Section 6 - Employer's Requirements

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ABBREVIATIONS

AC	-	Alternate Current
BESS	-	Battery Energy Storage System
CAPEX	-	Capital Expenditure.
DC	-	Direct Current
DG	-	Diesel Generators
DOD	-	Depth Of Discharge
EMS	-	Energy Management System
FENAKA	-	The Utility responsible for electricity, water and sanitation
FOC	-	Fiber Optics Cable
PMU	-	Project Management Unit
GUI	-	Graphical User Interface
GRIDB	-	Grid Building Battery Inverter
MPP	-	Maximum Power Point
OEM	-	Original Equipment Manufacturer
PV	-	Photovoltaic
RE	-	Renewable Energy.
SCADA	-	Supervisory control and data acquisition
SLD	-	Single Line Diagram
SOC	-	State Of Charge
SWA	-	Steel wire armoured
SS	-	Substation
THD	-	Total Harmonics Distortion
UPS	-	Uninterruptible Power Supply

WEIGHTS AND MEASURES

kW	–	Kilowatt
kWh	–	Kilowatt-hour
MW	–	Megawatt

1 Scope of Supply of Plant and Services

1.1 General

The aim of the present tender is to implement a **Flow BESS (Battery Energy Storage System)** and an **EMS (Energy Management System)** on **one** island located in **Faafu atoll** and **one** island located in **Haa Alifu atoll**, Maldives.

The specific islands for the BESS and EMS are listed in Table 1-1 and Table 1-2, respectively.

Faafu Atoll		
Island Code	**Island Name**	**Coordinates**
L06	F Nilandhoo	03º03' N 72º53' E

Table 1-1:List of islands for BESS & EMS with island code for Faafu Atoll

Haa Alifu Atoll		
Island Code	**Island Name**	**Coordinates**
A10	Ha Dhidhoo	06º53' N 73º6' E

Table 1-2: List of islands for EMS with island code for Haa Alifu Atoll

An aerial view of the islands are provided below:

Figure 1-1 : Faafu aerial view with some selected islands

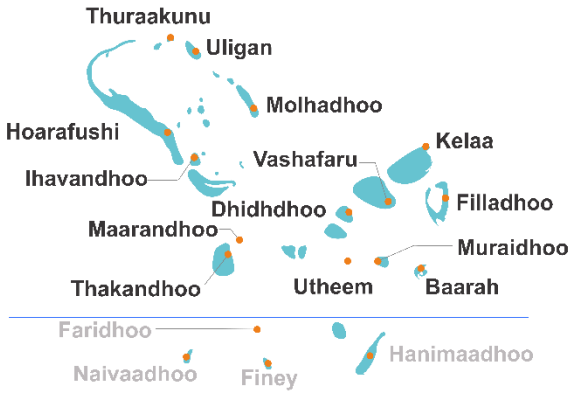

Figure 1-2: Haa Alifu aerial view with some selected islands

1.2 Scope of work

The scope of supply, works and services shall cover, but not limited to the following:

- assessment of the site and site characteristics.
- development, detailed design, engineering (including equipment specifications), coordination of sub bidders, permitting, procurement, manufacturing, factory testing, supply of all equipment (also including spare parts, consumable, special tools and handling equipment, etc.), transport to site, storage on site, erection, construction, commissioning and performance testing of the systems.
- works and services related to preparation, civil, mechanical, electrical, instrumentation and control (I&C) and communication works including all required equipment for the execution of these works and services,
- providing security on site during construction as per insurance requirements and the security technical specifications of the Employer as per all applicable regulations, codes and standards
- providing training of personnel according to Employer´s Requirements
- providing operation and maintenance (O&M) services during the initial 2 years operation
- implement occupational health and safety and environment measures for design, construction and operation of the plant per the environmental management plan.

The Contractor shall be responsible for detailed design, engineering and building of the overall system, consisting of:

- Battery storage system with storage batteries, bi-directional battery inverters (if applicable grid building inverters), containers to store the storage battery system, battery management and monitoring system and controller, UPS, DC cabling, AC cabling, communication cables, earthing, electricity meters and sensors, electrical connection to the existing system. The system must have compatible provision to share live data with the central SCADA.
- Energy Management System capable of integrating and synchronising the existing Diesel Generators and it must be compatible with the central SCADA to exchange live data.

It is the sole responsibility of the Bidder to design, engineer and plan all related work and installations, buildings, sub-systems, elements, system facilities, equipment, services, including system hardware and software.

The Contractor shall collect and investigate all basic data which are needed for a proper design, planning and engineering. This includes, but is not limited to:

- conduct site visits and basic evaluation needed for a proper design and engineering

- survey of existing installation locations with regards to condition and suitability for proposed installations
- review of static calculations and where such are not available static verification of the proposed locations
- survey for suitability of proposed installation locations for equipment like storage batteries, inverters, controllers and other devices
- survey related to the grid upgrade works which include but not limited to cable routes from Flow BESS to grid in each island, condition assessment of low voltage distribution boxes, LV distribution boards in Powerhouse, LV distribution boards in substations, MV distribution network (where applicable) etc.

The Contractor is responsible for import, transport, storage and handling of any equipment and material needed for installation and implementation of services.

The Contractor shall provide complete engineering data, calculations, drawings, reports, manuals for Employer's review, approval and records.

The Bidder shall include in its scope all facilities and equipment necessary for the generation of power from the system and all works and services including workshop and store equipment, special tools and handling equipment, spare parts, consumables, etc. necessary for complete, safe, reliable, and efficient operation and preventive and corrective maintenance of the system.

The scope includes also works not explicitly stated in Section 6 or elsewhere in the tender document, but which are reasonably required for the installation and operation of the systems according to good engineering practice.

All deliveries and works shall meet or exceed applicable requirements set forth by the latest edition of the following international and national codes and standards or their equivalents. In addition, all local rules and regulations shall be strictly adhered in all respects.

- ISO/IEC
- EN
- ISA (International Society of Automation)
- IEEE
- ITU (International Telecommunication Union)
- Maldives local regulations

No claims for extras will be considered in respect of failure by the Bidder to comply with any of the above.

Reputable manufacturers shall manufacture new equipment, which shall be subject to Employer's review and approval. Used, reconditioned, or salvaged equipment or material shall not be allowed. All equipment used in connection with the project shall be of proven design for the intended use of the equipment. As a general principle, the latest, commercially

proven, most modern and up-to-date technologies will be selected, and licensing terms agreed with the objective of maximizing value to the Employer.

All parts of the plant shall be suitable in every respect for continuous operation at maximum efficiency as well as part loads and minimum load, under consideration of the climatic conditions peculiar to the site and environmental restrictions.

The Bidder shall apply a well-established component classification and identification system. The international SI system of units shall be used for design, drawings, diagrams, instruments, etc.

Project language is English. This applies also to any kind of documents, drawings, manuals, etc.

The individual islands are described in detail in Chapter 2 Site Specifications. Any specification which is not provided in Chapter 2 but needed for a proper design, engineering, implementation, O&M services and any related work shall be investigated by the Bidder.

Disclaimer: Source of all satellite pictures shown in this Tender is Google Earth.

2 Site Specifications

2.1 General

The following section describes the specific island and its site conditions as well as climate logical parameters for the atoll.

The Bidder is responsible for its own investigations to establish sufficient and accurate information for the design of the Plant. The Contractor shall visit the proposed sites and shall ascertain the nature and location thereof and all conditions which may, affect design/layout of the Flow BESS and Energy Management System (EMS), and the project costs.

The Bidder shall make its own assessment of any and all of the information provided in this Bid and collect own information. Neither the Employer nor any representative or advisor is responsible for the accuracy or completeness of any such information.

2.2 Logistic

The Contractor is free to choose the seaport of entrance. There are a several seaports. Upon arrival at one of these ports the Contractor shall take care of the clearance. However, Employer shall provide the relevant supporting documents to the Contractor. After clearance it is the Contractor's obligation to continue delivery up to the final destination at the respective islands.

2.3 Hybrid mini-grid systems and general behaviour

For systems with Grid Building Battery Inverters (GRIDB), the main control unit shall turn off the Diesel Generators completely, if the available solar energy and the State of Charge (SOC) of the battery allows it. Solar energy shall always be the prioritized energy to be used in the system, and Diesel Generators (DG) shall only be turned on if necessary.

The system should also allow operation of multiple masters (grid forming entities such as Battery or Diesel Generators) and only use PV as a slave. If one master fails, the other master units should be able to run the grid giving the system extra redundancy.

The Battery inverter must be synchronized to other voltage sources in both cases: i) Battery inverter is online first and the other voltage source (DG, Grid, other Battery Inverter) must be synched to the battery inverter, ii) Other voltage sources are online first (DG, other Battery Inverter), the battery inverter must be synchronized to them. Especially when a static (isochronous) voltage source such like an DG without synchronization capability the synchronization must be done with an external synch check and breaker. The measurement of the requirement parameters of voltage, frequency etc. must be done fast and accurate enough to guaranty synchronization.

2.3.1 Categorization of Renewable Energy Projects under ASSURE Framework

The aim of this categorization is to identify various types of renewable energy systems that incorporate photovoltaic (PV) technology and DGs with or without energy storage solutions. Three main types are defined as:

- Type A PV + DGs
- Type B PV + DGs + Small-scale BESS for grid support
- Type C PV + DGs + Large-scale BESS for shutting down DGs

2.3.2 Type C Hybrid system: PV-DG-Grid forming battery

During the day, the PV and battery system provides 100% of the load and charges the battery. If battery is fully charged and PV output power is higher than the loads in the system, the PV power can be curtailed by frequency droop control and additionally commands via Fiber Optics Cable (FOC) connection.

The battery is discharged during the night until the defined minimum State of Charge is reached.

Diesel Generators are used as backup and started to provide energy to the load when the SOC_{min} of the Flow BESS is reached.

The communication between the hybrid system controller (located in the powerhouse) and the PV inverters can be performed via frequency droop to curtail the active power when needed.

2.3.3 Type C: Energy distribution (typical day)

The following graphics present the power production from each energy source (PV, Diesel Generators, Battery) for type B and C of hybrid systems in order to help understanding the functioning of the controller simulated and how the energy is distributed between the different power sources. Two typical days of an island were chosen and are analysed.

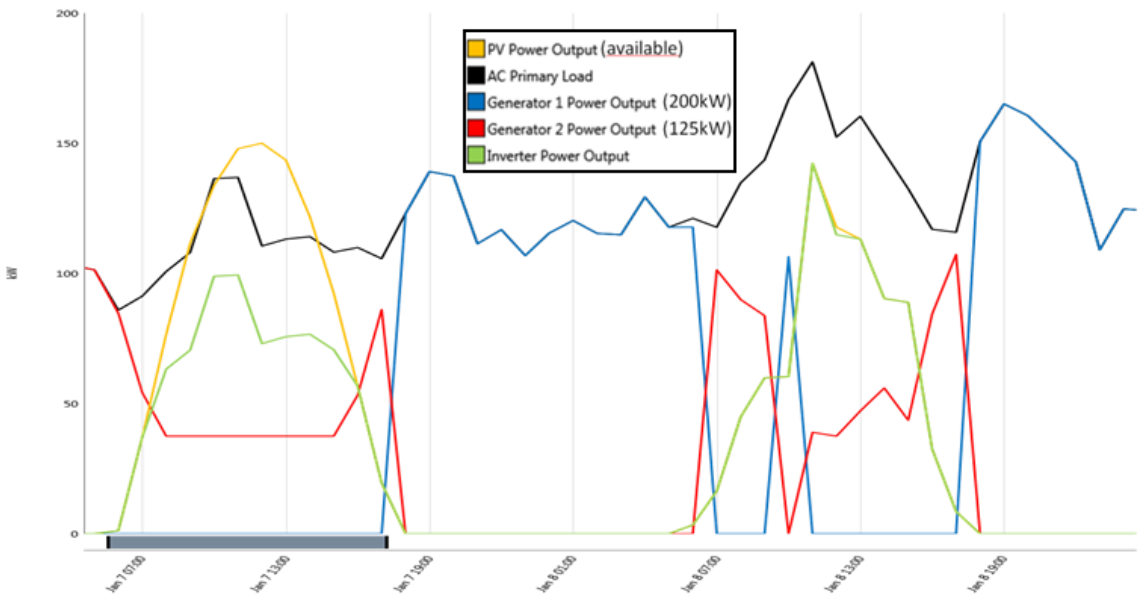

Figure 2-1: Simulation of energy distribution over 2 typical days (Type B: PV-Diesel-grid support battery)

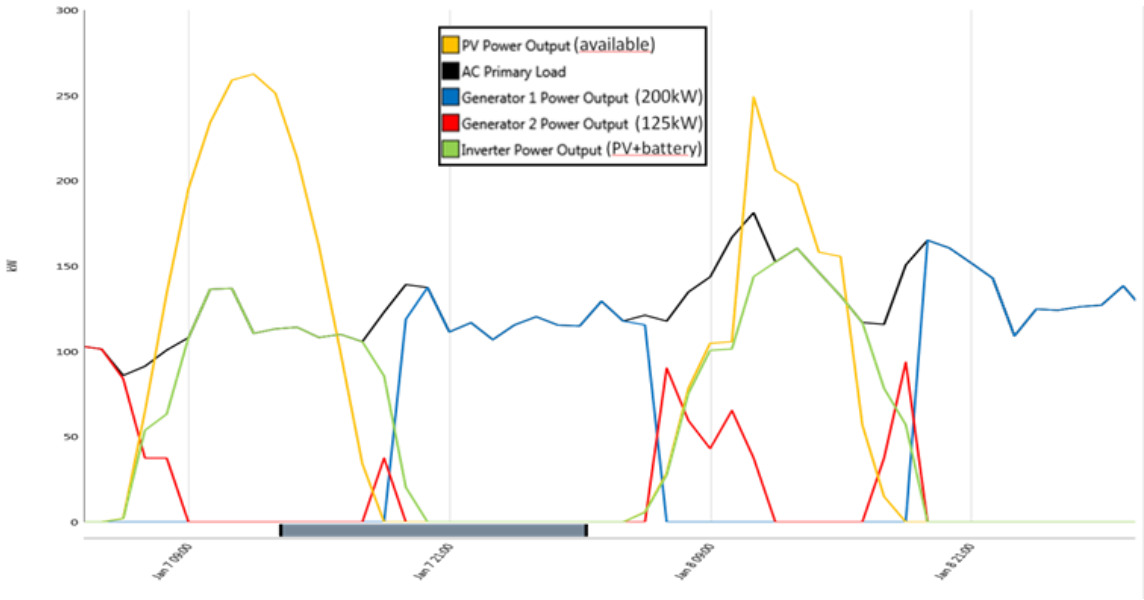

Figure 2-2: Simulation of energy distribution over 2 typical days (Type C: PV-Diesel-grid forming battery)

The functioning of the hybrid systems of Type B and the relative benefit provided by the grid supporting battery can be observed by comparing the two first figures:

- for the first day in both graphics there is enough PV power to possibly cover the whole load in the system. For Type B systems it is necessary to have a generator running at all times, as the grid building function of the battery inverters is not activated. It is to be noted that in Type C the generator power (red line) drops down to zero and the generator is completely shut down, whereas for Type B the generator remains running at its minimum partial load.

- for the second day represented on the figures, the following small difference can be observed: In the case of Type B (Figure 2-1) the grid support battery provides additional spinning reserve to the hybrid system and as a result the controller starts the smaller Diesel Generator (125kW) and preventing excess of energy in this specific case. This situation happens when the available PV power and the load are relatively high at the same time.
- The Type C (Figure 2-2) with a "small" grid forming battery inverter shows that the Diesel Generators can be turned off during the day as soon as the PV power exceeds the load and the battery State of Charge is high enough. Therefore, higher diesel savings and significant running hour reductions of the Diesel Generators can be achieved.

2.3.4 Other technical characteristics

Regarding the energy management system and associated infrastructure, all islands should be readily available to future upgrade/downgrade to any of the type A or B.

2.4 Other design characteristics

2.4.1 Load profile

The islands show a fluctuating energy consumption usually with morning (around 12 am) and evening (around 10 pm) peaks. Last few years recorded data show little seasonality.

A yearly demand load growth for each particular island has been estimated with data provided by the utility. The considered planning horizon is 2025.

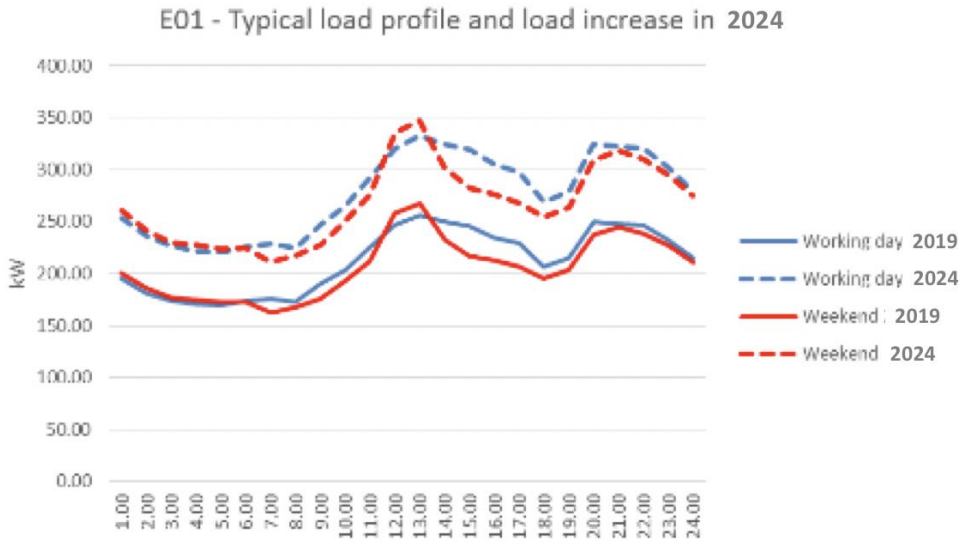

Figure 11: Typical Daily Load Profile for 2019 and 2024

2.4.2 Diesel Generators

Each island runs with minimum of three Diesel Generators. It is out of the scope of this tender to install new Diesel Generator. However, the Contractor is responsible to integrate the

existing Diesel Generators within the EMS of the Hybrid energy mini grid and provide main signals to the central SCADA. Furthermore, EMS shall not be limited by number/size/model of Diesel Generators and shall be able to accommodate future changes in number of DG's and size.

2.5 Summary of the characteristics of the Flow BESS to be built

The Contractor shall implement the described systems on the all the atoll as summarized in the tables below.

Island	System Type	Flow battery and battery inverter required minimum power	Minimum required flow battery capacity	Energy Management System (EMS)	Type of PV systems to be integrated to the system
Faafu atoll					
L06 – F NILANDHOO	Type C	1,000 kW	3,000 kWh (*1)	Yes	1,200 kWp floating solar
Sum		**Total installed Battery inverter power: 1,000 kW**	**Total installed Battery Capacity: 3000 kWh**	**EMS: 1**	
Haa Alifu Atoll					
A10 – HA DHIDHOO	Type C	2,000 kW	3,000 kWh (*1)	Yes	Rooftop and ground mounted
Sum		**Total installed Battery inverter power: 2,000 kW**	**Total installed Battery Capacity: 3,000 kWh**	**EMS: 1**	
Sum	**Type C**	**Total installed battery power across 2 islands: 3 MW**	**Total Battery capacity across 2 islands: 6 MWh**	**Total EMS across 2 islands: 2**	

(*1) During the lifecycle of flow BESS, the following capacity is required.
3,000 kWh at the initial
2,900 kWh as the norm at the end of lifecycle
2,700 kWh as the minimum at the end of lifecycle

Table 2-1 : Summary of Flow BESS & EMS System to be installed in each atoll

2.6 L06 F Nilandhoo island

The island is located in the Faafu Atoll.

The general data of the island is shown in the following table:

Island code, name	L06 - Nilandhoo
Atoll name	Faafu
Utility	FENAKA
GPS coordinates	03°03′20″N 72°53′28″E
Inhabitants (approx.)	1,663
Harbour type	Harbour 185x100x5m
Powerhouse Location	3°03'33.25" N 72°53'19.95" E

Table 2-2 : L06 - Island identification and general data

A map of the island provided in the next figure

Figure 2-3 : L06 – Map of island

2.6.1 Load profile

The island has a fluctuating energy consumption. The forecasted average peak load for the target year is 947 kW with a consumption of 12,500 kWh.

2.6.2 Diesel Generators

4 Diesel Generators of different sizes are installed on the island.

The following Diesel Generators are currently used.

Item	Diesel Generator 1	Diesel Generator 2	Diesel Generator 3	Diesel Generator 3
Engine manufacturer & Engine Model	Cummins KTA50-G1	Cummins KTA38-G2	Deutz BF8M1015C	Cummins KTA50-G3
Engine power rating (continuous) [kW]	800kW	600kW	400kW	1000kW

Table 2-3 : L06 Diesel Generator currently installed

2.6.3 Grid Infrastructure

2.6.3.1 *The Electrical system*

- Generation: 400/230V
- Frequency: 50 Hz
- Phase and type: three phase Wye, earthed neutral, four wire system

Distribution Network: Low Voltage (400V) / Medium Voltage (11kV)

The powerhouse in Nilandhoo Island have four Diesel Generators that supply the complete load requirements of the island.

Generators are connected to a single bus bar at low voltage (230/400V). There are existing synchronizers for generation connection and also manual load following operation strategy defined by the powerhouse operators. Distribution losses are almost entirely losses in low voltage distribution cables as there is almost no electricity theft, as the customers' meters are generally accurate. For this island the distribution losses are estimated to be 5-15% of the total generated energy.

Electrical supply to single phase consumers is commonly 230V, single phase, earthed neutral, two wire connections and for three phase consumers it is (400/230V) Wye, earthed neutral four wires.

The Single Line Diagram for Nilandhoo is shown in Figure 2-4Figure 2-4 : Single Line Diagram for reference.

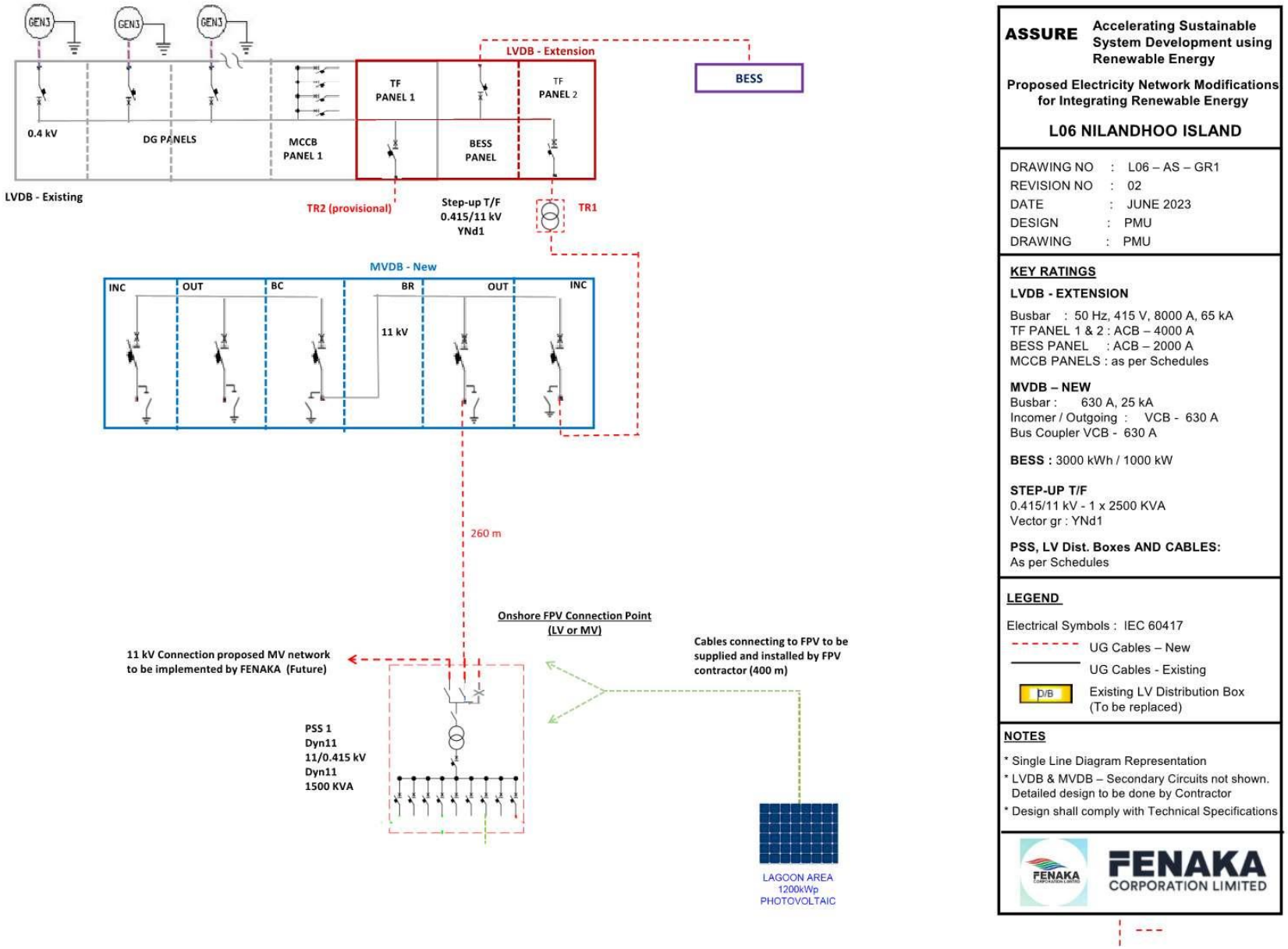

Figure 2-4 : Single Line Diagram for Nilandhoo Island

2.7 A10 Dhidhoo island

Dhidhoo is one of the inhabited islands of Haa Alifu Atoll. The general data of the island is shown in the following table:

Island code, name	A10 Dhidhoo
Atoll name	Haa Alifu
Utility	FENAKA
GPS coordinates	6°53'16.60" N 73°06'49.55" E
Inhabitants (approx.)	4,186
Harbour type	Harbour 395x75x5m
Powerhouse Location	6°53'17.33" N 73°06'47.11" E

Table 2-4 : A10 - Island identification and general data

A map of the island and potential locations for PV are next provided

Figure 2-5 : A10 - Map of island

2.7.1 Load profile

The island has a fluctuating energy consumption. The forecasted average peak load for the target year is 1981 kW with a consumption of 25500 kWh.

2.7.2 Diesel Generators

3 Diesel Generators of different sizes are installed on the island.

The following Diesel Generators are currently used.

Item	Diesel Generator 1	Diesel Generator 2	Diesel Generator 3	Diesel Generator 3
Engine manufacturer & Engine Model	Cummins QST30-G4	Cummins KTA50-G3	Cummins QSK-38G2	Cummins KTA38-G2
Engine power rating (continuous) [kW]	800kW	1000kW	800kW	600kW

Table 2-5 : A10 - Diesel Generators currently installed

2.7.3 Grid Infrastructure

2.7.3.1 *Electrical system*

- Generation: 400/230V
- Frequency: 50 Hz
- Phase and type: three phase Wye, earthed neutral, four wire system
- Distribution Network: Low Voltage (LV)

The powerhouse in this Island has four Diesel Generators that supply the complete load requirements of the island. The requirement related to existing Diesel Generators and associated systems are described in the above sections.

The island is fed through the low voltage distribution network connected to the main low voltage distribution board of the powerhouse. The island is fed through LV distribution boxes located across the island and connected in a loop-in loop-out low voltage distribution network from the main low voltage distribution board of the powerhouse.

Electrical supply to single phase consumers is commonly 230V, single phase, earthed neutral, two wire connections and for three phase consumers it is (400/230V) Wye, earthed neutral four wires.

EMS is present on this island to control the DG, PV, and small BESS.

The Single Line Diagram for Dhidhoo is shown in Figure 2-6 for reference.

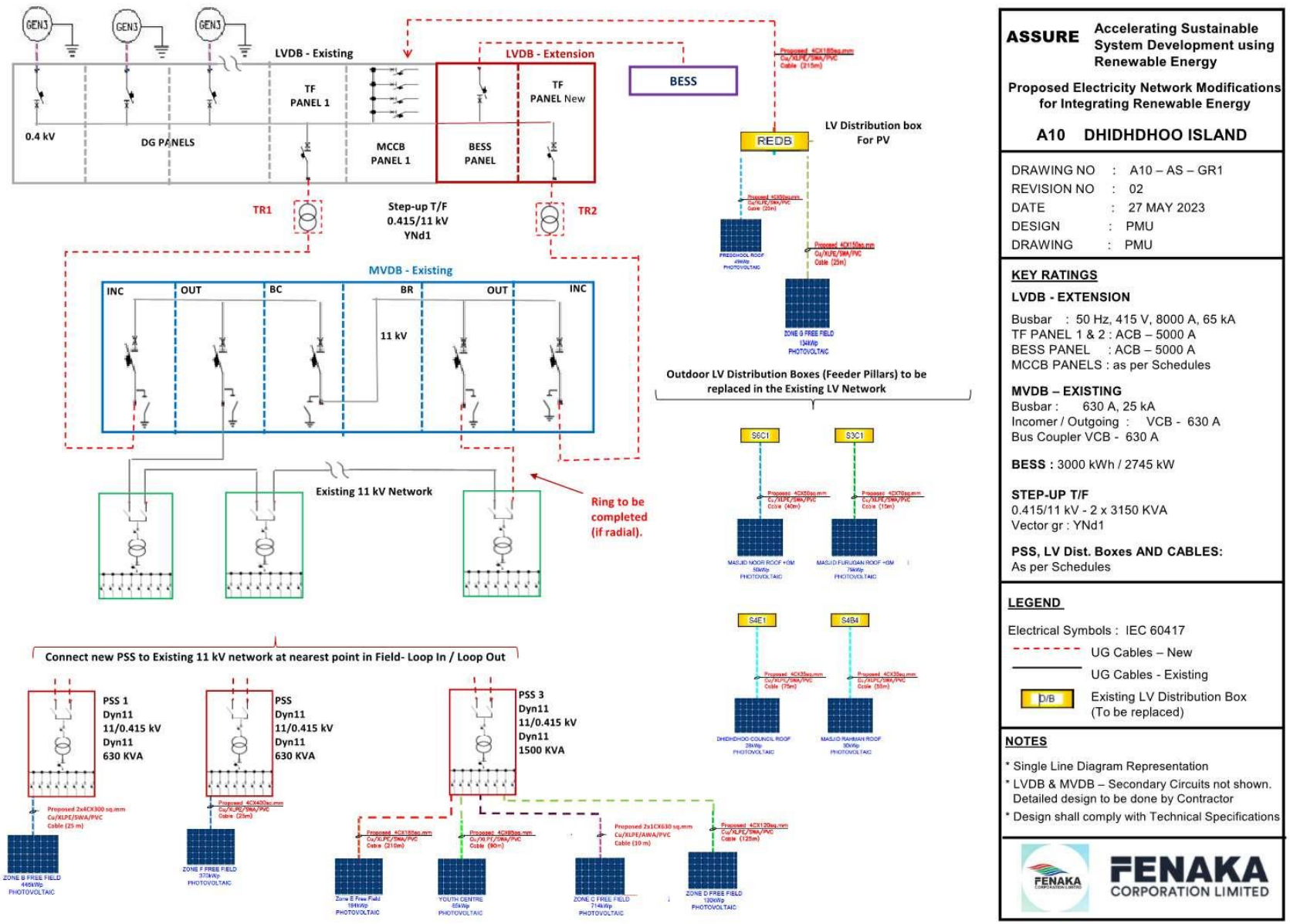

Figure 2-6 Single Line Diagram for Dhidhoo Island

3 Technical specifications

3.1 General

The following sections describe the general requirements for design, manufacturing, installation, testing and commissioning of all components related to Flow BESS and EMS.

Beside all the component specific documentation to be delivered, the Bidder shall also provide at least:

- For minimum technical requirements, Section 4, “Data Sheets”.
- A general Layout showing the overall design of the Flow BESS system including positioning of containers or any other choice of battery hosting structure, positioning of inverters, architecture of EMS, controllers, transformer, and grid connection of Flow BESS system. A two-dimensional drawing in PDF format is required.
- Proposed daily operation for the hybrid systems
- A general Single Line Diagram (SLD)
- A Single Line Diagram (SLD) of generator control panel and distribution panel
- Sizing calculations
- Cable schedules
- Modification design

3.2 Flow Battery Energy Storage System (Flow BESS)

The flow BESS mainly consists of the following parts:

- Storage Battery
- Battery Inverters

  Container

The system shall operate fully automated, be remotely monitored and be delivered as a turn-key system.

The flow BESS is mainly designed to support the Diesel Generator system with active and reactive power following the command of the EMS. The type of battery shall be a power battery that can deliver a high power for a short period of time.

The function of the flow BESS is to store and supply energy as required, in accordance with the hybrid system’s energy demand.

The battery energy storage system shall perform but not be restricted to the following functionalities:

- Power balancing: The flow BESS shall ensure an instantaneous active and reactive balance between load and generation. The system shall stabilize the frequency of the grid independently of the changes on load or renewable generation systems.
- Contribution to voltage regulation: The power electronics part of the system shall contribute to the voltage regulation of the grid, performing a proper management of the reactive power circulating in the grid.
- The measured DC round trip efficiency: ≧ 80 %

General additional requirements to the system operation:

- The flow BESS shall be maintenance free, meaning that no regular works or software updates shall be required for a continuous operation.
- The Bidder will inform about the requirement of some kind of preventive maintenance scheduling and the impact of these labours on the warranty terms and conditions of the system.
- The Bidder will also inform about the indicated personnel to perform the above-mentioned maintenance tasks (manufacturer, certified sub bidder, etc.)
- The flow BESS shall have low environmental impact. A life-cycle assessment in the product design and all the environmental considerations will be supplied by the Bidder.
- The Bidder shall provide all the safety considerations of the battery manufacturer about the system and shall supply all the ancillary systems that may be needed to avoid.
- The Bidder shall have a program for battery dismantling and return to factory after its operation life.
- Battery Management System (BMS) shall be equipped with the flow BESS. The BMS shall monitor the status of the flow BESS, store operation data, and remotely control the flow BESS in accordance with the EMS command control.

3.2.1 Storage Battery

Technical requirements of the storage battery:

- The storage battery itself shall then be composed of cell stack, electrolyte tank, auxiliary equipment like heat exchanger, pumps, sensors, and all of these shall be installed inside containers.
- The electrolyte of the storage battery shall be vanadium.
- The storage battery shall be able to deliver the minimum required power as specified in Chapter 2.5 (column "flow battery and battery inverter required minimum power") and

meet the requirements of minimum battery capacity at nominal discharge output (column “Minimum required flow battery capacity”).

- Recycling certificate: when the storage battery has achieved its end of life it must enter in a recycling program from the Manufacturer. The transport and shipment costs will be carried by the Employer. The Bidder shall provide a certificate proving that the Manufacturer agrees to receive and recycle the storage batteries according to international applicable standards.
- If electrolyte of the storage battery needs to be filled into the tank on-site, the necessary tools and equipment shall be transported.
- The cycle life and durability of the storage battery is a major requirement in the system. The Bidder shall provide components that full fill the following points:
  - The lifetime of flow battery applied shall be minimum 15 years, and 20 years as the norm, at DOD (depth of discharge) 100% at nominal output power.
  - Copy of the manufacturer's test report opened to public, submitted to external official agency, or published in reputable international journal shall be submitted in Technical Bid.
  - The Bidder shall submit the capacity calculation sheets with degradation ratio certificate of BESS to achieve requirements of capacities.
- Standards compliance
  - IEC62932-2-1: Performance general requirements and test methods
  - IEC62932-2-2: Safety Requirements
  - UL1973: Batteries for Use in Light Electric Rail (LER) and Stationary Applications
- The storage battery shall satisfy the following safety and environmental requirements:
  - Electrolyte tank shall provide a duplicated acid-resistant structure (i.e., having secondary containment), or the bund of 110% capacity shall be provided around the electrolyte tank to prevent electrolyte leakage even when the whole amount of the electrolyte flows out of the electrolyte tank.
  - Cell stack of the storage battery shall be UL1973-certified or compliant with UL1973.
  - The storage battery shall be compliant with Annex B (Safety Requirements for Stacks) of IEC62932-2-2 (Flow Battery Energy Systems for Stationary Applications - Part 2-2: Safety Requirements). The bidder shall submit past implementation results as evidence.
  - The bidder shall submit the seismic design document of the electrolyte tank and the battery container.
- Environmental condition shall be as follows:

- Ambient operating temperature: -5 to +40 degrees Celsius
- Operating humidity: 0 to 80 % RH
- Enclosure rating: IP54
- Maximum elevation: 1,000 m

- Earthquake resistance shall be as follows:
- Horizontal: 1.0 G
- Vertical: 0.5 G

3.2.2 Battery Inverters/Chargers

- The battery inverters shall be bidirectional and act as inverter and charger to storage battery.
- The battery inverters shall have capability to operate parallel in voltage source mode while Disel Generators are running as grid-forming element.
- For each island, the battery inverters must be able to deliver the required power as stated in Chapter 2.5 in both directions (nominal power).
- The overload capability of the inverter must be at least 150% of its nominal power for at least 30 seconds.
- Minimum conversion efficiency: ≥95% (one way)
- It is preferred to have the same size of battery inverters for 2 islands to be able to have a fast change from the spare part storehouse.
- For Type C islands, the battery inverters shall be configured for a ***grid building operation***.
- The battery inverters shall always be able to operate in parallel with a Diesel Generator and communicate with the EMS via Modbus/TCP.
- The battery inverters shall be able to operate in power-frequency-droop control. Adjusting of droop curves shall be possible during operation without a system shutdown.
- The battery inverters shall be able to provide sufficient short circuit power to the system. The required currents must be in accordance with the grid protection concept and the grid study.
- The Bidder shall be available on site for the repair or exchange of parts within 72 hours during the defect liability period.
- The battery inverters shall be equipped with suitable DC-breakers and fuses for the battery strings, they shall both be easily accessible and exchangeable.

- The battery inverters DC voltage range needs to fit the battery voltage range, to ensure a full utilisation of the installed battery capacity.
- On the AC side, the battery inverter shall be equipped with circuit breakers and disconnectors.
- The battery inverters shall have isolation supervision.
- The battery inverters shall be equipped with an initial charging circuit that allows charging from 0% SOC or a DC-DC converter capable of operating from 0V voltage.

3.2.2.1 *Active/Reactive power control function of battery inverter*

- The battery inverters shall be capable of active/reactive regulation of output power to meet the main power demand of the load in the P/Q operation mode. The maximum response time shall be less than 20 ms (twenty milliseconds) and must act faster than the Diesel Generators which has a response time of 20 ms.

3.2.3 Container

The Flow BESS system with cooling system shall be installed inside the container. The container shall be installed next to the FENAKA powerhouse where the genset power system is located. The potential installation sites for the flow BESS are shown in Figure 3-1. If additional space for installation is required, the Contractor shall submit the drawings showing required space for prior approval of Employer and/or Employer's representative.

Only under explicit Client authorization it would be possible to provide the system in a pre-wired ISO-Container that shall be installed next to the powerhouse. It is mandatory to use proper concrete foundations for the container. In case of powerhouse re-allocation, a pre-wired ISO-Container is mandatory. The following specifications for the flow BESS container have to be fulfilled:

- **The size of each container** shall not be more than 40HC feet type and shall accommodate equipment and component mentioned at Chapter 3.2.1, and shall be salt weather resistance finishing, to adopt local weather at least 20 years.
- **The substructure** shall be designed to withstand all dead loads and live loads including wind, ceiling, mechanical and electrical systems. For installation of container, flat concrete base of adequate size shall be designed considering the total weight of container. Substructure must be included ground beam, pad footing and reinforcement, and excavation not exceeding 900 mm from ground level.
- **Painting:** Two coats of emulsion paint on cement plastered walls and concrete surfaces to be applied. Exterior walls should be applied with weatherproof paint. Allow for applied 1-coats of Alkali Resisting primer on all plastered surfaces. The paint coating shall be suitable for hot and saline environments.
- **The air conditioning system** should have sufficient cooling capacity to remove excess heat from the battery room and maintain the temperature within the recommended

operating range for the flow BESS used. The system should be designed to ensure proper air circulation within the room, preventing the formation of hotspots.

- It shall be equipped with a redundant inverter air conditioning system, where a failure of one system will not lead to a complete failure of the battery system. A failure in the air conditioning system must be communicated to the operator via a control system. This can be done with a temperature sensor inside the battery inverter room. The air conditioning system shall be built using reliable brand of air conditioners which are available locally or which could be easily replaced with similar brands in local market.
- The ambient battery temperature and surrounding air humidity shall always be kept within the manufacturers' specifications.
- For a maximum cooling efficiency, the container of the Flow BESS must have a thermal insulation on walls, ceiling and floor.
- If containers are used, they shall be painted white, and coating must be according to corrosion protection class 5 for maritime environments. The container shall be salt weather resistance, waterproof, dust proof, vermin proof and body of container shall be electrically grounded and accommodate all above contains adopting local weather at least for expected life at 20 years, with proper maintenance instruction.
- IP54 standard shall be used for the ISO-Containers.
- A fire & smoke detection system shall be installed in all rooms/containers of the system. In case of fire, a visual and audible alarm has to be activated. The fire protection system shall be equipped with a UPS system to ensure functionality even in case of grid failures.

(a) The powerhouse in Nilandhoo Island

(b) The powerhouse in Dhidhoo Island

Figure 3-1 Potential installation sites for the Flow BESS (red rectangle).

3.2.4 Protections

3.2.4.1 *AC protections*

- AC overvoltage protection
- AC undervoltage protection
- Electromagnetic Interference filter (EMI) filter
- Grid voltage variations
- Frequency failures
- Asymmetric currents
- Voltage sag compensation

3.2.4.2 *DC protections*

- DC overvoltage protection
- DC undervoltage protection
- Inverter shutting down overload error
- Inverter system isolation detector

3.2.4.3 *Others*

- Output coil and IGBT over-temperature
- Breaker protections of auxiliary systems

Standards

The power storage system to be implemented must comply with international standards in the applicable fields, e.g.:

IEC 62932-1	Flow battery energy systems for stationary applications – Part 1: Terminology and general aspects
IEC 62932-2-1	Flow battery energy systems for stationary applications – Part 2-1: Performance general requirements and test methods
IEC 62932-2-2	Flow battery energy systems for stationary applications – Part 2-2: Safety requirements
UL 1973	Batteries for Use in Light Electric Rail (LER) Applications and Stationary Applications
IEC 61427	Secondary cells and batteries for photovoltaic energy systems
IEEE 1375	Guide for the Protection of Stationary Battery Systems.
EN 50272-2	Safety requirements for secondary batteries and battery installations.
EN 50178 / IEC 60950	Electronic equipment for use in power installations
IEC 62040-2	Uninterruptible power systems (UPS) – Part 2: Electromagnetic compatibility (EMC) requirements (IEC 62040-2:2005)
IEC 62093	Balance-of-system components for photovoltaic systems – Design qualification natural environments

3.3 Civil and Mechanical requirements

3.3.1 General

The design, execution and performance of civil and mechanical works shall follow the requirements laid down in the Maldives National Building Code 2008 and subsequently released compliance documents (e.g. Approved Document for Maldives Building Code Structure Clause B1 and Durability Clause B2), which shall be state of the art, functional and complete in all parts. Acceptable solution or verification method described in a compliance document is automatically deemed to comply with the Code.

Other alternative ways of design can be used, provided these can be demonstrated to the satisfaction of the regulating agency as meeting the required performance standards stipulated in the Building Code. These other methods are alternative solutions and need to be approved by the regulating agencies before a building consent can be issued based on the alternative solution.

3.3.2 Applicable Standards

The latest editions of the British Standards as per Approved Document for Maldives Building Code Structure Clause B1 and Durability Clause B2 are valid for the construction of structures. The list does not claim to be complete but serves as a minimum framework for all works.

3.3.3 Earthworks

3.3.3.1 *General*

The design and execution of the earth works shall be state of the art, functional and complete in all parts. The site investigation shall be carried out in accordance with BS 5930-2015; Code of Practice for Ground Investigations and BS 1377; Method of Test for Soil for Civil Employing Purposes.

This specification applies to all earth and rockwork required for the construction of buildings, any types of structure and burying service lines in the ground as well as to excavation works in connection with pavement, roadwork and landscaping as far as earthwork is concerned and deals with the handling and disposal of the materials to be re-used or taken to soil dumps on or off site.

The Bidder shall satisfy himself as to the on-site conditions on the site including the nature of the strata to be excavated, obstructions, etc.

Generally, shelter, foundations, slabs and other structures shall be founded on form bearing strata by means that all excavation work for foundations shall meet the requirements of structural analysis based on the results obtained from the soil investigation and of the available information.

Excavation shall be done to the required dimensions including required working spaces and shall be finished according to the specified lines and slopes. All necessary precautions shall be taken to cause the minimum possible alteration or disturbance to the material lying under and adjacent to the excavation final lines.

Excavations below ground-water level must be approved by the Employer and kept water-free. Contractor solely shall assume the full responsibility for both shoring and strutting of excavations and for dewatering operations.

The fill materials used are to be examined and approved. Excavated materials can be used if they can be compacted to the specified / required densities in a reasonable length of time. It shall be free of highly plastic clays, of all materials subject to decay, decomposition or dissolution, and of cinders or other materials which will corrode installed materials.

Compaction below foundations is to be performed with approved equipment, properly adjusted for the type of excavation to be compacted and the fill material to be used. After placement, even distribution, and correct adjustment of the moisture content of the fill material, it is to be compacted to at least 95 % Proctor compaction density. If the specified density cannot be achieved the material shall be excavated and disposed of as unsuitable material.

If applicable the backfilled or reinstated areas shall be protected against washouts or erosion by a layer of rip rap and the Contractor is also responsible to provide adequate flood prevention measures in and around the area of all installed facilities. The used materials must be weather- and water-proof and must not suffer any ill effects through the action of seawater.

The earthworks shall also include all landscaping works as required.

3.3.3.2 *Execution (Assembling, Installation)*

All execution works shall be in accordance with the specification.

The works shall be excavated either by hand or by use of excavating plant and tools accepted by the Employer.

Excavation by hand is required mandatory close to existing installations (if any) and/or underground services.

The Bidder shall carry out all kind of earth and rockwork for the following works as defined hereafter (where applicable):

- Clearing and grubbing
- Excavation of top soil
- Open cut excavation including shoring and dewatering as required
- Backfilling
- Safety precaution during earthwork
- Grading
- Replacement of material
- Trench excavation for service lines
- Embankments and erosion protection
- Landscaping

3.3.3.3 *Safety Precaution*

The Bidder shall be responsible for all necessary safety measures.

Proper strutting, sheeting and bracing, including re-arrangement of the installations when necessary, stabilization and protection of slopes, methods of excavation to reduce risks of slides shall be Bidders responsibility. The additional moving of soil resulting from such damages shall not be considered as additional work.

3.3.3.4 *Protection of Existing Utilities and Services*

During construction, the Contractor shall provide all protection for existing utilities and services as required for construction operations.

In addition to the requirements specified herein, the Bidder shall comply with the following requirements.

Use all necessary precautionary and protective measures required to maintain existing utilities, services and appurtenances that shall be kept in operation. In particular, the Bidder shall take adequate measures to prevent undermining of utilities and services presently in services.

Protect existing or new utilities and services where required by the Bidders operations and/or as required by the Employer. The Bidder shall be responsible for bracing and supporting utilities and services to prevent settlement, displacement or damage.

3.3.3.5 *Dust Control*

The Contractor shall use all means necessary to control dust on the construction site.

Surfaces shall be regularly watered to prevent dust becoming a nuisance for the public and interfering with the proper execution of the works. Waste oil is not permitted for the use as dust control.

3.3.4 Foundations

3.3.4.1 *General*

Foundation works shall be performed so as to ensure the bearing of all loads without detriment for and damage to the structures. The Bidder shall choose up to date methods and equipment in accordance with relevant internationally recognized standards.

3.3.4.2 *Civil Design*

The design and engineering shall be state of the art in accordance with all relevant codes and standards, functional and complete in all aspects.

3.3.4.3 *Design Criteria for Layout, Arrangement, Drawings, Execution*

3.3.4.4 *Foundations*

Foundations for structures, equipment, transformers (with oil containment) or Flow BESS are described where the foundations rest on the natural bearing soil. Design of such foundations shall meet with the safe loading requirements and in line with the relevant international standards. Depth of foundations shall be according to design criteria of sub-structures.

Contractor shall bear all costs for any soil improvement.

3.3.4.5 *Shop Drawings*

The Bidder shall prepare and submit for the Employer for approval, shop drawings showing in detail, profiles, sections, jointing, cast-in items, reinforcing, anchorage and fastenings to be employed in this work. The Bidder shall be fully responsible for the design of any supplementary steel reinforcement required to withstand handling and erection stresses. This reinforcement shall be clearly indicated on the shop drawings.

Approval of shop drawings shall not relieve the Bidder of responsibility or liability for structural failures of fastening devices supplied by him or for damage of any kind during handling and erection.

3.3.5 Specifications for concrete structures

All buildings, equipment and material used must withstand environment with high humidity, salinity and temperature over the power plant life time.

This specification refers to exposure class 'Aggressive, with Chlorides and Sulphates' which is applicable to any structure exposed to occasional spray or splash from seawater or discharge water and any structure in the ground or in contact with the ground up to 0.5 m above ground elevation.

Materials (cement, aggregates, water, admixtures etc.) and mix design shall be selected in order to withstand the exposure class for the lifetime of the plant.

3.3.5.1 *Materials*

Concrete constituent materials shall mean the materials which are used in the concrete mix, as specified in this chapter or as otherwise agreed in writing. The materials shall be obtained from approved sources known to produce the required quality and with no adverse effect on the durability of the concrete.

The Contractor shall obtain the approval of Employer in writing for all materials before they are brought to site. To obtain the approval of a proposed material, the Contractor shall submit a fully documented request stating:

- type of material;
- for which mix it is intended to be used;
- to which part of the specification it refers;
- name and address of source, manufacturer, and supplier;
- representative samples;
- reference list for similar application;
- relevant test results;

The samples will be kept for reference for the duration of the project. The test results shall include the outcome of the tests specified in this chapter. Where more than one test has been performed, the results shall be presented as average, minimum and maximum values.

Employer has the right at any time to withdraw approvals and/or to reject any material if the subsequent production test values deviate from the approved pre-test values, or if in their opinion the material does not meet the objective of the works. Employer shall have access to all sources of supply and to transport and storage facilities for the purpose of inspection and sampling.

3.3.5.2 *Design and Pretesting of Mix*

The Contractor shall select constituent materials and design his concrete mix in compliance with the environmental conditions. He shall through the specified sampling and testing, including the specified documentation from trial mixing and production trials, demonstrate that he has fulfilled these requirements.

The documentation shall be submitted to the Employer for approval in adequate time before the planned start of concrete production for permanent works. No concrete shall be placed in the permanent works until the pretesting has been completed, documented, submitted, and accepted in writing by the Employer. However, for blinding layers pretesting shall be limited to documentation of materials and compressive strength.

The pre-tested and approved mix design shall not be changed without prior written approval from the Employer. However, the approved admixture dosage may be changed +-25% as required to ensure consistent concrete properties, without prior approval, but always subject to the condition that the total amount of admixture shall be within the limits recommended by the manufacturer and within limits documented by pre-testing to give an acceptable quality.

The Contractor shall keep written records for all materials used in the works, to show that they have been tested and found in conformity. This applies also to any ready-mix supply. The Contractor shall furthermore keep records of the production quality control.

3.3.5.3 *Concreting Workmanship*

3.3.5.3.1 Planning and Documentation

Before any concreting is allowed to proceed, the following shall have been fully documented by the Contractor, found compliant, and accepted by the Employer, all in accordance with relevant chapters of this specification:

- concrete materials and pretesting of concrete production;
- a specific method statement with a comprehensive planning documentation for each casting;
- inspection of excavations, construction joints, water stops, forms, reinforcement and embedded items;
- Contractor’s notice confirming that the above has been completed and that he intends to cast the concrete.

3.3.5.3.2 Placing and Compaction

Concrete shall be delivered as close to its final place of deposit as practically possible, as quickly as possible, and always within the time limits and the temperature limits specified.

All handling of the fresh concrete into its final place of deposit shall be completed as quickly as possible and always before the initial set, by methods which will prevent segregation and loss of ingredients and in a manner which will assure that the required quality of concrete is

maintained. ACI 304R cl 5.1 (General Considerations) shall apply unless otherwise stated or implied in this specification.

Concrete shall not be allowed to drop into place from a height of more than 1 meter, and dropping concrete shall not be disturbed in its vertical fall by hitting reinforcement, etc, which may cause segregation. Where necessary to limit drop heights or to avoid segregation, placing shall be by means of trunks, chutes, buckets, hoppers, etc. ACI 304R cl 5.4 (Placing) shall apply unless otherwise stated or implied in this specification.

