| DOCKETED | |
|---|---|
| **Docket Number:** | 03-AFC-02C |
| **Project Title:** | Los Esteros Phase II Compliance |
| **TN #:** | 224870 |
| **Document Title:** | Los Esteros Critical Energy Facility Responses to Staff's Data Requests, Set 1, A1 through A23 |
| **Description:** | N/A |
| **Filer:** | Eric Janssen |
| **Organization:** | Ellison Schneider Harris & Donlan LLP |
| **Submitter Role:** | Applicant Representative |
| **Submission Date:** | 10/2/2018 4:53:30 PM |
| **Docketed Date:** | 10/2/2018 |

**LOS ESTEROS CRITICAL ENERGY FACILITY, LLC**

**717 TEXAS AVENUE**
**SUITE 1000**
**HOUSTON, TX 77002**

October 2, 2018

John Heiser
Compliance Project Manager
Siting, Transmission and
Environmental Protection (STEP Division)
California Energy Commission
1516 Ninth Street, MS-2000
Sacramento, CA 95814
John.Heiser@energy.ca.gov

RE: Docket No. 03-AFC-02C: Petition for Modification
Responses to Staff's Data Requests, Set 1, A1 through A23

Dear Mr. Heiser:

On behalf of the Los Esteros Critical Energy Facility ("Project"), Los Esteros Critical Energy Facility, LLC ("Project Owner") submits the following responses to California Energy Commission ("Commission") Staff's Data Requests Set 1.

If you have any questions regarding these responses, please contact Barbara McBride at 925-570-0849 or Barbara.McBride@calpine.com.

Sincerely,

/S/

Barbara McBride

## AIR QUALITY

### A1. Please describe how the batteries would be operated in conjunction with the existing generation equipment.

**RESPONSE:** The Battery Energy Storage System ("BESS") will connect to the auxiliary bus of the Los Esteros Critical Energy Facility and would have the flexibility to supplement or displace current generation depending on California Independent System Operator ("CAISO") dispatch instructions without exceeding the maximum project capacity. It may also operate to provide some of the Project's auxiliary loads as needed. The system will receive and respond to a signal from CAISO to charge or discharge, and the state of charge and other status information will be visible through the Remote Intelligent Gateway ("RIG"). The system will have its own metering and resource ID.

### A2. Please describe the combined operations of the batteries and generation units with respect to:

a. **increases or decreases in the number of combustion turbine startup and shut downs, per day, month and year;**

**RESPONSE:** No change is expected to the number of combustion turbine startup and shutdowns.

b. **the increase or decrease in the duration of the combustion turbine startup and shut downs;**

**RESPONSE:** No change is expected to the duration of the combustion turbine startup and shutdowns.

c. **whether the existing combustion turbines can or would be used to recharge the battery storage component; and,**

**RESPONSE:** The system will receive and respond to a signal from CAISO to charge or discharge. While it is possible for the BESS to be charged from the combustion turbines (through the unit auxiliary transformer(s) connected to the 4160V bus), the Project Owner does not expect that this is how the BESS will be charged.

d. **any limitations placed on the use of the batteries, given they would be interconnected at the 4160V auxiliary bus.**

**RESPONSE:** No limitations are expected.

## CULTURAL RESOURCES

A3. Please provide the depth and lateral extent of ground disturbance and excavation that is anticipated for the installation of the battery's concrete foundation and secondary containment structure for both of the proposed storage systems.

**RESPONSE:** For a three megawatt ("MW")/12 megawatt hour ("MWh") flow battery:

The expected lateral extent of ground disturbance is 160 feet by 85 feet.
The expected depth of ground disturbance is 1.6 feet (assuming the bearing capacity of the soil is sufficient).

For each 250 kilowatt ("kW") module, the weights of the tank and battery container are provided below. Each 250kW module has one battery container and two tank containers.

Table 2. Container dimensions, weight

| Constitution | Size | Weight* |
|---|---|---|
| Battery Container | $6.1m^{L} \times 2.5m^{W} \times 2.9m^{H}$ ($20'^{L} \times 8'^{W} \times 9'6"^{H}$) | 20 ton (44.1 kips) |
| Tank Container | $9.1m^{L} \times 2.5m^{W} \times 2.9m^{H}$ ($30'^{L} \times 8'^{W} \times 9'6"^{H}$) | Net: 12 ton (26.4 kips)<br>Gross: 68 ton (149.9 kips) |

* Net value: Weight excluding electrolyte, Gross value: Weight including electrolyte.

