Base Load Power Hub (BLPH)

HAZID Report

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1. INTRODUCTION

1.1. PROJECT OVERVIEW

Crosswind, a Shell and Eneco joint venture, was awarded the tender to develop the offshore Hollandse Kust Noord (HKN) wind farm, located 18.5km off the coast of Netherlands near the town of Egmond aan Zee. The consortium plans to have HKN operational in 2023 with an installed capacity of 759MW generating at least 3.3TWh per year. This is sufficient renewable power to supply more than 1 million Dutch households with green electricity.

Offshore wind farms produce intermittent electricity and balancing these dips and peaks and integrating this electricity into the national energy system requires new technologies. For this reason, the offshore wind farm will include several new technologies that could be implemented at full-scale in the future. The new technologies being explored include a floating solar park, a short-duration battery storage as well as long-term storage via green hydrogen produced by water electrolysis and subsequently consumed in a fuel cell. The combination of these individual measures, herein referred to as the Base Load Power Hub (BLPH) will ensure a continuous power supply regardless of the wind situation.

1.1.1 Project Location

The Hollandse Kust Noord (HKN) wind farm is located 18.5km off the coast of the Netherlands near the town of Egmond aan Zee.

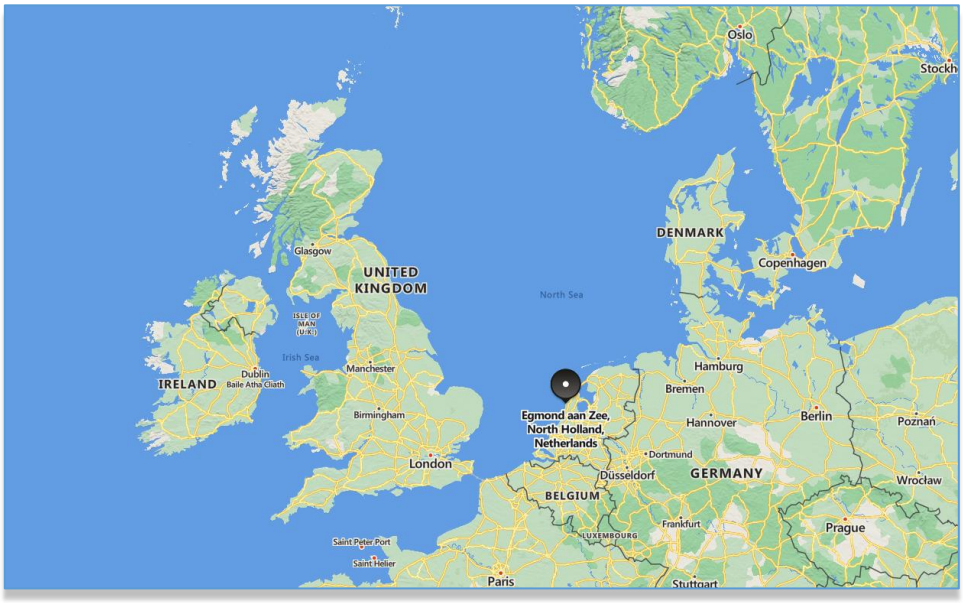


Figure 1 - HOLLANDSE KUST NOORD WIND PARK Location Map

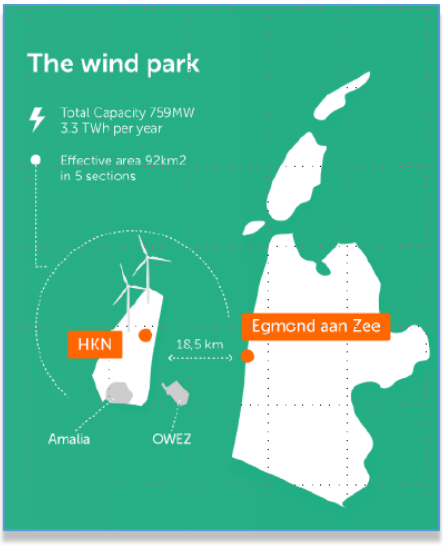


Figure 2 - Wind Park Details

The wind farm will consist of No. 69 x 11.5MW wind turbine generators each to be installed on a dedicated monopile structure. A 70th monopile located on coordinates E 590719.1, N 5841602.3 is reserved for installing the platform accommodating the BLPH. The monopile structure was designed and installed by Van Oord Offshore Wind (VooW) and therefore not part of the BLPH scope.

1.1.2 Project Concept

All components included in the BLPH will be integrated onshore on a topsides and installed in an offshore location within the boundaries of the HKN wind farm. At its simplest, the BLPH will store energy during periods of high electricity generation from renewable sources (a wind turbine generator and the floating solar PV farm) and release it during periods of low generation. In practice. It is expected that the energy stored will supplement generation from renewable sources to ensure that at least 1.0MW of power is exported to the electrical grid regardless of wind/solar availability.

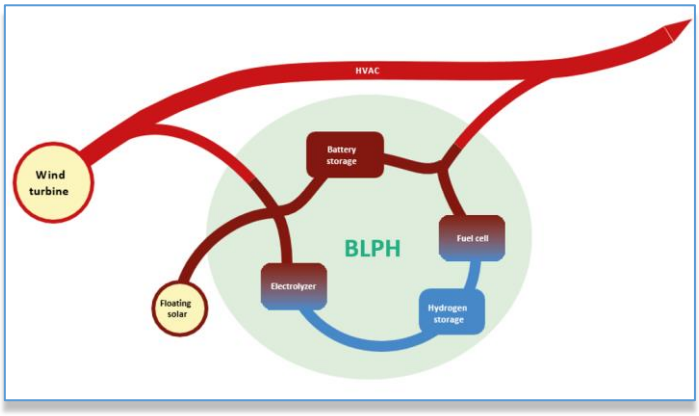


Figure 3 - BLPH Concept

Electricity in the BLPH will be stored in the form of electrons in a battery energy storage system (BESS) as well as converted into green hydrogen via water electrolysis. When the power output from the connecting wind turbine drops to below 1 MWe, the BLPH will return its stored energy to supplement the remaining power output. This will be by discharging the BESS, while stored hydrogen will be converted back into electricity using a fuel cell to extend the discharge duration.

The purpose of the BLPH s to function as a testbed for the integration of energy storage technologies with renewable generation. It is expected that equipment installed on the BLPH will operate as Normally Unmanned Installation for at least two (2) years with no or minimal maintenance and it will have its own independent control room with the ability to communicate with Crosswind's control room.

2. PURPOSE AND SCOPE

The Hazard Identification (HAZID) Report provides a systematic assessment of potential hazards associated with a particular project, process, or operation. The primary objective is to identify and evaluate potential risks at an early stage, enabling stakeholders to implement appropriate measures to mitigate these risks and ensure safety of operations.

This HAZID study was conducted for the Engineering Procurement and Construction (EPC) Phase of the project with the following objectives:

- Identify major hazard scenarios, which result from the operation under consideration (emphasis on Severity 5 and Red Risk Hazards on the Risk Assessment Matrix (RAM), see Table 4) and threats that relate to potential major hazard accidents.
- Identify the essential controls required to ensure risks are tolerable and ALARP (As Low As Reasonably Practicable).
- Make recommendations/action items that will be implemented in the design. Subsequent completion of these actions to eliminate, reduce and control risks will become a key part of the formal demonstration of ALARP.
- Identify and assign the action owner for each recommendation made.
- Gain a common understanding of the relevant Health Safety and Environment (HSE) risks.
- Provide input to update the Hazards & Effects Risk Register.
- Perform one of the first steps of the Hazard and Effect Management Process (HEMP).
- Provide input to bow tie assessments or equivalent methodology for the major HSE hazards (Severity 5 and Red Risk Hazards) and information to identify Safety Critical Elements (SCE) in support of the ALARP Demonstration.

The scope of the HAZID is the overall BLPH excluding the incoming electrical cables from windfarm and solar farm. Hazards related to construction phase were excluded from this assessment, as they will be covered by dedicated construction hazards identification assessments.

2.1. REFERENCES

Doc. No.	Description
123A90-DDL-PP-DS-70070	Preliminary version of BLPH Base Load Power Hub Plot Plan
K559-2254-PM-PLN-003	Basic Design Engineering Package
K559-2254-PR-REP-001	Process Description
K559-2254-SE-REP-001	FEED HAZID Report
123A90-DDL-PR-BL-80002	Heat & Mass Balance

Doc. No.	Description
123A90-DDL-PR-DG-80003	BLPH Process Flow Scheme Electrolyser And Hydrogen Drying Package
123A90-DDL-PR-DG-80004	BLPH Process Flow Scheme Hydrogen Storage
123A90-DDL-PR-DG-80005	BLPH Process Flow Scheme Fuel Cell Package
123A90-DDL-PR-UFD-80006	BLPH Utility Flow Diagram Water Treatment Plant
123A90-DDL-PR-UFD-80007	BLPH Utility Flow Diagram Instrument Air And Nitrogen Systems
123A90-DDL-PR-UFD-80008	BLPH Utility Flow Diagram Vent Systems
123A90-DDL-SAF-RE-30001	Fire Protection Philosophy
123A90-DDL-SAF-RE-30046	HSE Design Philosophy
123A90-DDL-SAF-RE-30008	HAZID Terms of Reference

Table 1 - Reference Documents

2.2. DEFINITIONS AND ABBREVIATIONS

COMPANY or Client (CPY):	Crosswind
CONTRACTOR (CTR):	ROSETTI MARINO S.p.A.
PROJECT:	HOLLANDSE KUST NOORD WIND PARK Project
ALARP	As Low As Reasonably Practicable
BESS	Battery Energy Storage System
BLPH	Base Load Power Hub
EPC	Engineering Procurement Construction
ERP	Emergency Response Plan
FEED	Front End Engineering Design
FERA	Fire and Explosion Risk Assessment
HAZID	Hazard Identification
HEMP	Hazard and Effect Management Process
HER	Hazard and Effect Register
HKN	Hollandse Kust Noord
HSE	Health, Safety, Environment
HVAC	Heating Ventilation and Air Conditioning

PEM	Proton Exchange Membrane
PFD	Process Flow Diagram
PPE	Personnel Protective Equipment
O&M	Operation and Maintenance
RAM	Reliability Availability and Mantainability
RO	Reverse Osmosis
SCE	Safety Critical Element
SHESAMS	Safety, Health, Environment, Security Action Management
SME	Subject Matter Expert
UV	Ultraviolet
WTG	Wind Turbine Generator

Table 2 - Definitions and Abbreviations

Here below a list of definitions of words often used during an HAZID Session:
Guideword: Key words to be used in association with their associated expanders in order to guide and stimulate creative thinking towards the identification of representative hazards.

Hazard: Anything with the potential to cause harm, including ill health or injury, damage to properties and environment or community impact.

Incident: Any accident and near miss according to their definition.

Likelihood: The expectation, possibility or chance of something happening (also referred as frequency).

Loss: The adverse impact of any event on business causing:

- Harm to persons
- Harm to the environment
- Asset damage
- Damage to community

Node: A logic section of the plant/system to be examined in the HAZID (typically consists of a specific project configuration like Option 1, Option 2, etc. or a part of the facilities to be analysed.

Residual risk: The level of risk remaining after implementation of existing controls and recommended preventive and mitigating measures.

Risk: Combination of the likelihood of occurrence of a hazardous event and the severity of consequence that can be caused by the event or exposure(s).

Risk Ranking: A means of expressing the risk of an activity in terms of a value that represents both its likelihood and severity.

3. HAZID STUDY METHODOLOGY

The main reasons for carrying out HAZID studies are to:

- provide a forum to draw on collective experience at an early stage to ensure inherent safety, health aspects/risks and environmental issues are properly considered in design;
- focus on identifying hazards to people working on the installation, both in terms of accident or long/short term exposure to biological/chemical hazards, and/or to the Assets considering also security aspects and/or to environment or community;
- check whether the precautions and safeguards incorporated in the project development are sufficient to either prevent the hazard to occur or mitigate the severity of any consequence and reduce the risk to ALARP level.

The HAZID technique consists of a structured brainstorming of potential hazard scenarios using a comprehensive set of guidewords. Guidewords used in the assessment are shown in Attachment 2 - LIST OF GUIDEWORDS. The adequacy and presence of the existing safeguards (either preventive or mitigating) are assessed and finally, the risk associated to the hazardous event is evaluated with the support of the risk matrix shown in Table 4. If the identified control measures are not considered sufficient, recommendations are made, which could reduce the frequency or severity of the hazard identified.

HAZID gives emphasis to the use of the checklist as a prompt for the team to brainstorm. The team knowledge and creativity is used to identify credible causes and hence applicability of the issues. It is important that the checklist is used in a creative manner and not applied too rigidly. It is only in this way that new or unusual hazards will be recognised, or where specific combinations of factors will be identified as causes of concern.

The HAZID has been carried out in accordance with HAZID Terms of Reference and the principles of ISO 17776.

3.1. HAZID WORKFLOW

The HAZID was performed by reviewing the precompiled worksheet done during Front End Engineering Phase (FEED) phase and changing it based on new information and project development. Recommendations from the FEED phase were either considered as barriers, if closed, or deleted from the worksheet, if open, as they are already tracked into Safety, Health, Environment, Security Action Management (SHESAMS), to avoid unnecessary repetitions.

The leader started the workshop with the first 'Node' to be studied; the intention of that node was discussed and agreed by the team. Table 3 identifies the nodes used in the analysis.

Node	Node Description
1	Electrical System
2	Hydrogen System
3	Water & Utilities System

4	General Node

Table 3 - Node description

The leader then moved on to the HAZID checklist and within each checklist section, the team followed the following procedure.

- The leader nominated a Category from the checklist and then asked the team to consider each Guide Word.
- The team assessed the applicability of each guide word. If the guide word was considered applicable, the leader asked the team to identify by brainstorming any potential hazardous events and their effects. Whatever was already present as a hazard in the worksheet from FEED, was reviewed and changed, as required. New hazards were also entered into the worksheet.
- The brainstorming process was then used to identify all the potential threats or causes of the release of the hazard.
- The team then assessed appropriate controls that would be put in place during project development to prevent or control each threat.
- The team checked the recommendations done in FEED and if still applicable, but open, they were deleted from the worksheet to avoid doubling follow-up efforts (as already tracked on SHEAMS). New recommendations were added where the team considered that risk should or could be reduced further to ALARP.

3.2. PRIORITY

Team members decided the importance or severity of each issue based on the risk assessment matrix.

The RAM, see Table 4, is used to give a simple priority rating on a qualitative basis for each of the risk categories (people, assets, environment and community) to the risks associated with the hazards/issues identified. The worksheet (spreadsheet) is designed such that each issue may be categorised by colour and by grid reference in the RAM.

It is important to recognise that the risk rankings performed was based on a Worst-Case Credible scenario. A worst-case credible scenario is an event that could realistically occur and that has the worst outcome from release of a Hazard, if Controls fail. The approach defines the risk ranking associated with each released hazard, which is useful in ranking the hazards according to their intrinsic potential to cause harm in the actual operating environment. It allows prioritisation of mitigation measures to be determined by the project based on maximising risk reduction.

- High Risk (red). Issues that could affect the viability of the project or have significant HSE or societal impact (e.g. grid D4 or E5 in Table 4).
- Medium Risk (yellow). Issues that will require significant cost or time resources to resolve (e.g. grid B4 or C3 in Table 4).