Pumping, if used, shall be controlled so that segregation does not occur in the discharged concrete, and the loss of slump shall be within pre-determined limits.

At no time shall the fresh concrete be in contact with aluminium or aluminium alloys.

All equipment which is used in handling fresh concrete shall be kept clean and free of hardened concrete. Under no circumstances shall spilled concrete or hardened concrete be allowed to enter into the permanent works.

Compaction shall be performed to ensure that the concrete becomes a dense, homogeneous mass, completely filling the form and surrounding the reinforcement, thus achieving the desired strength, appearance, and durability.

Concreting shall not take place during rain or during storms, or until rainwater and dust has been removed from the form after such events.

3.3.5.3.3 Making good of Defects

While certain casting defects may occur in spite of all precautions, the Contractor shall do his best to minimize such defects, and he shall adjust his methods if the number, size or type of defects in the opinion of the Employer gives reasonable cause for concern.

All defects after casting shall be recorded by the Contractor and brought to the attention of the Employer before any making good is carried out.

The making good shall comply with the following minimum requirements which are intended for normally occurring defects of limited and acceptable extent.

Any defect which in the opinion of the Employer is frequent or large or unusual, including any defect which is not covered by this specification shall be subject to a specific procedure to be proposed by the Contractor for the Employer's acceptance.

Repairs will be accepted only if they can bring the structure to the quality level of a well build new structure. If this cannot be achieved and documented, the faulty work shall be replaced.

If it is found that a significant amount of voids, cavities, honeycombs, etc, is concealed behind a surface skin of laitance or mortar, then the Contractor shall expose the full extent of the defects by sweep-blasting or by a similar method to the approval of the Employer.

3.3.5.3.4 Temperature during hardening

The maximum temperature in the concrete during hardening shall not exceed 55°, unless the Contractor can document to the satisfaction of the Employer that a higher temperature will have

no detrimental effects on the strength and durability (crack-width due restraint forces) of the structure. The documentation shall take into account that higher temperatures may cause larger pores and lower durability in the concrete.

The Contractor shall always minimize thermal cracking by proper planning of the work and by taking precautions to minimize temperature differences. Thermal cracks are likely to develop in massive structures (smallest dimension more than 0.5 m) and structures with restrained movement in the hardening phase (e.g. wall/slab) unless adequate measures are taken.

The particular amendment to the standard specification may state specific limits to the acceptability of cracks in certain structures; the Contractor shall take all necessary precautions to comply with such specified limits, including but not limited to precautions mentioned in the following guidelines.

The Contractor's planning and methods for temperature monitoring and control shall be submitted as a part of the relevant method statement. It shall be revised if experience on site shows that the adopted methods do not lead to the desired results.

Any crack which occurs in spite of the planning shall be injected to the satisfaction of the Employer, or other measures shall be taken if in the opinion of the Employer they are needed to achieve an acceptable and compliant structure.

3.3.5.3.5 Protection against Evaporation

Concrete shall always be protected against evaporation during hardening. Particular care must be exercised to implement the curing at the earliest possible stage during periods of high temperature, low relative humidity, or strong winds which alone or in combination can cause extremely rapid drying-out.

Curing shall be performed for a period of not less than 14 days. The Contractor shall keep a log record with starting and completion dates plus dates of all specified curing operations.

3.3.5.3.6 Construction Joints

Construction joints are the joints between different pours. Such joints shall be pre-planned and kept to the minimum for the execution of the work, and they shall take into account structural requirements as well as requirements to appearance. Keys or other details may be specified in the particular amendments to the specification or in the drawings, and shall always take priority over the requirements specified in this section.

Joints which are not shown on the drawings but which are considered desirable for practical reasons shall be proposed by the Contractor for the Engineer's approval.

If kickers are used at wall or column bases, it must be ensured that the concrete in the kickers are compacted and cured in accordance with this specification. Kickers at walls shall be poured in one go with the base slab.

The alignment of joints shall generally be straight, horizontal or vertical, parallel or perpendicular to adjoining parts of the structure.

Vertical joint faces shall have a formed surface; horizontal joint faces shall be level and flat.

Reinforcement shall continue across joints.

3.3.6 Protection of Concrete

Protection of concrete as specified in this chapter shall mean blinding's, membranes, coating systems, etc., which shall be applied for the purpose of protecting the finished concrete structure against exposure to action or substances which may cause deterioration of concrete and/or corrosion of reinforcement.

3.3.6.1 *Protection on Concrete Structures in Contact with the Ground*

Foundations and concrete structures in contact with the ground shall have a protection on all earth-covered faces of the underground part as follows:

All sides and any earth-covered top of such structures shall be protected by a bituminous coating system consisting of:

- a penetrating bituminous primer applied in one coat;
- a high build bituminous coating with a content of fibres, applied in minimum three coats;

The total dry film thickness of the coating shall be not less than 1.0 mm.

The bottom side of the structure shall be protected by a preformed membrane. Tanking may be provided by a flexible self-adhesive impervious composite sheeting of a total thickness not less than 1.5 mm consisting of a sheet not less than 0.3 mm thick of three layer cross-laminated high density poly-ethylene, and a rubber-bitumen compound.

All preparation, priming, ancillary materials, accessories, details and workmanship for the application shall be in strict accordance with the manufacturer's recommendations.

The overlap between the membrane under the structure and the coating on vertical faces shall be detailed by the Contractor to the satisfaction of the Employer, making sure that all faces remain protected.

The bottom-protection membrane (on the blinding concrete) shall be protected by a concrete overlay and shall be laid on a concrete blinding and protected by a concrete overlay of minimum 50 mm thickness.

3.3.6.2 *Protection on Concrete Structures above Ground*

Sea-walls and similar shore-line structures directly facing the sea shall be considered as being in a splash zone even if they are standing on the shore above the high-water level. Where such structures are exposed to spray from the surf, it may be necessary to treat them as splash zone in their full height.

Splash zones and tidal zones of structures standing in the sea shall be coated from 2 m below lowest low-water level and to the top of the splash zone. The extent of the splash zone shall be defined in the design drawings but shall generally not be less than 4 m above mean sea level.

Higher levels may be relevant where the structure is exposed to surf, large waves and/ or large tidal variations.

The coating shall effectively seal the concrete from ingress of chlorides and sulphates and it shall have adequate flexibility to follow temperature movements on exposed faces without cracking. The coating shall be durable and resistant to warm saline sea-water, wave action, and UV exposure; the coating should be easy to repair and re-apply and must be available in light colours.

The successful performance of the complete coating system shall be documented on basis of similar applications in marine structures under similar climatic conditions. The guaranteed minimum service life shall be at least 15 years.

The system shall at least be equal to an epoxy-polyurethane system (solvent free epoxy base coat followed by polyurethane topping). It shall always be obtained from a well reputed manufacturer with a fully documented record from similar applications, and it must have documented test results to show that it is effective in stopping chloride ingress. The work for an epoxy-polyurethane system shall as a minimum include:

- sweep-blasted of the concrete surface to remove any loosely adhering matter;
- making good of casting defects after the sweep blasting;
- apply levelling layer of approved cementitious material;
- apply primer/sealer if recommended by the manufacturer, followed by minimum three applications of high-build layers to a minimum total dry film thickness of 350 microns, or a thickness as stated in the manufacturer's guarantee;

3.3.7 Structural Steel Work

3.3.7.1 *Material*

The steel qualities for the individual construction elements are to be chosen in accordance with UBC, chapter 22, structural steel. The steel quality is to be verified by the manufacturer's certificate.

Other types of steel may only be used after thorough tests of the technological properties and acceptance by the Employer.

3.3.7.2 *Workmanship*

3.3.7.2.1 Drawings

All necessary drawings for the manufacture and erection must be prepared in accordance to the general time schedule and approved prior to commencement of work.

The shop drawings shall clearly indicate all different items with respect to the erection work.

A separate material recognition list shall be prepared for each building.

The item numbers in these lists must be identical to those shown in the shop drawings.

3.3.7.2.2 Design and Construction

Buildings and structures must be designed for seismic loads. SBC shall be followed.

Compatibility of dimensions and setting-out data of steelwork shall be verified by the Contractor before fabrication of steelwork commences.

All joints and connections are to be made by welding or by means of screws.

The tolerances for the steel structure must be in accordance with those for the other parts of the building.

Attention must be given to the effects of temperature fluctuation on the steel structure.

The Contractor shall make all necessary expansion joints. Movement shall be made possible by providing double columns.

The Contractor shall allow for deformation due to permanent loads and the process and sequence of fabrication, erection and construction such that the completed steelwork is within the specified tolerances.

Braces (wind braces and gable walls) which resist live loads and assure stability of the building are to be used for buildings.

Connection design shall provide adequate access for welding and inspection during fabrication. The profile of the joint shall enable satisfactory non-destructive testing to be carried out.

Special attention is drawn to the deflection limitations of the steel structures.

The maximum deflection of trusses, floor beams and girders may not exceed 1/300 of the span. For trusses the deflection due to dead load may be compensated by super elevation. The maximum deflection of rafters and spars must be less than 1/400 of the span.

The design loads for buildings are to be taken from SBC and AISC standards.

A velocity of 45 m/sec is to be assumed for calculation of wind loads.

Additional to wind loads a vertical live load for roofs is to be calculated with 1 kN/m2. Live loads for flat roofs have to be chosen according to the purpose of use.

3.3.7.2.3 Erection Program

Before starting the execution of the works, the Contractor shall furnish a detailed programme according to the general time schedule. Each month the Contractor shall provide a progress report in duplicate to the Employer, indicating the progress of work.

The Contractor shall be solely responsible for the accuracy of all relevant dimensions of the structure.

3.3.7.2.4 Manufacturer's Instruction

All work at site, i.e. handling, storage and erection shall be carried out strictly in accordance with the manufacturer's instructions and recommendations.

3.3.8 Brickwork

3.3.8.1 *Materials*

Clay bricks and blocks, calcium silicate bricks and concrete bricks and blocks shall comply with the relevant requirements of BS 3921, BS 187, BS EN 772-2, BS EN 772-3 and BS EN 771-3 respectively. The dimensions of special bricks shall comply with BS 4729.

Clay bricks and blocks, calcium silicate bricks and concrete bricks and blocks shall comply with the relevant requirements of BS 3921, BS 187, BS EN 772-2, BS EN 772-3 and BS EN 771-3 respectively. The dimensions of special bricks shall comply with BS 4729.

The Contractor shall supply the brick samples of each type to be used together with the test certificates for crushing strength through the independent laboratory to the Employer for his approval. The crushing test shall be fulfilled according BS EN 772-2. Separate samples of each type of block taken at random from loads delivered shall be deposited for approval by the Employer. The Employer will reject any load or part load which would be determined below the required strength, uncured, under or over the required size, damage or to have any other defect which may consider detrimental to the work concerned.

Bricks and blocks shall where practicable be grooved or keyed where they are to receive plastering or rendering.

3.3.8.2 *Workmanship*

Unless otherwise specified, brick and blockwork walls shall be constructed in accordance with the recommendations of BS EN 1996.

Prior to the laying of any facing brickwork, sample panels 900 mm by 600 mm of each facing brick shall be built using mortars made with different fine aggregates, white or coloured cements, or colouring agents as directed by the Employer. When the required ingredients for the mortar have been determined and approved by the Employer they shall be used for all mortar for facing brickwork and the appropriate test panel shall be retained for reference and shall represent the standard to which all facing brickwork shall conform.

Reinforcement has to be applied in accordance with static requirements, fire rating etc.

Lugs galvanized mild steel butterfly type shall be provided at all junctions between block walls and reinforced concrete columns. These lugs are to be cast into reinforced concrete columns and built into ends of exterior wall panels. They shall be spaced vertically not exceeding 450 mm.

3.3.8.3 *Mortar for brickwork and blockwork*

Cement shall be ordinary Portland cement. Lime shall be hydrated high calcium lime or hydrated semi-hydraulic lime to BS EN 459-1. Sand shall be clean natural sand free from clay or clay film over the grains or shall be crushed natural stone of approved quality.

Both sand and crushed stone shall be to BS EN 13139. Water used for mixing mortar shall be from the same source as water used for concrete.

Lime mortar shall be used for brickwork and blockwork above the ground level damp proof course unless otherwise specified or ordered by the Employer. Such mortar shall consist of cement, lime and sand in the proportions of 1:1:6 unless otherwise specified or ordered by the Employer.

Cement and lime shall be stored at the site in a perfectly dry structure and all consignments shall be used in order of delivery. Cement and lime affected by dampness shall not be used in the works.

Vertical damp proof courses shall be approved at all door and window reveals and shall comply with BS 8215.

Contractor shall also make provision for pocket chases etc. for electrical and other installations.

Mortar shall be mixed and used in accordance with clauses 2.1.2 (3) of BS EN 1996-2 including PD 6697 (recommendation for the design of masonry structures to BS EN 1996-1 and BS EN 1996-2).

Where approved by the Employer, plasticizers or proprietary masonry cements may be used as an alternative to lime in the mortar. In this case the proportions of the mix shall be based upon the manufacturer's instructions but shall be to the Employer's approval.

All engineering brickwork and brickwork below damp proof course level shall be built using cement mortar.

3.3.8.4 *Joints in brickwork and blockwork*

Joints shall be broken accurately and the thickness of bed joints shall be not greater than 12 mm and not less than 9 mm.

Facing brickwork shall be finished with weathered joints 3 mm deep formed before the mortar has set.

Brickwork or blockwork for internal surfaces which are not to be rendered or plastered shall be fair faced with a flush joint made as work proceeds.

Joints in brickwork or blockwork which is to be rendered or plastered shall be raked out to a depth of 5 to 10 mm.

Separation joints shall be formed by inserting approved joint filler 10 mm thick. 4 weeks after the bricks have been laid the filler shall be raked out to a depth of 20 mm and the joints shall be pointed with mortar.

3.3.9 Painting

Subject of this specification are external paints on plaster and concrete as well as internal paints on plaster, concrete, gypsum and metal.

3.3.9.1 *Materials*

All materials are to be delivered to the site in original barrels. At the latest after the drying none of the paints or coats used shall cause any odour nuisance. For control purposes the individual paints are to be different in shade as far as oil-and varnish-paints are concerned.

External paint on plaster areas:

This paint is to be carried out with plastic dispersion. It is to be capable of breathing, shall be rain-tight and completely resistant against exhaust gases of any kind. The paint is to consist of a prime coat and a finish coat. According to the suction capacity of the base, thinning with water of up to 50 % is allowed.

As far as the finish coat is concerned, the thinning is limited to 10 % however.

External paint on concrete:

This paint is to be conducted with concrete scumble glaze. It is to be capable of breathing, shall be lightfast, weather resistant and hardened against exhaust gases of any kind. The surface of this paint is to be glazing. The paint consists of a prime coat with undiluted colour and a finish coat with the same colour. The drying times between the individual paints are to be strictly adhered to.

Internal paint on plaster areas:

This paint is to be conducted with plastic dispersion. It is to be capable of breathing, shall be lightfast and wash-resistant. The paint consists of a prime coat, the so-called impregnation base, thinned up to 30 % according to the suction capacity of the base. This paint is not to rest glossy (bright) on the surface.

The second paint also consists of dispersion, however, thinned up to 10 % only. The third paint is to be thinned up to 5 % only.

Internal paint on concrete:

This paint is to be carried out exactly in the same manner as external paint on concrete. Special attention shall be paid that the finish concrete surface shall be either semi glossy or mat to avoid any reflection caused by the lighting system.

Paint on metal:

The paint on metal consists of three coats, i.e. a prime coat by twofold application of protection against corrosion according to specification. Holes, cracks etc. are to be levelled with suitable sealing material. Onto the prime coat a rubbing varnish paint of impact resisting rubbing varnish is to be applied. After the drying of the rubbing varnish the finish varnish coat is to be applied with silky lustre varnish. Structural steelwork is to be painted according to specification sections above.

3.3.9.2 *Workmanship*

For the respective paints sufficiently big samples with at least three gradations of colour are to be mixed.

The base is to be cleaned of all contaminations, influencing the paint and its adhesion capacity respectively. Loose plaster and damages respectively are to be removed or to be repaired with the same material. For repairs of plaster gypsum is to be used by no means.

The repaired surface is to be in accordance with the original surface; no application points are to show. The surfaces to be painted are to be absolutely dry, formwork lube residues are to be removed from concrete surfaces and to be pre-treated respectively so as to guarantee a perfect adhesion of the paint without spotting. Dispersion paints are to be applied with a lambskin roller, at places of difficult access suitable brushes are to be used. The paints are to be applied in such a manner that the painted surface appears as uniform surface without application points, strips, brush streaks, splashes etc. Separation lines between paints of different colours as well as delimitation lines are to be sharp and clean.

Painting works outside are to be carried out at the most favourable weather-conditions prevailing for the respective kind of paint. No painting works are to take place if the temperature of the base or the surrounding air is above 50°C.

The temperature limits indicated are to be adjusted correspondingly when using special materials. The paints are to be applied in such a manner that they appear as uniform surface without application points, strips, brush streaks, splashes etc.

Separation lines in the paint as well as delimitation lines are to be sharp and clean. In addition to the visual check on the paints pine hole check and dry film thickness shall be required by using appropriate equipment to conform the continuity of the painting and also the thickness of the coating.

After the completion of the paint the ground and body colours used, the method of rust removal, as well as year and time of the paint (from ... to ...) are to be indicated at an easily visible place with varnish paint of corresponding hiding power and durability.

Because of excellent readability the text is to be written in sufficiently big letters and numbers. The examination of the paints is conducted according to the following method:

- Degree of rust removal
- Thickness of the prime and finish coats
- Overall dry layer
- Non-porous state
- Observance of the working conditions
- Observance of intermediate and final drying times

Wings of doors and gates are to be treated in horizontal position. All surfaces, objects, fittings etc. which are subjected to the danger of contamination or damages are to be covered or otherwise protected according to the circumstances. Paints not in compliance with the specification are to be removed; these surfaces are to be coated again with the corresponding paint.

3.3.10 Water Proofing

The waterproofing of the usable areas for the roof shall be guaranteed for 10 years for material, workmanship and other liabilities which may be caused by leaks/failure of the system. The guarantee provided by the Bidder shall be supported by manufacturers guarantee for the same period.

3.4 Energy Management System – EMS

This chapter describes the minimum overall requirements for design, delivery, installation, testing and tuning of the overall Energy Management System (EMS) which shall be obligator fulfilled by each EMS located at the individual site locations.

The EMS shall provide interactive control and monitoring for specific parts of the PV power plants, the Flow Battery Energy Storage Systems (Flow BESS), Diesel Generator station and auxiliaries, as defined in this specification. Furthermore, all alarms and indications shall be available on Operator workstations. The workstations shall be located close to the Diesel Generator station or in the control room of the already existing Diesel Generator station. The EMS will be fully compatible with existing *D-hybrid* central SCADA located in Male.

It is within the scope and responsibility of the Contractor to design the details in especially with respect to the technical features and possibilities of the EMS System family and components finally selected for realization.

Special functions and / or exceptions and add-ons dedicated to the individual PV plants are listed in a separate specification dedicated to each plant.

3.4.1 General Requirements

3.4.1.1 *General Approach*

The system shall be a state of the art, field proven system based on microprocessor technology. The architecture shall foresee distributed intelligence comparable to an automated real-time control system for data acquisition, processing, transmission, storage and archival, graphical presentation and display.

All components shall be of approved and reliable design with the highest attainable attributes for uniformity, interoperability and interchangeability. The design shall be modular to facilitate easy maintenance, fault diagnosis and repair of the components, and to support installation and expansion in increments.

The minimum data logging interval for all relevant parameters will be defined by the Employer during detailed design. The systems should have enough data storage capacity to store data up to 2 years. The storage process has to be managed automatically.

The EMS System provided by the Contractor should be easily adjustable to operate either with or without BESS with no need of extra specialist.

3.4.1.2 *Scope and Limits*

All components for the EMS, interfaces and interconnection at the defined destinations, including all equipment for safe, undisturbed and reliable operation, cabling, connectors, patch panels, accessories, tools, software, even if not mentioned explicitly in this document are within the scope of the Contractor.

All required interfaces and switches shall be included and provided by the Contractor.

The Bidder is responsible for delivery of the operational EMS. This includes the design, documentation, certification, supply, delivery, installation, testing and commissioning of EMS, including all associated balance of plant, meeting the functional requirements of this specification.

The scope shall include the replacement of the existing EMS on each island with a new system. The new EMS must be integrated with the existing DG, PV sites and batteries.

The scope shall also include training and capacity building of local staff to operate and maintain the system as well as provide warranties for equipment and workmanship and performance guarantees and defects liability for the complete system as a whole.

The works shall include but not be limited to the following:

- Design of the EMS
- Supply and installation of EMS including:
    - Programmable logic controllers (PLCs)
    - Software packages to allow plant operators to interrogate (and troubleshoot) the system
    - Racking and cabinets
    - Power supply converters
    - Cables and communications and media converters as required
        - All local communications at the power station, including any supporting infrastructure such as power supplies, cabinets, etc. are the responsibility of the Bidder
        - Communications to remote solar PV plants will be via fibre optic cables will be provided by others. Bidder is responsible for interfacing to this communications infrastructure.

    - Configuration settings and application backup (in native file format)
- Supply and installation of any required structures, footings, cable management
- All system lightning and surge protection as required.
- All system earthing and equipotential bonding as required, including interface to existing earth grids as relevant.
- Co-ordination with the site owner for access and coordination of activities.
- Submission of documentation as per the documentation deliverables list.
- Provide training and capacity building of local staff in the operation, maintenance and safety of the system.
- Supply of all required spares as per the contract, including storage cabinet or equivalent.
- Supply of a full set of tools required for the maintenance and operation of the system.
- Ensuring compatibility with existing equipment and other plant supplied by the Bidder – especially ensuring that the existing controllers, meters and subsystems are also compatible with the procured equipment.
- Assess data available from existing plant (Diesel Generator controller), BESS and solar PV inverters and ensure that all information required for the effective operation of the EMS is available on the EMS.
- All required interfaces and switches shall be included and provided by the Bidder.

3.4.1.3 *Bid Documentation*

The bid documentation shall describe

- The full system functionality,
- The main system components,
- Performance and parameters (data sheets),
- redundancy and/or failure measure concept,
- communication interfaces,
- a backup and recovery concept for the EMS,
- anti-virus and malware protection,

3.4.1.4 *Spares and spare capacity*

Spare capacity on hardware level:

A minimum spare capacity at hardware level of 20 % shall be considered in the design.

Spare capacity in data network and signal transmission and processing:

Signal transmission and processing have to be prepared with sufficient capacity and spare in bandwidth, bitrate, reliable termination etc. to guarantee the reliable function of the plant.

Spare capacity

- Provide expansion capability to add or reconfigure Flow BESS, solar PV, or Diesel Generators over the EMS life (up to 20% of initial connections as spare)
- All Input/Output modules shall include minimum 20% spare capacity.
- Spare capacity in data network and signal transmission and processing:
- Signal transmission and processing have to be prepared with sufficient capacity and spare in bandwidth, bitrate, reliable termination etc. to guarantee the reliable function of the plant.

Spare parts

- key parts (that cannot be readily repaired or replaced within 5 days) of the EMS must have spares provided. Where applicable, spares must be pre-programmed with the same program and parameters as the operational equivalent.
- All supplied spare parts shall be of same material / workmanship and interchangeable with the corresponding parts of the executed work, protected against corrosion, have identification labels.

3.4.1.5 *Spare Parts and Special Tools*

All special tools required for the operation and maintenance of the system shall be provided by Bidder.

The Bidder must provide sufficient information so that the Employer can order replacement parts for the EMS as required. Supplied spare parts and tools shall be listed in detail, including, manufacturer, model, part number, stockist, present cost and typical lead time during the design review stage.

3.4.2 Main functionality

3.4.2.1 *High Diesel efficiency*

Respecting the limits of grid stability and energy spinning reserve, the system shall always be running on the generator point where the highest efficiency of the diesel system can be achieved and at the same time the maximum available PV energy to be fed in the system.

Therefore, the EMS shall chose the smallest possible Diesel Generator and have it running on a high percentage of its rated power. If sufficient PV energy is available and the system is already running with the smallest generator, the EMS will allow the DGs to go down to its minimum load and even underneath this minimum load for a certain time, depending on the manufacturers specifications. In any case the EMS always has to take care that there is no reverse current in any of the three phases.

3.4.2.2 *Maximum PV energy to be used*

In order to have the highest benefit of the solar power, the EMS should not cut the PV power until a certain minimum level of power production of the DG is reached and the Flow BESS are charged up to a predefined maximum level. The minimum and maximum limits of the Flow BESS shall be variable and are set at the commissioning of the system.

The system shall be designed in order to allow a DG with maximum rated capacity smaller than the actual load in the system running in parallel to the Flow BESS and the PV system, if there is enough energy from the PV system available.

3.4.2.3 *Emergency Mode*

It is mandatory that an emergency mode for the PV inverters is implemented. This mode will automatically be activated in the PV inverters, once the communication to the EMS is lost due to component failure, communication cable break or any other reason.

Once the communication is lost, the PV inverter shall automatically change into emergency mode. The PV inverter shall then work as a normal grid connected inverter that is limited in it's output power to a certain value that is to be set during commissioning and shall be easily adjustable by the operator at a later stage if necessary.

All other parameters on the inverter shall also be easily changeable for this specific mode and may be different to the normal operation.

3.4.2.4 *System stability*

Either Diesel Generator or Flow BESS can act as frequency and voltage regulator (multiple master concept) and be supported by PV system with reactive and active power to serve the demanded energy.

BESS shall always be able to support the system, until a new DG is started to take over the load in case of sudden PV drops and load variations. The EMS must always react quickly enough to avoid a blackout in the system due to sudden PV drops or load increases.

3.4.2.5 *Generator switching*

It shall also be avoided to have frequent start and stop scenarios of the Diesel Generator. If an additional DG is started or the DG was switched for a bigger one, there shall be a minimum time for how long this DG has to stay online, before it is switched off or changed for a smaller one. This parameter shall be easily adjustable by the operator. Additional parameters have to be respected before a DG can be switched.

3.4.2.6 *Load ramp*

If the PV system is already providing its maximum available power to the system and the load demand is still rising the Diesel Generator has to provide this energy. If there are slow load changes, the Diesel Generator will directly serve the loads and rise its power output. For sudden load changes caused by either PV drops or load increase, or both at the same time, the Flow

BESS shall support the system. The parameter of the allowed load ramp on the DG shall be adjustable by the operator.

3.4.2.7 *System Parameters*

All limits as well as minimum and maximum values of all parameters needed to configure the system shall be easy adjustable by the controller from the controlling room on site as well as from selected users online, anywhere with internet connection. The access has to be Password and Username protected. Especially parameters like: load set-points of Diesel Generators, allowed ramp rates of generator, ramp rates of Flow BESS, timing of Flow BESS, all setup parameters of needed current sensors and parameters that are provided from DG controllers.

The EMS shall support at least 6 DG sets, 10 PV sites and 2 battery inverters without any modification or upgrade to the system. In addition, control logic of EMS shall be configured such that at least 10 DG sets and 3 battery inverters can be added in future without changes to the control logic.

3.4.2.8 *Grid building system concept*

For systems with Grid Building Battery Inverters (GRIDB), the main control unit shall turn off the Diesel Generators completely, if the available solar energy and the SOC of the battery allows it. Solar energy shall always be the prioritized energy to be used in the system, and Diesel Generators shall only be turned on if necessary.

The system should also allow operation of multiple masters (grid forming entities such as Flow Battery or Diesel generators) and only use PV as a slave. If one master fails, the other master units should be able to run the grid giving the system extra redundancy.

The Battery inverter must be synchronized to other voltage sources in both cases: *i)* Battery inverter is online first and the other voltage source (DG, Grid, other Battery Inverter) must be synched to the battery inverter, *ii)* Other voltage sources are first online (DG, other Battery Inverter), the battery inverter must be synchronized to them. Especially when a static (isochronous) voltage source such like an DG without synchronization capability the synchronization must be done with an external synch check and breaker. The measurement of the requirement parameters of voltage, frequency etc. must be done fast and accurate enough to guaranty synchronization.

3.4.2.9 *Other Functionalities*

Other functionalities (or equivalents) that shall be available.

Settings Operator User level:

There will be two configurable DG control mode: Manual and Auto: the DGs are controlled by the EMS depending on the actual requirements by load, the availability of solar power, as well as the SOC of the battery system.

If the system is set to AUTO mode, the following range of setting options should be available:

• DG start/stop control mode and changeover capability between MANUAL DG CONTROL MODE & AUTO DG CONTROL MODE

• Status of the start stop control

• Activation time-based Priority Swap

• Deactivation of some DGs so that they are not considered any further for AUTO start/stop operation

• Information on the actual configuration of the DGs: Nominal power, Actual priority for the DGs (considering the presently valid priority set)

Administrator User Level:

The following range of setting options should be available in Administrator user Level

• Potential Drop in Actual PV Power

• Potential Increase in Load Power

• Minimum DGs Operating Point

• Prevent daytime discharge

• State of Charge criteria for charging/discharging

• DGs target operating point for battery discharge

• Charge battery to hold DGs set for minimum operation

• Max ramp up /. Ramp down rate for DGs.

• Diesel gen set time of use

3.4.3 Main Topics of EMS

The Contractor shall provide standard hardware and software configurations to the extent possible as long as it meets or exceeds the requirements of this specification. International standards shall be applied for hardware and software interfaces to allow system expansion in terms of equipment and software functions (if required).

3.4.3.1 *System Security*

The EMS or each subsystem shall be designed in accordance with ISO / IEC 27002, ISA 99 or equivalent Standard.

For security reasons all log-in and log-out events shall be logged in the event list. All user changes and modifications to the system as well as parameter and program modification shall be logged with the exact time and operator’s assignment in the event list too. It shall be possible to print this information.

For software security, at least the following has to be provided:

- Up to date anti-virus program to be delivered and installed
- Up to date firewall to be delivered and installed
- All access ports (USB, CF-cards, etc.) shall be included in the security scenario and protected/secured against infiltration of malware

3.4.3.2 *Over-Voltage Protection*

Those parts of the system that are electrically connected to cables leaving a building shall be fitted with over-voltage protection.

3.4.3.3 *Grounding*

The EMS equipment shall be connected via a common potential equalization bar to the earthing network Station.

The Contractor shall coordinate earthing concept and requirements with the manufacturer of the EMS and accordingly provide the earthing system that shall be approved by the Employer.

3.4.3.4 *Labelling and Marking*

All terminals, plugs, internal and external connecting cables shall be labelled durable and readable with a code approved by the Employer.

For Ethernet connectivity interfaces, only shielded cables of type CAT 6 or better shall be applied in a structured cabling according to ISO 24702 and to the description within this specification.

Fibre optic cables shall be delivered and installed according to the description within this specification.

3.4.3.5 *Cabinets*

Central Unit Servers and associated accessories shall be accommodated in dedicated equipment cabinets.

For indoor application, the cabinets shall be constructed as follows:

- Standard sized steel cabinets with external painting colour as per Employer/Engineers approval
- Certified for minimum IP41 protection class
- Power distribution box with main filter and main switch (separate 2-pole breakers for each device)
- Front-patches for LAN cabling
- Cable organisers, cable trays, suspensions and termination components with strain relief for all internal and external cabling
- Over-voltage protection for all devices (if required)

- 20 % housing space for future equipment
- Ventilation fan to ensure that maximum allowable operating temperature of all equipment inside the cabinets shall not be exceeded
- Bottom cable access
- Document pocket
- Grounding bus bar for earthing connection
- Doors with glass or another material front and locking system
- Inner light and power socket for maintenance
- Provision of easy access for maintenance and repair, all devices with rear plugs shall be drawable

3.4.3.6 *Electrical Interface Units*

EIUs as data acquisition modules shall be designed and provided to perform the interface between the electrical equipment and the EMS. The EIU hardware shall be fitted with process interface slot-in modules for digital inputs and outputs, analogue inputs, Ethernet communication modules, etc. Output from all generating sources shall be measured directly and not through any intermediary meters such as Battery Control Units or Generator controllers.

The EIU shall be of same make and type all over the Plant and shall have Ethernet connection with EMS. The power supply of the EIU shall be powered from the UPS.

3.4.3.7 *Performance and Reliability*

All equipment shall be of high quality and reliability. The overall system availability of the EMS shall be 99% or better.

All equipment shall be protected against cyber-attacks.

3.4.3.8 *Software Requirements*

The EMS shall be based on standard proven firmware and software, which shall already been implemented in other systems. The software engineering tool shall be provided to configure, set up and modify the data acquisition, data processing and database system components. The software application shall include facilities to perform programmable logic functions.

The software tool of EMS shall provide a high degree of configurability, including but not limited to, changes in number of DG’s, Flow BESS, PV sites, operational parameters, capacities of generating sources, remote configuration of BESS and inverters where possible.

The system shall have monitoring and self-diagnostics features for both, hardware and software.

Licensed software copy required for the proposed system shall be provided. The latest proven anti-virus software shall be installed in the EMS.

All logins to the system shall be password protected. Data transmission via public internet shall be encrypted.

3.4.4 Alarm and Event Management

3.4.4.1 *General*

All alarms including system alarms and important events shall be listed up on the display. The lists shall be in chronological sequence showing:

- The precise date and time with the specified resolution in actual sequential of events;
- Plant identification code;
- Clear text/denomination of alarms and events;
- Status message (open, close, off, high, low);
- The actual value in case of high/low alarms derived from analogue values;
- Sorting of alarms per sub group shall be possible.

Alarms and signals that happened in the past can be recalled by the operator at any time. If any new alarm appears while monitoring any other page, flashing signal on the screen shall show the new event/signal to the operator.

Dedicated soft pushbuttons shall serve the operator for alarm handling such as buzzer signal acknowledgement, alarm acknowledgement, alarm clearing and page flipping. Differentiation between alarms and events shall be done by colour coding (e.g., Alarms: red colour). Further colour for distinction of alarms according to the degree of urgency or type of alarms is also required.

Flashing functions of alarm messages shall be according to standards related to conventional alarm.

The flashing frequency for coming and going alarms shall be different.

First out alarms shall be marked clearly and needs special acknowledgement.

3.4.4.2 *Report Generation*

Automatic and configurable generation of typical reports (total or detailed power generation data, problems, efficiency analysis, weather reporting etc.) shall be supported internally or with the help of formatted data output and provisioning of corresponding templates and input filters for e.g., MS Excel or similar. It shall be possible to print the generated reports. The format of the logs and reports shall be subject to the approval of the Employer. Reports shall be generated locally in each island as well as in Central SCADA.

3.4.5 Data Communication Network

The EMS shall have the communication via Modbus TCP to all energy producers, respectively Diesel Generators, PV inverters and Flow BESS units. It will receive all necessary measurement data from those sources, such as voltage, ampere, cos phi, battery SOC, frequency and warnings/alarms at the connection points of the sources. According to the actual state of the system it will then decide and send the control to the relevant sources, if and how they should react, be switched on or off or regulate their power output. The communication shall be realized with network cables CAT 6 and fibre optic cables for longer distances. The system shall communicate with and provide data to the SCADA system. In accordance with Section 3.4.7, the data for PV Plant, DG, and Flow Battery are transmitted to the Central SCADA.

The EMS shall also be able to Include any other sensors necessary for the functioning of the system and provide the data of additionally included sensors in the Modbus protocol. The communication protocol of the sensors to be included may be of a different kind than Modbus.

The supplied system shall include a data communication network to ensure the proper interconnection of all components of the EMS such as but not limited to cables, accessories, media converters, repeaters, amplifiers, switching and routing equipment including accessories, their housing as required, as well as the management systems necessary to operate the data communication network.

Ethernet with a minimum data rate of 100 Mbit/s shall be provided.

The network shall be fault tolerant for single failure and shall at least be installed in ring structure.

Switches used in the network and to interface equipment shall be manageable and able to interface to FOC on upper-level cabling structure.

All FOC cables shall be terminated to patch panels; no fibres to be loose.

Interface to switches shall be performed via patch cables.

Underground splices shall not be foreseen.

3.4.6 Power Supply & Cabling

3.4.6.1 *General*

Power supply for EMS shall be provided from UPS. All redundant devices shall have redundant power supply modules.

The Contractor shall perform all cabling and installations works for outdoor and indoor equipment as well as the interface interconnection and termination at existing devices. No cable joints shall be used for interfacing of EMS with any other equipment.

3.4.6.2 *Additional communication cable*

There shall be an additional fibre optic cable installed between the powerhouse and the council of each island. In the powerhouse the cable shall be routed to the control room where the EMS

will be installed. It shall be connected to the FOC network of the power plant. In the council the cable shall be routed into a room that is selected from the council. On each side a spare cable of 20 meters shall be left.

3.4.6.3 *Electrical connections and UPS*

Redundant power supply for EMS shall be provided from UPS. A minimum of 30 min. of independent power supply shall be guaranteed for on-site conditions.

Over-Voltage Protection: Those parts of the system that are electrically connected to cables leaving a building shall be fitted with over-voltage protection. For special specifications see Chapter 3.9 Lightning protection.

Grounding: The EMS equipment shall be connected via a common potential equalization bar to the earthing network of the diesel power station building.

The Bidder shall coordinate earthing concept and requirements with the manufacturer of the EMS and accordingly provide the earthing system that shall be approved by the Employer.

Labelling and Marking: All terminals, plugs, internal and external connecting cables shall be labelled durable and readable with a code approved by the Employer. Code list shall be included in documentation.

3.4.6.4 *Category 6 cables*

At least shielded Cat 6 cables shall be used for Ethernet communication system with a length less than 100m. The cables shall be according to ISO 24702 suitable to function properly and faultless under the prevailing environmental conditions and rodent-protected for direct buried application. The cables shall have a frequency spectrum up to 250 MHz and be terminated in 8P8C modular connectors.

The cables shall be halogen free.

3.4.6.5 *Fibre Optic Cables (FOC)*

Depending on the requirements by the proposed control system single mode and / or multi-mode FOCs shall be used.

The manufacturing, construction, labelling and testing of the fibre optic cable system shall meet the requirements established in the relevant applicable ITU and IEC codes, standards and recommendations.

Application

The fibre optic cable shall be suitable to function properly and faultlessly under the prevailing environmental conditions and rodent-protected for direct buried application.

The fibre optic cable shall be laid in buried cable conduits. Therefore, a fully dielectric fibre optic cable suitable for ducted or direct buried applications, filled with compound to prevent axial and

longitudinal ingress of water and / or soluble chemicals throughout the cable shall be provided. The cable shall have loose tubes as secondary coating of fibres.

Main Cable Structure

The cable shall be:

- Halogen free
- Metal free
- Axial and longitudinal tightness against water and / or soluble chemicals
- Rodent-protected
- Traction elements of Kevlar
- Lifetime of cable >30 years
- FOC fibre with primary coating Ø 250 +/- 15µm
- Secondary coating of fibres
- Filled centre fibre with 24 fibres
- Standard colouring

Outer cladding:

- Halogen free
- UV persistent
- Markings containing
- Manufacturer numbering
- Type of cable
- Number of fibres and type of fibre
- Date; Metering and P/N marking

Cable markings shall be printed on the outer fibre cable jacket. The markings shall be permanent, insoluble in water and be legible for the duration of cable life. The markings shall be printed at intervals of not more than 2 meters.

Fibres and number of fibres

Diameter fibre:9 µm (+/- 10 %) – Single Mode

Diameter fibre:62,5 µm (+/- 10 %) – Multi Mode

Diameter cladding:125 µm (+/- 3µm)

Diameter coating:250 µm (+/- 15µm)

Damping: Single Mode max:

< 0,4dB/km, typ. 0,36dB/km at 1310 nm wavelength and

< 0,3 dB/km, typ. 0,26 dB/km at 1550 nm wavelength.

Multi Mode max:

< 0,9 dB/km, typ. 0,9 dB/km at 1310 nm wavelength.

Number of fibers: The long-distance cable shall contain a minimum number f 12 fibres.

3.4.6.6 *Measurement after Cable Installation*

Measurement of splices

To verify the maximum damping of splices ODTR measurement in both directions shall be performed. The max damping of 0.1 dB per splice shall not exceed.

Measurement of Cable Run from Termination to Termination

The characteristics of the cable run shall be measured and verified and protocolled by:

- Bi-directional Power Loss Measurement at 1310 +30/-15 nm and 1550 +30/-70 nm
- Bi-directional OTDR Measurement at 1310 +30/-15 nm und 1550 +30/-70 nm

The values for maximum damping are:

- max. damping splice: 0,10 dB
- max. damping connectors (pair): 0,50 dB

3.4.6.7 *Fibre Optic Cable Accessories*

A detectable reinforced underground marking and warning tape shall be laid in the ground 300 mm above the protection conduit.

The patch cord consists of a single / multi-phase fibre optic cable with plug connections on both ends. Pigtails are fibre cables pre-assembled with a connector at one end. The fibres of the patch cords and pigtails shall be according to the specified fibres and all components shall have a service life of more than 20 years with a minimum of contact durability of 1000.

Type of connectors shall match the requirements of EMS I/O modules and shall be of same type all over the plant. Contractor shall decide the used type (ST; SC; FC/PC)

The connecter loss shall not exceed 0.5 dB per connector pair.

OTDR (Optical Time Domain Reflectometer) test report shall be submitted to Employer/Engineer.

The termination of each fibre in transmit and receive direction shall be provided on an optical distribution frame (ODF) for access to the transmission equipment. The ODF for receive and transmit direction shall be configured in accordance to the specified number of fibres (24). The

ODF are to be installed in termination cabinets, which may be combined with the communication system.

3.4.6.8 *Industrial Ethernet Switches (Managed type)*

Industrial Ethernet Switches foreseen for installation shall provide the following:

- Compliance: IEEE 802.3 ISO/IEC 8802/3
- Technology: Store and forward
- Filtering Services / prioritization: IEEE 802.1 D/p
- Port type: Min 100 Mbps Media as necessary
- Diagnostics: Indication of power status, link status, data, full duplex, link failure (fibre disconnected)
- Management: SNMP, HTTP
- Design: Fan less
- Mechanical design: Stability against shock and vibration
- Min. operating temp. range: 0°C - 55°C
- Rel. humidity: 0% - 100%
- Diagnostics: LEDs for indication of power status, link status, data, full duplex, link failure (fibre disconnected)
- EMC: EN 55022, EN 50082-2
- VLAN support: IEEE 802.1Q, MAC Address / Port Based
- MTBF: >20 years

3.4.7 List of Signals to be sent to central SCADA

The following data shall be sent from the EMS to the central SCADA in Male.

3.4.7.1 PV Plant

Table 3-1: PV Plant data to be sent to the central SCADA

Measurement	Sub Measurement	Unit
Active Power	Power Plant Active Power	kW
	Phase A Active Power	kW
	Phase B Active Power	kW
	Phase C Active Power	kW
Reactive Power	Power Plant Reactive Power	kVAr
	Phase A Reactive Power	kVAr
	Phase B Reactive Power	kVAr

	Phase C Reactive Power	kVAr
Current Injection	Phase A Current	A
	Phase B Current	A
	Phase C Current	A
Voltage	Phase A Voltage	V
	Phase B Voltage	V
	Phase C Voltage	V
Daily Active Energy	Power Plant Active Energy	kWh
	Phase A Active Energy	kWh
	Phase B Active Energy	kWh
	Phase C Active Energy	kWh
Daily Reactive Energy	Power Plant Reactive Energy	kVAhr
	Phase A Reactive Energy	kVAhr
	Phase B Reactive Energy	kVAhr
	Phase C Reactive Energy	kVAhr
Total Active Energy	Power Plant Active Energy	kWh
	Phase A Active Energy	kWh
	Phase B Active Energy	kWh
	Phase C Active Energy	kWh
Total Reactive Energy	Power Plant Reactive Energy	kVAhr
	Phase A Reactive Energy	kVAhr
	Phase B Reactive Energy	kVAhr
	Phase C Reactive Energy	kVAhr
Power Factor	Power Plant Cos Phi	-
	Phase A Cos Phi	-
	Phase B Cos Phi	-
	Phase C Cos Phi	-
Plant Usage	Hours of PV Plant Usage	hours
Temperature	Weather PV plant temperature	ºC
Irradiance	PV plat Irradiance	W/m2
Operating Status	Normal / Disturbance	-
Connection Status	Connected / Disconnected	-
Control Set	Connect / Disconnect	-

3.4.7.2 Diesel Generator

Table 3-2: DG data to be sent to the central SCADA

Measurement	Sub Measurement	Unit
Active Power	Power Plant Active Power	kW
	Phase A Active Power	kW
	Phase B Active Power	kW
	Phase C Active Power	kW
Reactive Power	Power Plant Reactive Power	kVAr
	Phase A Reactive Power	kVAr
	Phase B Reactive Power	kVAr
	Phase C Reactive Power	kVAr

Current Injection	Phase A Current	A
	Phase B Current	A
	Phase C Current	A
Voltage	Phase A Voltage	V
	Phase B Voltage	V
	Phase C Voltage	V
Daily Active Energy	Power Plant Active Energy	kWh
	Phase A Active Energy	kWh
	Phase B Active Energy	kWh
	Phase C Active Energy	kWh
Daily Reactive Energy	Power Plant Reactive Energy	kVAhr
	Phase A Reactive Energy	kVAhr
	Phase B Reactive Energy	kVAhr
	Phase C Reactive Energy	kVAhr
Total Active Energy	Power Plant Active Energy	kWh
	Phase A Active Energy	kWh
	Phase B Active Energy	kWh
	Phase C Active Energy	kWh
Total Reactive Energy	Power Plant Reactive Energy	kVAhr
	Phase A Reactive Energy	kVAhr
	Phase B Reactive Energy	kVAhr
	Phase C Reactive Energy	kVAhr
Power Factor	Power Plant Cos Phi	-
	Phase A Cos Phi	-
	Phase B Cos Phi	-
	Phase C Cos Phi	-
Speed	Primary Genset Speed	rpm
Power	Primary Genset Power	kW
Torque	Primary Genset Torque	Nm
Instant Fuel Consumption	Primary Genset Fuel consumption	l/h
Total Fuel Consumption	Primary Genset Total Fuel usage	l
Generator Usage	Hours of Genset Usage	hours
Operating Status	Normal / Disturbance	-
Connection Status	Connected / Disconnected	-
Control Set	Connect / Disconnect	-

3.4.7.3 Flow Battery

Table 3-3: Flow BESS data to be sent to the central SCADA

Measurement	Sub Measurement	Unit
Active Power	Battery AC Power	kW
	Battery AC Power	kW
	Phase B Active Power	kW
	Phase C Active Power	kW
Reactive Power	Power Plant Reactive Power	kVAr
	Phase A Reactive Power	kVAr

	Phase B Reactive Power	kVAr
	Phase C Reactive Power	kVAr
Current Injection	Phase A Current	A
	Phase B Current	A
	Phase C Current	A
Voltage	Phase A Voltage	V
	Phase B Voltage	V
	Phase C Voltage	V
DC Site	DC Discharging Power	kW
	DC Charging Power	kW
	DC Discharging Current	A
	DC Charging Current	A
	DC Voltage	V
Operating Status	Normal / Disturbance	-
Connection Status	Connected / Disconnected	-
Control Set	Connect / Disconnect	-

3.5 Utility compatibility

3.5.1 General

The applicable standard related to interconnecting an inverter to a utility network is IEC 61727: 2004, "Photovoltaic (PV) systems – Characteristics of the utility interface". The inverter's AC voltage, current and frequency shall be compatible with the utility system in accordance with IEC 61727.

3.5.2 Normal voltage operating range

Inverter shall operate at and shall support the network voltage. The inverter shall synchronise with the utility network before a connection is established. The inverter shall not generate the voltage of the grid but shall inject current into the system.

3.5.3 Flicker

The operation of the inverter, in conjunction with other existing and future loads at the same point of connection, shall not cause flicker levels to increase beyond the levels specified in IEC 61000-3.

3.5.4 DC injection

The static power converter of the inverter shall not inject DC current exceeding 1 % of the rated AC output current into the utility AC. Interface under any operating condition in accordance with EN 50178 or its equivalent. This relates specifically to inverters where the static power converter has no simple separation from the utility network.

3.5.5 Electromagnetic Compatibility

EMC to possible electromagnetic emissions from facilities or equipment to be installed, so the installation team is right to safe conditions of use, as well as the equipment to be connected to it. The inverter must be prepared and be electromagnetic compatible in function of electromagnetic immunity (IEC61000-6-2) and Emission (IEC61000-6-4).

3.5.6 Harmonics and waveform distortion

In accordance with IEC 61000-3 and IEEE519, only devices that inject low levels of current and voltage harmonics will be accepted; the higher harmonic levels increase the potential for adverse effects on connected equipment.

Acceptable levels of harmonics, voltage and current depend upon distribution system characteristics, type of service, connected loads or apparatus, and established utility practice. The embedded generator output shall have low current-distortion levels to ensure that no adverse effects are caused to other equipment connected to the utility system.

Total harmonic distortion (THD) and odd harmonics distortion shall be less than 5% and 3% respectively at rated generator output in accordance with IEEE519.

3.5.7 Power factor

The inverter shall not inject reactive power into the utility network, while the drain of reactive power shall be limited to a power factor of 85%. The inverter shall operate at these power factors in the range 10% to 100% of nominal power.

3.5.8 Synchronization

The inverter shall synchronize with the utility network before the parallel connection is made. Automatic synchronization equipment shall be the only method of synchronization. The limits for the synchronizing parameters for each phase are:

- frequency difference: 0,3 Hz,
- Voltage difference: 5 % = 11,5 V per phase, and phase angle difference: 20°.

3.5.9 Safety and protection

General: The safe operation of the inverter in conjunction with the utility network shall be ensured at all times.

Safety disconnection from utility network: The inverter shall automatically and safely disconnect from the grid in the event of an abnormal condition. Abnormal conditions include

- network voltage or frequency out-of-bounds conditions,
- loss-of-grid conditions and prevention of islanding
- DC current injection threshold exceeded

- PV field earth leakage
- Inverter over temperature

Disconnection switching unit: The inverter shall be equipped with a disconnection switching unit which separates the inverter from the grid due to the above abnormal conditions.

- The disconnection switching unit shall be able to operate under all operating conditions of the utility network.
- A failure within the disconnection switching unit shall lead to disconnection and indication of the failure condition.
- A single failure within the disconnection switching unit shall not lead to failure to disconnect.
- Failures with one common cause shall be taken into account and addressed through adequate redundancy.
- The disconnection switching unit shall disconnect from the network by means of two series switches. Each switch shall be separately rated to the inverter's nominal power output. At least one of the switches shall be an electromechanical switch while the second switch may be part of the existing solid state switching circuits of a utility-interconnected static power converter. The electromechanical switch shall disconnect the inverter on the neutral and the live wire(s).
- The fault current breaking capacity of the disconnecting switch shall be appropriately sized for the application.

Abnormal conditions can arise on the utility system and requires a response from the connected inverter. This response is to ensure the safety of utility maintenance personnel and the general public, and also to avoid damage to connected equipment. The abnormal utility conditions of concern are voltage and frequency excursions above or below the values stated in this clause. The inverter shall disconnect if these conditions occur. The parameters for disconnection shall correspond to those below but shall be adjustable.

Over-voltage and under-voltage: The inverter shall cease to energize the utility distribution system should the network voltage deviate outside the conditions specified in table below. This applies to any phase of a multiphase system. The system shall sense abnormal voltage and respond. The following conditions shall be met, with voltages in r.m.s. and measured at the POC (Point of Connection). All discussions regarding system voltage refer to the nominal voltage. The parameters for disconnection shall correspond to those below, but shall be adjustable in the field.

Response to abnormal voltages	
1	2
Voltage range **(at point of utility connection)**	**Maximum trip time** S
V < 50 %	0,2 s
50 % ≤ V < 85 %	2 s
85 % ≤ V ≤ 110 %	Continuous operation
110 % < V < 120 %	2 s
120 % ≤ V	0,16 s

Over-frequency and under-frequency: The inverter system shall cease to energize the utility network when the utility frequency deviates outside the specified conditions. When the utility frequency is outside the range of 49,5 Hz and 50,5 Hz, the system shall cease to energize the utility.

Prevention of islanding: An islanding condition shall cause the inverter to cease to energize the utility network within 2 s, irrespective of connected loads or inverters. One active islanding detection method and one passive island detection method shall be used to avoid an unintentional island.

Active and passive types of anti-islanding protection of inverters	
Active type	Passive type
Frequency shift	Power phase jump detection
Active power fluctuation	3rd harmonic voltage rise
Reactive power fluctuation	Frequency change rate detection
Load fluctuation	

DC current injection: The static power converter of the inverter shall not inject DC current greater than 1 % of the rated AC output current into the utility interface under any operating condition. The inverter shall cease to energize the utility network within 500 ms if this threshold is exceeded.

