## 1. SCOPE

This Specification details the Company's requirements for 30V, 30/48V, 48V and 110V standby auxiliary D.C. supplies. The auxiliary D.C. supplies will be used for operation of switch tripping, protection tripping and other ancillary apparatus within primary or secondary substations.

## 2. ISSUE RECORD

This is a Reference document. The current version is held on the EN Document Library.

**It is your responsibility to ensure you work to the current version.**

| Issue Date | Issue No. | Author | Amendment Details |
|---|---|---|---|
| June 2009 | 6 | D Neilson | 6th Issue, Update to Drawings |
| Sept 2010 | 7 | P Dolan | 7th Issue, Major Amendments to Document. Addition of load disconnection functionality for in line with Black Start Resilience Strategy |
| March 2014 | 8 | P Dolan | 8th Issue, Updates to System Types and Requirements |
| Dec 2016 | 9 | P Dolan | 9th Issue, Updates to Battery Fusing Arrangements, DC Inputs and addition of separate distribution board requirements |
| Dec 2020 | 10 | P Dolan | 10th Issue, General updates |
| January 2026 | 11 | S Matveyev | 11th Issue, Batteries and chargers' requirements amended. System 120 hours resilience included. Battery sizing calculations provided. |

## 3. ISSUE AUTHORITY

| Author | Owner | Issue Authority |
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## 4. REVIEW

This is a Reference document which has a 5 year retention period after which a reminder will be issued to review and extend retention or archive.

## 5. DISTRIBUTION

This document is not part of a Manual maintained by Document Control and does not have a maintained distribution list but is published on the SP Energy Networks website.

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## 7. DEFINITIONS AND STANDARDS

### 7.1 Definitions

For the purpose of this specification, the following definitions shall apply:

| | |
|---|---|
| Approved: | Equipment which is approved in accordance with SP Energy Networks documents for use or installation on the Company network. |
| Company: | Refers to SP Distribution plc, SP Transmission plc and SP Manweb plc. |
| Energisation: | The application of Voltage to an item(s) of Equipment from the system. |
| Engineer: | The Company's representative having authority over technical matters contained in this Specification. |
| New: | Approved Equipment which has not previously been connected to the system and which has been routine tested in a Manufacturing Facility with a Quality Management System in accordance with the relevant standard prior to delivery. |
| SPEN: | SP Energy Networks, the brand name for the division of the ScottishPower group of Companies that encompasses SP Distribution plc, SP Manweb plc, SP Transmission plc, SP Power Systems Ltd and ScottishPower Energy Networks Holdings Ltd. |
| SP Distribution plc: | The Distribution Licence Holder for the distribution service area formerly known as ScottishPower. |
| SP Transmission plc: | The Transmission Licence Holder for the transmission service area formerly known as ScottishPower. |
| SP Manweb plc: | The Distribution Licence Holder for the distribution service area formerly known as Manweb. |
| Tenderer: | The supplier invited to tender in accordance with this Specification. |

### 7.2 International and British Standards

Equipment must preferably comply with all specified requirements, including those in the British Standards or other primary standards listed in this Specification, and all ENA Technical Specifications to which this standard refers. Where equipment is designed to an associated or equivalent standard, the Tenderer shall state in the tender all variations from the listed primary standard in equipment design/performance and shall state the title of any Associated or equivalent standard.

### 7.3 Equipment Components to be offered for Approval

Where components are specified in general terms, and specific types stated to be Approved items, equivalents may be offered for Approval. However, this must be made clear in the tender documents and sufficient information on the design and engineering performance of the equivalent components must be provided to enable a complete appraisal to be made.

Unless otherwise specified or approved, all materials and equipment used in the contract works shall be in accordance with the latest revisions, at the time of tender of such Company Technical Specification, Electricity Networks Association Technical Specification, British Standards, ISO and IEC Standards as are applicable, and in that order of preference.

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## 8. REFERENCES

The following standards and other documents are referred to in this Specification:

### 8.1 Statutory Legislation

Health and Safety at Work Act 1974
Electricity at Work Regulations 1989
Provision and Use of Work Equipment Regulations 1992

### 8.2 International Standards

| | |
|---|---|
| IEC 60297-3-101 | Mechanical structures for electronic equipment Dimensions of mechanical structures of the 482,6 mm (19 in) series Part 3-101: Subracks and associated plug-in units |
| IEC 61000 | Electromagnetic compatibility (EMC) |
| IEC 60068 | Environmental Testing |
| IEC 62271-1 | High-voltage switchgear and controlgear – Part 1: Common specifications for alternating current switchgear and controlgear |
| IEC 60269-1 | Low Voltage Fuses – Part 1: General requirements |
| ETS 300 132-2 | Environmental Engineering (EE); Power supply interface at the input of Information and Communication Technology (ICT) equipment; Part 2: -48 V Direct Current (DC) |
| IEEE 485-2020 | Recommended Practice for Sizing Lead-Acid Batteries for Stationary Applications |

### 8.3 British Standards (BS)

| | |
|---|---|
| BS 60269 | Low-voltage fuses |
| BS 60060 | High-voltage test techniques |
| BS 3864 | Graphical symbols - Safety colours and safety signs |
| BS 6121 | Mechanical cable glands |
| BS EN 62485 | Safety requirements for secondary batteries and battery installations |
| BS 6231 | Electrical cables - Single core PVC insulated flexible cables of rated voltage 600/1000 V for switchgear and controlgear wiring |
| BS 60896-21 | Stationary lead-acid batteries - Part 21: Valve regulated types - Methods of test |
| BS 60896-22 | Stationary lead-acid batteries - Part 22: Valve regulated types - Requirements |
| BS 7671 | Requirements for Electrical Installations.; IET Wiring Regulations |
| BS 61558 | Safety of transformers, reactors, power supply units and combinations thereof |
| BS 60898 | Electrical accessories - Circuit-breakers for overcurrent protection for household and similar installations |
| BS EN 60529 | Degrees of protection provided by enclosures (IP Code) |
| BS 5499 | Guidance for the selection and use of safety signs and fire safety notices |
| IEC 61000-4 | Electromagnetic compatibility (EMC) - Testing and measurement techniques - Unbalance, immunity test for equipment with input current not exceeding 16 A per phase |

### 8.4 ENA Technical Specifications (TS) and Engineering Recommendations (ER)

| | |
|---|---|
| ENA TS 09-06 | Auxiliary multicore and multipair cables |
| ENA TS 50-18 | Application of ancillary electrical equipment |
| ENA TS 98-1 | Environmental classification and corrosion protection of structures, plant and equipment |
| ENA TS 50-19 | Standard numbering for small wiring (for switchgear and transformers together with their associated relay panels) |
| ENA TS 48-5 | Environmental test requirements for protection and control equipment and systems |

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| | |
|---|---|
| ER G5 | Harmonic voltage distortion and the connection of harmonic sources and/or resonant plant to transmission systems and distribution networks in the United Kingdom |
| ENA ER G91 | Substation Black Start Resilience |

### 8.5 SPEN Documents

| | |
|---|---|
| BATT-03-003 | Substations D.C. Load Management Controller Requirements |
| | SPEN Approved Equipment Register – Batteries |
| SUB-01-022 | SPD/SPM Substation Electricity System Restoration (Formerly 'Black Start') Resilience Strategy and Policy |

### 8.6 Drawings

The schematic drawings for requested Battery Systems are shown in Section 10, BATTERY SYSTEMS INDIVIDUAL REQUIREMENT SCHEDULES.

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## 9. REQUIREMENTS

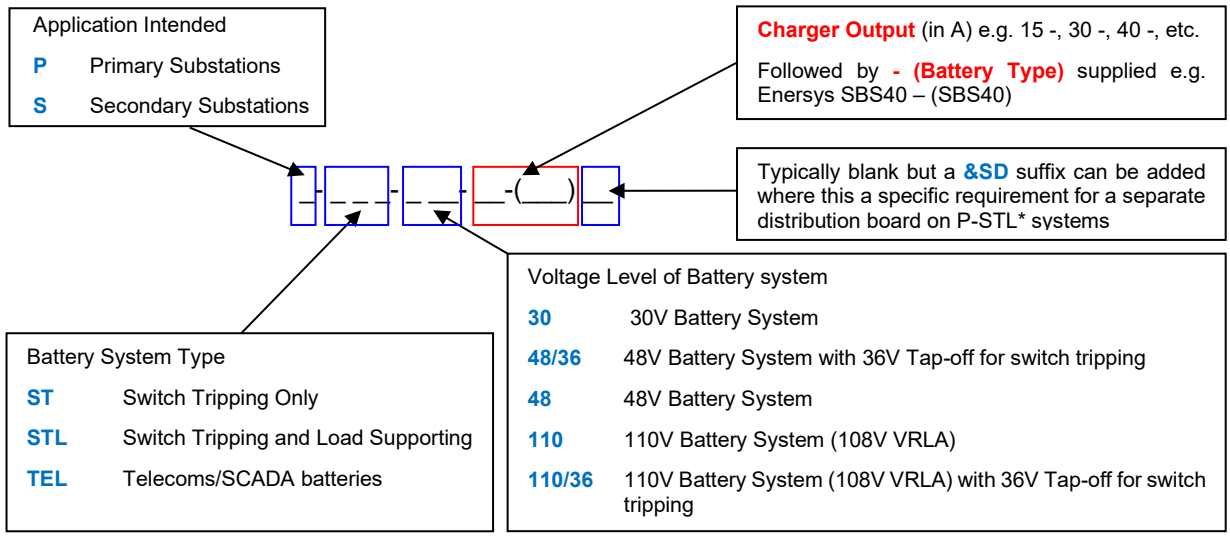
### 9.1 General Requirements

There is a requirement for three types of battery systems in this specification, mainly:

- Systems with requirement to perform switch tripping with no standing load
- Systems with requirement to perform switch tripping and support standing load
- Systems with requirement to support standing load no switch tripping requirement

Monitoring is not required on battery systems with no standing load requirement. All battery systems with requirement to support standing load shall be monitored (see section 9.7).

The naming convention for battery types shall be as follows:




The tender will provide one solution for each of the battery systems defined in the table below. Aside from the battery systems defined in the table, bespoke battery systems may be required for specific substation applications. All battery systems of the types outlined above must meet all of the relevant requirements outlined in this document.

Parts of the naming convention marked in Blue are set identifiers for the generic system type. Part of the naming convention marked in Red will be specific to prospective supplier's offerings for the generic system types.



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| Type | Description | Min Charger Output | Charger Shall accommodate batteries with capacities up to |
|---|---|---|---|
| **S-ST-30**-Y(Cylon X) | Wall Mounted Unmonitored 30V Switch Tripping Only Battery System | 0.5A | 5AHr |
| **S-ST-48**-Y(Cylon X) | Wall Mounted Unmonitored 48V Switch Tripping Only Battery System | 0.5A | 5AHr |
| **S-STL-48**-Y(X) | Monitored 48V Switch Tripping and Load Supporting Battery System | 5A | 40AHr |
| **S-STL-110**-Y(X) | Monitored 110V Switch Tripping and Load Supporting Battery System | 10A | 62AHr |
| **P-STL-30**-Y(X) | Monitored 30V Switch Tripping and Load Supporting Battery System | 30A | 310Ahr |
| **P-STL-48**-Y(X)<br>**P-STL-48/36**-Y(X) | Monitored 48V Switch Tripping and Load Supporting Battery System with option of 36V tapping fully rated for switch tripping. | 15A | 125Ahr |
| | | 25A | 190Ahr |
| | | 70A | 570Ahr |
| | | 110A | 950Ahr |
| **P- STL-110**-Y(X)<br>**P- STL-110**-Y(X)**&SD**<br>**P- STL-110/36**-Y(X)<br>**P- STL-110/36**-Y(X)**&SD** | Monitored 110V Switch Tripping and Load Supporting Battery System. | 20A | 125Ahr |
| | | 25A | 190Ahr |
| | | 30A | 250Ahr |
| | | 50A | 380Ahr |
| | | 70A | 570Ahr |
| | | 90A | 760Ahr |
| | | 100A | 950Ahr |
| **P- TEL-48**-Y(X) | Monitored 48V Telecoms and SCADA Load Supporting Positively Earthed Battery System. | 40A | 380Ahr |
| | | 60A | 570Ahr |
| | | 100A | 950Ahr |
| **SD** | Separate DC distribution Board which couples with P-STL systems | N/A | N/A |
| **E-Cab** | Extension cabinet and shelving to set up to two sets of 110 (108)V batteries (with facility to couple with existing installation | N/A | 190Ahr |

## 9.2 Equipment Standards

The Company welcomes innovation and alternatives to traditional designs that still meet the functional requirements of this Specification.

Variations must be clearly identified and prices for compliant and non-compliant equipment separately detailed.

## 9.3 Equipment Description

The design of equipment shall meet the requirements of the Health and Safety at Work Act 1974, the Electricity at Work Regulations 1989 and the Provision and Use of Work Equipment Regulations 1992, for the maximum safety of all personnel.

A brief description of the charger control design principles shall be included with the tender, such that the method of operation and the component types used are made clear.

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### 9.4 Departures from Specification

The Tenderer shall state in Technical Schedule B4 all departures from the requirements of this Specification.

### 9.5 Charger Requirements

Inputs and Outputs to the charger shall be easily accessible for testing purposes.

The Tenderer will be required to complete the Technical Schedule B2.

#### 9.5.1 Input

The charger will be operated from a 230V A.C. 50 Hz single-phase supply. The variations of supply will be between +10/-10% of the voltage and +/-1% of the frequency.

Isolation between input and output shall be provided by a double wound transformer having its windings separated by an earth screen in accordance with BS EN 61558 and further detailed in BS 7671: IEE Wiring Regulations: Protective measure: extra low voltage 414.3 & 414.4.

All elements of the design shall be able to withstand an overvoltage 433V A.C. R.M.S. differential across all terminals (connected to mains input) for up to 1 sec without any damaged to components or permanent loss of function.

#### 9.5.2 Charger Output

All battery chargers shall include temperature compensated charging capability.

The voltage output setting range of the charger shall be quoted in the tender so that all compatible batteries can be identified by the Company. Charger output settings shall be adjusted in line with the battery manufacturer's guidelines for all batteries supplied with the associated chargers.

Where batteries are not supplied with the charger and the batteries that will be coupled with the charger are not defined at the time of order, a default setting of 2.30V charge per cell at 20°C shall be applied, and temperature compensated charging shall be enabled. Otherwise, the charger output and temperature compensated range shall be matched the defined battery by the charger supplier.

Output from the charger shall be constant D.C. with a ripple content that shall not exceed +/-3%, without the battery connected.

**Charger Sizing Requirements for STL and TEL Systems**

For STL and TEL systems, the DC output current rating of the charger shall be no less than:
Minimum Charger Output Capability = C10 current of the battery + (Charger Design Margin × Standing Load Current)

To account for potential unforeseen increases in DC system load, it is advisable to include a design margin. A charger design margin factor of 1.1 shall be applied in the sizing calculation.

**Charger Sizing Requirements for ST Systems**

For ST systems that are not intended to support a standing load, the DC output current rating of the charger shall be no less than:
Minimum Charger Output Capability = C10 current for the battery

The value of any internal discharge on loss of A.C. supply via the charger with no load connected shall be stated in the tender. Internal discharge shall not exceed 0.25mA for all battery systems not designed

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to support standing load (ST Systems). Internal discharge shall not exceed 25mA for (STL) load supporting battery systems and telecoms (TEL) battery systems.

### 9.5.3 Environment

The charger shall not produce interference on the A.C. input more than that specified in EA Engineering Recommendation G5.

The equipment offered shall be tolerant of temperatures (-10C – +55C) and humidity levels 5% – 93%). Reference should be made to the IEC 60068-2.

Systems will be installed in some environments where dust is present, therefore systems which are not reliant on forced air-cooling will be considered favourably in the enquiry.

### 9.5.4 Charger Asset Life Expectancy

Chargers offered for Tripping applications shall have evidence to support a minimum expectancy life of 25 years and Chargers offered for “TEL” supporting applications shall have evidence to support a minimum expectancy life of 20 years within the environments quoted. Switch Mode Rectifiers shall not be offered for ST or STL systems. For TEL systems, Switch Mode Rectifiers shall be only considered if applied as part of a dual rectifier system.

### 9.5.5 Terminals and Connectors

All terminations shall be to ENA TS 50-18. The main connections between the charger unit, battery and D.C. distribution board shall be provided by PVC or XLPE insulated cable of adequate mechanical strength and current carrying capacity and terminating in two ring type terminations on the battery.

Terminals & connectors shall be protected against inadvertent contact by an operator. Battery terminal shrouding shall allow access for maintenance and measurement.

The P-STL-110/36 and P-STL-48/36 battery systems shall have a reduced tapping point at 36V that shall be fully rated.

