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TABLES

18.0 MAJOR ACCIDENTS AND DISASTERS

18.1 Introduction

18.1.1 This chapter of the Preliminary Environmental Information (PEI) Report presents an assessment of the Major Accidents and Disasters (MA&D) that have the potential to arise during the construction, operation and decommissioning of the Proposed Development. This includes an assessment of the reasonably foreseeable worst-case environmental consequences (i.e. the likely significant effects), the measures envisaged to prevent or mitigate the likely significant adverse effects of such events on the environment, and details of the preparedness for and proposed response to MA&D hazards and threats relevant to the construction, operation and decommissioning of the Proposed Development.

18.1.2 The underlying objective of this assessment is to identify appropriate precautionary actions, to prevent or mitigate potentially significant risks associated with MA&D.

18.2 Legislation, Planning Policy and Guidance

National Legislation

18.2.1 The Infrastructure Planning (Environmental Impact Assessment) Regulations 2017 ('the EIA Regulations') implement the requirements of Directive 2014/52/EU of the European Parliament and of the Council of 16 April 2014 amending Directive 2011/92/EU on the assessment of the effects of certain public and private projects on the environment ('EIA Directive') which introduced the requirement for MA&D to be considered as part of the EIA process.

18.2.2 Regulation 5, Part 4 of the EIA Regulations states that:

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

18.2.3 Schedule 4, paragraph 8 requires an Environmental Statement (ES) to provide:

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

18.2.4 An assessment of the risk of MA&D relevant to the Proposed Development is therefore required, together with the measures envisaged to prevent or mitigate the significant adverse effects of such events on the environment and details of the preparedness for and proposed response to such emergencies.

18.2.5 The Construction (Design and Management) (CDM) Regulations 2015 ('the CDM Regulations') and accompanying guidance place particular duties on clients, designers and contractors, to ensure that health and safety is considered throughout the lifecycle of project, from inception, design, construction, operation and into subsequent demolition and removal. Under the CDM Regulations, designers must avoid foreseeable risks, as far as reasonably practicable.

18.2.6 During its operation, depending on the volumes of hazardous materials stored on the Proposed Development Site, a Hazardous Substances Consent (HSC) may be necessary under the Planning (Hazardous Substances Regulations) 2015 and the Proposed Development could be subject to the Control of Major Accident Hazards (COMAH) Regulations 2015 (HSE, 2015) ('the COMAH Regulations') which implement Directives 96/82/EC and 2003/105/EC on the control of major accident hazards involving dangerous substances.

18.2.7 The aim of the COMAH Regulations is the prevention of major accidents and limitation of their consequences for people and the environment. The competent authority for the purposes of the COMAH Regulations in England is the Health and Safety Executive (HSE) and the Environment Agency.

18.2.8 If the installation falls within the COMAH Regulations, the Applicant will be required to:

- take all measures necessary to prevent major accidents and limit their consequences for persons and the environment;
- prepare an on-site emergency plan;
- demonstrate to the competent authority that all measures necessary to comply with the COMAH Regulations are in place; and
- notify any major accidents to the competent authority.

18.2.9 The primary legislation governing the safety of pipelines in the UK is the Pipelines Safety Regulations (PSR) 1996 ('PSR 1996') which encompasses control of aspects including integrity, safe design, construction, installation, operation, maintenance and decommissioning. The PSR considers emergency events and the need to ensure that procedures are in place to limit the risk of loss of containment. Specific reference is made to major accident hazards which for the purposes of PSR is defined as "death or serious injury involving a dangerous fluid". Additional duties are included in PSR for major accident hazard pipelines (MAHP) which transport products defined as dangerous fluids.

18.2.10 An Environmental Permit will be required for the operation of the Proposed PCC Site in accordance with the Environmental Permitting Regulations (EPR) 2016. It is envisaged that the Applicant will seek to agree the permitting requirements with the Environment Agency, however, this could take the form of a 'Substantial Variation' to the Environmental Permit for the Keadby 2 Power Station, once issued. An application for an Environmental Permit will be made shortly after submission of the DCO Application.

Planning Policy Context

18.2.11 The overarching National Policy Statement (NPS) for Energy (EN-1) (DECC, 2011a) provides the primary policy framework within which the Proposed Development will be considered. National Policy Statement for Fossil Fuel Electricity Generating Infrastructure (NPS EN-2) (DECC, 2011b) and the UK Marine Policy Statement (Department for Environment, Food & Rural Affairs, 2011) also relevant (refer to **Chapter 7**: Legislation and Planning Policy Context in PEI Report Volume I). Published in 2011, these policy statement pre-date the EIA Regulations and therefore

do not contain any specific requirements in relation to MA&D assessment. Of relevance, however, is Section 4.15 of NPS EN-1 which states that the Department of Energy and Climate Change (now Department for Business, Energy and Industrial Strategy) works closely with Government security agencies to reduce the vulnerability of the most 'critical' infrastructure assets in the sector to terrorism and other national security threats. This has therefore been noted in this assessment.

18.2.12 The UK Marine Policy Statement ('the MPS') (Department for Environment, Food & Rural Affairs, 2011) provides the framework for preparing Marine Plans and taking decisions affecting the marine environment. The UK MPS notes that environmental impacts which may occur through accidental pollution from ships in the course of navigation or lawful operations, pollution caused by unlawful operational discharges by ships, such as oil, waste or sewage, or physical damage caused by groundings or collisions should be considered as part of the decision making process. This scenario has therefore been considered in this assessment.

18.2.13 The National Planning Policy Framework (NPPF) (Ministry of Housing, Communities and Local Government 2019) also provides relevant considerations for MA&D assessment. Paragraph 45 requires that: 'Local planning authorities should consult the appropriate bodies when considering applications for the siting of, or changes to, major hazard sites, installations or pipelines, or for development around them'. Paragraph 95 notes that decisions *'should promote public safety and take into account wider security and defence requirements by … anticipating and addressing possible malicious threats and natural hazards, especially in locations where large numbers of people are expected to congregate…this includes appropriate and proportionate steps that can be taken to reduce vulnerability, increase resilience and ensure public safety and security.'*

18.2.14 North Lincolnshire Local Plan (saved September 2007) saved policy DS10 - New Hazardous Installations and Pipelines is relevant to the MA&D assessment in that it notes *'Planning permission for development which involves the storage of materials or the carrying out of processes that are toxic, highly reactive, explosive or highly flammable will only be granted if the applicant can demonstrate that the proposal will impose no significant development restrictions upon surrounding land users; will not put at risk surrounding residential properties; or prove a risk to other premises in the locality where significant numbers of people regularly congregate'.*

Other Guidance

18.2.15 The Institute of Environmental Management and Assessment (IEMA, September 2020) has recently developed a guidance document 'Major Accidents and Disasters in EIA: A Primer' (IEMA, 2020) to increase awareness of major accidents and disasters within EIA and its application. The guidance outlines an assessment methodology based on known current practice within the UK to date, and key terminology that can be used in MA&D assessments. This guidance, in particular the assessment methodology and terminology, has been considered within this assessment.

18.2.16 There is also a considerable amount of information and guidance available to developers on the identification and control of major hazards associated with the design and operation of gas fired power stations, the storage and use of chemicals,

and MAHP conveying high pressure gases. Comparable facilities have been in operation for many years and employ conventional, established technology to produce electrical power from the combustion of natural gas. The HSE publishes a number of applicable guidance notes on their website relating to these assets, including:

- Emergency planning for major accidents: Control of Major Accident Hazards Regulations 1999 (COMAH), (HSE, 1999);
- Further guidance on emergency plans for major accident hazard pipelines (HSE, 1996); and
- The Control of Substances Hazardous to Health Regulations (HSE, 2002).

18.2.17 As a regulator, the HSE uses the principles of 'as low as reasonably practicable' ('ALARP') in risk management (HSE, 2020). In a practical sense, ALARP involves 'weighing a risk against the trouble, time and money needed to control it' noting that 'ALARP describes the level to which we expect to see risks controlled' (IEMA 2020). For the purposes of this assessment, ALARP has been used.

18.2.18 Carbon dioxide (CO_2) is not harmful to human health at low concentrations, is not flammable and will not support combustion. Compared with many other materials conveyed via major pipelines in the UK such as natural gas and ethylene, the risks to human health and the environment from events such as explosion are relatively low. However, as the concentration of CO_2 in ambient air or water rises, the hazardous effects on people and the environment increase. The key risk relates to its potential to act as an asphyxiant gas at low-lying locations, should it displace air from these locations due to its higher density. High levels of dissolved CO_2 in water can also result in impacts from acidification and subsequent effects on shell-forming species.

18.2.19 Guidance and best practice information for carbon capture plant (CCP) technology and carbon dioxide transport via pipeline is available from the HSE, who have published a number of guidance documents including:

- Guidance on conveying carbon dioxide in pipelines in connection with carbon capture and storage projects (HSE, 2020); and
- CO_2 Pipelines Good Practice Guidelines – Technical Report (HSE, 2013).

18.2.20 The HSE does not currently provide Land Use Planning (LUP) advice for CO_2 capture, transport or storage, and the status of the Proposed Development relating to the COMAH Regulations has not been confirmed. However, the HSE is a statutory consultee for all Nationally Significant Infrastructure Projects (NSIP), such as the Proposed Development, and therefore consultation with the HSE will be ongoing throughout the design and planning process.

18.2.21 Other guidance that is of relevance to the assessment of MA&D includes:

- Chemicals and Downstream Oil Industries Forum Guidelines, Environmental Risk Tolerability for COMAH Establishments (CDOIF, 2017);
- Guidelines for Environmental Risk Assessment and Management (Defra, 2011);

- ISO 31000:2009 Risk Management principles and guidelines (The International Standards Organization, 2009);
- Chapter 4 of the Cabinet Office's Emergency Preparedness guidance on part 1 of the Civil Contingencies Act 2004 (hereafter referred to as the 'CCA risk assessment framework') (HM Government, 2006); and
- Reducing Risks, Protecting People: HSE's decision making process, (HSE, 1999).

18.2.22 Additionally, the following guidance has been considered in the identification of all potential major accidents and disasters:

- The National Risk Register of Civil Emergencies (The Cabinet Office, 2017 Edition); and
- Early Warning, Early Action (The International Federation of Red Cross & Red Crescent Societies, 2008).

18.3 Assessment Methodology and Significance Criteria

Definitions

18.3.1 Major accidents are defined as '*Events that threaten immediate or delayed serious environmental effects to human health, welfare and/ or the environment and require the use of resources beyond those of the client or its appointed representatives to manage. Whilst malicious intent is not accidental, the outcome (e.g. train derailment) may be the same and therefore many mitigation measures will apply to both deliberate and accidental events.'* (IEMA 2020).

18.3.2 The impact of major accidents can be significant, with the potential to impact people both on and off-site, assets and property on and off-site, and the surrounding environment.

18.3.3 Disasters can may be natural hazards, such as earthquakes, landslides and flooding or can be man-made hazards (e.g. caused by accidental loss of containment) or external hazards (e.g. act of terrorism) which result in consequences for people or the environment.

