Immingham Green Energy Terminal

TR030008

Volume 6

6.2 Environmental Statement

Chapter 22: Major Accidents and Disasters

Planning Act 2008

Regulation 5(2)(a)

Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009 (as amended)

September 2023

Infrastructure Planning

Planning Act 2008

The Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009 (as amended)

Immingham Green Energy Terminal

Development Consent Order 2023

6.2 Environmental Statement

Chapter 22: Major Accidents and Disasters

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Table of contents

Tables

22 Major Accidents and Disasters

22.1 Introduction

22.1.1 This chapter presents the findings of an assessment to determine the likely significant adverse effects of the Project on human health, welfare and/or the environment as a result of major accident and/or disaster ("MA&D") scenarios which are relevant to the Project.

22.1.2 The Institute of Environmental Management and Assessment ("IEMA") publication "Major Accidents and Disasters in Environmental Impact Assessment ("EIA"): A Primer" (Ref 22-2) comprises the key guidance document for the assessment of MA&D, and defines these as:

a. *"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."*

b. *"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."*

22.1.3 In relation to the Project, relevant scenarios are those which could credibly arise during its construction, operation and decommissioning phases.

22.1.4 The potential adverse effects of the Project derive from its vulnerability to relevant MA&D, which is the potential for harm to occur as a result of the event. The assessment of vulnerability considers the consequences of the MA&D scenario and the sensitivity of the receptor (for example humans).

22.1.5 Effects are defined primarily on a qualitative basis by the nature of their consequences, size, and/or location. Potential MA&D scenarios which, following an initial assessment are deemed credible, are termed 'MA&D risk events'.

22.1.6 Where MA&D risk events cannot be eliminated, appropriate mitigation of their adverse effects must be considered. This chapter includes a description of the measures embedded into the Project design to prevent or mitigate potential significant adverse effects of MA&D risk events and contains a description of the preparedness for (and response to) such risk events.

22.1.7 The Health and Safety Executive ("HSE") have established the concept of "*reasonably practicable*" as the risk-reduction goal for duty-holders established within the Health and Safety at Work etc. Act 1974 (Ref 22-1). The mitigation measures associated with MA&D risk events must therefore be suitable and sufficient to reduce the risk of the event to a level that can be demonstrated to the HSE is 'as low as reasonably practicable' ("ALARP").

22.1.8 This assessment of MA&D has considered the findings of other key studies reported in the Environmental Statement ("ES") to: establish flood risk; marine navigation risks; and identify environmental and human health receptors relevant to the Project and their vulnerability. Accordingly, information within the following chapters of the ES **[TR030008/APP/6.2]** has been referenced in the MA&D assessment:

a. **Chapter 12: Marine Transport and Navigation**.

b. **Chapter 18: Water Use, Water Quality, Coastal Protection, Flood Risk and Drainage**.

c. **Chapter 24: Human Health and Wellbeing**.

22.1.9 This chapter is supported by the following figures **[TR030008/APP/6.3]**:

a. **Figure 22.1:** Major Accidents and Disasters Study Area.

22.1.10 The assessment references relevant consents and notifications associated with MA&D that will be required in order for the Project to satisfy other regulatory regimes outside of the Development Consent Order ("DCO") application process. These include:

a. Hazardous Substances Consent – an application for Hazardous Substances Consent has been prepared by Air Products and submitted to North East Lincolnshire Council ("NELC").

b. Competent Authority notification – to ensure compliance with Regulation 6(1) of The Control of Major Accident Hazards Regulations 2015 ("COMAH Regulations") (Ref 22-3) Air Products will formally notify the Competent Authority (HSE and Environment Agency "EA") prior to commencement of construction of the establishment. A further notification will be made by Air Products prior to commencing operation of the establishment.

c. HSE notification – to ensure compliance with Regulation 20 of the Pipeline Safety Regulations 1996 (Ref 22-6) ("PSR"), Air Products will formally notify the HSE prior to commencement of construction of the pipelines. A further notification will be made by Air Products to comply with Regulation 21 of the PSR, prior to commencing operation of the pipelines.

Project Expertise

Air Products (BR) Limited ("Air Products")

22.1.11 The hydrogen production facility will be operated by Air Products who have significant experience and expertise (Founded in 1940, Air Products develops, engineers, builds, owns and operates some of the world's largest industrial gas projects), in industrial gas manufacture including hydrogen production and are the world's largest supplier of hydrogen. The company develops, builds and operates facilities in over 50 countries worldwide, employing over 20,000 people, 1,500 of which work in the UK. Globally, Air Products own and operate 80 hydrogen manufacturing plants and over 700 miles of hydrogen pipework and have established a reputation for reliability and safe operation. As a competent operator, all plant and equipment will be controlled under an appropriate safety

management system applicable to a level required to satisfy the COMAH Competent Authority (HSE and EA) with regard to a COMAH installation.

22.1.12 Air Products is a member of a number of industry organisations which share knowledge and best practice associated with hydrogen operations. These include:

a. The Hydrogen Council which was launched in 2017 by 13 founding members and now comprises over 150 organisations who collaborate in the development of hydrogen technology.

b. Hydrogen Europe which is an association representing the interest of the hydrogen industry with a number of objectives including the promotion and coordination of research, development and innovation of clean hydrogen technologies.

c. European Clean Hydrogen Alliance which was established in 2020 with a broad remit to support the clean hydrogen industry to develop good practice and policy recommendations.

d. European Industrial Gases Association ("EIGA") established in 1930 which helps establish and promote technical standards in the area of safety, health, environmental issues and standardisation, alongside the other major Associations, the Compressed Gas Association ("CGA"), the Asia Industrial Gases Association ("AIGA") and the Japanese Industrial and Medical Gases Association ("JIMGA") have launched a website – the Hydrogen Ecosystem – which is accessible at H2safety.info.

e. British Compressed Gases Association established more than 40 years ago which helps establish and promote UK specific technical standards in the area of safety, heath, environmental and regulatory standardisation.

22.1.13 Air Products has over 30 years' experience operating in the Humberside area, with several industrial gas manufacturing and distribution sites including facilities at Saltend, Hull and in Stallingborough, a short distance from the Site.

22.1.14 Liquid hydrogen was developed from laboratory to industrial scale in the 1950s. Air Products started production of liquid hydrogen in 1957 with the first large scale plant built in west Palm Beach in 1959. This was then followed by two more plants in the early 1960s, with other plants following in the 1970s and 1980s. Air Products' newest hydrogen manufacturing plant is in LaPorte, Texas, which came on stream in 2021 and produces up to 30 tonnes a day.

22.1.15 Transport and storage of hydrogen is a common process that Air Products has been carrying out for many years. Nearly all of Air Products' hydrogen facilities have associated onsite storage with vehicle filling and delivery systems. Consequently, the organisation can draw on many years of expertise and experience in hydrogen operations which will be invaluable to the Project.

Associated British Ports ("ABP")

22.1.16 The jetty facilities will be operated by ABP who are one of the UK's leading ports groups, owning and operating 21 ports across England, Wales and Scotland. ABP's principal operations, handling oil and petroleum products are located on the Humber. Immingham Oil Terminal supports major refineries which supply a significant proportion of the nation's petroleum and fuel, whilst the Port of Hull houses the chemical site to store businesses' product requirements and supply the PX Saltend Chemicals Park. Other liquid bulk handling infrastructure can be found at the Eastern and Western Jetties and enclosed dock basin at the Port of Immingham, and similarly within the enclosed dock basins at the Port of Hull.

22.1.17 The Port of Immingham is operated by ABP and is the UK's largest port by tonnage and has been in operation for over 100 years.

22.1.18 ABP's Health and Safety Policy Statement includes a commitment to compliance with the requirements of the Port Marine Safety Code (Ref 22-26), the Railways and Other Guided Transport (Safety (Amended) Regulations 2011) (Ref 22-38), the Merchant Shipping Act 1995 (Ref 22-39), the Pilotage Act 1987 (Ref 22-40) and the Safety in Dock Approved Code of Practice ("ACOP") and Guidance (Ref 22-41).

22.1.19 Embedding a safety-led culture is a critical aspect of ABP's operations with the aim of eliminating harm and creating a great place to work for all employees. The continuous emphasis on behavioural safety has involved colleagues taking part in an extended range of safety culture and leadership courses.

22.1.20 ABP are also deploying new technologies, such as Virtual Reality, to help increase awareness of safety issues amongst colleagues.

22.2 Consultation and Engagement

22.2.1 A scoping exercise was undertaken in August 2022 to establish the form and nature of the MA&D assessment, and the approach and methods to be followed.

22.2.2 The outcomes of this exercise were recorded in a Scoping Report **[TR030008/APP/6.4]**, which detailed the technical guidance, standards and best practice to be applied in the assessment to identify and evaluate the likely significant effects of the Project in relation to MA&D.

22.2.3 A Scoping Opinion was adopted by the Secretary of State on 10 October 2022 **[TR030008/APP/6.4]**; this confirmed the assessment scope and identified a number of matters that the Planning Inspectorate and consultees deemed relevant for consideration in the assessment.

22.2.4 The first Statutory Consultation took place between 9 January and 20 February 2023 in accordance with the Planning Act 2008 ("2008 Act") (Ref 22-42). The Applicant prepared a Preliminary Environmental Information Report ("PEI Report"), which was publicised as part of this consultation.

22.2.5 Through consideration of the responses to the first Statutory Consultation, the developing environmental assessments and ongoing design-development and assessment, a series of changes to the Project were identified. A second Statutory Consultation took place between 24 May 2023 and 20 July 2023 in accordance with the 2008 Act (Ref 22-42) and a PEI Report Addendum was publicised, accompanying this second consultation.

22.2.6 Consultation undertaken with statutory consultees to inform this assessment, including a summary of comments raised within the Scoping Opinion (**Appendix 1.A [TR030008/APP/6.4]**) and those returned in response to the formal consultation and other pre-application engagement is summarised in **Table 22-1.**

Table 22-1: Consultation Summary Table

Reference/Date	Consultee	Summary of Response	How comments have been addressed in this chapter
Scoping Report August 2022	Planning Inspectorate	The Scoping Report states that study area for the assessment of major accidents and disasters is not defined within regulatory guidance or standardised methodology, but that the study area is based on experience and judgement and includes nearby major hazard sites, pipelines other sites whose land use planning zones may encroach on any part of the Proposed Development. The ES should contain a robust justification to support the chosen study area and sensitive receptors selected for the purposes of the ES assessment, based on professional guidance such as that published by IEMA. The study area should be consulted on and agreed with relevant consultation bodies where possible. Figure 2.1 in Appendix A is stated to provide a figure showing the site boundary with respect to infrastructure and industrial sites and natural features and protected environmental sites, however this does not appear to map any major hazard sites or receptors near to the Proposed Development. A figure showing relevant receptors and potential major hazard risks should be provided in the ES.	**Figure 22.1 [TR030008/APP/6.3]** presents the study area and identifies key receptors, infrastructure and existing major accident installations. Information has been included in **Section 22.6** to describe receptors including other COMAH installations and environmental receptors including groundwater vulnerability. A radius of 5km from the Site Boundary has been used to define the study area, explained further in **Section 22.5**. The extent of the Site Boundary has been refined following the submission of the Scoping Report; these modifications have been assessed to have no impact on the study area. No specific comments on the geographic extent of the study area were made by consultees during scoping; however, **Section 22.5** includes a more detailed description of the area within 5km of the Site supported by **Figure 22.1 [TR030008/APP/6.3]**.
		The assessment should consider the vulnerability of the Proposed Development to a potential accident or disaster and the Proposed Development's potential to cause an accident or disaster including the use of Very Large Gas Carriers (VLGCs). The ES should also provide consideration of future hazards associated with transportation and storage of CO_2.	The future use of Project facilities to transport and/or store carbon dioxide (CO_2) has been described, noting that CO_2 is another bulk liquid (in addition to ammonia) that is likely to be used at the new terminal in future. Specific proposals are being developed for the import and export of liquified CO_2 from carbon capture and storage projects elsewhere, but these are at an early stage and would be subject to separate

Reference/Date	Consultee	Summary of Response	How comments have been addressed in this chapter
		The assessment should consider how any surrounding hazardous installations may impact on the major accident hazards arising from the Proposed Development's site operation. Any assessment should include consideration of the impact on surrounding hazardous installations including potential cumulative effects from multiple major accidents which the Proposed Development could become part of cumulatively. Where qualitative assessments are made the professional qualifications and experience of the assessors should be made clear in the ES.	applications for consents for associated landside development and any permits as may be necessary. There are no chemical incompatibilities which would prevent facilities such as the jetty from handling CO_2, as well as hydrogen and ammonia. There would be engineering equipment, systems and procedures in place to prevent these liquified products coming into contact such as isolation valves and vents. CO_2 is not a prescribed substance under COMAH and ALARP measures and emergency planning for accident scenarios involving both CO_2 and ammonia on the jetty are no more onerous than those for ammonia in isolation (see **Paragraph 22.8.14**). Potential effects to and from nearby major accident hazard pipelines and installations have been described and considered throughout the chapter, in particular in **Table 22-4** and **Table 22-5**, and in **Section 22.8**. The potential for a 'domino' event to have an impact on several sites cumulatively has been assessed in **Section 22.8** following Quantitative Risk Assessment ("QRA") and consequence modelling. The qualifications and experience of the author of the MA&D assessment is included in **Appendix 1.E [TR030008/APP/6.4]**.
	Health & Safety Executive	According to HSE's records the proposed site is in the vicinity of a number of major accident hazard installations with Hazardous Substances Consent. Given the nature of the proposal the site will need to consider all the major hazards associated with its proposed operations including both the impact on the surrounding hazardous Installations and how these installations may impact on the major	The chapter includes a detailed description of industrial neighbours and the potential for domino events. The potential hazards of existing operational facilities such as COMAH sites and major accident hazard pipelines have been considered during construction, operation and future decommissioning within Risk Event 13.

Reference/Date	Consultee	Summary of Response	How comments have been addressed in this chapter
		accident hazards arising from the site operation. The site would likely need to be included in a domino group of sites. Also according to our records the site is in close proximity to a major hazards pipeline operated by Cadent Gas ltd. It is noted that the EIA recognise the potential impact of these major hazard operations on to the site, but consideration also needs to be given to the impact of the site onto these sites through the lifecycle of the facility including construction.	Detailed hazard analysis such as QRA and consequence modelling has been undertaken to refine the assessment of potential domino effects as set out in **Section 22.8**.
		The proposal laid out in the EIA recognises the operation of the [Project] will involve the presence of hazardous substances on, over or under land at or above set threshold quantities (Controlled Quantities) will therefore require Hazardous Substances Consent (HSC) under the Planning (Hazardous Substances) Act 1990 as amended, as set out in The Planning (Hazardous Substances) Regulations 2015 as amended. Table 21.3 of the EIA recognises that HSC would be required given the proposal involves the handling of Named Hazardous Substances or Categories of Substances at or above the controlled quantities set out in Schedule 1 of these Regulations. The proposal also recognises the site will be within the scope of Control of Major Accident Hazard Regulations 2015 and will therefore require notification to the COMAH Competent Authority prior to construction. However, what is not identified in this table is whether notification is required under the Pipelines Safety Regulations 1996 in relation to the construction and operation of the pipelines that are proposed within the application. It is recommended that details of the proposed	The chapter includes details of the requirement for the Project to comply with the Pipelines Safety Regulations 1996 (Ref 22-6) (“PSR”). Pipelines containing hydrogen and ammonia are within the definition of dangerous substances contained within the PSR; therefore specific controls described in the PSR will apply to these. The applicability of legislation pertinent to the assessment, including the PSR, is presented in **Table 22-2**. This chapter confirms that the operator of the pipelines would fulfil all statutory requirements for compliance with the PSR, including the production of a Major Accident Prevention Document(s) (“MAPD”) and the appropriate emergency plans.

Reference/Date	Consultee	Summary of Response	How comments have been addressed in this chapter
		pipelines and whether they come within the scope of PSR are included in future consultation documentation.	
	Environment Agency	The Environment Agency will have a role in regulating the site in line with COMAH and has no comments to make on the proposed assessment for planning purposes. However, we welcome the acknowledgement that the proposed development will present major accident hazards and identifies the importance of the Humber as a receptor.	The Environment Agency's response is noted, and the Humber Estuary has been identified as a MADs receptor (**Table 22-4**).
	North East Lincolnshire Council	Thank you for the opportunity to comment on the submitted EIA Scoping report provided by the Applicant. On the whole NELC are content with the scope of the proposed EIA, responses from internal consultees are provided at the bottom of this letter. NELC would like to highlight the importance of fully understanding and considering the extent of any Hazardous Zones associated with the development and the land use planning implications of such zones. This should be through consultation with the Health and Safety Executive.	The HSE is a statutory consultee during the planning process. The land use planning implications of the Project are addressed in this assessment. The Site is within the consultation distances of a number of major hazard sites and pipelines; this is a key factor which has been taken into account in the assessment and through consultation with the HSE.
PEI Report (Statutory Consultation) January 2023	Environment Agency	Paragraph 4.6.5 correctly identifies that the development will require a permit to operate under The Environmental Permitting (England and Wales) Regulations 2016 and will also fall to be regulated under The Control of Major Accident Hazards Regulations 2015. We have noted form the information in the PEI Report that it is intended to use natural gas as fuel in some parts of the production process. This is something that we will review further and is likely to be a topic that will need to be discussed during the pre-application stage for the environmental permit.	An Environmental Permit application for the Project is currently being developed. A COMAH notification was submitted to the HSE on 5 April 2023. The hazards associated with the use of natural gas have been considered, with associated risk reduction and mitigation measures identified. These measures include compliance with the Dangerous Substances and Explosive Atmospheres Regulations ("DSEAR") 2002 (Ref 22-9).

Reference/Date	Consultee	Summary of Response	How comments have been addressed in this chapter
	Local Resident (living within approx. 10km of the Project)	Concern expressed about the danger associated with the storage and transport of hydrogen.	Risk assessments have been carried out by the Project team to identify and mitigate any hazards associated with the storage and transport of hydrogen (see **Section 22.8**). During the development and operation of the Project facilities, the risks associated with the production and storage of hydrogen will be appropriately managed through a comprehensive safety and environmental protection programme. This is implemented via engineering design, operational procedures and management to achieve a level of risk which can be demonstrated to be ALARP, as required by regulations applicable to the Project, including COMAH (Ref 22-23), Environmental Permitting (Ref 22-24), Hazardous Substances (Ref 22-7) and the PSR (Ref 22-6). Transport of hydrogen to users via the road network will comply with The Carriage of Dangerous Goods and Use of Transportable Pressure Equipment Regulations ("CDG") SI 2009 No 1348 (Ref 22-23). These regulations impose a highly structured and prescriptive regime for transport of materials such as hydrogen, covering requirements such as packaging, loading, crew and vehicle requirements. Compliance with these regulations will appropriately manage the risk associated with transport of hydrogen.
	Local Resident (living within approx. 10km of the Project)	Concern expressed about the storage and potential release of ammonia with prevailing north easterly winds carrying gas over Immingham.	Risk assessments have been carried out by the Project team to identify and mitigate any hazards associated with the storage of ammonia. These studies are described in **Section 22.8**. **Section 22.6** describes the hazards of ammonia and key safety systems associated with its delivery, storage and use.