- Low Risk (dark blue). Issues, which need to be managed for continuous improvement through the effective implementation of the HSSE Management System (e.g. grid A4 or B3 in Table 4).
- Low Risk (light blue). Issues which need to be managed for continuous improvement, although Businesses may set lower priority for further Risk reduction. (e.g. grid B1 or C0 in Table 4).

SEVERITY	CONSEQUENCES				INCREASING LIKELIHOOD				
	People	Assets	Community	Environment	A	B	C	D	E
					Never heard of in the Industry	Heard of in the Industry	Has happened in the Organisation or more than once per year in the Industry	Has happened at the Location or more than once per year in the Organisation	Has happened more than once per year at the Location
0	No injury or health effect	No damage	No effect	No effect					
1	Slight injury or health effect	Slight damage	Slight effect	Slight effect					
2	Minor injury or health effect	Minor damage	Minor effect	Minor effect					
3	Major injury or health effect	Moderate damage	Moderate effect	Moderate effect					
4	PTD or up to 3 fatalities	Major damage	Major effect	Major effect					
5	More than 3 fatalities	Massive damage	Massive effect	Massive effect					

Table 4 – Risk Assessment Matrix (RAM)

4. HAZID SESSION AND TEAM MEMBERS

Dates & locations: Session 1: 5th October 2023, 9:00-18:00 (MILAN); and
Session 2: 6th October 2023, 9:00-12:00 (MILAN).

The HAZID workshop consisted of a multi-disciplinary team of engineers and other key personnel to enhance the identification of potential hazards. The HAZID was led by an independent third party from MES Italia.

The team members who attended the HAZID workshop are presented in Table 5 below. Not all participants were available full-time and some expertise was only required for specific topics. The attendance list duly signed is shown in Attachment 1 - ATTENDANCE LIST.

Name	Role/Discipline	Company	Date 05/10/2023	Date 06/10/2023
Michela Fratini	Chairman	MES	Present full time	Present full time
Carolina Caracciolo	Technical Safety Leader	Rosetti	Present full time	Present full time
Riccardo Dalungi	Technical Safety	Rosetti	Present full time	Present full time
Dominik Sznajder	BLPH Project Manager	Crosswind	Present full time	-
Stephen Bremner	BLPH Project Manager	Crosswind	Present full time	Present full time
Ciro Impradice	Process Engineer	Rosetti	Present full time	Present full time
Jeroen Van Loon	Construction Manager	Crosswind	Present full time	Present full time
Paul van Rossum	Technical Safety	Crosswind	Present full time	Present full time
Hamant Patel	Process Lead	Crosswind	Present full time	Present full time
Nicolas Le Brun	HSSE Lead Innovation	Crosswind	Present full time	Present full time
Ampur Fune	Electrical & Integration Lead	Crosswind	Present full time	Present full time
Loredana Calabrese	Instrumentation	Rosetti	Present full time	-
Alessandro Bucciero	Technical Safety Manager	Rosetti	Present full time	-
Domenico Vaccariello	Electrical Department Manager	Rosetti	Present full time	-
Davide Lo Sterzo	Project Engineer Manager	Rosetti	Present full time	Present full time
Tommaso Tosti	Scribe	MES	Present full time	-
Tirso Suarez	Commissioning Engineer	Crosswind	Remote full time	Remote full time
Ken Rose	Electrical Engineer	Crosswind	Remote full time	Remote full time

Table 5 – HAZID Attendees

5. HAZID OUTCOMES

This section summarises the key outputs of the HAZID with detailed worksheets shown in Attachment 3 - HAZID WORKSHEET. The Major risks identified are identified in Table 6 and are related to hydrogen leaks in the electrolyser or in the process and thermal runaway reactions in BESS.

Node	Item	Hazard	Threat	Consequence
Node 1	H-03.05a	Hydrogen	Leakage of Hydrogen from (Proton Exchange Membrane) PEM.	Potential of Explosion. Jet fire & impingement to adjacent equipment. Escalation. Invisible flames. Potential for personal injuries if people are on the platform Asset damage
Node 1	H-03.05d	Oxygen & Hydrogen	Hydrogen leaking into oxygen system leading to fire in the PEM	Potential for internal explosion
Node 1	H-11.02c	Temperatures greater than 150°C	Thermal runaway within BESS during maintenance activities	Potential explosive atmosphere. Potential fatalities.
Node 2	H-03.05a	Hydrogen	"Leakage from Hydrogen system.	Potential of Explosion. Jet fire & impingement to adjacent vessel. Escalation. Invisible flames.
Node 2	H-03.05d	Oxygen & Hydrogen	Hydrogen leaking into oxygen system	Potential of formation of explosive mixture leading to internal explosion

Table 6 – Major Accidental Hazards

A total of 14 recommendations were recorded during the HAZID. A summary of the recommendations is presented in Table 7. The table lists the actions by action number, the responsible party and hazard reference number referring to the location of the individual Node in the worksheet.

Dedicated Action sheets have been produced to ensure proper action follow up. Actions sheets can be found in Attachment 4 - ACTION SHEETS.

Node	Item	Recommendations	Recommendations	Responsible party
Node 1	H-03.05a	Hydrogen	Fire and Explosion Risk Assessment (FERA) to be uptated in detail design to include scenarios and protections from the electrolyzer and fuel cell package	Contractor & Company
Node 1	H-19.01	Low oxygen atmospheres	Verify with the BESS vendor the type of fire suppression system and update Hazard and Effect Register (HER if required)	Company
Node 1	H-22.13a	Cadmium compounds and other heavy metals	Check the risk ranking based on Company Health Subject Matter Expert (SME) and update the HER if required	Company
Node 1	H-22.13a	Cadmium compounds and other heavy metals	Evaluate the possibility to use portable eye wash and shower	Contractor
Node 2	H-03.05a	Hydrogen	Develop a bow-tie for hydrogen hazard	Contractor & Company
Node 2	H-03.05b	Hydrogen	Ensure a no-fly zone is established around the facilities if required	Company
Node 2	H-19.04	Excessive N2	Verify that electrolyzer container is not considered a confined space	Company
Node 3	H-05.01a	Bottled gases under pressure	Establish requirements for nitrogen bottle on the platform. Update HER if required	Contractor

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Node	Item	Recommendations	Recommendations	Responsible party
Node 3	H-16.01	Ultraviolet radiation	Vendor to confirm that Ultraviolet (UV) radiation is safe	Contractor
Node 3	H-20.05b	Chlorine	Verify with Vendor the amount of hydrogen produced by electroclorination package. Update the risk ranking and HER based on the outcome of this verification	Contractor
Node 3	H-21.12	Scale inhibitors	Clarify type of chemical used as scale inhibitor and update HER afterwards, if required	Contractor
Node 3	H-22.15	Chemicals for Cleaning Reverse Osmosis (RO) Membrane	Clarify type of chemical used for cleaning RO membrane and update the HER	Contractor
Node 3	H-24.03	Small animals	Verify with Sea Water Tratment System Vendor if it is possible to have fish trapped and decomposing in the package	Contractor
Node 4	H-27.01a	Piracy, hijack, kidnap, terrorism	Consider to provide physical barrier on the stair	Contractor

Table 7 - Recommendations

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ATTACHMENT 1 - ATTENDANCE LIST

CROSSWIND	HOLLANDSE KUST NOORD WIND PARK Project Contract No. CW-I-WP4-2023-05	ROSETTI MARINO
Document Title:	HAZID Terms of Reference	Sheet 18 of 33 Date: 02/10/2023 Rev: 1

ATTACHMENT 1 - ATTENDANCE LIST TEMPLATE

Name	Role / Discipline	Company	Sign	05/10/23	06/10/23
Michele Fiorini	CHAIRMAN	HSE		X	X
~~Tommaso Tosti~~					
Carolina Carocciolo	Tech. safety leader	Rosetti		X	X
Riccardo Dalungi	Technical Safety	Rosetti		X	X
Dominik Szmajdzr	BLPH Project Manager	Crosswind		X	
Stephen Bremner	BLPH Packages Lead	Crosswind		X	
ERO IMTRADIPE	PROCESS ENGINEER	ROSETTI		X	X
Jeroen van Laan	construction manager	Crosswind		X	X
Paul K. Rossum	Tech Safety	cross wind		X	X
HAMANT PATEL	PROCESS LEAD.	CROSSWIND		X	X
Nicolas Le Brun	HSSE Lead Inmunions	Crosswind		X	X
Amhar Sand	electrical & Instrumentation	Cross wind		X	X
LOREDANA CALABRESE	INSTRUMENTATION	ROSETTI		X	
ALESSANDRO BUCCIERO	TECH SAF MANAGER	ROSETTI		X	
Domenico Vaccariello	Electrical Dpt. Manager	Rosetti		X	
DAVIDE LO STORTO	PROJECT ENGINEERING MNG.	ROSETTI		X	X
TOMMASO TOSTI	SCRIBE	MES		X	
Tirso Suarez	Operations	Crosswind		X	
Ken Rose	Electrical Lead	Crosswind		X	

ATTACHMENT 2 - LIST OF GUIDEWORDS

Hazard number	Hazard description
01	**Hydrocarbons**
H-01.01	Oil under pressure
H-01.02	Hydrocarbons in formation
H-01.03	LPGs (e.g. Propane)
H-01.04	LNGs
H-01.05	Condensate
H-01.06	Hydrocarbon gas
H-01.07	Oil at low pressures
H-01.08	Wax
H-01.09	Coal
02	**Refined hydrocarbons**
H-02.01	Lube and seal oil
H-02.02	Hydraulic oil
H-02.03	Diesel fuel
H-02.04	Aviation Fuel, Petrol
H-02.05	Hydrocarbons above auto- ignition temp
H-02.06	Asphalt
H-02.07	Bunker Fuel
H-02.08	Heat Transfer Fluid
H-02.09	Transformer Oil
03	**Other flammable materials**
H-03.01	Cellulosic materials
H-03.02	Pyrophoric materials
H-03.03	Carbon-fibre-reinforced vegetation
H-03.04	Dry Vegetation
H-03.05a	Hydrogen
H-03.05b	Oxygen

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Hazard number	Hazard description
H-03.06	Flammable gases in bottles
H-03.07	Hydrocarbon Vapours in pipe vents
04	**Explosives**
H-04.01	Detonators
H-04.02	Conventional explosive material
H-04.03	Perforating gun charges
H-04.04	Explosive gases
05	**Pressure hazards**
H-05.01	Bottled gases under pressure
H-05.02	Fluid under Pressure
H-05.03	Non-hydrocarbon gas under pressure in pipework
H-05.04	Air under high pressure
H-05.05	Hyperbaric operations
H-05.06	Decompression
H-05.07	Water under pressure
06	**Hazards associated with differences in height**
H-06.01	People at height >1.8m
H-06.02	People at height <1.8m
H-06.03a	Overhead equipment
H-06.03b	Dropped objects
H-06.04	People under water
H-06.05	People below grade
07	**Objects under induced stress**
H-07.01	Objects under tension
H-07.02	Objects under compression
H-07.03	Objects under variable/dynamic/cyclic loading
08	**Dynamic situation hazards**
H-08.01	On-land transport (driving)
H-08.02	On-water transport (boating)
H-08.03	In-air transport (flying)

Hazard number	Hazard description
H-08.04	Boat collision hazard to other vessels and offshore structures
H-08.05	Marine Activity (diving)
H-08.06	Equipment with moving or rotating parts
H-08.07a	Use of hazardous hand tools (grinding, sawing)
H-08.07b	Use of knives, machetes and other sharp objects
H-08.08	Transfer from boat, Flotel to offshore platform
H-08.09	Ship-to-Ship Collison
H-08.10	Vessel quality
09	**Environmental hazards**
H-09.01	Weather
H-09.02	Sea state / river currents
H-09.03	Tectonic
10	**Hot surfaces**
H-10.01	Process piping and equipment between 60 °C and 150 °C
H-10.02	Process piping and equipment over 150 °C
H-10.03	Engine and turbine exhaust systems
H-10.04	Steam piping
11	**Hot fluids**
H-11.01	Temperatures between 100 °C and 150 °C
H-11.02	Temperatures greater than 150 °C
12	**Cold surfaces**
H-12.01	Process piping between -25 °C and -80 °C
H-12.02	Process piping less than -80 °C
H-12.03	Cold Surfaces
13	**Cold fluids**
H-13.01	Oceans, seas and lakes less than 10 °C
H-13.02	Cryogenic Liquids
14	**Open flame**
H-14.01	Heaters with fire tube
H-14.02	Direct-fired furnaces

Hazard number	Hazard description
H-14.03	Flares
15	**Electricity**
H-15.01	Voltage > 50V to 600V in cables
H-15-02	Voltage > 50V to 600V in equipment
H-15.03	Voltage >600V
H-15.04	DC Voltage
H-15.05	Lightning discharge
H-15.06	Electrostatic energy
16	**Electromagnetic radiation**
H-16.01	Ultraviolet radiation
H-16.02	Infrared radiation
H-16.03	Microwaves
H-16.04	Lasers
H-16.05	E/M radiation: high voltage AC cables
17	**Ionizing radiation - Open source**
H-17.01	Alpha, beta, open source
H-17.02	Gamma rays, open source
H-17.03	Neutron, open source
H-17.04	Naturally occurring ionising radiation
H-17.05	X-rays
18	**Ionizing radiation - Closed source**
H-18.01	Alpha, beta, closed source
H-18.02	Gamma rays, closed source
H-18.03	Neutron, closed source
19	**Asphyxiates**
H-19.01	Low oxygen atmospheres
H-19.02	Excessive CO2
H-19.03	Drowning
H-19.04	Excessive N2
H-19.05	Halon

Hazard number	Hazard description
H-19.06	Smoke
H-19.07	SF6 (Sulphur Hexafluoride)
20	**Toxic gas**
H-20.01	H2S (hydrogen sulphide, sour gas)
H-20.02	Exhaust fumes
H-20.03	SO2
H-20.04	Benzene
H-20.05	Chlorine
H-20.06	Welding fumes
H-20.07	Tobacco smoke
H-20.08	CFCs
H-20.09	CO
H-20.10	HF
21	**Toxic liquid**
H-21.01	Mercury
H-21.02	PCBs
H-21.03	Biocides
H-21.04	Methanol
H-21.05	Brines
H-21.06	Glycols
H-21.07	Degreasers
H-21.08	Isocyanates
H-21.09	Sulphanol
H-21.10	Amines
H-21.11	Corrosion inhibitors
H-21.12	Scale inhibitors
H-21.13	Liquid mud additives
H-21.14	Odorant additives
H-21.15	Alcoholic beverages
H-21.16	Recreational drugs

