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20.0 MAJOR ACCIDENTS AND DISASTERS

20.1 Introduction

20.1.1 This chapter of the Environmental Statement (ES) identifies the potential impacts and effects on Major Accidents and Disasters (MA&Ds) that are to be considered as part of the Environmental Impact Assessment (EIA) of the Proposed Development. The assessment has been undertaken in accordance with best practice guidance, including Major Accidents and Disasters in EIA: An IEMA Primer, published by the Institute of Environmental Management and Assessment (IEMA) (IEMA, 2020).

20.1.2 This chapter includes:

- an assessment of reasonably foreseeable worst-case MA&D scenarios that could credibly arise during the construction, commissioning, operation and decommissioning of the Proposed Development;
- the potential environmental consequences;
- the measures envisaged to prevent or mitigate potentially significant adverse effects of such events on the environment; and
- details of the preparedness for, and proposed response to, MA&D hazards.

20.1.3 The assessment of MA&Ds has incorporated the findings of a number of key studies, carried out in support of the ES, including the identification of environmental and human health receptors in the vicinity of the Proposed Development, and the assessment of the sensitivity of receptors such as ground, groundwater, surface water, ecological and others. For further information relating to sensitive environmental receptors, refer to Chapter 3: Description of the Existing Environment, Chapter 9: Surface Water, Flood Risk and Water Resources, Chapter 10: Geology, Hydrogeology and Contaminated Land, Chapter 12: Ecology and Nature Conservation, Chapter 13: Ornithology, Chapter 14: Marine Ecology and Chapter 17: Cultural Heritage (ES Volume I, EN070009/APP/6.2).

20.1.4 The objective of this assessment is to define appropriate precautionary actions to prevent, or mitigate, potentially significant risks associated with MA&Ds.

20.2 Legislation, Planning Policy Context and Other Guidance

20.2.1 This section identifies and describes legislation, planning policy and guidance that is of relevance to the assessment of MA&Ds effects.

Legislative Background

International Legislation

The Environmental Impact Assessment Directive 2014/ 52/ EU

20.2.2 The topic of MA&Ds was introduced into the EIA Regulations as a result of EU Directive 2014/52/EU, which states:

"In order to ensure a high level of protection of the environment, precautionary actions need to be taken for certain projects which, because of their vulnerability to

major accidents, and/or natural disasters (such as flooding, sea level rise, or earthquakes) are likely to have significant adverse effects on the environment. For such projects, it is important to consider their vulnerability (exposure and resilience) to major accidents and/or disasters, the risk of those accidents and/or disasters occurring and the implications for the likelihood of significant adverse effects on the environment."

National Legislation

The Infrastructure Planning (Environmental Impact Assessment) Regulations 2017

20.2.3 Regulation 5, paragraph 4 of the Infrastructure Planning (Environmental Impact Assessment) Regulations 2017 (the EIA Regulations) (HM Government, 2017) states that:

"The significant effects to be identified, described and assessed include, where relevant, the expected significant effects arising from the vulnerability of the proposed development to major accidents or disasters that are relevant to that development."

20.2.4 Schedule 4, paragraph 8 of the EIA Regulations requires an ES to provide:

"A description of the expected significant adverse effects of the development on the environment deriving from the vulnerability of the development to risks of major accidents and/or disasters which are relevant to the project concerned."

The Health and Safety at Work Act 1974

20.2.5 The Health and Safety at Work Act (HSWA) (HM Government, 1974) provides a regulatory framework to ensure the provision of a safe working environment of those in the UK. It also includes provision for those visiting a worksite and those who may be affected offsite by workplace emergencies. It includes the requirement to undertake a risk assessment of occupational hazards and apply the hierarchy of controls to mitigate identified risks such that the residual risks are reduced to a level that is As Low as Reasonably Practicable (the ALARP principle).

20.2.6 Many associated regulations have been made under the HSWA including, but not limited to the following of relevance to the control of MA&Ds of the Proposed Development:

- The Pipelines Safety Regulations (PSR) (SI 1996 No. 825) (HM Government, 1996a) (as amended SI 2023 No. 284);
- The Gas Safety (Management) Regulations (SI 1996 No. 551) (HM Government, 1996b);
- The Management of Health and Safety at Work Regulations (SI 1999 No. 3242) (HM Government, 1999);
- The Control of Substances Hazardous to Health Regulations (SI 2002 No. 2677) (HM Government, 2002a);
- The Dangerous Substances and Explosive Atmospheres Regulations (SI 2002 No. 2776) (HM Government, 2002b);

- The Construction (Design and Management) (CDM) Regulations (SI 2015 No. 51) (HM Government, 2015a); and
- The Control of Major Accident Hazards (COMAH) Regulations (SI 2015 No. 483) (HM Government, 2015b).

20.2.7 The Proposed Development will be subject to the HSWA and associated regulations, including those listed above. These regulations will be referenced where appropriate throughout the assessment, however, this assessment does not seek to duplicate the assessment of matters covered by these regulatory regimes. Instead, it assumes that they are embedded in the design and operation of the Proposed Development and are effective in their intent to reduce residual risks to ALARP.

Other Relevant Legislation

20.2.8 The legislative basis for issues which may influence the control of, or responsibility for, MA&Ds, in the UK, includes, but is not limited to, the following regulations. This legislation is referenced where appropriate in the course of this assessment, but, as stated above, this assessment does not substitute for the appropriate assessment of matters required by these regulations:

- Occupier's Liability Act (SI 1984 No. 3) (HM Government, 1984);
- Civil Contingencies Act (SI 2004 No. 36) (HM Government, 2004);
- The Supply of Machinery (Safety) Regulations (SI 2008 No. 1597) (HM Government, 2008);
- The Provision and Use of Work Equipment Regulations (SI 1998 No. 2306) (HM Government, 1998);
- Classification, Labelling and Packaging (CLP) Regulations (SI 2015 No. 21) (HM Government, 2015c), which have been retained in law with modifications due to the UK exit from the EU within:
  - The Chemicals (Health and Safety) and Genetically Modified Organisms (Contained Use) (Amendment etc.) (EU Exit) Regulations (SI 2019 No. 720) (HM Government, 2019) (as amended);
- The Planning (Hazardous Substances) Regulations (SI 2015 No. 627) (HM Government, 2015d);
- The Equipment and Protective Systems Intended for Use in Potentially Explosive Atmospheres Regulations (SI 2016 No. 1107) (HM Government, 2016a);
- The Pressure Equipment (Safety) Regulations (SI 2016 No. 1105) (HM Government, 2016b); and
- The Environmental Permitting (England and Wales) Regulations (EPR) (SI 2016 No. 1154) (HM Government, 2016c).

Planning Policy Context

National Planning Policy

The Overarching National Policy Statement for Energy (EN-1) (2023)

20.2.9 The National Policy Statements (NPSs) for energy infrastructure set out the Government's policy for the delivery of major energy infrastructure (Department of Energy Security and Net Zero (DESNZ), 2023a).

20.2.10 The Overarching NPS for Energy (EN-1) (DESNZ, 2023a) provides the primary policy framework within which the Proposed Development will be considered. Published in November 2023 and designated in January 2024, this policy statement does not contain any specific requirements in relation to MA&Ds assessment. The following sections are of relevance:

- Section 4.13 states that the Health and Safety Executive (HSE) is responsible for enforcing health and safety legislation, some of which is relevant to the construction, operation and decommissioning of energy infrastructure, and that some energy infrastructure will be subject to the COMAH Regulations. These Regulations aim to prevent major accidents involving dangerous substances and limit the consequences to people and the environment of any that do occur. COMAH regulations apply throughout the life cycle of the facility, i.e. from the design and build stage through to decommissioning. They are enforced by the Competent Authority comprising HSE and the EA acting jointly in England.
- Section 4.14 states that all establishments wishing to hold stocks of certain hazardous substances above a threshold need Hazardous Substances consent. The Hazardous Substances Authority (HSA) has responsibility for deciding whether the risk of storing hazardous substances is tolerable for the community. The HSA will usually be the local planning authority (LPA). Applicants must consult the HSA and HSE at pre-application stage for such consents if the project is likely to need hazardous substances consent.
- Section 4.16 states that DESNZ works closely with UK Government security agencies including the National Protective Security Authority (NPSA) and the National Cyber Security Centre (NCSC) to provide advice to the most critical infrastructure assets on terrorism and other national security threats, as well as on risk mitigation.

The National Policy Statement for Gas Supply Infrastructure and Gas and Oil Pipelines (EN-4) (2023)

20.2.11 The NPS for Gas Supply Infrastructure and Gas and Oil Pipelines (EN-4) (DESNZ, 2023b) references Major Accidents in section 2.6: Control of Major Accident Hazards, which refers back to section 4.13 of EN-1 with respect to the COMAH Regulations. In section 2.20: Natural Gas and Oil Pipelines, which states that the HSE enforces the Pipeline Safety Regulations which are the principal legislation governing the safety of pipelines and require that pipelines are designed, constructed and operated so that the risks are as low as reasonably possible (ALARP).

The National Policy Statement for Electricity Networks Infrastructure (EN-5) (2023)

20.2.12 The NPS for Electricity Networks Infrastructure (EN-5) (DESNZ, 2023c) makes no reference to MA&Ds assessment.

The National Planning Policy Framework (2023)

20.2.13 The National Planning Policy Framework (NPPF) (Department for Levelling Up, Housing and Communities (DLUHC), 2023) refers to hazards in the context of planning decision making in paragraphs 45 and 101 as follows:

"Local planning authorities should consult the appropriate bodies when considering applications for the siting of, or changes to, major hazard sites, installations or pipelines, or for development around them."

"Planning policies and decisions should promote public safety and take into account wider security and defence requirements by … anticipating and addressing possible malicious threats and natural hazards, especially in locations where large numbers of people are expected to congregate…this includes appropriate and proportionate steps that can be taken to reduce vulnerability, increase resilience and ensure public safety and security."

The Planning Practice Guidance for Hazardous Substances (2019)

20.2.14 The Planning Practice Guidance (PPG) for Hazardous Substances (DLUHC, 2019) explains land use planning controls relating to the storage of hazardous substances in England and how to handle development proposals around hazardous establishments. This includes guidance on:

- hazardous substances consent;
- dealing with hazardous substances in plan-making; and
- handling development proposals around hazardous installations.

Local Planning Policy

Redcar and Cleveland Borough Council Local Plan (2018)

20.2.15 The Redcar and Cleveland Borough Council (RCBC) Local Plan (RCBC, 2018) does not set out any principles for the assessment of MA&Ds. However, it does consider public safety within the context of local development within Policy SD4 – General Development Principles, which states:

"In assessing the suitability of a site or location, development will be permitted where it… avoids locations that would put the environment, or human health or safety, at unacceptable risk."

Stockton-on-Tees Borough Council Local Plan (2019)

20.2.16 The Stockon-on-Tees Borough Council (STBC) Local Plan (STBC, 2019) does not set out any principles for the assessment of MA&Ds. However, it does consider public safety within the context of local development within Policy SD8 – Sustainable Design Principles, which states:

"All proposals will be designed with public safety and the desire to reduce crime in mind, incorporating, where appropriate, advice from the Health and Safety Executive, Secured by Design, or any other appropriate design standards."

20.2.17 Further, hazardous installations are considered in Policy EG4 – Seal Sands, North Tees and Billingham, which states:

"Proposals which require hazardous substance consent will be designed and located to prevent an unacceptable increase in the level of risk to human health and the environment from an industrial accident or prejudice adjacent operational facilities or allocated sites."

Hartlepool Borough Council Local Plan (2018)

20.2.18 The Hartlepool Borough Council (HBC) Local Plan (HBC, 2018) does not set out any principles for the assessment of MA&Ds. However, it does consider public safety within the context of local development within Policy QP5 – Safety and Security which states inter-alia:

"The Borough Council will seek to ensure that all developments are designed to be safe and secure.

Developers will be expected to have regard to the following matters, where appropriate:

1) Adhering to national safety and security standards as set out by central government…"

Other Guidance

20.2.19 There is no specific guidance available that sets out the approach for undertaking a MA&Ds assessment within an EIA. However, the scope of the assessment has been developed with reference to Major Accidents and Disasters in EIA: An IEMA Primer (IEMA, 2020) which lays out emerging best practice. In addition to this guidance, there is a considerable amount of information and guidance available to developers on the identification and control of major hazards associated with industrial chemical processes, the storage and use of chemicals, and major accident hazard pipelines conveying hazardous fluids.

20.2.20 The HSE publishes a number of applicable guidance notes on its website, including:

- Emergency Planning for Major Accidents (HSG 191): COMAH Regulations 2015 (HSE, 1999);
- Further Guidance on Emergency Plans for Major Accident Hazard Pipelines (HSE, 1996); and
- Reducing Risks, Protecting People: HSE's Decision Making Process (HSE, 2001).

20.2.21 Other guidance that is of relevance to the assessment of MA&Ds includes:

- Chemicals and Downstream Oil Industries Forum Guidelines "Environmental Risk Tolerability for COMAH Establishments" (CDOIF, 2017); and

- Chapter 4 of the Cabinet Office's Emergency Preparedness Guidance on Part 1 of the Civil Contingencies Act 2004 (Revised 2012) (HM Government, 2012).

20.3 Assessment Methodology and Significance Criteria

Definitions

20.3.1 Major Accidents and Disasters in EIA: An IEMA Primer (IEMA, 2020) defines major accidents and disasters as follows:

"A major accident is an event (for instance, train derailment or major road traffic incident) that threatens immediate or delayed serious effects to human health, welfare and/or the environment and requires the use of resources beyond those of the client or its appointed representatives (e.g., contractors) to manage.

A disaster is a man-made/external hazard (such as an act of terrorism) or a natural hazard (such as an earthquake) with the potential to cause an event or situation, which meets the definition of a major accident above."

20.3.2 Both natural and accidental causes of MA&Ds are considered in this assessment to determine the potential impact on sensitive receptors.

20.3.3 The definition of a major accident in the context of the PSR (HM Government, 1996a) means death or serious injury involving a dangerous fluid (where dangerous fluid encompasses certain flammable, toxic, and oxidising fluids, and fluids which react violently with water as specified in Schedule 2 of the PSR) from a fire, explosion or uncontrolled emission from a pipeline.

