GUAM POWER AUTHORITY **STANDARD OPERATING PROCEDURE**	Prepared By: Jessica T. Lazatin — 2/10/21 **Engineer I** Paz A. Tison — 2/10/21 **Special Projects Engineer**
TITLE: Operation and Maintenance Responsibilities for the Agana and Talofofo Energy Storage Systems	Reviewed By: Lorraine O. Shinohara, P.E. — 2/10/21 **Engineer Supervisor** Jennifer G. Sablan, P.E. — 2/10/21 **SPORD Manager**
NO: SOP-169 **Supersedes:**	Concurred By: John J. Cruz Jr., P.E. — 2/10/21 **AGMETS** Melinda C. Marnas, P.E — 2/17/2021 **AGMO** Beatrice P. Limtiaco — 2/18/2021 **AGMA**
Page 1 of 17	Approved By: John M. Benavente, P.E — 2/18/2021 **General Manager**

1.0 PURPOSE

This Standard Operating Procedure (SOP) governs the responsibilities of the various Guam Power Authority ("GPA") divisions and LG CNS America Inc. ("Contractor") for the operation and maintenance of the GPA Energy Storage Systems ("ESS") at Agana and Talofofo. This SOP also provides guidance for authorized GPA and Contractor personnel to achieve a safe and predictable outcome in the operation and maintenance of both facilities.

2.0 REFERENCES

2.1 **ESS O&M Plan (Attachment A)**

2.2 **Agana ESS Emergency Response Plan (Attachment B)**

2.3 **Talofofo ESS Emergency Response Plan (Attachment C)**

2.4 **ESS Environmental, Health and Safety Manual (Attachment D)**

2.5 **ESS Technical Library**

The ESS Technical Library consists of the as-built drawings, manufacturers' O&M manuals, training documents, this SOP with Attachments A through D and any other relevant documents. All files can be downloaded from \\gpaupd.local\fad\Energystorage.

3.0 DEFINITIONS

3.1 **GPA Agana Energy Storage System ("Agana ESS"):** The 24MW-6MWh Energy Storage System located within the GPA Agana Substation. The entrance to the site is through the west side front entrance of the Agana Substation.

3.2 **GPA Talofofo Energy Storage System ("Talofofo ESS"):** The 16MW-16MWh Energy Storage System located behind the GPA Talofofo Substation. The entrance to the site is located west of the Talofofo Substation.

3.3 **Maintenance:** The scheduled and unscheduled maintenance work for the ESS and associated interconnection equipment performed by certified Contractor personnel and GPA personnel.

3.4 **Operation:** The management, monitoring and operation of the ESS and associated interconnection equipment performed by certified Contractor personnel and GPA personnel.

3.5 **Contractor's O&M Manager:** The Energy Storage System O&M manager assigned by Contractor. The Contractor's O&M Manager shall be GPA's primary contact and responsible for coordinating trouble calls, preventive maintenance, corrective maintenance, outages, spare parts management, reporting, documentation, site safety and emergency response plan, data record keeping, operation, inspections and all other requirements.

3.6 **Contractor:** Licensed, trained, and certified LG-CNS America, Inc. personnel assigned to the ESS O&M contract, and all qualified subcontractors of LG-CNS America, Inc. assigned to work on the ESS.

3.7 **Work:** Operation and Maintenance of the ESS.

4.0 FACILITY OVERVIEW

4.1 Agana Energy Storage System ("Agana ESS")

The Agana ESS consists of:

A. 3 battery containers which each contain 4 battery banks of 13 racks with each rack consisting of 17 battery modules

B. 1 control container which contains the ESS energy management system, switchgear, UPS, rectifier, relays and meters

C. 12 PCS inverters

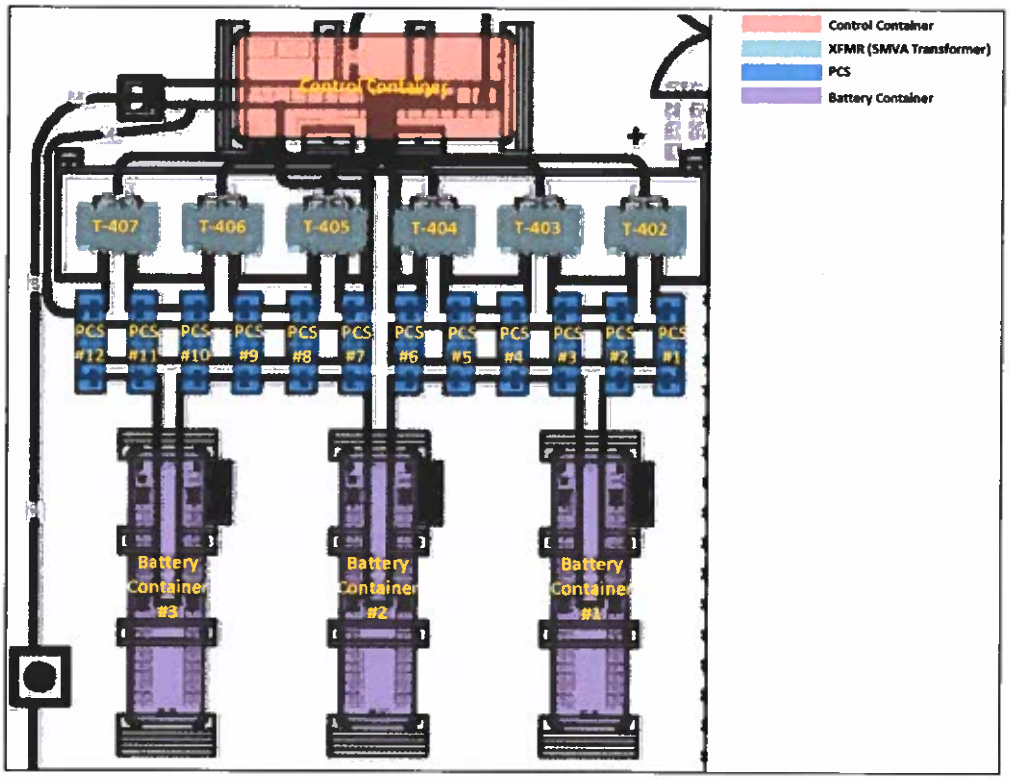
D. 6 transformers (5 MVA)

E. 1 auxiliary transformer (500 kVA)

F. 300 kW standby generator with ATS

G. T-401 transformer (30 MVA) located outside of the ESS fence

The Agana ESS site layout is shown below:



4.2 **Talofofo Energy Storage System ("Talofofo ESS")**

The Talofofo ESS consists of:

A. 4 battery containers which each contain 4 battery banks of 13 racks with each rack consisting of 17 battery modules

B. 1 control container which contains the ESS energy management system, switchgear, UPS, rectifier, relays and meters

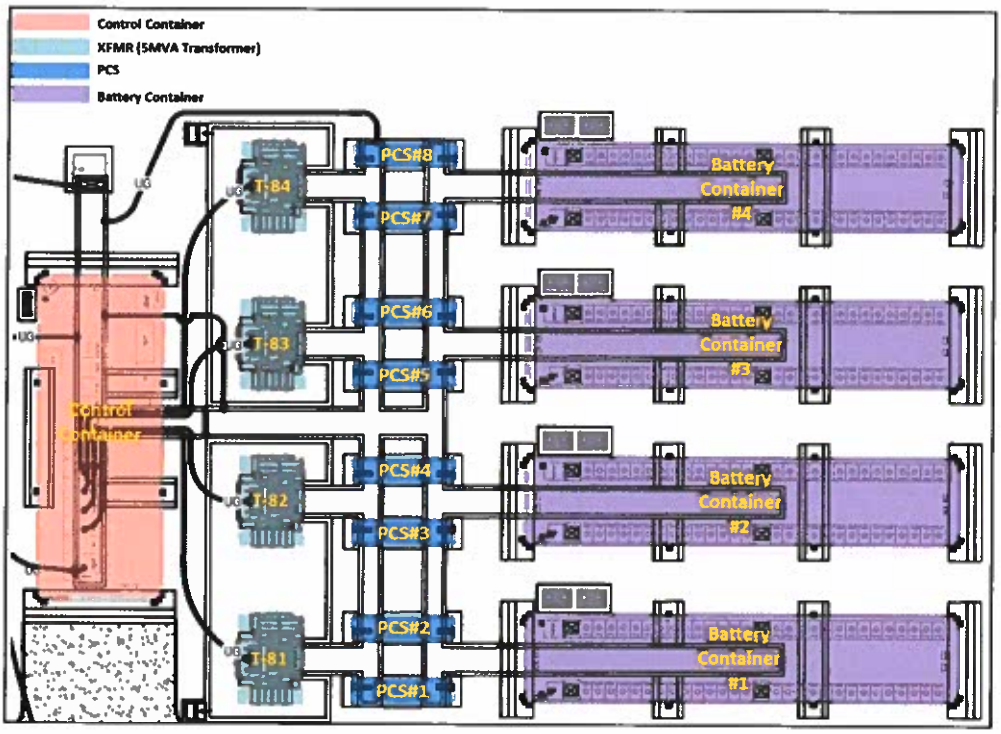
C. 8 PCS inverters

D. 4 transformers (5 MVA)

E. 1 auxiliary transformer (500 kVA)

F. Outdoor switchyard which contains Bus 2 and the X-128 outdoor circuit breaker located inside the ESS fence

The Talofofo ESS site layout is shown below:



5.0 RESPONSIBILITIES

5.1 LG CNS America, Inc. ("Contractor")

Contractor shall be responsible for:

A. The scheduled preventive and corrective maintenance work, monitoring work and warranty management work listed in the ESS O&M Plan

B. Emergency service work listed in the ESS O&M Plan and ESS Emergency Response Plan

C. Repairs, improvements, replacements and other works other than the scheduled maintenance work

D. Maintaining the ESS O&M Plan and ESS O&M Manual and obtaining GPA's approval

E. Submission of monthly and annual reports

F. Creation and storage of operation and maintenance records (including electronic records) and the Agana ESS & Talofofo ESS performance monitoring

G. Storage and management of all spare parts, replacement parts, consumable parts

H. Preparation of maintenance plan and obtaining GPA's prior approval as indicated in the ESS O&M Plan

I. Supervision and acceptance inspection of all deliveries, replacements, repairs, warranties, and tests and verification by equipment suppliers, etc.

J. Responses or reports to related agencies, electric utility, and local related parties that are necessary for performing the Work and operating the facility

K. Obtaining and maintaining permits, authorizations and licenses that must be obtained in the name of Contractor for the performance of the Work

L. Compliance with the provisions of the agreements specified in the ESS O&M documents and otherwise affecting the operation, repair and maintenance of the Agana ESS & Talofofo ESS, as well as the requirements under the applicable permits

M. Promptly notifying or reporting to GPA regarding events and accidents at or affecting the Agana ESS & Talofofo ESS

N. Handling of complaints filed against GPA regarding the operation and maintenance of the Agana ESS & Talofofo ESS

O. Periodic testing and reporting of the results of the Agana ESS & Talofofo ESS performance metrics to GPA

P. All aspects of daily operation for the scope indicated in the ESS O&M Plan

Q. Monitoring of alarms and providing required services to correct such alarm conditions within 1 hour for the Agana ESS site and 2 hours for the Talofofo ESS site

R. Coordination of scheduled and forced outages with GPA SPORD

S. Reviewing and updating the ESS Emergency Response Plan in accordance with any updates in safety standards and applicable laws

T. Providing supplier/manufacturer-approved O&M training and safety training for all Contractor staff, sub-contractors, and GPA staff who will be performing the Work.

U. Placing tags with GPA PSCC when Contractor's O&M personnel are on-site for inspections, maintenance, repairs, etc.

V. Providing a safe work environment for its personnel and following the safety procedures in Section 8.0

W. All work that is related to or is necessary under applicable laws and regulations and applicable permits in association with each of the above

X. All work related to the O&M services as required in the contract

5.2 **Computer Services Division**

Computer Services Division shall be responsible for:

A. The operation and maintenance of the network infrastructure in the Agana and Talofofo Substation control buildings which interconnect to the ESS as indicated in Section 6.0 and providing assistance with the operation and maintenance of the network infrastructure normally performed by Contractor if needed.

5.3 **Facilities Division**

Facilities Division shall be responsible for:

A. The maintenance of the ESS site facilities that do not directly affect the ESS performance such as the eyewash stations, water lines, gates, fence and others not covered by the Contractor in the ESS O&M Plan.

5.4 **Generation Division – Water Systems Diesel**

Generation Water Systems Diesel shall be responsible for:

A. Performing scheduled and unscheduled (preventive and corrective) maintenance work for the Agana ESS standby generator and automatic transfer switch (ATS). The generator and ATS can be found between the Agana ESS control container and T-408 auxiliary transformer.

B. Refueling the Agana ESS standby generator as needed.

5.5 **Planning and Regulatory Division ("P&R")**

P&R shall be responsible for:

A. Performing routine environmental compliance inspections of the ESS sites and informing SPORD if Contractor or GPA is required to address any issues.

5.6 **Power System Control Center Division ("PSCC")**

PSCC shall be responsible for:

A. Monitoring the ESS alarms for fire, hydrogen gas, container temperature, container humidity and the equipment indicated in Section 6.0 and notifying the personnel at the site and the ESS O&M Manager of the alarms.

B. Monitoring and control of ESS-related devices indicated in the table included in Section 6.3.

C. Performing the ESS operation responsibilities indicated in Section 6.4.

D. Monitoring status of ESS communication line to GPA Dispatch. Any Loss of Communication (LOC) event shall be reported to Contractor's O&M Manager immediately. PSCC shall be responsible for restoring communication from the RTU to PSCC Dispatch and shall inform Contractor's O&M Manager when restored. Contractor shall be responsible for restoring communication within the ESS site and to the RTU. Until communication is restored, O&M Contractor will monitor alarms and notify GPA PSCC of any emergency alarms received. However, if the LOC situation remains beyond 9:00 PM, the ESS shall be shut down as a safety precaution.

E. The operation and maintenance of the SCADA equipment in the Agana and Talofofo Substation control buildings which interconnect to the ESS as indicated in Section 6.0 and providing assistance with the operation and maintenance of the SCADA equipment normally performed by Contractor if needed.

F. Contacting 911 and the Contractor's Emergency Response Coordinator in the event of an emergency as indicated in the ESS Emergency Response Plan.

G. Coordinating with the Contractor's Emergency Response Coordinator for Loss of Communication (LOC) during an Emergency.

   If there are personnel on site during an emergency and LOC to GPA SCADA system occurs, personnel on site shall first call 911 and then notify PSCC of type of emergency.

   If there are no personnel on site during an emergency and LOC to GPA SCADA system occurs, the ESS control software will send the emergency alarm notification via e-mail and via SMS mobile text to Contractor's O&M personnel. O&M personnel shall call 911 and then notify PSCC of type of emergency.

H. Coordinating with the Contractor's O&M personnel and SPORD in the event that ESS requires isolation from the GPA grid.

I. Contacting Contractor's O&M Manager whenever GPA personnel are at the site and providing information about GPA's work scope.

5.7 **Safety Division**

Safety Division shall be responsible for:

A. Safety inspections at the ESS sites including, but not limited to, the following:

i. Floors: condition, slip, trip, falls

ii. Aisles: marking unobstructed

iii. Stairs: condition, railings, unobstructed

iv. Exits: unobstructed

v. Chemicals: SDS (Safety Data Sheet)

vi. Eye protection: eye-wash stations

vii. Fire protection: extinguishers, training, locations

viii. First aid: kits, training

ix. Work practices: unsafe work practices observed

x. Evacuation diagram: Diagram shall identify designated Muster Location

xi. Fire Bill

xii. Posted Emergency contact numbers

B. If needed, requesting an updated ESS Emergency Response Plan or ESS Environmental, Health and Safety Manual in the event that NESC Guidelines, OSHA Standards, NFPA Standards, or applicable work safety laws are updated.

5.8 **Strategic Planning & Operations Research Division ("SPORD")**

SPORD shall be responsible for:

A. Management and coordination of the ESS O&M contract with LG CNS America, Inc.

B. Review of reports and invoices prior to submission to management for approval and processing.

C. Coordination of scheduled and forced outages with PSCC.

5.9 **Transmission and Distribution Division ("T&D")**

T&D shall be responsible for:

A. The operation of the equipment in the Agana Substation switchyard, Talofofo ESS switchyard and control buildings which interconnect to the ESS, including T-401 (at Agana), outdoor circuit breakers, disconnect switches, protection, auxiliary, and other associated equipment as indicated in Section 6.0. T&D shall operate X-400 (at Agana) and X-410 (at Talofofo).

B. Performing scheduled and unscheduled (preventive and corrective) maintenance work for equipment in the Agana Substation switchyard, Talofofo ESS switchyard and control buildings which interconnect to the ESS, including T-401 (at Agana), outdoor circuit breakers, disconnect switches, protection, auxiliary and other associated equipment as indicated in Section 6.0. Contractor shall maintain X-400 (at Agana) and X-410 (at Talofofo).

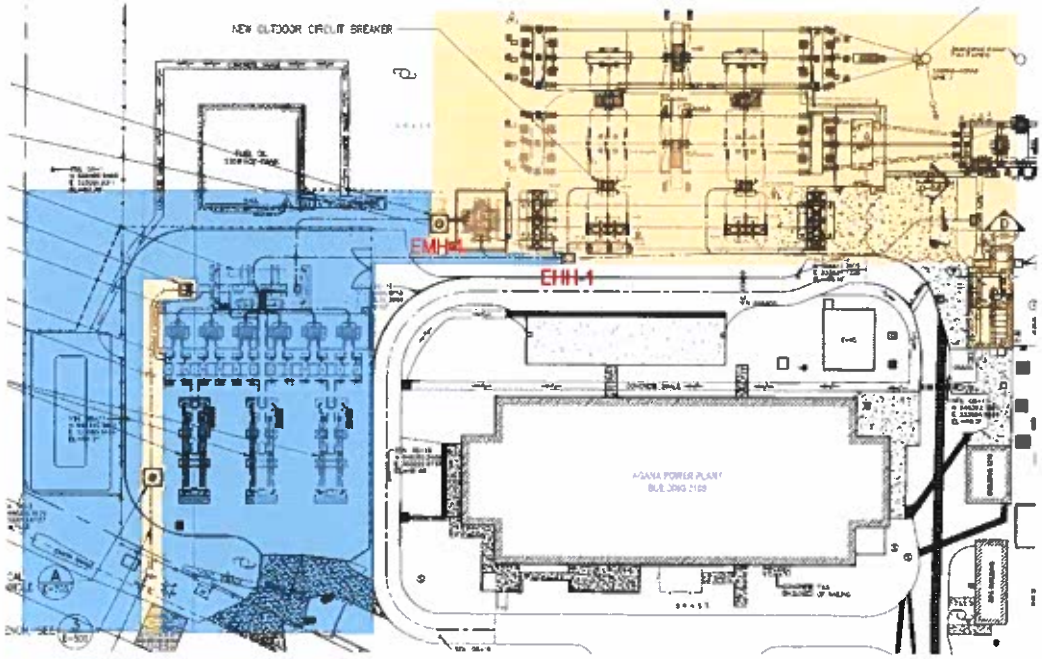
6.0 OPERATION & MAINTENANCE

6.1 Contractor and GPA O&M Scope for Agana ESS

Contractor shall be responsible for the operation and maintenance of the ESS including all equipment, network and communication infrastructure in the control and battery containers, PCS, 5MVA transformers (T-402, T-403, T-404, T-405, T-406, T-407), cables/conduits up to EMH-1 and EHH-1, and associated equipment within the blue areas shown in the layout below. The CGIS feeder breakers (X-401, X-402, X-403, X-404, X-405, X-406) inside the control container shall be operated and maintained by Contractor. All maintenance work performed by Contractor is outlined in the ESS O&M Plan and its appendices. These works are considered routine maintenance as recommended by the manufacturer in order to prolong equipment life, maintain equipment efficiency and safety, and avoid unplanned maintenance activities thereby reducing ESS unavailability.

GPA shall be responsible for the operation and maintenance of the equipment, network and communication infrastructure in GPA's switchyard and 115 kV control building which interconnect to the ESS including the 30MVA transformer (T-401), gas circuit breaker (H-405), motorized disconnect switch (DST-401-1), disconnect switches (DSH-405-1, DSH-405-2), protection, auxiliary, and other associated equipment within the yellow areas shown in the layout below. Additionally, the auxiliary transformer (T-408), 13.8 kV line,

standby generator and ATS within the ESS site will be operated and maintained by GPA. The incoming CGIS breaker (X-400) located inside the control container will be operated by GPA but maintained by Contractor.



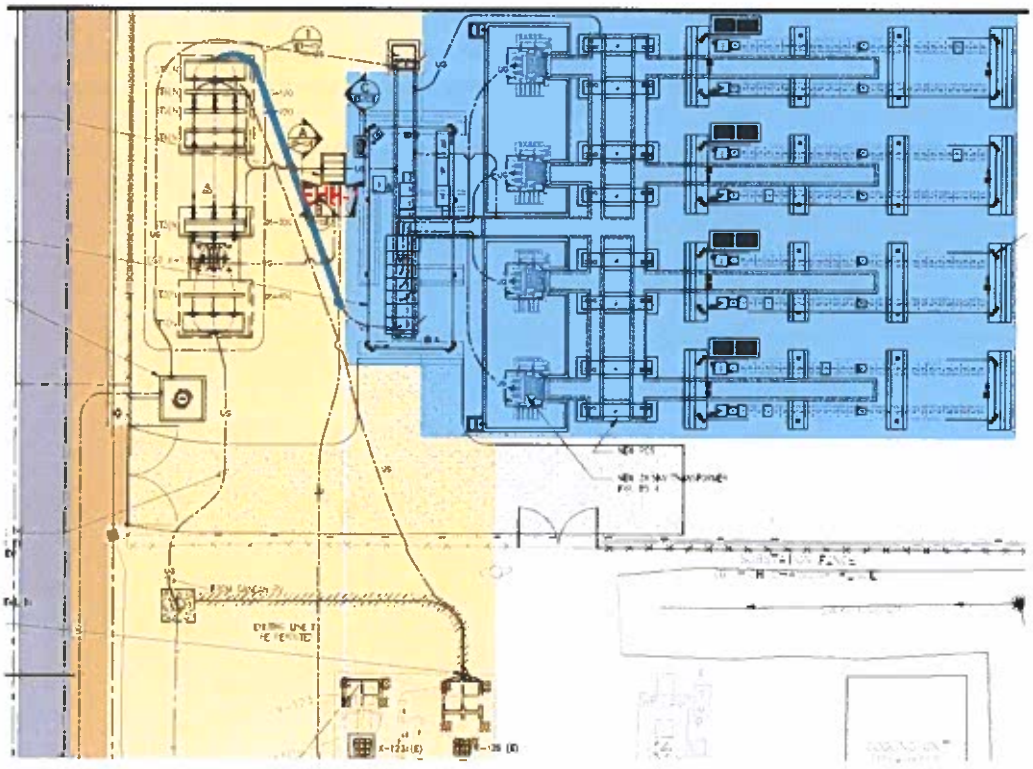
For further details on the Agana ESS O&M scope, refer to the ESS O&M Plan.

6.2 Contractor and GPA O&M Scope for Talofofo ESS

Contractor shall be responsible for the operation and maintenance of the ESS including all equipment, network and communication infrastructure in the control and battery containers, PCS, 5MVA transformers (T-81, T-82, T-83, T-84), cables/conduits up to EHH-1, and associated equipment within the blue areas shown in the layout below. The CGIS feeder breakers (X-411, X-412, X-413, X-414) inside the control container shall be operated and maintained by Contractor. All maintenance work performed by Contractor is outlined in the ESS O&M Plan and its appendices. These works are considered routine maintenance as recommended by the manufacturer in order to prolong equipment life, maintain equipment efficiency and safety, and avoid unplanned maintenance activities thereby reducing ESS unavailability.

GPA shall be responsible for the operation and maintenance of the equipment, network and communication infrastructure in the Talofofo ESS switchyard which interconnect to the ESS including the gas circuit breaker (X-128), motorized disconnect switch (DSX-410-1), disconnect switches (DSX-128-1, DSX-128-2, DSBUS2-1), protection, auxiliary, and other associated equipment within the yellow areas shown in the layout below. Additionally, the auxiliary transformer (T-85) and 13.8 kV line within the ESS site will be

operated and maintained by GPA. The incoming CGIS breaker (X-410) located inside the control container will be operated by GPA but maintained by Contractor.



For further details on the Talofofo ESS O&M scope, refer to the ESS O&M Plan.

6.3 **Control and Monitoring of ESS Devices**

GPA shall control and monitor the ESS devices as indicated in the table below.

Location				Device		GPA(SCADA)		LG(HMI)	
				Type	ID	Monitor	Control	Monitor	Control
Agana	ESS Control Container	CGIS	X-400	Relay	751/X-400	●	●	●	
			CT		787/ESS-24(P) BUS5	●			
					787/ESS-24(B) BUS5	●			
			X-401		751/X-401	●		●	●
			X-402		751/X-402	●		●	●
			X-403		751/X-403	●		●	●
			X-404		751/X-404	●		●	●
			X-405		751/X-405	●		●	●
			X-406		751/X-406	●		●	●
		ACB Panel		Relay	751/T-408	●	●	●	●
				Meter	735/T-408	●		●	
		PMS Panel		Discrete Controller	DPAC#1	●		●	
					DPAC#2	●		●	
					DPAC#3	●		●	
	115kV Control Building	Protection Panel		Relay	751/H401-H405	●	●		
					751BU/ESS(L)	●			
					787/ESS-24 T-401	●			
				Meter	735/ESS-100	●			
Talofofo	ESS Control Container	Protection Panel		Meter	735/ESS 16	●			
					735/ESS PV	●			
		CGIS	X-410	Relay	751/X-410	●	●	●	
			CT		787/ESS-16(P) BUS3	●			
					787/ESS-16(B) BUS3	●			
			X-411		751/X-411	●		●	●
			X-412		751/X-412	●		●	●
			X-413		751/X-413	●		●	●
			X-414		751/X-414	●		●	●
		ACB Panel		Relay	751/T-85	●	●	●	●
				Meter	735/T-85	●		●	
		PMS Panel		Discrete Controller	DPAC#1	●		●	
					DPAC#2	●		●	
	34.5kV Control Building	X-126 (Existing)		Relay	751/X-126	●	●		
					787/COMB BUS 2(P)	●			
					787/COMB BUS 2(B)	●			
				Meter	735/COMB	●			

6.4 ESS Operation

The primary application for the 24 MW Agana ESS is to provide frequency regulation. The ESS is expected to work in tandem with the existing generation assets to regulate system frequency. The primary application for the 16 MW Talofofo ESS is to provide solar PV ramping support for the fluctuating output from the nearby 25 MW solar farm in Dandan such that ramp-rates are kept within 1% of rated power output per minute (250 kW/min) measured at the Talofofo ESS site.

The ESS at both sites will be on automatic mode and should not require GPA intervention for the majority of the time. However, the following circumstances will require the indicated action by GPA:

A. Conventional Generator Unit Trip (Agana ESS Only)

The ESS will respond to fifty large system disturbances, such as a conventional generator unit trip, per year and provide frequency support until the batteries reach their minimum state of charge (SOC) limit. Before this limit is reached, PSCC shall add the conventional generation needed to maintain the grid frequency.

Additionally, for each instantaneous generation loss of 10 MW or more, PSCC shall send the SCADA command labeled as "ESS Battery Spinning Reserve" to the ESS. This updates the event count until the total reaches 50, after which the ESS will no longer respond to these large system disturbances unless an alternate agreement is reached.

B. Maintaining Battery SOC Within Limits (Agana ESS Only)

To the extent possible, PSCC shall add or reduce the conventional generation needed to keep the Agana ESS below the maximum and above the minimum state of charge (SOC) limits specified by the manufacturer. The recommended practice is to add or reduce the conventional generation, every 15 minutes, to enable the ESS to reduce its output to 0 MW. The SOC limits set by the manufacturer may be adjusted in the future to meet operational needs.

If the Agana ESS reaches the maximum or minimum SOC limit, it can no longer regulate the grid frequency due to insufficient battery charge. When this occurs, the ESS will not charge or discharge until the grid frequency is within the deadband (59.1 to 60.1 Hz). Therefore, PSCC will be responsible for maintaining the grid frequency until the ESS SOC returns to a sufficient level and the ESS resumes frequency regulation.

C. Fire Emergency

In the event of a fire, the ESS PMS will trigger the fire alarm (stage 1) and will automatically shut down the ESS by opening the PCS DC breakers, CGIS feeder breakers and the auxiliary power breaker.

When the alarm is received, PSCC shall do the following:

1. Contact 911, any personnel at the site and the ESS Emergency Response Coordinator and inform them of the situation and follow the procedures identified in the ESS Emergency Response Plan.
2. Isolate the ESS by remotely opening the CGIS incoming breaker (X-400 at Agana, X-410 at Talofofo).
3. Verify if the ESS PMS has automatically shut down the ESS by checking if the PCS DC breakers are in the open position.

4. If the PCS DC breakers are not in the open position, then PSCC shall send the SCADA command labeled as "ESS Fire Emergency Stop" to the ESS. This command will then open the PCS DC breakers, CGIS feeder breakers and the auxiliary power breaker (ACB/T-408 at Agana, ACB/T-85 at Talofofo). When the auxiliary power in the containers is shut off, it will notify all occupants to exit the site due to a possible emergency.
5. **The "ESS Fire Emergency Stop" command shall only be used for fire emergencies.**

D. Isolation of ESS

If the shutdown of the ESS is required for scheduled maintenance to the interconnection infrastructure, PSCC shall notify SPORD and the ESS O&M Manager at least two days in advance so that ESS O&M personnel can prepare the ESS for shutdown and coordinate requirements with PSCC.

If the shutdown of the ESS is required for unscheduled but urgent maintenance to the interconnection infrastructure, PSCC shall isolate the ESS by opening the CGIS incoming breaker (X-400 at Agana, X-410 at Talofofo). PSCC shall also notify SPORD and the ESS O&M Manager of the situation. If this isolation method will cause an undesirable effect on the grid frequency, PSCC also has the option to stop the ESS so that it ramps down to 0 MW at a rate of 2 MW/min.

6.5 **Maintenance of ESS Site Facilities**

Contractor shall be responsible for the maintenance of all equipment, devices and facilities affecting the ESS performance as indicated in Sections 6.1 through 6.3.

GPA shall be responsible for the maintenance of the ESS site facilities that do not directly affect the ESS performance such as the eyewash stations, water lines, gates, fence and others not covered by the Contractor in the ESS O&M Plan.

6.6 **Grounds and Foliage Maintenance**

Contractor shall maintain the grounds and foliage within the fenced area of the Agana and Talofofo ESS sites weekly or as needed. Contractor shall contact PSCC to place a tag when at the site and shall take the appropriate safety precautions when near the energized equipment.

7.0 <u>SITE ACCESS</u>

The Agana and Talofofo ESS sites will be remotely operated and unmanned. However, circumstances such as inspections, maintenance, repairs or trouble calls may require GPA or the Contractor's O&M personnel to visit the site.

7.1 **Access to ESS Site General Area, ESS Control Container and Substation General Area**

Access to the Agana and Talofofo ESS site general area, ESS control container and substation general area shall be shared by GPA and Contractor. Both parties shall be allowed to enter the general areas and control container unescorted by the other party and shall be required to place a tag with PSCC whenever visiting the site. However, since Contractor is providing a 20-year warranty for the ESS, only authorized personnel shall be allowed to enter the control container. PSCC shall contact Contractor's O&M Manager when GPA personnel are at the site or inside the control container and provide information about GPA's work scope.

The gates to the ESS sites will be secured with two locks connected in series. One of the locks can be unlocked by GPA personnel with the substation master key. The other lock can be unlocked only by Contractor.

PSCC, T&D Substation, T&D Relay, Safety and SPORD will keep copies of the control container keys. Safety and SPORD will keep copies of the battery container keys.

7.2 **Access to Battery Containers**

Contractor shall have primary access to the battery containers at the Agana And Talofofo ESS sites. Since Contractor is providing a 20-year warranty for the ESS, only authorized GPA personnel shall be allowed to enter the battery containers. If access is needed, GPA shall request access with Contractor's O&M Manager at least 24 hours in advance but shall be allowed unescorted access during emergencies. Please refer to the ESS Emergency Response Plan for procedures to follow during emergencies.

8.0 SAFETY AND EMERGENCY RESPONSE

Contractor and GPA shall follow the safety guidelines identified in the ESS Environmental, Health and Safety Manual. All personnel who have authorization to enter the ESS sites shall wear the appropriate personal protective equipment (PPE), observe all posted caution and warning signs, and shall be mindful of any alarms that may occur. Contractor shall ensure that O&M personnel are provided with safety briefings for further awareness of safety protocols at the sites.

All personnel inside any of the control or battery containers shall exit the site and contact PSCC if the auxiliary power (for lights and air conditioning) is shut off. This condition shall alert personnel that a possible first stage fire alarm has been triggered.

Contractor and GPA shall follow the procedures detailed in the ESS Emergency Response Plan for the following events:

A. Fire

B. Medical emergency

C. Flooding or flash flooding

D. Tropical storm or typhoon

E. Earthquake

F. Hydrogen gas leak

ATTACHMENT A
ESS O&M PLAN

SOP-169
OPERATION AND MAINTENANCE RESPONSIBILITIES FOR THE AGANA AND TALOFOFO ENERGY STORAGE SYSTEMS

EFFECTIVE DATE: 2/18/21

GPA ESS Phase Ⅰ

ESS O&M Plan

Prepared by
LG CNS Tony (Hyunjoon) Tae 

Revision History

No	Amendments	Revised By	Date

Table of Contents

1. Overview

1.1 Purpose

This document specifies the O&M (Operation & Maintenance) plan for Guam Power Authority's (the "Owner") Energy Storage System Phase I project (the "Project") located in Agana (24MW-6MWh Battery Energy Storage System) substation and Talofofo (16MW-16MWh Battery Energy Storage System) substation (the "Site").

This plan includes 1) Scope of Work 2) O&M Staffing 3) Preventive Maintenance 4) Corrective Maintenance 5) Outage and Maintenance Coordination 6) Spare Parts Management 7) Reporting, Documentation & Records 8) Site Safety & Emergency Response Plan

The purpose of this plan is to define its scope of work & procedure, to operate & maintain ESS as designed, and to report its performance to GPA.

Note: This document is not a replacement for the contract, but is intended as a working tool to identify commonly needed information established in the contract and to clarify interfaces. In cases of differences between the contract and this document, the contract shall govern.

1.2 References

- Contract Section 27. O&M SCOPE OF WORK
- ENERGY STORAGE SYSTEM Phase I, INVITATION FOR MULTI-STEP BID (No.: GPA-082-15)

2. Scope of Work

2.1 Work

LG CNS America, Inc. ("Contractor") shall perform the following work (collectively, the "Work") related to operation, maintenance and management of the Project (which includes, without limitation, the works listed below; the "O&M Work"):

1) The scheduled maintenance work, monitoring work and warranty management work listed in the O&M Agreement;
2) Emergency service work listed in the O&M Agreement (collectively with the above, the "Scheduled Maintenance Work" or "Preventive Maintenance Work");
3) Repairs, improvements, replacements and other works other than the Scheduled Maintenance Work and other than as otherwise expressly contemplated hereunder (the "Unscheduled Maintenance Work" or "Corrective Maintenance Work");
4) Maintaining the O&M manual and obtaining Owner's approval (to the extent not otherwise provided under the EPC Agreement);
5) Submission of daily reports, monthly reports and semi-annual "inspection result" reports;
6) Creation and storage of operation and maintenance records (including electronic records) and Project performance monitoring;
7) Storage and management of all spare parts, replacement parts, consumable parts;
8) Preparing of annual maintenance plan and obtaining Owner's prior approval as contemplated in the O&M Agreement;
9) Supervision and acceptance inspection of all deliveries, replacements, repairs, warranties, and tests and verification by equipment suppliers etc. (the "Service Providers");
10) Responses or reports to related agencies, electric utility, and local related parties that are necessary for performing the Work and operating the Project;
11) Obtain and maintain permits, authorizations and licenses that must be obtained in the name of Contractor for the performance of the Work;
12) Compliance with the provisions of the Project agreements specified in the O&M Agreement and otherwise affecting the operation, repair and maintenance of the Project, as well as the requirements under the applicable permits;
13) Promptly notifying or reporting to Owner regarding events and accidents at or affecting the Project;
14) Handling of complaints filed against Owner regarding the operation and maintenance of the Project;
15) Periodic testing and reporting of the results of the ESS performance ratio to Owner under the EPC Agreement and remedial actions required by EPC Contractor;
16) All work that is related to or is necessary under applicable laws and regulations and applicable permits in association with each of the above; and
17) All work related to the O&M services as required in the GPA-082-15 contract documents.

2.2 Maintenance Support System

Contractor shall secure the necessary and appropriate personnel and organization for performing the Work and shall maintain a system that enables Contractor to commence any repairs in case an event requiring the repairs occurs within the response times set forth in the O&M Agreement.

2.3 Environmental, Health and Safety Manual

Contractor shall prepare an environmental, health, and safety manual indicating the protocols for performing the Work safely and in accordance with the applicable laws and regulations and applicable permits, submit it to Owner no later than 30 days prior to the Commencement Date and obtain approval from Owner.

2.4 Hazardous Substances

Contractor shall not use or bring into the Site any "Hazardous Materials" (as defined in the O&M Agreement) except as set forth in the O&M Agreement consistent with "Good Industry Practice" and applicable laws and permits. Contractor shall comply with applicable laws and regulations and permits when disposing "Hazardous Materials" or using "Hazardous Materials" in furtherance of performing its obligations under the O&M Agreement.

2.5 Inspection by Owner

Owner may conduct inspections on or off the Site with respect to the performance of the Work as necessary, including any testing of the Work following any warranty work. Owner shall also reserve the right to witness any inspections performed by the O&M Contractor, however, it shall not affect any inspection schedules or change inspection procedures. In case Owner reasonably determines that the performance of the Work by Contractor does not meet the applicable performance standards (Appendix D), safety standards, O&M Plan guidelines or applicable recommendations by the manufacturer, Contractor shall implement necessary measures to bring such Work in compliance with the O&M Agreement. Contractor shall provide the inspection schedule to Owner before the start of the O&M work and notify Owner two weeks prior to any schedule changes.

2.6 Subcontracts

In case Contractor subcontracts a part of the work to subcontractors, it shall notify Owner and obtain its prior written approval. All Work to be performed by subcontractors shall be subject to, and performed in compliance with, the requirements of the O&M Agreement to the same extent as if Contractor were performing such Work. Contractor shall be responsible for, and supervise, all aspects of the Work, including any part performed by such subcontractors. Contractor shall expedite Work of subcontractors.

2.7 ESS Performance Report

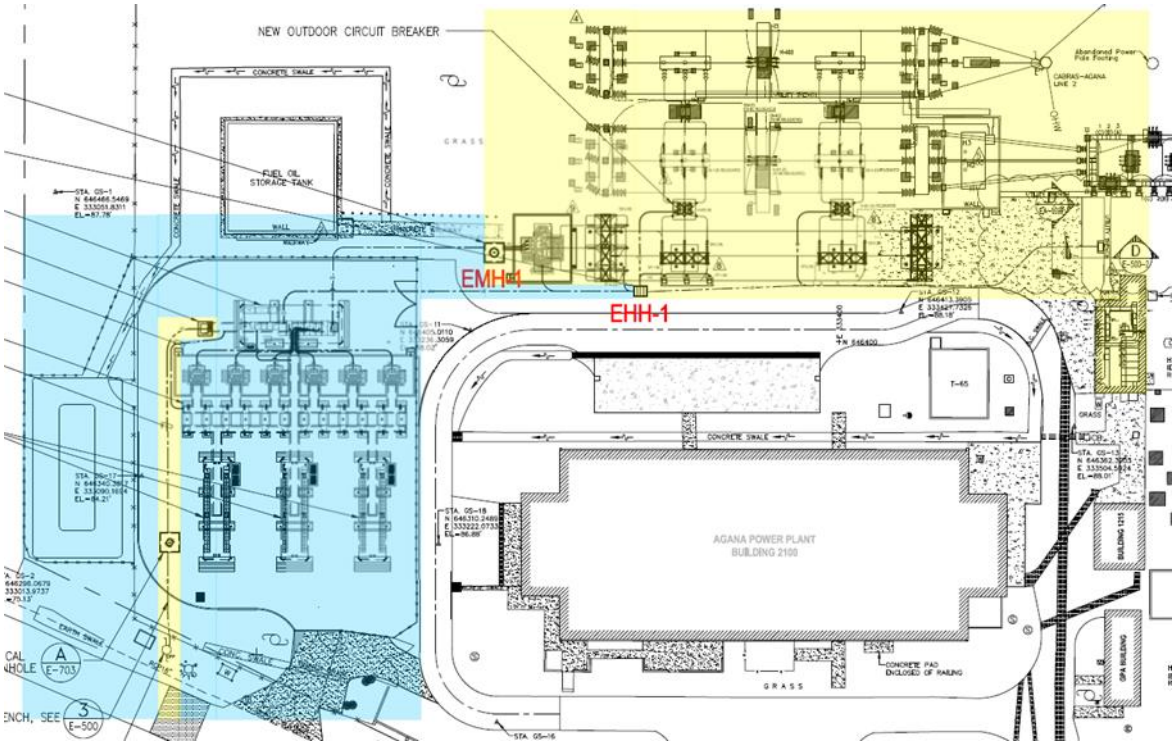
From the date when the "Performance Guarantee" (as defined in the EPC Agreement) under the EPC Agreement, Contractor shall report the results of the ESS performance test defined in the EPC Agreement.

2.8 Training for Transition of Services

During the last one month of the Term (in the case of an expiration of the O&M Agreement) or for a period of 30 days, in the case of an earlier termination of the O&M Agreement, Contractor shall provide training and transition services to the Owner to enable the Owner to continue to perform the operation and maintenance services for the Project in accordance with the terms of the O&M Agreement and "Good Industry Practice".

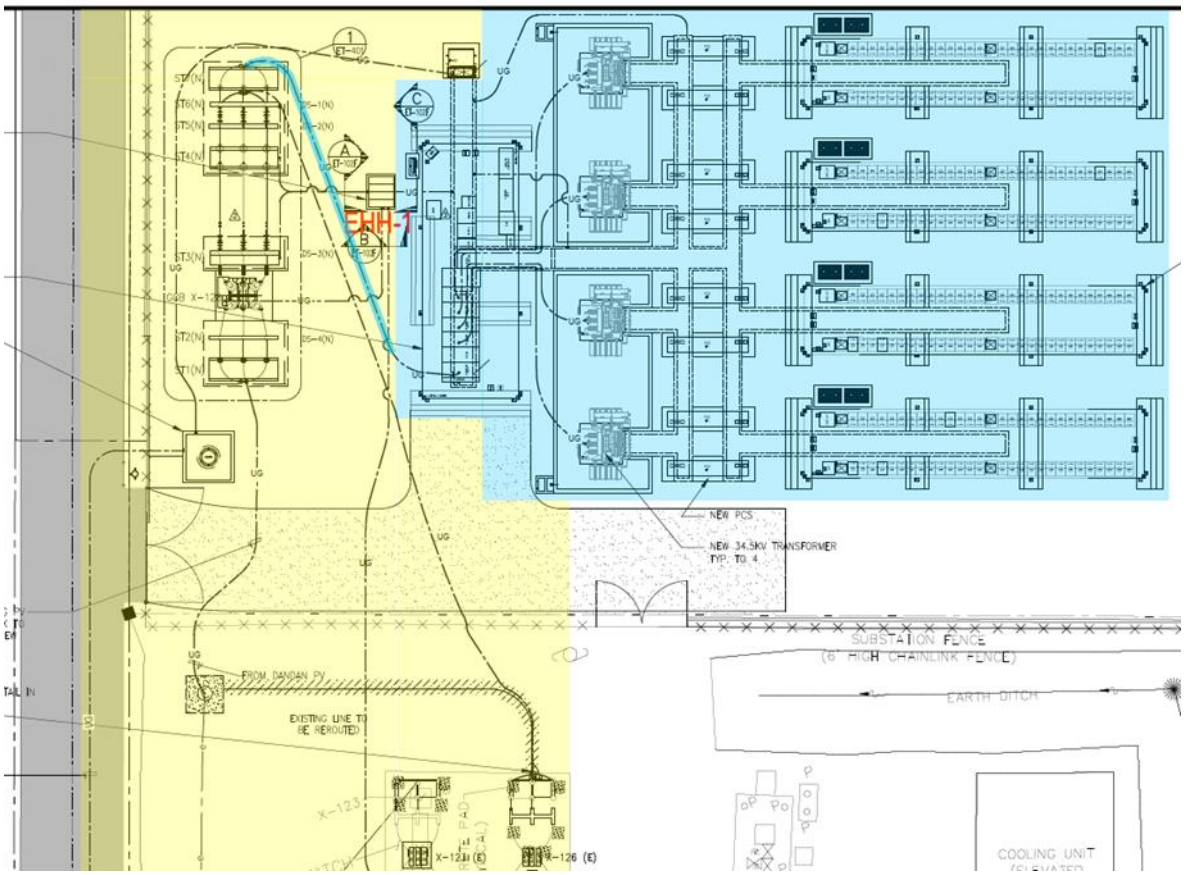
2.9 GPA's Operation & Maintenance

Equipment in GPA's switchyard and control building at the Agana Site which interconnect to the ESS will be operated and maintained by GPA including the new 30MVA transformer, gas circuit breaker, disconnect switches, protection devices, auxiliary equipment, and associated hardware and software within the yellow areas shown in the drawing below. However, X-400 (CGIS INCOMING) in the control container will be operated by GPA. The ESS equipment such as all the equipment in the battery containers and control container, PCSs, 5MVA transformers, cables/conduits up to EMH-1 and EHH-1, and associated hardware and software within the blue areas shown in the drawing below will be maintained by Contractor.