A4. The northern portion of the site where the battery installation would occur appears in historical aerial imagery to have been used as a construction laydown area.

a. Please describe the current nature of the soil or pavement where installation of the battery and foundation would occur and;

**RESPONSE:** It is expected that the site for the BESS will have a similar soil consistency as the rest of the Project site, which varies from soft to very stiff lean to fat clays, silty clays to clayey silts and sandy silts.

b. Please describe the use of this portion of the site from when the project was first undertaken to the present.

**RESPONSE:** The site proposed for the BESS was previously used for construction trailers. The north portion of the site is currently unused with the exception of a few small buildings and a patch in the north east corner used for laydown of metals.

A5. Would ground-disturbing activities be required for the interconnection to the existing auxiliary bus? If so, please describe the depth and extent of excavation anticipated and provide a site map with the location of the interconnection relative to other plant facilities.

**RESPONSE:** Yes, it is anticipated that a minimal addition to the excavations for the vanadium flow battery foundation will be needed for the interconnection, depending on the type of interconnection. If the connection is through a bus duct, then trenching will be required. All civil, structural, and electrical items will be built in accordance with the California Building Code ("CBC"). Electrical components will also be designed to confirm with National Fire Protection Association Standard 70 ("NFPA 70").

A6. Would ground-disturbing activities be required for the installation of the new meter? If so, please describe the depth and extent of excavation anticipated and provide a site map with the location of the interconnection relative to other plant facilities.

**RESPONSE:** Ground-disturbing activities are not anticipated for installation of the new meter.

A7. The petition does not identify the location of a construction laydown area.

a. Please provide a map showing the location of the proposed construction laydown area relative to other plant facilities and;

**RESPONSE:** The laydown area is expected to be located in a gravel patch due west of the BESS site, and is expected to cover an area between 7,600 to 10,000 feet.

b. Please indicate whether any ground-disturbing activities would take place in preparation or use of that location.

**RESPONSE:** <u>No ground disturbing activities will occur to facilitate use of this location.</u>

## HAZARDOUS MATERIALS MANAGEMENT

A8. Please describe the materials of which the tank would be constructed that would hold the vanadium electrolytes.

**RESPONSE:** The tank material is rubber.

A9. Please clarify if there would be secondary containment around the electrolyte tanks to help contain a catastrophic failure. Please clarify the assumptions going into the catastrophic failure.

**RESPONSE:** The rubber tank is installed within the container. The container is acid-resistant and watertight, therefore this container works as the secondary containment to keep all electrolytes contained if catastrophic failure were to occur. Furthermore, the container has a leakage sensor for early detection so that countermeasures can be taken in the event of a leakage. Such countermeasures include an automatic stop in operation and alert to personnel. A catastrophic failure is defined as a leakage of electrolyte.

A10. Please provide any preliminary drawings that show outline of the vanadium redox flow battery installation with the secondary containment.

**RESPONSE:** Please refer to Attachment DRA10, "Typical Vanadium Flow Containment Drawing".

A11. Please provide the safety data sheets for the materials in the lithium ion batteries.

**RESPONSE:** Please refer to Attachment DRA11, "Typical Lithium Ion MSDS".

A12. Please provide a written narrative and any preliminary drawings describing the secondary containment for the lithium ion battery installation.

**RESPONSE:** The design of the secondary containment for a lithium battery BESS will not be known until a battery vendor is selected.

## LAND USE & SOCIOECONOMICS

A13. Please clarify if the approximately 167' x 112' x 20' system layout dimensions would accommodate the vanadium flow batteries, Li-ion batteries, or both. Would the dimensions change if only one battery type or both are used and what would they be?

**RESPONSE:** The dimensions described above are approximate, and would accommodate installation of either technology type, not both, depending on which one the Project Owner chooses to install.

A14. Please provide additional information specifying the necessary workforce and timeframe for the construction and installation of each of the three proposed possible scenarios of vanadium batteries, Li-ion batteries, and both.

**RESPONSE:** Please see Attachment DRA14, "Typical Installation Plan", for an estimated schedule and general timeline for installation of a 3MW system. For both technologies, a 12-week (3 month) timeline only for construction and installation is anticipated. A high-level estimation of workforce for a Vanadium Flow system is around a 15 personnel crew working 60 hours a week on average, whereas a similar size lithium-ion size system will require a 10 personnel crew working 60 hours a week on average. Please note the workforce and timeframe will be refined during detailed design.

## TRAFFIC AND TRANSPORTATION

A15. Please provide the following information for the Traffic analysis.

1. Number of heavy-haul truck trips anticipated.

**RESPONSE:** Please see Attachment DRA14. Currently, it is anticipated that there will be a total of 119 heavy-haul truck trips; maximum per day is anticipated to be 5 trips.

2. Number of worker vehicle trips (or number of construction workers anticipated).

**RESPONSE:** The anticipated number of total worker vehicle trips is 975, with an estimated maximum of 30 trips per day.

