Eaton's Lithium-ion UPS Battery Q&A

This document will serve as a guide for Eaton salespersons, sales support personnel, engineering clients, and end users who have questions regarding the lithium battery cabinets used with Eaton UPS systems.

Section 1: General FAQs

1) **Which vendors does Eaton offer?**
   a. Samsung cabinets containing 128 or 136 battery cells (16 or 17 battery modules respectively).
2) **What vendors has Eaton offered previously?**
   a. LG Chem cabinets populated with a single string or a double string of battery modules. LG Chem has discontinued this UPS battery, but many are deployed in the field, and will continue to be supported.
   b. LiiON cabinets that have been installed in several locations. This manufacturer still offers this battery, but Eaton does not support its use on Eaton products. Any service on these systems will be provided by LiiON.
3) **Which Eaton UPS products can use lithium-ion batteries?**
   a. The 9395/9395P/9395C and all 93PM products are approved for lithium batteries.
      i. NOTE the 93PM with Samsung batteries uses only the Samsung 128 model, not the 136 version.
   b. Note: the 9390 and 9315 are not currently approved for lithium batteries.
4) **What are the major differences between each manufacturer's product?**
   a. Capacity (kWh)
      i. 32.6 kWh for Samsung 128S, 34.6 kWh for the 136S models
      ii. LG offers 2 strings, 14 kWh each, in a single cabinet, allowing for single string or double string configurations in a single cabinet.
   b. Samsung has been evaluated to Seismic Zone 4 and is OSHPD certified for the UL9540A (Black) cabinet.
   c. LG has been evaluated to Seismic Zone 4
   d. AC power source
      i. Samsung requires a 'UPS protected' source for the BMS. Gen 1 (white cabinet units, have a transformer in the conduit landing box that steps up 208Vac from the UPS to 480Vac to run the cabinet from a 208 output UPS. Gen 2 UL9540A (Black cabinets) should be selected with a 1-phase 120/240V protected power source for use with a 208V UPS or a 480V 3-phase source for a 480V or 600 V UPS. In these Gen 2 systems, there is no transformer in the conduit landing box; the battery cabinet internal power supply will be provisioned with a 480VAC or 208VAC input based on the user's BMS voltage selection at the time of order.
      ii. LG Chem requires 1x 120-240Vac single phase 'UPS protected' power source for the BMS
5) **Will there be additional vendors for lithium-ion products?**
   a. Yes, Eaton intends to offer multiple vendors, in future, and evaluations of those different vendors are continuing
6) **Are they safe?**
   a. Eaton is comfortable and confident that all the vendors' products Eaton offers are safe, when used with Eaton UPS; installed per the manufacturer's recommendations; and when their environmental requirements are observed
   b. The battery management system (BMS) is one component which ensures the safe operation of the battery, by monitoring temperature, voltage balance, etc., and it has the ability to disconnect the battery string if conditions warrant. The other component is the design of the battery cells and battery modules.
      i. All Eaton vendors comply with UL1642 (Battery cell safety); UL1973 (Battery module/cabinet safety). The BMS complies with UL1973 which pulls in UL991, UL1998 (Software safety), and UL9540A (large scale fire testing) as required
      ii. Eaton selects lithium battery chemistries that provide a balance of energy density and thermal performance
   c. Eaton has a very large installed base of lithium cabinets since 2017. It numbers in the thousands of cabinets, with no safety related failures or incidents!
7) **How is thermal runaway detected and mitigated?**
   a. The BMS and battery module construction handles the detection and mitigation and meets UL9540A requirements. The BMS can disconnect the string via opening the cabinet breaker.
8) **How long does Eaton expect the batteries to last in a UPS application?**
   a. All vendors expect 10-15-year service life like Eaton utilizes in UPS equipment.
9) **What is the vendor's warranty?**
   a. Samsung provides a 3-year defect warranty and a Performance warranty of 10-years years, guaranteeing the lithium battery's ability to provide rated capacity.

b. NOTE that all warranties have specific requirements to keep the batteries within the environmental requirements specified in the installation or operation manuals. Data logging is required for most warranty claims.
c. Administration of the vendors' pass-through warranty will be identical to what Eaton provides for VRLA, but labor charges on lithium-ion battery solutions are not included.