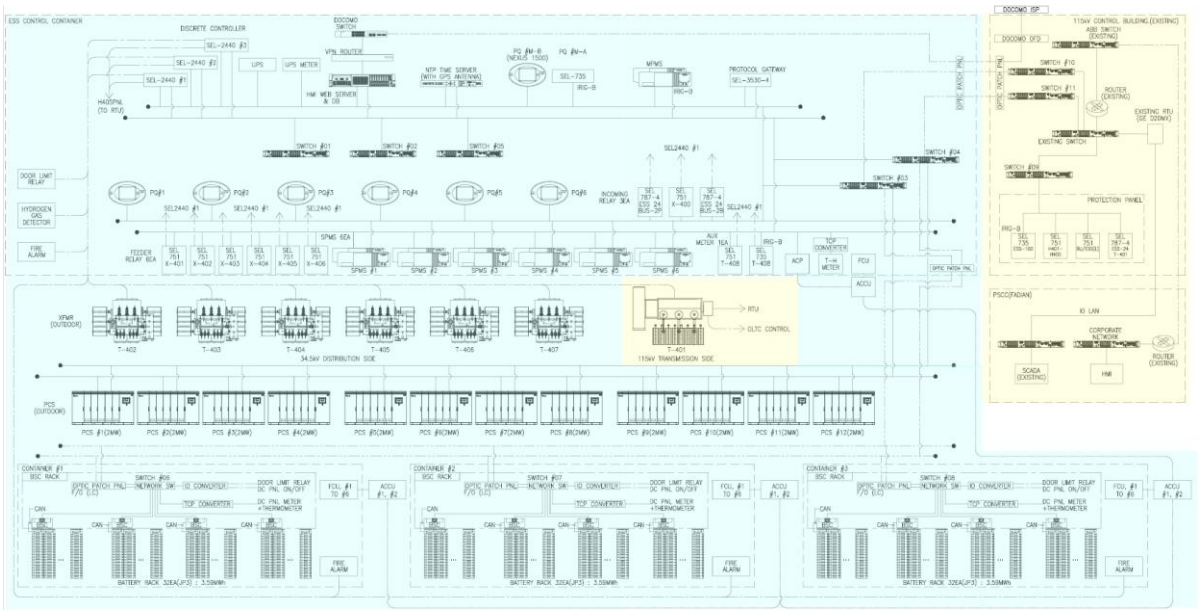


Equipment in GPA's switchyard and control building at the Talofofo Site which interconnect to the ESS will be operated and maintained by GPA including the new gas circuit breaker, disconnect switches, protection devices, auxiliary equipment, and associated hardware and software within the yellow areas shown in the drawing below. However, X-410 (CGIS INCOMING) in the control container will be operated by GPA and X-128(PROTECTION PANEL) in the control container will be operated and maintained by GPA. The ESS equipment such as all the equipment in the battery containers and control container, PCSs, 5MVA transformers, cables/conduits up to EHH-1, and

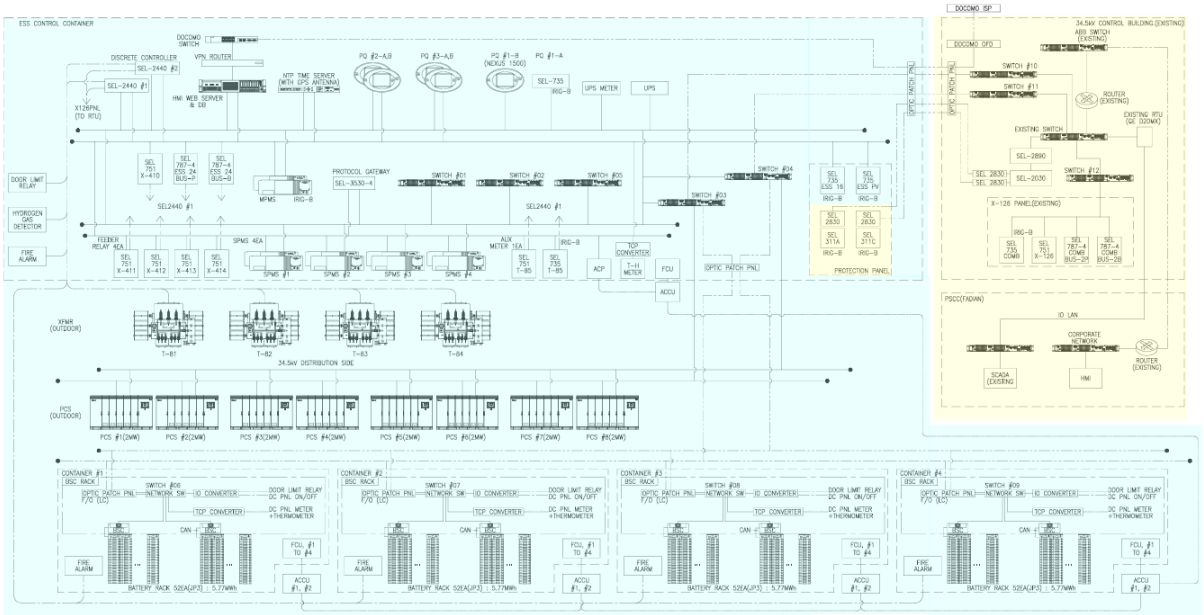
associated hardware and software within the blue areas shown in the drawing below will be maintained by Contractor.



The communication network infrastructure at the Agana site will be operated and maintained by GPA within the yellow areas shown in the drawing below and the network infrastructure at the Agana site will be operated and maintained by Contractor within the blue areas shown in the drawing below



The communication network infrastructure at the Talofofo site will be operated and maintained by GPA within the yellow areas shown in the drawing below and the network infrastructure at the Talofofo site will be operated and maintained by Contractor within the blue areas shown in the drawing below



3. O&M Staffing and R&R (Roles & Responsibilities)

3.1 Owner (GPA) Staffing

During ESS O&M period, GPA as an ESS asset owner shall provide:

1) Review and approval of all the submittals such as O&M Plan, Manual, Report, etc. within agreed review period;
2) Approval of access to the GPA property where ESS is installed when LG CNS O&M staff request access for maintenance purpose;
3) Appropriate working environment such as outage when required;
4) Proper coordination with GPA's internal division in timely manner for LG CNS O&M works;
5) Auxiliary power source for ESS-related equipment;
6) Fuel delivery & fill-up of back-up generator at Agana ESS site;
7) Monitoring and control of ESS components as agreed in the table below;

Location				Device		GPA(SCADA)		LG(HMI)		Remark
				Type	ID	Monitor	Control	Monitor	Control	
Agana	ESS Control Container	CGIS	X-400	Relay	751/X-400	●	●	●		
			BUS-5		787/ESS-24(P) BUS5	●				
					787/ESS-24(B) BUS5	●				
			X-401		751/X-401	●		●	●	
			X-402		751/X-402	●		●	●	
			X-403		751/X-403	●		●	●	
			X-404		751/X-404	●		●	●	
			X-405		751/X-405	●		●	●	
			X-406		751/X-406	●		●	●	
		ACB Panel		Relay	751/T-408	●	●	●	●	
				Meter	735/T-408	●		●		
		PMS Panel		Discrete Controller	DPAC#1	●		●		
					DPAC#2	●		●		
					DPAC#3	●		●		
				Meter	735/PQ #M-A (POI)	●		●		
	115kV Control Building	H-405 Protection Panel		Relay	751/H401-H405	●	●			
					751BU/ESS(L)	●				
					787/ESS-24 T-401	●				
				Meter	735/ESS-100	●				
Talofofo	ESS Control Container	X-128 Protection Panel		Relay	311C/X128	●	●			
					311A/X128	●	●			
				Meter	735/ESS-16	●		●		
					735/PV	●		●		
		CGIS	X-410	Relay	751/X-410	●	●	●		
			BUS-3		787/ESS-16(P) BUS3	●				
					787/ESS-16(B) BUS3	●				
			X-411		751/X-411	●		●	●	
			X-412		751/X-412	●		●	●	
			X-413		751/X-413	●		●	●	
			X-414		751/X-414	●		●	●	
		ACB Panel		Relay	751/T-85	●	●	●	●	
				Meter	735/T-85	●		●		
		PMS Panel		Discrete Controller	DPAC#1	●		●		
					DPAC#2	●		●		
				Meter	735/PQ #1-A (COMB)	●		●		
	34.5kV Control Building	X-126 Protection panel (Existing)		Relay	751/X126	●	●			
					787/COMB BUS 2(P)	●				
					787/COMB BUS 2(B)	●				
				Meter	735/COMB	●				

Table 3.1 – GPA Organization Chart

Title	Division	Contact
ESS O&M Contract Manager	SPORD	Lorraine Shinohara loshinohara@gpagwa.com 671-648-3101
ESS Interconnection Operation	PSCC	Phone: 671-475-1472; 1473; 1474

3.2 Contractor (LG CNS) Staffing

Contractor Staffing consists of 3 parts: LG CNS, Local O&M Subcontractor (JMI Edison) and ESS equipment / solution providers. Below are each party's roles and responsibilities.

LG CNS O&M Engineers will be based in Korea, but will be available to travel to Guam within a day if issues cannot be resolved by the Local O&M Subcontractor or through remote assistance via video conference calls. Travel time will depend on limitations due to the pandemic. The O&M Engineers shall be dedicated full-time to this project and shall be able to communicate directly with GPA through emails if needed. If further verbal discussion is needed, a translator may be provided by LG CNS. The O&M Engineers shall check the status of the PMS daily, provide daily remote support as needed and review reports submitted by the Local O&M Subcontractor. Any issues shall be emailed to GPA.

LG CNS shall ensure that all maintenance activities are performed by properly trained personnel. If needed, the manufacturers will send specialists to Guam for any equipment maintenance or repairs that the Local O&M Subcontractor is not qualified to perform.

GPA reserves the right to request a change in the O&M team if the current arrangement does not adequately provide the services required in this O&M Plan.

Company		Location	R&R
LG CNS America, Inc.	Contractor	New Jersey	・25-year O&M contractor ・Project administration
LG CNS Co., Ltd.	Head Quarters	Korea	・Remote operation monitoring (Korea) ・Performance analysis ・ESS alarm / fault analysis & trouble shooting (corrective maintenance) order to the local O&M company ・Annual performance verification
JMI Edison	Local O&M Subcontractor	Guam	・5-year local O&M subcontractor (contract will renew every 5 years up to 25 years) ・Remote operation monitoring (Guam) ・Response to alarm/fault conditions ・Preventive maintenance ・Support of annual performance verification ・Corrective maintenance ・Spare parts management ・Reporting, documentation & records ・Site safety

Company		Location	R&R
PXiSE	Control System S/W	San Diego	・25-year contract after SAT (Site Acceptance Test) for the following software confidence program: - Technical support: 24/7 on call/email - Bug fixes - Remote monitoring, support, & updates to ensure operation as designed - Remote support service by using remote control tool - On site assistance if PXiSE is unable to resolve any software trouble remotely
LG Chem	Battery	Korea	・20-year Equipment & Service Warranty and Performance Warranty for Batteries after SAT ・On call/email technical support
Destin Power	PCS	Korea	・20-year Equipment & Service Warranty and Performance Warranty for PCS after SAT ・Technical support (on call/email)
LG Electronics	Container Incl. AC & Fire	Korea	・Materials and Workmanship Warranty for Containers - Container Frame and Paint: Shall be free from defects of Product & Service for 20 years after SAT - Air conditioning and AC Electric Cabinet: Shall be free from defects of Product & Service for 3 years after SAT ・Technical support (on call/email) ・Yearly check & repair of the paint condition
Hyundai Electric	Transformer Switchgear	Korea	・1-year Product & Service Warranty after SAT ・Technical support (on call/email)
ZENITHTEK	Control System H/W (PMS H/W)	Korea	・H/W Warranty after SAT varies as below: - ESS Controller: 10 years - GPS Time Server: 3 years - KVM Switch: 1 year - PQ-Meter (Nexus 1500+): 4 years - HMI Server/Workstation: 3 years - Network Switch: 5 years ・Technical support (on call/email)
FIRE PRO	Fire Alarm & Suppression System	Korea	・1-year Equipment & Service warranty after SAT ・Technical support (on call/email)
UPS	Delta Solution	Korea	・1-year Equipment & Service warranty after SAT ・Technical support (on call / email)
Rectifier	IHWA Technologies Information	Korea	・1-year Equipment & Service warranty after SAT ・Technical support (on call/email)

Table 3.2 - LG CNS Organization Chart

Title	Company	Contact
Manager (Local / 1st Point of Contact)	LG CNS	Tony (Hyunjoon) Tae hjtae@lgcns.com

Title		Company	Contact
			+1 671 686 7371 +82 10 2299 5139
O&M Engineers (Head Quarters)		LG CNS	Won Kwan Choi wkchoi7@lgcns.com +82 10 8279 9123
		LG CNS	Woonyoung Park wyp777@lgcns.com +82 10 2880 1297
Local O&M Manager (2nd Point of Contact)		JMI Edison	Romeo Oriondo romeooriondo@jmiguam.com + 1 671 646 6400
SSHO (Site Safety and Health Officer) / Safety Manager		JMI Edison	Nelson Rodriguez
Project Engineer (Primary)		JMI Edison	Marionito Buisel
Electrical Technician (Primary)		JMI Edison	Noel Mirasol
Electrical Technician (Primary)		JMI Edison	Mark Labiscase
Backup Technician		JMI Edison	Vincent Legason
Backup Technician		JMI Edison	Roy Montejo
Backup Technician		JMI Edison	Renato Reburiano
Backup Technician		JMI Edison	Armando Tolentino
Backup Technician		JMI Edison	Keith Adelbai
ESS Equipment / Solution Providers	Control System S/W	PXiSE	Support E-mail: support@pxise.com Support Line: +1 833 506 7261
	Battery	LG Chem	Seunghyun Cho shjo21c@lgchem.com +82 10 6511 2106 Alex(Sunghyuk) Lee leesunghyuk@lgchem.com +82 2 6924 3690
	PCS	Destin Power	A/S Team / MinJae Kim taylor.kim@destinpower.com +82 10 8760 5938 A/S Team / YoungDo Kwon Youngdo.kwon@destinpower.com +82 10 2049 2999
	Container	LG Electronics	SL Min seunglee.min@lge.com +82 10 4009 8937
	A/C System	LGE Guam	Terry Kim terry@lgeguam.com +1 671 482 5434
	Fire Alarm & Suppression System	Fire-pro / G4S	Fire-pro (ChangHoon Park) supportoller@naver.com +82 32 325 5214 G4S (Joseph) guam@gu.g4s.com +1 671 646 2307
	Transformer	Hyundai-Electric	service@hyundai-electric.com +82-52-230-7778, +82-52-202-7777
	Switchgear (CGIS)	Hyundai-Electric	SH Chae seunghee.chae@hyundai-electric.com +82 10 2010 6411
	Control System H/W (PMS H/W)	ZENITHTEK	DS Hong hongds@zenithtek.co.kr +82 10 6204 6224

Title		Company	Contact
	UPS	Delta Solution	Service Desk +82 31 5175 3633 Contact Person (JungGil Lee) ljgeti2003@hanmail.net +82 10 9861 0097
	Rectifier	IHWA Technologies Information	Service Desk +82 2-414-8111 ohjyoung@eti21.com Contact Person (JuYoung Oh) + 82 10 2019 5354

4. Preventive Maintenance

Local O&M Subcontractor will perform all works described below and according to Inspection Guide (Appendix A) and will submit work plan & report for preventive maintenance in accordance with provided template of Work Plan & Report (Appendix B), which includes O&M work procedures. The Local O&M Subcontractor will refer to these appendices for the criteria for inspection and "Action in Case of Abnormal" that need to be performed. Owner shall reserve the right to witness these inspections, however, it shall not affect any inspection schedules or change inspection procedures. Contractor shall address any deficiencies which are related to the ESS performance, safety, non-conformance with the ESS O&M Plan or applicable recommendations by the manufacturer. Contractor shall provide the inspection schedule to Owner before the start of the O&M work and notify Owner two weeks prior to any schedule changes.

Local O&M Subcontractor will employ Lockout/Tagout (LOTO) procedures (Appendix E) appropriate for the maintenance work to be performed.

4.1 Daily Inspection

4.1.1 Remote Operation Monitoring (by using PXiSE S/W)

For Daily Inspection, Local O&M Subcontractor should access PXiSE S/W via VPN and check "Active Alarm List". All the alarm/fault conditions including following daily inspection items have been integrated into PXiSE S/W. If daily inspection items do not meet the acceptable criteria, the PXiSE S/W will detect related alarms/faults and will display them on the "Active Alarm List" page. Thus, daily task for Local O&M Subcontractor is to check "Active Alarm List" and to take action according to this document and O&M Manual. If Local O&M Subcontractor cannot clear active alarm, it is recommended to contact manufacturer and/or LG CNS for more instruction. If Local O&M Subcontractor personnel are not able to connect via VPN, they shall visit the site and check VPN equipment status such as power lamp status, cable connection status and switch status in the AC D/P for trouble-shooting.

For the loss of communication (LOC) case, LOC alarm will be activated on the PXiSE S/W and Local O&M Subcontractor will get a notification of LOC alarm via their mobile devices. They shall visit the site and check physical status for trouble-shooting. If issues are found with any physical connections within the ESS site and to the GPA RTU, Local O&M Subcontractor personnel shall proceed with the needed repairs accordingly. Until communication is restored, O&M Subcontractor will monitor alarms and notify GPA PSCC of any emergency alarms received. However, if the LOC situation remains beyond 9:00 PM, the ESS shall be shut down as a safety precaution.

1) When system is running, check master controller to make sure it is in the "running" state and operate as designed. If not in the "running" state, check the alarm and fault information remotely or on site and then follow provided procedures. If you can't operate the system as desired condition, immediately call PXiSE and/or LG CNS.

2) Check if there are any alarms/faults in the PXiSE S/W for the following:

If there are no alarms/faults and conditions are normal, provide screenshot showing there are no active alarms for each system checked. Note date and time that inspection was done. If the conditions are not normal, dispatch maintenance personnel to site and then follow provided procedures to fix problems. If you can't operate the system as desired condition, immediately call Manufacturer and/or LG CNS.

① Battery (Battery daily status check)

A. Battery status history
If there are any warnings/faults, send the log file to LG Chem.

B. Cell voltage deviation
If deviation in the maximum and minimum cell voltages of each bank is more than 10%, it is a Warning. If more than 15%, it is a Fault. In case of Warning/Fault, send the log file to LG Chem.

C. Temperature deviation
If deviation in the maximum and minimum temperatures of each bank is more than 8℃, it is a Warning. If more than 10℃, it is a Fault. For Maximum Cell Temperature, warning is 53℃ and fault is 58℃. For Minimum Cell Temperature, warning is 0℃ and fault is -10℃.
When the temperature is out of the standard, check the HVAC system in the container and check battery module fan if operational. And also, send the log file to LG Chem and replace defective battery modules found if defective is confirmed by manufacturer.

D. Offline racks
If there are any offline racks, operator shall visit the site and check the alarm list on the BSC. Operator shall try re-connection of the rack. If re-connection fails, the operator shall contact manufacturer with log file and manufacturer will guide further action. Operator shall include the list of offline racks with the offline duration in the Daily Report.

② 5MVA Transformer

A. Transformer temperature
Transformer oil and winding temperature are monitored and recorded in every second via PXiSE S/W. When temperatures are not in proper range, PXiSE S/W will provide alarm/trip according to setting values.
Criteria:
- Alarm: Oil Temperature > 85℃, Winding Temperature > 95℃
- Fault (Trip): Oil Temperature > 95℃, Winding Temperature > 105℃

In case of Alarm, watch temperature variation, report to manufacturer and follow-up manufacturer's guide. In case of Fault (Trip), contact manufacturer ASAP and action for trouble shooting according to the manual.

B. Oil level
Oil levels are monitored and recorded in every second via PXiSE S/W. When not in proper range, PXiSE S/W will provide alarm/trip according to setting values.
Criteria:
- Alarm: Low oil level
- Fault (Trip): Low-Low oil level

In case of Alarm, watch oil level variation, report to manufacturer and follow-up manufacturer's guide. In case of Fault (Trip), contact manufacturer ASAP and action for trouble shooting according to the manual.

C. Oil leakage

Oil levels are monitored and recorded in every second via PXiSE S/W for oil leakage. When not in proper range or in case of oil leaks, PXiSE S/W will provide alarm/trip according to setting values.

Criteria:

- Without oil leakage / Normal Oil level (No Alarm/Fault)

In case of Alarm/Fault (Trip), check oil level and check if there are oil leaks at any connections such as valves, meters and particularly welding points. Refasten all the loose connections if any.

D. Pressure relief

Pressure relief is monitored and recorded in every second via PXiSE S/W. When not in proper range, PXiSE S/W will provide trip according to setting values.

Criteria:

- Trip: Operated at 0.7kg/cm^2

In case of Trip, check for cracks, damages and traces of oil spouting in the pressure relief device and do root cause analysis (internal fault or the other reason). If needed, stop & repair.

E. Cooling equipment

Oil levels are monitored and recorded in every second via PXiSE S/W for cooling equipment. Alarm/trip is triggered when not in proper range, or if there are oil leaks.

Criteria:

- Without oil leakage / Normal Oil level (No Alarm/Fault)

In case of Alarm/Fault (Trip), check oil level and check if there are oil leaks at any connections of cooling equipment. If yes, stop & repair.

F. Buchholz relay

Buchholz relay is monitored and recorded in every second via PXiSE S/W. Alarm/trip is triggered when not in proper range, according to setting values.

Criteria:

- Alarm: Volume of gas is more than 200 ㎤
- Fault (Trip): Oil velocity is more than 1.1m/sec

In case of Alarm, watch increased gas amount (variation), report to manufacturer and follow-up manufacturer's guide. In case of Fault (Trip), contact manufacturer ASAP and action for trouble shooting according to the manual.

G. Loose connections and valves

Oil levels and gas are monitored and recorded in every second via PXiSE S/W for loose connections and valves. When it is not in proper range, PXiSE S/W will provide alarm/trip according to setting values.

Criteria:

- Without loosening of nuts and bolts / Normal Oil level (No Alarm/Fault) / Normal Gas level (No Alarm/Fault)

In case of Alarm/Fault (Trip), check if there are leaks or loose connections and valves. Refasten all the connections and valves if any. Check for any loose connections such as connectors main circuits, grounding circuits, auxiliary circuits, foundation bolts and

the like. Valves are vulnerable to vibration. These shall be checked with particular care. After the correction, O&M personnel shall visit the site and check the equipment status daily until equipment operation is back to normal.

H. Oil Stop Valves / Oil Drain Pit Inspection

Inspect daily according to GPA's Oil Stop Valve Inspection Form for 5 MVA transformers and 30 MVA transformer. If criteria is not met, clean or repair as needed.
Criteria:

- Containment area does not require draining
- Gate valves for emptying containment are secured
- Containment area/base free of weeds and debris
- Containment have sufficient freeboard to contain precipitation
- Containment walls and floors do not have cracks or damages
- Transformer is free of leakage and deterioration
- Valves are free of leakage or deterioration

Contractor will inspect it as Daily for one month and request to change it as Weekly if inspection result has no critical issue.

③ Switchgear (CGIS)

A. Breaker Status including Relay

Check alarm/fault list on the PXiSE S/W for any alarms/faults. If yes, conduct site visit for verification.

④ Container

A. Temperature

Check alarm/fault list on the PXiSE S/W for any alarms/faults (temperature shall be between 19℃ and 27℃). If yes, conduct site visit for verification.

B. Humidity

Check alarm/fault list on the PXiSE S/W for any alarms/faults (below 80% for battery container and below 85% for control container). If yes, conduct site visit for verification.

⑤ Fire System

A. Current Status

Check alarm list on the PXiSE S/W if there are any alarms. If yes, conduct site visit for verification.

⑥ UPS System

A. Current Status

Check alarm/fault list on the PXiSE S/W for any alarms/faults. If yes, conduct site visit for verification.

⑦ Remote Access (VPN)

A. Current Status

If unable to access VPN, check VPN device status at site.

3) Performance Monitoring

① Availability shown on the PXiSE S/W. Check if Availability is not less than 95% (0.25% annual degradation). If less than 95%, report to LG CNS.

② Talofofo 1% Ramp Rate Control Success Rate shown on the PXiSE S/W. Check if Success Rate of 1% Ramp Rate Control is not less than 97% (0.25% annual degradation). If less than 97%, contact PXiSE and report to LG CNS.

③ Agana Frequency Regulation Success Rate shown on the PXiSE S/W. Check if Frequency Regulation within Tolerance (59.85 Hz – 60.15 Hz) Success Rate is not less than 95% (0.25% annual degradation). If less than 95%, check if there are large system disturbances or SOC limit events, contact PXiSE, and report to LG CNS. GPA will not include large system disturbances or SOC limit events in the success rate calculation.

4.1.2 Response to Alarm/Fault Conditions

1) Respond to alarm conditions and provide required services to correct such alarm conditions within specified time frame from the inception of the alarm condition. (Response time will vary according to each alarm level.)

2) Respond to fault conditions and provide required services 24 hours a day, 7 days a week, to correct such fault conditions within two hours for Talofofo and one hour for Agana from the inception of the fault condition.

3) Follow the LG CNS provided O&M manual that includes the recommended corrective action and maintenance procedures for each alarm level or observed condition provided.

4) Alarm/fault will be notified through email/email-to-text message to Contractor's O&M manager and Local O&M technicians' email accounts.

4.2 Weekly Inspection

1) On-site Inspection

Check if the following are normal conditions at site on a weekly basis. If the conditions are not normal, follow provided procedures to fix problems. If you can't operate the system as desired condition, immediately call manufacturer and/or LG CNS.

① Battery

A. Indoor Temperature

Measure the indoor temperature with a proper instrument. (Real-time measuring will be performed and monitored by PXiSE S/W.) Check temperature of thermo-hygrometer, air conditioning monitor screen, and PXiSE S/W.

When the temperature is out of the standard (19 to 27℃), adjust the indoor temperature with the air conditioning system.

B. Indoor Humidity

Measure the indoor humidity with a proper instrument. (Real-time measuring will be performed and monitored by PXiSE S/W.) Check humidity on thermo-hygrometer and PXiSE S/W.

When the humidity is out of the standard (Below 85%), take proper measures such as 1) checking doors are not open 2) checking air conditioning system for proper operation 3) checking doors and openings for proper seals.

C. Battery rack

Check if the door is closed. When the door is open, it can interrupt workers' movement and let foreign substances flow into the battery rack. Close the door.
Check for any deformation in the battery rack, and conduct required repair and replacement.

D. BPU Status
Check if BPU LED is Green. If not, check if there is fault/warning from battery system through the PXiSE S/W or BSC.

② Transformer

A. Glass of Oil Level Indicator
O&M personnel will check if the glass is clean or not at site once a week at minimum. Once the glass of oil level indicator remains dirty after cleaning, O&M personnel will check it on a daily basis to find out root cause.

B. Breather (Silicagel Pink Color, Oil Level)
- Discoloration of the silicagel: O&M personnel will check if there is any discoloration of the silicagel at site once a week at minimum. After redrying or exchanging silicagel, O&M personnel will check it daily for one week if there is any progress of discoloration.
- Level of the sealing oil in oil cup: O&M personnel will check the level of the sealing oil in oil cup at site once a week at minimum. After adding oil up to red line, O&M personnel will check it daily during a week if there is any change of oil level.

C. Bushing Contamination
Check visually the extent of any contamination on the bushing. O&M personnel will check if the bushing is clean or not at site once a week at minimum. Once the bushing remains dirty after cleaning, O&M personnel will check it on a daily basis to find out root cause

D. Cooling equipment
For forced oil cooled or fan cooled type, O&M personnel will check if there are any abnormal rotating sounds, vibration and dust on radiator surface at site once a week at minimum. If there is abnormal sound compared with other units, stop & repair. Once abnormal sound and vibration remains, O&M personnel will check it on a daily basis to find out abnormal noise and vibration source.

E. Noise and vibration
O&M personnel will check if there are any abnormal sounds and vibration etc. at site once a week at minimum. If there is abnormal sound compared with other units, investigate abnormal noise source, send a video recording to manufacturer, and then follow-up manufacturer's guide. Once abnormal sound and vibration remains, O&M personnel will check it on a daily basis to find out abnormal noise and vibration source.

③ Fence & Gate

A. Vandalism
If there is any vandalism, report to LG CNS / GPA.

④ House-keeping

A. Weed-removal
Perform weed removal on an as-needed basis to avoid grassy condition inside the ESS area.

⑤ PCS Noise

A. Abnormal Sound
If there are any abnormal sounds, report to manufacturer.

⑥ Container

A. Rust (External and Internal)
If there are any abnormal sounds, report to LG CNS and follow-up guide.

B. Door & Lock
If there are any issues on door & lock, report to LG CNS and follow-up guide.

C. Condensation
If there is any trace of condensation, report to LG CNS and follow-up guide.

D. House-keeping & Pest Control
If there is a need for House-keeping & Pest Control, report to LG CNS and clean and complete pest control.

E. Alarm / Deformation
If there are any alarms/deformation on the equipment in the container, report to LG CNS and follow-up guide.

⑦ Conditions of Under the Trench Area (Talofofo only)
If rain-water under the trench, immediately pump out the water by using water pump located in the control container.

4.3 Monthly Inspection

1) PCS Visual Inspection

① PCS Exterior and environment check (including rust of PCS exterior and guy wires)
Check for any PCS exterior damage. If yes, send pictures to manufacturer.

② PCS Operating Status Lamp
Check all the Lamp Displays. Lamp light should be green in operation. If there are any problems, contact manufacturer.

2) Fire Extinguisher Inspection
In case of abnormal condition, replace Fire Extinguisher.

① Confirm the extinguisher is visible, unobstructed, and in its designated location.

② Verify the locking pin is intact and the tamper seal is unbroken. Examine the extinguisher for obvious physical damage, corrosion, leakage, or clogged nozzle.

③ Confirm the pressure gauge or indicator is in the operable range or position, and lift the extinguisher to ensure it is still full.

④ Make sure the operating instructions on the nameplate are legible and facing outward.

⑤ Check the last professional service date on the tag. (A licensed fire extinguisher maintenance contractor must have inspected the extinguisher within the past 12 months.)

⑥ Initial and date the back of the tag.

3) Success Rate for Talofofo 1% Ramp Rate Control
Check Monthly Success Rate for Talofofo 1% Ramp Rate Control on the PXiSE S/W. If it is lower than 97% (0.25% annual degradation), report to PXiSE and LG CNS.

4) Success Rate for Agana Frequency Regulation within Tolerance
Check Monthly Success Rate for Agana Frequency Regulation within Tolerance (59.85 Hz – 60.15 Hz) on the PXiSE S/W. If it is lower than 95% (0.25% annual degradation), check if there are large system disturbances or SOC limit events, contact PXiSE, and report to LG CNS. GPA will not include large system disturbances or SOC limit events in the success rate calculation.

4.4 Quarterly Inspection / Maintenance

1) Visual Inspection of PCS parts condition, condensation and dust inside the enclosure: In case of abnormal condition, take pictures and send them to manufacturer, Destin Power. **(Power Off)**
   ① PCS Interior
   Check appearance of PCS parts (Clean, no damage & no burnt parts). If there is any abnormal appearance, send pictures to manufacturer.
   ② PCS Internal Humidity (Condensation/Rust)
   Check Internal Humidity (Condensation/Rust). If there are any abnormal conditions, send pictures to manufacturer.
   ③ PCS Internal Dust
   Check Internal Dust. If there are any abnormal conditions, send pictures to manufacturer.
2) Visual Inspection of Air-Conditioning
   ① Filter of Indoor FCU
   If filters are dirty (i.e., dust stuck in the filters), remove dust by using air-gun. If dust cannot be removed clearly, send pictures to LGE Guam if replacement or other measures are required.
   ② Coils & Fins of Outdoor ACCU
   If coils & fins are dirty (i.e., dust stuck in the coils & fins), remove dust by using water-blasting. If dust cannot be removed clearly, send pictures to LGE Guam if replacement or other measures are required.

3) Thermography Inspection on the Batteries (Bus Bar & Cable Connection Area)
Perform inspection while batteries are in operation using Thermal Imaging Camera. Criteria for abnormal heating on the bus bar & cable connection area is over 75°C. In case of abnormal heating on a battery rack, re-tighten the bolts and re-inspect. If abnormal heating continues, disconnect that battery rack and contact manufacturer.

4.5 Half-Yearly Inspection

1) Transformer Visual Inspection of Breather Silicagel Pink Color and Thermography Inspection
   ① Breather Silicagel Pink Color
   Check the discoloration of silicagel in breather due to moisture in breathed air. If quantity of silicagel that has changed into pink (discoloration) is more than two-thirds, exchange silicagel with new one.
   ② Bushing (Thermography Inspection)

Check if there is any overheating of terminals in the bushing through thermal image to analyze. Monitor the terminals for heat in the bushing and accumulate the data. Criteria for abnormal heating is over 75℃. (Maximum durable temperature of the cable is 90℃ and cable ampere allowance temperature is 75℃.) In case of abnormal heating, send thermography image to manufacturer for further instructions.

2) PCS Visual Inspection of Air Filters for all the Enclosures. **(Power Off)**
O&M personnel will clean all air filters by using air-gun. Clean according to manual.

3) Fire Alarm & Suppression System Visual Inspection
   ① Control Panel
   If there are any alarms/damage, contact manufacturer.
   ② Aerosol fire suppression system
   If there is any damage, contact manufacturer.

4) Rectifier Check
   ① Input value check : Input Voltage, Input Frequency (Refer to Appendix A for the Criteria.)
   ② Output value check : Output Voltage, Battery Voltage, Battery Charger Output Current, Load Current, Battery Current (Refer to Appendix A for the Criteria.)
   ③ Others : LAMP, ALARM, DISPLAY Status, CABLE Connection Status, TR & FAN Status, Cleanliness Status, Indoor Temperature
   ④ Alarm Status & History Data
   ⑤ Thermography Inspection: Battery cabinet should be less than 35°C and Rectifier cabinet should be less than 40°C

   Call manufacturer if any of the criteria is not met.

4.6 Annual Inspection & Maintenance

4.6.1 Battery Inspection

1) Environmental Inspection
   ① Indoor Temperature
   Measure the indoor temperature with a proper instrument. Check temperature of thermo-hygrometer, air conditioning monitor screen, and PXiSE S/W. When the temperature is out of the standard (19 to 27℃), adjust the indoor temperature with the air conditioning system.
   ② Indoor Humidity
   Measure the indoor humidity with a proper instrument. Check humidity on thermo-hygrometer and PXiSE S/W. When the humidity is out of the standard (Below 85%), take proper measures such as 1) check doors are not open 2) check air conditioning system for proper operation 3) check doors and openings for proper seals.

2) Functional Inspection: DC power blocked and the AC power supplied
   - Stop the PCS when no charge or discharge is in progress.
   - Open DC panel switch (DO NOT turn off BSC).

   ① Battery history check
   Check for history alarms in the PXiSE S/W or BSC. If there are Offline Racks, send the log file to LG Chem.

   ② Cell voltage
   Check min/max cell voltage in the PXiSE S/W or BSC. Cell voltage should be between 3 to 4.2 V and deviation should be within 40 mV. When the voltage is out of the standard, replace the battery module.

   ③ Module temperature
   Check min/max module temperature in the PXiSE S/W or BSC. When the temperature is out of the standard, check the HVAC system in the container and check battery module fan if operational. Send the log file to LG Chem and replace defective battery modules found if it is confirmed by manufacturer.
   - Warning Conditions:
     Temperature deviation between modules for Max Module Temperature and Min Module Temperature > 8℃
     Max Module temperature is 53℃
     Min Module temperature is 0℃
   - Fault Conditions:
     Temperature deviation between modules for Max Module Temperature and Min Module Temperature > 10℃
     Max Module Temperature is 58℃
     Min Module Temperature is -10℃

   ④ BPU function test (Relay)
   Check the operation of relays, i.e., check if there are any racks that show zero rack voltage in the BSC. If yes, verify it using multi-meter. Rack voltage should be monitored (should not be zero) under closed relay when the inspector measures voltage from PCS(+) point to PCS(-) point on the BPU by using multi-meter. If rack voltage shows 0 with relay closed, replace the BPU.

   ⑤ BPU function test (E-Stop)
   Check the operation of E-Stop, i.e., command Stop using BSC and check if all BPUs are offline. E-Stop should trip the battery system (MC Open). When the E-Stop is not functional, check the E-Stop function of the whole system or replace the BPU.

3) Comprehensive Inspection: both the DC power and AC power blocked
   - Stop the PCS when no charge or discharge is in progress.
   - Turn off the circuit breaker in the DC distribution panel.
   - Turn off the Battery system.

   ① Visual Inspection of battery racks (doors)
   Check if the doors can be opened or closed without issues. If there are issues, replace door(s).

② Visual inspection of battery racks (deformation)
Check for any deformation in the battery rack. If yes, send the picture of rack deformation to LG Chem. LG Chem will recommend if replacement or other action is required together with the possible cause of deformation. According to LG Chem's recommendation, proceed with the follow-up action.

③ Visual inspection of battery racks (discoloration)
Check for any discoloration in the battery rack. If yes, send the picture of rack discoloration to LG Chem. LG Chem will recommend if replacement or other action is required together with the possible cause of discoloration. According to LG Chem's recommendation, proceed with the follow-up action.

④ Visual inspection of battery racks (cable connection)
Check eye marks of all the cable connections.
Criteria:
Eye marks should be correct and aligned for every power cable connection
If eye mark shows difference between nut and bolt, check all power cable connection with Torque wrench. For re-tightened connection, torque value is 9Nm (allowable range is 8Nm - 10Nm).

⑤ Voltage test
Perform random test for rack voltage (one rack per bank). Compare rack voltage (as read from calibrated meter) against what the BMS is reporting for accuracy.
Criteria:
714V ~ 999V (714V is the voltage when SOC is 0% and 999V is the voltage when SOC is 100%)
When one rack has failed the voltage test (i.e. out of 714V ~ 999V), perform voltage test for all racks per bank and check all modules' voltage in the rack. According to the warranty, manufacturer will change defective modules in case voltage does not fall within specified range.

⑥ Insulation resistance test
Perform random test for insulation resistance (one rack per bank). Monitoring device (IMD) is checking insulation resistance 24x7 and alarms/faults for abnormal conditions.
Criteria:
Above 30 MΩ (at 1000V over 10 seconds)
When one rack has failed insulation test (i.e. below 30MΩ at 1000V over 10 seconds), perform insulation test for all racks per bank and check power cable connection and insulation resistance of each component in the rack. If it fails again, replace the BPU.

4.6.2 PCS inspection

1) Interior Check **(Power Off)**

① Enclosures - Limit switch
Check whether limit switch operates normally. If not, contact manufacturer.

② AC/DC Enclosures - Screws and bolts
Check for loose screws and bolts (check bolt marking for proper alignment). If there are loose screws and bolts, contact manufacturer and re-tighten.

③ DC Enclosure - Cooling FAN
Check cooling FAN functionality when PCS is in operation. If it does not function properly or it is dirty, clean according to manual.

④ DC Enclosure - Insulation Resistance
Check if DC insulation resistance at DC link (positive & negative) is at least 1MΩ or higher at 1,000Vdc for 60 sec. If not, contact manufacturer.

2) Stack Enclosure **(Power Off)**

① PEBB Control Board
Check if PEBB Control Board LED lamp is RED. Check cable connections and discoloration. If there are any abnormal conditions, contact manufacturer.

② PEBB (IGBT Module)
Check if there are any alarms/faults of PEBB in the PXiSE S/W. If any alarms/faults of PEBB, contact manufacturer. Manufacturer may perform PWM signal test.

③ Reactor
Check cable connections (discoloration, bolt loosening). If there are any abnormal conditions, contact manufacturer.

④ Capacitor
Check leaking. If there is any leaking, contact manufacturer.

⑤ Cooling FAN
Check cooling FAN functionality when PCS is in operation. If it does not function properly or it is dirty, clean according to manual.

⑥ Screws and bolts
Check for loose screws and bolts (check bolt marking for alignment). If there are loose screws and bolts, contact manufacturer and re-tighten.

3) AC Enclosure **(Power Off)**

① MCU Control Board
Check LED Lamp of MCU Control Board. If there are any abnormal conditions, contact manufacturer.

② Cooling FAN
Check cooling FAN functionality when PCS is in operation. If it does not function properly or it is dirty, clean according to manual.

③ Emergency (Test when PCS is in stand-by operation)
Check Emergency Switch functionality. If it does not function properly, contact manufacturer.

④ SMPS
Check if SMPS has burn marks, tightness of cables, tightness of connectors and 24V (±2V). If not, contact manufacturer.

⑤ CB3
Check contact wiring and CB operation. If there are any abnormal conditions, contact manufacturer.

⑥ Control Power Cable

Check the external power cable and connection status. If there are any abnormal conditions, contact manufacturer.

⑦ Insulation Resistance
(Monitoring device (IMD) is checking insulation resistance 24x7 and alarm/fault for abnormal conditions.) Check if AC insulation resistance at AC output side (A, B, C phase) is at least 1MΩ or higher at 500Vac for 60 sec. If not, contact manufacturer.

4) Thermography Inspection
Perform inspection on ACE, SE, DCE area while PCS is in operation using Thermal Imaging Camera or Thermal Meter.
Criteria:
- No abnormal heat (Compare yearly measurement with 1st measurement of thermography during the commissioning for any abnormal heat.)
- 1st measurement during the commissioning: ACE 45°C, SE 47°C, DCE 48°C
- Abnormal heat guided by manufacturer: over 70°C

If there is any abnormal heat, contact manufacturer.

4.6.3 Transformer Inspection

1) Insulation Oil Sampling & Test (3rd party)
   ① Oil Sampling according to Transformer Manual 3.6 (1) Sampling of oil from transformer.
   ② Contact Insulation Oil Analysis Lab (NOTHERN TECHNOLOGIES & TESTING or WEIDMANN ELECTRICAL TECHNOLOGY), request following analysis and deliver oil samples.
      A. Dielectric Breakdown ASTM 1816 (Pass Criteria: Min 23)
      B. Acid Number ASTM D-974 (Pass Criteria: Max 0.2 mg KOH/gm)
      C. Specific Gravity, ASTM D-1298 (Pass Criteria: Max 0.91)
      D. Interfacial Tension ASTM D-971 (Pass Criteria: Min 25 Dynes/Cm)
      E. Color / Visual Examination Number ASTM D-1500/ D1524 (Pass Criteria: Max 1.0, Bright & Clear)
      F. Moisture Content; ASTM D-1533 (Pass Criteria: Max 35ppm)
      G. Power Factor-25 ASTM D-924 (Pass Criteria: Max 0.5% at 25°C)
      H. Dissolved Gas Analysis (DGA) ASTM D-3612 (Pass Criteria: per manufacturer)
   ③ Provide test report to manufacturer and request recommendation.
   ④ Follow-up and proceed with manufacturer's recommendation.

2) Off-circuit Tap Changer
   ① Tap Position Check
   Check whether the tap position is correct or not. **(Do not operate off-circuit tap changer when the transformer is energized).** Current tap position is "3". If it is out of the tap position, stop transformer operation and revise tap position correctly.
   ② Tap Operation Check
   If it is not possible to change tap position, stop transformer operation and repair tap changer
   ③ Oil Leaks Check

Check if there are any oil leaks. If yes, stop transformer operation and repair tap changer.

3) External of Transformer

① Visual Inspection (oil leak, rust, coating damage)
Check transformer tank and its accessories for any oil leaks, rust, coating damage. If yes, stop transformer operation and repair and recoat surface if needed.

② Visual Inspection (connections)
Check to see whether all connections are in good condition. If not, stop transformer operation and repair. (Tighten loose connections.)

4) Control Panel and Terminal Box **(Power Off)**

① Switch Operation
Check operation of all switches (Oil level indicator, Buchholz relay, Pressure relief device, Sudden relief device, Oil temp. indicator, Winding temp. indicator) annunciates and lamps to observe proper functions according to schematic diagrams, i.e., perform test according to "Check List of Mechanical Protective Device Test" below:

==========
INSPECTION / SETTING / FUNCTION
==========
OIL LEVEL INDICATOR / LOW / TRIP
OIL LEVEL INDICATOR / HIGH / ALARM
BUCHHOLZ RELAY / STAGE 1 / ALARM
BUCHHOLZ RELAY / STAGE 2 / TRIP
PRESSURE RELIEF DEVICE / STAGE 1 / TRIP
SUDDEN PRESSURE RELAY / STAGE 1 / TRIP
OIL TEMP. INDICATOR / 85℃ / ALARM
OIL TEMP. INDICATOR / 95℃ / TRIP
WINDING TEMP. INDICATOR(LV) / 95℃ / ALARM
WINDING TEMP. INDICATOR(LV) / 105℃ / TRIP
WINDING TEMP. INDICATOR(TV) / 95℃ / ALARM
WINDING TEMP. INDICATOR(TV) / 105℃ / TRIP

If any part mal-operates, adjust or exchange them with new one.

4.6.4 Switchgear (CGIS) Inspection

1) Enclosure
Check the exterior for damage, discoloration or unusual noise. If there is any damage, discoloration or unusual noise, contact service department of manufacturer with photo of abnormal point.

2) SF6 (Visual Inspection)
Check if lamp on pressure meter HDM3 is Green and the values are 1.35~1.5 bar.
Criteria:
Gas pressure: 1.35~1.5 bar

If the pressure is in Low zone (1.3~1.35 bar.abs, yellow lamp, and signal), perform inspection of gas leakage. (See manual 7.8 SF6 Gas Inspection.) If the pressure is less than the minimum level (Low Low zone: < 1.3 bar.abs, red lamp, and signal), the gas should be refilled as soon as possible. (See manual 7.10 SF6 Gas Refilling.)

3) Operating mechanism **(Power Off)**

① Visual Inspection
Check for loose bolts, nuts and stop ring in the operating mechanism and the external parts, i.e., check for marked line on bolts, nuts & stop ring. If there are any faults, contact service department of Manufacturer with photo of abnormal point.

② Interlock Status
Check for close/open and interlock status of circuit breaker and 3 position disconnector.
- CB (Circuit Breaker) Operation
  Check if CB position is Close/Open via supervision window when CB lever Close/Open.
- 3PS (3 position disconnector) Operation
  Check if 3PS position is Connected/Disconnected via supervision window when DS(Disconnect Switch) lever Close/Open.
  Check if 3PS position is Earth/Disconnected via supervision window when ES(Earth Switch) lever Close/Open.
- Interlock
  Check if 3PS is interlocked with CB, i.e., 3PS cannot be operated when CB is in Close position.

If there are any faults, contact service department of manufacturer with report on detailed present situation.

4) Secondary circuit
Check the operating voltage and the control voltage on the Rectifier Display (rated voltage of Rectifier is 125VDC).
Compare the value with the voltage in design below:
- For motor : 85~110% of rated voltage (106.25 ~ 137.5VDC)
- For closing control : 85~110% of rated voltage (106.25 ~ 137.5VDC)
- For trip control : 70~110% of DC rated voltage (87.5 ~ 137.5VDC)

i.e. Voltage Value on the Rectifier Display should be between 106.25 ~ 137.5VDC
If the value is not in 106.25 ~ 137.5 VDC, open the main breakers (q51, q57) of the auxiliary power circuit and check the health of power supply supplied by user. If there is no problem, then contact manufacturer.

5) Thermography Inspection
Perform inspection while CGIS is in operation using Thermal Imaging Camera. For energized panels, it is recommended that the thermostat be closed at 35°C and open at 40°C
For any abnormal heat, contact manufacturer.

4.6.5 Container Inspection

1) Container Condition

① Paint Status (Rust check): If rust, contact manufacturer.

② Insulation (Condensation check): If condensation, contact manufacturer.

③ Door Operation (Operation check) including door limit switch: If it does not operate normally, contact manufacturer.

2) Lighting and Switching
   ① Door-Flood Light Switch: If it does not operate normally, contact manufacturer and repair or replace.
   ② Indoor Light Switch: If it does not operate normally, contact manufacturer and repair or replace.
   ③ Door Limit Switch: If it does not operate normally, contact manufacturer and repair or replace.
   ④ Receptacle: If it does not operate normally, contact manufacturer and repair or replace.
   ⑤ Door Light: If it is OFF, contact manufacturer and repair or replace.
   ⑥ Flood Light: If it is OFF, contact manufacturer and repair or replace.
   ⑦ Indoor (LED) Light: If it is OFF, contact manufacturer and repair or replace.
   ⑧ Exit Lamp: If it is OFF, contact manufacturer and repair or replace.
   ⑨ Thermo-hygrometer: If it does not operate normally, contact manufacturer and repair or replace.

3) Electric Panel (AC)
   ① Panel: If there are any signs of burning, contact manufacturer.
   ② Breaker: If it does not operate normally, contact manufacturer.
   ③ Accessories (Light, Fan, TB schedule): If there is any damage, contact manufacturer.

4) Accessory
   ① ACP Network: If there is any damage, contact manufacturer.
   ② Anchoring for container: If there is any damage, contact manufacturer.
   ③ Grounding: If there is any damage, contact manufacturer.