### 9.5.6 Small Wiring

Small wiring shall be suitably rated stranded conductor, Type B, in accordance with BS 6231. Wires shall be coloured in accordance with the following code: ENA TS 50-18 ‘small wiring shall be coloured white, except for earth cables, which shall be Green/Yellow. End marking shall be in accordance with clause 4.8.

All wires at the equipment interface point shall have numbered ferrules at both ends in accordance with ENA TS 50-19.

### 9.5.7 Equipment Identification

For material control and inspection purposes, equipment markings, nameplates and supplier’s information shall be in accordance with international standards.

All the information shall be marked in an indelible manner on the equipment itself or on a rating plate. The Charger equipment shall carry at least the following marking:

- Manufacturer and model
- SP Type Identifications (ST, STL or TEL)
- Serial number
- Year/month of manufacture
- DC Voltages and current output ratings

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In addition, a Quick Response (QR) Code tag in VCard Format shall be provided, either on the rating plate or as a separate plate, including the most relevant data to identify the specific unit. This shall include, as a minimum, manufacturer and model, date of manufacture, serial number, SP Type identification, DC voltage, Current Output rating. In addition, it should include electronics modules firmware edition(s), equipment drawing and manual references information. This QR code shall be readable during the lifetime of the asset. For this reason, laser engraving will be preferred, although other methods can be considered for agreement with the Engineer.

### 9.6 Battery Requirements

The tenderer shall offer the option to supply Chargers with and without batteries. The type of battery offered with the chargers will be at the choice of the Tenderer subject to SPEN approval.
The required life expectancy of the battery shall be 10 years or greater at environmental conditions (-10°C – +25°C) and shall have a Eurobatt classification of 12 Year+ design life. A statement to that effect shall be included in the tender. Where nominal 110V VRLA Battery sets are requested, 108V made up of 54 Cells (9X12V Blocks) are required.

The Battery System (Charger, Fittings, Wiring, D.C. distribution board) shall be capable of withstanding the D.C. short circuit current of any batteries (sets) offered as per BS EN 60896-22:2004, Clause 6.3.

VRLA batteries submitted in the Tenderer's proposal shall be tested in accordance with BS EN 60896-21:2004 and meet all requirements identified in BS EN 60896-22:2004. Test data for all tests performed on the VRLA batteries proposed shall be made available upon request. The tender will need to complete Schedule B1 for any batteries offered for consideration for all products not currently approved (for the application identified), this requests information relating to a number of the tests specified in BS EN 60896-22.

**Further information required from the Tenderer regarding battery selection shall be completed in Technical Schedule B1 - Battery.**

All batteries shall be clearly marked to identify the manufacturer, the type reference and the date of manufacture, which shall not be a code. This marking shall be clearly visible from the front of the unit without dismantling the batteries. The +ve and -ve, and all reduced voltage terminals shall be clearly labelled.

All batteries shall be supplied in a fully charged condition and within 3 months from date of manufacture.

Approval in writing shall be obtained from the Engineer for batteries offered in this contract; any deviations for new solutions should be referenced against SPEN Approved Equipment Register - Batteries.

#### 9.6.1 Operational Requirements

A minimum resilience period shall be specified for individual battery systems during the tender or contract stage. This period will be determined based on the overall site resilience requirements and shall align with the SUB-01-022 policy.

Distribution primary substations that do not rely on AC motive power for circuit breakers and associated disconnectors shall where practicable, wherever possible, be equipped with enhanced battery and charger units. These batteries shall be sized to provide 120 hours (5 days) of resilience based on the standing DC load of the substation, unless an alternative approach is adopted. Such alternatives may aim to avoid constraints related to space or configuration by reducing the standing demand on the protection/control battery system where practicable.

Where feasible, a reduced standby period may be requested if a DC load disconnection controller is integrated with the battery system. This controller helps preserve battery life and maintain overall site resilience by shedding designated site loads. Applicable loads will be clarified at the time of enquiry.

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There are two main options that should be considered: Total DC demand disconnection and Partial DC demand disconnection.

Decision factors for Total DC demand disconnection:

- High standing demand on the battery system.
- Insufficient space to install additional battery capacity or a larger battery system.
- Complex network configuration where it is difficult to classify loads as essential or non-essential, particularly within the SPM interconnected network.
- Presence of robust Telecoms/SCADA systems equipped with 120-hour resilience batteries, providing the capability to remotely re-energise the site.

Decision factors for Partial DC demand disconnection:

- Sufficient space available to install additional battery capacity or a larger battery system.
- Essential DC loads can be clearly categorised.
- Ability to remotely re-energise the site from other locations if Telecoms/SCADA systems are not available.

The extent of DC demand that can be disconnected depends on the classification of loads as essential or non-essential. The proportion of essential DC demand varies depending on the substation's size, design, and function. Typically, switchgear bays for incomers, bus sections, and bus zone protection are considered essential as a minimum.

If a Partial DC demand disconnection scheme is implemented, to achieve 120 hours of resilience, substation batteries must supply essential loads for the full 120 hours and non-essential loads for a minimum of 12 hours. This is based on the assumption that a sustained loss of external supply is defined as lasting more than 6 hours. Therefore, non-essential DC loads shall be disconnected 6 hours after the loss of external supply and reconnected 6 hours prior to substation re-energisation.

It may be challenging to limit essential supplies strictly to the panel types previously mentioned. Certain feeders supplying embedded generation sites must also be classified as essential, as they may contribute to system restoration following a loss of external supply. Therefore, to simplify the sizing and selection of batteries associated with Partial DC Demand Disconnection schemes, and to ensure adequate supply resilience, an overall resilience period of 72 hours for the total DC load is proposed and considered acceptable.

Under the Total DC Demand Disconnection scheme, a sustained loss of external supply will result in the complete isolation of all DC loads from the substation battery system. In view of this and taking into account the factors outlined above – such as insufficient space and the complexity of the existing network configuration – it is proposed that the battery system be sized for a 48-hour standby period rather than the full 120 hours duration, with the standing load disconnected accordingly.

The use of DC demand disconnection schemes is not recommended for batteries supporting Telecoms/SCADA systems; therefore, the battery shall be sized to achieve 120 hours of resilience period.

Other options listed in the SUB-01-022 policy for achieving the required 120-hour (5-day) resilience period – such as the use of standby generation or mobile generator connection points – have not been considered and fall outside the scope of this specification.

### 9.6.2 Battery Sizing

Battery Systems Duty Requirements and required Resilience Period shall be provided at the time of the enquiry. The battery system should be sized accordingly to meet the following conditions. Lead acid batteries shall be sized in accordance with IEEE 485-2020 Recommended Practice for Sizing Lead-Acid Batteries for Stationary Applications

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a) Number of cells and minimum cell voltage

| | 30V Systems | 48V Systems | 110V Systems |
|---|---|---|---|
| Nominal voltage | 30V (15 cells at 2V per call) | 48V (24 cells at 2V per call) | 108V (54 cells at 2V per call) |
| Normal working voltage | 34.4V (15 cells at 2.29V per call) | 55.0V (24 cells at 2.29V per call) | 123.7V (54 cells at 2.29V per call) |
| Minimum permissible voltage at the battery terminals at the end of the duty cycle | 27.8V (15 cells at 1.85V per call) | 44.4V (24 cells at 1.85V per call) | 99.9V (54 cells at 1.85V per call) |
| | 3 monoblocs x 5 cells per monobloc = 15 cells, or<br>5 monoblocs x 3 cells per monobloc = 15 cells | 4 monoblocs x 6 cells per monobloc = 24 cells | 9 monoblocs x 6 cells per monobloc = 54 cells |

b) Temperature correction factor

For battery system rating, a minimum temperature of 5°C shall be used. Manufacturers typically provide ratings based on an ambient temperature of 20°C. To account for the lower operating temperature of 5°C, a temperature correction factor of 1.289 is generally applied during battery sizing calculations. This correction factor is based on a 1-hour discharge rate and is selected using IEEE 485-2020. The manufactures might provide more accurate data but in the absent of this IEEE 485-2020 factor shall be used.

c) Design margin

It is prudent to provide a capacity margin to allow for unforeseen additions to the dc system and less-than optimum operating conditions of the battery due to improper maintenance, recent discharge, ambient temperatures lower than anticipated, or a combination of these factors. A battery design margin of 1.1 shall be applied to the battery sizing calculation.

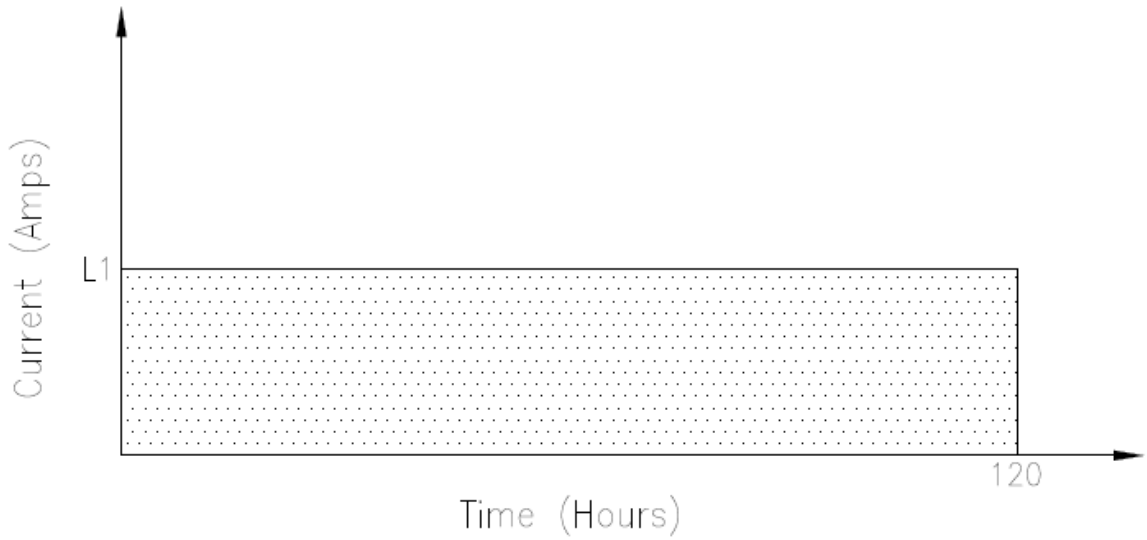
a) Ageing factor

The end of the battery's service life is defined as the point when its actual capacity falls to 80% of its nominal capacity. To ensure the battery can meet its design load throughout its service life, its rated capacity should be at least 125% of the expected load at end-of-life. Accordingly, a sizing factor of 1.25 shall be applied to account for aging in the battery sizing calculation.

b) Battery Duty Cycle

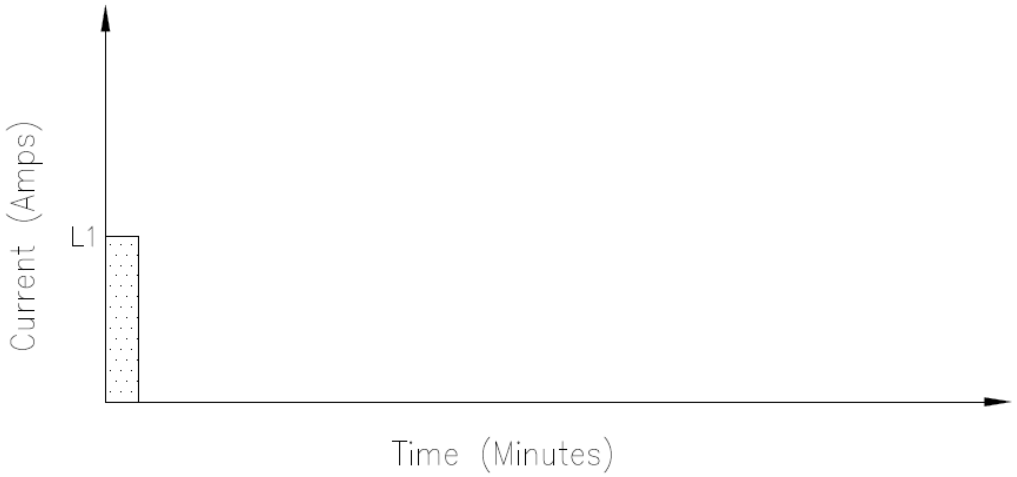
The TEL battery system shall, in the event of a failure of either the charger or its ac supply, be capable of supporting the standing dc load for a period of 120 hours.

- L1 is the standing continuous load current




The ST battery system shall, in the event of a failure of either the charger or its ac supply, be capable of supporting:

- The simultaneous opening (tripping) of the circuit breaker (L1 period)




The STL battery system shall, in the event of a failure of either the charger or its ac supply, be capable of supporting:

- The standing dc load for a specified period, followed by
- The simultaneous opening (tripping) of all circuit breakers, followed by
- The sequential closing of all circuit breakers



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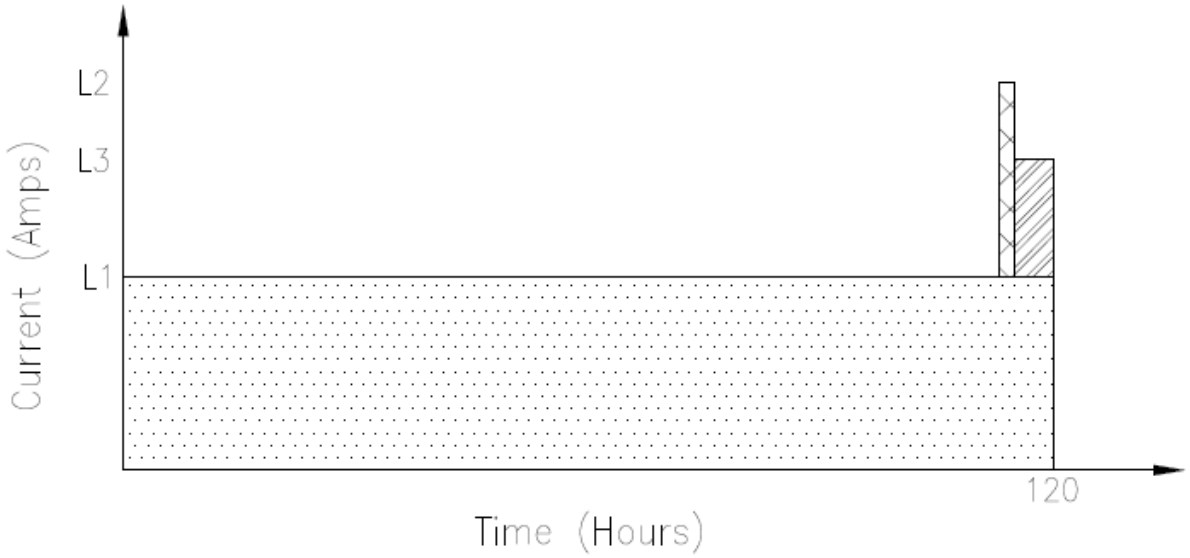


- L1 is the standing continuous load current
- L2 is the transient load current due to the simultaneous tripping of all circuit breakers (during 120 hours period) plus the standing continuous load current
- L3 is the transient load current due to the sequential closing of all circuit breakers (following their tripping) plus the standing continuous load current

### 9.6.3 Initial Calculation of Cell / Monobloc Type

Battery sizing calculations require the use of discharge characteristics specific to a chosen cell or monobloc. Therefore, a preliminary selection of the most suitable cell/monobloc type must be made before proceeding.

The selected cell/monobloc must be capable of delivering a 72-hour (in case of the DC load disconnection schemes in use) or 120-hour discharge current greater than 1.77 times the standing load current. This multiplier accounts for the design margin, ageing factor, and temperature correction factor.

For example, if the standing load current is 0.82 A, the required 120-hour discharge current is:

$$1.77 \times 0.82 = 1.45\ A$$

According to manufacturer data, Enersys 12V190F monoblocs provide a 120-hour discharge current capacity of 1.70 A, which satisfies the required threshold. Battery discharge performance data indicates that the average cell voltage will remain above the minimum specified value of 1.85 V throughout the duty cycle. This ensures compliance with the minimum permissible voltage at the battery terminals at the end of the discharge period.

Note that manufacturers typically provide discharge data for durations up to 24 hours. To estimate discharge rates for 72 and 120 hours, the 24-hour discharge rate shall be divided by factors of 3 and 5, respectively.

If the sizing calculations indicate that the selected cell/monobloc is unsuitable, the process must be repeated with an alternative type.