10) What is a performance warranty?

a. The vendor warrants that when the battery is installed per vendor's instructions, operated within vendors environmental guidelines, and charged by the UPS as specified, the battery system will provide at least 78-80% of its initial capacity at the 10-year mark. If the battery or string fails to provide that capacity, it will be replaced at no charge. Labor is not covered.
b. The battery must be operated within the environmental specifications and cycle life limits set by the battery vendor. Data recordkeeping is the responsibility of the user (like VRLA). If the evidence indicates that the battery has been misused:
    i. Samsung may cancel the 10-year warranty
    ii. LG Chem decreases the warranty coverage time length, depending on the degree of misuse (temperature and/or cycle count)

11) Can Eaton supply copies of each vendor's warranty document?

a. Yes. Access this through the DCCG group in Raleigh and is provided with all quotations or sales.

12) How are the batteries shipped? Can they be air shipped?

a. Eaton will ship battery cabinet systems by ground. Individual replacement batteries may be air shipped.
b. Refrigerated ground shipment is not required
c. Shipments must be in accordance with UN38.3 requirements. All shippers must be trained on Class 9 shipment of hazardous goods. These requirements involve specific packaging, labeling of said packaging, and accompanying paperwork. Trucker and the truck must be certified with proper signage.
d. Batteries for air shipment must not exceed 30% state of charge (SoC). Eaton will ship all lithium batteries at 30% SoC, whether ground or air shipment.
e. It will require about 4 hours of charge time to bring the newly replaced battery up to full charge
f. Samsung and LG Battery cabinet systems are shipped disassembled. All assembly and start-up/commissioning activities are included in Eaton pricing.

13) What are lead-times?

a. 4 to 8 weeks from stock. Note this may vary with current supply chain challenges. Eaton sales can verify lead times from the published lead time report.

14) Can they be recycled?

a. Yes, using the same processes and vendors that Eaton offers on http://www.Eaton.com/batteryrecycle website. The site shows Eaton's recycling partner is Heritage Environmental, but the user/owner is free to work with other recycling vendors.
b. Alternatively, some battery vendors, and some 3rd parties will recommend that, rather than recycling, the used batteries should be shipped to them, where they will be refurbished and reused in a 'second life application', where they may be in service for an additional 5-6 years before finally reaching their end of life. While few of these organizations exist today, it is likely that many battery re-use entities will enter the market over the initial 10-year life of a UPS lithium-ion battery.

15) How long can lithium-ion batteries be stored without recharging?

a. LG Chem: the storage times are 6 months at 25°C.
b. Samsung's Warranty is voided after 6 months of storage, including storage prior to shipment, but there are exceptions. Check with your Eaton representative if batteries will be stored longer, or at different temperatures than mentioned here. And, to ensure a functional battery when put into service, a voltage check of stored batteries should be done every 6 months to ensure that batteries remain functional. If the voltages are out of vendor's limits, a recharge will be required. After recharge, the batteries may be stored an additional 6 months, and should still work properly. Eaton Service can provide the voltage check service and recharge service onsite.

16) Can different vendor's batteries be mixed?

a. No, battery vendors' products cannot be mixed on the same UPS. For example, Samsung 128S and 136S cabinets should not be mixed on the same UPS system.
b. Paralleled UPSs should all utilize the same battery; Eaton recommends against mixing of VRLA and lithium, and no mixing of different lithium products on the same parallel system.

17) Should DC cable lengths from each lithium battery cabinet to the UPS be identical?

a. Yes, this must be considered at the room layout and system design stage. Lithium batteries are more sensitive to cable impedance than are lead acid batteries, and current imbalances can occur. Eaton needs <1% DC voltage drop across the length of the cable between battery and UPS. IMPORTANT: Failure to observe this requirement may result in problems that could reduce backup time of the system.

