Base Load Power Hub (BLPH)

Safety Critical Task Analysis Workshop 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.

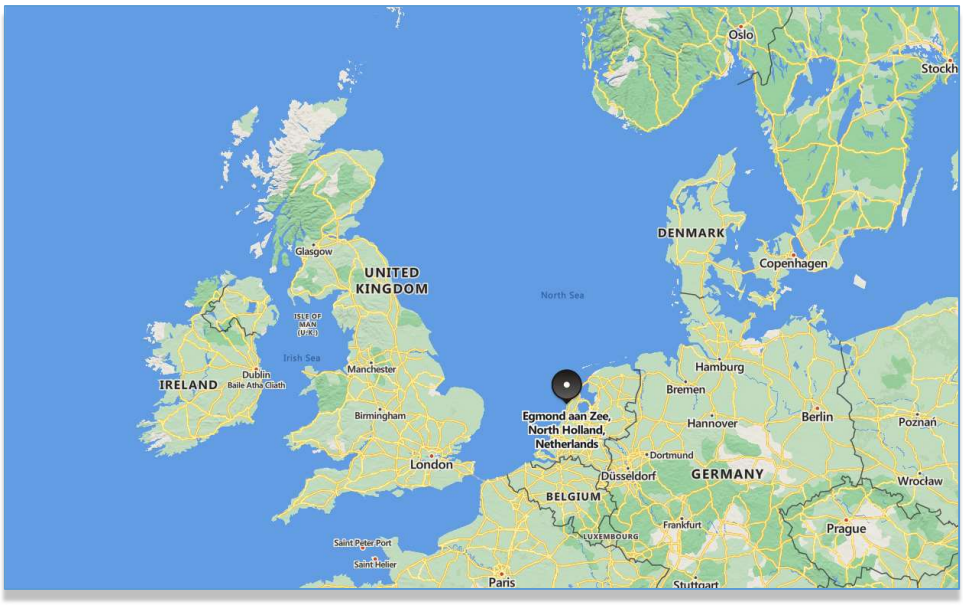


Figure 1 HOLLANDSE KUST NOORD WIND PARK Location Map

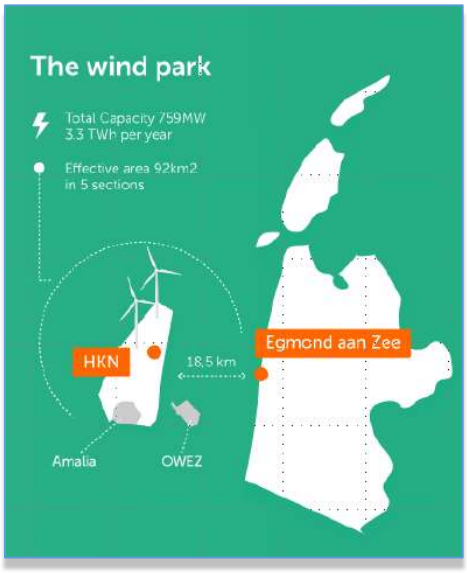


Figure 2 - Wind Park Details

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.

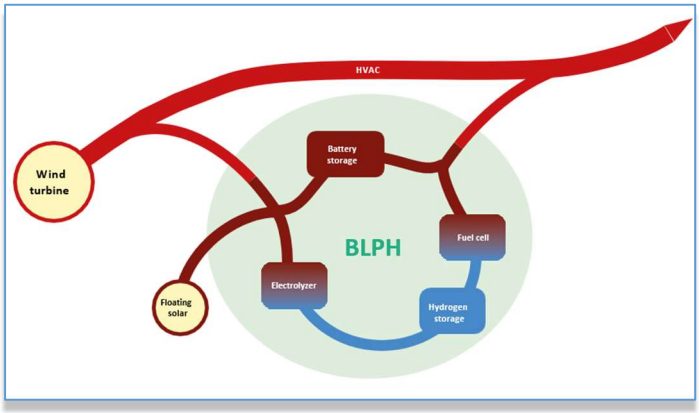


Figure 3 – BLPH Concept

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 EXECUTIVE SUMMARY

This document has the purpose of detailing the results of the Safety Critical Task Analysis Workshop for the new Base Load Power Hub (BLPH) which will be installed in the framework of HOLLANDSE KUST NOORD WIND PARK Project.