### 9.6.4 Battery Sizing Methodology

Consider the battery duty cycle illustrated on an amplified scale:

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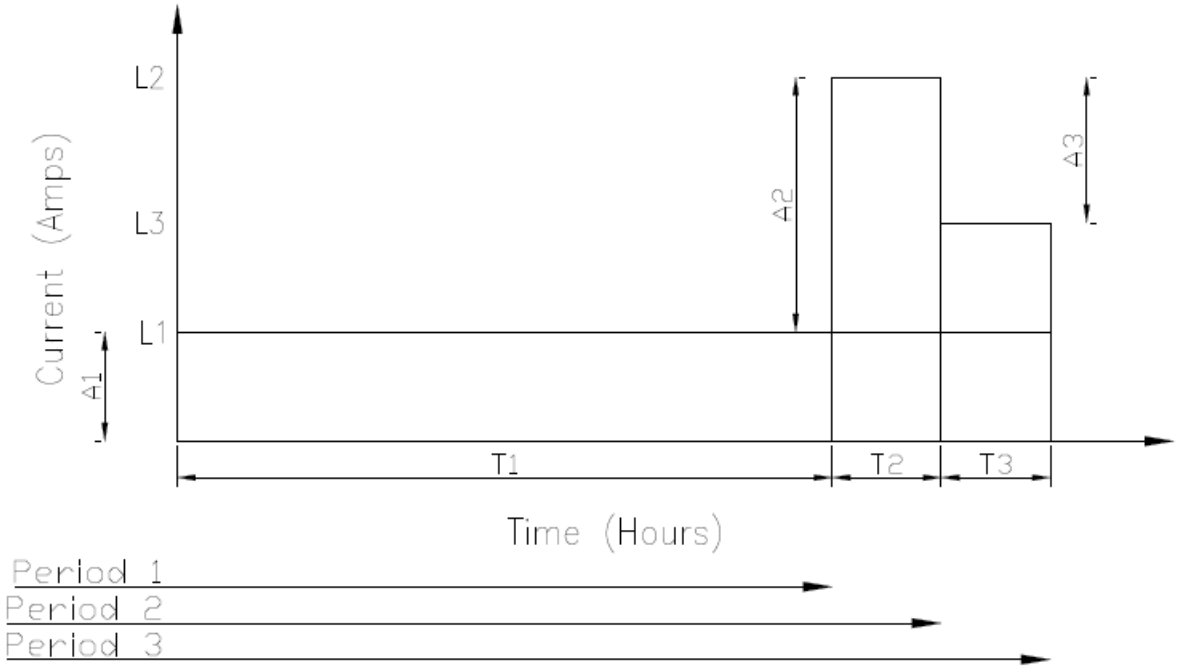



Note: A3 will be positive if L3>L2 and A3 will be negative if L2>L3.

A1 = L1
A2 = L2 – L1
A3 = L3 – L2

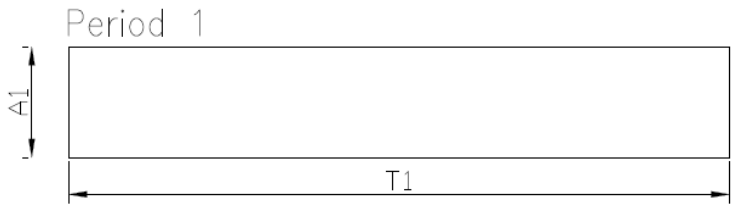
The battery must have sufficient capacity to support the combined loads throughout the entire duty cycle. To verify this, the duty cycle is divided into a series of discrete time periods. For each period, the maximum required capacity is calculated. This iterative process continues until all periods have been evaluated, and the highest (worst-case) capacity requirement is identified.

This approach ensures that the average cell voltage always remains above the specified minimum of 1.85 V during the duty cycle.
Methodology:

- Begin with Period 1 and calculate the required capacity based on its load.
- When analysing Period 2, assume the current from Period 1 continues. Adjust the capacity to account for any change in current between Periods 1 and 2.
- Apply the same logic to Period 3, and subsequent periods.

In other words, each period builds upon the previous one, ensuring cumulative capacity is accurately assessed.

$$Capacity\ for\ Period\ 1\ = \frac{A1 \times Nominal\ C10\ Capacity}{Disharge\ Current\ (T1)}$$



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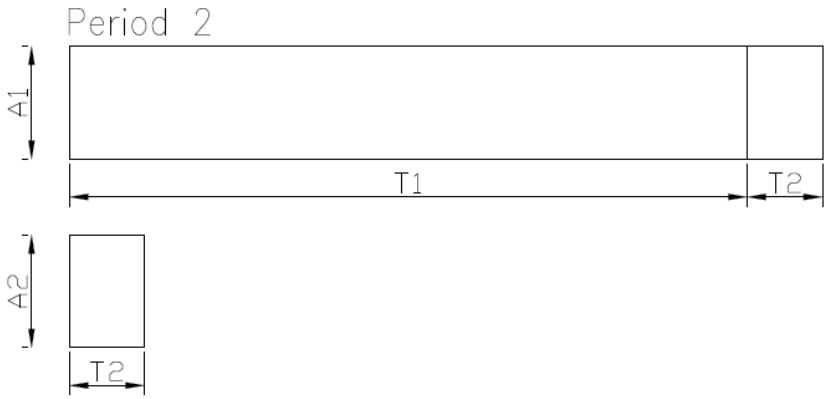
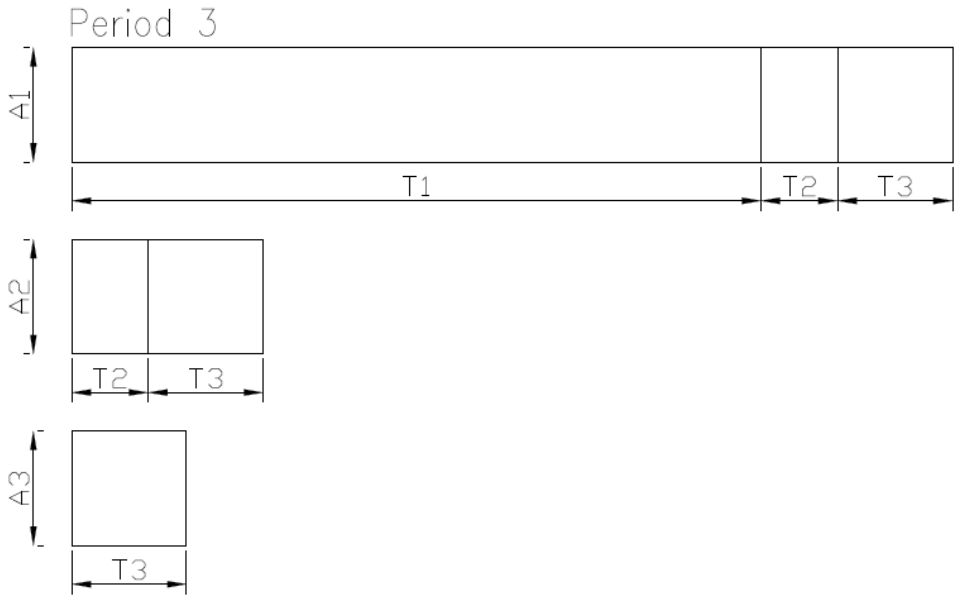
$$Capacity\ for\ Period\ 2\ = \frac{A1 \times Nominal\ C10\ Capacity}{Disharge\ Current\ (T1+T2)} + \frac{A2 \times Nominal\ C10\ Capacity}{Disharge\ Current\ (T2)}$$




$$Capacity\ for\ Period\ 3 = = \frac{A1 \times Nominal\ C10\ Capacity}{Disharge\ Current\ (T1+T2+T3)} + \frac{A2 \times Nominal\ C10\ Capacity}{Disharge\ Current\ (T2+T3)} + \frac{A3 \times Nominal\ C10\ Capacity}{Disharge\ Current\ (T3)}$$




### 9.6.5 Example Calculation

A 110V STL battery charger system is required to support an 11kV substation containing three circuit breakers.

Each circuit breaker demands:

- 200 watts for 60 milliseconds for tripping operations.
- A spring charging motor that requires 180 watts for 6 seconds to recharge.
- 200 watts for 60 milliseconds for closing operations.

The combined standing continuous load across the three panels is 90 watts.

T1 = 120 hours
T2 = 60 milliseconds
T3 = 18 seconds (i.e. 3 x 6 seconds)



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Loads expressed in watts should be converted to a current equivalent. Minimum cell voltage should be used for the purpose of this conversion.

L1 = 90W / (54 cells x 1.85V per call) = 0.90 A
A1 = L1 = 0.90 A

L2 = L1 + simultaneous tripping burden
= L1 + (3 x 200W) / (54 cells x 1.85V per call) = L1 + 6.01 A
A2 = L2 – L1 = 6.01 A

L3 = L1 + sequential closing burden + sequential spring motor charging
= L1 + (200W+ 180W) / (54 cells x 1.85V per call) = L1 + 3.80 A
A3 = L3 – L2 = (L1 + 3.80 A) - (L1 + 6.01 A) = - 2.21 A

Note that A3 is negative in this instance.

**Initial Calculation of Cell / Monobloc Type**

A suitable cell or monobloc type must be selected with a 120-hour discharge current capability, as all three panels are considered part of the essential supply. The selected unit must be capable of delivering a current greater than 1.77 times the standing load current.

In this case, the standing load current is 0.82 A, resulting in a required discharge current of:

$$1.77 \times 0.90 = 1.59\ A$$

The Enersys 12V190F monobloc is capable of supplying 1.70 A over a 120-hour period, which meets the requirement.

**Period 1 Calculation**

T1 = 72 hours

Enersys 12V190F monoblocs characteristics are:

- 120-hour discharge current = 1.70 A
- Nominal C10 capacity = 190 Ah

Current A1 = 0.90 A
T1 = 120 hours

Capacity = 0.90 x 190 / 1.70 = 100.59 Ah [1A]

Capacity for Period 1 = [1A]
= 100.59 Ah

**Period 2 Calculation**

T2 = 60 milliseconds
T1 = 72 hours

Enersys 12V190F monoblocs characteristics are:

- 60 milliseconds discharge current = 332.6 A (5-minute value is used)
- 120-hour 60 milliseconds discharge current = 1.70 A (120-hour value is used)
- Nominal C10 capacity = 190 Ah

Current A1 = 0.90 A
T1+T2 = 120 hours 60 milliseconds

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| | | |
|---|---|---|
| Capacity | = 0.90 x 190 / 1.70 = 100.59 Ah | [2A] |
| Current A2 | = 6.01 A | |
| T2 | = 60 milliseconds | |
| Capacity | = 6.01 x 190 / 332.6 = 3.43 Ah | [2B] |
| Capacity for Period 2 | = [2A] + [2B]<br>= 100.59 Ah + 3.43 Ah<br>= 104.02 Ah | |

**Period 3 Calculation**

T3 = 18 seconds
T2 = 60 milliseconds
T1 = 72 hours
Enersys 12V190F monoblocs characteristics are:

- 18 seconds discharge current = 332.6 A (5-minute value is used)
- 18.060 seconds discharge current = 332.6 A (5-minute value is used)
- 120-hour 60 milliseconds discharge current = 1.70 A (120-hour value is used)
- Nominal C10 capacity = 190 Ah

| | | |
|---|---|---|
| Current A1 | = 0.90 A | |
| T1+T2+T3 | = 120 hours 18.060 seconds | |
| Capacity | = 0.90 x 190 / 1.70 = 100.59 Ah | [3A] |
| Current A2 | = 6.01 A | |
| T2+T3 | = 60 milliseconds | |
| Capacity | = 6.01 x 190 / 332.6 = 3.43 Ah | [3B] |
| Current A3 | = -2.21 A | |
| T3 | = 18.060 seconds | |
| Capacity | = -2.21 x 190 / 332.6 = -1.26 Ah | [3B] |
| Capacity for Period 3 | = [3A] + [3B] + [3C]<br>= 100.59 Ah + 3.43 Ah -1.26 Ah<br>= 102.76 Ah | |

**Highest Capacity Period**
The period with the highest capacity is Period 2 = 104.02 Ah

**Battery Capacity Required**

104.02 Ah x 1.1 (Design Margin) x 1.25 (Ageing Factor) x 1.289 (Temperature Correction Factor) = 184.36 Ah

**Overall Assessment**

A battery with a nominal C10 capacity not less than 184.36 Ah is required.

Enersys 12V190F monoblocs have a nominal C10 capacity of 190Ah and therefore are adequate for the intended application.

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**Charger Sizing**

The charger's DC output current rating must be no less than the sum of:

C10 current of the battery + (Charger Design Margin × Standing Load Current)

(Refer to Section 9.5.2 for details.)

For the Enersys 12V190F monoblocs:

- Nominal C10 capacity = 190 Ah
- Nominal C10 discharge current = 19 A

Standing load current = 0.90 A

Therefore, the minimum required charger output current is:

$$19\ A + (1.1 \times 0.90\ A) = 19.99\ A$$

Conclusion:
A charger with a DC output current rating of at least 20 A should be selected.

## 9.7 Charger Controls, Indications and Alarms

The charger fittings required will be specific to the individual battery systems as detailed in the individual system schedules outlined in section 10.

Voltmeters and Ammeters may be by means of analogue instruments or via LCD displays. The Voltage Across each battery set shall be monitored and displayed locally and transmitted remotely.

All Battery Systems shall have Test switches of the self re-set type controlling a battery test load.

Where specified D.C. charger input fuse holders shall be fitted with appropriately rated HRC fuses, to allow the D.C. supply to be maintained from an alternative source while maintenance/ replacement of the main battery cells is undertaken.

Where specified, battery monitoring shall have the following features:

- Periodic battery asymmetry monitoring and alarm;
- Periodic battery impedance monitoring and alarm;
- Configurable High and Low voltage detection and alarm:
    - These must be set to manufacturer's recommendation for specific cells used where cells are supplied with the charger
    - Where chargers are supplied without cells the following default settings must be applied:
        - Low Alarm – 2.1V / cell (Default)
        - Low Alarm Reset – 2.25V / cell, 30 sec alarms reset required
        - High Alarm – 2.4V / cell (Default), 2.5 Seconds reset required
        - High Voltage Charger shutdown and alarm– 2.53V/Cell (Default)
            - High Volts shutdown shall be manual reset (and reconnection via a push button switch).
- An earth fault alarm shall be configured for STL battery systems; this is not required for positive earthed TEL battery systems:
    - This shall detect Earth faults on either pole of the associated D.C. system
- Supply fail and charger failure alarm;
- Fuse Fail Alarms (TEL Systems Only).

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### 9.7.1 Auto Test Facility

The facility to automatically test the battery sets by switching charger output down and supply the standing load (only) shall be provided with all STL and TEL D.C. systems. The regularity and duration of the test should be adjustable and be executed in a manner where there is no risk to the continuity of supply to the load and such that there is no appreciable degradation of the battery asset life.

### 9.7.2 Battery Deep Discharge Protection

Options should be offered for solutions to prevent deep discharge on TEL battery systems and STL systems intended for use in secondary substations. Details of all solutions offered, and costs should be included in the enquiry. Where offered, associated systems shall have the facility to enable or disable deep discharge protection as required.

### 9.7.3 High Voltage Charger shutdown

The high voltage and charger shutdown facility should, alarm and cut-off respectively when the charger output goes beyond a pre-set threshold (default 2.53V/Cell). Reconnection of the charger supplies should be manually initiated by a dedicated push button.

### 9.7.4 Unauthorised D.C. Load Connection (TEL Systems)

The battery charger system shall include monitoring functionality to detect any unauthorised D.C. load connections exceeding the rated charger output. This alarm shall be configurable based on site-specific requirements. Upon detection, an alarm signal shall be generated and transmitted to SCADA after a defined time delay, ensuring visibility and enabling appropriate action. This measure supports system integrity and compliance with operational standards.

### 9.7.5 Test Discharge Function

All systems shall include a dedicated Push Button; Self Reset Type which when pressed imposes a battery test load in addition to all connected D.C. loads. Safeguards must be provided to ensure that the load is not applied for a period exceeding 10 seconds. When connected, the test load shall draw a current equal or greater than the charger output capability / C10 Current Rate of associated battery unless otherwise agreed.

This switch shall either disconnect the charger or lower the charger output when pressed and shall either initiate an alarm if battery problem is detected or give a visual indication of battery output voltage for the duration of the test (for unmonitored systems).

The test load resistor shall be located within the battery and charger system and shall be placed in manner as to reduce risk of fire and risk of personal contact.