Response to utility recovery: After a voltage or frequency out-of-range condition that has caused the inverter to cease energizing the utility network, the inverter shall not re-energize the utility network for 60 s after the utility service voltage and frequency have recovered to within the specified ranges.

3.6 Earthing

3.6.1 General requirements

The bonding of equipment should prevent dangerous voltage differentials arising between metallic equipment during fault conditions and provide alternative conduction paths to power cables should ground surges from nearby lightning strikes arise.

The main earth point for the system shall be a systems earth electrode, as specified in Section Earth electrode. It shall be located directly below each array structure.

The earth electrode shall be the common point for the casings of all balance of system components, and the array structure.

The risk of lightning strikes varies according to location. However, for all site locations the following basic guidelines will apply, as the electrical distribution is contained within one building.

For some sites additional lightning protection circuits may be required.

3.6.2 Earth electrode

Two types of earth electrode are suitable:

- Spike earths
- Multiple spike earths (trench earth)

Bare copper or bare galvanised steel, in stranded, strip or rod form are satisfactory earth materials in non-aggressive soils. Because galvanised ferrous materials corrode sacrificially to copper, galvanised iron and steel electrodes should not be buried in close proximity to bare copper. In aggressive soils only galvanised steel earth rods should be used. The down conductors shall be connected to copper or galvanised/stainless earth spikes of minimum length 1200mm.

The spikes shall be driven vertically into the ground till buried to a depth of at least 0.3 m. If necessary, several spikes shall be interconnected as a trench earth to achieve the required resistance.

10mm2 shall be used as earth straps to bind components to the earth electrode, no loops shall be created to avoid inductive voltage. Polyethylene (PE) cable will be wired jointly with the positive and negative unipolar cable. Under no circumstances shall connection points, bolts, screws, etc. used for bonding or earthing be utilised for any other purpose. It will be responsibility of the Bidder to supply and fit earth terminals or clamps on equipment that must be earthed where these are not provided.

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3.6.3 Equipment Earthing and Bonding

All metal equipment and casings shall be bonded together, as they are inter-connected by the power cables. The bonding shall be made using copper conductors of 10mm2 minimum. A separate conductor shall be used specifically for that purpose.

The resistance requirement in between enclosures shall be less than 1 ohm. The resistance measured against ground shall be less than 1 ohm.

The design shall base on international standards and codes like IEC or specific Maldivian standards and codes. The specific standards applicable for earthing requirements are:

IEC 60364-7-712 Electrical installations of buildings Part 7-712 Requirements for special installation locations-Solar photovoltaic (PV) power supply systems

IEC 60364-5-54 Electrical installations of buildings Part 5-54 Selection and erection of electrical equipment–- Earthing arrangements, protective conductors, and protective bonding conductors

3.7 Over voltage protection

Lightning protection shall be designed inherently into the system configurations, earthing, and some level of surge protection shall be built into the inverters themselves.

For mitigation of overcurrent the Bidder shall follow the installation practice below:

- All DC cables should be installed to provide as short runs as possible and positive and negative cables of the same string or main DC supply should be bundled together, avoiding the creation of loops in the system. This requirement for short runs and bundling includes any associated earth/bonding conductors.
- Long cables (e.g., PV main DC cables over about 50 m) should be installed in earthed metal conduit or trunking or be screened cables such as mineral insulated or armoured.

Additionally, the following overvoltage protection devices shall be provided:

- DC system: surge arrestors, class 2, on the inverter DC inputs or DC distribution box shall be provided.
- AC system: surge arrestors, class 2, at the incoming point of supply shall be provided. The surge arrestors shall be installed in the Main DB.

The surge arrestors shall be of class 2 with visual fault indication, 40kA (8/20) according to IEC 61643-1 for sensitive electronics, clamping voltage to less than 1,500V. Units with replaceable LP modules are required.

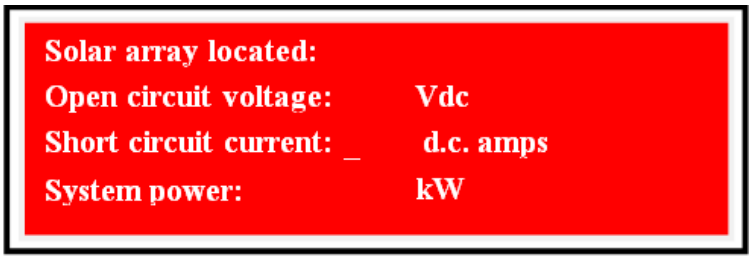
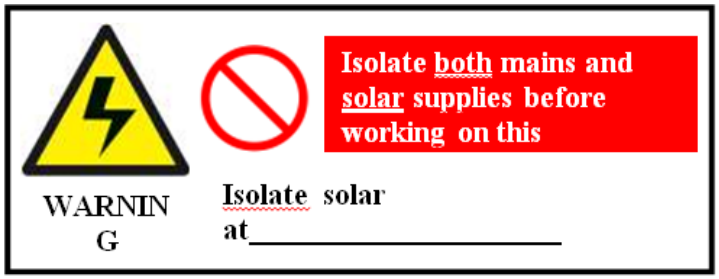
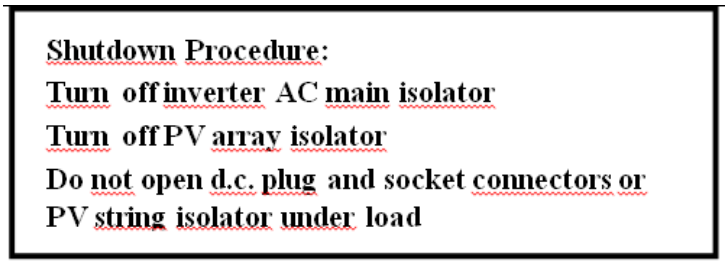
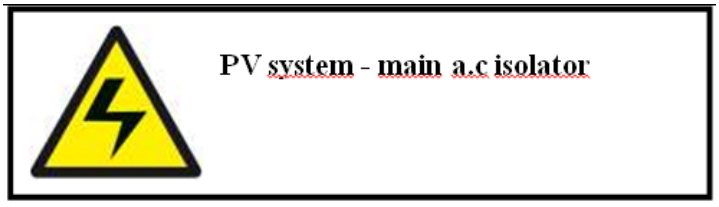
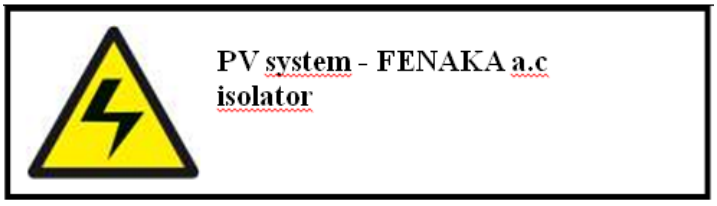
3.8 Labelling, safety signs and notices

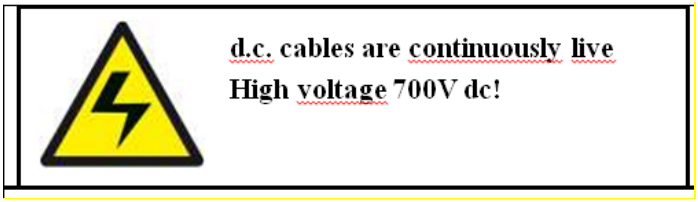
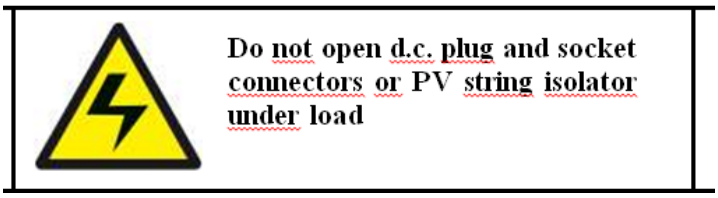
All labelling and signage must be in English. All notices, labels or signs shall be durable and not removable except by determined and deliberate action. The inscriptions shall be legible and

indelible. All custom signage to be ABS plastic silk-screened quality, indelible and shall be easily noticeable.

Where possible, standard approved symbolic safety signage is to be used. All DB labels shall be professional quality signage.

In addition to the standard electrical labels required in terms of British DTI standards regarding electrical installations, the following signs are required:

Locations	Sign number	Example design
• Main DB • Main display	1	
• FENAKA • Transformer • Tx breaker cubicle • Main DB • Inverter DB	2	
• Inverter • Inverter DB	3	
• Main DB	4	
• Tx Breaker cubicle	5	

Locations	Sign number	Example design
• Inverter DB • Long DC cable runs from array JB to inverter	7	
• Roof top locations	8	

3.9 Noise and Radio Interference

The systems offered shall be designed, supplied and installed to minimise audible noise. The maximum allowable residual sound level is 50 dB LAeq for all electronic equipment. This requirement does not apply to the Diesel Generators.

The systems shall be screened from emitting electromagnetic interference.

No equipment may generate any radio interference with other equipment or systems and all equipment shall be suppressed to prevent interference of commercial radio and TV reception. The equipment and methods used in determining the acceptable levels of radio interference shall be as specified in IEC CISPR 22.6

3.10 Commissioning and Onsite Acceptance Tests

Prior to delivery of the project, the Bidder must perform a series of onsite tests to verify the proper performance of every system.

The onsite test will be divided per individual systems: Flow BESS and EMS. After performing the tests per each system, it will be performed the tests for the entire system.

Commissioning tests effectively place responsibility for system or component performance on the supplier. The commissioning tests are the responsibility of the supplier.

All the tests shall be properly documented and checked by the Project Management Team prior to the delivery of the project.

Tests shall be made on the respective electrical components, isolators and circuit breakers, metering, earthing, bonding, and operation of the data-logging system and monitoring.

3.10.1 Commissioning and testing of Flow BESS and EMS

Tests of separate control system allow at least check the correct operation of the control hardware and communications interfaces.

The Bidder will provide a detailed test plan for this system separately, which shall include at least the following items:

- Visual inspection, labelling and technical specifications checking
- Power supply test.
- Test of communication with SCADA.
- Test of command sending and reception to Diesel Generators.
- Test of reception of monitoring parameters of the distributed systems
- Test of communication latency
- Several full charge and discharge cycles at rated and peak power will be carried out, or at least to the minimum state of charge expected to operate the system on a daily basis.
- During charge and discharge testing process the Flow BESS shall achieve the peak power ratings at least once per complete cycle. The duration of the peak power shall be the necessary to archive the optimum control of the hybrid plant and will be within the values provided by the manufacturer.
- With reference to Figure 1 of Section 1.3 in Section 3, it shall be verified that RTE (round- trip efficiency) of the Flow BESS at rated power align with the specifications of the Flow BESS submitted during the bidding process.
- Communications between the battery inverter or the BMS and EMS will be tested. The tests will be performed at zero, nominal and peak power ratings of the system, in order to ensure that possible electromagnetic noise will not affect the communications.
- The Flow BESS must communicate with EMS, so it is considered essential to carry out communications tests of these subsystems separately. Communications tests shall include both the sending of control operating commands from EMS to Flow BESS and monitoring parameters from the Flow BESS to the EMS. Tests must be conducted both at zero power and at nominal power.
- The correct functioning of ancillary systems of the Flow BESS will be tested, including at least:
    - Air conditioning system temperature regulation is working correctly.
    - Lights
    - Electric Outlet

The functional performance onsite tests of the control algorithm will be carried out during the hybrid plant tests.

Tests performed onsite will let the provider to verify the correct operation of the Flow BESS at the final location. The test record shall include at least measurements of battery temperatures, power electronics temperatures, current and power values achieved, possible detected alarms and any other outstanding incidence that may occur. The tests of the Flow BESS will include at least the following features.

Mechanical completion: The mechanical completion checking will consist of the following:

- Batteries power output is properly connected to the battery inverters.
- Communications wiring between Batteries and Battery Inverter and Energy Management System is correctly connected.
- No mechanical damages exist.

3.10.2 Hybrid Plant Test

The hybrid plant tests are intended to validate the performance of the entire plant and will involve all the systems operating in a coordinated way to achieve the target of a reliable power supply of the islands, with a significant reduction on the diesel consumption.

The test of the full hybrid plant will be the last to be completed, and will require a good coordination between all suppliers, which shall be available to be present during the tests of the systems together.

The Bidder will provide the details of the test plan for the whole system, which shall include at least the following items:

- Power balance tests. Through these tests the capability of maintaining the power balance in the grid versus sudden reduction in photovoltaic generation and/or increments in the loads will be verified. The tests shall include the manual reduction of the PV generation at different rates at least 25%, 50%, 75% and 90% of PV when a constant PV power of min. 80% of installed kWp is available for the AC PV connected capacity. This shall be repeated with different ramp rates (reduction of kW/sec), that have to be confirmed by the Employer.
- Tests to verify the response to voltage variations will be also performed. It shall be checked that the compensation response of the system to voltage variations to be less than 1 minute.
- Settings and adjustments of diesel protections and their performance versus sudden power unbalances in the grid.
- Power quality tests. Measurements of all the parameter related with the power quality shall be taken during the tests phase: THD (voltage and current), flicker, frequency and voltages. All these measurements shall show the compliance with the national requirements, as well as the technical requirements stated on this bid.

- Measurement of the diesel consumption. It shall be carried out a comparison between the previously recorded diesel consumption and the new measured consumption rates. The results shall be given to the Employer in form of a report.

3.11 Documentation

The bid documentation shall describe the full system functionality, main system components, performance and parameters (data sheets), connection of existing equipment, redundancy principle, communication interfaces, the backup and recovery concepts for the EMS, anti-virus and malware protection, and shall include the software and hardware requirements for the proposed backup concept.

3.11.1 Documentation to be submitted with Bid

The Bidder must complete all forms given in Section 4–- Bidding Forms of the Bidding Document for the Flow BESS & EMS. All of them shall be submitted electronically as PDF, Excel or Word-file. Technical data sheets should be supplemented by additional descriptions, explanations, drawings and all other information necessary for a clear understanding of the bid to enable the Employer to undertake the necessary assessment, evaluation and verification of the technical and performance features of the bid.

In any case major deviations are discouraged and Employer reserves the right to reject any bid as noncompliant in his sole discretion.

The Bidder shall include the interface documents in his bid.

The Bidder shall include a list of his sub-contractors.

The Bidder shall submit a record of the executed projects in the power sector within the last 10 years.

The Bidder shall include the civil design criteria in his bid consisting of but not limited to corrosion protection plan, load bearing capacities of roads and bridges for truck traffic. The Bidder shall prepare a binding description of included furniture, equipment, appliances and the like together with the respective type of quality.

3.11.2 Documentation to be submitted after contract award

The following describes the minimum scope of information, documents, drawings, etc. to be submitted by the successful Bidder to the Employer after award of contract during the design and engineering phase and during site construction of the Flow BESS & EMS. The Employer reserves the right to request from the successful Bidder such additional information, drawings, documents, etc. as may be reasonably required for proper understanding and definition of the design and engineering of the project.

The successful Bidder shall provide four (4) copies of all drawings and documentation to be submitted by him. For the as-built documentation a well-organized electronic file including an Excel based table of contents, two (2) copies (plus electronic copy) shall be provided. All

information with respect to connection points and interfaces between the Plant and the grid, and any other interface as well as for the entire Flow BESS & EMS itself shall be included. The number of copies or the final content may be amended as may otherwise be required by the provisions of the Contract or as may otherwise be reasonably required by the Employer.

Bi-monthly status reports shall be provided by the successful bidder. Any revision of the project implementation schedule shall not be delivered later than seven (7) days after such revision.

3.11.3 Documentation to be submitted during detail design

The following documents shall be submitted as a minimum by the successful Bidder to the Employer within a maximum of two (2) months after the date of contract award:

- Detail design reports of all systems, buildings, and structures.
- The Bidder shall hand-in his method statements for construction methods.
- General arrangement and layout drawings
- Project documents (data sheets, specifications, drawings) for major systems and components including system description of the main systems
- Single line diagrams
- Calculations and layouts for grounding, earthing, lightning protection, surge prevention
- Cable list and cable size calculation
- Soil resistivity measurement
- Detailed layout drawings not limited to architectural, structural and electrical drawings.
- Report of the design loads and load bearing capacities buildings and structures
- Underground / aboveground ducts and cable arrangement drawings (civil and electrical)
- Quality assurance philosophy
- Information about corrosion protection for steel structures
- Operation and maintenance philosophy
- Emergency Response Plan
- HSE plan

3.11.4 Final Documentation

Before the final acceptance of the Flow BESS and EMS the Contractor shall deliver to the Employer the final documentation, both in digital and hard copies (2x). The final documentation for the Flow BESS shall be prepared in accordance with the IEC 62446 standard.

For the Flow BESS and EMS, the final documentation shall comprise at least the following:

- All As-built drawings (civil, mechanical, electrical) but not limited to:
  - SLD’s
  - Cable routing plans and calculations
  - Cable list
  - Substructure and module mounting details
  - Generator synchronizing panel and main distribution panel drawings
- Data sheets of installed components
- Warranties of installed components

- O&M manuals
- Site safety procedures
- HSE procedure and plan
- Test protocols
- Performed studies and tests
- Mechanical completion documents (not limited to):
  - Data sheets and manuals of components and equipment
  - Serial number of inverters, transformers, combiner boxes, etc.
  - Flash list of installed modules
  - Acceptance protocols
  - Calibration protocols
- Factory Acceptance Test Reports for all mechanical and electrical equipment
- Acceptance protocols between Contractor and Subcontractor
- Commissioning protocols
- Provisional Acceptance Certificate
- Punch lists (Reserve lists) for the Defects Liability Period
- Password for inverters, internal communication and SCADA system

3.12 Training Program

The Bidder is required to provide training at manufacturer's site for two persons from each powerhouse, two staff from FENAKA head office and two staff from PMU (total 10 persons). In addition, local staff should be given training on operation and maintenance during construction.

The training shall take one week on the manufacturer's premises plus 24 days on the 2 construction sites for each team separate.

All living, accommodation, food, transport expenses of the trainees during the period of training/study tour including airfares, incidental expenses, medical expenses, medical insurances etc. will be covered by the Contractor including pocket allowance of US$100/day/person for training abroad.

The goal of the training and qualification program is to ensure that the Flow BESS / EMS personnel acquire and maintain the combination of knowledge and demonstrated skills to full fill their responsibilities. Likewise, the Employer will acquire the knowledge required to full fill his responsibilities as plant owner during operation. This will reasonably assure that the plant is operated safely and efficiently, while also ensuring its long-term economic success.

The trained persons must subscribe in a list and sign, how many hours they have attended the training.

Every attendant must receive a training documentation/handbook, where the training subjects are documented in detail.

During implementation the Contractor shall train the Employer's personnel. The training shall be split in a practical and a theoretical part.

For the practical part, the staff to be trained shall be involved in the building process of the power plant, in order to understand the overall system.

The practical part shall consist of 14 training days with a 2 hours session each day.

The theoretical part shall be 10 days with a 2 hours session each day.

The Bidder shall be flexible enough to adapt the content of the training to the state of knowledge of the attendees

The training shall comprise but not be limited to the following:

- Technical basics and components of the Flow BESS and EMS
- General function of the Flow BESS
- Norms and standards
- Health, Safety, and Environmental (HSE), First Aid
- Control room daily work
- Operation of EMS
- Monitoring of Flow BESS
- Access to EMS
- Fault detection
- Action plan after fault detection
- Preventive maintenance
- Supervision and managing of corrective maintenance
- Performance of first level corrective maintenance, such as the replacement of spare parts and / or spare inverters
- Spare parts logistic and usage
- Plant documentation
- Monthly reporting
- Communication with suppliers
- Managing of insurance claims
- Maintenance of green areas, internal paths

3.13 Ongoing O&M and troubleshooting support

For the first two years from the date of commissioning of the projects (including defect liability period), the Contractor will be responsible to remotely monitor on a day-to-day basis the functioning and performance of all units of the Flow BESS and EMS and submit a monthly performance report to the Owner. In case there is any fault, malfunctioning or unexpected low performance of any of the units of Flow BESS or EMS the Contractor will immediately report the Owner and take necessary measures to rectify the same at the minimum possible time. The above-mentioned services for the first two years will be a part of the supply contract.

After initial support for two years as stated above, the Contractor will provide technical support to FENAKA for another 3 years to address any technical, functional and performance issues of any of the units of Flow BESS or EMS. This requirement is mandatory but will not be part of the bid evaluation. The Contractor will depute competent technical personnel to jointly work with FENAKA personnel to address such issues to the satisfaction of the employer.

The Contractor will submit a separate quote for the above-mentioned services on per year basis for a duration of not less than 3 years after two years of operation of the systems.

3.14 O&M Service Requirements during the initial two-year operation

3.14.1 Plant operation and control

Bidder shall provide O&M services (no daily operation of the plant is required). The operation and control system of the plant system should not be limited to registration of data but should comprise functions for assessment and interpretation of operating conditions in particular in order to allow for remote diagnosis of errors.

Electrical load data, diesel engine data and the battery status (SOC) shall be acquired by the EMS and handled within data storage, protocol, reporting and monitoring. It is mandatory that the EMS shall retrieve all necessary data to ensure reliability and performance according to its intended purpose.

Bidder shall prepare monthly reports using the remote EMS regarding the operation of the plant including electricity production, efficiency, fuel consumption, availability. Any maintenance performed during the month shall also be reported and the action taken described clearly.

Bidder shall perform a minimum quarterly periodic maintenance services and service reports.

Bidder may sub-contract the performance of parts or all of the services, subject to the approval of the Employer and on the basis that the Bidder remains fully liable for the performance of the sub- contracted obligations.

Moreover, Bidder shall liaise with the original equipment manufacturer to identify changes in the recommendations for the monitoring and maintenance of the equipment that constitutes the plant. Preventive maintenance requirements

The maintenance of the plant shall be based on the following operation, dispatching, and other requirements:

- Maintenance activities for the plant affecting the power output shall take place outside the peak load periods, i.e., during the period of low power demand and low solar irradiation conditions (morning/ evening/ at night).
- Maintenance of the plant shall be carried out at a minimum in accordance with the equipment manufacturers' suggested maintenance requirements and the scheduling requirements of Employer and follow applicable standards and industry practices.

3.14.2 Flow BESS specific maintenance activities

The scope of work shall comprise of but not limited to the following activities:

- Inspection and testing according to IEC 62932-2-2: 2020. In particular the inspection shall comprise the control and preventive maintenance of
    - Inverters

- Junction boxes
- Cabling
- Cable terminations
- transformers

- Maintenance of the site including green areas, paths, cable servitudes etc.
- Cleaning of battery cabinets
- Battery module maintenance
- Monitoring and maintaining Heating, Ventilation, and Air Conditioning (HVAC)

3.14.3 Corrective maintenance requirements

For the first two years of operation of the hybrid plant, the Bidder is required to provide full corrective maintenance . Corrective maintenance means the repair or replacement of defective material and components.

Corrective maintenance activities shall be initiated as soon as a failure is detected. It shall always be ensured that the staff of the Employer is present and trained during each corrective maintenance activities.

If a failure will be detected, O&M personal shall initiate corrective maintenance measures within 6 hours after its occurrence.

The Bidder shall be responsible for maintaining and refilling the spare parts stock. An overview of the spare parts approach, major inspection, overhauls of equipment, and replacement program of equipment shall be provided, including:

- Spare and wear parts and consumables necessary for the proper and continuing functioning of the plant during the Defect Liability Period (DLP)
- Requirements and storage conditions for the spare and worn parts and consumables.
- Replacement strategy, spare parts, and reaction periods for inverters for the first years after the provisional acceptance of the plant.

Furthermore, the Bidder shall manage all warranty cases including the dismantling, packaging, shipping and / or safe disposal of defective materials.

3.15 Detailed scope of Maintenance

The Contractor shall provide routine and preventive maintenance schedules for the Employer’s approval and shall carry out all routine and preventive maintenance accordingly.

The Contractor shall perform periodic preventive maintenance required for Flow BESS, and EMS in accordance with the recommendations of Original Equipment Manufacturers (or OEMs) and as per their OEM official O&M manuals.

The Contractor shall perform all breakdown maintenance and other maintenance in the Facility.

The Contractor shall provide the required spare parts, tools and tackles, and consumables required for comprehensive operation and maintenance of the facility. The Contractor shall

make arrangements to procure required spare parts, or equipment/s as required, tools and equipment, required to operate and maintain the facility in accordance with the recommendations of individual original equipment manufacturers at his own cost.

A list of recommended spare parts shall be submitted by the Contractor at the beginning of services; however, the complete recommended spares will be in the scope of the Contractor only. In case any equipment or spares is not listed in the mandatory spares list but are required vitally for the operation of the plant, then the same shall be procured and provided by the Contractor without any additional cost implication to the Employer.

The Contractor shall employ only such personnel who are adequately qualified and experienced for operating and maintaining and troubleshooting Flow BESS, and EMS.

The Contractor shall provide copies of all necessary documents including the following:

- Operation and maintenance manuals for all equipment
- Failure Analysis/history/troubleshooting details of all the equipment
- List of vendors indicating names and addresses for procurement of essential spare parts
- Root cause analysis report for any major failure
- Record of consumables / spare parts

The Contractor shall implement software updates to control and monitor the systems including EMS/BMS to meet the plant facility operating requirements.

The Contractor shall, at all times, allow and provide the Employer all necessary information for the operation of the Flow BESS and EMS full, free, unconditional, safe and complete access to the EMS.

The Contractor shall provide the training to the Employer's personnel in relation to the operation of the complete facility.

The Contractor shall carry out the performance monitoring for the Facility (Flow BESS and EMS) on a continuous basis and in case of any deviation, the Contractor shall perform the due diligence appropriately to find out the actual root cause of such deviation. Thereafter the corrective action required to mitigate such deviation shall be undertaken by the Contractor without any additional cost.

The Contractor should monitor the annual service package, manage/supervise/complete the scheduled routine maintenance, repair services and testing activities of the Flow BESS and EMS and document all O&M services completed via an agreed methodology. It should update the records with preventive maintenance services and track any problems or warranty issues. Through the analysis of the maintenance records, it should organize the next interventions to maintain the physical state of all equipment supplied.

The Contractor should confirm availability and take any measures to secure operating instructions, warranties and performance guarantees, and other project documentation.

The Contractor shall specify safety features in the O&M manual under normal operation and under emergency situations. The Contractor shall provide clear safety instructions to regional/local personnel engaged by the Contractor as well as the Employer's staff for safe handling of the equipment.

The Contractor must provide a description of all failure modes, failure impacts, and the failsafe philosophy and explain the safety principles and implementation scheme for each component of the Battery system.

Emergency Response procedures must be provided by the Contractor, detailing the recommended strategy to fight a battery fire, manage a thermal runaway event, and the necessary PPE for the Fire Fighters.

The Contractor shall submit a Hazardous material management plan, emergency response plan, decommission plan and disposal plan for Employer's approval.

The Contractor shall clearly document and share with the Employer regarding the presence of all hazardous materials. The Flow BESS shall be configured to prevent personal contact of hazardous material or environmental contamination due to hazardous materials. The Flow BESS will include appropriate first aid equipment for contact with hazardous materials. All hazardous material shall have a clearly documented method of safe disposal.

The Contractor shall be responsible for the removal and disposal of equipment associated with the Flow BESS system, as directed by the Employer, as and when during the 2 years O&M period.

3.16 Spare parts, consumables and special tools

The Bidder shall provide all spares parts and consumables necessary for the correct functioning during the warranty period (two years) and for performing the necessary maintenance activities. All spare parts shall be directly interchangeable with the corresponding parts in the power plants and shall meet the requirements of the present specifications.

Spare parts comprise all disciplines (civil, mechanical, electrical and I&C works) and shall be in compliance with the corresponding Schedules in Section 4.

All the special tools and other equipment necessary for the overhaul, maintenance, and adjustment of the power plant facilities and equipment shall be included in the Bidder's scope of supply.

4 Environmental, Health and Safety Management Requirement

The bidder will enter into an agreement with suppliers for disposal of used batteries as hazardous waste. Hazardous waste collected will be regularly transported off island at the contractor (suppliers) cost of transboundary disposal per national regulations and not be allowed to accumulate on site over long periods.

Contractor will provide a leak proof, fully enclosed battery collection system to FENEKA allowing the environmentally safe and sound temporary storage of the used battery cells whilst awaiting disposal.

The bidder will not take access of the powerhouse site from the Employer until they have satisfied themselves that FENEKA has complied with the corrective action plan for existing facilities.

The bidder will implement all actions and responsibilities allocated to the contractors under the EMP (Annex 1) for the full duration of the contractor's involvement in the project, ensuring adherence to all applicable national environment, health, safety, and labor laws and regulations in force at the time and ensuring adherence to ADB's Safeguard Policy Statement (2009) and the related IFC Environment, Health and Safety (EHS) guidelines.

The bidder will ensure the feasibility studies and detailed designs reflect the EMP requirements; seeking to ensure the same or no worse impact than the design assessed in the IEE available at https://www.adb.org/projects/documents/mld-55191-001-iee.

The bidder will ensure adequate budget and staff resources are allocated to comply with and implement the contractor's responsibilities under the EMP and to supervise and monitor the active construction site to protect the environment and ensure the health and safety of all workers and affected communities. They will ensure a suitably qualified and experienced safeguards team has been appointed to undertake regular on-site supervision and monitoring activities before the commencement of works. Each island and active construction site is to have adequate health and safety supervision to ensure the health and safety of all workers and local communities; the environment officer and health and safety officer will be supported by full-time on-site EHS supervisors with at least one supervisor per island, and full-time on-site Health and Safety stewards with at least one steward at each active construction site

The bidder will undertake and document a facilitated health and safety risk assessment considering all stages of the project, not just those stages the contractor is responsible for.

The bidder will prepare a Construction Environment Management Plan (CEMP) and a Construction Health and Safety Management Plan (CHSMP) both with sub-plans as specified in the EMP for review and approval by the Employer prior to the commencement of works – these documents will comprise the contractor's Environmental, Health, and Safety Management Plan (EHSMP).

The Environmental, Health, and Safety Management Plan (EHSMP) shall cover, but not limited to the following:

Standards and Guidelines to be followed:

- IEC 62932-2-1 Flow battery energy systems for stationary applications – Part 2-1: Performance general requirements and test methods
- IEC 62932-2-2 Flow battery energy systems for stationary applications – Part 2-2: Safety requirements
- UL 1973 Batteries for Use in Stationary, Vehicle Auxiliary Power and Light Electric Rail (LER) Applications
- IEC 61427-1, 2, Secondary cells and batteries for renewable energy storage
- UL 9540 Energy Storage System (ESS) Requirements - Evolving to Meet Industry and Regulatory Needs
- National environment, health and safety (labor) laws and regulations as detailed in the IEE, Chapter II
- IFC EHS General Guidelines (https://www.ifc.org/en/insights-reports/2000/general-environmental-health-and-safety-guidelines)
- ILO Safety and Health in Construction (https://www.ilo.org/global/topics/safety-and-health-at-work/normative-instruments/code-of-practice/WCMS_107826/lang--en/index.htm)
- ILO worker accommodation standards (https://www.ilo.org/wcmsp5/groups/public/---ed_emp/---emp_ent/---multi/documents/publication/wcms_116344.pdf)
- World Health Organization Community Noise Guidelines and Ambient Air Quality Guidelines.
- World Health Organization Drinking Water Standards where more stringent than national standards

The bidder will ensure no site establishment or construction activity is to take place before the Employer has received and approved the detailed design and requisite contractor's EHSMP (CEMP and CHSMP including all sub-plans).

The bidder will ensure that all construction workers including all formal and informal employees and subcontractors understand their responsibilities to implement the EMP and mitigate environmental impacts associated with pre-construction and construction activities. They will ensure attendance at EHS training provided by the Employer. They will provide and ensure attendance at EHS training for formal and informal construction workers and other personnel as required.

The bidder will adopt a zero-tolerance approach to OHS on the project, enforce all workers to comply with the OHS requirements of the EMP including the wearing of appropriate PPE on the construction site.

The bidder will support the Employer in undertaking ongoing public consultations and implementing the site-level GRM; in particular, the contractor's GRM focals (safeguards team) shall thoroughly document details of complaints and make its best efforts to resolve the complaints at project site level; all this information is to be included in monthly reports to be submitted by the contractor to the Employer.

The bidder will undertake environmental monitoring as set out in the EMOP (Annex 1) for the duration of their involvement in the project and documenting qualitative and quantitative monitoring results.

The bidder will establish their own internal systems for monitoring and reporting their EMP implementation.

The bidder will attend monthly EHS meetings and submit monthly and quarterly environmental management reports per an agreed template to the Employer (these reports will be included as part of the contractor's monthly progress reports), relating the work undertaken over the reporting period and documenting the environmental measures including monitoring activities that have been carried out, problems encountered, record data including near misses and incidents, grievances received, and follow-up actions that were taken (or will be taken) to correct the problems.

The bidder will inform the Employer immediately in case of any approved detailed design changes or unanticipated environmental impacts occurring during the project implementation stage, and as required, provide any information needed to the Employer to enable them to promptly update the IEE/EMP for clearance by ADB before any changes are implemented.

The bidder will inform the Employer within 24 hours in case of chance find or incident on site and providing within 48 hours an incident report with corrective action detailing how reoccurrence will be prevented.

The bidder will inform the Employer immediately in case of any non-compliance and help them to prepare as necessary a corrective action plan for clearance by the financier, the contractor is required to implement all necessary corrective action requested by the Employer to ensure the project remains in compliance with national regulatory requirements, ADB's Safeguard Policy Statement (2009), the project's loan covenants and EMP requirements.

Some of the environmental concerns envisaged for the project and its mitigation measures are mentioned in the IEE available at
https://www.adb.org/projects/documents/mld-55191-001-iee**:**

Fire and Emergency Response:

During operation, there is a risk of fire and other accidents. The Flow BESS must be designed to prevent or suppress the propagation of thermal runaway or to prevent the build-up of combustive vent gases, in case it exceeds the limit of voltage and current or temperature of the surroundings, which may further surpass the safe limit of the off-gas concentration.

Safety requirements to mitigate the Fire emergency:

- The contractor needs to demonstrate that safety has been incorporated in all stages of the Flow BESS design to the highest available national and international standards/guidelines.
- A battery protection circuit will be required to improve safety, by making accidents less likely or by minimizing their severity when they do occur.
- Construction and location measures to reduce risks and provide a safety zone.
- An adequate supply of water and a fire protection system suitable for the chemistry of the battery and the type of chemical fire that could result from it.
- Ventilation and temperature control systems should be incorporated.
- Gas detection and smoke detection system should be incorporated.

- Incorporation of a maintenance plan.

Battery Disposal and Decommissioning:

- Any batteries that are rejected during installation and commissioning due to damage or failure will immediately be removed from the site and returned to the supplier for the disposal.
- The estimated lifespan the Flow BESS is 20 years, at which point it is expected that it may be decommissioned. Replaced battery cells will be temporarily stored in the leak proof, fully enclosed battery collection system until they are removed off site by the contractor (supplier) – as per contract agreement with suppliers for the disposal of used batteries.
- Dispose the batteries as hazardous waste to a hazardous waste management facility requiring the transboundary disposal under the Basel Convention since facilities do not exist on the Maldives. Handling and disposal of used batteries shall be done in compliance with Waste Management Policy and Waste Regulations (2013) of Maldives as well as in compliance with Basel Convention on the Control of Transboundary Movement of Hazardous Wastes and their Disposal (1989).

Impact on workers:

- Workers may be put at physical risk from electrical shocks, dust, handling heavy materials and equipment, falls and falling objects, work on slippery surfaces, fire hazards, and chemical hazards such as toxic fumes and vapours from batteries which cause significant damage; all of which will be present throughout the project construction period. Workers may come into contact with high-voltage power lines/equipment during operation, maintenance and repair. Other hazards include accidents, flammable gas, carbon monoxide, and fire. These impacts can be mitigated by undertaking a risk assessment, and management planning following the mitigation hierarchy including the use of Personal Protective Equipment (PPE) as the last resort and Emergency Response Procedures (ERP), developed in compliance with relevant safety regulations and guidelines.
- Project construction has the potential to cause disturbances in the community, such as public safety risks from construction activities, fires, spills of materials, and risks associated with unauthorized entry into work areas. These potential impacts can be mitigated by implementing good community health and safety practices, installation of site safety fencing and warning signs and, employing on-site supervision personnel (including night guards) as determined by the risk, to prevent unauthorized access to construction areas.

In addition to the above, the contractor should follow the requirements of the Environmental Management Plan provided in Annex 1.

Schedule for monitoring and supervision:

The contractor shall undertake periodic monitoring as per an agreed schedule to ensure that management measures are being fulfilled to mitigate environmental and social impacts.

Monitoring will focus on the two key areas discussed below as well as those required under the Environmental Monitoring Plan attached in Annex 1:

Compliance Monitoring

- During the project preparation phase, compliance monitoring activities will focus on ensuring the effective implementation of the EMP and contractor's Environmental, Health, and Safety Management Plan.
- The environmental officer and health and safety officer of the Contractor agency will ensure proper and timely implementation of environment, health and safety measures in compliance with the EMP and contractor's Environmental, Health, and Safety Management Plan.
- During the implementation phase, compliance monitoring by the Employer will include inspections during the construction of the project's components to verify the extent to which environmental authorization conditions and the EMP and contractor's EHSMP are being adhered to.
- Ensuring the environmental and social performance of subcontractors during project construction, operation and decommissioning will be the responsibility of the Contractor.

Impact monitoring:

- It will be the responsibility of the Contractor to monitor and make sure that no violations take place at the site.
- The EMP and contractor's Environmental, Health, and Safety Management Plan (EHSMP) will form the basis for contractor activities at the project site to ensure that works proceed in accordance with required mitigation and management measures.

Arrangement for Reporting:

Monthly and quarterly project environmental and social progress reports will be compiled as part of project performance reporting. Such environmental and social reporting would be integrated with overall project status and performance reporting. The reporting should include parameters required to be monitored by the Contractor as outlined in the Environmental Monitoring Plan in Annex 1.

Requirement for training and capacity building:

The implementing agency will provide training to all the staff working on-site. This training program will focus on environmental, health and safety laws, regulations and policies, operation and maintenance of a battery energy storage system.

5 Drawings

The bidder shall submit any drawing appropriate to help explain the solution provided.

6 Certificates

6.1 Form of Completion Certificate

Contract: [. . . . *insert name of contract and contract identification details*. . . . .]

Date: .....

Certificate No.: .....

To: [. . . . *insert name and address of contractor*. . . . .]

Dear Ladies and/or Gentlemen,

Pursuant to GCC Clause 24 (Completion of the Facilities) of the General Conditions of the Contract entered into between yourselves and the Employer dated [. . . . *insert date*. . . . .], relating to the [. . . . *brief description of the Facilities* . . . .], we hereby notify you that the following part(s) of the Facilities was (were) complete on the date specified below, and that, in accordance with the terms of the Contract, the Employer hereby takes over the said part(s) of the Facilities, together with the responsibility for care and custody and the risk of loss thereof on the date mentioned below.

1. Description of the Facilities or part thereof: [. . . . *description* . . . .]

2. Date of Completion: [. . . . *date* . . . .]

However, you are required to complete the outstanding items listed in the attachment hereto as soon as practicable.

This letter does not relieve you of your obligation to complete the execution of the Facilities in accordance with the Contract nor of your obligations during the Defect Liability Period.

Very truly yours,

[. . . . *Signature* . . . .]

Project Manager

6.2 Form of Operational Acceptance Certificate

Contract: [. . . . *insert name of contract and contract identification details*. . . . .]

Date: .....

Certificate No.: .....

To: [. . . . *insert name and address of contractor*. . . . .]

Pursuant to GCC Subclause 25.3 (Operational Acceptance) of the General Conditions of the Contract entered into between yourselves and the Employer dated [. . . *date*. . .], relating to the [. . . *brief description of the facilities*. . . .], we hereby notify you that the Functional Guarantees of the following part(s) of the Facilities were satisfactorily attained on the date specified below.

1. Description of the Facilities or part thereof: [. . . *description* . . .]

2. Date of Operational Acceptance: [. . . *date* . . .]

This letter does not relieve you of your obligation to complete the execution of the Facilities in accordance with the Contract nor of your obligations during the Defect Liability Period.

Very truly yours,

[. . . . *Signature* . . . .]

Project Manager

7 Change Orders

7.1 Change order procedure

7.1.1 General

This section provides samples of procedures and forms for implementing changes in the Facilities during the performance of the Contract in accordance with GCC Clause 39 (Change in the Facilities) of the General Conditions.

7.1.2 Change Order Log

The Contractor shall keep an up-to-date Change Order Log to show the current status of Requests for Change and Changes authorized or pending. Entries of the Changes in the Change Order Log shall be made to ensure that the log is up-to-date. The Contractor shall attach a copy of the current Change Order Log in the monthly progress report to be submitted to the Employer.

7.1.3 References for Changes

(1) Request for Change as referred to in GCC Clause 39 shall be serially numbered CR-X-nnn.

(2) Estimate for Change Proposal as referred to in GCC Clause 39 shall be serially numbered CN-X-nnn.

(3) Acceptance of Estimate as referred to in GCC Clause 39 shall be serially numbered CA-X-nnn.

(4) Change Proposal as referred to in GCC Clause 39 shall be serially numbered CP-X-nnn.

(5) Change Order as referred to in GCC Clause 39 shall be serially numbered CO-X-nnn.

Note:

(a) Requests for Change issued from the Employer's Home Office and the Site representatives of the Employer shall have the following respective references:

Home Office	CR-H-nnn
Site	CR-S-nnn

(b) The above number "nnn" is the same for Request for Change, Estimate for Change Proposal, Acceptance of Estimate, Change Proposal and Change Order.

7.2 Change Order Forms

7.2.1 Request for Change Proposal Form

[*Employer's letterhead*]

To: [*Contractor's name and address*] Date:

Attention: [*Name and title*]

Contract Name: [*Contract name*]

Contract Number: [*Contract number*]

Dear Ladies and/or Gentlemen:

With reference to the captioned Contract, you are requested to prepare and submit a Change Proposal for the Change noted below in accordance with the following instructions within [*number*] days of the date of this letter [or on or before (*date*)].

1. Title of Change: [*Title*]
2. Change Request No./Rev.: [*Number*]
3. Originator of Change:

   Employer: [Name]

   Contractor (by Application for Change Proposal No. [Number Refer to Annex 6.2.7])
4. Brief Description of Change: [*Description*]
5. Facilities and/or Item No. of equipment related to the requested Change: [*Description*]
6. Reference drawings and/or technical documents for the request of Change:

   Drawing No./Document No. *Description*
7. Detailed conditions or special requirements on the requested Change: [*Description*]
8. General Terms and Conditions:

(a) Please submit your estimate showing what effect the requested Change will have on the Contract Price.

(b) Your estimate shall include your claim for the additional time, if any, for completing the requested Change.

(c) If you have any opinion that is critical to the adoption of the requested Change in connection with the conformability to the other provisions of the Contract or the safety of the Plant or Facilities, please inform us in your proposal of revised provisions.

(d) Any increase or decrease in the work of the Contractor relating to the services of its personnel shall be calculated.

(e) You shall not proceed with the execution of the work for the requested Change until we have accepted and confirmed the amount and nature in writing.

[*Employer's name*]

[*Signature*]

[*Name of signatory*]

[*Title of signatory*]

7.2.2 Estimate for Change Proposal Form

[*Contractor's letterhead*]

To: [*Employer's name and address*] Date:

Attention: [*Name and title*]

Contract Name: [*Contract name*]

Contract Number: [*Contract number*]

Dear Ladies and/or Gentlemen:

With reference to your Request for Change Proposal, we are pleased to notify you of the approximate cost to prepare the below-referenced Change Proposal in accordance with GCC Subclause 39.2.1 of the General Conditions. We acknowledge that your agreement to the cost of preparing the Change Proposal, in accordance with GCC Subclause 39.2.2, is required before estimating the cost for change work.

1. Title of Change: [*Title*]
2. Change Request No./Rev.: [*Number*]
3. Brief Description of Change: [*Description*]
4. Scheduled Impact of Change: [*Description*]
5. Cost for Preparation of Change Proposal: [*insert costs, which shall be in the currencies of the contract*]

(a)	Engineering		(Amount)
	(i)	Engineer _____ hours (hrs) x _____ rate/hr =	_____
	(ii)	Draftsperson _____ hrs x _____ rate/hr =	_____
		Sub-total _____ hrs	_____
		Total Engineering Cost	_____
(b)		Other Cost	_____
		Total Cost (a) + (b)	_____

[*Contractor's name*]

[*Signature*]

[*Name of signatory*]

[*Title of signatory*]

7.2.3 Acceptance of Estimate Form

[*Employer's letterhead*]

To: [*Contractor's name and address*] Date:

Attention: *[Name and title]*

Contract Name: *[Contract name]*

Contract Number: *[Contract number]*

Dear Ladies and/or Gentlemen:

We hereby accept your Estimate for Change Proposal and agree that you should proceed with the preparation of the Change Proposal.

1. Title of Change: [*Title*]
2. Change Request No./Rev.: [*Request number/revision*]
3. Estimate for Change Proposal No./Rev.: [*Proposal number/revision*]
4. Acceptance of Estimate No./Rev.: [*Estimate number/revision*]
5. Brief Description of Change: [*Description*]
6. Other Terms and Conditions: In the event that we decide not to order the Change accepted, you shall be entitled to compensation for the cost of preparing the Change Proposal described in your Estimate for Change Proposal mentioned in para. 3 above in accordance with GCC Clause 39 of the General Conditions.

[*Employer's name*]

[*Signature*]

[*Name of signatory*]

[*Title of signatory*]

7.2.4 Change Proposal Form

[*Contractor's letterhead*]

To: [*Employer's name and address*] Date:

Attention: [*Name and title*]

Contract Name: [*Contract name*]

Contract Number: [*Contract number*]

Dear Ladies and/or Gentlemen:

In response to your Request for Change Proposal No. [Number], we hereby submit our proposal as follows:

1. Title of Change: [*Name*]
2. Change Proposal No./Rev.: [*Proposal number / revision*]
3. Originator of Change: Employer: [*Name*] / Contractor: [*Name*]
4. Brief Description of Change: [*Description*]
5. Reasons for Change: [*Reason*]
6. Facilities and/or Item No. of Equipment related to the requested Change: [*Facilities*]
7. Reference drawings and/or technical documents for the requested Change:

   [*Drawing/Document No./Description*]
8. Estimate of increase/decrease to the Contract Price resulting from the Change Proposal:

		Amount
		[*insert amounts in the currencies of the Contract*]
(a)	Direct material	_____
(b)	Major construction equipment	_____
(c)	Direct field labor (Total hrs)	_____
(d)	Subcontracts	_____
(e)	Indirect material and labor	_____
(f)	Site supervision	_____
(g)	Head office technical staff salaries	
	Process engineer _____ hrs @ _____ rate/hr	_____

Project engineer _____ hrs @ _____ rate/hr _____

Equipment engineer_____ hrs @ _____ rate/hr _____

Procurement _____ hrs @ _____ rate/hr _____

Draftsperson _____ hrs @ _____ rate/hr _____

Total _____hrs

(h) Extraordinary costs (computer, travel, etc.) _____

(i) Fee for general administration, % of Items _____

(j) Taxes and customs duties _____

Total lump sum cost of Change Proposal [*Sum of items (a) to (j)*]

Cost to prepare Estimate for Change Proposal [*Amount payable if Change is not accepted*]

9. Additional time for Completion required due to Change Proposal

10. Effect on the Functional Guarantees

11. Effect on the other terms and conditions of the Contract

12. Validity of this Proposal: within [Number] days after receipt of this Proposal by the Employer

13. Other terms and conditions of this Change Proposal:

    (a) You are requested to notify us of your acceptance, comments or rejection of this detailed Change Proposal within [Number] days from your receipt of this Proposal.

    (b) The amount of any increase and/or decrease shall be taken into account in the adjustment of the Contract Price.

    (c) Contractor's cost for preparation of this Change Proposal: [*. . . .insert amount. This cost shall be reimbursed by the employer in case of employer's withdrawal or rejection of this Change Proposal without default of the contractor in accordance with GCC Clause 39 of the General Conditions . . . .*]

[*Contractor's name*]

[*Signature*]

[*Name of signatory*]

[*Title of signatory*]

7.2.5 Change Order Form

[*Employer's letterhead*]

To: *[Contractor's name and address]* Date:

Attention: *[Name and title]*

Contract Name: *[Contract name]*

Contract Number: *[Contract number]*

Dear Ladies and/or Gentlemen:

We approve the Change Order for the work specified in the Change Proposal (No. [*number*]), and agree to adjust the Contract Price, Time for Completion, and/or other conditions of the Contract in accordance with GCC Clause 39 of the General Conditions.

1. Title of Change: [*Name*]
2. Change Request No./Rev.: [*Request number / revision*]
3. Change Order No./Rev.: [*Order number / revision*]
4. Originator of Change: Employer: [*Name*] / Contractor: [*Name*]
5. Authorized Price:

   Ref. No.: [*Number*] Date: [*Date*]

   Foreign currency portion [*Amount*] plus Local currency portion [*Amount*]
6. Adjustment of Time for Completion

   None Increase [*Number*] days Decrease [*Number*] days
7. Other effects, if any

Authorized by: _____ Date: _____

Employer

Accepted by: _____ Date: _____

Contractor

7.2.6 Pending Agreement Change Order Form

[*Employer's letterhead*]

To: *[Contractor's name and address]* Date:

Attention: *[Name and title]*

Contract Name: *[Contract name]*

Contract Number: *[Contract number]*

Dear Ladies and/or Gentlemen:

We instruct you to carry out the work in the Change Order detailed below in accordance with GCC Clause 39 of the General Conditions.

1. Title of Change: [*Name*]
2. Employer's Request for Change Proposal No./Rev.: [*number/revision*] dated: [*date*]
3. Contractor's Change Proposal No./Rev.: [*number / revision*] dated: [*date*]
4. Brief Description of Change: [*Description*]
5. Facilities and/or Item No. of equipment related to the requested Change: [*Facilities*]
6. Reference Drawings and/or technical documents for the requested Change:

   [*Drawing / Document No. / Description*]
7. Adjustment of Time for Completion:
8. Other change in the Contract terms:
9. Other terms and conditions:

[*Employer's name*]

[*Signature*]

[*Name of signatory*]

[*Title of signatory*]

7.2.7 Application for Change Proposal Form

[*Contractor's letterhead*]

To: [*Employer's name and address*] Date:

Attention: [*Name and title*]

Contract Name: [*Contract name*]

Contract Number: [*Contract number*]

Dear Ladies and/or Gentlemen:

We hereby propose that the work mentioned below be treated as a Change in the Facilities.

1. Title of Change: [*Name*]
2. Application for Change Proposal No./Rev.: [*Number / revision*] dated: [*Date*]
3. Brief Description of Change: [*Description*]
4. Reasons for Change:
5. Order of Magnitude Estimation (amount in the currencies of the Contract): [*Amount*]
6. Scheduled Impact of Change:
7. Effect on Functional Guarantees, if any:
8. Appendix:

[*Contractor's name*]

[*Signature*]

[*Name of signatory*]

[*Title of signatory*]

8 Personnel Requirements

Using Form PER-1 and PER-2 in Section 4 (Bidding Forms), the Bidder must demonstrate that it has personnel who meet the following requirements:

No.	Position	Total Work Experience [years]	Experience In Similar Work [years]
1	Project Manager (Electrical Engineer)	15	7
2	EMS Specialist	10	5
3	Flow BESS Specialist	10	5
4	Electrical Engineer	10	5
5	Environment and Social Expert meeting the EMP requirements	10	5
6	Health and Safety Expert meeting the EMP requirements	15	7
7	Environment, health and safety supervisors meeting the EMP requirements	10	5
8	Health and safety stewards meeting the EMP requirements	7	3
9	Construction Engineer (civil and cabling)	7	3

All staff must be fluent in English.

9 Equipment Requirements

Using Form EQU in Section 4 (Bidding Forms), the Bidder must demonstrate that it has the key equipment listed below:

No.	Equipment Type and Characteristics	Minimum Number Required
1	Crane to move and place the containers	1 per site
2		
3		

Annex 1. Environmental Management Plan

The environmental management plan includes the implementation arrangements, mitigation measures and monitoring requirements given in Chapter VII, Appendix 16 and Appendix 17 (given below) of the Initial Environmental Examination (IEE) for the ASSURE project and also available at https://www.adb.org/projects/documents/mld-55191-001-iee.

This EMP will form part of the contract document together with General Environment, Health & Safety (EHS) Conditions of Contract (CoC) for all contractors.

This EMP will form the basis for the contractor to prepare their environmental, health and safety management plan.