Consultation

18.3.4 An EIA Scoping Opinion was received from the Planning Inspectorate in June 2020 (**Appendix 1B**: Scoping Opinion, PEI Report, Volume II).

18.3.5 Table 18.1 provides an account of how comments raised by stakeholders in the Scoping Opinion in relation to MA&D have been considered, and actioned where appropriate.

Table 18.1: Key Issues Raised in Relation to Major Accidents and Disasters During EIA Scoping

Consultee or Organisation	Date and nature of consultation	Summary of Response	How have comments been addressed in this chapter
Secretary of State	June 2020 (Scoping Opinion)	Secretary of State Scoping Opinion, 3.3.11: The Scoping Report proposed to scope out a specific assessment for major accidents or disaster vulnerability and that a discussion of accidental events would be included in the relevant ES chapters. The Secretary of State Scoping Opinion outlines that the ES should include a description and assessment (where relevant) of the likely significant effects resulting from accidents and disasters applicable to the Proposed Development. Use should be made of appropriate guidance and the description and assessment should consider the vulnerability of the Proposed Development to a potential accident or disaster, the Proposed Development's potential to cause an accident or disaster, and measures that will be employed to prevent and control significant effects.	As a result of the Inspectorate's comments a Major Accidents and Disasters chapter has been produced in line with available guidance. This assessment includes fires/ explosions, noxious substances, storms, climate change, terrorism/ arson, earthquakes, lightning, aeroplane/ drone impacts, and domino effects from neighbouring facilities. Embedded mitigation and design and impact avoidance measures will be implemented for the construction, operational and decommissioning phases of the Proposed Development to minimise the risk of MA&D, including a HAZID, a HAZOP, a COMAH licence, and an Environmental Permit.
Secretary of State	June 2020 (Scoping Opinion)	Secretary of State Scoping Opinion, 4.14.2: construction and decommissioning phases. The Scoping Report states that risks from the operation of the project would be considered in the Environmental Risk Assessment, but the Secretary of State has advised that the ES should address	This chapter identifies risks that have the potential to impact upon the construction and operation phases of the Proposed Development and assesses them. Risks during the decommissioning phase have not specifically been included since the hazards are anticipated to be similar to those addressed within

Consultee or Organisation	Date and nature of consultation	Summary of Response	How have comments been addressed in this chapter
		significant effects across all phases of the Proposed Development.	the construction and operational phases. No additional decommissioning hazards have been identified.
Secretary of State	June 2020 (Scoping Opinion)	Secretary of State Scoping Opinion, 4.14.3: screening of major accidents and disasters. The Inspectorate has advised that design mitigation identified to reduce potentially significant risks should be presented within the ES.	This chapter includes standard industry approaches to managing risk, and design and impact avoidance measures that have already been identified and are considered in the assessment of potential MA&D in Section 18.6.
Secretary of State	June 2020 (Scoping Opinion)	Secretary of State Scoping Opinion, 4.14.4: vulnerability to disasters. The Secretary of State highlighted that the National Risk Register of Civil Emergencies identifies a range of potential hazards that may affect the UK and noted that the Scoping Report does not provide information to justify scoping out other potential hazards. The Secretary of State has advised that the ES should therefore assess the effects associated with a broader range of civil emergencies such as diseases, major accidents, societal risks and malicious attacks, where significant effects are likely to occur.	This chapter includes an assessment of a broad range of potential hazards, including those detailed within the National Risk Register of Civil Emergencies. Where potential hazards have been scoped out, justification has been provided in Section 18.3.

Approach to Assessment

18.3.6 As discussed above, the MA&D assessment approach differs from the generic EIA methodology in which assessments broadly consider the magnitude of impacts and value/ sensitivity of resources/ receptors that could be affected in order to classify effects.

18.3.7 The MA&D assessment identifies the reasonably foreseeable worst-case consequence of a hazard or a threat (i.e. the likely significant effect) on human health and the environment on the basis of its potential severity of harm and duration. However as by definition, all MA&D hazards and threats could result in some form of serious damage and therefore the assessment then considers the likelihood of a significant hazard or threat occurring. Furthermore, the arrangements that have been identified to manage the risk to be ALARP are considered. This is determined based on review of available documentation; any risks which may require further mitigation are identified.

18.3.8 In identifying the potential for the Proposed Development to create or alter the existing baseline MA&D risks for receptors, the assessment is conducted using a staged approach:

- identification of receptors;
- identification of hazards and threats based on the concept design work completed to date and in accordance with industry standard approaches to hazard identification;
- screening of hazards and threats, including the potential for likely significant effects;
- identification of prevention, minimisation and/ or mitigation measures; and
- determination of whether risk has been mitigated to ALARP and identification of any residual risks and their significance.

18.3.9 MA&D assessment considers domino effects which may occur in the event of a major accident at the Proposed Development Site which causes consequences for nearby sites, and vice versa. In respect of such domino effects, the vulnerability of the Proposed Development to a major accident has also been considered.

18.3.10 The vulnerability of the Proposed Development to natural disasters is assessed, using findings in particular of other assessments including **Chapter 17**: Climate Change and Sustainability (PEI Report Volume I) and **Appendix 12A**: Flood Risk Assessment (PEI Report Volume II); both address future climate change scenarios and resilience measures required for the Proposed Development.

Information sources

18.3.11 MA&D 'risk events', to which the Proposed Development is considered vulnerable, have been identified by referring to the results of preliminary risk assessments undertaken for the Proposed Development and determining whether there is potential interaction with an 'in-scope' receptor. Information sources for identifying these

source-pathway-receptor linkages for MA&D hazards have included review of the following:

- potential natural hazards using data reported in a Landmark EnviroCheck Report (Landmark Information Group, 2020) for the Proposed Development Site, augmented by desk based research published by British Geological Society (BGS);
- meteorological hazards based on data reported in **Chapter 17**: Sustainability and Climate Change (PEI Report Volume I);
- existing major accident hazard sources within the Proposed Development Site or off-site within the study area based upon data presented on the HSE website (COMAH sites) and within the Landmark EnviroCheck Report (HSC sites);
- other hazards and threats identified within the UK National Risk Register; and
- sensitive environmental receptors within the study area at risk of MA&D hazards, taking into account **Chapter 3**: The Site and its Surroundings (PEI Report Volume I).

18.3.12 In addition to the above, the baseline presented within the MA&D assessment has utilised baseline information presented within other technical assessments of the PEI Report, where relevant including receptors identified in **Chapters 8 to 17** of this PEI Report.

Identification of receptors

18.3.13 Receptors considered in this assessment include:

- population and human health of members of the public, local communities and nearby workers at other facilities, if relevant;
- biodiversity, with particular attention to species and habitats protected under The Conservation of Habitats and Species Regulations 2017 (the Habitats Regulations) (transposing the EU Council Directives on Birds and Habitats (Council Directive 92/43/EEC));
- land, soil, water, air and climate; and
- property and material assets, cultural heritage and the landscape.

18.3.14 It is recognised that potential effects of the Proposed Development on the Applicant's employees and/ or its contractors and suppliers (e.g. construction, operational and maintenance staff) are managed through compliance with other health and safety legislation, as described in Section 18.2. Through compliance with health and safety legislation, risks to employees will be mitigated to ALARP and no further mitigation will be available. However, for completeness, risks to employees and/ or contractors, including those at neighbouring facilities, are included within the assessment results presented in Section 18.6.

18.3.15 The Applicant proposes to adopt appropriate measures to provide a secure boundary for the Proposed Development which will reduce the likelihood of trespass to ALARP. As no further mitigation will be available, effects on these receptors groups will be

mitigated to ALARP. For completeness, potential effects related to vandalism/ terrorism are included within the assessment results presented in Section 18.6.

Assessment Criteria

18.3.16 An approach that has been commonly adopted in MA&D assessments in recent applications for NSIP considers the Chemical and Downstream Oil Industries Forum Guidelines on Environment Risk Tolerability for COMAH Establishment (CDOIF, 2017). These guidelines characterise threats or hazards against the following categories in order to assign a tolerability and a risk classification to each hazard or threat:

- severity of harm;
- duration;
- consequence; and
- probability.

18.3.17 Severity of harm, duration, and the consequence of a hazard or threat are determined on the basis of a reasonably foreseeable worst-case environmental effect of the event, in the absence of mitigation. The probability and magnitude of the hazard or threat occurring is determined considering the proposed embedded mitigation, and whether the proposed embedded mitigation measures need augmenting further. This is because embedded mitigation would reduce the likelihood of the maximum severity of harm, duration, consequence and/ or frequency of a hazard or threat occurring.

18.3.18 As outlined in the CDOIF, 2017 Guidelines on Environment Risk Tolerability for COMAH Establishment, for COMAH sites, environmental risk can be assessed within the ALARP framework and residual risk can be evaluated to be either 'intolerable', 'tolerable if ALARP' or 'broadly acceptable'. The tolerability of the residual risk is determined by combining the reasonably foreseeable worst-case consequence and probability categories.

18.3.19 As a general rule:

- 'tolerable if ALARP' and 'broadly acceptable' risks are considered as 'not significant'; and
- intolerable risks are considered as 'significant'.

18.3.20 Risks categorised as 'tolerable if ALARP' would generally require further approval of the details of proposed mitigation by an appropriate regulatory body such as the HSE or Environment Agency.

18.3.21 In addition to CDOIF, 2017, assessment criteria have been considered taking into account emerging EIA good practice, including published guidance on MA&D assessment in EIA (IEMA 2020), which considers other relevant documentation, including the Cabinet Office's National Risk Register of Civil Emergencies (The Cabinet Office, 2007).

18.3.22 The assessment criteria have been developed in accordance with the criteria provided within the CCA risk assessment framework to allow for future emergency planning at a local level.

18.3.23 Significance will be considered for each identified receptor in conjunction with the appropriate environmental topics for this EIA. Taking into account IEMA 2020 guidance, factors that are considered in this chapter in determining whether potential adverse effects are significant include:

- the geographic extent of the effects. Effects beyond the project boundaries are more likely to be considered significant;
- the duration of the effects. Effects which are permanent (i.e. irreversible) or long lasting are considered significant;
- the severity of the effects in terms of number, degree of harm to those affected and the response effort required. Effects which trigger the mobilisation of substantial civil emergency response effort are likely to be considered significant;
- the sensitivity of the identified receptors; and
- the effort required to restore the affected environment. Effects requiring substantial clean-up or restoration efforts are likely to be considered significant.

18.3.24 For the Proposed Development, a significant adverse effect is considered to mean the loss of life or permanent injury, and/ or permanent or long-lasting/ irreversible damage to an environmental receptor. Other effects that do not meet this definition are considered not significant.

Study Area

18.3.25 The study area for individual identified hazards and threats has been considered based on the likely impact pathways, distances to receptors, the scale of potential worst-case impact from case-study incidents, or on professional judgement if no information on previous events is available.

18.3.26 In considering the geographical scope, external features/ sites that may present a hazard to the Proposed Development, including those beyond the Proposed Development Site boundary have been considered where there is a potential for these to interact with the Proposed Development.