4.6.6 Fire Alarm & Suppression System Inspection

1) Test according to Operation Sequence (Drawing No. F-001 SD) which may require GFD witness Before the testing, stop ESS Service via PXiSE S/W and test for warning systems and alarms.

2) Check & Replace Fire System's stand-by battery (Every 3 years replacement recommended)
   ① Check if the low-battery indicator illuminates.
   ② Check if standby-batteries operates for 24 hours without aux-power. (24 hours before the testing time, fire switch inside the AC DP should be open for standby-batteries testing.)
   ③ If it illuminates or it is unable to operate for 24 hours without aux-power, then replace batteries. Every 3 years, batteries shall be replaced as manufacturer's guide is 3 to 5 years.

3) Coordination with Fire system installer, G4S Guam may be needed.

4.6.7 UPS Inspection

1) Input value check : Input Voltage, Input Frequency (Refer to Appendix A for the Criteria for Agana and Talofofo respectively.)
2) Output value check : Output Voltage, Output Ampere, Output Frequency, Load Factor, Battery Charging Voltage (Refer to Appendix A for the Criteria for Agana and Talofofo respectively.)
3) Others: LAMP, ALARM, DISPLAY Status, CABLE Connection Status, TR & FAN Status, Cleanliness Status, Indoor Temperature
4) Alarm Status & History Data
5) Thermography Inspection: Battery cabinet should be less than 35°C and UPS cabinet should be less than 40°C.
   Call manufacturer if any of the criteria is not met.

4.6.8 PMS H/W Inspection

1) Check normal operation for following devices. (No red lamp, refer to PMS O&M Manual). If not, contact manufacturer.
   ① Network Switch (RS940GNC)
   ② Network Switch (RSG2488NC)
   ③ PMS (SEL-3355)
   ④ PQ Meter (Nexus 1500+)
   ⑤ NTP SERVER (Lantime M300/GPS)
   ⑥ Protocol Gateway (SEL-3530-4)
   ⑦ HMI&DB Server (DL-380 Gen9)
   ⑧ HMI(Client) Workstation (HP Z840)
   ⑨ Discrete Controller (SEL-2440)
   ⑩ Network Switch (IE-3010-16S-8PC)
   ⑪ ACP (AC Smart IV)
   ⑫ Docomo Modem (HPE Aruba 2530-8-PoE+)

2) Thermography Inspection
   Perform inspection while PMS is in operation using Thermal Imaging Camera. It is recommended that the thermostat be lower than 40°C.

4.6.9 Annual Performance Verification

1) ESS Efficiency: 85% (0.25% annual degradation)

2) ESS Availability: 95% (0.25% annual degradation)

Contact LG CNS if any of the criteria is not met.

4.6.10 Capacity Test (Real Power & Energy)

1) Agana: Capacity Test if Agana ESS is 24MW Rated Power Output for 15 minutes

2) Talofofo: Capacity Test if Talofofo ESS is 16MW Rated Power Output for 1 hour

Contact LG CNS if any of the criteria is not met.

4.7 Over-yearly inspection

4.7.1 Transformer inspection (2-3 yearly)

1) Control panel and terminal box **(Power Off)**
   ① Check the water-tightness: If there is water ingress, exchange the gasket with a new one.
   ② Check the tightness of all connections: If there is connection loosening, tighten the loose bolts.
   ③ Insulating resistance: If insulating resistance is lower than 2 MΩ, repair or replacement is required.

2) Bushing **(Power Off)**
   ① Check for any oil leaks: If there is oil leakage, stop and repair (clean-up oil, check bolt tightening & replace gasket).
   ② Check for any pollution or damage to the bushing: If contaminations are excessive, clean them up. In case of damage, stop and contact manufacturer for repair (replacement).

3) Protective relays **(Power Off)**
   ① Check for external construction: If there is oil leakage or damage, repair or replace.
   ② Measure insulation resistance: If insulating resistance is lower than 2 MΩ, repair or replacement is required. (First, report to transformer or device manufacturer.)
   ③ Check operation (thermometer, level gauge, flow indicator, gas detector, pressure relay, vacuum gauge). If devices are not operating, contact manufacturer.

4) Insulation of winding **(Power Off)**
   ① Send Insulation Oil Sampling Report to manufacturer and manufacturer will recommend if Insulation Resistance Test is required.
   ② If it is required, perform measurement of the insulation resistance between windings and between winding and ground as below:
   - For High Voltage, use 5,000V megger for 10 minutes and it should be over 5,000 (MΩ)
   - For Low Voltage, use 1,000V megger for 10 minutes and it should be over 100 (MΩ)
   ③ Report test result to transformer manufacturer.

4.7.2 Switchgear (CGIS) Inspection (4 yearly)

1) Enclosure and instrument **(Power Off)**

① Remove dust inside/outside of the switchgear with vacuum cleaner (except inside of gas compartment). Refer to the status of commissioning and clean if needed.

② Wipe with dry cloth and cleanser for adherents. Refer to the status of commissioning and clean if needed.

③ Check the relay, meters, VT and CT according to their individual manual.

④ Check the exterior and connection status between switchgears, busbar connector, VT, SA/LA and cable plugs. Refer to the status of commissioning and clean and/or refasten if needed.

2) Switching device mechanism parts **(Power Off)**

① Check operation and interlock system of the switching devices: Refer to Commissioning Report (Test Report Section 3.3). Verify operation and sequencing of interlocking systems. Refer to Appendix A for the Document IDs. Contact service department of manufacturer if there are any issues or abnormalities.

② Wipe out old grease and slightly grease with a clean cloth on the mechanism parts. (See manual Clause 7.3 Lubrication) Note that lubrication of the operating mechanism of circuit breaker or 3-position disconnector is necessary about every 4 years or every 5,000 operating cycles for circuit breaker mechanism, and 1,000 operating cycles for 3 position mechanism. (See Clause 7.3 in the manual).

4.7.3 Switchgear (CGIS) Inspection (12 yearly)

1) Inspection of SF6 Gas

① Measuring of Gas pressure

A. Check if lamp on pressure meter HDM3 is green and the values are 1.35~1.5bar.
B. If the pressure is in Low zone (1.3~1.35 bar.abs, Yellow lamp, and signal), perform inspection of gas leakage. (See manual 7.8 SF6 Gas Inspection).
C. If the pressure is less than the minimum level (Low Low zone: < 1.3 bar.abs, red lamp, and signal), the gas should be refilled as soon as possible. (See manual 7.10 SF6 Gas Refilling).

② Inspection of SF6 gas leakage **(Power Off)**

A. Inspection of SF6 gas leakage is necessary when gas pressure is less than normal value or after filling the gas.
B. The inspection can be carried out with portable SF6 gas detector by means of investigating around near the o-ring and bolt connections of gas compartments.
C. If a leakage is detected by the detector, smear the spot with soapy water where the leak is detected for confirming the leakage.
D. If there is a leakage or any case of uncertainty, contact service department of manufacturer.

③ Measuring of air content **(Power Off)**

A. After input gas into the gas compartment, connect device to gas filling valve.
B. Content of gas must not exceed 3% of SF6 gas.

C. Measuring of air can be skipped after vacuum operation.

④ Measuring of moisture **(Power Off)**

A. Measuring of moisture can be carried out with moisture measuring device by means of measuring dew point at atmospheric pressure. Refer to the individual manual for more details about moisture measuring device.

B. If it is measured under actual pressure in the compartment, the gas in the compartment should be evacuated because the gas in the measuring device and input hose flow to the compartment.

C. The dew point should be less than -10℃. If the dew point is higher than -10℃, it should be maintained.

Perform maintenance work required (refilling/evacuation/opening the gas compartment/filling) according to Clause 7.9 in the manual.

5. Corrective Maintenance

When the correction is required, Local O&M Company will report to LG CNS and LG CNS will request the correction to the related Manufacturer and/or Construction Company which have an obligation for correction during the warranty period. When LG CNS makes a decision for correction work to Local O&M Company, LG CNS will give a correction work order to Local O&M Company.

Local O&M Company warrants that all the corrective works shall, for a period of twelve (12) months following the date of its correction, be free of defects in material or workmanship and of a standard compliant with the relevant specifications as set forth in the As-Built Documentation.

Local O&M Subcontractor will employ Lockout/Tagout (LOTO) procedures (Appendix E) appropriate for the maintenance work to be performed.

In accordance with the conditional approval of the commissioning of the 30 MVA (T-401) transformer inside the GPA substation, LG CNS shall provide additional oil for the 30 MVA transformer (T-401) when the oil level reaches an unacceptable level as determined by GPA T&D. This is needed since the oil level before the transformer was energized was deemed too low by GPA and GPA's third-party witness.

6. Outage and Maintenance Coordination

6.1 Forced Outages

Operator (LG CNS and/or Local O&M Company) shall notify GPA via telephone immediately upon discovering that the -ESS is unable to deliver all or part of any functions of ESS due to a Forced Outage. Operator will provide GPA with an expected duration, and will keep GPA updated, as return to service information is determined.

* Forced Outage: Forced Outage is the shutdown condition of the ESS, transmission line or distribution line when the ESS is unavailable to charge/discharge due to unexpected breakdown. Forced outage can be caused by equipment failures, disruption in the power line, operation error etc.

6.2 Scheduled Maintenance

For the purpose of periodic preventive maintenance, outage (ESS equipment power-off) is required as defined as “Power Off” in chapter 4.

By -the commissioning completion date of each year, Operator shall deliver in writing to GPA the Planned Outage Schedule for each year for GPA concurrence. No later than fourteen (14) days prior to a planned site outage that requires isolation and opening of X400 and X410, Operator shall submit a completed Outage Request form to GPA.

6.3 Revision/Amendment of Scheduled Maintenance

Operator shall be entitled to change any Scheduled Maintenance Outages for the current year by notifying GPA in writing:

Any changes in the annual scheduled maintenance of up to two (2) days duration shall require a one (1) week prior written notice

Any changes in the annual scheduled maintenance of greater than two (2) days but less than three (3) weeks duration shall require a one (1) month prior written notice.

6.4 Additional Maintenance Outages

Operator shall contact GPA in writing with any requested changes to the Planned Outage Schedule if ESS must be shut down to conduct maintenance that cannot be delayed until the next scheduled Planned Outage.

* Planned Outage: A planned outage is any time the contractor intentionally disrupts ESS service to perform system maintenance or install new equipment.

6.5 GPA Dispatch & Outage Coordination

6.5.1 Unplanned

In the event that GPA needs to power-off ESS, the following steps shall be taken:

GPA's Power System Control Center (PSCC) will place a phone call to Operator and provide the following: power-off -time, reason for power-off and anticipated duration of power-off.

6.5.2 Planned

Should GPA need to power-off the output of ESS to accommodate foreseen or planned circumstances, coordination of the power-off shall take place between GPA's PSCC and Operator. Both parties shall coordinate as far advance as reasonably possible when planned events are going to occur that may affect the operational status of the ESS.

6.5.3 Outage Coordination for T-401 at Agana

According to GPA's SOP (Standard Operation Procedure), in case of unplanned and planned outages for T-401 at Agana, the PCS breakers shall be racked out by the O&M Personnel to properly isolate T-401 for maintenance or trouble-shooting. The maximum response time from time of contact to time of arrival at site shall be one hour. This coordination shall be provided until GPA installs a new disconnect switch between X-400 and T-401.

6.5.4 ESS Spinning Reserve Discharging and Charging Rate

If a sudden loss of conventional generation from the GPA grid occurs, the Agana ESS will provide the SR (Spinning Reserve) operation automatically within the remaining battery SOC (State of Charge) at that moment. The discharge rate (MW/min) of the battery will vary according to the under-frequency condition. The ESS will be completely discharged after the battery's remaining SOC is used. To prevent further stress on the grid, the ESS will not start to charge until GPA's grid frequency reaches a stable condition. When reached, the ESS will charge at a rate of 2MW/min. However, this rate may be adjusted based on further evaluation of GPA's conventional generation response capabilities.

7. Spare Parts Management

1) LG CNS will deliver to Local O&M Company with the spare parts, consumables and tools (each individual item being defined as a Spare Part).

2) Upon delivery of all the Spare Parts, Local O&M Company will immediately populate the initial Spare Parts inventory (the Spare Parts Inventory). For the avoidance of doubt, the Spare Parts Inventory shall be consistent with the Spare Parts list provided and should be updated monthly. (Monthly Report to LG CNS)

3) All Spare Parts remain the sole property of LG CNS.

4) Local O&M Company shall identify and number all Spare Parts using a spare parts numbering system. Local O&M Company shall ensure that all Spare Parts are labeled.

5) The Spare Parts shall be stored in Local O&M Company's Warehouse safely and shall be in good condition.

6) LG CNS shall provide a copy of the Spare Parts Inventory list to GPA within two weeks after the start of the O&M contract period. GPA reserves the right to inspect the Spare Parts Inventory at any time within the contract period.

8. Reporting, Documentation & Records

1) Local O&M Company's Daily reports containing the matters set forth in this document shall be delivered to LG CNS not later than next day. When Local O&M Company provides advance excuse notice to LG CNS, Daily monitoring and submission of Daily reports may be excusable. However, all other obligations such as response to alarm/fault shall be performed.

2) Local O&M Company's Monthly Reports containing the matters set forth in this document shall be delivered to LG CNS not later than the tenth (10th) day of the subsequent calendar month and LG CNS shall submit Monthly Report to GPA within five (5) working days. The Monthly Report shall include the daily, weekly and monthly inspection results. After each quarter and half-year, the Monthly Report shall also include these inspection results.

3) Annual Reports containing the matters set forth in Preventive Maintenance of this document shall be delivered to GPA not later than thirty-one (31) calendar days following the end of the applicable Operating Year. The Annual Report shall include the yearly inspection results. The Annual Report shall also include battery replacement history document, LG Chem's recommendations from battery log file analysis which includes all the necessary analysis for battery warranty, and the updated spare parts inventory list.

4) Availability, efficiency, and real power and energy performance shall be assessed by GPA annually and the success rate performance shall be assessed by GPA monthly. The availability, efficiency, and real power and energy performance results will be included in the annual report and submitted to the GPA ESS O&M Manager. The success rate performance results will be included in the monthly report and submitted to the GPA ESS O&M Manager.

5) Reports shall include applicable responses and instructions from the respective manufacturers, if necessary.

6) GPA reserves the right to modify the format or information requested on any report if needed at any time within the O&M contract period. If these changes cause excessive O&M time and efforts, LG CNS reserves the right to request change order to GPA. However, it shall be noted that change orders requested for procedures and formats that are found not to be justifiable for cost increase may be denied.

7) GPA reserves the option to request any Daily or Weekly Report. LG CNS shall provide the report within five (5) working days upon request.

8) Updated annual O&M Plan shall be submitted to GPA when there are any changes to the O&M Plan.

9) Updated O&M Manual shall be submitted to GPA when there are any changes to the O&M Manual.

10) Local O&M Company shall keep the O&M records (including electronic records).

11) Operator shall maintain a log of all material operations and maintenance information. Such log or logs shall include but not be limited to ramp-rate success rate, efficiency, availability, maintenance performed, outages, results of inspections, manufacturer recommended services, replacements, and control settings or adjustments of equipment, etc.

9. Site Safety & Emergency Response Plan

1) Contractor and Local O&M Company (including its subcontractors) will comply with all existing Applicable Laws regarding Site health and safety rules and procedures, applicable to the Site.

2) Any incident/issue concerning the health and safety at the site including but not limited to personal injury, disease or death of any person shall be immediately reported to GPA and shall be recorded.

3) Local O&M Company shall immediately inform LG CNS and GPA in case of witnessing any suspicious security events including but not limited to non-authorized people accessing the Site, theft or vandalism.

4) According to local safety regulation and practice, more than 2 persons shall be at Site during the performance of O&M works.

5) Safety Briefings shall be provided to all workers before performing O&M works and shall include instructions for the minimum clearance allowed from the live switchyard according to NESC and OSHA guidelines.

6) In case of Emergency, perform proper action according to Emergency Response Plan (Appendix C).

7) Local O&M Company shall manage access and secure the sites during adverse weather conditions, post-emergency investigations, and as needed.

8) In the event of an emergency affecting the ESS, GPA's Power System Control Center, or Operator, shall contact the following parties as soon as practicable:

GPA Control Center	PSCC	Phone: 671-475-1472; 1473; 1474
GPA Project Manager	SPORD	Lorraine Shinohara +1 671 648-3101
Local Monitoring	LG CNS manager (1st contact)	Tony (Hyunjoon) Tae +1 671 686 7371
	JMI Edison (2nd contact)	Romeo Oriondo + 1 671 646 6400
HQ Monitoring	LG CNS HQ Engineer (3rd contact)	Won Kwan Choi wkchoi7@lgcns.com +82 10 8279 9123 Woonyoung Park wyp777@lgcns.com +82 10 2880 1297
PXiSE Monitoring	PXiSE Help Desk (4th contact)	support line: +1 833 506 7261

10. Site Access

1) The Agana and Talofofo ESS sites shall be joint-use facilities. Access to both sites shall be shared by both GPA and O&M personnel. O&M contractors are allowed to access the inside of the ESS fenced area. O&M contractors may enter the GPA substation area during emergencies or if needed to perform any O&M work.

2) O&M personnel shall place a tag with GPA PSCC Dispatch upon entering the ESS site. The first person to arrive at the ESS site shall call 475-1472/3/4 (GPA PSCC Dispatch) to place his tag and provide his name, contact number and purpose of visit. If this person leaves the site, he shall call Dispatch and transfer his tag to someone else at the site or remove his tag if no other person will remain at the site. This procedure will allow Dispatch to notify the personnel at the site of an emergency situation.

3) A two-day notice is required if the O&M contractor needs assistance from GPA personnel at the site.

4) All personnel (except US and FSM citizens) will be subject to the foreign visitors request prior to entering the ESS or substation sites. The updated foreign visitors log with the pertinent visitor information shall be submitted to GPA at least two weeks prior to site entry.

5) The daily visitors log and the foreign visitors log shall be submitted to GPA with the monthly reports.

Appendix D. Performance Standards

1) Availability

The CONTRACTOR and/or Energy Storage System manufacturer(s) shall provide a 20-year service and parts warranty that guarantees the ESS performs, at a minimum, according to the guaranteed availability of 95%.

The availability shall be assessed by GPA annually. The CONTRACTOR shall proceed with corrective measures within seven days of notification by GPA if the performance guarantee is not met and shall resolve the issue within six months.

If the ESS does not meet the annual minimum guaranteed availability, the CONTRACTOR shall be assessed a penalty based on the percentage amount below the minimum. The O&M payments to the CONTRACTOR will be reduced by this percentage amount for the following year.

A 0.25% annual degradation will be allowed for the 20-year period such that the minimum requirement at the end of the 20 years is 90% availability.

2) Efficiency

The CONTRACTOR and/or Energy Storage System manufacturer(s) shall provide a 20-year service and parts warranty that guarantees the ESS performs, at a minimum, according to the guaranteed AC-AC round-trip efficiency of 85%.

The efficiency shall be assessed by GPA annually. The CONTRACTOR shall proceed with corrective measures within seven days of notification by GPA if the performance guarantee is not met and shall resolve the issue within six months.

If the ESS does not meet the annual minimum guaranteed AC-AC round-trip efficiency, the CONTRACTOR shall be assessed a penalty based on the GPA Rate Schedule I which can be found on the following webpage:

http://guampowerauthority.com/gpa_authority/rates/documents/20151001.05-RS-I.pdf for each output kWh below the required minimum. Such penalties shall be deducted from the O&M payments to the CONTRACTOR.

A 0.25% annual degradation will be allowed for the 20-year period such that the minimum requirement at the end of the 20 years is 80% AC-AC round-trip efficiency.

3) Success Rate – Talofofo

The Talofofo 16 MW ESS must also control the ramp-rate of the 25 MW solar farm to 1% of rated power output per minute (250 kW/min) at the guaranteed success rate of 97%. The net output of the solar farm and ESS shall be measured from a metering device to calculate the ramp-rate. The success rate shall be calculated every second for one-minute intervals. If the ramp-rate is less than

or equal to 250 kW/min, it shall be counted as successful. At least 97% of the total number of calculated ramp-rates must be considered successful.

The success rate performance shall be assessed by GPA monthly. The CONTRACTOR shall proceed with corrective measures within seven days of notification by GPA if the success rate falls below 97% for a given month and shall resolve the issue within six months.

A 0.25% annual degradation for the 20-year period such that the minimum requirement at the end of the 20 years is 92% success rate of 1% ramp-rate control.

4) Success Rate – Agana

The Agana 24 MW ESS must also regulate the frequency to stay within the tolerance of 59.85 Hz to 60.15 Hz with a success rate of 95% or greater. GPA will not include large system disturbances or SOC limit events in the success rate calculation.

The success rate performance shall be assessed by GPA monthly. The CONTRACTOR shall proceed with corrective measures within seven days of notification by GPA if the success rate falls below 95% for a given month and shall resolve the issue within six months.

A 0.25% annual degradation for the 20-year period such that the minimum requirement at the end of the 20 years is 90% success rate of frequency regulation within the tolerance.

Appendix E. Lockout/Tagout (LOTO) procedures

Lockout/TagOut (LOTO) procedures are to be completed before any service or maintenance work on equipment, and/or before entry into any area where operating equipment poses a hazard to the entrant.

1. Each LOTO will follow the general process listed below.

2. LOTO will follow the specific instructions for each piece of equipment to identify, disconnect, isolate, lock out and verify the lock out of the appropriate energy sources. (Refer to work procedures defined in the Appendix B. Work Plan & Report.)

3. Ending LOTO – follow the general LOTO Release process listed below, using the specific instructions for the equipment to activate energy sources. (Refer to work procedures defined in the Appendix B. Work Plan & Report.)

General Lockout Steps		
#	**Step**	**Instruction**
1	Notify Employees	Notify all affected employees what equipment will be shutdown and locked out.
2	Review Procedures	Ensure each person performing LOTO (authorized employee) understands the type and magnitude of the energy present, the associated hazards and the proper methods of control.
3	Shutdown Equipment	If the equipment is operating, shut it down by the normal stopping procedure.
4	Disconnect & Isolate the Energy Source	Disconnect/de-activate the energy isolating devices(s) so the equipment is isolated from the energy source(s).
5	Lockout Controls	Lockout and tag out the energy isolating device(s) as indicated in the specific instructions
6	Release Energy	Release and/or dissipate any stored or residual energy as indicated in the specific instructions.
7	Try out	Verify the energy source has been isolated as indicated in specific instructions.
Lockout Release Steps		
#	**Step**	**Instruction**
1	Inspect Equipment	Check the equipment to ensure the components are operational.
2	Check Area	Check the immediate area to ensure all employees have been safely positioned, and tools and any nonessential items have been removed.
3	Check Controls	Verify that operating controls are off (not on).
4	Re-energize	Remove the lockout device(s) and activate the energy isolating device(s) to re-energize the equipment.
5	Notify Employees	Notify affected employees the servicing or maintenance is completed and the equipment is ready for use.
6	Startup Equipment	Startup equipment and monitor for several operating cycles to ensure it is functioning properly.

ATTACHMENT B
AGANA ESS EMERGENCY RESPONSE PLAN

SOP-169
OPERATION AND MAINTENANCE RESPONSIBILITIES FOR THE AGANA AND TALOFOFO ENERGY STORAGE SYSTEMS

EFFECTIVE DATE: 2/18/21

GPA ESS Phase Ⅰ
AGANA Substation

Emergency Response Plan

Document ID: AGA-ERP -01

Prepared by
LG CNS **Tony (Hyunjoon) Tae** 

AGANA ESS EMERGENCY RESPONSE PLAN

Record of Revisions*

Change #	Date of Change	Substance of Change	Entered By

* This document is updated version of #9 Emergency Action Plan in the SAFETY & HEALTH MANUAL.

Table of Contents

1. Introduction

1.1 Purpose

The following emergency response procedures are provided so that all AGANA ESS site personnel understand the practices that are to be followed to be prepared for and to provide immediate and effective response to emergencies that might arise at the facility. Because the safety of employees is of primary concern, the AGANA ESS site Emergency Response Coordinator and each member of the AGANA ESS site staff are committed to providing a safe, healthy work environment and are responsible for ensuring implementation of these procedures.

Life safety of personnel shall be the highest priority during any event.

1.2 Limitations

This plan does not imply, nor should readers infer, that its implementation will guarantee that a perfect response will be practical or possible. No plan can shield individuals from all events.

Responders will attempt to coordinate the plan and response according to all applicable laws and standards.

Response to emergencies, events or disasters shall only be undertaken to the level of the responders' training, Personal Protective Equipment (PPE), and resources available.

There may be little to no warning during specific events to implement operational procedures.

The success or failure of all emergency plans depends upon effective training, continual (e.g., annual) review of this response plan, and execution of the response.

Sites and operators shall comply with applicable codes, standards, and other requirements as apply in their locality, even if those codes, standards, and requirements contradict this plan.

Successful implementation of this plan depends on timely identification of capabilities, available resources at the time of the incident and a thorough information exchange between responding organizations and the facility or transporter.

1.3 Facility Description

AGANA ESS site is located in AGANA at Agana Substation, Mongmong-Toto-Maite, Guam. The site is comprised of Lithium-ion Battery Energy Storage System in 3 of containerized enclosures. The primary entrance is located at the road side of AGANA existing substation with a secondary entrance at the switchyard of AGANA existing substation.

Appendix 1 provides a map of the facility. Notification information for plant and external support organizations (police, fire department, medical facilities, etc.) that may be called to respond to

emergency situations at AGANA ESS site is included in Appendix 4. The Local O&M Manager or their delegated substitute is available via cellular phone in case of an emergency.

1.4 Plan Review and Revision

A review of this emergency response plan shall be conducted and documented at minimum on an annual basis. The plan shall also be reviewed and amended whenever there are updates in safety standards or applicable laws or there is a change in facility design, construction, operation, or maintenance that affects emergency response planning. When outside resources are changed or modified the plan shall be reviewed and updated to reflect the changes that may affect this plan.

2. Emergency Response Management

2.1 Overall Organization

Overall responsibility for the Emergency Response Plan (ERP) lies with the AGANA ESS site Emergency Response Coordinator. The Emergency Response Coordinator or their designee is responsible for program implementation, including designating evacuation routes and employee assembly points, coordinating severe weather activities, communicating emergency response procedures to site personnel, contracting with emergency response organizations, and contractor coordination.

2.2 Roles and Responsibilities

Specific management personnel will assume leadership roles for emergency responses. The Emergency Response Coordinator, Local O&M Manager, and/or Lead Technicians will assist in the implementation of this plan by knowing and communicating evacuation routes to workers during emergency evacuation and reporting the status of the evacuation to the Fire Department. The Emergency Response Coordinator is responsible for seeing that this plan is implemented and will appoint an adequate number of personnel to enforce the plan, assure everyone is familiar with this plan and act as a liaison with the local Fire Department(s).

All facility personnel have a responsibility to immediately report emergency situations to the Lead Technician on duty or local emergency responder personnel when appropriate. There shall be no delay to report emergency events that require the local emergency responders. The Lead Technician will then notify the Emergency Response Coordinator and other key personnel of the situation using the AGANA ESS site Emergency Notification Telephone List (refer to Appendix 4). Where a Lead Technician is not assigned, facility personnel will refer to the Emergency Notification Telephone list to inform key personnel. Titles and roles are summarized in Appendix 3.

The Emergency Response Coordinator (or designee) shall be responsible for initiating a 'phone tree' for informing relevant operations and administrative contacts in Owner, GPA (Guam Power Authority), including the Regional Manager to initiate corporate awareness and public communications activities in accordance with company structure and policies.

A Subject Matter Expert (SME) shall be contactable at all times by telephone. This person and a designated Secondary SME contact should be readily available to first responders in the case of emergency situations. The SME shall be versed in the battery's failure modes and hazards. A working knowledge of incident command systems will allow the SME to integrate into the emergency response operations when needed. If this is not practical, telephone numbers of Local O&M Company and LG CNS headquarters should be available such that first responders may call at any time, and be given operational data on the system, including its current state of health, system alarm notifications, and advice on how to proceed during an emergency event.

2.3 Preparation and Planning for Emergencies

2.3.1 Pre-planning for emergencies is a crucial element of this plan. The following steps have been taken in planning for emergency situations at the site:

- Fire department and other first responders have received a copy of this plan and have participated in an on-site familiarization meeting.
- All emergency responder access points to the facility shall be identified.
- An emergency response information notice board shall be maintained at the right side of Control Container Main Door, identified in Appendix 1 and contain key contacts for emergencies, and other notices as outlined in this document or as deemed appropriate by the Emergency Response Coordinator.
- All road exits are established and posted on the emergency information notice board.
- Evacuation route diagrams have been documented and posted on the emergency information notice board.
- All buildings and property surrounded by fencing will be marked by signage that identifies specific hazards (such as the NFPA diamond, and all applicable Danger, Caution, Warning signal words).
- Site personnel receive instruction to keep exits from the site clear and to maintain ready access to fire extinguishers by not blocking them with furniture, or any other means. Refer to Appendix 5 for locations of fire extinguishers.
- Safe approach distances are established for equipment's different failure modes, personnel are trained in these distances, and such information is communicated in writing to first responders during emergency response informational meetings.
- Locations of Eyewash/Shower Stations are identified in Appendix 1.
- The Site Safety and Health Officer shall be certified in First Aid and O&M personnel shall be trained in First Aid. Refer to Appendix 5 for locations of First Aid Kits.

2.3.2 Emergency Routes

AGANA ESS site evacuation sheet shall be posted and orally communicated to site personnel. These procedures shall be discussed at periodic safety meetings in addition to being covered during new employee orientation. Personnel are to know at least two exits whenever possible and be familiar with the evacuation routes posted in the location indicated on the site map (Appendix 1).

Depending upon the degree of emergency, weather and/or site conditions, roadways as designated on the site map (Appendix 1) will be used for routes of evacuation. In the event of an evacuation, all personnel will meet at the designated muster point for further information. If the primary muster point is inaccessible or hazardous, personnel shall gather at the secondary muster point and inform the emergency coordinator. The emergency response coordinator shall inform personnel of a diversion to the secondary muster point by such mean as are available, to include radio or loud hailer. If personnel are unable to make it to the designated muster points, they should seek shelter wherever possible and contact their supervisor for further instructions. Accountability of personnel shall be of the upmost importance and be conducted in a timely manner. Responder access points shall be kept

unobstructed at all times so first responders will not be hindered in their operations when responding to emergencies within the site.

2.4 Communications

Timely and efficient communications are essential to deal with an emergency response situation. The Emergency Response Coordinator is the central point of contact for all involved in an emergency response, including for first responders and Subject Matter Experts (SMEs). The following processes shall be observed during emergency communications:

- Employees using radios/phones shall yield to individuals who are the most directly involved in an emergency response activity, i.e. emergency response takes priority over all other communication on company network.
- Emergency transmissions should be clearly announced using signal words such as 'urgent' or 'mayday.' These signal words give priority to the radio transmitter to proceed with their message.
- If emergency phone communications are interrupted or unclear, employees shall proceed to the muster located at outside of AGANA ESS site main gate and identified in Appendix 1.
- All hand-held phones of on-site workers should be recharged daily.

2.5 Operator Safety & Equipment

2.5.1 General recommendations for operator safety

- System Monitoring daily for unsafe conditions.
- Keep hands away from exposed electrical connections.
- Keep hands away from hot surfaces.
- Observe all high voltage warnings.
- Any outstanding observations shall be reported to their supervisor immediately and documented.

2.5.2 Personal Protective Equipment

The operation or maintenance of specific equipment may have different safety requirements. There are different levels of PPE that must be checked and maintained. All personnel who wear levels of protection above and beyond their normal everyday attire must be trained in that PPE. All training of PPE shall be conducted by a competent person and documented. Some PPE have a SCAM (selection, care and maintenance) document that will instruct the end user on the limitations of the PPE and the proper maintenance of the PPE. Always be aware of individual equipment operational requirements and hazards as well as out of service dates. For example,

- Safety glasses with side shields (no dark glasses are permitted except those approved for welding or cutting)
- Face shields for cutting & grinding
- Approved safety toe shoes
- Approved hearing protection
- Approved hardhat

- Approved gloves
- Long sleeve shirt
- Long pants

All PPE is required to be worn at all times for the working being conducted. Any PPE that is compromised or no longer considered viable for protection shall be discarded and replaced. Any PPE that comes in contact with hazardous material shall be properly decontaminated and inspected for functionality before being returned to service.

2.6 Safety Training

2.6.1 General training requirements

Initial training for all site personnel with respect to the contents of this ERP shall be undertaken upon the start of employment or substantial changes in duties. Refresher training of the ERP to site personnel shall be conducted at least annually. Documentation of ERP training is to be maintained in site files.

The site Emergency Response Coordinator and Lead Technicians are trained in their specific duties upon being assigned these roles or beginning their employment.

Operator personnel should receive supplier / manufacturer approved training on the specific characteristics of the energy storage system. Applicable common standards (e.g. on electrical safety) should be taken into account. All personnel who wear levels of protection above and beyond their normal everyday attire must be trained in that PPE.

Initial and refresher training regarding warning systems and alarms shall be conducted at least annually. Documentation of training is to be maintained in site files.

Any personnel from the Guam Power Authority and the Guam Fire Department may participate in the annual training on this emergency response plan. Lessons learned from prior events shall be discussed and the emergency response plan shall be updated accordingly. Annual training report shall include attendance and details of the training provided and shall be included in the annual O&M report.

2.7 Warning Systems and Alarms

Audible and visual (e.g., flashing lights) alarm systems should be established that reflect specific on-site hazard analyses. Personnel should be trained on the significance of different alarms and the corresponding actions as outlined elsewhere in this Plan. Descriptions of each alarm and corresponding actions should be clearly posted on an emergency information notice board (location marked on map in Appendix 1).

Warning systems and alarms should be tested at least yearly or manufacturer specifications or code requirements. Tests shall be documented. All site personnel, as well as those offsite who are likely to hear or see an alarm, should be made aware of tests so as not to cause undue concern. Local O&M Manager shall inform GPA PSCC at least two days prior to the testing date.

Fire alarm/suppression system is connected 24x7 and notifies, in real-time, GPA PSCC (Power System Control Center) and Control S/W of any alarms. Control S/W also notifies Local O&M Company (JMI Edison) and LG CNS HQ personnel of these alarms. GPA PSCC and/or Local O&M Company shall call 911 immediately when notified of a fire alarm. Main and first contact point to GFD (Guam Fire Department) is GPA PSCC.

In case there is a Loss of Communication (LOC) between GPA PSCC and the ESS site, GPA PSCC shall notify O&M Contractor of the situation and vice versa. Regardless of communication status, O&M Contractor shall always call 911 and contact GPA PSCC whenever any emergency (fire, hydrogen gas, etc.) alarms are received on-site or off-site. Any GPA personnel on-site shall also notify GPA PSCC whenever any emergency alarms are noticed. GPA PSCC shall then notify O&M Contractor and any personnel at the site of these alarms. Until communication is restored, O&M Contractor will monitor alarms and notify GPA PSCC of any emergency alarms received. However, if the LOC situation remains beyond 9:00 PM, the ESS shall be shut down as a safety precaution.

3. Emergency Response

3.1 Analyze, Plan, Implement, Evaluate

The phases of emergency response may be categorized under the 'APIE' scheme for handling an emergency: Analyze, Plan, Implement and Evaluate.

- Analyze: Analyzing the response is the phase in which the notification takes place to emergency responders.
- Plan: Planning the response is the phase in which the proper resources and equipment are called to the emergency scene and a plan is developed to mitigate the emergency.
- Implement: Once a plan is developed and the proper resources and equipment are there, then the Emergency Response Coordinator will make the determination to implement the plan.
- Evaluate: Once the plan is implemented, it shall be evaluated for safety and effectiveness. If the plan is not safe or effective, then the process should start over again with Analyze, Plan, Implement, and Evaluate.

Only personnel who are properly trained may respond to hazardous chemical releases. No employee is required or permitted to place himself or herself in harm's way in order to facilitate extinguishment, evacuation, or rescue. All rescue operations will be performed by trained professionals upon their arrival. Rescue operations will only be conducted after a risk-reward analysis is done and proper PPE is used to protect against any adverse hazards that may be encountered.

Incidents where local fire department personnel are involved will be managed under a system established by the fire department, called 'Incident Command System.' This establishes a primary incident commander and a liaison to or for the Emergency Response Coordinator.

3.1.1 Analyze

Without entering an immediate hazard area, the employee who first discovers an emergency should identify the following:

- Is there a fire, spill, explosion, or other incident happening?
- Does medical assistance appear to be needed?
- Who/what is at risk: people, the environment, or property?
- What are the weather and terrain conditions and risks?

The employee will also isolate the area to keep people away from the scene until trained responders arrive, as long as it is safe to do so. An employee who has not received training in emergency response should take no actions beyond notification, isolation of the area, and personal safety precautions. Any efforts made to rescue persons, protect property, or protect the environment must be weighed against the possibility of becoming part of the problem. Attempts to rescue others shall only be attempted with proper PPE, proper training, and in a manner that does not create significant risk to rescuer or others. Persons at the scene must not contact spilled material or inhale fumes, smoke, or vapors.

3.1.2 Plan

After all life hazards are no longer a threat, a plan of operation shall be devised for remediation of the event. The plan shall be communicated to all responders and safety of all responders shall be paramount. A staging area, if needed, shall be identified for extra personnel and equipment that may be needed to accomplish the plan's objectives. All responders that will enter the hot zone (affected area) must be made aware of any decontaminated area upon their exit of the hot zone. Trained responders will be called to the scene by the Local O&M Manager and/or Lead Technicians to begin the process of hazard assessment and to establish objectives and priorities. The hot zone shall be identified, and all non-essential personnel shall not be permitted to enter this area without proper training and permission of the Emergency Response Coordinator.

3.1.3 Implement

The initial response phase starts with notification, which activates the emergency response system. Anyone who observes or receives information regarding an emergency at AGANA ESS site should immediately notify 911 first and then notify available personnel using the AGANA ESS site radio network or their issued cell phones. The Emergency Response Coordinator and/or Lead Technician will also ensure 911 and the proper personnel are notified. At AGANA ESS site, employees are notified of emergencies by cell phone/radio and word of mouth from the Emergency Response Coordinator and/or Lead Technicians. Appendix 4 provides a list of emergency notification information for AGANA ESS site personnel.

If an event has the potential to impact the local community, AGANA ESS site will contact local fire/police to make community notifications. The contact list in Appendix 4 also provides notification information for the GPA Public Affairs team who will provide guidance for instances involving media. The Emergency Response Coordinator and/or Lead Technicians will coordinate any media efforts through the AGANA ESS site Owner GPA. The incident command post will be set up in a location free of contaminants and located upwind uphill and upstream. The Emergency Response Coordinator or designee shall remain at the incident command post to serve as a liaison to the Incident Commander designated by emergency responders. Trained responders may enter a 'hot zone' only when wearing appropriate protective equipment. Personnel entering the hot zone shall be briefed on the plan before entering. All communication devices shall be tested prior to entry into the hot zone. A decontamination corridor shall be established prior to entry into the hot zone. There shall be accountability taken of all personnel entering and leaving the hot zone. A back up team that has the same PPE shall be at the ready in the event of the entry team needs quick assistance. A decontamination team shall be ready to for after exiting the location (warm zone). There shall be a doffing station that is set up immediately at the end of the decontamination section that will allow the responders a safe place to remove their PPE. Only trained responders are authorized to risk exposure to chemicals for purposes of containing or stopping the material release.

The Emergency Response Coordinator or a designee will be responsible for notifying the appropriate regulatory agencies. Appendix 4 includes a list of emergency contacts and agencies that may be notified in the event of an emergency. The incident will be documented and kept on file.

3.1.4 Evaluate

During the implementation phase of the emergency, response, action and progress shall be analyzed by the Emergency Response Coordinator constantly. If the plan seems to be ineffective or unsafe the responders shall be removed from the hot zone and the plan shall be revised. The new plan shall be implemented, and that revised plan shall be analyzed for safety effectiveness again.

3.2 Evacuation Procedures

When notified to evacuate, site personnel shall do so in a calm and orderly fashion, keeping the following instructions in mind:

- Walk, don't run. Help others who need assistance as long as doing so does not put you at greater risk.
- Stay upwind, upstream, and uphill whenever possible.
- Watch for other traffic and equipment on access roads and roadways.
- Be aware of wet and loose gravel conditions.
- Drive safely.

Site personnel shall go to the primary designated muster area as identified in Appendix 2. If employees are unable to make it to the muster area, they should divert to the secondary muster area and immediately contact their supervisor for further instructions. During evacuation, the Emergency Response Coordinator and/or Lead Technicians should ensure that every person on his/her crew has been notified and that evacuation routes are clear. Any person with a disability (mobility, hearing, sight, etc.) who requires assistance to evacuate is responsible for pre-arranging with someone in their immediate work area to assist them in the event of an emergency. Anyone knowing of a person with a disability or injury who was not able to evacuate will report this fact immediately to their supervisor. This information shall be communicated to emergency responders immediately upon their arrival if the disabled person has not been evacuated.

Once an evacuation is complete, the Emergency Response Coordinator or Lead Technician should account for all personnel. This accountability information shall be communicated to the emergency responders immediately upon their arrival. When a person is unaccounted for, the following information shall be communicated to the emergency responders:

- Name of the individual
- Disabled or not disabled
- Work location
- Last known location

3.3 Post Emergency Reporting Procedures

Following any emergency described in this plan, and in compliance with facility permits and other local or federal requirements, an incident report will be prepared by the Emergency Response Coordinator and transmitted to the appropriate individuals and agencies after review by the Company Regional Manager.

The Emergency Response Coordinator shall compile all documentation and perform a post-emergency investigation. Immediate performance of this activity will aid in determining the exact circumstances and cause of the incident. Issues to be determined include:

- Causes of the incident.
- Effectiveness of the emergency response plan.
- Need for amendments to the response plan.
- Need for additional training programs.

The fire department will make the final determination regarding when the scene is safe to release the site to staff. In some circumstances the scene may need to be safeguarded for investigators to examine the event failures. If the facility is not able to reopen due to the event, the Local O&M Manager will make a determination regarding continuity of operations for the facility in consultation with the Company Regional Manager.

4. Fire Incidents

All personnel working at AGANA ESS site are to be trained and should know how to prevent and respond to a fire emergency. All on-site personnel shall:

- Complete an on-site training program identifying the fire risks at AGANA ESS site.
- Understand the protocol and follow emergency procedures should an event occur.
- Review and report potential fire hazards to the Emergency Response Coordinator.

No employee is required or permitted to place himself or herself in harm's way in order to facilitate extinguishment, evacuation, or rescue. All rescue operations will be performed by trained professionals upon their arrival.

4.1 Conditions Associated with Energy Storage Systems

4.1.1 Unique Challenges

Energy storage systems present a unique challenge for fire fighters. Unlike a typical electrical or gas utility, an energy storage system does not have a single point of disconnect. Whereas there are disconnects that will de-energize select parts of the system, batteries will remain energized.

The following hazards may be encountered when fighting fires in energy storage systems:

- Shock or arcing hazard due to the presence of water during suppression activities.
- Related electrical enclosures may not resist water intrusion from the high pressure stream of a fire hose.
- Batteries damaged in the fire may not resist water intrusion.
- Damaged conductors may not resist water intrusion.
- Shock hazard due to direct contact with energized components.
- No means of complete electrical disconnect.
- Chemical spills (In case that fire is melting down battery cells inside the module case)
- Toxic gases (In case that fire is melting down battery cells inside the module case)
- Thermal runaway and explosions (In case that BMS (Battery Management System) is not able to monitor and stop operation when battery temperature goes up.)

4.1.2 Fire and Water

Due to the hazards described above, care and consideration should be applied when considering fire suppression by means of water inundation within energy storage systems. But because water as an extinguishing agent is commonplace, the appropriate use of water should be assessed. The local fire department should be informed of appropriate fire suppression methods for the energy storage system type as identified by the equipment manufacturer. Manufacturer, LG Chem confirmed fire suppression by means of water inundation within battery container if automatic fire suppression system fails fire suppression. To suppress fire on outdoor equipment (PCS and Transformer) and the control container, local fire department may use water.

All fire extinguishing equipment, whether automatic or manual, shall be regularly inspected for functionality as per manufacturers' guidance.

4.2 Response to a Fire Incident

In the event of an incipient stage (beginning, small) fire, employees should notify adjacent individuals of this situation and exit the area. Only employees trained in the use of fire extinguishers or other manual fire suppression systems should attempt to use an extinguisher or system. Employees are not expected or authorized to respond to fires beyond the incipient stage. The fire department should be immediately notified by dialing 911 when any type of unintended fire has taken place. Site management shall also be immediately notified of any emergency.

GPA PSCC shall contact the personnel with any tags at the site if any fire alarms are received. Personnel at the site shall also call GPA PSCC if a fire alarm is noticed or if the lights inside any of the containers turn off unexpectedly. (The ESS control system will automatically turn off the auxiliary power inside all containers when a fire alarm is received as a safety precaution in case an external fire alarm is not audible from inside the container.) The personnel shall proceed according to the following procedures based on the type of alarm.

4.2.1 Fire External to Container or Enclosure

- Call 911 and report the following:
  - Site name: AGANA ESS site
  - The address of the main entrance: Agana Substation, Mongmong-Toto-Maite, Guam
  - Fire Location: Inform fire location to GFD
  - Injuries, if any, and need for ambulance
- Contact GPA PSCC to notify any other personnel known to be at the site.
- Make sure the immediate area of the fire is clear of personnel.
- Account for all employees, contractors, and visitors who were working in the immediate area of the fire. If any personnel are unaccounted for from the immediate fire area, communication shall be made through out the facility in attempt to locate the person(s) missing.
- Contact the Local O&M Manager (if present) and Emergency Response Coordinator (if not the Local O&M Manager) immediately.
- Contact GPA PSCC and inform them that X-400 and T-401-1 DS should be opened by GPA PSCC for safety. When GPA PSCC opens X-400, the AC and DC breakers of all the PCS will be opened automatically and then the ESS will be de-energized. **However, it shall be noted that some of the equipment in the battery containers will remain energized no matter what actions are taken.**
- GPA PSCC shall confirm ESS de-energization status by checking if the DC breakers of all the PCS are open via SCADA. If not, then GPA PSCC can send the Emergency Stop command for all the PCS via SCADA remotely.
- If the ESS is not de-energized remotely, the last option is for the operator or firefighter to press the Emergency Stop button on all the PCS at the site.
- Confirm that the back-up generator is off.
- Inform GFD that they may use water to suppress fire after the ESS site is de-energized.
- Remove any obstructions (vehicles, material, etc.) that might impede response to the scene.
- Station available personnel at road intersections to stop traffic flow into the fire scene.

- Evacuate the energy storage system area immediately if the fire warning alarm sounds or fire warning lights illuminate.
- Proceed to the designated muster point for head count.
  - If onsite, the designated Emergency Response Coordinator will do a head count and relay any information/instructions.
- If you encounter heavy smoke, stay low and breathe through a handkerchief or other fabric; move away from the area.
- Assist anyone having trouble leaving the area so long as doing so does not put the assistor at additional risk.
- Do not leave the designated muster point until advised to do so. If risk (e.g. smoke) requires evacuation of the muster point, the secondary muster point (designated on the map in Appendix 2) will be used.
- The Emergency Response Coordinator will issue an 'all clear' only when the fire department informs them that it is safe to do so.
- The energy storage system is not to be accessed until the Local O&M Manager or designated Emergency Response Coordinator gives authorization.
- Contact GPA Safety Division and inform them of the situation.
- Contact GPA Planning and Regulatory Division in case of incidents involving hazardous materials or environmental regulations.