VII. ENVIRONMENTAL MANAGEMENT PLAN

A. Introduction

313. ADB's Safeguard Policy Statement (2009) requires that an environmental management plan (EMP) be prepared and implemented for a category B environment project. The EMP is the synthesis of all the mitigation measures to avoid, minimize, mitigate, or compensate/offset for the adverse environmental impacts and risks on the physical, biological, and socioeconomic environment that have been identified in the previous sections of the IEE as well as to enhance positive impacts. It aims to ensure compliance with (i) ADB's Safeguard Policy Statement 2009 requirements and international good practice as set out in the related International Finance Corporation (IFC) Environment, Health and Safety (EHS) general, Electric Power Transmission and Distribution and Wind Energy guidelines, and (ii) applicable environmental, health and safety requirements of the Government of Maldives, including the international agreements which it is a signatory too, as well as the sensitivity of local ecological and human receptors in the project area of influence.

314. The EMP outlines the mitigation measures to be implemented set to a timeframe, and the responsibilities for implementing them, whilst a monitoring plan elaborates on the monitoring requirements and responsibilities. To ensure these mitigation and monitoring plans are implemented, MOECCT and their Project Management Unit (PMU) supported by a Project Management Consultant (PMC) will need to undertake a program of environmental supervision and monitoring during project implementation. The institutional arrangements for this are also set out. The definitive version of the EMP cleared by ADB is the version disclosed on its website. The EMP is dynamic and can be updated as appropriate during the project implementation. However, any update to the EMP will first need to be cleared by ADB. In addition, any unanticipated impacts including changes to the project design and layouts as assessed in the IEE, or requirements for corrective action due to non-compliance identified during project implementation will be reported to ADB. In this case appropriate action will be agreed and taken by MOECCT and their contractors and FENAKA/Island Councils once operational to address them and bring the project implementation back on track.

315. The major components of the EMP are:

(i) Corrective action plan for existing facilities (powerhouses) to be implemented by FENAKA pre-construction;
(ii) Mitigation plan including performance standards to be followed by concerned parties during preconstruction, construction, operation and decommissioning of the project components;
(iii) Monitoring plan including performance standards for quantitative monitoring to be undertaken; and
(iv) Institutional arrangements, including organizational roles and responsibilities for mitigation, supervision, monitoring and reporting on EMP implementation, capacity development and training requirements for MOECCT, the PMU, their contractors, and FENAKA/Island Councils on various aspects of EMP implementation and, an indicative cost estimates/budget for its implementation.
(v) Grievance redress mechanism (GRM)–Chapter F of the IEE report sets out the GRM for the project with roles and responsibilities for MOECCT, the PMU, their contractors, and FENAKA/Island Councils.

316. The EMP will form part of all bidding and contract documents and during planning and detailed design (pre-construction) and construction the contractors will be responsible for implementing all relevant measures under the supervision of the MOECCT. Any updates to it will be incorporated into the contract document. The contractors must always follow the definite version of the EMP which is the version that is disclosed on ADB's website. Contractors will cover the costs where corrective action is required due to non-compliance on behalf of the contractors, their subcontractors or third parties with the EMP.

317. There are five EPC contract packages to be awarded for the (i) lithium-ion BESS, (ii) flow BESS, (iii) ocean energy pilot, (iv) wind energy pilot, and (v) ground mounted solar on Thoddoo island. There are also two works contract packages for (i) grid upgrades and (ii) rooftop solar, under which there may be 3–4 lots each. For these the equipment will be separately procured under two goods contracts. Both the EPC and works contracts must append a full copy of the EMP including both the general and site-specific mitigation and monitoring plans relevant to the contract. For goods contracts MOECCT PMU will need to ensure relevant EMP measures including prohibitions on PCBs, asbestos containing materials, and SF6 are reflected in the equipment specifications.

B. Existing Facilities Corrective Action Plan

318. Since the project involves existing facilities that have been subject to environmental audit it is necessary for corrective action to be undertaken. Appendix 7 contains the corrective action plan for existing facilities (powerhouses); unless otherwise indicated, all actions are to be completed by FENAKA or delegated to the contractors through the scope of the relevant contracts prior to the contractor being given access to the project sites.

319. MOECCT PMU will be responsible to submit a report on the status of the corrective actions undertaken by FENAKA or delegated to ADB for clearance prior to the contractor being given access to the powerhouses in question to undertake works including site establishment. Contractors will be responsible for implementing any corrective actions delegated to them, or otherwise outstanding on gaining access to the powerhouses in addition to the requirements of the mitigation plan.

C. Mitigation Plan

320. The mitigation hierarchy; avoid, minimize, mitigate, offset/compensate; has been used to guide the mitigation of environmental and social impacts from the project components. Careful site selection and project design at the planning and detailed design stage can avoid significant impact. This is especially so since the ocean energy pilot is to be sited in the marine environment in a location that is still to be confirmed, and since the wind energy pilot can have noise, shadow flicker and safety impacts if it is not designed to meet performance standards in line with the IFC EHS Guidelines on Wind Energy. The environment, health and safety parameters to be followed for the ocean energy and wind energy pilots are set out in the mitigation plan and will need to be taken on board by the contractor, MOECCT PMU with the support of the PMC must ensure the performance standards are adhered to before approving any detailed design. The rest of the proposed mitigation strategy focuses on minimizing the minor to moderate impacts of the project components. In addition to the impacts of the ocean and wind energy systems mentioned above the main anticipated impacts and risks of the project-funded components relate to short-term (approximately 3-5 days for smaller works and up to two months for larger works i.e. wind turbine installation) disruption and disturbance during construction; pollution risks; and health and safety

risks to workers and local communities, for example, island roads will be blocked and noise and dust emissions will be created from the operation of construction machinery such as concrete mixers, bulldozers, dump trucks, cranes etc.

321. A general mitigation plan showing the stage-wise potential impacts and proposed mitigation measures and responsible party has been prepared in a matrix form and presented in Table 1, Appendix 16. Considering there are several project components which involve construction work, this common matrix will be applicable for all the components involving construction activities and will be attached to all EPC and works contracts. Operational phase mitigation measures are primarily for FENAKA, except for the ocean energy and wind energy pilots where the contractor will continue to be responsible for operation during and decommissioning at the end of the pilot, and the agricultural interventions which will be handed over to the Island Councils. All maintenance works during the operation phase, including by the contractors during their defect liability period and any operation and maintenance obligations will be undertaken following the construction measures. Separate matrices have been prepared for the individual components addressing component-specific impacts and mitigation of a particular component as follows:

(i) General mitigation plan matrix for all construction work (Table 1, Appendix 16) including environmental codes of practice (Appendix 17),
(ii) Mitigation plan matrix for BESS, EMS and Grid Upgrades (Table 2, Appendix 16),
(iii) Mitigation plan matrix for solar photovoltaic plants (rooftop and ground mounted) (Table 3, Appendix 16),
(iv) Mitigation plan matrix for Wind Energy Pilot (Table 4, Appendix 16),
(v) Mitigation plan matrix for Ocean Energy Pilot (Table 5, Appendix 16) which is to be updated for ADB clearance following confirmation of the selected island, and
(vi) Mitigation plan matrix for agricultural intervention (Table 6, Appendix 16) which is to be updated for ADB clearance following confirmation of the scope of physical interventions.

322. These mitigation plan matrixes for the ocean energy pilot and agricultural intervention will be updated as part of updating the IEE following the feasibility studies since the locations and exact scope are still be studied, the updated EMP will be cleared by ADB before the feasibility study is approved by MOECCT.

D. Monitoring and Reporting

The extent of monitoring and reporting must be commensurate with the project's impacts and risks. Throughout implementation of the project, MOECCT, and FENAKA/Island Councils during operation, will need to supervise and monitor EMP implementation progress and the impacts of the project in the field, the performance standard being all EMP mitigation and monitoring measures are implemented in full at the appropriate time. The environmental monitoring plan (EMOP) (Table 7, Appendix 16) sets out the minimum provisions for quantitative environmental monitoring and performance standards to be achieved—scope and periodicity is commensurate with the project's impacts and risks. Monitoring activities including any laboratory analysis for air quality, noise and water quality are to be carried out by a suitably qualified and experienced third-party monitoring organization that is approved by the EPA. Quantitative monitoring activities may be modified during project implementation, depending on the contractors' performance and analytical results obtained. If performance is worse than expected, corrective action will be identified, and environmental monitoring activities adjusted accordingly by MOECCT and their contractors if during pre-construction and construction and FENAKA/Island Councils once

operational, to help resolve any unsatisfactory performance. MOECCT will establish a system for supervision and monitoring and preparing semi-annual environmental monitoring reports for submission to ADB and local disclosure with inputs from FENAKA/Island Councils during operation.

E. Implementation Arrangement

The main institutions that will be involved in environmental management activities are the Ministry of Finance as the executing agency (EA); and MOECCT as implementing agency (IA) of the project, project management consultant (PMC), EPC and works contractors, and line agencies including the Environment Protection Agency (EPA). The project management unit (PMU) will be established under MOECCT for implementing the project facilities. MOECCT will be responsible for implementation, supervision and monitoring of the project with the support of FENAKA and the Island Councils.

323. MOECCT PMU will coordinate with EPA to seek advice on regulatory requirements for the project. If required MOECCT with support from PMC environment experts will update this IEE and EMP to meet the EPA requirements to get necessary approvals as per national requirements.

324. Efficient project implementation related to the EPC, works and goods contracts will be provided by the PMC and will include preparation of bidding documents; assistance during the bidding process and evaluation; and supervision of the technical design, equipment supply, construction, and commissioning as well as piloting and decommissioning in respect of the ocean and wind energy.

325. The EA/IA have overall responsibility for all aspects of the project. The IA through the PMU with support of the PMC will be responsible for day-to-day management of technical aspects of the project. The PMU will be responsible for updating the IEE and EMP as well as approving contractors' feasibility studies, detailed designs, and construction related management plans, and to ensure on-ground implementation by the contractors of the EMP. The EA/IA will ensure the environmental management and monitoring budgets are available and utilized as necessary for timely implementation of the EMP and CAP for existing facilities by all government entities.

326. The existing capacity of MOECCT in managing project level environmental aspects needs strengthening to ensure compliance with ADB and government requirements. PMU will have an environment officer and social (community liaison) officer in the project organization structure who will be full-time and primarily responsible for ensuring that the EMP and CAP for existing facilities is properly implemented. PMC will provide training and capacity building to PMU staff on managing the environmental issues associated with project and be responsible for ensuring the quality of deliverables before submission to ADB. Costs for the appointment of PMU officers and for the PMC consultant support are included in the capacity building component of the Project.

327. The contractors will be informed of their responsibility to comply with the EMP and the requirements of ADB. There are specific responsibilities for EMP compliance during construction phase that will rest with the contractors who will be supervised and monitored by the safeguards team of PMU and PMC. The contractors will be required to have one staff with experience in environmental management and one staff with experience of health and safety to supervise and monitor day-to-day EMP implementation and be responsible for preparing plans such as the CEMP, CHSMP, etc.

1. Institutional Arrangement

328. MOECCT will have ultimate responsibility for implementing the provisions of the EMP with the main parties involved in environmental management and monitoring activities for this project being:

(i) **Ministry of Finance** as the executing agency to provide guidance to MOECCT on all project related matters.

(ii) **Ministry of Environment, Climate Change and Technology** as the implementing agency responsible for environmental, health and safety management and compliance with the government regulatory requirements, ADB's Safeguard Policy Statement 2009, the project's loan covenants and EMP requirements ultimately lies with the MOECCT management.

(iii) **Project management unit.** Responsible for the overall day-to-day management of the technical, environmental, and social aspects of project implementation and thus compliance with the government regulatory requirements, ADB's Safeguard Policy Statement 2009, the project's loan covenants and EMP requirements. The PMU will include an Environmental Officer and Social (Community Liaison) Officer who will be responsible for advising the technical arm of the PMU on EMP implementation requirements, supervising and monitoring EMP implementation including on-site supervision, acting as a GRM Focal, and preparing the semi-annual EMRs for submission to ADB.

(iv) **Project management consultants)**. Consulting firm to support PMU in overseeing project implementation, including and international environment consultants and national environment and terrestrial/marine ecological consultants to support PMU with updating of the IEE, providing regular (monthly) on-site supervision during the construction period, and undertaking ecological field survey work.

(v) **International marine ecology expert**. To provide environment safeguards capacity development support, this expert will be separately appointed under TA6603.

(vi) **Contractors and their subcontractors (if any).** Through the contract, MOECCT will delegate responsibility for implementing all relevant EMP measures to their contractors. The contractors are to employ suitably qualified and experienced full-time environment and social officers and health and safety officers as their safeguards team with a dedicated EHS supervisor on each island and health and safety steward on each active construction site where there are multiple islands/sites involved. For the wind pilot and ocean pilot ecologists will also be employed.

(vii) **Construction workers employed formally or informally by the contractors and their subcontractors**. These workers will need to abide, in their behavior and work, to directives issued by their employer with regards to environmental, health and safety management.

(viii) **FENAKA.** Responsible for implementation of the CAP and operation of the BESS, grid upgrades, rooftop and ground mounted solar upon handover from the contractors.

(ix) **Island councils**. Responsible for providing and enforcing island-levels permissions as well as operation of the agricultural intervention upon handover.

(x) **Environment protection agency.** Responsible for providing and enforcing all national environmental clearances required.

(xi) **Project financers**–ADB.

329. Key roles and responsibilities with respect to EMP implementation, supervision, monitoring and reporting are discussed in more detail below with the implementation arrangements illustrated in Figure 42. Reporting, instructions, liaison/consultation, and advice/inspection channels are also shown.

2. Ministry of Environment, Climate Change and Technology and Project Management Consultants Roles and Responsibilities

330. MOECCT will be the implementing agency and their management will establish a new PMU to be responsible for day-to-day management of project implementation including EMP implementation, supervision, and monitoring of their contractors' performance as well as establishment of the GRM and resolution of any grievances received. MOECCT will delegate relevant detailed design, pre-construction, and construction measures to its contractors through the contract. It will also put in place the institutional arrangements to ensure private sector developers will follow the Safeguard Policy Statement (2009) requirements (not just the government regulatory requirements) in developing associated facilities of the project. However, MOECCT will have ultimate responsibility for ensuring the provisions of the EMP are implemented by all parties concerned.

331. During project implementation, MOECCT/PMU is responsible for the following activities (not an exclusive list):

(i) Ensuring adequate budget, institutional/management support, and staff resources are allocated to implement, supervise, and monitor the EMP throughout the project.
(ii) Upon loan effectiveness appointing a suitably qualified and experienced, named environment officer and social (community liaison) officer and providing them with adequate resources and facilities to support MOECCT/PMU with EMP implementation.
(iii) Providing with the support of PMC and the international marine ecology expert a suite of training activities for PMU staff, contractors, and EPA in relation awareness raising on Safeguard Policy Statement (2009) requirements and EMP implementation.
(iv) Ensuring that all PMU staff support and attend all capacity development and training activities provided, and to facilitate the provision of the training venues etc.
(v) Adopt a zero-tolerance approach to OHS on the project, enforce all PMU staff to comply with the OHS requirements of the EMP including the wearing of appropriate PPE on the construction site to set a good example to the contractor and their workers.
(vi) Securing national environmental clearances before contract award and complying with any requirements set.
(vii) Implementing the EMP and supervising and monitoring implementation by the contractor during all relevant stages of project implementation.
(viii) Incorporating the EMP into the bidding and contract documents before issuing tenders and contract awards. The contract will explicitly require the contractors to provide an environment safeguards team to support EMP implementation, to report at least monthly to the PMU on their EMP implementation and immediately report any unanticipated impacts including health and safety incidents and chance finds.
(ix) Reviewing bids to ensure they are in accordance with the EMP requirements prior to contract award.

(x) Reviewing and approving in a timely manner contractors' detailed designs as well as any additional environmental safeguard assessments and their CEMP and CHSMP and sub-plans to ensure they incorporate and are in accordance with the EMP requirements.

(xi) Updating the IEE/EMP as required in consultation with ADB prior to approval of the feasibility studies and detailed designs to reflect any changes from the scope and design assessed by the IEE and obtaining ADB's clearance for the update prior to commencement of any work, including site establishment. Once cleared, ADB will disclose the updated IEE on its website whilst PMU will locally disclose it.

(xii) Preparing a community liaison/consultation plan and training plan to elaborate on EMP implementation.

(xiii) Developing with the support of PMC international environment expert formal systems and templates for the PMU environment officer, the contractors, and national PMC consultants to supervise, monitor and report on day-to-day implementation of all aspects of EMP implementation, including the immediate reporting of non-compliances, unanticipated impacts, accidents, and chance finds etc.

(xiv) Undertaking on-site supervision with all active construction sites (excluding rooftop solar sites) being physically visited by the PMU environment officer at least once per month to determine the status of EMP implementation by the contractors – FENAKA supervision staff will also assist PMU with day to day monitoring of EMP implementation.

(xv) Keeping daily records and photo logs of site observations to inform preparation of the semi-annual EMRs.

(xvi) With the support of PMC conduct monthly EHS meetings with each contractor's management including physical "spot check" site visits to at least one of their active construction sites (including rooftop solar sites) and the ocean and wind energy pilot projects during their first year of O&M to audit EMP implementation.

(xvii) Identifying areas for improvement, unsafe acts, and any non-compliance with the EMP by the contractor and instructing corrective action to be taken by them to bring implementation back on track.

(xviii) Ensuring that prior to handover from the contractors the project components as constructed will enable FENAKA and the Island Councils to comply with their O&M actions; undertaking site visits to check their EMP compliance during O&M stage.

(xix) With the support of PMC developing O&M SOPs reflecting O&M-related environment, health and safety measures to be adopted and followed by FENAKA site operations management teams upon handover to them. For the powerhouses (grid upgrades) SOPs will include safe handling, storage, and disposal of diesel fuel, oil residues, and lubricating oil associated with existing diesel generators.

(xx) Thoroughly investigating all unanticipated impacts, near-misses, accidents, and chance finds; preparing a detailed incident report where applicable, identifying and instructing corrective action particularly to avoid any repetition of near-misses and accidents.

(xxi) Monitoring and reporting on EMP implementation including the submission of semi-annual EMRs to ADB from loan effectiveness and at least the first year of operation up until the ADB project completion report (usually 1-2 years after financial close) or longer period if required due to outstanding environmental issues.

(xxii) Undertaking ongoing consultation with island councils and local communities to inform them of progress with project implementation including prior to finalization

of detailed designs, giving attention to consultations with women and other vulnerable groups. All ongoing consultation, such as, minutes of the meetings will be documented in the EMRs submitted to ADB.

(xxiii) Upon loan effectiveness establishing and operationalizing the GRM for affected persons (construction workers and local community members) in line with provisions of the IEE report, including establishing a grievance redress committee for affected persons, recording and promptly addressing all environmental and social grievances received. Contact details for the GRM will be prominently displayed on notice boards at the project site. All ongoing grievance-related information will be documented in the EMRs submitted to ADB. Further details on the GRM are provided in Section 6.

(xxiv) Locally disclosing the IEE and other environmental safeguards documentation. This will include MOECCT website publication and ensuring full copies of the IEE report and its executive summary translated into Dhivehi are available at the island council, powerhouse and construction site offices. Notices will also be placed on noticeboards at the project site and offices informing of the main findings of the IEE and the availability of the IEE report with notice given that help with translation into affected persons' languages or an explanation of their content will be extended free of charge on request.

(xxv) Reporting any unanticipated impacts, incidents, and chance finds to ADB within 48 hours of them occurring along with a corrective action plan.

(xxvi) Updating the IEE/EMP as necessary and locally disclosing any updates if unanticipated impacts (including project scope or design changes) occur during implementation; any such updates must be submitted to ADB for clearance and disclosed on the ADB website before any related works commence or are cleared to continue.

(xxvii) Upon any decommissioning including of the ocean energy pilot and wind energy pilot if not successful, ensure construction-related measures in relation to the dismantling of equipment and restoration of the sites and other specific activities like transport and disposal of used batteries, photovoltaic panels, and electrical equipment are being followed.

(xxviii) Developing and taking all requisite corrective action in case of any non-compliance with the EMP during pre-construction and construction, including repair of any property damage and financial compensation (insurance) for any health and safety incidents.

3. Project Management Consultant Roles and Responsibilities

332. The PMC will be comprised of individuals or a firm including international and national environment consultants and national terrestrial and marine ecological consultants. There will be a separate international marine ecology consultant employed under ADB TA. These consultants will support MOECCT/PMU by undertaking the following activities (not an exclusive list):

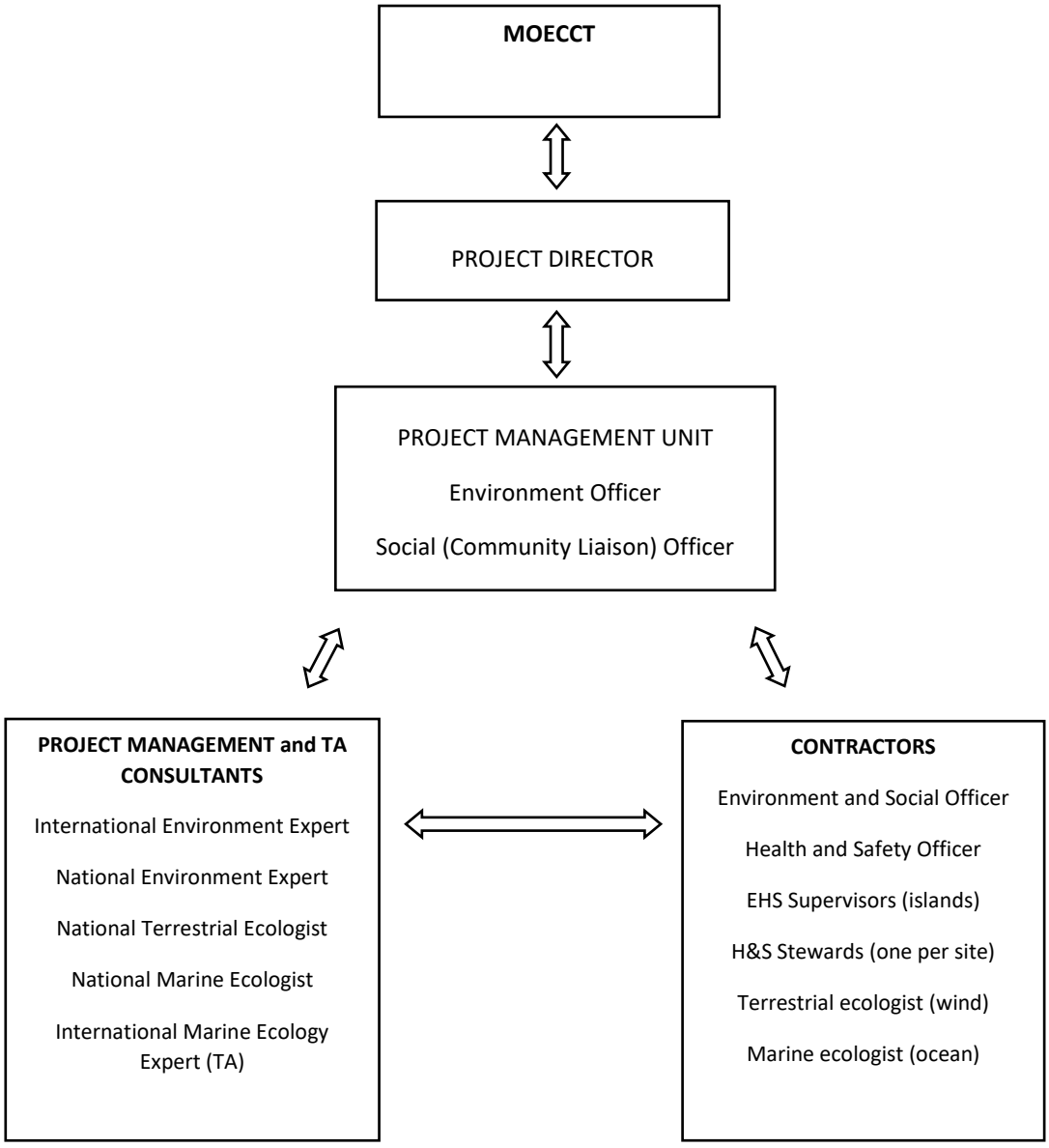
(i) Support delivery of safeguard training and capacity building activities and provide on-the-job guidance to PMU and contractors ensuring compliance with the EMP requirements.

(ii) Supporting PMU to obtain national environmental clearances before contract award.

(iii) Supporting PMU to incorporate the EMP into the bidding and contract documents before issuing tenders and contract awards.

(iv) Supporting PMU in reviewing bids to ensure they are in accordance with the EMP requirements prior to contract award.
(v) Supporting PMU in reviewing contractors' detailed designs as well as any additional environmental safeguard assessments and their CEMP and CHSMP and sub-plans.
(vi) Leading on updating the IEE/EMP as required in consultation with ADB prior to approval of the feasibility studies and detailed designs to reflect any changes from the scope and design assessed by the IEE.
(vii) Helping to prepare the community liaison/consultation plan and training plan to elaborate on EMP implementation.
(viii) Developing the formal systems and templates for supervision and monitoring to ensure that contractors adhere to all the provisions in the EMP as well as their CEMPs, CHSMPs, and sub-plans as approved by the PMU.
(ix) Organizing and conducting monthly EHS meetings with each contractor's management including physical "spot check" site visits to at least one of their active construction sites (including rooftop solar sites) to audit the EMP implementation.
(x) Keeping records and photo logs of site observations to inform preparation of the semi-annual EMRs.
(xi) Helping to develop O&M SOPs reflecting O&M-related environment, health and safety measures to be adopted and followed by FENAKA site operations management teams upon handover to them.
(xii) Helping to prepare the EMRs for submission to ADB.
(xiii) Reporting on any grievances or violations of the EMP and assisting in implementing solutions and remedial measures.
(xiv) Supporting PMU to undertake ongoing meaningful consultation with affected communities to keep them informed of progress and local disclosure of the findings of the IEE reports and EMRs etc.
(xv) Supporting implementation of the GRM and assisting PMU to resolve on-going issues related to environmental and social safeguards during pre-construction and construction.

Figure 42: Institutional Arrangement for Environment Management Plan Implementation



Source: PAM

4. Contractor Roles and Responsibilities

333. The contractors will be required to comply with the EMP during all relevant phases, closely supervised and monitored by PMU supported by the PMC. The contractors will be delegated, through the contract, the requirement to undertake relevant mitigation and monitoring actions as set out in this EMP at the construction sites as well as at any overnight accommodation provided by them, and to assist with operation of the GRM. The contractors are required to ensure that the EMP requirements are cascaded down to all subcontractors undertaking works relating to the project, regardless they are formally or informally employed. The construction contractors will have a corporate EHS policy and environmental management certifications preferably such as ISO 14001 (or equivalent) and EHS certification such as ISO 45001 or equivalent.

334. The contractors are to employ the following suitably qualified and experienced officers as their safeguards team:

(i) at least one dedicated environment and social officer with an environmental management bachelor's degree or similar qualification to be based full-time on-site for the duration of works under the contract package, to monitor and supervise the contractor's EMP implementation on a day-to-day basis reporting to their management and ensure quantitative monitoring as per the EMOP requirements,

(ii) at least one dedicated health and safety officer with NEBOSH/IOSH certification or similar qualification to be based full-time on-site for the duration of works under the contract package, to monitor and supervise the health and safety aspects of the contractor's EMP implementation on a day-to-day basis reporting to their management and ensure quantitative monitoring as per the EMOP requirements.

(iii) For the wind pilot and ocean pilot, a terrestrial or marine ecologist respectively to implement the EMP requirements and support the environment and social officer in undertaking ecological quantitative monitoring as per the EMOP requirements.

335. Further, each island and active construction site is to have adequate health and safety supervision to ensure the health and safety of all workers and local communities; the health and safety officer will be supported by full-time on-site EHS supervisors with at least one supervisor per island, and full-time on-site Health and Safety stewards with at least one steward at each active construction site.

336. The safeguards team of the contractors will be responsible for reporting environmental safeguards progress and performance at least monthly to the PMU including recording all data required by the EMOP and providing necessary inputs to the quarterly progress reports and semi-annual EMRs for the duration of their contract. The contractor's safeguards team will also act as the GRM Focals for each contract package/lot to keep affected persons informed of works and be available to receive and deal with any grievances from workers and the local community at the project site level.

337. During project implementation, the contractors are responsible for the following activities (not an exclusive list):

(i) Implementing all actions and responsibilities allocated to the contractors under the EMP for the full duration of the contractor's involvement in the project.

(ii) Ensuring adherence to all applicable national environment, health, safety, and labor laws and regulations in force at the time.

(iii) Ensuring adherence to ADB's Safeguard Policy Statement (2009) and the related IFC Environment, Health and Safety (EHS) guidelines.

(iv) Ensuring the feasibility studies and detailed designs reflect the EMP requirements; seeking to ensure the same or no worse impact than the design assessed in the IEE.

(v) Supporting PMU to update (as required) the IEE in respect of the feasibility studies and detailed design by undertaking further assessment as required by the EMP and providing sufficient details to inform a revised project description and any subsequent reassessment of impacts.

(vi) Ensuring adequate budget and staff resources are allocated to comply with and implement the contractor's responsibilities under the EMP and to supervise and monitor the active construction site to protect the environment and ensure the health and safety of all workers and affected communities.

(vii) Ensuring a suitably qualified and experienced safeguards team has been appointed to undertake regular on-site supervision and monitoring activities before the commencement of works.

(viii) Undertaking and documenting a facilitated health and safety risk assessment considering all stages of the project, not just those stages the contractor is responsible for, and including consideration of COVID-19 risks amongst others.

(ix) Preparing a Construction Environment Management Plan (CEMP) and a Construction Health and Safety Management Plan (CHSMP) both with sub-plans as specified in the EMP for review and approval by PMU prior to the commencement of works.

(x) Ensuring that all construction workers including all formal and informal employees and subcontractors understand their responsibilities to implement the EMP and mitigate environmental impacts associated with pre-construction and construction activities.

(xi) Providing and ensuring attendance at EHS training to formal and informal construction workers and other personnel as required.

(xii) Adopting a zero-tolerance approach to OHS on the project, enforce all workers to comply with the OHS requirements of the EMP including the wearing of appropriate PPE on the construction site.

(xiii) Supporting PMU in undertaking ongoing public consultations and implementing the site-level GRM; in particular, the contractor's GRM focals shall thoroughly document details of complaints and make its best efforts to resolve the complaints at project site level; all this information is to be included in the contractor's monthly reports to MOECCT.

(xiv) Undertaking environmental monitoring as set out in the EMOP (Table 7, Appendix 16) during pre-construction and construction (as well as the O&M stage for the wind and ocean pilot projects) and documenting qualitative and quantitative monitoring results.

(xv) Submitting monthly environmental management reports to PMU (these reports will be included as part of the contractor's monthly progress reports), relating the work undertaken over the reporting period and documenting the environmental measures including monitoring activities that have been carried out, problems encountered, record data including near misses and incidents, grievances received, and follow-up actions that were taken (or will be taken) to correct the problems.

(xvi) Informing PMU immediately in case of any approved detailed design changes or unanticipated environmental impacts occurring during the project implementation stage, and as required, provide any information needed to the PMU to enable them

to promptly update the IEE/EMP for clearance by ADB before any changes are implemented.

(xvii) Informing PMU within 24 hours in case of chance find or incident on site and providing within 48 hours an incident report with corrective action detailing how reoccurrence will be prevented.

(xviii) Informing PMU immediately in case of any non-compliance and help them to prepare as necessary a corrective action plan for clearance by ADB, the contractor is required to implement all necessary corrective action requested by PMU to ensure the project remains in compliance with national regulatory requirements, ADB's Safeguard Policy Statement (2009), the project's loan covenants and EMP requirements.

338. For the O&M and decommissioning phases, any contractors hired for major maintenance works or decommissioning will also be supervised and monitored by MOECCT or FENAKA with their EMP roles and responsibilities the same as those of the contractors for construction.

F. Monitoring and Reporting Arrangements

339. An Environment Monitoring Report (EMR) (template included in Appendix 13) will be submitted to ADB on a semi-annual basis by the PMU with safeguards inputs provided to quarterly progress reports as per the PAM. Since no social safeguard impacts are anticipated, the environmental monitoring reporting will also reflect on any social impacts. Following loan effectiveness, semi-annual EMRs will be due for submission to ADB within 15 days of the month following period end, e.g., before mid-July and mid-January each year. The EMRs will describe project implementation progress, any scope or design changes, compliance against environment and social safeguard requirements that are covenanted in the legal agreements, progress with environment mitigation implementation, quantitative monitoring results in accordance with the EMOP, and details of grievances received. If any performance standards are breached or any of the safeguard requirements that are covenanted in the legal agreements are found not to be satisfactorily with complied by MOECCT or their contractors, an appropriate, time bound, budgeted, corrective action plan (CAP) will be developed and implemented as agreed upon with ADB to rectify unsatisfactory project performance or any safeguard noncompliance in a timely manner. EMRs, any CAP or updated IEE submitted to ADB during project implementation will first be reviewed by ADB for quality and acceptability and then once cleared by ADB disclosed locally (on the MOECCT website and in island council, powerhouse, and construction site offices) and on the ADB website upon receipt. PMU will carry out the following actions to supervise and monitor EMP implementation (not an exclusive list) and ensure intended environmental safeguard outcomes are being achieved by the ASSURE project:

(i) Undertaking regular on-site supervision each month and keeping daily records and photo logs of site observations to inform preparation of the semi-annual EMRs– FENAKA supervision staff will also assist PMU with day-to-day monitoring of EMP implementation.

(ii) Conducting monthly EHS meetings including "spot check" site visits to audit in more depth EMP implementation by the contractors and those responsible for O&M.

(iii) Obtaining monthly reports from contractors and during O&M the FENAKA operational site management teams.

(iv) Reviewing qualitative and quantitative monitoring results to identify any issues of concern.

(v) Identifying areas for improvement, unsafe acts, and any non-compliances with the EMP and instructing corrective action to be taken by them to bring implementation back on track.
(vi) Keeping records of all monthly reports, meetings, inspections and audits and time-bound corrective actions instructed.
(vii) Supervising and monitoring the implementation of corrective actions alongside EMP implementation to ensure that these are implemented in a timely manner.

340. In addition to standard contract monitoring systems established by the PMU the PMC will develop formal systems and templates for monitoring and reporting on EMP implementation, with the following reporting lines. Those responsible shall ensure timely submissions of reports with an acceptable level of detail:

(i) Contractors will establish their own internal systems for monitoring and reporting their EMP implementation.
(ii) Contractors as the main executors of the EMP will formally submit monthly and quarterly environmental management reports per an agreed template to PMU who will share the report with the Environment Officer who in turn will share with PMC.
(iii) Once works commence on site the PMU Environment Officer will keep written records and photo logs of their site observations reporting their findings at least weekly to the PMC who will prepare written monthly summaries of the EMP progress–these monthly summary reports will be attached to the EMRs submitted to ADB.
(iv) Photographic records will be kept, covering all activities on site as well as key locations such as stores, sanitation and welfare facilities, overnight accommodation etc. Photographs for key areas will also be taken prior to beginning of construction activities, to provide the environmental baseline. Copies of all geo-referenced photographs will be retained centrally by the Environment Officer and PMC along with their site observation records and the written monthly summaries.
(v) PMC to convene monthly EHS meetings to be attended by the PMU staff, PMC, and contractor's management and safeguard team to discuss EMP implementation progress; initially progress will be discussed in relation to detailed design actions and as the project progresses will move onto pre-construction and contraction actions etc.
(vi) During the monthly EHS meetings areas for improvement, unsafe acts, and any non-compliances, time-bound corrective actions and responsibilities to address them will be discussed, agreed, and documented – minutes of monthly EHS meetings will be taken by the PMC and submitted to the Environment Officer to be attached to EMRs submitted to ADB.
(vii) Environment Officer will be able to instruct other members of the PMU and be given delegated authority to instruct the contractors to take corrective action at any time in relation to EMP implementation.
(viii) Environment Officer will maintain the time-bound corrective action plan, monitoring and reporting of corrective actions will be undertaken alongside monitoring and reporting of EMP implementation.

341. The Environment Officer will be responsible for obtaining and centrally maintaining documentation, and that document control is ensured through access by and distribution to relevant personnel. Documentation and records to be kept by all parties in hard copy as well as electronic format are as follows (not an exclusive list):

(i) Definitive IEE and EMP (as disclosed on the ADB website)
(ii) National environmental clearance documentation
(iii) Tree felling permits, etc.
(iv) Community liaison/consultation plan and records of all consultations undertaken
(v) Training plan and training records
(vi) Records of emergency preparedness and response drills
(vii) Document review and approval records
(viii) CEMP, CHSMP and their subplans
(ix) Contractor's certifications and insurances
(x) Completed site checklists and photographic records
(xi) Corrective action instructions
(xii) Contractor's records and incident reports
(xiii) GRM records

342. MOECCT and those with O&M responsibilities will facilitate ADB−or any third party selected on behalf of ADB−to carry out the following monitoring actions to supervise project implementation:

(i) Conduct periodic site visits during the project implementation to confirm compliance with ADB's Safeguard Policy Statement 2009, the project's loan covenants and EMP requirements.
(ii) If required, conduct supervision missions with detailed review by ADB's safeguard specialists/officers or consultants.
(iii) Review and comment on the periodic EMRs to ensure that adverse impacts and risks of the project are mitigated as was planned and agreed with ADB, that any corrective actions have been duly implemented, and that the GRM is fully functional.
(iv) Work with MOECCT and those with O&M responsibilities to rectify to the extent possible any failures to comply with their safeguard commitments, as covenanted in the loan agreement, and exercise remedies to re-establish compliance as appropriate.
(v) Prepare a project completion report that assesses whether the objective and desired outcomes of the EMP have been achieved, considering the baseline conditions, and monitoring results.

343. For this purpose, MOECCT, and their contractors, FENAKA and the Island Councils will provide ADB with access to the site and all requested information on the project. For any ADB supervision missions to ongoing construction works, MOECCT and the contractors will be required to provide all ADB staff with a project site health and safety induction and adequate PPE in accordance with Table 2.7.1 of the IFC EHS General Guidelines–Occupational Health and Safety Section.

G. Capacity Development

344. Given a new PMU will be set up for the project with staff lack familiarity with EHS requirements especially international good practice those working on the project will need trainings on environmental safeguards in general and the specifics of management and monitoring requirements for the project. The contractors' staff would also need some training and awareness raising to ensure they fully understand the EMP requirements. Thus, a training program will be implemented per Table 50. These training modules will be delivered by the PMC and are not part of the contractor's cost (other than their staff attendance) but will be a part of the

project cost that includes institutional strengthening, capacity building and training for safeguards. Training modules can be changed during project implementation based on MOECCT requirements. Separate to the EMP training in Table 49 the international consultants will also deliver training to the MOECCT and EPA with respect to ESMS implementation and reviewing and approving the private sector components which are associated facilities of the project.

Table 49: Training Programme

Item	Duration/Method	Attendees	Delivered by	Estimated Cost in $	Budget Source
Introduction to ADB's Safeguard Policy Statement (2009), IFC EHS Guidelines, National Requirements, and Project EMP	1 day face to face event	PMU Staff Contractors' Management and Environment Safeguards Teams	PMC National and International Environment Expert	2,000	PMC Contract
EMP Implementation for Pre-Construction including CEMP and CHSMP development	1 day face to face event	PMU Staff Contractors' Management, Site Engineers and Environment Safeguards Teams	PMC National and International Environment Expert	2,000	PMC Contract
EMP Implementation for Wind Energy	1 day face to face event	PMU Staff Contractors' Management, Detailed Design, and Environment Safeguards Teams	PMC National and International Environment Expert	2,000	PMC Contract
EMP Implementation for Ocean Energy	1 day face to face event	PMU Staff Contractors' Management, Detailed Design, and Environment Safeguards Teams	PMC National and International Environment Expert, together with International Marine Ecology Expert	3,000	PMC Contract TA 6603
GRM operation	1 day face to face event	GRM Focals PMU Staff FENAKA Supervision Staff Contractors' Management and Environment Safeguards Teams	PMC National and International Environment Expert	2,000	PMC Contract
Site supervision and monitoring including use of detailed monitoring framework (checklists) and preparing period Environmental Monitoring Reports	2-day face to face event	PMU Staff FENAKA Supervision Staff Contractors' Management and Environment Safeguards Teams	PMC National and International Environment Expert	4,000	PMC Contract
CAP implementation and safe handling, storage, and disposal of diesel fuel, oil residues, and lubricating oil associated with existing diesel generators	1 day face to face event	PMU Staff FENAKA management Powerhouse Staff	PMC National and International Environment Expert	2,000	PMC Contract

Item	Duration/Method	Attendees	Delivered by	Estimated Cost in $	Budget Source
EMP Implementation for O&M handover including the SOPs	1 day face to face event	PMU Staff FENAKA management Powerhouse Staff	PMC National and International Environment Expert	2,000	PMC Contract
Total				**19,000**	

ADB = Asian Development Bank, EHS = Environmental, Health, and Safety, EMP = environmental management plan, GRC = Grievance Redress Committee, GRM = grievance redress mechanism, IFC = International Finance Corporation, PMC = Project Management Consultants, PMU = Project Management Unit

H. Environmental Management Plan Implementation Schedule and Budget

345. The indicative implementation schedule is shown in Chapter III, Table 17. The contractors will submit a more detailed project implementation schedule. During the pre-construction period, a formal screening option will be obtained by PMU from the EPA under the EIA regulations and the requisite national environmental clearance will be obtained before any contracts are awarded except in the case of the pilot projects and agricultural intervention where the feasibility studies will need to be completed first. In these cases, the feasibility studies will not be approved until the environmental clearance has been obtained from EPA and the contractor will need to program this procedure into their program. Strictly no contracts will be awarded before the EMP has been incorporated into the contract documentation. Further, no site establishment or construction activity is to take place before the PMU has received and approved the detailed design and requisite contractor's CEMP and CHSMP including all sub-plans.

346. Necessary budgetary provisions must be made by MOECCT, and its contractors, to ensure financial resources area available for implementing the environmental measures of the project. For the EMP implementation a sum of about $2–3 million is estimated to be required with $0.25 million counterpart funds set aside for environmental and social mitigation cost covering items such as EPA application costs, compensatory plantation etc. This budget will also be used for non-resource person costs for conducting the training and supervision and monitoring throughout project implementation. For contract and consultancy related costs these are only an estimate, since these are subject to competitive bidding it will be for the contractor/consultants to reflect in their BOQ and ensure adequate budgeting is provided in their bids for the EMP implementation. The indicative costing breakdown for the ASSURE project is shown in Table 50.

Table 50: Indicative Costing for Environmental Management Plan Implementation

Mitigation Measures	Estimated Cost in $	Budget Source
PMU Consultant Support		PMU Consulting Services Budget
PMU Environment Officer for the 5-year implementation period (@2000/month for 5 years)	120,000	
PMU Social (Community Liaison) Officer for the 5-year implementation period (@2000/month for 5 years)	120,000	
PMC Consultant Support		PMC Consulting Services Budget
International environmental specialist (1 for 6.5 PM intermittent @ 16,500/month)	107,250	
National environment specialist (1 for 12 PM intermittent @ 7,500/month)	90,000	
National terrestrial ecologist (1 for 3 PM intermittent @ 7,500/month)	22,500	
National marine ecologist (1 for 12 PM intermittent @ 7,500/month)	90,000	
EMP Training Cost - see training table for details of activities	18,000	
TA 6603 Consultant Support		ADB TA Budget
International marine ecology expert (1 x 4.5 PM intermittent @ 25,000/month)	112,500	
EMP Training Cost - see training table for details of activities	1,000	
Contractor Staffing Costs		Contract Cost
E&S Expert (@ 1,500/month for 36 months X up to 13 contract packages/lots)	702,000	
health and safety Expert with NEBOSH/IOSH (@ 1,500/month for 36 months X up to 13 contract packages/lots – additionally EHS officers and health and safety stewards are required for packages/lots having multiple islands/sites the numbers of which are unknown and will need to be determined by the contractors based on their scope of work)	702,000	
Terrestrial Ecology Expert – Wind Pilot (@ 1,500/month for 36 months)	54,000	
Marine Ecology Expert – Ocean Pilot (@ 1,500/month for 36 months)	54,000	
Implementation of Existing Facilities Corrective Action Plan @ $5,000 per substation	100,000	FENAKA O&M Budget
Contractor's Mitigation Plan Cost including PPE provision @ 1% of $51m contract cost for 13 contract packages/lots	510,000	Contract Cost
Contractor's Quantitative Environmental Monitoring - see EMOP (Appendix 16) for details of activities	127,500	Contract Cost
Compensatory Reforestation (LS)	25,000	E&S Mitigation Budget Counterpart Fund
EPA application cost, Ongoing Consultation, GRM Implementation, including COVID-19 Precautions for Consultation or GRC Meetings to cover ad hoc cost of printing leaflets, purchasing masks and hand sanitizers for consultees, hire of venue or food purchase etc. (LS)	25,000	E&S Mitigation Budget Counterpart Fund
TOTAL	**2,980,750**	

ADB = Asian Development Bank, EHS = Environmental, Health, and Safety, EMP = environmental management plan, EMOP = environmental monitoring plan, GRM = grievance redress mechanism, IOSH = institute of occupational safety and health, NEBOSH = National Examination Board in Occupational Safety and Health, PMC = Project Management Consultants, PPE = personal protective equipment.

Initial Environmental Examination

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Maldives: Accelerating Sustainable System Development Using Renewable Energy Project

Appendix 16

Prepared by the Ministry of Finance, Government of Maldives for the Asian Development Bank.

Table 1: General Project Environmental Management Plan

Topic	Impact or Risk	Mitigation Measure	Performance Standard	Budget Source/ Mitigation Cost	Implementation responsibility	Monitoring responsibility	Implementation schedule
A. Planning and Detailed Design/Pre-construction (also see following tables)							
Compliance with regulatory requirements and international good practice	General impacts and risk on project affected persons, including construction and O&M workers and local communities General General	Comply with all applicable national laws and regulations, conditions of permits and clearances, ADB's SPS 2009, and IFC EHS guidelines in addition to the measures in this mitigation plan and the environmental codes of practice-if any conflict between requirements the most stringent requirements will be followed Contractor will not engage in any activities described on the ADB Prohibited Investment Activities List in Appendix 5 of ADB's SPS (2009) Contractor will have in place corporate environment, health and safety policies and corporate environment, health, and safety management system certifications, such as, ISO 14001 for environment, ISO 45001 for health and safety, or local equivalents.	No breaches of national laws and regulations and international good practice requirements	Counterpart funding and contract budget	PMU and Contractor	E&S team of PMU with support PMC	Upon loan effectiveness for MOECCT Upon award of contract for contractor
Compliance with environmental assessment and other permitting and clearance requirements		Submit written screening requests for all individual project components to the EPA except rooftop solar and obtain screening opinions and subsequent environmental clearance	No breaches of environmental assessment or other permitting or clearance requirements Copies of all screening letters, environmental clearances, and other permits and clearances submitted in EMR for period in which they were obtained Updated IEE and EMP disclosed on ADB website and locally by MOECCT before related works start	Counterpart funding and PMC budget	PMU Contractor to immediately inform PMU if unanticipated impacts identified	E&S team of PMU with support PMC	Prior to the commencement works
		Obtain all other permits and clearances from island councils/government agencies					Prior to the commencement works
		Disclose in a timely manner the IEE report including the executive summary in Divehi, any updates to it, and other environment safeguards documentation by posting them on the MOECCT website with copies in Island Council, Powerhouse and Construction Site Offices. If requested a printed copy of the IEE will be provided and if required translated into Dhivehi free of charge on request.					Prior to the commencement of work and then throughout project implementation
		If a change in project scope, design or layout occurs during project implementation, or if unanticipated impacts are identified at any point, immediately inform ADB and if required update the IEE and EMP for clearance and disclosure by ADB					Throughout project implementation, for pilot projects and agricultural interventions prior to commencing works
Ongoing meaningful consultation and awareness raising		PMU to prepare detailed communication plan upon loan effectiveness to be followed by them and third parties including that in the context of the COVID-19 pandemic all consultations are carried out following latest national COVID-19 requirements and WHO social distancing and hygiene guidelines as detailed in Appendix 12 of the IEE report. To facilitate liaison with the local community and project workers the contractors EHS teams are required to speak Dhivehi and English in addition to the language of their contractor. Island councils, local communities as well as individual property owners are to be consulted by the contractors when selecting sites for temporary construction facilities prior to finalization of their location. Provide at least one-month advance notice to local communities about the schedule of, location plan, and details of planned construction works, including anticipated traffic disruption, if any, along access roads through consultation meetings, notices at project site and Island Councils to help manage any disruption and disturbance and potential conflicts with the local communities and then keep communities updated of progress and changes in schedule throughout construction works, especially those with properties adjacent to active construction works to keep them fully informed of the nature of those works and their schedule. Contractors to undertake construction and electrical safety community awareness raising activities in local communities and with local schools prior to construction and	Communication plan developed reflecting the ongoing consultation requirements per the IEE Local communities and other concerned stakeholders kept informed throughout project implementation and awareness raised. Consultation and awareness raising undertaken documented and reported in EMRs including photos and records of participant (including gender breakdown)	Counterpart funding and contract budget	PMU and Contractor	E&S team of PMU with support PMC	Upon loan effectiveness for MOECCT Upon award of contract for contractor

Topic	Impact or Risk	Mitigation Measure	Performance Standard	Budget Source/ Mitigation Cost	Implementation responsibility	Monitoring responsibility	Implementation schedule
		again on the completion of works having greater emphasis on electrocution and other operational risks to members of the public.					
Establishment and operation of a GRM to deal with project grievances		Identification of GRM focals and posting of contact details including SMS numbers for PMU and contractor focals at Island Council, Powerhouse and Construction site offices. Contractors to ensure that signage is prominently visible at the construction site detailing site-level GRM focals contact details with SMS numbers Undertake community awareness raising on each island of the GRM existence as well as the process and means of submitting a project grievance; awareness raising activities are to be documented. Contractor's EHS team will act as site level GRM focals and keep the local communities informed of the status of work and be readily available on-site to receive, document, and deal with any grievances at the site level. Contractors to carry out awareness raising for workers about the GRM at the start of their employment on site including disseminating GRM contact details on noticeboards at construction site offices. Encourage use of the GRM yet clarify that this does not prevent affected persons from pursuing any legal action, if they feel it is needed, and inform communities about the ADB Accountability Mechanism and their possibility to resort to it if any grievance is not resolved by the project level GRM.	GRM per IEE operationalized, affected persons aware of its existence and are actively using it to raise their grievances Details of GRM operationalization including photos of awareness raising activities to be submitted in first EMR. 100% grievances received are recorded and resolved in a timely manner with those reported or resolved during the period to be reported on in the subsequent EMR	Counterpart funding and contract budget	PMU and Contractor	E&S team of PMU with support PMC	Upon loan effectiveness for MOECCT Upon award of contract for contractor
Bidding and contract documentation		PMU to ensure the requirement to comply with the EMP and any updates to it forms an integral and binding part of bidding and contract documents. PMU to ensure the contract includes appropriate incentives and/or penalties for (non-) compliance by the contractors. Contractors will ensure all their subcontractors and third parties, irrespective of being formally or informally employed by them, also comply with the final EMP and any updates to it, as well as their own CEMP and that this responsibility is cascaded down any chain involved. Contactors will budget for all the EHS staff, mitigation measures and monitoring required. Contractor will comply with any corrective action required and cover the costs where that corrective action is due to non-compliance on behalf of the contractor, its subcontractor or third parties. Contractors will put in place appropriate incentives and/or penalties for (non-)compliance by workers related to use of PPE and worker code of conduct, etc.	Definitive EMP cleared by ADB (as disclosed on ADB's website) and related provisions included in both the bidding and contract document for all contract works packages. No breaches of the EMP requirements by contractor, subcontractor or other third parties with prompt corrective action being taken if required.	Counterpart funding and contract budget	PMU and Contractor	E&S team of PMU with support PMC	Prior to issue of bidding and contract documents by MOECCT In submission of bids and upon award of contract for contractor
Safeguard staffing and capacity development, construction worker labor welfare and local employment opportunities		Contractors to comply with national labor, health and safety regulations for protection of workers PMU to appoint suitably qualified and experienced staff per the EMP requirement upon loan effectiveness to undertake supervision and monitoring including holding monthly EHS meetings PMU E&S team to prepare a detailed training plan upon loan effectiveness elaborating how training and awareness raising activities required by EMP will be conducted and with the support PMC conduct required training sessions on EMP implementation and GRM operationalization for all those with management responsibilities to clarify requirements, roles and responsibilities, record keeping and reporting at each stage of the project Contractors to appoint suitably qualified and experienced staff per the EMP requirement upon contract award and ensure that each active construction site has adequate health and safety supervision to ensure the health and safety of all workers	100% of required EHS staff are on board to oversee EMP implementation, environment safeguard staff to be detailed in EMR. Detailed training plan reflecting EMP requirements developed upon loan effectiveness and training records are maintained. Trainings and awareness raising delivered in accordance with the training plan, records of training shared through EMR.	Counterpart funding and contract budget	PMU and Contractor	E&S team of PMU with support PMC E&S team to oversee EMP providing guidance and corrective action as required, and recording construction activities and EHS conditions	Upon loan effectiveness for MOECCT Upon award of contract for contractor

		and local communities; at least one EHS supervisor per island and health and safety steward(s) for each active construction site where there are multiple islands/sites. Contractors to ensure all members of their project management team, EHS team, design team, and construction management team attend PMU trainings on EMP requirements. Contractors to conduct their own trainings for their construction management and provide all workers and visitors on site, irrespective of them being formally or informally employed by the contractor, subcontractor or third party with an EHS induction before being allowed on site including dos and don'ts in relation to the construction site, overnight accommodation, code of conduct and interaction with local communities, etc. Contractors to ensure topics covered by training and induction will include but not be limited to: good housekeeping at all times; environmentally safe and sound waste management practices; hygiene and communicable disease prevention including COVID-19 and HIV/AIDS; sexual exploitation, abuse and harassment prevention; code of conduct and culturally acceptable practices; biodiversity conservation awareness; fire safety prevention; prohibition on fishing etc. by workers; chance find procedures; health and safety including use of PPE; etc. Contractors to conduct regular emergency preparedness and response drills involving all workers irrespective of them being formally or informally employed by contractor, subcontractor or third-party to prepare them in case of an EHS incident including spillage, fire, natural disaster, disease outbreak, drowning etc. Training for construction management will include modules on first aid and fire safety including include training on how to use first aid and firefighting equipment provided on-site, risks of working over or adjacent to waterbodies, and the scenario of potential or confirmed COVID-19 infection on-site. Contractors to continue to deliver short monthly EHS refresher sessions to construction management and all workers and cover pertinent EHS topics on daily basis in toolbox talks to be delivered to all workers. Records of all training activities are to be retained. Contractors to ensure workers with a specific role have before being allocated the task attended specialized health and safety trainings related that role e.g., first aiders, fire safety officers, as well as ensuring workers have task-specific trainings for working at height, working with electricity, working over water etc. Contractors must not discriminate in employment of workers and must proactively encourage the employment of suitably skilled women on the project. Contractors must proactively encourage local employment for unskilled roles whilst ensuring suitably qualified and experienced workers for skilled roles; local labor can undertake manual work with adequate health and safety training and eligible local workforce can have clerical and office jobs. No child will be employed, and no under 18s will be engaged on the construction site (hazardous work) GRM will be available to workers for receiving and handling complaints about unfair treatment or unsafe living or working conditions, ensuring no coercion nor reprisal Contractors to provide at least one 24-hour rest day a week and 30 days sick leave for construction workers; over 48 hours work overtime will be separately paid. Contractors to provide medical/accident insurance or otherwise ensure medical bills will be covered for all workers irrespective of them being formally or informally employed by contractor, subcontractor or third-party. Contractor's insurance must include a community liability clause for the payment of compensation in case of any accidents because of construction.	Contractor and construction workers fully aware of their responsibilities under the EMP through training No breaches of the EMP requirements by contractor, subcontractor or other third parties with prompt corrective action being taken if required.			on-site through photos etc.	