Section 2: Installation FAQs

1) **Which codes apply for lithium-ion battery installations?**
   a. *It is important to note that Eaton should not be the official source for these answers. Legal liabilities preclude Eaton's ability to act as the authority on any of this information. Clients are responsible for interpretation and compliance to the appropriate national and local codes. However, Eaton does want to provide general information on what clients should be aware of prior to the sale of lithium-ion battery systems. National and local codes could apply, and various codes may exceed or supersede Eaton's generic interpretations. Eaton has included a section in this document which describes which entity; the UPS vendor, or the site or owner personnel has the ultimate responsibility for code compliance.*
   b. Codes that may apply are, but not limited to:
      i. NFPA 1, section 52.3
      ii. IFC 1206, (now 1207) 2018, or 2021 edition, formerly section 608 in previous IFC codes. Note that some municipalities may not have adopted the latest fire codes
      iii. NFPA 855
      iv. The requirements and wording in all the above codes are similar but not identical. Different exceptions or exclusions could apply.
2) **What UL listings do Eaton battery offerings carry?**
   a. For Samsung products
   b. UL 1642 for the batteries
   c. UL 1973 for battery modules and systems
   d. UL 1998 for the BMS (part of UL 1973 testing)
   e. UL 9540A large scale fire testing; for Samsung black cabinets (Note: 9540A is a test method, not a 'listing' like UL9540). Eaton has copies of the UL 9540A test report available on request for evaluation by the client or their AHJ.
3) **Are there Building Code considerations for lithium battery installations?**
   a. Room location: Not greater than 75' above or 30' below the lowest fire department access level unless successful UL9540A testing and FMEA analysis convinces AHJ to approve.
   b. Seismic: Must comply with IBC Section 16, which describes the building structure, not the battery cabinet, but
      i. Samsung has been evaluated to seismic Zone 4 and is OSHPD certified with their latest (black) cabinets, when installed according to manufacturer's instructions.
      ii. LG Chem has been evaluated to seismic Zone 4 and passed the AC156 shake test.
   c. Ventilation: The below is not different than that which is required for VRLA installations.
      i. Maximum gassing is limited to <25% of the lower flammability limit (LFL) of that gas.
      ii. May require room ventilation or fans which must be remotely monitored
      iii. Smoke detectors are required.
      iv. Gas detectors that can automatically start the room fans are required.
4) **What size battery systems must comply with the fire code?**
   a. Any lithium-ion battery 'system' with capacity greater than 20 kWh must comply with applicable sections of the fire code IFC 1206 (now 1207), which replaced IFC 608 in 2018.
   b. Samsung single cabinet is 34 kWh,
   c. LG single cabinet is 28 kWh if both strings are present. So, a half-cabinet LG system is only 14 kWh, and technically does not need to comply with IFC 1206 (now 1207).
5) **What is a 'battery array' as referenced in IFC 1206 (now 1207) and NFPA 855?**
   a. An array is typically a single cabinet or rack of batteries. An 'array' cannot be larger than 50 kWh. Samsung, and dual-string LG Chem cabinets are considered to be "arrays."
6) **Cabinet (array) spacing. What is required?**
   a. *If the user has adopted the latest fire code IFC1206 (now 1207) or NFPA 855, the below will apply.*
   b. Battery arrays (i.e., each cabinet) must be spaced 3' apart on all sides from each other and from the walls. That's approximately 64 sq ft of floorspace, per cabinet.
   c. EXCEPTION to the above, for arrays tested to UL9540A (Samsung). In which case the AHJ can review and accept the test results and can waive the 3' side and rear spacing requirements.
7) **Can these limits be exceeded if the system is accompanied by special failure analysis and lab testing?**
   a. Yes, if the Authority Having Jurisdiction (AHJ, or electrical/building inspector) approves the analysis and data.
   b. A successful 9540A test and Eaton's available test report is likely to be approved by the AHJ but a site FMEA analysis may also be required.
8) **What are the Maximum Allowable Quantities (MAQ) referenced in IFC 1206 (now 1207) and NFPA 855?**
   a. MAQ for lithium batteries in a room is 600 kWh. If the amount of lithium battery capacity in the room exceeds the MAQ, then 'Hazardous Class H-2' room construction is required. This means the room must meet stricter