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Hazard number	Hazard description
H-21.17	Used engine oils
H-21.18	Carbon tetrachloride
H-21.19	Grey and/or black water
H-21.20	Paint, Solvents and General Chemicals
H-21.21	Shell Therma B Oil
22	**Toxic solid**
H-22.01	Asbestos
H-22.02	Man-made mineral fibre
H-22.03	Cement dust
H-22.04	Sodium hypochlorite
H-22.05	Powered mud additives
H-22.06	Sulphur dust
H-22.07	Pig trash
H-22.08	Oil-based muds
H-22.09	Pseudo-oil based muds
H-22.10	Water-based muds
H-22.11	Cement slurries
H-22.12	Dusts
H-22.13	Cadmium compounds and other heavy metals
H-22.14	Oil based sludges
H-22.15	Chemicals for Cleaning RO Membrane
H-22.16	Dechlorination Chemicals
23	**Corrosive substances**
H-23.01	Hydrofluoric acid
H-23-02	Hydrochloric acid
H-23.03	Sulphuric acid
H-23.04	Caustic soda (sodium hydroxide)
H-23.05	Battery Acids
24	**Biological hazards**
H-24.01	Poisonous plants

Hazard number	Hazard description
H-24.02	Large animals
H-24.03	Small animals
H-24.04	Food-borne bacteria (e.g. E.coli)
H-24.05	Water-borne bacteria (e.g. legionella)
H-24.06	Viral & Bacterial pathogens
H-24.07	Disease-transmitting insects
H-24.08	Respiratory disease infections
H-24.09	Blood-borne/sexually transmitted diseases
H-24.10	Latent disease or health problems
H-24.11	Other infections
25	**Ergonomic hazards**
H-25.01	Manual materials handling
H-25.02	Damaging noise
H-25.03	Loud steady noise > 85dBA
H-25.04	Heat stress (high ambient temperatures)
H-25.05	Cold stress (low ambient temperatures)
H-25.06	High humidity
H-25.07	Vibration
H-25.08	Workstations
H-25.09	Lighting
H-25.10	Incompatible hand controls
H-25.11	Awkward location of workplaces and machinery
H-25.12	Mismatch of work tophysical abilities
H-25.13	Mismatch of work to cognitive abilities
H-25.14	Long and irregular working hours/shifts
H-25.15	Poor organisation and job design
H-25.16	Work planning issues
H-25.17	Indoor climate (too hot/cold/dry/humid)
26	**Psychological hazards**
H-26.01	Living on the job/away from family

Hazard number	Hazard description
H-26.02	Working and living on a live plant
H-26.03	Post-traumatic stress
27	**Security-related hazards**
H-27.01	Piracy, hijack, kidnap, terrorism
H-27.02	Assault
H-27.03	Sabotage
H-27.04	Crisis (military action, civil disturbances, terrorism)
H-27.05	Theft, pilferage
28	**Use of natural resources**
H-28.01	Land
H-28.02	Water
H-28.03	Air under high pressure
H-28.04	Trees, vegetation
H-28.05	Gravel
H-28.06	Personal welfare & 3rd party relations
29	**Medical**
H-29.01	Medical unfitness
H-29.02	Motion sickness
30	**Noise**
H-30.01	High level noise
H-30.02	Intrusive noise

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ATTACHMENT 3 - HAZID WORKSHEET

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ITEM NO.	HAZARD	THREAT	CONSEQUENCE	SAFEGUARDS	RISK RANKING												RECOMMENDATION	OWNER	PROJECT PHASE	COMMENTS
					People			Assets			Community			Environment						
					S	P	R	S	P	R	S	P	R	S	P	R				
HYDROCARBONS																				
H-01.01	Oil under pressure	N/A																		
H-01.02	Hydrocarbons in formation	N/A																		
H-01.03	LPGs (e.g. Propane)	N/A																		
H-01.04	LNGs	N/A																		
H-01.05	Condensate	N/A																		
H-01.06	Hydrocarbon gas	N/A																		
H-01.07	Oil at low pressures	N/A																		
H-01.08	Wax	N/A																		
H-01.09	Coal	N/A																		
REFINED HYDROCARBONS																				
H-02.01	Lube and seal oil	N/A																		
H-02.02	Hydraulic oil	No hydraulic valves																		
H-02.03a	Diesel fuel	Malfunction in diesel generator	Local fire and asset damage Personelle injuries	Automatic fire suppression system in the generator Task risk assesment	1	B	1B	1	B	1B	1	B	1B							Diesel generator is used to start up the BLPH if disconnected to the wind turbine
H-02.03b	Diesel fuel	Leakage in diesel generator	Discharge in to the sea and local enviromental impact	Drip tray										2	C	2C				Diesel generator is used to start up the BLPH if disconnected to the wind turbine
H-02.04	Aviation Fuel, Petrol	N/A																		
H-02.05	Hydrocarbons above auto-ignition temp	N/A																		It is assumed that in case of maintenance the transformer is de-energized
H-02.06	Asphalt	N/A																		
H-02.07	Bunker Fuel	N/A																		
H-02.08	Heat Transfer Fluid	N/A																		
H-02.09	Transformer Oil	Refer to General Node																		
OTHER FLAMMABLE MATERIALS																				
H-03.01	Cellulosic materials	N/A																		
H-03.02	Pyrophoric materials	N/A																		
H-03.03	Carbon-fibre-reinforced vegetation	N/A																		
H-03.04	Dry Vegetation	N/A																		
H-03.05a	Hydrogen	Leakage of Hydrogen from PEM.	Potential of Explosion. Jet fire & impingement to adjacent equipment. Escalation. Invisible flames. Potential for personal injuries if people are on the platform Asset damage	Fire & gas detection & Emergency Shutdown Material selection report. Minimisation of Leak Sources.	5	B	5B	4	B	4B	4	B	4B	2	B	2B	FERA to be uptated in detail design to include scenarios and protections from the electrolyzer and fuel cell package	Contractor & Company		
H-03.05b	Hydrogen	Hydrogen released from BESS.	Refer to H-11.02b/c																	
H-03.05c	Hydrogen	Leakage of Hydrogen from UPS batteries.	No significant consequences due to small amount																	

ITEM NO.	HAZARD	THREAT	CONSEQUENCE	SAFEGUARDS	RISK RANKING												RECOMMENDATION	OWNER	PROJECT PHASE	COMMENTS
					People			Assets			Community			Environment						
					S	P	R	S	P	R	S	P	R	S	P	R				
H-03.05d	Oxygen & Hydrogen	Hydrogen leaking into oxygen system leading to fire in the PEM	Potential for internal explosion	Local UCP ESD Sistem depressurized and made safe before maintenance	5	A	5A	4	A	4A	4	A	4A	1	A	1A				The philosophy states that PEM system has to be depressurized before the crew arrives
H-03.06	Flammable gases in bottles	N/A																		
H-03.07	Hydrocarbon Vapours in pipe vents	N/A																		
EXPLOSIVES																				
H-04.01	Detonators	N/A																		
H-04.02	Conventional explosive material	N/A																		
H-04.03	Perforating gun charges	N/A																		
H-04.04	Explosive gases	N/A																		
PRESSURE																				
H-05.01	Bottled gases under pressure	N/A																		
H-05.02a	Fluid under Pressure	N/A																		
H-05.02b	Fluid under Pressure	Leakage from cooling medium (glycol water) system within BESS PCS or rectifier.	Electrical Short circuit. Potential personnel injury if people are on the platform	Within equipment design.	3	B	3B	1	C	1C				1	C	1C				
H-05.03	Non-hydrocarbon gas under pressure in pipework	N/A																		
H-05.04	Air under pressure	Leak from the Pressurized air sistem in the GIS	Potential personal injuries if personnel is present		1	A	1A													Air quantity is small and pressure is about 7 barg
H-05.04	Air under pressure	Leak from the Pressurized air sistem in the GIS	Electrical Arc causing short circuit Potential personnel injury if people are on the platform	GIS is arc proof	3	A	3A	1	A	1A										
H-05.05	Hyperbaric operations	N/A																		
H-05.06	Decompression	N/A																		
H-05.07	Water under pressure	N/A																		
DIFFERENCES IN HEIGHT																				
H-06.01	People at height >1.8m	Refer to General Node																		
H-06.02	People at height <1.8m	Refer to General Node																		
H-06.03a	Overhead equipment	Refer to General Node																		
H-06.03b	Dropped objects	Refer to General Node																		
H-06.03b	Dropped objects	Changing batteries modules within BESS container	Potential Personal injuries Potential asset damage	PPE Maintenance procedure	3	B	3B	1	B	1B										
H-06.04	People under water	N/A																		
H-06.05	People below grade	N/A																		
OBJECTS UNDER INDUCED STRESS																				
H-07.01	Objects under tension	Intermittent operation of electrolyser	Potential cyclic operations, potential leakage due to fatigue. *Refer to hydrogen leak for risk ranking*																	
H-07.02	Objects under compression	N/A																		

ITEM NO.	HAZARD	THREAT	CONSEQUENCE	SAFEGUARDS	RISK RANKING												RECOMMENDATION	OWNER	PROJECT PHASE	COMMENTS
					People			Assets			Community			Environment						
					S	P	R	S	P	R	S	P	R	S	P	R				
H-07.03	Objects under variable/dynamic/cyclic loading	Refer to H-07.01	*Refer to Node 2*																	
DYNAMIC SITUATIONS HAZARDS																				
H-08.01	On-land transport (driving)	Refer to General Node																		
H-08.02	On-water transport (boating)	Refer to General Node																		
H-08.03	In-air transport (flying)	Refer to General Node																		
H-08.04	Boat collision hazard to other vessels and offshore structures	Refer to General Node																		
H-08.05	Marine Activity (diving)	Refer to General Node																		
H-08.06	Equipment with moving or rotating parts	Refer to General Node																		
H-08.07	Use of hazardous hand tools (grinding, sawing)	Refer to General Node																		
H-08.07	Use of knives, machetes and other sharp objects	Refer to General Node																		
H-08.08	Transfer from boat, Flotel to offshore platform	Refer to General Node																		
H-08.09	Ship-to-Ship Collison	Refer to General Node																		
H-08.10	Vessel quality	Refer to General Node																		
ENVIRONMENTAL HAZARDS																				
H-09.01a	Weather	Refer to General Node																		
H-09.01b	Weather	Refer to General Node																		
H-09.01c	Weather	Refer to General Node																		
H-09.02	Sea state / river currents	Refer to General Node																		
H-09.03	Tectonic	Refer to General Node																		
HOT SURFACES																				
H-10.01	Process piping and equipment between 60C and 150C	N/A																		
H-10.02	Process piping and equipment over 150C	N/A																		
H-10.03	Engine and turbine exhaust systems	Hot exhaust from Diesel generator (black start-up)	Potential Personal injuries due to burns	Exhausted released at height PPE	2	B	2B													
H-10.04	Steam piping	N/A																		
HOT FLUID																				
H-11.01	Temperatures between 100C and 150C	N/A																		
H-11.02a	Temperatures greater than 150C	N/A																		
H-11.02b	Temperatures greater than 150C	Thermal runaway within BESS when no people around the platform	Potential explosive atmosphere. Asset damage.	Refer to bow tie (doc number K559-2254-SE-LST-001) Battery management system				4	B	4B	4	B	4B	3	B	3B				
H-11.02c	Temperatures greater than 150C	Thermal runaway within BESS during maintenance activities	Potential explosive atmosphere. Potential fatalities.	Refer to bow tie (doc number K559-2254-SE-LST-001) Battery management system	5	B	5B				4	B	4B	3	B	3B				
COLD SURFACES																				
H-12.01	Process piping between -25C and -80C	N/A																		
H-12.02	Process piping less than -80C	N/A																		
H-12.03	Cold Surfaces	N/A																		
COLD FLUIDS																				
H-13.01	Oceans, seas and lakes less than 10C	N/A																		

ITEM NO.	HAZARD	THREAT	CONSEQUENCE	SAFEGUARDS	RISK RANKING												RECOMMENDATION	OWNER	PROJECT PHASE	COMMENTS
					People			Assets			Community			Environment						
					S	P	R	S	P	R	S	P	R	S	P	R				
H-13.02	Cryogenic Liquids	N/A																		
OPEN FLAMES																				
H-14.01	Heaters with fire tube	N/A																		
H-14.02	Direct-fired furnaces	N/A																		
H-14.03	Flares	N/A																		
ELECTRICITY																				
H-15.01	Voltage > 50V to 600V in cables	No issues identified.																		
H-15-02	Voltage > 50V to 600V in equipment	Salty conditions. Stray currents.	Potential electrocutions.	Access control, maintenance procedures, electrically earthed where possible. Electrical safety kit	4	B	4B													
H-15.03	Voltage >600V	6.6kV systems, 66kV systems.	Potential electrocutions	Appropriate design for high voltage systems. PPE. Maintenance procedures	4	B	4B													
H-15.03	Voltage >600V	6.6kV systems, 66kV systems.	Arc flash and potential for personal injuries if standing besides a cabinet. Asset damage	Design of cabinets to deflect the arch waves	3	B	3B	2	B	4B										
H-15.04	DC Voltage	Residual voltage	Potential electrocutions	Access control, maintenance procedures, electrically earthered where possible.	4	B	4B													
H-15.05	Lightning discharge	Refer to General Node																		
H-15.06	Electrostatic energy	N/A																		
ELECTROMAGNETIC RADIATION																				
H-16.01	Ultraviolet radiation	N/A																		
H-16.02	Infrared radiation	N/A																		
H-16.03	Microwaves	N/A																		
H-16.04	Lasers	N/A																		
H-16.05	E/M radiation: high voltage AC cables	Communication interference from HV system & power electronics.	Impact on communication, potential escalation. *Post-meeting note - (escalation - not risk ranked)*	Incorporated into vendor specification																
			Potential injury to people wearing pacemaker	Medical offshore pass (Medical fitness)	3	B	3B													
IONISING RADIATION - OPEN SOURCE																				
H-17.01	Alpha, beta, open source	N/A																		
H-17.02	Gamma rays, open source	N/A																		
H-17.03	Neutron, open source	N/A																		
H-17.04	Naturally occurring ionising radiation	N/A																		
H-17.05	X-rays	N/A																		
IONISING RADIATION - CLOSED SOURCE																				
H-18.01	Alpha, beta, closed source	N/A																		
H-18.02	Gamma rays, closed source	N/A																		
H-18.03	Neutron, closed source	N/A																		
ASPHYXIATES																				
H-19.01	Low oxygen atmospheres	Potential operations of firefighting system within instrument cabinet or BESS	Asphyxiation of personnel.	Operation & Maintenance (O&M) Procedure. Manual selector to inhibit release when people are inside Inergen is not considered asphyxiant based on concentration	4	C	4C										Verify with the BESS supplier the type of fire suppression system and update HER if required	Company		
H-19.02	Excessive CO2	N/A																		
H-19.03	Drowning	N/A																		