Reference/Date	Consultee	Summary of Response	How comments have been addressed in this chapter
			During the development and operation of the Project, the risks associated with the production and storage of hydrogen will be appropriately managed by a comprehensive safety and environmental protection programme. This is implemented via engineering design, operational procedures and management to achieve a level of risk which can be demonstrated to be ALARP, as required by regulations applicable to the Project, including COMAH, Environmental Permitting, Hazardous Substances and Pipeline Safety Regulations.
	Local Resident (living within approx. 10km of the Project)	Concern expressed over the potential for loss of life of Immingham residents due to explosion.	From a human health perspective, perception of risk has been considered within **Chapter 24: Human Health and Wellbeing [TR030008/APP/6.2]**. During the development and operation of the Project, the risks associated with the production and storage of flammable substances with the potential to form explosive atmospheres will be appropriately managed by a comprehensive safety and environmental protection programme. This is implemented via engineering design, operational procedures and management to achieve a level of risk which can be demonstrated to be ALARP, as required by regulations applicable to the Project, including COMAH, Environmental Permitting (Ref 22-24), Hazardous Substances and the PSR (Ref 22-27). A preliminary hazardous area assessment has been carried out for the Project in accordance with an industry standard guidance document published by the Energy Institute (Ref 22-28). The purpose of this assessment and its importance in the engineering design process is described in **Section 22.8**.

Reference/Date	Consultee	Summary of Response	How comments have been addressed in this chapter
	Local Resident (living within approx. 10km of the Project)	The hydrogen plant is further development of the agricultural land which has historically provided a buffer between port/industry and residential town. The proposed development, handling & storing of dangerous and toxic chemicals, is within 500m of housing estates in Immingham. Any large scale incident has potential for a domino effect with all of the existing COMAH sites in the area.	From a human health perspective, perception of risk has been considered within **Chapter 24: Human Health and Wellbeing [TR030008/APP/6.2]**. A suitable location for the hydrogen production facility within and around the Port was identified taking into account all available space, the Port's existing development plans, ground conditions, presence of existing structures and services including existing transport corridors, proximity to residential conurbations, access, and proximity to the jetty. The two plots of land identified as the proposed location of the hydrogen production facility were selected as the most suitable. Further details are given in **Chapter 3: Needs and Alternatives [TR030008/APP/6.2]**. Domino scenarios where major accidents have an impact on more than one site are considered in the assessment of MA&D as described in **Section 22.8** and will also be thoroughly evaluated by the HSE during the COMAH notification process. When operational, the facility will form part of a COMAH domino group which will share safety information and coordinate emergency management arrangements.
	Local Resident (living within approx. 10km of the Project)	Concerns expressed about - the flammability of hydrogen; and - increased risk from hydrogen and ammonia storage.	This chapter contains an assessment of the potential risk events associated with the offloading and storage of ammonia and the production and storage of hydrogen. These risk events will be assessed in further detail within the safety studies described in **Section 22.8** and where risks cannot be eliminated, mitigation measures will reduce risks to a level demonstrated to be ALARP.

Reference/Date	Consultee	Summary of Response	How comments have been addressed in this chapter
			These measures include a comprehensive safety and environmental protection programme implemented via engineering design, operational measures and management. Demonstration of ALARP is required by the applicable regulations including COMAH (Ref 22-3), Environmental Permitting (Ref 22-24), Hazardous Substances and Pipeline Safety Regulations (Ref 22-7). Engagement with regulatory bodies is ongoing, with the Hazardous Substances Consent application submitted and validated in March 2023 and pre-construction COMAH notification submitted on the 5 April 2023. Risk management, including risk assessment and consequence analysis, will be part of an ongoing process throughout the lifecycle of the facility.
	DFDS Seaways	Mitigation for the most vulnerable part of the Immingham Oil Terminal ("IOT") trunkway in the IERRT proposal suggested moving the most vulnerable part of the trunkway, the finger pier, to the eastern side of the main jetty. The IGET prohibits this as a mitigation option as it is in the same space. The IGET proposals consider that there are not likely to be significant cumulative effects in relation to the IERRT when considered together with the IGET for Major Accidents and Disasters and so provides no mitigation for what could be a potentially environmentally and commercially disastrous incident between a vessel and the IOT trunkway as it handles flammable, toxic and potentially polluting products which would affect all users of the port and could affect the operation of critical national infrastructure. This is a major safety concern and alternative mitigation needs to be provided in the IERRT DCO application that does not involve	In relation to the Immingham Eastern Ro-Ro Terminal ("IERRT") application, following a full assessment which included a number of Hazard Identification ("HAZID") Workshops and navigational simulations and the submission of a comprehensive navigational risk assessment, which has been considered by the Applicant's HAZBoard, it has been concluded that the relocation of the IOT finger pier is not required as part of the IERRT development. As a consequence, the IERRT DCO application does not include the relocation of the finger pier as a mitigation and the relocation is not part of the scope of that application. It follows, therefore, that as such the IGET proposal does not conflict with the IERRT DCO application in this regard.

Reference/Date	Consultee	Summary of Response	How comments have been addressed in this chapter
		moving the finger pier, as the IGET proposal negates that option.	
		We remain extremely concerned that the safety risks, in particular around the IOT trunkway have been scoped out of assessment are not being considered in cumulative effect. Mitigation is needed to address the cumulative effect which the IGET will have with the IERRT and robust measures need to put in place before IGET can go ahead.	The cumulative effects of the Project with the proposed IERRT project have been assessed and are set out in **Chapter 25**: **Cumulative and In-Combination Effects** of the ES **[TR030003/APP/6.2]** and accompanying appendices. The cumulative effects assessment is also summarised in the **Non-Technical Summary** of the ES **[TR030008/APP/6.1]**.
	North East Lincolnshire Council	The environmental protection team acknowledges the proposal and anticipates the submission of the relevant environmental assessments. The construction phase also needs to be considered and detailed construction management measures put in place. We do note that a Hazardous Substance Consent has been submitted to the LPA and is currently going through validation. However, the LPA have reservations over the potential impact of the development and its associated HSE Zones with particular regard to human health, residential amenity and the effect such zones may have on future development. We look forward to working with the applicant to further understand this issue and the impacts of the development.	From a human health perspective, perception of risk has been considered in **Chapter 24: Human Health and Wellbeing [TR030008/APP/6.2]**. The health assessment also makes reference to the findings of the socio-economics assessment (**Chapter 23: Socio-Economics [TR030008/APP/6.2]**) which considers impacts on residential receptors. The Project has submitted a Hazardous Substances Consent application and COMAH notification and will work with the regulatory authorities via the consultation process to appropriately manage the impact of the development on all sensitive receptors. The impact of the land use planning zones (explained in **Section 22.3** below) on future development is addressed in **Chapter 23: Socio-Economics [TR030008/APP/6.2]**.
	Polynt Composites UK Ltd	Finally, and straddling both the construction and operational phases of the IGET Project, we consider that the consultation information contains insufficient information of the assessment of the cumulative impacts of introducing another COMAH hazard to this location, particularly given the traffic and transport impacts referred to above. This is a key concern relative to the health and wellbeing of our	This assessment considers the implications of introducing a further COMAH facility to the area in terms of MA&D. The cumulative effects in respect of traffic and transport impacts are considered in **Chapter 11: Traffic and Transport [TR030008/APP/6.2].** An application for hazardous substance consent has been submitted to NELC by Air Products in connection with the

Reference/Date	Consultee	Summary of Response	How comments have been addressed in this chapter
		employees and the ongoing viability of our operation from the Plant.	hydrogen production facility which requires assessment of cumulative impacts of the Project with the surrounding land uses. Air Products is engaging with local stakeholders regarding emergency plan arrangements as required pursuant to the COMAH Regulations, including in connection with the COMAH Safety Report. Emergency Plans will be developed in compliance with the COMAH Regulations. Since the first statutory consultation, Air Products has had a number of discussions with Polynt, responded to their concerns by letter dated 20 July 2023 and will continue to engage with them.
	Associated Petroleum Terminals (Immingham) Ltd	**Impacts of the Proposal on the IOT** The IOT Operators are concerned about site safety issues relating to the construction, operation and decommissioning phases of the IGET Development. The IOT Operators have concerns relating to safety from the IGET Development including the risk of major fire, explosion or release of toxic gas. This could occur as a result of the following: a) Hydrogen leakage from the pipelines that cross the East Site; b) Ammonia leakage from the refrigerated ammonia storage tank on the East Site; c) Hydrogen and/or ammonia leakage from the hydrogen production units on the East Site; and d) Hydrogen leakage from the hydrogen liquefiers on the East Site The IOT Operators are concerned that both ammonia and, to a greater extent, hydrogen are both flammable substances and a leakage may cause a major fire or an explosion, which may affect the IOT site. In addition, the release of ammonia	The IOT Operator's concerns in relation to the Project are noted and discussions are ongoing between the Applicant, Air Products and the IOT Operators to address the IOT Operators' concerns. Over the last 6 months the Applicant and Air Products have held a number of meetings and site visits with IOT and independent consultants (DNV and BakerRisk). Detailed studies are ongoing as set out below, the results of which will be discussed and evaluated in conjunction with the IOT Operators. IOT representatives have participated in a number of technical workshop and meetings including the Navigational Simulations and the navigational HAZID workshop for the Project. IOT Operators' views as to what it considers to be the major accident hazard risks, arising out of the potential for hydrogen and ammonia leakage at the Project, are noted. IOT Operators acknowledge the Applicant's and Air Products' commitment to managing risk - those commitments are further described in this chapter (see **Section 22.9** of this chapter).

Reference/Date	Consultee	Summary of Response	How comments have been addressed in this chapter
		gas may have impacts on the IOT. These events have the potential to cause significant injuries and loss of life for those working at the IOT as well as causing major disruption to the activities of the IOT activities. The IOT Operators note the commitments in Chapter 22 of the PEI Report on Major Accidents and Disasters that the IGET Development will comply with all relevant safety and environmental legislation for the management of risks on industrial facilities from the construction phase until decommissioning. The chapter also notes that the risks associated with the IGET Development will be reduced by a comprehensive safety and environmental protection programme implemented via engineering design, operational measures and management to achieve a level of risk which is as low was reasonably practicable as required by the COMAH regulations. The IOT Operators welcome these commitments. However, the IOT Operators request that additional details are provided to demonstrate how the level of risk will be controlled through design and operational measures and management. The IOT Operators also believe that in addition to these obligations, other controls should be introduced to mitigate the risk of damage to IOT infrastructure and employees. This could include the provision of refuge buildings on the IOT site which would allow those working there to be safe from any major fire, explosion or release of toxic gas. Furthermore, the Applicant would like assurances that the infrastructure on the East Site is constructed, operated and ultimately decommissioned in a safe and suitable manner. This would minimise the risk of any major accident occurring	The IOT Operators request that additional details are provided to demonstrate how the level of risk will be controlled through design and operational measures and management. As the IOT Operators are aware the Control of Major Accident Hazard (COMAH) Regulations 2015 will apply to the hydrogen production facility, as an “upper tier” establishment (the IOT is also understood to be an upper tier establishment). The “competent authority” enforces the COMAH regime, being the HSE and the Environment Agency acting jointly. The detailed design and operation of the hydrogen production facility will be controlled appropriately through the application of the COMAH regime, including the requirement for the submission of safety reports before commencement of construction and operation. The analysis contained within those safety reports must demonstrate that risks have been reduced to as low as reasonably practicable (“ALARP”) and all measures necessary have been taken to prevent major accidents for the Project to proceed. In the context of the responsibilities of Air Products under the COMAH Regulations, the following studies are being undertaken to inform the detailed design of the Project for the purposes of the safety report: a) As indicated in **Section 22.7** and **Section 22.8** of this chapter, process safety studies by the independent consultants, commissioned by Air Products, to assess in detail the potential consequences of a loss of containment of hydrogen and ammonia from the facilities are ongoing. b) The process safety studies include consequence modelling, the output of which will show the distance a

Reference/Date	Consultee	Summary of Response	How comments have been addressed in this chapter
		which would impact the IOT. The IOT Operators consider that they should be provided with plans and method statements in advance of construction and decommissioning to ensure that safety measures are being complied with during construction and decommissioning and that adequate monitoring and maintenance will take place during operation. The IOT Operators should be given the opportunity to consider these documents and provide feedback along with providing reasonable requirements or conditions for approval. It is considered that these measures could be secured through protective provisions or requirements included in the DCO. Other impacts of the IGET Development on the IOT could also be mitigated through the protective provisions. The IOT Operators would welcome further discissions with ABP and Air Products to understand the impacts of the IGET Development on the IOT including how the risk of major accidents could be minimized to a level acceptable to the IOT Operators. The IOT Operators also require additional information to be provided on the concerns outlined above including what protective measures could be offered to mitigate the risk of a major accident taking place on the East Site.	release of ammonia could potentially extend to in the event of an accidental loss of containment. This will help inform decision making in respect of the detailed layout of the Project, including the location of emergency shelters and toxic refuges which are buildings in which people can safely take refuge in the event of an emergency such as a release of toxic gas and will include an assessment of impacts on the IOT facilities. c) Similarly, modelling will help define thermal radiation exposure levels and explosion overpressure levels which could be reached in the event of an incident involving a loss of containment of flammable material. This will inform the detailed location and design of facilities within the Project, particularly occupied buildings such as control rooms and will include an assessment of impacts on the IOT facilities. The output of these studies will be shared with key stakeholders, including the IOT Operators, and will be contained within the safety report submitted to the competent authority under the COMAH Regulations. The parties will also share information in the context of responsibilities under COMAH relating to domino effects. IOT Operators state that, in addition to the above controls regarding design and operational measures and management, further controls to mitigate the risk of damage to IOT infrastructure and employees should be introduced. The outcome of the above studies, discussion, evaluation and co-operation will enable the parties to assess potential impacts on the safety of IOT employees and associated infrastructure,

Reference/Date	Consultee	Summary of Response	How comments have been addressed in this chapter
			and consider appropriate ALARP measures under the COMAH Regulations. The IOT Operators seek assurances that infrastructure on the East Site will be constructed, operated and decommissioned in a safe and suitable manner in order to minimise the risk of a major accident occurring which would impact the IOT. In particular, the IOT Operators seek plans and method statements in advance of construction and decommissioning and the opportunity to provide feedback, along with providing reasonable requirements or conditions for approval. In terms of major accident hazards, the regime established by the COMAH Regulations provides an appropriate framework for ensuring the safe and suitable construction, operation and decommissioning of the East Site infrastructure, as regulated by the Environment Agency and HSE as competent authorities. The need for an environmental permit will require the application of 'Best Available Techniques'. Air Products are committed to continuing to engage with the IOT Operators during the detailed design process required by the COMAH regime in order to obtain feedback and understand their views. In terms of other impacts during construction and decommissioning, draft **outline Construction and Decommissioning Environmental Management Plans** (which form part of the DCO application **[TR030008/APP/6.5** and **TR030008/APP/6.6]**) have been prepared, with the objectives of managing these activities safely and minimising impacts. The final plans will be submitted to and approved by North East Lincolnshire Council, as the relevant local planning authority, under a requirement of the DCO. IOT Operators note that appropriate measures could be secured within the DCO documentation including through

Reference/Date	Consultee	Summary of Response	How comments have been addressed in this chapter
			requirements and protective provisions. ABP and Air Products are committed to ongoing engagement with IOT Operators to seek to address its concerns including assessment, alongside IOT, as to whether protective measures are appropriate or protective provisions required for IOT's existing infrastructure. IOT states that it would welcome further discussions with ABP and Air Products to understand the impacts of the Project on the IOT including how the risk of major accidents could be minimised to an acceptable level to IOT Operators. As outlined above, further discussions have taken place since receipt of the IOT Operators' representations and will continue. Air Products and ABP are committed to working closely with the IOT Operators to minimise risks of major accidents in accordance with their statutory requirements.
		Assessed Need for the Scheme The IOT Operators recognize that the National Policy Statement for Ports contains a presumption in favour of granting consent to applications for ports development. Owever, that presumption is subject to the more specific policies contained within the NPS. Section 4.17 of the NPS states, amongst other things, that there may be national security considerations where development consent relates to potentially critical infrastructure. The IOT comprises nationally critical infrastructure and should be given due regard when the application for the IGET Development is considered. To be clear, the IOT Operators are not suggesting that the IGET Development is, as a matter of principle, incompatible with the IOT such that national security could be compromised. However, the IOT Operators consider that the status of the	The **Planning Statement [TR030008/APP/7.1]** submitted with the DCO application contained a detailed analysis of the Project against the policies in the National Policy Statement for Ports ("NPSfP") and includes consideration of paragraph 4.17 of that policy on national security. The acknowledgement from APT that there is no suggestion that the Project is, as a matter of principle, incompatible with the IOT such that national security should be compromised is welcomed. As noted above, the status of the IOT facility is recognized and discussions are ongoing between the Applicant, Air Products and the IOT Operators to seek to minimize the impact of the Project on the IOT operations.

Reference/Date	Consultee	Summary of Response	How comments have been addressed in this chapter
		IOT means that ABP should give significant consideration in the design of the IGET Development to the potential impacts to the IOT and should be able to demonstrate that they have done so at a future examination of the DCO. The IOT Operators expect ABP to have taken active steps to mitigate against any risks and impacts to the IOT.	
		Conclusion For the reasons outlined in this consultation response, the IOT Operators have substantial concerns about certain safety aspects of ABP's proposals. The IOT Operators are particularly concerned about the potential risk of major accidents occurring at the proposed East Site of the IGET Development. This could cause injuries and loss of life for those working at the IOT and cause major disruption to the activities of the IOT Operators. In order to fully understand these concerns, the IOT Operators have requested further information from ABP about various aspects of the proposals and have asked for certain plans and documents to be shared or prepared jointly between ABP and the IOT Operators at the earliest opportunity, to inform the assessment or risk presented by the IGET Development. As the initial tenants of the East Site, it is envisaged that Air Products would also form a key part of these discussions. Subject to further discussions and the provision of information requested above by the IOT Operators, it is also expected that any or all of the following measures may be required to be included in ABP's future application for development consent:	The summary of APT's concerns is noted and understood. The Project team looks forward to continued discussions with the IOT Operators with a view to minimizing the impact of the Project on their operations and to the continued sharing of information between the parties.

Reference/Date	Consultee	Summary of Response	How comments have been addressed in this chapter
		a) Protective provisions for the benefit of the IOT Operators' existing infrastructure during the construction of the ABP proposals; and / or b) Requirements controlling the manner in which the ABP proposals are constructed, operated and decommissioned for the protection of the IOT and the IOT Operators' equipment installed on it.	
Second Statutory Consultation May 2023 – July 2023	Local resident (living within approx. 10km of the Project)	Objection to the project noted on basis that western edge of project is too close to residential areas, which could result in a major incident due to the materials stored and processed on site, as well as on neighbouring sites in and around the port.	The Project has submitted a Hazardous Substances Consent application and COMAH notification and will work with the regulatory authorities via the consultation process to appropriately manage the impact of the development on all sensitive receptors. The impact of the land use planning zones (explained in **Section 22.3** below) on future development is addressed in **Chapter 23: Socio-Economics [TR030008/APP/6.2]**.
	Associated Petroleum Terminals (Immingham) Ltd	**Impacts of the Proposal on the IOT** The IOT Operators are concerned about site safety issues relating to the construction, operation and decommissioning phases of the IGET Development. The IOT Operators have concerns relating to safety from the IGET Development including the risk of major fire, explosion or release of toxic gas. This could occur as a result of the following: a) Hydrogen leakage from the pipelines that cross the East Site; b) Ammonia leakage from the refrigerated ammonia storage tank on the East Site; c) Hydrogen and/or ammonia leakage from the hydrogen production units on the East Site; and	The Applicant and Air Products note that APT also replied to the second Statutory Consultation resubmitting the earlier consultation response. APT's comments are addressed in the response to the first Statutory Consultation set out above.