3. Number of days for completion of construction activities.

**RESPONSE:** The estimated number of days for completion of construction activities is 60 days.

## TRANSMISSION SYSTEM ENGINEERING

A16. Please provide the one-line diagram of the proposed battery project's interconnection to the 4.16 KV plant low voltage system. Indicate the battery types, inverter capabilities, feedback software system information, and the arrangements, with ratings, of the components of the LECEF.

**RESPONSE:** Please see Attachment DRA16, "Los Esteros Battery One Line".

A17. Please provide a description of how the project would utilize the batteries for grid reliability (voltage, frequency) or store/supply power to the grid. If the proposed battery project increases the output of the LECEF, or receives power from the grid for storage purposes, indicate whether or not the interconnection of the battery project has been coordinated with California ISO.

**RESPONSE:** The interconnection of the BESS has been coordinated with both the CAISO and the Participating Transmission Owner, and will not require any additional Interconnection Facilities or Network Upgrades. The BESS will operate inside the fence line of the power plant, but will have a separate revenue meter, resource ID and scheduling coordinator. Both the charging and discharging cycles of the BESS will be subject to the requirement that the BESS respond to CAISO Dispatch instructions, including curtailment instructions to manage congestion or other operational issues on the system. In other words, the BESS will be subject to CAISO Dispatch instructions in both charging and discharging modes, which could curtail operation during either mode.

A18. Please provide the inverter capabilities and describe their ability to provide Var to the system for voltage regulation and to maintain a 0.95 or Unity power factor at the plant point of interconnection.

**RESPONSE:** The BESS can be designed with a power conversion system ("PCS") whose continuous Var capability is 100% of the nominal rating. The BESS can maintain the required power factor such that a 0.95 or Unity power factor is measured at the plant POI.

## WORKER SAFETY AND FIRE PROTECITON

A19. Please provide a written narrative detailing what fire protection and life safety systems would be provided for the lithium-ion battery installations. Please clarify if the fire suppression system would be water, a clean agent, or both.

**RESPONSE:** If the Project Owner chooses to utilize lithium-ion batteries in the BESS, the system will be designed and built to be compliant with applicable federal, state, and local fire codes and National Fire Protection Association (NFPA), National Electrical Safety Code (IEEE C2), and the National Electrical Code (NFPA 70) standard practices. The battery containers are designed to both house and protect the batteries and control equipment installed inside the container. Access to the batteries and other equipment contained in the enclosure will be provided via a series of hinged doors installed down the length of the container. The battery containers will provide an Ingress Protection rating of IP55 or better and will be designed to withstand the rain tests of UL 50E and IEEE C37.20.2. All battery containers will be equipped with UL listed and fully redundant heating, ventilation, and air conditioning ("HVAC") systems as well as UL listed and NFPA 2001 compliant fire suppression systems. An appropriate fire suppression agent will be implemented in the fire suppression systems.

A20. Please provide a written narrative of the general procedures and life safety measures that would be provided to help prevent and control any incipient fires in the lithium-ion battery installation.

**RESPONSE:** Fires typically originate from causes other than the batteries themselves—such as external factors, improper physical handling, misuse, and exposure to excessive heat. The Project Owner will update the facility's health and safety training component to include a component on safe battery handling and general procedures to follow in the event of a fire. General procedures will include safe handling of the batteries to avoid opening, puncturing, or crushing of the battery casings, and training regarding suitable extinguishing media.

A21. Please provide preliminary drawings of the vanadium redox flow battery installation showing the location of the hydrogen purge and the location of the fire alarm or alarms.

**RESPONSE:** Please see page 2 of attachment DRA10. If a fire alarm is required, it will be placed in the battery cell container as identified in the drawing. A small amount of hydrogen gas is generated in the cell stacks as a side reaction, and flows to the electrolyte tanks. In the event of an emergency, nitrogen gas is generated by nitrogen gas generators and flows to the tank to push the hydrogen gas to the atmosphere.

A22. Please provide a written narrative of the general procedures that on-site personnel would have to use to when interacting with the vanadium redox flow battery installation.

**RESPONSE:** Below are general guidelines and safe work practices associated with the different aspects of installation.

1. General
    - Proper PPE (hardhat, safety-glasses, safety-boots, safety-vest).
    - Daily contractor tailgate meetings to go over job hazards prior to start of work.

2. Tool setting
    - Ensure contractor site personnel have the appropriate licenses and permits to conduct the work.
    - Ensure all equipment being used is adequate to meet working load.
    - On-site personnel to be visible to operator during all lifts.

3. Electrical
    - Ensure proper isolation procedures are followed.
    - Develop procedures for energizing electrical equipment and conduct proper lockout/tagout compliant with accepted contractor and owner guidelines.

