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## Environmental Risk Assessment

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HOLD	Description	Section

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## 1. Introduction

E.ON UK are considering investment in a new state of the art, coal fired power plant at Kingsnorth. The CO<sub>2</sub> that this new plant produces is intended to be captured in the depleted Hewett reservoir, which is approximately 40 km East of Bacton, and approximately 270 km from Kingsnorth.

The broad concept has been selected: CO<sub>2</sub> will be captured from the flue gas at the proposed E.ON coal fired power plant located at Kingsnorth. The captured CO<sub>2</sub> will be compressed and dried at a new onshore plant at Kingsnorth before being transported in a new pipeline 36" pipeline to a new offshore platform, which is located at the Hewett reservoir.

The 36" CO<sub>2</sub> pipeline on leaving the Kingsnorth site will run underground for ca. 8 km to the landfall valve station. The onshore pipeline will be uninsulated except for pipeline protection. The landfall valve station is located directly north of Kingsnorth, near the St Mary's Marshes. The onshore section of the pipeline is isolatable from both the carbon capture facilities and the offshore pipeline by ESD valves located at the pigging facilities and landfall valve station. The onshore section of the pipeline can be depressurised by back-flowing to the pigging facilities where the CO<sub>2</sub> can be routed to the carbon capture plant vent system. The onshore pipeline will have a design pressure of 150 barg and with a design temperature range of minus 85 to 70°C.

The landfall valve station is where the onshore and offshore pipeline sections meet. A 36" full bore ESD valve will isolate the two sections. A bypass line around the 36" landfall ESD valve consisting of an ESD valve and manual valve will allow the pressure in the two sections to be equalised following closure of the 36" landfall ESD valve. There will also be the facility to tie in an additional pipeline downstream of the 36" ESD valve that will allow other CO<sub>2</sub> producers to utilise the Kingsnorth offshore CO<sub>2</sub> injection facilities. Any new tie in to the pipeline will require its own ESD valve to isolate it from the offshore pipeline. This arrangement will preclude through-pigging from the future additional pipeline to the Kingsnorth offshore facilities. Pigging of any future additional pipeline will only be as far as the onshore valve station. The landfall valve station will have a design pressure of 150 barg and with a design temperature range of minus 85 to 70°C.



The 36" offshore pipeline will run c. 270 km from the shoreline to the Hewett field. The offshore pipeline will be uninsulated except for pipeline protection and weighting purposes. The offshore pipeline will have a design pressure of 150 barg. The offshore pipeline will have design temperature range of minus 85 to 70°C for the first 20 km from Kingsnorth then changing to a design temperature range of minus 85 to 50°C for the remainder of its length.

The offshore platform will be a Normally Unattended Installation (NUI) and will be remotely operated from Kingsnorth.

### 1.1. Document Scope

The scope of this Environmental Risk Assessment covers the offshore activities associated with the Kingsnorth CCS project from the 36" landfall pipeline ESDV to the wing valve at Kingsnorth NUI (Figure 1-1).

This report describes the basis of the assessment of risks to the environment during the execution of the offshore scope of Phase 1a of the project.