fire rating and other fire and building code requirements. These limits may be waived by the AHJ, but they will need to see the UL9540A test report.

9) Is a BMS required by code?

a. Yes, and it must be listed to UL1973. All Eaton-supplied cabinets are listed.
b. IMPORTANT: Latest version of UL1973 requires, if one battery string breaker trips open, ALL of the other battery string breakers in that paralleled system must trip open as well. Manual re-closure of those breakers will be required before the battery system can be placed back into service.

10) What should you know about fire detection and suppression?

a. Smoke detectors are required, just like for VRLA.
b. Sprinkler systems (water) are required, as per IFC Sec. 903.3.1.1
c. 'Clean gaseous' agents like Novec 1230, FM200, and CO2 systems may be used, but due to their expense, are typically recommended for rooms where water would significantly damage other electrical equipment in the same room such as switchgear or IT equipment.
d. ABC type fire extinguishers are OK if the fire has NOT 'originated in or spread to', the battery itself. This does not replace the requirement for water sprinkler systems.
e. Water may be also used to cool the battery and other systems in the same room during a fire.
f. Use the battery vendor's Safety Data Sheets (SDS) to access instructions for fire suppression.

11) Signage on the battery cabinets

a. Eaton-supplied battery cabinets contain the correct signage, including nameplates, per the code
b. Note: other room signage is the responsibility of the site or owner.

12) Can lithium batteries ship internal to the battery cabinet?

a. Not yet, for Samsung. They are developing this capability.

13) Why is the Conduit Landing assembly required?

a. Conduit bushings or cable glands are required by code (NFPA 75 article 300.4(G) in the US and Canada, unless the room is restricted to authorized personnel only. Cable may not 'waterfall' into the cabinet from above tray, for example, in a room or environment that is not restricted. Some inspectors have waived this requirement, but Eaton will ship conduit landing kits with all standard lithium cabinets.
b. The Conduit landing assembly is mounted to the cabinet onsite. Instructions are provided. Total cabinet height would be an issue otherwise.

14) Why can Eaton use 2x 3/0 cables with a 600A breaker in the Samsung cabinet? Seems too small…?

a. Cable sizing for Eaton's batteries is not considered continuous operation, so Eaton can use different ratings than standard permanent continuous operation tables per NEC.
b. Eaton evaluated 2x 3/0 cables for use in Eaton Samsung solution with UL, based on temperature rise test method. That's where the recommendation comes from in Eaton's site plan. That's how the product was evaluated by UL and hence the recommendation in Eaton's site plan.

15) Can copies of Installation and Operators' Manuals be provided in advance?

a. Yes, for sales support… However, they may not be shared. The vendors' intent is that the user utilizes only the up-to-date manuals that ship with their cabinets.
b. Eaton's customer installation drawings can be shared at any time. They are posted for all lithium vendors on the Eaton.com website, found under the UPS product pages in the "drawings" section.
c. Eaton's Guide Form specifications can be shared at any time. Guide specs and Eaton customer drawings for both vendors are available on the Eaton.com website, found under the UPS product pages in the "Product specification guides" section.