ITEM NO.	HAZARD	THREAT	CONSEQUENCE	SAFEGUARDS	RISK RANKING												RECOMMENDATION	OWNER	PROJECT PHASE	COMMENTS
					People			Assets			Community			Environment						
					S	P	R	S	P	R	S	P	R	S	P	R				
H-19.04	Excessive N2	Leakage of nitrogen within electrolyser containers. Refer to Node 2																		
H-19.05	Halon	N/A																		
H-19.06	Smoke	Fire in BESS or electrical container or temporary diesel generator.	Potential smoke leading to difficulty to reach life raft or any emergency exit. Asset damage to the fuel cells (requiring cleaning)	2x 100% life raft provided (located on East & Westside of platform). Emergency response plan.	3	B	3B	3	B	3B	2	B	2B	1	B	1B				
H-19.07	SF6 (Sulphur Hexafluoride)			SF6 Free switchgear incorporated within design																
TOXIC GAS																				
H-20.01	H2S (hydrogen sulphide, sour gas)	N/A																		
H-20.02	Exhaust fumes	Refer to H-02.03a/b																		
H-20.03	SO2	N/A																		
H-20.04	Benzene	N/A																		
H-20.05	Chlorine	N/A																		
H-20.06	Welding fumes	N/A																		
H-20.07	Tobacco smoke	N/A																		
H-20.08	CFCs	N/A																		
H-20.09	CO	Refer to (Thermal runaway)																		
H-20.10	HF	Refer to (Thermal runaway)																		
TOXIC LIQUID																				
H-21.01	Mercury	N/A																		
H-21.02	PCBs	N/A																		
H-21.03	Biocides	N/A																		
H-21.04	Methanol	N/A																		
H-21.05	Brines	Refer to General Node																		
H-21.06	Glycols	Leakage of glycol into sea. Refer to Node 2																		
H-21.07	Degreasers	N/A																		
H-21.08	Isocyanates	N/A																		
H-21.09	Sulphanol	N/A																		
H-21.10	Amines	N/A																		
H-21.11	Corrosion inhibitors	N/A																		
H-21.12	Scale inhibitors	N/A																		
H-21.13	Liquid mud additives	N/A																		
H-21.14	Odorant additives	N/A																		
H-21.15	Alcoholic beverages	N/A																		
H-21.16	Recreational drugs	N/A																		
H-21.17	Used engine oils	N/A																		
H-21.18	Carbon tetrachloride	N/A																		
H-21.19	Grey and/or black water	N/A																		
H-21.20	Paint, Solvents and General Chemicals	N/A																		
H-21.21	Shell Therma B Oil	N/A																		
TOXIC SOLID																				
H-22.01	Asbestos	N/A																		
H-22.02	Man-made mineral fibre	N/A																		
H-22.03	Cement dust	N/A																		
H-22.04	Sodium hypochlorite	N/A																		
H-22.05	Powered mud additives	N/A																		
H-22.06	Sulphur dust	N/A																		
H-22.07	Pig trash	N/A																		

ITEM NO.	HAZARD	THREAT	CONSEQUENCE	SAFEGUARDS	RISK RANKING												RECOMMENDATION	OWNER	PROJECT PHASE	COMMENTS
					People			Assets			Community			Environment						
					S	P	R	S	P	R	S	P	R	S	P	R				
H-22.08	Oil-based muds	N/A																		
H-22.09	Pseudo-oil based muds	N/A																		
H-22.10	Water-based muds	N/A																		
H-22.11	Cement slurries	N/A																		
H-22.12	Dusts	N/A																		
H-22.13a	Cadmium compounds and other heavy metals	Leakage from UPS	Potential for personnel injury if exposed	Maintenance procedures Safe design from vendor PPE	3	B	3B										Check the risk ranking based on Company Health SME and update the HER if required	Company		
																	Evaluate the possibility to use portable eye wash and shower	Contractor		
H-22.13b	Lithium	Leakage from batteries due to solid fragments	Potential for personnel injury if exposed, asset damage	PPE	4	B	4B	1	B	1B	3	B	3B	1	B	1B				
H-22.14	Oil based sludges	N/A																		
CORROSIVE SUBSTANCES																				
H-23.01	Hydrofluoric acid	N/A																		
H-23-02	Hydrochloric acid	N/A																		
H-23.03	Sulphuric acid	N/A																		
H-23.04	Caustic soda (sodium hydroxide)	N/A																		
H-23.05	Battery Acids	N/A																		
BIOLOGICAL HAZARDS																				
H-24.01	Poisonous plants	Refer to General Node																		
H-24.02	Large animals	Refer to General Node																		
H-24.03	Small animals	Refer to General Node																		
H-24.04	Food-borne bacteria (e.g. E.coli)	Refer to General Node																		
H-24.05	Water-borne bacteria (e.g. legionella)	Refer to General Node																		
H-24.06	Viral & Bacterial pathogens	Refer to General Node																		
H-24.07	Disease-transmitting insects	Refer to General Node																		
H-24.08	Respiratory disease infections	Refer to General Node																		
H-24.09	Blood-borne/sexually transmitted diseases	Refer to General Node																		
H-24.10	Latent disease or health problems	Refer to General Node																		
H-24.11	Other infections	Refer to General Node																		
ERGONOMIC HAZARDS																				
H-25.01	Manual materials handling	Manual handling of battery module	Potential personal injury due to heavy weight	Maintenance procedures Design of batteries	3	B	3B													
H-25.02	Damaging noise	N/A																		
H-25.03	Loud steady noise > 85dB	Refer to General Node																		
H-25.04	Heat stress (high ambient temperatures)	Refer to General Node																		
H-25.05	Cold stress (low ambient temperatures)	Refer to General Node																		
H-25.06	High humidity	Refer to General Node																		
H-25.07	Vibration	N/A																		
H-25.08	Workstations	N/A																		
H-25.09	Lighting	Refer to General Node																		
H-25.10	Incompatible hand controls	Refer to General Node																		
H-25.11	Awkward location of work places and machinery	Refer to General Node																		

ITEM NO.	HAZARD	THREAT	CONSEQUENCE	SAFEGUARDS	RISK RANKING												RECOMMENDATION	OWNER	PROJECT PHASE	COMMENTS
					People			Assets			Community			Environment						
					S	P	R	S	P	R	S	P	R	S	P	R				
H-25.12	Mismatch of work to physical abilities	Refer to General Node																		
H-25.13	Mismatch of work to cognitive abilities	Refer to General Node																		
H-25.14	Long and irregular working hours/shifts	Refer to General Node																		
H-25.15	Poor organisation and job design	Refer to General Node																		
H-25.16	Work planning issues	Refer to General Node																		
H-25.17	Indoor climate (too hot/cold/dry/humid)	Refer to General Node																		
PSYCHOLOGICAL HAZARDS																				
H-26.01	Living on the job/away from family	Refer to General Node																		
H-26.02	Working and living on a live plant	Refer to General Node																		
H-26.03	Post-traumatic stress	Refer to General Node																		
SECURITY RELATED HAZARDS																				
H-27.01	Piracy, hijack, kidnap, terrorism	Refer to General Node																		
H-27.02	Assault	Refer to General Node																		
H-27.03	Sabotage	Refer to General Node																		
H-27.04	Crisis (military action, civil disturbances, terrorism)	Refer to General Node																		
H-27.05	Theft, pilferage	Refer to General Node																		
H-28.06	Personal welfare & 3rd party relations	Refer to General Node																		
USE OF NATURAL RESOURCES																				
H-28.01	Land	N/A																		
H-28.02	Water	N/A																		
H-28.03	Air under high pressure	N/A																		
H-28.04	Trees, vegetation	N/A																		
H-28.05	Gravel	N/A																		
MEDICAL																				
H-29.01	Medical unfitness	Refer to General Node																		
H-29.02	Motion sickness	Refer to General Node																		
NOISE																				
H-30.01	High level noise	N/A																		
H-30.02	Intrusive noise	N/A																		

ITEM NO.	HAZARD	THREAT	CONSEQUENCE	SAFEGUARDS	RISK RANKING												RECOMMENDATION	OWNER	PROJECT PHASE	COMMENTS
					People			Assets			Community			Environment						
					S	P	R	S	P	R	S	P	R	S	P	R				
HYDROCARBONS																				
H-01.01	Oil under pressure	N/A																		
H-01.02	Hydrocarbons in formation	N/A																		
H-01.03	LPGs (e.g. Propane)	N/A																		
H-01.04	LNGs	N/A																		
H-01.05	Condensate	N/A																		
H-01.06	Hydrocarbon gas	N/A																		
H-01.07	Oil at low pressures	N/A																		
H-01.08	Wax	N/A																		
H-01.09	Coal	N/A																		
REFINED HYDROCARBONS																				
H-02.01	Lube and seal oil	Leakages from pumps	Potential injuries for personnel. Environmental hazards. Possible small localised oil mist/spill.	Spill tray for pumps.	3	B	3B							2	C	2C				
H-02.02	Hydraulic oil	No hydraulic valves																		
H-02.03	Diesel fuel	N/A																		
H-02.04	Aviation Fuel, Petrol	N/A																		
H-02.05	Hydrocarbons above auto-ignition temp	N/A																		
H-02.06	Asphalt	N/A																		
H-02.07	Bunker Fuel	N/A																		
H-02.08	Hydrogen into Heat Transfer Fluid	Leakage of process into closed cooling water system within electrolyser package. Refer to hydrogen in this node																		
H-02.09	Transformer Oil	Refer to General Node																		
OTHER FLAMMABLE MATERIALS																				
H-03.01	Cellulosic materials	N/A																		
H-03.02	Pyrophoric materials	N/A																		
H-03.03	Carbon-fibre-reinforced vegetation	N/A																		
H-03.04	Dry Vegetation	N/A																		
H-03.05a	Hydrogen	Leakage from Hydrogen system.	Potential of Explosion. Jet fire & impingement to adjacent vessel. Escalation. Invisible flames.	Fire & gas detection Hydrogen Storage vessels segregated based on Leak Size Analysis -Technical Note (K559-2254-SE-TEN-001 Rev 0). Material selection Emergency Shutdown Fire Protection Minimisation of Leak Sources.	5	B	5B	4	B	4B	4	B	4B	4	A	4A	Develop a bow-tie for hydrogen hazard	Contractor & Company		Lead by company
H-03.05b	Hydrogen	Gas blowby to supporting systems.	Refer to connecting nodes. H-03.05																	
H-03.05b	Hydrogen	Venting of hydrogen when flying object is operating in the wind farm	Potential ignition of the vent Increased turbolence and potential for flying object crash *(Risk not ranked because it is a Crosswind general hazard instead of a BLPH specific one*)	Vent dispersion and radiation study (to indicate the area affected by dispersion of fire)													Ensure a no-fly zone is established around the facilities if required	Company		
H-03.05c	Oxygen	Oxygen released from O2 Vent. Maintenance activities during oxygen leakage.	Increased potential for ignition (clothing, hair, etc). Potential to transfer to off asset. Structural integrity impacted.	Segregation of equipment to allow oxygen dispersion. Hydrogen & Oxygen Vents segregated to minimise mixing. PPE (flame retardant clothing).	3	B	3B	2	B	2B	2	A	2A	0	B	0B				
H-03.05d	Oxygen & Hydrogen	Hydrogen leaking into oxygen system	Potential of formation of explosive mixture leading to internal explosion	BPCS ESD system	5	B	5B	4	B	4B	4	B	4B	4	A	4A	Refer to H-03-05a			
H-03.06	Flammable gases in bottles	N/A																		
H-03.07	Hydrocarbon Vapours in pipe vents	N/A																		
EXPLOSIVES																				
H-04.01	Detonators	N/A																		

ITEM NO.	HAZARD	THREAT	CONSEQUENCE	SAFEGUARDS	RISK RANKING												RECOMMENDATION	OWNER	PROJECT PHASE	COMMENTS
					People			Assets			Community			Environment						
					S	P	R	S	P	R	S	P	R	S	P	R				
H-04.02	Conventional explosive material	N/A																		
H-04.03	Perforating gun charges	N/A																		
H-04.04	Explosive gases	Refer to H-03.05																		
PRESSURE																				
H-05.01	Bottled gases under pressure	N/A																		
H-05.02	Fluid under Pressure	Stored electrolyte water (30 bar). Potential leakage.	Short term water jet, potential injury to personnel. Asset damage	Restricted access in operation ITP Management of asset integrity Material selection	4	B	4B	2	B	2B										
H-05.03	Non-hydrocarbon gas under pressure in pipework	Refer to H-03.05a & b.																		
H-05.04	Air under high pressure	No threats identified.																		
H-05.05	Hyperbaric operations	N/A																		
H-05.06	Decompression	N/A																		
H-05.07	Water under pressure	Refer to node 3																		
DIFFERENCES IN HEIGHT																				
H-06.01	People at height >1.8m	Refer to General Node																		
H-06.02	People at height <1.8m	Refer to General Node																		
H-06.03a	Overhead equipment	Refer to General Node																		
H-06.03b	Dropped objects	Refer to General Node																		
H-06.03c	Dropped objects	Refer to General Node																		
H-06.04	People under water	Refer to General Node																		
H-06.05	People below grade	Refer to General Node																		
OBJECTS UNDER INDUCED STRESS																				
H-07.01	Objects under tension	N/A																		
H-07.02	Objects under compression	N/A																		
H-07.03	Objects under variable/dynamic/cyclic loading	Leakage of hydrogen due to failure of TSA unit	Refer to Hydrogen Issue	TSA designed for thermocyclic operation																
DYNAMIC SITUATIONS HAZARDS																				
H-08.01	On-land transport (driving)	Refer to General Node																		
H-08.02	On-water transport (boating)	Refer to General Node																		
H-08.03	In-air transport (flying)	Refer to General Node																		
H-08.04	Boat collision hazard to other vessels and offshore structures	Refer to General Node																		
H-08.05	Marine Activity (diving)	Refer to General Node																		
H-08.06	Equipment with moving or rotating parts	Refer to General Node																		
H-08.07	Use of hazardous hand tools (grinding, sawing)	Refer to General Node																		
H-08.07	Use of knives, machetes and other sharp objects	Refer to General Node																		
H-08.08	Transfer from boat, Flotel to offshore platform	Refer to General Node																		
H-08.09	Ship-to-Ship Collison	Refer to General Node																		
H-08.10	Vessel quality	Refer to General Node																		
ENVIRONMENTAL HAZARDS																				
H-09.01a	Weather	Refer to General Node																		
	Post-Meeting Note: Natural and Environmental Hazards - Lightning	Refer to General Node																		
H-09.01b	Weather	Refer to General Node																		

ITEM NO.	HAZARD	THREAT	CONSEQUENCE	SAFEGUARDS	RISK RANKING												RECOMMENDATION	OWNER	PROJECT PHASE	COMMENTS
					People			Assets			Community			Environment						
					S	P	R	S	P	R	S	P	R	S	P	R				
H-09.01c	Weather	Refer to General Node																		
H-09.02	Sea state / river currents	Refer to General Node																		
H-09.03	Tectonic	Refer to General Node																		
HOT SURFACE																				
H-10.01	Process piping and equipment between 60C and 150C	Hot surfaces (downstream of electrolyser & fuel cell).	Injury/ Burns to personnel	PPE. Insulation philosophy. Piping layout philosophy. Maintenance to be done with sistem in shutdown	3	C	3C													
H-10.02	Process piping and equipment over 150C	N/A																		
H-10.03	Engine and turbine exhaust systems	N/A																		
H-10.04	Steam piping	N/A																		
HOT FLUID																				
H-11.01	Temperatures between 100C and 150C	N/A																		
H-11.02	Temperatures greater than 150C	N/A																		
COLD SURFACES																				
H-12.01	Process piping between -25C and -80C	N/A																		
H-12.02	Process piping less than -80C	N/A																		
H-12.03	Cold Surfaces	No threats identified.																		When vessel is depressured from max. pressure, min. ambient to atmospheric pressure there is insignificant change in fluid temperature, hence vessel wall temperature, due to hydrogen depressuring properties).
COLD FLUIDS																				
H-13.01	Oceans, seas and lakes less than 10C	N/A																		
H-13.02	Cryogenic Liquids	N/A																		
OPEN FLAMES																				
H-14.01	Heaters with fire tube	N/A																		
H-14.02	Direct-fired furnaces	N/A																		
H-14.03	Flares	N/A																		
ELECTRICITY																				
H-15.01	Voltage > 50V to 600V in cables	Refer to node 1																		
H-15-02	Voltage > 50V to 600V in equipment	Refer to node 1																		
H-15.03	Voltage >600V	Refer to node 1																		
H-15.04	DC Voltage	Refer to node 1																		
H-15.05	Lightning discharge	Refer to General Node																		
H-15.06	Electrostatic energy	N/A																		
ELECTROMAGNETIC RADIATION																				
H-16.01	Ultraviolet radiation	No issues identified.																		
H-16.02	Infrared radiation	N/A																		
H-16.03	Microwaves	N/A																		
H-16.04	Lasers	N/A																		
H-16.05	E/M radiation: high voltage AC cables	Refer to Node 1																		
IONISING RADIATION - OPEN SOURCE																				
H-17.01	Alpha, beta, open source	N/A																		
H-17.02	Gamma rays, open source	N/A																		
H-17.03	Neutron, open source	N/A																		
H-17.04	Naturally occurring ionising radiation	N/A																		
H-17.05	X-rays	N/A																		