20.3.4 More specifically, the criteria included in this assessment to define an accident or disaster as major, has been chosen to align with the criteria for an incident which would be notifiable to the European Commission as listed within Schedule 5 of the COMAH Regulations (HM Government, 2015b). This notification to the EU is no longer required following the UK's exit from the EU, however the criteria are still considered relevant to the identification of MA&Ds, in that it causes:

- an injury to a person which is fatal;
- up to six persons are injured within the establishment and hospitalised for at least twenty-four hours (hrs);
- one person outside the establishment is hospitalised for at least twenty-four hrs;
- a dwelling outside the establishment is damaged and is unusable as a result of the accident;
- the evacuation or confinement of persons for more than two hrs, where the value (persons × hrs) is at least five hundred;
- the interruption of drinking water, electricity, gas or telephone services for more than two hrs, where the value (persons × hrs) is at least one thousand;
- damage to property in the establishment, to the value of at least two million Euro;

- damage to property outside the establishment, to the value of at least five hundred thousand Euro;
- permanent or long-term damage to terrestrial habitats involving:
  - 0.5 hectares (ha) or more of a habitat of environmental or conservation importance protected by legislation; or
  - 10 ha or more of more widespread habitat, including agricultural land.
- significant or long-term damage to freshwater and marine habitats involving:
  - 10 km or more of river or canal;
  - 1 ha or more of a lake or pond;
  - 2 ha or more of delta; or
  - 2 ha or more of a coastline or open sea.
- significant damage to an aquifer or underground water of 1 ha or more.

Study Area

20.3.5 The study area for assessment of MA&Ds is not defined within regulatory guidance or standardised methodology, but is shown in Figure 20-1: Major Accident and Disaster Study Area.

20.3.6 The study areas used in this assessment were defined with reference to the likely Zone of Influence (ZoI) over which the Proposed Development may have potential to result in significant MA&D effects on relevant environmental receptors.

20.3.7 The ZoI are event specific and account for the principle of the Rochdale Envelope in relation to worst-case needs for assessment purposes.

20.3.8 The Proposed Development will be subject to the COMAH Regulations (HM Government, 2015b) as an Upper Tier installation, and professional judgement has been applied in defining the ZoI, recognising the current design stage of the plant and equipment and consideration of Major Accident Hazards (MAH). As the detailed design of the Proposed Development progresses a full Safety Case Report will be prepared for submission to the HSE, as required by COMAH, specifying the MAH and the residual impacts demonstrating the application of ALARP (As Low as is Reasonably Practicable) techniques.

20.3.9 A 5 km study area around the Proposed Development Site (the study area) has been considered recognising that this area of Teesside includes several installations regulated by the COMAH Regulations and MAH pipelines regulated by the PSR (HM Government, 1996a) and that COMAH requires the consideration of “domino” effects with neighbouring assets. The 5km has been selected on the basis of MAH sites greater than 5km from the site are unlikely to directly affected unless there is a Domino linkage with another site within the study area and this would be dealt with through the COMAH process.

Impact Assessment Methodology

20.3.10 MA&Ds scenarios have been considered for each phase of the Proposed Development, namely construction, commissioning, operation and decommissioning.

20.3.11 The following steps have been followed to identify credible MA&Ds scenarios for detailed assessment:

- Baseline information relevant to MA&Ds has been collated, including the potential for natural disasters (e.g., as a result of seismic activity or climate change), and the presence of neighbouring industrial facilities, for example, any sites regulated by the COMAH Regulations (HM Government, 2015b).
- An assessment of the substances which will be present within the Proposed Development Site has been carried out to identify those classified as hazardous, in accordance with the CLP Regulations (HM Government, 2015c). The storage requirements and process uses of hazardous substances has been identified to determine the potential for Risk Events which could constitute a MA&D related to these substances. Substances which are not classified as hazardous, or are present in relatively minor quantities, have been discounted at this stage.
- A review of the operations and activities carried out throughout the lifecycle of the Proposed Development has been undertaken to determine the potential for Risk Events which could constitute a MA&D related to these activities.
- A long list of unscreened Risk Events for MA&Ds has been collated, considering the substances, process and baseline conditions that have been identified.
- The long list of unscreened events does not include:
  - Risk Events which could have relatively minor consequences, regardless of the likelihood of occurrence, as they do not fall into the definition of a MA&D; or
  - Risk Events with a high likelihood of occurrence and significant consequences, which would be prevented by specific legislation application, i.e., COMAH (HM Government, 2015b) and PSR (HM Government, 1996a), and which ensures that facilities with this category of risk are not permitted.
- The resulting long list has been subject to a screening assessment. Those MA&D Risk Events which are considered very unlikely to occur (for example, due to the location of the Proposed Development) or for which there is no credible source-pathway-receptor linkage, have not been taken forward for further assessment. This is found in Appendix 20A: Long List of MA&Ds Risk Events (ES Volume III, EN070009/APP/6.4).
- All remaining MA&D Risk Events have been shortlisted for further assessment.

20.3.12 For those MA&D Risk Events which have been scoped in for detailed assessment, the following assessment process has been followed:

- Credible Scenarios related to the Risk Event have been identified - these constitute a reasonably foreseeable worst-case incident of the identified Risk Event;
- The potential impact of Credible Scenarios on receptors has been determined using the source – pathway – receptor linkage model;
- The magnitude of potential impacts of Credible Scenarios has been assessed, considering the severity of harm, its duration, and its consequences, as well as its probability of occurrence;
- Mitigation measures to eliminate the risk have been identified where possible; and if not possible, to reduce the risk to a level demonstrated to be ALARP; and
- The tolerability of any residual risk has been qualitatively considered.

Significance Criteria

20.3.13 The tolerability of the risk of a MA&D Credible Scenario is categorised via the application of professional judgement on the reasonably foreseeable worst-case consequence and the likelihood of occurrence. Risks are categorised as:

- Tolerable (Broadly acceptable). The levels of risk are generally regarded as adequately controlled and comparable to those that people regard as trivial in their daily lives. Further action to reduce risks is not normally required.
- Tolerable (if ALARP). People are prepared to tolerate this level of risk in order to secure benefits, such as employment or infrastructure. The expectation is that risks are properly assessed and kept as low as reasonably practicable (ALARP) through the application of appropriate mitigation, and risks are kept under review.
- Unacceptable. A risk falling into this region is regarded as unacceptable whatever the level of benefits associated with the activity.

20.3.14 The definitions of the above terms are contained in the document, Reducing Risks, Protecting People (HSE, 2001).

20.3.15 For consistency with other technical chapters, the assessment conclusions presented within this chapter have been translated into the significance terminology used within the wider ES (see Chapter 2: Assessment Methodology (ES Volume I, EN070009/APP/6.2)). This terminology translation is explained further below.

Table 20-1: Classification of Effects (comparison with ES terminology)

CLASSIFICATION OF EFFECT	TERMINOLOGY USED ELSEWHERE WITHIN THE ES	DESCRIPTION USED WITHIN MA&DS CHAPTER IN ACCORDANCE WITH HSE GUIDANCE
Significant (beneficial)	Major beneficial	-
	Moderate beneficial	-

CLASSIFICATION OF EFFECT	TERMINOLOGY USED ELSEWHERE WITHIN THE ES	DESCRIPTION USED WITHIN MA&DS CHAPTER IN ACCORDANCE WITH HSE GUIDANCE
Not Significant	Minor beneficial	-
	Negligible	Tolerable (broadly acceptable)
	Minor adverse	Tolerable (acceptable if ALARP)
Significant (adverse)	Moderate adverse	Intolerable (unacceptable)
	Major adverse	

20.3.16 As a general rule, tolerable and tolerable if ALARP risks are considered as being Not Significant in the context of MA&Ds. Intolerable risks are considered to be Significant and unacceptable.

20.3.17 Risks categorised as Tolerable –(if ALARP) generally require further assessment, typically carried out as part of the development of a COMAH Safety Report or Safety Case to the HSE, to allow operation. Detailed supporting studies, including Site Quantitative Risk Assessment (QRA), preliminary Consequence Modelling, Hazard Identification (HAZID) studies, Fire Hazard Analysis (FHA) and Explosion Hazard Analysis (EHA) may be required by the Applicant to support the future COMAH Safety Report, but do not form part of the evidence base for this ES chapter as they are not currently developed.

20.3.18 The scope of the future studies will be in accordance with HSE requirements for a COMAH Safety Report submission and the studies will form part of the submission; to demonstrate that ALARP has been applied to mitigate risks to an acceptable level without significant impacts. Where appropriate, the HSE will be consulted on the content of the COMAH Safety Report and supporting studies as they develop.

Sources of Information/ Data

20.3.19 The following sources of information have been reviewed and have informed the assessment:

- National Risk Register 2023 (HM Government, 2023);
- British Geological Survey (BGS) GeoIndex Onshore (BGS, 2022);
- HSE's COMAH 2015 Public Information Search (HSE website, 2023); and
- Google aerial and street view maps covering the study area (Google, 2023).

Consultation

Scoping Opinion

20.3.20 An EIA Scoping Opinion was requested from the Inspectorate on 6 April 2023. A response was received on 17 May 2023. For the Scoping Opinion and the Applicant's responses to them, refer to Appendix 1E of Chapter 1: Introduction (ES Volume III, EN070009/APP/6.4).

Statutory Consultation

20.3.21 The PEI Report was published for statutory consultation on 14 September 2023 and the consultation period ended on 26 October 2023. A second statutory consultation was held between 13 December 2023 and 23 January 2024, and additional targeted consultation was held between 9 February 2024 and 10 March 2024. The matters raised have been reviewed and an explanation of how the Applicant has had regard to them is set out in the Consultation Report (EN070009/APP/5.1).

20.3.22 Refer to Table 20-2 for a detailed summary of the Statutory Consultation feedback relevant to this chapter from Statutory Environmental Bodies, and the Applicant's responses.

Table 20-2: Responses to the Statutory Consultation Feedback

CONSULTEE	DATE AND METHOD OF CONSULTATION	SUMMARY OF CONSULTEE COMMENTS	SUMMARY OF RESPONSE/HOW COMMENTS HAVE BEEN ADDRESSED
Environment Agency	26/10/23	Control of Major Accident Hazards (COMAH) Regulations 2015 This site falls under the COMAH regulations 2015 and will be an Upper Tier COMAH site. The applicant must apply to the local authority for hazardous substance consent. The PEIR is missing a list of proposed dangerous chemicals and proposed inventory. If the development is within a vulnerable flood risk area, then any secondary and tertiary containment must be designed to meet Ciria guidance including any arrangements for maintenance and testing. Pollution control measures (drains and sumps) must be similarly designed, maintained, and tested with penstock arrangements to stop any loss of spillage or firewater runoff. It is recommended the activation of the penstock is linked to the fire alarm. The EA has a climate change adaptation questionnaire for all COMAH operators. Upper Tier COMAH Safety Reports are required to address the issues within the questionnaire covering all aspects of operations including, but not limited to, pre-construction, site layout, position of tanks on site, control room location away from danger zones and overlapping public information zones. The Health and Safety Executive (HSE) will advise. It is recommended the Applicant submits their safety report and climate change questionnaire response well in advance of construction commencing, to allow a full review.	Control of Major Accident Hazards (COMAH) Regulations 2015 The Applicant is aware of the requirement to seek consent under both COMAH and Hazardous Substances Regulations and will be engaging with the regulatory bodies (HSE and LPA) for each regime to progress both applications. A provisional chemical list is provided in Chapter 21: Major Accidents and Disasters (ES Volume I, EN070009/APP/6.2). For details on the Other Consents and Licences being pursued for the Proposed Development, please refer to Other Consents and Licenses Statement (EN070009/APP/5.7).

HSE Engagement

20.3.23 The Applicant has been meeting regularly with the HSE and has presented the following information to them:

- A general introduction to the Proposed Development;
- A session on the approach to compliance with the PSR; and
- A session focussed on the COMAH Regulations

20.3.24 Feedback received by the Applicant from the HSE is that the current approach to engagement is correct and has been helpful in advancing regulation of the energy transition.

Use of the Rochdale Envelope

20.3.25 To ensure a robust assessment of the likely significance of the environmental effects of the Proposed Development, the EIA is being undertaken adopting the principles of the Rochdale Envelope approach where appropriate in line with the Planning Inspectorate's (the Inspectorate's) Advice Note Nine (The Inspectorate, 2018). This involves assessing the maximum (or where relevant, minimum) realistic worst-case parameters for the elements where flexibility needs to be retained (building dimensions or operational modes for example).

20.3.26 Due to construction phasing, there may be a period following opening of Phase 1 where Phase 1 will be operational and Phase 2 will be in construction. The potential for a MA&D event is increased in the event that construction and operational activities are occurring on adjacent sites. The HSE will have a lead role in managing the risks under COMAH regulations (for the operational assets) and CDM Regulations for the construction activities. The Applicant will need to demonstrate that construction activities (for Phase 2) can be conducted safely adjacent to operational activities (Phase 1), through appropriate risk assessments and necessary revisions to the Framework Construction Environmental Management Plan (CEMP) (EN070009/APP/5.12) in order to define additional mitigation measures beyond those referenced in this chapter and contained within regulatory consents anticipated to be in place at that time (COMAH and Environmental Permit). In essence, construction activities and neighbouring operational plant can co-exist providing robust safety risk assessments are undertaken, agreed with the HSE, and the correct additional mitigation measures are applied to all sites.

20.3.27 In addition to the Proposed Development, other neighbouring projects are ongoing with different delivery timescales, i.e., HyGreen and Net Zero Teesside (NZT) Power. These projects will be in different stages of implementation through the construction, commissioning and operation of Phases 1 and 2 of the Proposed Development. During each phase of the Proposed Development, appropriate risk assessments and studies will be undertaken pursuant to the COMAH and Environmental Permitting and Health and Safety at Work Act processes, taking due regard of the construction and operational status of the immediate neighbouring facilities, in order to define mitigation measures, to manage the potential interaction between neighbouring sites, so that domino risks are managed to

ALARP. The Applicant has also begun engagement with the Environment Agency under the enhanced pre-application scheme and is finalising an application for an Environmental Permit anticipated to be submitted in 2024.