Section 3: Operational FAQs

1) **Can the battery be tested for runtime?**
   a. Yes, allow at least 4 hours for charging prior to a discharge test, assuming the batteries are at least 30% state of charge when installed with the UPS.
2) What are the BTUh levels for these battery systems?
   a. See the Eaton customer drawings for BTUh levels.
3) **How long does it take to return the battery to 90% capacity after a discharge?**
   a. At the vendor-specified UPS recharge currents, it typically takes no more than 4 hours. Very large battery systems may require longer recharge time.
4) **Should recharging be delayed after a full discharge?**
   a. No. Eaton has limited the charge current per cabinet to a level that will not add internal heating to the battery, thus Eaton can begin recharging immediately upon return of input power.
5) **Can the battery cabinet communicate over the network?**
   a. Yes, all vendors communicate by Modbus TCP. The customer's connection is via a TCP/IP (RJ45) connector from the bank battery BMS module, on the vendor's cabinet/system.
   b. NOTE: no alarm history is provided in Samsung or LG cabinets. Information is real time, unless the user creates an external logging program, or utilizes the Lithium Communicator Module (LCM) accessory which stores data logs for the system.
6) **How does the lithium Battery Management System (BMS) compare with a traditional Battery Monitoring System (also BMS), like Cellwatch, for example?**
   a. Lithium battery management systems and battery monitoring systems like Cellwatch and BTech have the following similarities:
      i. Both monitor individual battery voltages and string currents
      ii. Both provide instantaneous status of individual batteries
      iii. Both (can) monitor battery terminal temperature and cabinet ambient temperature and can warn of possible thermal runaway conditions
   b. Lithium battery management systems differ from Cellwatch/Btech, in the below capabilities:
      i. Lithium Management systems "manage" the battery and can take action independently of customer interaction. For example, the BMS can disconnect the entire lithium battery string (cabinet) from the UPS if determined to be necessary and can do this without the client's permission or acknowledgement.
      ii. Lithium BMS systems also track and manage individual pack DC voltage balance to limit potential for development of thermal issues.
      iii. Most Lithium BMSs lack a user-friendly HMI interface/display. Modbus information to the site's Building Management System (also called BMS), is available for the user to implement their own data log, and storage.
      iv. Lithium BMS tracks voltage, current, temperature, balance voltages constantly for every battery. It communicates status changes and alarms immediately to the UPS, which can then send this info onto the client's network via the INDGW-X2 card.
7) **Will cabinets eventually be connectable to PredictPulse?**
   a. Yes, with pertinent information and data monitored and logged
8) **Is user monitoring software available?**
   a. No, clients must use Modbus TCP which is built-in for all lithium vendors OR
   b. The client may purchase the Lithium Communicator Module (LCM) which offers a web browser-based user interface which allows monitoring of key parameters, status information and data logging, either locally or on Eaton's Cloud platform.