ITEM NO.	HAZARD	THREAT	CONSEQUENCE	SAFEGUARDS	RISK RANKING												RECOMMENDATION	OWNER	PROJECT PHASE	COMMENTS
					People			Assets			Community			Environment						
					S	P	R	S	P	R	S	P	R	S	P	R				
IONISING RADIATION - CLOSED SOURCE																				
H-18.01	Alpha, beta, closed source	N/A																		
H-18.02	Gamma rays, closed source	N/A																		
H-18.03	Neutron, closed source	N/A																		
ASPHYXIATES																				
H-19.01	Low oxygen atmospheres	Maintenance of hydrogen vessels	Asphyxiation of personnel	Operation & Maintenance (O&M) Procedure	4	C	4C				2	C	2C							
H-19.02	Excessive CO2	N/A																		
H-19.03	Drowning	N/A																		
H-19.04	Excessive N2	Leakage of nitrogen within electrolyzer container	Fatality	Forced ventilation inside container Operating and maintenance procedure	4	B	4B				2	B	2B				Verify that electrolyzer container is not considered a confined space	Company		
H-19.05	Halon	N/A																		
H-19.06	Smoke	N/A																		
H-19.07	SF6 (Sulphur Hexafluoride)	N/A																		
TOXIC GAS																				
H-20.02	Exhaust fumes	N/A																		
H-20.03	SO2	N/A																		
H-20.04	Benzene	N/A																		
H-20.05	Chlorine	N/A																		
H-20.06	Welding fumes	N/A																		
H-20.07	Tobacco smoke	N/A																		
H-20.08	CFCs	N/A																		
TOXIC LIQUID																				
H-21.01	Mercury	N/A																		
H-21.02	PCBs	N/A																		
H-21.03	Biocides	N/A																		
H-21.04	Methanol	N/A																		
H-21.05	Brines	Refer to General Node																		
H-21.06	Glycols (MEG)	Leakage of glycol into sea	Impact on marine life	Design of the system to minimise leakages							1	C	1C	2	C	2C				
H-21.07	Degreasers	N/A																		
H-21.08	Isocyanates	N/A																		
H-21.09	Sulphanol	N/A																		
H-21.10	Amines	N/A																		
H-21.11	Corrosion inhibitors	N/A																		
H-21.12	Scale inhibitors	N/A																		
H-21.13	Liquid mud additives	N/A																		
H-21.14	Odorant additives	N/A																		
H-21.15	Alcoholic beverages	N/A																		
H-21.16	Recreational drugs	N/A																		
H-21.17	Used engine oils	N/A																		
H-21.18	Carbon tetrachloride	N/A																		
H-21.19	Grey and/or black water	N/A																		
H-21.20	Paint, Solvents and General Chemicals	N/A																		
H-21.21	Shell Therma B Oil	N/A																		
TOXIC SOLID																				
H-22.01	Asbestos	N/A																		
H-22.02	Man-made mineral fibre	N/A																		
H-22.03	Cement dust	N/A																		
H-22.04	Sodium hypochlorite	N/A																		
H-22.05	Powered mud additives	N/A																		
H-22.06	Sulphur dust	N/A																		
H-22.07	Pig trash	N/A																		
H-22.08	Oil-based muds	N/A																		
H-22.09	Pseudo-oil based muds	N/A																		
H-22.10	Water-based muds	N/A																		
H-22.11	Cement slurries	N/A																		
H-22.12	Dusts	N/A																		

ITEM NO.	HAZARD	THREAT	CONSEQUENCE	SAFEGUARDS	RISK RANKING												RECOMMENDATION	OWNER	PROJECT PHASE	COMMENTS
					People			Assets			Community			Environment						
					S	P	R	S	P	R	S	P	R	S	P	R				
H-22.13	Cadmium compounds and other heavy metals	N/A																		
H-22.14	Oil based sludges	N/A																		
CORROSIVE SUBSTANCES																				
H-23.01	Hydrofluoric acid	N/A																		
H-23-02	Hydrochloric acid	N/A																		
H-23.03	Sulphuric acid	N/A																		
H-23.04	Caustic soda (sodium hydroxide)	N/A																		
H-23.05	Battery Acids	N/A																		
BIOLOGICAL HAZARDS																				
H-24.01	Poisonous plants	Refer to General Node																		
H-24.02	Large animals	Refer to General Node																		
H-24.03	Small animals	Potential oxygen rich atmosphere around vents	Potential impact on passing birds											1	A	1A				
H-24.04	Food-borne bacteria (e.g. E.coli)	Refer to General Node																		
H-24.05	Water-borne bacteria (e.g. legionella)	Refer to General Node																		
H-24.06	Viral & Bacterial pathogens	Refer to General Node																		
H-24.07	Disease-transmitting insects	Refer to General Node																		
H-24.08	Respiratory disease infections	Refer to General Node																		
H-24.09	Blood-borne/sexually transmitted diseases	Refer to General Node																		
H-24.10	Latent disease or health problems	Refer to General Node																		
H-24.11	Other infections	Refer to General Node																		
ERGONOMIC HAZARDS																				
H-25.01	Manual materials handling	Handling or spare parts during maintenance Refer to node 1																		
H-25.02	Damaging noise	N/A																		
H-25.03	Loud steady noise > 85dBA	Refer to General Node																		
H-25.04	Heat stress (high ambient temperatures)	Refer to General Node																		
H-25.05	Cold stress (low ambient temperatures)	Refer to General Node																		
H-25.06	High humidity	Refer to General Node																		
H-25.07	Vibration	N/A																		
H-25.08	Workstations	N/A																		
H-25.09	Lighting	Refer to General Node																		
H-25.10	Incompatible hand controls	Refer to General Node																		
H-25.11	Awkward location of work places and machinery	Refer to General Node																		
H-25.12	Mismatch of work to physical abilities	Refer to General Node																		
H-25.13	Mismatch of work to cognitive abilities	Refer to General Node																		
H-25.14	Long and irregular working hours/shifts	Refer to General Node																		
H-25.15	Poor organisation and job design	Refer to General Node																		
H-25.16	Work planning issues	Refer to General Node																		
H-25.17	Indoor climate (too hot/cold/dry/humid)	Refer to General Node																		
PSYCHOLOGICAL HAZARDS																				
H-26.01	Living on the job/away from family	Refer to General Node																		
H-26.02	Working and living on a live plant	Refer to General Node																		
H-26.03	Post-traumatic stress	Refer to General Node																		
SECURITY RELATED HAZARDS																				

ITEM NO.	HAZARD	THREAT	CONSEQUENCE	SAFEGUARDS	RISK RANKING												RECOMMENDATION	OWNER	PROJECT PHASE	COMMENTS
					People			Assets			Community			Environment						
					S	P	R	S	P	R	S	P	R	S	P	R				
H-27.01	Piracy, hijack, kidnap, terrorism	Refer to General Node																		
H-27.02	Assault	Refer to General Node																		
H-27.03	Sabotage	Refer to General Node																		
H-27.04	Crisis (military action, civil disturbances, terrorism)	Refer to General Node																		
H-27.05	Theft, pilferage	Refer to General Node																		
H-27.06	Personal welfare & 3rd party relations	Refer to General Node																		
USE OF NATURAL RESOURCES																				
H-28.01	Land	N/A																		
H-28.02	Water	N/A																		
H-28.03	Air under high pressure	N/A																		
H-28.04	Trees, vegetation	N/A																		
H-28.05	Gravel	N/A																		
MEDICAL																				
H-29.01	Medical unfitness	Refer to General Node																		
H-29.02	Motion sickness	Refer to General Node																		
NOISE																				
H-30.01	High level noise	N/A																		
H-30.02	Intrusive noise	N/A																		

ITEM NO.	HAZARD	THREAT	CONSEQUENCE	SAFEGUARDS	RISK RANKING												RECOMMENDATION	OWNER	PROJECT PHASE	COMMENTS
					People			Assets			Community			Environment						
					S	P	R	S	P	R	S	P	R	S	P	R				
HYDROCARBONS																				
H-01.01	Oil under pressure	N/A																		
H-01.02	Hydrocarbons in formation	N/A																		
H-01.03	LPGs (e.g. Propane)	N/A																		
H-01.04	LNGs	N/A																		
H-01.05	Condensate	N/A																		
H-01.06	Hydrocarbon gas	N/A																		
H-01.07	Oil at low pressures	N/A																		
H-01.08	Wax	N/A																		
H-01.09	Coal	N/A																		
REFINED HYDROCARBONS																				
H-02.01a	Lube and seal oil	Leakages from pumps	Potential injuries for personnel. Environmental hazards. Possible small localised oil mist/spill.	Spill tray for pumps.	3	B	3B							2	C	2C				
H-02.02	Hydraulic oil	No hydraulic valves																		
H-02.03	Diesel fuel	N/A																		
H-02.04	Aviation Fuel, Petrol	N/A																		
H-02.05	Hydrocarbons above auto-ignition temp	N/A																		
H-02.06	Asphalt	N/A																		
H-02.07	Bunker Fuel	N/A																		
H-02.08	Heat Transfer Fluid	N/A																		
H-02.09	Transformer Oil	Refer to General Node																		
OTHER FLAMMABLE MATERIALS																				
H-03.01	Cellulosic materials	N/A																		
H-03.02	Pyrophoric materials	N/A																		
H-03.03	Carbon-fibre-reinforced vegetation	N/A																		
H-03.04	Dry Vegetation	N/A																		
H-03.05a	Hydrogen	Leakage of Hydrogen into supporting systems	Refer to node 2																	
H-03.05b	Oxygen	N/A																		
H-03.06	Flammable gases in bottles	N/A																		
H-03.07	Hydrocarbon Vapours in pipe vents	N/A																		
EXPLOSIVES																				
H-04.01	Detonators	N/A																		
H-04.02	Conventional explosive material	N/A																		
H-04.03	Perforating gun charges	N/A																		
H-04.04	Explosive gases	N/A																		
PRESSURE																				
H-05.01a	Bottled gases under pressure	Potential dropped objects on nitrogen bottle	Potential for rupture causing missiles potentially leading to fatality	Bottles to be stored in secure area. Material handling philosophy. Lifting & Dropped object plan. Nitrogen distribution network to minimise handling of bottles.	4	B	4B	1	B	1B	2	B	2B				Establish requirements for nitrogen bottle on the platform. Update HER if required	Contractor		
H-05.01b	Bottled gases under pressure	Leak of Nitrogen bottle	Personal injury due to pressure release	Industry standard design	4	B	4B	2	B	2B							Refer to H-05.01a			

ITEM NO.	HAZARD	THREAT	CONSEQUENCE	SAFEGUARDS	RISK RANKING												RECOMMENDATION	OWNER	PROJECT PHASE	COMMENTS
					People			Assets			Community			Environment						
					S	P	R	S	P	R	S	P	R	S	P	R				
H-05.02a	Fluid under Pressure	Pumped desalinated/demineralized water. Potential leakage.	(Refer to Node 2)	Pipe layout philosophy to minimise leakages affecting operations.	4	B	4B	2	B	2B										
H-05.02b	Fluid under Pressure	Leakage from cooling medium (glycol water mixture) system within BESS, PCS or rectifier	(Refer to Node 1)	Pipe layout philosophy to minimise leakages affecting operations.																
H-05.03	Non-hydrocarbon gas under pressure in pipework	No issues identified.																		
H-05.04	Air under high pressure	No issues identified.																		
H-05.05	Hyperbaric operations	N/A																		
H-05.06	Decompression	N/A																		
H-05.07	Water under pressure	Refer to H-05.02																		
DIFFERENCES IN HEIGHT																				
H-06.01	People at height >1.8m	Refer to General Node																		
H-06.02	People at height <1.8m	Refer to General Node																		
H-06.03a	Overhead equipment	Refer to General Node																		
H-06.03b	Dropped objects	Refer to General Node																		
H-06.04	People under water	Refer to General Node																		
H-06.05	People below grade	Refer to General Node																		
OBJECTS UNDER INDUCED STRESS																				
H-07.01	Objects under tension	N/A																		
H-07.02	Objects under compression	N/A																		
H-07.03	Objects under variable/dynamic/cyclic loading	No issues identified.																		
DYNAMIC SITUATIONS HAZARDS																				
H-08.01	On-land transport (driving)	Refer to General Node																		
H-08.02	On-water transport (boating)	Refer to General Node																		
H-08.03	In-air transport (flying)	Refer to General Node																		
H-08.04	Boat collision hazard to other vessels and offshore structures	Refer to General Node																		
H-08.05	Marine Activity (diving)	Refer to General Node																		
H-08.06a	Equipment with moving or rotating parts	Refer to General Node																		
H-08.06b	Equipment with moving or rotating parts	Oxygen rich atmosphere (byproduct of Nitrogen generation or of electrolyzer) intake into instrument air compressor is considered a not credible scenario																		
H-08.07	Use of hazardous hand tools (grinding, sawing)	Refer to General Node																		
H-08.07	Use of knives, machetes and other sharp objects	Refer to General Node																		
H-08.08	Transfer from boat, Flotel to offshore platform	Refer to General Node																		

