



# SITA BTU Technical Specifications

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**Title: BTU Design, Supply, Installation and Commissioning**

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## Approval

The signatories hereof, being duly authorised thereto, by their signatures, hereto authorise the execution of the work detailed herein, or confirm their acceptance of the contents hereof and authorise the implementation/adoption thereof, as the case may be, for and on behalf of the parties represented by them.

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## 1 Installation Performance Requirements

1. The BTU installation shall be suitable for its intended duty with respect to the electrical supply, distribution, and load requirements.
2. The BTU installation shall be suitable for the environmental conditions, particularly with respect to corrosion resistance and ingress protection.
3. The BTU installation shall be suitable for its intended location, particularly with respect to the mechanical properties and impact strength of the components.
4. The BTU installation shall be compatible with existing equipment, plant, machinery and services.
5. The installation, including its circuit arrangements, shall satisfy the operational and functional requirements of the Employer and be readily and easily maintained throughout its operating life.
6. Unless otherwise specified, the minimum operating life of the installation shall be 30 years.
7. The performance of the items supplied in terms of this specification, as defined by the order, shall be warranted by the vendor/ contractor and, if specified, be tested in accordance therewith.
8. The equipment supplied is guaranteed for a period of twelve months from the date of commissioning against defective materials and workmanship. Tenderers are to indicate clause compliance with this specification and any divergences are to be clearly stated.
9. Tenderers are to submit a written undertaking at the time of tender that a complete range of spares for the equipment offered will be held by the manufacturer for a minimum period of 10 years from date of tender.

## 2 Standards

### 2.1 Regulations, Specifications and Standards

1. The BTU switchgear and the installation thereof shall be in accordance with the latest editions (current at the time of Tender) of all relevant National and International Standards, including but not limited to:

**Table 1: Reference Standards**

Standard Number	Description
ISO 9001, 9002 & 14001	Quality Management
IEC 60439	Low-voltage switchgear and control gear
IEC 60529	Degree of protection (IP rating)
IEC 60146-2	Semiconductor Converters – Part 2: Self commutated semiconductor converters including direct DC converters
IEC 60623	Secondary cells and batteries containing alkaline or other non-acidic electrolytes – Vented nickel-cadmium prismatic rechargeable single cells
OHS Act	Occupational Health and Safety Act 85 of 1993 (as amended)
SANS 1507 / SABS 150	PVC Cable
SANS 61558-2-17 -	Safety of Power transformers, power supply units and similar.
SANS 60156	MCB's and MCCB's
IEEE Standard 1115	Discharge performance of battery matched to load profile calculation
SABS152	Changeover Selector Switch
SABS1091	Paint

#### 2.1.1 The installation should also comply with:

1. This Specification, including all Technical Data Sheets; and
2. Any documentation issued by, or on behalf of, the Employer in respect of the Installation.

## 3 General specifications

### 3.1 Service conditions

1. Maximum 40°C
2. Minimum 0°C
3. Average 30°C

## 3.2 Electrical conditions

4. Tripping supply output voltage Main (110Volt DC)
5. DC Coil loading (200A)
6. Number to be energised simultaneously (7 breakers)
7. Duration of output pulse (200ms)
8. AC charger supply (230 Volt, 1 phase, 30A)
9. Earth Fault (+/-10%)

## 3.3 Extent of work

1. The Contractor will be responsible for the disconnecting of cables and the removal of and the disposal of the existing battery charger. The Contractor will be responsible for the delivery, off-loading and erection on site, testing and putting into operation of the BTU as per Section 4 of the Electrical Supply and Installation Bill of Quantity, 1001547-0100-BOQ-EE-001 and Data Sheet 1001547-0000-DST-EE-001.
2. The Contractor shall furthermore be responsible for checking all connections and for commissioning the BTU.
3. Any damages to the equipment during transport and/or erection and/or connecting, etc. shall be made good to the satisfaction of the Employer's Representative.

## 3.4 Labels and Designation plates

1. Labels shall preferably have black lettering on a white background, but danger plates and warnings shall have red lettering on a white background.
2. Suitable notices warning against malpractices such as incorrect operation of equipment, or any practice which may endanger the safety of the operator or other personnel, shall be provided when and as required. Such notices shall be to the approval of the Engineer in all respects.
3. Letter types and sizes for all labels shall be to approval.
4. Sufficient blank labels of the same type and size as that fitted on the board shall be supplied with the board for these positions where spare space or future possible circuit breakers have been called for.

# 4 Technical specifications

## 4.1 General

1. The charging equipment shall be suitable for operating under the substation conditions specified, at the voltages, currents and rating specified. Particular attention is directed to the temperature range at site and to the maximum permissible AC component of the charging current to prevent AC corrosion of the battery. Double pole circuitry is to be adopted throughout. The charger shall be rated to supply the continuous standing load in addition to the charging of the battery.
2. Each charger feeds a dedicated battery system.