Section 4: Service-related FAQs

1) **What does the user do if a battery fails in the field?**
   a. Call Eaton's field service dispatch 1-800-843-9433, same as for VRLA
2) **What parts of the installation is handled by the Eaton CSE vs. the electrical contractor?**
   a. Contractor places the empty cabinets
   b. Contractor secures the battery cabinet to the floor of the building following the installation manual instructions
   c. Contractor installs the conduit landing kit
   d. Contractor runs wire and conduit for AC control power (100-120VAC for LG, 480V or 208V 3W+G for Samsung). This power should be taken from the UPS output, so the BMS will remain functional during power outages.
   e. Contractor installs and connects all power and control wiring between the battery cabinets and the UPS
   f. Eaton field engineer installs the battery modules and other components in each cabinet for Samsung and connects the power and communication cabling internal to the cabinet.
   g. Eaton CSE performs the battery cabinet software setup and commissioning
   h. Eaton CSE makes applicable changes to the UPS charging functions, based on battery vendor's set points.
3) **How frequently are Preventative Maintenance (PM) visits recommended?**
   a. Once a year. More frequently if the user desires.
   b. PM procedure includes taking measurements, re-torquing connections, downloading and reviewing real time data from the BMS.
4) **Are spare parts recommended?**
   a. Spares kits are available from Eaton's Service sales department. Note: if spare batteries are purchased and stored, re-charge requirements (every 6 months) must be observed
5) **What information is required when quoting a field replacement for an existing VRLA installation?**
   a. Service Marketing will determine specific information required, but this commonly consists of UPS CTO number, existing battery CTO, available footprint, any weight restrictions, door height, plans for control power and connection to each cabinet's BMS system, and desired runtime for the new system.
   b. User should refer to local and national codes for compliance with lithium-ion battery installations. Eaton can advise on typical requirements.
6) **For LG Chem** (NOTE: LG Chem is discontinued for sale as of 10/2021), **what are common installation issues?** Refer to the installation manual shipped with each cabinet.
   a. **Cabinet Height:** The LG cabinet is 95" tall as shipped. Since the batteries are not installed, the cabined may be moved laying horizontally. Plan for moving this 225lb cabinet through doors, onto small elevators, and note ceiling heights where the cabinet(s) will be placed. Remember that conduit will land on top of the conduit box atop this 100.5" tall cabinet. Commercial/industrial ceiling heights are often 120", but not always. See customer drawing #110000683 for all dimensions and weights.
   b. **Wall-mount brackets:** The cabinet must be bolted to the floor, by the installing contractor, the wall mounts are not required, but are recommended.
   c. **Control power, AC:** The LG cabinet requires 100V-240VAC single phase power for its BMS and other controls. This power should be "protected," i.e., derived from the UPS output.
   d. **Remote trip of the battery cabinet breaker:** note that the UPS does NOT generate the shunt trip command for battery breakers. (a UPS "load off" or UPS EPO command will shut off the UPS but will not trip the battery breakers in the LG cabinets). The user is responsible for providing +24VDC wiring to each LG cabinet to facilitate a remote shunt trip of the battery cabinet breaker. See the installation manual and the customer drawing #110000683 for details of this connection.
   e. **Inter-cabinet control wiring for non-adjacent cabinet installations:** There is a required inter-cabinet jumper control harness that is supplied but is too short to reach from one cabinet to another when not installed adjacently. Eaton can provide a set of instructions, and parts list for this cable and its end connectors to be assembled onsite. This allows the installer to make a cable with custom length for their specific installation.
7) **For Samsung, what are common installation issues?** Refer to the installation manual part # 164000729, shipped with each cabinet.
   a. **Control Power AC:** Each cabinet has landing terminals for 2 sets of 480VAC, 15A 3-phase power, or 2 sets of 1-phase 120/240VAC. This is necessary to power the BMS and other controls. Minimum requirement is to provide a single, protected (derived from the UPS output, typically from customer's output distribution), 480V feed (or 120/240V feed, if powered by a 208VAC UPS). An additional 480V or 120/240Vfeed, from the UPS bypass source is recommended but not required. Note that if a single AC BMS power source is connected to multiple battery cabinets in parallel, the disconnection of that single source will result in all connected battery cabinets to trip their breaker. The battery system is not allowed to operate without its BMS functioning.

b. **Conduit landing kit:** This top-mounted landing kit is installed by the contractor and contains terminals for both DC power and control/status communications wiring. The installation instructions for Samsung are provided with the kit.
c. **Remote trip of the battery cabinet breaker:** note that the UPS does NOT generate the shunt trip command for battery breakers. (a UPS "load off" or UPS EPO command will shut off the UPS but will not trip the battery breakers in the Samsung cabinets). The user is responsible for providing a switch or dry contact that must close for 3 seconds to facilitate a remote shunt trip of the battery cabinet breaker. See the installation manual and the customer drawing P/N P-110000740 for details of this connection.