4. Chemical
    - All contractor personnel to be familiar with MSDS and chemical injection procedures and handling of the electrolyte.
    - Chemical PPE consistent with MSDS requirements such as chemical resistant wear and gloves and eye protection (goggles or face-shield) shall be used.
    - Prepare temporary station for eye wash if needed.

A23. Please provide any information related to the safety of the battery installation.

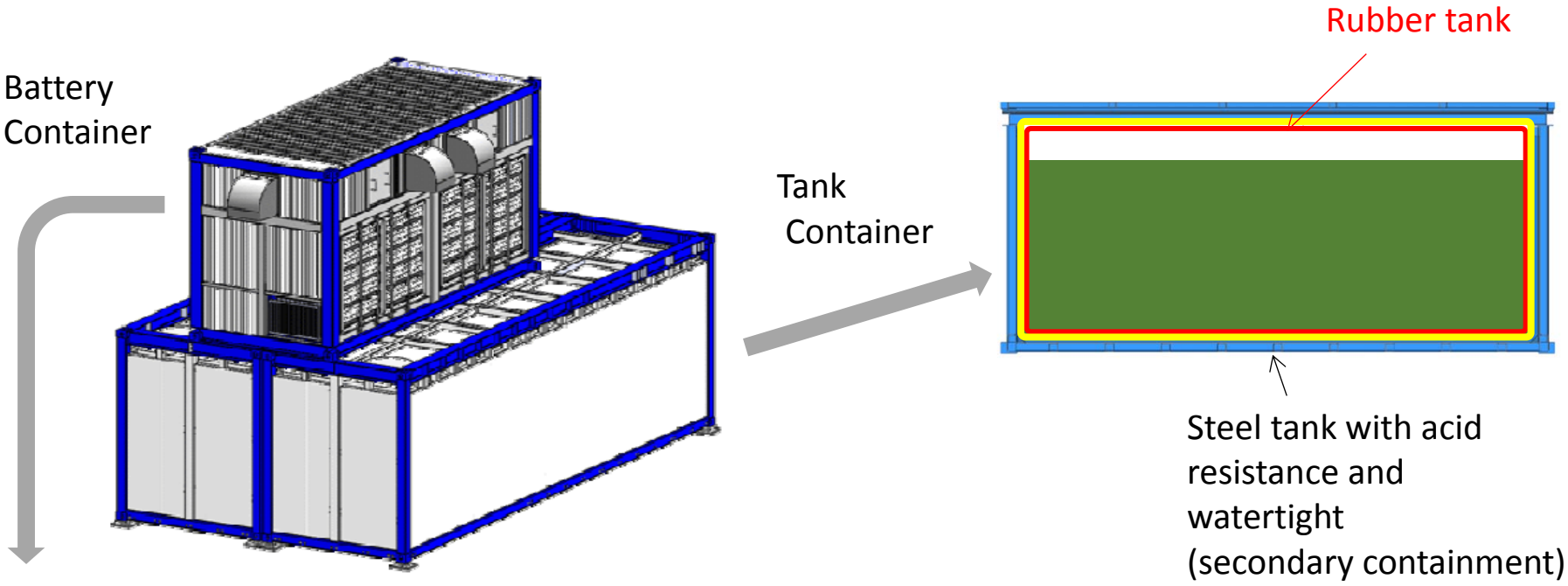
**RESPONSE:** Please see Attachment DRA23, which is GE's Fire Safety Information.