20.3.28 Given the assumptions detailed below, the assessment presents a reasonable worst-case approach in the line with the principles of the Rochdale Envelope.

Assumptions and Limitations

Assumptions

20.3.29 In line with the Inspectorate's guidance, the following assumptions have been made with regard to the construction phase of the Proposed Development:

- At this stage in the Proposed Development, an Engineering, Procurement and Construction (EPC) Contractor(s) (and hence Principal Contractor under the CDM Regulations) has not yet been assigned, and a detailed Construction Phase Plan has not been drawn up. However, it is assumed that standard industry approaches to managing risk will be used.

20.3.30 The following assumptions have been made for the operational phase of the Proposed Development:

- The design of the plant will be subject to further detailed design. Inherently safer design (ISD) principles will be embedded during the design selection process on an ALARP basis with respect to controlling major accidents to people and the environment and to mitigate the consequences in the event of an industrial accident.
- Where exact locations of plant and pipelines are not known, the external limits of the Main Site, Work Areas or the Order limits have been used as a worst case proxy of their potential locations in order to assess MA&Ds risks.
- The hydrogen (H_2) storage vessels have not yet been identified or designed at this stage of the Proposed Development. Their design, construction and operation will be in accordance, however, with industry standards and codes for hydrogen storage and use. The vessels will be UKCA (CE) marked, as legally required, which ensures that a recognised design code e.g., ASME VIII or PD 5500 etc. will have been followed for safe design of the vessels.
- At this stage in the Proposed Development, safety and control systems have not yet been designed, however, standard industry approaches to managing risk will be used. In addition, equipment such as process monitoring and safeguarding systems, and embedded mitigation, such as fire, flammable gas, toxic gas and leak detection, fire protection systems and emergency shutdown systems, will be installed as required.

Limitations

20.3.31 This assessment is based on construction, preliminary design, process and decommissioning information that is currently available and an early appraisal of potential hazards.

20.4 Baseline Conditions

20.4.1 This section presents a description of the baseline environmental characteristics within the study area.

Existing Baseline

Sensitive Environmental Receptors

20.4.2 The following sensitive receptors which could be vulnerable to MA&Ds risks include:

- private residences (and their inhabitants) within the local area;
- local economic receptors, including businesses and employees;
- healthcare receptors, including hospitals;
- community receptors, including Public Rights of Way (PRoWs), community land, and community buildings;
- the historic and cultural environment, including archaeology and built heritage;
- designated ecological sites, primarily the Teesmouth and Cleveland Coast Ramsar Site, Special Protection Area (SPA) and Site of Special Scientific Interest (SSSI);
- the water environment, including groundwater, the River Tees and the North Sea;
- infrastructure and the built environment, including transport infrastructure, industrial infrastructure and energy infrastructure; and
- the interactions between the receptors mentioned above.

Environmental Baseline

20.4.3 The Main Site is located at the mouth of the River Tees, approximately 150 m from Tees Bay. The surrounding area is predominantly industrial, with a number of protected ecological sites associated with the River Tees, as well as some residential areas.

20.4.4 The Teesmouth and Cleveland Coast Ramsar Site, SPA and SSSI fall within the study area, to the immediate north of the Main Site at its closest point. This covers the River Tees, part of the Tees Bay and important coastal habitats such as sand dune and saltmarsh, supporting invertebrates, waterbirds, and harbour seals and other protected species. There are no other SPAs, Special Areas of Conservation (SACs) or Ramsar Sites within the 5 km study area. Lovell Hill Pools SSSI is located approximately 2.4 km to the south-east of the Proposed Development Site. For further information relating to sensitive environmental receptors, refer to Chapter 3: Description of the Existing Environment (ES Volume I, EN070009/APP/6.2) and Chapter 12: Ecology and Nature Conservation (ES Volume I, EN070009/APP/6.2).

20.4.5 Also present within the study area are the residential population centres of Middlesbrough, Hartlepool, Stockton-on-Tees, Redcar, Billingham and Seaton Carew. The Main Site is generally remote from residential receptors. Marsh

Farmhouse is the closest residential receptor, located approximately 1.3 km east of the Main Site in Warrenby. The next closest residential areas to the Main Site are Dormanstown and Coatham, within the district of Redcar and Cleveland. There are further residential receptors close to the Hydrogen Pipeline Corridor, within the districts of Middlesbrough. The 2021 UK Census gives an estimated total population of Middlesbrough, Redcar and Cleveland, Stockton-on-Tees, and Hartlepool as 143,900, 136,500, 196,600, and 92,300, respectively (Office for National Statistics (ONS), 2022). The James Cook University Hospital is located within the study area, approximately 4.2 km south of the Order limits southern extent.

20.4.6 Teesside has a temperate oceanic climate typical of the UK. As described in Chapter 9: Surface Water, Flood Risk and Water Resources (ES Volume I, EN070009/APP/6.2), the main risk of flooding to the Proposed Development Site is tidal/fluvial, associated with the North Sea and watercourses in and around the Proposed Development Site. Whilst the Main Site, the Carbon Dioxide (CO_2) Export Corridors and the Natural Gas Connections Corridor are located entirely in Flood Zone 1, a significant amount of the Hydrogen Pipeline Corridor is located within Flood Zones 2 and 3. Small areas of the Electrical Connection Corridor, the Other Gases Connection Corridor and the Water Connections Corridor are also located within Flood Zones 2 and 3.

20.4.7 Four earthquakes (of maximum magnitude 3.1) have been recorded in the study area since 1994, but none of these were classified by the BGS as significant.

Infrastructure and Industrial Sites

20.4.8 The Teesside area is a significant industrial hub, with the chemical industry operating in this location for over a century. Chemical manufacturing still makes up a large proportion of the industrial sites in the area, along with oil and gas facilities and the nearby Hartlepool nuclear power station.

20.4.9 There are currently 32 COMAH regulated sites within the study area (based on a search of the HSE Public Register conducted on 8/12/2023) with operations in the following categories:

- bulk and fine chemical installations, with operations including manufacture / production, disposal, storage / warehousing and distribution;
- fuel processing and storage installations, including refining and distribution;
- waste storage, treatment and disposal sites; and
- power generation, supply and distribution.

20.4.10 These sites include:

- Wilton International, and other industrial sites in Redcar and Cleveland (Figure 20-1: Major Accidents and Disasters Receptors within 5 km of the Proposed Development Site Boundary) including the following operators:
  - Alpek Polyester Limited;
  - BOC Ltd.;

  - Ensus UK Ltd.;
  - Huntsman Polyurethanes (UK) Ltd.; and
  - SABIC UK Petrochemicals Ltd.
- Seal Sands Industrial Area, and Port Clarence Works within Stockton-on-Tees, including the following operators:
  - Air Products (BR) Ltd.;
  - Calor Gas Ltd.,
  - CF Fertilisers Ltd.;
  - ConocoPhillips Petroleum Company UK Ltd.;
  - Exolum Seal Sands Limited
  - Fine Organics Ltd. (now Lianhetech);
  - Industrial Chemicals Ltd.;
  - Navigator Terminals North Tees Ltd
  - Navigator Terminals Seal Sands Ltd.;
  - PX (TGPP) Ltd.;
  - Sabic UK Petrochemicals Ltd.; and
  - Wood Group PSN Ltd.
- Billingham Riverside and Chemical Complex and others in the vicinity within Stockton-on-Tees, including the following operators:
  - CF Fertilisers UK Ltd.;
  - Chemoxy International Ltd. (now Seqens);
  - Exolum Riverside Ltd.;
  - Exwold Technology Ltd.;
  - Mitsubishi Chemical UK Ltd.;
  - Origin UK Operations Ltd.;
  - SNF Oil and Gas Ltd; and
  - Tees Valley Net Zero Limited.
- The following industrial operators within Middlesbrough:
  - Chemoxy International Ltd.;

  - MP Storage and Blending Ltd.; and
  - Univar Ltd.
- The following industrial operators within Hartlepool:
  - Exwold Technology Ltd.;
  - Qualitech Environmental Services Ltd;
  - Venator Materials UK Limited.
- Hartlepool Power Station.

20.4.11 Due to the nature of industry in Teesside, there is an existing network of buried and above ground pipelines present within the Study Area, including major hazard pipelines, regulated in accordance with the PSR (HM Government, 1996).

20.4.12 As described in Section 10.4 of Chapter 10: Geology, Hydrogeology and Contaminated Land (ES Volume I, EN070009/APP/6.2), there are existing operational and redundant underground brinefield cavity storage systems at North Tees and Wilton areas. These store large volumes of substances associated with the industrial installations. In addition, they have historically been utilised for natural gas storage, as part of the national grid system.

20.4.13 There is also significant infrastructure associated with the transmission and distribution of energy in the Study Area, including high voltage 400 kilovolt overhead power lines.

20.4.14 Transport infrastructure within the Study Area includes ports, roads and rail. Teesport, located approximately 1 km to the south-west of the Main Site, is the UK's fifth largest seaport, handling approximately 28 million tonnes of cargo annually. Primary roads in the area include the A19, A174, A66 and A689. Middlesbrough, Billingham, South Bank, Seaton Carew and South Bank train stations, and their associated rail lines, also fall within the Study Area. Teesside Airport is the nearest airport, located approximately 11.5 km to the south-west of the Proposed Development Site.

Summary of Current Major Accidents and Disasters Risks for the Existing Locality

20.4.15 The Proposed Development Site is located within an area which has a number of COMAH installations, forming a domino group as described in Regulation 24 of COMAH. These are groups of sites where the risks or consequences of a major accident may be increased due to the proximity of the sites to each other. Potential risks include, but are not limited to, fire, explosion, release of (flammable, toxic, asphyxiant, corrosive, environmentally harmful etc.) substances to air, water, ground and groundwater.

Future Baseline

20.4.16 The Proposed Development is expected to form part of a cluster of developments operated by bp on or adjacent to the Main Site. These include Net Zero Teesside (NZT) Power and HyGreen. These establishments are also expected to be COMAH

sites (Upper and / or Lower Tier). This may increase the risks or consequences of a major accident due to the domino group effect as described above, however the design and construction phases will consider the risk of domino effects and appropriate mitigation measures will be adopted to demonstrate ALARP.

20.5 Proposed Development Design and Impact Avoidance / Minimisation

20.5.1 The EIA process aims to avoid, prevent, reduce or offset potential environmental effects through design and/or management measures. These are measures that are inherent in the design and construction of the Proposed Development (also known as embedded measures).

20.5.2 The following impact avoidance measures have either been incorporated into the design or are standard construction or operational practices. These measures have, therefore, been taken into account during the impact assessment and will be secured via Requirement through the Draft DCO (EN070009/APP/4.1).

Construction

20.5.3 The Framework CEMP (EN070009/APP/5.12) sets out the key measures to be employed during the construction of the Proposed Development, to control and minimise the impacts on the environment. The Framework CEMP sets out how impacts upon MA&Ds receptors are managed during construction. The Framework CEMP links into other management plans that have embedded ALARP practices to minimise risk, e.g., the Outline Site Waste Management Plan (SWMP) (appended to the Framework CEMP). The SWMP specifies where wastes are stored during construction, how they are handled and stored, with mitigation measures such as containment bunds / berms to prevent loss of containment. Another example of a relevant mitigation measure under the Framework CEMP are the diesel storage provisions (re-fuelling construction mobile plant), which would be on impermeable bunded areas onsite, protected from vehicular collisions / impacts.

20.5.4 In compliance with the CDM Regulations 2015 (HM Government, 2015a) the Applicant (Client under CDM Regulations) will develop and provide pre-construction information as soon as is practicable with the formal appointment of the Principal Designer and Principal Contractor (normally the roles are undertaken by the appointed EPC Contractor(s)).

20.5.5 In compliance with Regulation 6 of the CDM Regulations 2015 (HM Government, 2015a) a Notification of Construction Works will be submitted to the HSE prior to the commencement of construction. The EPC Contractor(s) (Principal Designer and Principal Contractor) will be contractually required to comply with the CDM Regulations to ensure the Proposed Development construction is carried out in a way that secures health and safety.

20.5.6 The appointed EPC Contractor(s) will develop the Construction Phase Plan prior to commencing construction works.

20.5.7 The Principal Designer, or where there is no Principal Designer, the EPC Contractor(s), will ensure that a final Health and Safety File is drawn up and handed to the Applicant. This will identify any environmental, health and safety information

about the Proposed Development likely to be needed during any subsequent work activities.

20.5.8 The use of suitably experienced contractors, risk assessments, working method statements, operating procedures and personnel training will minimise the risk of accidental scenarios occurring during the Proposed Development's construction. Atypical activities, which will be undertaken during construction, but not in normal operation, will be assessed as part of the risk assessment and mitigation processes. For example, the refuelling of construction vehicles from temporary diesel storage areas will be subject to both procedural and infrastructure measures to prevent spillages of fuel. Procedurally, vehicles will be stationary with engines switched off and keys taken out of ignition (to prevent drive away) during filling. The bulk diesel storage tank will be located away from potential vehicular collisions and in an area where spills can be contained and recovered (bunded area), and away from open drainage and open ground.

20.5.9 Specific construction mitigation measures are indicated in Table 20-3.

20.5.10 A Framework CEMP (EN070009/APP/5.12) has been prepared to accompany the ES submitted with the DCO Application. This sets out how construction activities will be managed and controlled in compliance with accredited health and safety and environmental management systems, relevant legislation and environmental permits, consents and licences.

20.5.11 (A) Final CEMP(s) will be prepared by the EPC Contractor(s) in accordance with the Framework CEMP prior to construction. The submission, approval, and implementation of the Final CEMP(s) will be secured by a Requirement of the Draft DCO (EN070009/APP/4.1).

