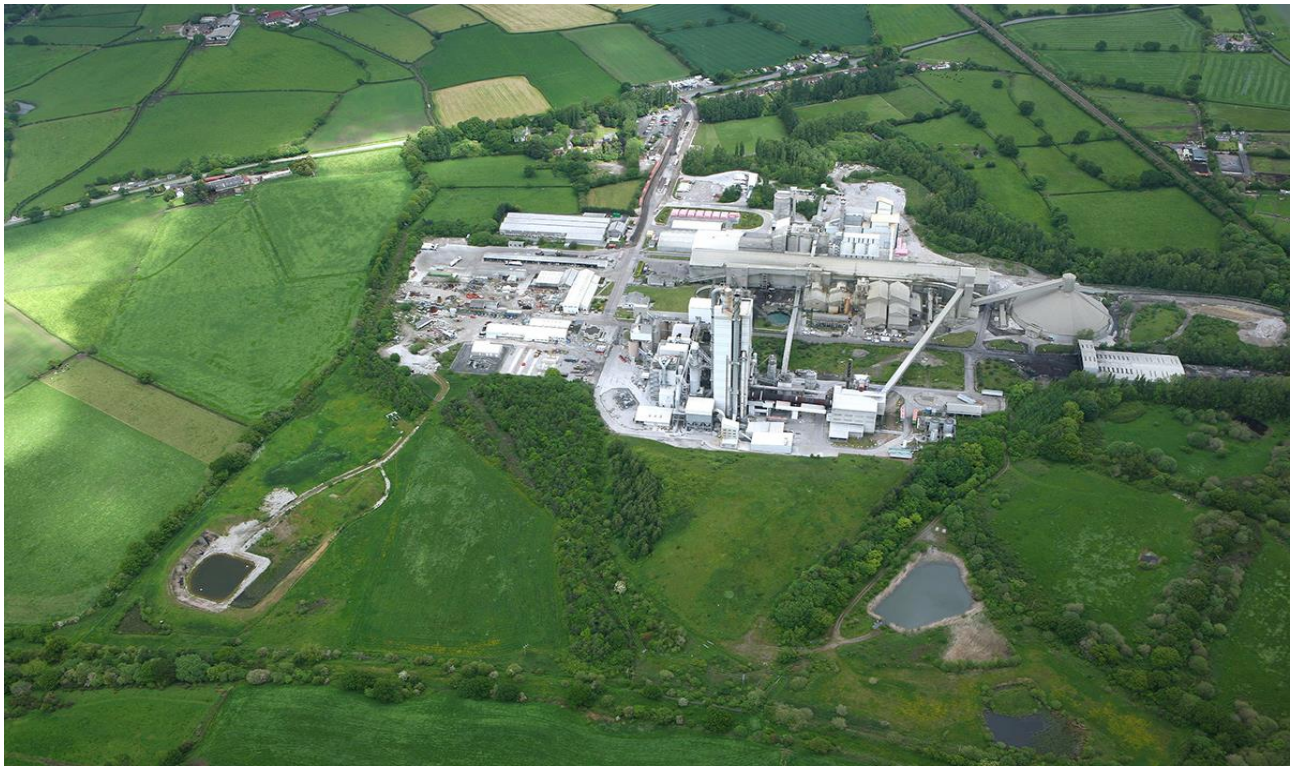
HEIDELBERG MATERIALS

Padeswood Carbon Capture Plant - FEED Phase

ENVID Report

Document no. Rev 0: 215000-00190-000-EN-REP-00004-A



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PROJECT 215000-00190-000 - 215000-00190-000-EN-REP-00004-A: Padeswood Carbon Capture Plant - FEED Phase - ENVID Report

Rev	Description	Originator	Reviewer	Worley Approver	Revision Date	Customer Approver	Approval Date
Rev 0	Issued for Design	Signed by: Alexander Stephen 0D5A266734FD414...	DocuSigned by: Owen Mancell Smith 47B40CE7C0BA47E...	DocuSigned by: Alireza Moghaddam 245F27B4D340405...	17 Oct 2024		
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Revision History

Rev	Status	Section	Description of Change
0	IFD	All	Issue for Design

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1. Introduction

1.1 Project Description

The Heidelberg Materials Padeswood Cement Works CCS Project will enable post combustion carbon capture from the existing cement kiln 4 and from a new Combined Heat and Power (CHP) plant designed to provide the heat and electricity required to operate the Carbon Capture Plant (CCP).

Captured CO_2 will be transported by pipeline to the HyNet CO_2 main pipeline at Northop Hall AGI for onward transportation to storage offshore in depleted gas fields operated by Eni U.

The whole project will enable the production of net zero cement for use in the UK construction industry.

The detailed description of the project process is covered in Ref 1.

1.2 Document Purpose

This document comprises a record of the activities and outcomes of the Environmental Impact Identification (ENVID) workshop.