Reference/Date	Consultee	Summary of Response	How comments have been addressed in this chapter
		d) Hydrogen leakage from the hydrogen liquefiers on the East Site The IOT Operators are concerned that both ammonia and, to a greater extent, hydrogen are both flammable substances and a leakage may cause a major fire or an explosion, which may affect the IOT site. In addition, the release of ammonia gas may have impacts on the IOT. These events have the potential to cause significant injuries and loss of life for those working at the IOT as well as causing major disruption to the activities of the IOT activities. The IOT Operators note the commitments in Chapter 22 of the PEI Report on Major Accidents and Disasters that the IGET Development will comply with all relevant safety and environmental legislation for the management of risks on industrial facilities from the construction phase until decommissioning. The chapter also notes that the risks associated with the IGET Development will be reduced by a comprehensive safety and environmental protection programme implemented via engineering design, operational measures and management to achieve a level of risk which is as low was reasonably practicable as required by the COMAH regulations. The IOT Operators welcome these commitments. However, the IOT Operators request that additional details are provided to demonstrate how the level of risk will be controlled through design and operational measures and management. The IOT Operators also believe that in addition to these obligations, other controls should be introduced to mitigate the risk of damage to IOT infrastructure and employees. This could include the provision of refuge buildings on the IOT site which would	

Reference/Date	Consultee	Summary of Response	How comments have been addressed in this chapter
		allow those working there to be safe from any major fire, explosion or release of toxic gas. Furthermore, the Applicant would like assurances that the infrastructure on the East Site is constructed, operated and ultimately decommissioned in a safe and suitable manner. This would minimise the risk of any major accident occurring which would impact the IOT. The IOT Operators consider that they should be provided with plans and method statements in advance of construction and decommissioning to ensure that safety measures are being complied with during construction and decommissioning and that adequate monitoring and maintenance will take place during operation. The IOT Operators should be given the opportunity to consider these documents and provide feedback along with providing reasonable requirements or conditions for approval. It is considered that these measures could be secured through protective provisions or requirements included in the DCO. Other impacts of the IGET Development on the IOT could also be mitigated through the protective provisions. The IOT Operators would welcome further discissions with ABP and Air Products to understand the impacts of the IGET Development on the IOT including how the risk of major accidents could be minimized to a level acceptable to the IOT Operators. The IOT Operators also require additional information to be provided on the concerns outlined above including what protective measures could be offered to mitigate the risk of a major accident taking place on the East Site. **Assessed Need for the Scheme**	

Reference/Date	Consultee	Summary of Response	How comments have been addressed in this chapter
		The IOT Operators recognize that the National Policy Statement for Ports contains a presumption in favour of granting consent to applications for ports development. Owever, that presumption is subject to the more specific policies contained within the NPS. Section 4.17 of the NPS states, amongst other things, that there may be national security considerations where development consent relates to potentially critical infrastructure. The IOT comprises nationally critical infrastructure and should be given due regard when the application for the IGET Development is considered. To be clear, the IOT Operators are not suggesting that the IGET Development is, as a matter of principle, incompatible with the IOT such that national security could be compromised. However, the IOT Operators consider that the status of the IOT means that ABP should give significant consideration in the design of the IGET Development to the potential impacts to the IOT and should be able to demonstrate that they have done so at a future examination of the DCO. The IOT Operators expect ABP to have taken active steps to mitigate against any risks and impacts to the IOT. **Conclusion** For the reasons outlined in this consultation response, the IOT Operators have substantial concerns about certain safety aspects of ABP's proposals. The IOT Operators are particularly concerned about the potential risk of major accidents occurring at the proposed East Site of the IGET Development. This could cause injuries and loss of life for those working at the IOT and cause major disruption to the activities of the IOT Operators.	

Reference/Date	Consultee	Summary of Response	How comments have been addressed in this chapter
		In order to fully understand these concerns, the IOT Operators have requested further information from ABP about various aspects of the proposals and have asked for certain plans and documents to be shared or prepared jointly between ABP and the IOT Operators at the earliest opportunity, to inform the assessment or risk presented by the IGET Development. As the initial tenants of the East Site, it is envisaged that Air Products would also form a key part of these discussions. Subject to further discussions and the provision of information requested above by the IOT Operators, it is also expected that any or all of the following measures may be required to be included in ABP's future application for development consent: c) Protective provisions for the benefit of the IOT Operators' existing infrastructure during the construction of the ABP proposals; and / or Requirements controlling the manner in which the ABP proposals are constructed, operated and decommissioned for the protection of the IOT and the IOT Operators' equipment installed on it.	
	DFDS Seaways	**Navigational Safety – the finger pier** Mitigation for the most vulnerable part of the Immingham Oil Terminal ("IOT") trunkway in the IERRT proposal suggested moving the most vulnerable part of the trunkway, the finger pier, to the eastern side of the main jetty. The IGET prohibits this as a mitigation option as it is in the same space. The IGET proposals consider that there are not likely to be significant cumulative effects in relation to the IERRT when considered together with the IGET for Major Accidents and	In relation to the Immingham Eastern Ro-Ro Terminal ("IERRT") application, following a full assessment which included a number of Hazard Identification ("HAZID") Workshops and navigational simulations and the submission of a comprehensive navigational risk assessment, which has been considered by the Applicant's HAZBoard, it has been concluded that the relocation of the IOT finger pier is not required as part of the IERRT development. As a consequence, the IERRT DCO application does not include

Reference/Date	Consultee	Summary of Response	How comments have been addressed in this chapter
		Disasters and so provides no mitigation for what could be a potentially environmentally and commercially disastrous incident between a vessel and the IOT trunkway as it handles flammable, toxic and potentially polluting products which would affect all users of the port and could affect the operation of critical national infrastructure. This is a major safety concern and alternative mitigation needs to be provided in the IERRT DCO application that does not involve moving the finger pier, as the IGET proposal negates that option.	the relocation of the finger pier as a mitigation and the relocation is not part of the scope of that application. It follows, therefore, that as such the IGET proposal does not conflict with the IERRT DCO application in this regard.
		Conclusion We remain extremely concerned that the safety risks, in particular around the IOT trunkway have been scoped out of assessment are not being considered in cumulative effect. Mitigation is needed to address the cumulative effect which the IGET will have with the IERRT and robust measures need to put in place before IGET can go ahead.	The cumulative effects of the Project with the proposed IERRT project have been assessed and are set out in **Chapter 25**: **Cumulative and In-Combination Effects** of the ES **[TR030003/APP/6.2]** and accompanying appendices. The cumulative effects assessment is also summarised in the **Non-Technical Summary** of the ES **[TR030008/APP/6.1]**.

22.3 Legislation, Policy and Guidance

22.3.1 **Table 22-2** presents the key legislation, policy and best practice which applies to the facilities included within the Project in the context of MA&D. The duty holder under the HSWA for these facilities may include operators other than the Applicant.

22.3.2 There are a considerable number of best practice guidance documents and engineering design standards applicable to the assessment of MA&D for the Project.

Table 22-2: Relevant Legislation, Policy and Best Practice Regarding MA&D

Legislation/Policy/Guidance	Consideration within the chapter
National Policy Statement for Ports ("NPSfP") (Ref 22-43)	
The National Policy Statement for Ports ("NPSfP") (Ref 22-43) contains a number of assessment principles concerning good design for infrastructure and pollution control that have relevance to the topic of MA&D. Although the NSPfP (Ref 22-43) does not make specific mention of MA&D, it does acknowledge the importance of early engagement with the HSE in relation to hazardous substances and the role that the planning system has in protecting and improving public safety.	The assessment principles of relevance to the topic of MA&D have been taken into account within the assessment. The HSE has been engaged as part of pre-application discussions, the outcomes of which have been considered as part of the assessment and discussions are ongoing between Air Products and the HSE.
National Planning Policy Framework ("NPPF") (Ref 22-44)	
The National Planning Policy Framework ("NPPF") (Ref 22-44) contains policies relating to the vulnerability to flooding of installations requiring hazardous substances consent. It also acknowledges that decision-making should promote public safety by anticipating malicious threats and natural hazards.	Relevant policies concerning hazards and safety have been reviewed and taken into account within the assessment. Through the consideration of alternative layouts, designs and technological solutions, the design-development process has sought to minimise risks to Project infrastructure from natural hazards, and risks from the Project on receptors.
National Planning Practice Guidance ("NPPG")	
National Planning Practice Guidance ("NPPG") supports the NPPF (Ref 22-44) by providing topic-specific guidance on national policy matters.	The following PPGs are relevant to MA&D and have been considered as part of the assessment process: Hazardous substances (Ref 22-45). Flood risk and coastal change (Ref 22-46). Climate change (Ref 22-47).

Legislation/Policy/Guidance	Consideration within the chapter
The Infrastructure Planning (Environmental Impact Assessment) Regulations 2017 (Ref 22-4)	
The Infrastructure Planning (EIA) Regulations 2017 require that the effects of a project, where these are likely to have a significant effect on the environment, are taken into account in the decision-making process for that project. These regulations indicate the process and requirements for the provision of adequate environmental information to enable the EIA process. Regulation 5 - Environmental Impact Assessment ("EIA") process Paragraph 4 The effects to be identified, described and assessed under paragraph (2) 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.	This chapter contains a description of the potential types of risk events identified as being relevant to the Project which could result in a MA&D. The IEMA guidance (Ref 22-2) defines a risk event as an identified, unplanned event, which is considered relevant to the development and has the potential to result in a major accident and/or disaster, subject to assessment of its potential to result in a significant adverse effect on an environmental receptor. A significant effect is defined as one which could include the loss of life, permanent injury and temporary or permanent destruction of an environmental receptor which cannot be restored through minor clean-up and restoration. The nature of the Project is such that there are a number of potential risk events as a result of the substances present on Site, however, the Project is required to demonstrate to the regulatory authorities that risks have been reduced to levels that are ALARP prior to the start of operational activities. This chapter therefore presents the assessment to identify risk events, categorise their significance and summarise the control and mitigation measures to reduce risk, for the purposes of the EIA process.
The Control of Major Accident Hazards Regulations 2015 (Ref 22-3)	
The COMAH Regulations 2015 (as amended) implement the Seveso III Directive and are applicable to the operators of establishments which store quantities of dangerous substances equal to or in excess of the qualifying quantities listed in Schedule 1 of the Regulations. The COMAH Regulations require that operators take all necessary measures to prevent major accidents involving dangerous substances and are enforced by the Competent Authority comprising HSE and Environment Agency ("EA") acting in cooperation. Part 2 General Duties of Operators The inventory of substances at the Project would be in excess of the qualifying quantities listed in Schedule 1 of the	This ES contains a high-level identification of credible MA&D which will be considered as part of the ongoing programme of work to be carried out by the operator (the person in control of operations at the COMAH establishment) to demonstrate that risks associated with the Project are reduced to a level ALARP, as required by the COMAH Regulations. (Control of Major Accident Hazards)

Legislation/Policy/Guidance	Consideration within the chapter
COMAH Regulations, therefore this legislation is applicable to the Project. Regulation 5(1) Every operator must take all measures necessary to prevent major accidents and to limit their consequences for human health and the environment. Notifications Regulation 6(1) Within a reasonable period of time prior to the start of construction of a new establishment the operator must send to the competent authority a notification containing the information set out in Regulation 6. Regulation 6(2) Within a reasonable period of time prior to the start of operation of a new establishment the operator mut send to the competent authority a notification containing the information set out in Regulation 6. Major Accident Prevention Policy and Safety Management System Regulation 7(1) Every operator must prepare and retain a written Major Accident Prevention Policy (MAPP). Regulation 7(3) A MAPP must be prepared by the operator of a new establishment within a reasonable period of time prior to construction or operation of the establishment. Regulation 7(7) An operator must implement its MAPP by a safety management system (SMS). COMAH Safety Report Regulation 8 Every operator of an Upper Tier COMAH establishment must prepare a COMAH Safety Report, containing the information set out in Regulation 8. Regulation 9(2) An operator must send a safety report to the Competent Authority within a reasonable period of time prior to the start of construction of the establishment and prior to the start of operation of the establishment. Regulation 12(1) Every operator of a Upper Tier establishment must prepare an internal emergency plan, specifying the measures to be taken inside the establishment.	

Legislation/Policy/Guidance	Consideration within the chapter
Land Use Planning Public Safety Advice (HSE) (Ref 22-25)	
The HSE is a statutory consultee for planning applications around major hazard sites and pipelines and on applications for hazardous substances consent. HSE's advice is aimed at mitigating the effects of a major accident on the population around a major hazard site The HSE is a statutory consultee for developments which are subject to COMAH Regulations, such as this Project. Part of the consultation process will involve a review by the HSE of the site location relative to existing installations (includes COMAH sites, major accident hazard pipelines). These existing installations will have defined consultation zones. The HSE's consultation zones (often referred to as land use planning zones) are categorised as either 'Inner', 'Middle' or 'Outer' and a separate category is applied for the safeguarding zones associated with explosive hazards. Within these zones, the HSE's decision making criteria are based on the type of development which is proposed within the zone, the vulnerability of those likely to be present within those developments and the societal tolerance of the associated risk. HSE's advice will usually depend upon: • The consultation zone within which the proposed development is located - the Inner Zone is closest to the major hazard where risks and hazards are greatest and restrictions on development are strictest, followed by the Middle Zone and the Outer Zone. The zones are normally determined by a detailed assessment of the risks and/or hazards of the installation which takes into account the quantity of hazardous substances for which hazardous substances consent is held and the details of storage and/or processing, the hazard range and consequences of major accidents involving the hazardous substances that could be present. • The "sensitivity level" of the proposed development derived from HSE's	The information contained within this chapter will form part of the information and assessments undertaken by Air Products to be considered by the HSE during the statutory consultation process on the HSC application and the COMAH notification. Information about this Project will be considered by the HSE alongside the existing consultation zones associated with existing installations within the area. The outcome from the consultation will inform the ongoing development of the Project. Further information about the application of land use planning zones to the Project is set out in **Section 22.3.**

Legislation/Policy/Guidance	Consideration within the chapter
categorisation of development types. There are 4 broad sensitivity levels: level 1 – based on the normal working population; level 2 – based on the general public at home and involved in normal activities; level 3 – based on vulnerable members of the public; and level 4 – large examples of level 3 and very large outdoor developments. Other rules may apply in more complex cases, for example where the project is located in more than one zone or there is more than one hazard or development type.	
The Environmental Permitting (England and Wales) Regulations ("EPR") 2016 Regulations (Ref 22-24)	
Installations which carry out one or more defined prescribed activities such as chemical manufacturing are subject to the Environmental Permitting Regulations (EPR). EPR requires operators to supply detailed information to the Regulator in the form of a Permit Application and only once the Permit is issued is operation allowed to commence. Operators of sites regulated by EPR are required to take the measures set out in the Permit to prevent incidents and accidents.	The chapter includes the identification of MA&D with environmental impacts which is also part of the requirements of the ERP regulation. This information is summarized in **Table 22-3** and **Table 22-4**.
The Planning (Hazardous Substances) Regulations 2015 (Ref 22-7)	
The Planning (Hazardous Substances) Regulations 2015 apply to facilities which would like to hold quantities of hazardous substances at or above defined limits within the Regulations. These facilities must obtain a Hazardous Substance Consent ("HSC"). Applications for HSC are made to the hazardous substance authority (usually the local planning authority and in this case, is North East Lincolnshire Council ("NELC")). The HSE is a statutory consultee for HSC applications. These Regulations amend planning procedures in relation to sites where hazardous substances are held and to land near those sites through the creation of land use planning zones as explained above.	The information required in connection with a HSC application and listed in Regulation 5(1)(d)(i) to (vi) is contained within **Chapter 2: The Project [TR030008/APP/6.2]**. The information required by Regulation 5(1)(d)(vii) and (viii) is included in this chapter, specifically **Figure 22.1 [TR030008/APP/6.3]** and **Section 22.7** respectively. The inventory of substances stored within the landside infrastructure areas of the Project would be in excess of the qualifying quantities listed in Schedule 1 of the Hazardous Substances Regulations, and therefore this legislation is applicable. An application for HSC has been submitted to NELC and validated. The assessment in this chapter considers the information included within the application for HSC to the Local Planning Authority.