Commissioning

20.5.12 Commissioning of the site will be undertaken in accordance with a Commissioning Plan. It is expected that the Commissioning Plan will be a pre-operational condition of the Environmental Permit, for the Environment Agency, and it will also be supplied to the HSE for approval as part of the COMAH Pre-Construction Notification process. The Applicant has also begun engagement with the Environment Agency under the enhanced pre-application scheme and is finalising an application for an Environmental Permit anticipated to be submitted in 2024.

Operation

20.5.13 The engineering design of the Proposed Development will incorporate a number of philosophies with regard to process safety and safeguarding, isolation, emergency shutdown and depressurisation. The layout of the Main Site will give due consideration to Inherently Safer Design (ISD) principles with respect to both on-site and off-site receptors.

20.5.14 ISD principles applied in the current plant design include:

- Consideration of separation distances between process areas, crosswind locations in order to minimise the escalation of any MA&D event; and

- Consideration of the size of the hydrogen storage in conjunction with pipeline sizing. The pipeline size was increased to 24" to reduce the hydrogen storage capacity to 5 tonnes.

20.5.15 During the Proposed Development design stages, the future operational risks will be managed via a number of studies such as Site QRA, preliminary Consequence Modelling, HAZID studies, FHA and EHA, and HAZOP studies. These studies have been, and will continue to be, carried out for the Proposed Development during the ongoing design process. This is a standard approach for the systematic identification of hazards and the development of barriers and other risk mitigation measures for preventing, or otherwise minimising, hazardous scenarios to ALARP through appropriate design during the Front-End Engineering Design (FEED) and the subsequent detailed design stages.

20.5.16 The Proposed Development will be operated in line with appropriate standards, whilst the operator will implement and maintain an Environment Management System (EMS) which will be attested to International Standards Organisation (ISO) 14001 (International Organization for Standardisation, 2015). The EMS will outline the requirements and procedures needed to ensure that the Proposed Development Site is operating to the appropriate standard.

20.5.17 The Hydrogen Production Facility will require an Environmental Permit under the Environmental Permitting (England and Wales) Regulations 2016 (HM Government, 2016c) to protect the environment. The Environmental Permit regime places a number of stipulations and requirements to be fulfilled to the satisfaction of the regulators, including the use of appropriate control and monitoring procedures, risk assessments, management systems and control measures; to minimise the risk of accidents occurring and to minimise the effects of any such accidents on off-site receptors as well as the operational workforce. The permit requires the approach to managing accidents and emergencies to be in accordance with the use of Best Available Techniques (BAT). The Applicant will ensure that BAT requirements and conditions are imposed, to ensure that the design of the Proposed Development will be suitable for the Environmental Permit application. The Applicant has also begun engagement with the Environment Agency under the enhanced pre-application scheme and is finalising an application for an Environmental Permit anticipated to be submitted in 2024.

20.5.18 Due to the expected inventory of dangerous substances, which will be present on-site, the Proposed Development is anticipated to be an Upper Tier COMAH installation. The COMAH status will be reviewed as the design develops. COMAH notifications are required to be submitted to the Competent Authority (CA), which comprises the HSE and the EA, three to six months prior to the start of the construction phase. A flowchart summarising the process of the COMAH application process is presented in Appendix 20C (ES Volume III, EN070009/APP/6.4), and the documents referred to in that flowchart are referenced in the assessment set out below. Major accident assessments and studies will be prepared over the course of the design of the Proposed Development, and a Safety Case Report and a Major Accident Prevention Plan (MAPP) will be prepared to support the COMAH

notification. The COMAH Safety Case Report will include appropriate risk assessments in line with the HSE Safety Report Assessment Manual (SRAM) criteria, which is used to demonstrate that the application is Duly Made to the regulator. The Safety Case Report will also include appropriate risk assessments in relation to Major Accidents to The Environment (MATTEs).

20.5.19 Other consents that will be required, which are relevant to the design and impact avoidance/minimisation with respect to MA&Ds include, but are not limited to the following:

- A Hazardous Substances Consent will be obtained from the LPA (RCBC) who would consult with the HSE in compliance with The Planning (Hazardous Substances) Regulations (HM Government, 2015d). A flowchart summarising the process of the Hazardous Substances Consent application process is presented in Appendix 20B (ES Volume III, EN070009/APP/6.4);
- A Gas Safety Case will be submitted to the HSE prior to the start of construction of the Natural Gas Corridor in compliance with The Gas Safety (Management) Regulations (HM Government, 1996b); and
- Pipeline Safety Notifications will be submitted to the HSE a minimum of six months prior to the start of construction and 14 days before first use of the Connection Corridors in compliance with the PSR (HM Government, 1996a).

20.5.20 Specific operational mitigation measures are indicated in Table 20-5.

Decommissioning

20.5.21 A Decommissioning Environmental Management Plan (DEMP) would be produced pursuant to a DCO Requirement of the Draft DCO (EN070009/APP/4.1). The DEMP would consider, in detail, all potential environmental risks on the Proposed Development Site and contain guidance on how risks can be removed or mitigated. This will include details of how MA&Ds should be managed during decommissioning and demolition. The DEMP is secured by a Requirement of the Draft DCO (EN070009/APP/4.1). The DEMP would also include an outline programme of works.

20.5.22 At the end of its design life, decommissioning of the Proposed Development would see the removal of all above ground equipment down to ground level to enable future re-use of the land. It is assumed that all underground infrastructure would remain in-situ; however, all connection and access points would be sealed or grouted to ensure isolation and disconnection.

20.5.23 All decommissioning and demolition activities will be controlled as applicable in relation to The Dangerous Substances and Explosive Atmospheres Regulations (SI 2002 No. 2776) (HM Government, 2002b); The Control of Substances Hazardous to Health Regulations (SI 2002 No. 2677) (HM Government, 2002a) and The Construction (Design and Management) (CDM) Regulations (SI 2015 No. 51) (HM Government, 2015a); or any equivalent legislation that has come into force by the time the Proposed Development reaches its decommissioning stage.

20.5.24 The use of suitably experienced contractors, risk assessments, working method statements, operating procedures and personnel training will minimise the risk of accidental scenarios occurring during Proposed Development decommissioning. The demolition activities will be considered as a HSE notifiable project under The CDM Regulations 2015 (HM Government, 2015a). An example of a risk scenario during decommissioning is the management of "dead legs" of liquid in pipework, where the pipework could not be drained or cleaned, and the risk of spillage exists during pipework removal.

20.5.25 Specific decommissioning mitigation measures are indicated in Table 20-6.

20.6 Impacts and Likely Significant Effects

20.6.1 This section introduces the hazardous substances that are present at each stage of the Proposed Development, the potential risks that they pose and sets out the shortlisted MA&D scenarios.

Construction

Hazardous Substances to be used on Site

20.6.2 Diesel would be used on the Main Site during construction for fuel for vehicles, plant and, if required, mobile power generators. Diesel is classified as flammable and harmful to the aquatic environment. A release, which if ignited, could cause harm to people via exposure to thermal radiation in a fire. A release which is unignited can cause harm to people if inhaled, ingested or exposed to skin. A release of diesel to the environment, such as the River Tees, could result in harm to flora and fauna. The quantities of diesel present on the Main Site will be kept to a minimum, relatively minor level; to reduce the inherent severity of any risk of loss of containment. Procedurally, vehicles will be stationary with engines switched off and keys taken out of ignition (to prevent drive away) during filling. The bulk diesel storage tank will be located away from potential vehicular collisions and in an area where spills can be contained and recovered, and away from open drainage and open ground. Storage will have tank bunding (whether external or integral double skinned tanks), drip trays and tank level indication; with alarms where appropriate. The refuelling operations will take place over an impermeable surface, with the capability of capturing any spillages. Spill kits will be available for minor spill cleanup. Surface water drainage systems will be protected by spill covers or the use of suitable interceptor systems e.g., oil / water separator (subject to site design). Details of these matters will be set out in the Final CEMP(s).

20.6.3 Liquid concrete could be present in significant quantities during construction of the Proposed Development. It may be produced on the Main Site from cement powder, which is classified as an irritant to skin as contact can cause alkali burns. This substance can harm the eyes and the respiratory system via inhalation of dust. If cement or wet concrete enters drains or watercourses, there is the potential for it to cause harm to the aquatic environment by increasing the pH of the water. Temporary protective drain covers will be available for use at drains at risk in the locality of cement civil works. The surface water drainage system (subject to detailed design) is likely to have silt traps, which could capture small spillages.

Consideration will be given to monitoring rainwater pH during construction, and this will be confirmed in the Final Water Management Plan.

20.6.4 Acetylene, contained in compressed gas cylinders, may be present on site to carry out welding and trimming rebar during construction.

20.6.5 Smaller quantities of other potentially dangerous and / or hazardous materials may also be present on-site. These substances will not be expected to initiate or exacerbate MA&Ds but could be harmful in the event of a major accident that causes loss of containment.

20.6.6 There is the potential for ground contamination to exist within the Proposed Development Site as a legacy of its historic industrial nature. This could include substances which, if released to the environment, have the potential to cause harm.

Review of Activities

20.6.7 STDC are currently completing site clearance in central and southern areas of Main Site and impacts from this activity have not been included in this assessment. It is currently anticipated that STDC will complete remediation works required to create a suitable development area before the Applicant's commencement of the construction of the Proposed Development. The scope of STDCs remedial works will include mitigation of any identified risks to controlled waters and / or human health, with STDC to obtain all necessary consents and permits for the works.

20.6.8 In particular, the Applicant understands that STDC are to submit reserved matters approval applications for remedial works in central and southern areas of Main Site, under their existing outline planning approval for the Foundry site. It is currently anticipated that STDC would submit additional reserved matters approval, or planning applications, for further site clearance and remedial works, if the Applicant proposed construction in the north-west or north-east of Main Site for Phase 2 of the Proposed Development, in accordance with STDCs stated aim to redevelop and regenerate the larger Teesworks site. If, for any reason, STDC do not bring forward these reserved matters planning applications, or the remediation works are not undertaken in the timescales required, the Applicant would undertake remedial activities required for the development, and this has been assumed as a worst case assumption for the purposes of the ES. As such, references to start of construction in this ES should be considered to include such works.

20.6.9 Prior to the design and construction of the Proposed Development on the Main Site, confirmatory GI will be undertaken which will include assessing whether and to what extent contamination is present at the Main Site. The GI will be carried out in accordance with appropriate specifications and standards as laid out in Chapter 10: Geology, Hydrogeology and Contaminated Land (ES Volume I, EN070009/APP/6.2).

20.6.10 The Applicant will also review the scope of any remedial measures considered to be required following the completion of (referred to herein as 'Additional'), or in place of, the remedial works undertaken by STDC. Additional remedial measures before or during construction, could include measures such as a discovery strategy for unexpected contamination, and will be reviewed following review of both GI and relevant remediation specifications and verification reports from STDC. The process

for securing the delivery of these remedial measures including the Additional measures is secured by DCO Requirement.

20.6.11 Two phases of construction would then commence as outlined in Chapter 5: Construction Programme and Management (ES Volume I, EN070009/APP/6.2).

20.6.12 Phase 1 will consist of a single hydrogen production unit, on-site hydrogen storage and supporting utilities. Phase 2 will consist of a further hydrogen production unit and supporting utilities constructed thereafter. The majority of the Hydrogen Pipeline Corridors to facilitate transportation of hydrogen to offtakers will be constructed and completed in Phase 1 except for specified short additional spurs within the Hydrogen Pipeline Corridors, to be completed in Phase 2.

20.6.13 Permitted preliminary works for Phase 1 are expected to start in the third quarter (Q3) of 2025 (subject to the granting of the DCO), with the main civils works beginning in Q4 of 2025. Construction of Phase 1 is anticipated to last approximately 32 to 36 months and is expected to be complete in Q2 2028. The early enabling works for Phase 2 may overlap with commissioning for Phase 1 in Q2 2028. It is expected that the main civils works for Phase 2 will begin in Q3 of 2028 (after Phase 1 is commissioned) and be completed by the end of 2030. It is proposed that there will be no overlap between the main construction phases of Phases 1 and 2.

20.6.14 If the duration of the construction of Phase 2 is extended (when compared to that for Phase 1 due to potential overlaps in Phase 1's operation and Phase 2's construction activities), ongoing management of the simultaneous operation and construction activities and minimisation of the associated risks and impacts would be required. The Applicant would be in control of both and would be able to implement any management required directly and through its respective contractors operating Phase 1 and constructing Phase 2.

20.6.15 Phase 2 would be constructed adjacent to Phase 1, at a suitable safe distance that would be defined by consequence modelling of MAH scenarios between the phased assets. The modelling, safe distance and plant design will need to demonstrate that risks are ALARP, as both phases will be subject to COMAH legislation requirements. In addition, any mitigation measures which would be needed, to reduce the risk of domino events between other neighbouring facilities (HyGreen and NZT) would be defined as part of the COMAH Safety Case

Assessment of Shortlisted Major Accidents and Disasters Scenarios

20.6.16 Considering the baseline conditions, the hazardous substances present and the identified likely construction activities, a long list of MA&D Risk Events has been prepared. This unscreened long list can be found in Appendix 20A: Long List of MA&Ds Risk Events (ES Volume III, EN070009/APP/6.4), along with justification for the shortlisting of the following MA&D Risk Events:

- ground instability;
- structural collapse / accidental impact;
- utility (pipeline or electrical cable) strike / unexploded ordnance (UXO) impact;

- release of ground contamination;
- domino effect (pipelines); and
- road traffic accident.

20.6.17 Credible Scenarios for Construction Risk Events are summarised in Table 20-3. The Credible Scenarios associated with a pipeline rupture are assessed as Tolerable (if ALARP) given that at this stage in the assessment process the mitigation measures considered in this assessment are primarily the standard construction protocols. Embedded mitigation measures will be confirmed as the detailed design of the Proposed Development progresses and a QRA or similar detailed safety studies are produced to assess the level of residual risk. The Proposed Development design and construction is ratified as meeting ALARP through achieving COMAH authorisation and Pipeline Safety Regulations approval from the HSE. The EPC Contractor(s) will define the safe working practices under the CDM Regulations, to the satisfaction of the HSE. The level of risk presented by all other Credible Scenarios has been assessed based on the information currently available as Tolerable, taking into consideration the proposed mitigation measures.