1.3 Abbreviations and Definitions

Abbreviation	Description
AGI	Above Ground Installation
CCP	Carbon Capture Plant
CCS	Carbon Capture and Storage
CHP	Combined Heat and Power
CO_2	Carbon Dioxide
ENVID	Environmental Impact Identification
FEED	Front End Engineering Design
H_2S	Hydrogen Sulphide
HCN	Hydrogen Cyanide
HM	Heidelberg Materials
MHI	Mitsubishi Heavy Industries
NOx	Oxides of Nitrogen
SOx	Oxides of Sulphur
VOC	Volatile Organic Compounds

Table 1-1: Table of Abbreviations

1.4 Technical Terms

Term	Description
Cause	Event, situation, or condition that results, or could result, directly or indirectly in an accident or incident.
Client	Heidelberg Materials
Consequence	Direct, undesirable result of an accident sequence usually involving a fire, explosion, or release of toxic material. Consequence descriptions may be qualitative or quantitative estimates of the effects of the accident in terms of factors such as health impacts, economic loss and environmental damage.
Contractor	Consortium of Worley and MHI
Environmental Impact Identification (ENVID)	Is a team-based brainstorming workshop used to identify environmental aspects and impacts associated with the project design, construction, operations and decommissioning. ENVID workshops may be broad in their scope and thus have a wide applicability.
Hazard	Condition or practice with the potential to cause harm to people, the environment, property or reputation.
Licensor	Licensor of packages
Project	Padeswood Carbon Capture Plant
Risk	A measure of loss / harm to people, the environment, compliance status, reputation, assets or business performance in terms of the product of the probability of an event occurring and the magnitude of its impact.

Table 1-2: Table of Terms

1.5 References

Ref	Document Number	Document Title
Ref 1	215000-00190-000-EN-PRO-00001	ENVID Terms of Reference
Ref 2	MS-EP-STD-0097	Worley Hazard Identification (HAZID) Study Standard
Ref 3	215000-00190-000-MS-HS-TEM-0041	Environmental Aspect and Impacts Register

Table 1-3: References

2. Objectives and Scope

2.1 ENVID Objectives

The key objective of the ENVID workshop is to explore the opportunities for reducing environmental impacts from the project in a structured manner. An ENVID assessment is a multi-disciplinary collaborative brainstorming exercise undertaken during a workshop in which the stakeholders of the PROJECT can contribute to the identification and ranking of environmental risk.

The specific aims for undertaking ENVID are to

- Systematically identify activities and analyse planned and unplanned environmental aspects of the PROJECT
- Identify all aspects of environment and evaluate impacts associated with all activities
- Identify control and monitoring measures that are in place
- Identify additional measures required, if any, to prevent or mitigate impact to allowable environmental standards; and
- Provide input to management in its efforts to manage risks related to environmental issues.

2.2 ENVID Scope & Boundary

The ENVID assessment considered environmental impacts from the Construction, Commissioning / Start-up and Operational phases of the PROJECT across the entire PROJECT FEED scope, encapsulating the

- Common Site Infrastructure
- Combined Heat & Power
- Waste Heat Recovery Unit
- Carbon Capture Plant
- CO_2 Compression and Conditioning
- Utilities, Non-Process and Offsite.

Types of environmental impacts considered in the assessment cover

- Environmental impact (impact of land, water, air)
- Legal and regulatory compliance issues
- Social Impacts (i.e., noise, odour issues)

The ENVID assessment considered the design & layout of the facility as described in project and engineering documentation available at the time of the ENVID.

2.3 Assumptions & Exclusions

As the PROJECT is only in early FEED, there is currently little project-specific data on the decommissioning activities to undertake a thorough assessment of the environmental impacts during decommissioning. Therefore, the phase was not covered in the scope of the assessment.

The ENVID assessment was undertaken using layouts and project documents existing at the time of the workshop.

Items identified as Business as usual (i.e., risks of routine and/or expected activities inherent in all projects) were discussed and, if agreed nothing warranted further look, were not ranked during the workshop to save time.

Furthermore, the aspect of commercial and business risk was not assessed as one of the aspects in the ENVID.

3. Methodology

3.1 Overview

The ENVID assessment was undertaken broadly following the methodology laid out in the ENVID Terms of Reference (ToR) document (Ref 1) and briefly summarised below.

Prior to the workshop commencing, a brief introductory presentation was given by the facilitator, which summarised the PROJECT, objectives, high-level ENVID process and the risk ranking methodology. The workshop participants introduced themselves and their role in the PROJECT. Copies of PROJECT documentation covering site plans and process flow diagrams (PFD) were issued to the participants for reference.

Once the assessment commenced, the facilitator guided the workshop group through the process, working through the guidewords (Section 3.2), identifying potential hazards under each and risk assessing these hazards based on the Risk Matrix (Section 3.3). The facilitator, with aid of the scribe compiled this information into the ENVID worksheet.