### 9.7.6 Local Indications and Remote Alarms

When battery monitoring is specified & fitted, the following Local Indications and Remote Alarms shall be raised for the following conditions:

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| Condition | Local Indication | | | Remote Alarm | |
|---|---|---|---|---|---|
| | Presentation | Time Delay | Potential Display Grouping | Time Delay | SCADA Alarm Grouping |
| Mains Fail<br>Loss of A.C. Supplies to the Charger unit | LED / LCD | Instantaneous | Mains / Charger Fail | 10 minutes | Urgent |
| Charger / Rectifier Fail (“) | LED / LCD | Instantaneous | | 10 minutes | |
| High Volts Alarm | LED / LCD | Instantaneous | | 1 minute | |
| High Volts Shutdown | LED / LCD | Instantaneous | | 1 minute | |
| Low Volts alarm | LED / LCD | Instantaneous | | 1 minute | |
| Asymmetry alarm | LED / LCD | Instantaneous | Battery Fail | 1 minute | |
| Auto-test facility (Battery Fail detection) | LED / LCD | Instantaneous | | 1 minute | |
| High Impedance (option) | LED / LCD | Instantaneous | | 1 minute | |
| Deep Discharge Protection Operations (if provided) | LCD | Instantaneous | | 1 minute | |
| Fuse Fail Alarm (^) | LCD | Instantaneous | Fuse fail | 1 minute | |
| Earth Fault (*)<br>Positive Side of the D.C. distribution | LED / LCD | Instantaneous | Earth Fault | 1 minute | Non-Urgent |
| on Negative Side of the D.C. distribution | LED / LCD | Instantaneous | | 1 minute | |

**(“) For Dual Rectifier Solutions Urgent Alarm for failure of either rectifier**
**(^) Required for TEL Systems only**
**(*) Not required for TEL Systems**

Indications of operation of each of the individual alarms provided shall be clearly visible from the charger unit front panel. All fault conditions must initiate a clearly viable Alarm LED or equivalent, however it is acceptable to distinguish individual conditions via LCD display menu (not individual LED indications).

For Fuse Fail Indications, individual Fuse Fail Indications are required for B & C type systems and preferred for A type systems.

Remote alarms shall only be raised after a specified time delay and shall be cancelled in the condition which has initiated the condition is not sustained to stop nuisance alarms caused by transients.

When battery monitoring is specified & fitted, alarm contacts should be of the normally closed in the de-energised state and shall be held open under normal conditions. Any failure in the relays from which the alarms are derived shall result in the issue of the associated alarm(s).

All alarms should be non-latching (or “self-resetting”) in nature and shall be presented as volt-free contacts (wetting current 5-20mA).

In addition to generic requirements alarm output requirements, TEL (B & C) Type Systems shall be remote managed by IP using HPOV or similar, this functionality is preferred for TEL (A) Type Systems but not essential. The supplier shall ensure that all MIBS used are pre-determined and agreed with the Engineer. A RJ45 connection shall be made available for the remote management.

### 9.7.7 Voltage Monitoring

The Voltage Across each battery set shall be monitored and transmitted remotely for selected Primary Substation STL Systems confirmed in schedules, Section 10 BATTERY SYSTEMS INDIVIDUAL



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REQUIREMENT SCHEDULES. The minimum of accuracy of all measured analogue values shall be +/- 1%.

Outputs should be presented in either of the following formats as required:

- 0 – 10mA
- 4 – 20mA

If offered, options for serial communications will be considered on an individual application basis.

### 9.8 Enclosure and Distribution Board Requirements

#### 9.8.1 Enclosure Requirements

All Cabinets shall have a minimum rating of IP31, BS EN 60529. All cabinets provided shall be of sheet steel construction throughout. Cabinets shall be front entry.

Where a cubicle has been specified to house a full D.C., system associated sub-elements of the system should be grouped together within the same panel. Charger components, distribution ways and batteries should be segregated and clearly labelled on both the front and rear of the cubicle.

Provision should be made to accommodate a future load disconnection device within the charger cabinet (a minimum rack space of 4u height) for all systems where this requirement is identified, Section 10.

Considerations shall be given to the future maintenance and repair of all battery system components contained within cubicles at the time of the design.

All Cabinets which house batteries shall have adequate ventilation at the highest point in order to prevent the potential build-up of gases should overcharging occur. Cabinet ventilation shall be designed to safely handle gas emissions as would be expected for batteries declared as compatible with the system as per clause 6.1, BS EN 60896-21:2004 (or otherwise applicable standards where an alternative technology to Lead Acid Batteries is offered).

Arrangement of the cabinets for housing batteries should take into consideration the codes of practice set out in BS EN 62485 for lead acid. Each cabinet shall be acid resistant.

All cabinets housing batteries shall be arranged such that all cells/battery blocks can be visually inspected in situ. Where applicable, the cabinets shall be adequately sized to allow topping up of cells in situ and arranged so that cell levels can be viewed with all cells in position. Battery inspection, maintenance and cell replacement should be able to be carried out by accessing the batteries through doors of the cabinet which do not require tools for access.

The charger components and alarm relay should be sufficiently accessible for test purposes, and for replacement, without compromising the safety of the personnel.

All cabinets shall be fitted with removable M12 high tensile brass earth studs at the bottom of both sides of the cabinet for connecting the substation earth bar to the cabinet for earthing all metalwork. Lifting eyes shall be provided on all free-standing cabinets. Wall mounted Cabinets which weight more than 50kg shall also be provided with lifting eyes.

Cabinets shall be adequately packed to avoid damage in transit. Where reasonably practical a robust pocket, suitable for accommodating the “Commissioning, Operation and Maintenance Manual” and the Battery Logbook, shall be provided on the inside of the cubicle.

In addition to the generic cabinet requirements, individual battery systems have the specific requirements detailed in the individual battery system requirements schedules section 10.

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A drawing of the cabinet(s) layout shall be provided at the time of tender. The available space for the accommodation of the battery shall be clearly stated in the tender. The Engineer shall agree cabinet(s) design and layout before the award of the contract.

### 9.8.2 Cable Entry

Cable entry requirements will be specific to individual systems / distribution boards and as such are defined in battery systems requirements schedules, section 10. Where Cable Glands are provided they shall be to BS 6121. There should be adequate internal access to the cabinet to enable wiring to internal terminals from each respective cable entry point.

There shall be no requirement to modify or dismantle any internal panels to terminate cables of continuous current carrying capacity equal to or greater than the fuses designated for associated D.C. ways. Sufficient space shall be available in the enclosure such that associated cables are able to be terminated without exceeding the manufacturers recommended bend radii and without impinging on any surface or apparatus within the enclosure.

### 9.8.3 Labelling of Fittings

All enclosures shall be marked in accordance with Clause 5-10 of IEC 62271-1 as referred to in ENA TS 50-18.

A label showing black letters on a white background shall be affixed adjacent to each fitting and terminal, to indicate the function. In the case of a relay, if there is a visible internal label, no additional label is required.

Each Cabinet shall be identified by a non-corroding indelibly marked data plate giving the following information and marked in accordance with ENA TS 50-18.

- Manufacturer's Name
- Year of Manufacture
- Serial Number
- Diagram of Connections, Drawing Number
- The Company's Order Number

Safety-warning labels shall comply with BS 5499 referenced in ENA TS 50-18.

### 9.8.4 A.C. Supply

Each charger's input supply shall be fitted with appropriately rated 2 pole MCB which comply with ENA TS 50-18 and BS EN 60898-1 and accommodate the maximum inrush of the transformer associated with the charger system.

### 9.8.5 D.C. Busbars and Distribution

The Fusing/Linking and D.C. distribution arrangements of the battery and battery system controller / instrumentation and distribution ways shall be adequate for the systems where they are provided including safely requirements listed in BS EN 62485-1 and BS EN 62485-2.

It shall be possible to fully isolate the charger unit from the D.C. Busbars and Battery. Each ring and spare way shall be supplied with suitable labelling of output fuse holders.

Suggested distribution configurations are listed in the charger schedules, Section 10 which includes options for batteries and chargers with integrated distribution boards and external distribution boards. Variations from these nominal distribution arrangements will be requested as required for individual site requirements.

Battery Systems with an integrated D.C. Distribution board where the charger can be replaced without disturbing the D.C. Distribution board shall be looked upon favourably in the tender.

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In Systems with a separate D.C. distribution board, it shall be possible to locally isolate the distribution board from the battery and charger unit with the aid of a lockable isolation switch.

Termination for outgoing distribution cables shall be provided on a terminal block that will then be wired to a fuse way fitted with locknuts and washers.

The number of distribution ways is listed for each type in Section 10, suppliers should identify limits to number of ways that can be supplied with each design and incremental option costs for additional ways (for ratings of fuses already listed for the application type).

### 9.8.6 Fuses and Links

Battery connections and all distribution ways shall be fitted with Fuse Holders and protected with appropriately rated HRC fuses. Fuses and Links, shall be cartridge type, BS88 and comply with ENA TS 50-18 Clause 6, IEC 60269-1.

Fuse bases and associated carriers intended to accommodate a fuse link shall be of clearly distinguishable colour. Fuse bases and associated fuse carriers intended to accommodate a solid – link (non-fusible link) shall be coloured white. Each battery string shall be fused on both the positive and negative poles for all applications.

Systems offered shall be adequately protected as to withstand the maximum battery short circuit current appropriate to the battery (set) offered BS EN 60896-22: Clause 6.3.

All STL Chargers shall be provided with a spare set of Battery Fuses secured to the internal side of the charger front panel door.

### 9.8.7 D.C. Temporary Connections Way

Anderson SB175 or equivalent Sockets for connection of temporary supplies or test loads shall be provided for Battery Systems Distributions where this requirement is identified as per section 10. These D.C. Sockets shall be 2 Connector Multi-pole Type, of a size and rating appropriate to the associated D.C. System, mounted such that associated plugs cannot be fitted incorrectly. Full details of the proposed make and type should be included in tender for approval.

Sockets shall be provided on the distribution board busbars and shall have labels affixed stating **“Connections shall only be made to the input socket where there is adequate source protection on the incoming supply and the supply is equal in voltage to the battery and charger system to which it is being connected”.**

Sockets shall be provided feeder side of the outgoing tripping supplies derived from a tap off from a higher voltage battery where this arrangement is provided. Associated sockets shall have labels affixed stating **“Connections shall only be made to the input socket where there is adequate source protection on the incoming supply and after the outgoing way has been isolated from the battery and charger system”.**

Additionally, sockets may be supplied downstream of battery fuse ways for battery testing purposes at the option of the tenderer.

### 9.8.8 D.C. Load Disconnection

All primary substations STL battery systems which support a standing D.C. load shall be constructed such that controllers for disconnecting selected D.C. loads can be easily integrated into the battery and charger system as required. The requirements of Load disconnection control systems that may be added are specified in BATT-03-003.

The minimum requirement within associated battery charger systems shall be the provision of a removable bolted link on the Positive D.C. Busbar with terminals provided such that suitably rated wiring

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can be installed in parallel with a device capable of making/breaking load when the linking bar is removed. Systems shall be provided such that fuse ways (D.C. loads) can be selectively disconnected on applications where the distributions board is integrated with the battery charger system and provided as a separate board. On separate D.C distributions boards, linking and isolation shall be arranged such that it is possible to completely back feed the D.C distribution board from a single connection and fully isolate it from the battery and charger. Further detail can be found in equipment schedules, section 10.

## 9.9 Testing

### 9.9.1 Charger Transformer and Circuit Insulation

The insulation between windings, screen, core and frame of the transformer and circuits directly connected to the 230V A.C. shall withstand 2 kV A.C. rms, 50 Hz for one minute. Immediately afterwards the insulation resistance measured at 500 volts D.C. shall not be less than 20 MΩ.

All circuits intended to be connected to the 230 V A.C. supply shall withstand 2 kV A.C. rms., 50 Hz for one minute. Immediately afterwards the insulation resistance measured at 500 V D.C. shall not be less than 20 MΩ.

### 9.9.2 Environmental Testing Requirements

Reference should be made to IEC 61000-4 EMC compatibility testing. The vendor shall also demonstrate that Charger Control and Alarm Modules offered as part of the overall solution meet adequate Electrical Environment and EMC Requirements by completing Tables in Schedule B3.

The list of the tests to be completed are taken from ENA TS 48-5 however it is acceptable that Vendor equipment offered is tested to equivalent test procedures. The procedure used for each test must be confirmed, along with specified and actual test levels, compliance statements and acceptance criteria where appropriate.

Specifically, electronic circuitry shall be type tested by application of 5 kV full standard lightning impulse with 1.2/50 µS characteristics as defined in BS 60060 (or equivalent). Three positive and three negative impulses shall be applied as follows:

- Between the output terminals with the battery connected;
- Between the output terminals connected together and earth, with the input terminals earthed; and
- Between the input terminals connected together and earth, with the output terminals earthed.

After the above tests, there shall be no indication of failure and the charger shall still provide the required performance. The insulation resistance between the electronic circuitry and earth when measured at 500 V D.C. shall not be less than 20 MΩ.

The psophometric noise level of the complete TEL systems shall not exceed the equivalent emf of 2 mV rms at a frequency of 800 Hz after weighting as specified by ITU-T and shall not exceed an emf of 10 mV in the frequency range 25 Hz to 5 kHz as specified in ETS 300 132-2.

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## 10. BATTERY SYSTEMS INDIVIDUAL REQUIREMENT SCHEDULES

| Battery System Type(s) | **S-ST-30** | | **S-ST-48** |
|---|---|---|---|
| Voltage | 30V | | 48V |
| Description | Unmonitored 30V Switch Tripping Only Battery System | | Unmonitored 48V Switch Tripping Only Battery System |
| Charger Output | ~0.5A | | ~0.5A |
| Capacity Requirements | 5Ahr Capacity | | 5Ahr Capacity |
| Charger Setting Range | Charge setting range shall be adjustable such to enable all currently available batteries of the required capacity to be installed with the charger at batteries manufacturers advised settings ranges. Where temperature compensated chargers are offered ambient temperatures range shall be -10°C – 25°C. | | |
| Internal Discharge Requirements | The value of Internal Discharge on loss of A.C. supply via the charger with no load connected shall not exceed 0.25mA | | |
| Cabinet Requirements | Type | | Wall Mounted |
| | Maximum Dimensions Guidance | | 400W/300D/500H |
| | Cable Entry Requirements | | 2 x 20mm with Gland plate (2 each top left and right sides) pre-drilled and covered |
| Charger Fittings | Item | Description | |
| Meters (Section 9.7) | Voltmeter | Shall give indications of voltage across charger/battery output terminals (On Push Button Acceptable) | |
| | Ammeter | Shall Indicate Charge and Discharge Currents | |
| Manual Switches (Section 9.7.5) | Test Switch | Dedicated Push Button Self Reset Type Controlling a battery test load which disconnects or lower charger output when pressed | |
| Alarm Requirements | No Alarms Required | | |
| A.C. Input | Shall be fitted with appropriately rated 2 pole MCB | | |
| Battery and D.C. Ways Requirements | System Fused only at Battery with 20A fuse ways for single outgoing way<br><br>Red and Black Anderson Genderless Powerpole Type sockets to be provided to connect battery main terminals | | |

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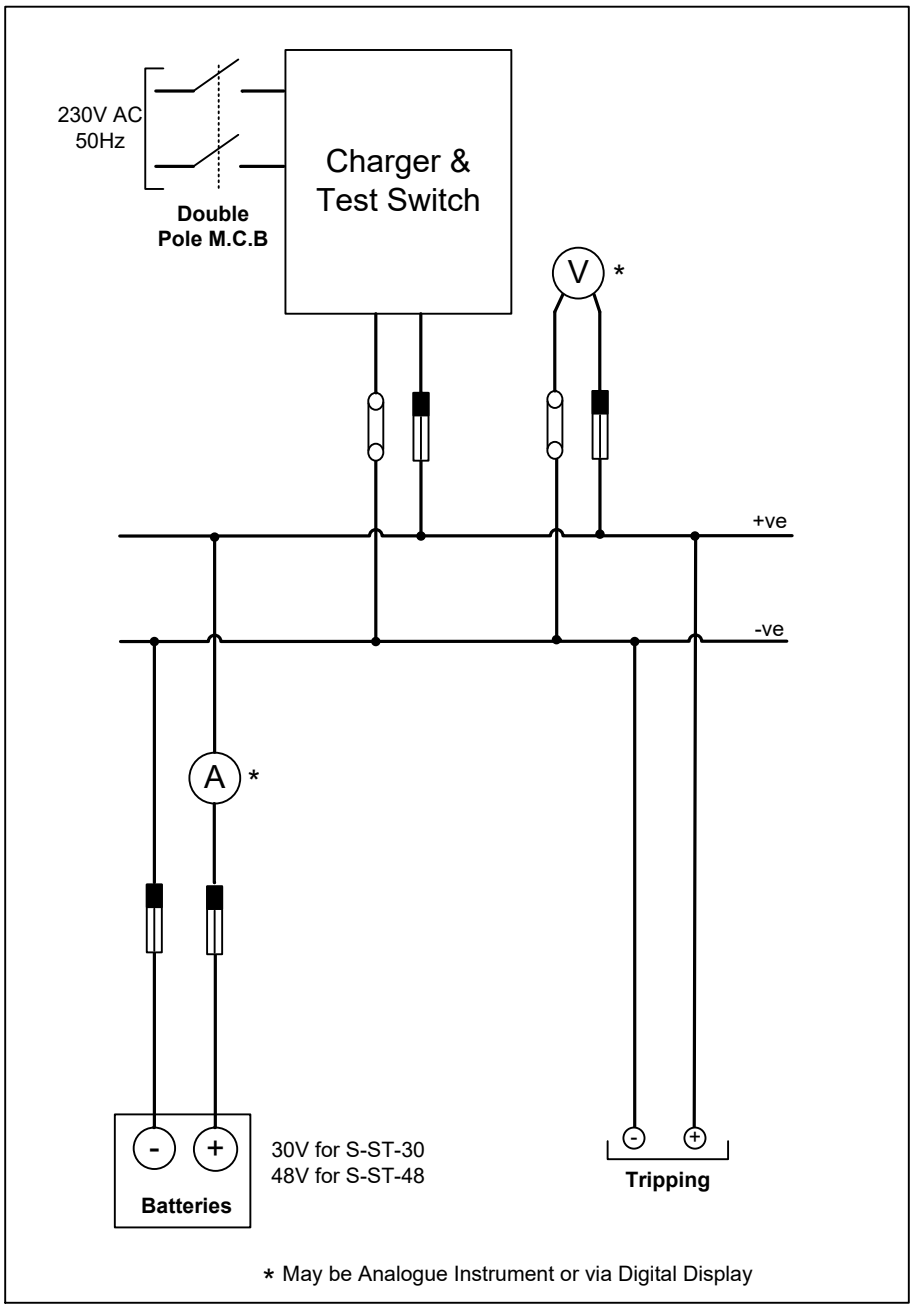