A Safety Critical Task is a task where human factors could cause, or contribute to, a major accident or fail to reduce the effect of one, including during:

- operational tasks;
- prevention and detection;
- control and mitigation, and
- emergency response.

This definition implies that maintenance activities performed on all SECEs are SCTs.

The scope of this document is limited to the topsides structure and associated facilities up until connection with the monopile. The monopile itself is not within the scope of this document.

Following objectives are included in the scope of the study:

1. Identify maintenance tasks performed by operators.
2. Identify possible human failures.
3. Identify the consequences of human failures.
4. Determine safety measures to control risk of human failures.
5. Identify recommendations, if agreed by the team.

A specific SCTA checklist has been applied to verify which maintenance activities have the potential to cause a MAH, if not performed in the correct manner.

It is necessary to point out that the platform is completely unmanned and the presence of operators is expected once every 6 months for a total period of 2 years only to perform routine maintenance activities, with the platform being shut-down. Operators will visit the platform a total of 4 times during the life of the platform.

For these reasons, some aspects are considered partially applicable or not applicable to the BLPH. In addition, other aspects such as platform evacuation and the presence of hazardous areas have been addressed (or will be addressed) through specific studies and are partially taken into account in this study.

A total of 10 SCTs, which are reported in Chapter 5 - Conclusions, emerged from the analysis. The overall worksheet projected during the meeting is reported in Attachment 2.

For each identified SCT, the existing safety measures were considered appropriate, and no additional recommendations arose during the workshop.

The workshop was held on September 5th, 2024, in Rosetti Marino's premises in Milan, with availability of technicians connected via video conference meeting. The attendance list is reported in Attachment 1.

2.1 MAIN REFERENCES

Ref.	Description
1	Human factors engineering in projects, IOGP Report No. 454, 2020
2	EU Framework Directive: Council Directive of 12 June 1989 on the introduction of measures to encourage improvement in the safety of workers at work
3	DEP 30.00.60.20-Gen. 2011 - Human Factors Engineering – Workspace Design
4	OFFSHORE STANDARDS DNVGL-OS-A101 Safety principles and arrangements July 2019
5	NORSOK Standard S-002 Working Environment, 2018
6	ICARO Guideline, 2017 - "Specification for Human Factor Engineering in projects"
7	ISO 14122, Safety of machinery - Permanent means of access to machinery
8	123A90-DDL-PR-RE-80040 – Process Design Philosophy
9	123A90-DDL-SAF-RE-30046 – HSE Design Philosophy
10	123A90-DDL-SAF-RE-30050 – Safety Critical Task Analysis Terms of Reference
11	Guidance on human factors safety critical task analysis, Energy Institute 2020
12	3D model of platform / layouts
13	Operating and Maintenance Manual BESS PRO, FREQCON
14	Maintenance Schedule BESS, FREQCON
15	1723001595-EL-MAN-00031 - Installation, Operating and Maintenance Manual - 66kV GIS
16	1723001756-MAC-MAN-00019 - Instruction Operating Manual H2 Storage Vessel V-25001 A÷F
17	1723002197-EL-MAN-00054 - Installation Operating and Maintenance Manual
18	1724000163-MAC-MAN-00015 - Installation and Operating Maintenance Manual (IOM)
19	1724000518-IN-MAN-00010 - Installation, Operation and Maintenance Manual PSV
20	1724000791-IN-MAN-00013 - Installation Operating and Maintenance Manual

Ref.	Description
21	1724001299-IN-MAN-00008 - Installation, Operating and Maintenance Manual
22	C63-PMO-002 - Maintenance Plan (Phase 2)
23	Maintenance Plan, FCwave™ 200kW, Ballard

Table 1 - Reference Documents

2.2 DEFINITIONS AND ABBREVIATIONS

2.2.1 Definitions

COMPANY or Client (CPY):	Crosswind
EPC CONTRACTOR (CTR):	ROSETTI MARINO S.p.A.
PROJECT:	HOLLANDSE KUST NOORD WIND PARK Project
MAJOR ACCIDENT HAZARD	An occurrence such as a major emission, fire, or explosion resulting from uncontrolled developments in the course of the operation leading to serious danger to human health or the environment
RECOMMENDATIONS	Improvements /actions required to reduce the identified risk.