The overall procedure can be broken down into a 6-step process:

- Step 1 - Select the guideword
- Step 2 - Identify potential hazard.
- Step 3 - Assessment of probable causes and consequences.
- Step 4 - Identify prevention, control or mitigating measures.
- Step 5 - If appropriate, identify further risk reduction or mitigation measures.
- Step 6 – Repeat this process for each guideword.

Not all hazard scenarios were risk ranked. All high consequence events (Major to Critical) were risk ranked, but lower consequence items were selectively ranked to save time in the review. Some scenarios did not have a single identified consequence, and so were not risk ranked.

3.2 ENVID Guidewords and Aspects

Guidewords were used to provide structure to the ENVID process and ensure the full range of potential environmental aspects are captured.

The following guide words were used:

- Emissions to Atmosphere
- Emissions to Water (Watercourse, groundwater)
- Waste Generation
- Contamination of Land
- Energy Used and Emitted (i.e., heat and vibration)
- Resource Use
- Nuisance

- Ecology
- Other

Under each guideword, pre-populated Environmental Aspects were listed on the ENVID worksheet. The full list of guidewords and environmental aspects is given in the table of Appendix A.

Additional aspects were added during the course of the workshop.

3.3 ENVID Risk Ranking

The hazards identified in the study were ranked in accordance with the Risk Matrix (Table B- 1 of Appendix B) and Severity definitions (Table B- 2 of Appendix B) which was based on the Worley HAZID guidance (Ref 2).

Current risks were only scored based on the Consequence (with all planned safeguards ignored i.e., worst-case consequences) and Likelihood (considering all planned safeguards) to arrive at an overall risk ranking from Low to Very High, as defined in Table 3-1.

Not all hazard scenarios were risk ranked. All high consequence events (High to Very High) were risk ranked, but lower (Low to Medium) consequence severities were selectively ranked in order to save time.

The risk ranking followed the basis below:

- Where residual risks are Broadly Acceptable (i.e., Low), no further recommendations for risk reduction are strictly necessary. Minor, continuous improvement recommendations e.g., update company procedures, should be implemented as a matter of course.
- Where residual risks are Tolerable (i.e., Medium), further recommendations for additional risk reduction should be considered to demonstrate that risks are ALARP; and
- Where residual risks are Unacceptable (i.e., Very High or High), further recommendations for additional risk reduction shall be made to demonstrate that risks are ALARP. Risk reduction measures must be implemented, irrespective of cost, to lower the risk level.

Some risks may need to be deferred and addressed in the later phases of the project.

Where significant risks have been identified, which will require considerable effort / increase in hours for their resolution, these should be input into the Project Risk Register.

Ranking	Definition	
VH	Very High	Risk intolerable. Immediate cessation of the activity, procedure, plant, process, substance, situation or other circumstance associated with the hazard. Continuation only with executive management approval. Risk reduction measures must be implemented, irrespective of cost, to lower the risk level.
H	High	Risk tolerable but risk reduction measures must be implemented to reduce risk to ALARP. Cost / benefit analysis may be required to ensure risk reduction is proportional to cost.
M	Medium	Risk tolerable but risk reduction measures must be implemented to reduce risk to ALARP. Cost / benefit analysis may be required to ensure risk reduction is proportional to cost.
L	Low	Risk acceptable. Risk reduction measures generally not required. Minor 'continuous improvement" recommendations e.g., update procedures, should be implemented as a matter of course

Table 3-1: Risk Definitions

3.4 ENVID Study recommendations

Any environmental concerns that could not be satisfactorily answered at the meeting were raised as a Recommendations and the appropriate attendee designated as the named owner assigned for resolution of the issue(s) raised within a specified period.

These will be tracked in the Environmental Aspects and Impacts Register (Ref 3).

It is the responsibility of the Lead Environmental Engineer to verify that responses to environmental issues are adequate and supported by auditable proof.

3.5 Recording and Reporting

PHA-Pro was used to record the ENVID proceedings. The resulting worksheets from the ENVID are shown in Appendix C.

The worksheet was populated to the extent reasonably possible given the allocated workshop time. Some aspects needed to be treated at a higher level of detail than others and time was balanced such that areas of perceived greater risk or project importance received a greater share of attention.

As there are limited design studies completed at this stage, but with many detailed studies planned, the workshop team decided not to add specific recommendations to conduct studies or include design elements that were considered "business as usual". Where standard design process in the following project phases will address the issue, the following statement was recorded: "Discussed by team. Covered by existing design processes."

Findings of the ENVID will be registered on OMIE and tracked during design development by Contractor.

3.6 Workshop Particulars

3.6.1 Date and Location

The ENVID workshop was held on the 16 January 2024 hosted at MHI's London office location.

3.6.2 Study Group

The ENVID team for the study consisted of suitably qualified and experienced personnel from Worley, Mitsubishi Heavy Industries and Heidelberg Materials. They were gathered to provide a cross-section of relevant disciplines and knowledge.

Some members of the workshop attended remotely via Microsoft TEAMS.