20.6.18 Scenarios associated with an accidental release of diesel or liquid concrete were not considered to reach the threshold for a major accident and have not been included within a more detailed assessment.

Table 20-3: Credible Scenarios Related to the Construction of the Proposed Development

SCENARIO REFERENCE	CREDIBLE SCENARIO	POTENTIAL IMPACTS	EMBEDDED MITIGATION	TOLERABILITY
C-1	Ground Instability Construction activity results in disturbance of manmade or naturally occurring ground related hazards. Vibration causes ground instability / collapse / settlement.	Localised collapse and subsidence of ground at the surface / surface settlement could lead to uncontrolled movement affecting objects /people / materials / plant / equipment which could cause harm to persons on-site and /or lead to secondary impacts e.g., damage to utilities leading to explosion.	A GI, with appropriate testing, according to appropriate specifications and standards and pursuant to DCO Requirement, will be carried out, to understand the potential risks and inform the construction methods to be used. To reduce risks associated with ground instability, there will be the use of industry standard construction methods / design features appropriate to the context of the Proposed Development.	Tolerable (Not Significant)
C-2	Structural Collapse / Accidental Impact Construction activity results in damage to structures or impact with workers.	Collapse of new and existing buildings, structures and excavations via accidental impact with vehicles or via other failure mechanisms. Could cause harm to persons on-site.	Thorough structural engineering design of new structures, assessments of existing structures and temporary structures such as excavations will be in accordance with industry codes and standards. (A) Final CEMP(s) will be in place to control potential impacts of construction works. (A) Final Construction Traffic Management Plan(s) (CTMP) will also be in place after being produced by the EPC Contractor(s) based on the Framework CTMP (EN070009/APP/5.16).	Tolerable (Not Significant)
C-3	Utility / pipeline / UXO Strike	Impact with gas pipeline or UXO, potential risk of fire / explosion and release of	Consultation and regular discussions with appropriate stakeholders such as National Grid Gas Transmission, the operator of the Central Area Transmission System	Tolerable – if ALARP (Not Significant)

SCENARIO REFERENCE	CREDIBLE SCENARIO	POTENTIAL IMPACTS	EMBEDDED MITIGATION	TOLERABILITY
	Construction activity, such as excavation, accidentally impacts underground gas pipeline or UXO. Alternatively, where above ground pipelines are routed alongside existing Major Hazard Pipelines in existing infrastructure a construction accident could also result in a pipeline rupture.	harmful gas leading to harm to person(s) on-site and member(s) of public. Risk of fire /explosion causes damage to environmental receptor or structural damage to buildings and / or infrastructure. Firewater run-off containing contaminants could contaminate groundwater and / or land or sea habitats including the Teesmouth and Cleveland Coast Ramsar Site, SPA and SSSI.	(CATS) Pipeline, other asset owners and the HSE will be undertaken to manage interfaces and define appropriate control measures when working close to other stakeholders live pipelines. The Application is accompanied by a Pipelines Statement (EN070009/APP/5.5). Possible control measures could include, for example, GPR surveys and magnetometer surveys of site and positive ID of all pipelines prior to construction, in accordance with PAS 120, and will be determined by the Principal Contractor. A Final CEMP(s) will be in place to control potential environmental impacts of construction works, which will define control measures and procedures associated with excavations and avoidance of underground strikes. A desk top study on the risk of a UXO strike is to be conducted pre construction. If the risk level is unacceptable, based on the available information, then appropriate testing is to be undertaken, i.e., magnetometer scanning for UXO. Control measures will be implemented to prevent fires and procedures will be prepared and implemented to respond to fires, in the event that they were to arise.	

SCENARIO REFERENCE	CREDIBLE SCENARIO	POTENTIAL IMPACTS	EMBEDDED MITIGATION	TOLERABILITY
			Firewater containment provisions will be defined in the Final CEMP(s). Appropriate anti-strike protection (anti-collision guards) will be implemented, where identified, to protect existing and new above ground pipework.	
C-4	Release of existing ground contamination Accidental release of pollutants (from existing contaminated land) into groundwater / surface water due to construction activities	Contamination of groundwater. Loss of abstraction water supply. Contamination of land or sea habitats including the Teesmouth and Cleveland Coast Ramsar Site, SPA and SSSI, and impacts on dependent species leading to irreversible damage.	A GI including soils testing is to be carried out to identify the presence of areas of ground onsite with the potential contain contaminants, pursuant to DCO Requirement. Where remedial measures are required, based on the results of the GI, these could include the placement of clean cover, soil treatment, soil stabilisation and / or removal of localised hotspots of identified contamination as described in Chapter 10: Geology, Hydrogeology and Contaminated Land (ES Volume I, EN070009/APP/6.2). Where contaminated land material is determined to be not acceptable for re-use, is not treatable economically or is surplus to requirement will be removed as part of the remediation works and will be disposed of as hazardous waste as described in Chapter 21: Materials and Waste (ES Volume I, EN070009/APP/6.2).	Tolerable (Not Significant)

SCENARIO REFERENCE	CREDIBLE SCENARIO	POTENTIAL IMPACTS	EMBEDDED MITIGATION	TOLERABILITY
			The remediation works will be designed with appropriate mitigation measures adopted to control potential pathway creation during construction works that could result in the migration of contamination to groundwater and/or surface water. If required, containment/sheet piling and/or localised pumping will be adopted to control the presence and movement groundwater and mitigate against any migration and/or release of substances. A Final CEMP(s) will be in place to control the potential environmental impacts of construction works. If previously unidentified contamination is encountered during the construction of the Proposed Development an appropriate risk assessment will be undertaken, including sampling and testing if required and based on the laboratory and site data a quantitative risk assessment undertaken. Any significant contaminant linkages identified will be addressed through remedial measures which will be agreed with the LPAs and in consultation with the EA where risks to controlled waters are identified, before the remedial mitigation measures are undertaken, unless agreed otherwise with the regulators. The contamination assessment will be undertaken in accordance with, but not exclusively, Land	

SCENARIO REFERENCE	CREDIBLE SCENARIO	POTENTIAL IMPACTS	EMBEDDED MITIGATION	TOLERABILITY
			Contamination: Risk Management (EA, 2023) and CIRIA C552 – Contamination Land Risk Assessment, A Guide to Good Practice. The required remedial measures will be adopted as part of the mitigation works for the Proposed Development Site. Protective measures related to leaks and spills are presented in Chapter 9: Surface Water, Flood Risk and Water Resources (ES Volume I, EN070009/APP/6.2).	
C-5	Domino Effects/Explosion An event on the construction site impacts and escalates at another hazardous (COMAH) site.	Risk of escalation of fire/explosion to nearby COMAH sites, due to an explosion or fire on the construction site or affecting a rupture of Major Hazard Pipelines during construction and operation.	As part of the COMAH application, a COMAH Safety Report will be developed and submitted to the Competent Authority 3 to 6 months before commencement of construction. As an Upper Tier COMAH site, the Safety Report will consider major accident risks, controls and mitigation measures and will include the development of a Major Accident Prevention Policy (MAPP). The MAPP will include information about the Emergency Plan for the site, which will in turn be used by the LPA RCBC in developing / refining their off-site emergency plans. In developing the MAPP for the site, consultation with appropriate stakeholders such as operators of Major Hazard Pipelines and COMAH establishments identified as having the potential for a domino effect (domino sites) will be undertaken to manage interfaces and define appropriate control measures.	Tolerable - if ALARP (Not Significant)

SCENARIO REFERENCE	CREDIBLE SCENARIO	POTENTIAL IMPACTS	EMBEDDED MITIGATION	TOLERABILITY
			The Identification of potential domino effects and management of risks to ALARP will be considered as part of the COMAH process (noting that each of the potential domino developments would also have gone through this process).	
C-6	Accidental Vehicle Impact Construction equipment and vehicles could collide with workers on-site.	A collision between construction vehicles and workers could cause harm to persons on-site. Should vehicles be carrying construction materials such as diesel or concrete these may spill into the local area although the quantities of material will be limited such that significant environmental effects are not expected.	(A) Final CEMP(s) will be in place to control potential impacts of construction works. (A) Final CTMP(s) will also be in place.	Tolerable (Not Significant)
C-7	Vandalism A malicious destructive act onsite whereby material loss of containment could occur, resulting in fire/explosions	Harm to members of the public off site from fire/explosions; and/ or irreversible damage to environmental receptors (listed building, ecological site, watercourse etc.).	Appropriate security measures will be installed at the construction site, including CCTV, site security and fencing to prevent trespassers and mitigate this risk to ALARP as per the Framework CEMP (EN070009/APP/5.12). The final security measures will be set out in the Final CEMP(s) to be produced by the EPC Contractor(s).	Tolerable (Not Significant)

SCENARIO REFERENCE	CREDIBLE SCENARIO	POTENTIAL IMPACTS	EMBEDDED MITIGATION	TOLERABILITY
			During construction, on-site chemicals inventory is limited (diesel etc.) and thus the severity of a potential incident would be limited.	
C-8	Extreme weather Storms, wind, rain, snow, ice, flooding impacting the construction phase of the development. Debris leaving the site (wind) or plant / equipment destabilised. Loss of containment of site chemicals	Harm to onsite workers. Irreversible damage to environmental receptor (listed building, ecological site, watercourse etc.). Worsened extreme weather impact leads to harm to members of public.	Extreme weather working practices and procedures will be in place and with worsening weather conditions, construction activities will be stopped, to ensure safety to the workforce / members of the public. Protection from adverse weather (working outdoors) is required as part of the CDM Regulations. Suitable sheltering / housing will be provided. The construction site will be kept, as far as practicable, free from loose debris that can be blown offsite in adverse weather.	Tolerable (Not Significant)
C-9	Aircraft/drone impact Impact on site infrastructure and/or site personnel from above aircraft / drones.	Aircraft incident results in harm to site personnel and / or member of public and / or irreversible damage to environmental receptor (listed building, ecological site, watercourse etc.).	The Proposed Development is located in an area which does not have a high density of air traffic. The Final CEMP(s) will require that consultation be undertaken with relevant airports / Civil Aviation Authority (CAA) to manage interfaces and define appropriate control measures, including the need for aviation warning lighting to be fitted to tall construction machinery.	Tolerable (Not Significant)

Commissioning

Hazardous Substances to be Used on Site

20.6.19 Commissioning of the site will be undertaken in accordance with a Commissioning Plan. It is expected that the Commissioning Plan will be a pre-operational condition of the Environmental Permit, for the Environment Agency, and it will also be supplied to the HSE for approval as part of the COMAH Pre-Construction Notification process. The Applicant has also begun engagement with the Environment Agency under the enhanced pre-application scheme and is finalising an application for an Environmental Permit anticipated to be submitted in 2024.

20.6.20 The Commissioning Plan will cover the Hazardous Substances to be used onsite, most of which will be those to be used in operation of the development. There may be some chemicals introduced as a "one off" application, e.g., degreasing chemicals for plant and equipment. The commissioning plan will address the hazards and risks of hazardous substances during the commissioning phase.

Operation

Hazardous Substances to be Used on Site

20.6.21 The key substances which will be present within the Proposed Development Site during operation are summarised in Table 20-4, along with their properties and arrangements for storage and use.

Table 20-4: Hazardous Substances Likely to be Present during the Operation of the Proposed Development (Phases 1 and 2)

SUBSTANCE	USE	TRANSPORTATION / STORAGE	HAZARDS	POTENTIAL EFFECTS
Process Gases				
Hydrogen (H_2)	The production of H_2 from natural gas is the purpose of the Proposed Development.	H_2 will be exported off-site using a gaseous phase pipeline network at a maximum operational rate of around 45,000 kg/hr. H_2 will be stored at the Main Site in an area to the north-west of the main plant area. The storage layout is subject to adjustment following safety engineering consequence modelling. The hydrogen storage will either have a capacity of 5 tonnes usable volume (with a 10.3 tonnes total site inventory) for 100 bar storage pressure, or up to 6.4 tonnes (with 250 bar storage pressure). Multiple cylinder assemblies are proposed.	Extremely flammable. A qualifying substance under COMAH (a named dangerous substance in the regulations).	Fire and / or explosion. Leading to onsite harm to workforce.
Natural gas (comprising a mixture of hydrocarbons;	Raw material for the manufacture of H_2.	Natural gas will be imported via a pipeline, with a diameter expected to be 24", and will be connected to the UK high pressure gas supply	Extremely flammable. A qualifying substance under COMAH (a named dangerous substance in the regulations).	Fire and / or explosion. Leading to onsite harm to workforce.