ITEM NO.	HAZARD	THREAT	CONSEQUENCE	SAFEGUARDS	RISK RANKING												RECOMMENDATION	OWNER	PROJECT PHASE	COMMENTS
					People			Assets			Community			Environment						
					S	P	R	S	P	R	S	P	R	S	P	R				
H-08.09	Ship-to-Ship Collison	Refer to General Node																		
H-08.10	Vessel quality	Refer to General Node																		
ENVIRONMENTAL HAZARDS																				
H-09.01a	Weather	Refer to General Node																		
H-09.01b	Weather	Refer to General Node																		
H-09.01c	Weather	Refer to General Node																		
H-09.02	Sea state / river currents	Refer to General Node																		
H-09.03	Tectonic	Refer to General Node																		
HOT SURFACES																				
H-10.01	Process piping and equipment between 60C and 150C	Hot surfaces on discharge of compressor.	Injury/ Burns to personnel	PPE	3	C	3C													
H-10.02	Process piping and equipment over 150C	N/A																		
H-10.03	Engine and turbine exhaust systems	N/A																		
H-10.04	Steam piping	N/A																		
HOT FLUID																				
H-11.01	Temperatures between 100C and 150C	N/A																		
H-11.02	Temperatures greater than 150C	N/A																		
COLD SURFACES																				
H-12.01	Process piping between -25C and -80C	Leakage from nitrogen bottles.	JT effect, cold burns	PPE Equipment located in secure location.	3	B	3B										Refer to H-05.01a			
H-12.02	Process piping less than -80C	N/A																		
H-12.03	Cold Surfaces	Refer to H-12.01																		
COLD FLUIDS																				
H-13.01	Oceans, seas and lakes less than 10C	N/A																		
H-13.02	Cryogenic Liquids	N/A																		
OPEN FLAMES																				
H-14.01	Heaters with fire tube	N/A																		
H-14.02	Direct-fired furnaces	N/A																		
H-14.03	Flares	N/A																		
ELECTRICITY																				
H-15.01	Voltage > 50V to 600V in cables	Refer to node 1																		
H-15-02	Voltage > 50V to 600V in equipment	Refer to node 1																		
H-15.03	Voltage >600V	Refer to node 1																		
H-15.04	DC Voltage	Refer to node 1																		
H-15.06	Electrostatic energy	Build up of electrostatic energy on PVC piping is not considered a credible scenario																		
ELECTROMAGNETIC RADIATION																				
H-16.01	Ultraviolet radiation	UV radiation from water filter	No significant consequence														Vendor to confirm that UV radiation is safe	Contractor		
H-16.02	Infrared radiation	N/A																		
H-16.03	Microwaves	N/A																		
H-16.04	Lasers	N/A																		
H-16.05	E/M radiation: high voltage AC cables	N/A																		
IONISING RADIATION - OPEN SOURCE																				

ITEM NO.	HAZARD	THREAT	CONSEQUENCE	SAFEGUARDS	RISK RANKING												RECOMMENDATION	OWNER	PROJECT PHASE	COMMENTS
					People			Assets			Community			Environment						
					S	P	R	S	P	R	S	P	R	S	P	R				
H-17.01	Alpha, beta, open source	N/A																		
H-17.02	Gamma rays, open source	N/A																		
H-17.03	Neutron, open source	N/A																		
H-17.04	Naturally occurring ionising radiation	N/A																		
H-17.05	X-rays	N/A																		
IONISING RADIATION - CLOSED SOURCE																				
H-18.01	Alpha, beta, closed source	N/A																		
H-18.02	Gamma rays, closed source	N/A																		
H-18.03	Neutron, closed source	N/A																		
ASPHYXIATES																				
H-19.01	Low oxygen atmospheres	Refer to H-19.04																		
H-19.02	Excessive CO2	N/A																		
H-19.03	Drowning	N/A																		
H-19.04	Excessive N2	Leakage of nitrogen from the nitrogen generation system (outdoor system)	No significant consequence as the release is outdoor																	
H-19.05	Halon	N/A																		
H-19.06	Smoke	Refer to Node 1			3	B	3B	3	B	3B	2	B	2B	1	B	1B				
H-19.07	SF6 (Sulphur Hexafluoride)	N/A																		
TOXIC GAS																				
H-20.02	Exhaust fumes	N/A																		
H-20.03	SO2	N/A																		
H-20.04	Benzene	N/A																		
H-20.05a	Chlorine	Handling of sodium hypochlorite used as biocide	Exposure of personnel to *chlorine*	Operating procedures	2	B	2B							1	B	1B				
H-20.05b	Chlorine	Production of hydrogen from the electrolysis process	Production of hydrogen leading to formation of explosive atmosphere														Verify with Vendor the amount of hydrogen produced by electroclorination package. Update the risk ranking and HER based on the outcome of this verification	Contractor		Dosing conducted at low sodium hypochlorite concentrations (less than 1% chlorine (quantities of hydrogen generated are small) (no stored quantities of sodium hypochlorite)
H-20.06	Welding fumes	N/A																		
H-20.07	Tobacco smoke	N/A																		
H-20.08	CFCs	N/A																		
H-20.09	CO	N/A																		
H-20.10	HF	N/A																		
TOXIC LIQUID																				
H-21.01	Mercury	N/A																		
H-21.02	PCBs	N/A																		
H-21.03	Biocides	Refer to H20.05 (Chlorine)																		
H-21.04	Methanol	N/A																		
H-21.05	Brines	Refer to General Node																		
H-21.06	Glycols	N/A																		
H-21.07	Degreasers	N/A																		
H-21.08	Isocyanates	N/A																		
H-21.09	Sulphanol	N/A																		
H-21.10	Amines	N/A																		
H-21.11	Corrosion inhibitors	N/A																		

ITEM NO.	HAZARD	THREAT	CONSEQUENCE	SAFEGUARDS	RISK RANKING												RECOMMENDATION	OWNER	PROJECT PHASE	COMMENTS
					People			Assets			Community			Environment						
					S	P	R	S	P	R	S	P	R	S	P	R				
H-21.12	Scale inhibitors	Leakage from stored chemicals *(e.g. nitric acid / acetic acid etc)*	Potential Environmental consequence and personnel injury	Bund's provided where required to contain leakages from storage tanks. Chemical selection to minimise environmental impact.	2	B	2B							1	B	1B	Clarify type of chemical used as scale inhibitor and update HER afterwards, if required	Contractor		
H-21.13	Liquid mud additives	N/A																		
H-21.14	Odorant additives	N/A																		
H-21.15	Alcoholic beverages	N/A																		
H-21.16	Recreational drugs	N/A																		
H-21.17	Used engine oils	N/A																		
H-21.18	Carbon tetrachloride	N/A																		
H-21.19	Grey and/or black water	N/A																		
H-21.20	Paint, Solvents and General Chemicals	N/A																		
H-21.21	Shell Therma B Oil	N/A																		
TOXIC SOLID																				
H-22.01	Asbestos	N/A																		
H-22.02	Man-made mineral fibre	N/A																		
H-22.03	Cement dust	N/A																		
H-22.04	Sodium hypochlorite	Refer to H-20.05																		
H-22.05	Powered mud additives	N/A																		
H-22.06	Sulphur dust	N/A																		
H-22.07	Pig trash	N/A																		
H-22.08	Oil-based muds	N/A																		
H-22.09	Pseudo-oil based muds	N/A																		
H-22.10	Water-based muds	N/A																		
H-22.11	Cement slurries	N/A																		
H-22.12	Dusts	N/A																		
H-22.13	Cadmium compounds and other heavy metals	N/A																		
H-22.14	Oil based sludges	N/A																		
H-22.15	Chemicals for Cleaning RO Membrane	Leak of Various chemicals *(sodium hydroxide, nitric acid, sodium hypochlorite)*	Personnel injury.	Chemical Selection to reduce impact on personnel. PPE. ERP	2	B	2B							1	B	1B	Clarify type of chemical used for cleaning RO membrane and update the HER	Contractor		
H-22.16	Dechlorination Chemicals	Leak of Sodium Bisulfite	Personnel injury/ adverse marine impact *(serious irritant for eye)*	Chemical Selection to reduce marine impact. PPE. ERP	2	B	2B							1	B	1B				
CORROSIVE SUBSTANCES																				
H-23.01	Hydrofluoric acid	N/A																		
H-23-02	Hydrochloric acid	N/A																		
H-23.03	Sulphuric acid	Refer to H-22.15																		
H-23.04	Caustic soda (sodium hydroxide)	Refer to H-22.15																		
H-23.05	Battery Acids	N/A																		
BIOLOGICAL HAZARDS																				
H-24.01	Poisonous plants	Refer to General Node																		
H-24.02	Large animals	Refer to General Node																		
H-24.03	Small animals	Marine growth or small marine faune	Blockage of sea water intake systems. Impact to process. Potential for fish decomposing and health effect to personnel *(scenario not ranked as not sufficient information are available)*	Sea water filtration & chemical dosing systems. Screen on the suction side of pumps Backwash filter cleaning													Verify with Sea Water Tratment System Vendor if it is possible to have fish trapped and decomposing in the package	Contractor		

ITEM NO.	HAZARD	THREAT	CONSEQUENCE	SAFEGUARDS	RISK RANKING												RECOMMENDATION	OWNER	PROJECT PHASE	COMMENTS
					People			Assets			Community			Environment						
					S	P	R	S	P	R	S	P	R	S	P	R				
H-24.04	Food-borne bacteria (e.g. E.coli)	Refer to General Node																		
H-24.05	Water-borne bacteria (e.g. legionella)	Refer to General Node																		
H-24.06	Viral & Bacterial pathogens	Refer to General Node																		
H-24.07	Disease-transmitting insects	Refer to General Node																		
H-24.08	Respiratory disease infections	Refer to General Node																		
H-24.09	Blood-borne/sexually transmitted diseases	Refer to General Node																		
H-24.10	Latent disease or health problems	Refer to General Node																		
H-24.11	Other infections	Refer to General Node																		
ERGONOMIC HAZARDS																				
H-25.01	Manual materials handling	N/A																		
H-25.02	Damaging noise	N/A																		
H-25.03	Loud steady noise > 85dBA	Refer to General Node																		
H-25.04	Heat stress (high ambient temperatures)	Refer to General Node																		
H-25.05	Cold stress (low ambient temperatures)	Refer to General Node																		
H-25.06	High humidity	Refer to General Node																		
H-25.07	Vibration	N/A																		
H-25.08	Workstations	N/A																		
H-25.09	Lighting	Refer to General Node																		
H-25.10	Incompatible hand controls	Refer to General Node																		
H-25.11	Awkward location of work places and machinery	Refer to General Node																		
H-25.12	Mismatch of work to physical abilities	Refer to General Node																		
H-25.13	Mismatch of work to cognitive abilities	Refer to General Node																		
H-25.14	Long and irregular working hours/shifts	Refer to General Node																		
H-25.15	Poor organisation and job design	Refer to General Node																		
H-25.16	Work planning issues	Refer to General Node																		
H-25.17	Indoor climate (too hot/cold/dry/humid)	Refer to General Node																		
PSYCHOLOGICAL HAZARDS																				
H-26.01	Living on the job/away from family	Refer to General Node																		
H-26.02	Working and living on a live plant	Refer to General Node																		
H-26.03	Post-traumatic stress	Refer to General Node																		
SECURITY RELATED HAZARDS																				
H-27.01	Piracy, hijack, kidnap, terrorism	Refer to General Node																		
H-27.02	Assault	Refer to General Node																		
H-27.03	Sabotage	Refer to General Node																		
H-27.04	Crisis (military action, civil disturbances, terrorism)	Refer to General Node																		
H-27.05	Theft, pilferage	Refer to General Node																		
H-27.06	Personal welfare & 3rd party relations	Refer to General Node																		
USE OF NATURAL RESOURCES																				
H-28.01	Land	N/A																		
H-28.02	Water	Use of sea water-not considered as an issues																		

ITEM NO.	HAZARD	THREAT	CONSEQUENCE	SAFEGUARDS	RISK RANKING												RECOMMENDATION	OWNER	PROJECT PHASE	COMMENTS
					People			Assets			Community			Environment						
					S	P	R	S	P	R	S	P	R	S	P	R				
H-28.03	Air under high pressure	N/A																		
H-28.04	Trees, vegetation	N/A																		
H-28.05	Gravel	N/A																		
MEDICAL																				
H-29.01	Medical unfitness	Refer to General Node																		
H-29.02	Motion sickness	Refer to General Node																		
NOISE																				
H-30.01	High level noise	N/A																		
H-30.02	Intrusive noise	N/A																		

ITEM NO.	HAZARD	THREAT	CONSEQUENCE	SAFEGUARDS	RISK RANKING												RECOMMENDATION	OWNER	PROJECT PHASE	COMMENTS
					People			Assets			Community			Environment						
					S	P	R	S	P	R	S	P	R	S	P	R				
H-01.01	Oil under pressure	N/A																		
H-01.02	Hydrocarbons in formation	N/A																		
H-01.03	LPGs (e.g. Propane)	N/A																		
H-01.04	LNGs	N/A																		
H-01.05	Condensate	N/A																		
H-01.06	Hydrocarbon gas	N/A																		
H-01.07	Oil at low pressures	N/A																		
H-01.08	Wax	N/A																		
H-01.09	Coal	N/A																		
REFINED HYDROCARBONS																				
H-02.01	Lube and seal oil	N/A																		
H-02.02	Hydraulic oil	No hydraulic valves																		
H-02.03	Diesel fuel	N/A																		
H-02.04	Aviation Fuel, Petrol	N/A																		
H-02.05	Hydrocarbons above auto-ignition temp	N/A																		
H-02.06	Asphalt	N/A																		
H-02.07	Bunker Fuel	N/A																		
H-02.08	Hydrogen into Heat Transfer Fluid	N/A																		
H-02.09	Transformer Oil	Potential of Leakage	Environmental impact											2	C	2C				
OTHER FLAMMABLE MATERIALS																				
H-03.01	Cellulosic materials	N/A																		
H-03.02	Pyrophoric materials	N/A																		
H-03.03	Carbon-fibre-reinforced vegetation	N/A																		
H-03.04	Dry Vegetation	N/A																		
H-03.05a	Hydrogen	N/A																		
H-03.05b	Hydrogen	N/A																		
H-03.05b	Hydrogen	N/A																		
H-03.05c	Oxygen	N/A																		
H-03.06	Flammable gases in bottles	N/A																		
H-03.07	Hydrocarbon Vapours in pipe vents	N/A																		
EXPLOSIVES																				
H-04.01	Detonators	N/A																		
H-04.02	Conventional explosive material	N/A																		
H-04.03	Perforating gun charges	N/A																		
H-04.04	Explosive gases	Refer to H-03.05																		
PRESSURE																				
H-05.01	Bottled gases under pressure	N/A																		
H-05.02	Fluid under Pressure	N/A																		
H-05.03	Non-hydrocarbon gas under pressure in pipework	N/A																		
H-05.04	Air under high pressure	N/A																		
H-05.05	Hyperbaric operations	N/A																		
H-05.06	Decompression	N/A																		
H-05.07	Water under pressure	N/A																		