4. ENVID Output

4.1 Overview

Across the ENVID assessment, a total of 45 environmental hazards were identified. The distribution of these impacts is illustrated in Figure 4-1 below, which highlights the majority of hazards are associated with atmospheric emissions albeit low risk.

Of the identified hazards,

- 39 were considered low risk (i.e., handled by existing design process);
- 2 medium risk (M); and
- 4 high risk (H).

No very high (VH) risks were identified.

The medium and high-risk impacts are discussed in following sections.

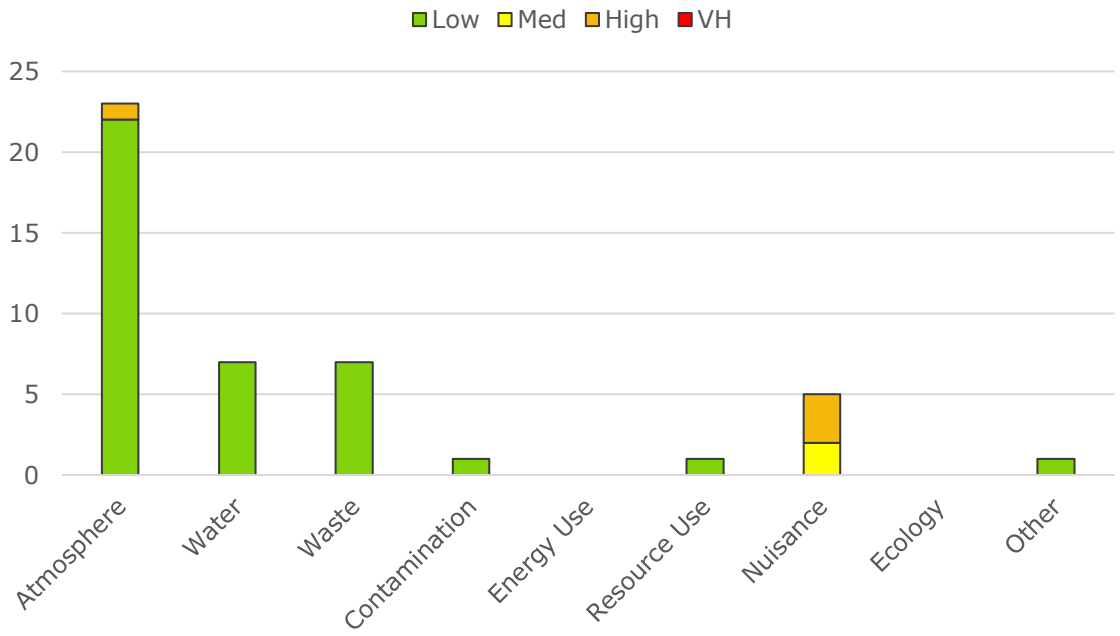

Figure 4-1: Distribution of hazards and Risk Ranking

4.2 Low Risks

The majority (circa 87%) of identified impacts were ranked as low-risk. These were discussed during the workshop and decided these were 'business as normal' type risks adequately covered by existing design procedures and therefore requiring no further discussion. Two (2) recommendations were raised for further investigation to understand potential mitigation requirements (See recommendations 2 and 3 in Section 4.6).

4.3 Medium Risks

The medium risks are associated with societal impacts, particularly the risk of triggering nuisance complains of foul odours from the facility by residents of the neighbouring farm area, and or users of the adjacent footpath. The odorous sources were identified as the vents from the Ammonia storage bullets and the sections of the plant where amine solvent is used. The latter was referred to as a lingering "fishy" smell, common to plants that use amine.

Both hazards were ranked as Medium risk based on minor severity and likely occurrence.

Existing safeguards in design for the vent were highlighted (Nitrogen blanket on Ammonia storage tanks and vent gas scrubber).

No existing safeguard was identified for the amine solvent storage and an action to review odour levels to inform of requirement for odour abatement was raised (see Recommendation 6 of Section 4.6).

Aspect	Impact	Concern	Impact Description	Safeguards (existing)
Nuisance	Odour	Ammonia Venting from Ammonia Storage bullets (25% NH_3)	Potential complaints from adjacent neighbours	Nitrogen Blanket Vent scrubber
		Amine Solvent		

Table 4-1: Medium Risks

4.4 High Risks

Four (4) high risks were identified, 1 pertaining to atmospheric emissions while the remaining 3 are associated with noise complaints.

The CO_2 venting (1st row in table below) relates to events where the CO_2 export line is not available, such a start-up and upsets. In this scenario the CO_2 stream is recombined with post-treatment flue gas and emitted to atmosphere via the new stack. As both streams will have different flow rates and temperatures, the blending of these characteristics may negatively impact the dispersion of the plume, with the plume potentially falling to the ground. This hazard was given a high-risk ranking based on a critical severity but remote/rare likelihood.

A recommendation for modelling of the plume has been raised (see recommendation 1).