Scenarios

18.3.27 The scope of this assessment addresses potential unplanned events or situations that have been determined as relevant to the Proposed Development, with a potential to result in significant adverse effects. The assessment of potential MA&D associated with the Proposed Development is structured around the following scenarios:

- construction phase, including construction of the Proposed Power, Capture and Compression (PCC) Site, and the connections within the identified connection corridors;
- operation phase of the Proposed Development; and

18.3.28 As described in Table 18.1, MA&D effects arising during the decommissioning phase of the Proposed Development are considered comparable to those that would be experienced during the construction period. At this stage, a Decommissioning Environmental Management Plan (DEMP) would be submitted to the relevant planning authority and/ or HSE, depending on COMAH licence status, for approval, secured by a Requirement of the draft DCO. Appropriate best practice mitigation measures will be applied during any decommissioning works and documented in a DEMP.

Use of Rochdale Envelope

18.3.29 This assessment is a preliminary review, based on the current engineering design documentation. This assessment does not seek to duplicate the assessment of matters covered by other regulatory regimes such as the COMAH Regulations or EPR; instead it provides a summary of the types of MA&D hazards and threats anticipated by these regimes, the potential worst-case environmental consequences these could pose and any required mitigation. Further hazard and risk analysis will be included in the ES and undertaken throughout the Proposed Development lifecycle, in accordance with the requirements of EPR and COMAH Regulations.

18.3.30 This assessment for the PEI Report has applied Rochdale Envelope principles, which assesses credible, worst-case MA&D risks and consequences associated with the Proposed Development. This conservative methodology establishes the worst-case scenarios, the risk of which should be reduced to a level that is ALARP during the detailed design, construction planning and operation of the Proposed Development. At this stage in the project, safety and control systems have not yet been fully designed for the Proposed Development. However, standard industry approaches to managing risk will be used. In addition, equipment such as process monitoring and safeguarding systems and embedded mitigation such as fire and gas detection, and passive and active fire prevention measures will be installed as required.

18.4 Baseline Conditions

18.4.1 This section presents a description of the baseline environmental characteristics within the study area. The baseline relevant to this topic comprises:

- a description of potential natural hazards which may impact the Proposed Development Site, including meteorological hazards, geological hazards and other types of hazards;
- existing major accident hazard sources that may impact the Proposed Development Site;
- sensitive environmental receptors within the study area at risk of MA&D hazards associated with the Proposed Development; and
- other hazards that have been screened out of the assessment.

Natural Hazards

Meteorological Hazards

18.4.2 Hazards resulting from severe weather events which could impact the Proposed Development have been derived considering the baseline information reported in **Chapter 17**: Climate Change and Sustainability (PEI Report Volume I) and **Appendix 12A**: Flood Risk Assessment (PEI Report Volume II) and are considered to include:

- flooding following heavy rainfall events including fluvial (due to proximity of River Trent, Stainforth and Keadby Canal and the Three Rivers), surface water, ground water and sewer flooding;
- storms and gales;
- drought;
- heatwave;
- cold and snow;
- lightning and electrical storms (thunderstorms);
- events of reduced visibility and air quality (e.g. due to dust sand or fog);
- extreme temperatures (heatwaves and sub-zero temperatures); and
- extreme humidity (high and low).

18.4.3 The potential for climate change to impact upon the frequency and severity of these meteorological hazards in future years is discussed in **Chapter 17**: Climate Change and Sustainability (PEI Report Volume I).

Geological and Ground Related Hazards

18.4.4 According to a Landmark EnviroCheck report (Landmark Group, 2020), there is no risk/ very low to low risk of hazards associated with ground stability, such as landslides, ground collapse, sinkholes, running sand and shrinking or swelling of clay at the Proposed Development Site.

18.4.5 **Appendix 13A**: Phase 1 Desk Based Assessment (PEI Report, Volume II) presents the geology underlying the Proposed Development Site and considers the potential for natural deposits to present ground related hazards. The published geology and historic boreholes indicate the presence of firm clays, silt and peat, noting that where peat is present, this might cause local areas of settlement. EnviroCheck data for the Proposed Development Site confirms that the potential for compressible ground stability hazards is moderate.

Seismic Hazards

18.4.6 Based on available information published by the British Geological Survey (BGS, 2020) the Proposed Development Site is located in one of the lowest areas of seismic hazard risk in the UK.

Existing Major Accident Hazards

18.4.7 Industrial sites that could be the source of, or increase the risk or consequences of, a major accident and/ or domino effect have been identified. Existing major accident hazard sources include industrial sites (such as those operated under the COMAH Regulations and HSC) and other notably local industrial sites identified by desk based research.

18.4.8 Desk based searches have been undertaken in order to determine the proximity of such sites to the Proposed Development Site. **Appendix 13A**: Phase 1 Desk Based Assessment (PEI Report Volume II) adopts a land contamination study area that extends 250m from the boundary of the Proposed Development Site. To provide a conservative screening distance for MA&D, sites within the following study areas have been identified:

- relevant COMAH sites located within 1km of the Proposed Development Site; and
- HSC sites located within 500m of the Proposed Development Site.

18.4.9 According to the HSE website (https://notifications.hse.gov.uk/COMAH2015/Search.aspx), there are no COMAH sites located within 1km of the Proposed Development Site. The nearest COMAH sites are:

- Flixborough Industrial Estate (Upper Tier COMAH site) operated by Jotun Paints Ltd located 3.6km downstream of the closest point to the Proposed Development Site (River Water Discharge Corridor outfall) and over 4.8km from the Proposed PCC Site; and
- Grove Wharf, Gunness, (Lower Tier COMAH site) operated by Brenntag UK Limited located 1.2km downstream of the closest point to the Proposed Development Site (River Water Discharge Corridor outfall) and over 2.6km from the Proposed PCC Site.

18.4.10 Both COMAH sites identify relevant major accident hazards related to accidental release of dangerous substances, explosion and fire. As both sites are located beyond the 1km screening distance considered relevant for the Proposed Development, they are not considered further in the assessment tables (Table 18.2 and Table 18.3) provided in Section 18.6, although Section 18.5 includes relevant design and impact avoidance measures to be adopted by the Applicant and Section 18.6 includes further information about each of these sites.

18.4.11 As reported in **Appendix 13A**: Phase 1 Desk Based Assessment (PEI Report Volume II) there is one HSC located 55m west of the Abnormal Indivisible Load Route (approximately 1.2km from the Proposed PCC Site). This consent (PA/2014/0176) is registered to PD Port Services for ammonium nitrate-based fertilisers which conforms to the Fertilisers Regulations 1991(a) and composite fertilisers containing phosphate and/or potash. However, according to the Landmark EnviroCheck Report (2020) the status of this consent appears to have been withdrawn.

18.4.12 No other relevant industrial sites are located within 500m of the Proposed Development Site. Those located beyond 500m which are not considered further due

to distance from the Proposed Development Site or absence of relevant source-pathway-receptor links include Solventis – a chemicals (solvent) manufacturer located approximately 990m south-east of the Proposed Waterborne Transport Offloading Area at Station Road, Gunness Wharf. Further information is presented on this site in Section 18.6.

Other potential major accident hazards

18.4.13 The existing Keadby 1 Power Station and Proposed Keady 2 Power Station could present a risk of MA&D that require consideration, particularly given their close proximity to the Proposed PCC Site. It is noted that the Applicant operates an environmental management system (EMS) which is integrated within a safety, health and environmental (SHE) Management System, accredited to ISO14001:2015 standard. The SHE Management System is underpinned by a Safety and Health Policy which includes a Major Accident Prevention Policy and Environment and Climate Change Policy and broadly covers:

- systematic identification of hazards and risk assessment;
- plant integrity and maintenance;
- safe systems of work;
- controls for the safe operation of processes; and
- emergency planning including preparedness and response.

18.4.14 Implementation of this SHE Management System to minimise the risk of MA&D hazards for the Proposed Development Site is implicit within this assessment.

18.4.15 The Proposed Development Site contains a number of utilities including high voltage overhead lines and equipment, an existing 400kV and 132kV electrical substation and high pressure gas infrastructure which may pose a risk to the Proposed Development Site. Risks associated with on-Site facilities have been implicitly considered in the design of the Proposed Development and are discussed further in Section 18.6.

18.4.16 The nearest airfield is the privately owned Sandtoft Airfield located approximately 5.0km south-west of the closest part of the Proposed Development Site (A18 access). Although the airfield has not published details of any relevant aerodrome safeguarding or obstacle limitation surface (OLS) distances, it is considered that the Proposed Development Site would be highly unlikely to interfere with any such zones, if they exist, given the intervening distance. The Applicant will consult with Sandtoft Airfield as part of its stage 2 consultation to confirm that this is the case.

18.4.17 Keadby Wind Farm is located directly adjacent to the Proposed Development Site and owned by SSE Renewables Ltd. The design of the Proposed Development has carefully considered the location of existing turbines and design mitigation including exclusion zones are discussed further in Sections 18.5 and 18.6.

18.4.18 As reported in **Appendix 13A**: Phase 1 Desk Based Assessment (PEI Report Volume II) residual risks from unexploded ordnance (UXO) have been considered. A specialist preliminary UXO report for the Proposed Development Site identifies that the potential for UXO to exist is assessed as unlikely, with a conclusion that no further

action is required to address the UXO risk. For this reason, the risk of UXO is not considered further in this chapter.

18.4.19 The Scunthorpe to Doncaster passenger rail line interacts with the Proposed Development Site where it runs beneath North Pilfrey Bridge. North Pilfrey Bridge also spans the Stainforth and Keadby Canal used by pleasure craft and anglers. The bridge was designed to ensure that the minimum headroom clearance (approx. 5.2m above track level) specified by Network Rail was adhered to and was constructed in 2012.

18.4.20 As the bridge has been operating for its intended purposes since this time and the proposed use of the bridge by the Proposed Development for construction and operational traffic is not contrary to its existing use, the only relevant MA&D consideration relates to compliance with any weight restrictions existing for Pilfrey Bridge during transport of Abnormal Indivisible Loads (AIL) during construction to avoid a potential MA&D risk to this asset. **Chapter 10**: Traffic and Transport (PEI Report Volume I) and **Appendix 10A**: Transport Assessment (PEI Report Volume II) provide further information on routing of AIL, including alternative routes via Bonnyhale Road. On this basis, it is not considered that this rail line requires further assessment.

18.4.21 The potential for risks occurring in the marine environment which could pose a MA&D risk to the Proposed Development have been considered in Section 18.6.

Societal Risks

18.4.22 Existing societal risks include influenza pandemics, which may cause civil emergencies and large numbers of people to fall ill and risk of terrorist attack on infrastructure is also included in Section 18.6.

Sensitive Environmental Receptors

18.4.23 **Chapter 3**: The Site and Surrounding Area (PEI Report, Volume I) sets out the closest environmental receptors to the Proposed Development Site. These include residential receptors and Public Rights of Way (PRoW). **Figure 3.4** (PEI Report Volume III) illustrates the location of urban areas and PRoW surrounding the Proposed Development Site where members of the public could be present.

18.4.24 The location of sensitive ecological receptors in proximity to the Proposed Development Site that require consideration in relation to MA&D risk are shown in **Figure 11C.1 to 11C.4** in **Appendix 11C**: Preliminary Ecological Appraisal (PEI Report Volume II).

