seabirds. Introduction of benthic predators such as *Rapana venosa* can cause changes to benthic species diversity which in turn can impact larger species (fish, birds or mammals) which feed on these species.

13.5.6.2 Potential Impacts to Socio-Economic Receptors

As the introduction of invasive species can have knock-on effects for larger species, higher up the food chain, commercially important fish populations could be impacted through a decrease in the availability of their food source. A collapse or reduction in the fish stocks would cause a reduction in the fish available to fisheries.

13.5.6.3 Mitigation Measures – Invasive Species

Given the above, the introduction of invasive species, although a rare event, could potentially have adverse environmental and socio-economic consequences. It is therefore a key objective of the Project to minimise the likelihood of occurrence of the introduction of invasive species and to develop measures that would effectively minimise the adverse impacts on potentially impacted marine habitats and associated species. Where practicable, mitigation measures to be applied include the following:

- Where relevant and practicable these measures will be based on those identified in the IPIECA (Global Oil and Gas Industry Association for Environmental and Social Issues) document Alien Invasive Species and the Oil and Gas Industry, Guidance for Prevention and Management (Ref. 13.5) and the International Maritime Organisation (IMO) Ballast Water Management Convention and Guidelines (Ref. 13.6). They will be applied to all marine plant and equipment that is used on the Project and which has the potential to be a vector of live organisms, spores, larvae and young and will include ballast water management, use of antifouling coatings, cleaning of equipment prior to deployment and the change of cooling water. The contractor Health, Safety, Security and Environment (HSSE) Plan will contain a detailed description of the actions to be taken to implement these requirements, which may include the following:
    - Vessels entering the Black Sea will have on-board, and implement, a Ballast Water and Sediment Management Plan;
    - Vessels entering the Black Sea will have a Ballast Water Record Book to record when ballast water is taken on board; circulated or treated for ballast water management purposes; and discharged into the sea or reception facilities;
    - Vessels entering the Black Sea using ballast water exchange will, whenever possible, conduct ballast water exchange as far from the nearest land as possible, and in all cases at least 50 nautical miles (nm) from the nearest land, and in water at least 200 m in depth; and

  - Vessels entering the Black Sea will conduct ballast water management in accordance with their year of construction and ballast water capacity.
- Where practicable, cleaning of hulls and tanks before use and prior to entering the Black Sea; and
- Where practicable, the use anti-fouling coatings (non-Tributyltin (TBT)) or sealing coatings to minimise inadvertent transport of organisms.

13.6 Operational Phase

13.6.1 Events Identification

During the Operational Phase of the Project unplanned events at sea may occur as a result of unplanned leakages of natural gas from the pipelines, as well as the introduction of invasive species by maintenance vessels.

Table 13.3 lists the activities that are discussed in this section that could result in an unplanned event, describes the events, and the receptors that could be affected.

Table 13.3 Marine Activities Potentially Resulting in an Unplanned event (Operational Phase)

Activity	Event	Receptors	
		Environmental	Socio-Economic
Operation of the pipelines	Failure of or damage to the pipeline which may result in gas releases and fire / explosions	✓	✓
	Introduction of invasive species by maritime vessels	✓	✓

13.6.2 Maritime Risk Assessment

In order to assist in the risk assessment process, a Shipping Risk Report was prepared for the Project (Ref. 13.7). The report considers the risks to the marine pipelines posed by shipping in the Black Sea. The following shipping hazards were identified as posing a potential risk to the integrity of the pipelines:

- *Ship sinking onto and damaging the pipeline*: The risks of ship sinking damaging the pipelines can occur along the entire Pipeline route, although there is only a risk when the ship is large enough to cause damage to the Pipeline. The likelihood of this occurring is reduced given the water depths in which the Project lies; and
- *Ships dropping objects (such as containers) onto the pipeline*: The risks of ships dropping objects on to the pipeline can occur along the entire Pipeline route. When a container hits

the top of a pipeline, the result can be a dent in a pipeline. The likelihood of this occurring is reduced given the water depths in which the Project lies.

The hazards as detailed above have the potential to result in pipeline damage or failure, which could result in the release of gas (and potential subsequent fire) from the pipeline which has the potential to impact upon environmental, socio-economic and human health receptors. However, due to the pipeline engineering design standards being applied which aim to minimise the potential for pipeline rupture and associated gas leakages and quality assurance during construction, together with the high external pipeline pressure at 2,000 m water depth, the potential for such a safety incident from an offshore pipeline is remote.

For a fire incident following a gas leakage to impact upon human health receptors, it would require a pipeline failure and gas leakage, followed by ignition at the sea surface in conjunction with a passing vessel. The most likely occurrence of this type of event would be where an object such as a container or the vessel itself, causes an impact failure by sinking on the pipeline as detailed above. The potential resultant impacts associated with environmental, socio-economic and human health receptors is discussed in the following sections.