The (3) remaining high risks are linked to potential neighbour complaints due to the noise of the Steam Vent, Machinery and CO_2 Vent. These hazards were assigned a severity of major and

possible likelihood. Existing safeguards were identified for all three and recommendations made (see recommendation 4 and 5).

Aspect	Impact	Concern	Impact Description	Safeguards (existing)
Emissions to Atmosphere	Emissions	CO_2 Venting (intermittent)	CO_2 will be added to treated flue gas but may have increased flowrates compared to untreated flue gas and different temperatures.	
Nuisance	Noise	Steam Venting during start up and upsets	Potential complaints from adjacent neighbours	Silencer on steam ventline (not PSV)
		Machinery Noise	Potential complaints from adjacent neighbours	Existing design processes
		CO_2 Venting during start up and upsets	Potential complaints from adjacent neighbours	Orifice downstream of vent valve (not PSV)

Table 4-2: High Risks

4.5 Very High Risks

No very high-risk environmental hazards were identified during the workshop.

4.6 Recommendations

The following recommendations were documented during the ENVID.

	Recommendation	Risk Rank	Responsible Party	Target Phase
1	Review the CO_2 venting scenarios and conduct any modelling identified after initial screening. CO_2 will be added to the treated/untreated flue gas flowing to the new flue stack but may have increased CO_2 flowrates, different discharge temperatures and may disperse differently compared to the flue gas from the existing flue gas stack.	H	Worley (Tech Safety)	FEED
2	Review the requirements for rinse water for removing amine before vessel entry, and for cleaning fresh packing before start-up. Also consider how to dispose of the contaminated rinse water.	L	Worley / MHI (process)	FEED
3	Review the composition of the degraded solvent waste from the Reclaimer to identify potential toxins/carcinogens to humans and the environment. Advise the company on any measures required to mitigate health hazards.	L	MHI	FEED
4	Review any significant sources of noise following the planned initial noise modelling study based on initial vendor data, to identify early design changes that may be required. Consider Steam and CO_2 venting (continuous and emergency) and major machinery noises as a minimum. Note that Vendor noise information will not be available until detailed design.	H	RSK	FEED
5	Consider undertaking an additional tonal noise study later in the design process for significant sources of noise that have been identified in the initial noise modelling study. Vendor noise information should be used for mitigation modelling, though the information will likely not be available until detailed design.	H	HM	Detailed Design
6	Review sources of odour and consider whether a full model is required or just a Qualitative Report.	M	RSK	FEED

Table 4-3: Recommendations

Appendix A. Guidewords

Guide word	Environmental Aspect
Emissions to Atmosphere	Venting and Flaring
	Leaks and fugitive emissions
	Combustion emissions (from static and mobile sources)
	Volatile Organic Compounds (VOC)
	Halogenated Hydrocarbons
	SOx, NOx, CO, H_2S, Benzene, 1,3-butadiene, HCN, Amine, Ammonia
	Halogenated Hydrocarbons
	Particulates
	Toxic / persistent Chemicals/ heavy metals
	Steam
Emissions to Water (Watercourses, groundwater)	Oil Spillage
	Produced Water
	Chemical storage, transfer and discharge
	Diesel and aviation fuel
	Bilges, Machinery space or open drains
	Lube oil and hydraulic fluids
	Fire-fighting water, foam and chemicals
	Sand, drilling mud, drill cuttings etc
	Dropped objects (Flotsam and jetsam)
	Toxic / persistent chemical / heavy metals
	Radioactive substances
	Cathodic / fouling protection
	Hot condensate (e.g., from steam traps)
	Cooling water
	Stormwater drainage
	Hydrotest water
	Rinse water for packing
Waste Generation	Solids
	Liquids
	Gaseous
	Hazardous wastes
	Radioactive Substances
Contamination of Land	Liquid spills
	Solid Waste
	Hazardous Waste
	Toxic, persistent chemicals / heavy metals
	Radioactive substances
Energy Used and emitted (i.e., heat, vibration)	Transport
	Power Generation
	Machinery (pumps, turbines etc)
	Heating and Lighting

Guide word	Environmental Aspect
Resource Use	Water
	Land
	Raw Materials
	Processed materials, chemical, solvents, consumables
Nuisance	Noise (e.g., continuous, seismic, blasting)
	Odour
	Dust. Smoke, fume, condensing steam
Ecology	Footprint / land take
	Disturbance of habitats and species
	Development in a protected area
Other	Cultural Heritage
	Visual Impact
	Amenity / Community / fishermen