Topic	Impact or Risk	Mitigation Measure	Performance Standard	Budget Source/ Mitigation Cost	Implementation responsibility	Monitoring responsibility	Implementation schedule
Detailed design, location of and access to project components	Impacts of detailed design not adequately assessed prior to construction	Contractors to ensure that detailed designs reflect the requirements of this EMP and the international engineering best practice/good EHS practices and consider bioengineering techniques On completion of the detailed design, MOECCT will consult ADB regarding the need to update the IEE. If deemed necessary the IEE and EMP will be updated, reviewed, and cleared by ADB prior to detailed design approval and the start of the construction works.	PMU approved detailed designs minimize impacts and risks on EHS during subsequent stages of the project	Contractor to reflect in contact costs	PMU through PMC to employ ecologist for survey work under the E&S team. Contractor to prepare detailed design and undertake additional baseline surveys as per the EMoP PMU to review detailed design with support of PMC to confirm all EMP measures adequately incorporated	E&S team of PMU with support PMC	Pre-construction stage; compliance prior to approval of detailed design and any works commencing on site including site establishment
	Encroachment into protected areas, ecologically sensitive zones, natural habitats or physical cultural resources	All project sites and layouts will be as described in the IEE, any changes to project locations or layouts will require consultation with ADB and if required the IEE/EMP updated to address associated impacts before the detailed design is approved. PMC ecologists to map the habitats beneath the project footprint, reconfirming no protected areas, ecologically sensitive zones, if modified or natural habitat is present, and listing species encountered. Presence or absence of sensitive ecological receptors and critical habitat species identified in the IEE to be confirmed by PMC ecologist. The ecologist will enumerate the number and species of trees requiring to be cut/lopped based on the detailed design confirming numbers have been minimized to the extent possible prior to the detailed design approval. Adaptive management measures are to be applied according to the findings of the surveys, e.g., relocation of foundations to avoid tree roots, etc. The PMC ecologist will identify the number of trees for compensation plantation and identify and agree with the Island Council locations for this plantation to take place. PMC environment expert to map physical cultural resources in the project footprint, presence or absence as identified in the IEE to be confirmed by PMC environment expert	No project sites encroach into protected areas, ecologically sensitive zones, natural habitats or physical cultural resources (except ocean energy in marine environment affecting natural habitat and rooftop solar permitted on the mosque roofs)				
	Disturbance to coastal vegetation, beach and adjacent marine habitat, cutting of trees within the footprint	No clearance of any vegetation within 20m of the coast is allowed. Carefully design the layouts within the allocated sites to avoid or at least minimize the need to cut/trim trees. All project sites and layouts will be as described in the IEE, any changes to project locations or layouts will require consultation with ADB and if required the IEE and EMP to be updated to address associated impacts on vegetation clearance and tree cutting before detailed design is approved. Contractors to ensure that there is no illegal or accidental clearing of vegetation, felling of trees or disturbance of fauna.	Minimal clearance of vegetation and trees in the project footprint.				
	Disturbance to residential areas	Sensitive use of drones during planning surveys with permission from Island Councils with nearby residents informed in advance All project sites and layouts will be as described in the IEE, any changes to project locations or layouts will require consultation with ADB and if required the IEE and EMP to be updated to address associated impacts on residential areas before detailed design is approved.	Project sites other than works in powerhouses, along existing roads for cables, and rooftop solar are located as far as possible from residential areas				
	Geological risks including earthquake	All designs for foundations and structures shall follow GIIP seismic design codes and be reviewed by an engineer independent to the contractor's designer to confirm that this is the case	PMU approved detailed designs are resilient to geological risks				
	Climate change risks including cyclones and strong winds	All designs will incorporate climate change adaptation measures per the climate risk assessment including use of compact and preassembled systems resistant to marine/coastal environments and foundations that are designed for worst case wind loading	PMU approved detailed designs are resilient to climate change risks				

Topic	Impact or Risk	Mitigation Measure	Performance Standard	Budget Source/ Mitigation Cost	Implementation responsibility	Monitoring responsibility	Implementation schedule
	Exposure to hazardous materials and working conditions	Use of any asbestos containing materials, chlorofluorocarbons (CFCs) including halon, PCBs and SF6 is prohibited. Use of SF6 in fire extinguishers provided to be avoided. No oil filled transformers will be used. Designs to comply with the reference levels of the International Commission on Non-Ionizing Radiation Protection (ICNIRP) for EMF exposure.	PMU approved detailed designs minimize impacts and risks on EHS during subsequent stages of the project				
Construction planning and management	Impacts due to inadequate EHS planning and management prior to construction	Contractors to develop a Construction Environmental Management Plan (CEMP) and Construction Health and Safety Management Plan (CHSMP) reflecting the EMP requirements including the ECoP and international engineering best practice/good EHS practices for their contract and submit to PMU for approval prior to any works commencing on site. These will be living documents, to be updated as required and re-approved by PMU if the construction methods or site conditions change, in response to an accident, incident, near miss etc. **<u>Environment Provisions</u>** • CEMP to provide details on how the contractor plans to implement the construction mitigation measures specified in this EMP and relevant parts of the IFC EHS General Guidelines including the Construction and Demolition section. CEMP will include Construction Method Statements identifying all construction activities, schedule, off- and on-site access routes, anticipated traffic volumes, and construction methods to be used as well as temporary construction facilities needed and their location e.g., laydown areas, stores, construction workers rest areas, kitchen facilities, toilets/washrooms, overnight accommodation etc. • Include in CEMP (i) prohibitions on fishing etc. (ii) an emergency fauna rescue and handling procedure, including contacts of nearest veterinary etc. (iii) measures to avoid the spread of invasive species, and (iv) a Chance Find Procedure for physical cultural resources in accordance with the ECoP. • CEMP to include a Pollution Prevention sub-plan covering dust and emissions to air management, noise management, the protection of water resources and environmentally sound and safe storage, use, and disposal of all fuels, chemicals and oils used on site and an emergency preparedness and response plan in the event of any leaks or spills or an incident such as flood in accordance with national laws and regulations and the IFC EHS General Guidelines. • Plan construction works within 20m of marine environment, or with no vegetation or buildings separating the works site from the marine environment, considering soil erosion issues and marine water pollution risk. Contractors to schedule all earthworks during the dry season to minimize exposed areas subject to erosion by surface water runoff. • In relation to noise contractors will confirm the distance from their construction works to noise sensitive receptors to confirm if the noise standards can be met based on their construction methods or temporary acoustic barriers are required. Construction methods to ensure construction noise will be limited to 1-hour LAeq 55 (day) and 45 (night) dB(A) at the nearest adjacent residential properties or levels will not increase by more than 3 dB(A) above the background levels if obtained. If these noise levels may be exceeded, contractor to erect temporary acoustic barrier(s) around either the noise source and/or site boundary to attenuate noise to level such that noise levels will be met. • Contractors to avoid soil compaction, piling or blasting and other vibration inducing activities. If these are necessary for earthworks or foundation installation, contractor to quantitatively model the noise levels that will be experienced at the adjacent properties based on their proposed construction method and the effect of	PMU approved CEMP and CHSMP minimize impacts and risks on EHS during subsequent stages of the project Copy of the approved CEMP and CHSMP included in EMR during period of approval	Contractor to reflect in contact costs	Contractor to prepare; PMU to review with support of PMC to confirm all EMP measures adequately incorporated	E&S team of PMU with support PMC	Pre-construction stage; compliance prior to any works commencing on site including site establishment

Topic	Impact or Risk	Mitigation Measure	Performance Standard	Budget Source/ Mitigation Cost	Implementation responsibility	Monitoring responsibility	Implementation schedule
		additional mitigation measures to be adopted, the noise assessment will need to be submitted to PMU for review and approval alongside the detailed design. Contractor will develop a detailed assessment and soil compaction/blasting/piling management sub-plan to the CEMP addressing both the noise and vibration impacts. • Contractors to identify any adjacent properties at risk of vibration damage, undertake a through pre-construction structural survey of them, supported by photographic evidence, and determine whether such buildings may require the installation of vibration monitors during construction to monitor movement. If risk of structural damage to adjacent properties identified due to current condition, consider alternative construction method or temporary relocation of occupants during works if at risk. Structural or cosmetic damage is to be repaired by contractor to at least pre-project condition at their own cost. • CEMP will include a Solid and Hazardous Waste Management sub-plan dealing with all solid and hazardous waste generated in an environmentally sound and safe manner, per national regulations and the IFC EHS General Guidelines section on Waste Management. Off island movements will need to be factored in given the given the lack of suitably engineered and licensed sanitary waste facilities on the islands, for hazardous waste any transboundary movement will need to accord with the Basel Convention. • Contractors to provide adequate facilities for the collection, separation, and storage of construction waste (including municipal wastes) on-site and safe transportation for composting or recycling or disposal through reputable, legitimate, licensed third parties with all waste transfer records retained. Such areas should be sufficient distance from residential properties and screened from view from them. Since all waste management facilities are off-island adequate storage will need to be provided on site prior to disposal. Leaving or disposing of construction wastes by burying them on-site or disposing of them at the island waste management facilities which are unsanitary open dumps is strictly prohibited. **<u>Health and Safety Provisions</u>** • Contractors to provide workers with a source of drinking water that meets EPA/WHO drinking water standards. For sources proposed for use if test results are not available from the supplier (Island Council) the contractor to undertake a baseline water quality sampling per EMoP to confirm its suitability and, if necessary, provide the additional water treatment facilities during construction to facilitate safe drinking water supply. • Contractors to undertake a health and safety risk assessment through a facilitated workshop to be attended by PMU, PMC and FENEKA during the detailed design so that it can inform both the detailed design and pre-construction preparations. Health and safety risk assessment to consider both occupational and community health and safety risks resulting from all subsequent stages of the project. • Informed by the health and safety risk assessment the CHSMP will include occupational and community health and safety management sub-plans as well as a labor management sub-plan addressing migrant workers and sanitation and welfare etc. Measures reflected in the health and safety sub-plans will be in accordance with the IFC EHS General Guidelines sections on Occupational and Community Health and Safety. The CHSMP will include a Construction Emergency Preparedness and Response Plan (CEPRP) including communication systems and protocols to report an emergency e.g., health emergency, work-related accident,					

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		traffic accident, accident involving the community, natural disaster including fire, virus etc. • In undertaking health and safety risk assessment and preparing CHSMP adequate attention will be given to the risks associated with COVID-19 pandemic and other communicable diseases. National restrictions for containing the spread of COVID-19 or other epidemics must be complied with, as well as further guidance detailed in Appendix 12. • Contractors to set up an accident reporting system for any health and safety incidents (near miss, minor, lost time, fatal) involving workers or community to be reported to PMU within 24 hours of occurrence with a response plan detailing the incident and how its reoccurrence will be avoided. PMU to then report any lost time or fatal incidents to ADB within 48 hours. Record of all incidents and response taken should include date, time, details of incident, treatment given and outcome, and lessons learnt for the future. Contractors will ensure all workers are covered by insurance to pay out in line with national requirements in the event of a disability or fatality. • Contractors will provide adequate sanitation and welfare facilities including hand washing by making arrangements to use existing powerhouse facilities or similar, and will provide clean PPE in sufficient quantity on-site and at overnight accommodation; contractor will also consider the ability of communities to comply with protective measures such as regular handwashing and the local health care facilities' capacity to deal with any infections agreeing with the with nearest Health Center and/or hospital for emergency cares of workers. CEPRP must include response flow chart and contact details to deal with any construction worker or community member being diagnosed with COVID-19 or similar during the work. Medical insurance will be provided by contractor for all workers with sick leave allowance to ensure symptomatic workers do not attend site; contractor will avoid no-work-no-pay policies, whereby by fear of not getting paid workers would be tempted to report to work and hide any symptoms. Public health officials must be consulted in undertaking communicable diseases risk assessment and management planning for COVID-19 or other communicable disease epidemics. • CHSMP will include a traffic management sub-plan detailing use of public roads to transport plant, materials, and equipment to site avoiding peak travel times and school starting and leaving hours when children walk along the road. Set speed limits based on national rules but also the state of the road e.g., 10-15km/hr on unsurfaced roads to avoid dust generation. On pinch points traffic management will be provided and flag persons used. **<u>Code of Conduct</u>** Prepare a worker Code of Conduct and information video/brochure/leaflet for distribution to all workers during induction addressing the culturally acceptable practices etc. Code of Conduct must be informed by the CEMP and CHSMP and address the following aspects: • Zero tolerance in respect of health and safety • Requirement on always wearing PPE on site (all PPE provided free of charge by the contractors) • Zero tolerance of bribery or corruption • Respect for local community and customs, avoiding the community conflict situations • Zero tolerance of illegal and unacceptable activities/behaviour, including but not limited to engagement in: prostitution; gender-based violence/sexual exploitation,					

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		abuse, and harassment; illegal sale or purchase of alcohol; sale, purchase, or consumption of drugs; gambling; fighting etc. • Alcohol and drugs policy and testing regime • Role of workers in good housekeeping • Role of workers in maintaining good hygiene including COVID-19 measures e.g., social distancing • Respect of wildlife and the environment • Description of disciplinary measures for infringement of the code of conduct and other employer rules (e.g., immediate removal from site, fine etc.)					
	Impacts due to temporary requirement for site access during construction, transport of materials and equipment to site	All project sites will be accessed by using the existing road network and existing wharf/jetty where present or if absent (e.g., Raimandhoo) existing alternative boat landing facilities already available on the island. No new landing on the undisturbed beaches will be permitted, and no new access roads or wharfs/jetties constructed to facilitate project construction. Temporary and permanent access tracks within an allocated project site will only be constructed as described and assessed in the IEE. In case a requirement arises for access tracks not already considered, the IEE and EMP will need to be updated to address associated impacts before such works can be considered by the contractor. Creation of temporary access tracks will be minimized in length and width, to reduce impacts on terrestrial habitat and avoid land acquisition. If use of existing access roads by construction traffic is anticipated to cause damage to the road pavement, then the contractor to consider the need to upgrade the surface in advance of works. Photographic record and/or structural pre-condition surveys will be made of the pre-construction condition of existing access roads, including any public utilities or infrastructure that may be damaged during transport of materials, and land which is to be used for any temporary access tracks by the contractor before construction, including site establishment, to inform the reinstatement works. These must be documented in a PMU agreed pre-project condition report, and which will serve as a baseline in case any damage to property occurs. Contractor will be required to restore any property damage that is caused by their works including damage caused by heavy construction traffic using existing access roads to at least pre-project condition at their own cost. On completion of construction, access roads and land used for any temporary access tracks will be restored to their original condition in accordance with the agreed report. Boats used for transporting materials will be well maintained and operated (MAPROL 73/78) and driven by experienced boat handlers to avoid pollution, health and safety incident	No new access roads or wharfs/jetties constructed to facilitate project construction. PMU approved detailed designs for temporary and permanent access tracks within allocated project sites minimize impacts and risks on EHS during subsequent stages of the project				
	Impacts due to use of natural resources, storage of materials and other establishment of temporary facilities	Contractors will use locally sourced materials as far as practical to reduce transportation, but all raw materials will be sourced only from existing licensed sources. Construction water to be sourced from an existing island council supply (preferred option for potable water supplies) or rainwater harvesting if non-potable – no new water sources will be developed.	No temporary facilities encroach in 20m of coastal habitat or beaches or could otherwise indirectly impact adjacent marine habitat. Temporary facilities setup minimizes impacts and risks on EHS during subsequent stages of the project.				

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		Concrete batching plants and hot mix plants will not be permitted. Contractors to strictly locate all temporary construction facilities required within the existing Powerhouses or allocated project sites as described and assessed in the IEE, except for overnight accommodation that will be provided in existing properties off-site. If storage areas are required elsewhere land use is to be negotiated with the private landowner, submit land ownership papers and copy of agreement for temporary land use. No vegetation will be cleared for any temporary facilities. No temporary facilities including storage of spoil, fuel, oil and chemicals will be set up within 20m of beaches and marine habitat unless within the walled boundaries of an existing Powerhouse. No land requiring the cutting of trees is to be used for temporary facilities even if within the allocated project site. Noisy and dusty storage facilities or those that may generate sediment laden runoff or wastewater (e.g., stockpiles, refueling areas) will be located as far as possible from beaches/marine habitat and the nearest residential properties whilst laydown and storage areas that are not potential pollution sources may be located minimum 20m distant. Only volumes of material required for the day's work will be stored at the allocated project site; all other materials to be kept in the boundaries of existing Powerhouses. A photographic record will be made of the pre-construction condition of land used for temporary facilities before construction to inform the reinstatement works. After completion of construction any temporary structures will be completely removed, and the land will be restored to its earlier condition.					
Site clearance	Loss of trees requiring compensatory plantation	Removal of only those trees for which the permission has been granted by the island council, no vegetation and trees will be removed unless this was assessed in the IEE and EMP Compensatory plantation is to be undertaken for all trees to be cut at a ratio of 1:2 or 1:4 for coconut palms; the ecologist of PMC to calculate the actual requirement based on the detailed design and identify and agree suitable sites and locally native species in consultation with the Island Council. Contractors to implement the agreed compensatory plantation plan prior to starting the work, and then maintain these planted trees for the duration of their contract replacing any that do not survive.	100% of trees cut compensated prior to the commencement of works.	Counterpart funding and contract budget	PMU and Contractor	E&S team of PMU with support PMC	Prior to the commencement of works
B. Construction (also see following tables)							
General construction activities including site establishment, site clearance, earthworks, excavation, civil works, installation, an influx of workers etc.	Generation of dust from movement of vehicles for transport of materials and equipment, loading and unloading of raw materials, earthworks, excavation and civil works Generation of oxides of nitrogen, sulphur dioxide and	Comply with project EMP plus approved CEMP including the pollution prevention sub-plan, ECOP and the IFC EHS General Guidelines in relation to air quality and noise during construction works and avoid the occurrence of pollution incidents and noise and vibration disturbance to the local communities as far as practical in consultation with the Island Councils. Use tarpaulin covers tied down securely to the body of all vehicles and boats when transporting the loose material. Large heavy vehicles will not be utilized in transporting materials and equipment on islands but since the roads are unsurfaced cover roads with geotextile and stone or steel plates to minimize dust throw if there will be a high volume of traffic movement. Contractors will undertake weekly dust soiling checks of surfaces of the closest non-FENEKA properties during earthworks and those adjacent to unsurfaced access roads and help with cleaning of external surfaces of property if there is any dust is evident.	Compliance with the project level air quality, noise, and water quality standards as per chapter 2 of the IEE with quantitative monitoring per EMoP as required--if these levels are exceeded, the contractor will be required to implement additional mitigation. EMP/CEMP requirements successfully implemented as determined through regular site checks, photographic record etc.	To be included contract cost.	Contractor	E&S team of PMU with support PMC	Prepare during pre-construction and comply throughout construction stage

Topic	Impact or Risk	Mitigation Measure	Performance Standard	Budget Source/ Mitigation Cost	Implementation responsibility	Monitoring responsibility	Implementation schedule
	particulate emissions by construction plant and vehicles Erosion of exposed soil due to surface water runoff especially during monsoon season, sediment laden runoff from exposed soil or stockpiles of loose material resulting in increased turbidity of marine water Generation of noise and vibration from movement of vehicles for transport of materials and equipment, loading and unloading of raw materials, earthworks, excavation, civil works, installation, an influx of workers Spillage or leaks of fuel, oil, and chemical used in construction impacting the quality of groundwater or marine water	Ensure all stationary emission sources such as diesel generator sets, and all construction vehicles are regularly serviced and maintained in good working order in accordance with manufacturer instructions and have passed emission tests; keep log of maintenance work undertaken Belching of black smoke prohibited. Keep vehicles clean to avoid transport of mud from the project site and use twice daily sprinkling of water on the project site and access roads when in active use during the dry (non-monsoon) season to suppress dust. Spraying of water will be done using just the right quantity of water to suppress dust whilst avoiding excess surface water runoff or the ponding up of water. Minimize soil erosion, windblown dust, and surface water runoff by reducing the extent of earthworks. Undertake sequenced construction especially for cable trenching and revegetate areas immediately construction activities are completed in one area rather than undertaking earthworks on all parts of the site to minimize the area of bare ground exposed at any one time. Keep stockpiles of soil, aggregate and waste materials at least 20m from the coast, keep them covered except when in active use to avoid suspension or dispersal by wind. Minimize double handling and drop loads for the storage and use of loose materials. For works with earthworks and excavations within 20m of the marine environment or with no vegetation or buildings separating the works site from it, contractor will install cut off ditches or use sediment fences (semi-permeable geotextile) to guard against loss of soil from surface water runoff during heavy rainfall. Open burning of any project-related waste is strictly prohibited. Noise level at nearest residential property or other sensitive receptor not to exceed project noise levels (or <3dB(A) increase if already exceeded and a baseline noise monitoring was conducted to inform this; project noise levels are per Chapter 2 IEE. Timing of works to be agreed in consultation with the Island Councils to choose times that will cause minimum disturbance to the local community. Strictly limit the working hours to weekday daytimes with no work on weekends, holidays, or festivals. Conduct noisy works including earthworks, excavation and trenching and traffic movements only during 8am-5pm, and avoid all construction works at night from 10pm to 7am. Loud construction noise to be kept to short periods of time in each hour. Schedule the noisy works where there is a risk of noise standards being exceeded in the vicinity of properties and mosques between 10am to 4pm and outside of lunch and prayer time to ensure the noise will not disturb residential area resting times. Residents within 500m will be informed well in advance of the construction schedule for noisy activities and be kept informed daily. Construction work adjacent schools will be scheduled to avoid classroom disturbance, in the school holidays or after hours. Sound levels received by workers must not be over 85 dB(A) during continuation of 8 working hours without wearing PPE. Construction methods and machinery are to be selected seeking to minimize ground disturbance, noise and vibration. Use modern, low noise generating equipment e.g., <55dBA sound pressure level at 1m. Follow the IFC EHS General Guidelines in relation to the use and storage of any fuel, oil, and chemical to minimize pollution incident risk including spill prevention, emergency response, spill clean-up and remediation. Fuel, oil, and chemicals actively in use to be stored in labelled, sealed containers on drip trays to provide secondary containment. In designated storage areas, they will be kept under lock and key on an	No outstanding air quality, dust, noise, vibration, groundwater or marine water quality related grievances from local communities or other interested stakeholders				

Topic	Impact or Risk	Mitigation Measure	Performance Standard	Budget Source/ Mitigation Cost	Implementation responsibility	Monitoring responsibility	Implementation schedule
		undercover, impermeable surface bunded to 110% capacity and ideally located in the powerhouse. Refueling operations, equipment servicing and washdown to take place on an impermeable surface at least 20m away from the marine environment with all drainage directed through oil and grease interceptors before being discharged to ground. Provide spill response kit with sufficient absorbent materials (e.g., sorbents, dry sand, sandbags) at the stores and on-site for soaking up any fuel, oil, or chemical leaks or spills. Conduct regular training of workers on the pollution prevention sub-plan including good housekeeping requirements, management of earthworks and excavations to avoid sediment laden surface runoff, the environmentally sound and safe storage and use of all fuels, chemicals and oils used on site, and how to respond to and clean up leaks and spills and dispose of the contaminated sorbent material which would be treated as a hazardous waste.					
Generation of construction waste and wastewater	Use of raw materials for construction (cement, aggregate, sand, etc.) Inappropriate disposal of inert spoil from excavations in the island landscape blocking drains, resulting in windblown dust and increased turbidity of marine water Inappropriate disposal of solid wastes generated from project site, including packaging materials from equipment, left over/unused/ damaged/end of life parts, etc. Inappropriate disposal of hazardous wastes generated from project site and workers e.g., left over/used oils, lubricants, chemicals, e-wastes etc.	Comply with project EMP plus approved CEMP including the waste management sub-plan, ECOP and the IFC EHS General Guidelines in relation to waste management during construction works Construction materials (especially sand and gravel e.g., for trenching and on-site access track construction) will be sourced from existing approved sources with operating licenses, and records kept of all the materials used and their source. Contractors to provide adequate facilities for the handling and storage of raw materials ideally located in the powerhouses to reduce the amounts of waste caused by damage or exposure to the elements. Leaving or disposing of construction waste on-site or disposing of it at Island Council waste management facilities is strictly prohibited. Prohibit use of waste (e.g., empty cement bags and containers, plastic, wooden planks) for backfilling – only inert spoil may be used for backfilling to avoid the need for off-site disposal Dumping of construction waste, including any excess spoil on agricultural fields, into drains, any surface water bodies, and into the marine environment is to be prohibited. Prohibit open burning of construction waste. Balance cut and fill in the construction area as far as practical, if excess spoil needs to be taken off-site it will be disposed of on the island in conjunction with the Island Council at a location that is suitable for accepting the inert waste and in a manner that will not result in windblown dust, sediment laden surface water runoff etc. Contractors will quantify the extent of earthwork and excavation required and locations for disposal of excavated spoil. Records of volumes of generated and reused spoil, and all transfer and location records of the disposal off-site are to be kept by the contractor. Discharge of sediment laden surface water runoff directly into the marine environment is forbidden. If discharge is not to ground construction of sedimentation ponds is required to allow sediment to settle out of the water before its release of water into the marine environment. Packaging materials once removed to be immediately collected and stored so it cannot be blown by the wind. Prior to the start of works contractors will ensure an appropriate waste management collection, storage and disposal system for domestic solid waste and construction waste is established at the construction site and all overnight accommodation that is provided by the contractors.	Compliance with the project marine water quality standards as per chapter 2 of the IEE with quantitative monitoring per EMoP as required--if these levels are exceeded, the contractor will be required to implement additional mitigation. EMP/CEMP requirements successfully implemented as determined through regular site checks, photographic record etc. No outstanding material sourcing, waste related or marine water quality related grievances from local communities or other interested stakeholders	To be included contract cost.	Contractor	E&S team of PMU with support PMC	Prepare during pre-construction and comply throughout construction stage

Topic	Impact or Risk	Mitigation Measure	Performance Standard	Budget Source/ Mitigation Cost	Implementation responsibility	Monitoring responsibility	Implementation schedule
	Construction waste especially packaging covers of materials if not collected and securely stored can result in litter, those blown away into marine water can block the light of corals and have direct detrimental effects on marine fauna such as entanglement and ingestion in case of species like marine turtles	Encourage recovery of all waste that could either be reused or sold to recyclers rather than disposing of it, the segregated collection of waste will ensure recycling values are maximized. In preparation for off-island disposal collect and store all waste produced in an environmentally safe and sound manner in a designated, labelled area. Separate covered waste containers (skips, bins, drums, or bags) will be provided for all the different types of waste generated facilitating segregation for reuse and recycling purpose and correct disposal destination. Waste containers will be appropriate to their content e.g., solid waste within enclosed bins to contain leachate and avoid vermin, hazardous waste storage must incorporate impermeable concrete surface bunded to 110% volume which is not connected to the drainage system to collect spills and leaks. Sensitize workers on good housekeeping and the environmentally safe and sound storage and disposal of wastes, most importantly not to leave loose garbage lying around. Provide regular toolbox talks and ensure all workers are familiar with the need for waste management, segregation and place waste containers to collect the different wastes so they are not thrown on the floor. Develop a procedure/system to penalize, through escalating fines or similar, any construction workers who breach these waste management requirements. Solid waste collected will be regularly transported off island at the contractors cost for disposal at the licensed waste management facility of Thilafushi and not be allowed to accumulate on site over long periods. Hazardous collected will be regularly transported off island at the contractors cost for disposal transboundary per national regulations and not be allowed to accumulate on site over long periods. Document all solid and hazardous waste removed off site using transfer notes, to be taken by licensed waste contractor who should reuse/recycle or dispose of the waste according to type to suitably licensed and engineered waste management facilities. On completion of works, no waste will be left on the island for the Island Councils to dispose of. PMU and Island Councils to confirm all waste has been removed before handover. For sanitation and welfare facilities for construction workers including toilets and hand washing facilities existing facilities connected to wastewater treatment or septic tanks with soak-away will be used such as those at powerhouses, no new sanitary facilities will be established. No untreated sanitary wastewater is to be discharged direct to the marine environment or to ground.				
General construction activities including site establishment, site clearance, earthworks, excavation, civil works, installation, an influx of workers etc.	Exposure to occupational and community health and safety risks	Comply with project EMP plus approved CHSMP including the occupational and community health and safety sub-plans, labor management subplan, traffic management subplan, ECOP and the IFC EHS General Guidelines in relation to occupational and community health and safety, ILO guidelines on construction site health and safety[1] and labor accommodation[2] whilst taking a zero-tolerance approach. Contractors are responsible for ensuring health and safety of everyone on the construction site including visitors and sub-contractor workers regardless they have been formally or informally employed. Require all subcontractors and workers to confirm they have seen and understood the requirements of the CHSMP before proceeding with their work. Ensure the dedicated health and safety supervisors and stewards are always present on site when active. If staff on annual leave or off sick provide alternative supervision staff.	Compliance with national labor, health and safety regulations Zero tolerance approach to health and safety adopted No fatalities or lost time incidents during construction works 100% of health and safety incidents including near miss recorded, immediately	To be included contract cost.	Contractor	E&S team of PMU with support PMC	Prepare during pre-construction and comply throughout construction stage

[1] https://www.ilo.org/sector/Resources/codes-of-practice-and-guidelines/WCMS_861584/lang--en/index.htm
[2] https://www.ilo.org/wcmsp5/groups/public/---ed_emp/---emp_ent/---multi/documents/publication/wcms_116344.pdf

Topic	Impact or Risk	Mitigation Measure	Performance Standard	Budget Source/ Mitigation Cost	Implementation responsibility	Monitoring responsibility	Implementation schedule
		Enforce disciplinary systems (e.g., immediate removal from site) for non-compliance with PPE requirements and other health and safety measures	investigated, and corrective action taken to prevent repeat EMP/CEMP requirements successfully implemented as determined through regular site checks, photographic record etc. No outstanding health and safety related grievances from workers, local communities or other interested stakeholders				
	OHS risks related to dust and noise, operation and movement of construction plant and vehicles, working conditions, road-related accidents for drivers, transport-loading and unloading risks, earthworks and excavations for trenches and foundations, electrical and fire hazards including working in vicinity to electric power, working in remote island location, etc.	Require workers to observe the OHS measures in IFC EHS Guideline on Construction and Demolition and for those working with electrical equipment in the IFC EHS Electric Power T&D Guideline Only allow suitably trained and qualified workers to be allowed to work on electrical equipment and at height, these workers must have a training record of attending suitable training course on electrical safety and working at height and be provided with and wear the appropriate PPE for their role. Untrained workers must never be permitted to work with live electricity or at height. Provide recommended Personal Protective Equipment to workers (regardless formal and informal, directly contracted or subcontracted) in accordance with Table 2.7.1. Summary of Recommended Personal Protective Equipment according to hazard in IFC EHS Guidelines on OHS and the ILO guidelines on construction site health and safety. Provide regular worker training on health and safety and daily briefings led by the EHS supervisor, conduct regular drills on execution of the emergency preparedness and response plan. Ensure good housekeeping at the construction site, storage areas, overnight accommodation, etc. – these are all to be kept neat and tidy, no trip hazards e.g., no materials, equipment, trash laying around. Given the remoteness of the construction site ensure a qualified first aider (with immediate access to a doctor) and trained fire marshal is always available on-site with an appropriately equipped first aid kit and appropriate in-date/serviced fire extinguishers and other firefighting equipment immediately available for use. Eye wash station and water supply to shower to be provided where there is a risk of a hazardous substance encountering the skin. Provide an ambulance (car/boat/helicopter) which is always available on-call for the more serious cases and arrange with the nearest Health Center and/or Hospital for emergency cares of workers. Prepare signboards reminding of health and safety measures and procedures to follow in case of accident, including key contact details (ambulance, doctor, hospital, etc.) Keep a log of all occupational and community health and safety incidents, near-misses and accidents.		To be included contract cost.	Contractor	E&S team of PMU with support PMC	Prepare during pre-construction and comply throughout construction stage
	OHS risks related to sanitation and welfare of employees including COVID-19, HIV/AIDS and other communicable diseases spread – at project site and accommodation, etc. Spread of COVID-19, HIV/AIDS, and other communicable diseases to local community through unsanitary conditions or presence of project workers	Provision of access to sufficient existing toilet and washing facilities should be provided for the number of workers with 1 toilet per 6 workers; male and female facilities are to be provided or there should be an indication of whether the toilet facility is “in use” or “vacant” if not segregated. Toilet facilities used to be provided with adequate supplies of hot and cold running water, soap, and hand drying devices. Toilets to be cleaned at least twice a day to ensure maintained in hygienic condition. Provide workers with access to a shaded rest area onsite or immediately adjacent so breaks can be taken at any time they feel it is necessary. Provide workers with access to clean eating areas and kitchen facilities for breaks and mealtimes with a supply of drinking water meeting EPA/WHO drinking water standards. For workers not local to the area, suitable overnight accommodation (refer to ILO guidance on workers’ accommodation) must be provided by the contractor, use should be made of existing accommodation facilities and no worker’s camp will be established. It must be ensured each worker has their own bed and locker. Construction workers to follow healthy hygiene practices to lower the risk of disease spread. Check health condition of workers on daily basis, for example, use of a self-certification forms and temperature checks before being allowed on the construction site with more thorough monthly health checks by qualified medical professional		To be included contract cost.	Contractor	E&S team of PMU with support PMC	Prepare during pre-construction and comply throughout construction stage

Topic	Impact or Risk	Mitigation Measure	Performance Standard	Budget Source/ Mitigation Cost	Implementation responsibility	Monitoring responsibility	Implementation schedule
	Community conflict with project workers including sexual exploitation, abuse, and harassment	For hiring of migrant workers medical tests are to be undertaken to screen for health conditions including COVID-19 and HIV/AIDS per national procedures; for all workers not local to the area COVID-19 screening to be undertaken before travel to site Prevent standing water as it may become a breeding habitat for mosquitoes etc. Contractor staff and local communities will be given awareness raising in COVID-19 and HIV/AIDS, other communicable diseases, local culture and heritage, and sexual, exploitation, abuse, and harassment by PMU and contractors EHS team with workers having strict penalties (e.g., immediate removal from site) for any non-compliance of workers to the agreed code of conduct					
	Impacts on community health due to dust, noise, vibration, water pollution etc. Community risks due to community access to construction works including open excavations etc. Community risks related to traffic congestion and increased risk of road-related accident Risks due to accidents from community access to electrical infrastructure	Comply with project EMP plus approved CEMP including the pollution prevention sub-plan, ECOP and the IFC EHS General Guidelines in relation to air quality and noise during construction works and avoid the occurrence of pollution incidents and noise and vibration disturbance to the local communities as far as practical in consultation with the Island Councils. Restrict access to the construction sites. Erect a temporary solid fence or barriers (not tapes) and sign construction sites and open excavations with hazard warning signs to prevent public access; this is applicable to all works accessible from the public domain Do not leave hazardous conditions (e.g., unlit open excavations without a means of escape) overnight unless absolutely no access from the public can be ensured. Signboards on site boundary fences are to include key contact details in case of local community accident (contractor, ambulance, doctor, health center, hospital, etc.) In conjunction with Island Council contractor to undertake regular construction and electrical safety community awareness raising activities in local affected communities and with local schools starting prior to the construction. Drivers to strictly follow traffic management sub-plan, and all road safety regulations Ensure proper execution of traffic controls at the harbour, on the access roads, and at the site entrance including use of highly visible advance warning signs and flag persons to control loading and unloading and entry and exit, temporary gates to construction sites are to be set sufficiently far back to prevent vehicles having to stop/queue on the existing access roads etc.		To be included contract cost.	Contractor	E&S team of PMU with support PMC	Prepare during pre-construction and comply throughout construction stage
Undertaking of construction works in public domain	Hindrance to public access and road users due to use of existing access roads, wharfs/jetties and construction activities	Comply with project EMP plus the ECOP and approved traffic management subplan Boat and traffic movements to avoid periods of peak traffic, timing of deliveries to be agreed in consultation with the Island Council to minimize disturbance to harbour and road users Ensure access to public and private property is maintained throughout construction period in consultation with the residents and the Island Councils, safe access will be maintained and alternative signed routes and access will be provided if there is to be temporary diversions or blockages	EMP/ECOP/CHSMP requirements successfully implemented as determined through regular site checks, photographic record etc. No outstanding access related grievances from the local community or other stakeholders	To be included contract cost.	Contractor	E&S team of PMU with support PMC	Prepare during pre-construction and comply throughout construction stage
	Unintentional property or public utilities damage	Implement careful construction practices to avoid damage to existing structures (e.g., buildings) and roads, public utilities, drains etc. Use will be made of existing access roads; in locations where access is restricted use of manual labor utilizing push carts instead of motor vehicles to transport the materials and equipment. On completion of works restore all temporarily used sites and access roads to at least their pre-project condition following works; this will involve cleaning site of any debris or wastes, left over material and soil/rocks/sand, contaminated soil although this should have been avoided through EMP measures; revegetation if required; drainage if	No unanticipated damage to physical cultural resources because of the construction works EMP/ECOP/CHSMP requirements successfully implemented as determined through regular site checks, photographic record etc.	To be included contract cost.	Contractor	E&S team of PMU with support PMC	Prepare during pre-construction and comply throughout construction stage

Topic	Impact or Risk	Mitigation Measure	Performance Standard	Budget Source/ Mitigation Cost	Implementation responsibility	Monitoring responsibility	Implementation schedule
		required; local topographical adjustments; addition of good quality soil if the latter was eroded or removed by construction works; etc.	No outstanding damage related grievances from the local community or other stakeholders				
Earthworks and excavations for trenches and foundations	Potential risk of damage to below ground resources, including undiscovered archaeological resources in case of chance find	Comply with ECOP chance find procedure; implement procedure as soon as any potential physical cultural resources encountered during the construction activities. Strictly ensure no known physical cultural resources or chance finds are tampered with. Brief workers on the known physical cultural resources and chance find protocol, the types of finds to be reported and penalties applying for tempering with them through induction and toolbox talks before the commencement of any works. Contractor to declare a chance find to MOECCT/PMU within 24h of find. MOECCT/PMU to report on any chance find having occurred within 48h to ADB.	National regulations on physical cultural resources complied with No unanticipated damage to physical cultural resources because of the construction works EMP/ECOP/CEMP requirements successfully implemented as determined through regular site checks, photographic record etc. No outstanding physical cultural resources related grievances from workers or community health and safety related grievances from local communities	To be included contract cost.	Contractor	E&S team of PMU with support PMC	Prepare during pre-construction and comply throughout construction stage
C. Operation and Maintenance (see following tables)							
N/A							
D. Decommissioning (where required, see following tables)							
N/A							

Table 1: Environmental Management Plan for Battery Energy Storage Systems, Energy Management System, and Grid Upgrades (To be Implemented in Addition to the Table 1 General Measures)

Topic	Impact or Risk	Mitigation Measure	Performance Standard	Budget Source/ Mitigation Cost	Implementation responsibility	Monitoring responsibility	Implementation schedule
A. Pre-construction							
Non-compliance of existing facilities with regulatory requirements and international good practice	Pollution risks and occupational and community health and safety risks associated with existing powerhouse operations	Implement the corrective action plan set out in Appendix 7 for all existing facilities (powerhouses) and submit a report on the status of actions to ADB to confirm the completion of all short-term actions before handing over the site to contractor. Upon handover of the project components to FENEKA undertake a third-party audit to confirm continued implementation of national laws and regulations and international good practice in the operation of FENEKA existing facilities plus compliance with long-term actions and submit the report to ADB as part of the EMR. In the long term, FENAKA will also prepare and implement a plan for fuel and oil storage and handling. This will include (i) improvements to the existing bunded structures at the fuel storage tanks so that they will be protected from rain and will store spilt or leaked fuel for pump-out and environmentally safe and sound disposal; (ii) redesign of the existing oil-separators; and (iii) construction of bunded, impermeable concrete areas for the storage of empty lubricant oil drums. Additionally, work practices and site environmental management need to match this requirement to ensure that no fuel, oil or other lubricant is allowed to enter the external environment. If the third-party environmental audit identifies non-compliance FENEKA will immediately implement the recommendations made and report on this in the next EMR.	Corrective action plan implemented, short term actions completed prior to handover of site to contractor and long-term actions before project closure. No breaches of national laws and regulations and international good practice in the operation of FENEKA existing facilities upon project closure	FENAKA O&M Cost	FENEKA	E&S team of PMU with support PMC	Short term actions completed prior to handover of site to contractor Long-term actions and environmental audit recommendations before project closure is reached
Detailed design, location of and access to project components, construction planning and management	Encroachment into protected areas, ecologically sensitive zones, natural habitats or physical cultural resources	BESS and EMS will be installed only within the boundaries of existing powerhouses No vegetation will be cleared and no trees will be cut to install the BESS and EMS in the powerhouses Grid upgrade cable works will be done only along the existing island roads No vegetation will be cleared and no trees will be cut to install cables in the existing roads Cable routes to avoid the area beneath tree crowns (zone for root protection) especially for mature trees. Contractors to provide an inventory of physical cultural resources e.g., mosques adjacent to the grid cable works to inform the construction workers of the need to avoid damage to them, and to inform the timing of noisy construction works	No project sites encroach into protected areas, ecologically sensitive zones, natural habitats or physical cultural resources No clearance of vegetation and trees within the project footprint	Contractor to reflect in contact costs	Contractor	E&S team of PMU with support PMC	Pre-construction stage; compliance prior to approval of detailed design and any works commencing on site including site establishment
	Disturbance to residential area	Quietest available equipment with manufacturer-supplied noise mitigation will be installed. Contractors to ensure that the design of the project components alone enables their operation to always comply with 1-hour LAeq 70 dB(A) at the site	PMU approved detailed designs minimize impacts and risks on EHS during subsequent stages of the project PMU approved CEMP and CHSMP minimize impacts and risks on EHS during subsequent stages of the project				

Topic	Impact or Risk	Mitigation Measure	Performance Standard	Budget Source/ Mitigation Cost	Implementation responsibility	Monitoring responsibility	Implementation schedule
		boundary and 45 dB(A) at the nearest residential properties (irrespective of the background noise levels from diesel generators) Routing of cables along existing roads to avoid the damage to existing buildings and structures, public utilities, street furniture etc. If existing services must be disrupted the contractors (via service providers if appropriate) to notify affected communities well in advance of any power outage etc. In relation to cumulative impact liaise with other utilities regarding the timing and extent of other construction works in the same location and ensure plans for construction works are coordinated so emissions/disruption/ disturbance are minimized.					
	Unintentional property or public utilities damage	For private property or public utilities/street furniture that may be damaged during construction, including from potential breaking/drilling vibration damage (buildings, roads, drains etc.) photographic and/or structural pre-condition surveys are to be completed and agreed with MOECCT prior to any works, including site establishment. To be documented in a pre-project condition report, which will serve as baseline in case any inadvertent damage or vibration impact to property occurs. If risk of structural damage to adjacent properties from vibration identified due to current condition, consider alternative construction methods or temporary relocation of occupants during works if at risk. Check with public service providers (electric, water, telecoms) whether there are known pipes, cables, or other utility lines and carry out a scan using cable avoidance tool to identify any unknown underground utilities prior to excavation. Contractors to identify in consultation with service providers appropriate measures to minimize period of disruption to utilities and reduce health and safety risks during installation.	PMU approved CEMP and CHSMP minimize impacts and risks on EHS during subsequent stages of the project				
	BESS building design results in EHS impacts	Minimize visual impact and clutter in locating the above ground equipment, BESS buildings are to be in keeping with the local vernacular of the existing powerhouse. For BESS buildings and containers provide adequate natural and/or artificial lighting levels to meet the IFC EHS Guidelines on Occupational health and safety (Table 2.3.3. Minimum Limits for Workplace Illumination Intensity) -- design to ensure that all lighting is of energy efficient LED type with solar powered LED lighting where practical. Use of fluorescent/HPSV lamps will be avoided since they are less energy efficient and classed as hazardous waste for purposes of disposal. For BESS buildings take a life-cycle approach to detailed design, considering the use of construction materials and the energy efficiency of the building that must be kept cool during operation adopting the “green building” concept e.g., using natural cooling for reducing the need for air conditioner. Detailed design to include rainwater harvesting and enable FENEKA to readily fit solar panels on any building rooftop once operational. Final surface level of foundations will be at least 1 m above the existing ground level or highest flood level including an allowance for climate change based on the findings of climate change assessment prepared for the Project (whichever is higher) Foundations to be constructed in such a way as to be adequately drained to prevent washout.	PMU approved detailed designs minimize impacts and risks on EHS during subsequent stages of the project				
	Occupational and community health and safety risks to FENEKA	Ensure maximum sound power level of equipment at 1 m is 85 dBA, if these noise levels will be exceeded OHS noise warning signage identifying the ear protection to be worn must be installed.	PMU approved detailed designs minimize impacts and risks on				

Topic	Impact or Risk	Mitigation Measure	Performance Standard	Budget Source/ Mitigation Cost	Implementation responsibility	Monitoring responsibility	Implementation schedule
	staff and public from electrical infrastructure	All electrical hazards will feature written and visual warning signs that meet the IEEE standards to include the ISO 7010 "Hazard Type: Electrical Symbol" warning of the risk of electrocution. To prevent against cable break incident of new cables, cable markings will be installed above the cable to inform those who may be excavating in future. In case the armour is broken by a third party and the core damaged, protection relays to which the cables connect will be designed to detect this and stop sending electricity immediately by automatically opening switchgear to prevent a live shock to the person.	EHS during subsequent stages of the project				
	BESS health and safety risks	Location of battery storage building or container away from normal work areas of FENEKA. BESS will be installed with adjacent fresh water tap with eye wash and shower in case staff come into contact with the battery solution. Batteries bought for the project will be of high quality and come in prefab casing with built in automatic fire alarm system, fire extinguishers and sand buckets will also be provided. Provide automatic fire alarm and fire suppression system in buildings and containers with emergency exit signage. Provide fire extinguishers (for electric fires) in a prominent, signed location near to fire-risk locations with service and expiration dates clearly labelled along with posters on fire safety. Provide fully stocked, in-date first aid kit installed in a prominent, signed position, first aid posters and emergency contacts to also be displayed. Display material data sheets for any fuels, oil, or chemicals used in the BESS.	PMU approved detailed designs minimize impacts and risks on EHS during subsequent stages of the project				
O&M	General impacts and risk on project affected persons, including O&M workers and local communities	Develop in conjunction with FENEKA an O&M Plan for the BESS, EMS and grid upgrades setting out the schedule of inspections, maintenance required, and all EHS measures to be followed during any maintenance works. O&M Plan to be informed by a facilitated risk assessment and include a health and safety Plan and an Emergency Response and Preparedness Plan in relation to the BESS operation	O&M Plan included in handover to FENEKA to minimize impacts and risks on EHS during subsequent stages of the project	Contractor to reflect in contact costs	Contractor	E&S team of PMU with support PMC	Pre-construction stage; compliance prior to handover to FENEKA
	Impacts from inappropriately disposed used batteries	Include in the bidding document and contract agreement with suppliers for disposal of used batteries as hazardous waste. Hazardous waste collected will be regularly transported off island at the contractor (suppliers) cost of disposal transboundary per national regulations and not be allowed to accumulate on site over long periods. Contractor will provide a leak proof, fully enclosed battery collection system to FENEKA allowing the environmentally safe and sound temporary storage of the used battery cells whilst awaiting disposal.	Provisions for disposal of batteries by supplier included in both the bidding and contract document for all contract works packages. No breaches of the EMP requirements by contractor.	Counterpart funding and contract budget	PMU and Contractor	E&S team of PMU with support PMC	Prior to issue of bidding and contract documents by MOECCT In submission of bids and upon award of contract for contractor
B. Construction							
Noisy construction work	Disturbance to fauna using adjacent forest and coastal vegetation	For powerhouses with forest and coastal vegetation adjacent noisy works only permitted from one hour after sunrise to one hour before sunset to minimize its disturbance	EMP/ECOP/ CHSMP requirements successfully implemented as determined through regular site checks, photographic record etc. No outstanding grievances from local communities or other stakeholders	To be included contract cost.	Contractor	E&S team of PMU with support PMC	Prepare during pre-construction and comply throughout construction stage
	Disturbance to mosques	For powerhouses with mosques adjacent no noisy works will be undertaken during prayer time; same will apply to the cable laying adjacent to mosques					
Trench digging and cable laying for cable upgrades	Difficulty in road access and health and safety risks during the	Trenching and cable laying work will be carried out as fast as possible; the trenches will only be left open for a single day Whole roads will not be blocked with temporary diversion plans following the traffic management sub-plan as needed Work will be barricaded with solid moveable fences/barriers, warning signs, lights, and flag persons provided to control pedestrian and traffic movement					

Topic	Impact or Risk	Mitigation Measure	Performance Standard	Budget Source/ Mitigation Cost	Implementation responsibility	Monitoring responsibility	Implementation schedule
Disposal and management of batteries	Impacts from inappropriately disposed defunct batteries during installation	Any batteries that are rejected during installation and commissioning due to damage or failure will immediately be removed from the site and returned to the supplier as per O&M requirements	100% of batteries disposed of by the supplier, no batteries remaining on site for disposal Compliance with national laws and regulations. EMP requirements successfully implemented as determined through regular site checks, photographic record etc.	To be included contract cost.	Contractor	E&S team of PMU with support PMC	Prepare during pre-construction and comply throughout construction stage
C. Operation and Maintenance							
O&M	General impacts and risk of powerhouse and grid network including BESS and EMS on project affected persons, including FENEKA O&M workers and local communities	Implement the agreed O&M Plan During maintenance activities all the mitigation measures applicable to the construction stage are also applicable to FENEKA maintenance workers or contractors and are to be followed, including strict prohibitions on workers. Regular visual and technical inspection of condition and maintenance as required to be carried out, keep photographic records and log of all inspections, including register of faulty equipment found, and actions taken in response. Electrical equipment and electric wiring to be checked for safe current and voltage ratings. Maintain all noise generating project equipment to ensure noise to be limited to the following as 1-hour LAeq: (i) 70 dB(A) at the site boundary; (ii) at residential properties, 55 (day) and 45 (night) dB(A) Ensure all liquids (fuel, oil, or chemicals) are stored in an undercover area with impermeable floor with spill containment bund of 110% capacity under lock and key. Label all drums and containers with their content and potential risk signs (e.g., flammable, corrosive, toxic, etc.) and always keep spill prevention equipment available on site. Display material data sheets for any fuels, oil, or chemicals used on site. Keep spill prevention equipment available on site.	Project infrastructure maintained in working order and is always in good condition. Compliance with national laws and regulations. EMP/O&M Plan successfully implemented by FENEKA as determined through regular site checks, photographic record etc. No outstanding O&M related grievances from local communities or other stakeholders	FENEKA O&M	FENEKA	FENEKA supported by E&S team of PMU and the PMC for duration of project	Prepare during pre-construction and comply throughout O&M stage
	General occupational and community health and safety risks of powerhouse and grid network operations including BESS and EMS	Implement the agreed O&M Plan Ensure all O&M staff have received appropriate OHS trainings for their role including for the additional health and safety risks related to the BESS and EMS O&M.[3] Always keep the additional operational area of the BESS neat and tidy. Store equipment in a dedicated, covered, labelled storage area (materials, tools, equipment, and any spare parts). Remove any trip hazards on the ground, e.g., open channels, materials, equipment, trash laying around. Visually inspect for any standing water around the BESS building or container, and when identified, remove, or provide appropriate drainage to remove it in a timely manner; ensure the drainage system is not blocked and fully operational. Display clear emergency exits signs (in working order, if light signs, ensure works) in the BESS buildings and containers and keep all the exits clear of any blockage. Maintain all lights in working order. Ensure all vents free of blockages and regularly maintained. Ensure a recent, full, first aid kit and adequate firefighting equipment is always available on site, stored in clearly labelled and easily accessible area. Replace	Compliance with national laws and regulations. EMP/O&M Plan successfully implemented by FENEKA as determined through regular site checks, photographic record etc. Zero project-related health and safety accidents reported during O&M No outstanding O&M related grievances from local communities or other stakeholders	FENEKA O&M Cost	FENEKA	FENEKA	Prepare during pre-construction and comply throughout O&M stage

[3] Training on the operation and maintenance of the lithium ion and flow batteries will be provided by the EPC contractor to the FENAKA operators.