Section 5: Responsibilities for Section 1206 (or7) of 2018 (or 2021) International Fire Code

General

Section 1206 (now 1207) of the 2018 revision of the International Fire Code is specifying product and site requirements of Electrical Energy Storage Systems which can impact Uninterruptible Power Supply (UPS) Systems. **This document is intended to help the reader understand what portions of the code are site or owner requirements and what portions are requirements for the UPS system supplier.**

Clause/Subclause	Notes	Requirement of Site or Owner	Requirement of UPS System Supplier
1206.1	Scope	UPS equipment covered in scope	
1206.2	Stationary storage battery systems	70 kWh and above for lead acid or nickel cadmium batteries and 20 kWh and above for lithium batteries are covered in scope	
1206.2.1	Permits	Yes	—
1206.2.2	Construction documents	—	—
1206.2.2 (1)	Location and layout diagram	Yes	—
1206.2.2 (2)	Details of fire resistance materials	Yes	—
1206.2.2 (3)	Quantities and types of storage batteries	—	Yes
1206.2.2 (4)	Manufacturer's specifications, ratings, Listings	—	Yes
1206.2.2 (5)	Details on energy management system	—	Yes
1206.2.2 (6)	Location and content of signage	Yes	—
1206.2.2 (7)	Details of fire-extinguishing, smoke detection, and ventilation systems	Yes	—
1206.2.2 (8)	Rack storage arrangement, including seismic support criteria	—	Yes
1206.2.3	Hazard mitigation analysis	Yes	—
1206.2.3.1	Fault condition	—	—
1206.2.3.1 (1)	Thermal runaway	—	Yes
1206.2.3.1 (2)	Failure of energy management system	—	Yes
1206.2.3.1 (3)	Failure of required ventilation system	Yes	
1206.2.3.1 (4)	Voltage surges	—	Yes
1206.2.3.1 (5)	Short circuits	—	Yes
1206.2.3.1 (6)	Failure of smoke detection, fire-extinguishing, or gas detections system	Yes	—
1206.2.3.1 (7)	Spill neutralization not provided or secondary containment system	Yes	—
1206.2.3.2	Analysis approval	—	—
1206.2.3.2 (1)	Fires or explosion within unoccupied battery storage rooms	Yes	—
1206.2.3.2 (2)	Fires or explosions in battery cabinet	Yes	—
1206.2.3.2 (3)	Toxic and highly toxic gases reaching IDLH levels	Yes	—
1206.2.3.2 (4)	Flammable gases released during normal operation	Yes	—
1206.2.3.2 (5)	Flammable gases released during abnormal operation	Yes	—
1206.2.3.3	Additional protection measures	—	Yes
1206.2.4	Seismic and structural design	—	Yes
1206.2.5	Vehicle impact protection	Yes	—
1206.2.6	Combustible storage	Yes	—
1206.7	Testing, maintenance, and repair	Yes	—
1206.2.8.1	Location and construction	Yes	—
1206.2.8.2	Separation	Yes	—
1206.2.8.3	Stationary battery arrays	Yes	Yes
1206.2.8.4	Separate rooms	Yes	Yes