4.2.2 Fire Internal to Control Container (Building #1)

- Call 911 and report the following:
  - Site name: AGANA ESS site
  - The address of the main entrance: Agana Substation, Mongmong-Toto-Maite, Guam
  - Fire Location: Inform fire location to GFD that fire is in the Building #1. (Refer to Appendix 1. Building #1 is Control Container.)
  - Injuries, if any, and need for ambulance
- Contact GPA PSCC to notify any other personnel known to be at the site.
- Make sure the immediate area of the fire is clear of personnel.
- Account for all employees, contractors, and visitors who were working in the area of the fire. If any personnel are unaccounted for from the immediate fire area, communication shall be made through out the facility in attempt to locate the person(s) missing.
- Contact the Local O&M Manager (if present) and Emergency Response Coordinator (if not the Local O&M Manager) immediately.
- Contact GPA PSCC and inform them that X-400 and T-401-1 DS should be opened by GPA PSCC for safety. When GPA PSCC opens X-400, the AC and DC breakers of all the PCS will be opened automatically and then the ESS will be de-energized. **However, it shall be noted that some of the equipment in the battery containers will remain energized no matter what actions are taken.**
- GPA PSCC shall confirm ESS de-energization status by checking if the DC breakers of all the PCS are open via SCADA. If not, then GPA PSCC can send the Emergency Stop command for all the PCS via SCADA remotely.
- If the ESS is not de-energized remotely, the last option is for the operator or firefighter to press the Emergency Stop button on all the PCS at the site.
- Confirm that the back-up generator is off.

- Evacuate the area immediately if the fire warning alarm sounds or fire warning lights illuminate.
- Remove any obstructions (vehicles, material, etc.) that might impede response to the scene.
- Proceed to the designated muster point for head count.
- If onsite, the designated Emergency Response Coordinator will do a head count and relay any information/instructions.
- If you encounter heavy smoke, stay low and breathe through a handkerchief or other fabric.
- If there is a second means of egress that is clear of smoke, that egress path will be used and a mobile phone or other type of communication shall be made stating that the clear egress point for other personnel to use for escape is the second means of egress.
- Assist anyone having trouble leaving the area so long as doing so does not put the assistor at additional risk.
- The fire suppression system is designed to work in a contained environment. **DO NOT** open the doors until it has been determined that the agent has been fully released and a pre-determined amount of time (1 hour) has passed to ensure no hazards are present, and with approval of emergency personnel and Subject Matter Expert.
- **DO NOT** put anyone in harm's way to save the equipment in the container.
- Once the Fire Department arrives, provide them with the following:
  - Assistance isolating equipment electrically
  - This emergency response plan
  - Inform GFD that they may use water to suppress fire after the ESS site is de-energized. However, the doors of the Control Container should remain closed for at least 1 hour.
  - Information on the location of the 34.5 kV equipment inside the Control Container
  - A liaison to remain with the fire department Incident Commander as needed
  - Notify GFD that there are lead-acid batteries for the UPS and Rectifier and the Fire Department needs to understand that batteries will remain energized no matter what actions are taken, and the recommended option is containment. Batteries remain energized even if all the contactors, breakers, and switches have been opened.
- Do not leave the designated muster point until advised to do so. If risk (e.g. smoke) requires evacuation of the muster point, the secondary muster point (designated on the map in Appendix 2) will be used.
- The Local O&M manager and/or Emergency Response Coordinator (if not the Local O&M manager) will issue an 'all clear' only when the fire department informs them that it is safe to do so and the site (or portions of it) can be reoccupied or normal working conditions can be resumed again.
- The energy storage system is not to be accessed until the Local O&M Manager or designated Emergency Response Coordinator and the emergency responders give authorization.
- Contact GPA Safety Division and inform them of the situation.
- Contact GPA Planning and Regulatory Division in case of incidents involving hazardous materials or environmental regulations.

In the event of a fire incident, the GPA PSCC is responsible for the safe shutdown of the plant (i.e. verify switchgear (X-400) is open and Disconnect Switch (T-401-1 DS) is open) to ensure the grid side of the plant is de-energized and O&M personnel is responsible for the isolation of the batteries as best able to (i.e. verify the AC and DC breakers are open in the PCS). When 1st stage of fire alarm is activated, the PMS will send Emergency Stop commands automatically in order to stop all PCS, all BSC and following relays:
- Agana: X-401, X-402, X-403, X-404, X-405, X-406, T-408
- Talofofo: X-411, X-412, X-413, X-414, T-85

4.2.3 Fire Internal to Battery Containers (Building #2, Building #3, Building #4)

- Call 911 and report the following:
  - Site name: AGANA ESS site
  - The address of the main entrance: Agana Substation, Mongmong-Toto-Maite, Guam
  - Fire Location: Inform fire location to GFD, for example, Fire in the Building #2. (Refer to Appendix 1. Building #2 is Battery Container #1. Building #3 is Battery Container #2. Building #4 is Battery Container #3.)
  - Injuries, if any, and need for ambulance
- Contact GPA PSCC to notify any other personnel known to be at the site.
- Make sure the immediate area of the fire is clear of personnel.
- Account for all employees, contractors, and visitors who were working in the area of the fire. If any personnel are unaccounted for from the immediate fire area, communication shall be made through out the facility in attempt to locate the person(s) missing.
- Contact the Local O&M Manager (if present) and Emergency Response Coordinator (if not the Local O&M Manager) immediately.
- Contact GPA PSCC and inform them that X-400 and T-401-1 DS should be opened by GPA PSCC for safety. When GPA PSCC opens X-400, the AC and DC breakers of all the PCS will be opened automatically and then the ESS will be de-energized. **However, it shall be noted that some of the equipment in the battery containers will remain energized no matter what actions are taken.**
- GPA PSCC shall confirm ESS de-energization status by checking if the DC breakers of all the PCS are open via SCADA. If not, then GPA PSCC can send the Emergency Stop command for all the PCS via SCADA remotely.
- If the ESS is not de-energized remotely, the last option is for the operator or firefighter to press the Emergency Stop button on all the PCS at the site.
- Confirm that the back-up generator is off.
- Evacuate the area immediately if the fire warning alarm sounds or fire warning lights illuminate.
- Remove any obstructions (vehicles, material, etc.) that might impede response to the scene.
- Proceed to the designated muster point for head count.
- If onsite, the designated Emergency Response Coordinator will do a head count and relay any information/instructions.
- If you encounter heavy smoke, stay low and breathe through a handkerchief or other fabric.

- If there is a second means of egress that is clear of smoke, that egress path will be used and a mobile phone or other type of communication shall be made stating that the clear egress point for other personnel to use for escape is the second means of egress.
- Assist anyone having trouble leaving the area so long as doing so does not put the assistor at additional risk.
- The fire suppression system is designed to work in a contained environment. **DO NOT** open the doors until it has been determined that the agent has been fully released and a pre-determined amount of time (24 hours) has passed to ensure no hazards are present, and with approval of emergency personnel and Subject Matter Expert.
- **DO NOT** put anyone in harm's way to save the battery equipment in the container.
- Once the Fire Department arrives, provide them with the following:
  - Assistance isolating equipment electrically
  - This emergency response plan
  - Inform GFD that they may use water to suppress fire after the ESS site is de-energized. However, the doors of the Battery Container should remain closed for at least 24 hours.
  - A liaison to remain with the fire department Incident Commander as needed
  - Notify following **"specific actions in the event of a thermal event"** on site to GFD. Appendix 6 is Manufacturer, LG Chem's guide for Fire Fighting Measures.
    1) The Fire Department needs to understand that some of the equipment (batteries) will remain energized no matter what actions are taken, and the **recommended option is containment**. Batteries remain energized even if all the contactors, breakers, and switches have been opened.
    2) The battery container should be kept **closed and monitored for 24 hours or longer** to see if there is a continued rise in temperature or whether there is visible smoke.
    3) If it is determined by the Incident Commander that there is not an immediate threat to lives, it could be possible to use an approach of monitoring the battery container from safe distance for 24 hours or more to further assess the situation.
    4) When the Incident Commander decides to have the battery container door opened, the door opening operation should be performed **remotely at a safe distance using non-conducting ropes, hooks, poles, or similar devices without anyone standing directly in front of the door**. The main intent is to minimize personnel exposure in front of the open door or to avoid a life-threatening situation due to heated gas or a flying object by potential explosion. After the battery container door is opened, the battery container should be monitored for 12 hours or longer to see if there is a rise in temperature or visible smoke.
- Do not leave the designated muster point until advised to do so. If risk (e.g. smoke) requires evacuation of the muster point, the secondary muster point (designated on the map in Appendix 2) will be used.
- The Local O&M manager and/or Emergency Response Coordinator (if not the Local O&M manager) will issue an 'all clear' only when the fire department informs them that it is safe to do so and the site (or portions of it) can be reoccupied or normal working conditions can be resumed again.

- The energy storage system is not to be accessed until the Local O&M Manager or designated Emergency Response Coordinator and the emergency responders give authorization.
- Contact GPA Safety Division and inform them of the situation.
- Contact GPA Planning and Regulatory Division in case of incidents involving hazardous materials or environmental regulations.

In the event of a fire incident, the GPA PSCC is responsible for the safe shutdown of the plant (i.e. verify switchgear (X-400) is open and Disconnect Switch (T-401-1 DS) is Open) to ensure the grid side of the plant is de-energized and O&M personnel is responsible for the isolation of the batteries as best able to (i.e. verify the AC and DC breakers are open in the PCS). When 1st stage of fire alarm is activated, the PMS will send Emergency Stop commands automatically in order to stop all PCS, all BSC and following relays:
- Agana: X-401, X-402, X-403, X-404, X-405, X-406, T-408
- Talofofo: X-411, X-412, X-413, X-414, T-85

4.2.4 After a Fire

Hazards after a fire should be identified at the time of installation such that recommendations for personal protective equipment (PPE) are available for clean-up crews and hazardous materials (HAZMAT) teams. This may include respirators to protect personnel from toxic gas that continues to be generated from hot cells. Firewater retention and cleanup measures may be required by local regulations. Once first responders have turned the site back to Guam Power Authority, the Subject Matter Expert, in coordination with the Emergency Response Coordinator, shall direct on-site personnel on procedures for securing the site for safety and pending any investigation.

In addition to the gas generation risk, cells that remain hot also pose a delayed ignition risk, whereby heat in the cell may transfer to undamaged adjacent cells or remaining active material and reignite the fire. As such, fire-damaged equipment must remain monitored for a period identified in consultation with equipment manufacturer. (Contact manufacturer in Appendix 4)

Care should be taken to ensure that damaged batteries containing energy have been safely de-energized in accordance with disposal procedures, if possible, before handling and disposal. If unable to completely de-energize batteries involved in a fire, care should be taken with handling or dismantling battery systems involved in fires as they may still contain hazardous energy levels.

4.2.5 Post-Event Assessment Procedures

An incident report will be prepared by the Emergency Response Coordinator and transmitted to the appropriate individuals and agencies including GPA within 30 days (or later if extenuating circumstances) after review by the Company Regional Manager.

The Emergency Response Coordinator shall compile all documentation and perform a post-emergency investigation. Immediate performance of this activity will aid in determining the exact circumstances and cause of the incident. Issues to be determined include:

- Causes of the incident.

- Effectiveness of the emergency response plan.
- Need for amendments to the response plan.
- Need for additional training programs.

The fire department will make the final determination regarding when the scene is safe to release the site to staff. In some circumstances the scene may need to be safeguarded for investigators to examine the event failures. If the facility is not able to reopen due to the event, GPA will make a determination regarding continuity of operations for the facility in consultation with Contractor.

4.3 Site Maintenance and Housekeeping

- Fire extinguishers shall be inspected monthly as per NFPA 10.
- Fire extinguishers shall not be obstructed and should be in conspicuous locations with appropriate signage as per NFPA 10. (See Appendix 5 for a map that shows the locations of the fire extinguishers)
- Combustible material shall not be stored in mechanical rooms, electrical equipment rooms, or energy storage system enclosures.
- Outside dumpsters shall be kept at least five (5) feet away from combustible materials and the lids should be kept closed.
- Materials or equipment storage is not allowed in electrical equipment rooms, or near electrical panels.
- Electrical panel openings must be closed and secured.
- Power strips must be plugged directly into an outlet and not daisy-chained and should be for temporary use only.
- Extension cords and flexible cords should not be substituted for permanent ones.

5. Medical Emergency

5.1 Medical Emergency Response Procedures

If an employee is injured, or an accident has occurred on site and first aid is not enough treatment for the emergency, 911 must be called. The call to 911 can be made by phone by any available site personnel. The caller must state to the dispatch that they are at the "GPA, AGANA ESS site." A second notification will be made to the Local O&M Manager to inform GPA PSCC, GPA Safety Division and others of the situation.

All employees shall designate a personal emergency contact, which shall be kept on file.

5.1.1 Serious Injury

The following procedures apply for serious medical injuries such as loss of consciousness, heart attack, bone fractures, neck trauma, or severe burns.

1. If life threatening, call 911.
2. Notify Local O&M Manager and/or Safety Managers.
3. Provide name, exact location, number of injured persons, and brief description of incident.
4. On-site personnel shall meet EMS responders at site entrance and direct them to location of incident.
5. Do not leave or move the injured unless directed to by Safety Managers or EMS responders.
6. Administer first aid if necessary.
7. The site manager shall inform the employee's personal emergency contact.
8. Document incident and keep on file.

5.1.2 Attending an Incident

When attending an incident, the following procedures apply:

1. Clear a path to the injured person for Local O&M Manager and/or Safety Managers and assign personnel to assist with signaling EMS responders to the location of the incident.
2. Identify location of Project Site entrance nearest to the incident and notify EMS responders.
3. Local O&M Manager and/or Safety Managers shall meet EMS responders at site entrance.
4. Direct and accompany EMS responders to location of incident.
5. Follow all directions of EMS responders.
6. Contact management personnel and/or subcontractors.
7. Document incident and keep on file.

5.1.3 Medical Facilities

The nearest medical facility to the project site is:
Guam Memorial Hospital
850 Gov. Carlos G Camacho Rd, Tamuning, 96913, Guam
+1 671-647-2555

5.2 Non-Emergency Safety Incident

5.2.1 Notification of Minor Incidents

In the event a safety incident occurs where emergency response is not required (first aid treatment, near miss, etc.) work is to be stopped immediately and reported to the Emergency Response Coordinator and/or Lead Technician. Risk will be reassessed, adequate controls implemented, and the situation made safe before resuming the task. The event will be documented and kept on file.

5.2.2 Heat Illness

When the temperature exceeds 95 degrees Fahrenheit (35 degrees Celsius), or is expected to be so during the course of a shift or work project, the O&M Manger will hold short staff meetings to review the weather report; reinforce heat illness prevention with all workers; and provide reminders to drink water frequently, to be on the lookout for signs and symptoms of heat illness, and inform them that shade can be made available upon request.

Employees shall have free access to potable drinking water provided and located as close as practicable to the areas where employees are working. Where drinking water is not plumbed or otherwise continuously supplied, it shall be provided in sufficient quantity at the beginning of the work shift to provide one quart per employee per hour for drinking for the entire shift. Employers may begin the shift with smaller quantities of water if they have effective procedures for replenishment during the shift as needed to allow employees to drink one quart or more per hour. The frequent drinking of water shall be encouraged.

6. Environmental Hazards

For the flash flood and seismic events, O&M personnel should request X-400 and T-401-1 DS open to GPA PSCC when he/she can foresee any damage to the ESS facility. GPA PSCC, Safety and Planning and Regulatory Divisions should also be notified shortly after any event if significant damage to the ESS facility has occurred

6.1 Flooding and Flash Flood

Flash flooding is a result of heavy localized rainfall such as that from slow moving, intense thunderstorms. Flash floods often result from small creeks and streams overflowing during heavy rainfall. These floods often become raging torrents of water which rip through riverbeds or canyons, sweeping everything with them. Flash flooding can occur within 30-minutes to six hours of a heavy rain event. In hilly terrain, flash floods can strike with little or no advance warning. Distant rain may be channeled into gullies and ravines causing flash flooding in minutes. In the event of a flash flood, the following procedures shall apply:

- Contact the Local O&M Manager (if present) and Emergency Response Coordinator (if not the Local O&M Manager) immediately. GPA PSCC must also be contacted and it will be determined if X-400 and T-401-1 DS should be opened.
- During periods of thunderstorms, always remain alert to heavy rains in your immediate area or upstream from your location. It does not have to be raining at your location for flash flooding to occur.
- Do not drive through flooded areas. Even if it looks shallow enough to cross.
- Do not cross flowing streams on foot where water is above your ankles.
- Be especially cautious at night. It is harder to recognize water danger then.
- Do not attempt to outrace a flood on foot. If you see or hear it coming, move to higher ground immediately.
- Be familiar with the land features where you work. It may be in a low area, near a drainage ditch, or small stream.
- Stay tuned to weather forecasts and updates for the latest statements, watches, and warnings concerning heavy rain and flash flooding in the Project Area.
- Waiting 15 to 30 minutes, or until high water recedes, is a simple safety measure.
- The post-event assessment procedures are as follows:
  - Check if there is any alarm/fault on the PXiSE software
  - Perform visual inspection of ESS equipment
  - Check if there is any damaged area or equipment due to flooding
  - A post-event assessment shall be included in the Daily O&M report and provided to GPA within 2 working days (or later if extenuating circumstances).

6.2 Tropical Storm

In the event a tropical storm is within 48 hours (COR3), the following procedures shall apply.

- Notify Local O&M Manager and/or Safety Manager, and all on-site employees.
- Stop work safely and head to staging and laydown yards in vehicles.
- If the weather permits, remove or secure loose debris, materials or equipment that may fly during the storm and damage adjacent containers and equipment.

- Remain at staging and laydown yards, get update on weather conditions.
- If storm/lighting is still approaching the Project Site, get in and stay in company or personal vehicles that have rubber tires only.
- If safe enough to do so, take cover in on-site designated shelters.
- Once storm passes, remain in a safe location depending on passing storm severity, and wait for an "OK" from the Local O&M Manager or Emergency Response Coordinator in charge of monitoring the storm.
- The post-event assessment procedures are as follows:
  - Check if there is any alarm/fault on the PXiSE software
  - Perform visual inspection of ESS equipment
  - Check if there is any damaged area or equipment due to tropical storm
  - A post-event assessment shall be included in the Daily O&M report and provided to GPA within 2 working days (or later if extenuating circumstances).

6.3 Seismic Event

Earthquakes may strike with little to no advance warning. As such, when an earthquake does occur, it is important to stay as safe as possible. Be aware that some earthquakes are actually fore-shocks and a larger earthquake may subsequently occur. Also, be aware that many earthquakes are accompanied by aftershocks after the main event has occurred. If an earthquake occurs minimize your movements to a few steps to a nearby safe place and if you are indoors stay there until the shaking has stopped and you are sure exiting is safe.

The following actions should be followed for personnel indoors:

- Drop to the ground and take cover by getting under a sturdy piece of furniture and hold on until the shaking stops. If there isn't a desk or sturdy piece of furniture near you, cover your face and head with your arms and crouch in an inside corner of the building.
- Stay away from glass, windows, outside doors and walls, and anything that could fall such as lighting fixtures or furniture.
- Use a doorway for shelter only if it is in close proximity to you and if you know it is a strongly supported load-bearing doorway.
- Stay inside until the shaking stops and it is safe to go outside.

The following actions should be followed for personnel outdoors:

- If you are already outdoors stay there.
- Move away from buildings, structures, light poles, and utility wires.

Once in the open stay there until the shaking stops to prevent being hit by falling debris. Following seismic events, the site facility will be evaluated by O&M personnel for damage. GPA PSCC should also be notified shortly after the earthquake if significant damage to the ESS facility has occurred.

- The post-event assessment procedures are as follows:
  - Check if there is any alarm/fault on the PXiSE software
  - Perform visual inspection of ESS equipment
  - For earthquakes with magnitude greater than 5.3, perform visual inspection of torque eye-marks for one battery rack in each bank. If there are any torque eye-marks off, then power-off all the BSC and perform visual inspection of torque eye-marks for all battery modules for any loosening of bolts due to earthquake. For

earthquakes with magnitude greater than 6.0, perform torque eye-mark inspection for all battery modules.

- Check if there is any damaged area or equipment due to seismic event
- A post-event assessment shall be included in the Daily O&M report and provided to GPA within 2 working days (or later if extenuating circumstances).

7. Hydrogen Gas Hazards

The batteries for the UPS and the rectifier are installed in the control container. The hydrogen gas may leak from both batteries. The alarm occurs and notifies GPA PSCC via SCADA and O&M personnel via PXiSE software if a hydrogen leak is detected in either battery. The hydrogen gas leakage detection takes place in two stages: 1% and 2%.

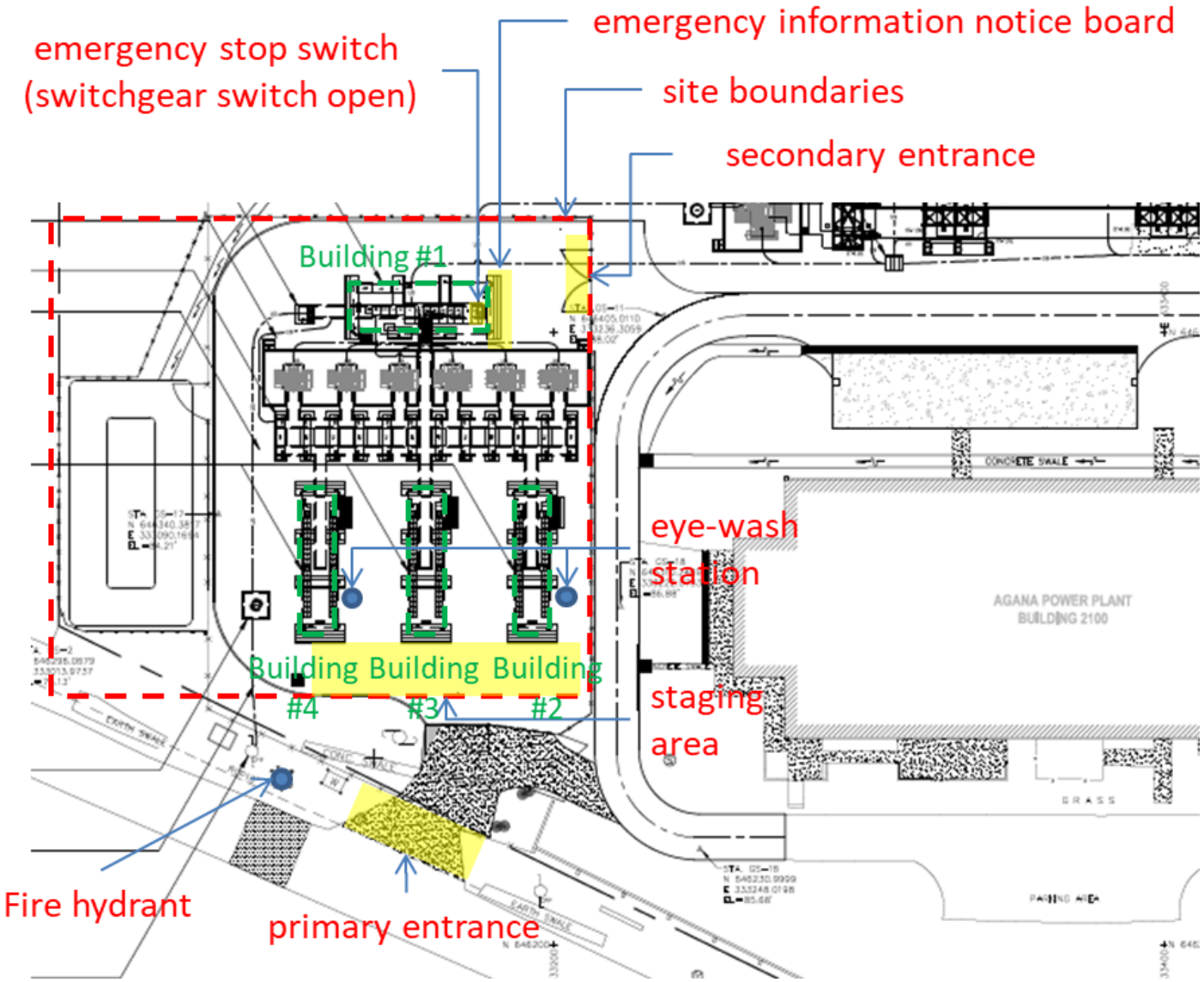
7.1 1% Hydrogen Gas Detection

When the 1% hydrogen gas leakage detection alarm occurs, the control system shows the WARNING alarm to GPA PSCC and O&M personnel and saves the log. GPA PSCC will call O&M personnel and inform them not to enter into the control container until the 1% alarm is cleared for safety. Also, the "1% Warning" yellow LED will light up on the main control of the unit and the fan will start to operate for ventilation. The fan will automatically stop when the alarm is cleared. GPA PSCC will notify 1% alarm clearance to O&M personnel. The O&M personnel on-site or off-site shall also contact GPA PSCC to notify them when an alarm has been received.

7.2 2% Hydrogen Gas Detection

When the 2% hydrogen gas leakage detection alarm occurs, the control system shows the FAULT alarm to GPA PSCC and O&M personnel and saves the log. GPA PSCC will call O&M personnel and inform them not to enter into the control container until the 1% and 2% alarms are cleared for safety. Should the hydrogen gas concentration reach 2% by volume, the "2% Alarm" red LED will light up, the strobe will flash and an audible alarm (85dB at 10') will sound. GPA PSCC will notify 1% and 2% alarm clearance to O&M personnel. The O&M personnel on-site or off-site shall also contact GPA PSCC to notify them when an alarm has been received.

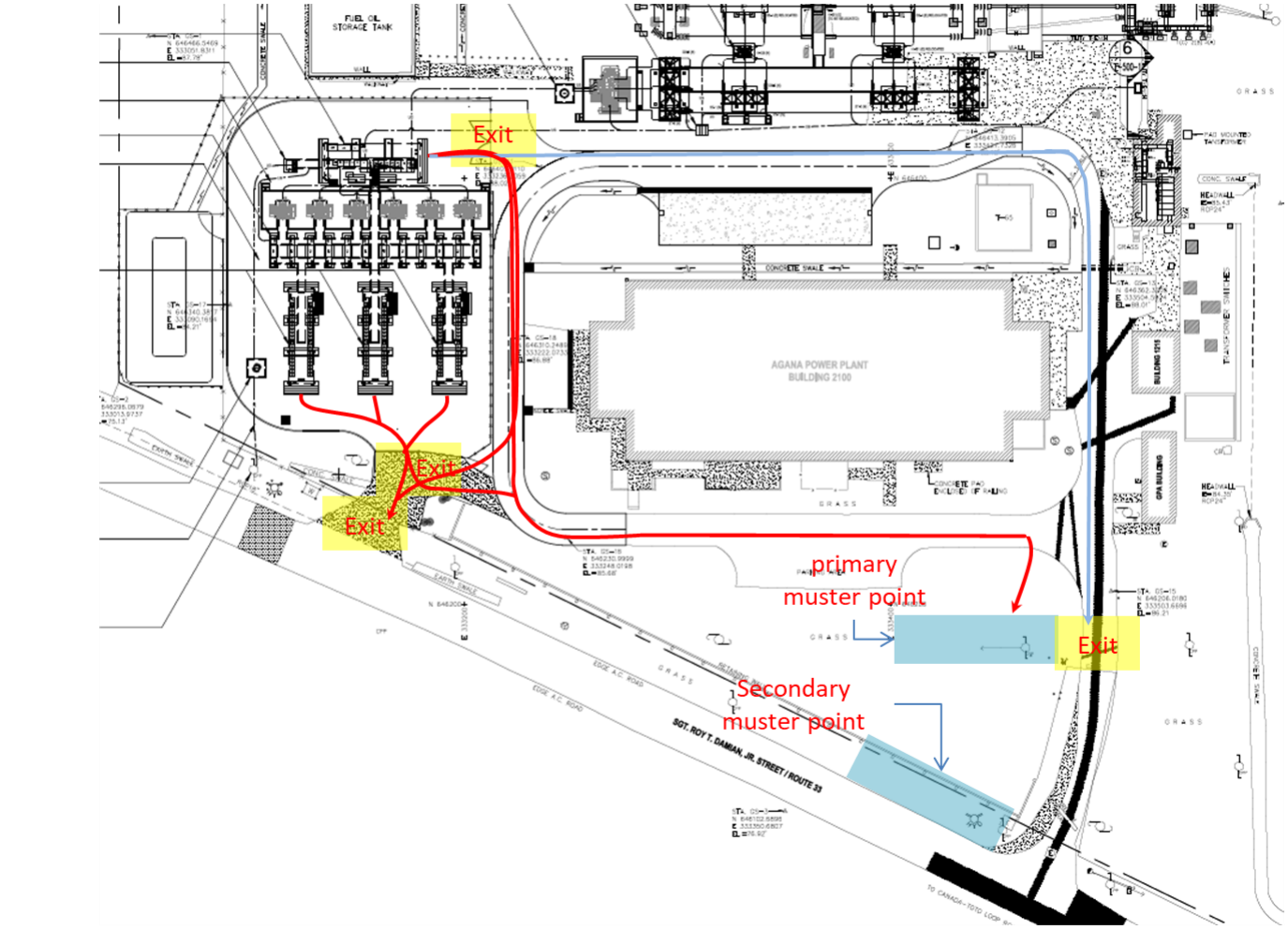
Appendix 1: Map of Site



Appendix 2: Evacuation Map

primary evacuation routes

alternate evacuation routes



Appendix 3: Referenced Titles and Roles

Note that some of these responsibilities may be combined within the duties of single individuals.

Company Regional Manager: A Company Regional Manager is an individual not directly responsible for the day to day operation of the site, nor for the immediate response during or immediately after an emergency, but who does bear responsibility for post-event assessment and broader planning, recovery, and learning from experience. The Regional Manager would typically bear the responsibility for ensuring incident records are maintained. Such a manager should also ensure a safety-based culture pervades across sites and ensure that Local O&M Managers are ensuring that training for safety is at the core of operations.

Emergency Response Coordinator: The Emergency Response Coordinator takes control of the emergency and any resources necessary until the emergency has been eliminated and the necessary cleanup and/or restoration are complete. This person shall lead the incident reporting. The emergency response coordinator is typically the Local O&M Manager; in her/his absence, the Lead Technician or other designated person shall assume this role. All personnel on site shall know who the Emergency Response Coordinator on duty is during their time on site. Remote operators shall likewise know who the Emergency Response Coordinator is for any given shift.

The Emergency Coordinator or a designee will be responsible for notifying the appropriate regulatory agencies and, if necessary, the Emergency Response Contractor or mutual aid groups. Appendix 4 includes a list of emergency contacts and agencies that may be notified in the event of an emergency. The incident will be documented and kept on file.

The Emergency Response Coordinator will direct the following activities during an emergency:

- Ensure the safety of all personnel.
- Evaluate if operations in the affected area should be shut down.
- Take precautions to prevent or limit the spread of fire or explosions.
- Isolate affected area and provide direction for radio announcements.
- Determine the source/cause of the emergency and evaluate the primary and secondary hazards to allow a full-scale, safe response.
- Ensure that appropriate internal and external notifications are made.
- Coordinate outside assistance from public or private organizations.
- Implement other appropriate response provisions as necessary.

Incident Commander: The on-scene ranking officer, representing the agency with incident jurisdiction. The Incident Commander authorizes incident objectives and strategies that collectively delineate a course of action. The Fire Department designates an Incident Commander as the primary incident manager; it should not be used by civilian organizations that are operating at an incident with emergency responders.

Local O&M Manager: The Operations and Maintenance Manager is the individual responsible for the normal operation and upkeep of the energy storage system on a day to day basis. This includes standard operating conditions and routine scheduled or responsive maintenance activities.

Lead Technician: A Lead Technician is an on- or off-site individual responsible for the operation of a site from a performance and technical perspective. Such responsibilities may lie with the O&M Manger or with a remote operator.

Subject Matter Expert (SME): An individual and designated secondary contact with detailed working knowledge of the energy storage system and incident command systems. The SME should have ready access to information on state of the system, status and meaning of alarms, etc. The SME's contact information must be available to the Emergency Response Coordinator and first responders, as well as others via information on the emergency information notice board.

Secondary SME: An individual who can take over the roles and responsibilities of SME in case of absence of SME. The Secondary SME should have ready access to information on state of the system, status and meaning of alarms, etc. The Secondary SME's contact information must be available to the Emergency Response Coordinator and first responders, as well as others via information on the emergency information notice board.

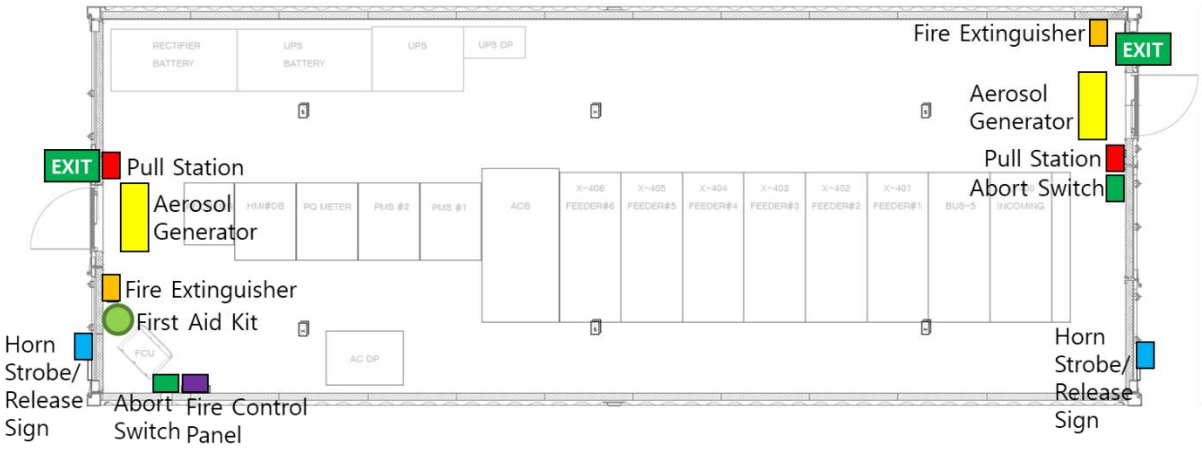
Safety Manager: Safety Manager or SSHO (Site Safety and Health Officer) is the individual responsible for the site safety during the O&M works on site. This includes standard operating conditions and routine scheduled or responsive maintenance activities.

Appendix 4: Emergency Contacts

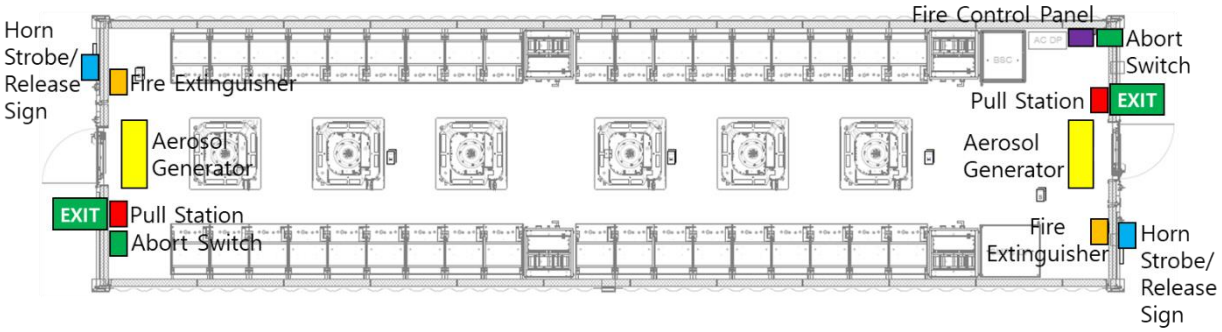
TITLE	COMPANY/INDIVIDUAL	CONTACTS
ESS Asset Owner	GPA Main Number GPA Safety GPA SPORD GPA PSCC	+1 671-648-3000 +1 671-648-3056 +1 671-648-3101 +1 671-475-1472; 1473; 1474
O&M Contractor	LG CNS	+82 2-3773-1114
Local O&M Contractor	JMI Edison	+1 671-649-5444
Company Regional Manager / Subject Matter Expert (SME)	LG CNS Tony (Hyunjoon) Tae	+ 1 671-686-7371
Lead Technician	LG CNS Won Kwan Choi	+82-10-8279-9123
Local O&M Manager / Emergency Coordinator	JMI Edison Romeo Oriondo	+ 1 671 646 6400
Secondary SME	LG CNS Woonyoung Park	+82 10 2880 1297
Safety Manager / SSHO (Site Safety and Health Officer)	JMI Edison Nelson Rodriguez	+1 671-649-5444
Emergency Assistance	Fire/Police/Ambulance State Police Hospital: Guam Memorial Hospital	911 911 +1 671-647-2555
Major Equipment Assistance [Battery]	LG Chem	+82-2-3773-1114
Major Equipment Assistance [PCS]	Destin Power	+82-31-778-5900
Major Equipment Assistance [Switchgear]	Hyundai Electric	+82-52-202-7773
Major Equipment Assistance [Transformer]	Hyundai Electric	+82-52-202-8486
Major Equipment Assistance [Control S/W]	PXiSE	+1 619-272-7672
GPA Power Systems Control Center	GPA	+1 671-475-1472 /3 /4
GPA Safety Division	GPA	+1 671-648-3056
GPA Planning & Regulatory Division	GPA	+1 671-648-3029

Appendix 5: Safety Related Location Map

Building #1 (Control Container)



Building #2, #3, #4 (Battery Containers)



Appendix 6: Fire-Fighting Measures Guided by Manufacturer, LG Chem

Responding to a Battery Enclosure without Venting: There can be cases where the battery enclosure is sealed and there is no visible venting of smoke or gases, but there is a rise in temperature indicating possible risk of fire. In these situations, there is the possibility of pressure buildup inside the container due to combustible gas, which can ignite and explode upon the in-rush of air. Alert trained first responders and the nearest fire department for appropriate guidance. If possible, the enclosure should be kept closed and monitored for 24 hours or longer to see if there is a continued rise in temperature or whether there is visible smoke.

Determining Possibility of Monitoring: If the ESS enclosure or building is not occupied by people and it is determined by the Incident Commander that there is not an immediate threat to lives, it could be possible to use an approach of monitoring the enclosure from safe distance for 24 hours or more to further assess the situation and to determine next steps.

Opening of Closed Battery Enclosure: When the Incident Commander decides to have an enclosure door opened, the door opening operation should be performed remotely at a safe distance using non-conducting ropes, hooks, poles, or similar devices without anyone standing directly in front of the door. The main intent is to minimize personnel exposure in front of the open door or to avoid a life-threatening situation due to heated gas or a flying object by potential explosion. After the enclosure door is opened, the enclosure should be monitored for 12 hours or longer to see if there is a rise in temperature or visible smoke.

Responding to a Venting Battery Enclosure: In cases where the battery enclosure is venting, the venting from lithium-ion batteries may cause fire or smoke. There is the possibility that the vented gases are flammable and may ignite at any time. In the event of a fire, keep the ESS enclosure or building closed and do not to open any windows or doors. Contact trained first responders and the nearest fire department.

Shutting Off Power: A trained first responder team or the local fire department should shut off power to the Battery Enclosure to prevent charging of the battery, if possible. However, shutting off power to the LG Chem ESS product does not de-energize the battery, and there is still the presence of a shock hazard. The LG Chem ESS product should then be monitored for evidence of continued smoke evolution. Application of high volumes of water from a safe distance to cool the battery pack may prevent further reaction and prevent a fire from developing.

Development of Fire: If a fire develops, the Incident Commander should determine whether an attempt will be made to suppress the fire (aggressive firefighting) or allow the battery to burn itself out, while protecting surrounding materials (defensive firefighting).
Virtually all fires involving lithium-ion batteries can be controlled with water. Based on currently available information, water has been found to be the most effective agent for controlling lithium-ion battery fires. Water can help suppress flames, cool cells and batteries, and limit thermal runaway propagation. If water is used, there is a possibility that the electrolysis of water (which is the splitting of water into hydrogen and oxygen) can contribute to the flammable gas mixture formed by venting cells and the burning of plastic and other combustibles. Abundant and significant amounts of water should be used to fight a lithium-ion battery fire.
Gaseous agents (carbon dioxide (CO_2), Novec 1230, or FM-200) or dry chemical suppressants may temporarily suppress flaming of lithium-ion battery packs, but they will not provide sufficient cooling of

lithium-ion batteries and will not suppress the propagation thermal runaway. Metal fire suppressants, such as copper powder or graphite powder are not appropriate agents for suppressing fires involving lithium-ion battery packs as they are unlikely to be effective.
A battery fire may continue for several hours and it may take 24 hours or longer for the battery pack to cool. A lithium-ion battery fire that has been extinguished can re-ignite due to the exothermic reaction of constituent materials from broken or damaged cells. To avoid this, remove sources of ignition and cool the burned mass by flooding with water.

Aggressive Firefighting: One possible approach for aggressive firefighting is to apply abundant amounts of water into the battery room. Applying water into the battery room may help provide cooling of the incident cell and could slow down the propagation. If a decision is made for trained first responders to apply water, it should be noted that plenty significant amount of water needs to be available and responders should maintain safe distances at all times.

Defensive Firefighting: One possible defensive reaction to a fire is to allow the fire to burn itself out (self-extinguish). Simultaneously, fire crews may spread water from a safe distance to reduce exposures to and diffusion of smoke. Please be aware that lithium-ion batteries can burn for several hours and there is the possibility of re-ignition events.

Firefighter Personal Protective Equipment: Firefighters should protect themselves at all times and wear turnout gear rated for fire protection, as well as a self-contained breathing apparatus (SCBA). There is a possibility that cells or batteries could develop flames or leak potentially hazardous organic vapors if exposed to excessive heat, fire or overvoltage conditions. These vapors may include, but are not limited to carbon monoxide, hydrogen gas, carbon dioxide, volatile organic compounds (VOCs), soot, and particulates containing oxides of nickel, aluminum, lithium, copper, and cobalt. There is also the possibility that vapors of phosphorus pentafluoride, POF3 and HF may form.

Fire Behavior Considerations: Some conditions and situations that can potentially occur during the course of the fire should be considered. This section examines these potential conditions, risks, and safety concerns. Lithium-ion battery fires can cause abnormalities such as Backdraft, Flashover, and Rollover.

Backdraft: Many battery enclosures are isolated fire-resistant structures, so when a fire proceeds, the combustion process typically involves slow smoke generation while lacking a supply of oxygen. In the event that large amounts of air (oxygen) are supplied while incompletely burned flammable gas and heat are concentrated, an explosive ignition can occur momentarily, resulting in backdraft.

Flashover: Flashover is the transition phase in the development of a contained fire in which surfaces exposed to thermal radiation from fire gases in excess of 600°C (1112°F), reach ignition temperature more or less simultaneously and fire spreads rapidly through the space. This is the most dangerous stage of fire development.

The following should be considered in a lithium-ion battery fire.
1) Flashover appears more frequently than backdraft.
2) During Backdraft and Flashover, windows can be broken, thereby enabling smoke and flames to hit the openings as shock waves are generated. This can result in parts of the enclosure collapsing.

3) If the combined gas generated by the fire occupies about 25% of the total space, an explosion can occur. If high-temperature vented gases are concentrated in a corner of the enclosure, an explosion can occur when the enclosure door is opened for search operations.
4) Explosive pressure generated within a limited space is a fatal hazard. Pressure levels higher than ambient pressure can destroy windows, collapse partitions, and even collapse brick walls.
This phenomenon generates when heat is transferred directly to the lithium-ion battery, which can be prevented by cooling the lithium-ion battery through continuous cooling with copious amounts of water and venting of smoke and gas.

Appendix 7: Safety Data Sheets

CGIS SF6 GAS

JP3 LITIUM-ION BATTERY CELL (AGANA)

5MVA XFMR OIL

CGIS SF6 GAS

SAFETY DATA SHEET

SULFUR HEXAFLUORIDE

Compilation Date: 19.11.2010 Revision Date 27.08.2018

SECTION 1: Identification of the substance/mixture and of the company/undertaking

1.1 Product identifier

- Trade name SULFUR HEXAFLUORIDE

1.2 Relevant identified uses of the substance or mixture and uses advised against

Uses of the Substance/Mixture

- Electrical industry
- Metallurgy.

1.3 Details of the supplier of the safety data sheet

Company

SOLVAY KOREA Co., Ltd
IJIN-RO, ONSAN-EUP
45010, ULSAN CITY
KOREA
Tel: +82-52-2310000
Fax: +82-52-2310095

E-mail address

manager.sds@solvay.com

1.4 Emergency telephone number

+82 (0)234 798 401 [CareChem 24] (South Korea in country number)
MULTI LINGUAL EMERGENCY NUMBER (24/7)
Europe/Latin America/Africa:+44 1235 239 670 (UK)
Middle East/Africa speaking Arabic:+44 1235 239 671 (UK)
Asia Pacific:+65 3158 1074 (Singapore)
China : +86 512 8090 3042
North America : 800 424 9300

SECTION 2: Hazards identification

2.1 Classification of the substance or mixture

Standards for classification and labeling of chemical substances and material safety data sheet (Ministry of Employment and Labor Public Notice No. 2016-19)

Gases under pressure, Liquefied gas H280: Contains gas under pressure; may explode if heated.

2.2 Label elements

Standards for classification and labeling of chemical substances and material safety data sheet (Ministry of Employment and Labor Public Notice No. 2016-19)

Pictogram

Signal word
- Warning

Hazard statements
- H280 Contains gas under pressure; may explode if heated.

Precautionary statements

General
- None

Prevention
- Not applicable

Response
- Not applicable

Storage
- P410 + P403 Protect from sunlight. Store in a well-ventilated place.

Disposal
- Not applicable

2.3 Other hazards which do not result in classification

- Causes asphyxiation in high concentrations.
- Hazardous decomposition products formed under fire conditions.

SECTION 3: Composition/information on ingredients

3.1 Substance

- Chemical name Sulfur hexafluoride
- Formula SF_6

Information on Components and Impurities

Chemical name	CAS-No.	Identification number	Concentration [%]
Sulfur hexafluoride (SF6)	2551-62-4	KECI Number: KE-32568	>= 99 - <= 100

3.2 Mixture

- Not applicable, this product is a substance.

SECTION 4: First aid measures

4.1 Description of first aid measures

In case of inhalation

- Remove to fresh air.
- Oxygen or artificial respiration if needed.
- If symptoms persist, call a physician.

Exposure to decomposition products

- Remove to fresh air.
- Immediate medical attention is required.

In case of skin contact

- Allow to evaporate.
- Wash off with warm water.
- If symptoms persist, call a physician.

In case of eye contact

- Allow to evaporate.
- Rinse thoroughly with plenty of water, also under the eyelids.
- If eye irritation persists, consult a specialist.
- Keep eyelids open to allow evaporation of product.

In case of ingestion

- Not applicable

4.2 Most important symptoms and effects, both acute and delayed

In case of inhalation

Symptoms

- At high concentrations:
- narcosis
- Asphyxia

In case of skin contact

Effects

- Contact with liquid or refrigerated gas can cause cold burns and frostbite.
- Prolonged skin contact may defat the skin and produce dermatitis.