Topic	Impact or Risk	Mitigation Measure	Performance Standard	Budget Source/ Mitigation Cost	Implementation responsibility	Monitoring responsibility	Implementation schedule
		the first aid equipment timely as required to keep all equipment within its expiry date. Service the firefighting equipment timely as required to keep all equipment in date. Provide first aid and firefighting training to select, volunteer staff in relation to the BESS; at least one staff having recently carried out first aid and firefighting training must be always present on site. Refreshers are to be provided once a year. Hang posters showing first aid procedures especially for electrocution, and fire procedures, as well as listing all emergency contacts. Display the emergency phone number and location of first aider, doctor, health center, and hospital in a clear and easily accessible location. Ensure BESS buildings and containers are structurally sound if any earthquake occurs, check building soundness prior to allowing workers back. Keep BESS buildings and containers always locked (except when workers are in-coming or exiting) but at times when the door is unlocked, ensure one staff is always present to control any unauthorized entry. Carry out periodic safety related awareness raising in local communities living in proximity to electrical installations, including but not limited to, electrocution risks.					
Disposal and management of batteries	Impacts from inappropriately disposed defunct batteries during installation	Use batteries according to given guidelines to maximize their lifetime and reduce the need for disposal. FENEKA O&M Plan will include an emergency plan that will be put in place in case of the accidental bursting of the batteries. Dispose the batteries as hazardous waste to a hazardous waste management facility requiring the transboundary disposal under the Basel Convention since facilities do not exist on the Maldives. Handling and disposal of used batteries shall be done in compliance with Waste Management Policy and Waste Regulations (2013) of Maldives as well as in compliance with Basel Convention on the Control of Transboundary Movement of Hazardous Wastes and their Disposal (1989). Replaced battery cells will be temporarily stored in the leak proof, fully enclosed battery collection system until they are removed off site by the contractor (supplier) – as per contract agreement with suppliers for the disposal of used batteries Only dry batteries will be transported to avoid possible leakages.	100% of batteries disposed of by the supplier, no batteries remaining on site for disposal Compliance with national laws and regulations. EMP successfully implemented by FENEKA as determined through regular site checks, photographic record etc.	FENEKA O&M	FENEKA	FENEKA supported by E&S team of PMU and the PMC for duration of project	Prepare during pre-construction and comply throughout O&M stage
D. Decommissioning							
Dismantling BESS batteries	Impacts from inappropriately disposed used batteries	Use batteries according to given guidelines to maximize their lifetime and reduce the need for disposal. Dispose the batteries as hazardous waste to a hazardous waste management facility requiring the transboundary disposal under the Basel Convention since facilities do not exist on the Maldives. Handling and disposal of used batteries shall be done in compliance with Waste Management Policy and Waste Regulations (2013) of Maldives as well as in compliance with Basel Convention on the Control of Transboundary Movement of Hazardous Wastes and their Disposal (1989). Replaced battery cells will be temporarily stored in the leak proof, fully enclosed battery collection system until they are removed off site by the contractor (supplier) – as per contract agreement with suppliers for the disposal of used batteries	100% of batteries disposed of by the supplier, no batteries remaining on site for disposal Compliance with national laws and regulations. EMP successfully implemented by FENEKA as determined through regular site checks, photographic record etc.	FENEKA O&M	FENEKA	FENEKA	Prepare during pre-construction and comply in decommissioning

Topic	Impact or Risk	Mitigation Measure	Performance Standard	Budget Source/ Mitigation Cost	Implementation responsibility	Monitoring responsibility	Implementation schedule
		Only dry batteries will be transported to avoid possible leakages.					

Table 32: Environmental Management Plan for Solar Photovoltaic (Rooftop and Ground Mounted) Systems (To be Implemented in Addition to the Table 1 General Measures and Table 2 re Battery Energy Storage Systems and Cable Works)

Topic	Impact or Risk	Mitigation Measure	Performance Standard	Budget Source/ Mitigation Cost	Implementation responsibility	Monitoring responsibility	Implementation schedule
A. Pre-construction							
Detailed design, location of and access to project components, construction planning and management	Encroachment into protected areas, ecologically sensitive zones, natural habitats or physical cultural resources	No trees will be cut to install either rooftop or ground mounted solar systems; if required some trimming of trees will be permitted to minimize shading of rooftop solar with island council permission Rooftop solar will only be installed on mosques with the prior agreement of the Imam Ground mounted PV installation in Thoddoo will be done only on land classified as modified habitat (agricultural) Grid connection cable works will be done only along the existing island roads No vegetation will be cleared and no trees will be cut to install cables in the existing roads Cable routes to avoid the area beneath tree crowns (zone for root protection) especially for mature trees.	No project sites encroach into protected areas, ecologically sensitive zones, natural habitats or physical cultural resources No clearance of vegetation and trees within the project footprint contrary to national regulations and other than as documented in the IEE	FENEKA – rooftop Ground mounted - contractor to reflect in contact costs	FENEKA – rooftop Contractor – ground mounted Contractor to prepare detailed design; PMU to review with support of PMC to confirm all EMP measures adequately incorporated	E&S team of PMU with support PMC	Pre-construction stage; compliance prior to approval of detailed design and any works commencing on site including site establishment
	Disturbance to residential area	Rooftop PV will be done on buildings only with the prior agreement of their owner Ground mounted PV installation in Thoddoo will be done on the land owned by the island council away from the residential areas to minimize the disturbance Routing of cables along existing roads to avoid the damage to existing buildings and structures, public utilities, street furniture etc.	PMU approved detailed designs minimize impacts and risks on EHS during subsequent stages of the project	FENEKA – rooftop Ground mounted - contractor to reflect in contact costs	FENEKA – rooftop Contractor – ground mounted Contractor to prepare detailed design; PMU to review with support of PMC to confirm all EMP measures adequately incorporated	E&S team of PMU with support PMC	Pre-construction stage; compliance prior to approval of detailed design and any works commencing on site including site establishment
	Solar PV design results in EHS impacts such as glint and glare	Selection of an environmentally safe and sound solar photovoltaic panel from a manufacturer who offers a facility for return of end-of-life solar PV equipment. Solar panels installed must not contain hazardous materials e.g., cadmium, lead, or selenium. Equipment purchased for use on the project is to be accompanied by letter from the manufacturer stating its composition and the leaching potential of any heavy metal content to determine if it is acceptable and how it is to be disposed on at end-of-life. Solar panels to have an anti-reflective coating to minimize glint and glare and maximize light absorption, tables/racks to be anti-reflective made of galvanized steel or aluminium. Detailed design to minimize visual impact and clutter, orientation is to avoid glint/glare. For islands with airports consult with the aviation authority regarding concern from glint/glare of solar panel and take on board any recommendations made.	PMU approved detailed designs minimize impacts and risks on EHS during subsequent stages of the project	FENEKA – rooftop Ground mounted - contractor to reflect in contact costs	FENEKA – rooftop Contractor – ground mounted Contractor to prepare detailed design; PMU to review with support of PMC to confirm all EMP measures adequately incorporated	E&S team of PMU with support PMC	Pre-construction stage; compliance prior to approval of detailed design

Topic	Impact or Risk	Mitigation Measure	Performance Standard	Budget Source/ Mitigation Cost	Implementation responsibility	Monitoring responsibility	Implementation schedule
		Provide visual warning signs to include the ISO 7010 "Hazard Type: Electrical Symbol" warning of risk of electrocution for electrical equipment in houses for rooftop solar and around the ground mounted solar power plant. On all individual items of electrical equipment provide written and visual warning signs to include the ISO 7010 "Hazard Type: Electrical Symbol" warning of risk of electrocution, high-risk equipment to be kept within a secure, locked cabinet. Detailed design to include lightening protection. Detailed design of ground mounted solar is to include for rainwater harvesting for solar photovoltaic panel cleaning. Foundations and racking system will be designed to withstand earthquakes and powerful cyclones and hurricanes, which will limit the probability of generation unavailability as well as reducing any potential hazard of PV panels being lifted and blown onto adjacent properties.					
	Ground mounted solar PV design results in EHS impacts such as ponding of water	To facilitate use of the space beneath the ground mounted solar power plant, allow the growth of vegetation and protect from flood, solar PV modules to be positioned on a pagoda with cabling suitably protected. To facilitate removal mass concrete foundations are not to be used, pre-cast concrete foundation blocks will make land restoration easier. Detailed designs of ground mounted solar will keep new impermeable surfaces to a minimum since the project site form part of a natural groundwater recharge zone. Foundations to be constructed in such a way as to be adequately drained to prevent washout. Ensure maximum sound power level of equipment at 1 m is 85 dBA, if these noise levels will be exceeded OHS noise warning signage identifying the ear protection to be worn must be installed.	PMU approved detailed designs minimize impacts and risks on EHS during subsequent stages of the project	Ground mounted - contractor to reflect in contact costs	Contractor – ground mounted Contractor to prepare detailed design; PMU to review with support of PMC to confirm all EMP measures adequately incorporated	E&S team of PMU with support PMC	Pre-construction stage; compliance prior to approval of detailed design
O&M of ground mounted solar followed by decommissioning at end of life	General impacts and risk on project affected persons, including O&M workers and local communities	Develop in conjunction with FENEKA an O&M Plan for the ground mounted solar setting out the schedule of inspections, maintenance required, and all EHS measures to be followed during any maintenance works. O&M Plan to be informed by a facilitated risk assessment and include a health and safety Plan and an Emergency Response and Preparedness Plan in relation to the PV operation Develop in conjunction with FENEKA a Decommissioning Plan for the works setting out how the solar PV panels will be removed and the associated EHS measures.	O&M and Decommissioning Plan included in handover to FENEKA to minimize impacts and risks on EHS during subsequent stages of the project	Ground mounted - contractor to reflect in contact costs	Contractor – ground mounted	E&S team of PMU with support PMC	Pre-construction stage; compliance prior to handover to FENEKA
B. Construction							
Site establishment and site clearance	Clearance/trimming of trees and vegetative cover during site establishment	Comply with project EMP plus approved CEMP and ECOP during construction works. Clearance of ground level vegetation only in the project footprint that will be marked out by the contractor under the supervision of the ecologist of PMC. Removal of only those trees for which permission has been granted by the island council – trees to be marked and a record of number of trees, species and size to be kept Remove and dispose of any identified invasive plant species in an ecologically sound manner, imported materials must be free of invasive plant material.	Compliance with national biodiversity regulations and achievement of no net loss biodiversity. EMP/CEMP requirements successfully implemented as determined through regular site checks, photographic record etc.	FENEKA – rooftop Ground mounted - contractor to reflect in contact costs	FENEKA – rooftop Contractor – ground mounted	E&S team of PMU with support PMC	Prepare during pre-construction and comply throughout construction stage

Topic	Impact or Risk	Mitigation Measure	Performance Standard	Budget Source/ Mitigation Cost	Implementation responsibility	Monitoring responsibility	Implementation schedule
		Encroachment outside the marked working area must be avoided, all site clearance is to be strictly controlled and supervised by PMC ecologist to ensure there is minimum loss of and no unnecessary removal of trees and vegetation. Trees and vegetation to be cleared outside the bird breeding season and all trees to be checked by PMC ecologist for nesting birds or bats prior to being cut – if present adults and the young must be allowed to leave the nest beforehand, as confirmed by the PMC ecologist. In addition to compensatory plantation, transplanting of any trees to be cut within the island if it is possible and planting of additional trees (enhancements) in coordination with the Island Council. Use of herbicides or burning to clear vegetation or burning of vegetation trimmings is strictly prohibited, leaves will be mulched and wood will be given to the island council. Separately strip and store topsoil and reinstate it after construction completed. Prior to earthworks and excavation, area will be checked by the PMC ecologist for any signs of burrows etc. If there is a risk of being occupied, then only the manual digging under the close supervision of the PMC ecologist will be permitted. Excavated pits will be robustly fenced or covered to prevent fauna accidentally falling in, further an escape ramp will be provided to allow their escape. Keep written record, supported by photographs, of any animal casualties, including a cause of death if known. Contractors to undertake regular, compulsory wildlife conservation awareness raising activities for all workers related to prohibitions with respect to fishing etc. including toolbox talks and posting of information and warning signs at construction site offices, overnight accommodation, regular inspections of the overnight accommodation, and, strict the disciplinary procedures for any contravention by the workers. Revegetate any disturbed areas not taken up by the project infrastructure to at least original condition through revegetation using native species seeds sourced from the site.	No outstanding biodiversity grievances from local communities or other interested stakeholders.				
Disposal and management of solar panels	Impacts from inappropriately disposed defunct solar panels during installation	Any solar photovoltaic panels that are rejected during installation and commissioning due to damage or failure will immediately be removed from the site and returned to the supplier per O&M requirements	100% of PV panels disposed of by the supplier, none remaining on site for disposal Compliance with national laws and regulations and any guidelines developed by MOECCT. EMP requirements successfully implemented as determined through regular site checks, photographic record etc.	FENEKA – rooftop Ground mounted - contractor to reflect in contact costs	FENEKA – rooftop Contractor – ground mounted	E&S team of PMU with support PMC	Prepare during pre-construction and comply throughout construction stage
C. Operation and Maintenance							
O&M	General impacts and risk of solar PV panels on project affected persons, including FENEKA O&M workers and local communities	Implement the agreed O&M Plan During maintenance activities mitigation measures applicable to the construction stage are also applicable to FENEKA maintenance workers or contractors and are to be followed, including strict prohibitions on workers. Prohibit the use of herbicides, pesticides or burning to control any vegetation growth or to manage vegetation waste.	Project infrastructure maintained in working order and is always in good condition. Compliance with national laws and regulations.	FENEKA O&M	FENEKA	FENEKA supported by E&S team of PMU and the PMC for	Prepare during pre-construction and comply throughout O&M stage

Topic	Impact or Risk	Mitigation Measure	Performance Standard	Budget Source/ Mitigation Cost	Implementation responsibility	Monitoring responsibility	Implementation schedule
		Water to be used for washing of the solar panels will ideally be taken from rainwater or if available the island council supply and no new groundwater source must be tapped. Only water is to be used to clean solar photovoltaic panels, no detergent or other chemicals are to be utilized. Consider use of “dry” cleaning methods to reduce water consumption. Maintain a logbook of ground water abstracted or Island Council water used. If bird droppings are soiling panels increase the frequency of washing them. Regular visual and technical inspection of condition and maintenance as required to be carried out, keep photographic records and log of all inspections, including register of faulty equipment found, and actions taken in response. Electrical equipment and electric wiring to be checked for safe current and voltage ratings. Maintain noise generating project equipment to ensure noise to be limited to the following as 1-hour LAeq: (i) 70 dB(A) at the site boundary; (ii) at residential properties, 55 (day) and 45 (night) dB(A) Ensure all liquids (fuel, oil, or chemicals) are stored in an undercover area with impermeable floor with spill containment bund of 110% capacity under lock and key. Label all drums and containers with their content and potential risk signs (e.g., flammable, corrosive, toxic, etc.) and always keep spill prevention equipment available on site. Display material data sheets for any fuels, oil, or chemicals used on site. Keep spill prevention equipment available on site if fuel, oil and chemical kept.	EMP/O&M Plan successfully implemented by FENEKA as determined through regular site checks, photographic record etc. No outstanding O&M related grievances from local communities or other stakeholders			duration of project	
Health and Safety	General occupational and community health and safety risks of solar PV panels operations	Implement the agreed O&M Plan Ensure all O&M staff have received appropriate OHS trainings for their role. Always keep the operational area neat and tidy. Store equipment in a dedicated, covered, labelled storage area (materials, tools, equipment, and any spare parts). Remove any trip hazards on the ground, e.g., open channels, materials, equipment, trash laying around. Visually inspect for any standing water on site, and when identified, remove, or provide appropriate drainage to remove in timely manner; ensure drainage system is not blocked and fully operational. Monitor closely in case of any extreme weather events and be ready to act immediately. Carry out periodic safety related awareness raising in local communities regarding living with and/or working in proximity to solar PV installations, including but not limited to, electrocution risks.	Compliance with national laws and regulations. EMP successfully implemented by FENEKA as determined through regular site checks, photographic record etc. Zero project-related health and safety accidents reported during O&M No outstanding O&M related grievances	FENEKA O&M Cost	FENEKA	FENEKA	Prepare during pre-construction and comply throughout O&M stage
Disposal and management of solar panels	Impacts from inappropriately disposed defunct solar panels during installation	Use solar panels according to given guidelines to maximize their lifetime and reduce the need for disposal. Define an environmentally safe and sound solar photovoltaic panel handing arrangement, with appropriate handling, storage, and recycling or disposal process for end-of-life equipment. Any solar photovoltaic panels that are rejected due to damage or failure will immediately be removed from the site for disposal by the FENEKA preferred option. FENEKA to establish agreements for disposal of PV panels; if no such agreement in place disposal will be in accordance with the manufacturer’s instructions and in the first instance should be returned to the manufacturer if still in operation after 25 years. If not, disposal must be by a certified industrial	100% of defunct solar panels disposed of by FENEKA, none remaining on site for disposal Compliance with national laws and regulations and any guidelines developed by MOECCT. EMP successfully implemented by FENEKA as determined through regular site checks, photographic record etc.	FENEKA O&M	FENEKA	FENEKA supported by E&S team of PMU and the PMC for duration of project	Prepare during pre-construction and comply throughout O&M stage

Topic	Impact or Risk	Mitigation Measure	Performance Standard	Budget Source/ Mitigation Cost	Implementation responsibility	Monitoring responsibility	Implementation schedule
		waste management company who will need to remove them to suitably licensed waste management facilities based on composition Solar panels must not be disposed of to a non-sanitary landfill or to a sanitary waste landfill if they are classed as hazardous waste. The PV panels that contain heavy metals will not be used since these could constitute hazardous waste.					
D. Decommissioning							
Dismantling PV panels	Impacts from decommissioning works	During decommissioning activities mitigation measures applicable to the construction stage are also applicable to FENEKA decommissioning workers or contractor and are to be followed, including strict prohibitions on workers. Infrastructure decommissioning will include the disconnecting and removal of all electrical equipment, removal of the solar photovoltaic panels and their mounting frames, dismantling of buildings and structures, excavation of concrete foundation pads and backfilling with soil sourced on site or imported. During decommissioning all decommissioned equipment and other wastes will be stored on site prior to disposal. On completion of infrastructure decommissioning restore the project site back to agricultural land, this will involve cleaning site of any debris or wastes, testing soil quality to confirm no residual contamination; left over material and soil/rocks/sand, contaminated soil although this should have been avoided through EMP measures; revegetation of exposed soils using locally native species; reinstatement of natural drainage as required; local topographical adjustments; etc.	Compliance with national laws and regulations. EMP successfully implemented by FENEKA as determined through regular site checks, photographic record etc. No outstanding decommissioning related grievances	FENEKA O&M Cost	FENEKA	FENEKA	Prepare during pre-construction and comply throughout decommissioning stage
	Impacts from inappropriately disposed defunct solar panels during installation	Define an environmentally safe and sound solar photovoltaic panel handing arrangement, with appropriate handling, storage, and recycling or disposal process for end-of-life equipment. FENEKA to establish agreements for disposal of PV panels; if no such agreement in place disposal will be in accordance with the manufacturer's instructions and in the first instance should be returned to the manufacturer if still in operation after 25 years. If not, disposal must be by a certified industrial waste management company who will need to remove them to suitably licensed waste management facilities based on composition Solar panels must not be disposed of to a non-sanitary landfill or to a sanitary waste landfill if they are classed as hazardous waste. The PV panels that contain heavy metals will not be used since these could constitute hazardous waste.	100% of defunct solar panels disposed of by FENEKA, none remaining on site for disposal Compliance with national laws and regulations and any guidelines developed by MOECCT. EMP successfully implemented by FENEKA as determined through regular site checks, photographic record etc.	FENEKA O&M	FENEKA	FENEKA supported by E&S team of PMU and the PMC for duration of project	Prepare during pre-construction and comply in decommissioning

Table 4: Environmental Management Plan for Wind Energy Project
(Also Follow the Environmental Management Plan for grid upgrade)
(To be Implemented in Addition to the Table 1 General Measures and Table 2 re Battery Energy Storage Systems and Cable Works)

Topic	Impact or Risk	Mitigation Measure	Performance Standard	Budget Source/ Mitigation Cost	Implementation responsibility	Monitoring responsibility	Implementation schedule
A. Pre-construction							
Detailed design, location of and access to project components, construction planning and management	General impacts and risk	Once the turbine has be selected, and the layout designed, inform ADB of any changes to the project description and if required update the IEE and EMP for clearance and disclosure by ADB Capacity of the turbines may be increased more than 25kW only if the turbine diameters are small enough, such that more turbines can be placed in the allotted area without inducing wake effects and noise, shadow flicker and set back requirements are met. If a temporary or permanent met mast is identified to be required – solid tower preferred to guyed design – this is to be treated as an unanticipated impact and the IEE and EMP will need to be updated to reflect the impacts of its installation. If piling works are required for foundations this is to be treated as an unanticipated impact and the IEE and EMP will need updating to reflect the impacts especially in relation to noise and vibration and ground water.	No breaches of environmental assessment requirements	Counterpart funding and PMC budget	PMU Contractor to immediately inform PMU if unanticipated impacts identified	E&S team of PMU with support PMC	Prior to the approval of detailed design
	Encroachment into protected areas, ecologically sensitive zones, natural habitats or physical cultural resources Cutting/trimming of trees and removal of vegetative cover	Turbines will be located avoiding beach sites due to this being a natural habitat and increased erosion potential. The proposed site in Manadhoo for wind turbine installations includes an area of land 20m from the coast that must not be cleared of any vegetation. Obtain written clearance from Island Council for the cutting of trees prior to the approval of the detailed design Turbines will be located to the extent possible in locations that support modified habitat and will not require the cutting of trees. Only those trees that are within the footprint of the foundation, crane pad and on-site access tracks will be cleared all other trees and vegetation will be retained. For offsite access no trees to be cut bur trimming of vegetation and trees may be required in consultation with the island council to accommodate abnormal loads. Cable routes to avoid the area beneath tree crowns (zone for root protection) especially for mature trees. Compensatory plantation of 1:2 or 1:4 for coconut palms will be provided on Manadhoo island in advance of site clearance/cutting of trees and will be maintained by the contractor for the entire contractual period to ensure they establish.	No project sites encroach into protected areas, ecologically sensitive zones, natural habitats or physical cultural resources No clearance of vegetation and trees within the project footprint contrary to national regulations and other than as documented in the IEE 100% of trees to be cleared are compensated for in advance of the site clearance/cutting of trees	Contractor to reflect in contact costs	Contractor	E&S team of PMU with support PMC	Prior to the approval of detailed design and any works commencing on site including site establishment
	Impacts to avifauna	The turbine must be selected, and the layout designed, to the extent possible to minimize collision risk to birds and bats – international good practice recommends to keep a 50 m buffer around trees or shrubs into which no part of the turbine will intrude[4] Design to avoid artificially creating features in the environment that could attract birds and bats On-site cables are to be buried underground No artificial light sources will be permitted unless mandated by aviation authorities in which case only use of low-intensity red lighting permitted	PMU approved detailed designs minimize impacts and risks on EHS during subsequent stages of the project Project component designed in accordance with IFC EHS Wind Energy guidelines	Contractor to reflect in contact costs	Contractor to prepare detailed design; PMU to review with support of PMC to confirm all EMP measures adequately incorporated	E&S team of PMU with support PMC	Prior to the approval of detailed design

[4] Bats and onshore wind turbines (Interim guidance) - TIN051 (naturalengland.org.uk)

Topic	Impact or Risk	Mitigation Measure	Performance Standard	Budget Source/ Mitigation Cost	Implementation responsibility	Monitoring responsibility	Implementation schedule
	Disturbance to residential area	The proposed site has been selected carefully away from inhabited areas; layout to ensure that wind turbines are no closer to the nearest residential property than that proposed in the IEE, a minimum buffer of 100m is to be adopted. In relation to cumulative impact liaise with other projects regarding the timing and extent of other construction works in the same location and ensure plans for construction works are coordinated so emissions/disruption/ disturbance are minimized.					
	Noise from wind turbines	Quietest available turbines with manufacturer-supplied noise mitigation will be installed. Ensure maximum sound power level of equipment at 1 m is 85 dBA, if these noise levels will be exceeded OHS noise warning signage identifying the ear protection to be worn must be installed. Contractors to ensure that the design of the project components alone enables their operation to always comply with a 1-hour LAeq 70 dB(A) at the site boundary (irrespective of the background noise levels from diesel generators) In the absence of baseline noise data to conduct a wind turbine noise assessment the turbine must be selected, and the layout designed, to achieve 35dB at 10m/s wind speed at 10m height as LA90 at the nearest residential receiver without shut down being required (a turbine with reference noise of 61 dB(A) should guarantee that there will be minimal noise but this is subject to confirmation by the contractor) For the powerhouse and FENEKA offices contractor to consult FENEKA over predicted noise occurrence and obtain their written acceptance of the detailed design Contractor to submit a preliminary model noise assessment using recognized international good practice software with the detailed design to demonstrate these levels are met.					
	Shadow flicker -- when the sun passes behind the wind turbine and casts a shadow, as the rotor blades rotate, shadows pass over the same point at a regular frequency causing an effect called shadow flicker, which will cause disturbances to households which fall within the shadow overcast area.	The turbine must be selected, and the layout designed, so shadow flicker at the residential receptors does not to exceed 30 hours per year and 30 minutes per day on the worst affected day, based on a worst-case scenario[5] -- a turbine with total height of at most 23 m should ensure that shadow flicker is still within the permissible range although this is subject to confirmation by the contractor. Contractor to submit a modelled shadow flicker assessment using recognized international good practice software with the detailed design to demonstrate these levels are met For the powerhouse and FENEKA offices contractor to consult FENEKA over predicted shadow flicker occurrence and obtain their written acceptance of the detailed design For the powerhouse and FENEKA offices (if shadow flicker modelled to occur) contractor to install blinds so that any operators bothered by shadow flicker may close these					

[5] There is continual sunshine and permanently cloudless skies from sunrise to sunset. There is sufficient wind for continually rotating turbine blades. Rotor is perpendicular to the incident direction of the sunlight. Sun angles less than 3 degrees above the horizon level are disregarded (due to likelihood for vegetation and building screening). Distances between the rotor plane and the tower axis are negligible. Light refraction in the atmosphere is not considered.

Topic	Impact or Risk	Mitigation Measure	Performance Standard	Budget Source/ Mitigation Cost	Implementation responsibility	Monitoring responsibility	Implementation schedule
	Set back and turbine safety	The turbine must be selected and the layout designed to achieve a setback distance of at least 1.5 x turbine height (tower + rotor radius) from all buildings regardless of ownership Contractor to submit details of the distance of each turbine to demonstrate the compliance One building (green roof on aerial photograph) will be removed before construction, this will need to be ensured otherwise it will not be possible for the project to meet a 100m set back requirement (or noise or shadow flicker levels) For the powerhouse and FENEKA offices contractor to consult FENEKA over predicted health and safety risk and obtain their written acceptance of the detailed design If power plant and FENEKA offices are within 100m, or over 3 x turbine height, contractor to facilitate with participation of FENEKA an OHS risk assessment to ensure that the risks are acceptable to them, based on the extent the area within 100m is used by its personnel – to inform this risk assessment the contractor will quantify the risks of turbine and blade failures.					
	Occupational and community health and safety risks to FENEKA staff and public from electrical infrastructure	Lightning protection systems to be installed Equip wind turbines with vibration sensors that can react to any imbalance in the rotor blades and shut down the turbine if necessary Consult with aviation authority and mark blade tips and install low-intensity red lighting at their request Turbines to be subject to independent design verification/certification per IEC 61400-1 and surveillance of manufacturing quality. Foundations will be designed to withstand earthquakes and powerful cyclones and hurricanes. Final surface level of foundations will be at least 1 m above the existing ground level or highest flood level including an allowance for climate change based on the findings of climate change assessment prepared for the Project (whichever is higher) Foundations, crane pads and on-site access tracks to be constructed in such a way to be adequately drained to prevent washout. Detailed designs will keep the length and width of on-site access tracks and new impermeable surfaces to a minimum since the project site forms part of a natural groundwater recharge zone. All electrical hazards will feature written and visual warning signs that meet the IEEE standards to include the ISO 7010 "Hazard Type: Electrical Symbol" warning of the risk of electrocution. Design to prevent access to the turbines: • Fence and gate the individual turbines to prevent public access to prevent access to turbine towers. • Post information boards about public safety hazards and emergency contact information. Design to eliminate or reduce the requirement to work at height during construction and O&M phases Working at height systems are to be fitted If working at height cannot be eliminated measures to prevent falls to be incorporated into the design – fall protection systems to take priority over use of all arrest systems					

Topic	Impact or Risk	Mitigation Measure	Performance Standard	Budget Source/ Mitigation Cost	Implementation responsibility	Monitoring responsibility	Implementation schedule
	Disturbance to telecoms systems	Layout of turbines to avoid direct physical interference of point-to-point communication systems; consult operators to establish the location of telecommunication links and relevant buffers to be applied to minimize impacts					
	Visual impact of wind turbines	Minimize visual impact and clutter in locating the above ground equipment The layout must maintain a uniform size and design e.g., type of turbine and tower as well as height Turbines to be painted with a matt, non-reflective finish, in off-white or grey color, color and any blade tip markings to be agreed in consultation with Island Council and aviation authorities Selected turbine and its layout must be agreed in consultation with the Island Council before approval of the detailed design					
Construction planning and management	Construction impacts on the marine environment	Given the proximity of the marine environment a construction method statement to be prepared for each individual turbine specifically stating the measures to be undertaken at that location to minimize impacts on the marine environment, especially in relation to risks of increased turbidity due to sediment run off and windblown wastes For those turbines with earthworks and excavations for foundations within 20m of the marine environment or with no vegetation or buildings separating the works site from it, contractor will install cut off ditches or use sediment fences to guard against the loss of soil from surface water runoff.	PMU approved CEMP minimize impacts and risks on EHS during subsequent stages of the project Copy of approved method statements included in the EMR	Contractor to reflect in contact costs	Contractor to prepare; PMU to review with support of PMC to confirm all EMP measures adequately incorporated	E&S team of PMU with support PMC	Pre-construction stage; compliance prior to approval of detailed design and any works commencing on site including site establishment
	Groundwater impacts of construction	Contractor will use gravity-based foundations to install the wind turbines; any different foundation construction method will require the IEE and EMP to be updated. Depth to groundwater needs to be confirmed by ground investigation pre-construction to confirm that foundation depth does not impact on the ground water lens and that pumping of water ingress from the foundations is not required.					
	Noise and vibration impacts of construction	Contractor will use gravity-based foundations to install the wind turbines; any different foundation construction method will require the IEE and EMP to be updated. Temporary acoustic noise barrier to be installed to reduce noise levels by a further 10dB(A) around construction activities and/or the site boundaries. Construction method statement to be prepared for each individual turbine specifically stating the measures to be undertaken at that location to minimize noise and vibration impact, in preparing this the contactor will undertake a quantified noise assessment of their construction method to determine if the project noise standards can be met and the mitigation measures required to ensure it. For private property or public utilities/street furniture that may be damaged by construction vibration (buildings, roads, drains etc.) photographic and/or structural pre-condition surveys are to be completed and agreed with MOECCT prior to any works, including site establishment. To be documented in a pre-project condition report, which will serve as baseline in case any inadvertent damage or vibration impact to property occurs. If risk of structural damage to adjacent properties from vibration identified due to current condition, consider alternative construction methods or temporary relocation of occupants during works if at risk.					

Topic	Impact or Risk	Mitigation Measure	Performance Standard	Budget Source/ Mitigation Cost	Implementation responsibility	Monitoring responsibility	Implementation schedule
	Construction health and safety	Health and safety risk assessment and planning to specifically address working at height and lifting operations and works adjacent to the water with reference to international good practice guidelines. Notably: Ensure all employees working at height are trained and competent in the use of all working-at height and rescue systems in place with safety harnesses provided, regularly inspected to ensure in good condition and worn at all times whilst working at height. Provide workers with a suitable work-positioning device; also ensure the connectors on positioning systems are compatible with the tower components to which they are attached. Ensure that hoisting equipment is properly rated and maintained and that hoist operators are properly trained. When working at height, all tools and equipment should be fitted with a lanyard, where possible, and capture netting should be used if practicable. Signs and other obstructions should be removed from poles or structures prior to undertaking work. An approved tool bag should be used for raising or lowering tools or materials to workers on elevated structures. Avoid conducting tower installation or maintenance work during poor weather conditions and especially where there is a risk of lightning strikes. Ensure all relevant information is known about the load, e.g., the size, weight, method of slinging, and attachment points. Ensure all lifting equipment (including load attachment points) is suitable, capable of supporting the load, in good condition, and in receipt of any statutory inspections required. Ensure all supervisors, equipment operators, and slingers are trained and competent in the lifting equipment and intended lifting techniques. Where possible, exclusion zones are to be established and maintained to prevent any unauthorized access to lifting areas. When lifting large loads, ensure weather conditions are favorable for the task. Heavy lifting equipment typically has safe operating parameters included in its operating manual and these parameters should not be exceeded at any time. Method statement for the lifts to be approved by MOECCT and include: the details of the lift, the roles of each party involved in the lift, and the methods used to communicate instructions among the parties. Health and safety supervisors to be at site and continuously monitor the heavy lifts. Heavy components must be handled carefully without any hastening All equipment must be checked to ensure to be in working order before installation. Health and safety plan to include for an emergency rescue plan detailing the methods to be used to rescue operatives should they become stranded or incapacitated while at height.	PMU approved CEMP and CHSMP minimize impacts and risks on EHS during subsequent stages of the project	Contractor to reflect in contact costs	Contractor to prepare; PMU to review with support of PMC to confirm all EMP measures adequately incorporated	E&S team of PMU with support PMC	Pre-construction stage; compliance prior to approval of detailed design and any works commencing on site including site establishment
	Transportation of oversized or heavy wind turbine components (blades, turbine tower sections, nacelle, and transformers) and cranes	Conduct logistics, traffic, and transportation study to assess loading capacity and other constraints and thus the impacts on existing offsite wharfs/jetties, access roads, culverts, turning radii, and public utilities, turbine designs are to be selected so that it can be accommodated without any upgrades. Schedule deliveries in consultation with Island Council outside of peak hours for harbor and road users to reduce delays. Only use approved access routes, provide traffic management to stop other traffic where needed (for example, at pinch-point locations) and provide flag persons and security escorts where required. Additionally, the oversized	PMU approved CEMP and CHSMP minimize impacts and risks on EHS during subsequent stages of the project	Contractor to reflect in contact costs	Contractor to prepare; PMU to review with support of PMC to confirm all EMP measures adequately incorporated	E&S team of PMU with support PMC	Pre-construction stage; compliance prior to approval of detailed design and any works commencing on site including site establishment

Topic	Impact or Risk	Mitigation Measure	Performance Standard	Budget Source/ Mitigation Cost	Implementation responsibility	Monitoring responsibility	Implementation schedule
		vehicles not to be driven on the public roads for any other purpose than transportation of the wind turbine equipment. For private property or public utilities/street furniture that may be damaged during transportation (buildings, roads, drains etc.) photographic and/or structural pre-condition surveys are to be completed and agreed with MOECCT prior to any works, including site establishment. To be documented in a pre-project condition report, which will serve as baseline in case any inadvertent damage or vibration impact to property occurs. If risk of structural damage to adjacent properties from vibration identified due to current condition, consider alternative construction methods or temporary relocation of occupants during works if at risk.					
O&M	General impacts and risk on project affected persons, including O&M workers and local communities	Develop in conjunction with FENEKA an O&M Plan for the wind turbines setting out the schedule of inspections, maintenance required, and all EHS measures to be followed during any maintenance works. O&M Plan to be informed by a facilitated risk assessment and include a health and safety Plan and an Emergency Response and Preparedness Plan in relation to the wind turbine operation. Develop in conjunction with FENEKA a Decommissioning Plan for the works setting out how the solar PV panels will be removed and the associated EHS measures.	O&M Plan included in handover to FENEKA to minimize impacts and risks on EHS during subsequent stages of the project	Contractor to reflect in contact costs	Contractor	E&S team of PMU with support PMC	Pre-construction stage; compliance prior to commissioning and then on handover to FENEKA
B. Construction							
Site establishment and site clearance	Clearance/trimming of trees and vegetative cover during site establishment	Comply with project EMP plus approved CEMP and ECOP during construction works. Clearance of ground level vegetation only in the project footprint that will be marked out by the contractor under the supervision of the ecologist of PMC. Removal of only those trees for which permission has been granted by the island council – trees to be marked and a record of number of trees, species and size to be kept Remove and dispose of any identified invasive plant species in an ecologically sound manner, imported materials must be free of invasive plant material. Encroachment outside the marked working area must be avoided, all site clearance is to be strictly controlled and supervised by PMC ecologist to ensure there is minimum loss of and no unnecessary removal of trees and vegetation. Trees and vegetation to be cleared outside the bird breeding season and all trees to be checked by PMC ecologist for nesting birds or bats prior to being cut – if present adults and the young must be allowed to leave the nest beforehand, as confirmed by the PMC ecologist. In addition to compensatory plantation, transplanting of any trees to be cut within the island if it is possible and planting of additional trees (enhancements) in coordination with the Island Council. Use of herbicides or burning to clear vegetation or burning of vegetation trimmings is strictly prohibited, leaves will be mulched and wood will be given to the island council. Separately strip and store topsoil and reinstate it after construction completed. Prior to earthworks and excavation, area will be checked by the PMC ecologist for any signs of burrows etc. If there is a risk of being occupied, then only the manual digging under the close supervision of the PMC ecologist will be permitted. Excavated pits will be robustly fenced or covered to prevent fauna accidentally falling in, further an escape ramp will be provided to allow their escape.	Compliance with national biodiversity regulations and achievement of no net loss biodiversity. EMP/CEMP requirements successfully implemented as determined through regular site checks, photographic record etc. No outstanding biodiversity grievances from local communities or other interested stakeholders.	To be included contract cost.	Contractor	E&S team of PMU with support PMC	Prepare during pre-construction and comply throughout construction stage

Topic	Impact or Risk	Mitigation Measure	Performance Standard	Budget Source/ Mitigation Cost	Implementation responsibility	Monitoring responsibility	Implementation schedule
		Keep written record, supported by photographs, of any animal casualties, including a cause of death if known. Contractors to undertake regular, compulsory wildlife conservation awareness raising activities for all workers related to prohibitions with respect to fishing etc. including toolbox talks and posting of information and warning signs at construction site offices, overnight accommodation, regular inspections of the overnight accommodation, and, strict the disciplinary procedures for any contravention by the workers. Revegetate any disturbed areas not taken up by the project infrastructure to at least original condition through revegetation using native species seeds sourced from the site. Plant the disturbed area with shrubs and small growing trees that will not affect the wind turbine operations. Once the works are over, the area around foundation base will be seeded to allow its revegetation but access tracks and crane pads will remain in case required for future O&M.					
Noisy construction work	Disturbance to fauna using adjacent forest and coastal vegetation	Due to forest and coastal vegetation adjacent noisy works only permitted from one hour after sunrise to one hour before sunset to minimize its disturbance	EMP/ECOP/ CHSMP requirements successfully implemented as determined through regular site checks, photographic record etc. No outstanding biodiversity grievances from local communities or other interested stakeholders.	To be included contract cost.	Contractor	E&S team of PMU with support PMC	Prepare during pre-construction and comply throughout construction stage
	Disturbance to residential areas	Earthworks, excavations and foundation installation to be carried out under the full-time supervision of the environment specialist of PMU to ensure measures set out in the agreed construction method statement for each turbine are being followed. Project noise standards as 1hr LAeq to be complied with duration of noisy works reduced to minimize the duration of exposure of occupants of adjacent properties to high noise levels within a given hour and day but with LAmax to be 75dBA. Eurocode 3 standards for vibration to be met during earthworks, excavations and foundation installation. No piling or drilling to install infrastructure will be conducted.	EMP/ECOP/ CHSMP requirements successfully implemented as determined through regular site checks, photographic record etc. No outstanding noise and vibration grievances from local communities or other stakeholders	To be included contract cost.	Contractor	E&S team of PMU with support PMC	Prepare during pre-construction and comply throughout construction stage
Works in proximity to the marine environment	Earthworks and excavations resulting in impact on the marine environment, due to sediment increasing turbidity etc.	Beach will be fenced off to ensure that there will be no accidental encroachment by construction workers Installation of turbines with earthworks and excavations for foundations within 20m of the marine environment or with no vegetation or buildings separating the works site from it, under the full-time supervision of the environment specialist of PMU to ensure measures set out in the agreed construction method statement for each turbine are followed Materials and equipment will be stored away from the coast with no materials permitted to be stored on the beach Do not permit the discharge or disposal of any material to the marine environment, anything that accidentally falls into the sea to be reclaimed No harmful materials will be released to the marine environment.	EMP/ECOP/ CHSMP requirements successfully implemented as determined through regular site checks, photographic record etc. No outstanding marine pollution grievances from local communities or other stakeholders	To be included contract cost.	Contractor	E&S team of PMU with support PMC	Prepare during pre-construction and comply throughout construction stage
Mobilization and transportation of materials	Impact on Manadhoo island harbor facility during loading and	Prior notice will be given to all harbor users of loading and unloading schedule Weather conditions must be studied before docking at the harbor and journeys must only be undertaken in the favorable conditions.	EMP/CEMP requirements successfully implemented as determined through regular site checks, photographic record etc.	To be included contract cost.	Contractor	E&S team of PMU with support PMC	Prepare during pre-construction and comply throughout

Topic	Impact or Risk	Mitigation Measure	Performance Standard	Budget Source/ Mitigation Cost	Implementation responsibility	Monitoring responsibility	Implementation schedule
	unloading of materials and equipment	Fenders to be placed along the barge before attempting to moor alongside the quay wall.	No outstanding access related grievances from local communities or other stakeholders				construction stage
C. Operation and Maintenance							
O&M	General impacts and risk of wind turbines on project affected persons, including FENEKA O&M workers and local communities	Implement the agreed O&M Plan. During maintenance activities mitigation measures applicable to the construction stage are also applicable to FENEKA maintenance workers or contractors and are to be followed, including strict prohibitions on workers. Prohibit the use of herbicides, pesticides or burning to control any vegetation growth or to manage vegetation waste. Regular visual and technical inspection of condition and maintenance as required to be carried out, keep photographic records and log of all inspections, including register of faulty equipment found, and actions taken in response. Electrical equipment and electric wiring to be checked for safe current and voltage ratings. Maintain noise generating project equipment to ensure noise to be limited to the following as 1-hour LAeq: (i) 70 dB(A) at the site boundary; (ii) at residential properties, 55 (day) and 45 (night) dB(A) Ensure all liquids (fuel, oil, or chemicals) are stored in an undercover area with impermeable floor with spill containment bund of 110% capacity under lock and key. Label all drums and containers with their content and potential risk signs (e.g., flammable, corrosive, toxic, etc.) and always keep spill prevention equipment available on site. Display material data sheets for any fuels, oil, or chemicals used on site. Keep spill prevention equipment available on site if fuel, oil and chemical kept.	Project infrastructure maintained in working order and is always in good condition. Compliance with national laws and regulations. EMP/O&M Plan successfully implemented by contractor for pilot phase and then FENEKA as determined through regular site checks, photographic record etc. No outstanding O&M related grievances from local communities or other stakeholders	To be included contract cost for first year of O&M. FENEKA O&M following handover	Contractor and FENEKA	E&S team of PMU with support PMC for first year of O&M FENEKA following handover	Prepare during pre-construction and comply throughout O&M
	General occupational and community health and safety risks of wind turbine operations	Implement the agreed O&M Plan Ensure all O&M staff have received appropriate OHS trainings for their role. Major maintenance will require external assistance from the wind turbine servicing team of the wind turbine supplier, FENEKA will need to establish a service agreement with the supplier at the end of 3 years once the pilot period is over. Always keep the operational area neat and tidy. Store equipment in a dedicated, covered, labelled storage area (materials, tools, equipment, and any spare parts). Remove any trip hazards on the ground, e.g., open channels, materials, equipment, trash laying around. Lightning protection and other safety systems to be maintained. Carry out periodic blade inspections and repair any defects that could affect blade integrity. Visually inspect for any standing water on site, and when identified, remove, or provide appropriate drainage to remove in timely manner; ensure drainage system is not blocked and fully operational. Ensure a recent, full, first aid kit and adequate firefighting equipment is always available on site, stored in clearly labelled and easily accessible area. Replace the first aid equipment timely as required to keep all equipment within its expiry date. Service the firefighting equipment timely as required to keep all equipment in date. Provide first aid and firefighting training to select, volunteer staff in relation to the wind turbines; at least one staff having recently carried out first aid and	Compliance with national laws and regulations. EMP successfully implemented by contractor for pilot phase and then FENEKA as determined through regular site checks, photographic record etc. Zero project-related health and safety accidents reported during O&M No outstanding O&M related grievances	To be included contract cost for first year of O&M. FENEKA O&M following handover	Contractor and FENEKA	E&S team of PMU with support PMC for first year of O&M FENEKA following handover	Prepare during pre-construction and comply throughout O&M

Topic	Impact or Risk	Mitigation Measure	Performance Standard	Budget Source/ Mitigation Cost	Implementation responsibility	Monitoring responsibility	Implementation schedule
		firefighting training must be always present on site. Refreshers are to be provided once a year. Hang posters showing first aid procedures especially for electrocution, and fire procedures, as well as listing all emergency contacts. Display the emergency phone number and location of first aider, doctor, health center and hospital in a clear and easily accessible location. Keep an accident log and make accident logbook available on site upon request. Monitor closely in case of extreme weather events and be ready to act immediately. Ensure turbines are structurally sound if any earthquake occurs, check turbine soundness prior to allowing workers back on site. Maintain the good condition of turbine fences and regularly check the security fences for any gaps and repair to prevent any unauthorized public access and trespass. Keep boundary gates and doors to turbines always locked (except when workers are in-coming or exiting) but at times when the gate or door has been unlocked, ensure one staff is always present to control any unauthorized entry. Carry out periodic safety related awareness raising in local communities regarding living in proximity to wind turbines, including but not limited to, minimizing activity in the area adjacent to turbines and electrocution risks.					
Unanticipated impacts of wind turbine operation	Impact on birdlife	Keep a record of any bird and bat mortality and if occurring during the first year of operation take adaptive measures such as shut down during migratory periods when more birds may be present or low wind speeds when bats at higher risk, in the event significant impacts are observed that cannot be resolved the wind turbines to be decommissioned after the pilot period. Free spinning of rotors under low wind conditions when the wind turbines are not generating power is not permitted	EMP successfully implemented by contractor for pilot phase as determined through regular site checks, photographic record etc. No outstanding O&M avifauna impacts or their related grievances	To be included contract cost for first year of O&M.	Contractor	E&S team of PMU with support PMC for first year of O&M	Prepare during pre-construction and comply throughout first year of O&M
	Shadow flicker.	Shadow flicker complaints from the community to be noted with the GRM record kept at the powerhouse facility. If the issue is persistent on any location during the first year of operation, assist in blocking the window using blinds etc. Or if not a desirable outcome, then turbine operation may need to be curtailed during the period of occurrence through installation of shadow flicker modules. In the event significant impacts are observed that cannot be resolved the wind turbines to be decommissioned after the pilot period.	EMP successfully implemented by contractor for pilot phase as determined through regular site checks, photographic record etc. No outstanding O&M shadow flicker impacts or their related grievances	To be included contract cost for first year of O&M.	Contractor	E&S team of PMU with support PMC for first year of O&M	Prepare during pre-construction and comply throughout first year of O&M
	Noise from wind turbines.	Noise complaints from the community to be noted with the GRM record kept at the powerhouse facility. Nighttime noise pollution, and related complaints from residences should be monitored especially vigilantly. If the issue is persistent on any location during the first year of operation, the turbines may need to be curtailed during nighttime, certain wind speeds etc. FENEKA may also to consider to provide additional noise insulation to residential properties. In the event significant impacts are observed that cannot be resolved the wind turbines to be decommissioned after the pilot period.	EMP successfully implemented by contractor for pilot phase as determined through regular site checks, photographic record etc. No outstanding O&M noise related impacts or their related grievances	To be included contract cost for first year of O&M.	Contractor	E&S team of PMU with support PMC for first year of O&M	Prepare during pre-construction and comply throughout first year of O&M
	General	If during the first year of pilot O&M any other unanticipated impacts are observed to occur, then adaptive management will be taken and the turbines will either be curtailed (shut down) during problematic wind speeds or decommissioned	EMP successfully implemented by contractor for pilot phase as determined through regular site checks, photographic record etc.	To be included contract cost for first year of O&M.	Contractor	E&S team of PMU with support PMC for first year of O&M	Prepare during pre-construction and comply throughout O&M

Topic	Impact or Risk	Mitigation Measure	Performance Standard	Budget Source/ Mitigation Cost	Implementation responsibility	Monitoring responsibility	Implementation schedule
			No outstanding O&M related impacts or their related grievances				
D. Decommissioning							
Dismantling wind turbines	Impacts from decommissioning works	During decommissioning activities mitigation measures applicable to the construction stage are also applicable to the contractor (if at end of pilot phase) or FENEKA decommissioning workers or contractor and are to be followed, including strict prohibitions on workers. Infrastructure decommissioning will include the disconnecting and removal of all electrical equipment, removal of the wind turbines in full, dismantling of buildings and structures, excavation of concrete foundations and backfilling with soil sourced on site or imported, cutting off foundations to a sufficient distance below ground level so as not to restrict future land use, the removal of crane pads and access tracks etc. During decommissioning all decommissioned equipment and other wastes will be stored on site prior to disposal. On completion of infrastructure decommissioning restore the project site back to agricultural land, this will involve cleaning site of any debris or wastes, testing soil quality to confirm no residual contamination; left over material and soil/rocks/sand, contaminated soil although this should have been avoided through EMP measures; revegetation of exposed soils using locally native species; reinstatement of natural drainage as required; local topographical adjustments; etc.	Compliance with national laws and regulations. EMP successfully implemented by contractor or FENEKA as determined through regular site checks, photographic record etc. No outstanding decommissioning related grievances	Contingency for decommissioning at end of first year of O&M in case pilot is not successful to be included in contract cost. Otherwise FENEKA O&M Cost if decommissioned at the end of life	Contractor if decommissioned at end of first year of O&M, otherwise FENEKA	E&S team of PMU with support PMC if decommissioned at end of first year of O&M, otherwise FENEKA	Prepare during pre-construction and comply throughout decommissioning stage

Table 53: Environmental Management Plan for Ocean Energy Pilot System
(To be Implemented in Addition to the Table 1 General Measures)

Topic	Impact or Risk	Mitigation Measure	Performance Standard	Budget Source/ Mitigation Cost	Implementation responsibility	Monitoring responsibility	Implementation schedule
A. Pre-construction							
Feasibility study on location of and access to project components	General impacts and risks	Develop the feasibility study and detailed design of the pilot following the requirements of the marine BAP Once the feasibility study is completed and the design and location of the ocean energy pilot has been determined, update the IEE and EMP for clearance and disclosure by ADB Further elaboration of the mitigation and monitoring measures in the updated IEE and EMP must ensure no net loss of critical habitat, and if appropriate, offsets will need to be proposed by MOECCT that would preferably lead to net gains. Presence of no marine-based physical cultural resources beneath the footprint of the ocean energy pilot is to be reconfirmed in updating the IEE for the selected location.	No breaches of environmental assessment requirements	Counterpart funding and PMC budget	PMU Contractor to immediately inform PMU if unanticipated impacts identified	E&S team of PMU with support PMC	Prior to the approval of feasibility study and then detailed design

Topic	Impact or Risk	Mitigation Measure	Performance Standard	Budget Source/ Mitigation Cost	Implementation responsibility	Monitoring responsibility	Implementation schedule
Feasibility study and detailed design – survey works	Impacts on the marine environment	Undertake detailed bathymetric surveys and hydrodynamic measurements around each of the islands where deployment may be undertaken to inform the feasible sites Install any ADCP buoys required for data collection under the supervision of the PMC marine ecologist, do not disturb any coral or sea grass (or other sensitive areas) habitat in placing buoys; also no anchoring on the reef flat or reef slope permitted Ensure buoy mooring lines are installed and maintained tautly to avoid entanglement of marine fauna Buoys and other survey equipment should not be imported by sea but constructed locally to avoid wet tow of materials that may have been subject to biofouling – if previously used in the marine environment elsewhere they must be thoroughly cleaned off site under the supervision of a marine ecologist (due to the risk of invasive species) Local support boats will be used for surveys, they will be well maintained and operated (MAPROL 73/78) and driven by experienced boat handlers to avoid pollution, health and safety incident No anchoring of support boats in areas of coral or sea grass (or other sensitive areas) Number of vessel movements to be kept to minimum Keep boat speeds low to avoid collision with marine fauna in working area and shallow water navigation routes (<5 knots for sea turtles) Do not permit the discharge or disposal of any material to the marine environment, anything that accidentally falls into the sea to be reclaimed	Compliance with national biodiversity regulations and achievement of no net loss biodiversity. EMP and mBAP requirements successfully implemented as determined through regular site checks, photographic record etc. No outstanding biodiversity grievances from local communities or other interested stakeholders.	Contract cost	Contractor	E&S team of PMU with support PMC	During conduct of marine surveys and prior to the approval of feasibility study and then detailed design
Feasibility study and detailed design – ecology surveys	Impacts on the marine environment	Undertake marine water quality samples per the EPA 'EIA Data Collection Guidelines' Undertake marine ecology surveys to a scope of work agreed with ADB (see attached example) and in line with those undertaken for marine floating solar associated facilities and including benthic habitat in anchor locations and any future cable route Undertake consultation regarding presence of whale shark, reef manta ray – including identification of cleaning sites around Muli Island, ornate eagle ray, and hawksbill turtle with relevant experts in the Maldives as per the ocean energy marine ecology impact assessment and take on board their views in determining the feasible sites – if areas are found to be of importance for critical habitat species, then deployment should not occur in their vicinity	PMU approved detailed designs minimize impacts and risks on EHS during subsequent stages of the project Ocean energy pilot designed and constructed in compliance with ADB natural and critical habitat requirements	Contract cost	Contractor	E&S team of PMU with support PMC	Prior to the approval of feasibility study and then detailed design

Topic	Impact or Risk	Mitigation Measure	Performance Standard	Budget Source/ Mitigation Cost	Implementation responsibility	Monitoring responsibility	Implementation schedule
Feasibility study and detailed design – detailed design and construction planning and management	Impacts on the marine environment	Design bottom clearance of ocean energy turbines to be greatest between either 25% of the vertical water column depth or 5 m Design to maximize light penetration below the floating structure Cumulative impact of land reclamation and the new bridge around the islands of Mathikomandoo and Komandoo to be taken into account in determining the feasible sites Feasibility study to identify the preferred sites with most potential for a successful pilot to minimize the number of sites that the ocean energy equipment is to be deployed at Selected sites must avoid damage to coral and sea grass from placement of anchors; reef flat and reef slope must not be used for installation The configuration of the turbines and moorings is to be carefully done to minimize impacts on movements of marine mammals and reptiles. Smallest number of devises possible to achieve 100 kW should be installed to reduce the potential for marine impacts Devises to be selected that have the slowest frequency of rotation and/ or smallest feasible rotor size to minimize the potential for injury that may ensue from any impact with blades Potential for locating energy devices in deeper water may be preferred to minimize the percentage of the water column within the rotor swept area, but this should only occur if these areas are not of greater sensitivity for species that may be at risk from collision. Devices will be designed to ensure containment of any harmful materials arising from leaks or machinery failure. Pollution prevention plan must include procedures in the event of a marine pollution incident with booms for containment of a fuel or oil spill available on the support boat, and the waste management plan to address waste management at sea as well as on the land During the pilot phase cables will not be connected to shore In locating the feasible sites the impact of any future cable must be taken into account, in terms of technical feasibility and ecological impact with coral and sea grass (or other sensitive areas) to be avoided	PMU approved detailed designs and CEMP minimize impacts and risks on EHS during subsequent stages of the project Ocean energy pilot designed and constructed in compliance with ADB natural and critical habitat requirements	Contract cost	Contractor	E&S team of PMU with support PMC	Prior to the approval of feasibility study and then detailed design and CEMP for ocean energy pilot
	Impacts on marine users, health and safety risks	Consult with fishers, marine tourism and other marine users and take on board their concerns and recommendations Detailed design to include for navigation warning signage and lighting – only low intensity red lighting will be used to mark All electrical hazards will feature written and visual warning signs that meet the IEEE standards to include the ISO 7010 "Hazard Type: Electrical Symbol" warning of the risk of electrocution.					