SUBSTANCE	USE	TRANSPORTATION / STORAGE	HAZARDS	POTENTIAL EFFECTS
primarily methane (CH_4))		network. Storage of natural gas onsite is not proposed. The expected supply rate of natural gas is around 120,000 kg/h.		
Syngas (Synthesis Gas) comprising a mixture of H_2, carbon monoxide (CO), and carbon dioxide CO_2	Produced in an intermediate process stage.	Syngas is a process intermediate and as such transportation and storage of syngas on-site is not proposed.	Toxic and flammable. Contains H_2, a qualifying substance under COMAH (a named dangerous substance in the regulations). Contains CO, a qualifying substance under COMAH (a health hazard dangerous substance in the regulations).	Fire and / or explosion. Harm to people via inhalation if exposed to gas.
Oxygen (O_2) – gaseous	Used in the production process.	O_2 may be produced on-site in an Air Separation Unit (ASU) or may be supplied by pipeline at an expected supply rate of around 100,000 kg/h. On-site storage of gaseous O_2 is not proposed.	Oxidant. A qualifying substance under COMAH (a named dangerous substance in the regulations).	May intensify fire.
Oxygen (O_2) - liquid Note: liquid oxygen would only be present in the event of the site having an	Air Separation Unit	Liquid oxygen storage up to 600 te per phase (1,200 te in total). If the ASU is not adopted, then gaseous oxygen would be supplied to the site and this hazardous substance would not be present.	Boiling Liquid Expanding Vapour Explosion (BLEVE) due to overpressure/overfill of storage vessel from blocked PSV outlet leading to rupture of storage vessels of liquid oxygen.	BLEVE (based on oxygen storage vessel) leading to flash fires / explosion / detonation. Leading to onsite harm to workforce. To be mitigated through plant design (e.g. location of control

SUBSTANCE	USE	TRANSPORTATION / STORAGE	HAZARDS	POTENTIAL EFFECTS
ASU (Air Separation Unit).			A qualifying substance under COMAH (a named dangerous substance in the regulations).	room and maintenance workshop).
Nitrogen (N_2) – gaseous	Used in the production process.	Nitrogen will be supplied by pipeline at an expected supply rate of 2,000 Nm^3/h.	Asphyxiant. Not a qualifying substance under COMAH.	Harm to people via inhalation if exposed to gas in high concentrations (where oxygen in air is displaced/reduced).
Nitrogen (N_2) – liquid Note: liquid oxygen would only be present in the event of the site having an ASU (Air Separation Unit).	Vapourised to gas and used in the production process	Vapourised to gas and used in the production process at up to 2,000 Nm^3/h gas	Cryogenic liquid – freezing hazard. Asphyxiant as gas. Not a qualifying substance under COMAH.	Cryogenic liquid – freezing / frostbite hazard. Harm to people via inhalation (as gas) if exposed to gas in high concentrations (where oxygen in air is displaced/reduced).
Carbon dioxide (CO_2) - gaseous	By-product.	CO_2 will be compressed as a gas and exported off-site using a pipeline network at a maximum rate of around 324,000 kg/hr. On-site storage of gaseous CO_2 is not proposed.	Asphyxiant. Not a qualifying substance under COMAH.	Harm to people via inhalation if exposed to gas (where oxygen in air is displaced/reduced).
Process Materials				
Hydrogenation catalyst (solid)	Process catalyst for natural gas pre-treatment	Hydrogenation catalyst will be imported by road tanker. The installed volume is expected to be	Toxicity to be confirmed pending selection of catalyst.	To be confirmed when catalyst confirmed.

SUBSTANCE	USE	TRANSPORTATION / STORAGE	HAZARDS	POTENTIAL EFFECTS
		around 50 m^3 (to be confirmed after FEED and definition of catalyst).		
Sulphur removal catalyst (solid) and ultra purification sulphur removal catalyst (solid) (Katalco 32-4 and 79-1 or equivalent)	Process catalysts for natural gas pre-treatment. Sulphur species removal	Sulphur removal catalysts will be imported by road tanker. The installed volume is expected to be around 124 m^3. Two catalyst beds used per single vessel – the bulk catalyst and then the ultra purification catalyst.	Substances may cause damage to human organs (prolonged exposure) and / or may cause cancer through inhalation. Substances are very toxic to aquatic life (acute or short-term effects and chronic or long-term effects). Qualifying substances under COMAH (as both a health hazard and also an environmental hazard dangerous substance in the regulations).	Harm to the environment if released to ground / water / groundwater. Harm to people in case of release and inhalation (dust).
Pre-reforming catalyst (Katalco 23-4HQ or equivalent)	Process catalyst to start reforming process	Pre-reforming catalyst will be imported by road tanker. The installed volume is expected to be 30.6 m^3.	Substance causes damage to human organs (prolonged exposure) and / or may cause cancer through inhalation. Substance is harmful to aquatic life (chronic or long-term effects). Qualifying substance under COMAH (as a health hazard	Harm to the environment if released to ground / water / groundwater. Harm to people in case of release and inhalation (dust).

SUBSTANCE	USE	TRANSPORTATION / STORAGE	HAZARDS	POTENTIAL EFFECTS
			dangerous substance in the regulations).	
Auto thermal reforming (ATR) catalyst (Katalco 28-4 or equivalent)	Process catalyst undertaking the bulk of the reforming process	ATR catalyst will be imported by road tanker.	Substance causes damage to human organs (prolonged exposure) and / or may cause cancer through inhalation. Substance may cause harm to aquatic life (chronic or long-term effects). Qualifying substance under COMAH (as a health hazard dangerous substance in the regulations).	Harm to the environment if released to ground / water / groundwater. Harm to people in case of release and inhalation (dust).
Selective Catalytic Reduction (SCR) Catalyst	Catalyst used for abating combustion plant emissions, i.e., NO_x reduction	SCR catalyst will be imported by road tanker. Catalyst will be charged to the process thermal heater system (around 24 m^3) and also to the auxiliary boiler (around 33 m^3) (to be confirmed after FEED and definition of catalyst).	Toxicity to be confirmed pending selection of catalyst.	To be confirmed when catalyst confirmed.
Aqueous ammonia (NH_3)	Used within SCR abatement system to reduce NO_x emissions from combustion equipment	NH_3 will be imported by road tanker and stored in a chemical storage facility on-site. The initial fill is expected to be 20 m^3 with an annual consumption of around 630 m^3 (for Phase 1). The values would	Very toxic to aquatic life. Harmful if swallowed. Causes skin burns and eye damage.	Harm to the environment if released to ground / water / groundwater. Harm to people via inhalation if exposed to vapour or in contact with skin or eyes.

SUBSTANCE	USE	TRANSPORTATION / STORAGE	HAZARDS	POTENTIAL EFFECTS
		double with the introduction of Phase 2.	May cause respiratory irritation. A qualifying substance under COMAH (as an environmental hazard dangerous substance in the regulations).	
Isothermal shift catalyst (Katalco 83-5 or equivalent)	Process catalyst for converting CO to CO_2	Isothermal shift catalyst will be imported by road tanker. The installed volume is expected to be around 112 m^3.	Material is very toxic to the aquatic environment with both acute (short-term) and chronic (long-lasting) effects. A qualifying substance under COMAH (as an environmental hazard dangerous substance in the regulations).	Harm to the environment if released to ground / water / groundwater.
Low temperature (LT) shift catalyst	Process catalyst for converting CO to CO_2	LT shift catalyst will be imported by road tanker. The installed volume is expected to be around 146.4172 m^3 (to be confirmed after FEED and definition of catalyst).	Toxicity to be confirmed pending selection of catalyst.	To be confirmed when catalyst confirmed.
High temperature shift catalyst (Katalco 71-2 or equivalent)	Process catalyst for converting CO to CO_2	Quantities unclear at this stage as it is unclear if HT shift is required (to be confirmed after FEED and definition of catalyst).	Toxicity to be confirmed pending selection of catalyst.	To be confirmed when catalyst confirmed.
Methanation catalyst	Process catalyst for H_2 purification (removal of	Quantities unclear at this stage to be confirmed as design progresses	Toxicity to be confirmed pending selection of catalyst.	To be confirmed when catalyst confirmed.

SUBSTANCE	USE	TRANSPORTATION / STORAGE	HAZARDS	POTENTIAL EFFECTS
	residual carbon oxides to methane)	(to be confirmed after FEED and definition of catalyst).		
Unsaturated alcohol amine	Used within carbon dioxide capture system.	Amine solution will be imported by road tanker and stored in a chemical storage facility on-site. The initial fill is expected to be approximately 380 m^3 (for Phase 1) with an annual consumption of scrub liquor of 3.1 m^3. Storage for both Phases 1 and 2 will be around 700 m^3.	Causes serious eye irritation. Not a qualifying substance under COMAH.	Minor harm to people if released.
Fuels				
Diesel	Fuel for backup generators, firewater pumps etc.	Diesel will be imported by road tanker and stored on-site at various locations, near point of use.	Flammable. Toxic to the aquatic environment with long lasting effects (chronic). A qualifying substance under COMAH (a named dangerous substance in the regulations).	Harm to people on-site in the event of release and / or fire. Harm to environment if released.
Utilities and Services Chemicals				
Sodium hypochlorite (NaOCl) 12% solution	Within the cooling water package as a biocide	Sodium hypochlorite will be imported by road tanker and a limited quantity will be stored in a chemical storage facility on-site. The	Harmful if swallowed. Causes severe skin burns and eye damage.	Harm to the environment if released to ground / water /groundwater.

SUBSTANCE	USE	TRANSPORTATION / STORAGE	HAZARDS	POTENTIAL EFFECTS
		initial fill is expected to be 3.4 m^3 with an annual consumption of around 38 m^3 (Phase 1). Phase 2 will double these quantities i.e., 6.8 m^3 storage and 76 m^3/annum consumption	May cause respiratory irritation. Substance is very toxic to aquatic life (acute or short-term effects and chronic or long-term effects). A qualifying substance under COMAH (as an environmental hazard dangerous substance in the regulations).	Harm to people via inhalation, if exposed to vapour, or in contact with skin or eyes.
Bromine (Br)	Within the cooling water package as a biocide	Bromine will be imported by road tanker and a limited quantity will be stored in a chemical storage facility on-site. The initial fill is expected to be 0.2 m^3 with an annual consumption of 6.5 tonnes.	Fatal if inhaled. Causes severe skin burns and eye damage. Substance is very toxic to aquatic life (acute or short-term effects and chronic or long-term effects). A qualifying substance under COMAH (a named dangerous substance in the regulations).	Harm to the environment if released to ground / water / groundwater. Harm to people via inhalation, if exposed to vapour, or in contact with skin or eyes.
Sulphuric acid (H_2SO_4) 93% concentration	Within the cooling water package for pH correction	Sulphuric acid will be imported by road tanker and a limited quantity will be stored in a chemical storage facility on-site. The initial fill is expected to be 7.2 m^3 with an	Causes severe skin burns and eye damage. At high concentrations – fatal if inhaled.	Short term harm to the environment if released to ground / water / groundwater. Harm to people via inhalation if in contact with skin or eyes.

SUBSTANCE	USE	TRANSPORTATION / STORAGE	HAZARDS	POTENTIAL EFFECTS
		annual consumption of around 83 m^3.	Harmful to aquatic life (acute or short-term effects) Not a qualifying substance under COMAH.	
Carbohydrazide 1% solution	Within the Boiler Feed Water dosing package as an oxygen scavenger (limits corrosion)	Carbohydrazide will be imported by road tanker and a limited quantity will be stored in a chemical storage facility on-site. The initial fill is expected to be 2.0 m^3 with an annual consumption of around 7.9 m^3.	Harmful if swallowed. Causes skin irritation. May cause an allergic skin reaction. Toxic to aquatic life with long lasting effects. A qualifying substance under COMAH (as an environmental hazard dangerous substance in the regulations).	Harm to the environment if released to ground / water / groundwater. Harm to people in contact with skin.
Morpholine 20% solution	Within the Boiler Feed Water dosing package as a corrosion protection chemical	Morpholine will be imported by road tanker and a limited quantity will be stored in a chemical storage facility on-site. The initial fill is expected to be 2.0 m^3 with an annual consumption of 17.3 m^3.	Flammable liquid and vapour. Harmful if swallowed. Harmful in contact with skin. Causes severe skin burns and eye damage. Harmful if inhaled. Not a qualifying substance under COMAH.	Harm to people via inhalation or if in contact with skin or eyes.

20.6.22 Smaller quantities of other potentially dangerous and / or hazardous materials may also be present on-site. These substances will not be expected to initiate or exacerbate MA&Ds but could be harmful in the event of a major accident that causes loss of containment. For example, if hazardous substances were released during a fire event, due to the failure of storage vessels, which resulted in the hazardous substances being present in the firewater runoff. These smaller quantities will be managed under the COMAH regime through embedded practices such as risk assessments and Management of Change to ensure their use will not initiate or contribute to a MA&Ds.

Review of Activities

20.6.23 The technology used for the manufacture of H_2 from natural gas is well established and the equipment to be used will be designed and constructed to precise industry standards. This industry is subject to rigorous safety and environmental regulations, with operators of such facilities required to demonstrate integrity via the submission of Safety Case documentation to comply with regulations including COMAH Regulations and PSR. The Safety Case will provide all the necessary information to the Competent Authority (HSE and EA) that the Proposed Development has minimised the risks of operation to ALARP as required by COMAH.

20.6.24 Within the Hydrogen Production Facility, natural gas would be treated with heat and steam to break down the simple hydrocarbons, primarily to carbon oxides and H_2 (or synthesis gas – syngas). This crude syngas would then be reformed further using pure oxygen (O_2) and more steam over catalysts in an Auto Thermal Reformer (ATR) to produce a higher specification of syngas, with low levels of hydrocarbons. After cooling, the syngas would be reacted in water-gas shift reactors to convert the carbon oxides to predominantly CO_2, resulting in a H_2 and CO_2 gas mixture.

20.6.25 The CO_2 and H_2 are separated using an amine scrubbing solution, which removes the CO_2 from the H_2. The hydrogen is sent for further purification, i.e. methanation for CO/CO_2 impurity removal and drying for water removal (silica gel), before being ready for export. The CO_2 is desorbed from the amine scrubbing solution, which is recycled for use, and the CO_2 is dried (water removal) and ready for export.

20.6.26 The Pipeline Connection Corridors associated with the Proposed Development would contain:

- natural gas and other gases (N_2 and O_2) supplied to the Main Site;
- H_2 delivered to offtakers within the Teesside industrial area; and
- CO_2 which would be exported for storage.

Assessment of Shortlisted Major Accidents and Disasters Scenarios

20.6.27 Considering the baseline, the hazardous substances likely to be present, and the operational activities identified, a long list of MA&D Risk Events has been prepared. This long list can be found in Appendix 20A: Long List of MA&Ds Risk Events (ES Volume III, EN070009/APP/6.4), along with justification for the shortlisting of the following MA&D Risk Events:

- fire caused by loss of containment of flammable gas (H_2 or natural gas), with the potential for intensification due to presence of O_2;
- explosion caused by loss of containment of flammable gas (H_2 or natural gas);
- toxic gas release (depending on concentration for syngas);
- asphyxiant gas release (primarily CO_2);
- domino effect (from and to neighbouring industrial facilities);
- flooding (coastal, fluvial, pluvial and groundwater);
- accidental vehicle impact;
- nuclear incident;
- failure of electricity supply;
- extreme meteorological events; and
- aircraft / drone impact.