**Figure 1: Schematic of S-ST-48 and S-ST-30 Type Systems**

| | | | | |
|---|---|---|---|---|
| Battery System Type | **S-STL-48-Y(X)** | | **S-STL-110-Y(X)** | |
| Voltage | 48V | | 110V (108V 54 Cells) | |
| Description | 48V Switch Tripping and Load Supporting Battery System | | 110V Switch Tripping and Load Supporting Battery System | |
| Charger Output | 5A | | 10A | |
| Battery Accommodation | Up to 40Ahr | | Up to 62Ahr | |
| Internal Discharge Requirements | The value of Internal Discharge on loss of A.C. supply via the charger with no load connected shall not exceed 25mA | | | |
| Cabinet Requirements | Type | | Wall Mounted where possible | |
| | Cable Entry Requirements | | 20mm x 8 Top and Bottom Entry with Gland Plates pre-drilled and covered | |
| Charger Fittings | Item | Description | | |
| Meters (Section 9.7) | Voltmeter | Shall give indications of voltage across charger/battery output terminals | | |
| | Ammeter | Shall Indicate Charge and Discharge Currents | | |
| | Ammeter | Shall Indicate the System Load (total outgoing ways) | | |
| Manual Switches (Section 9.7.3) (Section 9.7.5) | Test Switch | Dedicated Push Button Self Reset Type Controlling a battery test load which disconnects or lower charger output when pressed | | |
| | HV Shutdown Reset Switch | High Voltage Charger Shutdown and Manual Reset Required | | |
| Deep Discharge Protection (Option) | Contactor | Contactor to remove all load when the battery is entering deep discharge and reconnector load when charger supply re-established | | |
| Indications and Alarms | Condition | Possible Local Indication LED Grouping | SCADA Alarm Grouping | |
| Conditions to be Detected and Presented (Section 9.7.6) | Asymmetry | Battery Fail | Urgent | |
| | Impedance | | | |
| | Auto–Test (Battery Fail) | | | |
| | High Volts | Charger / Supply Fail | | |
| | Low Volts | | | |
| | Rectifier fail | | | |
| | Mains Fail | | | |
| | Earth Fault (+ve) | Earth Fault | Non-Urgent | |
| | Earth Fault (-ve) | | | |
| Auto Test Facility (Section 9.7.1) | Facility to automatically test the battery sets by switching charger output down and the standing supplying load (only) | | | |
| A.C. Input | Shall be fitted with appropriately rated 2 pole MCB | | | |
| D.C. Ways Requirements (Section 9.8.5 – Section 9.8.6) | Each Way shall be fitted with Fuse Holders and protected with appropriately rated HRC fuses | | | |
| | D.C. Ways | D.C. Inputs | D.C. Distribution Ways | |
| | Rating | N/A | 32A | |
| | Quantity | 0 | 1 | |

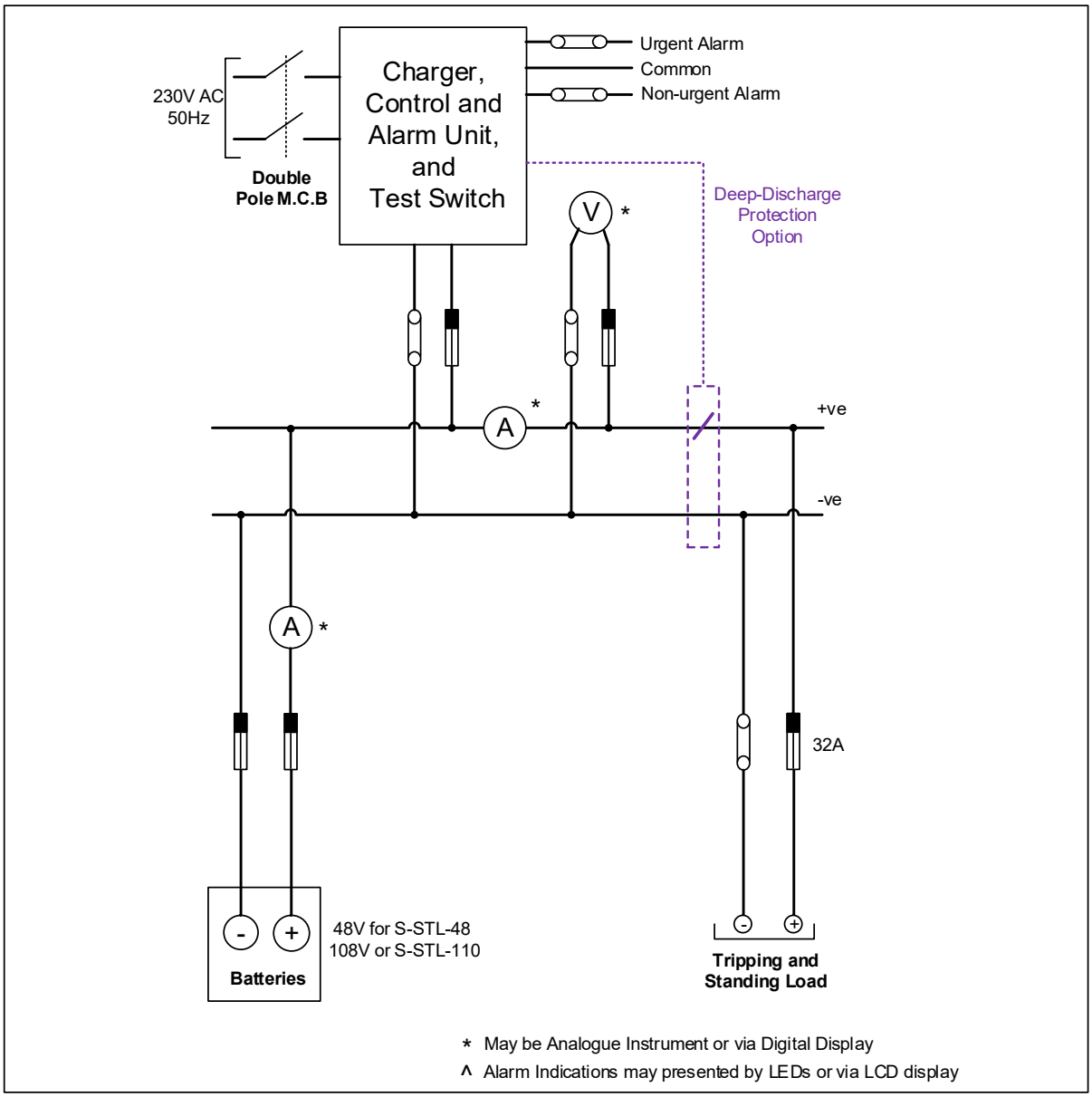


**Figure 2: Schematic for S-STL-48-Y(X) and S-STL-110-Y(X)**

<table>
<tr><td>Battery System Type</td><td colspan="5">P-STL-30-Y(X)</td></tr>
<tr><td>Voltage</td><td colspan="5">30V</td></tr>
<tr><td>Description</td><td colspan="5">Monitored 30V Switch Tripping and Load Supporting Battery System</td></tr>
<tr><td>Charger Output</td><td colspan="5">40A</td></tr>
<tr><td>Battery Accommodation</td><td colspan="5">Up to 310Ahr</td></tr>
<tr><td>Internal Discharge Requirements</td><td colspan="5">The value of Internal Discharge on loss of A.C. supply via the charger with no load connected shall not exceed 25mA</td></tr>
<tr><td rowspan="3">Cabinet Requirements</td><td colspan="2">Type</td><td colspan="3">Free Standing</td></tr>
<tr><td colspan="2">Cable Entry Requirements</td><td colspan="3">20mm x 8 Top and Bottom Entry with Gland Plates pre-drilled and covered</td></tr>
<tr><td colspan="5">Provision should be made to accommodate a future load disconnection device within the cabinet, minimum rack space of 4u height</td></tr>
<tr><td>Charger Fittings</td><td>Item</td><td colspan="4">Description</td></tr>
<tr><td rowspan="3">Meters<br><br>(Section 9.7)</td><td>Voltmeter</td><td colspan="4">Shall give indications of voltage across charger/battery output terminals</td></tr>
<tr><td>Ammeter</td><td colspan="4">Shall Indicate Charge and Discharge Currents</td></tr>
<tr><td>Ammeter</td><td colspan="4">Shall Indicate the System Load (total outgoing ways)</td></tr>
<tr><td rowspan="2">Manual Switches<br><br>(Section 9.7.3)<br>(Section 9.7.5)</td><td>Test Switch</td><td colspan="4">Dedicated Push Button Self Reset Type Controlling a battery test load which disconnects or lower charger output when pressed</td></tr>
<tr><td>HV Shutdown Reset Switch</td><td colspan="4">High Voltage Charger Shutdown and Manual Reset Required</td></tr>
<tr><td>Indications and Alarms</td><td>Condition</td><td colspan="2">Possible Local Indication LED Grouping</td><td colspan="2">SCADA Alarm Grouping</td></tr>
<tr><td rowspan="9">Conditions to be Detected and Presented<br><br>(Section 9.7.6)</td><td>Asymmetry</td><td colspan="2" rowspan="3">Battery Fail</td><td colspan="2" rowspan="7">Urgent</td></tr>
<tr><td>Impedance</td></tr>
<tr><td>Auto –Test (Battery Fail)</td></tr>
<tr><td>High Volts</td><td colspan="2" rowspan="4">Charger / Supply Fail</td></tr>
<tr><td>Low Volts</td></tr>
<tr><td>Rectifier fail</td></tr>
<tr><td>Mains Fail</td></tr>
<tr><td>Earth Fault (+ve)</td><td colspan="2" rowspan="2">Earth Fault</td><td colspan="2" rowspan="2">Non-Urgent</td></tr>
<tr><td>Earth Fault (-ve)</td></tr>
<tr><td>Voltage Monitoring (Section 9.7.7)</td><td colspan="5">The Voltage Across each battery set shall be monitored and transmitted remotely</td></tr>
<tr><td>Auto Test Facility (Section 9.7.1)</td><td colspan="5">Facility to automatically test the battery sets by switching charger output down and the standing supplying load (only)</td></tr>
<tr><td>A.C. Input</td><td colspan="5">Shall be fitted with appropriately rated 2 pole MCB</td></tr>
<tr><td rowspan="6">D.C. Ways Requirements<br><br>(Section 9.8.5 – Section 9.8.8)</td><td colspan="5">Each Way shall be fitted with Fuse Holders and protected with appropriately rated HRC fuses</td></tr>
<tr><td colspan="5">D.C. Input with 2 Connector Multi-pole Type Socket for connection an alternative D.C. supply or Test Load, Anderson SB175 or equivalent</td></tr>
<tr><td colspan="5">Removable Bolted link on Positive D.C. Bus with terminals for integration future of a load disconnection system</td></tr>
<tr><td rowspan="2">D.C. Ways</td><td rowspan="2">D.C. Inputs</td><td colspan="3">D.C. Distribution</td></tr>
<tr><td>Upstream of Disconnection Link</td><td colspan="2">Downstream of Disconnection Link</td></tr>
<tr><td>Rating</td><td>Unfused</td><td>32A</td><td>32A</td><td>16A</td></tr>
<tr><td>Quantity</td><td>1</td><td>1</td><td>1</td><td>1</td></tr>
</table>