ITEM NO.	HAZARD	THREAT	CONSEQUENCE	SAFEGUARDS	RISK RANKING												RECOMMENDATION	OWNER	PROJECT PHASE	COMMENTS
					People			Assets			Community			Environment						
					S	P	R	S	P	R	S	P	R	S	P	R				
DIFFERENCES IN HEIGHT																				
H-06.01	People at height >1.8m	Potential falls from height	Fatality	Procedures for working at height HSE Management System	4	C	4C													
H-06.02	People at height <1.8m	Refer to H-06.01																		
H-06.03a	Overhead equipment	Failing light structures	Injury to personnel	PPE Offshore wind guidance for equipment at height	4	B	4B													
H-06.03b	Dropped objects	Maintenance activity (transfer of equipment between boat & platform)	Potential damage to high voltage cable on seabed or personnel injury in the platform	Dropped object study	4	B	4B	3	C	3C	2	C	2C							
H-06.03c	Dropped objects	Dropped objects from monorail/lifting point	Potential damage to asset Personal Injury	Material handling study HFE study	4	B	4B	2	C	2C										
H-06.04	People under water	N/A																		
H-06.05	People below grade	N/A																		
OBJECTS UNDER INDUCED STRESS																				
H-07.01	Objects under tension	N/A																		
H-07.02	Objects under compression	N/A																		
H-07.03	Objects under variable/dynamic/cyclic loading	N/A																		
DYNAMIC SITUATIONS HAZARDS																				
H-08.01	On-land transport (driving)	N/A																		
H-08.02	On-water transport (boating)	N/A																		
H-08.03	In-air transport (flying)	N/A																		
H-08.04	Boat collision hazard to other vessels and offshore structures	Boats in vicinity Crewboat approaching the platform	Collision with asset or nearby vessel. Loss of stability. Potential Fatalities.	Navigation aids. Procedures developed by crosswind. Exclusion zone Ship collision study	4	C	4C	4	B	4B	2	C	2C	1	C	1C				Risk ranked on actual incidents within Crosswind and Shell asset
H-08.05	Marine Activity (diving)	N/A																		
H-08.06	Equipment with moving or rotating parts	Finfan cooler. Air/Nitrogen compressor Pumps	Potential injury to personnel	Mechanical guards for rotating parts.	4	B	4B													
H-08.07	Use of hazardous hand tools (grinding, sawing)	N/A																		
H-08.07	Use of knives, machetes and other sharp objects	N/A																		
H-08.08	Transfer from boat, Flotel to offshore platform	Transfer of personnel from boat to asset. *(made worse by fog)*	Personnel injury/ fatality.	Procedures in place for transfer of personnel onto asset.	3	C	3C													
H-08.09	Ship-to-Ship Collison	N/A																		
H-08.10	Vessel quality	N/A																		
ENVIRONMENTAL HAZARDS																				
H-09.01a	Weather	Lightning	Potential Explosion, Fire. *(escalation event only - not risk ranked)*	Earthed system with lightning protection.																
H-09.01b	Weather	Salty conditions	Increased rate of corrosion. Leakage. *(Escalation - not risk ranked, refer to hydrogen release)*	Material selection. Containers provided where required. Appropriate equipment specification.																
H-09.01c	Weather	Cold ambient conditions	Potential freezing. Loss of containment. *(refer to hydrogen release for risk ranking)*	Winterisation Philosophy																
H-09.02	Sea state / river currents	Refer to H-08.08																		
H-09.03	Tectonic	N/A																		
HOT SURFACES																				
H-10.01	Process piping and equipment between 60C and 150C	N/A																		

ITEM NO.	HAZARD	THREAT	CONSEQUENCE	SAFEGUARDS	RISK RANKING												RECOMMENDATION	OWNER	PROJECT PHASE	COMMENTS
					People			Assets			Community			Environment						
					S	P	R	S	P	R	S	P	R	S	P	R				
H-10.02	Process piping and equipment over 150C	N/A																		
H-10.03	Engine and turbine exhaust systems	N/A																		
H-10.04	Steam piping	N/A																		
HOT FLUID																				
H-11.01	Temperatures between 100C and 150C	N/A																		
H-11.02	Temperatures greater than 150C	N/A																		
COLD SURFACES																				
H-12.01	Process piping between -25C and -80C	N/A																		
H-12.02	Process piping less than -80C	N/A																		
H-12.03	Cold Surfaces	N/A																		
COLD FLUIDS																				
H-13.01	Oceans, seas and lakes less than 10C	N/A																		
H-13.02	Cryogenic Liquids	N/A																		
OPEN FLAMES																				
H-14.01	Heaters with fire tube	N/A																		
H-14.02	Direct-fired furnaces	N/A																		
H-14.03	Flares	N/A																		
ELECTRICITY																				
H-15.01	Voltage > 50V to 600V in cables	N/A																		
H-15-02	Voltage > 50V to 600V in equipment	N/A																		
H-15.03	Voltage >600V	N/A																		
H-15.04	DC Voltage	N/A																		
H-15.05	Lightning discharge	Refer to H-09.01																		
H-15.06	Electrostatic energy	N/A																		
ELECTROMAGNETIC RADIATION																				
H-16.01	Ultraviolet radiation	N/A																		
H-16.02	Infrared radiation	N/A																		
H-16.03	Microwaves	N/A																		
H-16.04	Lasers	N/A																		
H-16.05	E/M radiation: high voltage AC cables	N/A																		
IONISING RADIATION - OPEN SOURCE																				
H-17.01	Alpha, beta, open source	N/A																		
H-17.02	Gamma rays, open source	N/A																		
H-17.03	Neutron, open source	N/A																		
H-17.04	Naturally occurring ionising radiation	N/A																		
H-17.05	X-rays	N/A																		
IONISING RADIATION - CLOSED SOURCE																				
H-18.01	Alpha, beta, closed source	N/A																		
H-18.02	Gamma rays, closed source	N/A																		
H-18.03	Neutron, closed source	N/A																		
ASPHYXIATES																				
H-19.01	Low oxygen atmospheres	N/A																		
H-19.02	Excessive CO2	N/A																		
H-19.03	Drowning	N/A																		
H-19.04	Excessive N2	N/A																		
H-19.05	Halon	N/A																		
H-19.06	Smoke	N/A																		
H-19.07	SF6 (Sulphur Hexafluoride)	N/A																		

ITEM NO.	HAZARD	THREAT	CONSEQUENCE	SAFEGUARDS	RISK RANKING												RECOMMENDATION	OWNER	PROJECT PHASE	COMMENTS
					People			Assets			Community			Environment						
					S	P	R	S	P	R	S	P	R	S	P	R				
TOXIC GAS																				
H-20.02	Exhaust fumes	N/A																		
H-20.03	SO2	N/A																		
H-20.04	Benzene	N/A																		
H-20.05	Chlorine	N/A																		
H-20.06	Welding fumes	N/A																		
H-20.07	Tobacco smoke	N/A																		
H-20.08	CFCs	N/A																		
TOXIC LIQUID																				
H-21.01	Mercury	N/A																		
H-21.02	PCBs	N/A																		
H-21.03	Biocides	N/A																		
H-21.04	Methanol	N/A																		
H-21.05	Brines	Discharge of brine from process	Impact to marine life	Brine concentration within regulatory limits										1	B	1B				
H-21.06	Glycols (MEG)	N/A																		
H-21.07	Degreasers	N/A																		
H-21.08	Isocyanates	N/A																		
H-21.09	Sulphanol	N/A																		
H-21.10	Amines	N/A																		
H-21.11	Corrosion inhibitors	N/A																		
H-21.12	Scale inhibitors	N/A																		
H-21.13	Liquid mud additives	N/A																		
H-21.14	Odorant additives	N/A																		
H-21.15	Alcoholic beverages	N/A																		
H-21.16	Recreational drugs	N/A																		
H-21.17	Used engine oils	N/A																		
H-21.18	Carbon tetrachloride	N/A																		
H-21.19	Grey and/or black water	N/A																		
H-21.20	Paint, Solvents and General Chemicals	N/A																		
H-21.21	Shell Therma B Oil	N/A																		
TOXIC SOLID																				
H-22.02	Man-made mineral fibre	N/A																		
H-22.03	Cement dust	N/A																		
H-22.04	Sodium hypochlorite	N/A																		
H-22.05	Powered mud additives	N/A																		
H-22.06	Sulphur dust	N/A																		
H-22.07	Pig trash	N/A																		
H-22.08	Oil-based muds	N/A																		
H-22.09	Pseudo-oil based muds	N/A																		
H-22.10	Water-based muds	N/A																		
H-22.11	Cement slurries	N/A																		
H-22.12	Dusts	N/A																		
H-22.13	Cadmium compounds and other heavy metals	N/A																		
H-22.14	Oil based sludges	N/A																		
CORROSIVE SUBSTANCES																				
H-23.01	Hydrofluoric acid	N/A																		
H-23-02	Hydrochloric acid	N/A																		
H-23.03	Sulphuric acid	N/A																		
H-23.04	Caustic soda (sodium hydroxide)	N/A																		
H-23.05	Battery Acids	N/A																		
BIOLOGICAL HAZARDS																				
H-24.01	Poisonous plants	N/A																		
H-24.02	Large animals	N/A																		

ITEM NO.	HAZARD	THREAT	CONSEQUENCE	SAFEGUARDS	RISK RANKING												RECOMMENDATION	OWNER	PROJECT PHASE	COMMENTS
					People			Assets			Community			Environment						
					S	P	R	S	P	R	S	P	R	S	P	R				
H-24.03	Small animals	Bird droppings	Slippery surfaces - potential for injury		3	C	3C													
	Small animals	Bird droppings	Exposure of personnel to biohazard during cleaning (platform is unmanned for 6 months, it requires cleaning when maintenance is done)		1	C	1C													
H-24.04	Food-borne bacteria (e.g. E.coli)	N/A																		
H-24.05	Water-borne bacteria (e.g. legionella)	N/A																		
H-24.06	Viral & Bacterial pathogens	N/A																		
H-24.07	Disease-transmitting insects	N/A																		
H-24.08	Respiratory disease infections	N/A																		
H-24.09	Blood-borne/sexually transmitted diseases	N/A																		
H-24.10	Latent disease or health problems	N/A																		
H-24.11	Other infections	N/A																		
ERGONOMIC HAZARDS																				
H-25.01	Manual materials handling	N/A																		
H-25.02	Damaging noise	N/A																		
H-25.03	Loud steady noise > 85dBA	Rotating machinery	Hearing impairment to operators	Field noise study PPE	2	C	2C													
H-25.04	Heat stress (high ambient temperatures)	N/A																		
H-25.05	Cold stress (low ambient temperatures)	N/A																		
H-25.06	High humidity	N/A																		
H-25.07	Vibration	N/A																		
H-25.08	Workstations	N/A																		
H-25.09	Lighting	Insufficient lighting	Access for maintenance may be restricted if at high level. Excessive maintenance times. Potential for injury	Minimum design requirements	2	C	2C													
H-25.10	Incompatible hand controls	N/A																		
H-25.11	Awkward location of work places and machinery	N/A																		
H-25.12	Mismatch of work to physical abilities	N/A																		
H-25.13	Mismatch of work to cognitive abilities	N/A																		
H-25.14	Long and irregular working hours/shifts	N/A																		
H-25.15	Poor organisation and job design	N/A																		
H-25.16	Work planning issues	N/A																		
H-25.17	Indoor climate (too hot/cold/dry/humid)	N/A																		
PSYCHOLOGICAL HAZARDS																				
H-26.01	Living on the job/away from family	N/A																		
H-26.02	Working and living on a live plant	N/A																		
H-26.03	Post-traumatic stress	N/A																		
SECURITY RELATED HAZARDS																				

ITEM NO.	HAZARD	THREAT	CONSEQUENCE	SAFEGUARDS	RISK RANKING												RECOMMENDATION	OWNER	PROJECT PHASE	COMMENTS
					People			Assets			Community			Environment						
					S	P	R	S	P	R	S	P	R	S	P	R				
H-27.01a	Piracy, hijack, kidnap, terrorism	Unauthorised access	Damage to facility	Surveilance by marine operation HVAC room and electrical room are locked				4	B	4B	2	B	2B				Consider to provide physical barrier on the stair	Contractor		
H-27.01b	Cybersecurity	Unauthorised access to control system or similar	Damage to facility. Potential danger and personal injury (For risk ranking, refer to Crosswind cybersecurity risk assessment)	Cybersecurity risk assessement																
H-27.02	Assault	N/A																		
H-27.03	Sabotage	Refer to H-27.01																		
H-27.04	Crisis (military action, civil disturbances, terrorism)	N/A																		
H-27.05	Theft, pilferage	Refer to H-27.01a																		
H-27.06	Personal welfare & 3rd party relations	N/A																		
USE OF NATURAL RESOURCES																				
H-28.01	Land	N/A																		
H-28.02	Water	N/A																		
H-28.03	Air under high pressure	N/A																		
H-28.04	Trees, vegetation	N/A																		
H-28.05	Gravel	N/A																		
MEDICAL																				
H-29.01	Medical unfitness	N/A																		
H-29.02	Motion sickness	Crew journey by boat	Motion sickness and potential for mistakes		1	D	1D													
NOISE																				
H-30.01	High level noise	N/A																		
H-30.02	Intrusive noise	N/A																		

ATTACHMENT 4 - ACTION SHEETS

CROSSWIND ROSETTI MARINO

HOLLANDSE KUST NOORD WIND PARK Project

Base Load Power Hub (BLPH)

Action N : 01	**Rev.:** 001
Action Title: HAZID Study	**Date:** 05/10/2023
Reference Document n:	
Node: 1-Electrical System	
Hazard/Parameter: Hydrogen	**Deviation**
Cause: Leakage of Hydrogen from PEM	
Consequence: Potential of Explosion. Jet fire & impingement to adjacent equipment. Escalation. Invisible flames. Potential for personal injuries if people are on the platform. Asset damage	
Safeguards: Fire & gas detection & Emergency Shutdown. Material selection report. Minimisation of Leak Sources.	
Recommendation: FERA to be updated in detail design to include scenarios and protections from the electrolyzer and fuel cell package	
Responsible Part: Contractor & Company	
Response:	

Ref. Docs / Dwgs.:

123A90-DDL-EL-DG-20015; 123A90-DDL-PP-DS-70070;123A90-DDL-PR-DG-80003; 123A90-DDL-PR-DG-80004;123A90-DDL-PR-DG-80005;123A90-DDL-PR-DG-80006; 123A90-DDL-PR-DG-80007; 123A90-DDL-PR-DG-80008

RESPONSE ACCEPTANCE

Discipline Leader:	**Signature:**	**Date:**
HSE Leader:	**Signature:**	**Date:**
Project Manager:	**Signature:**	**Date:**
Company:	**Signature:**	**Date:**

CROSSWIND ROSETTI MARINO

HOLLANDSE KUST NOORD WIND PARK Project

Base Load Power Hub (BLPH)

Action N : 02	**Rev.:** 001
Action Title: HAZID Study	**Date:** 05/10/2023

Reference Document n:

Node: 1-Electrical System

Hazard/Parameter: Low oxygen atmospheres	**Deviation**

Cause: Potential operations of firefighting system within instrument cabinet or BESS

Consequence: Asphyxiation of personnel.