Clause/Subclause	Notes	Requirement of Site or Owner	Requirement of UPS System Supplier
1206.2.8.5	Occupied work centers	Yes	—
1206.2.8.5.1	Cabinets	Yes	—
1206.2.8.6	Signage	Yes	—
1206.2.8.6.1	Electrical disconnects	Yes	—
1206.2.8.6.2	Cabinet signage	—	Yes
1206.2.8.7	Outdoor installations	—	—
1206.2.8.7 (1)	Separation	Yes	—
1206.2.8.7 (2)	Means of egress	Yes	—
1206.2.8.7 (3)	Security of outdoor areas	Yes	—
1206.2.8.7 (4)	Walk-in units	Yes	—
1206.2.9	Maximum allowable quantities	Yes	—
1206.2.10	Storage batteries and equipment	—	—
1206.2.10.1	Listings	—	Yes
1206.2.10.2	Prepackaged and pre-engineered systems	—	Yes
1206.2.10.3	Energy management system	—	Yes
1206.2.10.4	Battery chargers	—	Yes
1206.2.10.5	Inverters	—	Yes
1206.2.10.6	Safety caps	—	Yes
1206.2.10.7	Thermal runaway	—	Yes
1206.2.10.8	Toxic and highly toxic gas	—	Yes
1206.2.11	Fire-extinguishing and detection systems	—	—
1206.2.11.1	Fire extinguishing systems	Yes	—
1206.2.11.1.1	Alternate fire-extinguishing systems	Yes	—
1206.2.11.2	Smoke detection system	Yes	—
1206.2.11.3	Ventilation	Yes	—
1206.2.11.3.1	Cabinet ventilation	—	Yes
1206.2.11.3.2	Supervision	Yes	—
1206.2.11.4	Gas detection system	Yes	—
1206.2.11.5	Spill control and neutralization	Yes	—
1206.2.12	Specific battery type requirements	—	—
1206.2.12.1	Lead-acid storage batteries	—	—
1206.2.12.1 (1)	Ventilation	Yes	—
1206.2.12.1 (2)	Spill control and neutralization	Yes	—
1206.2.12.1 (3)	Thermal run-away protection	—	Yes
1206.2.12.1 (4)	Signage	Yes	—
1206.2.12.2	Nickel cadmium storage batteries	—	—
1206.2.12.2 (1)	Ventilation	Yes	—
1206.2.12.2 (2)	Spill control and neutralization	Yes	—
1206.2.12.2 (3)	Thermal run-away protection		Yes
1206.2.12.2 (4)	Signage	Yes	—
1206.2.12.3	Lithium-ion Storage batteries		—
1206.2.12.3 (1)	Signage	Yes	—
1206.2.12.4	Sodium-beta storage batteries	—	—
1206.2.12.4 (1)	Ventilation	Yes	—
1206.2.12.4 (2)	Signage	Yes	—
1206.2.12.5	Flow storage batteries	—	—
1206.2.12.5 (1)	Ventilation	Yes	—
1206.2.12.5 (2)	Spill control and neutralization	Yes	—
1206.2.12.5 (3)	Signage	Yes	—
1206.2.12.6	Other battery technologies	—	—
1206.2.12.6 (1)	Gas detection system	Yes	—
1206.2.12.6 (2)	Ventilation	Yes	—
1206.2.12.6 (3)	Spill control and neutralization	Yes	—
1206.2.12.6 (4)	Signage	Yes	—
1206.3	Capacitor energy storage systems	—	—
1206.3.1	Permits	Yes	—
1206.3.2	Location and construction	Yes	—
1206.3.2.3	Capacitor arrays	Yes	Yes
1206.3.2.4	Signage	Yes	—
1206.3.2.5	Electrical disconnects	Yes	—

Clause/Subclause	Notes	Requirement of Site or Owner	Requirement of UPS System Supplier
1206.3.2.6	Outdoor installation of capacitor energy storage systems	—	—
1206.3.2.6.1	Separation	Yes	—
1206.3.2.6.2	Means of egress	Yes	—
1206.3.2.6.3	Security of outdoor areas	Yes	—
1206.3.2.6.4	Walk-in units	Yes	—
1206.3.3	Maximum allowable quantities	Yes	—
1206.3.4	Capacitors and equipment	—	—
1206.3.4.1	Listing		Yes
1206.3.4.2	Prepackaged and pre-engineered systems	Yes	—
1206.3.4.3	Energy management system	—	Yes
1206.3.4.4	Capacitor chargers	—	Yes
1206.3.4.5	Toxic and highly toxic gas	—	Yes
1206.3.5	Fire-extinguishing and detection systems	—	—
1206.3.5.1	Fire-extinguishing systems	Yes	—
1206.3.5.1.1	Alternative fire-extinguishing systems	Yes	—
1206.3.5.2	Smoke detection system	Yes	—
1206.3.5.3	Ventilation	Yes	—
1206.3.5.3.1	Supervision	Yes	—
1206.3.6	Spill control and neutralization	Yes	—
1206.3.7	Testing, maintenance, and repair	Yes	—