18.4.25 The location of designated and non-designated heritage assets in proximity to the Proposed Development Site that require consideration in relation to MA&D risk are shown in **Figure 15A1a** and **Figure 15A1b** in PEI Report Volume III.

Other hazards screened out

Volcanic eruptions

18.4.26 Volcanic eruptions present a risk of causing environmental damage, disruption to transport and poor air quality. Volcanic activity does not occur in the UK and has been screened out since it is not considered a risk to the Proposed Development.

Tsunamis

18.4.27 Tsunamis present a risk of causing environmental damage and damage to property and infrastructure. The Proposed Development will be located outside of a tsunami risk zone, and therefore the risk of tsunami will be screened out.

Coastal flooding

18.4.28 Coastal flooding can present a risk of causing environmental damage and damage to property and infrastructure in affected areas. The Proposed Development will be located inland and therefore this risk has been screened out, although the potential effects of tidal surges remains in-scope.

Avalanches

18.4.29 Avalanches present a risk of causing damage to property and infrastructure. The topography of the Proposed Development site is relatively flat and level and therefore the risk of avalanche has been screened out.

Wildfires

18.4.30 Wildfires can cause significant environmental damage and damage to infrastructure and property. The area surrounding the Proposed Development site does not contain woodland or vulnerable grassland, and therefore the risk of wildfires, including forest fires and bush fires, has been screened out.

Future Baseline

18.4.31 **Chapter 19**: Cumulative and Combined Effects (PEI Report Volume I) identifies developments that either have consent (and so may be constructed and/ or commence operating) or are in the consenting process. The initial long-list provided at PEI stage will be screened in the final ES, to identify those to be taken forward (shortlisted) into the cumulative assessment. For the purposes of this chapter, these developments will be considered as part of the future baseline, as they will be assumed to have been constructed before or during the construction of the Proposed Development.

18.4.32 To provide a conservative assessment in this chapter, the identified long-list of schemes in Table 19.5 have been considered as potential receptors to MA&D risks during construction and operation of the Proposed Development.

18.4.33 The list of developments has also been reviewed in order to determine whether they are likely to give rise to new off-site hazards that could impact the Proposed Development.

18.4.34 The potential for climate change to impact upon the frequency and severity of meteorological hazards in future years is inherent within the assessment and discussed in **Chapter 17**: Climate Change and Sustainability (PEI Report Volume I).

18.5 Development Design and Impact Avoidance

18.5.1 The following impact avoidance measures will either be incorporated into the design or are standard construction or operational measures. These measures have therefore been considered during the impact assessment process described in this chapter:

Design

18.5.2 Compliance with the CDM Regulations will ensure health and safety is at the heart of design, planning and construction work.

18.5.3 The design engineers will prepare a number of philosophies with regard to process safety and safeguarding, isolation, emergency shutdown and if required, depressurisation. The design engineers will also review the layout and give due consideration both to the on-site location of facilities as well as the off-site receptors.

18.5.4 A design hazard management plan will be prepared and a number of hazard identification and evaluation assessments (HAZID and HAZOP reviews) will be carried out on the Proposed Development during the design process, which is a standard approach to preventing or otherwise minimising hazardous scenarios through appropriate design during the Front End Engineering Design (FEED) studies to be progressed.

18.5.5 Major accident assessments and studies will be prepared over the course of the design development and a Major Accident Prevention Plan (MAPP) will be prepared to inform the application for COMAH Licence for the operational facility, if required.

18.5.6 The advice provided for high hazard sites relating to security measures (National Counter Terrorism Security Office and Association of Chief Police Officers (NaCTSO, 2014) to prevent trespassers will be considered in the detailed design of the Proposed Development.

Construction

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

18.5.8 A Construction Environmental Management Plan (CEMP) will be prepared to set out how construction 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. The scope of the CEMP will be set out in a Framework CEMP submitted with the Application and will control potential impacts upon people, businesses and the natural and historic environment.

18.5.9 In relation to the risk of flooding, as described in **Appendix 12A**: Flood Risk Assessment (PEI Report Volume II) the CEMP would incorporate measures aimed at

preventing an increase in flood risk during construction works, as far as reasonably practicable. This would include:

- topsoil and other construction materials would be stored outside of the 1 in 100-year (1% AEP) floodplain extent (Flood Zone 3) in laydown areas where elevations are higher;
- adequate containment of storage areas, to ensure that material does not wash away and cause pollution and damage to infrastructure;
- use of the Flood line Warnings Direct service;
- The Contractor would be required to produce a Method statement outlining appropriate temporary dewatering/ pumping measures to be employed in the event of a breach; and
- The Contractor would be required to produce a Flood Risk Management Action Plan which would provide details of the response to flooding in the event of a breach.

18.5.10 Potentially hazardous materials, construction equipment/ vehicles and welfare facilities would be located at locations that are outside of Flood Zones 2 and 3, or on raised areas.

Operation

18.5.11 As outlined previously, a COMAH Licence from the HSE and an Environmental Permit from the Environment Agency will be required for the operation of the Proposed Development. Both permissions require a number of stipulations and requirements to be fulfilled to the satisfaction of the regulators including use of appropriate control and monitoring procedures, risk assessments, management systems and control measures to minimise the risk of major accidents occurring and to minimise the effects of any such major accidents on off-site receptors as well as the operational workforce. The permit requires the approach to managing accidents and emergencies to be in accordance with the use of Best Available Techniques (BAT).

18.6 Likely Impacts and Effects

18.6.1 A number of potential major accident scenarios could occur during the construction, operational and decommissioning phases of the Proposed Development. These scenarios have been grouped into the following risk events:

- fire/ explosion and risk of release of harmful gas;
- spillage/ leak of chemicals or pollutants into groundwater/ surface water;
- extreme weather (e.g. flooding, drought);
- vandalism (trespass)/ terrorism;
- ground collapse;
- major road traffic accident;
- release of asbestos;

- aircraft/ drone impact;
- pandemic;
- domino effects from impacts at neighbouring facilities; and
- drowning.

Construction

18.6.2 A summary of identified potential construction risks are outlined within the relevant risk event groupings within Table 18.2.

Table 18.2: Potential Major Accident and/ or Disaster Events during Construction grouped by Risk Event

ID	Risk Event (High level)	Risk Description	Reasonable worst case consequence if event did occur	Embedded mitigation	Mitigated to ALARP?	Tolerability and Significance
C1	Fire/ explosion and risk of release of harmful gas.	Natural gas - disturbance of gas pipeline during construction results in loss of containment from supply pipeline. Disturbance of historical landfills located on site leading to risk of release of harmful gas. According to **Appendix 13A**: Desk Based Assessment (Table 15, link L3), the risks are considered to be moderate/ low for users of public open space (not accessing confined environments) and residential users (given distance from former landfills) and moderate for the workers within the existing Keadby 1 Power Station and current Keadby 2 construction workers.	Risk of fire/ explosion and release of harmful gas leading to fatality/ injury to member of public. Risk of fire/ explosion causes irreversible damage to environmental receptor (listed building, ecological site, watercourse etc.); or structural damage to buildings and/ or infrastructure. Firewater run-off containing contaminants could be potentially harmful the Humber Estuary Ramsar/ SAC/ SSSI designations and/ or Secondary A aquifer within superficial deposits.	A ground investigation will be designed to target the potentially contaminative sources identified, including the historical landfilling activities identified on the Proposed Development Site. Where risks are deemed to be significant, detailed remediation strategies will be developed accordingly. A preliminary planned targeted ground investigation proposed in 2020 will include ground gas monitoring. Consultation with appropriate stakeholders such as National Grid Gas and the Environment Agency will be undertaken to manage interfaces and define appropriate control measures. A Gas Connection Statement will be provided with the DCO Application.	Yes	Tolerable if ALARP (**not significant**)

ID	Risk Event (High level)	Risk Description	Reasonable worst case consequence if event did occur	Embedded mitigation	Mitigated to ALARP?	Tolerability and Significance
				A CEMP will be in place to control potential environmental impacts of construction works. Control measures will be implemented to prevent fires and procedures will be prepared and implemented to respond to fires, in the event that they were to arise.		
C2	Spillage/ leak of pollutants into groundwater/ surface water due to construction activities	Risk of contamination of water resources.	Irreversible damage to watercourse and dependant species/ habitats (see also risk related to fire water in C1). Loss of water supply	Impact avoidance measures related to leaks and spills are presented in section 13.5 of **Chapter 13**: Geology, Hydrogeology and Land Contamination. A CEMP will be implemented to manage storage of construction materials and potential environmental impacts of construction works.	Yes	Tolerable if ALARP (**not significant**)
C3	Extreme weather (e.g. flooding, drought) which is either caused or exacerbated by the	Tidal sources: The Site is at a 'low' risk of flooding from tidal and fluvial sources with the existing flood defences in place or resulting from overtopping of the	Irreversible damage to environmental receptor (listed building, ecological site, watercourse etc.). Worsened extreme weather impact leads to	Existing flood defences expected to continue to protect the Proposed Development Site, mitigating the overtopping risk. Refer to Section 18.5 for design and impact avoidance	Yes	Tolerable if ALARP (**not significant**)

ID	Risk Event (High level)	Risk Description	Reasonable worst case consequence if event did occur	Embedded mitigation	Mitigated to ALARP?	Tolerability and Significance
	construction of the Proposed Development and leads to release of stored construction related material, equipment and potential contaminants.	defences during events that exceed a 0.5% AEP (1 in 200 chance) of flooding. Overall, the risk of flooding from artificial waterbodies including the Stainforth and Keadby Canal is considered to be 'low'. There is therefore a low risk of floodwaters mobilising construction materials and potential contaminants on the Proposed Development Site.	fatality /injury to members of public.	measures that would be implemented by the contractor during construction to reduce this risk which would include location of stockpiles away from flood zones and sensitive watercourses where practicable, as far as reasonably practicable. Measures to be agreed with Environment Agency including need for any breach modelling.		
C4	Vandalism (trespass)	Risk of vandalism/ arson leading to fires/ explosions.	Fatality/ injury to member of public off site from fire/ explosions; and/ or irreversible damage to environmental receptor (listed building, ecological site, watercourse etc.).	As is currently the case for Keadby 2 construction site, appropriate security measures will be installed at the construction site, including site security and fencing to prevent trespassers and mitigate this risk to ALARP.	Yes	Tolerable if ALARP (**not significant**)