Table A- 1: ENVID Guidewords

Appendix B. Risk Matrix

Risk Matrix			Consequence Severity				
			1 Insignificant	2 Minor	3 Moderate	4 Major	5 Critical
Likelihood	**A** Almost Certain / Probable	Highly likely to occur. Possibility of repeated incidents. The review team may have direct knowledge of a similar event. Expected to occur in most circumstances. Will probably be experienced several times in the life of a facility	**M**	**H**	**H**	**VH**	**VH**
	B Likely	A credible scenario in the life of the facility. Approx. once in the life of the facility. Review team may not have direct knowledge of such an event but may be aware of a similar one in a different field of operations. Could occur in most circumstances	**L**	**M**	**H**	**VH**	**VH**
	C Possible	Easy to propose an incident scenario but considered unlikely Approx. once in the life of 10 facilities. May be expected to occur in the life of a large field with several installations	**L**	**M**	**M**	**H**	**VH**
	D Unlikely	Conceivable, but would require failures of both engineered systems and operational controls Could occur at some time in a group of large fields. Not likely to occur.	**L**	**L**	**M**	**H**	**VH**
	E Remote / Rare	Highly unlikely. Little chance of occurrence and would require multiple engineered systems and operational control failures. Practically impossible.	**L**	**L**	**M**	**M**	**H**

Table B- 1: Risk Matrix

		1. Insignificant	2. Minor	3. Moderate	4. Major	5. Critical
Safety and Health	Onsite	No medical treatment required	First Aid Required	Hospital Treatment Required	Single Fatality, small number of people disabled	Multiple fatalities, large number of people disabled
	Offsite	No medical treatment required but significant interruption (evacuation, traffic congestion, roadblocks etc.)	First Aid required		Hospital treatment required	Single fatality, small number of people disabled
Environment		Insignificant release	Release onsite, small clean up required, short term impact	Release onsite, large clean up required, long term impact	Release offsite, small clean up required, short term impact.	Release offsite, large clean up required, long term impact
Financial		<$100 k	$100k – $1M	$1M – $10M	$10M – $50M	>$50M
Lost production		< 3 days	3 days – 1 week	1 week – 1 month	1 – 6 months	>6 months

Table B- 2: Severity Definitions

Appendix C. ENVID Output

ENVID Study

Guideword	Environmental Aspect	Concern	Impact	Environmental Receptors		Safeguards - Controls in Place	Risk Matrix			Recommendations	Responsibility
				Receptors	Environmental Component		Severity	Likelihood	RR		
1. Emissions to Atmosphere	1. Venting and flaring	1. Treated Flue Gas (New Vent Stack)	1. Water, Nitrogen, Oxygen, CO2 and trace gas amounts. No environmental concerns.								
			2. Amine trace emissions (<1mg/Nm^3). Covered by standard design processes.								
			3. NOx, SOx and CO. Covered by standard design processes								
		2. Untreated Flue Gas (CCU/CHP in bypass/not running) (New Vent Stack)	1. Water, Nitrogen, Oxygen and trace gas amounts. No environmental concerns								
			2. NOx, SOx and CO. Covered by standard design processes.								
			3. CO2 that would normally be captured by CCU. Covered by standard design processes								
			4. Increased PM dust compared to Treated Flue Gas (similar to existing flue gas stack). Covered by standard design processes								
		3. CO2 Venting (Intermittent) (New Vent Stack)	1. CO2 will be added to treated flue gas but may have increased flowrates compared to untreated flue gas and different temperatures.	Air	Physical Environment		Critical	Remote / Rare	H	1. Review the CO2 venting scenarios and conduct any modelling identified after initial screening. CO2 will be added to the treated/untreated flue gas flowing to the new flue stack but may have increased CO2 flowrates, different discharge temperatures and may disperse differently compared to the flue gas from the existing flue gas stack.	Worley - Tech Safety
		4. Existing Flue Gas Stack	1. Existing Flue Stack will be available as a backup during commissioning and initial start up of CCU and will eventually decommissioned. Emissions will be the same as current operations and covered by existing permit.								
		5. Fuel Gas Overpressure Venting	1. Safe Area Vent. Safety use only								
		6. Steam Venting	1. Discussed by team. Covered by existing design processes.								
		7. Oxygen Venting from Hydrogen Generator (continuous)	1. Discussed by team. Covered by existing design processes.								