Legislation/Policy/Guidance	Consideration within the chapter
This consent process regulates the storage and use of hazardous substances and enables breaches of control, which may present serious risks, to be dealt with quickly and effectively. However, even after measures have been taken to prevent major accidents, there will remain a residual risk of an accident which cannot entirely be eliminated. The need for HSC ensures that this residual risk to people in the vicinity or to the environment is taken into account before a hazardous substance is allowed to be present in a controlled quantity. The extent of this risk will depend upon where and how a hazardous substance is present, and the nature of existing and prospective uses of the application site and its surroundings. Part 3 Hazardous Substances Consent Procedures Regulation 5(1) Subject to paragraph (2) and regulation 23 (application of the Act to hazardous substances authorities), an application for hazardous substances consent must: (d) include details of: (i) the location of the land to which the application relates; (ii) the person in control of the land to which the application relates; (iii) each hazardous substance for which consent is sought (“relevant substance”), including the maximum quantity of each relevant substance proposed to be present; (iv) the main activities carried out or proposed to be carried out on the land to which the application relates; (v) how and where each relevant substance is to be kept and used; (vi) how each relevant substance is proposed to be transported to and from the land to which the application relates; (vii) the vicinity of the land to which the application relates, where such details are relevant to the risks or consequences of a major accident; and	

Legislation/Policy/Guidance	Consideration within the chapter
(viii) the measures taken or proposed to be taken to limit the consequences of a major accident.	
Health and Safety at Work etc. Act 1974 ("HSWA") and Regulations made thereunder (Ref 22-1)	
The HSWA is the primary legislative instrument covering workplace health and safety in Great Britain. It sets out the general duties which employers have towards employees, and which employees have to themselves and each other. The HSWA establishes the obligations to ensure, so far as is reasonably practicable (SFAIRP), that persons are not exposed to risks to their health and safety. The HSE, along with local authorities, are responsible for enforcing the HSWA. Preliminary – Article 1 The provisions of this Part shall have effect with a view to— (a) Securing the health, safety and welfare of persons at work. (b) Protecting persons other than persons at work against risks to health or safety arising out of or in connection with the activities of persons at work. (c) Controlling the keeping and use of explosive or highly flammable or otherwise dangerous substances, and generally preventing the unlawful acquisition, possession and use of such substances.	This chapter contains a high level description of the mitigation measures proposed to manage the reasonably foreseeable identified risks to health and safety of persons working at the Site, in neighbouring facilities and other persons which may be affected by these operations. The mitigation measures described in this chapter include the primary containment systems for dangerous substances, such as hydrogen and ammonia, and the security systems to prevent unauthorised access to operational areas where they are present.
The Pipelines Safety Regulations 1996 ("PSR") (Ref 22-6)	
The PSR, made under the HSWA, do not cover the environmental aspects of accidents arising from pipelines. However, the Regulations, by ensuring that a pipeline is designed, constructed and operated safely, provide a means of securing pipeline integrity, thereby reducing risks to the environment. It is important that effects on the environment are considered at all stages in the life cycle of a pipeline.	This Project would include installation of pipelines connecting the two operational process areas and the jetty, crossing land which is not owned and under the control of the Applicant and therefore the PSR will apply. These pipelines would transport hydrogen and ammonia, consequently, these are categorised as MAH pipelines within the PSR. A further pipeline would transport nitrogen between the East and West Sites. Gaseous nitrogen is not classified as a dangerous fluid in accordance with regulation 18(2)

Legislation/Policy/Guidance	Consideration within the chapter
The PSR require operators of major accident hazard ("MAH") pipelines to ensure that they are designed (and subsequently modified if necessary) so that they are safe to operate within the range of operating conditions to which they will be subjected. Safety systems such as emergency isolation and pressure relief valves will be provided to secure safe operation. Specific emergency plans are required for the pipelines and a Major Accident Prevention Document ("MAPD") is to be produced, describing the hazards and safety management systems associated with management of risk. Operators are required to notify the HSE in advance of construction of a MAH pipeline and operations commencing.	and Schedule 2 of the PSR, therefore this pipeline is not categorised as a MAH pipeline. This chapter establishes the principles to be adopted by the Project to ensure compliance with these Regulations, including identification and management of the risks associated with their operation.
Construction (Design and Management) 2015 Regulations ("CDM") (Ref 22-8)	
The CDM Regulations place specific duties on those undertaking defined roles during construction activities, such as clients, designers and contractors. These duties are to ensure health and safety is managed throughout the life of a construction project.	This chapter includes certain general overarching principles of how the Project will comply with CDM, to manage risks which have the potential to be a major accident, such as the development of a Construction Environmental Management Plan ("CEMP").
The Dangerous Substances and Explosive Atmospheres Regulations 2002 ("DSEAR") (Ref 22-9)	
DSEAR set out the minimum requirements for the protection of workers from fire and explosion risks related to dangerous substances and potentially explosive atmospheres. These Regulations apply to employers at workplaces in Great Britain where a dangerous substance such as hydrogen is present or could be present. For COMAH Installations, DSEAR is enforced by the HSE. Compliance with DSEAR requires employers to assess and control risks and ensure safety measures are in place before beginning work activities. Areas where an explosive atmosphere may be present must be identified, and can include tank vents, around flanged connections in pipework and many others.	The presence of substances such as hydrogen, ammonia and natural gas – categorised in these Regulations as dangerous – render the DSEAR applicable. Mitigation measures to reduce the risk of MA&D events such as fire, explosion and toxic gas release include activities carried out for the purposes of DSEAR compliance. These activities would be undertaken throughout the lifecycle of the Project, from an early stage in the engineering design process where explosive atmospheres would be identified, and equipment (mechanical and electrical) would be specified appropriately. DSEAR compliance during construction includes assessments for the safe use of diesel which is classified as a flammable fluid within mobile plant. During Project operation and maintenance activities, detailed risk assessments would be completed,

Legislation/Policy/Guidance	Consideration within the chapter
New equipment supplied for use in places where an explosive atmosphere may occur must meet the requirements established by DSEAR to prevent a source of ignition becoming active and available, thus increasing the risk of fire and/ or explosion.	documented and regularly updated to reflect any changes made on site. These risk assessments would demonstrate a robust basis for safe operation of the Site as required by DSEAR.
The Chemical and Downstream Oil Industries Forum Guideline on Environmental Risk Tolerability for COMAH Establishments ("CDOIF") (Ref 22-10)	
The COMAH Competent Authority recognizes the CDOIF Guideline on Risk Tolerability at COMAH Establishments as providing an appropriate methodology to Operators completing their COMAH Safety Reports. These reports must include an assessment of the environmental consequences (extent, severity and duration) of potential accidents, to determine whether the effects might constitute a Major Accident to the Environment ("MATTE"). The CDOIF guideline methodology includes a structured approach to assessing environmental risks following major accidents, taking into consideration the extent (the area / distance), the severity (the degree of harm within the area of impact), and duration (the recovery period) of the event. The levels of harm to the environment which would be categorised as serious depends on the type of receptor, therefore this methodology includes threshold harm levels specific to categories of receptor e.g., groundwater and soils. Risk is evaluated taking into consideration the severity and duration of the event, and a category of MATTE can be concluded. These risk categories are A (lowest) to D (highest). Risks identified as being below category A are termed 'sub-MATTE' and can be screened out of further assessment. For each MATTE event identified, the CDOIF guidance presents frequency limits to identify events which can be categorised as 'intolerable' or 'broadly acceptable'. Where risks are classed as intolerable, Operators must take additional measures to reduce risk.	Operators of COMAH sites such as the Project recognise the CDOIF methodology as providing best practice for environmental risk assessment ("ERA"). An ERA is typically undertaken following or alongside the engineering design process prior to operation, to support the development of the COMAH Safety Report. However, this methodology is focused on oil and chemicals/hazardous liquids and not industrial gases processes and was not developed in consultation with the industrial gases industry, so will need be used with caution in this context. The measures to prevent and mitigate the consequences of MA&D include undertaking an ERA to support COMAH compliance and demonstrate that all measures necessary have been taken to prevent major accident hazards. The output of the ERA provides guidance to operators on the suitability of their installed systems such as bunding and containment, to prevent an accidental release reaching the environment. Consequently, a robust ERA employing the CDOIF methodology is listed as a mitigation measure in **Section 22.7**.

Legislation/Policy/Guidance	Consideration within the chapter
British Standard ("BS") 61508 (Ref 22-11) **/ 61511** (Ref 22-12) **Functional Safety of Electrical/Electronic/Programmable Electronic Safety-related Systems**	
Functional safety is a term used to describe engineering assessments and systems to reduce the risk to people and the environment from process operations via the use of automatic protection functions. COMAH Installations typically employ functional safety within Safety Instrumented Systems ("SIS"), which provide control functions for process operations. SIS incorporate devices such as automatic high pressure and low pressure trips, the purpose of which is to return a process operation to a safe condition if a deviation occurs, without the need to an operator in a control room to take action. SIS incorporate computer controlled functions to monitor process conditions and are connected to devices such as valves, which open or close automatically in response to a computer signal. The reliability of SIS is important to the safe operation of the Project's process facilities. The means of demonstrating an appropriate level of reliability can be achieved is established in a series of standards developed by the International Electrotechnical Commission ("IEC") and published by the British Standards Institution ("BS"). BS 61508 is a basic functional safety standard applicable to all industries and BS 61511 is specific guidance for the process industries as well as implementing Safety Instrumented Functions and safety lifecycle process in accordance with IEC61511. These guidance documents are recognised by the Competent Authority as representing best practice for functional safety.	Operators of COMAH sites such as the Project recognise these standards as providing best practice in the engineering design of process facilities and the specification of SIS Safety Instrumented Functions and safety lifecycle process in accordance with IEC 61511, which are important to prevent a loss of containment occurring from process systems which could lead to an accident. These standards are a key mitigation measure in the prevention of a number of risk events, such as fire, explosion and toxic release which are noted in **Section 22.7**.
IMDG International Maritime Dangerous Shipping Code (Ref 22-13)	
"IMDG" Code or International Maritime Dangerous Goods Code is accepted by the MSC (Maritime Safety Committee) as an international guideline to the safe transportation or shipment of dangerous goods or hazardous materials by water on	The control of transfer of dangerous goods from shipping vessels will be undertaken in liaison with the Port Authority, Shipping Agent, Ship Owner and Operator under the development of suitable procedures and operational checklists (ship-to-shore).

Legislation/Policy/Guidance	Consideration within the chapter
vessel. The liaison between operators and vessels transferring (ship to shore) dangerous goods transfer requires compliance with IMDG Code and all personnel who play a role in the maritime shipping or receiving of dangerous goods are required to comply with the IMDG Code. Section 1.3 of this code explains that IMDG shipping training is mandated for all shipping and receiving employees who handle dangerous goods.	Consultation with stakeholders including the Port operator has been carried out during a navigational hazard review workshop. The results of the NRA are described in detail in **Chapter 12: Marine Transport and Navigation [TR030008/APP/6.2]**. Prior to operation, an ERA would be produced for the Project which will use best practice such as the CDOIF methodology described in **Table 22-2**. This assessment would determine the sufficiency of protection measures in the event of a scenario such as a release to the marine environment and conclude if risks are within the tolerable category. Further mitigation measures are listed in **Table 22-6.**

22.3.3 **Table 22-3** presents the key legislation which applies to the facilities included within the Project of relevance to MA&D. The duty holder for these facilities may include operators other than the Applicant (including Air Products in respect of the hydrogen production facility). N/A denotes the legislation is not applicable.

Table 22-3: Applicability of Legislation to Project Facilities and Areas

Project Facility/ Area	COMAH Regulations	Hazardous Substances Consent	Pipelines Safety Regulations
Ships in Transit	N/A	N/A	N/A
Ships in Port	Applicable	N/A	N/A
Pipelines on Jetty Trestle	Applicable	N/A	Applicable
Terrestrial Pipelines (Connecting Process Facilities to Jetty)	Applicable	N/A	Applicable
Process Facilities (inc. Hydrogen and Ammonia Storage)	Applicable	Applicable	N/A

22.3.4 A key aspect of the COMAH Regulations and Hazardous Substances Consent Regulations is the consideration of the compatibility of certain types of new development, such as the Project, with other land uses, in order to maintain adequate separation from residential areas, buildings and areas of public use around major hazards where the development increases the risk or consequences of a major accident. Any new development should not significantly worsen the situation should a major accident occur. The HSE is a statutory consultee during the planning and HSC process and is responsible for advising whether the risks associated with a new development such as the Project are at

an acceptable level. This decision making process includes the use of criteria referred to as 'Consultation Distances' which are zones (referred to above as land use planning zones) established by the HSE around major accident hazard sites and pipelines for planning control.

22.3.5 The HSE's Consultation zones are categorised as either 'Inner', 'Middle' or 'Outer' and a separate category is applied for the safeguarding zones associated with explosive hazards. Within these zones, the HSE's decision making criteria are based on the type of development which is proposed within the zone, the vulnerability of those likely to be present and the societal tolerance of the associated risk. The Inner Zone is closest to the major hazard where risks and hazards are greatest and restrictions on development are strictest. A full description of these zones is found at HSE: Land Use Planning (Ref 22-25). The operator will still need to ensure that the overall risk of a major accident is reduced to ALARP in accordance with the COMAH Regulations (Ref 22-3).

22.3.6 The methodology used by HSE when providing land use planning advice is based on the following principles:

a. The risk considered is the residual risk which remains after all reasonably practicable preventative measures have been taken to ensure compliance with the requirements of the Health and Safety at Work etc. Act 1974 and its relevant statutory provisions.

b. Where it is beneficial to do so, advice takes account of risk as well as hazard, that is the likelihood of an accident as well as its consequences.

c. Account is taken of the size and nature of the proposed development, the inherent vulnerability of the exposed population and the ease of evacuation or other emergency procedures for the type of development proposed. Some categories of development (e.g. schools and hospitals) are regarded as more sensitive than others (e.g. light industrial), and advice is weighed accordingly.

d. Consideration is given to the risk of serious injury, including that of fatality, attaching weight to the risk where a proposed development might result in a large number of casualties in the event of an accident.

22.3.7 The Project is within the consultation distances of a number of major hazard sites and pipelines; this is a key factor which has been taken into account during the Project design and planning. As noted above, an application for HSC has been submitted to NELC in connection with the hydrogen production facility.

22.3.8 The land use planning zones are expected to impact the residential properties located on the west side of Queens Road, which are included within the Site boundary. This is based on a study commissioned by Air Products and completed by DNV which estimated the planning zones based on an assessment methodology which in DNV's experience reflects that used by HSE (HSE does not publish its methodology). This study informed the design process such that the proposed work area locations and what is proposed in each one take into account the sources of major accident hazards to reduce as far as possible the potential land use planning zones. On the basis of this work, once the hydrogen production facility on the West Site is fully operational, it is expected that these

properties will fall within or close to the Inner Zone associated with the operational Project.

22.3.9 The continued residential use of those properties is therefore considered incompatible with the operation of the hydrogen production facility on the West Site and will need to cease. Discussions are ongoing with the owners and occupiers with a view to negotiating the acquisition of the properties by agreement. Where it is not possible to acquire the properties through negotiation, compulsory acquisition powers will be sought through the DCO.

22.3.10 As explained in **Chapter 2: The Project [TR030008/APP/6.2]**, a number of businesses are also present in the same area on the west side of Queens Road. It is considered that the ongoing operation of those businesses will be compatible with the operation of the hydrogen production facility, based on the DNV study referenced in **paragraph 22.3.8** above.

22.4 Assessment Methodology

Overview

22.4.1 There is no set approach for this type of assessment contained within the EIA Regulations (Ref 22-4); however, guidance is available from sources such as IEMA (Ref 22-2) which this assessment is consistent with.

22.4.2 The methodology used in this chapter to identify credible major accidents relevant to the Project is based on an assessment of the properties of dangerous substances which could be present during the lifecycle of the Project, and the activities and operations involving these substances, from construction and operation to decommissioning and demolition.

22.4.3 The geographical location of the Project is also considered, to identify additional major accident scenarios and credible potential disaster scenarios. The Project location establishes the susceptibility of the Site to impacts such as climatic and seismic events and the vulnerability of receptors.

22.4.4 The location of the Site relative to industrial neighbours such as bulk fuel storage and chemical manufacturing facilities, can increase the risk to receptors from incidents which are referred to within the COMAH Regulations (Ref 22-3) as ‘domino effects’. An example of such an event is a fire occurring at a COMAH facility which initiates an incident at a neighbouring COMAH facility. This category of scenario can include events at the Site which can have an effect at a nearby industrial facilities and also events which are initiated at a nearby industrial facility which can reach the Site. The assessment of MA&D considers the potential for these events to occur and describes the approach to prevention and mitigation of the risks associated with domino effects.

22.4.5 The criteria to define the level of harm to people and the environment which would constitute a MA&D is not defined within the EIA Regulations (Ref 22-4). This assessment therefore uses the criteria for notification of a major accident hazard as established in the COMAH Regulations (Ref 22-3).

22.4.6 The COMAH Regulations (Ref 22-3) apply to sites in which quantities of hazardous materials are or could be present above defined thresholds. The substances stored in operational areas of the Project are expected to be present above the threshold quantities established in Annex 1 of the COMAH Regulations (Ref 22-3), and consequently this approach is considered reasonable for the assessment of MA&D carried out for this Project.

22.4.7 Schedule 5 of the COMAH Regulations (Ref 22-3) contained criteria for a major accident which would require notification to the European Commission. Following the exit of the UK from the European Union, this schedule was revoked and such notification is no longer required. Notwithstanding this, this information has been adopted as useful criteria in the identification and assessment of MA&D.

22.4.8 Criteria for a major accident includes the following based on the European Seveso III Directive on the Control of Major Accidents (Ref 22-5):

a. An injury to a person which is fatal.

b. Up to six persons are injured within the establishment and hospitalised for at least 24 hours.

c. One person outside the establishment is hospitalised for at least 24 hours.

d. A dwelling outside the establishment is damaged and is unusable as a result of the accident.

e. The evacuation or confinement of persons for more than two hours, where persons × hrs is at least 500.

f. The interruption of drinking water, electricity, gas or telephone services to persons for more than 2 hours, where persons × hours is at least 1,000.

g. Damage to property in the establishment, to the value of at least €2million.

h. Damage to property outside the establishment, to the value of at least €500,000.

22.4.9 The criteria for damage to the environment, which could be considered to represent a MA&D are also listed in Schedule 5 of the COMAH Regulations (Ref 22-3) and include the following benchmarks:

a. Permanent or long-term damage to terrestrial habitats involving:

   i 0.5 hectares (ha) (equivalent to 5,000 m^2) or more of a habitat of environmental or conservation importance protected by legislation.

   ii 10 or more hectares of more widespread habitat, including agricultural land.

b. Significant or long-term damage to freshwater and marine habitats involving:

   i 10km or more of river or canal.

   ii 1 ha or more of a lake or pond.

   iii 2 ha or more of delta.

   iv 2 ha or more of a coastline or open sea.

c. Significant damage to an aquifer or underground water of 1 ha or more.

22.4.10 Guidance provided by the HSE on the PSR (Ref 22-6) defines a major accident in the context of a pipeline as follows:

a. A major accident would cover death or serious injury from a fire, explosion or uncontrolled emission from a pipeline. This includes both events which have escalated beyond the control of the normal operating envelope of the pipeline and those resulting from third party interference. Whether an event leads to serious danger to people will depend on factors specific to the incident. Major accidents to people can be distinguished from other accidents by the severity of the injuries, the number of casualties, or by the physical extent of the damage in areas where people may be present.

22.4.11 Guidance provided by IEMA (Ref 22-2) includes the following definition of a significant environmental effect in relation to MA&D:

a. Could include the loss of life, permanent injury and temporary or permanent destruction of an environmental receptor which cannot be restored through minor clean-up and restoration.

22.4.12 The definition aligns with that which was contained in Schedule 5 of COMAH Regulations explained above (Ref 22-3).

Approach

22.4.13 The assessment of MA&D has involved the following steps:

a. Collation and review of baseline information pertaining to the hazardous properties of the substances (and their consequences) which are expected to be present during the construction and operation phases of the Project. The hazardous properties of the substances are informed by their classification in accordance with the Classification, Labelling and Packaging (“CLP”) Regulations (Ref 22-18).

b. Identification of hazards and threats based on the design work completed to date and in accordance with industry standard approaches to hazard identification.

c. The determination of the study area and assessment of the Project’s location in relation to the sensitivity of the environment and the potential for natural disasters, such as meteorological hazards, seismic events and climate change impacts was initially considered within the Scoping Report.

d. A review of the conclusions of the scoping and preliminary assessments to identify which natural disasters would be credible MA&D scenarios. The meteorological hazards assessed include the following:

i Flooding following heavy rainfall events (including fluvial, surface water, groundwater, river and sewer flooding).

ii Storms and high wind speeds.

iii Drought, heatwave and extreme humidity.

iv Extreme cold and snow conditions.

v Lightning and electrical storms.

vi Reduced visibility, such as severe fog.

e. An assessment of the potential impacts to and from neighbouring industrial facilities, which includes sites regulated by the COMAH Regulations (Ref 22-3) and PSR (Ref 22-6) i.e. the consideration of the local cluster of industrial sites.

f. Screening of hazards and threats, including the likely significant effects.

g. Assessment of the potential magnitude of impacts that result from credible scenarios, to identify those which may be significant and within the criteria benchmark for a MA&D. The output is a schedule of Risk Events, for which mitigation measures are considered.

h. For credible MA&D scenarios, measures to prevent, minimise and/or mitigate risk have been outlined in this assessment, so far as is possible. Embedded mitigation measures include engineering design by using industry standards, procedural controls and maintenance, fire and gas detection, fire protection and others.

i. Following consideration of the outlined mitigation measures, the residual risks are identified, and a conclusion reached on the tolerability and significance of the residual risks to determine if risks have been reduced to ALARP. A judgement is also provided as to whether these risks constitute significant environmental effects.