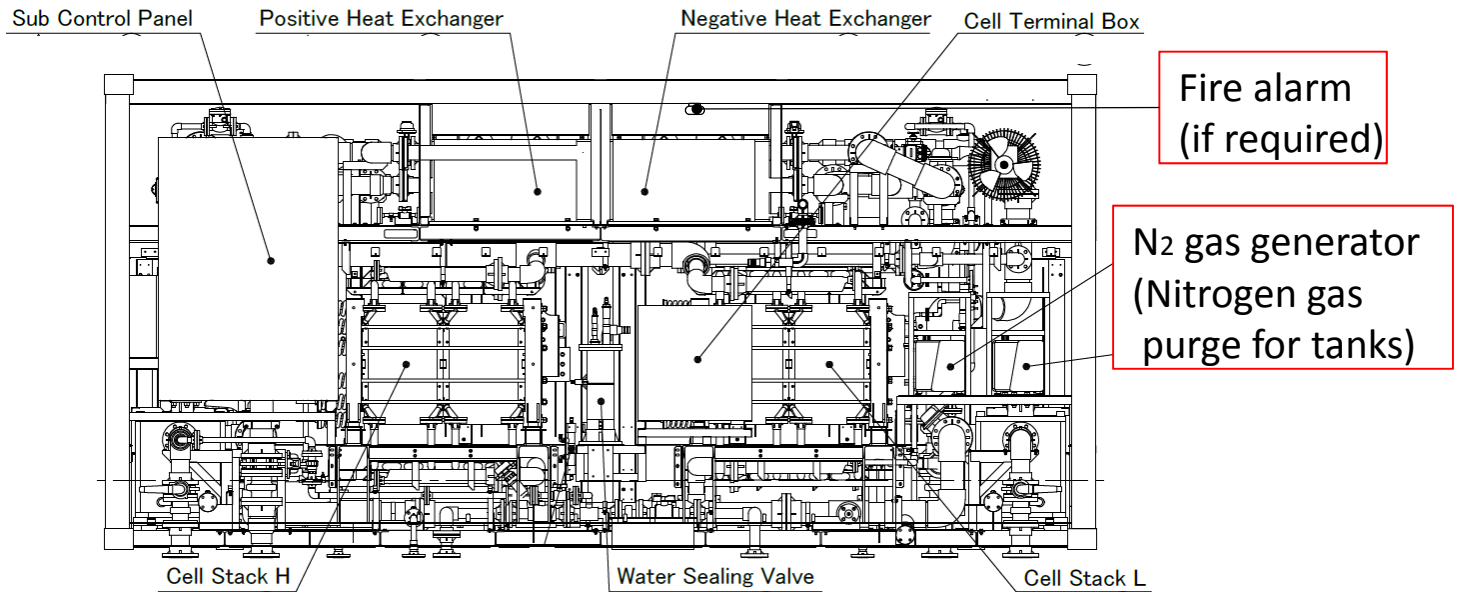
# LOS ESTEROS CRITICAL ENERGY FACILITY, LLC

## RESPONSES TO STAFF'S DATA REQUESTS, SET 1, A1 THROUGH A23

# ATTACHMENTS

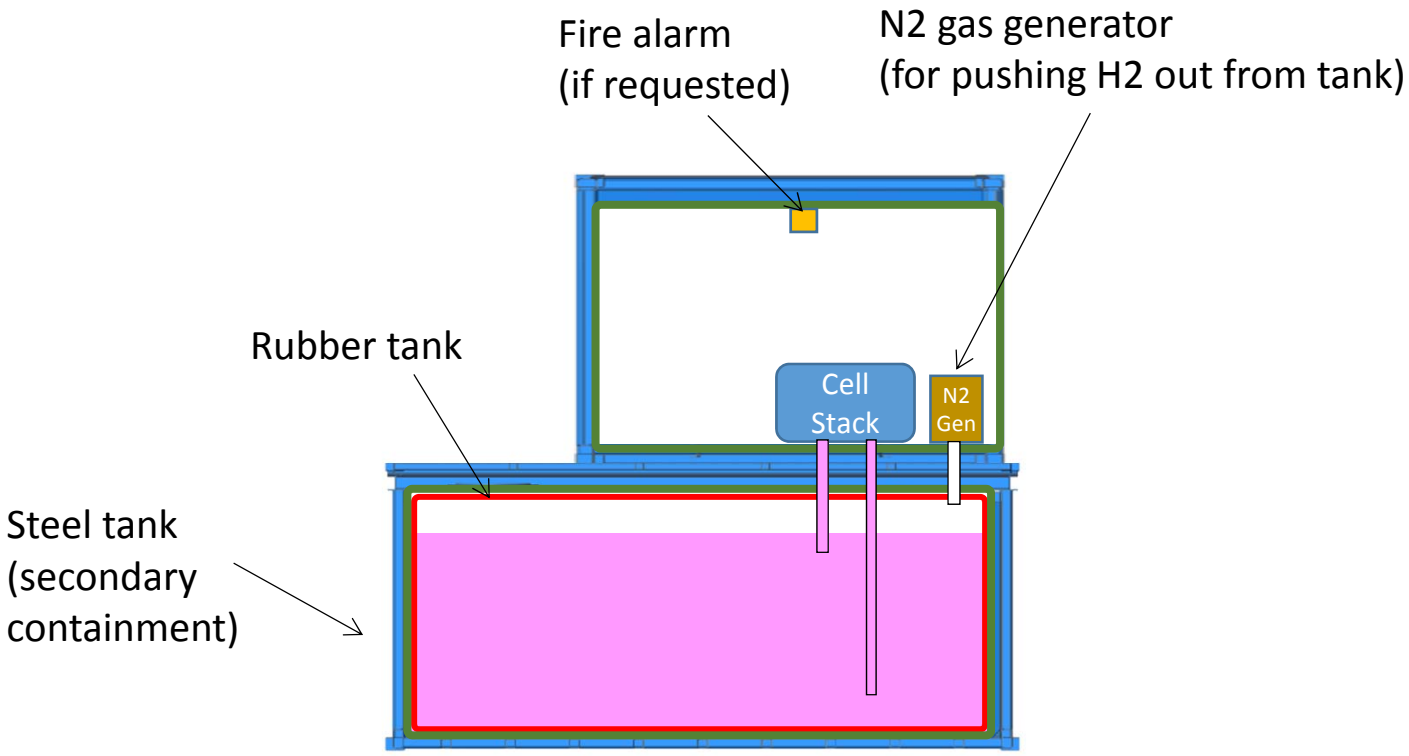
ATTACHMENT DRA10
TYPICAL VANADIUM FLOW CONTAINMENT DRAWING