In case of eye contact

Symptoms

- Lachrymation

In case of ingestion

Effects

- gas
- Not applicable

4.3 Indication of any immediate medical attention and special treatment needed

Notes to physician

- When symptoms persist or in all cases of doubt seek medical advice.

SECTION 5: Firefighting measures

5.1 Extinguishing media

Suitable extinguishing media

- Use extinguishing measures that are appropriate to local circumstances and the surrounding environment.

Unsuitable extinguishing media

- None

5.2 Special hazards arising from the substance or mixture

- The product is not flammable.
- Hazardous decomposition products formed under fire conditions.

5.3 Advice for firefighters

Special protective equipment for firefighters

- Wear self-contained breathing apparatus and protective suit.
- Wear chemical resistant oversuit

- Fire fighters must wear fire resistant personnel protective equipment.
- Protect intervention team with a water spray as they approach the fire.
- Clean contaminated surface thoroughly.

SECTION 6: Accidental release measures

6.1 Personal precautions, protective equipment and emergency procedures

Advice for non-emergency personnel

- Prevent further leakage or spillage if safe to do so.
- Keep away from incompatible products

Advice for emergency responders

- Approach from upwind.
- Suppress (knock down) gases/vapours/mists with a water spray jet.
- Avoid spraying the leak source.
- Try to re-position leaking containers, to have the leak in the gaseous phase.
- Vapours are heavier than air and can cause suffocation by reducing oxygen available for breathing.
- Keep away from open flames, hot surfaces and sources of ignition.

6.2 Environmental precautions

- Discharge into the environment must be avoided.
- Inform the responsible authorities in case of gas leakage, or of entry into waterways, soil or drains.
- Should not be released into the environment.

6.3 Methods and materials for containment and cleaning up

- Allow to evaporate.
- Prevent product from entering sewage system.

6.4 Reference to other sections

- Refer to protective measures listed in sections 7 and 8.

SECTION 7: Handling and storage

7.1 Precautions for safe handling

- Keep away from incompatible products

- Used in closed system
- Use only equipment and materials which are compatible with the product.
- Prevent any product decomposition from contacting hot spots.
- Prevent product vapours decomposition from electric arc action (welding).

Hygiene measures

- Eye wash bottles or eye wash stations in compliance with applicable standards.
- When using do not eat, drink or smoke.
- Gloves, overalls and boots have to be double layered (protection against cold temperature).
- Handle in accordance with good industrial hygiene and safety practice.

7.2 Conditions for safe storage, including any incompatibilities

Technical measures/Storage conditions

- Keep only in the original container.
- Keep in properly labelled containers.
- Keep in a bunded area.
- Keep away from sources of ignition - No smoking.

- Keep in a well-ventilated place.
- Refer to protective measures listed in sections 7 and 8.

- Keep away from:
- Incompatible products

Packaging material

Suitable material

- Steel drum

Requirements for storage rooms and vessels

Recommended storage temperature: < 50 °C

7.3 Specific end use(s)

- Contact your supplier for additional information

SECTION 8: Exposure controls/personal protection

8.1 Control parameters

Components with national occupational exposure limits

Components	Value type	Value	Basis
Sulfur hexafluoride (SF6)	TWA	1,000 ppm	Occupational Exposure Limits Korea

Components with other occupational exposure limits

Components	Value type	Value	Basis
Sulfur hexafluoride (SF6)	TWA	1,000 ppm	USA. ACGIH Threshold Limit Values (TLV)

8.2 Exposure controls

Control measures

Engineering measures
- Ensure adequate ventilation.
- Apply technical measures to comply with the occupational exposure limits.

Individual protection measures

Respiratory protection
- Wear self-contained breathing apparatus in confined spaces, in cases where the oxygen level is depleted, or in case of significant emissions.
- Use only respiratory protection that conforms to international/ national standards.

Hand protection
- Take note of the information given by the producer concerning permeability and break through times, and of special workplace conditions (mechanical strain, duration of contact).
- Protective gloves

Suitable material

- PVC
- Neoprene
- Natural Rubber

Eye protection
- Chemical resistant goggles must be worn.

Skin and body protection
- Wear suitable protective clothing.

Hygiene measures
- Eye wash bottles or eye wash stations in compliance with applicable standards.
- When using do not eat, drink or smoke.
- Gloves, overalls and boots have to be double layered (protection against cold temperature).
- Handle in accordance with good industrial hygiene and safety practice.

Environmental exposure controls
- Dispose of rinse water in accordance with local and national regulations.

SECTION 9: Physical and chemical properties

9.1 Information on basic physical and chemical properties

Appearance	Form:	Liquefied gas
	Physical state:	gaseous
	Colour:	colourless
Odour	odourless	
Odour Threshold	No data available	
Molecular weight	146 g/mol	
pH	neutral	
Melting point/freezing point	Freezing point: -50.8 °C	

Initial boiling point and boiling range	Boiling point/boiling range: -63.8 °C Sublimation point
Flash point	No data available
Evaporation rate (Butylacetate = 1)	No data available
Flammability (solid, gas)	The product is not flammable.
Flammability/Explosive limit	Explosiveness: Not expected
Auto-ignition temperature	No data available
Vapour pressure	23,700 hPa (25 °C)
Vapour density	5.1
Density	
Relative density	5 Sulfur hexafluoride
Relative density	
Solubility	Water solubility: 0.031 g/l (25 °C) slightly soluble Solubility in other solvents: Alcohol : soluble Ether : soluble
Partition coefficient: n-octanol/water	log Pow: 1.68
Decomposition temperature	<= 200 °C Exposure to moisture
Decomposition temperature	<= 800 °C dry air, Specific conditions
Viscosity	No data available
Explosive properties	No data available
Oxidizing properties	Not considered as oxidizing

9.2 Other information

Henry's Constant	ca. 458000 Pa.m3/mol (25 °C) Method: Calculation method considerable volatility, Air
Surface tension	8.02 mN/m (20 °C)

SECTION 10: Stability and reactivity

10.1 Reactivity

- Decomposition can be accelerated under influence of moisture.
- Decomposition temperature will be decreased.

10.2 Chemical stability

- Stable under recommended storage conditions.
- Vapours are heavier than air and may spread along floors.

10.3 Possibility of hazardous reactions

- Vapours are heavier than air and may spread along floors.
- Hazardous polymerisation does not occur.

10.4 Conditions to avoid

- Heat
- In case of heating:
- Exposure to moisture
- Keep away from direct sunlight.

10.5 Incompatible materials

- Oxidizing agents

10.6 Hazardous decomposition products

Hazardous decomposition products

- Gaseous hydrogen fluoride (HF).
- Sulphur oxides
- Sulphur compounds
- Thionyl difluoride
- Disulfur decafluoride

SECTION 11: Toxicological information

11.1 Information on toxicological effects

Acute toxicity

Acute oral toxicity	Not applicable
Acute inhalation toxicity	The product has a low acute toxicity
Acute dermal toxicity	Not applicable
Acute toxicity (other routes of administration)	No data available

Skin corrosion/irritation

No skin irritation

Serious eye damage/eye irritation

No eye irritation

Respiratory or skin sensitisation

no observed effect

Mutagenicity

Genotoxicity in vitro

In vitro tests did not show mutagenic effects

Genotoxicity in vivo

In vivo tests did not show mutagenic effects

Carcinogenicity

No data available

Toxicity for reproduction and development

Toxicity to reproduction/Fertility

Reproduction/developmental toxicity screening test - Rat
male and female
Inhalation
Fertility NOAEC Parent: 50,000 ppm
Method: OECD Test Guideline 422

Developmental Toxicity/Teratogenicity

Rat, male and female, Inhalation
Teratogenicity NOAEC:50,000ppm
Method: OECD Test Guideline 422
Reproduction/developmental toxicity screening test

STOT

STOT - single exposure No data available

STOT - repeated exposure

The substance or mixture is not classified as specific target organ toxicant, repeated exposure according to GHS criteria.

Inhalation 28-day - Rat , male and female
NOAEC: 50000 ppm(m)
no observed effect

Inhalation 90-day - Rat , male and female
NOAEC: 20000 ppm(m)
Method: OECD Test Guideline 413
no observed effect

Experience with human exposure No data available

Aspiration toxicity No data available

SECTION 12: Ecological information

12.1 Toxicity

Aquatic Compartment

Acute toxicity to fish

LC50 - 96 Days : 236 mg/l - Fish
Method: Calculation method

Acute toxicity to daphnia and other aquatic invertebrates

LC50 - 48 h : 247 mg/l - Crustaceans
Method: Calculation method
Water

Toxicity to aquatic plants

EC50 - 96 h : 151 mg/l - Algae
Method: Calculation method
Water

Toxicity to microorganisms No data available

Chronic toxicity to fish No data available

Chronic toxicity to daphnia and other aquatic invertebrates No data available

12.2 Persistence and degradability

Abiotic degradation

Stability in water

t 1/2 (Hydrolysis):
Hydrolysis time: > 1,000 y
non-significant hydrolysis, Medium, Water, Soil

Photodegradation

Half-life indirect photolysis: > 1,000 y
Air
non-significant photolysis

Physical- and photo-chemical elimination No data available

Biodegradation

Biodegradability

The methods for determining biodegradability are not applicable to inorganic substances.

12.3 Bioaccumulative potential

Partition coefficient: n-octanol/water No data available

Bioconcentration factor (BCF)

Not potentially bioaccumulable

12.4 Mobility in soil

Adsorption potential (Koc)

Soil/sediments
non-significant adsorption

Water
Method: Calculation method
The product evaporates readily.

Known distribution to environmental compartments No data available

12.5 Results of PBT and vPvB assessment This substance is not considered to be persistent, bioaccumulating and toxic (PBT).
This substance is not considered to be very persistent and very bioaccumulating (vPvB).

12.6 Other adverse effects

Ozone-Depletion Potential

Regulatory basis: Global warming potential
Ozone-Depletion Potential: 23.900
Halocarbon global warming potential; HGWP; (R-11 = 1)

Global warming potential

Regulatory basis: The Fourth Assessment Report of the United Nations Intergovernmental Panel on Climate Change (IPCC)
20-year global warming potential: 17,500
100-year global warming potential: 23,500
Radiative efficiency: 0.57 Wm2ppb
Additional Information: Fully Fluorinated Species

SECTION 13: Disposal considerations

13.1 Waste treatment methods

Product Disposal

- In accordance with local and national regulations.
- Refer to manufacturer/supplier for information on recovery/recycling.

Advice on cleaning and disposal of packaging

- To avoid treatments, as far as possible, use dedicated containers.

SECTION 14: Transport information

KR_DG

14.1 UN number	UN 1080
14.2 Proper shipping name	SULPHUR HEXAFLUORIDE
14.3 Transport hazard class	2.2
Label(s):	2.2
14.4 Packing group	
Packing group	
EmS 1	F-C
EmS 2	S-V
14.5 Environmental hazards	NO
14.6 Special precautions for user	
For personal protection see section 8.	

ADR

14.1 UN number	UN 1080
14.2 Proper shipping name	SULPHUR HEXAFLUORIDE
14.3 Transport hazard class	2
Label(s):	2.2
14.4 Packing group	
Packing group	
Classification Code	2A
14.5 Environmental hazards	NO
14.6 Special precautions for user	
Tunnel restriction code	(C/E)
Hazard Identification Number:	20

For personal protection see section 8.

RID

14.1 UN number	UN 1080
14.2 Proper shipping name	SULPHUR HEXAFLUORIDE
14.3 Transport hazard class Subsidiary hazard class: Label(s):	2 (13) 2.2 ((13))
14.4 Packing group Packing group Classification Code	 2A
14.5 Environmental hazards	NO

14.6 Special precautions for user

For personal protection see section 8.

IMDG

14.1 UN number	UN 1080
14.2 Proper shipping name	SULPHUR HEXAFLUORIDE
14.3 Transport hazard class Label(s):	2.2 2.2
14.4 Packing group Packing group	
14.5 Environmental hazards **Marine pollutant**	NO
14.6 Special precautions for user EmS	 F-C , S-V

For personal protection see section 8.

14.7 Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code
No data available

IATA

14.1 UN number	UN 1080
14.2 Proper shipping name	SULPHUR HEXAFLUORIDE
14.3 Transport hazard class	2.2
Label(s):	2.2
14.4 Packing group	
14.5 Environmental hazards	NO
14.6 Special precautions for user	
Packing instruction (cargo aircraft)	200
Max net qty/pkg	150.00 kg
Packing instruction (passenger aircraft)	200
Max net qty/pkg	75.00 kg

For personal protection see section 8.

Note: The above regulatory prescriptions are those valid on the date of publication of this sheet. Given the possible evolution of transport regulations for hazardous materials, it would be advisable to check their validity with your sales office.

SECTION 15: Regulatory information

15.1 Safety, health and environmental regulations/legislation specific for the substance or mixture

Occupational Safety and Health Act

Harmful Substances Prohibited from Manufacturing
Not applicable

Harmful Substances Required Permission for Manufacture
Not applicable

Controlled Hazardous Substances
Not applicable

Controlled Substances Subject to Environment Monitoring
Not applicable

Controlled Substances Subject to Health Examination
Not applicable

Please refer to Chapter 8 and 13 for the OEL and disposal

AREC (K-REACH) and Chemicals Control Act

Toxic Substances
Not applicable

Restricted Substances
Not applicable

Prohibited Substances
Not applicable

Toxic Release Inventory

Chemical name	CAS-No.	Group	Threshold limits
Sulfur hexafluoride	2551-62-4	Group 2	>= 1 %

Substances Requiring Preparation for Accidents
Not applicable

Safety Control of Dangerous Substances Act

Safety Control of Dangerous Substances Act	Not Applicable to Dangerous Materials
Wastes Control Act	Industrial waste Follow article 13 of the act to dispose the product waste

Notification status

Inventory Information	Status
United States TSCA Inventory	- Listed on Inventory
Mexico INSQ (INSQ)	- Listed on Inventory
Canadian Domestic Substances List (DSL)	- Listed on Inventory
New Zealand. Inventory of Chemical Substances	- Listed on Inventory
Australia Inventory of Chemical Substances (AICS)	- Listed on Inventory
Japan. CSCL - Inventory of Existing and New Chemical Substances	- Listed on Inventory
Korea. Korean Existing Chemicals Inventory (KECI)	- Listed on Inventory
China. Inventory of Existing Chemical Substances in China (IECSC)	- Listed on Inventory
Philippines Inventory of Chemicals and Chemical Substances (PICCS)	- Listed on Inventory
EU. European Registration, Evaluation, Authorisation and Restriction of Chemical (REACH)	- When purchased from a European Solvay legal entity, this product is compliant with the registration provisions of the REACH Regulation (EC) No. 1907/2006 as all its components are either excluded, exempt, and/or registered. When purchased from a legal entity outside of Europe, please contact your local representative for additional information.

SECTION 16: Other information

Full text of H-Statements

- H280 Contains gas under pressure; may explode if heated.

Key or legend to abbreviations and acronyms used in the safety data sheet

- TWA Time Weighted Average

Further information

- Update

The information provided in this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. Such information is only given as a guidance to help the user handle, use, process, store, transport,

dispose and release the product in satisfactory safety conditions and is not to be considered as a warranty or quality specification. It should be used in conjunction with technical sheets but do not replace them. Thus, the information only relates to the designated specific product and may not be applicable if such product is used in combination with other materials or in any other manufacturing process, unless otherwise specifically indicated. It does not release the user from ensuring he is in conformity with all regulations linked to its activity.

JP3 LITHIUM-ION BATTERY CELL (AGANA)

LG Chem	SAFETY DATA SHEET	Version: R0001.0002
		Date of issue: 2016-05-10
		Revision date: 2017-06-28
	LGCHEM JP3 Lithium-Ion Battery Cell	Change List: see Section 16.1

1. IDENTIFICATION

A. Product name

- LGCHEM JP3 Lithium-Ion Battery Cell

B. Recommended use and restriction on use

- General use : Rechargeable Lithium-Ion Battery Cell
- Restriction on use : Not available

C. Manufacturer / Supplier / Distributor information

○ **Manufacturer information**

- Company name : LG Chem Ltd.
- Address : LG Twin Tower, Youido-Dong, Youngdeungpo-Ku, Seoul, Korea
- Telephone number : +82-2-3773-6740
- E-mail address : lkblive@lgchem.com

○ **Supplier/Distributer information**

- Company name : LG Chem Ltd.
- Address : LG Twin Tower, Youido-Dong, Youngdeungpo-Ku, Seoul, Korea
- Telephone number : +82-2-3773-6740
- E-mail address : lkblive@lgchem.com

Legal Remark

U.S.A

- The Occupational Safety and Health Administration (OSHA) Hazard Communication Standard, 29 CFR Subpart 1910.1200 does not apply to various subcategories including anything defined by OSHA as an "article". The products are defined as "articles", and are exempted from the requirements for Material Safety Data Sheets.

EU

- The products are no “substances” or “mixtures” according to Regulation (EC) No 1907/2006 EC. Instead they have to be regarded as “articles”, no substances are intended to be released during handling. Therefore there is no obligation to supply a Safety Data Sheet according to Regulation (EC) 1907/2006, Article 31.

General remark

- This Safety Data Sheet is provided as a service to our customers. This information is based on our current knowledge and is intended to describe the product for the purposes of health, safety and environmental requirements only.
- It should not therefore be construed as guaranteeing any specific property of the product.

2. HAZARD IDENTIFICATION

A. GHS Classification

- No classification is presented since the product is legally an article rather than chemical substance or mixture according to The Occupational Safety and Health Administration (OSHA) Hazard Communication Standard, 29 CFR Subpart 1910.1200

B. GHS label elements

- Not applicable

C. Other hazards which do not result in classification :

- Not available

3. COMPOSITION/INFORMATION ON INGREDIENTS

Chemical Name	Trade names and Synonyms	CAS No.	Content(%)
Aluminium	Aluminium Foil	7429-90-5	2-10
Metal Oxide (proprietary)			20-50
1,1-Difluoroethene homopolymer	Polyvinylidene Fluoride (PVDF)	24937-79-9	<5
Copper	Copper Foil	7440-50-8	5-20
Carbon (proprietary)		7440-44-0	10-20
Electrolyte (proprietary)			10-20
Aluminum, Copper plate and inert materials		Not applicable	Remainder

Lithium-equivalent Content: 18.84g (235.5 Wh)

4. FIRST AID MEASURES

A. Eye contact

- Not a health hazard.

B. Skin contact

- Not a health hazard.

C. Inhalation contact

- Not a health hazard.

D. Ingestion contact

- Get medical attention immediately.

IF EXPOSURE TO INTERNAL MATERIALS WITHIN CELL DUE TO DAMAGED OUTER CASING, THE FOLLOWING ACTIONS ARE RECOMMENDED ;

- Obtain special instructions before use.
- Do not handle until all safety precautions have been read and understood.
- Keep away from heat/sparks/open flames/hot surfaces.
- Keep/Store away from clothing /combustible materials.
- Do not breathe dust/fume/gas/mist/vapours/spray.
- Do not get in eyes, on skin, or on clothing.
- Avoid release to the environment.
- Wear protective gloves/protective clothing/eye protection/face protection.
- Use personal protective equipment as required.

A. Eye contact

- Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.
- Get medical attention immediately.

B. Skin contact

- Wash with plenty of soap and water.
- Remove/Take off immediately all contaminated clothing. Rinse skin with water/shower.
- Take off contaminated clothing and wash it before reuse.
- Get medical attention immediately.
- If skin irritation or rash occurs, Get medical advice/attention.
- Wear gloves when washing the patient, and please avoid contact with contaminated clothing.

C. Inhalation contact

- Remove victim to fresh air and keep at rest in a position comfortable for breathing.
- Take specific treatment if needed.
- Get immediate medical advice/attention.
- If breathing is stopped or irregular, give artificial respiration and supply oxygen.

D. Ingestion contact

- Rinse mouth.
- Immediately call a POISON CENTER or doctor/physician.
- Get immediate medical advice/attention.
- About whether I should induce vomiting Take the advice of a doctor.

E. Delayed and immediate effects and also chronic effects from short and long term exposure

- Not available

F. Notes to physician

- Notify medical personnel of contaminated situations and have them take appropriate protective measures.

5. FIREFIGHTING MEASURES

A. Suitable (Unsuitable) extinguishing media

- Use extinguishing media suitable for the materials that are burning.

B. Specific hazards arising from the chemical

- Cell is not flammable but internal organic material will burn if the cell is incinerated. Combustion products include, but are not limited to hydrogen fluoride, carbon monoxide and carbon dioxide.

C. Special protective actions for firefighters

- Notify your local firestation and inform the location of the fire and characteristics hazard.
- Avoid inhalation of materials or combustion by-products.
- Use appropriate extinguishing measure suitable for surrounding fire.
- Wear appropriate protective equipment.
- Use fire fighting procedures suitable for surrounding area.
- If possible, remove cell(s) from fire fighting area. If heated above 150°C, cell(s) may combust/vent.
- Use NIOSH/MSHA approved full-face self-contained breathing apparatus (SCBA) with full protective gear.

6. ACCIDENTAL RELEASE MEASURES

A. Personal precautions, protective equipment and emergency procedures

- Protective equipment: Wear proper protective equipment
- Emergency procedures:

  On Land
  Place material into suitable containers and call local fire/police department.
  In Water
  If possible, remove from water and call local fire/police department.
- If required, notify relevant authorities according to all applicable regulations.

B. Environmental precautions

- Prevent runoff and contact with waterways, drains or sewers.
- Advise emergency services.

C. Methods and materials for containment and cleaning up

- Control personal contact by using protective equipment.
- Prevent, by any means available, containment from entering drains or water course.
- Dispose of waste in accordance with local regulation.

7. HANDLING AND STORAGE

A. Precautions for safe handling

- No special protective clothing required for handling individual cells.
- Do not expose battery or cell to extreme temperatures or fire.
- Do not disassemble, crush or puncture battery.
- Do not overcharge or over discharge the battery.
- Do not connect (short circuit) positive and negative terminals.
- Do not place the batteries on conductive metal.

B. Conditions for safe storage, including any incompatibilities

- Store in a cool, dry place.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

A. Exposure limits

- **ACGIH TLV**
  - Not available
- **OSHA PEL**
  - Not available

B. Engineering controls

- Keep away from heat and open flame.
- Store in cool and dry place.

C. Personal protective equipment

- **Respiratory protection**
  - Not required during normal operations.
  - SCBA required in the event of fire.
- **Eye protection**
  - Not required beyond safety practices of employer.
- **Hand protection**
  - Not required for handling of cells.
- **Skin protection**
  - Steel toed shoes recommended for large container handling.
- **Others**
  - Not available

9. PHYSICAL AND CHEMICAL PROPERTIES

A. Appearance	
- Appearance	Solid
- Color	Not available
B. Odor	Not available
C. Odor threshold	Not available
D. pH	Not available
E. Melting point/Freezing point	Not available
F. Initial Boiling Point/Boiling Ranges	Not available
G. Flash point	Not available
H. Evaporation rate	Not available
I. Flammability(solid, gas)	Not available
J. Upper/Lower Flammability or explosive limits	Not available
K. Vapour pressure	Not available
L. Solubility	Insoluble
M. Vapour density	Not available
N. Specific gravity(Relative density)	Not available
O. Partition coefficient of n-octanol/water	Not available
P. Autoignition temperature	Not available

Q. Decomposition temperature	Not available
R. Viscosity	Not available
S. Molecular weight	Not available

10. STABILITY AND REACTIVITY

A. Chemical Stability

- None during normal operating conditions.

B. Possibility of hazardous reactions

- None during normal operating conditions.

C. Conditions to avoid

- Avoid exposure to heat, open flame, and corrosives.
- Do not puncture, crush or incinerate.

D. Incompatible materials

- None during normal operating conditions.

E. Hazardous decomposition products

- None during normal operating conditions.
- If cells are damaged, hydrogen fluoride and carbon monoxide may be released.

11. TOXICOLOGICAL INFORMATION

A. Information on the likely routes of exposure

○ **(Respiratory tracts)**
- None during normal operating conditions.

○ **(Oral)**
- None during normal operating conditions.

○ **(Eye·Skin)**
- None during normal operating conditions.

B. Delayed and immediate effects and also chronic effects from short and long term exposure

○ **Acute toxicity**

*** Oral**
- This product does not elicit toxicological properties during routine handling and use.

*** Dermal**
- This product does not elicit toxicological properties during routine handling and use.

*** Inhalation**
- This product does not elicit toxicological properties during routine handling and use.

○ **Skin corrosion/irritation**
- No irritation.
- If the cells are opened through misuse or damage, discard immediately. Internal components of cell are irritants and sensitizers.

○ **Serious eye damage/irritation**
- Not available

○ **Respiratory sensitization**
- Not available

○ **Skin sensitization**
- No sensitization.
- If the cells are opened through misuse or damage, discard immediately. Internal components of cell are irritants and sensitizers.

○ **Carcinogenicity**
- Not available

○ **Germ cell mutagenicity**
- Not available

○ **Reproductive toxicity**
- This product does not elicit toxicological properties during routine handling and use.

○ **STOT-single exposure**
- Not available

○ **STOT-repeated exposure**
- Not available

○ **Aspiration hazard**
- Not available

12. ECOLOGICAL INFORMATION

A. Ecotoxicity

○ **Fish**
- Not available

○ **Crustaceans**
- Not available

○ **Algae**
- Not available

B. Persistence and degradability

○ **Persistence**
- Not available

○ **Degradability**
- Not available

C. Bioaccumulative potential

○ **Bioaccumulative potential**
- Some materials within the cell are bioaccumulative. Under normal conditions, these materials are contained and pose no risk to persons or the surrounding environment.

○ **Biodegration**
- Not available

D. Mobility in soil

- Not available

E. Other adverse effects

- Not available

13. DISPOSAL CONSIDERATIONS

A. Disposal methods

- Dispose of according to all federal, state, and local regulations.

Follow Directive 2006/66/EC.

California regulated debris

RCRA Waste Code : Non regulated

B. Special precautions for disposal

- Not available

14. TRANSPORT INFORMATION

A. UN No.

- 3480 / 3481

B. Proper shipping name

- Lithium Ion Batteries / Lithium Ion Batteries contained in equipment

C. Hazard Class

- Class 9
- Hazard label: Miscellaneous

D. Packing group

- II

E. Marine pollutant

- Not available

F. Special precautions for user related to transport or transportation measures

ICAO/IATA

- Packing Instruction: 965, 967
- Maximum Gross Weight per Package on Passenger and Cargo Aircraft: 5 kg
- Maximum Gross Weight per Package on Cargo Only Aircraft: 35 kg
- Special Provision: A45, A88, A99

IMO

-Packing Instruction: P903

- Special Provision: 188, 230, 310, 957
- EmS: F-A, S-I

US DOT

- This product is not subject to any other requirements of dangerous goods under 49
- CFR 173.185 (Lithium Batteries and Cells).

15. REGULATORY INFORMATION

A. National and/or international regulatory information

○ **Information of EU Classification**

- Information according to Regulation (EC) No 1272/2008 [CLP]
- Information according to Directive 67/548/EEC

○ **U.S. Federal regulations**

- Information according to ISHA
- Information according to TCCA and other chemical management regulations
- Dangerous Substances Safety Management Act
- Regulation of Disposal
- OSHA hazard communication standard (29 CFR 1910.1200)

__√__ Hazardous ___ Non-hazardous

16. OTHER INFORMATION

A. Reference

- This information is based on our present state of knowledge. It shall describe our products regarding safety requirements and shall not be construed as a guarantee or statement of condition and/or quality
- Information contained in this safety data sheet is based on LG Chem owned data and public sources deemed valid or acceptable. The absence of data elements indicates, that no data meeting these requirements is available

B. Issue date

- 2016-05-11

C. Revision number and Last date revised

- R1.1: Established / 2016-05-11
- R1.2: Change the product name (Li ion Polymer Battery → Li ion Battery Cell) / 2017-06-28

D. Other

- This SDS is prepared according to the Globally Harmonized System (GHS).

Apar Industries Limited **5 MVA XFMR OIL** **Safety Data Sheet**

Conforms to Regulation (EC) No. 1907/2006 (REACH), Annex II , as amended by Commission Regulation (EU) 2015/830.

1 – Identification of the substance/ mixture and of the company/ undertaking

1.1 Product Identifier

Product name	**Transformer oil POWEROIL®TO 1020 AUX**
Product description	Insulating oil
Product type	Liquid
MARPOL Annex- I	Oils

1.2 Identified uses

Distribution of substance	Industrial
Formulation & (re)packing of substances and mixtures	Industrial
Manufacture of substance	Industrial
Functional Fluids	Industrial

1.3 Details of the supplier of the safety data sheet

Supplier/ Manufacturer	Apar Industries Limited 18 T.T.C., M.I.D.C. Industrial Area , Thane Belapur Road , Rabale, Navi Mumbai – 400701. INDIA. +91 22 61110444 (Office hours 9.30am to 17.00pm) www.apar.com
e- mail address of person responsible for this SDS	hse@apar.com

1.4 Emergency telephone number +91 9833811132

2 – Hazards Identification

2.1 Classification of the substance or mixture

Product definition Mixture

Classification according to Regulation (EC) No. 1272/2008 [CLP/GHS]

Asp. Tox. 1, H304

The product is classified as hazardous according to Regulation (EC) 1272/2008 as amended.

See Section 16 for the full text of the H statements declared above.

2.2 Label elements

Hazard pictograms

Signal word	Danger
Hazard statements	H 304 : May be fatal if swallowed and enters airways. H412 - Harmful to aquatic life with long lasting effects.
Precautionary statements	
Prevention	P273 - Avoid release to the environment.
Response	P301 + P310 + P331 - IF SWALLOWED: Immediately call a POISON CENTER or physician. Do NOT induce vomiting.
Storage	P405 - Store locked up.
Disposal	P501 - Dispose of contents/container in accordance with all local, regional, national and international regulations.
Annex XVII - Restrictions on the manufacture, placing on the market and use of certain dangerous substances, mixtures and articles	Not applicable

2.3 Other hazards

Substance meets the criteria for PBT according to Regulation (EC) No. 1907/2006, Annex XIII	Not applicable
Substance meets the criteria for vPvB according to Regulation (EC) No. 1907/2006, Annex XIII	Not applicable

Conforms to Regulation (EC) No. 1907/2006 (REACH), Annex II , as amended by Commission Regulation (EU) 2015/830.

3 - Composition / Information on Ingredients

3.2 Mixtures Mixture

Product/ Ingredient name	Identifiers	%	Classification Regulation (EC) No. 1272/2008 [CLP]	Type
Distillate (petroleum), severely hydrotreated light Naphthenic Oil.	EC: 265-156-6 CAS: 64742-55-8	75 – 85	Asp. Tox. 1, H304	[1]
Distillate (petroleum), severely hydrotreated light Paraffinic Oil.	EC: 265-158-7 CAS: 64742-55-8	15 – 25	Asp. Tox. 1, H304	[1]
2,6 –Di-tert-Butyl-P-Cresol	CAS: 128-37-0 EC : 204-881-4	≤ 0.38	Aquatic Acute 1, H400 Aquatic Chronic 1, H410	[1]

Annex I Nota L applies to the base oil(s) in this product. Nota L - The classification as a carcinogen need not apply if it can be shown that the substance contains less than 3 % DMSO extract as measured by IP 346.
There are no additional ingredients present which, within the current knowledge of the supplier and in the concentrations applicable, are classified as hazardous to health or the environment, are PBTs or vPvBs or have been assigned a workplace exposure limit and hence require reporting in this section.
Type
[1] Substance classified with a health or environmental hazard
[2] Substance with a workplace exposure limit
[3] Substance meets the criteria for PBT according to Regulation (EC) No. 1907/2006, Annex XIII
[4] Substance meets the criteria for vPvB according to Regulation (EC) No. 1907/2006, Annex XIII
[5] Substance of equivalent concern

4 - First Aid Measures

4.1 Description of first aid measures

Eye contact	Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. If irritation, blurred vision or swelling occurs and persists, obtain medical advice from a specialist.
Inhalation	If breathing is difficult, remove victim to fresh air and keep at rest in a position comfortable for breathing. If casualty is unconscious and: If not breathing, if breathing is irregular or if respiratory arrest occurs, provide artificial respiration or oxygen by trained personnel. Get medical attention if adverse health effects persist or are severe. Maintain an open airway.
Skin contact	Wash with soap and water. Remove contaminated clothing and shoes. Handle with care and dispose of in a safe manner. Seek medical attention if skin irritation, swelling or redness develops and persists. Accidental high pressure injection through the skin requires immediate medical attention. Do not wait for symptoms to develop.
Ingestion	Always assume that aspiration has occurred. Do not induce vomiting. Can enter lungs and cause damage. If vomiting occurs, the head should be kept low so that vomit does not enter the lungs. Seek professional medical attention or send the casualty to a hospital. Do not wait for symptoms to develop. Never give anything by mouth to an unconscious person. If unconscious, place in recovery position and get medical attention immediately. Maintain an open airway. Loosen tight clothing such as a collar, tie, belt or waistband.
Protection of first-aiders	No action shall be taken involving any personal risk or without suitable training. It may be dangerous to the person providing aid to give mouth-to-mouth resuscitation. Before attempting to rescue casualties, isolate area from all potential sources of ignition including disconnecting electrical supply. Ensure adequate ventilation and check that a safe, breathable atmosphere is present before entry into confined spaces.

4.2 Most important symptoms and effects, both acute and delayed

Potential acute health effects

Eye contact	Eye contact may cause redness and transient pain.
Inhalation	Inhalation of oil mist or vapours at elevated temperatures may cause respiratory irritation.
Skin contact	No known significant effects or critical hazards.
Ingestion	May be fatal if swallowed and enters airways.

4.3 Indication of any immediate medical attention and special treatment needed

Notes to physician	Due to low viscosity there is a risk of aspiration if the product enters the lungs. Treat symptomatically.
Specific treatments	Always assume that aspiration has occurred.

Conforms to Regulation (EC) No. 1907/2006 (REACH), Annex II , as amended by Commission Regulation (EU) 2015/830.

5 - Fire Fighting Measures

5.1 Extinguishing media

Suitable extinguishing media	Dry chemicals. Foam. Carbon dioxide (CO_2). Water spray or foam.
Unsuitable extinguishing media	Do not use direct water jets on the burning product; they could cause splattering and spread the fire. Simultaneous use of foam and water on the same surface is to be avoided as water destroys the foam.

5.2 Special hazards arising from the substance or mixture

Hazards from the substance or mixture	In a fire or if heated, a pressure increase will occur and the container may burst. This substance will float and can be reignited on surface water.
Hazardous thermal decomposition products	Incomplete combustion is likely to give rise to a complex mixture of airborne solid and liquid particulates, gases, including carbon monoxide, H2S, SOx (sulfur oxides) or sulfuric acid and unidentified organic and inorganic compounds.

5.3 Advice for firefighters

Special precautions for firefighters	Promptly isolate the scene by removing all persons from the vicinity of the incident if there is a fire. No action shall be taken involving any personal risk or without suitable training.
Special protective equipment for fire-fighters	Fire-fighters should wear appropriate protective equipment and self-contained breathing apparatus (SCBA) with a full face-piece operated in positive pressure mode. Clothing for fire-fighters (including helmets, protective boots and gloves) conforming to European standard EN 469 will provide a basic level of protection for chemical incidents.

6 - Accidental release Measures

6.1 Personal precautions, protective equipment and emergency procedures

For non-emergency personnel	Avoid breathing vapour or mist. Keep non-involved personnel away from the area of spillage. Alert emergency personnel. Except in case of small spillages, the feasibility of any actions should always be assessed and advised, if possible, by a trained, competent person in charge of managing the emergency. Stop leak if safe to do so. Avoid direct contact with the product. Stay upwind/keep distance from source. In case of large spillages, alert occupants in downwind areas. Eliminate all ignition sources if safe to do so. Spillages of limited amounts of product, especially in the open air when vapours will be usually quickly dispersed ,are dynamic situations, which will presumably limit the exposure to dangerous concentrations. Note : recommended measures are based on the most likely spillage scenarios for this material; however, local conditions (wind, air temperature, wave/current direction and speed) may significantly influence the choice of appropriate actions. For this reason, local experts should be consulted when necessary. Local regulations may also prescribe or limit actions to be taken.
For emergency responders	Small spillages: normal antistatic working clothes are usually adequate. Large spillages: full body suit of chemically resistant and thermal resistant material should be used. Work gloves providing adequate chemical resistance, specifically to aromatic hydrocarbons. Note : gloves made of PVA are not water-resistant, and are not suitable for emergency use. Safety helmet, antistatic non-skid safety shoes or boots. Goggles and / or face shield, if splashes or contact with eyes is possible or anticipated. Respiratory protection : A half or full-face respirator with filter(s) for organic vapours (and when applicable for H2S) a Self Contained Breathing Apparatus (SCBA) can be used according to the extent of spill and predictable amount of exposure. If the situation cannot be completely assessed, or if an oxygen deficiency is possible, only SCBA's should be used.
6.2 Environmental precautions	Prevent product from entering sewers, rivers or other bodies of water. If necessary dike the product with dry earth, sand or similar non-combustible materials. In case of soil contamination, remove contaminated soil and treat in accordance with local regulations. In case of small spillages in closed waters (i.e. ports), contain product with floating barriers or other equipment. Collect spilled product by absorbing with specific floating absorbents. If possible, large spillages in open waters should be contained with floating barriers or other mechanical means. If this is not possible, control the spreading of the spillage, and collect the product by skimming or other suitable mechanical means. The use of dispersants should be advised by an expert, and, if required, approved by local authorities.

Conforms to Regulation (EC) No. 1907/2006 (REACH), Annex II , as amended by Commission Regulation (EU) 2015/830.

6 - Accidental release Measures

6.3 Methods and material for containment and cleaning up

Small spill	Stop leak if without risk. Absorb spilled product with suitable non-combustible materials.
Large spill	Large spillages may be cautiously covered with foam, if available, to limit vapour cloud formation. Do not use water jet. When inside buildings or confined spaces, ensure adequate ventilation. Transfer collected product and other contaminated materials to suitable containers for recovery or safe disposal.
6.4 Reference to other sections	See Section 1 for emergency contact information. See Section 8 for information on appropriate personal protective equipment. See Section 13 for additional waste treatment information.

7 - Handling and Storage

7.1 Advice on general occupational hygiene Storage	Ensure that proper housekeeping measures are in place. Contaminated materials should not be allowed to accumulate in the workplaces and should never be kept inside the pockets. Eating, drinking and smoking should be prohibited in areas where this material is handled, stored and processed. Wash hands thoroughly after handling. Change contaminated clothes at the end of working shift. See also Section 8 for additional information on hygiene measures.
7.2 Conditions for safe storage, including any incompatibilities	Storage area layout, tank design, equipment and operating procedures must comply with the relevant regional, national or local legislation. Storage installations should be designed with adequate bunds in case of leaks or spills. Cleaning, inspection and maintenance of internal structure of storage tanks must be done only by properly equipped and qualified personnel as defined by national, local or company regulations.
7.2 Conditions for safe storage, including any incompatibilities	Store separately from oxidising agents. Recommended materials for containers, or container linings use mild steel, stainless steel. Not suitable : Some synthetic materials may be unsuitable for containers or container linings depending on the material specification and intended use. Compatibility should be checked with the manufacturer. Keep only in the original container or in a suitable container for this kind of product. Keep container tightly closed and sealed until ready for use. Do not store in unlabelled containers. Containers that have been opened must be carefully resealed and kept upright to prevent leakage. Empty containers may contain harmful, flammable/combustible or explosive residue or vapours. Do not cut, grind, drill, weld, reuse or dispose of containers unless adequate precautions are taken against these hazards. Store locked up. Protect from sunlight.
7.3 Specific end use(s)	
Recommendations	Not available
Industrial sector specific solutions	Not available

8 - Exposure Controls / Personal Protection

The list of Identified Uses in Section 1 should be consulted for any available use-specific information provided in the Exposure Scenario(s).

8.1 Control parameters

Occupational exposure limits

Product/ Ingredient name	Exposure limits values
Distillate (petroleum), hydrotreated light naphthenic Oil mist	**AFS 2015:7 (Sweden, 12/2015).** TWA: 1 mg/m³ 8 hours. Form: mist and fume STEL: 3 mg/m³ 15 minutes. Form: mist and fume ***[Air contaminant]*** **AFS 2015:7 (Sweden, 12/2015).** TWA: 1 mg/m³ 8 hours. Form: mist and fume STEL: 3 mg/m³ 15 minutes. Form: mist and fume

Recommended monitoring procedures	If this product contains ingredients with exposure limits, personal, workplace atmosphere or biological monitoring may be required to determine the effectiveness of the ventilation or other control measures and/or the necessity to use respiratory protective equipment. Reference should be made to monitoring standards, such as the following: European Standard EN 689 (Workplace atmospheres - Guidance for the assessment of exposure by inhalation to chemical agents for comparison with limit values and measurement strategy) European Standard EN 14042 (Workplace atmospheres - Guide for the application and use of procedures for the assessment of exposure to chemical and biological agents) European Standard EN 482 (Workplace atmospheres - General requirements for the performance of procedures for the measurement of chemical agents) Reference to national guidance documents for methods for the determination of hazardous substances will also be required.

8.2 Exposure Controls	
Appropriate engineering controls	Mechanical ventilation and local exhaust will reduce exposure via the air. Use oil resistant material in construction of handling equipment. Store under recommended conditions and if heated, temperature control equipment should be used to avoid overheating.
Individual protection measures	
Hygiene measures	Wash hands, forearms and face thoroughly after handling chemical products, before eating, smoking and using the lavatory and at the end of the working period. Ensure that eyewash stations and safety showers are close to the workstation location. Wash contaminated clothing before reuse.
Eye/face protection	Recommended: Safety glasses with side shields.
Skin protection	
Hand protection	4 - 8 hours (breakthrough time): nitrile rubber
Body protection	Wear protective clothing if there is a risk of skin contact. Change contaminated clothes at the end of working shift.
Other skin protection	Appropriate footwear and any additional skin protection measures should be selected based on the task being performed and the risks involved and should be approved by a specialist before handling this product.
Respiratory protection	Respirator selection must be based on known or anticipated exposure levels, the hazards of the product and the safe working limits of the selected respirator. Use a properly fitted, particulate filter respirator complying with an approved standard if a risk assessment indicates this is necessary.
Environmental exposure controls	Emissions from ventilation or work process equipment should be checked to ensure they comply with the requirements of environmental protection legislation. In some cases, fume scrubbers, filters or engineering modifications to the process equipment will be necessary to reduce emissions to acceptable levels.

9 - Physical and Chemical Properties

Appearance	
Physical state	Liquid
Color	Colorless to Light yellow
Odor	Odorless
Odour threshold	Not available
pH	Not applicable
Melting point/Pour point	< -40°C (ASTM D-97)
Flash point	> 140°C Pensky-Mertens (ASTM D 93)
Evaporation rate	Not available
Flammability (solid, gas)	Not available
Flammability limits in air, lower, % by volume	Not available
Flammability limits in air, upper, % by volume	Not available
Vapour pressure	Not available
Density	0.910 max at 15°C
Solubility(ies)	
Solubility (water)	Insoluble in water
Partition coefficient (n-octanol/water)	Not available
Decomposition temperature	No Data
Auto-ignition temperature	> 250°C
Viscosity, Kinematic at 40°C (104°F)	0.08 cm^2/s to 0.11 cm^2/s (8.00 to 11.00 cSt)
Explosive properties	No Data
Oxidising properties	No Data
DMSO extractable compounds for base oil substance(s) according to IP346	< 3%

10 - Stability and reactivity

10.1 Reactivity	No specific test data related to reactivity available for this product or its ingredients.
10.2 Chemical stability	Stable under normal conditions
10.3 Possibility of hazardous Reactions	Under normal conditions of storage and use, hazardous reactions will not occur.
10.4 Conditions to avoid	Oxidising agent.
10.5 Incompatible materials	Keep away from extreme heat and oxidizing agents.

10.6 Hazardous decomposition products	Incomplete combustion is likely to give rise to a complex mixture of airborne solid and liquid particulates, gases, including carbon monoxide, H2S, SOx (sulfur oxides) or sulfuric acid and unidentified organic and inorganic compounds.

11 - Toxicological Information

11.1 Information on toxicological effects

Acute toxicity

Product/ingredient name	Result	Species	Dose	Exposure
Distillate (petroleum),hydrotreated light naphthenic	LC50 Inhalation Dusts and mists	Rat	>5.53 mg/l	4 hours
	LD50 Dermal	Rabbit	>5000 mg/kg	-
	LD50 Oral	Rat	>5000 mg/kg	-
Distillate (petroleum),hydrotreated Light paraffinic	LC50 Inhalation Dusts and mists	Rat	>2.18 mg/l	4 hours
	LD50 Dermal	Rabbit	>5000 mg/kg	-
	LD50 Oral	Rat	>15000 mg/kg	-
2,6-di-tert-butyl-p-cresol	LD50 Dermal	Rat	>5000 mg/kg	-
	LD50 Oral	Rat	>5000 mg/kg	-

Irritation/Corrosion	
Skin	No known significant effects or critical hazards.
Eye	No known significant effects or critical hazards.
Respiratory	No known significant effects or critical hazards.
Sensitisation	
Skin	No known significant effects or critical hazards.
Respiratory	No known significant effects or critical hazards.
Mutagenicity	No data available to indicate product or any components present at greater than 0.1% are mutagenic or genotoxic.

11 - Toxicological Information

Carcinogenicity	The base oil(s) in this product is based on a severely hydrotreated distillate. The product should not be regarded as a carcinogen.
Reproductive toxicity	Contains no ingredient listed as toxic to reproduction.
Specific target organ toxicity - single exposure	Not classified
Specific target organ toxicity - repeated exposure	Not classified
Aspiration hazard	Aspiration hazard - Category 1
Information on likely routes of exposure	Not available.
Potential acute health effects	
Eye contact	Eye contact may cause redness and transient pain.
Inhalation	Inhalation of oil mist or vapours at elevated temperatures may cause respiratory irritation.
Skin contact	No known significant effects or critical hazards.
Ingestion	May be fatal if swallowed and enters airways.
Potential chronic health effects	
General	No known significant effects or critical hazards.
Carcinogenicity	The base oil(s) in this product is based on a severely hydrotreated distillate. The product should not be regarded as a carcinogen.
Mutagenicity	No known significant effects or critical hazards.
Teratogenicity	No known significant effects or critical hazards.
Product/ingredient name	No known significant effects or critical hazards.
Fertility effects	No known significant effects or critical hazards.
Other information	Not available.
Specific hazard	

Conforms to Regulation (EC) No. 1907/2006 (REACH), Annex II , as amended by Commission Regulation (EU) 2015/830.

12 - Ecological Information

12.1 Toxicity	Not expected to be harmful to aquatic organisms.
12.2 Persistence and degradability	Not inherently biodegradable.
12.3 Bioaccumulative potential	Bioaccumulation is unlikely to be significant because of the low water solubility of this product.
12.4 Mobility in soil	Not considered mobile.
12.5 Results of PBT & vPvB Assessment	Not applicable.
12.6 Other adverse effects	Insoluble in water. Spills may form a film on water surfaces causing physical damage to organisms. Oxygen transfer could also be impaired.

13 - Disposal Considerations

The information in this section contains generic advice and guidance. The list of Identified Uses in Section 1 should be consulted for any available use-specific information provided in the Exposure Scenario(s).