Some unplanned events have been excluded from the assessment undertaken in this section as they are not expected to lead to significant environmental and socio-economic impacts. Unplanned events that have been excluded from discussion are:

- *Pipeline repairs and salvage as associated with unplanned events*: following unplanned events there may be the need for pipeline salvage/ repair works. It is considered that such activities would be similar to pipeline construction activities. Under such circumstances, salvage and remedial works would be undertaken in accordance with GIIP which would limit the potential for significant environmental impacts; and
- *Maritime vessel collisions and resultant oil spillages*: given the low number of survey vessels anticipated to be used during the Operational Phase, it is considered that the risk of collisions and oil spillages is remote therefore it can be scoped out of the assessment. Maritime vessels operated on behalf of the South Stream Transport will be operated in accordance with GIIP which would limit the potential for significant environmental impacts whilst Oil Spill Prevention and Response Plans will still be required to limit the potential for oil spills.

13.6.3 Potential Impacts to Environmental Receptors – Gas Leakages

In cases of an offshore leak, there are some locations along the South Stream Offshore Pipeline where gas will not leak from the pipelines. This will occur where the external pressure around the pipeline (i.e. the pressure of the seawater) is greater than the pressure of the gas within the pipeline. During normal operations, this would occur along approximately one third (the Western end) of the length of pipeline in Turkish waters. For areas where the water would not ingress, any gas released from a damaged sub-sea pipeline would rise through the water column as a plume of gas bubbles. On reaching the sea surface, the gas would disperse into the air.

Gas releases into the atmosphere would not be significant in the context of greenhouse gas emissions in Turkey, although methane levels at the release site would be temporarily elevated which could locally impact upon any present marine ecology including seabirds.

Gas passage through the water column could also impact upon marine organisms (such as fish and marine benthos), resulting in potential acute or chronic impacts depending upon exposure levels and environmental conditions (e.g. water temperature, dissolved oxygen) (Ref. 13.8). Gas is able to rapidly penetrate into marine organisms (especially through the gills) and disturb the main functional systems (respiration, nervous system, blood formation, enzyme activity, and others). Initially, organisms such as fish may exhibit behavioural symptoms such as startle responses, increased activity and scattering in the water. Thereafter, further exposure can lead to symptoms of poisoning. As with most toxicants, early life stages are most vulnerable to effects.

13.6.4 Potential Impacts to Socio-Economic Receptors – Gas Leakages and Fire

Should the marine Pipeline rupture via the unplanned events as detailed in Section 13.6.3, in certain locations along the Pipeline route gas would rise through the water column and disperse into the air.

Short-term human exposure to low concentrations of natural gas may cause headaches, dizziness, drowsiness, nausea and vomiting. High vapour concentration may lead to unconsciousness due to the absence of oxygen.

Natural gas is extremely flammable, forming a flammable mixture at a concentration of approximately 5% gas in air (by volume). In the unlikely event of a gas leakage, the risk to human health is associated with fire and explosion rather than gas exposure. Ignition of the gas cloud by an ignition source present on the ship in the gas cloud could result in a flash fire and harm, including potential ship's crew fatalities, as well as result in vessel damage.

Given that any gas leakages would be temporary (as the pipeline will be shut down as soon as is practicable) and localised, it is considered that fish species present in the vicinity would only be subject to short-term exposure and no significant mortalities are expected to occur. Therefore, it is anticipated that there will be no significant impact on fish populations which could have a secondary impact on fisheries.

13.6.5 Mitigation Measures

Chapter 5 Project Description describes how the pipeline design and operating philosophy minimises the potential for uncontrolled gas releases from the pipeline. Gas pressure, temperature, flow and other inventory parameters will be monitored at the landfall facilities and remotely by the Supervisory Control and Data Acquisition (SCADA) system. Any departure from defined parameters would trigger an emergency shutdown sequence, which will deploy emergency shutdown valves at the two landfalls and other events aimed at isolating the section of the pipeline where a leak is suspected thereby reducing the extent and duration of any leak.

A number of design controls have been identified to reduce the potential impacts of geohazards on the integrity of the pipeline. During the Development Phase, geohazard mapping was undertaken to facilitate route alignment based on the marine survey findings and associated engineering assessments (Ref. 13.9 and 13.10). In addition, the occurrence of mass movements triggered by events such as earthquakes was taken into account (Ref. 13.7). The pipelines will be designed in accordance with DNV-OS-F101 which considered standards for geohazard risk analyses.