ATTACHMENT DRA10
TYPICAL VANADIUM FLOW CONTAINMENT DRAWING

Detail of tank and secondary containment



| LG Chem | SAFETY DATA SHEET | Version: R0001.0001 |
|---|---|---|
| | | Date of issue: 2016-05-10 |
| | | Revision date: 2016-05-10 |
| | LGCHEM JH3 Lithium-Ion Polymer Battery | Change List: |



## 1. IDENTIFICATION

### A. Product name

- LGCHEM JH3 Lithium-Ion Polymer Battery

### B. Recommended use and restriction on use

- General use : Lithium-Ion Polymer Battery
- 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
- Dept. :
- Telephone number : +82-2-3773-6740
- Emergency telephone number :
- Fax number :
- E-mail address : lkblive@lgchem.com

○ **Supplier/Distributer information**

- Company name : LG Chem Ltd.
- Address : LG Twin Tower, Youido-Dong, Youngdeungpo-Ku, Seoul, Korea
- Dept. :
- Telephone number : +82-2-3773-6740
- Emergency telephone number :
- Fax number :
- 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

- Do not rub your eyes.
- 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.
- 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.
- About whether I should induce vomiting Take the advice of a doctor.
- Get immediate medical advice/attention.

### 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℃, 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:

  <u>On Land</u>
  Place material into suitable containers and call local fire/police department.
  <u>In Water</u>
  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

- Packing Instruction: P903
- Special Provision: 188, 230, 310, 957

- EmS: F-A, S-I

**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

- Not applicable

### D. Other

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

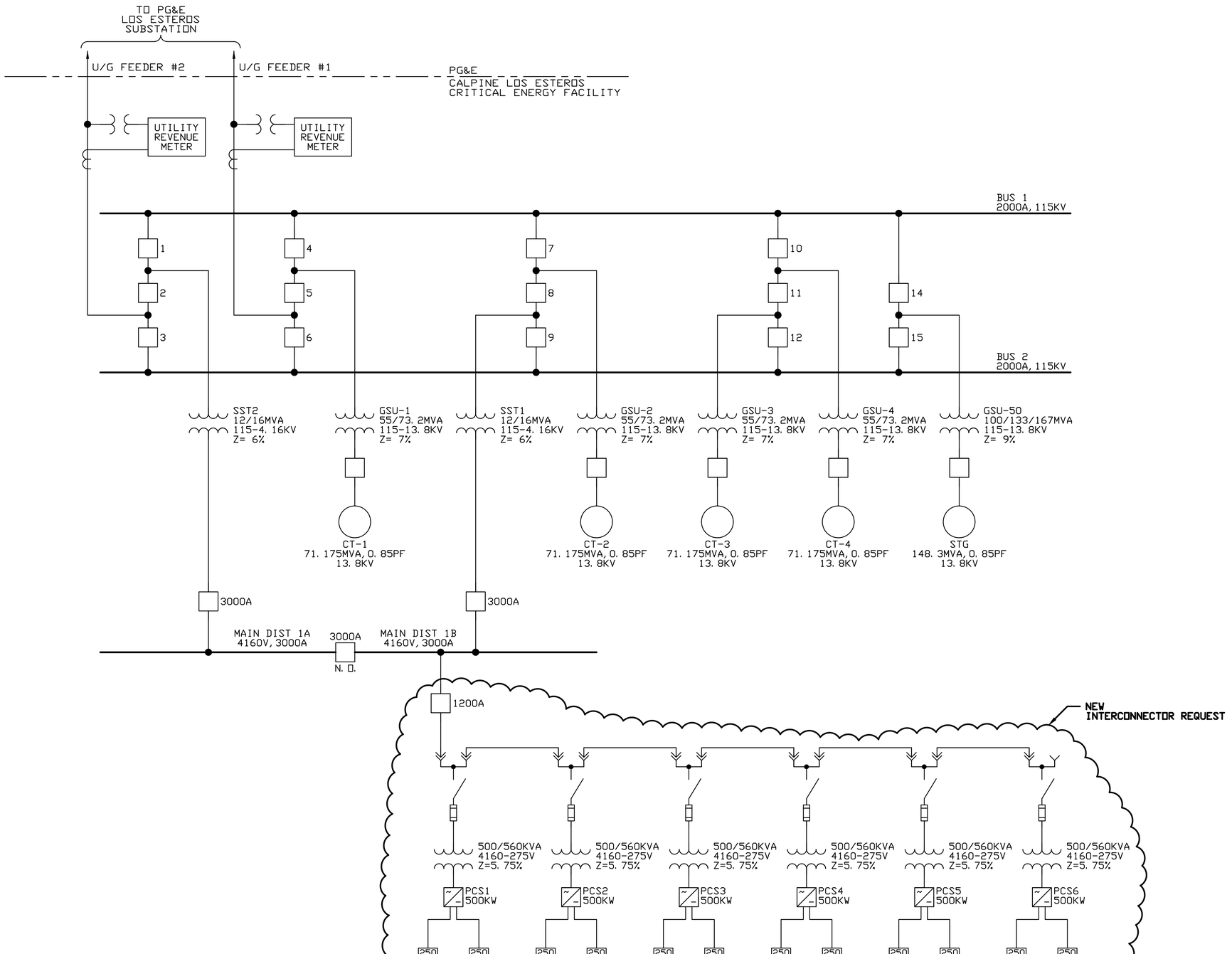
ATTACHMENT DRA14
TYPICAL INSTALLATION PLAN