ID	Risk Event (High level)	Risk Description	Reasonable worst case consequence if event did occur	Embedded mitigation	Mitigated to ALARP?	Tolerability and Significance
C5	Ground collapse	Risk of construction resulting in disturbance of manmade or naturally occurring ground related hazards. Vibration causes ground instability/ collapse/ settlement.	Localised collapse and subsidence of ground at the surface/ surface settlement could lead to uncontrolled movement affecting objects/ people/ materials/ plant/ equipment which could cause injury/ fatality to persons on site and/ or lead to secondary impacts e.g. damage to utilities leading to explosion.	**Appendix 13A**: Phase 1 Desk Based Assessment (PEI Report Volume II) summaries the ground related risks and proposed mitigation including a ground investigation with appropriate testing to understand the compressibility of deposits. This will inform the construction methods used. To reduce risks associated with ground instability, there will be use of industry standard construction methods/ design features appropriate to the context of the Proposed Development Site.	Yes	Tolerable if ALARP (**not significant**)
C6	Major road traffic accident	Construction work on/ adjacent to existing highway (A18). Movement of construction vehicles on local roads leading to increased risk of road traffic accidents.	Fatality/ injury to members of public.	Controls will be implemented including a construction traffic management plan (CTMP) and construction workers' travel plan (CWMP) – Framework CTMP and Frameworks CWMP will be submitted with the Application.	Yes	Tolerable if ALARP (**not significant**)

ID	Risk Event (High level)	Risk Description	Reasonable worst case consequence if event did occur	Embedded mitigation	Mitigated to ALARP?	Tolerability and Significance
				Risks to road users have been assessed in **Chapter 10**: Traffic and Transportation (PEI Report Volume I) and are not considered significant.		
C7	Release of asbestos	Risk of uncontrolled release of asbestos present on site, if disturbed during construction of the Proposed Development.	Risk of uncontrolled release of asbestos containing materials (ACM) during excavation works leading to short term exposure to construction personnel, and possibly members of the public in surrounding areas.	**Appendix 13A**: Phase 1 Desk Based Assessment (PEI Report Volume II) presents he initial findings of an asbestos assessment and concludes that risks to current users due to inhalation of asbestos are considered moderate/ low. A watching brief will be adopted during the construction works and an asbestos management plan developed as part of the CEMP. If identified, risks will be managed to ensure legal compliance through the Control of Asbestos Regulations 2012 (HM Government, 2012) governing	Yes	Tolerable if ALARP (**not significant**)

ID	Risk Event (High level)	Risk Description	Reasonable worst case consequence if event did occur	Embedded mitigation	Mitigated to ALARP?	Tolerability and Significance
				the handling and disposal of ACM.		
C8	Aircraft/ drone impact	Risk of collision between aircraft and tall construction machinery, e.g. cranes. Construction lighting and tall structures have the potential to present a visual distraction to pilots, causing aircraft incident. Potential risk of asset damage and subsequent fires/ explosions.	Aircraft incident results in fatality/ injury to member of public and/ or irreversible damage to environmental receptor (listed building, ecological site, watercourse etc.).	The Proposed Development is located in area which does not have a high density of air traffic. Consultation with relevant airports/ Civil Aviation Authority (CAA) to manage interfaces and define appropriate control measures including need for aviation warning lighting to be fitted to tall construction machinery. The CEMP will include vigilance and security systems to safely shutdown the plant in the event of any aircraft related incident.	Yes	Tolerable if ALARP (**not significant**)
C9	Pandemic	Risk of influenza pandemic causing civil emergency.	Risk of influenza pandemic occurring which may cause civil emergency and large numbers of people to fall ill, including construction workers.	If an influenza pandemic was to disrupt the construction of the Proposed Development, measures would be adopted taking into account experience at the Keadby 2 Power Station project in which the Covid 19 pandemic required	Yes	Broadly Acceptable (**not significant**)

ID	Risk Event (High level)	Risk Description	Reasonable worst case consequence if event did occur	Embedded mitigation	Mitigated to ALARP?	Tolerability and Significance
			Risk of loss of control of construction site.	construction works to temporarily cease. The CEMP would be followed to ensure no adverse environmental effects occurred during this time.		
C10	Domino effects from incidents at neighbouring facilities	Risk of incident at adjacent Keadby Windfarm, for example ice build-up on wind turbines during cold conditions leading to ice throw, this could cause damage to construction assets and may lead to major accident at the Proposed Development Site. Risk of a turbine collapse, which could fall onto the Proposed Development Site, potentially leading to fire and/ or explosion	Risk of injury/ fatality to site personnel.	Preliminary risk assessment has informed the inclusion of an exclusion zone for the built infrastructure associated with the Proposed Development to mitigate the risks related to the presence of wind turbines in close proximity. During detailed design, the contractor will engage with the windfarm operator (SSE Renewables) to inform the need for/ size of any similar exclusion zones for construction.	Yes	Tolerable if ALARP (**not significant**)
C11	Domino effects from incidents	The Proposed Development lies in close proximity to PD	Fire/ explosion impact upon the construction	Granting of a HSC provides an indication that the risk of storing hazardous substances	Yes	Tolerable if ALARP (**not significant**)

ID	Risk Event (High level)	Risk Description	Reasonable worst case consequence if event did occur	Embedded mitigation	Mitigated to ALARP?	Tolerability and Significance
	at neighbouring facilities	Port Services Keadby site where it is noted that a HSC for ammonium nitrate-based fertilisers (PA/2014/0176) was in place but appears to have now been withdrawn. Risk of accidental release of dangerous substances (if such substances are present), resulting in fire and/ or explosion at neighbouring industrial facilities.	of the Proposed Development.	is tolerable for the community (Planning Practice Guidance, 2016, paragraph 005). The Applicant will engage with PD Port Services Keadby to confirm the status of this HSC and presence of any hazardous substances stored on site. It is expected that existing safety precautions at neighbouring industrial sites, along with the implementation of a CEMP at the Proposed Development Site, will mitigate the risk of domino effects occurring. As part of the stage 2 consultation, further engagement with the HSE, local authorities and utility providers will be undertaken to understand locations of hazardous sites/ assets and the mitigation required.		

ID	Risk Event (High level)	Risk Description	Reasonable worst case consequence if event did occur	Embedded mitigation	Mitigated to ALARP?	Tolerability and Significance
C12	Domino effects from incidents at neighbouring facilities	The Keadby Power Station site encompasses the Keadby 2 Power Station (a 910MW CCGT power station fuelled by natural gas currently under construction). Risk of loss of containment of natural gas at Keadby 2 site leading to fire/explosion and risk of release of harmful gas which may spread to the Proposed Development due to close proximity.	Fire and/or explosion could spread to the Proposed Development due to the close proximity and result in significant harm (serious injuries / fatalities) to construction personnel. Risk of irreversible damage to environmental receptor (listed building, ecological site, watercourse etc.) or structural damage to buildings and/or infrastructure. Risk of harm to people, buildings and other receptors off-site depending on severity of fire/ explosion/ incident e.g. due to radiant heat burns and impact injuries from explosions.	It is expected that safety precautions implemented at the Keadby 2 Power Station site will minimise the risk of a major accident occurring. In addition, through the implementation of a CEMP at the Proposed Development Site, the risk of domino effects occurring will be minimised. Further details of the potential hazards associated with domino effects to and from neighbouring sites are contained in Section 18.6.	Yes	Tolerable if ALARP (**not significant**)

Operation

18.6.3 A summary of identified potential operation risks are outlined within the relevant risk event groupings within Table 18.3.

18.6.4 The assessment of MA&D considers operations on the Proposed PCC Site, including and up to CO_2 compression station prior to export to the Humber Low Carbon (HLC) cluster CO_2 export pipeline. Connections to the Proposed Development Site including the Gas Connection Corridor, Electrical Connection Area to National Grid 400kV Substation and Potential Electrical Connection to Northern Powergrid 132kV Substation are also considered.

18.6.5 There will be hazardous and potentially harmful substances present on the Proposed PCC Site, the CO_2 compression station and Natural Gas Connection in quantities which, if released, have the potential to cause a major accident.

18.6.6 In addition to CO_2 and natural gas, the hazardous substances required to be stored and used on the operational Proposed PCC Site are presented in Section 4.8 of **Chapter 4**: The Proposed Development (PEI Report Volume I) and in summary will include:

- Low, medium and high pressure CO_2 (when compressed to pipeline pressure for export) – CO_2 is an asphyxiant which is potentially toxic in high doses;
- natural gas, a highly flammable gas comprising mainly of methane supplied via a dedicated pipeline and to be used as primary fuel in the CCGT;
- hydrogen, a highly flammable gas, to be used as a coolant in the electrical generator and as a reagent in the oxygen removal system. Hydrogen will be stored on-site in compressed gas cylinders;
- distillate fuel oil, a flammable and environmentally harmful liquid, to be used to provide fuel for emergency standby plant;
- aqueous amine solutions (a proprietary blend of substances most likely including monoethanolamine (MEA)), which may potentially be classified as harmful liquids to be used in the carbon capture CO_2 absorption and regeneration system;
- reclaimer sludge from the absorber which is classed as hazardous waste;
- potentially aqueous ammonia, a toxic liquid, which may be used in the treatment of exhaust gas emissions from the CCGT and in the treatment of water within the Heat Recovery Steam Generator (HRSG); and
- other treatment chemicals as may be required for water treatment, wastewater treatment, solvent reclamation or other on-site processes.

18.6.7 Distillate fuel, aqueous ammonia and amine solutions will be stored in dedicated above ground bulk tanks mounted within secondary containment bunds, so as to contain any accidental spillages, should they occur.

18.6.8 Smaller quantities of other hazardous materials will also be present at the Proposed Development Site. These substances would not be expected to initiate or exacerbate major accidents or disasters but could be harmful in the event of a major accident,

that causes loss of containment (for example, if hazardous substances were released during a fire event, due to the failure of storage vessels, this could result in the hazardous substances being present in the firewater runoff). These hazardous materials, present in small quantities, include nitrosamines and nitramines, which are present within the CO_2 absorption/ regeneration system. Water and effluent treatment chemicals used on-site in smaller quantities will include sodium hydroxide and hydrochloric acid. Smaller inventories of synthetic oils will be present in transformers and rotating equipment.

18.6.9 Design and operational controls will be in place to manage the risks associated with the smaller inventories of the above hazardous substances including use of dedicated bunded above ground storage areas, segregation of incompatible materials, dedicated filling points and management procedures for the handling, storage and use of the materials.

18.6.10 Table 18.3 below lists the potential MA&D relevant to the operation of the Proposed Development and the storage and handling of hazardous substances present.

18.6.11 The information summarised in the tables below has been based on the Preliminary Hazard and Environmental Assessments (PHEA) undertaken for the Proposed Development.

18.6.12 Additional information is presented below Table 18.3 on the risks associated with a release of CO_2, and a description of the potential for large scale “knock-on” accidents, referred to as Domino Effects.