22.4.14 The conclusions of the assessment include qualitative and quantitative assessments of the significance of identified foreseeable credible events and the residual risks after mitigation measures are taken into account. Risk management will be part of an ongoing process throughout the lifecycle of the Project and a requirement for compliance with applicable legislation. For example:

a. Operators of COMAH installations are required to demonstrate within a Safety Report submitted pursuant to the COMAH Regulations that the risks associated with the facility have been comprehensively assessed and a conclusion has been reached on the tolerability of risk, including the sufficiency of measures to ensure risk is reduced to ALARP. It is a regulatory requirement that all measures necessary must be taken to reduce risk at COMAH installations and Safety Reports must be updated and resubmitted to the Competent Authority, comprising of the HSE and EA for review every five years, or in other circumstances including prior to any modifications to the establishment or changes to the safety management systems which could have significant consequences for major accident hazards.

b. Installations which carry out one or more defined prescribed activities are subject to the EPR (Ref 22-24), which will apply to the Project. This legislation requires operators to supply detailed information to the regulator (the Environment Agency) in the form of a permit application and only when the application is fully determined and the relevant environmental permit granted, is operation allowed to commence. Compliance with EPR requires

operators to regularly submit information and data such as emissions monitoring results to the Regulator to confirm the Site is operating within permitted limits (as set out in the environmental permit).

c. The Hazardous Substances Regulations (Ref 22-7) require operators to assess the inventory of defined hazardous substances which could be present at the Site against controlled quantities. If the inventory exceeds the controlled quantities, operators are required to obtain an HSC. An application is made to the Hazardous Substance Authority (normally the local planning authority) which is responsible for enforcement. The application must include a description of substances, operations and the identification of the hazards associated with the Site and relevant safety information. For the Project, an application for the Hazardous Substances Consent for the Project has been submitted to NELC.

d. Compliance with the PSR (Ref 22-6) requires operators to operate in accordance with a defined Safety Management System ("SMS") for the pipeline(s) which includes the production of a MAPD. This document must be developed during design to incorporate means to demonstrate that the risks of identified hazards have been evaluated and appropriately managed via means such as inspection. The PSR (Ref 22-6) require performance standards to be established and safety information regularly audited.

Limitations and Assumptions

22.4.15 This assessment has identified the credible, worst-case Risk Events relevant to the Project. The risk of these events is required by legislation to be reduced to a level demonstrated to be ALARP through the careful design and operation of the facilities. At this stage in the Project design the facilities have not yet been fully specified, therefore standard industry approaches to managing risk which are typically adopted at COMAH installations, and which will be required to ensure legislative compliance, have been assumed. These are explained in detail in **Table 22-5**.

22.4.16 The assessment has been based on the hazardous substances expected to be present on site (Jetty and landside) during the construction and operational phases. The quantities of these substances are likely to vary during the Project's development, as the terrestrial phases of the green hydrogen production facility is expanded and built out, although the means of storage and transport would not be expected to vary.

22.4.17 When in operation, the jetty and associated facilities may be used to import and export CO_2 as a bulk liquid from carbon capture and storage installations. CO_2 is not a prescribed substance under COMAH but was assessed in the accident scenarios as it has hazard potential .The risks to individuals and the marine environment from accidental CO_2 releases at the jetty individually and in combination with ammonia has been assessed and considered to be within the 'broadly acceptable region' and ALARP measures and emergency planning for accident scenarios involving both CO_2 and ammonia on the jetty are no more onerous than those for ammonia in isolation

22.5 Study Area

22.5.1 The extent of the study area for the assessment of MA&D is not defined within regulatory guidance or standardised methodology. Accordingly, an area defined by a radius of 5km from the Site Boundary has been applied based on experience and professional judgement in light of the circumstances set out below.

22.5.2 The extent of this study area takes into consideration the proximity of protected environmental receptors such as the Humber Estuary, industrial sites (which include the Humberside cluster of COMAH installations and Major Accident Hazard ("MAH") pipelines) and the residential area of Immingham. These receptors are all located within a 5km radius of the Site Boundary. Expanding the study area beyond 5km would not introduce new categories of receptor or more sensitive receptors of relevance to the assessment.

22.5.3 The study area is shown in **Figure 22.1 [TR030008/APP/6.3]** which identifies nearby major hazard sites, pipelines, and other sites whose land use planning zones may encroach on any part of the Project.

22.5.4 There have been minor changes to the Site Boundary and therefore the study area for MA&D since the publication of the Scoping and PEI Reports (**Appendix 1.A [TR030008/APP/6.4]**). These changes have made no appreciable impact on the study area or the assessment of MA&D.

22.6 Baseline Conditions

Overview

22.6.1 The current baseline environment for the consideration of MA&D has been established through a review of existing information sources. Within the study area shown in **Figure 22.1 [TR030008/APP/6.3]**, industrial facilities are present which are regulated as major accident hazard establishments through the COMAH Regulations (Ref 22-3), as well as major accident hazard pipelines regulated in accordance with the PSR (Ref 22-6). These installations and their corresponding hazards are therefore important factors being taken into consideration as part of the ongoing development of the Project design, in discussion with key stakeholders such as the regulatory authorities, including the HSE and EA.

Existing Baseline - Infrastructure and Industrial Sites

22.6.2 The industrial area of Immingham contains a number of COMAH sites which are regulated in accordance with the COMAH Regulations (Ref 22-3). The numbering of sites [#] corresponds to the locations identified on **Figure 22.1 [TR030008/APP/6.3]**:

a. [1] The Humber Refinery operated by Phillips 66 is located approximately 4 km in a westerly direction from the Site and processes crude oil to produce gasoline, diesel and aviation fuels as primary products.

b. [2] The Lindsey Oil Refinery operated by Prax Ltd is located approximately 5km in a westerly direction from the Site and undertakes similar operations to the Humber Refinery.

c. [3] The Humber LPG Terminal and underground gas storage caverns also operated by Phillips 66 Ltd, located approximately 4km from the Site in a westerly direction.

d. [4] Immingham Docks operated by ABP which comprises a number of discrete operational areas, some of which are COMAH Installations. These facilities store commodities including bulk fuels and fertilizer and include:

   i [4a] IOT) operated by Associated Petroleum Terminals ("APT"), located directly adjacent to the Site. The IOT Jetty and much of the connecting pipework to the nearby refineries is operated as a joint venture on behalf of Phillips 66 and Prax Ltd.

   ii Exolum Immingham Limited (formerly Inter Terminals Ltd) located 1.5km (east terminal [4b]) and 2km (west terminal [4c]) in a westerly direction from the Site.

e. [5] Tronox Pigment UK Ltd operate a chemical manufacturing facility located approximately 1km south-east of the Site.

f. [6] Air Products operate a facility for the manufacture and storage of industrial gases including oxygen and nitrogen which is located approximately 1.5km from the Site in an easterly direction.

g. [7] BOC operate a facility for specialty gas manufacturing and storage operations, located approximately 2km south-east of the Site.

h. [8] The South Humber Bank Power Station owned by EP UK Ltd which is a combined cycle gas turbine ("CCGT") facility supplied by a high pressure gas pipeline, located approximately 2.5km south-east of the Site.

i. [9] Synthomer Ltd operate a chemical manufacturing facility, producing substances such as adhesives and coatings. Location is approximately 2.5km south-east the Site.

22.6.3 The major accident hazard pipelines located in the study area are used to transport gas and petroleum products. These include a high-pressure gas pipeline operated by National Grid located approximately 4km from the Site, in a south-easterly direction, routed to the South Humber Bank Power Station [8]. National Grid also operate 400kV overhead electrical power distribution systems in the vicinity of the Site Boundary.

22.6.4 There are no major airports located within the vicinity of the Project, the closest airport being Humberside which is located approximately 12km in a south-westerly direction. The flight path for services at this airport and other routes crosses the industrial area of Immingham and the Humber Estuary.

22.6.5 In addition to the major accident hazard sites and pipelines, the baseline area consists of critical road, rail and seaport infrastructure and is an important industrial area within the UK. The Port of Immingham [4] currently handles thousands of ship movements per year, including the import of significant quantities of liquid and gaseous fuels. The Port of Immingham is located directly adjacent to the Project, and comprises loading and offloading jetties, bulk storage tanks for hydrocarbon liquids and fertiliser storage. Subterranean caverns [3] for the storage of liquefied petroleum gas ("LPG") are located approximately 3.5km in a westerly direction from the Project.

Existing Baseline – Natural Features and Protected Environmental Sites

22.6.6 The potentially credible disaster scenarios relevant to the Project are largely related to the existing natural features and proximity of protected environmental sites/receptors.

22.6.7 The UK experiences very low levels of seismic activity and there are no significant seismic events recorded by the British Geological Survey ("BGS") for the Humberside region at the nearest seismic monitoring location which is sited approximately 10km south of Humberside Airport.

22.6.8 The Humber Estuary [10] is classified as a Special Protection Area and is a designated Ramsar Site. The estuary is directly adjacent to the Project and contains areas which are designated as Special Areas of Conservation ("SAC") and Sites of Special Scientific Interest ("SSSI"). The wetland areas of the estuary support internationally important numbers of waterfowl in the winter, including golden plovers, and hosts the second largest colony of grey seals in the UK. An incident which has an impact on these receptors could satisfy the criteria for a disaster, and therefore requires consideration.

22.6.9 The bedrock groundwater within the Site Boundary is designated as a principal aquifer via the BGS and EA classification system. This designation corresponds with the most important type of groundwater which supports drinking water supplies and ecosystems. Potential impacts to groundwater are considered within the assessment of Risk Events.

22.6.10 The Humber Estuary is tidal and situated on low-lying land, therefore at risk of tidal flooding. Significant investment has been made in flood defences for this area; however continued efforts are required to combat the potential impacts of climate change. Currently, the flood risk level defined by the EA in the area of the Project is Low to Medium from rivers and the sea, therefore the potential impact of flooding on the Project is considered in this assessment.

22.6.11 Climate change resilience is being incorporated in the design of the Project as necessary. The expectations of the COMAH Competent Authority ("CA") (being the HSE and the EA) are that operators will include an assessment to identify and assess Major Accidents to the Environment ("MATTE") within their Safety Report for the Project. MATTE could include those initiated by climate change consequences, e.g. rising river levels. The assessment of MATTE will contain information on how natural events could directly or indirectly cause a MATTE. Best practice for the methodology to carry out this assessment is provided within

the CDOIF Guidance, which is recognised by the COMAH CA, described in **Table 22-2**.

22.6.12 There are no World Heritage Sites, Scheduled Monuments, Grade I listed buildings, conservation areas, registered parks and gardens, registered battlefields, or protected wreck sites within the 2km study area for designated heritage assets. A detailed assessment of heritage sites is contained in **Chapter 14: Historic Environment (Terrestrial)** and **Chapter 15: Historic Environment (Marine) [TR030008/APP/6.2]**.

Existing Baseline – Human Health and Safety

22.6.13 Immingham is the nearest town to the Project and has a population of around 11,728, located approximately 1.5km in a south-westerly direction. The conurbations of Grimsby (southeast) and Hull (north-west) have populations of around 86,105 and 287,705 respectively.

22.6.14 The closest residential premises to the Project are located on the west side of Queens Road within the western side of the Site and these are listed in **Chapter 2: The Project [TR30008/APP/6.2].** A large number of residential properties are also located approximately 500m to the west of the Site Boundary on the eastern edge of the town of Immingham.

22.6.15 Population and human health receptors include persons present on site during construction and operation as well as the wider external population. Persons present on neighbouring industrial facilities have also been taken into consideration. Off-site sensitive receptors include vulnerable locations such as hospitals, care homes and schools, of which there are a number within the town of Immingham but none closer than 3.5km from the Site. The nearest such sensitive receptor is the Immingham Day Nursery [11].

Future Baseline - Infrastructure and Industrial Sites

22.6.16 The future baseline of the area may include potential new developments located in and around the areas of Immingham, North and South Killinghome and Stallingborough. The IERRT is a development currently going through a separate DCO process and is associated with the development of the Port of Immingham. This facility would primarily service commercial cargo, with some use by passengers (members of the public) and involve construction and operation of marine and landside infrastructure. Further details are contained within **Chapter 25: Cumulative and In-Combination Effects [TR030008/APP/6.2]**.

22.6.17 The nature of the area around Immingham provides an attractive location for major projects and therefore additional industrial developments could be brought forward in future subject to consideration of land use planning zones.

22.7 Project Design and Impact Avoidance

22.7.1 The following impact avoidance measures comprise specific measures incorporated into the Project design (embedded mitigation), and best practice construction or operational measures (standard mitigation) that are typically included within industrial developments similar to the Project. At all stages of the Project appropriate formal risk assessment study processes, for example, Safety in Design, Hazard Identification ("HAZID"), Hazard and Operability ("HAZOP"), Hazards in Construction ("HAZCON") and ultimately ongoing Process Hazard Assessment ("PHA") will be undertaken. The Safety Report submitted to the Competent Authority will require the operator to demonstrate that these risk assessments have been undertaken.

22.7.2 These embedded and standard measures have therefore been taken account of in the impact assessment process on the basis that they will be delivered and implemented as part of the Project.

Design

22.7.3 During the Project design process, a number of design risk assessment studies (see **paragraph 22.7.1** above) with regard to process safety and safeguarding, isolation, emergency shutdown, and if required, depressurisation have been developed by Air Products for the hydrogen production facility and associated jetty topside infrastructure (and would be a requirement of the Safety Case Report to be submitted before construction under the COMAH Regulations).These hazard study methodologies follow an industry best practice approach in design safety and contribute in developing a satisfactory duly made COMAH Safety Case Report to demonstrate ALARP (As Low as is Reasonably Practicable).

22.7.4 Engineering philosophies produced for the process systems set out the standards to be applied in the design of equipment and pipework containing hydrogen and ammonia and would be a requirement of the Safety Report, including:

a. Design of ammonia storage in accordance with American Petroleum Institute ("API") 625 Tank Systems for Refrigerated Liquefied Gas Storage (Ref 22-33) which incorporates safety systems such as integral containment also known as 'double-skin' construction. This prevents a release of ammonia in the event of a failure within the primary containment area.

b. The ammonia storage tank is currently the subject of a Best Available Techniques ("BAT") assessment, being carried out by a specialist to determine the most appropriate design. The output of this assessment will be documented within the Environmental Permit application for the Project.

c. Emergency pressure relief systems for refrigerated storage tanks will also be designed in accordance with API 625 (Ref 22-33).

d. Pressure relief systems and devices will be designed in accordance with API 520 Sizing, Selection, and Installation of Pressure-Relieving Devices (Ref 22-34) and API 521 Pressure relieving and Depressuring Systems (Ref 22-35).

e. Liquid hydrogen process and storage facilities will be designed in accordance with guidance published by the EIGA document reference 06/18 (Ref 22-36).

22.7.5 The Project design process involves a number of process safety studies. A description of the studies which have been carried out for the Project to date is contained in **Section 22.8** along with a summary of how these studies will be developed as the engineering design of the Project is progressed. **Section 22.8** describes the formal process safety reviews which include HAZID and HAZOP which are a standard approach to risk management and have been applied to the engineering design of industrial facilities in the processing industries worldwide for decades. The objective of these assessments is to identify, eliminate, prevent or minimise hazardous scenarios through appropriate design during all stages of the facility lifecycle, from concept and Front End Engineering Design ("FEED") studies, progressing through detailed design, construction, operational and eventual decommissioning phases.

22.7.6 A Major Accident Prevention Plan ("MAPP") will be prepared to support the notification to the HSE of the hydrogen production facility as a COMAH establishment. This document is a high level policy statement which establishes the commitments made by the management team for the COMAH establishment to the prevention of major accidents. The commitments within the MAPP are delivered by the Safety Management Systems ("SMS") for the establishment, which comprises operational and emergency procedures. These documents will be reviewed by the COMAH CA to establish if they are suitable and sufficient to permit operation of the Project.

22.7.7 A MAPD will be developed for the pipelines. This is a comprehensive report which includes assessments to demonstrate that the hazards associated with the pipelines with the potential for a major accident have been identified and evaluated, and the risks reduced to ALARP. This document also includes a description of the SMS which applies specifically to the pipeline.

22.7.8 The CDM regulations (Ref 22-8) will be followed as required throughout the design phase which includes the development of design Risk Register(s). These are live documents, maintained by the Project Manager throughout the design and construction phases of projects to identify and document risks, assign ownership, priority and mitigation measures.

Construction

22.7.9 Formal risk assessments to identify potential hazards during construction ("HAZCON") are typically carried out prior to completion of the design phase for process facilities such as the Project to ensure compliance with the COMAH Regulations. This will involve development of the pre-construction information package to be included in the tender documents for review by the Principal Contractor. Once appointed, the Principal Contractor will develop a Construction Phase Plan in compliance with CDM Regulations. It is anticipated that the construction of this facility will be a HSE notifiable project.

22.7.10 During construction, a formal risk assessment of the potential hazards of simultaneous operations ("SIMOPS") will be carried out (in order to comply with the CDM Regulations) where activities at the Project are in close proximity to

existing operational facilities and there is a potential for conflict. This risk assessment will involve representatives from the Project alongside stakeholders such as neighbouring facilities, electricity and gas transmission specialists where there are existing high voltage electrical systems and gas pipelines and others as appropriate.

22.7.11 Established protocols will be used (to comply with HSWA) to develop Safety Systems of Work for activities carried out in the vicinity of high pressure ("HP") gas transmission pipelines and high voltage ("HV") electricity transmission systems. These protocols include guidance documents published by the HSE, National Grid and other network operators.

a. HP gas pipelines can operate at pressures up to 90 barg and are normally buried to a depth of at least 1.1 m. An excavation of 0.3 m or more above the pipeline must have prior agreement with the pipeline operator whose representative will typically be on site while the work is in progress to provide information and supervise activities.

b. HV electrical cables operate at voltages up to 400 kV and can either be connected to overhead transmission systems or buried below ground level. There are defined clearance distances to be observed between these cables and any structure or work activity.

22.7.12 The use of suitably experienced contractors, risk assessments, working method statements, operating procedures and personnel training minimise the risk of accidental scenarios occurring during construction of the Project.

22.7.13 An Outline CEMP has been prepared **[TR030008/APP/6.5]** as part of the DCO application. This sets out how construction measures and activities would be managed and controlled in compliance with accredited health and safety and environmental management systems, relevant legislation and environmental permits, consents and licences. Requirements in the draft DCO **[TR030008/APP/2.1]** will ensure that the Final CEMP is prepared substantially in accordance with the content of the Outline CEMP **[TR030008/APP/6.5]** and complied with.

Operation

22.7.14 As noted above, a HSC issued by the local authority, a COMAH Safety Report and pipelines MAPD approved by the HSE, and an Environmental Permit issued by the EA would be required for the operation of the Project. These consents and documents require 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 Environmental Permit would require the approach to managing accidents and emergencies to be in accordance with BAT.

Decommissioning of the hydrogen production facility

22.7.15 Similarly with construction and operation, formal process safety studies and risk assessments would be carried out to identify potential hazards prior to decommissioning and demolition of the hydrogen production facility. These studies would be carried out in accordance with industry best practice such as Hazards of Demolition ("HAZDEM"). These studies are typically prepared by a team of specialists to identify potential hazards, consider the associated risks and specify the appropriate mitigation and control measures required. As explained in **Chapter 2: The Project [TR030008/APP/6.2]**, the jetty, which comprises the Nationally Significant Infrastructure Project, would not be decommissioned, as it would become part of the port infrastructure and would be maintained and refurbished as necessary in accordance with this status.