**Typical Installation Plan for the Containerized VRFB of 3 MW / 12 MWh** Construction volume

- Battery Container: 12 Containers
- Tank Container: 24 Containers
- Electrolyte Volume: 253,500 gallons
- PCS: 2 Containers

| Description | Week | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| 1. Construction Works | | | | | | | | | | | | |
| 1-1 Tool Setting | | | | | | | | | | | | |
| 1-2 Wiring | | | | | | | | | | | | |
| 1-3 Piping | | | | | | | | | | | | |
| 1-4 Chemical Injection | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| 2. Start-up & Commissioning | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| 3. Resource (number of people per day) | | | | | | | | | | | | |
| Construction crew | 10 | 20 | 20 | 30 | 30 | 15 | 15 | 15 | | | | |
| Commissioning Crew | | | | | | | 10 | 10 | 5 | 5 | 5 | 5 |
| | | | | | | | | | | | | |
| 4. Logistic (trips) | | | | | | | | | | | | |
| 4-1 Heavy Haule Trucks | | | | | | | | | | | | |
| Crane | 1 | | | | | | | | | | | |
| Tool Transportation | 24 | 14 | | | | | | | | | | |
| Electrolyte Transportation | | | | 15 | 25 | 25 | 15 | | | | | |
| | | | | | | | | | | | | |
| 4-2 Worker Vehicle | 50 | 100 | 100 | 150 | 150 | 75 | 125 | 125 | 25 | 25 | 25 | 25 |
| (assume 1 car per person) | 10 per day | 20 per day | 20 per day | 30 per day | 30 per day | 15 per day | 25 per day | 25 per day | 5 per day | 5 per day | 5 per day | 5 per day |

ATTACHMENT DRA16
LOS ESTEROS BATTERY ONE LINE




PROGRESS PRINT
REVIEW IN PROGRESS

| REV | DATE | DESCRIPTION | DRAWN | CHECKED | REVIEWED | LEAD DESIGNER | ENGR/TECH SPEC | ENGR MGR | PROJ ENGR MANAGER |
|---|---|---|---|---|---|---|---|---|---|
| A | 03 30 15 | ISSUED FOR INFORMATION | CM | | | | PS | | BP |

PRELIMINARY STATUS — DATE
LDE P. SARNSEN 03-30-15
INFORMATION ONLY - NOT TO BE USED FOR CONSTRUCTION.

APPROVED STATUS — DATE
LDE
REPRESENTS REVIEWED AND APPROVED DESIGN. ANY PORTION MARKED "HOLD" RETAINS PRELIMINARY STATUS.

| ORIGINATING PERSONNEL | PROFESSIONAL ENGINEER'S SEAL |
|---|---|
| DRAWN BY: C. MULLINER | |
| CHECKED BY: | |
| LEAD DESIGNER: | |
| ENGINEER/TECH SPECIALIST: P. SARNSEN | |
| PROJECT ENGINEERING MANAGER: B. PIETRUCHA | |