Table 2 - Definitions

2.2.2 Abbreviations

ALARP	As Low As Reasonably Practicable
BESS	Battery Energy Storage System
BLPH	Base Load Power Hub
CB	Circuit Breaker
CIR	Circuit Breaker Cabinet
CPI	Company Provided Item
DS	Disconnection Switch
ES	Earthing Switch
F&G	Fire and Gas
HFE	Human Factor Engineering
HKN	Hollandse Kust Noord
HSE	Health, Safety and Environment
HV	High Voltage
IOGP	International Association of Oil & Gas Producers
KO	Knock Out
LO/TO	Lock out / Tag out
MAH	Major accident hazard
PCS	Power Conversion System
PIF	Performance influencing factors
PSV	Pressure Safety Valve
RO	Reverse Osmosis
SCT	Safety Critical Task
SCTA	Safety Critical Task Analysis
SECE	Safety and Environmental Critical Element
TOR	Terms of Reference
TP	Transition piece
UPS	Uninterruptible Power Supply

Table 3 - Abbreviations

3 SCTA STUDY

3.1 SCTA METHODOLOGY

An SCT is a task where human factors could cause, or contribute to, a major accident or fail to reduce the effect of one, including during:

- operational tasks;
- prevention and detection;
- control and mitigation, and
- emergency response.

This definition implies that maintenance activities performed on all SECEs are SCTs.

A simple step-wise process for SCTA has been developed:

1. Identify maintenance tasks performed by operators.
2. Identify possible human failures.
3. Identify the consequences of human failures.
4. Determine safety measures to control risk of human failures.
5. Identify recommendations, if agreed by the team.

STEP 1: IDENTIFY MAINTENANCE TASKS PERFORMED BY OPERATORS

Considering that the platform is unmanned, the presence of operator is required only during maintenance activities. The present SCTA was focused on the most critical maintenance activities connected with equipment handling hazardous substances, in order to identify the critical tasks which can lead to major accidents.

The critical tasks were identified and the relevant information was collected in agreement with the following references:

- Operating manuals and procedures (if available) or any existing information related to the task.
- Outputs from existing risk tools (e.g. HAZOP, fault trees etc.).
- Previously published SCT lists (if available).

Following information was collected for each main maintenance task activity:

- Description of the sub tasks (if any).
- Frequency and duration of the task.
- Location.
- Equipment / tools used.
- Operators involved (number and job).

Not every step (sub-tasks) in a SCT is necessarily worthy of detailed analysis. Thus, only critical steps/sub-tasks were deeply analysed.

STEP 2: IDENTIFY HUMAN FAILURES

For each critical task steps identified in the previews point, potential human errors needed to be identified.

A set of common guidewords is given in the next Table. The application of these guidewords to the SCTs produced a list of potential human failures (the set of guidewords reported below represents a list of possible actions to be applied in order to identify the misoperation in the step under analysis, but it **was not required to apply all guidewords** to the task).