22.8 Assessment of Likely Impacts and Effects

22.8.1 This section describes the hazardous properties of the substances which would be present on site during the lifecycle of the Project and potentially hazardous activities which have the potential to be a credible major accident scenario.

Construction

22.8.2 The potentially harmful substances which would be present during the construction phase include liquid cement and diesel fuel oil.

22.8.3 Cement and mixed liquid concrete 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 and if cement or wet concrete enters drains or watercourses, there is the potential to cause harm to the environment via an increase in the pH of water.

22.8.4 Diesel is likely be used within mobile power generators, construction plant and construction vehicles, even if it is possible that some of the construction plant and vehicles will use alternative power sources. This substance is classified as a flammable liquid and harmful to the aquatic environment. A release which is ignited could cause harm to people via exposure to thermal radiation in a fire, or if unignited, diesel can cause harm to people if inhaled, ingested or exposed to skin. A release of diesel to the environment such as the Humber could result in harm to flora and fauna.

22.8.5 Construction work can include potentially hazardous activities such as working near to overhead power supplies or buried services such as power cables and gas transmission mains. Accidents have occurred historically due to contact with HV electricity supplies, the collapse of excavations and structures during construction which have resulted in fatal injuries to workers on site.

Operation

22.8.6 When operational, the terminal would receive consignments of liquefied refrigerated ammonia delivered via ship to the jetty, where it would be transferred for storage in tanks onshore prior to use. Hydrogen gas would then be produced by the splitting of ammonia within process operations using the hydrogen

production units described in **Chapter 2: The Project [TR030008/APP/6.2]**. The hydrogen gas would then be cooled and liquefied prior to filling into bulk road tankers for delivery to end users. The hydrogen gas would also be directly compressed and transported in tube trailers or used for refuelling Air Products own tankers on Site. Hydrogen gas may also be delivered by pipeline to local customers, but this system would be subject to any separate applications for consents as may be necessary, and therefore is not included within this assessment.

22.8.7 Utility services supporting hydrogen production operations would include compressed air, nitrogen, natural gas (used as a source of energy, at least in the initial stages of the Project) and electrical power supplies. Cooling water would also be used, which would be circulated in a closed loop through the process with a purge stream to maintain water quality. Process wastewater would be treated on Site prior to discharge to the local sewerage system. Water would also be stored for the purposes of firefighting. Small quantities of substances such as biocides and scale inhibitor would be used to treat water on Site for use in the process, and while these substances can be categorised as dangerous to humans and the environment, the quantities used on Site are expected to be small.

22.8.8 Refrigerated anhydrous ammonia is classified as a flammable gas however the primary hazard associated with this substance is related to its toxicity. If released, ammonia can form explosive mixtures in air if allowed to accumulate in confined spaces. Ammonia does not however sustain combustion.

22.8.9 Ammonia is toxic to people if inhaled and causes severe skin burns, eye damage and respiratory irritation. It can be harmful to flora and fauna.

22.8.10 Ammonia is toxic to the environment if released to water and is incompatible with certain substances, such as oxidants e.g. sodium hypochlorite (bleach), which reacts with ammonia to release chlorine gas. No ammonia incompatible substances would be present in significant quantities on Site.

22.8.11 The most common cause of injuries to people associated with ammonia are as a result of gas inhalation. Serious incidents involving ammonia are rare events, when considering the very large number of operating hours of facilities handling ammonia in continual industrial processes. Where they have occurred, extensive investigations are carried out to identify lessons which can be learned to improve safety within industrial usage. Examples of such incidents include the ammonia release at a Petronas facility in Malaysia (Ref 22-14) and the Medicine Hat facility in Canada (Ref 22-15).

22.8.12 Hydrogen is an extremely flammable gas, with a wide flammable range (4% to 77% by volume) and can form explosive mixtures in air. The hazardous properties of hydrogen are well understood by industrial operators and there is a substantial body of safety regulation and industry guidance associated with the equipment used to store and use this material. Serious incidents involving hydrogen are rare. An example of an incident involving a release of hydrogen is the explosion at a chemical manufacturing facility in Illinois in 2019 (Ref 22-16).

22.8.13 Natural gas used as a source of fuel for the hydrogen production units is classified as extremely flammable and can form explosive mixtures in air. The consequences of a loss of containment of natural gas would be substantially similar to hydrogen, however the quantity of hydrogen would be substantially greater than natural gas, if a release were to occur. Legislative controls and engineering standards for equipment and pipework design and other mitigation measures to reduce risk are very closely aligned with those for hydrogen and consequently this assessment focuses on hydrogen as the primary flammable gas.

22.8.14 When in operation, the jetty and associated facilities may be used to import and export CO_2 as a bulk liquid from carbon capture and storage installations. This system would be subject to any separate applications for consents for associated landside development and any permits as may be necessary. Unlike ammonia, CO_2 is not a prescribed substance under COMAH Regulations and ALARP measures and emergency planning for accident scenarios involving both CO_2 and ammonia together are no more onerous than those assessed for ammonia in isolation.

22.8.15 Small quantities of substances such as mineral and synthetic lubricating and hydraulic oils would be used for equipment on Site with moving parts, such as pumps and compressors. These fluids are not generally categorised as hazardous and are of low flammability but are combustible in the event of a fire and may cause harm to the environment if released to water. The quantity of these materials is, however, expected to be small and would typically be stored in containers not exceeding 1,000 litres capacity as well as water treatment chemicals including small qualities of acid, hypochlorite and biocides which would be stored in bunded containers.

22.8.16 Process operations would include hazardous activities by virtue of the dangerous substances present on Site. A robust SMS is a requirement of the COMAH Regulations (Ref 22-3) and would be in place prior to operation to ensure operational risks are reduced to ALARP.

Jetty and Marine Operations

22.8.17 The vessels used to deliver refrigerated ammonia would be Very Large Gas Carriers (“VLGCs”). In order to assess a worst case and particularly in relation to the climate change considerations (see **Chapter 19: Climate Change [TR030008/APP/6.2]**), it is assumed that the VLGC, would initially be powered by marine fuel oil (“MFO”) which is a liquid hydrocarbon mixture similar to diesel fuel. If released, MFO is toxic to the aquatic environment, it is classified as a flammable liquid and vapour and is harmful to people. In the longer term, it is anticipated that the existing VLGC fleet for ammonia imports would be replaced by a fleet powered by sustainable low carbon fuels. Over the long term, a similar transition can be expected across the marine fleet, to include similar vessels in the carbon capture sector which are expected to use the new terminal.

22.8.18 VLGC vessels would contain ballast water which provides stability. This water can be contaminated with biological material such as pathogens native to the water of the country of origin of the delivery vessel. The vessel would also

contain grey water from washing and black water from toilet facilities. If released to the Humber, these waste waters could be harmful to the environment.

22.8.19 Jetty loading/offloading systems typically contain hydraulic oils, which are synthetic, non-flammable fluids. If released to water, these could potentially cause harm by forming a film on the surface which inhibits oxygen transfer. The quantities of hydraulic fluids present in the systems would be small and any release would be considered trivial, and an accidental release would be unlikely to reach the criteria for a potential major accident to the environment. Control of pollution during the operational phase of the Project is covered further in **Chapter 17: Marine Water and Sediment Quality** and **Chapter 18: Water Use, Water Quality, Coastal Protection, Flood Risk and Drainage [TR030008/APP/6.2]**.

22.8.20 The operational activities carried out at the jetty and the VLGC would, in relation to the hydrogen production facility, primarily be the offloading of refrigerated ammonia. This would be undertaken in a substantially similar manner to the loading and offloading of hazardous gases undertaken for many years at the Port of Immingham, in accordance with established safety procedures.

Demolition of the hydrogen production facility

22.8.21 The hazards associated with activities carried out during demolition are substantially the same as construction, however, as the process equipment and pipework have contained dangerous substances, additional safety precautions are required. These include gas purging, venting and cleaning processes and catalyst removal to ensure no hazardous substances remain prior to dismantling and demolition.

22.8.22 **Table 22-4** presents the results of the assessment of the hazardous properties of substances and activities, geographic location of the Project and the baseline study area, to identify credible MA&D scenarios, termed “Risk Events”. Further analysis of Risk Events will be undertaken to support the COMAH Safety Report and relevant Safety Case(s).

Table 22-4: Identification of Major Accident & Disaster Categories

Ref.	Hazard Category	Impact/Receptor	Credible MA&D
Construction Activities Credible hazard categories associated with construction activities include accidental damage to existing service infrastructure such as electrical power, gas and oil pipelines. Consequences of such incidents generally depend on the extent of contact made and proximity of people and sensitive receptors.			

Ref.	Hazard Category	Impact/Receptor	Credible MA&D
1	Release of Raw Materials used in Construction Activities A release of construction materials e.g. liquid concrete, diesel (used for power generation). Potential for minor harm to people if exposed to liquid cement, and/or diesel. Potential for minor harm if substances released to environment (due to quantities likely to be released).	Potential minor impact to human health (on-site workers) and environmental receptors on Site.	No
2	Construction Activities – Electrical Systems Strike Impact with overhead electrical transmission system e.g. crane impact on high voltage (HV) electrical cable or underground cable strike during excavation. Potential for harm to people including fatal injuries. Potential interruption to local electrical power supplies.	Potential significant impact to human health and safety on Site. Interruption to local power supplies.	Yes Risk Event 1
3	Construction Activities – Underground Gas Main/ Unexploded Ordnance (“UXO”) Strike Impact with underground gas main during excavation activities. Potential for UXO on the Site. Potential for a significant release of gas leading to fire and/or explosion, with harm to people including potential for fatal injuries. Potential explosion in event of UXO strike. Potential interruption to local gas supplies.	Potential significant impact to human health and safety on-Site and off-Site. Interruption to local gas supplies.	Yes Risk Event 2
4	Construction Activities – General/Other Incident during construction e.g. structural collapse of building(s), excavation collapse, collisions from construction vehicles. Potential for significant harm to people on-site (construction workers) including potential for fatal injuries.	Potential significant impact to human health and safety on-Site.	Yes Risk Event 3
Operational Activities (Commissioning and Commercial Operation) Credible hazard categories associated with process equipment failure, malfunction, accidental damage, vehicular impact, disturbance etc., resulting in the loss of containment of hazardous substances. The consequences depend on the type and quantity of substance released, which are considered below as fire/explosion/toxic release/environmental harm.			

Ref.	Hazard Category	Impact/Receptor	Credible MA&D
5	Fire Significant loss of containment of ammonia, hydrogen or natural gas which immediately finds a source of ignition. Potential for harm to people including fatal injuries. Potential for harm to the environment via release of contaminated firewater. Potential for damage to assets including buildings. Potential for domino effect, escalation to other areas on-site and off-site including nearby COMAH installations.	Potential significant impact at: Human health and safety – on-Site & off-Site populations. Environment - Humber Estuary	Yes Risk Event 4
6	Explosion /Energy release Significant loss of containment of ammonia, hydrogen or natural gas which accumulates, and ignition is delayed, resulting in an explosion. Impact depends on release point and level of congestion within process structures on-Site. Potential for harm to people including fatal injuries. Potential for damage to assets e.g. overhead power transmission systems, with subsequent loss of power to neighbours. Potential for domino effect, escalation to other areas on-Site and off-Site including nearby COMAH installations.	Potential significant impact at: Human health and safety – on-Site and off-Site populations. Environment – Humber Estuary	Yes Risk Event 5
7	Toxic (Ammonia) Release Significant loss of containment of ammonia gas from onshore facilities. Consequences include potential for significant harm to people exposed to high concentrations of ammonia gas. Potential for harm to people including fatal injuries. Rainout and/or dissolution in air to form ammonium hydroxide therefore potential for harm to the environment. Emergency services may issue shelter in place orders for neighbours until the incident has been resolved.	Potential significant impact at: Human health – on-Site and off-Site populations. Environment - Humber Estuary, soil and groundwater.	Yes Risk Event 6

Ref.	Hazard Category	Impact/Receptor	Credible MA&D
8	Asphyxiant (Nitrogen) Release Significant loss of containment of nitrogen gas from onshore facilities. If released into a confined area on-site where people are present, there is the potential for a release of nitrogen to result in harm via asphyxiation. If released to an open area, this gas would disperse, and concentrations would reduce to level which would not cause harm. Potential for harm to onsite workers including fatal injuries. In all scenarios, the concentrations of nitrogen at off-Site receptors would not be sufficient to cause harm to people or the environment. Design and operational measures provide high integrity containment systems and measures for safe disposal of nitrogen, therefore not considered a credible MA&D scenario.	Potential significant impact at: Human health – on-Site.	No
9	Release of Substances into the Marine Environment Scenarios include an accidental loss of containment of marine fuel oil or black grey/ballast water from marine transport. Incidents involving vessels at sea and during berthing could cause a loss of containment for example via accidental impact with other vessels or port infrastructure. A release of flammable substances could result in a fire if ignited, causing harm to people and the environment. A release of ammonia could have a significant impact on people onboard the vessel and at the port. Potential for harm to flora and fauna located at the Humber Estuary. The substances present on board vessels associated with the Project have potential for harm to the water environment if released, via an increase in Chemical and or Biological Oxygen Demand (COD/BOD) levels.	Potential significant impact at: Human health and safety (fire which affects persons on board vessel and/or at jetty). Environment - Humber Estuary.	Yes Risk Event 7

Ref.	Hazard Category	Impact/Receptor	Credible MA&D
10	Loss of Containment of Transported Dangerous Goods (by road) Collisions/accidents involving road tankers containing hydrogen causing loss of containment, potential subsequent fire and/or explosion. Potential for significant harm to people in the vicinity of the incident who are exposed to high levels of thermal radiation and/ or explosion overpressures. Potential for damage to property located near to incident. Emergency services may close roads and potential to interrupt power and water supplies in the event of damage to infrastructure.	Potential significant impact at: Human health and safety population (off-Site).	Yes Risk Event 8
Decommissioning Activities Credible hazard categories associated with decommissioning activities include accidental damage to existing service infrastructure such as electrical power, gas and oil pipelines.			
11	Decommissioning Activities – Dismantling Vessels and Pipework Incident occurring during decommissioning e.g. dismantling pipework and vessels using equipment which could generate a spark such as electrical grinders and saws. If systems have not been fully de-inventoried or isolated i.e. still contain flammable material there is the potential for fire and/or explosion causing harm to people on-Site. Causes include operator errors or lapses, failure in safety management systems. Failure to isolate electrical supplies prior to work on site could also result in harm to workers e.g. electrocution, arc flash injury.	Potential significant impact to human health and safety on-Site.	Yes Risk Event 9
Disasters Credible disaster categories include intentional malicious damage to assets and infrastructure (e.g. vandalism) and potential impacts of adverse weather including future climate change effects. Consequences of such incidents generally depend on the extent of the harm caused, the proximity of people and sensitive receptors.			

Ref.	Hazard Category	Impact/Receptor	Credible MA&D
12	Malicious Damage/Conflict/Arson Various scenarios resulting in loss of containment of hazardous substances such as malicious damage to process storage tanks or pipework including Theft/malicious damage /terrorist threat - external interference - (damage to the pipelines/power supplies) Consequences are considered above - see fire/explosion/toxic release scenarios.	Potential significant impact at: Human health and safety – on-Site and off-Site populations. Environment - Humber Estuary.	Yes (as fire/ explosion/ toxic release). Considered in Risk Events 4, 5, 6
13	Domino Event Various scenarios such as fire and/or explosion at a neighbouring facility, such as the nearby oil storage terminal, high pressure gas pipeline or others which has an impact at the Site. This category of Risk Event also includes incidents initiated at the Site which could potentially escalate and have an impact at facilities within the local industrial cluster. The potential impacts to and from the Project can include loss of containment via thermal radiation related failure mechanisms or accidental impact damage from projectiles generated during an explosion.	Potential significant impact at: Human health and safety – on-Site and off-Site populations. Environment - Humber Estuary.	Yes (as fire/ explosion/ toxic release) Considered in Risk Events 4, 5, 6
14	Seismic Event/Landslide A seismic event such as an earthquake could cause structural damage to process equipment, pipework, infrastructure and buildings causing loss of containment. Consequences considered above in Risk Events 4, 5, 6.	Potential significant impact at: Human health and safety – on-Site and off-Site populations. Environment - Humber Estuary.	No (plant and equipment will be designed for the appropriate seismic zone).

Ref.	Hazard Category	Impact/Receptor	Credible MA&D
15	Storms/Flooding/Climate Change/Storm Surge Potential for pluvial and fluvial flooding which reaches the Site and overwhelms drainage systems. A major flooding event has potential to cause asset damage leading to loss of containment of dangerous substances. The consequences of such a loss of containment are considered above. Lightning strike during a storm has potential to cause ignition of highly flammable gas if this were to occur while material was being vented directly to atmosphere. This would however be a very unlikely event.	Potential significant impact at: Human health and safety – on-Site and off-Site populations. Environment - Humber Estuary	Yes Risk Event 10

22.8.23 The potential initiating causes and impacts from the MA&D scenarios identified in **Table 22-4** are considered in further detail within **Table 22-5**.

22.9 Mitigation and Enhancement Measures

22.9.1 Project objective (d) is to minimise adverse impacts on the environment and safeguard the health and safety and amenity of local residents. A number of additional mitigation measures, over and above the embedded and standard measures, are described in this section; these will contribute to the safe delivery of this objective.

22.9.2 The hydrogen production facility is being developed to produce green hydrogen to replace fossil fuels and natural gas, for use particularly in the UK's transport sector, where other sources of renewable energy cannot be used.

22.9.3 Hydrogen is highly flammable, and therefore the potential for Risk Events such as those identified in **Table 22-4** cannot be entirely eliminated. Risks must therefore be carefully controlled, and reduced to ALARP via mitigation measures, as required by the COMAH Regulations (Ref 22-3). Production of hydrogen employs ammonia, which is a commonly used industrial substance. Ammonia is a toxic material and there are associated risks with its use, however, these risks would be appropriately managed by applying safety and environmental control measures. Unlike ammonia, CO_2 is not a prescribed substance under COMAH regulations and ALARP measures and emergency planning for accident scenarios involving both CO_2 and ammonia together are no more onerous than those assessed for ammonia individually.

22.9.4 The additional mitigation measures employed to prevent a loss of containment for gaseous substances are substantially similar for ammonia, hydrogen and natural gas.

22.9.5 The additional mitigation measures associated with the identified credible MA&D scenarios for the Project are presented in **Table 22-5** and **Table 22-6**. The measures presented are not an exhaustive list, as it is not possible to provide full details of all the extensive safety assessments, infrastructure, systems and

processes that will be in place throughout the lifecycle of the Project. This list of additional mitigation therefore presents an overview of the key measures to illustrate how risk management will be undertaken during the continued engineering and design-development of the Project. The relevant measures will be identified in and secured through approval of and compliance with the CEMP, CDM Regulations, EPR and COMAH Safety Report plus Health and Safety at Work Act (HASW) 1974. In addition, the port itself has an Emergency Plan and there is also an Emergency Plan for serious marine incidents on the estuary.