13.1 Waste treatment methods

Product

Methods of disposal	Where possible (e.g. in the absence of relevant contamination), recycling of used substance is feasible and recommended. This substance can be burned or incinerated, subject to national/local authorizations, relevant contamination limits, safety regulations and air quality legislation. Contaminated or waste substance (not directly recyclable): Disposal can be carried out directly, or by delivery to qualified waste handlers. National legislation may identify a specific organization, and/or prescribe composition limits and methods for recovery or disposal.
Hazardous waste	Yes

13 - Disposal Considerations

European waste catalogue (EWC)

Waste code	Waste designation
13 03 07*	mineral-based non-chlorinated insulating and heat transmission oils

Packaging

Methods of disposal	The generation of waste should be avoided or minimised wherever possible. Waste packaging should be recycled. Incineration or landfill should only be considered when recycling is not feasible.

14 - Transport Information

International transport regulations

	ADR/ RID	ADN	IMO/ IMDG Classification	ICAO/ IATA Classification
14.1 UN number	Not regulated.	Not regulated.	Not regulated.	Not regulated.
14.2 UN proper shipping name	-	-	-	-
14.3 Transport hazard class(es)	-	-	-	-
14.4 Packing group	-	-	-	-
14.5 Environmental hazards	No	No	No	No
Additional information	-	-	-	-

14.6 Special precautions for User	**Transport within user's premises:** always transport in closed containers that are upright and secure. Ensure that persons transporting the product know what to do in the event of an accident or spillage.
14.7 Transport in bulk according to Annex I of MARPOL 73/78 and the IBC Code	Oils

Conforms to Regulation (EC) No. 1907/2006 (REACH), Annex II , as amended by Commission Regulation (EU) 2015/830.

15 - Regulatory Information

15.1 Safety, health and environmental regulations/legislation specific for the substance or mixture

EU Regulation (EC) No. 1907/2006 (REACH)

Annex XIV - List of substances subject to authorization

Annex XIV	None of the components are listed.
Substances of very high concern	None of the components are listed.
Annex XVII - Restrictions on the manufacture, placing on the market and use of certain dangerous substances, mixtures and articles	Not applicable.

Other EU regulations

Seveso Directive	This product is not controlled under the Seveso Directive.

International Lists	Inventory name	On inventory (yes/no)*
National Inventory		
Australia	Australian Inventory of Chemical Substances (AICS)	Yes
Canada	Domestic Substances List (DSL)	Yes
Canada	Non-Domestic Substances List (NDSL)	No
China	Inventory of Existing Chemical Substances in China (IECSC)	Yes
Europe	European Inventory of Existing Commercial Chemical Substances (EINECS)	Yes
Europe	European List of Notified Chemical Substances (ELINCS)	No
Japan	Inventory of Existing and New Chemical Substances (ENCS)	Yes
Korea	Existing Chemicals List (ECL)	Yes
New Zealand	New Zealand Inventory	Yes
Philippines	Philippine Inventory of Chemicals and Chemical Substances (PICCS)	Yes
United States & Puerto Rico	Toxic Substances Control Act (TSCA) Inventory	Yes

* A "Yes" indicates that all components of this product comply with the inventory requirements administered by the governing country(s)
A "No" indicates that one or more components of the product are not listed or exempt from listing on the inventory administered by the governing country(s).

15.2 Chemical Safety Assessment

16 - Other Information

Revision comments	Not available.
Legend to abbreviations	
ADR	European agreement concerning the international carriage of dangerous good by road.
RID	Regulations agreement concerning the international carriage of dangerous good by rail.
IMDG – CODE	International maritime dangerous goods code.
ICAO	International Civil Aviation Organization.
IATA	International air transport association.
GHS	Globally Harmonized System of Classification and Labeling of Chemicals.
CLP	Classification, Labelling and Packaging Regulation [Regulation (EC) No.1272/2008].
SCBA	Self-Contained Breathing Apparatus.
REACH	Registration, Evaluation, Authorisation and Restriction of Chemicals Regulation [Regulation (EC) No. 1907/2006].
LC50	Median lethal concentration.
LD50	Median lethal dose.
PBT	Persistent, Bioaccumulative and Toxic.

Procedure used to derive the classification according to Regulation (EC) No. 1272/2008 [CLP/GHS]

Classification	Justification
Asp. Tox. 1, H304	Calculation method

Full text of abbreviated H-statements	H304 May be fatal if swallowed and enters airways.
Full text of classifications [CLP/GHS]	Asp. Tox. 1, H304 ASPIRATION HAZARD - Category 1.
Date of issue/Date of revision	January 2018.
Date of previous issue	December 2016.
Version	08

Disclaimer

The information provided in this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as a guidance for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process, unless specified in the text.

Appendix 8: Signatures of all assigned O&M personnel

TITLE	COMPANY/INDIVIDUAL	SIGNATURE
Company Regional Manager / Subject Matter Expert (SME)	LG CNS Tony (Hyunjoon) Tae	
Lead Technician	LG CNS Won Kwan Choi	
Local O&M Manager / Emergency Coordinator	JMI Edison Romeo Oriondo	
Secondary SME	LG CNS Woonyoung Park	
Safety Manager / SSHO (Site Safety and Health Officer)	JMI Edison Romeo Oriondo	
Technician	JMI Edison Mark Labiscase	
Technician	JMI Edison Noel Mirasol	
Technician	JMI Edison Marlonito Buisel	

ATTACHMENT C
TALOFOFO ESS EMERGENCY RESPONSE PLAN

SOP-169
OPERATION AND MAINTENANCE RESPONSIBILITIES FOR THE AGANA AND TALOFOFO ENERGY STORAGE SYSTEMS

EFFECTIVE DATE: 2/18/21

GPA ESS Phase Ⅰ
TALOFOFO Substation

Emergency Response Plan

Document ID: TFF-ERP -01

Prepared by
LG CNS **Tony (Hyunjoon) Tae** 

TALOFOFO ESS EMERGENCY RESPONSE PLAN

Record of Revisions*

Change #	Date of Change	Substance of Change	Entered By

* This document is updated version of #9 Emergency Action Plan in the SAFETY & HEALTH MANUAL.

Table of Contents

1. Introduction

1.1 Purpose

The following emergency response procedures are provided so that all TALOFOFO ESS site personnel understand the practices that are to be followed to be prepared for and to provide immediate and effective response to emergencies that might arise at the facility. Because the safety of employees is of primary concern, the TALOFOFO ESS site Emergency Response Coordinator and each member of the TALOFOFO ESS site staff are committed to providing a safe, healthy work environment and are responsible for ensuring implementation of these procedures.

Life safety of personnel shall be the highest priority during any event.

1.2 Limitations

This plan does not imply, nor should readers infer, that its implementation will guarantee that a perfect response will be practical or possible. No plan can shield individuals from all events.

Responders will attempt to coordinate the plan and response according to all applicable laws and standards.

Response to emergencies, events or disasters shall only be undertaken to the level of the responders' training, Personal Protective Equipment (PPE), and resources available.

There may be little to no warning during specific events to implement operational procedures.

The success or failure of all emergency plans depends upon effective training, continual (e.g., annual) review of this response plan, and execution of the response.

Sites and operators shall comply with applicable codes, standards, and other requirements as apply in their locality, even if those codes, standards, and requirements contradict this plan.

Successful implementation of this plan depends on timely identification of capabilities, available resources at the time of the incident and a thorough information exchange between responding organizations and the facility or transporter.

1.3 Facility Description

TALOFOFO ESS site is located in TALOFOFO at Talofofo Substation, 4A, Talofofo, Guam. The site is comprised of Lithium-ion Battery Energy Storage System in 4 of containerized enclosures across 66 ft X 81 ft within a 200 ft X 115 ft. The primary entrance is located at the North-West corner of TALOFOFO existing substation with a secondary entrance at the North fence of TALOFOFO existing substation.
Appendix 1 provides a map of the facility. Notification information for plant and external support organizations (police, fire department, medical facilities, etc.) that may be called to respond to

emergency situations at TALOFOFO ESS site is included in Appendix 4. The Local O&M Manager or their delegated substitute is available via cellular phone in case of an emergency.

1.4 Plan Review and Revision

A review of this emergency response plan shall be conducted and documented at minimum on an annual basis. The plan shall also be reviewed and amended whenever there are updates in safety standards or applicable laws or there is a change in facility design, construction, operation, or maintenance that affects emergency response planning. When outside resources are changed or modified the plan shall be reviewed and updated to reflect the changes that may affect this plan.

2. Emergency Response Management

2.1 Overall Organization

Overall responsibility for the Emergency Response Plan (ERP) lies with the TALOFOFO ESS site Emergency Response Coordinator. The Emergency Response Coordinator or their designee is responsible for program implementation, including designating evacuation routes and employee assembly points, coordinating severe weather activities, communicating emergency response procedures to site personnel, contracting with emergency response organizations, and contractor coordination.

2.2 Roles and Responsibilities

Specific management personnel will assume leadership roles for emergency responses. The Emergency Response Coordinator, Local O&M Manager, and/or Lead Technicians will assist in the implementation of this plan by knowing and communicating evacuation routes to workers during emergency evacuation and reporting the status of the evacuation to the Fire Department. The Emergency Response Coordinator is responsible for seeing that this plan is implemented and will appoint an adequate number of personnel to enforce the plan, assure everyone is familiar with this plan and act as a liaison with the local Fire Department(s).

All facility personnel have a responsibility to immediately report emergency situations to the Lead Technician on duty or local emergency responder personnel when appropriate. There shall be no delay to report emergency events that require the local emergency responders. The Lead Technician will then notify the Emergency Response Coordinator and other key personnel of the situation using the TALOFOFO ESS site Emergency Notification Telephone List (refer to Appendix 4). Where a Lead Technician is not assigned, facility personnel will refer to the Emergency Notification Telephone list to inform key personnel. Titles and roles are summarized in Appendix 3.

The Emergency Response Coordinator (or designee) shall be responsible for initiating a 'phone tree' for informing relevant operations and administrative contacts in Owner, GPA (Guam Power Authority), including the Regional Manager to initiate corporate awareness and public communications activities in accordance with company structure and policies.

A Subject Matter Expert (SME) shall be contactable at all times by telephone. This person and a designated Secondary SME contact should be readily available to first responders in the case of emergency situations. The SME shall be versed in the battery's failure modes and hazards. A working knowledge of incident command systems will allow the SME to integrate into the emergency response operations when needed. If this is not practical, telephone numbers of Local O&M Company and LG CNS headquarters should be available such that first responders may call at any time, and be given operational data on the system, including its current state of health, system alarm notifications, and advice on how to proceed during an emergency event.

2.3 Preparation and Planning for Emergencies

2.3.1 Pre-planning for emergencies is a crucial element of this plan. The following steps have been taken in planning for emergency situations at the site:

- Fire department and other first responders have received a copy of this plan and have participated in an on-site familiarization meeting.
- All emergency responder access points to the facility shall be identified.
- An emergency response information notice board shall be maintained at the right side of Control Container Main Door, identified in Appendix 1 and contain key contacts for emergencies, and other notices as outlined in this document or as deemed appropriate by the Emergency Response Coordinator.
- All road exits are established and posted on the emergency information notice board.
- Evacuation route diagrams have been documented and posted on the emergency information notice board.
- All buildings and property surrounded by fencing will be marked by signage that identifies specific hazards (such as the NFPA diamond, and all applicable Danger, Caution, Warning signal words).
- Site personnel receive instruction to keep exits from the site clear and to maintain ready access to fire extinguishers by not blocking them with furniture, or any other means. Refer to Appendix 5 for locations of fire extinguishers.
- Safe approach distances are established for equipment's different failure modes, personnel are trained in these distances, and such information is communicated in writing to first responders during emergency response informational meetings.
- Locations of Eyewash/Shower Stations are identified in Appendix 1.
- The Site Safety and Health Officer shall be certified in First Aid and O&M personnel shall be trained in First Aid. Refer to Appendix 5 for locations of First Aid Kits.

2.3.2 Emergency Routes

TALOFOFO ESS site evacuation sheet shall be posted and orally communicated to site personnel. These procedures shall be discussed at periodic safety meetings in addition to being covered during new employee orientation. Personnel are to know at least two exits whenever possible and be familiar with the evacuation routes posted in the location indicated on the site map (Appendix 1).

Depending upon the degree of emergency, weather and/or site conditions, roadways as designated on the site map (Appendix 1) will be used for routes of evacuation. In the event of an evacuation, all personnel will meet at the designated muster point for further information. If the primary muster point is inaccessible or hazardous, personnel shall gather at the secondary muster point and inform the emergency coordinator. The emergency response coordinator shall inform personnel of a diversion to the secondary muster point by such mean as are available, to include radio or loud hailer. If personnel are unable to make it to the designated muster points, they should seek shelter wherever possible and contact their supervisor for further instructions. Accountability of personnel shall be of the upmost importance and be conducted in a timely manner. Responder access points shall be kept

unobstructed at all times so first responders will not be hindered in their operations when responding to emergencies within the site.

2.4 Communications

Timely and efficient communications are essential to deal with an emergency response situation. The Emergency Response Coordinator is the central point of contact for all involved in an emergency response, including for first responders and Subject Matter Experts (SMEs). The following processes shall be observed during emergency communications:

- Employees using radios/phones shall yield to individuals who are the most directly involved in an emergency response activity, i.e. emergency response takes priority over all other communication on company network.
- Emergency transmissions should be clearly announced using signal words such as 'urgent' or 'mayday.' These signal words give priority to the radio transmitter to proceed with their message.
- If emergency phone communications are interrupted or unclear, employees shall proceed to the muster located at outside of TALOFOFO ESS site main gate and identified in Appendix 1.
- All hand-held phones of on-site workers should be recharged daily.

2.5 Operator Safety & Equipment

2.5.1 General recommendations for operator safety

- System Monitoring daily for unsafe conditions.
- Keep hands away from exposed electrical connections.
- Keep hands away from hot surfaces.
- Observe all high voltage warnings.
- Any outstanding observations shall be reported to their supervisor immediately and documented.

2.5.2 Personal Protective Equipment

The operation or maintenance of specific equipment may have different safety requirements. There are different levels of PPE that must be checked and maintained. All personnel who wear levels of protection above and beyond their normal everyday attire must be trained in that PPE. All training of PPE shall be conducted by a competent person and documented. Some PPE have a SCAM (selection, care and maintenance) document that will instruct the end user on the limitations of the PPE and the proper maintenance of the PPE. Always be aware of individual equipment operational requirements and hazards as well as out of service dates. For example,

- Safety glasses with side shields (no dark glasses are permitted except those approved for welding or cutting)
- Face shields for cutting & grinding
- Approved safety toe shoes
- Approved hearing protection
- Approved hardhat

- Approved gloves
- Long sleeve shirt
- Long pants

All PPE is required to be worn at all times for the working being conducted. Any PPE that is compromised or no longer considered viable for protection shall be discarded and replaced. Any PPE that comes in contact with hazardous material shall be properly decontaminated and inspected for functionality before being returned to service.

2.6 Safety Training

2.6.1 General training requirements

Initial training for all site personnel with respect to the contents of this ERP shall be undertaken upon the start of employment or substantial changes in duties. Refresher training of the ERP to site personnel shall be conducted at least annually. Documentation of ERP training is to be maintained in site files.

The site Emergency Response Coordinator and Lead Technicians are trained in their specific duties upon being assigned these roles or beginning their employment.

Operator personnel should receive supplier / manufacturer approved training on the specific characteristics of the energy storage system. Applicable common standards (e.g. on electrical safety) should be taken into account. All personnel who wear levels of protection above and beyond their normal everyday attire must be trained in that PPE.

Initial and refresher training regarding warning systems and alarms shall be conducted at least annually. Documentation of training is to be maintained in site files.

Any personnel from the Guam Power Authority and the Guam Fire Department may participate in the annual training on this emergency response plan. Lessons learned from prior events shall be discussed and the emergency response plan shall be updated accordingly. Annual training report shall include attendance and details of the training provided and shall be included in the annual O&M report.

2.7 Warning Systems and Alarms

Audible and visual (e.g., flashing lights) alarm systems should be established that reflect specific on-site hazard analyses. Personnel should be trained on the significance of different alarms and the corresponding actions as outlined elsewhere in this Plan. Descriptions of each alarm and corresponding actions should be clearly posted on an emergency information notice board (location marked on map in Appendix 1).

Warning systems and alarms should be tested at least yearly or manufacturer specifications or code requirements. Tests shall be documented. All site personnel, as well as those offsite who are likely to hear or see an alarm, should be made aware of tests so as not to cause undue concern. Local O&M Manager shall inform GPA PSCC at least two days prior to the testing date.

Fire alarm/suppression system is connected 24x7 and notifies, in real-time, GPA PSCC (Power System Control Center) and Control S/W of any alarms. Control S/W also notifies Local O&M Company (JMI Edison) and LG CNS HQ personnel of these alarms. GPA PSCC and/or Local O&M Company shall call 911 immediately when notified of a fire alarm. Main and first contact point to GFD (Guam Fire Department) is GPA PSCC.

In case there is a Loss of Communication (LOC) between GPA PSCC and the ESS site, GPA PSCC shall notify O&M Contractor of the situation and vice versa. Regardless of communication status, O&M Contractor shall always call 911 and contact GPA PSCC whenever any emergency (fire, hydrogen gas, etc.) alarms are received on-site or off-site. Any GPA personnel on-site shall also notify GPA PSCC whenever any emergency alarms are noticed. GPA PSCC shall then notify O&M Contractor and any personnel at the site of these alarms. Until communication is restored, O&M Contractor will monitor alarms and notify GPA PSCC of any emergency alarms received. However, if the LOC situation remains beyond 9:00 PM, the ESS shall be shut down as a safety precaution.

3. Emergency Response

3.1 Analyze, Plan, Implement, Evaluate

The phases of emergency response may be categorized under the 'APIE' scheme for handling an emergency: Analyze, Plan, Implement and Evaluate.

- Analyze: Analyzing the response is the phase in which the notification takes place to emergency responders.
- Plan: Planning the response is the phase in which the proper resources and equipment are called to the emergency scene and a plan is developed to mitigate the emergency.
- Implement: Once a plan is developed and the proper resources and equipment are there, then the Emergency Response Coordinator will make the determination to implement the plan.
- Evaluate: Once the plan is implemented, it shall be evaluated for safety and effectiveness. If the plan is not safe or effective, then the process should start over again with Analyze, Plan, Implement, and Evaluate.

Only personnel who are properly trained may respond to hazardous chemical releases. No employee is required or permitted to place himself or herself in harm's way in order to facilitate extinguishment, evacuation, or rescue. All rescue operations will be performed by trained professionals upon their arrival. Rescue operations will only be conducted after a risk-reward analysis is done and proper PPE is used to protect against any adverse hazards that may be encountered.

Incidents where local fire department personnel are involved will be managed under a system established by the fire department, called 'Incident Command System.' This establishes a primary incident commander and a liaison to or for the Emergency Response Coordinator.

3.1.1 Analyze

Without entering an immediate hazard area, the employee who first discovers an emergency should identify the following:

- Is there a fire, spill, explosion, or other incident happening?
- Does medical assistance appear to be needed?
- Who/what is at risk: people, the environment, or property?
- What are the weather and terrain conditions and risks?

The employee will also isolate the area to keep people away from the scene until trained responders arrive, as long as it is safe to do so. An employee who has not received training in emergency response should take no actions beyond notification, isolation of the area, and personal safety precautions. Any efforts made to rescue persons, protect property, or protect the environment must be weighed against the possibility of becoming part of the problem. Attempts to rescue others shall only be attempted with proper PPE, proper training, and in a manner that does not create significant risk to rescuer or others. Persons at the scene must not contact spilled material or inhale fumes, smoke, or vapors.

3.1.2 Plan

After all life hazards are no longer a threat, a plan of operation shall be devised for remediation of the event. The plan shall be communicated to all responders and safety of all responders shall be paramount. A staging area, if needed, shall be identified for extra personnel and equipment that may be needed to accomplish the plan's objectives. All responders that will enter the hot zone (affected area) must be made aware of any decontaminated area upon their exit of the hot zone. Trained responders will be called to the scene by the Local O&M Manager and/or Lead Technicians to begin the process of hazard assessment and to establish objectives and priorities. The hot zone shall be identified, and all non-essential personnel shall not be permitted to enter this area without proper training and permission of the Emergency Response Coordinator.

3.1.3 Implement

The initial response phase starts with notification, which activates the emergency response system. Anyone who observes or receives information regarding an emergency at TALOFOFO ESS site should immediately notify 911 first and then notify available personnel using the TALOFOFO ESS site radio network or their issued cell phones. The Emergency Response Coordinator and/or Lead Technician will also ensure 911 and the proper personnel are notified. At TALOFOFO ESS site, employees are notified of emergencies by cell phone/radio and word of mouth from the Emergency Response Coordinator and/or Lead Technicians. Appendix 4 provides a list of emergency notification information for TALOFOFO ESS site personnel.

If an event has the potential to impact the local community, TALOFOFO ESS site will contact local fire/police to make community notifications. The contact list in Appendix 4 also provides notification information for the GPA Public Affairs team who will provide guidance for instances involving media. The Emergency Response Coordinator and/or Lead Technicians will coordinate any media efforts through the TALOFOFO ESS site Owner GPA. The incident command post will be set up in a location free of contaminants and located upwind uphill and upstream. The Emergency Response Coordinator or designee shall remain at the incident command post to serve as a liaison to the Incident Commander designated by emergency responders. Trained responders may enter a 'hot zone' only when wearing appropriate protective equipment. Personnel entering the hot zone shall be briefed on the plan before entering. All communication devices shall be tested prior to entry into the hot zone. A decontamination corridor shall be established prior to entry into the hot zone. There shall be accountability taken of all personnel entering and leaving the hot zone. A back up team that has the same PPE shall be at the ready in the event of the entry team needs quick assistance. A decontamination team shall be ready to for after exiting the location (warm zone). There shall be a doffing station that is set up immediately at the end of the decontamination section that will allow the responders a safe place to remove their PPE. Only trained responders are authorized to risk exposure to chemicals for purposes of containing or stopping the material release.

The Emergency Response Coordinator or a designee will be responsible for notifying the appropriate regulatory agencies. Appendix 4 includes a list of emergency contacts and agencies that may be notified in the event of an emergency. The incident will be documented and kept on file.

3.1.4 Evaluate

During the implementation phase of the emergency, response, action and progress shall be analyzed by the Emergency Response Coordinator constantly. If the plan seems to be ineffective or unsafe the responders shall be removed from the hot zone and the plan shall be revised. The new plan shall be implemented, and that revised plan shall be analyzed for safety effectiveness again.

3.2 Evacuation Procedures

When notified to evacuate, site personnel shall do so in a calm and orderly fashion, keeping the following instructions in mind:

- Walk, don't run. Help others who need assistance as long as doing so does not put you at greater risk.
- Stay upwind, upstream, and uphill whenever possible.
- Watch for other traffic and equipment on access roads and roadways.
- Be aware of wet and loose gravel conditions.
- Drive safely.

Site personnel shall go to the primary designated muster area as identified in Appendix 2. If employees are unable to make it to the muster area, they should divert to the secondary muster area and immediately contact their supervisor for further instructions. During evacuation, the Emergency Response Coordinator and/or Lead Technicians should ensure that every person on his/her crew has been notified and that evacuation routes are clear. Any person with a disability (mobility, hearing, sight, etc.) who requires assistance to evacuate is responsible for pre-arranging with someone in their immediate work area to assist them in the event of an emergency. Anyone knowing of a person with a disability or injury who was not able to evacuate will report this fact immediately to their supervisor. This information shall be communicated to emergency responders immediately upon their arrival if the disabled person has not been evacuated.

Once an evacuation is complete, the Emergency Response Coordinator or Lead Technician should account for all personnel. This accountability information shall be communicated to the emergency responders immediately upon their arrival. When a person is unaccounted for, the following information shall be communicated to the emergency responders:

- Name of the individual
- Disabled or not disabled
- Work location
- Last known location

3.3 Post Emergency Reporting Procedures

Following any emergency described in this plan, and in compliance with facility permits and other local or federal requirements, an incident report will be prepared by the Emergency Response Coordinator and transmitted to the appropriate individuals and agencies after review by the Company Regional Manager.

The Emergency Response Coordinator shall compile all documentation and perform a post-emergency investigation. Immediate performance of this activity will aid in determining the exact circumstances and cause of the incident. Issues to be determined include:

- Causes of the incident.
- Effectiveness of the emergency response plan.
- Need for amendments to the response plan.
- Need for additional training programs.

The fire department will make the final determination regarding when the scene is safe to release the site to staff. In some circumstances the scene may need to be safeguarded for investigators to examine the event failures. If the facility is not able to reopen due to the event, the Local O&M Manager will make a determination regarding continuity of operations for the facility in consultation with the Company Regional Manager.

4. Fire Incidents

All personnel working at TALOFOFO ESS site are to be trained and should know how to prevent and respond to a fire emergency. All on-site personnel shall:

- Complete an on-site training program identifying the fire risks at TALOFOFO ESS site.
- Understand the protocol and follow emergency procedures should an event occur.
- Review and report potential fire hazards to the Emergency Response Coordinator.

No employee is required or permitted to place himself or herself in harm's way in order to facilitate extinguishment, evacuation, or rescue. All rescue operations will be performed by trained professionals upon their arrival.

4.1 Conditions Associated with Energy Storage Systems

4.1.1 Unique Challenges

Energy storage systems present a unique challenge for fire fighters. Unlike a typical electrical or gas utility, an energy storage system does not have a single point of disconnect. Whereas there are disconnects that will de-energize select parts of the system, batteries will remain energized.

The following hazards may be encountered when fighting fires in energy storage systems:

- Shock or arcing hazard due to the presence of water during suppression activities.
- Related electrical enclosures may not resist water intrusion from the high pressure stream of a fire hose.
- Batteries damaged in the fire may not resist water intrusion.
- Damaged conductors may not resist water intrusion.
- Shock hazard due to direct contact with energized components.
- No means of complete electrical disconnect.
- Chemical spills (In case that fire is melting down battery cells inside the module case)
- Toxic gases (In case that fire is melting down battery cells inside the module case)
- Thermal runaway and explosions (In case that BMS (Battery Management System) is not able to monitor and stop operation when battery temperature goes up.)

4.1.2 Fire and Water

Due to the hazards described above, care and consideration should be applied when considering fire suppression by means of water inundation within energy storage systems. But because water as an extinguishing agent is commonplace, the appropriate use of water should be assessed. The local fire department should be informed of appropriate fire suppression methods for the energy storage system type as identified by the equipment manufacturer. Manufacturer, LG Chem confirmed fire suppression by means of water inundation within battery container if automatic fire suppression system fails fire suppression. To suppress fire on outdoor equipment (PCS and Transformer) and the control container, local fire department may use water.

All fire extinguishing equipment, whether automatic or manual, shall be regularly inspected for functionality as per manufacturers' guidance.

4.2 Response to a Fire Incident

In the event of an incipient stage (beginning, small) fire, employees should notify adjacent individuals of this situation and exit the area. Only employees trained in the use of fire extinguishers or other manual fire suppression systems should attempt to use an extinguisher or system. Employees are not expected or authorized to respond to fires beyond the incipient stage. The fire department should be immediately notified by dialing 911 when any type of unintended fire has taken place. Site management shall also be immediately notified of any emergency.

GPA PSCC shall contact the personnel with any tags at the site if any fire alarms are received. Personnel at the site shall also call GPA PSCC if a fire alarm is noticed or if the lights inside any of the containers turn off unexpectedly. (The ESS control system will automatically turn off the auxiliary power inside all containers when a fire alarm is received as a safety precaution in case an external fire alarm is not audible from inside the container.) The personnel shall proceed according to the following procedures based on the type of alarm.

4.2.1 Fire External to Container or Enclosure

- Call 911 and report the following:
  - Site name: TALOFOFO ESS site
  - The address of the main entrance: Talofofo Substation, 4A, Talofofo, Guam
  - Fire Location: Inform fire location to GFD
  - Injuries, if any, and need for ambulance
- Contact GPA PSCC to notify any other personnel known to be at the site.
- Make sure the immediate area of the fire is clear of personnel.
- Account for all employees, contractors, and visitors who were working in the immediate area of the fire. If any personnel are unaccounted for from the immediate fire area, a communication shall be made through out the facility in attempt to locate the person(s) missing.
- Contact the Local O&M Manager (if present) and Emergency Response Coordinator (if not the Local O&M Manager) immediately.
- Contact GPA PSCC and inform them that X-394, X-126, X-410 and DSX-410-1 should be opened by GPA PSCC for safety. When GPA PSCC opens X-410, the AC and DC breakers of all the PCS will be opened automatically and then the ESS will be de-energized. **However, it shall be noted that some of the equipment in the battery containers will remain energized no matter what actions are taken.**
- GPA PSCC shall confirm ESS de-energization status by checking if the DC breakers of all the PCS are open via SCADA. If not, then GPA PSCC can send the Emergency Stop command for all the PCS via SCADA remotely.
- If the ESS is not de-energized remotely, the last option is for the operator or firefighter to press the Emergency Stop button on all the PCS at the site.
- Inform GFD that they may use water to suppress fire after the ESS site is de-energized.
- Remove any obstructions (vehicles, material, etc.) that might impede response to the scene.
- Station available personnel at road intersections to stop traffic flow into the fire scene.

- Evacuate the energy storage system area immediately if the fire warning alarm sounds or fire warning lights illuminate.
- Proceed to the designated muster point for head count.
  - If onsite, the designated Emergency Response Coordinator will do a head count and relay any information/instructions.
- If you encounter heavy smoke, stay low and breathe through a handkerchief or other fabric; move away from the area.
- Assist anyone having trouble leaving the area so long as doing so does not put the assistor at additional risk.
- Do not leave the designated muster point until advised to do so. If risk (e.g. smoke) requires evacuation of the muster point, the secondary muster point (designated on the map in Appendix 2) will be used.
- The Emergency Response Coordinator will issue an 'all clear' only when the fire department informs them that it is safe to do so.
- The energy storage system is not to be accessed until the Local O&M Manager or designated Emergency Response Coordinator gives authorization.
- Contact GPA Safety Division and inform them of the situation.
- Contact GPA Planning and Regulatory Division in case of incidents involving hazardous materials or environmental regulations.

4.2.2 Fire Internal to Control Container (Building #1)

- Call 911 and report the following:
  - Site name: TALOFOFO ESS site
  - The address of the main entrance: Talofofo Substation, 4A, Talofofo, Guam
  - Fire Location: Inform fire location to GFD that fire is in the Building #1. (Refer to Appendix 1. Building #1 is Control Container.)
  - Injuries, if any, and need for ambulance
- Contact GPA PSCC to notify any other personnel known to be at the site.
- Make sure the immediate area of the fire is clear of personnel.
- Account for all employees, contractors, and visitors who were working in the area of the fire. If any personnel are unaccounted for from the immediate fire area, a communication shall be made through out the facility in attempt to locate the person(s) missing.
- Contact the Local O&M Manager (if present) and Emergency Response Coordinator (if not the Local O&M Manager) immediately.
- Contact GPA PSCC and inform them that X-394, X-126, X-410 and DSX-410-1 should be opened by GPA PSCC for safety. When GPA PSCC opens X-410, the AC and DC breakers of all the PCS will be opened automatically and then the ESS will be de-energized. **However, it shall be noted that some of the equipment in the battery containers will remain energized no matter what actions are taken.**
- GPA PSCC shall confirm ESS de-energization status by checking if the DC breakers of all the PCS are open via SCADA. If not, then GPA PSCC can send the Emergency Stop command for all the PCS via SCADA remotely.
- If the ESS is not de-energized remotely, the last option is for the operator or firefighter to press the Emergency Stop button on all the PCS at the site.

- Evacuate the area immediately if the fire warning alarm sounds or fire warning lights illuminate.
- Remove any obstructions (vehicles, material, etc.) that might impede response to the scene.
- Proceed to the designated muster point for head count.
- If onsite, the designated Emergency Response Coordinator will do a head count and relay any information/instructions.
- If you encounter heavy smoke, stay low and breathe through a handkerchief or other fabric.
- If there is a second means of egress that is clear of smoke, that egress path will be used and a mobile phone or other type of communication shall be made stating that the clear egress point for other personnel to use for escape is the second means of egress.
- Assist anyone having trouble leaving the area so long as doing so does not put the assistor at additional risk.
- The fire suppression system is designed to work in a contained environment. **DO NOT** open the doors until it has been determined that the agent has been fully released and a pre-determined amount of time (1 hour) has passed to ensure no hazards are present, and with approval of emergency personnel and Subject Matter Expert.
- **DO NOT** put anyone in harm's way to save the equipment in the container.
- Once the Fire Department arrives, provide them with the following:
  - Assistance isolating equipment electrically
  - This emergency response plan
  - Inform GFD that they may use water to suppress fire after the ESS site is de-energized. However, the doors of the Control Container should remain closed for at least 1 hour.
  - Information on the location of the 34.5 kV equipment inside the Control Container
  - A liaison to remain with the fire department Incident Commander as needed
  - Notify GFD that there are lead-acid batteries for the UPS and Rectifier and the Fire Department needs to understand that batteries will remain energized no matter what actions are taken, and the recommended option is containment. Batteries remain energized even if all the contactors, breakers, and switches have been opened.
- Do not leave the designated muster point until advised to do so. If risk (e.g. smoke) requires evacuation of the muster point, the secondary muster point (designated on the map in Appendix 2) will be used.
- The Local O&M manager and/or Emergency Response Coordinator (if not the Local O&M manager) will issue an 'all clear' only when the fire department informs them that it is safe to do so and the site (or portions of it) can be reoccupied or normal working conditions can be resumed again.
- The energy storage system is not to be accessed until the Local O&M Manager or designated Emergency Response Coordinator and the emergency responders give authorization.
- Contact GPA Safety Division and inform them of the situation.
- Contact GPA Planning and Regulatory Division in case of incidents involving hazardous materials or environmental regulations.

In the event of a fire incident, the GPA PSCC is responsible for the safe shutdown of the plant (i.e. verify switchgear (X-410) is open and Disconnect Switch (DSX-410-1) is open) to ensure the grid side of the plant is de-energized and O&M personnel is responsible for the isolation of the batteries as best able to (i.e. verify the AC and DC breakers are open in the PCS). When 1st stage of fire alarm is activated, the PMS will send Emergency Stop commands automatically in order to stop all PCS, all BSC and following relays:
- AGANA: X-401, X-402, X-403, X-404, X-405, X-406, T-408
- TALOFOFO: X-411, X-412, X-413, X-414, T-85

4.2.3 Fire Internal to Battery Containers (Building #2, Building #3, Building #4, Building #5)

- Call 911 and report the following:
  - Site name: TALOFOFO ESS site
  - The address of the main entrance: Talofofo Substation, 4A, Talofofo, Guam
  - Fire Location: Inform fire location to GFD, for example, Fire in the Building #2. (Refer to Appendix 1. Building #2 is Battery Container #1. Building #3 is Battery Container #2. Building #4 is Battery Container #3. Building #5 is Battery Container #4.)
  - Injuries, if any, and need for ambulance
- Contact GPA PSCC to notify any other personnel known to be at the site.
- Make sure the immediate area of the fire is clear of personnel.
- Account for all employees, contractors, and visitors who were working in the area of the fire. If any personnel are unaccounted for from the immediate fire area, a communication shall be made through out the facility in attempt to locate the person(s) missing.
- Contact the Local O&M Manager (if present) and Emergency Response Coordinator (if not the Local O&M Manager) immediately.
- Contact GPA PSCC and inform them that X-394, X-126, X-410 and DSX-410-1 should be opened by GPA PSCC for safety. When GPA PSCC opens X-410, the AC and DC breakers of all the PCS will be opened automatically and then the ESS will be de-energized. **However, it shall be noted that some of the equipment in the battery containers will remain energized no matter what actions are taken.**
- GPA PSCC shall confirm ESS de-energization status by checking if the DC breakers of all the PCS are open via SCADA. If not, then GPA PSCC can send the Emergency Stop command for all the PCS via SCADA remotely.
- If the ESS is not de-energized remotely, the last option is for the operator or firefighter to press the Emergency Stop button on all the PCS at the site.
- Evacuate the area immediately if the fire warning alarm sounds or fire warning lights illuminate.
- Remove any obstructions (vehicles, material, etc.) that might impede response to the scene.
- Proceed to the designated muster point for head count.
- If onsite, the designated Emergency Response Coordinator will do a head count and relay any information/instructions.
- If you encounter heavy smoke, stay low and breathe through a handkerchief or other fabric.

- If there is a second means of egress that is clear of smoke, that egress path will be used and a mobile phone or other type of communication shall be made stating that the clear egress point for other personnel to use for escape is the second means of egress.
- Assist anyone having trouble leaving the area so long as doing so does not put the assistor at additional risk.
- The fire suppression system is designed to work in a contained environment. **DO NOT** open the doors until it has been determined that the agent has been fully released and a pre-determined amount of time (24 hours) has passed to ensure no hazards are present, and with approval of emergency personnel and Subject Matter Expert.
- **DO NOT** put anyone in harm's way to save the battery equipment in the container.
- Once the Fire Department arrives, provide them with the following:
  - Assistance isolating equipment electrically
  - This emergency response plan
  - Inform GFD that they may use water to suppress fire after the ESS site is de-energized. However, the doors of the Battery Container should remain closed for at least 24 hours.
  - A liaison to remain with the fire department Incident Commander as needed
  - Notify following **"specific actions in the event of a thermal event"** on site to GFD. Appendix 6 is Manufacturer, LG Chem's guide for Fire Fighting Measures.
    1) The Fire Department needs to understand that some of the equipment (batteries) will remain energized no matter what actions are taken, and the **recommended option is containment**. Batteries remain energized even if all the contactors, breakers, and switches have been opened.
    2) The battery container should be kept **closed and monitored for 24 hours or longer** to see if there is a continued rise in temperature or whether there is visible smoke.
    3) If it is determined by the Incident Commander that there is not an immediate threat to lives, it could be possible to use an approach of monitoring the battery container from safe distance for 24 hours or more to further assess the situation.
    4) When the Incident Commander decides to have the battery container door opened, the door opening operation should be performed **remotely at a safe distance using non-conducting ropes, hooks, poles, or similar devices without anyone standing directly in front of the door**. The main intent is to minimize personnel exposure in front of the open door or to avoid a life-threatening situation due to heated gas or a flying object by potential explosion. After the battery container door is opened, the battery container should be monitored for 12 hours or longer to see if there is a rise in temperature or visible smoke.
- Do not leave the designated muster point until advised to do so. If risk (e.g. smoke) requires evacuation of the muster point, the secondary muster point (designated on the map in Appendix 2) will be used.
- The Local O&M manager and/or Emergency Response Coordinator (if not the Local O&M manager) will issue an 'all clear' only when the fire department informs them that it is safe to do so and the site (or portions of it) can be reoccupied or normal working conditions can be resumed again.

- The energy storage system is not to be accessed until the Local O&M Manager or designated Emergency Response Coordinator and the emergency responders give authorization.
- Contact GPA Safety Division and inform them of the situation.
- Contact GPA Planning and Regulatory Division in case of incidents involving hazardous materials or environmental regulations.

In the event of a fire incident, the GPA PSCC is responsible for the safe shutdown of the plant (i.e. verify switchgear (X-410) is open and Disconnect Switch (DSX-410-1) is Open)) to ensure the grid side of the plant is de-energized and O&M personnel is responsible for the isolation of the batteries as best able to (i.e. verify the AC and DC breakers are open in the PCS). When 1st stage of fire alarm is activated, the PMS will send Emergency Stop commands automatically in order to stop all PCS, all BSC and following relays:
- AGANA: X-401, X-402, X-403, X-404, X-405, X-406, T-408
- TALOFOFO: X-411, X-412, X-413, X-414, T-85

4.2.4 After a Fire

Hazards after a fire should be identified at the time of installation such that recommendations for personal protective equipment (PPE) are available for clean-up crews and hazardous materials (HAZMAT) teams. This may include respirators to protect personnel from toxic gas that continues to be generated from hot cells. Firewater retention and cleanup measures may be required by local regulations. Once first responders have turned the site back to Guam Power Authority, the Subject Matter Expert, in coordination with the Emergency Response Coordinator, shall direct on-site personnel on procedures for securing the site for safety and pending any investigation.

In addition to the gas generation risk, cells that remain hot also pose a delayed ignition risk, whereby heat in the cell may transfer to undamaged adjacent cells or remaining active material and reignite the fire. As such, fire-damaged equipment must remain monitored for a period identified in consultation with equipment manufacturer. (Contact manufacturer in Appendix 4)

Care should be taken to ensure that damaged batteries containing energy have been safely de-energized in accordance with disposal procedures, if possible, before handling and disposal. If unable to completely de-energize batteries involved in a fire, care should be taken with handling or dismantling battery systems involved in fires as they may still contain hazardous energy levels.

4.2.5 Post-Event Assessment Procedures

An incident report will be prepared by the Emergency Response Coordinator and transmitted to the appropriate individuals and agencies including GPA within 30 days (or later if extenuating circumstances) after review by the Company Regional Manager.

The Emergency Response Coordinator shall compile all documentation and perform a post-emergency investigation. Immediate performance of this activity will aid in determining the exact circumstances and cause of the incident. Issues to be determined include:

- Causes of the incident.

- Effectiveness of the emergency response plan.
- Need for amendments to the response plan.
- Need for additional training programs.

The fire department will make the final determination regarding when the scene is safe to release the site to staff. In some circumstances the scene may need to be safeguarded for investigators to examine the event failures. If the facility is not able to reopen due to the event, GPA will make a determination regarding continuity of operations for the facility in consultation with Contractor.

4.3 Site Maintenance and Housekeeping

- Fire extinguishers shall be inspected monthly as per NFPA 10.
- Fire extinguishers shall not be obstructed and should be in conspicuous locations with appropriate signage as per NFPA 10. (See Appendix 5 for a map that shows the locations of the fire extinguishers)
- Combustible material shall not be stored in mechanical rooms, electrical equipment rooms, or energy storage system enclosures.
- Outside dumpsters shall be kept at least five (5) feet away from combustible materials and the lids should be kept closed.
- Materials or equipment storage is not allowed in electrical equipment rooms, or near electrical panels.
- Electrical panel openings must be closed and secured.
- Power strips must be plugged directly into an outlet and not daisy-chained and should be for temporary use only.
- Extension cords and flexible cords should not be substituted for permanent ones.

5. Medical Emergency

5.1 Medical Emergency Response Procedures

If an employee is injured, or an accident has occurred on site and first aid is not enough treatment for the emergency, 911 must be called. The call to 911 can be made by phone by any available site personnel. The caller must state to the dispatch that they are at the "GPA, TALOFOFO ESS site." A second notification will be made to the Local O&M Manager to inform GPA PSCC, GPA Safety Division and others of the situation.

All employees shall designate a personal emergency contact, which shall be kept on file.

5.1.1 Serious Injury

The following procedures apply for serious medical injuries such as loss of consciousness, heart attack, bone fractures, neck trauma, or severe burns.

1. If life threatening, call 911.
2. Notify Local O&M Manager and/or Safety Managers.
3. Provide name, exact location, number of injured persons, and brief description of incident.
4. On-site personnel shall meet EMS responders at site entrance and direct them to location of incident.
5. Do not leave or move the injured unless directed to by Safety Managers or EMS responders.
6. Administer first aid if necessary.
7. The site manager shall inform the employee's personal emergency contact.
8. Document incident and keep on file.

5.1.2 Attending an Incident

When attending an incident, the following procedures apply:

1. Clear a path to the injured person for Local O&M Manager and/or Safety Managers and assign personnel to assist with signaling EMS responders to the location of the incident.
2. Identify location of Project Site entrance nearest to the incident and notify EMS responders.
3. Local O&M Manager and/or Safety Managers shall meet EMS responders at site entrance.
4. Direct and accompany EMS responders to location of incident.
5. Follow all directions of EMS responders.
6. Contact management personnel and/or subcontractors.
7. Document incident and keep on file.

5.1.3 Medical Facilities

The nearest medical facility to the project site is:
Guam Memorial Hospital
850 Gov. Carlos G Camacho Rd, Tamuning, 96913, Guam
+1 671-647-2555

5.2 Non-Emergency Safety Incident

5.2.1 Notification of Minor Incidents

In the event a safety incident occurs where emergency response is not required (first aid treatment, near miss, etc.) work is to be stopped immediately and reported to the Emergency Response Coordinator and/or Lead Technician. Risk will be reassessed, adequate controls implemented, and the situation made safe before resuming the task. The event will be documented and kept on file.

5.2.2 Heat Illness

When the temperature exceeds 95 degrees Fahrenheit (35 degrees Celsius), or is expected to be so during the course of a shift or work project, the O&M Manger will hold short staff meetings to review the weather report; reinforce heat illness prevention with all workers; and provide reminders to drink water frequently, to be on the lookout for signs and symptoms of heat illness, and inform them that shade can be made available upon request.

Employees shall have free access to potable drinking water provided and located as close as practicable to the areas where employees are working. Where drinking water is not plumbed or otherwise continuously supplied, it shall be provided in sufficient quantity at the beginning of the work shift to provide one quart per employee per hour for drinking for the entire shift. Employers may begin the shift with smaller quantities of water if they have effective procedures for replenishment during the shift as needed to allow employees to drink one quart or more per hour. The frequent drinking of water shall be encouraged.

6. Environmental Hazards

For the flash flood and seismic events, O&M personnel should request X-410 and DSX-410-1 open to GPA PSCC when he/she can foresee any damage to the ESS facility. GPA PSCC, Safety and Planning and Regulatory Divisions should also be notified shortly after any event if significant damage to the ESS facility has occurred

6.1 Flooding and Flash Flood

Flash flooding is a result of heavy localized rainfall such as that from slow moving, intense thunderstorms. Flash floods often result from small creeks and streams overflowing during heavy rainfall. These floods often become raging torrents of water which rip through riverbeds or canyons, sweeping everything with them. Flash flooding can occur within 30-minutes to six hours of a heavy rain event. In hilly terrain, flash floods can strike with little or no advance warning. Distant rain may be channeled into gullies and ravines causing flash flooding in minutes. In the event of a flash flood, the following procedures shall apply:

- Contact the Local O&M Manager (if present) and Emergency Response Coordinator (if not the Local O&M Manager) immediately. GPA PSCC must also be contacted and it will be determined if X-410 and DSX-410-1 should be opened.
- During periods of thunderstorms, always remain alert to heavy rains in your immediate area or upstream from your location. It does not have to be raining at your location for flash flooding to occur.
- Do not drive through flooded areas. Even if it looks shallow enough to cross.
- Do not cross flowing streams on foot where water is above your ankles.
- Be especially cautious at night. It is harder to recognize water danger then.
- Do not attempt to outrace a flood on foot. If you see or hear it coming, move to higher ground immediately.
- Be familiar with the land features where you work. It may be in a low area, near a drainage ditch, or small stream.
- Stay tuned to weather forecasts and updates for the latest statements, watches, and warnings concerning heavy rain and flash flooding in the Project Area.
- Waiting 15 to 30 minutes, or until high water recedes, is a simple safety measure.
- The post-event assessment procedures are as follows:
  - Check if there is any alarm/fault on the PXiSE software
  - Perform visual inspection of ESS equipment
  - Check if there is any damaged area or equipment due to flooding
  - A post-event assessment shall be included in the Daily O&M report and provided to GPA within 2 working days (or later if extenuating circumstances).

6.2 Tropical Storm

In the event a tropical storm is within 48 hours (COR3), the following procedures shall apply.

- Notify Local O&M Manager and/or Safety Manager, and all on-site employees.
- Stop work safely and head to staging and laydown yards in vehicles.
- If the weather permits, remove or secure loose debris, materials or equipment that may fly during the storm and damage adjacent containers and equipment.