Action failures	Checking failures
A1 Operation too long/short	C1 Check omitted
A2 Operation mistimed	C2 Check incomplete
A3 Operation in wrong direction	C3 Right check on wrong object
A4 Operation too little/too much	C4 Wrong check on right object
A5 Operation too fast/too slow	**Selection failures**
A6 Misalign	S1 Selection omitted
A7 Right operation on wrong object	S2 Wrong selection made
A8 Wrong operation on right object	**Information retrieval failures**
A9 Operation omitted	R1 Information not obtained
A10 Operation incomplete	R2 Wrong information obtained
A11 Operation too early/late	R3 Information retrieval incomplete
A12 Operation in wrong order	R4 Information incorrectly interpreted
A13 Misplacement	
Planning failures	**Information communication failures**
P1 Plan omitted	I1 Information not communicated
P2 Plan omitted	I2 Wrong information communicated
Violations	I3 Information communication incomplete
V1 Deliberate actions	I4 Information retrieval unclear

Table 4 – Example human failure identification guidewords

The previous guidewords were considered in order to identify the worst - case in terms of possible expected consequences.

In addition, factors with the potential to affect human performance, e.g. work conditions (noise, lighting), time pressure, interface design, lack of stimulation during monotonous supervisory task were taken into consideration as causes of operator misoperation.

All this information was collected during the workshop through interviews with personnel who knows how to carry out the tasks. Relevant background information was gathered (e.g. if the tasks are conducted as per the written procedures) as well.

STEP 3 – IDENTIFY THE CONSEQUENCES OF HUMAN FAILURES

For each task step identified in the previews point, the potential consequences of task failure were analysed, in terms of possible damage to people and asset. If no MAH-triggering consequences were found, then no further analysis was conducted for the specific failure in terms of SCTA.

STEP 4 – DETERMINE SAFETY MEASURES TO CONTROL RISK OF HUMAN FAILURES

Once potential human failures had been identified, possible available safeguards were listed. Safeguards were classified as preventive measures, if their scope is to avoid operator wrong operation, or mitigative, if their scope is to mitigate the effect of the incorrect task.

STEP 5 – RECOMMENDATIONS

In order to identify possible additional safety measures, the following hierarchy of additional risk controls was considered:

- Can the hazard be removed?
- Can the human contribution be removed (e.g. by a more reliable automated system)?
- Can the consequences of the human failure be prevented or mitigated (e.g. by additional barriers in the system)?
- Can human performance be assured by mechanical or electrical means? Actions of individuals alone should not be relied upon to control a major hazard.
- Can the working conditions be optimised, (e.g. improve access to equipment, increase lighting, provide more time available for the task, improve supervision, revise procedures or address training needs)?

All the information gathered during all the steps described above, was collected in a specific excel form and shared between the participants during the workshop (see Annex 1 – SCTA form).

The form was prepared specifically for the Base Load Power Hub (BLPH).

3.2 APPLICATION OF THE SCTA CHECK LIST

A specific SCTA checklist was applied to verify whether each maintenance activity has the potential to cause a MAH in case it is not correctly performed, which are the possible human errors during the activity, the related consequences, and the existing safety measures.

The SCTA Check list was prepared specifically for the Base Load Power Hub (BLPH), based on the principles and requirements reported in "Guidance on human factors safety critical task analysis, Energy Institute 2020" [11].

The checklist was projected during the session to allow the workshop team to view the generated content as it was produced.

The checklist was applied to the following nodes, for each of which a specific set of maintenance tasks and sub-tasks was further analyzed.

SCTA nodes
Water treatment
Instrument air circuit
N2 circuit
Crane
Vent system
BESS (CPI)
HV Switchgear
H2 Storage Vessel (CPI)
Medium and low voltage switchboards
Hydrogen vent
PSV
Electrolyzer (CPI)
Fuel cell module (CPI)
Fire and gas detection system
Emergency safety equipment

Table 5 – BLPH analyzed in the SCTA

For the sake of completeness, the company provided items (CPIs), initially out of the scope of the workshop, were concisely analysed, but no thorough analysis was conducted on them.

4 RESULTS

The application of the checklist allowed the workshop team to identify which routine maintenance tasks and sub-tasks constitute Safety Critical Tasks.

The maintenance task activities for which the potential human errors were considered credible and the related consequences were deemed prone to causing a MAH. A total of 10 SCTs, which are reported in Chapter 5 - Conclusions, emerged from the analysis.