OneWay
to zero harm



ORIGINALLY PREPARED UNDER THE RESPONSIBLE SUPERVISION OF
PPO: _____ STATE: _____
LIC. NO.: _____ DATE: _____

WorleyParsons
resources & energy

CLIENT/PROJECT TITLE
CAPLINE
LECEF TEST STAND
MILPITAS, CA

3MW ENERGY STORAGE TEST FACILITY
SINGLE LINE DIAGRAM

SCALE: NONE
DRAWING SIZE: ARCH D (36" x 24")
WORLEYPARSONS DWG. NO.: LE-GNL-DE-E01-0003
REV: A

LE-GNL-DE-E01-0003.dwg
30-Mar-2015 - 09:03

**ATTACHMENT DRA23**

# Fire Safety Information – GE Lithium Ion Battery Systems

**Introduction:**

This document would serve as a guide to describe the levels of protection implemented to prevent any fires happening from within the batteries up to the whole Energy Storage Systems. GE performs rigorous technical audits of our battery suppliers and demand critical safety features be added if not present within their cell designs. GE also conducts regular quality audits and demands the stringent standards are met. In most cases today, if fires do occur they are not originated by the batteries themselves. Multiple overlapping and redundant systems are in place to monitor key safety parameters such as cell voltage, current and temperature with multi- tiered controls and protection deployed as described below.

**Summary:**

The Energy Storage Enclosure is designed and built to provide battery system along with protective and monitoring equipment while meeting UL, NEC, IEC Standards and intermodal shipping regulations. All electrical components within the enclosure are compliant to NEC for North American markets and Low Voltage & EMC Directives for IEC markets, as well as a CE and UL compliant HVAC system. Further, if the Energy Storage Enclosure is a "walk-in" design it will also have a fully integrated Fire Suppression system. A fire suppression system is not necessary for a "reach-in" Energy Storage Enclosure. GE Energy Storage performs comprehensive Safety Risk Assessment for the equipment based on ISO 12100, the recommendations for Safety Risk Assessments and ISO 13849, Functional Safety.

Most of these storage systems are expected to be outdoor installation behind utility level fencing with very limited human interaction. The protection plan detailed in this document is in place to ensure a fire doesn't start within the system. But if a fire does start, it's best to leave the system alone and use water to cool the surroundings. The internal fire suppression system will be activated to control the fire in the "walk-in" design. The 1-hour rating will provide ample time for the fire department to arrive and start their efforts to control and extinguish the fire. Any other storage systems in the vicinity or proximity to the one on fire should be shut down by opening the main breaker to the whole system

**Most common causes for fire are:**

- External factors (improper storage, external fire)
- Service activities - Severe Arc Flash incident

**Most unlikely causes for fire**

- Partitions within the cell are punctured due to physical abuse
- Overcharge/over discharge (misuse)
- Exposure to excessive heat/battery over temperature

# ATTACHMENT DRA23

**Cell Level Protection:**

- Each cell has Safety Function layer that maintains electrical separation even if polymer separator is damaged
- There is a positive polarity Aluminum can that prevents surface corrosion resulting in electrolyte leakage even after long-term usage
- The Overcharge Safety device will prevent current flow once its activated
- A vent in the cell will emit the generated gas effectively if the inside pressure goes abnormally high in abuse conditions
- The fuse/fusible link will cut the current path when abnormally high current flows

**Module Level Protection:**

- Modules have been successfully tested to applicable UL Standards to demonstrate that they are not susceptible to thermal runaway
- Each Module has a BMS that monitors status of each battery by measuring attributes such as cell voltage and cell temperature
- Each module has fusible links/fuses that will open on over current
- Module level controls will de-rate the Inverter for over temperature.. If temperate keeps going up in the module
- Each module has an integrated MSD and eliminates from a safe distance any electrical hazard

**Rack Level Protection:**

- The racks/switchgear have contactors that the BMS can open if fault condition is detected
- There are fuses that will open the circuit on over current
- If racks charge/discharge capability limits are exceeded warning signals are transmitted and the system could shut down
- Control system monitors sensors and will shut down rack on fault conditions

**Enclosure Level Protection:**

- Each enclosure has smoke and heat detectors. If a single detector detects smoke or heat an alarm is sent to the control system. If multiple detectors detect smoke or heat, the system does an E-Stop and Fire suppressant is released
- The Fire Suppression system in the “walk-in” design is always operational and has three staged approach for activation.
  - The alarm stage sends an alert to the operator
  - The release stage releases the fire suppressant
  - Fault stage notifies the operator something is wrong with the fire suppression system
- The RTD’s inside the ESS measure ambient air temperature which can be used to de-rate the system power

# ATTACHMENT DRA23

- Fire resistant construction separation between battery space and Aux power distribution and controls
- The enclosure is constructed with 1-hour fire resistance materials