Table 18.3: Potential Major Accident and/or Disaster Events during Operation grouped by Risk Event

ID	Risk Event (High level)	Risk Description	Reasonable worst case consequence if event did occur	Embedded mitigation	Mitigated to ALARP?	Tolerability
Op1	Fire/ explosion and risk of release of harmful gas.	Natural gas - Loss of containment of natural gas from supply pipeline and/ or power plant equipment leading to unconfined gas explosion. Hydrogen - Loss of containment from storage cylinders, pipework and/ or process equipment (cooling equipment and oxygen removal equipment). Whilst the volume of hydrogen stored on the site will be low, a release of flammable gas could be caused by mechanical failure or impact damage resulting in a loss of containment. Immediate ignition of the gas would lead to a localised flash or jet fire	Fire and/ or explosion could result in significant harm, with potential for injuries/ fatalities (on site personnel). There is also potential for harm to people, buildings and other receptors off-site due to radiant heat burns and impact injuries from explosions. Risk of fire/ explosion causes irreversible damage to environmental receptor. (listed building, ecological site, watercourse etc.). or structural damage to buildings and/ or infrastructure. Firewater run-off containing contaminants could be potentially harmful the Humber Estuary Ramsar/ SAC/ SSSI designations and/ or Secondary A aquifer within superficial deposits.	Design of the natural gas systems to relevant industry codes and standards. Compliance with relevant legislation including the Pressure Equipment (Safety) Regulations 2016 and the Pipelines Safety Regulations (PSR) (HSE, 1996). Selection of pipeline routes across the Proposed Development Site, depth of cover in areas of higher risk. Pipeline safety systems and gas/ liquid pressure regulation to be installed along with operational controls and monitoring. Gas detection systems at the Proposed Development Site.	Yes	Tolerable if ALARP (**not significant**)

ID	Risk Event (High level)	Risk Description	Reasonable worst case consequence if event did occur	Embedded mitigation	Mitigated to ALARP?	Tolerability
		depending on gas volume and pressure. Delayed ignition could lead to an explosion and/ or fire.		Minimising the storage volumes of high hazard materials to as low as reasonably practicable (e.g. small volumes of hydrogen) Fire detection and fire protection systems will be installed, including passive and active fire suppression systems. The Proposed PCC Site would be designed to contain firewater runoff and prevent material reaching unmade ground or other environmental receptors. Detailed emergency plans will be produced for the installation in accordance with the Environmental Permit and any other applicable Regulations e.g. COMAH, if required.		

ID	Risk Event (High level)	Risk Description	Reasonable worst case consequence if event did occur	Embedded mitigation	Mitigated to ALARP?	Tolerability
Op2	Fire/ explosion and risk of release of harmful gas.	Distillate fuel oil – release of flammable liquid from storage, pipework or operating equipment. Whilst the volume of distillate fuel stored on the site will be low, the ignition of this fuel, if released due to failure of primary containment, could result in a localised pool fire if the vapour found a source of ignition.	A local pool fire could result in harm to people on-site and damage to assets but would be unlikely to escalate to a major accident affecting areas off-site. This is because distillate fuel would only be used in small quantities as start-up fuel or for back-up generators located in close proximity to the main generating station or compression equipment, some distance from the Proposed Development Site boundary.	Design of the storage tanks to industry codes and standards. Installation of the storage tank(s) within a secondary containment system (bund) designed in accordance with CIRIA C736 guidance (CIRIA, 2014). Instrumentation and control systems will be installed to monitor tank contents and prevent overfill. Minimising the storage volumes of high hazard materials. Depending on the inventory of distillate fuel oil and other hazardous substances, the Proposed PCC Site may be regulated through the COMAH Regulations (HSE, 2015). It will also be regulated. though an Environmental Permit.	Yes	Tolerable if ALARP (**not significant**)

ID	Risk Event (High level)	Risk Description	Reasonable worst case consequence if event did occur	Embedded mitigation	Mitigated to ALARP?	Tolerability
Op3	Fire/ explosion and risk of release of harmful gas.	Accidental release of CO_2 at medium or high pressure on the Proposed PCC Site. CO_2 is toxic and an asphyxiant, depending on the concentration in air. It is also odourless and heavier than air. A release of CO_2 could be caused by mechanical failure or impact damage resulting in a loss of containment. A leak or rupture of a system containing high pressure (dense phase) CO_2 will be noisy and will be observed with the naked eye due to the transition between the phases. There will be an associated large reduction in temperature from a high-pressure release	The impact of the release on people and the environment depends on the pressure, temperature and mass of material that is lost, however there is the potential for a major accident resulting in significant harm and potential fatalities, both on-site and off-site. Risk of high levels of CO_2 dissolved in water can lead to acidification and effects on shell-forming species.	Relevant equipment has been located a minimum distance of 50m from the Proposed Development Site boundary and downwind (with respect to the prevailing wind) of all the typically occupied areas (site personnel) and the majority of the equipment. Quantitative risk assessment with dispersion modelling is proposed to confirm adequacy of this safeguarding measure for site personnel and general public. Detailed standards and codes of practice written specifically for the design and operation of dense phase or supercritical CO_2 plant and pipelines are still being developed, therefore	Yes	Tolerable if ALARP (**not significant**)

ID	Risk Event (High level)	Risk Description	Reasonable worst case consequence if event did occur	Embedded mitigation	Mitigated to ALARP?	Tolerability
		Further details of the hazards associated with a CO_2 release are presented below this table.		industry codes and standards for gas and chemical pipelines will be applied where appropriate. According to the HSE, "ongoing work suggests that the hazards involved with the bulk transport of CO_2 are similar to the hazards transporting natural gas". Compliance with PSR 1996 and additional specific safety measures for CO_2 pipelines will apply. The high pressure CO_2 will be managed to specification limits defined by the pipeline operator. The gas composition is linked to the pipeline design (materials of construction) and will be carefully managed to ensure no excursions via monitoring and trips. The		

ID	Risk Event (High level)	Risk Description	Reasonable worst case consequence if event did occur	Embedded mitigation	Mitigated to ALARP?	Tolerability
				pipeline operator has undertaken extensive studies of CO_2 pipeline design, including destructive testing. Pressure monitoring and pressure relief systems to prevent over pressurisation situations. Emergency shut down valves to be fitted on certain pipelines to mitigate risk of becoming over pressurised. Use of containment measures and barriers to prevent damage to pipelines and compliance with the Pressure Safety Regulations (2016). Detailed emergency plans will be produced for the installation in accordance with the Environmental Permit and all applicable Regulations.		

ID	Risk Event (High level)	Risk Description	Reasonable worst case consequence if event did occur	Embedded mitigation	Mitigated to ALARP?	Tolerability
				Leak detection systems. Isolation valves in the pipeline system to minimise inventory release to the atmosphere.		
Op4	Fire/ explosion and risk of release of harmful gas.	Release of abnormal levels of amine from CO_2 absorption/ regeneration system. Amines used in the CO_2 absorption/ regeneration system are non-flammable, toxic solvents which are harmful to people and hazardous to the environment. An abnormal release of amines could occur from failure in process equipment, pipework, the offloading (road tanker import) system and storage vessels and could be caused by mechanical failure or impact damage.	Loss of amines into surface water drains could reach local watercourses and result in irreversible damage to environmental receptor (ecological site, watercourse etc.) as a result of the toxicity of amines, increase in the pH of the environment and reduction in dissolved oxygen concentrations.	Amine storage tank(s), process equipment and pipework design and construction to industry standards. Site process water to be segregated from surface water drains and routed to holding tanks or wastewater treatment plant for treatment and testing prior to discharge. Surface water drains and attenuation system to have isolation valves installed to be closed in the event of accidental spillage into the uncontaminated surface water drainage system. Design of site containment facilities and drainage	Yes	Tolerable if ALARP (**not significant**)

ID	Risk Event (High level)	Risk Description	Reasonable worst case consequence if event did occur	Embedded mitigation	Mitigated to ALARP?	Tolerability
				systems to industry standards (e.g. CIRIA C736) and operated in accordance with the Environmental Permit.		
Op5	Fire/ explosion and risk of release of harmful gas.	Release of abnormal levels of N-amine formed as by-products within the CO_2 absorption/ regeneration system (CCP). These are non-flammable, toxic solvents which are harmful to people and hazardous to the environment. An abnormal release of N-amines could occur from process abnormalities and could give rise to elevated release concentrations from the emissions stack(s).	Irreversible damage to environmental receptor (ecological site, watercourse etc.) depending on concentrations/ duration of release.	Process equipment and pipework design and construction to industry standards. Gas sensors and emissions and process monitoring systems to monitor plant performance and amine degradation with alarms to inform operatives of elevated release levels and interlocks to automatically isolate or shut down systems in the event of an abnormal plant performance. Wastes from the CO_2 capture system to be collected for off-site disposal via a licensed	Yes	Tolerable if ALARP (**not significant**)

ID	Risk Event (High level)	Risk Description	Reasonable worst case consequence if event did occur	Embedded mitigation	Mitigated to ALARP?	Tolerability
				hazardous waste management contractor.		
Op6	Spillage/ leak of chemicals or hazardous materials	Release of aqueous ammonia solution used in the emissions abatement system, through loss of containment (aqueous liquid loss) and ammonia vapours from the liquid. Aqueous ammonia solution is harmful to people, causing burns, eye damage and respiratory irritation. It is toxic to aquatic life in the environment. Risk of spillage of hazardous waste (sludge containing metals and amine degradation products) from amine reclaimer. A release of these substances could occur from failure in process	Irreversible damage to environmental receptor (ecological site, watercourse etc.) depending on concentrations/ duration of release.	Ammonia storage tank(s), process equipment and pipework design and construction will meet relevant industry standards. Minimising the storage volumes of high hazard materials. Use of an appropriately licenced and competent hazardous waste contractor. Site drainage philosophy will ensure that process water is segregated from surface water drains and routed to holding tanks or wastewater treatment plant for treatment and testing prior to discharge. Surface water drains and attenuation system to have isolation valves installed to	Yes	Tolerable if ALARP (**not significant**)

ID	Risk Event (High level)	Risk Description	Reasonable worst case consequence if event did occur	Embedded mitigation	Mitigated to ALARP?	Tolerability
		equipment, pipework, the offloading (road tanker import) system and storage vessels and could be caused by mechanical failure or impact damage. There is a risk that on-site chemical storage facilities could be used for longer than sized for, leading to leaks. Risk of spillage of substances and hazardous goods during transportation off-Site.		be closed in the event of accidental spillage into the uncontaminated surface water drainage system. Design of site containment facilities and drainage systems to industry standards (e.g. CIRIA C736) and operated in accordance with the Environmental Permit. Transportation of hazardous substances to and from Site will be undertaken in accordance with The Carriage of Dangerous Goods and Use of Transportable Pressure Equipment Regulations 2009 (HM Government).		
Op7	Spillage/ leak of chemicals or hazardous materials	Risk of contamination of water resources / damage or contamination of aquifer or borehole.	Risk of drainage system failure leading to damage to local environment due to accidental discharges of oil or other chemicals, e.g. fire-fighting foam.	In order to mitigate the risk of chemical spillages and leaks leading to water contamination, there will be segregation of clean water/ rainwater/ fire water drains	Yes	Tolerable if ALARP (**not significant**)