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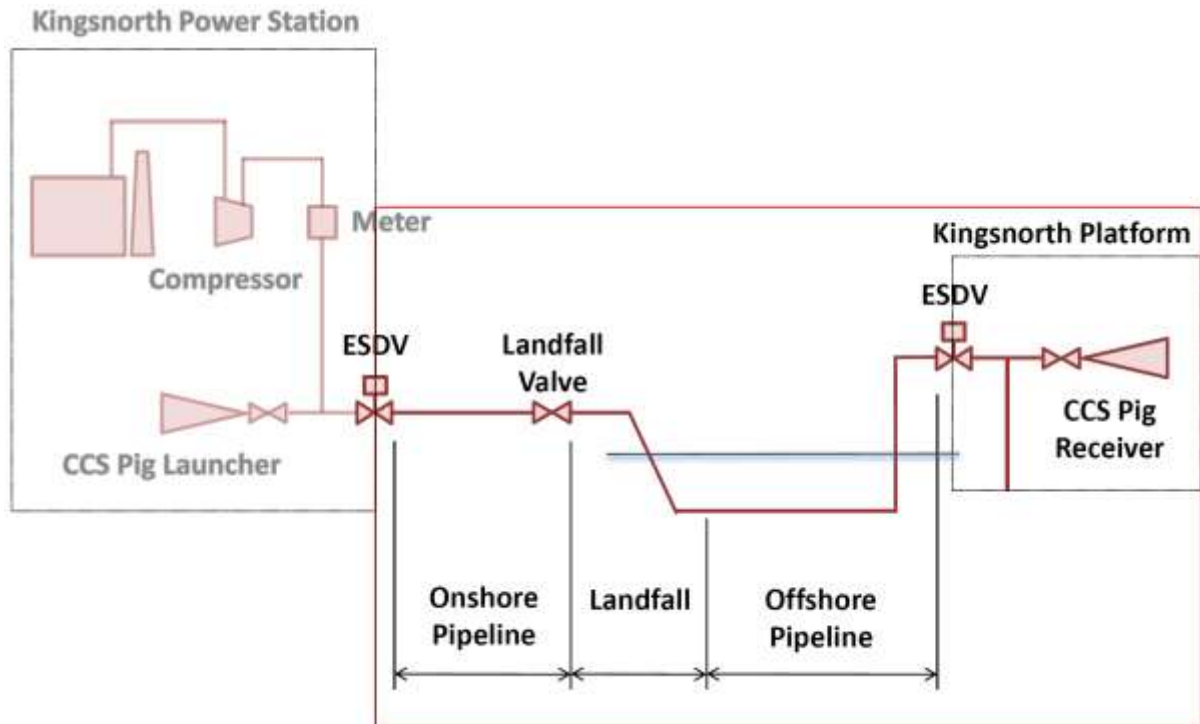




Figure 1-1 Genesis Workscope (Pig Launcher to Landfall)

## 1.2. Definitions

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

COMPANY	E.ON UK or its nominated representative.
CONTRACTOR	The companies designated on the purchase order form as being the selected Contractor of materials and services.
SUB-CONTRACTOR	The companies selected / designated by the CONTRACTOR as suppliers of materials and services.
WORK	The task, process or operation being conducted by the CONTRACTOR or SUBCONTRACTOR on any tier on behalf of COMPANY.
DEVIATION	Departure by CONTRACTOR or SUB-CONTRACTOR, without the APPROVAL of the COMPANY, from the requirements of this document.

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APPROVE / APPROVAL	Act of granting permission or act accepting as suitable, fit for purpose, etc., a document, process, procedure, etc. Used to indicate that the COMPANY or CONTRACTOR does not wish WORK to proceed unless certain features have been agreed in writing. Such APPROVAL shall not relieve the CONTRACTOR of its contractual or statutory responsibilities.
NON-CONFORMANCE REPORT	A report to be raised upon discovery by any party of a DEVIATION from this document.
Shall	Indicates mandatory requirement
Should	Indicates preferred course of action
May	Indicates optional course of action

In the context of this document, the titles and definitions shall be specific when shown in upper case and non-specific when shown in lower case

### 1.3. Abbreviations



Within this document, the following abbreviations are used:

AQS	Air Quality Standards
BMS	Business Management System
CCS	Carbon Capture and Storage
CO <sub>2</sub>	Carbon Dioxide
DECC	Department of Energy and Climate Change
EA	Environment Agency
EIA	Environmental Impact Assessment
EQS	Environmental Quality Standards
ES	Environmental Statement
ESD	Emergency Shut Down (valve)
FEED	Front End Engineering Design
GOGC	Genesis Oil and Gas Consultants
HAZID/ENVID	Hazard and Environmental Hazard Identification
HS&E	Health Safety and Environment
NUI	Normally Unattended Installation
PEC	Predicted Environmental Concentration
PNEC	Predicted No Effect Concentration
PPC	Pollution Prevention and Control (Regulations)
UKCS	United Kingdom Continental Shelf

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## **2. Environmental Risk Assessment**

There are a number of approaches to environmental risk assessment including those set out by the Environment Agency [S1] in support of PPC permit applications. The approach to risk assessment is not specific to the environment and follows a standard process (Figure 1) which includes:

1. the identification of the hazard, such as the release of carbon dioxide during venting or noise generated from piling operations;
2. an assessment of the exposure or concentration of the pollutant in the environment often expressed as the concentration in the environment at some fixed point and reported as the predicted environmental concentration (PEC). For noise this can be expressed in terms of the source term or the total energy;
3. the likely effect in the environment often expressed as the predicted no effect concentration (PNEC) based on toxicity testing; and
4. characterisation of the risk which can be defined as the ratio of the PEC to the PNEC and comparison against published quality standards such as Air Quality Standards (AQS) and Environmental Quality Standards (EQS). Generally a PEC/PNEC ratio greater than one is deemed to require further assessment.