It is worth noting that some maintenance activities are scheduled to be performed every 24 months, and thus they were out of the scope of the analysis, since the lifespan of the project is exactly two years. Therefore, although having the potential to cause a MAH, such activities were not analyzed during the workshop.

Overall, for each identified SCT, the existing safety measures were considered appropriate, since a safety management system is planned to be put in place for the BLPH, including PTW and LO/TO procedure, use of dedicated anti-sparkling tools, etc. Therefore, no additional recommendations arose during the workshop.

5 CONCLUSIONS

The SCTA workshop, through the application of a systematic checklist to the routine maintenance activities scheduled for the BLPH, had the objective of determining which of such activities might constitute Safety Critical Tasks. The outcome of the workshop is a set of 10 SCTs, listed in the table below. No recommendations were issued for the identified SCTs.

Further details and information are available in **Attachment 2**.

Item	Item TAG	#	Maintenance task activity	Sub-task #	Sub-task activity
Instrument air circuit	A-63000	3	Inspection activities of instrument Air	3.1	Compressor maintenance, filter cartridge replacement, visual inspection of the package.
N2 circuit	A-64000	4	Inspection activities of N2	4.1	Filter cartridge replacement, visual inspection of the package.
Vent system	Q-43004	7	Refilling of liquid in liquid seal drum	7.1	Check of filling level (e.g. Glycole)
BESS (CPI)	A-85000	11	Maintenance on FREQCON Battery Energy Storage Systems safety equipment	11.1	Inspection on Exhaust units
				11.2	Inspection on Fire dampers
				11.3	Inspection on H2 Sensors
H2 Storage Vessel (CPI)	V-25001 A÷F	14	Maintenance on H2 STORAGE VESSEL V-25001 A÷F	14.2	Maintenance and substitution of valve gaskets
Electrolyzer (CPI)	A-20000	19	Maintenance on safety system	19.1	Minor maintenance activities (cleaning, functioning test etc.) and calibration
Fuel cell module (CPI)	A-80000	21	Maintenance on safety system	21.1	Minor maintenance activities (cleaning, functioning test etc.) and calibration
Fire and gas detection system	-	22	Calibration and functioning test	22.1	F&G detectors are tested one by one. The whole F&G system is always in function.

Table 6 – Safety Critical Tasks

ATTACHMENT 1 – PARTICIPANT LIST

Name	Company	Role
Alberto Baldassarri	ICARO	Scribe
Stefano Mandorlo	ICARO	Facilitator
Claudia Giunchi	Rosetti	PE
Carolina Caracciolo	Rosetti	Technical Safety Lead
Daniele Ricci Picciloni	Rosetti	HSSE Manager
Edoardo Carminati	Rosetti	PE
Brunelli Massimiliano	Rosetti	PM
Davide Lo Sterzo	Rosetti	PEM
Paul van Rossum	Crosswind	Technical Safety Lead
Marta Iacopetti	Crosswind	PE
Nicolas Le Brun	Crosswind	HSSE Manager
Alessandro Sutto	Crosswind	BESS package lead
Stuart Sharkey	Crosswind	Operations lead
Paul Kyle	Crosswind	Fuel Cell package lead