The Pipeline design thus aims to minimise the occurrence of the unplanned gas releases following pipeline damage, whilst the Emergency Preparedness and Response Plan will minimise the potential environmental consequences of such events. The Emergency Response Plan to be prepared by each contractor will define actions to be taken during a gas release (making reference to South Stream Transport's overarching Emergency Preparedness and Response Plan). In addition, the Emergency Response Plan which will be prepared and maintained by each contractor will define actions to be undertaken to protect the workforce. Details of the Emergency Preparedness and Response Plan are provided in Section 13.4.

13.6.6 Invasive Species Risk Assessment

Maritime vessel operations during the Operational Phase will be limited to the periodic use of maintenance vessels (refer to **Chapter 5 Project Description**). During routine monitoring or in the event that repairs are necessary, there is potential for vessels to be used from outside of the Black Sea. As such, there is the potential to inadvertently introduce invasive alien species to the marine environment in the same manner as stated during the Construction and Pre-Commissioning Phase.

13.6.6.1 Potential Impacts to Environmental Receptors

The potential environmental consequences of introducing invasive species are considered under Section 13.5.6.1. Given the limited maritime vessel use required during the Operational Phase, it is considered that the risks of such events occurring is less than during the Construction and Pre-Commissioning Phase.

13.6.6.2 Potential Impacts to Socio-Economic Receptors

As stated in Section 13.5.6.2, the introduction of invasive species can have knock-on effects for commercial fisheries within the Black Sea. Given the limited vessel use required during operation, the likelihood of such an event occurring is less than during the Construction and Pre-Commissioning Phase.

13.6.6.3 Mitigation Measures – Invasive Species

Although the likelihood of introducing invasive species during the Operational Phase is much reduced when compared to the Construction and Pre-Commissioning Phase, the Project will develop measures that minimise the risks of adverse impacts upon marine habitats and associated species and fisheries. Mitigation measures as detailed in Section 13.5.6.3 will also be applied during the Operational Phase.

13.7 Decommissioning

The decommissioning programme will be developed during the Operational Phase of the Project (expected service lifetime of the South Stream Offshore Pipeline is 50 years). Technological options and preferred methods for decommissioning of such gas transportation systems as the South Stream Offshore Pipeline may be different in 50 years' time.

Consequently, unplanned events associated with the Decommissioning Phase are unknown at this stage; however, it is anticipated that some of the potential unplanned events will be similar in nature to some of those that may arise during the Construction and Pre-Commissioning Phase. As such, the mitigation actions as defined in Sections 13.5.5.2 and 13.5.6.3 and elsewhere within this ESIA Report are also likely to be applicable to the Decommissioning Phase.

Under all circumstances, decommissioning activities will be undertaken in accordance with GIIP and with the applicable international and national legislation and regulations prevailing at that time, and in liaison with the relevant regulatory authorities. As part of the decommissioning planning programme, the potential for unplanned events will be considered and appropriate mitigation and management measures put in place to reduce risks and consequences to the surrounding environmental and social receptors.

References

Number	Reference
Ref. 13.1	Black Sea Diesel and Fuel Release Modelling: South Stream Development. Genesis: Technical Note August 2013.
Ref. 13.2	Black Sea Contingency Plan 2002. To the Protocol on Cooperation in Combating Pollution of the Black Sea by Oil and Other Harmful Substances in Emergency Situations – Volume 1 Response to Oil Spills. AG ESAS 8.4d.
Ref. 13.3	"Guidelines for the development of the Shipboard Oil Pollution Emergency Plans", [IMO Resolution MEPC.54(32); adopted on March 6, 1992; and Resolution MEPC.86(44), adopted on 13 March 2000]
Ref. 13.4	IMO IB586E – Shipboard Oil Pollution Emergency Plans (SOPEP), 2010 Edition.
Ref. 13.5	Alien Invasive Species and the Oil and Gas Industry - Guidance for Prevention and Management. IPIECA. 2010.
Ref. 13.6	International Convention for the Control and Management of Ships Ballast Water & Sediments, 2004. http://globallast.imo.org/index.asp?page=mepc.htm. Accessed April 2014.
Ref. 13.7	South Stream Offshore Pipeline FEED - Shipping Risk Analysis Report. Intecsea Report 10-00050-10-SR-REP-0040-0011 dated February 2013.
Ref. 13.8	Intecsea Worley Parsons Group (2013) South Stream Offshore Pipeline FEED Pipeline Geohazard Summary Report 10-00050-10-SS-REP-0050-0003, 19-April-13, Rev B1.
Ref. 13.9	Intecsea Worley Parsons Group (2013) South Stream Offshore Pipeline FEED Pipeline Geohazard Impact Assessment Report 10-00050-10-MX-REP-0060-0013, 19-April-13, Rev 0.
Ref. 13.10	Intecsea Worley Parsons Group (2013) South Stream Offshore Pipeline FEED Pipeline Geohazard Study Review Report 10-00050-10-GE-REP-00520-0002, 27-Feb-13, Rev 0.