Internal Use

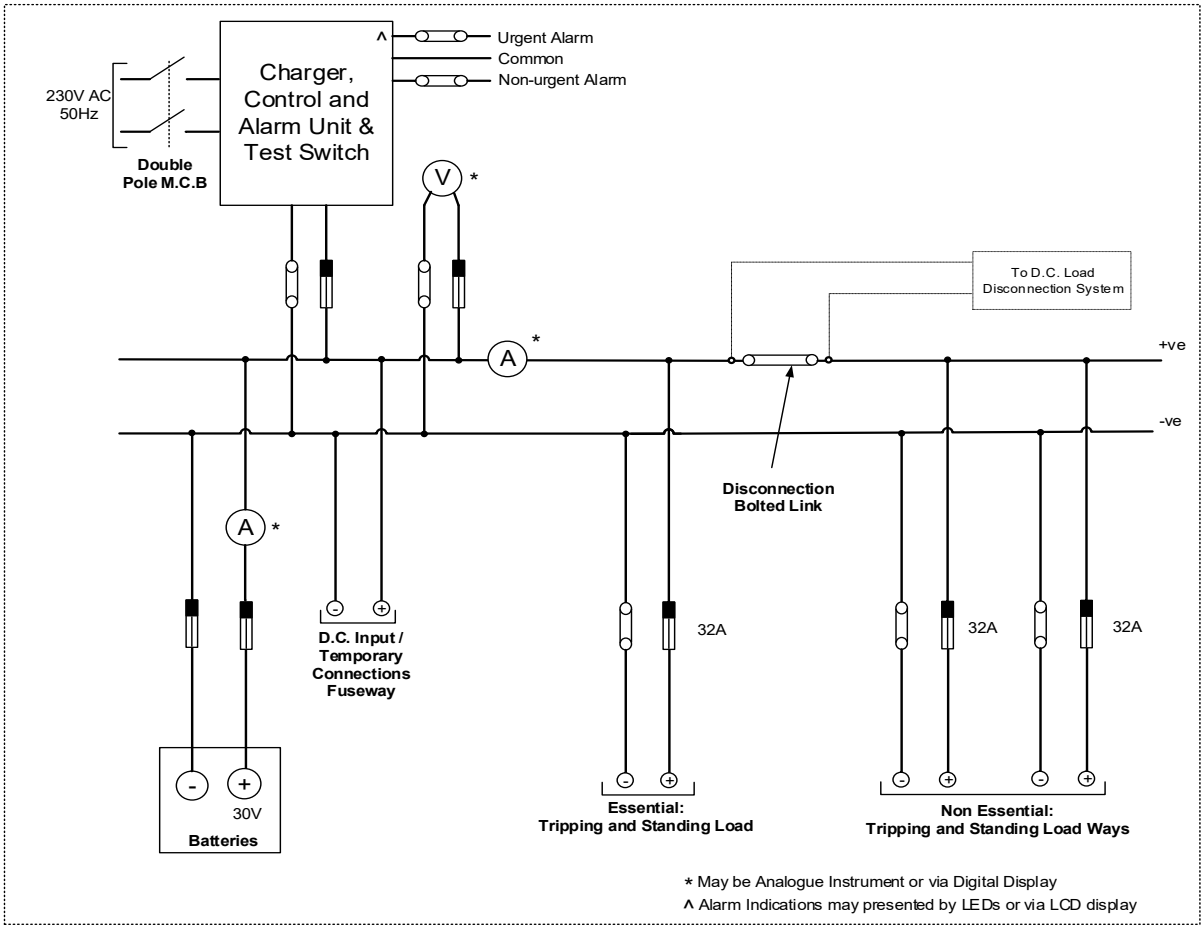


**Figure 3: Schematic of P-STL-30-Y(X) Systems**

<table>
<tr><td>Battery System Types</td><td colspan="8">P-STL-48-Y(X) & P-STL-48/36-Y(X) (2 Variants)</td></tr>
<tr><td>Voltage</td><td colspan="8">48V with 30V tap off (Tripping Only)</td></tr>
<tr><td>Description</td><td colspan="8">Monitored 48V Switch Tripping and Load Supporting Battery System with option of 36V tapping fully rated for switch tripping.</td></tr>
<tr><td>Variant</td><td colspan="2">A</td><td colspan="2">B</td><td colspan="2">C</td><td colspan="2">D</td></tr>
<tr><td>Charger Output</td><td colspan="2">15A</td><td colspan="2">25A</td><td colspan="2">70A</td><td colspan="2">110A</td></tr>
<tr><td>Battery Accommodation</td><td colspan="2">Up to 125Ahr</td><td colspan="2">Up to 190Ahr</td><td colspan="2">Up to 570Ahr</td><td colspan="2">Up to 950Ahr</td></tr>
<tr><td>Internal Discharge Requirements</td><td colspan="8">The value of Internal Discharge on loss of A.C. supply via the charger with no load connected shall not exceed 25mA</td></tr>
<tr><td rowspan="3">Cabinet Requirements</td><td>Type</td><td colspan="7">Free Standing</td></tr>
<tr><td>Cable Entry Requirements</td><td colspan="7">20mm x 8 Top and Bottom Entry with Gland Plates pre-drilled and covered</td></tr>
<tr><td colspan="8">Provision should be made to accommodate a future load disconnection device within the cabinet, minimum rack space of 4u height</td></tr>
<tr><td>Charger Fittings</td><td>Item</td><td colspan="7">Description</td></tr>
<tr><td rowspan="3">Meters<br><br>(Section 9.7)</td><td>Voltmeter</td><td colspan="7">Shall give indications of voltage across charger/battery output terminals</td></tr>
<tr><td>Ammeter</td><td colspan="7">Shall Indicate Charge and Discharge Currents</td></tr>
<tr><td>Ammeter</td><td colspan="7">Shall Indicate the System Load (total outgoing ways)</td></tr>
<tr><td rowspan="2">Manual Switches<br><br>(Section 9.7.3)<br>(Section 9.7.5)</td><td>Test Switch</td><td colspan="7">Dedicated Push Button Self Reset Type Controlling a battery test load which disconnects or lower charger output when pressed</td></tr>
<tr><td>HV Shutdown Reset Switch</td><td colspan="7">High Voltage Charger Shutdown and Manual Reset Required</td></tr>
<tr><td>Indications and Alarms</td><td>Condition</td><td colspan="4">Possible Local Indication LED Grouping</td><td colspan="3">SCADA Alarm Grouping</td></tr>
<tr><td rowspan="9">Conditions to be Detected and Presented<br><br>(Section 9.7.6)</td><td>Asymmetry</td><td colspan="4" rowspan="3">Battery Fail</td><td colspan="3" rowspan="9">Urgent</td></tr>
<tr><td>Impedance</td></tr>
<tr><td>Auto–Test (Battery Fail)</td></tr>
<tr><td>High Volts</td><td colspan="4" rowspan="4">Charger / Supply Fail</td></tr>
<tr><td>Low Volts</td></tr>
<tr><td>Rectifier fail</td></tr>
<tr><td>Mains Fail</td></tr>
<tr><td>Earth Fault (+ve)</td><td colspan="4" rowspan="2">Earth Fault</td></tr>
<tr><td>Earth Fault (-ve)</td><td colspan="3">Non-Urgent</td></tr>
<tr><td>Voltage Monitoring (Section 9.7.7)</td><td colspan="8">The Voltage Across each battery set shall be monitored and transmitted remotely.</td></tr>
<tr><td>Auto Test Facility (Section 9.7.1)</td><td colspan="8">Facility to automatically test the battery sets by switching charger output down and the standing supplying load (only)</td></tr>
<tr><td>A.C. Input</td><td colspan="8">Shall be fitted with appropriately rated 2 pole MCB</td></tr>
<tr><td rowspan="6">D.C. Ways Requirements<br><br>(Section 9.8.5 – Section 9.8.8)</td><td colspan="8">Each Way shall be fitted with Fuse Holders and protected with appropriately rated HRC fuses</td></tr>
<tr><td colspan="8">D.C. Input with 2 Connector Multi-pole Type Socket for connection an alternative D.C. supply or Test Load, Anderson SB175 or equivalent</td></tr>
<tr><td colspan="8">Removable Bolted link on Positive D.C. Bus with terminals for integration future of a load disconnection system</td></tr>
<tr><td rowspan="2">D.C. Ways</td><td rowspan="2">D.C. Inputs</td><td colspan="6">D.C. Distribution</td></tr>
<tr><td colspan="3">Upstream of Disconnection Link</td><td colspan="3">Downstream of Disconnection Link</td></tr>
<tr><td>Rating</td><td>Unfused</td><td>36V - 32A</td><td>48V - 6A</td><td>48V - 32A</td><td>32A</td><td>16A</td></tr>
<tr><td>Quantity</td><td>1 – 48V<br>1 – 36V</td><td>1(*)</td><td>1</td><td>1</td><td>1</td><td>1</td></tr>
</table>

(*) NB: Additional Fuse ways and D.C Inputs required for P-STL-48/36 systems in Blue



Internal Use

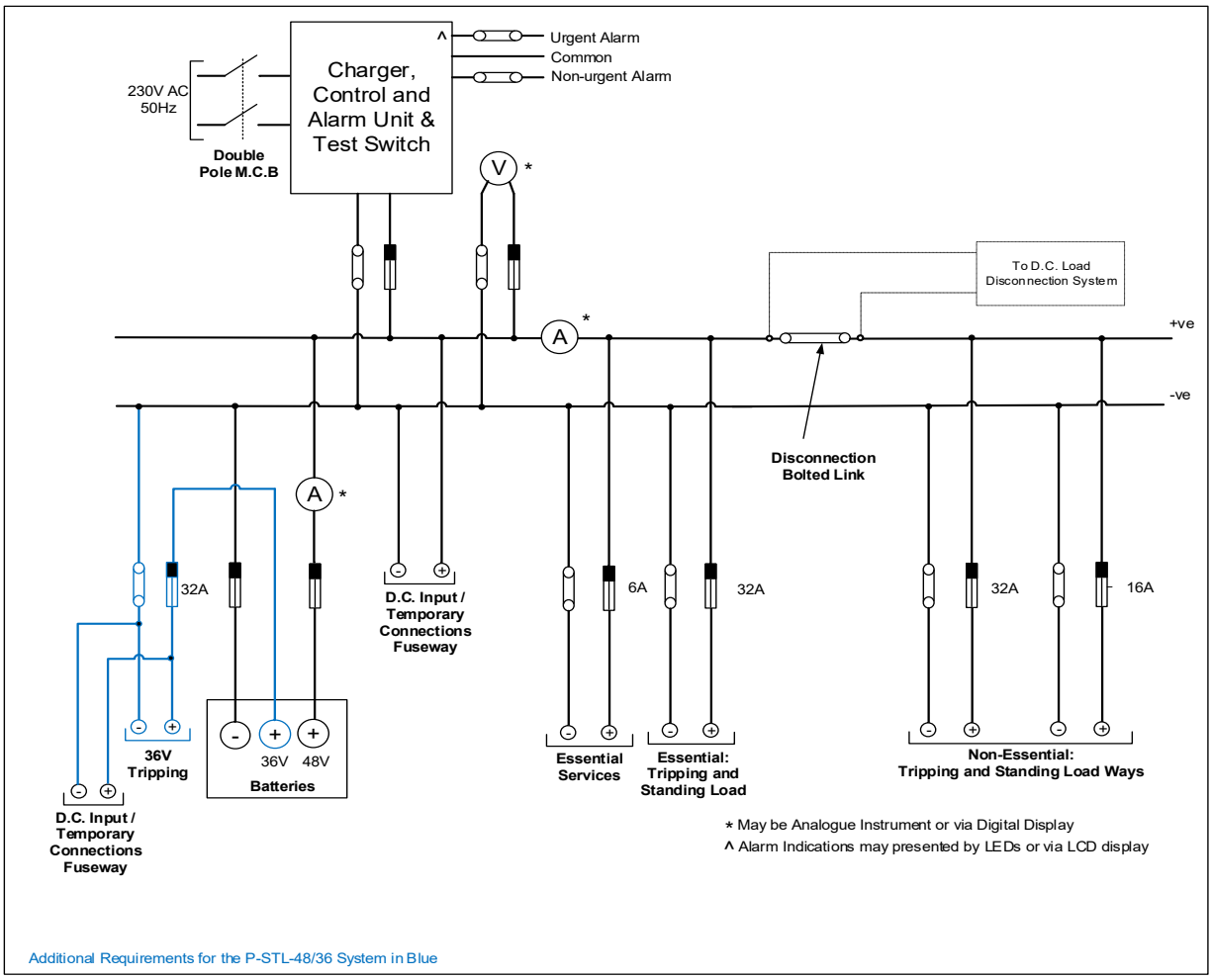


**Figure 4: Schematic of P-STL-48-Y(X) & P-STL-48/36-Y(X) Systems**

<table>
<tr><td>Battery System Types</td><td colspan="7">P-STL-110-Y(X), P-STL-110-Y(X)&SD, P-STL-110/36-Y(X), P-STL-110/36-Y(X)&SD Systems</td></tr>
<tr><td>Voltage</td><td colspan="7">110V (108V – 54 Cells)</td></tr>
<tr><td>Description</td><td colspan="7">Monitored 110V Switch Tripping and Load Supporting Battery System.<br>With option for with 36V tap off fully rated for switch tripping.</td></tr>
<tr><td>Variant</td><td>A</td><td>B</td><td>C</td><td>D</td><td>E</td><td>F</td><td>G</td></tr>
<tr><td>Charger Output</td><td>20A</td><td>25A</td><td>30A</td><td>50A</td><td>70A</td><td>90A</td><td>100A</td></tr>
<tr><td>Battery Accommodation</td><td>Up to 125Ahr</td><td>Up to 190Ahr</td><td>Up to 250Ahr</td><td>Up to 380Ahr</td><td>Up to 570Ahr</td><td>Up to 760Ahr</td><td>Up to 950Ahr</td></tr>
<tr><td>Internal Discharge Requirements</td><td colspan="7">The value of Internal Discharge on loss of A.C. supply via the charger with no load connected shall not exceed 25mA</td></tr>
<tr><td rowspan="3">Cabinet Requirements</td><td>Type</td><td colspan="6">Free Standing (Distribution Board Wall Mounted if separate)</td></tr>
<tr><td>Cable Entry Requirements</td><td colspan="6">20mm x 8 Top and Bottom Entry with Gland Plates pre-drilled and covered (5 or greater for Distribution Board in addition to the charger if separate)</td></tr>
<tr><td colspan="7">Provision should be made to accommodate a future load disconnection device within the cabinet, minimum rack space of 4u height</td></tr>
<tr><td>Charger Fittings</td><td colspan="2">Item</td><td colspan="5">Description</td></tr>
<tr><td rowspan="3">Meters<br><br>(Section 9.7)</td><td colspan="2">Voltmeter</td><td colspan="5">Shall give indications of voltage across charger/battery output terminals</td></tr>
<tr><td colspan="2">Ammeter</td><td colspan="5">Shall Indicate Charge and Discharge Currents</td></tr>
<tr><td colspan="2">Ammeter</td><td colspan="5">Shall Indicate the System Load (total outgoing ways)</td></tr>
<tr><td rowspan="2">Manual Switches<br><br>(Section 9.7.3)<br>(Section 9.7.5)</td><td colspan="2">Test Switch</td><td colspan="5">Dedicated Push Button Self Reset Type Controlling a battery test load which disconnects or lower charger output when pressed</td></tr>
<tr><td colspan="2">HV Shutdown Reset Switch</td><td colspan="5">High Voltage Charger Shutdown and Manual Reset Required</td></tr>
<tr><td>Indications and Alarms</td><td colspan="2">Condition</td><td colspan="3">Possible Local Indication LED Grouping</td><td colspan="2">SCADA Alarm Grouping</td></tr>
<tr><td rowspan="9">Conditions to be Detected and Presented<br><br>(Section 9.7.6)</td><td colspan="2">Asymmetry</td><td colspan="3" rowspan="3">Battery Fail</td><td colspan="2" rowspan="8">Urgent</td></tr>
<tr><td colspan="2">Impedance</td></tr>
<tr><td colspan="2">Auto–Test (Battery Fail)</td></tr>
<tr><td colspan="2">High Volts</td><td colspan="3" rowspan="4">Charger / Supply Fail</td></tr>
<tr><td colspan="2">Low Volts</td></tr>
<tr><td colspan="2">Rectifier fail</td></tr>
<tr><td colspan="2">Mains Fail</td></tr>
<tr><td colspan="2">Earth Fault (+ve) & (-ve)</td><td colspan="3">Earth Fault</td><td colspan="2">Non-Urgent</td></tr>
<tr><td>Voltage Monitoring (Section 9.7.7)</td><td colspan="7">The Voltage Across each battery set shall be monitored and transmitted remotely</td></tr>
<tr><td>Auto Test Facility (Section 9.7.1)</td><td colspan="7">Facility to automatically test the battery sets by switching charger output down and the standing supplying load (only)</td></tr>
<tr><td>A.C. Input</td><td colspan="7">Shall be fitted with appropriately rated 2 pole MCB</td></tr>
<tr><td rowspan="5">D.C. Ways Requirements<br><br>(Section 9.8.5 – Section 9.8.8)</td><td colspan="7">Each Way shall be fitted with Fuse Holders and protected with appropriately rated HRC fuses</td></tr>
<tr><td colspan="7">D.C. Input with 2 Connector Multi-pole Type Socket for connection an alternative D.C. supply or Test Load, Anderson SB175 or equivalent</td></tr>
<tr><td colspan="7">Removable Bolted link on Positive D.C. Bus with terminals for integration future of a load disconnection system</td></tr>
<tr><td rowspan="2">D.C. Ways</td><td rowspan="2">D.C. Inputs</td><td colspan="5">D.C. Distribution</td></tr>
<tr><td colspan="2">Upstream of Disconnection Link</td><td colspan="2">Downstream of Disconnection Link</td></tr>
<tr><td>Rating</td><td>TBC</td><td>36V-32A</td><td>110V-32A</td><td colspan="2">110V-32A</td><td>110V-16A</td></tr>
</table>

| | | | | | | |
|---|---|---|---|---|---|---|
| | Quantity | 1 – 48V<br>1 – 36V | **1(*)** | 2/3(^) | 2 /3(^) | 1 |

**(*)** NB: Additional Fuse ways requires for P-STL-110/36 systems in Blue
(^) Additional essential and non-essential ways fuse way for options with separate distribution boards.