ATTACHMENT 2 – WORKSHEET

Item	Item TAG	#	Maintenance task activity	Sub task #	Sub task activity	Potential for MAH?	Sub task notes	Potential human errors during the activity	Potential consequences due to human error	Safety Critical Task?	Existing safety measures	#	Actions / Recommendations	By
Water treatment	A-50007	1	Maintenance on water treatment package	1.1	Water pumps maintenance	No								
				1.2	Water filter replacements	No								
				1.3	RO membranes replacement	No								
	P-50001 A-B	2	Maintenance on Sea water pumps	2.1	inspection activities to the mechanical seal	No								
				2.2	refilling of clean water inside flushing "tank"	No								
Instrument air circuit	A-63000	3	Inspection activities of instrument Air	3.1	Compressor maintenance, filter cartridge replacement, visual inspection of the package.	Yes		Replacing the wrong filter or performing the maintenance on the wrong equipment.	Potential release of hydrogen leading to fire or explosion in case of ignition.	Yes	Operators training. Operating and maintenance procedures. BDVs go to safe position. Vent in safe location. Administrative control. Permit to work. Isolation procedures.			
N2 circuit	A-64000	4	Inspection activities of N2	4.1	Filter cartridge replacement, visual inspection of the package.	Yes		Replacing the wrong filter or performing the maintenance on the wrong equipment.	Potential release of hydrogen leading to fire or explosion in case of ignition.	Yes	Operators training, operating and maintenance procedures. BDVs go to safe position. Vent in safe location. Administrative control. Permit to work. Isolation procedures.			
Crane	X-99001	5	Inspection activities of Crane	5.1		No	Max load is 1 ton at 10 meters and 3 tons at 5 meters. No potential for the falling of loads on hydrogen system thanks to crane's limit switches (see dropped objects study).							
Vent system	Q-43004	6	Visual inspection activities Vent	6.1		No								
		7	Refilling of liquid in liquid seal drum	7.1	check of filling level (e.g. Glycole)	Yes	No information currently available on the refilling method of the drum.	Operator fails to refill or to check the liquid level in the seal drum.	Presence of hydrogen in waste water tank T-55001 leading to the potential formation of	Yes	Level transmitter and low level alarm to detect low level in H2 vent liquid seal Q-			
BESS (CPI)	A-85000	8	Maintenance on PCS Container CTRL cabinet	8.1	UPS battery - Functionality check	No								
				8.2	UPS battery - Remove battery from battery unit	No								
		9	Maintenance on PCS Container All switch cabinets	9.1	Intake fan filters - Check the fan filters for contamination and replace if necessary	No								
		10	Maintenance on PCS Container - CIR cabinet	10.1	Visual inspection of arc-chute covers	No								
				10.2	Visual inspection of arc chutes and contact system	No								
				10.3	Visual insepction of operating system	No								
		11	Maintenance on FREQCON Battery Energy Storage Systems safety equipment	11.1	Inspection on Exhaust units	Yes		Operator does not perform the activity in the correct way.	Safety equipment not working properly in case of emergency	Yes	Existing safety measures as per vendor manual. Permit to work. List of equipment to check.			
				11.2	Inspection on Fire dampers	Yes		Operator does not perform the activity in the correct way.	Safety equipment not working properly in case of emergency	Yes	Existing safety measures as per vendor manual. Permit to work. List of equipment to check.			
				11.3	Inspection on H2 Sensors	Yes		Operator does not perform the activity in the correct way.	Safety equipment not working properly in case of emergency	Yes	Existing safety measures as per vendor manual. Permit to work. List of equipment to check.			
		12	General maintenance on FREQCON Battery Energy Storage Systems	12.1	Minor maintenance activities (cleaning, functioning test etc.) and replacement of small components	No								
				12.2	Visual inspection (damage, leakage and corrosion, etc.)	No								
HV Switchgear		13	Maintenance on SWITCHGEAR ECO-FRIENDLY GIS	13.1	Patrolling Inspection	No								
				13.2	Ordinary Inspection	No								
				13.3	Tightening and Re-tightening	No								
				13.4	DRY AIR Gas System	No								
				13.5	DRY AIR Gas Refilling	No								
				13.6	Gas Density Detector Check	No								
				13.7	Dry – Air	No								
				13.8	Operation Test of CB (Circuit Breaker)	No								
				13.9	Resistance Measurement at Earthing Switch	No								
				13.10	Lubrication	No								
				13.11	Maintenance of Gas Circuit Breaker	No								
				13.12	Maintenance of DS & ES	No								
				13.13	Maintenance Procedure of others	No								
				13.14	Checking procedure for gas system	No								
				13.15	Earthing system	No								
H2 Storage Vessel (CPI)	V-25001 A÷F	14	Maintenance on H2 STORAGE VESSEL V-25001 A÷F	14.1	Visual inspection	No	Activity performed every 6 months.							
				14.2	Maintenance and substitution of valve gaskets	Yes	Activity performed every 24 months. Out of the scope of work.							
				15.1	Metallic structure	No								
				15.2	Painted or galvanised parts and Hinges, locks	No								
				15.3	Mechanical drives	No								
				15.4	Force blocks	No								
				15.5	Stop blocks, Safety blocks	No								
				15.6	Disconnecting contacts	No								
				15.7	Fixed contacts	No								
				15.8	Switch trolley, Contactor trolley, Special trolley	No								