The remaining components address the management of the risk such as the introduction of mitigation measures (for example, warning shots during piling), and monitoring which addresses, for instance, the frequency of further assessments.

In respect of the environment it is common to undertake a high level risk assessment in support of the Environmental Impact Assessment and subsequent Environmental Statement. This approach uses standard matrices to broadly classify risk in terms of the likelihood and hazard (impact) that a proposed project may have on the environment (see, for instance, Table 2-1, Table 2-2 and Table 2-3). This is a structured methodology for: the identification and quantification, where information allows, of emissions and discharges; determining the significance of the impact on the environment; and reporting the mitigation measures used to reduce the risk.

Implicit in the EIA process is a clear and well documented assessment of the impacts from each phase of the proposed project.

Potential effects are assessed both in terms of their likelihood, (how often they occur) and their impact (based on the hazard they pose) as described below.

When complete, the risk assessment process will take due account of the work being undertaken for the Environmental Statement (ES) and, where possible, will be aligned with the assessment processes in place for determining the significance of aspects set out in ES.


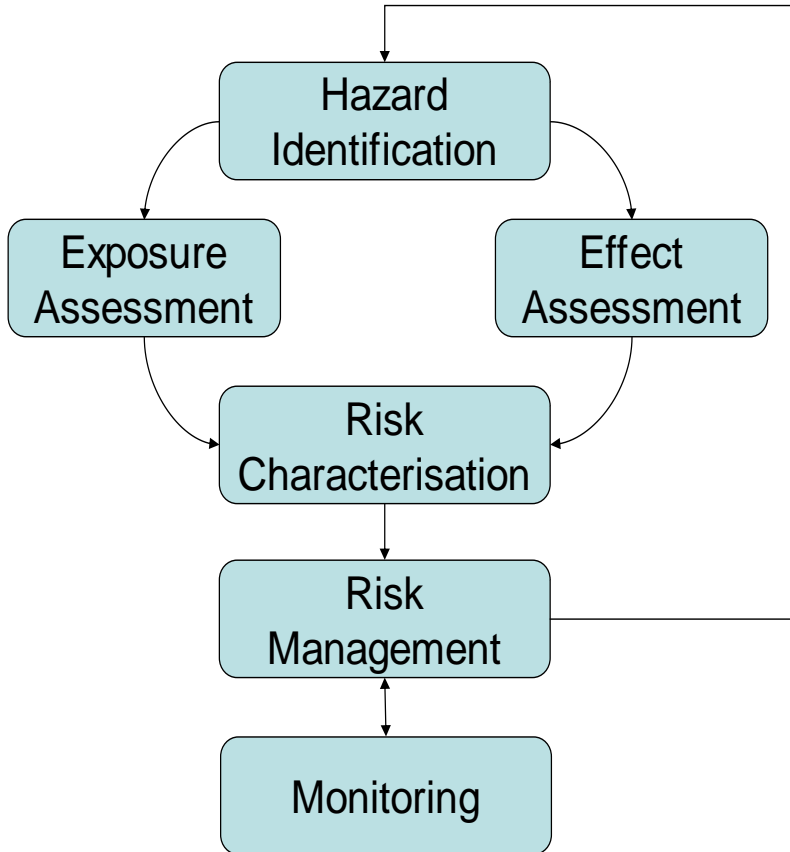
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Figure 2-1 Approach to Risk Assessment



## 2.1. Likelihood



The likelihood of realisation of each potential hazard is given a score of between one and five (Table 2-1). A low score means that the likelihood of a hazard leading to an impact is low.

Activity Duration	Likelihood of Event	Likelihood Category
One year to many years	Likely: More than once a year	5
One month to a year	Possible: Less than once per year and more than one every 10 years	4
One week to a month	Unlikely: Less than once every 10 years and more than once per 100 years	3
One day to a week	Remote: Less than once every 100 years and more than once per 1,000 years	2
Less than a day	Extremely remote: Less than once every 1,000 years	1

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	and more than once every 10,000 years	
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Table 2-1 Likelihood of Realisation of a Hazard

## 2.2. Consequence

The consequence of realisation of each hazard is also rated on a scale of one to five: five being the most severe, as shown in Table 2-2. Note that, where the consequence falls within 2 levels, the higher level is selected to provide a worst case scenario for the purposes of the assessment.