20.6.28 Credible Scenarios for these Risk Events are drawn up and assessed in Table 20-5. The Credible Scenarios associated with an accidental release of gas have been assessed as Tolerable - if ALARP, given that at this stage in the assessment process the mitigation measures considered in this assessment are primarily the standard engineering design controls typically included within industrial facilities such as the Proposed Development. Specific embedded mitigation measures will be confirmed as the detailed design of the Proposed Development progresses and a QRA or similar detailed safety study(s) are produced to assess the level of residual risk. The Proposed Development design and construction is ratified as meeting ALARP through achieving COMAH authorisation and Pipeline Safety Regulations approval from the HSE. The EPC Contractor(s) will define the safe working practices under the CDM Regulations, to the satisfaction of the HSE. Domino effect and flooding scenarios have also been assessed as Tolerable - if ALARP, based on the information currently available, recognising that the necessary mitigation measures and design of the Process as it develops will aim to meet the COMAH requirements of demonstrable ALARP.

Table 20-5: Credible Scenarios Related to the Operation of the Proposed Development

SCENARIO REFERENCE	CREDIBLE SCENARIO	POTENTIAL IMPACTS	EMBEDDED MITIGATION	TOLERABILITY
O-1	Fire and / or Explosion Natural Gas Fire due to loss of containment of natural gas (e.g., by mechanical failure or impact damage) from supply pipeline or process equipment. Explosion from ignition of escaped natural gas.	Fire and / or explosion could result in significant harm to people on-site. There is also the potential for harm to people and businesses off-site, such as radiant heat burns and impact injuries from explosions. The environmental impact of a major fire could affect the Teesmouth and Cleveland Coast Ramsar Site, SPA and SSSI, as a result of run-off of uncontained firewater. It is unlikely that radiant heat or smoke would have a significant impact on members of the public, considering the location of the Main Site. It is unlikely that this type of accident could impact listed	Design of the natural gas systems is to industry codes and standards and will include separation and segregation of pipework and equipment containing natural gas; inventory isolations and Integrated Control and Safety Systems (ICSS); and minimising operator complexity of operating the equipment. Locating occupied buildings away from hazardous zones where practicable as shown on the Works Plans (EN070009/APP/2.4); and designing occupied buildings within hazardous zones, such as the control room, to withstand a hazardous event and protect the people within for a specific period of time, usually one hour, Compliance with the Pressure Equipment (Safety) Regulations 2016 (HM Government, 2016a) and the PSR (HM Government, 1996a). Selection of pipeline routes away from sensitive receptors (where practicable), increased depth of cover in areas of higher risk, use of existing established pipe racks and the construction of safety systems to prevent pipeline damage, such as the installation of collision barriers. Pipeline safety systems and gas / liquid pressure regulation to be installed along with operational controls and monitoring. Leak / natural gas detection systems at the Proposed Development Site and in the vicinity of high hazard areas.	Tolerable - if ALARP (Not Significant)

SCENARIO REFERENCE	CREDIBLE SCENARIO	POTENTIAL IMPACTS	EMBEDDED MITIGATION	TOLERABILITY
		buildings or other heritage sites based on distance. Firewater run-off reaching areas of unmade ground could contain contaminants which would be potentially harmful to ground and groundwater.	Fire detection and fire protection systems will be installed on the Main Site, including passive and active fire suppression systems. The Proposed Development will be designed to contain firewater runoff in a retention basin and prevent material reaching unmade ground or other environmental receptors, please refer to Chapter 9 for further details (ES Volume I, EN070009/APP/6.2). Detailed emergency plans will be produced for the Proposed Development in accordance with all applicable regulations.	
O-2	Fire and / or Explosion Hydrogen Fire due to loss of containment of H_2 (e.g., by mechanical failure or impact damage) from storage tanks, Hydrogen Pipeline Corridor or process equipment.	Immediate ignition of H_2 gas would lead to a localised flash or jet fire, depending on gas volume and pressure. Delayed ignition could lead to an explosion and / or fire. Fire and / or explosion could result in significant harm to people on-site. There is also the potential for harm to people and businesses off-site, such as impact injuries from debris from explosions.	The H_2 storage location and layout will be subject to safety engineering consequence modelling and modifications made, should benefits be achieved in minimising risk. Design of the H_2 systems, including storage, is to industry codes and standards, including the selection of compatible materials for storage vessels, pipework and process equipment; separation and segregation of pipework and equipment containing H_2; inventory isolations and ICSS; and minimising operator complexity of operating equipment. Locating occupied buildings away from hazardous zones where practicable; and designing occupied buildings within hazardous zones, such as the control room, to withstand a hazardous event and protect the people within for a specific period of time, usually one hour.	Tolerable - if ALARP (Not Significant)

SCENARIO REFERENCE	CREDIBLE SCENARIO	POTENTIAL IMPACTS	EMBEDDED MITIGATION	TOLERABILITY
	Explosion following release of H_2.	The environmental impact of a major fire could affect the Teesmouth and Cleveland Coast Ramsar Site, SPA and SSSI, as a result of run-off of firewater. It is unlikely that radiant heat or smoke would have a significant impact on members of the public, considering the location of the site. It is unlikely that this type of accident could impact listed buildings or other heritage sites based on distance. Firewater run-off reaching areas of unmade ground could contain contaminants which would be potentially harmful to groundwater.	Compliance with the Pressure Equipment (Safety) Regulations 2016 (HM Government, 2016a) and the PSR (HM Government, 1996a). Selection of pipeline routes, away from sensitive receptors (where practicable), increased depth of cover in areas of higher risk, use of existing established pipe racks and corridors, and the construction of safety systems to prevent pipeline damage, such as the installation of collision barriers. Pipeline safety systems and gas pressure regulation to be installed along with operational controls and monitoring. Gas leak detection systems such as pressure monitoring instrumentation are to be installed at the Proposed Development Site and in the vicinity of high hazard areas. The details of the containment strategy for the hydrogen storage vessels are under consideration but these will be designed in accordance with industry codes and standards. Fire detection and fire protection systems will be installed on the Main Site, including passive and active fire suppression systems. The Proposed Development will be designed to contain firewater runoff in a retention basin and prevent material reaching unmade ground or other environmental receptors, please refer to Chapter 9 for further details (ES Volume I, EN070009/APP/6.2).	

SCENARIO REFERENCE	CREDIBLE SCENARIO	POTENTIAL IMPACTS	EMBEDDED MITIGATION	TOLERABILITY
			Detailed emergency plans will be produced for the Proposed Development in accordance with all applicable regulations. The Hydrogen Pipelines are being designed to IGEM/TD/1 Ed.6, including Supplement 2. ASME B31.12, which are the two most prominent Hydrogen Pipeline design codes. QRA are also being performed in line with HSE guidance and guidance from the aforementioned pipeline design codes. The pipeline system will be subject to a number of operational controls, including monitoring of key process parameters (pressure, temperature etc.) and automated shutdowns as necessary. The pipeline system will also be equipped with a leak detection system for as early as reasonably possible detection of any leaks. In addition to this, the pipeline system will have a prescribed Integrity Management Plan, which will include external Non-destructive Inspection (NDT), Public Right of Way (RoW) walkovers, Inline Inspection (ILI), Cathodic Protection testing etc. to detect any defects and anomalies. An Anomaly Management Process will be in place to: 1) assess the risk associated with any anomalies identified; 2) prepare remediation plans; and 3) implement remediation plans.	
O-3	Fire and / or Explosion Oxygen Exacerbation	Oxygen (O_2) is an oxidant and promotes rapid combustion of fuels and	At this juncture O_2 will either be supplied directly to the site, by pipeline as a gas, or a site-based Air Separation Unit (ASU) will generate liquid O_2 and liquid N_2 for use at the site. In the latter case there would also be liquid O_2 storage at the site.	Tolerable - if ALARP (Not Significant)

SCENARIO REFERENCE	CREDIBLE SCENARIO	POTENTIAL IMPACTS	EMBEDDED MITIGATION	TOLERABILITY
	Fire or exacerbation of fire due to loss of containment of oxygen (e.g., by mechanical failure or impact damage) from process equipment.	other organic materials in the event of ignition. An accidental release of O_2 could worsen a fire or cause an explosion in a fire scenario, and therefore worsen harm to people and the environment on and off-site, with the potential for fatal injuries.	ASU technology is well established and covered by industry codes and standards for design and safe operation. Similarly, O_2 pipeline design and use are also covered by well-established codes and standards. The design of the O_2 systems will be to the recognised industry codes and standards. O_2 storage and piping will be segregated from flammable materials on the Main Site, except for the import O_2 pipework, which may share pipeline corridors with pipelines containing hydrocarbons off site. Compliance with the Pressure Equipment (Safety) Regulations 2016 (HM Government, 2016a) and the PSR (HM Government, 1996a). Pipeline safety systems and gas / liquid pressure regulation to be installed along with operational controls and monitoring. Gas detection (excessive O_2 levels indicating enrichment) and pressure monitoring at the Proposed Development Site and in the vicinity of high hazard areas. Minimising the storage volumes of O_2. If the site adopts an ASU, then there will be liquid oxygen storage onsite (600te). Fire detection and fire protection systems will be installed on the Proposed Development Site, including passive and active fire suppression systems. Detailed emergency plans will be produced for the Proposed Development in accordance with all applicable regulations.	

SCENARIO REFERENCE	CREDIBLE SCENARIO	POTENTIAL IMPACTS	EMBEDDED MITIGATION	TOLERABILITY
			The inherent risks posed by the storage of liquid O_2 onsite are far greater than importing gaseous O_2 to the site. Consequently, mitigation measures will be required by the ASU option to meet the Tolerability – if ALARP criteria, beyond what would be in place for the import pipeline option. These measures will be required for the COMAH Safety Report and would be underpinned by supporting studies, such as Site QRA, preliminary Consequence Modelling, HAZID studies, FHA and EHA on the ASU option. Similar studies will be undertaken for the O_2 import pipeline option, to underpin the Tolerability – if ALARP criteria for this option.	
O-4	Toxic Gas Release Carbon monoxide (CO) Release of syngas containing CO (e.g., by mechanical failure or impact damage) from process equipment.	Release of syngas could result in harm to people on the Main Site. The impact of the release on people and the environment depends on the pressure, temperature and mass of material that is lost, however, there is the potential for harm from inhalation of toxic material. The potential for harm to members of the public off-	Design of the process systems to industry codes and standards. Pressure relief design to minimise the risk of mechanical failure and for safe venting or pressure lock-in of vessels to meet ALARP. Compliance with the Pressure Equipment (Safety) Regulations 2016 (HM Government, 2016a) and the PSR (HM Government, 1996a). Process monitoring, e.g. pressure and temperature, to allow controlled shutdown of operations. Gas detection (CO) at the Proposed Development Site and in the vicinity of high hazard areas. Detailed emergency plans will be produced for the Proposed Development in accordance with all applicable regulations.	Tolerable (Not Significant)

SCENARIO REFERENCE	CREDIBLE SCENARIO	POTENTIAL IMPACTS	EMBEDDED MITIGATION	TOLERABILITY
		site is low, due to the dispersal and dilution of a release over the distances involved to members of the public.		
O-5	Asphyxiant Gas Release Carbon Dioxide Release of CO_2 (e.g., by mechanical failure or impact damage) from export pipeline or process equipment.	Release of CO_2 could result in harm to people on-site. The impact of the release on people and the environment offsite depends on the pressure, temperature and mass of material that is lost, however, there is the potential for harm from asphyxiation as CO_2 is odourless and heavier than air. The potential for harm to members of the publice off-site is low due to the additional levels of containment that would have to be breached (i.e., pipeline integrity and trench fill) and the dispersal and dilution of a release over	Design of the process systems (CO_2 desorption system and gas compression) and piping to industry codes and standards. Compliance with the Pressure Equipment (Safety) Regulations 2016 (HM Government, 2016a) and the PSR (HM Government, 1996a). Pipeline safety systems and gas pressure regulation to be installed along with operational controls and monitoring. Oxygen depletion detection and pressure monitoring at the Proposed Development Site and in the vicinity of high hazard areas. Isolation valves in the pipeline system to minimise inventory release to the atmosphere in the event of pipeline failure. Detailed emergency plans will be produced for the Proposed Development in accordance with all applicable Regulations.	Tolerable (Not Significant)

SCENARIO REFERENCE	CREDIBLE SCENARIO	POTENTIAL IMPACTS	EMBEDDED MITIGATION	TOLERABILITY
		the distances involved to receptors.		
O-6	Domino Effects Domino effects from incidents at neighbouring facilities affecting the Proposed Development. Domino events initiated by the Proposed Development onto neighbouring facilities. This is in the context of SIMOPs (simultaneous operations).	Fire and / or explosion, toxic release, discharges to air and water from neighbouring facilities such that these impact on the Proposed Development triggering an event at the Proposed Development (i.e., further fire, explosion, or release of toxic or asphyxiant materials)	The Cleveland Emergency Planning Unit (CEPU) provides an emergency planning service to ensure that local authorities are prepared to respond to emergencies and to support the emergency services and the community. This organisation provides information to businesses and has many years of experience of working with COMAH sites and operators of major pipelines in Hartlepool, Middlesbrough, Stockton on Tees and Redcar and Cleveland. It is a requirement of COMAH that information is shared with the Local Authority for the development of their offsite Emergency Plans. As part of COMAH the Proposed Development will need to generate an on-site Emergency Plan that “dovetails” with the offsite Local Authority Emergency Plans. It is a requirement of the COMAH Regulations that neighbouring upper tier sites should review and update their Emergency Plans and Safety Reports to take into consideration potential impact of domino sites, which could potentially include this Proposed Development. This ensures that domino effects are assessed in detail by major accident installations. Domino effects are currently being considered and appropriate discussions will be held with affected sites as the COMAH Safety Report is prepared for approval by the HSE.	Tolerable – if ALARP (Not Significant)