Guideword	Environmental Aspect	Concern	Impact	Environmental Receptors		Safeguards - Controls in Place	Risk Matrix			Recommendations	Responsibility
				Receptors	Environmental Component		Severity	Likelihood	RR		
		8. Hydrogen Venting from Hydrogen Generator (overpressure)	1. Safe Area Vent. Safety use only								
		9. Ammonia Venting from Ammonia Storage Bullets (25% NH3)	1. Discussed by team. Covered by existing design processes.								
		10. Reclaimer Vent from Vacuum Pump to CO2 vent header and flue gas stack	1. Water and trace amounts of solvent. Included in treated flue stack amine concentrations.								
		11. Storage Tank breathers	1. Water								
			2. Amine storage tank breather would not contain amine in vapour or suspended aerosol droplets								
			3. Hot oil blanketed by nitrogen. No concerns identified								
	2. Leaks and fugitive emissions	1. Treated & Untreated Flue Gas fugitive emissions	1. Very low pressure and unlikely to extend far from leak source. Unlikely to have environmental impact								
		2. CO2 leaks and fugitive emissions	1. Health and Safety impact but limited environmental impact. Covered by existing design processes.								
		3. Fuel Gas and hydrogen	1. Health and Safety impact but limited environmental impact. Covered by existing design processes.								
		4. GIS Switchgear	1. Possible SF6 overpressure emissions or leaks. No GIS currently included in design								
	3. Combustion emissions (from static and mobile sources)	1. New Boiler	1. Additional Flue Gas compared to existing Plant. CO2 will be captured. See above (ENVID 1.1)								
	4. Volatile Organic Compounds (VOCs)	1. No further causes identified									
	5. SOx, NOx, CO, H2S, Benzene, 1,3-Butadiene, HCN, Amine, Ammonia	1. No further causes identified									
	6. Halogenated hydrocarbons	1. No causes identified									
	7. Particulates	1. No further causes identified									
	8. Toxic / persistent chemicals / heavy metals	1. No further causes identified									
	9. Steam	1. No further causes identified									
2. Emissions to Water (sea,	1. Oil spillage	1. Hot Oil leaks or filling	1. Discussed by team. Covered by existing design processes.								

Guideword	Environmental Aspect	Concern	Impact	Environmental Receptors		Safeguards - Controls in Place	Risk Matrix			Recommendations	Responsibility
				Receptors	Environmental Component		Severity	Likelihood	RR		
watercourses, groundwater)	2. Produced water (amount/contamination)	1. Flue gas condensate	1. Water is reused in cooling and sludge is separated and returned to cement plant. Discussed by team. Covered by existing design processes.								
		2. Blowdown from cooling tower	1. Water is reused after processing. Discussed by team. Covered by existing design processes.								
		3. Blowdown from steam	1. Water is reused after processing. Discussed by team. Covered by existing design processes.								
		4. FGD Wastewater to cement plant	1. Discussed by team. Covered by existing design processes.								
		5. Solvent Wastewater (Acid wash wastewater) to cement plant	1. Discussed by team. Covered by existing design processes.								
	3. Chemical storage, transfer and discharge	1. Discussed by team. Covered by existing design processes.									
	4. Diesel and aviation fuel	1. Discussed by team. Covered by existing design processes.									
	5. Bilges, machinery space or open drains	1. Solvent and other contaminated water drains will be separated and contained. Discussed by team. Covered by existing design processes.									
	6. Lube oil and hydraulic fluids	1. Discussed by team. Covered by existing design processes.									
	7. Fire-fighting water, foam and chemicals	1. Discussed by team. Covered by existing design processes.									
	8. Sand, drilling mud, drill cuttings etc.	1. Not Applicable									
	9. Dropped objects (flotsam and jetsam)	1. Not Applicable									
	10. Toxic / persistent chemicals / heavy metals	1. No further causes identified									
	11. Radioactive substances	1. No causes identified									
	12. Cathodic / fouling protection	1. Not Applicable									
	13. Hot condensate e.g. from stream traps	1. Discussed by team. Covered by existing design processes.									
	14. Cooling water	1. Discussed by team. Covered by existing design processes.									

Guideword	Environmental Aspect	Concern	Impact	Environmental Receptors		Safeguards - Controls in Place	Risk Matrix			Recommendations	Responsibility
				Receptors	Environmental Component		Severity	Likelihood	RR		
	15. Stormwater drainage	1. Discussed by team. Covered by existing design processes.									
	16. Hydrotest water	1. Discussed by team. Covered by existing design processes.									
	17. Rinse Water for packing	1. Absorber and Regenerator require multiple rinses during shutdown (for vessel entry) and before startup (to clean preservation oil off packing)	1. Large volumes of clean water required to be sourced and disposed of.	Natural resources	Physical Environment					2. Review the requirements for rinse water for removing amine before vessel entry, and for cleaning fresh packing before start-up. Also consider how to dispose of the contaminated rinse water.	Worley / MHI - Process
3. Waste Generation and Control	1. Solids	1. Used Filter media	1. Discussed by team. Covered by existing design processes.								
		2. Used catalysts/adsorbant	1. Discussed by team. Covered by existing design processes.								
	2. Liquids (including macerated food and sewage)	1. Slurry from filter cake sent to cement plant calciner	1. Discussed by team. Covered by existing design processes.								
		2. Reclaimed waste amine to cement plant calciner	1. Discussed by team. Covered by existing design processes.								
		3. Sewage from control room	1. Tied in to existing sewage system. Discussed by team. Covered by existing design processes.								
		4. Used Lube oil or hydraulic oil	1. Discussed by team. Covered by existing design processes.								
	3. Gaseous	1. No further causes identified.									
	4. Hazardous substances	1. Degraded reclaimed solvent waste	1. Potential human and environmental toxins. To be confirmed during further analysis							3. Review the composition of the degraded solvent waste from the Reclaimer to identify potential toxins/carcinogens to humans and the environment. Advise the company on any measures required to mitigate health hazards.	MHI
	5. Radioactive substances	1. No causes identified									
4. Contamination of Land	1. Liquid spills	1. No further causes identified.									
	2. Solid waste	1. Existing Contaminated Landfill adjacent to construction site	1. Discussed by team. Covered by existing design processes.								
	3. Hazardous waste	1. No further causes identified.									
	4. Toxic / persistent chemicals / heavy metals	1. No further causes identified.									
	5. Radioactive substances	1. No causes identified									
5. Energy Used (and emitted e.g. heat, vibration)	1. Transport	1. Discussed by team. Covered by existing design processes.									
	2. Power generation	1. Discussed by team. Covered by existing design processes.									