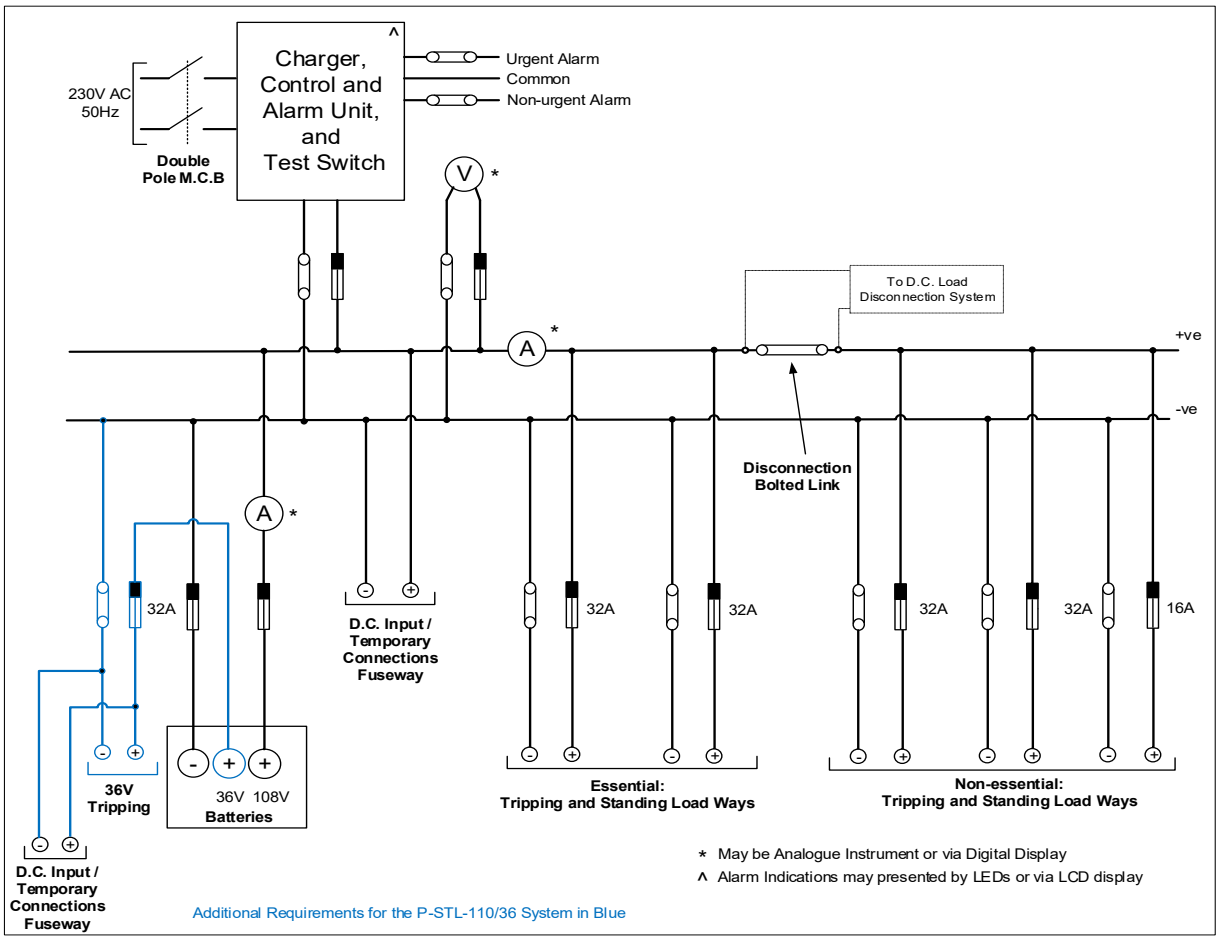


**Figure 5: Schematic of P-STL-110-Y(X) & P-STL-110/36-Y(X) Battery Systems**

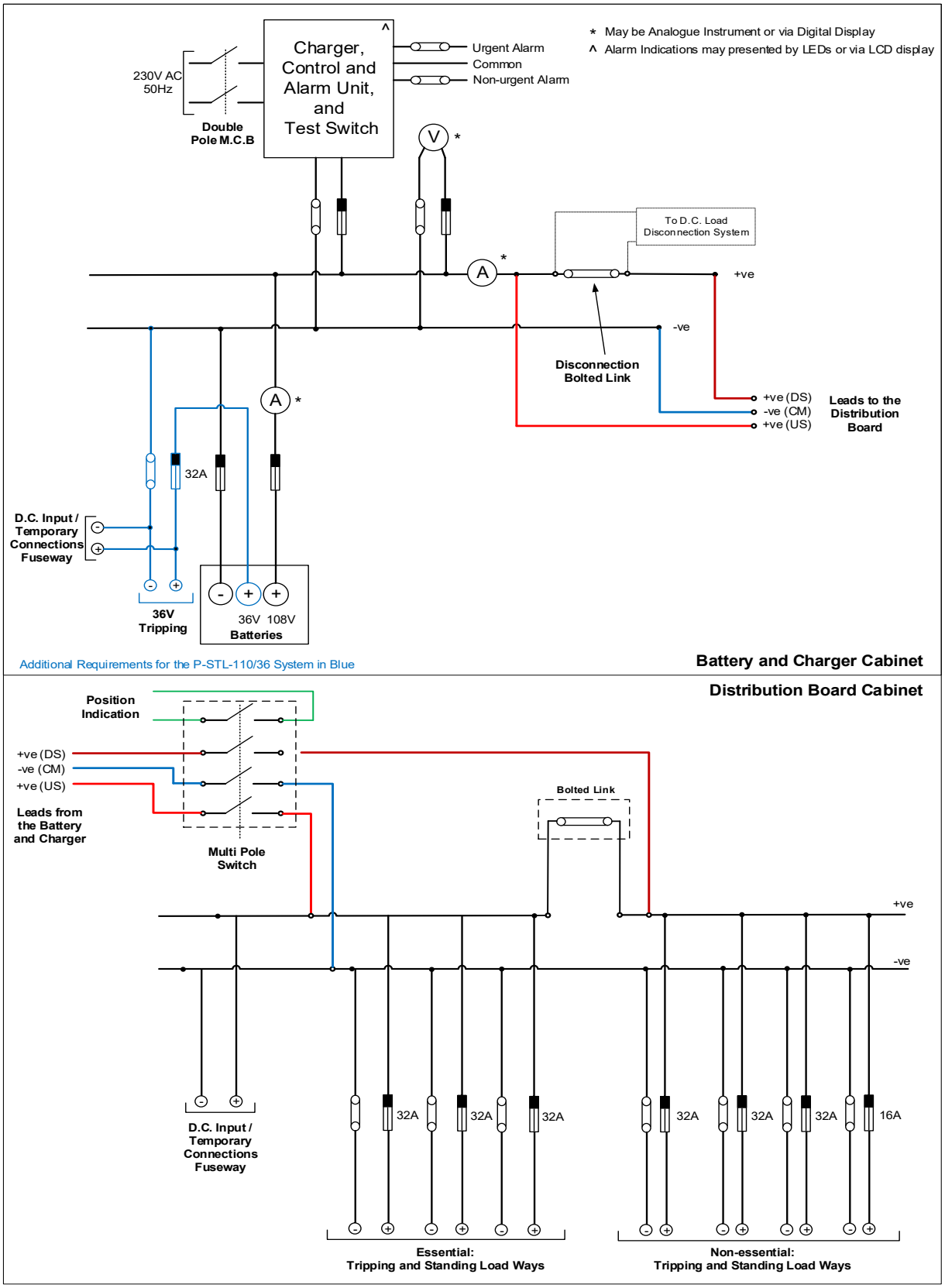


**Figure 6: Schematic of P-STL-110-Y(X)&SD & P-STL-110/36-Y(X)&SD Battery Systems**

| | | | | |
|---|---|---|---|---|
| Battery System Type | P-TEL-48 (Variants A 40A) | | | |
| Voltage | 48V | | | |
| Description | Telecoms and SCADA Load Supporting Positively Earthed Battery System. | | | |
| Variant | A | | | |
| Charger Output | 40A | | | |
| Battery Accommodation | Up to 380Ahr | | | |
| Cabinet Requirements | 19' Rack Mounted - charger and batteries should take no more than 10U in height | | | |
| Charger Fittings | Item | Description | | |
| Meters<br><br>(Section 9.7) | Voltmeter | Shall give indications of voltage across charger/battery output terminals | | |
| | Ammeter | Shall Indicate Charge and Discharge Currents | | |
| | Ammeter | Shall Indicate the System Load (total outgoing ways) | | |
| Manual Switches<br><br>(Section 9.7.3)<br>(Section 9.7.5) | Test Switch | Dedicated Push Button Self Reset Type Controlling a battery test load which disconnects or lower charger output when pressed | | |
| | HV Shutdown Reset Switch | High Voltage Charger Shutdown and Manual Reset Required | | |
| Deep Discharge Protection (Option) | Contactor | Contactor to remove all load when the battery is entering deep discharge and reconnector load when charger supply re-established | | |
| Indications and Alarms | Condition | Possible Local Indication LED Grouping | SCADA Alarm Grouping | |
| Conditions to be Detected and Presented<br><br>(Section 9.7.6) | Asymmetry | Battery Fail | Urgent | |
| | Impedance | | | |
| | Auto–Test (Battery Fail) | | | |
| | High Volts | Charger / Supply Fail | | |
| | Low Volts | | | |
| | Rectifier fail | | | |
| | Mains Fail | | | |
| | Deep Discharge Protection Operated (where applicable) | | | |
| | Fuse Fail | Fuse Fail | | |
| Voltage Monitoring (Section 9.7.7) | The Voltage Across each battery set shall be monitored and transmitted remotely in either of the following formats as required 0 – 10mA or 4 – 20mA | | | |
| Auto Test Facility (Section 9.7.1) | Facility to automatically test the battery sets by switching charger output down and the standing supplying load (only) | | | |
| A.C. Input | Shall be fitted with appropriately rated 2 pole MCB | | | |
| D.C. Ways Requirements<br><br>(Section 9.8.5 – Section 9.8.6) | Each Way shall be fitted with Fuse Holders and protected with appropriately rated HRC fuses | | | |
| | D.C. Ways | D.C. Inputs | D.C. Distribution | |
| | Rating | N/A | 1A | 2A |
| | Quantity | 0 | 1 | 1 |
| Other Requirements | Positive terminal of battery systems shall be earthed. | | | |

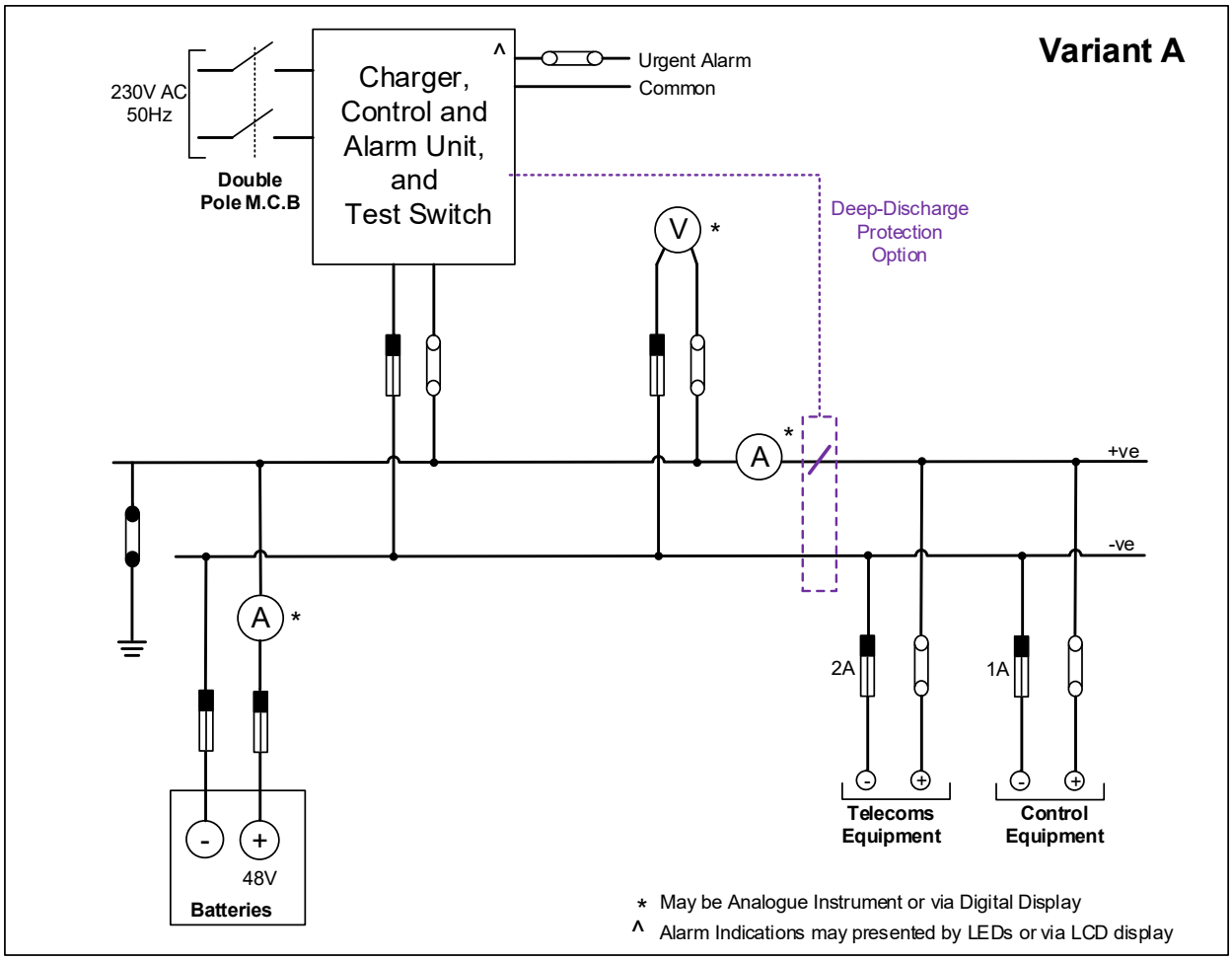


**Figure 7: Schematic of P-TEL-48 (Variant A)**



Internal Use

<table>
<tr><td>Battery System Type</td><td colspan="4">P-TEL-48 (Variant B 60A & C 100A)</td></tr>
<tr><td>Voltage</td><td colspan="4">48V</td></tr>
<tr><td>Description</td><td colspan="4">Telecoms and SCADA Load Supporting Positively Earthed Battery System.</td></tr>
<tr><td>Variant</td><td colspan="2">B</td><td colspan="2">C</td></tr>
<tr><td>Charger Output</td><td colspan="2">60A</td><td colspan="2">100A</td></tr>
<tr><td>Battery Accommodation</td><td colspan="2">Up to 570Ahr</td><td colspan="2">Up to 950Ahr</td></tr>
<tr><td rowspan="4">Cabinet Requirements</td><td>Type</td><td colspan="3">Free Standing and 19’ Rack Mounted Variants Required</td></tr>
<tr><td>Rack Mounted</td><td colspan="3">Guide Dimensions Charger and Batteries should take no more than 21U in height</td></tr>
<tr><td rowspan="2">Free Standing</td><td colspan="3">Cable Entry Requirements Guide Dimensions H 2000mm / W 600mm / 600mm</td></tr>
<tr><td colspan="3">20mm x 6 Top and Bottom Entry with Gland Plates pre-drilled and covered</td></tr>
<tr><td>Charger Fittings</td><td>Item</td><td colspan="3">Description</td></tr>
<tr><td rowspan="3">Meters<br><br>(Section 9.7)</td><td>Voltmeter</td><td colspan="3">Shall give indications of voltage across charger/battery output terminals</td></tr>
<tr><td>Ammeter</td><td colspan="3">Shall Indicate Charge and Discharge Currents</td></tr>
<tr><td>Ammeter</td><td colspan="3">Shall Indicate the System Load (total outgoing ways)</td></tr>
<tr><td rowspan="2">Manual Switches<br><br>(Section 9.7.3)<br>(Section 9.7.5)</td><td>Test Switch</td><td colspan="3">Dedicated Push Button Self Reset Type Controlling a battery test load which disconnects or lower charger output when pressed</td></tr>
<tr><td>HV Shutdown Reset Switch</td><td colspan="3">High Voltage Charger Shutdown and Manual Reset Required</td></tr>
<tr><td>Indications and Alarms</td><td colspan="2">Condition</td><td>Possible Local Indication LED Grouping</td><td>SCADA Alarm Grouping</td></tr>
<tr><td rowspan="10">Conditions to be Detected and Presented<br><br>(Section 9.7.6)</td><td colspan="2">Fuse Fail</td><td>Fuse Fail</td><td rowspan="10">Urgent</td></tr>
<tr><td colspan="2">Asymmetry</td><td rowspan="3">Battery Fail</td></tr>
<tr><td colspan="2">Impedance</td></tr>
<tr><td colspan="2">Auto–Test (Battery Fail)</td></tr>
<tr><td colspan="2">High Volts</td><td rowspan="5">Charger / Supply Fail</td></tr>
<tr><td colspan="2">Low Volts</td></tr>
<tr><td colspan="2">Mains Fail</td></tr>
<tr><td colspan="2">Deep Discharge Protection Operated (where applicable)</td></tr>
<tr><td colspan="2">Rectifier fail</td></tr>
<tr><td>Voltage Monitoring (Section 9.7.7)</td><td colspan="4">The Voltage Across each battery set shall be monitored and transmitted remotely in either of the following formats as required 0 – 10mA or 4 – 20mA</td></tr>
<tr><td>Auto Test Facility (Section 9.7.1)</td><td colspan="4">Facility to automatically test the battery sets by switching charger output down and the standing supplying load (only)</td></tr>
<tr><td>A.C. Input</td><td colspan="4">Shall be fitted with appropriately rated 2 pole MCB</td></tr>
<tr><td rowspan="5">D.C. Ways Requirements<br><br>(Section 9.8.5 – Section 9.8.7)</td><td colspan="4">Each Way shall be fitted with Fuse Holders and protected with appropriately rated HRC fuses</td></tr>
<tr><td colspan="4">D.C. Input with 2 Connector Multi-pole Type Socket for connection an alternative D.C. supply or Test Load, Anderson SB175 or equivalent</td></tr>
<tr><td>D.C. Ways</td><td>D.C. Inputs</td><td colspan="2">D.C. Distribution</td></tr>
<tr><td>Rating</td><td>TBC</td><td colspan="2">6A</td></tr>
<tr><td>Quantity</td><td>1</td><td colspan="2">6</td></tr>
<tr><td>Other Requirements</td><td colspan="4">Positive terminal of battery systems shall be earthed.</td></tr>
</table>