Topic	Impact or Risk	Mitigation Measure	Performance Standard	Budget Source/ Mitigation Cost	Implementation responsibility	Monitoring responsibility	Implementation schedule
		Selected turbine and its layout must be agreed in consultation with the Island Council before approval of the detailed design Undertake consultation with the Island Council to agree the extent of the required exclusion zone around the ocean energy installation to ensure community health and safety Anchors will be designed to withstand powerful cyclones and hurricanes, which will limit the potential hazard of the ocean energy equipment being lifted and blown onto the shore or out to sea. Health and safety risk assessment and planning to specifically address working over water with reference to international good practice guidelines. Health and safety plan to include for an emergency rescue plan detailing the methods to be used to rescue operatives should they fall overboard etc. Schedule installation in consultation with Island Council outside of peak hours for harbor to reduce delays.					
O&M	General impacts and risk on project affected persons, including O&M workers and local communities	Develop in conjunction with FENEKA an O&M Plan for the ocean energy pilot setting out the schedule of inspections, maintenance required, and all EHS measures to be followed during any maintenance works. O&M Plan to be informed by a facilitated risk assessment and include a health and safety Plan and an Emergency Response and Preparedness Plan in relation to the wind turbine operation. Develop in conjunction with FENEKA a Decommissioning Plan for the works setting out how the ocean energy will be removed and the associated EHS measures.	O&M Plan included in handover to FENEKA if they wish to retain as permanent to minimize impacts and risks on EHS during subsequent stages of the project	Contractor to reflect in contact costs	Contractor	E&S team of PMU with support PMC	Pre-construction stage; compliance prior to commissioning and then on handover to FENEKA if to be retained as a permanent installation
B. Construction							
Installation of ocean energy pilot	Impacts on the marine environment	Comply with project EMP and mBAP plus approved CEMP and ECOP during construction works. Materials for the ocean energy equipment will be stored on the wharf/harbor side with no materials permitted to be stored on the beach Install the ocean energy equipment under the supervision of the PMC marine ecologist, do not disturb any coral or sea grass (or other sensitive areas) in placing anchors; also no anchoring on reef flat or reef slope permitted Installation will only be carried out during the daytime from one hour after sunrise to one hour before sunset; no artificial lighting will be utilized during construction PMC marine ecologist to supervise installation and visually for the presence of monitor sensitive marine fauna, if observed in buffer zone installation must be temporarily halted to avoid risks of vessel strikes etc. Ocean energy equipment must not be imported by sea but constructed locally to avoid wet tow of materials that may have been subject to biofouling – if previously used in the marine environment elsewhere they must be thoroughly	EMP/mBAP/CEMP requirements successfully implemented as determined through regular site checks, photographic record etc.	To be included contract cost.	Contractor	E&S team of PMU with support PMC	Prepare during pre-construction and comply throughout construction stage

Topic	Impact or Risk	Mitigation Measure	Performance Standard	Budget Source/ Mitigation Cost	Implementation responsibility	Monitoring responsibility	Implementation schedule
		cleaned off site under the supervision of a marine ecologist (due to the risk of invasive species) Ensure anchor lines are installed and maintained tautly to avoid entanglement of marine fauna Local support boats will be used for installation, boats will be well maintained and operated (MAPROL 73/78) and driven by experienced boat handlers to avoid pollution, health and safety incident No anchoring of support boats in areas of coral or sea grass (or other sensitive areas) Number of vessel movements to be kept to minimum Keep boat speeds low to avoid collision with marine fauna in working area and shallow water navigation routes (<5 knots for sea turtles) Do not permit the discharge or disposal of any material to the marine environment, anything that accidentally falls into the sea to be reclaimed Deploy the ocean energy pilot outside of the seasonal monsoon periods when whale shark or reef manta ray may be present around islands (i.e., outside of the southwest monsoon around the islands of Muli and Mulah and NE monsoon around Komandoo Island). No harmful materials will be released to the marine environment. No piling or drilling to install infrastructure will be conducted.					
C. Operation and Maintenance							
O&M	General impacts and risk of ocean energy pilot on project affected persons, including FENEKA O&M workers and local communities	Implement the agreed O&M Plan. During maintenance activities mitigation measures applicable to the construction stage are also applicable to FENEKA maintenance workers or contractors and are to be followed, including strict prohibitions on workers. Regular visual and technical inspection of condition and maintenance as required to be carried out, keep photographic records and log of all inspections, including register of faulty equipment found, and actions taken in response. Electrical equipment and electric wiring to be checked for safe current and voltage ratings. Ensure all liquids (fuel, oil, or chemicals) are stored in an undercover area with impermeable floor with spill containment bund of 110% capacity under lock and key. Label all drums and containers with their content and potential risk signs (e.g., flammable, corrosive, toxic, etc.) and always keep spill prevention equipment available on site. Display material data sheets for any fuels, oil, or chemicals used on site. Keep spill prevention equipment available on site if fuel, oil and chemical kept.	Project infrastructure maintained in working order and is always in good condition. Compliance with national laws and regulations. EMP/O&M Plan successfully implemented by contractor for pilot phase and then FENEKA if retained as permanent as determined through regular site checks, photographic record etc. No outstanding O&M related grievances from local communities or other stakeholders	To be included contract cost for first year of O&M. FENEKA O&M following handover if retained as permanent	Contractor and FENEKA	E&S team of PMU with support PMC for first year of O&M FENEKA following handover if retained as permanent	Prepare during pre-construction and comply throughout O&M
	Impacts on the marine environment	Comply with project EMP and mBAP during O&M Do not permit the discharge or disposal of any material to the marine environment, anything that accidentally falls into the sea to be reclaimed No harmful materials will be released to the marine environment. All equipment used to be maintained regularly in accordance with the manufacturer's recommendations to help reduce the potential for accidental discharges. In the event of a marine fauna injury or fatality turbine operation will be immediately halted	Compliance with national laws and regulations. EMP/mBAP successfully implemented by contractor for pilot phase and then FENEKA as determined through regular site checks, photographic record etc.	To be included contract cost for first year of O&M. FENEKA O&M following handover	Contractor and FENEKA	E&S team of PMU with support PMC for first year of O&M FENEKA following handover	Prepare during pre-construction and comply throughout O&M

Topic	Impact or Risk	Mitigation Measure	Performance Standard	Budget Source/ Mitigation Cost	Implementation responsibility	Monitoring responsibility	Implementation schedule
			No net loss to the population viability of critical habitat species occurs				
	General occupational and community health and safety risks of ocean energy pilot	Implement the agreed O&M Plan Ensure all O&M staff have received appropriate OHS trainings for their role. Ensure a recent, full, first aid kit and adequate firefighting equipment is always available on site, stored in clearly labelled and easily accessible area. Replace the first aid equipment timely as required to keep all equipment within its expiry date. Service the firefighting equipment timely as required to keep all equipment in date. Provide first aid and firefighting training to select, volunteer staff in relation to the ocean energy pilot; at least one staff having recently carried out first aid and firefighting training must be always present on site. Refreshers are to be provided once a year. Hang posters showing first aid procedures especially for electrocution, and fire procedures, as well as listing all emergency contacts. Display the emergency phone number and location of first aider, doctor, health center and hospital in a clear and easily accessible location. Keep an accident log and make accident logbook available on site upon request. Monitor closely in case of extreme weather events and be ready to act immediately. Carry out periodic safety related awareness raising in local communities focused on fishers and other boat users as well as those conducting marine tourism regarding undertaking activities in proximity to ocean energy pilot.	Compliance with national laws and regulations. EMP successfully implemented by contractor for pilot phase and then FENEKA as determined through regular site checks, photographic record etc. Zero project-related health and safety accidents reported during O&M No outstanding O&M related grievances	To be included contract cost for first year of O&M. FENEKA O&M following handover	Contractor and FENEKA	E&S team of PMU with support PMC for first year of O&M FENEKA following handover	Prepare during pre-construction and comply throughout O&M
Unanticipated impacts of ocean energy pilot operation	Impacts to marine ecology	If during the pilot O&M unanticipated impacts are observed to occur on marine ecology then adaptive management will be taken, this may include alteration to blade rotation velocities, alternation of blade size, or decommissioning at that location and deployment to a location of lower sensitivity. If a site is found not to be technically or ecologically or socially feasible after deployment or after the 12 months of pilot the ocean energy equipment will be removed from site	EMP successfully implemented by contractor for pilot phase as determined through regular site checks, photographic record etc. No outstanding O&M related impacts or their related grievances No net loss to the population viability of critical habitat species occurs	To be included contract cost for first year of O&M.	Contractor	E&S team of PMU with support PMC for first year of O&M	Prepare during pre-construction and comply throughout O&M
D. Decommissioning							
Dismantling of the ocean energy pilot	Impacts from decommissioning works	During decommissioning activities mitigation measures applicable to the construction stage are also applicable to the contractor (if at end of pilot phase) or FENEKA decommissioning workers or contractor and are to be followed, including strict prohibitions on workers. Infrastructure decommissioning will include the disconnecting and removal of all electrical equipment, removal of the ocean energy pilot in full, removal of ground anchors etc. Decommissioned equipment must be handed over to Government or Maldives or disposed of off-island by the contractor	Compliance with national laws and regulations. EMP successfully implemented by contractor or FENEKA as determined through regular site checks, photographic record etc. No outstanding decommissioning related grievances	Contingency for decommissioning at end of first year of O&M in case pilot is not successful to be included in contract cost. Otherwise	Contractor if decommissioned at end of first year of O&M, otherwise FENEKA	E&S team of PMU with support PMC if decommissioned at end of first year of O&M, otherwise FENEKA	Prepare during pre-construction and comply throughout decommissioning stage

Topic	Impact or Risk	Mitigation Measure	Performance Standard	Budget Source/ Mitigation Cost	Implementation responsibility	Monitoring responsibility	Implementation schedule
	Impacts on the marine environment	Decommission the ocean energy pilot following the requirements of the EMP and marine BAP Removal will include taking out the anchors so that natural restoration can take place	EMP/mBAP successfully implemented by contractor or FENEKA as determined through regular site checks, photographic record etc. No outstanding decommissioning related grievances No net loss to the population viability of critical habitat species occurs	FENEKA O&M Cost if decommissioned at the end of life			
Retention of ocean energy pilot if successful	Impacts on the marine environment	It will only be permitted to retain the ocean energy equipment as a permanent installation if environmental clearance for doing so is first obtained from the EPA, following assessment and the development of an EMP for O&M as a permanent facility	EPA clearance obtained if ocean energy pilot is to be retained	MOECCT cost (not in project scope)	MOECCT	MOECCT	Prior to completion of 12-month operational period

Table 6: Environmental Management Plan for Agricultural Intervention
(Also follow the Environmental Management Plan for grid upgrade and ground mounted solar)
(To be Implemented in Addition to the Table 1 General Measures)

Topic	Impact or Risk	Mitigation Measure	Performance Standard	Budget Source/ Mitigation Cost	Implementation responsibility	Monitoring responsibility	Implementation schedule
A. Pre-construction							
Feasibility study	General impacts and risks	Once the feasibility study is completed and the design and location of the agricultural intervention has been determined, update the IEE and EMP for clearance and disclosure by ADB	No breaches of environmental assessment requirements	Counterpart funding and PMC budget	PMU Contractor to immediately inform PMU if unanticipated impacts identified	E&S team of PMU with support PMC	Prior to the approval of feasibility study
Feasibility and detailed design, location of and access to project components, construction planning and management	Encroachment into protected areas, ecologically sensitive zones, natural habitats or physical cultural resources	Shade houses and cold stores will only be located on modified habitat Ecology survey to be conducted as part of the feasibility survey No vegetation will be cleared and no trees will be cut to install the agricultural interventions	No project sites encroach into protected areas, ecologically sensitive zones, natural habitats or physical cultural resources No clearance of vegetation and trees within the project footprint	Contractor to reflect in contact costs	Contractor	E&S team of PMU with support PMC	Pre-construction stage; compliance prior to approval of detailed design and any works commencing on site including site establishment
	Use of water for irrigation depleting groundwater Impacts of cold storage chilling units	No additional water will be abstracted in relation to installing the irrigation system, no new water source will be developed. Cold store refrigeration equipment will not use any toxic chemicals or ozone depleting chemicals and be specified to have a noise level of <70dB(A) at 1m distance Cold storage refrigeration will need to comply with the Maldives HCFC reduction polies, and hence refrigerant such as R-22 (CHClF2 with 0.047 ozone depleting potential) must not be used. The project must ensure refrigerants such as R-71747 (ammonia, toxic and corrosive, can cause explosion/fire, but it is not ozone	PMU approved feasibility and detailed design minimize impacts and risks on EHS during subsequent stages of the project				

Topic	Impact or Risk	Mitigation Measure	Performance Standard	Budget Source/ Mitigation Cost	Implementation responsibility	Monitoring responsibility	Implementation schedule
		depleting) will also not be used with only normal cooling water discharged and no chemicals or other impurities will be let out through the drain. Support for the cultivation of betel nut will be excluded from the scope of the agricultural intervention as although legal it is addictive and carcinogenic					
O&M of agricultural interventions	General impacts and risk on project affected persons, including O&M workers and local communities	Develop in conjunction with Island Council an O&M Plan for the agricultural interventions setting out the schedule of inspections, maintenance required, and all EHS measures to be followed during any maintenance works. O&M Plan to be informed by a facilitated risk assessment and include a health and safety plan and an Emergency Response and Preparedness Plan in relation to the operation	O&M Plan included in handover to Island Council to minimize impacts and risks on EHS during subsequent stages of the project	Contractor to reflect in contact costs	Contractor	E&S team of PMU with support PMC	Pre-construction stage; compliance prior to handover to FENEKA
B. Construction							
Site establishment and site clearance	Clearance/trimming of trees and vegetative cover during site establishment	Comply with project EMP plus approved CEMP and ECOP during construction works. Clearance of ground level vegetation only in the project footprint that will be marked out by the contractor under the supervision of the ecologist of PMC. Removal of only those trees for which permission has been granted by the island council – trees to be marked and a record of number of trees, species and size to be kept Remove and dispose of any identified invasive plant species in an ecologically sound manner, imported materials must be free of invasive plant material. Encroachment outside the marked working area must be avoided, all site clearance is to be strictly controlled and supervised by PMC ecologist to ensure there is minimum loss of and no unnecessary removal of trees and vegetation. Trees and vegetation to be cleared outside the bird breeding season and all trees to be checked by PMC ecologist for nesting birds or bats prior to being cut – if present adults and the young must be allowed to leave the nest beforehand, as confirmed by the PMC ecologist. In addition to compensatory plantation, transplanting of any trees to be cut within the island if it is possible and planting of additional trees (enhancements) in coordination with the Island Council. Use of herbicides or burning to clear vegetation or burning of vegetation trimmings is strictly prohibited, leaves will be mulched and wood will be given to the island council. Separately strip and store topsoil and reinstate it after construction completed. Prior to earthworks and excavation, area will be checked by the PMC ecologist for any signs of burrows etc. If there is a risk of being occupied, then only the manual digging under the close supervision of the PMC ecologist will be permitted. Excavated pits will be robustly fenced or covered to prevent fauna accidentally falling in, further an escape ramp will be provided to allow their escape. Keep written record, supported by photographs, of any animal casualties, including a cause of death if known. Contractors to undertake regular, compulsory wildlife conservation awareness raising activities for all workers related to prohibitions with respect to fishing etc. including toolbox talks and posting of information and warning signs at construction site offices, overnight accommodation, regular inspections of the overnight accommodation, and, strict the disciplinary procedures for any contravention by the workers.	Compliance with national biodiversity regulations and achievement of no net loss biodiversity. EMP/CEMP requirements successfully implemented as determined through regular site checks, photographic record etc. No outstanding biodiversity grievances from local communities or other interested stakeholders.	To be included contract cost.	Contractor	E&S team of PMU with support PMC	Prepare during pre-construction and comply throughout construction stage

Topic	Impact or Risk	Mitigation Measure	Performance Standard	Budget Source/ Mitigation Cost	Implementation responsibility	Monitoring responsibility	Implementation schedule
		Revegetate any disturbed areas not taken up by the project infrastructure to at least original condition through revegetation using native species seeds sourced from the site.					
C. Operation and Maintenance							
O&M	General impacts and risk of agricultural interventions on project affected persons, including Island Council O&M workers and local communities	Implement the agreed O&M Plan During maintenance activities mitigation measures applicable to the construction stage are also applicable to Island Council maintenance workers or contractors and are to be followed, including strict prohibitions on workers. Prohibit the use of herbicides, pesticides or burning to control any vegetation growth or to manage vegetation waste. Regular visual and technical inspection of condition and maintenance as required to be carried out, keep photographic records and log of all inspections, including register of faulty equipment found, and actions taken in response. Electrical equipment and electric wiring to be checked for safe current and voltage ratings. Maintain noise generating project equipment to ensure noise to be limited to the following as 1-hour LAeq: (i) 70 dB(A) at the site boundary; (ii) at residential properties, 55 (day) and 45 (night) dB(A) Ensure all liquids (fuel, oil, or chemicals) are stored in an undercover area with impermeable floor with spill containment bund of 110% capacity under lock and key. Label all drums and containers with their content and potential risk signs (e.g., flammable, corrosive, toxic, etc.) and always keep spill prevention equipment available on site. Display material data sheets for any fuels, oil, or chemicals used on site. Keep spill prevention equipment available on site if fuel, oil and chemical kept.	Project infrastructure maintained in working order and is always in good condition. Compliance with national laws and regulations. EMP/O&M Plan successfully implemented by Island Council as determined through regular site checks, photographic record etc. No outstanding O&M related grievances from local communities or other stakeholders	Island Council cost	Island Council	Island Council	Prepare during pre-construction and comply throughout O&M stage
Health and Safety	General occupational and community health and safety risks of agricultural interventions	Implement the agreed O&M Plan Ensure all O&M staff have received appropriate OHS trainings for their role. Always keep the operational area neat and tidy. Store equipment in a dedicated, covered, labelled storage area (materials, tools, equipment, and any spare parts). Remove any trip hazards on the ground, e.g., open channels, materials, equipment, trash laying around. Monitor closely in case of extreme weather events and be ready to act immediately. Carry out periodic safety related awareness raising in local communities especially focused towards the farmers who will benefit regarding agricultural interventions.	Compliance with national laws and regulations. EMP successfully implemented by Island Council as determined through regular site checks, photographic record etc. Zero project-related health and safety accidents reported during O&M No outstanding O&M related grievances	Island Council cost	Island Council	Island Council	Prepare during pre-construction and comply throughout O&M stage

Table 7: Quantitative Environmental Monitoring Plan

Project Component/ Environmental Features	Aspect to be Monitored	Time and Frequency of Monitoring	Location	Performance Standard	Budget Source/ Mitigation Cost	Implementation responsibility	Monitoring responsibility
Preconstruction Stage							
Grid Upgrade/Air Quality	24hr air quality at boundary of powerhouse PM10 and PM2.5 to be measured as 24hrs period along with meteorological data-temperature, humidity, solar speed, and solar direction Measurement professional, calibrated monitoring devices by accredited service provider (record full 24-hour data)	Prior to commencement of works (dry season)	Project Site	EMP compliance; baseline establishment	Contractor Cost	Contractor	E&S team of PMU supported by PMC
Grid Upgrade/Noise	24hr noise levels at boundary of power house LAeq 1hr, LAeq day 7am-10pm, and LAeq night 10pm-7am, LAmax, LAmin over 24hrs period Measurement professional, calibrated monitoring devices by accredited service provider (record full 24-hour data)	Prior to commencement of works	Project Site	EMP compliance; baseline establishment	Contractor Cost	Contractor	E&S team of PMU supported by PMC
Wind Energy/Noise	24hr noise levels at nearest residential receptor and boundary of powerhouse LAeq 1hr, LAeq day 7am-10pm, and LAeq night 10pm-7am, LAmax, LAmin over 24hrs period Measurement professional, calibrated monitoring devices by accredited service provider (record full 24-hour data) Note: this will not constitute a noise monitoring study per IFC EHS Guidelines on Wind Energy for purposes of allowing turbine noise >35dBA	Prior to commencement of works	Project Site	EMP compliance; baseline establishment	Contractor Cost	Contractor	E&S team of PMU supported by PMC
Ocean Energy/Water Quality	Marine water quality per EPA guidelines Water sample is to be taken in a clean, non-contaminated, well-sealed container and tested within the next 48h by accredited laboratory	Prior to commencement of works	Project Site	EMP compliance; baseline establishment	Contractor Cost	Contractor	E&S team of PMU supported by PMC
Wind Energy/Ecology	Terrestrial ecology survey Detailed survey/inventory of the number, location, size, and species of trees and shrubs to be cut based on detailed design as well as details of ground vegetation to be cleared Detailed survey/inventory of the status of compensatory tree plantation to be conducted in the pre-construction phase of work	Prior to and to inform detailed design	Project Site	EMP compliance; baseline establishment	Contractor Cost	Contractor	E&S team of PMU supported by PMC
Ocean Energy/Ecology	Marine ecology survey during feasibility study to scope to be agreed with ADB (to be in line with scope undertaken for floating solar as reference for costing purposes-see attached draft TOR	Prior to and to inform detailed design	Project Site	EMP compliance; baseline establishment	Contractor Cost	Contractor	E&S team of PMU supported by PMC
Ground Mounted Solar and Agricultural Intervention/ Ecology	Terrestrial ecology survey	Prior to and to inform detailed design	Project Site	EMP compliance; baseline establishment	Contractor Cost	Contractor	E&S team of PMU supported by PMC
Construction stage							
All terrestrial components except rooftop solar/soil	Keep records of earthworks involved, including total volume in cubic meters of soil excavated and reused (any disposed of as spoil off site to waste disposal facilities recorded as per waste generation)	Ongoing with monthly progress report	Project Site	EMP compliance; all excavated material and cut, and fill volume accounted for, either reused on-site or disposed of off-site to licensed waste disposal facilities	Contractor Cost	Contractor	E&S team of PMU supported by PMC

Project Component/ Environmental Features	Aspect to be Monitored	Time and Frequency of Monitoring	Location	Performance Standard	Budget Source/ Mitigation Cost	Implementation responsibility	Monitoring responsibility
All terrestrial components except rooftop solar/water	Keep records of all water abstracted/used and source	Ongoing with monthly progress report	Project Site	EMP compliance; No grievance received regarding conflict with other water users	Contractor Cost	Contractor	E&S team of PMU supported by PMC
All/pollution incidents	Keep records of all pollution incidents (e.g., type of material spilled, amount in kg or cubic meters, and action taken to clean up) Carry out visual inspection and interviews with workers and the affected communities to identify if any unrecorded incidents occurred	Ongoing with monthly progress report	Project Site	EMP compliance; zero major incidents occurred. Minor incidents responded to in accordance with EMP with lessons learnt for future.	Contractor Cost	Contractor	E&S team of PMU supported by PMC
All/materials used and waste generated	Keep records of all types of materials used and wastes produced by type, volume/weight. Document waste disposal through transfer notes including type, volume/ weight, transport provider, intermediaries if any and final treatment or disposal facility (with copy of its license and its capacity)	Ongoing with monthly progress report	Project Site	EMP compliance; Transfer of 100% of construction wastes documented, and all wastes disposed of in an environmentally safe and sound manner in accordance with IFC General EHS Guidelines	Contractor Cost	Contractor	E&S team of PMU supported by PMC
All/health and safety	Keep records of near miss, minor, lost time, and fatal health and safety incidents related to the project, compile records from construction site Carry out interviews with workers and affected communities to identify if any unrecorded incidents occurred. During the COVID-19 pandemic, temperature checks to be carried out at entrance of the work site at start of shift	Ongoing with monthly progress report	Project Site	Zero lost time incidents or fatalities (among workers and affected communities) For 100% lost time incidents or fatalities /confirmed COVID-19 cases immediate action taken to avoid repeat or escalation of situation. All incidents including minor and near miss dealt with in accordance with EMP with lessons learnt for future 100% lost time and fatalities/confirmed COVID-19 cases reported to MOECCT within 24 hours and ADB within 48 hours	Contractor Cost	Contractor	E&S team of PMU supported by PMC
All/Employment	Keep records of employment generated, age/gender/sex-disaggregated employment data, home locations, and trainings received	Ongoing with monthly progress report	Project Site	EMP compliance	Contractor Cost	Contractor	E&S team of PMU supported by PMC
Grid Upgrade/Air Quality	24hr air quality at boundary of powerhouse PM10 and PM2.5 to be measured as 24hrs period along with meteorological data-temperature, humidity, solar speed, and solar direction Measurement professional, calibrated monitoring devices by accredited service provider (record full 24-hour data)	Only if complaints raised from local residents about dust during construction On completion of works before handing over grid upgrade to FENEKA (dry season)	Project Site	EMP compliance; project air quality levels met at receptors or no deterioration compared to the baseline	Contractor Cost	Contractor	E&S team of PMU supported by PMC
Grid Upgrade/Noise	24hr noise levels at boundary of power house LAeq 1hr, LAeq day 7am-10pm, and LAeq night 10pm-7am, LAmax, LAmin over 24hrs period Measurement professional, calibrated monitoring devices by accredited service provider (record full 24-hour data)	Only if complaints raised from local residents about noise during construction On completion of works before handing over grid upgrade to FENEKA	Project Site	EMP compliance; project noise levels met at receptors or no deterioration compared to the baseline	Contractor Cost	Contractor	E&S team of PMU supported by PMC

Project Component/ Environmental Features	Aspect to be Monitored	Time and Frequency of Monitoring	Location	Performance Standard	Budget Source/ Mitigation Cost	Implementation responsibility	Monitoring responsibility
Wind Energy/Noise	24hr noise levels at nearest residential receptor LAeq 1hr, LAeq day 7am-10pm, and LAeq night 10pm-7am, LAmax, LAmin over 24hrs period Measurement professional, calibrated monitoring devices by accredited service provider (record full 24-hour data)	Monthly during construction for general construction, daily for undertaking of any piling works On completion of works before handing over pilot project to FENEKA	Project Site and Receptors	EMP compliance; project noise levels met at receptors or no deterioration compared to the baseline	Contractor Cost	Contractor	E&S team of PMU supported by PMC
	Noise compliance testing to verify the modelled noise levels	On completion of works before handing over pilot project to FENEKA					
All/Groundwater Sources	EPA/WHO drinking water standards; all basic health parameters to be tested for to confirm not being polluted due to the construction. Water sample is to be taken in a clean, non-contaminated, well-sealed container and tested within the next 48 hours by external laboratory	Only if complaints raised from local residents about pollution of ground water sources	Project Site	EPA/WHO drinking water standards	Contractor Cost	Contractor	E&S team of PMU supported by PMC
All/Drinking Water Quality	EPA/WHO drinking water standards; if supplier does not provide records all basic health parameters to be tested for to confirm not being polluted due to the construction and fit for human consumption Water sample is to be taken in a clean, non-contaminated, well-sealed container and tested within the next 48 hours by external laboratory	Monthly during construction	Project Site	EPA/WHO drinking water standards	Contractor Cost	Contractor	E&S team of PMU supported by PMC
Wind Energy/Ecology	Detailed survey/inventory of the success of compensatory tree plantation to be conducted in the pre-construction phase of work	On completion of works before handing over pilot project to FENEKA	Compensatory Plantation Sites	EMP compliance; 100% survival of planted trees or their replacements after one year	Contractor Cost	Contractor	E&S team of PMU supported by PMC
Operation and Maintenance Stage							
Rooftop and ground mounted solar/water	Keep records of all water abstracted/used and source	Ongoing with monthly progress report	Project Site	EMP compliance; No grievance received regarding conflict with other water users	FENEKA	FENEKA	FENEKA supported by E&S team of PMU and the PMC for duration of project
BESS and solar/end of life batteries and solar PV panel waste generated	Keep records of all end of life batteries and solar PV panels produced by type, volume/weight. Document waste disposal through transfer notes including type, volume/ weight, transport provider, intermediaries if any and final treatment or disposal facility (with copy of its license and its capacity)	Ongoing with monthly progress report	Project Site	EMP compliance; Transfer of 100% of batteries and solar PV panel wastes documented, and all wastes disposed of in an environmentally safe and sound manner in accordance with IFC General EHS Guidelines	FENEKA	FENEKA with support of battery supplier where contractual agreement is in place	FENEKA supported by E&S team of PMU and the PMC for duration of project
All/health and safety	Keep records of near miss, minor, lost time, and fatal health and safety incidents related to the project, compile records from construction site Carry out interviews with workers and affected communities to identify if any unrecorded incidents occurred. During the COVID-19 pandemic, temperature checks to be carried out at entrance of the work site at start of shift	Ongoing with monthly progress report	Project Site	Zero lost time incidents or fatalities (among workers and affected communities) For 100% lost time incidents or fatalities /confirmed COVID-19 cases immediate action taken to avoid repeat or escalation of situation.	FENEKA	FENEKA	FENEKA supported by E&S team of PMU and the PMC for duration of project

Project Component/ Environmental Features	Aspect to be Monitored	Time and Frequency of Monitoring	Location	Performance Standard	Budget Source/ Mitigation Cost	Implementation responsibility	Monitoring responsibility
				All incidents including minor and near miss dealt with in accordance with EMP with lessons learnt for future 100% lost time and fatalities/confirmed COVID-19 cases reported to MOECCT within 24 hours and ADB within 48 hours			
Ocean Energy/ Underwater Noise	Underwater sound measurements following guidance set out by Polagye and Bassett (2021) including approaches that seek to differentiate sound produced by the energy device and broader natural and anthropogenic sources	During first year of O&M to inform adaptive management	Project Site	EMP compliance; zero animal casualties occurred	Contractor Cost	Contractor	E&S team of PMU supported by PMC
Ocean Energy/Water Quality	Marine water quality per EPA guidelines Water sample is to be taken in a clean, non-contaminated, well-sealed container and tested within the next 48h by accredited laboratory	During pilot period, first year of O&M	Project Site	EMP compliance; baseline establishment	Contractor Cost	Contractor	E&S team of PMU supported by PMC
Wind Energy/Ecology	Case of avifauna behavior change, injury or mortality from project facilities – vantage point and carcass research survey per methodology to be agreed with ADB and in line with the EHS Guidelines on Wind Energy	During first year of O&M to inform adaptative management	Project Site	EMP compliance; zero animal casualties occurred	Contractor Cost	Contractor	E&S team of PMU supported by PMC
	Keep written record, supported by photographs, of any animal casualties, including a cause of death if known	During O&M	Project Site	EMP compliance; zero animal casualties occurred	Contractor Cost	Contractor	E&S team of PMU supported by PMC
Ocean Energy/Ecology	Case of marine fauna behavior changes, injury or mortality from project facilities following the requirements of the marine BAP – nearfield research survey using video, ground truthing of species presence, measurement of stimuli per methodology to be agreed with ADB, in line with other ocean energy pilot studies implemented globally and as set out in the marine ecology impact assessment (Appendix 9)	During first year of O&M to inform adaptive management	Project Site	EMP compliance; zero animal casualties occurred	Contractor Cost	Contractor	E&S team of PMU supported by PMC
	Keep written record, supported by photographs, of any animal casualties, including a cause of death if known	During O&M	Project Site	EMP compliance; zero animal casualties occurred	Contractor Cost	Contractor	E&S team of PMU supported by PMC
	Marine ecology survey to scope to be agreed with ADB	During pilot period and on decommissioning	Project Site	EMP compliance; no change in habitat, flora or fauna from the baseline situation	Contractor Cost	Contractor	E&S team of PMU supported by PMC
Ground Mounted Solar and Agricultural Intervention/ Ecology	Terrestrial ecology survey	On completion of construction works	Project Site	EMP compliance; comparison to baseline establishment	Contractor Cost	Contractor	E&S team of PMU supported by PMC
Agricultural Intervention – Cold Storage/Hazardous Materials	Service records including replenishment of refrigerant	Ongoing with monthly progress report	Project Site	EMP compliance	Island Council	Island Council	Island Council supported by E&S team of PMU and the PMC for duration of project

SCOPE OF MARINE ECOLOGY SURVEYS FOR OCEAN ENERGY

I. Survey Areas

1. A rapid assessment seabed survey is required to determine the status of seabed habitats beneath the initially proposed ocean energy pilot areas, along potential cable routes to shore, and to provide a broader understanding around sites to inform the site selection process (i.e., avoidance of importance habitats through alternative sighting of turbines). The survey should be completed at two spatial scales at each site as detailed below, as well as at alternative site locations:

(i) *Baseline ecological survey* shall be carried out to establish marine environmental baseline at the proposed site. Ecological survey also needs to be carried out a control site which can be used for future monitoring purpose. The survey shall include coral cover, fish, and seagrass.

(ii) *Seabed condition.* Visual survey of the seabed at proposed site and alternative site need to be undertaken at all islands to examine the condition of the seabed. The visual survey needs to include appearance of the materials of the seabed and any other physical properties which might be an interest when anchoring the ocean energy structures. Representative number of photos of the seabed need to be recorded.

(iii) *Depth measurements.* The depths beneath the turbine area + 10 meters (m) offset from outside boundary should be measured, in order to allow conclusions on the anchoring and mooring of the ocean energy pilot. Additionally, the seabed depth shall be recorded at each of the sample stations of 1 and 2 to have additional measurement points. At each measured location, the coordinates (WGS84) shall be recorded with the use of a professional handheld GPS/GLONASS device (±1.5 m spatial differential precision is expected).

(iv) *Marine seawater quality (seawater hardness and salinity test).* The marine seawater hardness, conductivity, pH, and salinity should be established at the sites specified.

(v) *Onsite observations.* While at the site, observations on the general area of the ocean energy pilot and related facilities shall be made, potential sites for construction area identified and the conclusions documented in the site questionnaire provided. This includes information on topography/bathymetry, geology, hydrology, infrastructure, etc. as can be observed while standing at the site.

2. All proposed stations should be mapped as part of the development of a survey plan for review and agreement prior to the survey commencing with a kmz file provided to show the locations.

II. Methods[6]

A. Baseline Ecological Survey

3. Marine survey provides information on the condition of habitats, abundance of the biota and the diversity of the site. To get baseline line transect survey, fish belt transect, and sea-grass survey need to be undertaken.[7]

1. Line Intercept Transects

4. Line intercept transects (LIT) could be used to determine the percentage cover of benthic communities at the project site, alternative sites and control site at each island. The LIT transects need to be 100 mlong, divided into four segments, each 19.5 m long. For example, if the first segment start point is 0 m, last point is 19.5m, the next segment will start at 25 m leaving 5 m gap in between to ensure sample independence at finishes at 44.5 m. The benthic categorization shall follow under the Reef Check[8] protocol, which emphasizes on benthic composition categorizing such as hard corals, sand, rock, and others.

2. Fish Belt Transect

5. This method aims to count (quantify) the abundance and community composition of fish on transect. This is the principle recommended fish method under Global Coral Reef Monitoring Network. Fish belt transect should be done along with LIT. Observers would swim at a constant speed and careful not to count the same fish or group of fish twice as they can move along the transect. Species would be noted on a slate along with the tape, particular station/site name, the name of the data recorder/observer, date, GPS coordinate of start and end point.

3. Seagrass Survey

6. Seagrass survey would be carried out using the methodology derived from Maldives Seagrass Monitoring Network, 2020 and Environmental Protection Agency Data Collection Guideline. Percentage cover would be measured within replicate quadrats placed at regular intervals along the length of a transect.

7. The following procedure could be used for seagrass percentage cover survey:
   (i) 50 cm x 50 cm quadrats at 10 m regular intervals to estimate the percentage cover,
   (ii) transects placed perpendicular to the shore and that extend to the outer limits of the beds, (where seagrass disappears), and
   (iii) take photos of each transect and these photos would be analyzed.

8. The following method could be used for mapping the distribution and density of meadows:
   (i) Aerial mapping of the meadows could be conducted by using a real-time kinematic drone (please refer for aerial mapping methodology).
   (ii) Photos taken could be analyzed using a software and combined image into a geographic information system software.
   (iii) Seagrass meadow boundary could be showed using geographic information system along with the area of distribution.

[6] If the proposed methodology is not feasible, the consultant can present an alternative methodology–noting that a rapid assessment using video is preferred and a quantified transect/quadrat approach is not needed at this time.
[7] These methods are from Environmental Protection Agency Data Collection Guideline, Global Coral Reef Monitoring Network and Maldives Seagrass Monitoring Network.
[8] Reef Check Instruction Manual: A Guide to Reef Check Coral Reef Monitoring

9. Site location, time and date should be recorded for each transect. At each sampling point, GPS coordinates shall be provided to mark the surveyed transect. All videos and photographs should be stored and provided with a map of survey locations as part of the reporting for the survey.

B. Seabed condition

10. The seabed condition of the site could be physically surveyed if the water depth is shallow. Van Veen Grab could be used to take samples from the seabed, if the location has deeper water. The samples need to be photographed and inspected visually.

C. Marine seawater quality

11. The marine seawater shall be sampled and tested at a laboratory for hardness, conductivity, pH, and salinity at the sites.

D. Onsite Observations

12. While at site, the surroundings and shoreline close to the site should be checked and observations noted according to the questionnaire provided. Where information on possible locations is required, a photograph should document the location and the coordinates of the site.

III. Interpretation of data

13. An ecological baseline of the marine environment needs to be established at each site based on the field survey results. The baseline shall provide a current status of the marine habitat, an account of any environmental stress, visual signs of pollution and any other factor that could be important for the establishment of the ocean energy pilot. The rapid data collection should be able to support the analysis and reporting which could include the following indicators:

(i) Seabed condition–substrate classification
(ii) Habitat type cover, distribution, and extent (live coral, dead coral, seagrass, and algae)
(iii) Presence of the *Acropora rudis*, an endangered coral species present in the Maldives
(iv) The general health of habitats, e.g., for coral this will include bleaching signs, mortality, presence and diversity of associated organisms, and stress factors.

14. From the onshore observations, suggestions on suitable locations for the storage, assembly, launching ramp and operations and maintenance area of the ocean energy pilot should be made. It should further be noted whether the areas near the shore are steep, muddy or otherwise noteworthy, and the width and slope of the shoreline documented (please refer to site visit questionnaire for further details).

A. Ad Hoc Species Documentation

15. During the off-station survey period, the presence of other species in the survey area should be recorded, including seabirds, fishes, sea turtles and marine mammals. The species name, abundance, frequency and approximate location should be recorded, along with the time and date of any records taken.

B. Sea Turtle Nesting Beach Rapid Assessment Survey

16. There is no data available on the potential nesting of sea turtles on sandy beaches that may be present at the proposed ocean energy pilot sites; and coverage of nesting surveys across all potential habitat used for nesting across the Maldives is limited to certain areas. Understanding the potential for nesting is important to determine potential impacts on critical habitat triggers, especially as Endangered green turtle (*Chelonia mydas*) and critically endangered hawksbill turtle (*Eretmochelys imbricata*) are known to nest in the Maldives. Impacts will primarily relate to the potential trenching of cables through intertidal sandy beaches where they are present. To help to understand the potential for sea turtle nesting, a rapid assessment of beaches near to ocean energy pilot sites should be undertaken using the "Sea Turtle Nesting Beach Indicator Tool" that is available here: https://bluedotassociates.com/rapid-data/. The tool employs a scoring and rating system to assess Beach Suitability, which is the potential for supporting a viable nesting population based on habitat features; and Human Impacts and how these are affecting nesting beaches (Cousins et al., 2017). The tool provides indicative rather than conclusive results on nesting potential, i.e., indications of poor suitability for certain beaches should not be used as evidence there is no nesting. This rapid assessment can be supported by the local community consultations as outlined below.

C. Informal Local Community Consultation

17. A strategic screening exercise undertaken for the ocean energy pilot islands has determined a number of species that could be present in the seascape that may trigger critical habitat classification. It is unlikely (due to seasonality or frequency of presence or absence) that the surveys proposed above will positively identify these species. Therefore, informal community consultation should be undertaken with local key stakeholders on the islands (e.g., tourism operators, hotel associated marine biologists, fishermen, community members) to determine the potential presence of these species in the site area. There is no need to follow specific interview techniques for this consultation, but consultees should be identified and approached prior to survey; and their responses recorded along with their names, position/occupation, and date met. Any consultee discussions must be supported by photographic representation of key species to confirm identification. Any records of key species (see below) should be marked on a map to confirm that the sightings have been made in the local area.

18. The key species that should be focused upon include:
    (i) Whale shark (*Rhincodon typus*)
    (ii) Ornate eagle ray (*Aetomylaeus vespertilio*)
    (iii) Reef manta ray (*Manta alfredi*)
    (iv) Northern Maldivian little heron (*Butorides striata didii*)
    (v) Presence of green and hawksbill turtles in reef flat areas; and also, to confirm the presence or absence of nesting.

19. In addition, consultations should seek to determine if any ecosystem services activities occur within the intertidal and marine areas at the ocean energy pilot sites, e.g., if fisheries and eco-tourism.

References:

Cousins, N.; Rees, A. F.; Godley, B.J. (2017). Announcement: A Sea Turtle Nesting Beach Indicator Tool to Help Identify Areas with Potential for Sea Turtle Nesting. Marine Turtle Newsletter No. 153, 2017 - Page 13.

Hodgson, G., Hill, J., Kiene, W., Maun, L., Mihaly, J., Liebeler, J., Shuman, C. and Torres, R. Reef Check Instruction Manual: A Guide to Reef Check Coral Reef Monitoring. Reef Check Foundation, Pacific Palisades, California, USA
EPA, (2012), EPA Data Collection Guideline
Maldives Seagrass Monitoring Network Methods, (2020)

ENVIRONMENTAL CODES OF PRACTICE

I. Environment

A. Chance Find Procedures

(i) If suspected physical cultural resources are encountered, all works at the find site should be immediately halted.

(ii) The find should be assessed by a competent official of government, and procedures to avoid, minimize or mitigate impacts to such physical cultural objects should then be agreed in writing with them.

(iii) Work will not begin or resume until the procedures to avoid, minimize, or mitigate impacts to the physical cultural resources have been agreed and implemented in full.

(iv) If avoidance is not feasible, and no alternatives to removal exist, cost-benefit assessment needs to be carried out to assess whether the project works should continue or stop at site. If the project benefits outweigh the anticipated cultural heritage loss from removal which is unlikely unless in case of resource of local value, following clearance of ADB, the physical cultural resources should be removed and preserved using the best available technique in accordance with relevant provisions of national heritage protection laws and decrees as well as international best archaeological practice.

(v) Records to be maintained of all finds, including chain of custody instructions for movable finds.

B. Pollution Prevention

1. Air Pollution (Dust)

(i) Use of modern equipment, exclude over-aged or worn-out equipment or vehicles from the construction site

(ii) Boats and trucks importing loose raw materials or removing spoil must be covered with tarpaulin to reduce dust generation

(iii) Position any stationary emission sources (e.g., pumps, diesel generators, compressors, etc.) as far as practical from the nearest properties

(iv) Impose speed limits on construction vehicles on off- and on-site access roads to minimize exhaust and dust emissions especially where access roads run adjacent to properties

(v) Prohibit engine idling

(vi) Stockpiles of spoil and other dust generating materials to be kept to a minimum necessary to undertake works for the day and covered with tarpaulin

(vii) Minimize double handling and drop loads

(viii) Cover exposed soil with materials like gravel to minimize re-suspension of dust

(ix) Sprinkle earthworks, off- and on-site access roads that are not blacktopped, and material stockpiles with water during the construction period to avoid dust being dispersed by wind and mitigate dust related issues due to frequent movement of construction vehicles as necessary i.e., 2-3 times per day but more often if needed during excavations, dry and windy conditions that enable dust to be easily mobilized and the dust to be visible.

(x) Regularly clean dust from the off-site access roads during and immediately after construction work is completed.

(xi) Strictly prohibit the burning of wastes generated by project-related activities.

(xii) Ensure workers working near or having long exposure to vehicle exhausts and earthworks are provided with clean N95 dust masks to avoid inhalation or particulate matter and other pollutants.

(xiii) Periodic medical respiratory checks to be performed on workers exposed to high dust levels.

2. Noise and Vibration

(i) Use of modern equipment, exclude over-aged or worn-out equipment or vehicles from the construction site

(ii) Select construction techniques and low noise generating equipment e.g., less than 55 dBA sound pressure level at 1m, and stage noisy works to limit their duration to minimize noise and vibration

(iii) Fit all equipment and vehicles used in construction with exhaust silencers where the manufacturer's design allows this

(iv) Position any stationary emission sources (e.g., pumps, diesel generators, compressors, etc.) as far as practical from the nearest properties

(v) Prohibit engine idling

(vi) Prohibit use of horn by construction vehicles

(vii) Impose speed limits on construction vehicles on off- and on-site access roads to minimize noise emissions especially where access roads run adjacent to properties

(viii) Provide appropriate PPE (acoustic ear plugs or earphones capable of reducing noise levels to 85 dB(A) for hearing protection) to any workers subjected to noise levels of 85 dBA for more than 8 hours per day and ensure they wear it e.g., if piling etc.

(ix) No unprotected ear should be exposed to a peak sound pressure level (instantaneous) of more than 140 dB(C) or average maximum sound levels of 110 dB(A).

(x) Periodic medical hearing checks to be performed on workers exposed to high noise levels of 80 dBA for more than 8 hours per day.

3. Soil and Water Pollution

(i) Avoid storage of all fuel, oil, and chemicals in areas adjacent to the marine environment, freshwater and wells to avoid direct contamination or contamination through run off

(ii) Drums, containers or tanks of fuel, oil, or chemicals to be labelled and kept in a designated, labelled storage area under lock and key when not in use

(iii) Establish dedicated fuel, oil, and chemicals stores (drums/containers/tanks) on impermeable bunded area of 110% volume to avoid spills and leaks contaminating soil and affecting water quality

(iv) Secondary containment design to also consider means to prevent contact between incompatible materials in the event of a release.

(v) Place all drums or containers of fuel, oil, or chemicals on drip trays not sited on impermeable surface with 110% bunded capacity.

(vi) Place all equipment that contains fuel or oil on drip trays it not sited on impermeable surface with 110% bunded capacity.

(vii) Undertake refilling or refueling only on areas of hard protected soil, preferably bunded, away from the marine environment freshwater and wells with all drainage directed through oil interceptors.

(viii) Provide drip trays/catch basins or other overflow/drip containment measures at connection points or possible overflow locations during refilling or refueling

(ix) Use of dripless hose connections for vehicle tanks and fixed connections with storage tanks

(x) Use dedicated fittings, pipes, and hoses on containers or tanks and regularly inspect their condition

(xi) Use of refilling or refueling equipment that is compatible and suitable for the characteristics of the materials being transferred and designed to ensure safe transfer

(xii) Overfills of drums, containers, and tanks to be prevented as they are among the most common causes of leaks and spills resulting in soil and water contamination

(xiii) Maintain procedures to prevent hazardous materials from being stored in incorrect containers or tanks

(xiv) Provide spill response kit with sufficient absorbent materials (e.g., sorbents, dry sand, sandbags) on-site for immediately soaking up any fuel, oil, or chemical leaks/spills that do accidentally occur

(xv) Undertake construction during the dry season to minimize exposed areas subject to erosion by surface water runoff and to avoid flood risk, leading to accidents and/or water contamination.