Level	Definition
Severe (5)	Change in ecosystem leading to long term ( greater than 10 years) damage with poor potential for recovery to an area 2 hectares of more, or to internationally or nationally protected populations, habitats or sites. Likely effect on human health. Long term, substantial loss of private users of public finance.
Major (4)	Change in ecosystem leading to medium term (greater than 2 years) damage with recovery likely within between 2 and 10 years to an area 2 hectares or more, or to internationally or nationally protected species, habitats or sites.
Moderate (3)	Change in ecosystem leading to short term damage with likelihood for recovery within 2 years to an area 2 hectares or less, or to protected or locally important sites. Possible but unlikely effect on human health. May cause nuisance. Possible short term minor loss to private users or public finances.
Minor (2)	Change is within scope of existing variability but potentially detectable.
Negligible (1)	Effects are unlikely to be noticed or measured.

Table 2-2 Definition of Magnitude of Environmental Effects

## 2.3. Combining Likelihood and Consequences to Establish Risk

The overall environmental risk of each environmental aspect is assessed using the combination of the likelihood and consequence scores as set out in Table 2-3, below.



		Consequence of Effect				
		5	4	3	2	1
Likelihood of occurrence	5	High	High	Moderate	Moderate	Low
	4	High	High	Moderate	Moderate	Low
	3	High	High	Moderate	Low	Low

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	2	High	High	Moderate	Low	Low
	1	High	Moderate	Low	Low	Low

Table 2-3 Classification of Risk

## 2.4. Objective

The overall objective of the offshore environmental risk assessment is to identify those elements of the project which pose the greatest risk to the environment. To assist in the identification of aspects and impacts the project will ensure that:

- potential environmental hazards associated with the design are identified, via techniques such as HAZID/ENVIDs;
- those measures that contribute to a reduction in the risk to the environment are incorporated or carried through for implementation at later project phases of the project;
- identifying the internal procedures / mechanisms through which GOGC will ensure that the solutions selected for the mitigation of identified hazards comply with the appropriate codes and / or standards and that the associated risks are minimised with respect to GOGC scope of work.

## 2.5. Performance

GOGC will monitor key aspects of its environmental performance throughout the Project as required by its EMS & BMS and in-line with E.ON UK HS&E objectives and performance criteria.

## 3. Environmental Risk Assessment

### 3.1. Risk Assessment Process

Qualitative environmental risk assessments are routinely undertaken in support of Environmental Statements. These are generally informed by ENVIDs a number of which are included in the project schedule.

### 3.2. Hazard Identification and Environmental Hazard Identification

The GOGC scope includes the undertaking of Hazard Identification and Environmental Hazard Identification (HAZID / ENVID).

Key aspects identified by GOGC during the HAZID / ENVID and review processes will be captured in a Key Issues Register and will be communicated to E.ON for inclusion, if relevant, in the Environmental Statement.

### 3.3. Assessment and Mitigation



Any significant risks identified during HAZID / ENVID, HAZOP or other risk based assessments will be analysed. Analyses will be completed by using engineering judgement to determine the relative risks. GOGC will, in general, seek to incorporate all risk reduction measures identified by the risk assessment process into the design of the offshore systems.

For those mitigation measures where the benefit is uncertain in comparison to the effort involved in its implementation, a quantitative analysis can be carried out if requested by E.ON. This analysis can then be complemented with a Cost Benefit Analysis.

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### 3.4. HAZOP

A HAZOP covering the safety and environmental risks of the operational aspects of the offshore elements of the Kingsnorth Transport Pipeline and Injection Facilities and their impact on the overall facilities infrastructure, will be carried out by GOGC internally. GOGC actions will be recorded and closed-out accordingly.

The above process will be undertaken for all identified aspects (hazards) with the results presented in the Environmental Statement. For those aspects identified as of moderate risk, additional mitigation measures will be considered to demonstrate that the risk is as low as reasonably practicable (ALARP). Aspects identified as being a high risk will be engineered out and/or subject to additional assessment.

## 4. References

[S1] Environment Agency H1 Environmental Risk Assessment – Overview v2.0 April 2010