Item	Item TAG	#	Maintenance task activity	Sub task #	Sub task activity	Potential for MAH?	Sub task notes	Potential human errors during the activity	Potential consequences due to human error	Safety Critical Task?	Existing safety measures	#	Actions / Recommendations	By
Medium and low voltage switchboards		15	Maintenance on Miniver/C Standardised medium voltage switchboards	15.9	Earthing connection componentsConnections to the earthing system	No								
				15.10	Auxiliary circuits connections	No								
				15.11	External connections, Power circuits	No								
				15.12	Check the insulation resistance Power circuits Auxiliary circuits	No								
				15.13	Functional checks	No								
Hydrogen vent	V-43001	16	Maintenance on HYDROGEN VENT KO DRUM	16.1	Periodic check of tightening of the bolts and the integrity of the connection gaskets.	No								
				16.2	Check the integrity of the welds on the vessel while on duty	No								
PSV		17	Maintenance on PSV - SAFETY VALVE	17.1	Check of the seat and disc on the plant	No	Visual inspection performed every 12 months.							
				17.2	Check of the seal outwards in case of back pressure on the plant	No	Visual inspection performed every 12 months.							
				17.3	Check of the painting condition on the plant.	No	Visual inspection performed every 12 months.							
				17.4	Ordinary maintenance of the assembled on the plant, including the seal check and surface check of the movable components.	No	Visual inspection performed every 12 months.							
				17.5	General maintenance of the valve removed from the plant including the disassembling, the seat and the disc check, the possible seat and disc lapping, gaskets substitution, painting restoration and inspection on the test bench.	Yes	Activity performed every 24 months. Out of the scope of work.							
Electrolyzer (CPI)	A-20000	18	General maintenance activities	18.1	Minor maintenance activities (cleaning, functioning test etc.) and replacement of small components	No								
				18.2	Visual inspection (damage, leakage and corrosion, etc.)	No								
		19	Maintenance on safety system	19.1	Minor maintenance activities (cleaning, functioning test etc.) and calibration	Yes		Operator does not perform the activity in the correct way.	Safety equipment not working properly in case of emergency	Yes	Existing safety measures as per vendor manual. Permit to work. List of equipment to check.			
				19.2	Visual inspection (damage, leakage and corrosion, etc.)	No								
Fuel cell module (CPI)	A-80000	20	General maintenance activities	20.1	Minor maintenance activities (cleaning, functioning test etc.) and replacement of small components	No								
				20.2	Visual inspection (damage, leakage and corrosion, etc.)	No								
		21	Maintenance on safety system	21.1	Minor maintenance activities (cleaning, functioning test etc.) and calibration	Yes		Operator does not perform the activity in the correct way.	Safety equipment not working properly in case of emergency	Yes	Existing safety measures as per vendor manual. Permit to work. List of equipment to check.			
				21.2	Visual inspection (damage, leakage and corrosion, etc.)	No								
Fire and gas detection system		22	Calibration and functioning test	22.1	F&G detectors are tested one by one. The whole F&G system is always in function.	Yes		Operator forgets to reactivate F&G detector.	Presence of flammable gases leading to fire or explosion in case of ignition.	Yes	Existing safety measures (i.e., voting logic degradation, pushbuttons tested only when the platform is completely depressurized). Manual alarm after functional test reactivates automatically after the			
Emergency safety equipment		23	Visual inspection and general maintenance of equipment	23.1		No				Yes	Part of both vendor manual and operating manual of the platform is to include maintenance activities to be performed on emergency equipment.			