(xvi) Deep excavations to be limited to dry season to prevent the need to pump out and dispose of sediment laden water.

(xvii) Works over or near the marine environment will adopt protection measures to guard against loss of soil that would result in the turbidity of water.

(xviii) Minimize soil erosion and surface water runoff by reducing the extent of earthworks, revegetating earthworks on completion, and covering stores of sand and spoil with tarpaulin

(xix) Ensure surface water runoff from the construction site shall not discharge directly to surface water but shall be discharged through sedimentation basin and oil interceptor. Construction of three-stage sedimentation ponds/tanks with an inlet, mid, and outlet section is required to allow sediment to settle out of surface water runoff before release of water. Silt fences can be used to channel surface water runoff to the sedimentation pond/tank. The working volume of the sedimentation pond/tank must be sufficient to allow for a minimum hydraulic retention time of at least 120 minutes under the peak surface water runoff conditions. If runoff rates exceed the capacity of a sedimentation pond/tank, one or more additional sedimentation ponds/tanks will be needed in parallel to accommodate the higher flow rates. Maximum sediment accumulation in the sedimentation pond/tank must be 25% or less.

Figure 1: Sedimentation Pond or Tank Illustrations

Source: Minnesota Strom Water Manual, https://www.eng.auburn.edu/research/centers/hrc-temp/news/erosion-control.html, https://cals.ncsu.edu/crop-and-soil-sciences/extension/training-programs/workshops/erosion-and-sediment-control/

(xx) Provision of oil-water separator on all drainage systems
(xxi) If water from excavations is pumped it must be disposed of via a sedimentation basin, it must not be disposed of directly to the marine environment/freshwater
(xxii) Do not allow washing of equipment or vehicles in the marine environment/freshwater and ensure all washing water is discharged to sedimentation basin and oil interceptor instead of directly to surface water.
(xxiii) Provision of designated hard standing areas for equipment servicing, refueling and wash down located away from the marine environment freshwater and wells, with drainage directed through oil and grease interceptors before discharge into a settling pond
(xxiv) Cement will be stored in enclosed storage facilities and not exposed to the elements.
(xxv) Do not undertake any concrete mixing adjacent to the marine environment, freshwater and wells
(xxvi) Strict prohibition on open defecation and urination by construction workers
(xxvii) Only existing toilets and washing facilities connected to a wastewater treatment plant or septic tank (with soak pit) are to be used (no pit latrines)
(xxviii) No untreated wastewater is to be discharged direct to surface water or the ground
(xxix) Spent engine oil from the equipment will be collected and sent for recycling and re-use.

C. Materials and Waste Management

(i) Import all materials from existing licensed sources and keep records of all materials used, and sources.
(ii) Storage yards will be fenced using a solid fence to catch windblown material.
(iii) Minimize waste generation, restrict use of plastics and polyethene and use recyclable/biodegradable materials during construction to the extent possible
(iv) Use durable, long-lasting materials that will not need to be replaced as often, thereby reducing the amount of construction waste generated over time.
(v) Purchase perishable construction materials e.g., paints incrementally to reduce spoilage of unused materials.
(vi) Use building materials that have minimal packaging to avoid generation of excessive packaging waste
(vii) Use construction materials containing recycled content when possible and in accordance with technical standards
(viii) Prior to the start of works the contractor will ensure the waste management system is established at the construction sites

(ix) Separate waste containers (drums, bins, skips or bags) will be provided for different types of waste; prevent the commingling or contact between incompatible wastes and allow for inspection between containers to monitor leaks or spills
(x) Sensitize workers on good housekeeping and the environmentally sound storage and disposal of construction and wastes, and importantly not to leave garbage lying around.
(xi) Collect and segregate construction wastes including scrap metal, oil, and solid waste; ensure all workers are familiar with this segregation and arrange garbage bins to collect these wastes so they are not thrown on the floor
(xii) Clearly identifying (label) and demarcating the waste storage area(s) on a site plan
(xiii) Store all the wastes produced in an environmentally sound manner in designated, labelled area with separate waste containers (drums, bins, skips or bags) for each distinct type of waste.
(xiv) Store solid waste in enclosed bins to contain leachate and avoid vermin.
(xv) Store hazardous waste so as to prevent accidental releases to air, soil, and water resources in closed containers away from direct sunlight and rain
(xvi) Limiting access to hazardous waste storage areas to workers who have received proper training
(xvii) Secondary containment systems to be constructed using materials appropriate for the wastes being contained
(xviii) Provide adequate ventilation where volatile wastes are stored
(xix) Conducting periodic inspections of waste storage areas and documenting the findings
(xx) Encourage recovery of recyclable wastes that could be reused or sold to licensed recyclers, rather than disposing of it.
(xxi) Prohibit use of waste (e.g., empty cement bags and containers, plastic, wooden planks) for backfilling – only inert spoil may be used for backfilling to avoid need for off-site disposal (any excess inert spoil is to be disposed of at suitably licensed waste facilities).
(xxii) Prohibit burning of construction wastes.
(xxiii) Prohibit dumping of construction wastes on-site, into the marine environment, in agricultural fields etc.
(xxiv) Provide weekly toolbox talk to remind of the importance of waste disposal, prohibition of disposal on the road, in the marine environment etc., prohibition on burning of wastes, and open defecation and urination.
(xxv) Develop a procedure/system to penalize through escalating fines or similar any construction workers who breach these requirements.
(xxvi) Document all wastes removed off site (including excavated soil, solid and hazardous waste) using transfer notes, to be taken by licensed waste contractors who should reuse/recycle or dispose of the waste to suitably licensed and engineered waste management facilities according to type
(xxvii) Excavated spoil that cannot be reused to a licensed disposal site as suitable for accepting inert wastes ensuring no solid or hazardous wastes are comingled with the inert excavated spoil
(xxviii) Dispose of solid waste to suitably engineered and licensed sanitary waste facilities
(xxix) Ensure any hazardous waste such as oily rags or old drums disposed of in suitably licensed hazardous waste facilities

(xxx) Waste containers designated for off-site shipment to be secured and labelled with the contents and associated hazards, be properly loaded on the transport vehicles before leaving the site, and be accompanied by a shipping paper, that describes the load and its associated hazards

D. Emergency Preparedness and Response Planning

For spills and leaks an emergency preparedness and response plan tailored to the hazards associated with the project, should include:

(i) SOP for the management of containment structures, specifically the removal of any accumulated fluid, such as rainfall, to ensure that the intent of the system is not accidentally or willfully defeated
(ii) Implementation of inspection programs to ensure containment structures are physically intact and being well managed
(iii) Identification of locations of hazardous materials and associated activities on an emergency plan
(iv) Documentation of availability of specific personal protective equipment and training needed to respond to an emergency
(v) Documentation of availability of spill response equipment sufficient to handle at least initial stages of a spill and a list of external resources for equipment and personnel, if necessary, to supplement internal resources
(vi) Description of response activities in the event of a leak, spill, release, or other emergency including internal and external notification procedures, specific responsibilities of individuals, decision process for assessing severity of the incident and determining appropriate action, first aid and emergency medical treatment, evacuation routes, post-event activities such as clean-up and disposal, incident investigation, worker re-entry, and replenishment of used PPE and spill response equipment
(vii) Inspecting, testing, and maintaining the emergency response equipment
(viii) Training of workers on release prevention, including drills specific to hazardous materials stored on site

II. Health and Safety

Preventive and protective measures should be introduced according to the following order of priority:

(i) Eliminating the hazard by removing the activity from the work process.
(ii) Controlling the hazard at its source through use of engineering controls.
(iii) Minimizing the hazard through design of safe work systems and administrative or institutional control measures.
(iv) Providing appropriate personal protective equipment (PPE) in conjunction with training, use, and maintenance of the PPE.

A. OHS Training

(i) Provisions to be made to provide OHS orientation training to all new workers to ensure they are apprised of the basic site rules of work at / on the site and of personal protection and preventing injury to fellow workers.
(ii) Training should consist of basic hazard awareness, site- specific hazards, safe work practices, and emergency procedures for fire, evacuation, and natural disaster, as appropriate. Site-specific hazard or color coding in use should be thoroughly reviewed as part of orientation training.

(iii) Specialty courses should be provided, as needed, to ensure that workers are oriented to the specific hazards of individual work assignments.
(iv) Training to be provided to management, supervisors, workers, and occasional visitors to areas of risks and hazards.
(v) Workers with rescue and first-aid duties should receive dedicated training so as not to inadvertently aggravate exposures and health hazards to themselves or their co- workers.

B. Good Health and Safety Practices

(i) Always ensure good housekeeping in the premises, including on construction site, workers camps, storage areas, etc.
(ii) The perimeter is to be kept neat and tidy, with no trip hazards on the ground e.g., open channels, materials, equipment, trash laying around.
(iii) Do not leave hazardous conditions (e.g., unlit open excavations without means of escape) overnight
(iv) Drums/containers/tanks that may contain substances that are hazardous because of chemical or toxicological properties, or temperature or pressure, to be labeled as to the contents and hazard, or appropriately color coded.
(v) Check the load of the vehicles before use, all drivers, and passengers to fasten seatbelt and comply with all transportation-related health and safety laws and regulations.
(vi) Examination of all equipment and tools' quality and the presence of operational safety features before use
(vii) Checking all electrical cords, cables, and hand power tools for frayed or exposed cords and following manufacturer recommendations for maximum permitted operating voltage of the portable hand tools
(viii) Untrained workers will not be permitted to work with live electricity or at height.
(ix) Observe IFC EHS Guideline on Electric Power Transmission and Distribution requirements for working with live electricity - only allow suitably trained workers that meet the requirements set out in above-referred IFC guideline to work with live electricity with strict adherence to safety standards including those listed in said guidelines; these workers must have training record of attending suitable training course on electrical safety and be provided with and wear the appropriate PPE for their role.
(x) Ensure proper grounding and deactivation of any live electricity during construction work or before any work near power lines and that this has been checked and certified by the H&S Officer in advance.
(xi) Measure exposure levels to electromagnetic fields (EMF) and provide workers working in zones where EMF levels are above reference levels with personal EMF monitoring device to be attached onto their PPE.
(xii) Require workers to observe the minimum approach distances for excavations, tools, vehicles, pruning, and other activities when working around power lines.
(xiii) Double insulating/grounding all electrical equipment used in environments that are, or may become, wet; using equipment with ground fault interrupter protected circuits
(xiv) Marking all energized electrical devices and lines with warning signs
(xv) Labelling of service rooms housing high voltage equipment (electrical hazard) and where entry is controlled or prohibited conducting detailed identification and marking of all buried electrical wiring prior to any excavation work

(xvi) Fall prevention and protection measures should be implemented whenever a worker is exposed to the hazard of falling >2m:
(xvii) Observe IFC EHS Guideline on Electric Power Transmission and Distribution requirements for working at height; only allow suitably trained and qualified workers to work at height, these workers must have training record of attending suitable training course and be provided with and wear the appropriate PPE for their role.
(xviii) Require workers to test the structural integrity of towers prior to proceeding with the work.
(xix) Proper use of ladders and scaffolds by trained workers
(xx) Installation of guardrails with mid-rails and toe boards at the edge of any fall hazard area
(xxi) Use fall protection measures when working on towers, i.e., mobile elevated working platform, and all workers at height are required to wear body harness. Safety belt and lanyard travel limiting devices to prevent access to fall hazard area, or fall protection devices such as full body harnesses used in conjunction with shock absorbing lanyards or self- retracting inertial fall arrest devices attached to fixed anchor point or horizontal lifelines
(xxii) Ensure sufficient harnesses and gear are available on site for all workers, that workers are trained to use such harness and are obligated to always use the latter when working at height.
(xxiii) Inclusion of rescue and/or recovery plans, and equipment to respond to workers after an arrested fall
(xxiv) Implementation of safety measures while excavating to avoid collapse e.g., shoring if soil unstable
(xxv) PPE to be provided for all workers (regardless formal and informal, directly contracted or subcontracted) in accordance with Table 2.7.1. Summary of Recommended Personal Protective Equipment According to Hazard in IFC EHS Guidelines on OHS.
(xxvi) Enforce disciplinary system (e.g., immediate removal from site) for non-compliance with PPE requirements and other health and safety measures (e.g., social distancing for COVID-19).
(xxvii) Eye wash station and water supply to shower to be provided during works due to risk of fuel, oil, or chemical encountering skin.
(xxviii) During construction works, ensure qualified first aider and trained fire marshal is always available on-site with an appropriately equipped first aid kit and appropriate fire extinguisher and other firefighting equipment immediately available for use.
(xxix) Provide an ambulance for more serious cases to transport the patient to the hospital for treatment
(xxx) Prepare signboards reminding of health and safety measures and procedures to follow in case of accident, including key contact details (ambulance, doctor, hospital, etc.)
(xxxi) Keep a log of all incidents, near-misses and accidents and include these in monthly monitoring reports
(xxxii) Check health condition of workers on daily basis, for example, use of self-certification forms and temperature checks before being allowed on the construction site with more thorough monthly health checks by qualified medical professional.

(xxxiii) Temporary construction camps will include proper sanitation, alternative fuel to firewood, clean eating area, water supply, and secure storage of domestic solid wastes for disposal off site to suitably licensed waste management facilities.
(xxxiv) Pit latrines prohibited, and adequate number (about 1 toilet per 6 workers, segregated male and female) of toilets and washing facility with hot and cold running water.
(xxxv) Toilets to be equipped with soap and hand sanitizer.
(xxxvi) There should be an indication of whether toilet and washing facility is “in use” or “vacant” if not gender segregated
(xxxvii) Toilets should be cleaned at least twice daily to ensure they are kept in a hygienic condition.
(xxxviii) Prevent standing water as it may become a breeding habitat for mosquitoes etc.
(xxxix) Provide workers with access to a shaded rest area on-site.
(xl) Provide workers with a clean eating area for breaks and lunchtime.
(xli) Provide all construction workers will an adequate supply of potable drinking water meeting national standards.
(xlii) If ground or surface water is used for drinking water, it must first be tested to confirm it meets drinking water standards and continue to be regularly tested. If drinking water standards are not met, potable water shall be imported to site.
(xliii) If workers are not local to the area use may be made of existing accommodation facilities but if a construction camp is provided it must be adequately equipped with sufficient toilets, hand washing facilities, showers or baths, food preparation and clean eating area, etc.
(xliv) Installation of barriers (a temporary fence ideally solid fence) at construction areas with hazard warning signs to deter people from accessing the construction site
(xlv) Require all project drivers to always abide by Maldives road safety regulations.
(xlvi) Road safety and warning signs must be posted at 500m, 100m, and immediately in advance of the works at least two weeks prior to the works commencing to inform the public of the temporary blockage.
(xlvii) Access to the construction site will be under traffic controls when trucks enter and exit.
(xlviii) Establishing rights-of-way, site speed limits, vehicle inspection requirements, operating rules and procedures, and control of traffic patterns or direction
(xlix) Ensuring drivers undergo medical surveillance
(l) Ensuring moving equipment with restricted rear visibility is outfitted with audible back-up alarms
(li) Construction workers including subcontractors will be given awareness raising in HIV/AIDS, other communicable diseases including COVID-19, and sexual, exploitation, abuse, and harassment with strict penalties (e.g., immediate removal from site) for any non-compliance of workers to an agreed code of practice
(lii) Avoid ponding of water during construction to avoid habitat creation of vector borne diseases e.g., malaria.
(liii) No employee should be exposed to a noise level greater than 85 dB(A) for a duration of more than 8 hours per day without hearing protection. In addition, no unprotected ear should be exposed to a peak sound pressure level (instantaneous) of more than 140 dB(C).
(liv) Use of hearing protection should be enforced actively when the equivalent sound level over 8 hours reaches 85 dB(A), the peak sound levels reach 140 dB(C), or

the average maximum sound level reaches 110dB(A). Hearing protective devices provided should be capable of reducing sound levels at the ear to at least 80 dB(A).

(lv) Hearing protection is preferred for any period of noise exposure more than 80 dB(A) an equivalent level of protection can be obtained, but less easily managed, by limiting the duration of noise exposure. For every 3 dB(A) increase in sound levels, the allowed exposure period or duration should be reduced by 50%.

(lvi) Prior to the issuance of hearing protective devices as the final control mechanism, use of acoustic insulating materials, isolation of the noise source, and other engineering controls should be investigated and implemented, where feasible

(lvii) Storing flammables away from ignition sources and oxidizing materials.

(lviii) Defining and labelling fire hazards areas to warn of special rules (e.g., prohibition in use of smoking materials, cellular phones, or other potential spark generating equipment)

(lix) Providing specific worker training in handling of flammable materials, and in fire prevention or suppression

(lx) Oxyacetylene burning equipment will not be permitted in any confined space.

(lxi) Burning equipment of the oxy-propane type shall be used.

C. Construction Occupational Health and Safety Plan

Occupational Health and Safety Plan (OHSP) will aim to ensure that the workplace is safe and healthy by addressing the hazards and risks at the workplace; outlining the procedures and responsibilities for preventing, eliminating and minimizing the effects of those hazards and risks; identifying the emergency management plans for the workplace or workplaces; and specifying how consultation, training and information are to be provided to employees at various workplaces.

1. Steps to ensure maximizing of safety at construction site. The contactor will be responsible for implementation of the following:

(i) Installation of signboards and symbols in risky and hazardous areas, to inform workers to be careful.

(ii) Ensuring that materials are all stacked, racked, blocked, interlocked, or otherwise secured to prevent sliding, falling, or collapse.

(iii) Vehicles will be moved only along pre-assigned routes and have well-functioning horns, reverse light and buzzer, rear view mirrors, etc.

(iv) Removing all scrap and waste material from the immediate work area as the work progresses.

(v) Use only trained staff to construct, install, handle, and repair all electrical equipment to prevent risks of electrical shocks and electrocution.

(vi) Install fire extinguishers and/or other fire-fighting equipment at every work site to prepare for any accidental fire hazards.

(vii) First aid kits shall be always made available throughout the entire construction period. Arrangement shall be made to ensure medical attention for workers who have met with an accident or sudden illness at any time during the construction period.

(viii) Fire protection: the employer shall be responsible for fire protection and prevention throughout all phases.

(ix) Hand and power tools: Conditions of all hand and power tools or other reciprocating, rotating, or moving parts of equipment shall be maintained by the employer in a safe condition to prevent any accidents.

(x) Aisles and passageways shall be kept clear to provide free and safe movement of material handling equipment and workers. Material if stored/stacked at roadside must not hinder free movement of vehicles and persons.

(xi) The areas used for construction shall be kept in good repair to ensure safe movement of vehicle or person.

2. **Personnel protective equipment**. Risks to the health and safety of workers can be prevented by provision of Personal Protective Equipment (PPEs) for all workers. Personal protective equipment like safety gloves, helmet, mufflers etc. will be provided during the construction period and during the maintenance work. Depending on the nature of work and the risks involved, contractors must provide, without any cost to the workers, the following protective equipment. All PPE must be of good quality with mark of quality standard certification.

(i) Helmet shall be provided to all workers, or visitors visiting the site, for protection of the head against impact or penetration of falling or flying objects.

(ii) Safety belt shall be provided to workers working at heights for bridge construction, etc.

(iii) Safety boots shall be provided to all workers for protection of feet from impact or penetration of falling objects on feet.

(iv) Ear protecting/ earmuffs/plugs shall be provided to all workers in high noise zones.

(v) Eye and face protection equipment shall be provided to all welders to protect against sparks.

(vi) Respiratory protection devices shall be provided to all workers during occurrence of fumes, dusts, or toxic gas/vapor.

(vii) The supervisor must ensure that appropriate personal protective equipment is available to workers; properly worn when required and properly cleaned, inspected, maintained, and stored.

(viii) A worker shall be responsible for using the items of personal protective equipment provided by the employer.

(ix) A worker who is required to use personal protective equipment must-

(a) Use the equipment in accordance with training and instruction.

(b) Inspect the equipment before use.

(c) Refrain from wearing protective equipment outside of the work area which if done so would constitute a hazard; and

(d) Report any equipment malfunction to the supervisor or employer.

(x) A worker who is assigned responsibility for cleaning, maintaining, or storing personal protective equipment must do so in accordance with training and instruction provided.

(xi) The safety and emergency procedures manual will be kept. Necessary training regarding the safety aspects of the personnel working at the project site will be provided.

(xii) First aid facilities will be made available, and doctors will be called when necessary.

Personal Protective Equipment for Safety of Different Body Parts

Sr. No.	Body Part to be protected	Personal Protective Equipment
1	Head	Safety helmet, hard hat, Crash helmets
2	Eye	Eye protectors, eye protectors for radiations, shield and helmet, zero power goggles
3	Ear	Earplug, earmuffs
4	Noise-Mouth	Du respirator, gas mask, self-contained breathing apparatus, dust masks
5	Hand	Standard work gloves, cutting gloves, leather work gloves, heat protective gloves, anti-vibration gloves
6	Foot	Industrial safety boots, chemical-proof boots
7	Body	Standard work clothing, chemical-proof clothing, heat protective clothing, leather apron
8	Others	Safety belts, personal protective equipment for radiation protection, back support belts
9	COVID-19	Sanitizer, masks, etc.

Contents of First-Aid Box

Sr. No.	Description	Quantity
1	First aid leaflet	1 copy
2	Sterilized finger dressing	10 nos.
3	Sterilized hand or foot dressing	10 nos.
4	Sterilized body or large dressing	6 nos.
5	Sterilized burns dressing - small	4 nos.
6	Sterilized burns dressing - large	2 nos.
7	Sterilized burns dressing – extra large	6 nos.
8	Sterilized cotton wool (25 gms)	2 tubes
9	Cetavolon	2 tubes
10	Eye pads	6 nos.
11	Adhesive plaster	1 spool
12	Assorted roller bandage	6 nos.
13	Triangular bandages	6 nos.
14	Safety pins	6 nos.
15	Scissors, ordinary, 12.7cms, both sides sharp	1 pair
16	Antiseptic liquid, 150 ml, or equivalent	2 nos.
17	Cotton wool for padding, 100 gms	2 packets
18	Eye Ointment of sulphacetamide preparation	1 tube
19	Loose woven gauze (28”x8”), compressed pack	1 packet
20	Aspirin, 300 mg (10 tablets)	5 strips
21	Note Pad, with a pencil in a plastic cover	1 no.
22	Adhesive dressing strips	10 strips
23	Field dressing of modified army pattern	3 nos.
24	Record cards in a plastic cover	1 set
25	Torch, medium size	1 no.
26	Eye wash	1 no.
27	Wooden splints, small	1 set
28	Wooden splints, big	1 set
29	Disinfectant, Spirt, 100ml	1 bottle

3. **Health management plan**. Full-fledged hospital facilities should be made available round the clock for attending emergency arising out of accidents, if any. All working personnel should be medically examined at least once every six

month and at the end of his/her term of employment. This is in addition to the pre-employment medical examination. Contractor will implement the following:

(i) **Medical emergency response planning for disaster management plan.**
- (a) Control of vectors in the project site; stagnant water to be drained off, raise awareness among the workers to combat spread of vector borne diseases, self-hygiene.
- (b) Screening Programs for Diabetes, Hypertension, COVID-19, AIDS, and Occupational Diseases etc.
- (c) Preventive Health Examinations e.g., Pre-employment, Periodic (Annual) health examinations.
- (d) Medical Surveillance Program for health impacts of hazards.
- (e) Workers Immunization against Tetanus, Hepatitis, COVID-19 etc.

(ii) **Records and documentation**. Contractor will document and keep record making them available for review. Reports prepared by the contractor should include information on the place, date and time of the incident, name of persons involved, cause of incident, witnesses present and their statements. Based on such reports, the management can jointly identify any unsafe conditions, acts or procedures and recommend for the contractor to undertake certain mitigative actions to change any unsafe or harmful conditions.

(iii) **Accidents and diseases monitoring**. Establish procedures and systems for reporting and recording:
- (a) Occupational accidents and diseases
- (b) Dangerous occurrences and incidents
- (c) These systems should enable workers to report immediately to their immediate supervisor any situation they believe presents a danger to life or health.
- (d) The systems and the employer should further enable and encourage workers to report to management all:
  - (1) Occupational injuries and near misses
  - (2) Suspected cases of occupational disease
  - (3) Dangerous occurrences and incidents

All reported occupational accidents, occupational diseases, dangerous occurrences, and incidents together with near misses should be investigated with the assistance of a person knowledgeable/competent in occupational safety. The investigation should: Establish what happened; Determine the cause of what happened, identify measures necessary to prevent a recurrence, Distinction is made between fatal and non-fatal injuries. The two main categories are divided into three sub-categories according to time of death or duration of the incapacity to work. The total work hours during the specified reporting period should be reported to the appropriate regulatory agency.

(iv) **Compensation for Injuries and death**. Any casualty or injury resulting from occupational activities should be compensated as per Maldives regulations. Where compensation is sought by the injured party, proper procedures for documentation of the case will be followed, including a detailed report on the accident, written reports from witnesses, report of the examining doctor and

his/her recommendation for treatment. Each individual contractor will be responsible for ensuring compensation for the respective workers.

(v) **Offences**. Workers should abide by the following regulations also, which are to be supervised by the Contractor:
- (a) No gambling is to be in project site area, either construction site or camps, which may lead to conflicts
- (b) No drugs or alcohol abuse to be tolerated in the project site area
- (c) Workers should not be minor (below 18 years age)

Restriction on keeping any dangerous arms or equipment (licensed or not) when in the project area, except for security personals.

(vi) **Structural Safety of Project Infrastructure**
- (a) Inclusion of buffer strips or other methods of physical separation around project sites to protect the public from major hazards associated with hazardous materials incidents or process failure, as well as nuisance issues related to noise, odors, or other emissions
- (b) Incorporation of siting and safety engineering criteria to prevent failures due to natural risks posed by earthquakes, cyclone, cloud burst, flooding, and fire. To this end, all project structures should be designed in accordance with engineering and design criteria mandated by site-specific risks, including but not limited to seismic activity, wind loading, and other dynamic loads
- (c) Application of locally regulated or internationally recognized building codes to ensure structures are designed and constructed in accordance with sound architectural and engineering practice, including aspects of fire prevention and response
- (d) Engineers and architects responsible for designing and constructing facilities, building, plants, and other structures should certify the applicability and appropriateness of the structural criteria employed.

(vii) **Fire prevention**. Fire prevention addresses the identification of fire risks and ignition sources, and measures needed to limit fast fire and smoke development. These issues include:
- (a) Fuel load and control of combustibles
- (b) Ignition sources
- (c) Interior finish flame spread characteristics
- (d) Interior finish smoke production characteristics
- (e) Human acts, and housekeeping and maintenance
- (f) Fire Suppression and Control. Fire suppression and control includes all automatic and manual fire protection installations, such as:
- (g) Automatic sprinkler systems
- (h) Manual portable extinguishers
- (i) Fire hose reels

(viii) **Emergency response plan.** An Emergency Response Plan is a set of scenarios–based procedures to assist staff and emergency response teams during real life emergencies and training exercises.

(ix) **Traffic safety**

(a) Traffic safety should be promoted by all project personnel during displacement to and from the workplace, and during operation of project equipment on private or public roads. Prevention and control of traffic related injuries and fatalities should include the adoption of safety measures that are protective of project workers and of road users, including those who are most vulnerable to road traffic accidents. Road safety initiatives proportional to the scope and nature of project activities should include:

(b) Adoption of best transport safety practices across all aspects of project operations with the goal of preventing traffic accidents and minimizing injuries suffered by project personnel and the public. Measures should include:

(c) Emphasizing safety aspects among drivers

(d) Improving driving skills and requiring licensing of drivers

(e) Adopting limits for trip duration and arranging driver rosters to avoid overtiredness

(f) Avoiding dangerous routes and times of day to reduce the risk of accidents

(g) Use of speed control devices (governors) on trucks, and remote monitoring of driver actions

(h) Regular maintenance of vehicles and use of manufacturer approved parts to minimize potentially serious accidents caused by equipment malfunction or premature failure.

(x) The procedures for transportation of hazardous materials should include:

(a) Proper labelling of containers, including the identify and quantity of the contents, hazards, and shipper contact information

(b) Providing a shipping document (e.g. shipping manifest) that describes the contents of the load and its associated hazards in addition to the labelling of the containers. The shipping document should establish a chain-of-custody using multiple signed copies to show that the waste was properly shipped, transported and received by the recycling or treatment/disposal facility

(c) Ensuring that the volume, nature, integrity and protection of packaging and containers used for transport are appropriate for the type and quantity of hazardous material and modes of transport involved

(d) Ensuring adequate transport vehicle specifications o Training employees involved in the transportation of hazardous materials regarding proper shipping

(e) procedures and emergency procedures using labelling and placarding (external signs on transport vehicles), as required

(f) Providing the necessary means for emergency response on call 24 hours/day

D. Operational Occupational Health and Safety Plan

Powerhouses have significant hazards present which can result in injury or death. Risks should be reduced through proper hazard identification, careful planning of works, briefing of procedures to be followed, documented and regular inspection and maintenance. The health

and safety objective of O&M of all project facilities is to keep all people at the site, visitors, or workers, and to operate the facility in a safe manner so that health and safety are integrated into all that we do. It is important that all O&M personnel have the relevant qualifications to perform the works in a safe, responsible, and accountable manner. Managing the risks posed by the plant to the health and safety of people, both on and around the plant, is a primary concern of all stakeholders.

(i) Any person coming on to the plant should expect some form of induction to ensure they are briefed on any hazards and risks.
(ii) Staff working on electrical equipment must be appropriately trained, experienced, and supervised, but it is also key that others working around the equipment - for example panel cleaners - are equally aware of the potential risks and have safe methods of working around HV and LV electricity.
(iii) Hazardous areas and equipment should carry appropriate markings to warn personnel of possible hazards and wiring sequence. Such markings should be clear and evident to all personnel and third parties (and intruders) entering the plant premises.
(iv) It is important that the plant access control and security system keeps people away from areas of danger and that they are appropriately supervised and inducted as necessary.
(v) FENAKA is ultimately responsible for the compliance of health and safety regulations within the site/plant.
(vi) FENAKA must make sure that, always, the installation and all equipment meet the relevant legislations of the country and also, that all contractors, workers and visitors respect the H&S legislation by strictly following the established procedures, including the use of established personal protective equipment (PPE).
(vii) At the same time, the O&M Contractor employed for various works should prepare and operate its own safety management systems to be agreed with FENAKA taking into account site rules and the works in relation to health and safety and perceived hazards.
(viii) To achieve a safe working environment, all work must be planned in advance, normally written plans are required.
(ix) Risk assessments need to be produced which detail all the hazards present and the steps to be taken to mitigate them.
(x) The following dangers are likely to exist on most power plant and must be considered when listing hazards in order to identify risks. The severity of any injuries caused may be exacerbated by the terrain and remoteness of the plant.

1. General Health and Safety Instructions

It is critical personnel know and understand the safety rules and requirements that apply to the work being performed. Specifically, to:

(i) Follow all safety programs, policies, procedures and work rules
(ii) Ensure your own safety and the safety of your fellow workers
(iii) Ensure there are a sufficient number of qualified workers to perform the work
(iv) Immediately address any unsafe conditions or behaviors observed in the workplace
(v) Immediately report any unsafe condition so that it can be corrected

(vi) If you encounter an unsafe condition, feel that there is an unaddressed safety concern or are not comfortable with your ability to perform a job...STOP and resolve the situation before continuing work.

2. General Site Safety Rules

All contractor personnel working or visiting the site for the first time must receive Safety Induction Training prior to being allowed access to the array or any equipment

(i) All contractor personnel must report to work fit for duty and free of the effects of drugs or alcohol
(ii) Personnel shall not consume alcohol or drugs while working or driving
(iii) All visitors must be escorted while on site unless they have completed appropriate training and have been approved for unescorted access
(iv) All personnel must always wear the appropriate Personal Protective Equipment (PPE)
(v) Electrical work shall be performed under a Lockout Tag out and only after the circuit has been tested to ensure a zero-energy state
(vi) Authorization and a Confined Space Entry Permit shall be obtained prior to working in a classified confined space
(vii) Never walk under a suspended load
(viii) Do not use mobile phones while driving or operating equipment
(ix) Always wear a seat belt in vehicles and do not exceed the posted speed limits
(x) All accidents, injuries, spills or environmental incidents and near-miss events shall be reported to the site in charge or designee as soon as possible. In all cases reports must be made within 24 hours

3. Emergency Response Instructions

(i) Ensure a two-way communication means is available on site for prompt emergency response, as a minimum this is to be an operating Mobile Phone
(ii) Ensure emergency contact information is readily available. The “Emergency Contact Poster” should be prominently posted in the OPERATIONS building for quick and easy access
(iii) Immediately contact the Site In charge or Designee to inform of the emergency
(iv) In the event of an emergency, the safety of people shall always be the PRIORITY
(v) Attend to any injured personnel in so far as is required to prevent further injury and provided no other person is put at risk in the process
(vi) All personnel on the site shall be alerted to emergencies by verbal command and directed to a designated Muster Point.
(vii) Emergency Muster Point
    (a) The location of the site emergency muster point or evacuation area is the Main Plant Access Gate. This will be communicated during the Site Safety Induction training
    (b) Once emergency services have been notified, site personnel shall, at the earliest opportunity, contact the Site In charge to report the incident and determine the appropriate course of action.

4. First aid

(i) FENAKA will make sure that all its personnel and contractors have access to the necessary first aid facilities and competent personnel as required under safety legislation, including a list of First Aid officers and training requirements

(ii) A First Aid Kit and an Automated External Defibrillator (AED) will be made available on site
(iii) First Aid Kits are to be available in the O&M Building and in the vehicles
(iv) An AED will be in the O&M Building.

5. Incident reporting

(i) A vital part of performing quality work includes the ongoing responsibility for each worker to evaluate working conditions for themselves and their co-workers and to promptly report any unsafe conditions or any condition which may lead to or cause a safety violation.
(ii) FENAKA will not terminate, discipline, or otherwise discriminate against any employee for bringing safety or environment concerns to the attention of supervision.
(iii) All incidents that cause or have the potential to cause personal injury or damage to property or material harm to the environment must be externally reported and investigated to prevent re-occurrence.

6. What is to be reported:

(i) All injuries or illnesses, regardless of severity, sustained by employees, contractors and visitors or members of the public
(ii) Any site property damage
(iii) Any damage to the environment. However only material harm incidents are reported externally
(iv) Any hazard or near-miss incident which has the potential for injury, illness or damage to the environment, property, or assets
(v) All medical treatment injuries and first aid injuries are to be reported.

7. Why is it to be reported:

(i) To initiate the process of assessment of risks associated with a hazard or incident and investigation of its causes, so that corrective actions can be implemented to prevent future occurrences
(ii) To allow us to learn from the experience of others, thus maintaining a prevention focus

E. Housekeeping and Orderliness

9. Prior to entering work location, employees should STOP to observe the work area and make note of any hazards, or conditions that may have changed since their last entry. The following are general rules of good housekeeping and orderliness that enhance the ability to work safely:

(i) Scrap, trash, and other wastes shall be placed in the appropriate designated containers
(ii) Waste shall be placed in containers specifically designated for that material
(iii) Areas shall be cleaned up as the work progresses
(iv) Cords and hoses shall not be routed in walkways. They should be routed, preferably overhead, in a manner that shall not present a tripping hazard
(v) Tools and equipment shall be properly stored in a stable position (tied, stacked, or choked) to prevent rolling or falling
(vi) Cleaning materials and consumables shall be kept in approved containers and stored properly

(vii) Safe access to all work areas and emergency exits shall be maintained
(viii) Do not block emergency equipment, electrical disconnect switches or breaker panels. Cables, ropes, barricade tape, hoses, or shielding shall not be attached to such equipment
(ix) Work areas shall be checked at the beginning and end of each shift to ensure safe conditions.
(x) Work areas shall have adequate lighting.
(xi) Personnel must take responsibility for identifying housekeeping hazards that contribute to an unsafe work environment by reporting them promptly to their immediate supervisor or by removing the hazard.

8. Office Safety

(i) When using stairs, hold handrails to maintain two points of contact
(ii) Keep stairways, hallways, aisles, and walkways clear of clutter and tripping hazards
(iii) Go around corners slowly to avoid collisions
(iv) Do not run or slide across floors or through doorways
(v) Open doors slowly to avoid striking someone on the other side
(vi) Use door handles, do not push on glass panes on doors
(vii) No smoking in offices or storage areas
(viii) Keep desks, file and cabinet drawers, door slides and locker doors closed when not in use
(ix) Know the location of emergency exits, fire extinguishers, and first aid kit
(x) Use proper ladders or portable steps to gain access to elevated materials and equipment
(xi) Do not use chairs, desks, or tables as a substitute for proper ladder
(xii) Ensure all power cords and extension cords are properly insulated and placed so to not create a tripping hazard
(xiii) Do not store materials on top of racks or shelves within 50cm of light fixtures, light bulbs, or sprinkler heads
(xiv) Do not store materials in front of mounted fire extinguishers or within 40cm of electrical panels
(xv) Principles of good housekeeping should be adhered to.

9. Personal Protective Equipment

(i) **General PPE Instructions**. Inspect all PPE prior to use to ensure it is safe, properly assembled and not visibly defective. Personal Protective Equipment (PPE) shall be maintained in a sanitary and reliable condition. Damaged or otherwise unserviceable PPE shall be properly disposed of and replaced. Personnel shall be trained and must demonstrate that they understand the following:
  (a) When PPE is necessary
  (b) What PPE is necessary
  (c) How to properly adjust, wear and use PPE
  (d) The limitations of the PPE
  (e) The care, maintenance, useful life, and disposal of PPE.

(ii) **Minimum PPE Requirements**. PPE requirements are based on Job Hazard Analysis for the specific work that is to be performed. Minimum PPE requirements

are usually established for routine work such as site tours and visual inspections. These minimum requirements are:

(a) Hard Hat
(b) Safety Glasses
(c) Safety Shoes –Safety Toed with Electrical rated soles preferred
(d) Work Clothing – No shorts, sweatpants or sleeveless shirts allowed. Long pants and work type shirt (long or short sleeved). Site Technicians are required to wear Arc Rated clothing as part of their regular work uniform (HRC 2 or > 8.1 cal/cm2)
(e) Work Gloves – Leather, shall be carried if there is a possibility of material handling.
(f) Based on the job you are performing additional PPE may be required. Additional PPE may include:
(g) Arc Rated (FR) Clothing–Arc rating is based on Arc Hazard Analysis and is typically identified on Equipment Arc Flash Hazard Labels. Clothing may include shirt and pants or could include higher rated Arc Flash Suits
(h) Arc Flash Face Shield – Arc Flash Face Shields are required where hazards are HRC 2 or above
(i) Hearing Protection – For areas posted as greater than 80dB or where noise levels make it difficult to hear another worker speaking
(j) Safety Vest – To improve visibility
(k) Kevlar or cut resistant gloves – For glass handling activities
(l) Protective Chemical Clothing – If exposed to or handling chemicals
(m) Insulated gloves for electrical work.

(iii) FENAKA will provide PPE including hard hats, safety eyeglasses, hearing protection, and work gloves.

(a) Work Clothing: Arc Flash Clothing including a shirt covering the shoulders and trousers covering the legs and ankles shall be always worn when working on or near energized electrical equipment.
(b) Arms—When working in the vicinity of energized lines or equipment (both high and low voltage), on high temperature lines, grinding, welding, or other high exposure hazards to the arm, full-length sleeves shall be worn.
(c) Legs—Workers should not have cuffs on trousers when welding or performing any job that produces sparks.

10. Personnel Work Policy

(i) Working Alone

(a) A person is alone at work when they are on their own, when they cannot be seen or heard by another person, and when they cannot expect a visit from another worker or member of the public for some time.
(b) The risk of injury or harm to an individual who works alone may be increased because of difficulty contacting emergency services when they are required.
(c) Emergency situations may arise because of the sudden onset of a medical condition, accidental work-related injury or disease, attack by an animal, exposure to the elements, or by becoming stranded without food or water.

(d) The consequences may be very serious, and the injury or disease may be fatal.

(e) In preparing to undertake work that may involve working alone, the following must be considered:

(1) When and wherever possible, avoid working alone. Tasks should be scheduled during normal business hours, or when another worker capable of helping in the event of an emergency is present.

(2) The work to be done, which will typically be energy isolation activity (and conducted as part of energy isolation, should be discussed during the pre-start discussion for that day.

(3) Regular communication (via radio) should be made by the person undertaking the work and they should check back in after the work is completed.

(ii) **Working at Night**

(a) There may be a requirement to work at night, this poses several additional hazards and risks to personnel than normal day working; these are typically related to visibility and the ability to move around the site safely

(b) Working at night requires some specific activities to occur (during daylight hours) to ensure the night shift personnel are assisted and protected from hazards and risks. For example, appropriate lighting equipment must be in place to provide adequate illumination of the work area and immediate surrounds to ensure personnel have optimal visibility

(c) All work at night shall be assessed and approved by the site in charge on a case-to-case basis.

(iii) **Hand and Power Equipment**

(a) All hand-held power tools and appliances are protected by an RCD

(b) Where available, only double insulated power tools are used at the site

(c) Power tools, leads and plugs are regularly tested-and tagged for external damage or makeshift repairs

(d) Do not use tools if the casing, cords or plugs are broken or damaged

(e) Do not adjust tools without first switching off and removing the plug from the outlet.

(f) All personnel required to use hand tools and/or power equipment, including chain saws, brush cutters, powder-actuated tools, and similar high-hazard implements, are appropriately trained to enable the safe operation of such equipment.

(iv) **General EHS requirements include but not limited to:**

(a) Use the right tool for the job

(b) Don't use broken or damaged tools, dull cutting tools, or screwdrivers with worn tips

(c) Cut in a direction away from the body

(d) Make sure grip and footing are secure when using large tools

(e) Always keep tools secure when working at heights

(f) Pass a tool to another person by the handle - never throw a tool

(g) Use the right PPE for the job

(h) Never carry sharp or pointed tools such as a screwdriver in a trouser pocket

(i) Select ergonomic tools for the work task, particularly when movements are repetitive and forceful
(j) Ensure tools are always kept in good condition
(k) Store tools properly at the end of shift.
(l) Personnel shall also inspect all hand tools and power equipment on a regular basis. Defective tools or equipment shall be immediately removed and tagged Out of Service or destroyed to prevent further use.

11. Material Handling and Storage

(i) **Musculoskeletal injuries.** A musculoskeletal disorder is an injury or disease of the musculoskeletal system. Musculoskeletal disorders may arise in whole or in part from performing manual tasks in the work environment, whether occurring suddenly or over a prolonged period. Musculoskeletal disorders include body-stressing injuries and conditions such as:
(a) Sprains and strains of muscles, ligaments and tendons (e.g. back strain)
(b) Joint injuries or degeneration (e.g. frozen shoulder or arthritis of the back)
(c) Disc protrusions, disc herniations or disc degeneration of the back or neck
(d) Nerve injury or compression (e.g., carpal tunnel syndrome)
(e) Muscular and vascular disorders (e.g. vibration-induced white finger from hand-arm vibration)
(f) Soft tissue injuries. Musculoskeletal disorders may result from:
(g) Gradual wear and tear caused by frequent or prolonged periods of performing manual tasks
(h) Sudden damage caused by intense or strenuous manual handling or awkward lifts
(i) Direct trauma caused by unexpected events.

(ii) **Preventing Injuries**
(a) Prior to undertaking any manual handling activity, personnel must evaluate the object and the required task to determine if they can handle the object safely.
(b) Some evidence shows that the risk of back injury increases significantly with objects over 16 kg, therefore, from a standing position it is advisable to keep the load below this weight. In seated work, it is advisable not to lift loads more than 4.5 kg.
(c) In the event personnel are in doubt about whether they can safely move the object by themselves, additional manual or mechanical help should be obtained, or the task should be avoided.
(d) If a heavy object is to be moved to another location, the safest transport route should be determined prior to the activity. The area around the object and the route over which it will be transported should be checked for slip, trip, and fall hazards. Hazards should be removed prior to initiation of the task.
(e) The object to be moved should be inspected for pinch points, grasping, or handling hazards, including slivers, sharp edges, grease, water, etc. Eliminate or abate any identified hazards where possible. Safe grasping or handling points on the object should be determined.

(iii) **Material handling and/or lifting.** Check for stability by testing the weight carefully either by pushing or lifting at one of the corners. The following proper lifting techniques shall be always observed:

(a) Make sure you have a clear path to carry the load, and a place to set it down
(b) Bend the knees, place your feet close to the object and center yourself over the load
(c) Get a good handhold
(d) Lift straight up, smoothly, and let your legs do the work, not your back!
(e) Exhale as you make the lift
(f) Do not twist or turn your body while carrying the load
(g) Set the load down slow and controlled
(h) Always push a load on a cart or dolly, do not pull it
(i) If it's a long load or awkward, get additional help
(j) Split the load into several smaller ones when you can.

12. Electrical safety

(i) Training and Qualifications

(a) Only persons who are qualified and authorized are permitted to perform work on or near exposed, energized electrical equipment or to open enclosures or panels that contain exposed energized electrical parts or equipment.
(b) All energized work must be performed with two qualified persons. Both persons shall be certified in First Aid, CPR, and the use of an AED
(c) Persons working on “live” lines or equipment shall have had appropriate training, be competent and familiar with the equipment and be aware of the all the potential risks involved with the work.

(ii) Basic Electrical Safety Principles

(a) Emphasis must be put on avoiding working on energized electrical equipment, unless unavoidable. All electrical lines and equipment shall be considered “live” (energized) until proven “dead” (de-energized)
(b) The “live, dead, live” testing method shall be used to prove that a line or piece of equipment is de-energized
(c) All electrical lines and equipment shall not be worked as “de-energized” until a Lockout/Tagout (LOTO) is in place
(d) Workers must be insulated from the energized parts with insulated gloves and/or sleeves, or a barrier or guard shall be in place between energized parts and the worker
(e) Conductive items such as jewelry or clothing shall not be worn during energized electrical work.

(iii) Working on or Around Electrical Equipment

(a) All persons who work near live electrical apparatus shall understand the hazards and the limits of their movements.
(b) A Safety Observer shall be appointed when persons are working on or near energized electrical lines.
(c) All Energized work shall have an “Energized Electrical Work Permit” completed prior to the start of work. All insulated hand tools used near live

electrical equipment must be insulated to 2x the highest voltage likely to be encountered.

(d) Visually inspect all insulated tools prior to use and check for testing certification or calibration details (Been done? Within date?)

(e) Verify that test metering or sensing devices are operating properly and that appropriate settings are used

(f) Safe approach distances are areas around energized electrical lines and equipment into which no part of a person, equipment, or object (other than insulated) may encroach.

13. Operation of Vehicles and Equipment

(i) Mobile Equipment. Ensure the safe operation of mobile/heavy equipment, such as graders, water trucks, loaders, and other smaller equipment, such as excavators, forklifts, mobile cranes, backhoes and other large trucks. Mobile/heavy equipment should have the following safety specifications:

(ii) Seat belts for all occupants

(a) Adequate lighting (e.g., headlights, tail, turn, brake, operating strobe or flashing light)

(b) Adequate walkways, railing, steps/grab handle combinations and boarding facilities including an alternative path of disembarking in case of emergency

(iii) Reversing alarms and the use of spotters

(iv) Horn

(v) Effective windscreen wipers

(vi) Effective guarding on accessible moving parts

(vii) Signage on the equipment that allows clear and easy identification from a distance.

(a) Approved or certified roll-over protection

(b) Two-way radio or other forms of communication.

14. Walking and Working Surfaces

(i) Risk factors that contribute to slip, trip, and fall injuries will vary according to the work environment and work tasks being completed. Common risk factor categories include:

(ii) Floor surface and condition

(iii) Uneven terrain and dense vegetation

(iv) Floor contamination

(v) Objects on the floor

(vi) Ability to see floor, walkways, barricades and/or hazards

(vii) Cleaning/ spill containment

(viii) Space and design

(ix) Stairs and stepladders

(x) Work activities, pace, and processes

(xi) Footwear and clothing

(xii) Individual factors

(xiii) Slip, trip and fall hazards may be identified by reviewing hazard or incident reports, talking with Project personnel, completing a regular walk-through and inspections of work environments. DGPL shall ensure the implementation of a risk-based approach to the management of slips, trips and falls at the power plant.

This should include regular inspections of work areas to identify areas or items of risk.

15. Fire Safety, Vegetation/Tree Fire Management

(i) **Fire Prevention**

(a) Be alert for fire hazards and eliminate such hazards if possible. If a fire hazard cannot be eliminated, then report it to the site in charge

(b) Good housekeeping is one of the most effective aids to fire prevention. Keep work areas clean and clutter-free.

(c) Wastepaper, rags, and other combustible material shall not be allowed to accumulate.

(d) Vegetation on the site should not be allowed to grow such that dry conditions will create a risk of ground fire on the site or propagate an offsite grass fire throughout the site. Vegetation across the site and along site boundaries shall be monitored monthly.

(e) Explosive, flammable, or combustible material shall be stored only in approved containers consistent with manufacturer instructions. Store all flammable and combustible liquid containers in a fireproof cabinet designed to safely store such materials.

(f) Explosive or flammable material storage areas shall be in areas that minimize the propagation of fire to occupied areas or other structures.

(g) Spark-producing equipment shall be prohibited within 20 meters of explosive or flammable storage or where flammable liquids, or vapors or vegetation and grass are present.

(h) Outdoor cooking equipment shall not be used, nor shall spark-producing activities be conducted when wind gusts are periodic or during periods of high velocity sustained winds.

(ii) **Fire detection and alarms.** Fire detection equipment will be installed in the O&M and ancillary/office buildings, staff quarters, and all major system/units. These detectors will:

(a) Activate alarms locally.

(b) Shall be checked annually with a smoke generator

(c) Shall have the battery replaced annually as applicable.

(d) Evaluate the location, type, and size of the fire to determine necessary actions.

(e) The address and name of the nearest fire/facility should be clearly posted and lighted or otherwise illuminated.

(f) Specific fire code requirements address how and where fire extinguishers are located within a building, therefore the current location of mounted fire extinguishers shall not be changed unless approved because of a building code review by a qualified person.

(g) Fire extinguishers should also be available within each Company vehicle. Fire extinguishers shall be checked monthly to verify no visible damage or obstructions, proper charge/pressure, and accessibility/availability.

16. Emergency Scenarios

(i) **Fatal Accidents**

(a) During emergency operation, if there is any injured person, ensure attendance of First Aid Team and carry out the first aid.
(b) Inform the Emergency Response Team.
(c) If the accident is severe, ensure an emergency vehicle for taking the victim to local hospital or recommended nursing home, phone numbers should be available in the site.
(d) Accident report should be prepared with the help of witnesses and preserve it to the Emergency Response Team.

(ii) **For Flood**

(a) Evacuate the people from flooded areas and place them to a safe area.
(b) Switch of the power supply from effected area.
(c) Although no record of flood in the plant area, the structures will be designed to factor in the flooding risk.
(d) Coordinate with local Emergency Response Team and act as per their guidelines.
(e) In case of any accident, ensure the presence of first aid team and get medical attention as soon as possible.
(f) Ensure presence of nearby firefighting team/system in case of worst or out of control situation.

(iii) **For Earthquake**

(a) Isolate electrical supply wherever it is possible.
(b) All electric connections of the plant should be cut off.
(c) Safe evacuation is important for everybody, and measures should be taken accordingly.
(d) Must evacuate as per evacuation plan.
(e) Project should have Rescue Team to help the injured employees. And they will also take the injured employees for treatment.
(f) Ensure the flammable liquids i.e., Petrol, Diesel and other petroleum products are stored under secondary containment with due precautions.

(iv) **For Fire**

(a) Evacuate the people from the fire hazard area and send them to a safe exit direction.
(b) Remove unwanted combustible material.
(c) Inform the substation/GRID to get the plant isolated from power supply.
(d) Keep Fire Hydrant accessible.
(e) Keep good condition fire hoses and Fire Extinguishers readily available.
(f) Ensure one operator is always present at Hydrant system area when using the fire hydrant system.
(g) If the fire is very small, use the correct Fire Extinguisher for extinguishing the fire.
(h) Try to isolate the fire by removing the surrounding inflammable material around.
(i) In case of large fire use local hydrant system for extinguishing the fire.
(j) If the fire is beyond control, inform the security or higher authority to call local fire brigade and Inform Emergency Response Team.
(k) On arrival of the fire brigade, help them to reach the site of fire.

(l) In case of any accident of human, ensure immediate medical attention as soon as possible.