- Remain at staging and laydown yards, get update on weather conditions.
- If storm/lighting is still approaching the Project Site, get in and stay in company or personal vehicles that have rubber tires only.
- If safe enough to do so, take cover in on-site designated shelters.
- Once storm passes, remain in a safe location depending on passing storm severity, and wait for an "OK" from the Local O&M Manager or Emergency Response Coordinator in charge of monitoring the storm.
- The post-event assessment procedures are as follows:
  - Check if there is any alarm/fault on the PXiSE software
  - Perform visual inspection of ESS equipment
  - Check if there is any damaged area or equipment due to tropical storm
  - A post-event assessment shall be included in the Daily O&M report and provided to GPA within 2 working days (or later if extenuating circumstances).

6.3 Seismic Event

Earthquakes may strike with little to no advance warning. As such, when an earthquake does occur, it is important to stay as safe as possible. Be aware that some earthquakes are actually fore-shocks and a larger earthquake may subsequently occur. Also, be aware that many earthquakes are accompanied by aftershocks after the main event has occurred. If an earthquake occurs minimize your movements to a few steps to a nearby safe place and if you are indoors stay there until the shaking has stopped and you are sure exiting is safe.

The following actions should be followed for personnel indoors:

- Drop to the ground and take cover by getting under a sturdy piece of furniture and hold on until the shaking stops. If there isn't a desk or sturdy piece of furniture near you, cover your face and head with your arms and crouch in an inside corner of the building.
- Stay away from glass, windows, outside doors and walls, and anything that could fall such as lighting fixtures or furniture.
- Use a doorway for shelter only if it is in close proximity to you and if you know it is a strongly supported load-bearing doorway.
- Stay inside until the shaking stops and it is safe to go outside.

The following actions should be followed for personnel outdoors:

- If you are already outdoors stay there.
- Move away from buildings, structures, light poles, and utility wires.

Once in the open stay there until the shaking stops to prevent being hit by falling debris. Following seismic events, the site facility will be evaluated by O&M personnel for damage. GPA PSCC should also be notified shortly after the earthquake if significant damage to the ESS facility has occurred.

- The post-event assessment procedures are as follows:
  - Check if there is any alarm/fault on the PXiSE software
  - Perform visual inspection of ESS equipment
  - For earthquakes with magnitude greater than 5.3, perform visual inspection of torque eye-marks for one battery rack in each bank. If there are any torque eye-marks off, then power-off all the BSC and perform visual inspection of torque eye-marks for all battery modules for any loosening of bolts due to earthquake. For

earthquakes with magnitude greater than 6.0, perform torque eye-mark inspection for all battery modules.

- Check if there is any damaged area or equipment due to seismic event
- A post-event assessment shall be included in the Daily O&M report and provided to GPA within 2 working days (or later if extenuating circumstances).

7. Hydrogen Gas Hazards

The batteries for the UPS and the rectifier are installed in the control container. The hydrogen gas may leak from both batteries. The alarm occurs and notifies GPA PSCC via SCADA and O&M personnel via PXiSE software if a hydrogen leak is detected in either battery. The hydrogen gas leakage detection takes place in two stages: 1% and 2%.

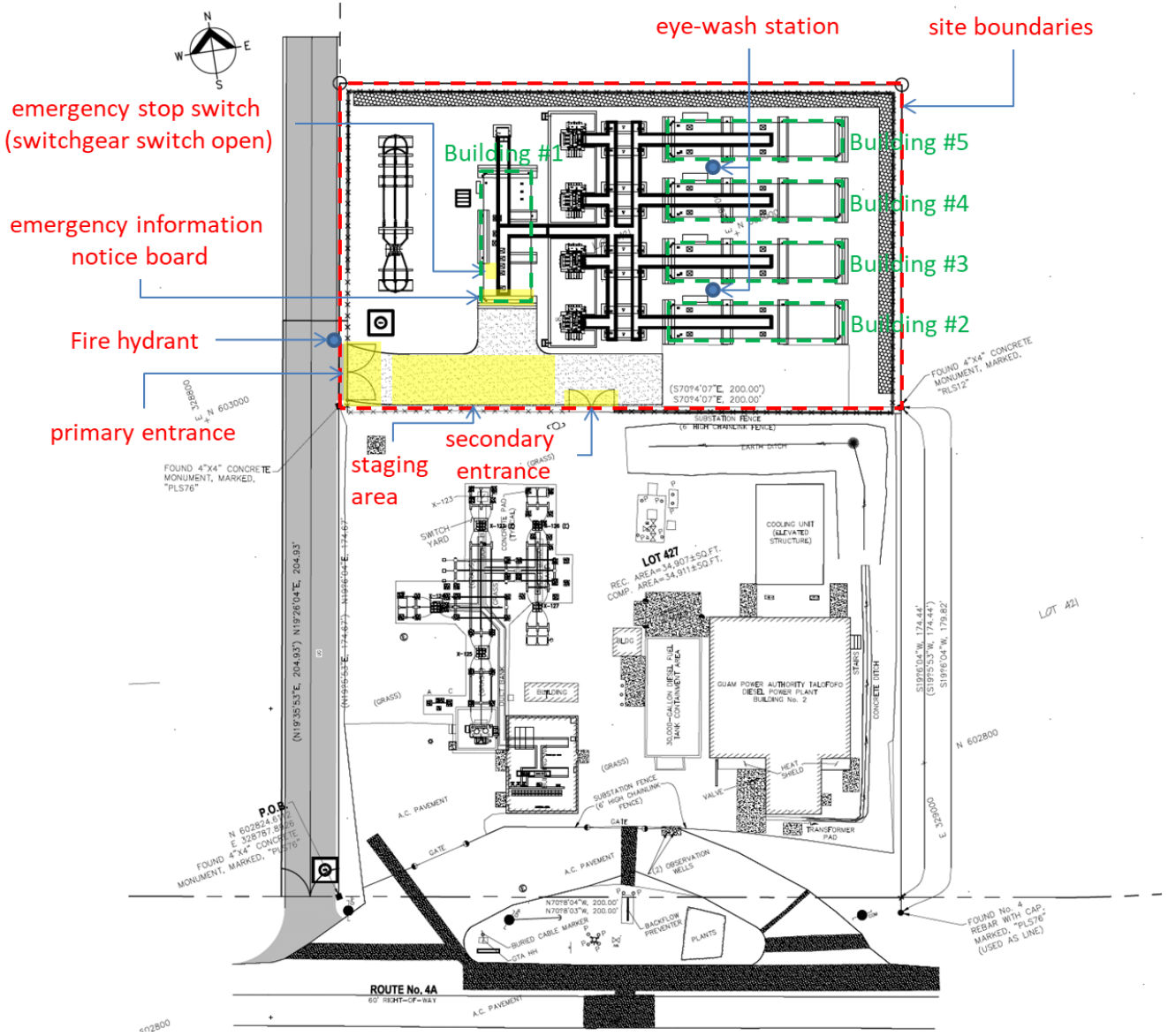
7.1 1% Hydrogen Gas Detection

When the 1% hydrogen gas leakage detection alarm occurs, the control system shows the WARNING alarm to GPA PSCC and O&M personnel and saves the log. GPA PSCC will call O&M personnel and inform them not to enter into the control container until the 1% alarm is cleared for safety. Also, the "1% Warning" yellow LED will light up on the main control of the unit and the fan will start to operate for ventilation. The fan will automatically stop when the alarm is cleared. GPA PSCC will notify 1% alarm clearance to O&M personnel. The O&M personnel on-site or off-site shall also contact GPA PSCC to notify them when an alarm has been received.

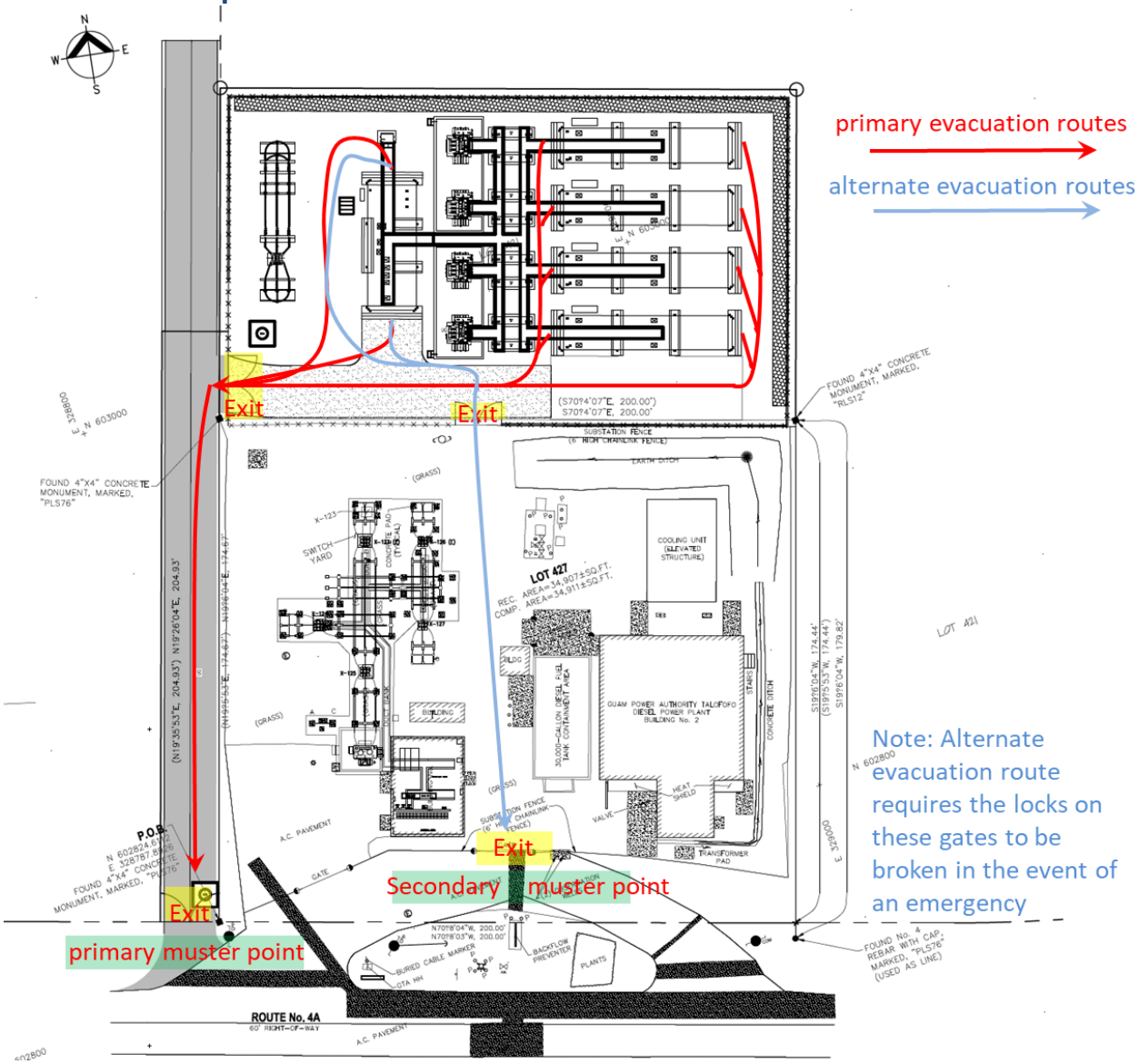
7.2 2% Hydrogen Gas Detection

When the 2% hydrogen gas leakage detection alarm occurs, the control system shows the FAULT alarm to GPA PSCC and O&M personnel and saves the log. GPA PSCC will call O&M personnel and inform them not to enter into the control container until the 1% and 2% alarms are cleared for safety. Should the hydrogen gas concentration reach 2% by volume, the "2% Alarm" red LED will light up, the strobe will flash and an audible alarm (85dB at 10') will sound. GPA PSCC will notify 1% and 2% alarm clearance to O&M personnel. The O&M personnel on-site or off-site shall also contact GPA PSCC to notify them when an alarm has been received.

Appendix 1: Map of Site



Appendix 2: Evacuation Map



Appendix 3: Referenced Titles and Roles

Note that some of these responsibilities may be combined within the duties of single individuals.

Company Regional Manager: A Company Regional Manager is an individual not directly responsible for the day to day operation of the site, nor for the immediate response during or immediately after an emergency, but who does bear responsibility for post-event assessment and broader planning, recovery, and learning from experience. The Regional Manager would typically bear the responsibility for ensuring incident records are maintained. Such a manager should also ensure a safety-based culture pervades across sites and ensure that Local O&M Managers are ensuring that training for safety is at the core of operations.

Emergency Response Coordinator: The Emergency Response Coordinator takes control of the emergency and any resources necessary until the emergency has been eliminated and the necessary cleanup and/or restoration are complete. This person shall lead the incident reporting. The emergency response coordinator is typically the Local O&M Manager; in her/his absence, the Lead Technician or other designated person shall assume this role. All personnel on site shall know who the Emergency Response Coordinator on duty is during their time on site. Remote operators shall likewise know who the Emergency Response Coordinator is for any given shift.

The Emergency Coordinator or a designee will be responsible for notifying the appropriate regulatory agencies and, if necessary, the Emergency Response Contractor or mutual aid groups. Appendix 4 includes a list of emergency contacts and agencies that may be notified in the event of an emergency. The incident will be documented and kept on file.

The Emergency Response Coordinator will direct the following activities during an emergency:

- Ensure the safety of all personnel.
- Evaluate if operations in the affected area should be shut down.
- Take precautions to prevent or limit the spread of fire or explosions.
- Isolate affected area and provide direction for radio announcements.
- Determine the source/cause of the emergency and evaluate the primary and secondary hazards to allow a full-scale, safe response.
- Ensure that appropriate internal and external notifications are made.
- Coordinate outside assistance from public or private organizations.
- Implement other appropriate response provisions as necessary.

Incident Commander: The on-scene ranking officer, representing the agency with incident jurisdiction. The Incident Commander authorizes incident objectives and strategies that collectively delineate a course of action. The Fire Department designates an Incident Commander as the primary incident manager; it should not be used by civilian organizations that are operating at an incident with emergency responders.

Local O&M Manager: The Operations and Maintenance Manager is the individual responsible for the normal operation and upkeep of the energy storage system on a day to day basis. This includes standard operating conditions and routine scheduled or responsive maintenance activities.

Lead Technician: A Lead Technician is an on- or off-site individual responsible for the operation of a site from a performance and technical perspective. Such responsibilities may lie with the O&M Manger or with a remote operator.

Subject Matter Expert (SME): An individual and designated secondary contact with detailed working knowledge of the energy storage system and incident command systems. The SME should have ready access to information on state of the system, status and meaning of alarms, etc. The SME's contact information must be available to the Emergency Response Coordinator and first responders, as well as others via information on the emergency information notice board.

Secondary SME: An individual who can take over the roles and responsibilities of SME in case of absence of SME. The Secondary SME should have ready access to information on state of the system, status and meaning of alarms, etc. The Secondary SME's contact information must be available to the Emergency Response Coordinator and first responders, as well as others via information on the emergency information notice board.

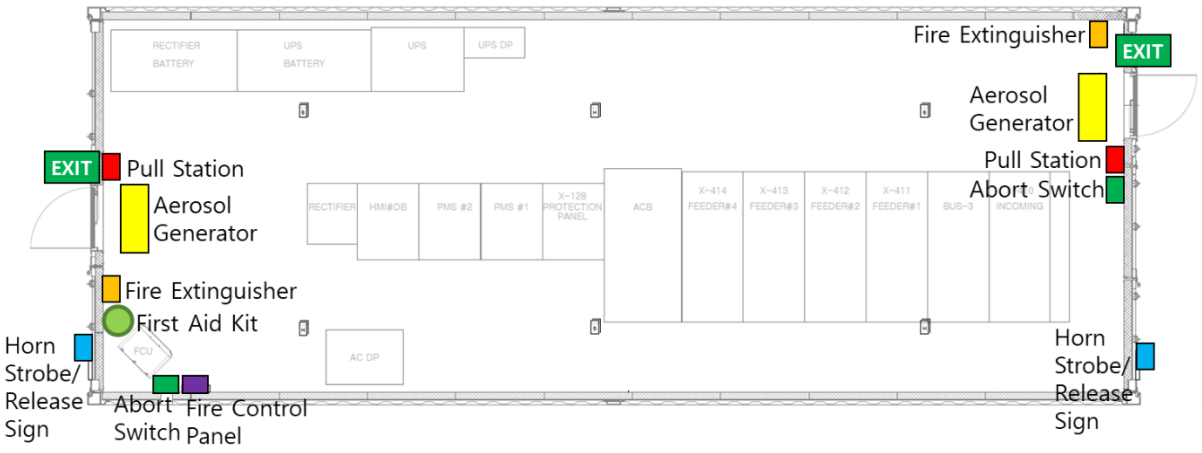
Safety Manager: Safety Manager or SSHO (Site Safety and Health Officer) is the individual responsible for the site safety during the O&M works on site. This includes standard operating conditions and routine scheduled or responsive maintenance activities.

Appendix 4: Emergency Contacts

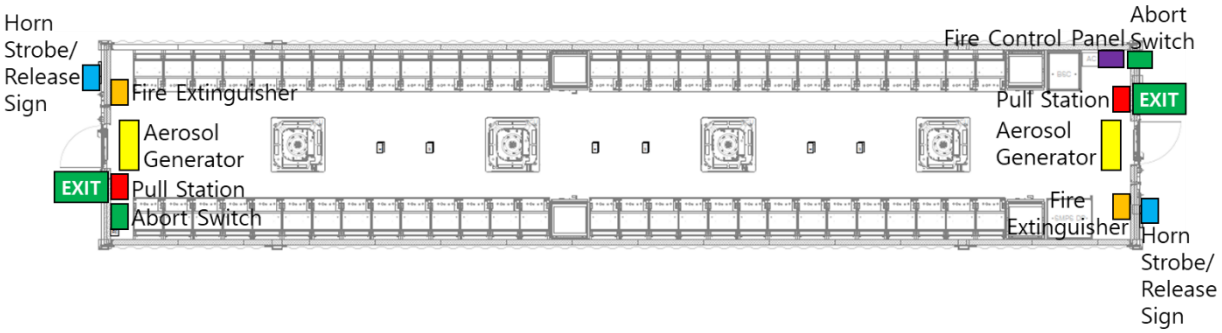
TITLE	COMPANY/INDIVIDUAL	CONTACTS
ESS Asset Owner	GPA Main Number GPA Safety GPA SPORD GPA PSCC	+1 671-648-3000 +1 671-648-3056 +1 671-648-3101 +1 671-475-1472; 1473; 1474
O&M Contractor	LG CNS	+82 2-3773-1114
Local O&M Contractor	JMI Edison	+1 671-649-5444
Company Regional Manager / Subject Matter Expert (SME)	LG CNS Tony (Hyunjoon) Tae	+ 1 671-686-7371
Lead Technician	LG CNS Won Kwan Choi	+82-10-8279-9123
Local O&M Manager / Emergency Coordinator	JMI Edison Romeo Oriondo	+ 1 671 646 6400
Secondary SME	LG CNS Woonyoung Park	+82 10 2880 1297
Safety Manager / SSHO (Site Safety and Health Officer)	JMI Edison Nelson Rodriguez	+1 671-649-5444
Emergency Assistance	Fire/Police/Ambulance State Police Hospital: Guam Memorial Hospital	911 911 +1 671-647-2555
Major Equipment Assistance [Battery]	LG Chem	+82-2-3773-1114
Major Equipment Assistance [PCS]	Destin Power	+82-31-778-5900
Major Equipment Assistance [Switchgear]	Hyundai Electric	+82-52-202-7773
Major Equipment Assistance [Transformer]	Hyundai Electric	+82-52-202-8486
Major Equipment Assistance [Control S/W]	PXiSE	+1 619-272-7672
GPA Power Systems Control Center	GPA	+1 671-475-1472 /3 /4
GPA Safety Division	GPA	+1 671-648-3056
GPA Planning & Regulatory Division	GPA	+1 671-648-3029

Appendix 5: Safety Related Location Map

Building #1 (Control Container)



Building #2, #3, #4, #5 (Battery Containers)



Appendix 6: Fire-Fighting Measures Guided by Manufacturer, LG Chem

Responding to a Battery Enclosure without Venting: There can be cases where the battery enclosure is sealed and there is no visible venting of smoke or gases, but there is a rise in temperature indicating possible risk of fire. In these situations, there is the possibility of pressure buildup inside the container due to combustible gas, which can ignite and explode upon the in-rush of air. Alert trained first responders and the nearest fire department for appropriate guidance. If possible, the enclosure should be kept closed and monitored for 24 hours or longer to see if there is a continued rise in temperature or whether there is visible smoke.

Determining Possibility of Monitoring: If the ESS enclosure or building is not occupied by people and it is determined by the Incident Commander that there is not an immediate threat to lives, it could be possible to use an approach of monitoring the enclosure from safe distance for 24 hours or more to further assess the situation and to determine next steps.

Opening of Closed Battery Enclosure: When the Incident Commander decides to have an enclosure door opened, the door opening operation should be performed remotely at a safe distance using non-conducting ropes, hooks, poles, or similar devices without anyone standing directly in front of the door. The main intent is to minimize personnel exposure in front of the open door or to avoid a life-threatening situation due to heated gas or a flying object by potential explosion. After the enclosure door is opened, the enclosure should be monitored for 12 hours or longer to see if there is a rise in temperature or visible smoke.

Responding to a Venting Battery Enclosure: In cases where the battery enclosure is venting, the venting from lithium-ion batteries may cause fire or smoke. There is the possibility that the vented gases are flammable and may ignite at any time. In the event of a fire, keep the ESS enclosure or building closed and do not to open any windows or doors. Contact trained first responders and the nearest fire department.

Shutting Off Power: A trained first responder team or the local fire department should shut off power to the Battery Enclosure to prevent charging of the battery, if possible. However, shutting off power to the LG Chem ESS product does not de-energize the battery, and there is still the presence of a shock hazard. The LG Chem ESS product should then be monitored for evidence of continued smoke evolution. Application of high volumes of water from a safe distance to cool the battery pack may prevent further reaction and prevent a fire from developing.

Development of Fire: If a fire develops, the Incident Commander should determine whether an attempt will be made to suppress the fire (aggressive firefighting) or allow the battery to burn itself out, while protecting surrounding materials (defensive firefighting).
Virtually all fires involving lithium-ion batteries can be controlled with water. Based on currently available information, water has been found to be the most effective agent for controlling lithium-ion battery fires. Water can help suppress flames, cool cells and batteries, and limit thermal runaway propagation. If water is used, there is a possibility that the electrolysis of water (which is the splitting of water into hydrogen and oxygen) can contribute to the flammable gas mixture formed by venting cells and the burning of plastic and other combustibles. Abundant and significant amounts of water should be used to fight a lithium-ion battery fire.
Gaseous agents (carbon dioxide (CO_2), Novec 1230, or FM-200) or dry chemical suppressants may temporarily suppress flaming of lithium-ion battery packs, but they will not provide sufficient cooling of

lithium-ion batteries and will not suppress the propagation thermal runaway. Metal fire suppressants, such as copper powder or graphite powder are not appropriate agents for suppressing fires involving lithium-ion battery packs as they are unlikely to be effective.
A battery fire may continue for several hours and it may take 24 hours or longer for the battery pack to cool. A lithium-ion battery fire that has been extinguished can re-ignite due to the exothermic reaction of constituent materials from broken or damaged cells. To avoid this, remove sources of ignition and cool the burned mass by flooding with water.

Aggressive Firefighting: One possible approach for aggressive firefighting is to apply abundant amounts of water into the battery room. Applying water into the battery room may help provide cooling of the incident cell and could slow down the propagation. If a decision is made for trained first responders to apply water, it should be noted that plenty significant amount of water needs to be available and responders should maintain safe distances at all times.

Defensive Firefighting: One possible defensive reaction to a fire is to allow the fire to burn itself out (self-extinguish). Simultaneously, fire crews may spread water from a safe distance to reduce exposures to and diffusion of smoke. Please be aware that lithium-ion batteries can burn for several hours and there is the possibility of re-ignition events.

Firefighter Personal Protective Equipment: Firefighters should protect themselves at all times and wear turnout gear rated for fire protection, as well as a self-contained breathing apparatus (SCBA). There is a possibility that cells or batteries could develop flames or leak potentially hazardous organic vapors if exposed to excessive heat, fire or overvoltage conditions. These vapors may include, but are not limited to carbon monoxide, hydrogen gas, carbon dioxide, volatile organic compounds (VOCs), soot, and particulates containing oxides of nickel, aluminum, lithium, copper, and cobalt. There is also the possibility that vapors of phosphorus pentafluoride, POF3 and HF may form.

Fire Behavior Considerations: Some conditions and situations that can potentially occur during the course of the fire should be considered. This section examines these potential conditions, risks, and safety concerns. Lithium-ion battery fires can cause abnormalities such as Backdraft, Flashover, and Rollover.

Backdraft: Many battery enclosures are isolated fire-resistant structures, so when a fire proceeds, the combustion process typically involves slow smoke generation while lacking a supply of oxygen. In the event that large amounts of air (oxygen) are supplied while incompletely burned flammable gas and heat are concentrated, an explosive ignition can occur momentarily, resulting in backdraft.

Flashover: Flashover is the transition phase in the development of a contained fire in which surfaces exposed to thermal radiation from fire gases in excess of 600°C (1112°F), reach ignition temperature more or less simultaneously and fire spreads rapidly through the space. This is the most dangerous stage of fire development.

The following should be considered in a lithium-ion battery fire.
1) Flashover appears more frequently than backdraft.
2) During Backdraft and Flashover, windows can be broken, thereby enabling smoke and flames to hit the openings as shock waves are generated. This can result in parts of the enclosure collapsing.

3) If the combined gas generated by the fire occupies about 25% of the total space, an explosion can occur. If high-temperature vented gases are concentrated in a corner of the enclosure, an explosion can occur when the enclosure door is opened for search operations.
4) Explosive pressure generated within a limited space is a fatal hazard. Pressure levels higher than ambient pressure can destroy windows, collapse partitions, and even collapse brick walls.
This phenomenon generates when heat is transferred directly to the lithium-ion battery, which can be prevented by cooling the lithium-ion battery through continuous cooling with copious amounts of water and venting of smoke and gas.

Appendix 7: Safety Data Sheets

CGIS SF6 GAS

JH3 LITIUM-ION BATTERY CELL (TALOFOFO)

5MVA XFMR OIL

CGIS SF6 GAS

SAFETY DATA SHEET

SULFUR HEXAFLUORIDE

Compilation Date: 19.11.2010 Revision Date 27.08.2018

SECTION 1: Identification of the substance/mixture and of the company/undertaking

1.1 Product identifier

- Trade name SULFUR HEXAFLUORIDE

1.2 Relevant identified uses of the substance or mixture and uses advised against

Uses of the Substance/Mixture

- Electrical industry
- Metallurgy.

1.3 Details of the supplier of the safety data sheet

Company

SOLVAY KOREA Co., Ltd
IJIN-RO, ONSAN-EUP
45010, ULSAN CITY
KOREA
Tel: +82-52-2310000
Fax: +82-52-2310095

E-mail address

manager.sds@solvay.com

1.4 Emergency telephone number

+82 (0)234 798 401 [CareChem 24] (South Korea in country number)
MULTI LINGUAL EMERGENCY NUMBER (24/7)
Europe/Latin America/Africa:+44 1235 239 670 (UK)
Middle East/Africa speaking Arabic:+44 1235 239 671 (UK)
Asia Pacific:+65 3158 1074 (Singapore)
China : +86 512 8090 3042
North America : 800 424 9300

SECTION 2: Hazards identification

2.1 Classification of the substance or mixture

Standards for classification and labeling of chemical substances and material safety data sheet (Ministry of Employment and Labor Public Notice No. 2016-19)

Gases under pressure, Liquefied gas H280: Contains gas under pressure; may explode if heated.

2.2 Label elements

Standards for classification and labeling of chemical substances and material safety data sheet (Ministry of Employment and Labor Public Notice No. 2016-19)

Pictogram

Signal word
- Warning

Hazard statements
- H280 Contains gas under pressure; may explode if heated.

Precautionary statements

General
- None

Prevention
- Not applicable

Response
- Not applicable

Storage
- P410 + P403 Protect from sunlight. Store in a well-ventilated place.

Disposal
- Not applicable

2.3 Other hazards which do not result in classification

- Causes asphyxiation in high concentrations.
- Hazardous decomposition products formed under fire conditions.

SECTION 3: Composition/information on ingredients

3.1 Substance

- Chemical name Sulfur hexafluoride
- Formula SF_6

Information on Components and Impurities

Chemical name	CAS-No.	Identification number	Concentration [%]
Sulfur hexafluoride (SF6)	2551-62-4	KECI Number: KE-32568	>= 99 - <= 100

3.2 Mixture

- Not applicable, this product is a substance.

SECTION 4: First aid measures

4.1 Description of first aid measures

In case of inhalation

- Remove to fresh air.
- Oxygen or artificial respiration if needed.
- If symptoms persist, call a physician.

Exposure to decomposition products

- Remove to fresh air.
- Immediate medical attention is required.

In case of skin contact

- Allow to evaporate.
- Wash off with warm water.
- If symptoms persist, call a physician.

In case of eye contact

- Allow to evaporate.
- Rinse thoroughly with plenty of water, also under the eyelids.
- If eye irritation persists, consult a specialist.
- Keep eyelids open to allow evaporation of product.

In case of ingestion

- Not applicable

4.2 Most important symptoms and effects, both acute and delayed

In case of inhalation

Symptoms

- At high concentrations:
- narcosis
- Asphyxia

In case of skin contact

Effects

- Contact with liquid or refrigerated gas can cause cold burns and frostbite.
- Prolonged skin contact may defat the skin and produce dermatitis.

In case of eye contact

Symptoms

- Lachrymation

In case of ingestion

Effects

- gas
- Not applicable

4.3 Indication of any immediate medical attention and special treatment needed

Notes to physician

- When symptoms persist or in all cases of doubt seek medical advice.

SECTION 5: Firefighting measures

5.1 Extinguishing media

Suitable extinguishing media

- Use extinguishing measures that are appropriate to local circumstances and the surrounding environment.

Unsuitable extinguishing media

- None

5.2 Special hazards arising from the substance or mixture

- The product is not flammable.
- Hazardous decomposition products formed under fire conditions.

5.3 Advice for firefighters

Special protective equipment for firefighters

- Wear self-contained breathing apparatus and protective suit.
- Wear chemical resistant oversuit

- Fire fighters must wear fire resistant personnel protective equipment.
- Protect intervention team with a water spray as they approach the fire.
- Clean contaminated surface thoroughly.

SECTION 6: Accidental release measures

6.1 Personal precautions, protective equipment and emergency procedures

Advice for non-emergency personnel

- Prevent further leakage or spillage if safe to do so.
- Keep away from incompatible products

Advice for emergency responders

- Approach from upwind.
- Suppress (knock down) gases/vapours/mists with a water spray jet.
- Avoid spraying the leak source.
- Try to re-position leaking containers, to have the leak in the gaseous phase.
- Vapours are heavier than air and can cause suffocation by reducing oxygen available for breathing.
- Keep away from open flames, hot surfaces and sources of ignition.

6.2 Environmental precautions

- Discharge into the environment must be avoided.
- Inform the responsible authorities in case of gas leakage, or of entry into waterways, soil or drains.
- Should not be released into the environment.

6.3 Methods and materials for containment and cleaning up

- Allow to evaporate.
- Prevent product from entering sewage system.

6.4 Reference to other sections

- Refer to protective measures listed in sections 7 and 8.

SECTION 7: Handling and storage

7.1 Precautions for safe handling

- Keep away from incompatible products

- Used in closed system
- Use only equipment and materials which are compatible with the product.
- Prevent any product decomposition from contacting hot spots.
- Prevent product vapours decomposition from electric arc action (welding).

Hygiene measures

- Eye wash bottles or eye wash stations in compliance with applicable standards.
- When using do not eat, drink or smoke.
- Gloves, overalls and boots have to be double layered (protection against cold temperature).
- Handle in accordance with good industrial hygiene and safety practice.

7.2 Conditions for safe storage, including any incompatibilities

Technical measures/Storage conditions

- Keep only in the original container.
- Keep in properly labelled containers.
- Keep in a bunded area.
- Keep away from sources of ignition - No smoking.

- Keep in a well-ventilated place.
- Refer to protective measures listed in sections 7 and 8.

- Keep away from:
- Incompatible products

Packaging material

Suitable material

- Steel drum

Requirements for storage rooms and vessels

Recommended storage temperature: < 50 °C

7.3 Specific end use(s)

- Contact your supplier for additional information

SECTION 8: Exposure controls/personal protection

8.1 Control parameters

Components with national occupational exposure limits

Components	Value type	Value	Basis
Sulfur hexafluoride (SF6)	TWA	1,000 ppm	Occupational Exposure Limits Korea

Components with other occupational exposure limits

Components	Value type	Value	Basis
Sulfur hexafluoride (SF6)	TWA	1,000 ppm	USA. ACGIH Threshold Limit Values (TLV)

8.2 Exposure controls

Control measures

Engineering measures
- Ensure adequate ventilation.
- Apply technical measures to comply with the occupational exposure limits.

Individual protection measures

Respiratory protection
- Wear self-contained breathing apparatus in confined spaces, in cases where the oxygen level is depleted, or in case of significant emissions.
- Use only respiratory protection that conforms to international/ national standards.

Hand protection
- Take note of the information given by the producer concerning permeability and break through times, and of special workplace conditions (mechanical strain, duration of contact).
- Protective gloves

Suitable material

- PVC
- Neoprene
- Natural Rubber

Eye protection
- Chemical resistant goggles must be worn.

Skin and body protection
- Wear suitable protective clothing.

Hygiene measures
- Eye wash bottles or eye wash stations in compliance with applicable standards.
- When using do not eat, drink or smoke.
- Gloves, overalls and boots have to be double layered (protection against cold temperature).
- Handle in accordance with good industrial hygiene and safety practice.

Environmental exposure controls
- Dispose of rinse water in accordance with local and national regulations.

SECTION 9: Physical and chemical properties

9.1 Information on basic physical and chemical properties

Appearance	Form:	Liquefied gas
	Physical state:	gaseous
	Colour:	colourless
Odour	odourless	
Odour Threshold	No data available	
Molecular weight	146 g/mol	
pH	neutral	
Melting point/freezing point	Freezing point: -50.8 °C	

Initial boiling point and boiling range	Boiling point/boiling range: -63.8 °C Sublimation point
Flash point	No data available
Evaporation rate (Butylacetate = 1)	No data available
Flammability (solid, gas)	The product is not flammable.
Flammability/Explosive limit	Explosiveness: Not expected
Auto-ignition temperature	No data available
Vapour pressure	23,700 hPa (25 °C)
Vapour density	5.1
Density	
Relative density	5 Sulfur hexafluoride
Relative density	
Solubility	Water solubility: 0.031 g/l (25 °C) slightly soluble Solubility in other solvents: Alcohol : soluble Ether : soluble
Partition coefficient: n-octanol/water	log Pow: 1.68
Decomposition temperature	<= 200 °C Exposure to moisture
Decomposition temperature	<= 800 °C dry air, Specific conditions
Viscosity	No data available
Explosive properties	No data available
Oxidizing properties	Not considered as oxidizing

9.2 Other information

Henry's Constant	ca. 458000 Pa.m3/mol (25 °C) Method: Calculation method considerable volatility, Air
Surface tension	8.02 mN/m (20 °C)

SECTION 10: Stability and reactivity

10.1 Reactivity

- Decomposition can be accelerated under influence of moisture.
- Decomposition temperature will be decreased.

10.2 Chemical stability

- Stable under recommended storage conditions.
- Vapours are heavier than air and may spread along floors.

10.3 Possibility of hazardous reactions

- Vapours are heavier than air and may spread along floors.
- Hazardous polymerisation does not occur.

10.4 Conditions to avoid

- Heat
- In case of heating:
- Exposure to moisture
- Keep away from direct sunlight.

10.5 Incompatible materials

- Oxidizing agents

10.6 Hazardous decomposition products

Hazardous decomposition products

- Gaseous hydrogen fluoride (HF).
- Sulphur oxides
- Sulphur compounds
- Thionyl difluoride
- Disulfur decafluoride

SECTION 11: Toxicological information

11.1 Information on toxicological effects

Acute toxicity

Acute oral toxicity	Not applicable
Acute inhalation toxicity	The product has a low acute toxicity
Acute dermal toxicity	Not applicable
Acute toxicity (other routes of administration)	No data available

Skin corrosion/irritation

No skin irritation

Serious eye damage/eye irritation

No eye irritation

Respiratory or skin sensitisation

no observed effect

Mutagenicity

Genotoxicity in vitro

In vitro tests did not show mutagenic effects

Genotoxicity in vivo

In vivo tests did not show mutagenic effects

Carcinogenicity

No data available

Toxicity for reproduction and development

Toxicity to reproduction/Fertility

Reproduction/developmental toxicity screening test - Rat
male and female
Inhalation
Fertility NOAEC Parent: 50,000 ppm
Method: OECD Test Guideline 422

Developmental Toxicity/Teratogenicity

Rat, male and female, Inhalation
Teratogenicity NOAEC:50,000ppm
Method: OECD Test Guideline 422
Reproduction/developmental toxicity screening test

STOT

STOT - single exposure No data available

STOT - repeated exposure

The substance or mixture is not classified as specific target organ toxicant, repeated exposure according to GHS criteria.

Inhalation 28-day - Rat , male and female
NOAEC: 50000 ppm(m)
no observed effect

Inhalation 90-day - Rat , male and female
NOAEC: 20000 ppm(m)
Method: OECD Test Guideline 413
no observed effect

Experience with human exposure No data available

Aspiration toxicity No data available

SECTION 12: Ecological information

12.1 Toxicity

Aquatic Compartment

Acute toxicity to fish

LC50 - 96 Days : 236 mg/l - Fish
Method: Calculation method

Acute toxicity to daphnia and other aquatic invertebrates

LC50 - 48 h : 247 mg/l - Crustaceans
Method: Calculation method
Water

Toxicity to aquatic plants

EC50 - 96 h : 151 mg/l - Algae
Method: Calculation method
Water

Toxicity to microorganisms No data available

Chronic toxicity to fish No data available

Chronic toxicity to daphnia and other aquatic invertebrates No data available

12.2 Persistence and degradability

Abiotic degradation

Stability in water

t 1/2 (Hydrolysis):
Hydrolysis time: > 1,000 y
non-significant hydrolysis, Medium, Water, Soil

Photodegradation

Half-life indirect photolysis: > 1,000 y
Air
non-significant photolysis

Physical- and photo-chemical elimination No data available

Biodegradation

Biodegradability

The methods for determining biodegradability are not applicable to inorganic substances.

12.3 Bioaccumulative potential

Partition coefficient: n-octanol/water No data available

Bioconcentration factor (BCF)

Not potentially bioaccumulable

12.4 Mobility in soil

Adsorption potential (Koc)

Soil/sediments
non-significant adsorption

Water
Method: Calculation method
The product evaporates readily.

Known distribution to environmental compartments No data available

12.5 Results of PBT and vPvB assessment This substance is not considered to be persistent, bioaccumulating and toxic (PBT).
This substance is not considered to be very persistent and very bioaccumulating (vPvB).

12.6 Other adverse effects

Ozone-Depletion Potential

Regulatory basis: Global warming potential
Ozone-Depletion Potential: 23.900
Halocarbon global warming potential; HGWP; (R-11 = 1)

Global warming potential

Regulatory basis: The Fourth Assessment Report of the United Nations Intergovernmental Panel on Climate Change (IPCC)
20-year global warming potential: 17,500
100-year global warming potential: 23,500
Radiative efficiency: 0.57 Wm2ppb
Additional Information: Fully Fluorinated Species

SECTION 13: Disposal considerations

13.1 Waste treatment methods

Product Disposal

- In accordance with local and national regulations.
- Refer to manufacturer/supplier for information on recovery/recycling.

Advice on cleaning and disposal of packaging

- To avoid treatments, as far as possible, use dedicated containers.

SECTION 14: Transport information

KR_DG

14.1 UN number	UN 1080
14.2 Proper shipping name	SULPHUR HEXAFLUORIDE
14.3 Transport hazard class	2.2
Label(s):	2.2
14.4 Packing group	
Packing group	
EmS 1	F-C
EmS 2	S-V
14.5 Environmental hazards	NO
14.6 Special precautions for user	
For personal protection see section 8.	

ADR

14.1 UN number	UN 1080
14.2 Proper shipping name	SULPHUR HEXAFLUORIDE
14.3 Transport hazard class	2
Label(s):	2.2
14.4 Packing group	
Packing group	
Classification Code	2A
14.5 Environmental hazards	NO
14.6 Special precautions for user	
Tunnel restriction code	(C/E)
Hazard Identification Number:	20

For personal protection see section 8.

RID

14.1 UN number	UN 1080
14.2 Proper shipping name	SULPHUR HEXAFLUORIDE
14.3 Transport hazard class Subsidiary hazard class: Label(s):	2 (13) 2.2 ((13))
14.4 Packing group Packing group Classification Code	 2A
14.5 Environmental hazards	NO

14.6 Special precautions for user

For personal protection see section 8.

IMDG

14.1 UN number	UN 1080
14.2 Proper shipping name	SULPHUR HEXAFLUORIDE
14.3 Transport hazard class Label(s):	2.2 2.2
14.4 Packing group Packing group	
14.5 Environmental hazards **Marine pollutant**	NO
14.6 Special precautions for user EmS	 F-C , S-V

For personal protection see section 8.

14.7 Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code
No data available

IATA

14.1 UN number	UN 1080
14.2 Proper shipping name	SULPHUR HEXAFLUORIDE
14.3 Transport hazard class	2.2
Label(s):	2.2
14.4 Packing group	
14.5 Environmental hazards	NO
14.6 Special precautions for user	
Packing instruction (cargo aircraft)	200
Max net qty/pkg	150.00 kg
Packing instruction (passenger aircraft)	200
Max net qty/pkg	75.00 kg

For personal protection see section 8.

Note: The above regulatory prescriptions are those valid on the date of publication of this sheet. Given the possible evolution of transport regulations for hazardous materials, it would be advisable to check their validity with your sales office.

SECTION 15: Regulatory information

15.1 Safety, health and environmental regulations/legislation specific for the substance or mixture

Occupational Safety and Health Act

Harmful Substances Prohibited from Manufacturing
Not applicable

Harmful Substances Required Permission for Manufacture
Not applicable

Controlled Hazardous Substances
Not applicable

Controlled Substances Subject to Environment Monitoring
Not applicable

Controlled Substances Subject to Health Examination
Not applicable

Please refer to Chapter 8 and 13 for the OEL and disposal

AREC (K-REACH) and Chemicals Control Act

Toxic Substances
Not applicable

Restricted Substances
Not applicable

Prohibited Substances
Not applicable

Toxic Release Inventory

Chemical name	CAS-No.	Group	Threshold limits
Sulfur hexafluoride	2551-62-4	Group 2	>= 1 %

Substances Requiring Preparation for Accidents
Not applicable

Safety Control of Dangerous Substances Act

Safety Control of Dangerous Substances Act	Not Applicable to Dangerous Materials
Wastes Control Act	Industrial waste Follow article 13 of the act to dispose the product waste

Notification status

Inventory Information	Status
United States TSCA Inventory	- Listed on Inventory
Mexico INSQ (INSQ)	- Listed on Inventory
Canadian Domestic Substances List (DSL)	- Listed on Inventory
New Zealand. Inventory of Chemical Substances	- Listed on Inventory
Australia Inventory of Chemical Substances (AICS)	- Listed on Inventory
Japan. CSCL - Inventory of Existing and New Chemical Substances	- Listed on Inventory
Korea. Korean Existing Chemicals Inventory (KECI)	- Listed on Inventory
China. Inventory of Existing Chemical Substances in China (IECSC)	- Listed on Inventory
Philippines Inventory of Chemicals and Chemical Substances (PICCS)	- Listed on Inventory
EU. European Registration, Evaluation, Authorisation and Restriction of Chemical (REACH)	- When purchased from a European Solvay legal entity, this product is compliant with the registration provisions of the REACH Regulation (EC) No. 1907/2006 as all its components are either excluded, exempt, and/or registered. When purchased from a legal entity outside of Europe, please contact your local representative for additional information.

SECTION 16: Other information

Full text of H-Statements

- H280 Contains gas under pressure; may explode if heated.

Key or legend to abbreviations and acronyms used in the safety data sheet

- TWA Time Weighted Average

Further information

- Update

The information provided in this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. Such information is only given as a guidance to help the user handle, use, process, store, transport,

dispose and release the product in satisfactory safety conditions and is not to be considered as a warranty or quality specification. It should be used in conjunction with technical sheets but do not replace them. Thus, the information only relates to the designated specific product and may not be applicable if such product is used in combination with other materials or in any other manufacturing process, unless otherwise specifically indicated. It does not release the user from ensuring he is in conformity with all regulations linked to its activity.

JH3 LITHIUM-ION BATTERY CELL (TALOFOFO)

LG Chem	SAFETY DATA SHEET	Version: R0001.0002
		Date of issue: 2016-05-10
		Revision date: 2017-06-28
	LGCHEM JH3 Lithium-Ion Battery Cell	Change List: see Section 16

1. IDENTIFICATION

A. Product name

- LGCHEM JH3 Lithium-Ion Battery Cell

B. Recommended use and restriction on use

- General use : Rechargeable Lithium-Ion Battery Cell
- Restriction on use : Not available

C. Manufacturer / Supplier / Distributor information

○ **Manufacturer information**

- Company name : LG Chem Ltd.
- Address : LG Twin Tower, Youido-Dong, Youngdeungpo-Ku, Seoul, Korea
- Telephone number : +82-2-3773-6740
- E-mail address : lkblive@lgchem.com

○ **Supplier/Distributer information**

- Company name : LG Chem Ltd.
- Address : LG Twin Tower, Youido-Dong, Youngdeungpo-Ku, Seoul, Korea
- Telephone number : +82-2-3773-6740
- E-mail address : lkblive@lgchem.com

Legal Remark

U.S.A

- The Occupational Safety and Health Administration (OSHA) Hazard Communication Standard, 29 CFR Subpart 1910.1200 does not apply to various subcategories including anything defined by OSHA as an "article". The products are defined as "articles", and are exempted from the requirements for Material Safety Data Sheets.

EU

- The products are no “substances” or “mixtures” according to Regulation (EC) No 1907/2006 EC. Instead they have to be regarded as “articles”, no substances are intended to be released during handling. Therefore there is no obligation to supply a Safety Data Sheet according to Regulation (EC) 1907/2006, Article 31.

General remark

- This Safety Data Sheet is provided as a service to our customers. This information is based on our current knowledge and is intended to describe the product for the purposes of health, safety and environmental requirements only.
- It should not therefore be construed as guaranteeing any specific property of the product.

2. HAZARD IDENTIFICATION

A. GHS Classification

- No classification is presented since the product is legally an article rather than chemical substance or mixture according to The Occupational Safety and Health Administration (OSHA) Hazard Communication Standard, 29 CFR Subpart 1910.1200

B. GHS label elements

- Not applicable

C. Other hazards which do not result in classification :

- Not available

3. COMPOSITION/INFORMATION ON INGREDIENTS

Chemical Name	Trade names and Synonyms	CAS No.	Content(%)
Aluminium	Aluminium Foil	7429-90-5	2-10
Metal Oxide (proprietary)			20-50
1,1-Difluoroethene homopolymer	Polyvinylidene Fluoride (PVDF)	24937-79-9	<5
Copper	Copper Foil	7440-50-8	5-20
Carbon (proprietary)		7440-44-0	10-20
Electrolyte (proprietary)			10-20
Aluminum, Copper plate and inert materials		Not applicable	Remainder

Lithium-equivalent Content: 18.56g (233 Wh)

4. FIRST AID MEASURES

A. Eye contact

- Not a health hazard.