Guideword	Environmental Aspect	Concern	Impact	Environmental Receptors		Safeguards - Controls in Place	Risk Matrix			Recommendations	Responsibility
				Receptors	Environmental Component		Severity	Likelihood	RR		
	3. Machinery (pumps, turbines etc.)	1. Discussed by team. Covered by existing design processes.									
	4. Heating and lighting	1. Discussed by team. Covered by existing design processes.									
6. Resource use	1. Water	1. Zero Liquid Discharge	1. Project philosophy to maximise water recovery and reuse								
	2. Land	1. Discussed by team. Covered by existing design processes.									
	3. Raw materials	1. Discussed by team. Covered by existing design processes.									
	4. Processed materials, chemicals, solvents, consumables	1. Discussed by team. Covered by existing design processes.									
7. Nuisance	1. Noise (e.g. continuous, seismic, blasting)	1. Steam Venting during start up and upsets	1. Potential complaints from adjacent neighbours	Communities	Socio-Cultural Environment	1. Silencer on Steam ventline (not PSV)	Major	Possible	H	4. Review any significant sources of noise following the planned initial noise modelling study, to identify early design changes that may be required. Consider Steam and CO2 venting (continuous and emergency) and major machinery noises as a minimum. Note that Vendor noise information will not be available until detailed design.	RSK
										5. Consider undertaking an additional tonal noise study later in the design process for significant sources of noise that have been identified in the initial noise modelling study. Note that Vendor noise information will not be available until detailed design.	HM
		2. Machinery Noise (continuous) Note that Vendor noise information will not be available until detailed design.	1. Potential complaints from adjacent neighbours	Communities	Socio-Cultural Environment	1. Existing Design Processes	Major	Possible	H	4. Review any significant sources of noise following the planned initial noise modelling study, to identify early design changes that may be required. Consider Steam and CO2 venting (continuous and emergency) and major machinery noises as a minimum. Note that Vendor noise information will not be available until detailed design.	RSK
										5. Consider undertaking an additional tonal noise study later in the design process for significant sources of noise that have been identified in the initial noise modelling study.	HM

Guideword	Environmental Aspect	Concern	Impact	Environmental Receptors		Safeguards - Controls in Place	Risk Matrix			Recommendations	Responsibility
				Receptors	Environmental Component		Severity	Likelihood	RR		
										Note that Vendor noise information will not be available until detailed design.	
		3. CO2 Venting during start up and upsets	1. Potential complaints from adjacent neighbours	Communities	Socio-Cultural Environment	1. Orifice downstream of vent valve (not PSV)	Major	Possible	H	4. Review any significant sources of noise following the planned initial noise modelling study, to identify early design changes that may be required. Consider Steam and CO2 venting (continuous and emergency) and major machinery noises as a minimum. Note that Vendor noise information will not be available until detailed design.	RSK
										5. Consider undertaking an additional tonal noise study later in the design process for significant sources of noise that have been identified in the initial noise modelling study. Note that Vendor noise information will not be available until detailed design.	HM
	2. Odor	1. Ammonia Venting from Ammonia Storage Bullets (25% NH3)	1. Potential complaints from adjacent neighbours	Communities	Socio-Cultural Environment	1. Nitrogen Blanketed 2. Scrubber	Minor	Likely	M	6. Review sources of Odour and consider whether a full model is required or just a Qualitative Report.	RSK
		2. Amine solvent	1. Potential complaints from adjacent neighbours	Communities	Socio-Cultural Environment		Minor	Likely	M	6. Review sources of Odour and consider whether a full model is required or just a Qualitative Report.	RSK
	3. Dust, smoke, fume, condensing steam	1. No significant visible plume identified									
8. Ecology	1. Footprint / land take	1. Discussed by team. Covered by existing design processes.									
	2. Disturbance of habitats and species	1. Construction to be covered by license for Great Crested Newt. Covered by existing design processes.									
	3. Development in a protected area	1. Discussed by team. Covered by existing design processes.									
9. Other	1. Cultural Heritage	1. No causes identified									
	2. Visual Impact	1. Discussed by team. Covered by existing design processes.									
	3. Amenity / Community / Fishermen	1. Public footpath crossing site which will be diverted around site boundary	1. Discussed by team. Covered by existing design processes.								