Safeguards: Operation & Maintenance (O&M) Procedure. Manual selector to inhibit release when people are inside. Inergen is not considered asphyxiant based on concentration

Recommendation: Verify with the BESS supplier the type of fire suppression system and update HER if required

Responsible Part: Company

Response:

Ref. Docs / Dwgs.:

123A90-DDL-EL-DG-20015; 123A90-DDL-PP-DS-70070;123A90-DDL-PR-DG-80003;123A90-DDL-PR-DG-80004;123A90-DDL-PR-DG-80005;123A90-DDL-PR-DG-80006;123A90-DDL-PR-DG-80007;123A90-DDL-PR-DG-80008

RESPONSE ACCEPTANCE

Discipline Leader:	**Signature:**	**Date:**
HSE Leader:	**Signature:**	**Date:**
Project Manager:	**Signature:**	**Date:**
Company:	**Signature:**	**Date:**

CROSSWIND ROSETTI MARINO

HOLLANDSE KUST NOORD WIND PARK Project

Base Load Power Hub (BLPH)

Action N : 03	**Rev.:** 001
Action Title: HAZID Study	**Date:** 05/10/2023
Reference Document n:	
Node: 1-Electrical System	
Hazard/Parameter: Cadmium compounds and other heavy metals	**Deviation**
Cause: Leakage from UPS	
Consequence: Potential for personnel injury if exposed	
Safeguards: Operation & Maintenance (O&M) Procedure. Manual selector to inhibit release when people are inside. Inergen is not considered asphyxiant based on concentration	
Recommendation: Check the risk ranking based on Company Health SME and update the HER if required	
Responsible Part: Company	
Response:	

Ref. Docs / Dwgs.:

123A90-DDL-EL-DG-20015; 123A90-DDL-PP-DS-70070;123A90-DDL-PR-DG-80003;123A90-DDL-PR-DG-80004;123A90-DDL-PR-DG-80005;123A90-DDL-PR-DG-80006;123A90-DDL-PR-DG-80007;123A90-DDL-PR-DG-80008

RESPONSE ACCEPTANCE

Discipline Leader:	**Signature:**	**Date:**
HSE Leader:	**Signature:**	**Date:**
Project Manager:	**Signature:**	**Date:**
Company:	**Signature:**	**Date:**

CROSSWIND ROSETTI MARINO

HOLLANDSE KUST NOORD WIND PARK Project

Base Load Power Hub (BLPH)

Action N : 04	**Rev.:** 001
Action Title: HAZID Study	**Date:** 05/10/2023

Reference Document n:

Node: 1-Electrical System

Hazard/Parameter: Cadmium compounds and other heavy metals	**Deviation**

Cause: Leakage from UPS

Consequence: Potential for personnel injury if exposed

Safeguards: Operation & Maintenance (O&M) Procedure. Manual selector to inhibit release when people are inside. Inergen is not considered asphyxiant based on concentration

Recommendation: Evaluate the possibility to use portable eye wash and shower

Responsible Part: Contractor

Response:

Ref. Docs / Dwgs.:

123A90-DDL-EL-DG-20015; 123A90-DDL-PP-DS-70070;123A90-DDL-PR-DG-80003;123A90-DDL-PR-DG-80004;123A90-DDL-PR-DG-80005;123A90-DDL-PR-DG-80006;123A90-DDL-PR-DG-80007;123A90-DDL-PR-DG-80008

RESPONSE ACCEPTANCE

Discipline Leader:	**Signature:**	**Date:**
HSE Leader:	**Signature:**	**Date:**
Project Manager:	**Signature:**	**Date:**
Company:	**Signature:**	**Date:**

CROSSWIND ROSETTI MARINO

HOLLANDSE KUST NOORD WIND PARK Project

Base Load Power Hub (BLPH)

Action N : 5	**Rev.:** 001
Action Title: HAZID Study	**Date:** 05/10/2023

Reference Document n:

Node:2-Hydrogen System

Hazard/Parameter: Hydrogen	**Deviation**

Cause: Leakage from Hydrogen system.

Consequence: Potential of Explosion.

Jet fire & impingement to adjacent vessel.

Escalation.

Invisible flames.

Safeguards: Fire & gas detection.Hydrogen Storage vessels segregated based on Leak Size Analysis -Technical Note (K559-2254-SE-TEN-001 Rev 0).Material selection.Emergency Shutdown.Fire Protection.Minimisation of Leak Sources.

Recommendation: Develop a bow-tie for hydrogen hazard

Responsible Part: Contractor & Company

Response:

Ref. Docs / Dwgs.:

123A90-DDL-PP-DS-70070;123A90-DDL-PR-DG-80003;123A90-DDL-PR-DG-80004;123A90-DDL-PR-DG-80005;123A90-DDL-PR-DG-80006;123A90-DDL-PR-DG-80007;123A90-DDL-PR-DG-80008

RESPONSE ACCEPTANCE

Discipline Leader:	**Signature:**	**Date:**
HSE Leader:	**Signature:**	**Date:**
Project Manager:	**Signature:**	**Date:**
Company:	**Signature:**	**Date:**

CROSSWIND ROSETTI MARINO

HOLLANDSE KUST NOORD WIND PARK Project

Base Load Power Hub (BLPH)

Action N : 6	**Rev.:** 001
Action Title: HAZID Study	**Date:** 05/10/2023

Reference Document n:

Node:2-Hydrogen System

Hazard/Parameter: Hydrogen	**Deviation**

Cause: Venting of hydrogen when flying object is operating in the wind farm

Consequence: Potential ignition of the vent

Increased turbolence and potential for flying object crash

(Risk not ranked because it is a Crosswind general hazard instead of a BLPH specific one)

Safeguards: Vent dispersion and radiation study (to indicate the area affected by dispersion of fire)

Recommendation: Ensure a no-fly zone is established around the facilities if required

Responsible Part: Company

Response:

Ref. Docs / Dwgs.:

123A90-DDL-PP-DS-70070;123A90-DDL-PR-DG-80003;123A90-DDL-PR-DG-80004;123A90-DDL-PR-DG-80005;123A90-DDL-PR-DG-80006;123A90-DDL-PR-DG-80007;123A90-DDL-PR-DG-80008

RESPONSE ACCEPTANCE

Discipline Leader:	**Signature:**	**Date:**
HSE Leader:	**Signature:**	**Date:**
Project Manager:	**Signature:**	**Date:**
Company:	**Signature:**	**Date:**

CROSSWIND ROSETTI MARINO

HOLLANDSE KUST NOORD WIND PARK Project

Base Load Power Hub (BLPH)

Action N : 7	**Rev.:** 001
Action Title: HAZID Study	**Date:** 05/10/2023

Reference Document n:

Node:2-Hydrogen System

Hazard/Parameter: Excessive N2	**Deviation**

Cause: Leakage of nitrogen within electrolyzer container

Consequence: Fatality

Safeguards:
Forced ventilation inside container
Operating and maintenance procedure

Recommendation: Verify that electrolyzer container is not considered a confined space

Responsible Part: Company

Response:

Ref. Docs / Dwgs.:
123A90-DDL-PP-DS-70070;123A90-DDL-PR-DG-80003;123A90-DDL-PR-DG-80004;123A90-DDL-PR-DG-80005;123A90-DDL-PR-DG-80006;123A90-DDL-PR-DG-80007;123A90-DDL-PR-DG-80008

RESPONSE ACCEPTANCE

Discipline Leader:	**Signature:**	**Date:**
HSE Leader:	**Signature:**	**Date:**
Project Manager:	**Signature:**	**Date:**
Company:	**Signature:**	**Date:**

CROSSWIND ROSETTI MARINO

HOLLANDSE KUST NOORD WIND PARK Project

Base Load Power Hub (BLPH)

Action N : 8	**Rev.:** 001
Action Title: HAZID Study	**Date:** 05/10/2023

Reference Document n:

Node:3- Water&Utilities

Hazard/Parameter: Bottled gases under pressure	**Deviation**

Cause: Potential dropped objects on nitrogen bottle

Consequence: Potential for rupture causing missiles potentially leading to fatality

Safeguards: Bottles to be stored in secure area.
Material handling philosophy.
Lifting & Dropped object plan.
Nitrogen distribution network to minimise handling of bottles.

Recommendation:
Establish requirements for nitrogen bottle on the platform.
Update HER if required

Responsible Part: Contractor

Response:

Ref. Docs / Dwgs.:
123A90-DDL-PP-DS-70070;123A90-DDL-PR-DG-80003;123A90-DDL-PR-DG-80004;123A90-DDL-PR-DG-80005;123A90-DDL-PR-DG-80006;123A90-DDL-PR-DG-80007;123A90-DDL-PR-DG-80008

RESPONSE ACCEPTANCE

Discipline Leader:	**Signature:**	**Date:**
HSE Leader:	**Signature:**	**Date:**
Project Manager:	**Signature:**	**Date:**
Company:	**Signature:**	**Date:**

CROSSWIND ROSETTI MARINO

HOLLANDSE KUST NOORD WIND PARK Project

Base Load Power Hub (BLPH)

Action N : 9	**Rev.:** 001
Action Title: HAZID Study	**Date:** 05/10/2023
Reference Document n:	
Node:3- Water&Utilities	
Hazard/Parameter: Ultraviolet radiation	**Deviation**
Cause: UV radiation from water filter	
Consequence: No significant consequence	
Safeguards:	
Recommendation: Vendor to confirm that UV radiation is safe	
Responsible Part: Contractor	
Response:	

Ref. Docs / Dwgs.:
123A90-DDL-PP-DS-70070;123A90-DDL-PR-DG-80003;123A90-DDL-PR-DG-80004;123A90-DDL-PR-DG-80005;123A90-DDL-PR-DG-80006;123A90-DDL-PR-DG-80007;123A90-DDL-PR-DG-80008

RESPONSE ACCEPTANCE

Discipline Leader:	**Signature:**	**Date:**
HSE Leader:	**Signature:**	**Date:**
Project Manager:	**Signature:**	**Date:**
Company:	**Signature:**	**Date:**

CROSSWIND ROSETTI MARINO

HOLLANDSE KUST NOORD WIND PARK Project

Base Load Power Hub (BLPH)

Action N : 10	**Rev.:** 001
Action Title: HAZID Study	**Date:** 05/10/2023
Reference Document n:	
Node:3- Water&Utilities	
Hazard/Parameter: Chlorine	**Deviation**
Cause: Production of hydrogen from the electrolysis process	
Consequence: Production of hydrogen leading to formation of explosive atmosphere	
Safeguards:	
Recommendation: Verify with Vendor the amount of hydrogen produced by electroclorination package. Update the risk ranking and HER based on the outcome of this verification	
Responsible Part: Contractor	
Response:	

Ref. Docs / Dwgs.:
123A90-DDL-PP-DS-70070;123A90-DDL-PR-DG-80003;123A90-DDL-PR-DG-80004;123A90-DDL-PR-DG-80005;123A90-DDL-PR-DG-80006;123A90-DDL-PR-DG-80007;123A90-DDL-PR-DG-80008

RESPONSE ACCEPTANCE

Discipline Leader:	**Signature:**	**Date:**
HSE Leader:	**Signature:**	**Date:**
Project Manager:	**Signature:**	**Date:**
Company:	**Signature:**	**Date:**

CROSSWIND ROSETTI MARINO

HOLLANDSE KUST NOORD WIND PARK Project

Base Load Power Hub (BLPH)

Action N : 11	**Rev.:** 001
Action Title: HAZID Study	**Date:** 05/10/2023

Reference Document n:

Node:3- Water&Utilities

Hazard/Parameter: Scale inhibitors	**Deviation**

Cause: Leakage from stored chemicals (e.g. nitric acid / acetic acid etc)

Consequence: Potential Environmental consequence and personnel injury

Safeguards:
Bund's provided where required to contain leakages from storage tanks.
Chemical selection to minimise environmental impact.

Recommendation: Clarify type of chemical used as scale inhibitor and update HER afterwards, if required

Responsible Part: Contractor

Response:

Ref. Docs / Dwgs.:
123A90-DDL-PP-DS-70070;123A90-DDL-PR-DG-80003;123A90-DDL-PR-DG-80004;123A90-DDL-PR-DG-80005;123A90-DDL-PR-DG-80006;123A90-DDL-PR-DG-80007;123A90-DDL-PR-DG-80008

RESPONSE ACCEPTANCE

Discipline Leader:	**Signature:**	**Date:**
HSE Leader:	**Signature:**	**Date:**
Project Manager:	**Signature:**	**Date:**
Company:	**Signature:**	**Date:**

CROSSWIND ROSETTI MARINO

HOLLANDSE KUST NOORD WIND PARK Project

Base Load Power Hub (BLPH)

Action N : 12	**Rev.:** 001
Action Title: HAZID Study	**Date:** 05/10/2023
Reference Document n:	
Node:3- Water&Utilities	
Hazard/Parameter: Chemicals for Cleaning RO Membrane	**Deviation**
Cause: Leak of Various chemicals (sodium hydroxide, nitric acid, sodium hypochlorite)	
Consequence: Personnel injury.	
Safeguards: Chemical Selection to reduce impact on personnel. Personnel Protective Equipment (PPE). Emergency Response Plan (ERP)	
Recommendation: Clarify type of chemical used for cleaning RO membrane and update the HER	
Responsible Part: Contractor	
Response:	

Ref. Docs / Dwgs.:
123A90-DDL-PP-DS-70070;123A90-DDL-PR-DG-80003;123A90-DDL-PR-DG-80004;123A90-DDL-PR-DG-80005;123A90-DDL-PR-DG-80006;123A90-DDL-PR-DG-80007;123A90-DDL-PR-DG-80008

RESPONSE ACCEPTANCE

Discipline Leader:	**Signature:**	**Date:**
HSE Leader:	**Signature:**	**Date:**
Project Manager:	**Signature:**	**Date:**
Company:	**Signature:**	**Date:**

CROSSWIND ROSETTI MARINO

HOLLANDSE KUST NOORD WIND PARK Project

Base Load Power Hub (BLPH)

Action N : 13	**Rev.:** 001
Action Title: HAZID Study	**Date:** 05/10/2023

Reference Document n:

Node:3- Water&Utilities

Hazard/Parameter: Small animals	**Deviation**

Cause: Marine growth or small marine faune

Consequence:
Blockage of sea water intake systems.
Impact to process.
Potential for fish decomposing and health effect to personnel (scenario not ranked as not sufficient information are available)

Safeguards: Sea water filtration & chemical dosing systems.
Screen on the suction side of pumps.
Backwash filter cleaning.

Recommendation: Verify with Sea Water Treatment System Vendor if it is possible to have fish trapped and decomposing in the package

Responsible Part: Contractor

Response:

Ref. Docs / Dwgs.:
123A90-DDL-PP-DS-70070;123A90-DDL-PR-DG-80003;123A90-DDL-PR-DG-80004;123A90-DDL-PR-DG-80005;123A90-DDL-PR-DG-80006;123A90-DDL-PR-DG-80007;123A90-DDL-PR-DG-80008

RESPONSE ACCEPTANCE

Discipline Leader:	**Signature:**	**Date:**
HSE Leader:	**Signature:**	**Date:**
Project Manager:	**Signature:**	**Date:**
Company:	**Signature:**	**Date:**

CROSSWIND ROSETTI MARINO

HOLLANDSE KUST NOORD WIND PARK Project

Base Load Power Hub (BLPH)

Action N : 14	**Rev.:** 001
Action Title: HAZID Study	**Date:** 05/10/2023

Reference Document n:

Node: General Node

Hazard/Parameter: Piracy, hijack, kidnap, terrorism	**Deviation**

Cause: Unauthorised access

Consequence: Damage to facility

Safeguards:
Surveilance by marine operation
Heating Ventilation and Air Conditioning (HVAC) room and electrical room are locked

Recommendation: Consider to provide physical barrier on the stair

Responsible Part: Contractor

Response:

Ref. Docs / Dwgs.:
123A90-DDL-PP-DS-70070;123A90-DDL-PR-DG-80003;123A90-DDL-PR-DG-80004;123A90-DDL-PR-DG-80005;123A90-DDL-PR-DG-80006;123A90-DDL-PR-DG-80007;123A90-DDL-PR-DG-80008

RESPONSE ACCEPTANCE

Discipline Leader:	**Signature:**	**Date:**
HSE Leader:	**Signature:**	**Date:**
Project Manager:	**Signature:**	**Date:**
Company:	**Signature:**	**Date:**