SCENARIO REFERENCE	CREDIBLE SCENARIO	POTENTIAL IMPACTS	EMBEDDED MITIGATION	TOLERABILITY
			It is expected that existing safety precautions at neighbouring industrial sites will reduce the risk of domino effects occurring. Should any new developments take place near to the Proposed Development in the future these will need to be sited to prevent domino effects from occurring by following the HSE standard land use planning methodology (Planning Advice for Developments near Hazardous Installations (PADHI) assessment (HSE, 2023). The Proposed Development COMAH Safety Report will inform the zoning around the site in terms of PADHI, for locating new facilities.	
O-7	Flooding A tidal or river flood event or storm surge causes the Proposed Development to flood	The consequences of flooding the Main Site could include contamination with polluting substances, destabilising assets and compromising the integrity of plant and equipment. Floodwater reaching electrical equipment could trigger knock-on impacts to the electrical systems and present a risk to health due to electrocution.	A Preliminary Flood Risk Assessment (FRA) is appended to the ES (Appendix 9A: Flood Risk Assessment (ES Volume III, EN070009/APP/6.4)). The Main Site is located within Flood Zone 2 and some sections of the Connection Corridors are within Flood Zone 2 areas. The FRA will be used to inform the detailed design of the Proposed Development in terms of surface water management and the selection of finished floor levels. Mitigation measures are described in the FRA, which include identifying a suitable level of the development platform for the Main Site, building the Proposed Development using Flood Resistant and Resilient Design standards, a system for monitoring flood warnings, and the development of a Flood Emergency Response Plan.	Tolerable (Not Significant)

SCENARIO REFERENCE	CREDIBLE SCENARIO	POTENTIAL IMPACTS	EMBEDDED MITIGATION	TOLERABILITY
			The Main Site is on a raised platform to accommodate the flood zone and hence critical electrical equipment, such as transformers and switchgear, are located above the predicted flood levels. Flooding is considered by the HSE under COMAH as a potential "initiating event" to a Major Accident and consequently mitigation measures are required to be defined in the COMAH Safety Report, to demonstrate risks have been mitigated to ALARP. Flooding guidance is provided by the EA for sites regulated under the EPR (2016) (HM Government, 2016c).	
O-8	Accidental Vehicle Impact Vehicles delivering operational substances to site could be involved in a road traffic accident	A collision between vehicles and workers could cause harm to persons onsite. Should vehicles be carrying hazardous materials, such as diesel or aqueous ammonia, these may spill into the local area although the quantities of material will be limited such that significant environmental effects are not expected.	During operation, the primary raw materials are gaseous and are transported via pipeline. Other substances, including catalyst materials and other chemicals in smaller quantities such as diesel and aqueous ammonia will be transported by road. The delivery frequencies are low (catalysts deliveries are measured in years) and the volumes of consumable chemicals (ammonia solution) are relatively small. On public highways, losses in containment of these materials are controlled by regulations for the carriage of dangerous goods including an emergency response plan in case of release of material. The size of the operational workforce is relatively small and an Operational Traffic Management Plan is not proposed. Traffic plans will however be in place when major events occur onsite such as TAR (Planned Shutdowns or a plant	Tolerable (Not Significant)

SCENARIO REFERENCE	CREDIBLE SCENARIO	POTENTIAL IMPACTS	EMBEDDED MITIGATION	TOLERABILITY
			turnaround or TAR). Site Health, Safety, Security and Environment provisions will cover traffic movements on site, such as induction procedures for visiting drivers at the site entrance, one-way routes on-site, requirements for PPE, and supervision by local staff. On-site containment systems will ensure that in the event of a spill there will be no significant release to watercourses or off-site locations.	
O-9	Nuclear Incident Domino effects from incidents at Hartlepool Nuclear Power Station	A significant nuclear event could impact on the Proposed Development causing a halt in operations, if falling within an assigned evacuation zone for an event described within the Safety Case for the Power Station.	The Proposed Development will be designed to shut down to a safe condition, in the event of a notified incident from the Nuclear Power Station. In addition, the Proposed Development will be designed to be safe in the event of an extended shutdown. The effects from an incident at the power station, i.e., thermal radiation (fire) and non-nuclear explosion overpressure (secondary fuels onsite), are not expected to have a significant impact at the Proposed Development due to the separation distance of more than 2 km. The Hartlepool Nuclear Power Station has its own set of robust mitigation measures to reduce the risk of a major accident and is regulated by the ONR (Office of Nuclear Regulation).	Tolerable (Not Significant)
O-10	Failure of electricity supply An event affecting the electricity supply causes electricity to be	A significant electrical outage could impact on the Proposed Development causing a halt in operations.	Backup energy sources will be in place at the Proposed Development. The nature of the backup systems is in design but it is likely that the site will have a Uninterrupted Power Supply (UPS) battery system, augmented by an alternative power source such as diesel powered generators. The emergency back up systems will allow the safe shutdown of	Tolerable (Not Significant)

SCENARIO REFERENCE	CREDIBLE SCENARIO	POTENTIAL IMPACTS	EMBEDDED MITIGATION	TOLERABILITY
	lost for an extended period at the Proposed Development.		operations and the Proposed Development will be designed to be safe in the event of an extended shutdown. In an emergency event, where all power supplies are lost, whilst the Proposed Development is shutting down safety with the backup systems, an emergency gas flare will be provided for the safe disposal of flammable gases.	
O-11	Extreme meteorological events Extreme meteorological events such as storms could cause damage to the fabric of the Proposed Development	A significant meteorological event could cause damage to the Proposed Development. It could also hinder staff access to site. Either or both of these could cause a halt in operations.	Operating and Emergency Strategies and Procedures will be developed as part of the Proposed Development FEED and Execution Phases to address the Hydrogen Production Facility's Design Capability and Organisational response to a forecast of a developing Natural Hazards event to ensure, as far as reasonably practicable, that the event will not escalate resulting in further environmental impact. An appropriate range of design and engineering barriers and mitigations will be put in place to address credible ranges in meteorological conditions be that temperature, wind speed, changes in sea level or excess rainfall which could impact continuing safe operations and a range of access routes for the emergency services and site personnel in abnormal conditions. The strategies will inform the design criteria and the procedures will provide guidance on the actions to be taken at certain threshold levels. These will include, in advance of the event occurring (where practicable) proactive activities such as plant partial or full shutdown, lockdown of the Hydrogen Production Facility or the temporary reduction in activities	Tolerable (Not Significant)

SCENARIO REFERENCE	CREDIBLE SCENARIO	POTENTIAL IMPACTS	EMBEDDED MITIGATION	TOLERABILITY
			across the site to ensure the continuing safety of personnel and protection of the environment. A minimum safe resourcing level for continuing operations will be defined, which is appropriate in the event of a natural hazard event or local restrictions to site access. The Proposed Development will be designed to be safe in the event of an extended shutdown. Under the COMAH regime, mitigation measures will be routinely reviewed to make sure they remain adequate.	
O-12	Aircraft/drone impact Impact on site infrastructure and/or site personnel from above aircraft / drones.	The impact of an aircraft crash on the Proposed Development would be a major accident with the potential for significant injuries to people and damage to assets, both on-site and off-site.	The Proposed Development is located in an area which does not have a high density of air traffic and facilities in the area are not designed to withstand such an impact. The nearest Airport is Teesside Airport, which is located some 22.5 km to the south-west of the site. Consequently, vigilance and security systems are the key mitigation measures, with shutdown and interlocks installed as part of the plant operating philosophy to safely shut down the plant, in the event of debris strike. Aircraft warning lights would be included on the top of process stacks or structures, if required by Civil Aviation Authority Regulations.	Tolerable (Not significant)

Decommissioning

Hazardous Substances to be Used on Site

20.6.29 During decommissioning there is the potential for process fluids to remain in-situ in the event of a failure to fully empty and clean process systems and pipework. An accidental release of these substances could result in a fire and / or explosion in the event of contact with an ignition source, with the potential for significant harm to persons on-site. In addition, there is the potential for soil / groundwater / surface water contamination in the event of a loss of containment of entrained materials.

20.6.30 Waste materials would be generated during the decommissioning and demolition process. However, these would be recycled wherever possible and managed in accordance with the legislation applicable at the time. For further information regarding waste management, refer to Chapter 21: Materials and Waste (ES Volume I, EN070009/APP/6.2).

Review of Activities

20.6.31 Activities carried out during decommissioning would also have significant potential hazards associated with ground stability and vehicle impacts on-site. Decommissioning would involve a significant process of dismantling above and below-ground structures and the cleaning, removal or capping off of pipelines. This activity has the potential for an accidental loss of containment of process fluids.

Assessment of Shortlisted Major Accidents and Disasters Scenarios

20.6.32 Considering the baseline, the hazardous substances likely to be present, and the identified decommissioning and demolition activities, a review of credible MA& D Risk Events contained in Appendix 20A: Long List of MA&Ds Risk Events (ES Volume III, EN070009/APP/6.4), concluded that the only MA&D Risk Events shortlisted for further assessment is fire / explosion and exposure to toxic, used process catalyst.

20.6.33 Credible Scenarios for decommissioning Risk Events are summarised in Table 20-6. The level of risk presented by all Credible Scenarios has been assessed as Tolerable, taking into consideration the proposed mitigation measures.

Table 20-6: Credible Scenarios Related to the Decommissioning of the Proposed Development

SCENARIO REFERENCE	CREDIBLE SCENARIO	POTENTIAL IMPACTS	EMBEDDED MITIGATION	TOLERABILITY
D-1	Fire and / or Explosion Demolition activity results in a loss of containment of gas, as a result of failure to empty, clean and purge process systems, and is ignited by an unrestricted source.	Process pipework and equipment containing extremely flammable gases (H_2, natural gas) and/or O_2, which is not fully removed prior to demolition activities has the potential to result in a fire and / or explosion causing significant harm to persons carrying out this work.	All decommissioning and demolition activities will be controlled as applicable in relation to The Dangerous Substances and Explosive Atmospheres Regulations (SI 2002 No. 2776) (HM Government, 2002b); The Control of Substances Hazardous to Health Regulations (SI 2002 No. 2677) (HM Government, 2002a) and The Construction (Design and Management) (CDM) Regulations (SI 2015 No. 51) (HM Government, 2015a); or any equivalent legislation that has come into force by the time the Proposed Development reaches its decommissioning stage. The demolition phase will be a notifiable project under CDM Regulations. Risk assessments will be produced prior to demolition activities, which are only to be carried out by suitably trained and experienced personnel. Activities with a high level of risk, such as hot work (activities such as welding or using tools where there is a risk of ignition in a hazardous area), will be strictly controlled. Job method statements will include gas testing systems to ensure that plant and equipment have been fully vented and are clean prior to demolition. Compliance with safety legislation by the implementation of controls is considered to be sufficient to reduce risks to a level which is tolerable.	Tolerable (Not Significant)

SCENARIO REFERENCE	CREDIBLE SCENARIO	POTENTIAL IMPACTS	EMBEDDED MITIGATION	TOLERABILITY
D-2	Exposure to toxic catalyst material failure to empty and clean process systems prior to demolition	Used catalyst material, which is not fully removed from the catalyst beds prior to demolition activities, has the potential to result in the dispersion of catalyst dust causing harm to persons carrying out this work.	There are legislative requirements to control this work to ensure it is carried out safely. Risk assessments will be produced prior to demolition activities, which are only to be carried out by suitably trained and experienced personnel. Job method statements will include checks to ensure process equipment has been fully de-inventoried and are clean prior to demolition. Compliance with safety legislation by the implementation of controls is considered to be sufficient to reduce risks to a level which is tolerable.	Tolerable (Not Significant)

20.7 Embedded Mitigation and Enhancement Measures

Construction

Embedded Mitigation

20.7.1 The assessed Credible Scenarios during the construction phase of the Proposed Development have been assessed as having either a Tolerable or Tolerable – if ALARP level of risk (which are both considered Not Significant for the Development). The embedded mitigation measures proposed during construction are considered to be sufficient.

Enhancement Measures

20.7.2 No specific enhancement measures related to MA&Ds during construction have been identified. However, depending on the relative timing of the construction of Phase 2 alongside Phase 1 operation, additional enhancement measures may be required to mitigate the risk of the MA&Ds event.

Operation

Embedded Mitigation

20.7.3 The assessed Credible Scenarios identified during the operational phase of the Proposed Development have been assessed as having a level of risk which is Tolerable or Tolerable - if ALARP (which are both considered Not Significant). The embedded mitigation measures are considered to be sufficient.

20.7.4 Further embedded mitigation measures will be defined as the design of the Proposed Development progresses and the mitigation measures will be detailed within the COMAH Safety Report, so as to demonstrate that risk at the Proposed Development is ALARP.

20.7.5 This will include undertaking further analyses and studies to support the COMAH Safety Report, which will be outlined in a Design Hazard Management Plan (DHMP) and include, but not be limited to activities such as Consequence Modelling of loss of containment studies, Fire Hazard Analysis, Explosion Hazard Analysis, Toxic Hazard Analysis, and QRA studies.

Enhancement Measures

20.7.6 No specific enhancement measures related to MA&Ds during operation have been identified.

Decommissioning

Embedded Mitigation

20.7.7 The Credible Scenario identified during the decommissioning phase of the Proposed Development has been assessed as having a Tolerable level of risk (Not Significant). The embedded mitigation measures are considered to be sufficient.

Enhancement Measures

20.7.8 No specific enhancement measures related to MA&Ds during decommissioning have been identified.

20.8 Residual Effects and Conclusions

20.8.1 It is considered that all MA&D Risk Events identified during the construction, operation and decommissioning of the Proposed Development would be Tolerable or Tolerable - if ALARP (Not Significant). These assessments have been undertaken qualitatively at an early stage in the Proposed Development design, prior to the conclusion of a number of quantitative studies, such as Consequence Modelling of loss of containment studies, Fire Hazard Analysis, Explosion Hazard Analysis, Toxic Hazard Analysis and QRA studies. This notwithstanding, it is inherent in the design process that the Proposed Development meet the requirements of COMAH and the Pipeline Safety Regulations such that the operations are considered ALARP by the Competent Authorities (the HSE and the EA). Therefore, the residual effects are Not Significant.

20.9 Summary of Residual Effects

20.9.1 It is considered that all MA&D Risk Events identified during the construction, operation and decommissioning of the Proposed Development would be Tolerable or Tolerable if ALARP (Not Significant). Therefore, the residual effects at this time, based on the information available to date, are deemed Not Significant.

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