Table 22-5: Assessment of Major Accident & Disaster Risk Event Scenarios

Risk Event	Risk Event Description	Summary Description of Risk Event	Risks and Consequences before Additional Mitigation	Additional Mitigation Measures	Mitigated to ALARP?
1	**Contact with high voltage (HV) electricity (overhead or underground)**	Contact with overhead electrical transmission system e.g. crane impact on HV electrical cable or underground cable strike during excavation. Contact with overhead HV electricity cables can occur via accidental contact with the jib of construction cranes. Similarly, during excavation, contact of an excavator bucket with underground electrical cable.	Potential for harm to construction workers including fatal injuries. Potential interruption to local electrical power supplies.	Project notifications would be communicated to utility service providers, including National Grid and others. This service ensures up-to-date information is available on the location of above and below ground electrical cables on drawings/maps. Locations of utilities will be confirmed by use of specialist tools to detect underground cables and pipes. During the construction phase of the Project, activities which would be carried out in proximity to HV electrical distribution networks would be carefully controlled via risk assessments. Appropriate techniques including hand-dig would be used as required by these risk assessments. Protective measures and safety signage would be used to alert personnel to overhead and below ground electrical hazards. Only suitably qualified and experienced personnel (“SQEP”) would operate	**Yes**

Risk Event	Risk Event Description	Summary Description of Risk Event	Risks and Consequences before Additional Mitigation	Additional Mitigation Measures	Mitigated to ALARP?
				equipment such as cranes and excavators.	
2	**Contact with underground gas main or UXO**	Potential for UXO on Site and gas transmission infrastructure. Impact with gas main/UXO during excavation activities causing a release of gas and fire/or explosion.	Potential for harm to construction workers including fatal injuries. Potential for harm to people off-Site via thermal radiation/explosion projectiles. Potential interruption to gas supplies used for power generation and to local industry and residents.	Measures as Risk Event 1 for underground services such as gas mains. The Project would work with UK Gas Transmission services to ensure work is carried out safely where gas infrastructure has been identified as present. An UXO survey would be completed for the Site and any remedial activities safely completed prior to construction commencing.	**Yes**
3	**Construction incident – structural collapse, collision**	Incident such as structural collapse of building(s) and/ or process structures caused by inadequate design, accidental impact from vehicle, malicious interference and so forth. Excavation collapse caused by inadequate supports.	Potential for significant harm to construction workers including fatal injuries.	The engineering design of the Project, in particular civil and structural engineering would be carried out in accordance with all applicable legislative requirements and associated industry standards. Groundworks to ensure site stability would be carried out as part of the Project development. Equipment and vehicles used during construction would be carefully selected	**Yes**

Risk Event	Risk Event Description	Summary Description of Risk Event	Risks and Consequences before Additional Mitigation	Additional Mitigation Measures	Mitigated to ALARP?
		Collisions with vehicles, such as overturning or when reversing.		and appropriate temporary construction access installed. Security controls would be in place throughout construction including guards and CCTV to prevent unauthorized access to Site.	
4	**Fire**	Significant loss of containment of flammable substance (principally hydrogen or natural gas) caused by accidental damage or failure of containment systems. Fire could also be initiated via malicious damage/conflict/arson. Potential for fire at a neighbouring major hazard installation to escalate to site via domino effect. Also, potential for fire at the Site to have an impact on neighbouring sites. Storm events such as flooding could initiate a	Potential for significant harm to people on-Site, including fatal injuries and harm to people off-Site via thermal radiation. Potential for domino effect, escalation to other areas on-Site and off-Site including COMAH installations. Escalation of the fire to other installations at the Port of Immingham could initiate emergency plans at those sites causing a significant disruption to critical facilities, along with potential harm to persons on those sites	Measures included in design to reduce the potential for a loss of containment include the following: - Engineering design of the facility by experienced, qualified personnel. - The specification, construction and installation of equipment and pipework to industry codes and standards. - The design of hydrogen vents will be in accordance with EIGA Doc 06/19 (Ref 22-36). This guidance includes a specification for height of the hydrogen vent stack outlet which should be either 7m above ground level or 3m above the top of the tank whichever is the greater for protection of the operating personnel and equipment. - Plant design and plant layout to keep hazardous substances as far as is practical from offsite receptors.	**Yes**

Risk Event	Risk Event Description	Summary Description of Risk Event	Risks and Consequences before Additional Mitigation	Additional Mitigation Measures	Mitigated to ALARP?
		loss of containment via damage to assets. A release of hydrogen can ignite as a result of friction during discharge resulting in a fire. Lightning strike could ignite flammable gas/vapour released from vent stack or relief valve. Flammable gas which finds a source of ignition will result in a flash or jet fire.	and damage to their assets. Potential for direct harm to the environment from thermal radiation such as impact on flora and fauna near to Site. Also, harm to the environment via release of contaminated firewater to environmental receptors including the Humber Estuary. Emergency services are likely to advise local residents to close doors and windows and remain indoors for the duration of the event.	- HAZID and HAZOP studies carried out for the Project as described in **Section 22.8** to eliminate hazards where possible, determine requirements for protection and mitigation systems and identify hazards which require further assessment. - Engineering design risk assessments and QRA carried out to demonstrate ALARP as required by the COMAH Regulations (Ref 22-3). - Domino discussions with neighbouring COMAH facilities - Use of fully welded connections rather than flanged connections for gaseous systems. Flange guards are to be fitted as necessary where welding is not practical. - The Pressure Systems Safety Regulations 2000 (“PSSR”) (Ref 22-17) apply to equipment and pipework at the Site. Compliance with PSSR requires detailed scheduled inspection and testing to prevent a loss of containment. - Certification of equipment by notified bodies prior to use which demonstrate “fit for purpose” equipment.	

Risk Event	Risk Event Description	Summary Description of Risk Event	Risks and Consequences before Additional Mitigation	Additional Mitigation Measures	Mitigated to ALARP?
				- Control systems to be installed to continuously monitor process parameters including pressure and temperature. - Safety instrumented systems would be designed, operated and maintained in accordance with guidance documents BS 61508/11 (Ref 22-11,Ref 22-12) which is recognised as providing best practice. - Fire and gas detection and alarm systems would be in operation. - Passive and active fire suppression systems would be employed subject to risk assessments. - Although not generally considered flammable (due to narrow range of flammability) ammonia will be routed to a flare system for safe disposal in the event of a process upset. Natural gas systems will also be routed to a flare for safe disposal. - In the event of a process upset, hydrogen would be routed to a vent system for disposal. The vent system will be designed to safety vent hydrogen in accordance with EIGA 06/19 (Ref 22-36).	

Risk Event	Risk Event Description	Summary Description of Risk Event	Risks and Consequences before Additional Mitigation	Additional Mitigation Measures	Mitigated to ALARP?
				- All process areas of Site would be subject to hazardous area classification, to determine where mechanical and electrical equipment is to be certified in accordance with the Appareils destinés à être utilisés en ATmosphères EXplosives (“ATEX”) Directive (Ref 22-18), to reduce the risk of an active source of ignition. This would be carried out as part of the programme of compliance with the DSEAR (Ref 22-9) at the Project. DSEAR implements both EU ATEX directives, the ‘equipment directive’ (Ref 22-18) and the ‘workplace directive’ (Ref 22-19) into UK Legislation. Currently, no changes are planned to these Regulations as a result of the UK leaving the EU. Determination of hazardous area classification will be in accordance with methodology provided by Energy Institute Model Code of Safe Practice Part 15 – Area Classification for Installations Handling Flammable Fluids (Ref 22-28). - Anhydrous ammonia would be stored and handled as a liquid in a	

Risk Event	Risk Event Description	Summary Description of Risk Event	Risks and Consequences before Additional Mitigation	Additional Mitigation Measures	Mitigated to ALARP?
				cold/refrigerated condition. This is inherently safer than storing, handling, and transporting as a compressed gas at ambient temperature and high pressure. The management and operational controls to reduce the potential for a loss of containment include the following: - Operation and management of the facility by experienced, qualified personnel. - Security systems to be deployed including cyber security. - Operability risk assessments carried out during design phase. - An SMS would be developed and in place prior to operation, incorporating Management of Change (“MoC”) procedures. - Planned preventative maintenance systems to prevent equipment defects and failures. - Inspection regimes to detect corrosion and other mechanisms which could lead to equipment defects.	

Risk Event	Risk Event Description	Summary Description of Risk Event	Risks and Consequences before Additional Mitigation	Additional Mitigation Measures	Mitigated to ALARP?
				- Emergency planning and response procedures including regular live tests. - A risk assessment in accordance with DSEAR (Ref 22-9) would be produced prior to operation including Hazardous Area Drawings. These drawing define areas where electrical and mechanical equipment is to be appropriately certified in accordance with the ATEX Directives (Ref 22-18,Ref 22-19).	
5	**Explosion/Energy release**	Significant loss of containment of ammonia, hydrogen or natural gas caused by accidental damage or failure of containment systems. Explosion could also be initiated via malicious damage/conflict/arson. Potential for incident at a neighbouring major hazard installation to escalate to Site via domino effect and vice versa.	Potential for significant harm to people on-Site, including fatal injuries and harm to people off-Site via explosion overpressure. Potential for damage off-Site such as broken glass, impact from projectiles. Potential for damage to critical assets e.g. overhead power transmission systems. Potential for domino effect, escalation to	The design and operating mitigation measures are the same as those defined for Risk Event 4, which is a major fire. Principally, these measures involve preventing a loss of containment by applying industry standards and best practice to the engineering design of the facilities which would be subject to rigorous safety assessments. These measures are a fundamental requirement for legislative compliance, without which the facility would not be permitted to operate. On Site occupied buildings will be designed to withstand explosion overpressures which will be determined using the Phast consequence modelling	**Yes**

Risk Event	Risk Event Description	Summary Description of Risk Event	Risks and Consequences before Additional Mitigation	Additional Mitigation Measures	Mitigated to ALARP?
		If released gas accumulates and ignition is delayed, an explosion could occur. Degree of impact depends on release point and level of congestion within process structures on-Site.	other areas on-Site and off-Site including COMAH installations.	software and the Baker Strehlow Tang vapour cloud explosion model.	
6	**Release of toxic gas**	Significant loss of containment of ammonia gas from onshore facilities caused by accidental damage, failure of containment systems or malicious damage. Potential for incident at a neighbouring major hazard installation to escalate to and from site via domino effect. Material could be released as gas or rainout and/or dissolution in air to form ammonium hydroxide.	Potential for significant harm to people on-Site, including fatal injuries and harm to people off-Site via contact with ammonia. Emergency services are likely to advise local residents to close doors and windows and remain indoors for the duration of the event. Significant interruption to operations at Immingham Port and other key locations.	The principal design and operating mitigation measures are as those defined for Risk Event 4. In addition to these measures, a specific toxic gas detection system would be installed, with a corresponding emergency alarm and procedures. This would allow an early intervention by operators in the event of an accidental loss of containment of ammonia. The ammonia storage tank will incorporate secondary containment and will be designed to industry best practices to minimise the risk of ammonia release/ leakage, to include multiple redundance in pressure relief and instrumented protection systems.	**Yes**

Risk Event	Risk Event Description	Summary Description of Risk Event	Risks and Consequences before Additional Mitigation	Additional Mitigation Measures	Mitigated to ALARP?
			Potential for harm to the environment if material released to Humber Estuary.	Ammonia piping systems, including the ship offloading system will be designed to minimise risk of releases and severity of releases, including: - Minimise leak points - Use of two smaller ship offloading lines rather than single larger line - Use of emergency shutoff valves. Toxic gas detectors will be located at appropriate locations on the facility to enable early detection and alarm of any ammonia release. Safe havens will be located on Site and on or at the foot of the jetty, to allow operators to shelter in the event of an ammonia release. The design of these facilities will be informed by the output of modelling studies but will be expected to provide a minimum of 30 minutes protection. Active fire protection systems will be installed at the jetty, comprising water deluge and monitors, which are systems designed to apply high rates of water to extinguish fires and cool adjacent structures.	

Risk Event	Risk Event Description	Summary Description of Risk Event	Risks and Consequences before Additional Mitigation	Additional Mitigation Measures	Mitigated to ALARP?
7	**Incident(s) associated with jetty and marine operations**	Various scenarios associated with marine and jetty operations including the potential for a release of environmentally harmful material to the Humber Estuary. These scenarios include the following: An accidental release of marine fuel oil or black/grey/ballast water from marine transport. Accidental damage to ammonia vessels such as collisions with jetty infrastructure, allisions with other vessels and incidents during berthing causing a loss of containment. Additional scenarios have been identified in the Jetty HAZID study,	Potential for significant harm to persons on board vessels, at jetties or other locations close to vessels. A release of flammable substances such as fuel oil leading to potential for fire if ignited, resulting in harm to people and the environment. If not ignited, material could form a plume on water restricting oxygen supplies to the marine environment. All substances listed have potential for harm to the water environment if material(s) released, via increase in Chemical and or Biological Oxygen Demand (COD/BOD) levels.	Measures included in design to reduce the potential for a loss of containment to the marine environment include the following: - The fuel systems onboard ships would be designed to the appropriate maritime engineering standards. These would include the technical integrity of the fuel storage systems, leakage detection and spill containment. - Fuel leaks would be readily detected by devices such as flow and pressure indicators and isolated (using isolation valves etc.) to minimise the loss of material to secondary containment. - Onshore facilities at the Port are to be used for the treatment and disposal of ballast/grey/black water. This material would not be discharged to the Humber Estuary. - The design and operation of the VLGC would incorporate safety features, primarily the robust design of the ship and cargo tanks, which typically incorporate a double-hull construction. - Lloyds Register publish a list of standards to be adopted for the ammonia transport ships, contained in	**Yes**

Risk Event	Risk Event Description	Summary Description of Risk Event	Risks and Consequences before Additional Mitigation	Additional Mitigation Measures	Mitigated to ALARP?
		which are contained in **Table 22-6.**		'The Rules and Regulations for the Construction and Classification of Ships for the Carriage of Liquefied Gases in Bulk', published July 2022 (Ref 22-20). - Control systems including Emergency Shutdown ("ESD") systems, would be designed, and installed according to engineering design standards, such as those published by International Electrotechnical Commission ("IEC"). These systems minimise the potential for human error and mitigate the consequences, should an error be made, by a fast, safe shutdown of the transfer systems. - In the event of a fire onboard vessels or at the jetty, a protected route along the jetty will be provided to allow people to reach a place of safety. This is typically onshore at the base of the jetty. - The jetty will be designed to include the capability for emergency services to access all areas. - In the event of a fire onboard vessels, the coastguard can deploy firefighting measures, as required for compliance with best practice contained in HSG	

Risk Event	Risk Event Description	Summary Description of Risk Event	Risks and Consequences before Additional Mitigation	Additional Mitigation Measures	Mitigated to ALARP?
				186, which is guidance provided by the HSE on the bulk transfer of dangerous liquids and gases between ship and shore (Ref 22-37). The management and operational controls to reduce the potential for a loss of containment include the following: - An oil spillage plan would be produced prior to operation as required by the International Convention for the Prevention of Pollution from Ships ("MARPOL") Annex 1, Regulations for the Prevention of Pollution by Oil, Regulation 26 (Ref 22-21) The MARPOL convention is enacted in the UK via The Merchant Shipping (Prevention of Oil Pollution) Regulations 2019 (Ref 22-22). - The Project will comply with applicable responsibilities for marine safety which are established in the Port Safety Marine Code and the associated Guide to Good Practice which are published by the Department for Transport ("DfT") and Maritime and Coastguard Agency (Ref 22-26). A NRA and Navigational Simulation Study have been developed for the Project by a	

Risk Event	Risk Event Description	Summary Description of Risk Event	Risks and Consequences before Additional Mitigation	Additional Mitigation Measures	Mitigated to ALARP?
				consultant specialising in marine and transportation safety (Anatec Ltd). These assessments of navigational risks incorporate simulations and analysis of marine traffic movements to identify potential hazards. The NRA has been carried out in accordance with the methodology contained in IMO Guidelines for Formal Safety Assessment (Ref 22-27). Consultation with stakeholders including the Port operator has been carried out during a navigational hazard review workshop. The results of the NRA are described in detail in **Chapter 12: Marine Transport and Navigation [TR030008/APP/6.2]**. Prior to operation, an ERA would be produced for the Project which will use best practice such as the CDOIF methodology described in **Table 22-2**. This assessment would determine the sufficiency of protection measures in the event of a scenario such as a release to the marine environment and conclude if risks are within the tolerable category. Further mitigation measures are listed in **Table 22-6**	

Risk Event	Risk Event Description	Summary Description of Risk Event	Risks and Consequences before Additional Mitigation	Additional Mitigation Measures	Mitigated to ALARP?
8	**Release during road transport off-site**	Collisions/accidents involving road tankers containing hydrogen causing loss of containment, leading to fire and/or explosion.	Potential for significant harm to persons within and near to vehicle including potential fatalities. Significant interruption to road traffic, requiring intervention by emergency services.	The design, construction, operation, maintenance and repair of road vehicles for the transport of hydrogen would be in accordance with The Carriage of Dangerous Goods and Use of Transportable Pressure Equipment Regulations 2009 (Ref 22-23) and ADR. Vehicles containing hydrogen would be driven by ADR trained drivers only. Training and management of these drivers would be in accordance with this legislation and supported by advice from a dangerous goods safety advisor.	**Yes**
9	**Decommissioning Activities – Dismantling Vessels and Pipework**	An incident occurring during decommissioning such as dismantling pipework where vessels have not been fully de-inventoried or isolated (still contain flammable material). Potential for fire and/or explosion. Failure to isolate services such as electrical cabling during these activities could	Potential for significant harm to persons on-Site carrying out activities, including potentially fatal injuries. Due to quantities involved which would be less than normal operation, no impact would be expected off-Site.	At the end of the operational life of the Project, there are a number of factors which must be considered to safely carry out the decontamination, decommissioning and disposal of process equipment and pipework which has contained the dangerous substances. These include ensuring systems are ‘gas-free’ via the removal of the inventory, venting systems to atmosphere and ensuring they are sufficiently clean so no remaining gas can be detected. Comprehensive plans for decommissioning safety and environmental management would be developed prior to work	**Yes**

Risk Event	Risk Event Description	Summary Description of Risk Event	Risks and Consequences before Additional Mitigation	Additional Mitigation Measures	Mitigated to ALARP?
		also result in harm to human health, such as electrocution.		commencing, to risk assess tasks and produce method statements for the work. This would be required as part of the COMAH Safety Report and to ensure compliance with the Environmental Permit. All decommissioning work to be controlled via permit to work systems as part of the required Safety Management System. Isolation procedures such as 'Lock-out/Tag-Out' are standard industrial practice for the isolation of electrical systems on process and manufacturing sites.	
10	**Storms / Flooding / Climate Change**	Potential for pluvial and fluvial flooding to cause asset damage leading to loss of containment of substances, consequences considered above within Risk Events 4, 5 and 6. Lightning strike during storm has potential to cause ignition of highly flammable gas. Potential for the frequency and severity	Potential for significant harm to persons on Site in the event of a loss of containment via fire/ explosion/toxic release. Potential for harm to people off-Site in the event of a major release. Potential harm to the environment e.g. via release of contaminated flood water.	The Flood Risk Assessments (**Appendix 18A [TR030008/APP/6.4]**) has been undertaken out to inform the addition of flood protection measures, if required. Climate change resilience is a consideration under the COMAH Regulations (Ref 22-3) e.g. flooding as a consequence of climate change is considered as an initiating event for a major accident hazard. Design and construction of drainage systems in accordance with civil engineering codes and standards to withstand storm events.	**Yes**

Risk Event	Risk Event Description	Summary Description of Risk Event	Risks and Consequences before Additional Mitigation	Additional Mitigation Measures	Mitigated to ALARP?
		of consequences of storm events could increase as a result of climate change.		Engineering design of jetty and other systems to allow for potential increase in tidal range and potential climate change impacts.	