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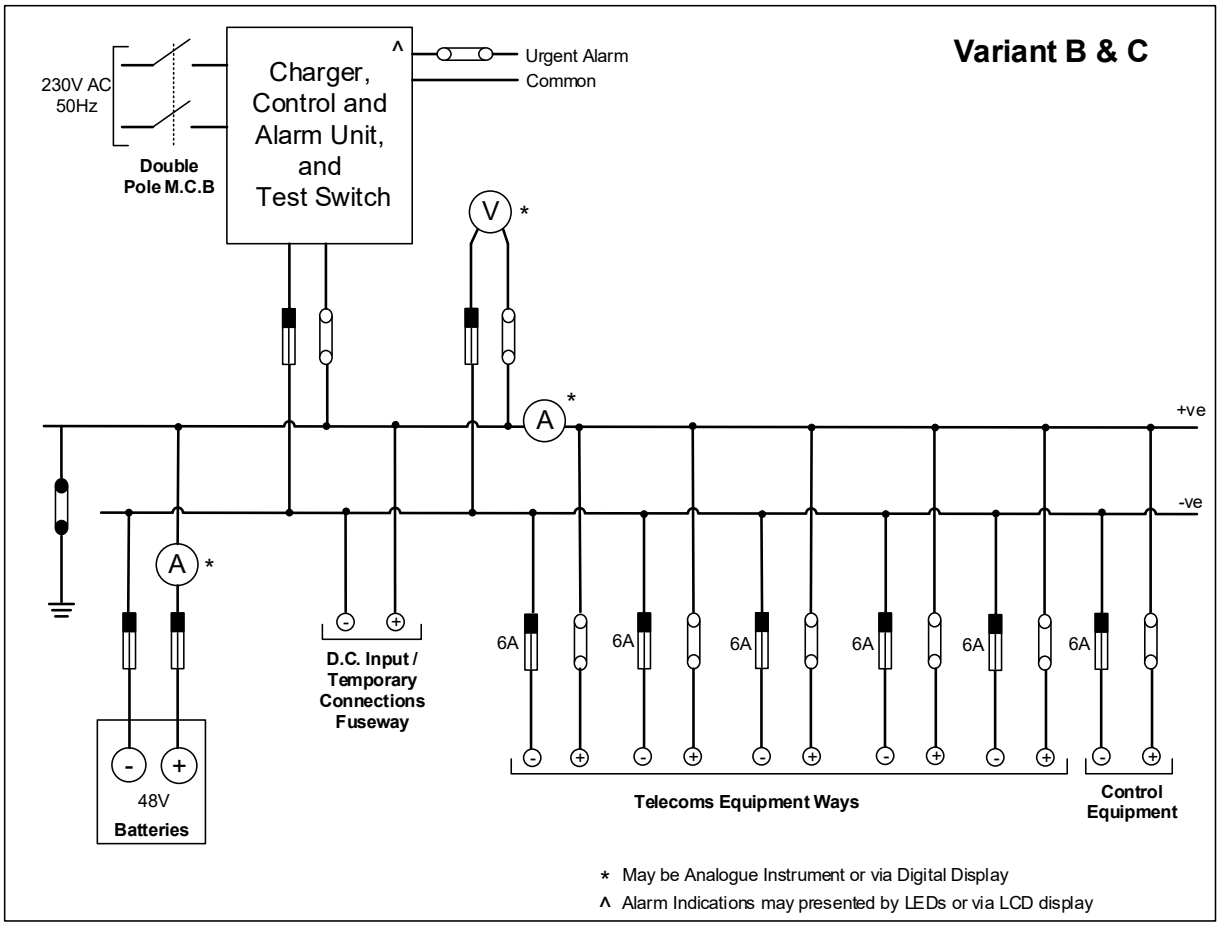


**Figure 8: Schematic of P-TEL-48 (Variant B & C)**

## 11. WORKS INSPECTION

On receipt of the order, the Tenderer shall immediately agree with the Company a provisional dated programme for witnessing of the works testing and inspection. The Company require a minimum of three weeks' notice to confirm the test and inspection programme date.

## 12. COMMISSIONING, OPERATION AND MAINTENANCE MANUAL

A Commissioning, Operation and Maintenance Manual shall be provided with each charger. The manual shall include a copy of the following drawings:

- Wiring diagram for the complete equipment;
- Circuit diagram for the charger chassis, detailing the value and types of the electronic components. Such components may alternatively be detailed on a separate component list;
- Circuit diagram for the high/low voltage relay;
- Full test instructions for provision of all required alarm function on site at time of commissioning and any future maintenance / fault faulting;
- A general fault finding guide.

The manuals/drawings shall be approved by the Engineer

## 13. APPROVAL

Following approval of any item, no change shall be made by the manufacturer without the written agreement of the Engineer.

## 14. QUALITY REQUIREMENTS

Analysis of defective items on receipt and in use will be used to assist in subsequent tender analysis.

### 14.1 Quality Assurance

Manufacturers shall operate a fully documented quality assurance system and should indicate with their tenders the QA Approvals granted to the manufacturer.

### 14.2 Progress and Inspection Requirements

Access to the supplier's or Sub-Contractor's works shall be granted, at any reasonable time, to allow the engineering staff to verify the progress status of the work.

### 14.3 Quality Plans/Inspection Checklists

The supplier shall submit to the Company, before the commencement of design/manufacture, quality plans/inspection checklists for "mark-up" of the Company's requirements with respect to document approval and quality control activities.

Two copies of all approved documents shall be supplied to the Company.

### 14.4 Inspection and Witnessing of Tests

The Engineer shall carry out, where appropriate, inspections and witness routine tests in accordance with the "mark-up" on the approved quality plans/inspection checklists and agreed test programme.

The supplier shall give seven days' notice of his intention to carry out any witness points referenced on the quality plans/inspection checklists.

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### 14.5 Retention of Quality Records

The supplier shall maintain the quality records in an area of safe deposit for a minimum period of 10 years and not dispose of these records without prior agreement of the Company. During the retention period, copies of the quality records shall be made available to the Company on request.

### 14.6 Certificate of Conformance

The supplier shall provide a certificate of conformance for each item that required a quality plan/inspection checklist and will be signed by the supplier's nominated representative.

This document shall reference the quality plan/inspection checklist, the quality records being retained, the supplier's unique identification and the Company's order number.

In addition, any certification required to meet the statutory requirements for pressure parts/lifting equipment shall be issued with the certificate of conformance.

One copy of the certificate of conformance and, where relevant, the statutory certification shall be despatched with the item and a second copy issued to the Company.

A certificate of conformance shall be provided upon completion of each order placed with the successful Tenderer(s), identifying the appropriate technical specifications with which the items comply.

The Tenderer shall submit the following documents with the tender:

- Overall quality policy statement;
- Copies of any formal quality approvals; and
- Quality plans for each item offered (these must identify the control stages during manufacture and test).

## 15. PROTECTION AND PACKAGING

The Supplier shall ensure that each item is suitably protected and packaged to maintain it “fit for service” before installation.

## 16. DELIVERY

Tenderers shall state on the Price Schedule the lead times offered on all items.

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## 17. INFORMATION REQUIRED FROM THE TENDERER

The Tenderer is required to complete all the schedules attached to this specification including all the appropriate information in respect of each item offered.

The Tenderer shall return the following additional documentation with copies of the completed schedules at the time of tendering:

| Item | Description | Clause |
|---|---|---|
| 1 | Variations from the Primary Standards | 7.2, 7.3 |
| 2 | Equivalents offered | 7.3 |
| 3 | Completion of Technical Schedule B1 (All Batteries offered that are not on SPEN Approved Equipment Register - Batteries) | 9.6 |
| 4 | Certificates of battery classification | 9.6 |
| 5 | Completion of Technical Schedule B2 (All Chargers offered) | 9.5 |
| 6 | Description of Charger Control Design principle | 9.5.2 |
| 7 | Value of discharge from battery to charger when supply is lost | 9.5.2 |
| 8 | Completion of Technical Schedule B3 (All Chargers Controllers and Alarm units offered): Proof of Environmental testing | 9.9.2 |
| 9 | Departures from Specification: Technical Schedule B4 | 9.2 |
| 10 | Cabinet layout drawings | 9.8.1 |
| 11 | Manuals and drawings | 12 |
| 12 | Details of quality systems | 14.6 |
| 13 | Completion of Schedule B5: Prices For Battery Systems Types | |
| 14 | Completion of Schedule B6: Prices For Battery Sets | |
| 15 | Any other information requested elsewhere in this Specification or specifically requested in the Enquiry documents accompanying this Specification. | |

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## 18. SCHEDULES TO BE COMPLETED BY TENDERER

### 18.1 TECHNICAL SCHEDULE B1: BATTERY

Copy to be completed for each battery rating – Schedules required only for Batteries not currently on SPEN Approved Equipment Register - Batteries.

| | |
|---|---|
| Selected battery Type | |
| Manufacturer, country of origin and type reference | |
| Standards with which the battery conforms | |
| Recommended battery manufacturer man hours of Maintenance required per year | |
| Guaranteed life span of battery (Life span prediction shall take into account of ambient and cabinet temperatures) | |
| Nominal voltage | |
| Normal float voltage | |
| Dimensions of cells (width x height x depth) | |
| Material of battery case | |
| Battery capacity at 10 hour discharge rate | |
| Current disposal costs per cell | |

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| BS EN 90896-22 Clause | Product specification information | | | | | | |
|---|---|---|---|---|---|---|---|
| | **Product safe operation in service** | **Compliance information mandatory** | | | | | |
| 6.1 | Gas emission (at float voltage and at 2,40 Vpc) | Float charge voltage | | ml Per Cell | Per Hour | Per Ahr | |
| | | Over charge voltage | | ml Per Cell | Per Hour | Per Ahr | |
| 6.2 | High current tolerance | Pass / Fail | | | | | |
| 6.3 | Short circuit current and d.c. internal resistance | Short circuit current | | | | Amps | |
| | | Internal Resistance | | | | Ohms | |
| 6.4 | Internal ignition from external spark sources | Pass / Fail | | | | | |
| 6.5 | Protection against ground short propensity | Pass / Fail | | | | | |
| 6.6 | Content and durability of required markings | Pass / Fail | | | | | |
| 6.7 | Material identification | Pass / Fail | | | | | |
| 6.8 | Valve operation | Pass / Fail | | | | | |
| | **Product performance in service** | **Compliance information mandatory or on as-needed basis** | | | | | |
| 6.11 | Discharge capacity | Data for | c10 | c8 | c3 | c | C0.25 |
| | | Pass/ Fail | | | | | |
| 6.12 | Charge retention during storage | Pass / Fail | | Capacity retention (%) | | | |
| 6.14 | Recharge behaviour | Pass / Fail | | | | | |
| | **Product durability in service** | **Compliance information mandatory or on as-needed basis** | | | | | |
| 6.15 | Service life at an operating temperature of 40 °C | Value to be requested as function of service environment | | | | years | |
| 6.17 | Abusive over-discharge Value to be requested if service environment warrants | Caod | | Caoc | | | |
| 6.18 | Thermal runaway sensitivity | Pass / Fail | | | | | |
| 6.19 | Low temperature sensitivity (Freezing Conditions) | Pass / Fail | | | | | |
| 6.21 | Stability against mechanical abuse of units during installation | Pass / Fail | | | | | |

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## 18.2 TECHNICAL SCHEDULE B2: CHARGER

| | | | |
|---|---|---|---|
| Manufacturer, country of origin and type reference | | | |
| Maximum physical dimensions | | | |
| Width x Height x depth (mm) | W: | H: | D: |
| Type (Wall / Rack Mounted / Free Standing Panel) | | | |
| IP rating | | | |
| D.C. output 30V, 48V or 110V:<br>Rectifier Type (Thyristor / Dual Switch Mode)<br>Float voltage<br>Current Output<br>Ripple (%) with Battery Disconnected<br>Charger Life Expectancy (years)<br>Charger Maintenance Requirements / Other Details | | | |
| Batteries Compatible with Charger/Enclosure | | | |
| Current limitation range | | | |
| Voltage limitation range | | | |
| Noise level limit | | | |
| Time to recharge battery to 90% from fully discharged state (hours) – (Assume Largest Compatible Battery) | | | |
| Charger efficiency | | | |
| Overload protection | | | |
| Deep Discharge Protection Options (where applicable)<br>-> Cost Delta for Solution | | | |
| Details of Manual Switches | | | |
| Controls, indications and Alarms Modules | | | |
| Details of terminations and terminals used | | | |
| Details of D.C. Distribution<br>-> Cost Delta for additional Fuse ways | | | |

## 18.3 TECHNICAL SCHEDULE B3: ENVIRONMENTAL TESTING COMPLIANCE STATEMENTS

Electrical Environmental Requirements

| ENA Technical Specification 48-5 Clause | Procedure used for Test | Specified Test Level | Compliance Y or N | Actual Test Level | Remarks / Acceptance Criteria |
|---|---|---|---|---|---|
| 6.2 – AC Supply Voltage | | | | | |
| 6.5.1 – Insulation – Dielectric | | | | | |
| 6.5.2 – Insulation – Impulse Voltage | | | | | |



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Electromagnetic Compatibility (EMC) Requirements

| ENA Technical Specification 48-5 Clause | Procedure used for Test | Specified Test Level | Compliance Y or N | Actual Test Level | Remarks / Acceptance Criteria |
|---|---|---|---|---|---|
| 7.1 Oscillatory waves immunity test (High Frequency Disturbance) | | | | | |
| 7.2 Electrostatic Discharge immunity tests | | | | | |
| 7.3 Radiated electromagnetic field disturbance test (RFI) | | | | | |
| 7.4 Electrical fast transient/burst immunity | | | | | |
| 7.5 Surge immunity test | | | | | |
| 7.6 Conducted electromagnetic field disturbance tests | | | | | |
| 7.7.1 Power frequency magnetic field immunity test | | | | | |
| 7.7.2 Power frequency General | | | | | |
| 7.8 Pulse magnetic field immunity test | | | | | |
| 7.9 Damped oscillatory magnetic field immunity test | | | | | |
| 7.11 Conducted and Radiated Emission | | | | | |

## 18.4 TECHNICAL SCHEDULE B4: DEPARTURES FROM SPECIFICATION

The Tenderer will be deemed compliant with the Specification except to the extent those deviations are stated in this Schedule.

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## 18.5 SCHEDULE B5: PRICES FOR BATTERY SYSTEMS TYPES

| Battery System Type | Description | | Charger Output | Price | Compatible Batteries |
|---|---|---|---|---|---|
| **S-ST-30-Y(X)** | Wall Mounted Unmonitored 30V Switch Tripping Only Battery System | | | | |
| **S-ST-48-Y(X)** | Wall Mounted Unmonitored 48V Switch Tripping Only Battery System | | | | |
| **S-STL-48-Y(X)** | Monitored 48V Switch Tripping and Load Supporting Battery System | | | | |
| | Cost Delta for Deep Discharge Protection Option | | | | |
| **S-STL-110-Y(X)** | Monitored 110V Switch Tripping and Load Supporting Battery System | | | | |
| | Cost Delta for Deep Discharge Protection Option | | | | |
| **P-STL-48-Y(X)**<br>**P-STL-48/36-Y(X)** | Monitored 48V Switch Tripping and Load Supporting Battery System | A | | | |
| | | B | | | |
| | | C | | | |
| | | D | | | |
| | Cost Delta for 36V tapping fully rated for switch tripping Option. | | | | |
| **P-STL-110-Y(X)**<br>**P-STL-110/36-Y(X)** | Monitored 110V Switch Tripping and Load Supporting Battery System. | A | | | |
| | | B | | | |
| | | C | | | |
| | | D | | | |
| | | E | | | |
| | | F | | | |
| | | G | | | |
| | Cost Delta for 36V tapping fully rated for switch tripping Option. | | | | |
| | Cost Delta for additional fuse ways | | | | |
| **P-STL-110-Y(X)&SD**<br>**P-STL-110/36-Y(X)&SD** | Monitored 110V Switch Tripping and Load Supporting Battery System (not including the 110V distribution). | A | | | |
| | | B | | | |
| | | C | | | |
| | | D | | | |
| | | E | | | |
| | | F | | | |
| | | G | | | |
| | Cost Delta for 36V tapping fully rated for switch tripping Option. | | | | |
| | Cost Delta separate distribution board | | | | |
| | Cost Delta for additional fuse ways | | | | |

Continued



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| Battery System Type | Description | | Charger Output | Price | Compatible Batteries |
|---|---|---|---|---|---|
| P-TEL-48 | Monitored 48V Telecoms and SCADA Load Supporting Positively Earthed Battery System. | A | | | |
| | | | | | |
| | | B | | | |
| | | | | | |
| | | C | | | |
| | | | | | |
| | Cost Delta for Deep Discharge Protection Option (System A) | | | | |
| E-Cab(X) | Extension Cabinet with traying and accommodation for up to 2 sets of 110 (108) V batteries | | N/A | | |
| | | | | | |
| | | | | | |

* Prices for associated Batteries to be recorded in table below

### 18.6 SCHEDULE B6: PRICES FOR BATTERY SETS

| Battery | | | | | Price | Compatible Battery Systems (Battery/Charger System Reference) |
|---|---|---|---|---|---|---|
| Manufacturer | Series | Model | Voltage (per Block) | Voltage (of Set) | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
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In addition, please confirm costs for conducting commissioning charge on batteries per block and per set



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