ID	Risk Event (High level)	Risk Description	Reasonable worst case consequence if event did occur	Embedded mitigation	Mitigated to ALARP?	Tolerability
				through use of paved areas and rain shelters above outdoor equipment.		
Op8	Spillage/ leak of chemicals or hazardous materials and damage caused by 3rd party vessels	Risk of pollution of canal or river water intended for abstraction through accidents/ unlawful discharges (e.g. oil, waste or sewage) by 3rd party vessels. Risk of grounding/ collision with abstraction infrastructure from passing 3rd party vessels causing damage to abstraction infrastructure.	Temporary cessation of operations. Safe shutdown of systems within the power plant. No MA&D risk for the Proposed Development.	Any oil, fuel or chemical spill within the marine environment must be reported to the Marine Management Organisation (MMO) Marine Pollution Response Team. If Applicant detects pollution through routine monitoring, MMO and Environment Agency would be notified.	Yes	Not significant
Op 9	Extreme weather (e.g. flooding, drought) which is either caused or exacerbated by the operation of the Proposed Development.	Tidal sources: The Site is at a 'low' risk of flooding from tidal and fluvial sources with the existing flood defences in place or resulting from overtopping of the defences during events that exceed a 0.5% AEP	Worsened extreme weather impact leads to fatality/ injury to site operative and/ or in irreversible damage to environmental receptor (ecological site, watercourse etc.). The consequences of water flooding the PCC could	The flood risk assessment contained in **Appendix 12A** (PEI Report, Volume II) includes recommendations for measures within the ongoing design of the Proposed Development to withstand predicted tidal	Yes	Tolerable if ALARP (not significant)

ID	Risk Event (High level)	Risk Description	Reasonable worst case consequence if event did occur	Embedded mitigation	Mitigated to ALARP?	Tolerability
		(1 in 200 chance) of flooding. Overall, the risk of flooding from artificial waterbodies including the Stainforth and Keadby Canal is considered to be 'low'. However, a residual risk of flooding as a result of either a breach in the defences (a failure in the flood defence structure) or overtopping in a future extreme event as a result of sea level rise (and consequent increases in the River Trent water levels) is predicted (refer to **Appendix 12A** in PEI Report Volume II). Mitigation for this risk	include contamination with polluting substances, destabilising assets and compromising the integrity of plant and equipment.	flood levels and mitigate the residual risk/ impacts including a) flood resistance and resilience measures; b) flood emergency response plans; c) flood warnings and alerts; d) emergency access and egress; and e) design capacity exceedance. This will be used to inform the detailed design of the Proposed Development in terms of surface water management and selection of finished floor levels. Critical items of plant including electrical equipment such as transformers and switchgear are to be located above predicted residual risk flood levels.		

ID	Risk Event (High level)	Risk Description	Reasonable worst case consequence if event did occur	Embedded mitigation	Mitigated to ALARP?	Tolerability
				Details to be provided in final FRA to accompany the DCO application. Flooding guidance is provided by the Environment Agency for sites regulated under the Environmental Permitting Regulations will also be adhered to.		
Op10	Extreme weather (e.g. flooding, drought)	Ambient temperature extremes, high windspeeds.	The impact of climate change causing extremes of temperature and winds may affect process operation of the Proposed PCC Site such as the cooling systems and structural stability. This could potentially impact the operation and efficiency of the Proposed Development.	The concept engineering design and future detailed design take into account the predicted ambient temperatures and wind speeds over the operational lifecycle of the Proposed Development. The design will incorporate future climate resilience measures, if required to ensure use of suitable materials in the design of utility systems such as cooling water. Such measures will be outlined,	Yes	Tolerable if ALARP (**not significant**)

ID	Risk Event (High level)	Risk Description	Reasonable worst case consequence if event did occur	Embedded mitigation	Mitigated to ALARP?	Tolerability
				if required, in **Chapter 17**: Climate Change and Sustainability of the ES.		
Op11	Extreme weather (e.g. flooding, drought)	Risk of lightning strike leading to asset damage, including electrical failure, and potential subsequent fires/ explosions.	A lightning strike could cause a major accident, harm to people on-site and damage to site infrastructure. A lightning strike could also damage the distribution network, leading to damage to the national electricity transmission system. Lightning could also present a source of ignition to flammable materials. A subsequent major fire could harm people both on-site and off-site.	The engineering design of the Proposed Development will include appropriate electrical earthing and bonding systems. The design and maintenance of these systems will reduce the likelihood of a major accident being initiated by a lightning strike to a very low level. It is anticipated that existing black start operations will be used to recover the electricity transmission network from total or partial shutdown. Guidance is provided by the HSE on the management of potential ignition caused by lightning (HSE, 2014).	Yes	Tolerable if ALARP (**not significant**)

ID	Risk Event (High level)	Risk Description	Reasonable worst case consequence if event did occur	Embedded mitigation	Mitigated to ALARP?	Tolerability
Op12	Vandalism (trespass)/ terrorism	Risk of vandalism/ terrorism leading to fires/ explosions.	The worst-case risks and effects of this could be significant harm to site personnel, with potential for injuries/ fatalities. There is also potential for harm to people, buildings and other receptors off site due to radiant heat burns and impact injuries from explosions.	Security measures will be installed at the Proposed Development Site, including site security, CCTV and fencing to prevent trespassers and cyber security measures to prevent hacking. Security advice for high hazard sites provided by the National Counter Terrorism Security Office and Association of Chief Police Officers (NaCTSO, 2014) will be considered during detailed design.	Yes	Tolerable if ALARP (**not significant**)
Op13	Major road traffic accident	Risk of presence of operation/ maintenance vehicles on local roads leading to increased road traffic accidents due to additional traffic affecting members of public. Road traffic accident causes loss of containment of	Fatality /injury to members of public. Irreversible damage to environmental receptor (ecological site, watercourse etc.)	Risks to road users has been assessed in **Chapter 10**: Traffic and Transportation (PEI Report Volume I) and are not significant. Transportation of hazardous substances and goods will be undertaken in accordance with The Carriage of	Yes	Tolerable if ALARP (**not significant**)

ID	Risk Event (High level)	Risk Description	Reasonable worst case consequence if event did occur	Embedded mitigation	Mitigated to ALARP?	Tolerability
		hazardous substances being transported.		Dangerous Goods and Use of Transportable Pressure Equipment Regulations 2009 (HM Government).		
Op14	Aircraft/ drone impact	Tall structures have the potential to present a visual distraction to pilots, causing aircraft incident. Risk of asset damage, potential subsequent fires, explosions	Aircraft incident results in fatality/ injury to member of public and/ or irreversible damage to environmental receptor (listed building, ecological site, watercourse etc.).	The Proposed Development is located in an area which does not have a high density of air traffic. Consultation with relevant airports/ Civil Aviation Authority (CAA) to manage interfaces and define appropriate control measures including aviation warning lighting. Facilities are not designed to withstand such an impact. Consequently, vigilance and security systems are the key mitigation measures, with automated shutdown and interlocks installed as part of the plant operating philosophy to safely shut	Yes	Tolerable if ALARP (**not significant**)

ID	Risk Event (High level)	Risk Description	Reasonable worst case consequence if event did occur	Embedded mitigation	Mitigated to ALARP?	Tolerability
				down the plant in the event of an abnormal incident. Use of bunding and impermeable surfacing will minimise the risk of chemical releases to ground or controlled waters in the event of any incident.		
Op15	Pandemic	Risk of influenza pandemic causing civil emergency.	Risk of influenza pandemic occurring which may cause civil emergency and large numbers of people to fall ill, including site operatives.	In order to mitigate against an influenza pandemic disrupting operation of the Proposed Development, management plans will be implemented, and emergency protocols followed to ensure the critical infrastructure associated with the Proposed Development is able to operate safely.	Yes	Broadly Acceptable (**not significant**)
Op16	Domino effects from incidents at neighbouring facilities	Risk of incident at adjacent Keadby Windfarm could lead to major accident at the Proposed Development	There is a risk that if a major accident were to occur at the adjacent Keadby wind farm, for example ice build-up on wind turbines during cold	Risk assessment has informed the inclusion of an assumed exclusion zone of 140 m from the base of the turbine (1.5 x	Yes	Tolerable if ALARP (**not significant**)

ID	Risk Event (High level)	Risk Description	Reasonable worst case consequence if event did occur	Embedded mitigation	Mitigated to ALARP?	Tolerability
		site e.g. fire and/or explosion.	conditions leading to ice throw, this could cause damage to assets and injury/fatality to personnel on site. If an incident such as turbine collapse were to occur, this could fall onto the Proposed Development site, potentially leading to fire and/or explosion.	mast height) to mitigate the risk of ice throw/ a turbine falling onto the Proposed PCC Site. Refer to **Figure 4.1** in PEI Report Volume III.		
Op16	Domino effects from incidents at neighbouring facilities	The Proposed Development lies in close proximity to PD Port Services Keadby site where it is noted that a HSC for ammonium nitrate-based fertilisers (PA/2014/0176) was in place but is reported to be withdrawn. Upper and lower tier COMAH sites lie at greater distances. Risk of accidental release of dangerous	Fire and/ or explosion at off-site facilities could result in significant harm to site personnel, with potential for injuries/ fatalities. Resulting fire/ explosion at the Proposed Development Site due to domino effects has the potential for harm to people, buildings and other receptors off-site depending on severity of fire/ explosion/ incident e.g. due to radiant heat burns and impact injuries from explosions.	Further details of the potential hazards associated with domino effects to and from neighbouring industrial sites are contained in below this table in Section 18.6. Based on the distance between the Proposed Development and the nearest COMAH sites (refer to Section 18.4), the risk of domino effect is considered acceptable.	Yes	Tolerable if ALARP (**not significant**)

ID	Risk Event (High level)	Risk Description	Reasonable worst case consequence if event did occur	Embedded mitigation	Mitigated to ALARP?	Tolerability
		substances (if such substances are present), resulting in fire and/ or explosion at neighbouring industrial facilities.	Potential for domino effects to cause irreversible damage to environmental receptor e.g. due to firefighting run-off.	The status of the HSC at PD Ports is reported to be withdrawn, although further engagement will be undertaken to confirm this status. Should new developments/ applications for HSC be made either at this site, or in proximity to the Proposed Development site in future, these would need to be sited to prevent domino effects from occurring by following the HSE standard land use planning methodology (PADHI assessment). Consultation will be undertaken with the Health and Safety Executive, local authorities and utility providers to ensure locations of any additional hazardous sites/ assets are identified and that		

ID	Risk Event (High level)	Risk Description	Reasonable worst case consequence if event did occur	Embedded mitigation	Mitigated to ALARP?	Tolerability
				required mitigation is implemented.		
Op17	Domino effects from incidents at neighbouring facilities.	Risk of incident occurring at the adjacent Keadby 2 Power Station 910MW CCGT leading to a major accident at the Proposed Development.	There is a risk that if a major accident were to occur at the adjacent Keadby 2 Power Station, such as a loss of containment of natural gas, then a fire and/or explosion could occur and spread to the Proposed Development. Risk of injury/fatality to on site personnel and irreversible damage to environmental receptors (listed buildings, ecological site, watercourse etc.). There may also be potential structural damage to buildings and/or infrastructure. Risk of harm to people, buildings and other receptors off-site depending on severity of fire/ explosion/ incident e.g. due to radiant heat burns	It is expected that safety precautions implemented at both the Keadby 2 site and the Proposed Development site will minimise the risk of a major accident occurring. Further details of the potential hazards associated with domino effects to and from neighbouring sites and contained in Section 18.6 below.	Yes	Tolerable if ALARP (**not significant**)

ID	Risk Event (High level)	Risk Description	Reasonable worst case consequence if event did occur	Embedded mitigation	Mitigated to ALARP?	Tolerability
			and impact injuries from explosions.			
Op18	Accidental drowning	Risk of 3rd party access/ trespassers falling into attenuation pond.	Fatality of member of public.	Requirements under legislation to ensure safe design to avoid harm to public. Fencing will be installed around the entire Proposed Development Site to prevent access.	Yes	Tolerable if ALARP (**not significant**)

Potential for Major Accidents Associated with Carbon Dioxide Releases

18.6.13 The HSE publication on the major hazards associated with CO_2 (HSE, 2011) states that this gas is an asphyxiant which displaces oxygen in air at a concentration of 50%v/v. However, even at lower concentrations, CO_2 creates an immediate threat to life at a concentration of only 15% in air due to the toxicological impact it has on the body when inhaled at this concentration.