22.9.6 In **Table 22-6**, ammonia is considered as it is the substance with the most significant potential consequences.

22.9.7 CO_2 is not a prescribed substance under COMAH Regulations but was assessed in the accident scenarios as it has hazard potential. The risks to individuals and the marine environment from accidental CO_2 releases at the jetty individually and in combination with ammonia have been assessed and ALARP measures and emergency planning for accident scenarios involving both CO_2 and ammonia on the jetty are no more onerous than those for ammonia in isolation.

Table 22-6: Detailed Assessment of Risk Event 7 – Marine Environment MA&D Scenarios

Risk Event	Risk Event Description	Description of Risk Event	Risks and Consequences before Additional Mitigation	Additional Mitigation Measures	Mitigated to ALARP?
7.1	Accidental release of ammonia e.g. from loading arm coupling or other pipework flange or connection.	The coupling is installed or disconnected incorrectly (gasket, or O ring type), resulting in a release of ammonia	Two-phase (liquid and vapour) ammonia release, risk to ship crew and Jetty Operators Release into the river channel area Potential for significant harm to people and the environment	Marine loading coupling design, selection and installation Technician training in connecting and disconnecting coupling Shut off valves to minimise product releases Emergency stop manually activated push button at local panel Jetty Operator present at jetty head for initial loading period and final loading period plus periodic monitoring Deluge monitors available to suppress the cloud of ammonia vapour Safe Haven containing Self-Contained Breathing Apparatus (“SCBA”) Emergency Escape Breathing Apparatus (“EEBA”)	**Yes**

Risk Event	Risk Event Description	Description of Risk Event	Risks and Consequences before Additional Mitigation	Additional Mitigation Measures	Mitigated to ALARP?
				Gas detection systems to alarm and alert Jetty Operators and ship crew to release	
7.2	Vessel tow away due to excessive movement of the vessel, damage to loading equipment and potential release of ammonia	The ship once moored will constantly move upwards/downwards with the rise and fall of the estuary levels. If the ship moves outside design limits the ship can tow away the Marine Loading Arm	Release of ammonia refrigerated liquid and formation of a vapour cloud Potential for significant harm to people and the environment Damage to assets including the loading arm and jetty structure	Marine Loading Arm design features include a monitoring and trip system that will sense the ships movement and shut the loading valves if excessive movement is detected A breakaway coupling will separate the loading arm from the ship and seal both open ends of the pipework Safe Haven containing SCBA and EEBA Development of appropriate interface protocols between operations staff, vessel master, and harbour authority, all to be set out in the jetty operations manual	**Yes**
7.3	Vehicle collision with piping or equipment located on the jetty, impact damage and potential release of ammonia	Vehicle(s) driving along the jetty pier section (approx.1250m length) which strikes equipment/ pipework causing release of ammonia	Damage to piping and/ or equipment potentially causing a release of ammonia resulting in toxic vapour release and/or fire Potential for significant harm to people and the environment	Physical separation of the piping and equipment from the vehicle movements Lighting provided along the Jetty Vehicular access with consideration to pull off areas Control of maintenance vehicles to prevent unauthorized access Security access gate and warning lights when loading or Offloading is in operations	**Yes**

Risk Event	Risk Event Description	Description of Risk Event	Risks and Consequences before Additional Mitigation	Additional Mitigation Measures	Mitigated to ALARP?
				Shut off valves to minimise product releases in the event of damage	
7.4	Electrical static shock from mooring ropes	When mooring the ship and tying off to the mooring equipment located on the Jetty Head Platform and Mooring and Breasting Dolphins, significant static electricity can build up into the mooring ropes from friction	Static electrical shock with potential for harm to people present Static discharge presents a source of ignition if accompanied by a release of flammable substances	Correct specification of insulated (non-conductive) mooring ropes Procedure for tying off mooring ropes Risk assessment for operation to incorporate awareness of potential static discharge	**Yes**
7.5	Accidental release of ammonia which effects personnel during ship navigation	Release of ammonia caused by failure or accidental damage to containment systems Ammonia vapour reaches personnel located on adjacent or passing vessels	Injury to ship crew and/or loss of control effecting passing vessels due to adverse effects of ammonia leak	Design and construction of ammonia containment systems on board vessel to prevent accidental releases Gas detection and alarms to alert crew Further risk assessment required as part of the COMAH Safety Report including modelling to be carried out to ensure risks are reduced to ALARP	**Details of the final mitigation to be confirmed following the additional risk assessments referred to.**
refer7.6	Accidental release of ammonia which ignites resulting in fire	Release of ammonia caused by failure or accidental damage to containment systems	Injury to ship crew and/or loss of control effecting passing vessels due to fire Damage to vessels	As 7.5 Further risk assessment required as part of the COMAH Safety Report including modelling to be carried out to ensure risks are reduced to ALARP	**Details of the final mitigation to be confirmed following the additional risk**

Risk Event	Risk Event Description	Description of Risk Event	Risks and Consequences before Additional Mitigation	Additional Mitigation Measures	Mitigated to ALARP?
		Ammonia vapour ignites resulting in a fire causing harm to people and damage to vessel			**assessments referred to.**
7.7	Mooring line snapback (Incident in which a mooring line under tension can become free and release sufficient energy to harm persons present)	Workers in mooring area enter snap back zone and are injured due to snap back from mooring line	Risk to operations staff and vessels crew due to line parting	Provision of load monitoring equipment on Quick Release Hook ("QRH") Determination of appropriate staffing and communications interface/protocols between jetty control/vessel master and berth operations staff, to be documented in jetty operating manual Proper consideration using AQP during design, and identification of danger zones with associated operational restrictions as needed	**Yes**
7.8	Risk of drowning associated with workers present on vessels and within Jetty area	Individual falls from ship, gantry or jetty as a result of accident, loss of footing etc Loading /offloading period will encompass all types of weather and daylight conditions	Potential for harm to people if the enter water accidentally including potential for fatal drowning	Jetty to have access point(s) that person overboard can swim to and climb from Sufficient PPE, flotation suit devices available to deploy in an emergency Emergency alarm to call for Emergency Services Emergency procedures and training Sufficient lighting Two man operating team no lone working	**Yes**

Risk Event	Risk Event Description	Description of Risk Event	Risks and Consequences before Additional Mitigation	Additional Mitigation Measures	Mitigated to ALARP?
				Warning lines near jetty edge Provision of safety equipment	
7.9	Mariners leaving the vessel without obtaining authorisation	Potential for mariners to leave the ship for various reasons including sickness or leave	Unauthorised permission to leave the vessel	Procedure to hold and process individuals. Contact Customs person for passport processing. Sickness requiring ambulance access to jetty head. Mariners hold a special passport /identification. Dock operating plan	**Yes**

Design Safety Studies

22.9.8 Further to the additional mitigation measures relating to the defined risk events presented in **Table 22-5**, design safety studies are being undertaken as required pursuant to the COMAH Regulations.

22.9.9 The design safety studies are an essential part of the engineering design development of the Project from the initial conceptual stage, throughout the operational lifetime and eventual decommissioning and demolition of the facility. The design safety studies such as HAZID and HAZOP typically involve a multidisciplinary project team, consisting of engineers, scientists and other specialists, facilitated by experienced technical safety study leaders. Where computer modelling is used, these studies are carried out by technical safety specialists on behalf of the project team.

22.9.10 The number and complexity of these studies is such that it is only practical to include an overview of the intent and outcome of key studies; however, the output of these studies has been, and will continue to be, communicated at the appropriate time with the relevant stakeholders including the regulatory authorities and statutory consultees.

22.9.11 A standard methodology is employed for these assessments, which has been applied for many years throughout the process industries. This methodology includes:

a. Concept Risk Review

   i A concept risk review is typically undertaken at a very early stage in the project development to review the proposed location and fundamental design and intent of the facility to identify and eliminate significant hazards. The Project engaged a third party specialist to conduct this review, which identified a number of opportunities to reduce risk. This study incorporated consequence analysis in which computer modelling software is used to determine the severity and extent of hazardous events, such as a fire or release of toxic gas.

b. A separate consequence analysis study has been carried out on the risks of an explosion following an accidental release of flammable gas. The purpose of this study was to assess explosion overpressure levels to inform the site layout and specification of buildings. This study has also been carried out by a third party using specialist software and will be regularly reviewed and updated as the Project engineering design is progressed.

c. Further consequence analysis studies will be carried out and the output will be included within the COMAH Safety Report for the Project.

d. Field experiments have been commissioned by Air Products at a site in the UK to study two-phase (gas and liquid) releases of refrigerated ammonia to land and water across a range of weather conditions. The purpose of these experiments was to obtain a greater degree of accuracy in the terms used to model such releases, therefore achieve a high level of confidence in the results generated by computer modelling. The results of these experiments

have been published in the journal Process Safety Progress, March 2023 (Ref 22-29).

e. Site Layout Review

   i The arrangement of process units and services is an important factor in risk management for facilities such as the Project, therefore a site layout review is typically carried out at the concept stage to interrogate the proposed layout and ensure inherent safety measures are incorporated such as spacing and segregation of systems and to inform the DNV study on potential land use planning zones.

   ii A general layout review has been carried out for the Project and more detailed reviews completed for sections of the Site including the Hydrogen Liquefiers and hydrogen production units. Further layout reviews are planned throughout the engineering design phase to assess all areas in detail.

   iii The methodology used for the layout review incorporates industry guidance on separation distances for equipment items such as the liquid hydrogen storage tank and gaseous hydrogen pipework published by the National Fire Protection Association (“NFPA”).

f. HAZID Studies

   i HAZID studies are typically carried out during a FEED stage of projects to identify a wide range of potential hazards using a structured guideword based methodology.

   ii A HAZID was carried out for the Jetty facilities in May 2023 which identified a total of nine (9) specific risk events. The output of this study is summarised in **Table 22-6.**

g. Further HAZID studies are planned for the Project and will be carried out at the appropriate juncture in order to meet legislative requirements.

h. HAZOP Studies

   i Air Products has designed and operated a number of hydrogen facilities worldwide for many years which rely on processes identical to that proposed for the Project. Extensive HAZOP studies have been carried out previously on these systems including the hydrogen liquefier, hydrogen storage and hydrogen production units. These studies have helped to optimise the design, improving safety and operability and therefore will be used as a basis for HAZOP studies to be carried out for the Project. The Applicant’s project team will review and update these studies at the appropriate stage in the design process, so they incorporate any specific elements associated with installation of the equipment at the Project.

i. Hazardous Area Classification Studies

i A preliminary hazardous area classification study has been carried out for the Project in accordance with industry standard guidance published in the Energy Institute Model Code of Safe Practice Part 15. The purpose of this study is to identify areas of the installation in which there is the potential for an explosive atmosphere to be present during the expected operational activities. These areas typically include emergency vents from storage vessels and fugitive emissions from flanges and pipework connections containing flammable substances. Once identified, these potential sources can be either eliminated or controlled. The extent of the potentially explosive area is then quantified and sources of ignition such as electrical and mechanical equipment can be appropriately controlled. Equipment which is required to operate in areas where there is a risk of potentially explosive atmospheres is appropriated specified to reduce the risk of ignition.

ii The hazardous area classification assessment is a fundamental requirement for safety and compliance with DSEAR (Ref 22-9). This assessment and the corresponding drawings produced by specialist safety engineers showing the location and extent of these areas, will be subject to continuous review and update throughout the operational life of the Project.

j. Fire Protection Studies

i Preliminary fire protection studies have been carried out for the Project. These studies comprise a number of key assessments which are:

- Segregation of the installation into discrete fire zones. The purpose of segregation is in an emergency, this helps to prevent the spread of a fire from one area of the facility to another.
- Design of the active fire suppression for the installation. This includes a fire water storage and distribution system, designed in accordance with industry standard guidance such as Energy Institute model code of safe practice part 19 (Ref 22-30).

k. Functional Safety Studies

i Functional safety is the term used to establish and verify the safety of instrumented systems used to fulfil important safety functions such as automatic high pressure and high temperature trip systems installed in process equipment. These systems use sensors to detect parameters such as pressure and temperature, with signals routed to computers whose software compares the observed conditions with set points. If the process conditions are observed to be deviating from these set points, a software signal will be sent to devices such as valves which will open or close in response to return the process conditions to the set point.

ii These systems are subject to formal process safety analysis to establish their required reliability, that is, how important it is that they operate as designed when needed. Once the reliability has been established, the safety loop comprising of sensor, software and operating element (valve) is validated to ensure that it can achieve the design reliability.

l. Industry standard methodology is used to establish the required reliability, which is provided in the standards BS EN IEC 61508 (Ref 22-31) and 61511 (Ref 22-32), which is the standard developed for process industries such as the Project.

22.10 Assessment of Residual Effects

Construction

22.10.1 The potential risk events during Project construction activities have been identified and assessed in **Table 22-4** and **Table 22-5.** Where risks cannot be eliminated, they would be reduced to ALARP, and the residual risks associated with construction hazards managed via the controls listed in **Table 22-5**. The controls and mitigation measures are primarily compliance with the CDM Regulations (Ref 22-8) and the development and use of a comprehensive CEMP.

22.10.2 A COMAH pre-construction Safety Report will be submitted for review by the competent authority prior to Project construction. The purpose of this report is to demonstrate to the competent authority that all measures necessary to manage risk have been taken.

Operation

22.10.3 The presence of toxic and flammable gases during Project operation means that their associated hazards cannot be entirely eliminated, but must be managed to reduce risks to ALARP, in accordance with the HSE's requirements under the COMAH Regulations (Ref 22-3). Risk reduction and mitigation is secured via compliance with all applicable UK legislation and permits including the terms of the Safety Report required by the COMAH Regulations and the Environmental Permit (which will set out the standards and guidance that the operation of hydrogen production facility will need to comply with).

22.10.4 **Paragraphs 22.10.5** to **22.10.9** set out actions that will be taken in order to meet the requirements of the COMAH Regulations and the EPR (in addition to other legislative requirements relevant to the hydrogen production facility).

22.10.5 Continuous process monitoring systems will be provided in the Project control room, such as Supervisory Control and Data Acquisition ("SCADA"). These systems comprise of computer hardware and software connected to the process systems which observe operational conditions such as temperature and pressure, providing real time data to process operators, data logging and trending analysis. SCADA provides a means of automating process operations reducing the requirement for manual interventions and therefore the potential for human error.

22.10.6 COMAH establishments such as the Project are required to adhere to good practice in all aspects of operation which includes inspection and planned preventive maintenance. These processes are a key aspect of demonstrating the integrity of plant and equipment and will be carried out to prevent failures and identify defects such as corrosion. These procedures will form part of the Safety Management System for the Project, to ensure it operates safely and efficiently.

22.10.7 All personnel associated with the operation of the Project facilities would be subject to rigorous standards of training and competency assurance, including process operators, vessel and jetty personnel and road tanker drivers.

22.10.8 The proposed operation of the Site and the on and off site emergency plans would be subject to rigorous appraisal by the COMAH competent authority and other stakeholders. The operator of the facility would be required to notify the competent authority prior to operation and submit the COMAH Safety Report for review. The competent authority would authorise Site operations through review and assessment of the COMAH Safety Report.

22.10.9 When operational, the Site would form part of a COMAH cluster. The purpose of these groups is to share information and provide a cooperative, collaborative forum for operators of COMAH sites. The information shared includes the hazards which are present on each site and emergency response plans. Humberside is one of the main clusters in the UK, with sites working together to share information with local residents and people working near the sites as well as with the competent authority and local authorities.

Decommissioning of the hydrogen production facility

22.10.10 Process substances present at the facility are primarily flammable gases, therefore risks would be reduced to ALARP during decommissioning via controls such as the use of equipment including electrical tools. Prior to dismantling equipment and pipework, the contents would be safely vented to ensure no flammable or toxic materials remain and portable gas detectors would be used to confirm a ‘gas-free’ status prior to commencement of work. These requirements would need to be met in order to comply with the terms of the Environmental Permit (which will require a decommissioning plan to be agreed with the Environment Agency).

22.11 Summary of Assessment

22.11.1 The purpose of this chapter is to present an assessment to identify and describe the potential, credible MA&D scenarios which could be pertinent to the Project. The Project is defined within **Chapter 2: The Project [TR030008/APP/6.2]** and comprises a jetty in the Humber Estuary to be used for the import and export of liquid bulk products and a landside facility to store and convert ammonia to hydrogen which will be liquified and transported off site for use.

22.11.2 A total of 15 potential hazardous scenarios were initially identified, of which ten were considered credible and therefore termed Risk Events, requiring further assessment. These Risk Events include incidents such as fire and/or explosion caused by a major loss of containment of flammable and toxic gases.

22.11.3 Potential Risk Events have been identified during construction, operation and decommissioning phases of the Project.

22.11.4 The consequences of Risk Events identified are primarily harm caused to people present on-site. This is as a result of an exposure to thermal radiation generated by fire, exposure to explosion overpressure, impact with missiles generated by an explosion such as glass fragments and exposure to toxic ammonia gas. The harm caused by these events can include the potential for fatal injuries, corresponding to the criteria for a MA&D established in **Paragraph 22.4.8**.

22.11.5 There are potentially harmful consequences to the environment as a result of the identified Risk Events. These include direct harm from thermal radiation to flora and fauna in and around the Humber Estuary caused by a major fire. A release of harmful substances such as MFO from vessels transporting ammonia to Site could also cause harm which could potentially correspond to the criteria established in **Paragraph 22.1.2**, which is long term damage to 0.5 ha of the river.

22.11.6 Given the inherent properties of Hydrogen and Ammonia, it is not possible to eliminate risks entirely. Risk must therefore be managed by a comprehensive safety and environmental protection programme implemented via engineering design, operational measures and management to achieve a level ALARP, as required by the COMAH Regulations (Ref 22-3).

22.11.7 The Project would comply with all relevant safety and environmental legislation for the management of risks on industrial facilities, from the design and construction phase, through operation and eventual decommissioning.

22.11.8 Further analysis of the risks to the health and safety of people (on-site and off-site) and to the environment will be carried out throughout the lifecycle of the Project from design through operation to eventual decommissioning. A number of these process safety studies have already been carried out to inform the design process and identify mitigation and control measures to reduce the risk of major accidents.

22.11.9 A description of the risk assessments carried out to date has been incorporated within **Section 22.8**, however further safety studies will be ongoing and the output and conclusions of these will be shared with stakeholders including the regulatory authorities.

22.12 References

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Ref 22-32 BS EN IEC 61511 (multi-part series) Functional safety. Safety instrumented systems for the process industry sector.

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Ref 22-34 API 520 Part I, 10th Edition, Sizing, Selection, and Installation of Pressure-Relieving Devices in Refineries

Ref 22-35 API 521 Pressure-Relieving and Depressurizing Systems, provides guidance, recommendations, and alternatives for the design of pressure-relieving and vapor de-pressuring systems at liquefied natural gas terminals, petrochemical facilities, gas plants, and other petroleum production facilities.

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