B. Skin contact

- Not a health hazard.

C. Inhalation contact

- Not a health hazard.

D. Ingestion contact

- Get medical attention immediately.

IF EXPOSURE TO INTERNAL MATERIALS WITHIN CELL DUE TO DAMAGED OUTER CASING, THE FOLLOWING ACTIONS ARE RECOMMENDED ;

- Obtain special instructions before use.
- Do not handle until all safety precautions have been read and understood.
- Keep away from heat/sparks/open flames/hot surfaces.
- Keep/Store away from clothing /combustible materials.
- Do not breathe dust/fume/gas/mist/vapours/spray.
- Do not get in eyes, on skin, or on clothing.
- Avoid release to the environment.
- Wear protective gloves/protective clothing/eye protection/face protection.
- Use personal protective equipment as required.

A. Eye contact

- Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.
- Get medical attention immediately.

B. Skin contact

- Wash with plenty of soap and water.
- Remove/Take off immediately all contaminated clothing. Rinse skin with water/shower.
- Take off contaminated clothing and wash it before reuse.
- Get medical attention immediately.
- If skin irritation or rash occurs, Get medical advice/attention.
- Wear gloves when washing the patient, and please avoid contact with contaminated clothing.

C. Inhalation contact

- Remove victim to fresh air and keep at rest in a position comfortable for breathing.
- Take specific treatment if needed.
- Get immediate medical advice/attention.
- If breathing is stopped or irregular, give artificial respiration and supply oxygen.

D. Ingestion contact

- Rinse mouth.
- Immediately call a POISON CENTER or doctor/physician.
- Get immediate medical advice/attention.
- About whether I should induce vomiting Take the advice of a doctor.

E. Delayed and immediate effects and also chronic effects from short and long term exposure

- Not available

F. Notes to physician

- Notify medical personnel of contaminated situations and have them take appropriate protective measures.

5. FIREFIGHTING MEASURES

A. Suitable (Unsuitable) extinguishing media

- Use extinguishing media suitable for the materials that are burning.

B. Specific hazards arising from the chemical

- Cell is not flammable but internal organic material will burn if the cell is incinerated. Combustion products include, but are not limited to hydrogen fluoride, carbon monoxide and carbon dioxide.

C. Special protective actions for firefighters

- Notify your local firestation and inform the location of the fire and characteristics hazard.
- Avoid inhalation of materials or combustion by-products.
- Use appropriate extinguishing measure suitable for surrounding fire.
- Wear appropriate protective equipment.
- Use fire fighting procedures suitable for surrounding area.
- If possible, remove cell(s) from fire fighting area. If heated above 150°C, cell(s) may combust/vent.
- Use NIOSH/MSHA approved full-face self-contained breathing apparatus (SCBA) with full protective gear.

6. ACCIDENTAL RELEASE MEASURES

A. Personal precautions, protective equipment and emergency procedures

- Protective equipment: Wear proper protective equipment
- Emergency procedures:

  On Land
  Place material into suitable containers and call local fire/police department.
  In Water
  If possible, remove from water and call local fire/police department.
- If required, notify relevant authorities according to all applicable regulations.

B. Environmental precautions

- Prevent runoff and contact with waterways, drains or sewers.
- Advise emergency services.

C. Methods and materials for containment and cleaning up

- Control personal contact by using protective equipment.
- Prevent, by any means available, containment from entering drains or water course.
- Dispose of waste in accordance with local regulation.

7. HANDLING AND STORAGE

A. Precautions for safe handling

- No special protective clothing required for handling individual cells.
- Do not expose battery or cell to extreme temperatures or fire.
- Do not disassemble, crush or puncture battery.
- Do not overcharge or over discharge the battery.
- Do not connect (short circuit) positive and negative terminals.
- Do not place the batteries on conductive metal.

B. Conditions for safe storage, including any incompatibilities

- Store in a cool, dry place.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

A. Exposure limits

- **ACGIH TLV**
  - Not available
- **OSHA PEL**
  - Not available

B. Engineering controls

- Keep away from heat and open flame.
- Store in cool and dry place.

C. Personal protective equipment

- **Respiratory protection**
  - Not required during normal operations.
  - SCBA required in the event of fire.
- **Eye protection**
  - Not required beyond safety practices of employer.
- **Hand protection**
  - Not required for handling of cells.
- **Skin protection**
  - Steel toed shoes recommended for large container handling.
- **Others**
  - Not available

9. PHYSICAL AND CHEMICAL PROPERTIES

A. Appearance	
- Appearance	Solid
- Color	Not available
B. Odor	Not available
C. Odor threshold	Not available
D. pH	Not available
E. Melting point/Freezing point	Not available
F. Initial Boiling Point/Boiling Ranges	Not available
G. Flash point	Not available
H. Evaporation rate	Not available
I. Flammability(solid, gas)	Not available
J. Upper/Lower Flammability or explosive limits	Not available
K. Vapour pressure	Not available
L. Solubility	Insoluble
M. Vapour density	Not available
N. Specific gravity(Relative density)	Not available
O. Partition coefficient of n-octanol/water	Not available
P. Autoignition temperature	Not available

Q. Decomposition temperature	Not available
R. Viscosity	Not available
S. Molecular weight	Not available

10. STABILITY AND REACTIVITY

A. Chemical Stability

- None during normal operating conditions.

B. Possibility of hazardous reactions

- None during normal operating conditions.

C. Conditions to avoid

- Avoid exposure to heat, open flame, and corrosives.
- Do not puncture, crush or incinerate.

D. Incompatible materials

- None during normal operating conditions.

E. Hazardous decomposition products

- None during normal operating conditions.
- If cells are damaged, hydrogen fluoride and carbon monoxide may be released.

11. TOXICOLOGICAL INFORMATION

A. Information on the likely routes of exposure

○ **(Respiratory tracts)**
- None during normal operating conditions.

○ **(Oral)**
- None during normal operating conditions.

○ **(Eye·Skin)**
- None during normal operating conditions.

B. Delayed and immediate effects and also chronic effects from short and long term exposure

○ **Acute toxicity**

*** Oral**
- This product does not elicit toxicological properties during routine handling and use.

*** Dermal**
- This product does not elicit toxicological properties during routine handling and use.

*** Inhalation**
- This product does not elicit toxicological properties during routine handling and use.

○ **Skin corrosion/irritation**
- No irritation.
- If the cells are opened through misuse or damage, discard immediately. Internal components of cell are irritants and sensitizers.

○ **Serious eye damage/irritation**
- Not available

○ **Respiratory sensitization**
- Not available

○ **Skin sensitization**
- No sensitization.
- If the cells are opened through misuse or damage, discard immediately. Internal components of cell are irritants and sensitizers.

○ **Carcinogenicity**
- Not available

○ **Germ cell mutagenicity**
- Not available

○ **Reproductive toxicity**
- This product does not elicit toxicological properties during routine handling and use.

○ **STOT-single exposure**
- Not available

○ **STOT-repeated exposure**
- Not available

○ **Aspiration hazard**
- Not available

12. ECOLOGICAL INFORMATION

A. Ecotoxicity

○ **Fish**
- Not available

○ **Crustaceans**
- Not available

○ **Algae**
- Not available

B. Persistence and degradability

○ **Persistence**
- Not available

○ **Degradability**
- Not available

C. Bioaccumulative potential

○ **Bioaccumulative potential**
- Some materials within the cell are bioaccumulative. Under normal conditions, these materials are contained and pose no risk to persons or the surrounding environment.

○ **Biodegration**
- Not available

D. Mobility in soil

- Not available

E. Other adverse effects

- Not available

13. DISPOSAL CONSIDERATIONS

A. Disposal methods

- Dispose of according to all federal, state, and local regulations.

Follow Directive 2006/66/EC.

California regulated debris

RCRA Waste Code : Non regulated

B. Special precautions for disposal

- Not available

14. TRANSPORT INFORMATION

A. UN No.

- 3480 / 3481

B. Proper shipping name

- Lithium Ion Batteries / Lithium Ion Batteries contained in equipment

C. Hazard Class

- Class 9
- Hazard label: Miscellaneous

D. Packing group

- II

E. Marine pollutant

- Not available

F. Special precautions for user related to transport or transportation measures

ICAO/IATA

- Packing Instruction: 965, 967
- Maximum Gross Weight per Package on Passenger and Cargo Aircraft: 5 kg
- Maximum Gross Weight per Package on Cargo Only Aircraft: 35 kg
- Special Provision: A45, A88, A99

IMO

-Packing Instruction: P903

- Special Provision: 188, 230, 310, 957
- EmS: F-A, S-I

US DOT

- This product is not subject to any other requirements of dangerous goods under 49
- CFR 173.185 (Lithium Batteries and Cells).

15. REGULATORY INFORMATION

A. National and/or international regulatory information

○ **Information of EU Classification**

- Information according to Regulation (EC) No 1272/2008 [CLP]
- Information according to Directive 67/548/EEC

○ **U.S. Federal regulations**

- Information according to ISHA
- Information according to TCCA and other chemical management regulations
- Dangerous Substances Safety Management Act
- Regulation of Disposal
- OSHA hazard communication standard (29 CFR 1910.1200)

__√__ Hazardous ___ Non-hazardous

16. OTHER INFORMATION

A. Reference

- This information is based on our present state of knowledge. It shall describe our products regarding safety requirements and shall not be construed as a guarantee or statement of condition and/or quality
- Information contained in this safety data sheet is based on LG Chem owned data and public sources deemed valid or acceptable. The absence of data elements indicates, that no data meeting these requirements is available

B. Issue date

- 2016-05-11

C. Revision number and Last date revised

- R1.1: Established / 2016-05-11
- R1.2: Change the product name (Li ion Polymer Battery → Li ion Battery Cell) / 2017-06-28

D. Other

- This SDS is prepared according to the Globally Harmonized System (GHS).

Apar Industries Limited **5 MVA XFMR OIL** **Safety Data Sheet**

Conforms to Regulation (EC) No. 1907/2006 (REACH), Annex II , as amended by Commission Regulation (EU) 2015/830.

1 – Identification of the substance/ mixture and of the company/ undertaking

1.1 Product Identifier

Product name	**Transformer oil POWEROIL®TO 1020 AUX**
Product description	Insulating oil
Product type	Liquid
MARPOL Annex- I	Oils

1.2 Identified uses

Distribution of substance	Industrial
Formulation & (re)packing of substances and mixtures	Industrial
Manufacture of substance	Industrial
Functional Fluids	Industrial

1.3 Details of the supplier of the safety data sheet

Supplier/ Manufacturer	Apar Industries Limited 18 T.T.C., M.I.D.C. Industrial Area , Thane Belapur Road , Rabale, Navi Mumbai – 400701. INDIA. +91 22 61110444 (Office hours 9.30am to 17.00pm) www.apar.com
e- mail address of person responsible for this SDS	hse@apar.com

1.4 Emergency telephone number +91 9833811132

2 – Hazards Identification

2.1 Classification of the substance or mixture

Product definition Mixture

Classification according to Regulation (EC) No. 1272/2008 [CLP/GHS]

Asp. Tox. 1, H304

The product is classified as hazardous according to Regulation (EC) 1272/2008 as amended.

See Section 16 for the full text of the H statements declared above.

2.2 Label elements

Hazard pictograms

Signal word	Danger
Hazard statements	H 304 : May be fatal if swallowed and enters airways. H412 - Harmful to aquatic life with long lasting effects.
Precautionary statements	
Prevention	P273 - Avoid release to the environment.
Response	P301 + P310 + P331 - IF SWALLOWED: Immediately call a POISON CENTER or physician. Do NOT induce vomiting.
Storage	P405 - Store locked up.
Disposal	P501 - Dispose of contents/container in accordance with all local, regional, national and international regulations.
Annex XVII - Restrictions on the manufacture, placing on the market and use of certain dangerous substances, mixtures and articles	Not applicable

2.3 Other hazards

Substance meets the criteria for PBT according to Regulation (EC) No. 1907/2006, Annex XIII	Not applicable
Substance meets the criteria for vPvB according to Regulation (EC) No. 1907/2006, Annex XIII	Not applicable

Conforms to Regulation (EC) No. 1907/2006 (REACH), Annex II , as amended by Commission Regulation (EU) 2015/830.

3 - Composition / Information on Ingredients

3.2 Mixtures Mixture

Product/ Ingredient name	Identifiers	%	Classification Regulation (EC) No. 1272/2008 [CLP]	Type
Distillate (petroleum), severely hydrotreated light Naphthenic Oil.	EC: 265-156-6 CAS: 64742-55-8	75 – 85	Asp. Tox. 1, H304	[1]
Distillate (petroleum), severely hydrotreated light Paraffinic Oil.	EC: 265-158-7 CAS: 64742-55-8	15 – 25	Asp. Tox. 1, H304	[1]
2,6 –Di-tert-Butyl-P-Cresol	CAS: 128-37-0 EC : 204-881-4	≤ 0.38	Aquatic Acute 1, H400 Aquatic Chronic 1, H410	[1]

Annex I Nota L applies to the base oil(s) in this product. Nota L - The classification as a carcinogen need not apply if it can be shown that the substance contains less than 3 % DMSO extract as measured by IP 346.
There are no additional ingredients present which, within the current knowledge of the supplier and in the concentrations applicable, are classified as hazardous to health or the environment, are PBTs or vPvBs or have been assigned a workplace exposure limit and hence require reporting in this section.
Type
[1] Substance classified with a health or environmental hazard
[2] Substance with a workplace exposure limit
[3] Substance meets the criteria for PBT according to Regulation (EC) No. 1907/2006, Annex XIII
[4] Substance meets the criteria for vPvB according to Regulation (EC) No. 1907/2006, Annex XIII
[5] Substance of equivalent concern

4 - First Aid Measures

4.1 Description of first aid measures

Eye contact	Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. If irritation, blurred vision or swelling occurs and persists, obtain medical advice from a specialist.
Inhalation	If breathing is difficult, remove victim to fresh air and keep at rest in a position comfortable for breathing. If casualty is unconscious and: If not breathing, if breathing is irregular or if respiratory arrest occurs, provide artificial respiration or oxygen by trained personnel. Get medical attention if adverse health effects persist or are severe. Maintain an open airway.
Skin contact	Wash with soap and water. Remove contaminated clothing and shoes. Handle with care and dispose of in a safe manner. Seek medical attention if skin irritation, swelling or redness develops and persists. Accidental high pressure injection through the skin requires immediate medical attention. Do not wait for symptoms to develop.
Ingestion	Always assume that aspiration has occurred. Do not induce vomiting. Can enter lungs and cause damage. If vomiting occurs, the head should be kept low so that vomit does not enter the lungs. Seek professional medical attention or send the casualty to a hospital. Do not wait for symptoms to develop. Never give anything by mouth to an unconscious person. If unconscious, place in recovery position and get medical attention immediately. Maintain an open airway. Loosen tight clothing such as a collar, tie, belt or waistband.
Protection of first-aiders	No action shall be taken involving any personal risk or without suitable training. It may be dangerous to the person providing aid to give mouth-to-mouth resuscitation. Before attempting to rescue casualties, isolate area from all potential sources of ignition including disconnecting electrical supply. Ensure adequate ventilation and check that a safe, breathable atmosphere is present before entry into confined spaces.

4.2 Most important symptoms and effects, both acute and delayed

Potential acute health effects

Eye contact	Eye contact may cause redness and transient pain.
Inhalation	Inhalation of oil mist or vapours at elevated temperatures may cause respiratory irritation.
Skin contact	No known significant effects or critical hazards.
Ingestion	May be fatal if swallowed and enters airways.

4.3 Indication of any immediate medical attention and special treatment needed

Notes to physician	Due to low viscosity there is a risk of aspiration if the product enters the lungs. Treat symptomatically.
Specific treatments	Always assume that aspiration has occurred.

Conforms to Regulation (EC) No. 1907/2006 (REACH), Annex II , as amended by Commission Regulation (EU) 2015/830.

5 - Fire Fighting Measures

5.1 Extinguishing media

Suitable extinguishing media	Dry chemicals. Foam. Carbon dioxide (CO_2). Water spray or foam.
Unsuitable extinguishing media	Do not use direct water jets on the burning product; they could cause splattering and spread the fire. Simultaneous use of foam and water on the same surface is to be avoided as water destroys the foam.

5.2 Special hazards arising from the substance or mixture

Hazards from the substance or mixture	In a fire or if heated, a pressure increase will occur and the container may burst. This substance will float and can be reignited on surface water.
Hazardous thermal decomposition products	Incomplete combustion is likely to give rise to a complex mixture of airborne solid and liquid particulates, gases, including carbon monoxide, H2S, SOx (sulfur oxides) or sulfuric acid and unidentified organic and inorganic compounds.

5.3 Advice for firefighters

Special precautions for firefighters	Promptly isolate the scene by removing all persons from the vicinity of the incident if there is a fire. No action shall be taken involving any personal risk or without suitable training.
Special protective equipment for fire-fighters	Fire-fighters should wear appropriate protective equipment and self-contained breathing apparatus (SCBA) with a full face-piece operated in positive pressure mode. Clothing for fire-fighters (including helmets, protective boots and gloves) conforming to European standard EN 469 will provide a basic level of protection for chemical incidents.

6 - Accidental release Measures

6.1 Personal precautions, protective equipment and emergency procedures

For non-emergency personnel	Avoid breathing vapour or mist. Keep non-involved personnel away from the area of spillage. Alert emergency personnel. Except in case of small spillages, the feasibility of any actions should always be assessed and advised, if possible, by a trained, competent person in charge of managing the emergency. Stop leak if safe to do so. Avoid direct contact with the product. Stay upwind/keep distance from source. In case of large spillages, alert occupants in downwind areas. Eliminate all ignition sources if safe to do so. Spillages of limited amounts of product, especially in the open air when vapours will be usually quickly dispersed ,are dynamic situations, which will presumably limit the exposure to dangerous concentrations. Note : recommended measures are based on the most likely spillage scenarios for this material; however, local conditions (wind, air temperature, wave/current direction and speed) may significantly influence the choice of appropriate actions. For this reason, local experts should be consulted when necessary. Local regulations may also prescribe or limit actions to be taken.
For emergency responders	Small spillages: normal antistatic working clothes are usually adequate. Large spillages: full body suit of chemically resistant and thermal resistant material should be used. Work gloves providing adequate chemical resistance, specifically to aromatic hydrocarbons. Note : gloves made of PVA are not water-resistant, and are not suitable for emergency use. Safety helmet, antistatic non-skid safety shoes or boots. Goggles and / or face shield, if splashes or contact with eyes is possible or anticipated. Respiratory protection : A half or full-face respirator with filter(s) for organic vapours (and when applicable for H2S) a Self Contained Breathing Apparatus (SCBA) can be used according to the extent of spill and predictable amount of exposure. If the situation cannot be completely assessed, or if an oxygen deficiency is possible, only SCBA's should be used.
6.2 Environmental precautions	Prevent product from entering sewers, rivers or other bodies of water. If necessary dike the product with dry earth, sand or similar non-combustible materials. In case of soil contamination, remove contaminated soil and treat in accordance with local regulations. In case of small spillages in closed waters (i.e. ports), contain product with floating barriers or other equipment. Collect spilled product by absorbing with specific floating absorbents. If possible, large spillages in open waters should be contained with floating barriers or other mechanical means. If this is not possible, control the spreading of the spillage, and collect the product by skimming or other suitable mechanical means. The use of dispersants should be advised by an expert, and, if required, approved by local authorities.

Conforms to Regulation (EC) No. 1907/2006 (REACH), Annex II , as amended by Commission Regulation (EU) 2015/830.

6 - Accidental release Measures

6.3 Methods and material for containment and cleaning up

Small spill	Stop leak if without risk. Absorb spilled product with suitable non-combustible materials.
Large spill	Large spillages may be cautiously covered with foam, if available, to limit vapour cloud formation. Do not use water jet. When inside buildings or confined spaces, ensure adequate ventilation. Transfer collected product and other contaminated materials to suitable containers for recovery or safe disposal.
6.4 Reference to other sections	See Section 1 for emergency contact information. See Section 8 for information on appropriate personal protective equipment. See Section 13 for additional waste treatment information.

7 - Handling and Storage

7.1 Advice on general occupational hygiene Storage	Ensure that proper housekeeping measures are in place. Contaminated materials should not be allowed to accumulate in the workplaces and should never be kept inside the pockets. Eating, drinking and smoking should be prohibited in areas where this material is handled, stored and processed. Wash hands thoroughly after handling. Change contaminated clothes at the end of working shift. See also Section 8 for additional information on hygiene measures.
7.2 Conditions for safe storage, including any incompatibilities	Storage area layout, tank design, equipment and operating procedures must comply with the relevant regional, national or local legislation. Storage installations should be designed with adequate bunds in case of leaks or spills. Cleaning, inspection and maintenance of internal structure of storage tanks must be done only by properly equipped and qualified personnel as defined by national, local or company regulations.
7.2 Conditions for safe storage, including any incompatibilities	Store separately from oxidising agents. Recommended materials for containers, or container linings use mild steel, stainless steel. Not suitable : Some synthetic materials may be unsuitable for containers or container linings depending on the material specification and intended use. Compatibility should be checked with the manufacturer. Keep only in the original container or in a suitable container for this kind of product. Keep container tightly closed and sealed until ready for use. Do not store in unlabelled containers. Containers that have been opened must be carefully resealed and kept upright to prevent leakage. Empty containers may contain harmful, flammable/combustible or explosive residue or vapours. Do not cut, grind, drill, weld, reuse or dispose of containers unless adequate precautions are taken against these hazards. Store locked up. Protect from sunlight.
7.3 Specific end use(s)	
Recommendations	Not available
Industrial sector specific solutions	Not available

8 - Exposure Controls / Personal Protection

The list of Identified Uses in Section 1 should be consulted for any available use-specific information provided in the Exposure Scenario(s).

8.1 Control parameters

Occupational exposure limits

Product/ Ingredient name	Exposure limits values
Distillate (petroleum), hydrotreated light naphthenic	**AFS 2015:7 (Sweden, 12/2015).** TWA: 1 mg/m³ 8 hours. Form: mist and fume STEL: 3 mg/m³ 15 minutes. Form: mist and fume
Oil mist	***[Air contaminant]*** **AFS 2015:7 (Sweden, 12/2015).** TWA: 1 mg/m³ 8 hours. Form: mist and fume STEL: 3 mg/m³ 15 minutes. Form: mist and fume

Recommended monitoring procedures	If this product contains ingredients with exposure limits, personal, workplace atmosphere or biological monitoring may be required to determine the effectiveness of the ventilation or other control measures and/or the necessity to use respiratory protective equipment. Reference should be made to monitoring standards, such as the following: European Standard EN 689 (Workplace atmospheres - Guidance for the assessment of exposure by inhalation to chemical agents for comparison with limit values and measurement strategy) European Standard EN 14042 (Workplace atmospheres - Guide for the application and use of procedures for the assessment of exposure to chemical and biological agents) European Standard EN 482 (Workplace atmospheres - General requirements for the performance of procedures for the measurement of chemical agents) Reference to national guidance documents for methods for the determination of hazardous substances will also be required.

8.2 Exposure Controls	
Appropriate engineering controls	Mechanical ventilation and local exhaust will reduce exposure via the air. Use oil resistant material in construction of handling equipment. Store under recommended conditions and if heated, temperature control equipment should be used to avoid overheating.
Individual protection measures	
Hygiene measures	Wash hands, forearms and face thoroughly after handling chemical products, before eating, smoking and using the lavatory and at the end of the working period. Ensure that eyewash stations and safety showers are close to the workstation location. Wash contaminated clothing before reuse.
Eye/face protection	Recommended: Safety glasses with side shields.
Skin protection	
Hand protection	4 - 8 hours (breakthrough time): nitrile rubber
Body protection	Wear protective clothing if there is a risk of skin contact. Change contaminated clothes at the end of working shift.
Other skin protection	Appropriate footwear and any additional skin protection measures should be selected based on the task being performed and the risks involved and should be approved by a specialist before handling this product.
Respiratory protection	Respirator selection must be based on known or anticipated exposure levels, the hazards of the product and the safe working limits of the selected respirator. Use a properly fitted, particulate filter respirator complying with an approved standard if a risk assessment indicates this is necessary.
Environmental exposure controls	Emissions from ventilation or work process equipment should be checked to ensure they comply with the requirements of environmental protection legislation. In some cases, fume scrubbers, filters or engineering modifications to the process equipment will be necessary to reduce emissions to acceptable levels.

9 - Physical and Chemical Properties

Appearance	
Physical state	Liquid
Color	Colorless to Light yellow
Odor	Odorless
Odour threshold	Not available
pH	Not applicable
Melting point/Pour point	< -40 °C (ASTM D-97)
Flash point	> 140 °C Pensky-Mertens (ASTM D 93)
Evaporation rate	Not available
Flammability (solid, gas)	Not available
Flammability limits in air, lower, % by volume	Not available
Flammability limits in air, upper, % by volume	Not available
Vapour pressure	Not available
Density	0.910 max at 15°C
Solubility(ies)	
Solubility (water)	Insoluble in water
Partition coefficient (n-octanol/water)	Not available
Decomposition temperature	No Data
Auto-ignition temperature	> 250 °C
Viscosity, Kinematic at 40 °C (104 °F)	0.08 cm^2/s to 0.11 cm^2/s (8.00 to 11.00 cSt)
Explosive properties	No Data
Oxidising properties	No Data
DMSO extractable compounds for base oil substance(s) according to IP346	< 3%

10 - Stability and reactivity

10.1 Reactivity	No specific test data related to reactivity available for this product or its ingredients.
10.2 Chemical stability	Stable under normal conditions
10.3 Possibility of hazardous Reactions	Under normal conditions of storage and use, hazardous reactions will not occur.
10.4 Conditions to avoid	Oxidising agent.
10.5 Incompatible materials	Keep away from extreme heat and oxidizing agents.

10.6 Hazardous decomposition products	Incomplete combustion is likely to give rise to a complex mixture of airborne solid and liquid particulates, gases, including carbon monoxide, H2S, SOx (sulfur oxides) or sulfuric acid and unidentified organic and inorganic compounds.

11 - Toxicological Information

11.1 Information on toxicological effects

Acute toxicity

Product/ingredient name	Result	Species	Dose	Exposure
Distillate (petroleum),hydrotreated light naphthenic	LC50 Inhalation Dusts and mists	Rat	>5.53 mg/l	4 hours
	LD50 Dermal	Rabbit	>5000 mg/kg	-
	LD50 Oral	Rat	>5000 mg/kg	-
Distillate (petroleum),hydrotreated Light paraffinic	LC50 Inhalation Dusts and mists	Rat	>2.18 mg/l	4 hours
	LD50 Dermal	Rabbit	>5000 mg/kg	-
	LD50 Oral	Rat	>15000 mg/kg	-
2,6-di-tert-butyl-p-cresol	LD50 Dermal	Rat	>5000 mg/kg	-
	LD50 Oral	Rat	>5000 mg/kg	-

Irritation/Corrosion	
Skin	No known significant effects or critical hazards.
Eye	No known significant effects or critical hazards.
Respiratory	No known significant effects or critical hazards.
Sensitisation	
Skin	No known significant effects or critical hazards.
Respiratory	No known significant effects or critical hazards.
Mutagenicity	No data available to indicate product or any components present at greater than 0.1% are mutagenic or genotoxic.

11 - Toxicological Information

Carcinogenicity	The base oil(s) in this product is based on a severely hydrotreated distillate. The product should not be regarded as a carcinogen.
Reproductive toxicity	Contains no ingredient listed as toxic to reproduction.
Specific target organ toxicity - single exposure	Not classified
Specific target organ toxicity - repeated exposure	Not classified
Aspiration hazard	Aspiration hazard - Category 1
Information on likely routes of exposure	Not available.
Potential acute health effects	
Eye contact	Eye contact may cause redness and transient pain.
Inhalation	Inhalation of oil mist or vapours at elevated temperatures may cause respiratory irritation.
Skin contact	No known significant effects or critical hazards.
Ingestion	May be fatal if swallowed and enters airways.
Potential chronic health effects	
General	No known significant effects or critical hazards.
Carcinogenicity	The base oil(s) in this product is based on a severely hydrotreated distillate. The product should not be regarded as a carcinogen.
Mutagenicity	No known significant effects or critical hazards.
Teratogenicity	No known significant effects or critical hazards.
Product/ingredient name	No known significant effects or critical hazards.
Fertility effects	No known significant effects or critical hazards.
Other information	Not available.
Specific hazard	

Conforms to Regulation (EC) No. 1907/2006 (REACH), Annex II , as amended by Commission Regulation (EU) 2015/830.

12 - Ecological Information

12.1 Toxicity	Not expected to be harmful to aquatic organisms.
12.2 Persistence and degradability	Not inherently biodegradable.
12.3 Bioaccumulative potential	Bioaccumulation is unlikely to be significant because of the low water solubility of this product.
12.4 Mobility in soil	Not considered mobile.
12.5 Results of PBT & vPvB Assessment	Not applicable.
12.6 Other adverse effects	Insoluble in water. Spills may form a film on water surfaces causing physical damage to organisms. Oxygen transfer could also be impaired.

13 - Disposal Considerations

The information in this section contains generic advice and guidance. The list of Identified Uses in Section 1 should be consulted for any available use-specific information provided in the Exposure Scenario(s).

13.1 Waste treatment methods

Product

Methods of disposal	Where possible (e.g. in the absence of relevant contamination), recycling of used substance is feasible and recommended. This substance can be burned or incinerated, subject to national/local authorizations, relevant contamination limits, safety regulations and air quality legislation. Contaminated or waste substance (not directly recyclable): Disposal can be carried out directly, or by delivery to qualified waste handlers. National legislation may identify a specific organization, and/or prescribe composition limits and methods for recovery or disposal.
Hazardous waste	Yes

13 - Disposal Considerations

European waste catalogue (EWC)

Waste code	Waste designation
13 03 07*	mineral-based non-chlorinated insulating and heat transmission oils

Packaging

Methods of disposal	The generation of waste should be avoided or minimised wherever possible. Waste packaging should be recycled. Incineration or landfill should only be considered when recycling is not feasible.

14 - Transport Information

International transport regulations

	ADR/ RID	ADN	IMO/ IMDG Classification	ICAO/ IATA Classification
14.1 UN number	Not regulated.	Not regulated.	Not regulated.	Not regulated.
14.2 UN proper shipping name	-	-	-	-
14.3 Transport hazard class(es)	-	-	-	-
14.4 Packing group	-	-	-	-
14.5 Environmental hazards	No	No	No	No
Additional information	-	-	-	-

14.6 Special precautions for User	**Transport within user's premises:** always transport in closed containers that are upright and secure. Ensure that persons transporting the product know what to do in the event of an accident or spillage.
14.7 Transport in bulk according to Annex I of MARPOL 73/78 and the IBC Code	Oils

Conforms to Regulation (EC) No. 1907/2006 (REACH), Annex II , as amended by Commission Regulation (EU) 2015/830.

15 - Regulatory Information

15.1 Safety, health and environmental regulations/legislation specific for the substance or mixture

EU Regulation (EC) No. 1907/2006 (REACH)

Annex XIV - List of substances subject to authorization

Annex XIV	None of the components are listed.
Substances of very high concern	None of the components are listed.
Annex XVII - Restrictions on the manufacture, placing on the market and use of certain dangerous substances, mixtures and articles	Not applicable.
Other EU regulations	
Seveso Directive	This product is not controlled under the Seveso Directive.

International Lists	Inventory name	On inventory (yes/no)*
National Inventory		
Australia	Australian Inventory of Chemical Substances (AICS)	Yes
Canada	Domestic Substances List (DSL)	Yes
Canada	Non-Domestic Substances List (NDSL)	No
China	Inventory of Existing Chemical Substances in China (IECSC)	Yes
Europe	European Inventory of Existing Commercial Chemical Substances (EINECS)	Yes
Europe	European List of Notified Chemical Substances (ELINCS)	No
Japan	Inventory of Existing and New Chemical Substances (ENCS)	Yes
Korea	Existing Chemicals List (ECL)	Yes
New Zealand	New Zealand Inventory	Yes
Philippines	Philippine Inventory of Chemicals and Chemical Substances (PICCS)	Yes
United States & Puerto Rico	Toxic Substances Control Act (TSCA) Inventory	Yes

* A "Yes" indicates that all components of this product comply with the inventory requirements administered by the governing country(s)
A "No" indicates that one or more components of the product are not listed or exempt from listing on the inventory administered by the governing country(s).

15.2 Chemical Safety Assessment

16 - Other Information

Revision comments	Not available.
Legend to abbreviations	
ADR	European agreement concerning the international carriage of dangerous good by road.
RID	Regulations agreement concerning the international carriage of dangerous good by rail.
IMDG – CODE	International maritime dangerous goods code.
ICAO	International Civil Aviation Organization.
IATA	International air transport association.
GHS	Globally Harmonized System of Classification and Labeling of Chemicals.
CLP	Classification, Labelling and Packaging Regulation [Regulation (EC) No.1272/2008].
SCBA	Self-Contained Breathing Apparatus.
REACH	Registration, Evaluation, Authorisation and Restriction of Chemicals Regulation [Regulation (EC) No. 1907/2006].
LC50	Median lethal concentration.
LD50	Median lethal dose.
PBT	Persistent, Bioaccumulative and Toxic.

Procedure used to derive the classification according to Regulation (EC) No. 1272/2008 [CLP/GHS]

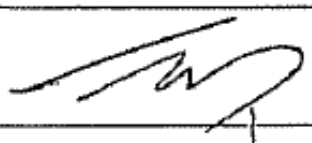
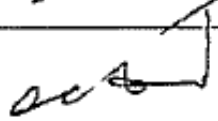
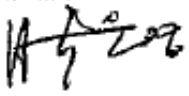
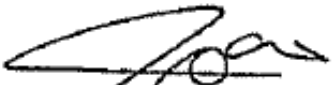
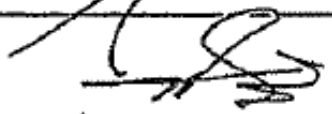
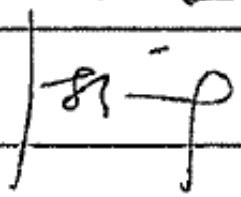
Classification	Justification
Asp. Tox. 1, H304	Calculation method

Full text of abbreviated H statements	H304 May be fatal if swallowed and enters airways.
Full text of classifications [CLP/GHS]	Asp. Tox. 1, H304 ASPIRATION HAZARD - Category 1.
Date of issue/Date of revision	January 2018.
Date of previous issue	December 2016.
Version	08

Disclaimer

The information provided in this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as a guidance for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process, unless specified in the text.

Appendix 8: Signatures of all assigned O&M personnel

TITLE	COMPANY/INDIVIDUAL	SIGNATURE
Company Regional Manager / Subject Matter Expert (SME)	LG CNS Tony (Hyunjoon) Tae	
Lead Technician	LG CNS Won Kwan Choi	
Local O&M Manager / Emergency Coordinator	JMI Edison Romeo Oriondo	
Secondary SME	LG CNS Woonyoung Park	
Safety Manager / SSHO (Site Safety and Health Officer)	JMI Edison Romeo Oriondo	
Technician	JMI Edison Mark Labiscase	
Technician	JMI Edison Noel Mirasol	
Technician	JMI Edison Marionito Buisel	

ATTACHMENT D
ESS ENVIRONMENTAL, HEALTH & SAFETY MANUAL

SOP-169
OPERATION AND MAINTENANCE RESPONSIBILITIES FOR THE AGANA AND TALOFOFO ENERGY STORAGE SYSTEMS

EFFECTIVE DATE: 2/18/21

GPA ESS Phase I

Environmental, Health and Safety Manual

Prepared by
LG CNS **Tony (Hyunjoon) Tae** 

Revision History

No	Amendments	Revised By	Date

Table of Contents

Referenced documents

1. ESS O&M Plan
2. ESS O&M Manual
3. Emergency Response Plan for Agana
4. Emergency Response Plan for Talofofo

Section 1. Corporate Safety Policy

The Occupational Safety and Health Act of 1970 clearly states our common goal of safe and healthful working conditions. The safety and health of our employees continues to be the first consideration in the operation of our business.

Safety and health in our business must be a part of every operation. Without question it is every employee's responsibility at all levels.

It is the intent of *Contractor (LG CNS America, Inc.)* to comply with all laws. To do this we must constantly be aware of conditions in all work areas that can produce injuries. No employee is required to work at a job he or she knows is not safe or healthful. Your cooperation in detecting hazards and, in turn, controlling them is a condition of your employment. Inform your supervisor immediately of any situation beyond your ability or authority to correct.

The personal safety and health of each employee of *Contractor* is of primary importance. The prevention of injuries and illnesses is of such consequence that it will be given precedence over operating productivity whenever necessary.

Our objective is a safety and health program that will reduce the number of injuries and illnesses to an absolute minimum. Our goal is always zero accidents and injuries.

Section 2. Company Policies and Procedures

1. Program Requirements.

Contractor will ensure that the hazards at our jobsites are evaluated and communicated to its employees. Safety is also the responsibility of every employee of this company. The Safety Officer (SSHO, Site Safety and Health Office) is the sole person authorized to amend these instructions.

2. Safety related documents

2.1. **ESS O&M Plan.** Follow safety procedures defined in the ESS O&M Plan (Refer to 9. Site Safety & Emergency Response Plan). Maintenance Work Procedures are defined in the Work Plan (Appendix B of the ESS O&M Plan) and employees are required to follow those procedures. Especially, "power-off" procedures should be followed for their safety.

2.2. **ESS O&M Manual.** Follow safety instruction and/or guide defined in the ESS O&M Manual (Refer to 2. Safety Instructions) and Manufacturer's O&M manuals.

2.3. **Emergency Response Plan.** Specific Hazards and response procedures at our jobsites such as Fire, Flooding, Tropical Storm and Seismic Event are defined in the Emergency Response Plan. Thus, all employees are required to have a training for the Emergency Response Plan.

3. Health and Safety Program Responsibility.

3.1. **Contractor Responsibilities.** The *Contractor* recognizes the importance of safety and has committed to creating a place of employment which is free from recognized hazards. The *Contractor* is ultimately responsible for the safety of all employees of *Contractor*. The *Contractor* will ensure that all levels of management in the company are delegated the necessary authority to cultivate a safe environment and to take the appropriate actions to correct any deviations or deficiencies relating to safety on the job.

3.2. **Safety Officer Responsibilities.** The company Safety Officer will be responsible for the day to day management of the company safety program. The Safety Officer will assist the company in remaining in compliance with all applicable health and safety regulations. The Safety Officer will identify and coordinate training sessions to ensure that all employees are equipped with the needed safety skills and knowledge.

3.3. **Project Manager (or Supervisor) Responsibilities.** Project Manager (or Supervisor) will be responsible for safety on their respective projects. Project Manager (or Supervisor) will be expected to involve the Safety Officer at the beginning of every project even before work has started. Project Manager (or Supervisor) will take recommendations from and work with the Safety Officer to ensure the safety of employees on the job. Project Manager (or Supervisor) will conduct periodic safety meetings for their employees. Project Manager (or Supervisor) will take the

appropriate actions to correct any deviations or deficiencies relating to safety on the job. Project Manager (or Supervisor) will be attentive to employee safety concerns and report them to the Safety Officer. Project Manager (or Supervisor) will keep in communication with the Safety Officer to ensure all employees receive training, refresher training, or retraining as needed.

3.4. **Employee Responsibilities.** Employees are the first lines of defense as it pertains to safety at all *Contractor* jobsites. Employees are expected to abide by all of the safety policies and procedures in the company safety program. They will be held responsible for their own safety and are expected to report unsafe conditions to their Project Manager (or Supervisor) immediately. If the Project Manager (or Supervisor) is unavailable, they will report safety violations or concerns to *Contractor* or Safety Officer. Employees, if feasible, are also expected to correct safety violations within their immediate areas. They will ensure they report to work in a state of readiness, with the appropriate clothing, and with all issued personal protective equipment. Employees will only operate equipment on which they have been trained and authorized to use. They will report accidents, injuries, and near misses immediately to their Supervisor.

4. Owner's Safety and Health Inspections.

Owner, GPA (Guam Power Authority) may have safety and health inspections of all job sites. The inspection will be conducted to discover conditions and work practices that may lead to job accidents and industrial illnesses, through specific, methodical auditing, checking, or inspection procedures.

Inspection elements: The following inspection elements will be checked during safety inspections.

- Floors: Condition, slip, trip, falls
- Aisles: Marking unobstructed
- Stairs: Condition, railings, unobstructed
- Exits: unobstructed
- Chemicals: SDS (Safety Data Sheet)
- Eye protection: Eye-wash Station
- Fire protection: Extinguishers, training, locations
- First Aid: Kits, training
- Work practices: Unsafe work practices observed?
- Evacuation diagram: Diagram shall identify designated Muster Location
- Fire Bill
- Posted emergency contact numbers for PSCC

5. Hazard Reporting.

All employees are required to report potential or known hazards immediately upon identification. If possible, the hazard should be eliminated immediately when found. Otherwise, the project manager or supervisor must be notified and all work where employees are exposed to the hazard must be discontinued until the hazard has been removed.

6. First Aid Procedures.

6.1. **Serious Injuries.** Project Manager (or Supervisor) will be responsible to ensure all employees report serious accidents or injuries immediately to the Safety Officer. Where employees require professional medical attention, Project Manager (or Supervisor) will accompany the employee to the hospital or clinic and observe the employees condition and status. Project Manager (or Supervisor) will report directly to the Safety Officer the condition of the employee and ensure that proper accident investigation procedures are followed.

6.2. **Minor injuries.** Minor injuries, such as cuts, scratches, bruises, and burns that do not require a doctor's treatment, may be handled by the employee at the jobsite. Recurring first aid injuries will be reported to the Safety Officer to ensure they do not become serious.

6.3. **First Aid Kits.** First aid kits will be maintained at each jobsite by Project Manager (or Supervisor). All employees will be made aware of the location and availability of the first aid kit. The type of first aid kit to be maintained will be for minor emergencies such as cuts and skin abrasions.

7. Accident Investigation.

Accident investigation is primarily a fact-finding procedure; the facts revealed are used to prevent recurrences of similar accidents. The focus of accident investigation will be to prevent future accidents and injuries to increase the safety and health of all our employees.

7.1. **Immediate concerns.**

7.1.1. Ensure any injured person receives proper care.

7.1.2. Ensure co-workers and personnel working with similar equipment or in similar jobs are aware of the situation. This is to ensure that procedural problems or defects in certain models of equipment do not exist.

7.1.3. Start the investigation promptly.

7.2. **Accident Investigation Form.** An investigation form which details specific company requirements for investigation will be used to gather data to determine causes and corrective actions. As a minimum, the form will contain the following areas of concern.

7.2.1. Accident investigation form data.

- Injured employee's name

- Date and time of injury
- Occupation or task being performed when injured
- Employee's address
- Sex/age/DOB
- Social security number
- Length of service
- Length of time at specific job
- Time shift started
- Overtime length when injury occurred
- Physician's and hospital name (if transported)
- Type of injury
- Resulting fatalities
- Description and analysis of accident
- Action taken to prevent recurrence and person
- Employee's statement
- Witnesses' statement
- Person completing form and date
- Person reviewing form and date

7.3. Project Manager (or Supervisor) is responsible for ensuring that employees follow safe work practices and receive appropriate training to enable them to do this. Supervisors will be responsible to fill out accident reporting/investigation requirement forms and to reinforce the *Contractor* safety program.

8. General Safety Rules for all Employees.

The following safety rules are established by this company as general safety rules for all Employees.

8.1. Never operate any machine or equipment unless you are authorized and trained to do so.

8.2. Do not operate defective equipment. Do not use broken hand tools. Report them to your supervisor immediately.

8.3. Never start on any hazardous job without being completely familiar with the safety techniques which apply to it. Check with your Project Manager (or Supervisor) if in doubt.

8.4. Make sure all safety attachments are in place and properly adjusted before operating any machine.

8.5. Do not operate any machine or equipment at unsafe speeds. Shut off equipment which is not in use.

8.6. Wear all protective garments and equipment necessary to be safe on the job. Wear proper shoes. Sandals or other open-toed or thin-soled shoes should not be worn.

8.7. Do not wear loose, flowing clothing or long hair while operating moving machinery.

8.8. Never repair or adjust any machine or equipment unless you are specifically authorized to do so by your foreman.

8.9. Never oil, clean, repair, or adjust any machine while it is in motion.

8.10. Never repair or adjust any electrically driven machine without opening and properly tagging the main switch.

8.11. Put tools and equipment away when they are not in use.

8.12. Do not lift items which are too bulky or too heavy to be handled by one person. Ask for assistance.

8.13. Keep all aisles, stairways, and exits clear of skids, boxes, air hoses, equipment, and spillage.

8.14. Do not place equipment and materials that would block emergency exit routes, fire boxes, sprinkler shutoffs, machine or electrical control panels, or fire extinguishers.

8.15. Stack all materials neatly and make sure piles are stable.

8.16. Keep your work area, machinery and all company facilities which you use clean and neat.

8.17. Do not participate in horseplay, or tease or otherwise distract fellow workers.

8.18. Power-truck operators must safeguard other workers at all times; workers must show courtesy to power-truck operators.

8.19. Floor mounted extension cords should be placed so that they are flush to the ground at all times.

8.20. Frayed or damaged electrical cords should be replaced.

8.21. Never take chances. If you're unsure, you're unsafe!

8.22. Ask for help, if needed.

8.23. Safety Briefings shall be provided to all workers before performing O&M works and shall include instructions for the minimum clearance allowed from the live switchyard according to NESC and OSHA guidelines.

9. Fire Prevention and Protection.

Fire and explosion pose a serious risk to our employees during operations involving open flames or high heat sources such as the use of propane or electric torches. Flames can be produced which could quickly become uncontrollable under certain situations.

9.1. **Basic safety precautions.** Heat, open flame, or any operations where sparks may be produced will be permitted only in areas that are or have been made fire safe. When work cannot be moved practically, as in most construction/maintenance work, the area will be made safe by removing combustibles or protecting combustibles from ignition sources.

9.2. **Fire extinguishers.** Suitable fire extinguishing equipment will be maintained in a state of readiness for instant use. Such equipment may consist of hose or portable extinguishers depending upon the nature and quantity of the combustible material exposed. Employees will not use portable fire extinguishers unless they have been trained.

9.3. **Housekeeping.** All employees will be familiar with the Housekeeping and will ensure that flammable or combustible materials do not accumulate in the work area.

9.4. **Authorization.** Employees performing heat or open flame operations must obtain authorization from their Project Manager (or Supervisor).

10. Evacuation Procedures. (FIRE BILL)

All employees upon receipt of an evacuation order will exit the work area via the Nearest Exit. They will proceed to the designated evacuation muster location in a timely order, as quickly as possible and remain at the muster location until further instruction is given.

10.1. **Egress Routes.** All employees will be familiar with the location of primary and secondary egress routes.

10.2. **Evacuation Muster Location.** All employees will be familiar with the designated evacuation muster location and must report to the designated senior employee. The designated senior employee will take accountability of assigned section employees and report to the Fire Department of any missing employee. NO ONE WILL LEAVE AN EVACUATION MUSTER LOCATION WITHOUT THE EXPRESS PERMISSION OF THE SENIOR EMPLOYEE PRESENT OR UNTIL THE FIRE DEPARTMENT GIVES THE ALL CLEAR.