18.6.14 The HSE has undertaken a Dangerous Toxic Load assessment for CO_2 which concludes a significant danger to humans through asphyxiation and loss of consciousness if they inhale CO_2 at concentrations above around 7% in air (i.e. > 70,000 ppm). The HSE has derived and published Specified Level of Toxicity (SLOT) and Significant Likelihood of Death (SLOD) Levels for hazardous substances and concluded that CO2 data indicates it does not meet the criteria for classification as a dangerous substance.

18.6.15 However, in addition to the hazard posed by CO_2 if inhaled, there are additional hazards associated with dense phase CO_2 that are likely to occur when CO_2 is handled in large quantities and at high pressure (dense phase). These can arise when a release occurs, and the pressure suddenly falls or is lost completely and result in cryogenic burns to living creatures and damage to assets such as embrittlement of metallic structures and pipework.

18.6.16 HSE (2011) describes historical accidents involving CO_2, including a release of 15 tonnes of CO_2 from a facility in Germany which resulted in the hospitalisation of 107 people in the local area. The inventory involved in this accident provides an indicative estimate of the potential harm caused by a CO_2 release from a pipeline fitted with isolation valves.

18.6.17 Modelling of CO_2 releases using industry standard software has been undertaken by the HSE, which is presented in HSE (2011). For example, page 16 of HSE (2011) states that the hazardous distance associated with the rupture of a dense phase CO_2 pipeline would be of the order 100m to 200m. The hazardous distance is defined as the distance which would cause severe distress to people and may result in fatalities if vulnerable persons or living creatures are exposed.

18.6.18 A number of research projects have been undertaken to refine and validate the software used for modelling dense phase CO_2 releases and to further understand the potential hazards of a major release. The Proposed Development will use industry standard tools to model CO_2 releases. The outcomes of this modelling will be reviewed by the project team and incorporated into the design of the Proposed Development.

Domino Effects

18.6.19 As outlined in Tables 18.2 and 18.3, no neighbouring installations have been identified that could be the source of, or increase the risk or consequences of, a major accident and/ or domino effect. A potential single exception has been noted in relation to a HSC consent (PD Ports Services) located adjacent to the Proposed Development Site. It is understood that this HSC has now been withdrawn.

18.6.20 Similarly, while there are several nearby facilities that could be affected by a major accident associated with the Proposed Development, the Proposed Development and

in particular, the Proposed PCC Site has been deliberately selected to minimise such an effect.

18.6.21 Neighbouring facilities that have been considered in more detail include:

- Grove Wharf, Gunness, (Lower Tier COMAH site) operated by Brenntag UK Limited located 1.2km downstream of the closest point to the Proposed Development Site (River Water Discharge Corridor outfall) and over 2.6km from the Proposed PCC Site.
  - This Lower Tier COMAH site is regulated under the COMAH Regulations for chemical installation distribution, storage/ warehousing and chemical manufacture/ production and/ or disposal.
  - An accident, such as a major fire at the Proposed Development, may restrict operation of this installation, such as preventing operators working outside, however there is significant distance between this installation and the Proposed Development Site to prevent the risk of fire spreading from one facility to another.
  - The installation is regulated under the COMAH Regulations and consequently, it will have assessed its impact upon neighbours in the event of a major accident through its Safety Report, along with potential domino effects.
- Flixborough Industrial Estate (Upper Tier COMAH site) operated by Jotun Paints Ltd located 3.6km downstream of the closest point to the Proposed Development Site (River Water Discharge Corridor outfall) and over 4.8km from the Proposed Development Site:
  - This Upper Tier COMAH site is regulated under the COMAH Regulations due to chemical manufacture/ production and/ or disposal.
  - An accident at the Proposed Development is unlikely to affect the operation of this installation since there is a significant distance between the two sites.
  - The installation is regulated under the COMAH Regulations and consequently, will have assessed its impact upon neighbours in the event of a major accident, along with potential domino effects.
  - It is noted in the information provided by the HSE that in the event of a major accident at the installation, advice about the action to take in the event of a major accident will begiven by local radio/TV station.

18.6.22 It is a requirement of the COMAH Regulations that upper tier sites should review and update their off-site emergency plans and safety reports to take into consideration potential impact of domino effects at neighbouring sites, which could potentially include the Proposed Development Site. If required by the HSE, this would provide further safeguards to ensure that domino effects are assessed by this major accident installation.

- PD Port Services, Keadby is located immediately adjacent to the Proposed Development Site. It is a port handling a variety of cargo, specialising in steel handling and storage.
  - An accident, such as a major fire at the installation, has the potential to impact dock operations at the Waterborne Offloading Area and would prevent vessels any AIL on vessels from berthing, in the event that an incident were to coincide with an AIL delivery during construction of the Proposed Development Site.

This would be expected to result in a temporary impact for the duration of the incident.
    - The potential for a domino effect to occur if an accident, such as a major fire, were to occur at the PD Port Services Keadby site is discussed in Table 18-3.
    - It is expected that existing controls/ safety precautions at the PD Port Services Keadby site, along with proposed safety measures at the Proposed Development Site will mitigate the risk of domino effects occurring.
- Keadby Windfarm operated by SSE Renewables comprises 34 turbines to the north and south of the Proposed Development Site; the closest of which are located immediately to the north of the Proposed PCC Site.
    - Operation of the Proposed Development will have sufficient design and operational safeguards so as not to impact the adjacent Keadby Windfarm. Both installations are under the control of the Applicant.
    - In the event of a major accident, such as an explosion at the Proposed Development Site, it is possible that this could affect the closest wind turbines. Emergency plans will be updated for the operational Keadby Windfarm to take account of the Proposed Development prior to construction.
- If a major accident were to occur at the Keadby Windfarm site, it is unlikely that a domino effect would occur for the Proposed Development Site due to the nature of the Keadby Windfarm; effects such as ice throw and a turbine toppling are discussed in Table 18-2 including embedded mitigation (exclusion zone from the base of the turbine (1.5 x mast height).
- Keadby 2 Power Station, a 910MW CCGT power station will be operated by the Applicant. It is currently under construction and is located immediately adjacent to the Proposed Development site, within the Keadby Power Station site.
    - Operation of the Proposed Development will have sufficient design and operational safeguards so as not to impact the adjacent Keadby 2 Power Station, since both developments are under the control of the Applicant.
    - In the event of a major accident, such as a fire or explosion, at the Proposed Development Site, it is possible that this could affect the Keadby 2 Power Station and associated infrastructure due to its proximity (and vice versa). Controls and safety precautions will be updated for the operational Keadby 2 Power Station to take account of the Proposed Development. These measures, along with the proposed safety measures at the Proposed Development Site, will mitigate the risk of domino effects occurring.
- Solventis Limited, a major chemical solvent supplier, located approximately 1.3 km south east of the Proposed Development site.
    - Solventis Ltd is located on the adjacent bank of the River Trent. An accident, such as a major fire at the Proposed Development, may temporarily restrict operations at Solventis Ltd, such as preventing distribution of chemical solvents via vessels. However, this would be a temporary impact for the duration of the incident and would be unlikely to result in a long term effect on operations due to the distance between the installation and the Proposed Development Site.
    - It is considered that the distance between this installation and the Proposed Development Site precludes the risk of a domino effect.

- RMS Trent Ports Limited is located on the adjacent bank of the River Trent, approximately 4.5 km north east. It is a port complex, handling cargo, and providing storage and supporting shipping. Due to the distance between the Proposed Development Site and RMS Trent Ports, it is unlikely that there would be any risk of a domino effect occurring should a major accident occur at either of the two sites.

18.6.23 The high concentration of industrial facilities in the local area provides a wealth of experience in the management of major accidents. The North Lincolnshire Council Emergency Planning Team are part of the Humber Emergency Planning Service (HEPS) which provides emergency planning provision for North Lincolnshire Council.

18.6.24 The HEPS provides an emergency planning service to ensure local authorities are prepared to respond to emergencies and to support the emergency services and the community. This organisation provides information to businesses and has many years' experience working with COMAH sites.

18.7 Mitigation and Monitoring

18.7.1 The assessment has identified the potential MA&D which could be applicable to the Proposed Development, associated with the substances present and operations to be undertaken. Principally, these could include fires, explosions and the release of CO_2 gas. These incidents have an extremely low probability of occurrence but could have significant impacts on people and the environment without mitigation.

18.7.2 The Proposed Development will be within an area of North Lincolnshire where similar facilities such as power plants and chemical works have been in operation for many years, including Keadby Power Station owned by the Applicant which forms part of the Proposed Development Site. Consequently, these hazards are well understood by plant operators and controlled by the regulatory authorities. The Applicant will draw on this expertise, in addition to its own experience of designing, building and operating major power generation facilities globally to reduce the risk of major accidents occurring to ALARP.

18.7.3 The engineering design of the Proposed Development will incorporate appropriate standards, proven design methods and control measures necessary to reduce the risks of such accidents to an acceptable level, i.e. ALARP, which is the standard expected by the regulatory authorities (HSE and Environment Agency).

18.7.4 The Proposed Development will require appropriate permissions to be in place for its operation including a COMAH licence, if required and Environmental Permit, and these regulatory controls will stipulate a number of requirements that must be demonstrated to prevent or minimise the effects of major accidents.

18.7.5 With the implementation of these measures in addition to those described in Tables 18.2 and 18.3 above, the MA&D risks are considered to have been mitigated to 'tolerable if ALARP' and therefore the effects are considered as 'not significant' for both plant construction and operation.

18.7.6 No additional mitigation measures (i.e. beyond those embedded mitigation measures within the Proposed Development) have been identified as being required to further mitigate any significant effects for MA&D at this stage. Detailed emergency plans will

be produced for the installation in accordance with the Environmental Permit and all applicable regulations.

18.8 Summary of Likely Significant Residual Effects

18.8.1 No likely significant residual effects have been identified.

18.9 Limitations or Difficulties

18.9.1 This assessment is based on the preliminary design of the Proposed Development and early appraisal of potential hazards that will be refined and reappraised as the project develops.

18.9.2 It is noted that a number of the degradation products of amines have not yet been classified. **Chapter 8**: Air Quality (PEI Report Volume I) (paragraphs 8.2.14 and 8.2.15) provides further discussion on the status of current guidance. It is possible that any future classification may give rise to additional hazards that have not been considered in this chapter.

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