3. The load circuits/breakers shall be rated for the application.
4. The 230V AC supply shall be single phase 30A.

## 4.2 Battery Tripping unit

1. The DC Supply System shall consist of a single battery charger, one set of batteries and with Output Circuit Breakers installed into one panel.
2. The output shall be smoothed to 5% RMS of the nominal DC output with the battery
3. The charging unit shall be of the constant voltage controlled current type suitable for pre-selection of the DC float voltage which is to be maintained across the battery to within  $\pm 1\%$  for a variation in AC supply voltage of  $\pm 10\%$ . The voltage adjusting devices shall be mounted inside the panel and provided with screw driver slots for adjustment. Each adjustment shall be labelled to indicate its purpose and the direction it must be rotated to raise or lower the voltage setting.
4. The design of the charger shall be such that the failure of the control equipment shall automatically reduce the DC output current to a safe minimum value.
5. A double pole AC circuit breaker shall be provided for the incoming AC supply, for single phase chargers and triple pole for three phase chargers.
6. The outgoing circuits shall be protected by Load Circuit Breakers "LCB"
7. The charger shall be provided with static overload protection to ensure that in the event of the charger output being short circuited, the maximum output current is kept to a value within the continuous rating of the charger components.
8. All indicating instruments shall be of the flush mounting, square dial type. An ammeter shall be provided to indicate charger output. A voltmeter shall be provided across the battery.
9. The charger shall be equipped with a proprietary automatic boost, test and alarm system.
10. Unless otherwise approved all control wiring shall be wired in multi strand PVC wires of the appropriate cross section.
11. All wiring shall be numbered by means of numbering ferrules. Crimped lugs shall be used for terminations.
12. Care shall be taken that the wiring is adequately supported, insulated and carried out in a neat manner.
13. The battery or charger unit shall be vermin proofed and provision shall be made for termination of all external cabling, both top and bottom. Undrilled removable punch out gland plates are to be used.
14. A rating plate shall be supplied indicating the maximum charge current, AC and DC voltage, number and type of battery cell.
15. The cells forming the battery will be supplied complete with all inter-cell and inter-row connectors and nuts and bolts.

16. Labels shall be provided on the front panels and interior of the unit for marking terminals, switches, fuses, alarm devices and outgoing terminals. These labels shall correspond with the schematic diagram.
17. Material used shall be anodized aluminium or white/black traffolyte and shall be engraved in accordance with approved label schedules. The labels shall be finished to give an overall neat appearance.
18. For warning labels, white letters on a red background are preferred.
19. External labels shall be fixed by means of screws.
20. Labels on the front shall be in English.
21. After drilling, cutting etc. the cubicles shall be cleaned and painted with structured gloss paint to SANS 1091. The interior chassis plate of the cubicle shall be finished in gloss white.
22. The charger and battery compartments are to be entirely separated from one another with no air movement possible between them. Battery shelves shall be protected by coating with Polyurethane rubber paint.
23. Charger construction shall incorporate the following features:
  - (a) Alarms as specified
  - (b) DC Voltmeter {Battery Voltage}
  - (c) DC Out Charger Ammeter {Charger Current}
  - (d) DC Ammeter {Load Output Current}
  - (e) Incoming supply circuit breaker
  - (f) AC supply live - LED indicator
  - (g) Automatic equalising charge cycle 28 days
  - (h) Automatic battery capacity test with manual override for spot check indication.
  - (i) Ripple content: Less than 5% RMS V.
  - (j) The charger shall have built-in monitoring to prevent over-charging. Excessive voltage output should result in the shutdown of the charger controller with a corresponding alarm.

## 4.3 This system should indicate the following

### 4.3.1 Automatic Boost & Manual Boost Selector

1. Boost charging is to be initiated every 28 days and automatically changed back to float when the battery is fully charged. Boost charging also to be initiated if the battery is discharged to the present low voltage alarm level. Boost charge is automatically terminated by means of a 2-hour override timer or by HVA 1 or HVA 2 as described below.

### 4.3.2 High Volt Alarm (HVA1)

1. This alarm level to be pre-set to just above the normal float voltage. HVA 1 allows for boost charging whilst providing protection against overcharging or excessive load voltage. Boost charge is terminated after 5,5 hours in the HVA 1 condition. An alarm is initiated if the battery voltage exceeds this pre-set level for 11 hours, or alternatively is above normal float for 21 hours.

### 4.3.3 High Volt Alarm (HVA2)

1. This alarm level to be pre-set to just above the normal boost voltage. When the HVA 2 level is reached, boost is immediately terminated, and a high voltage alarm initiated.

### 4.3.4 Automatic Battery Testing

1. Modern standby chargers are of the constant voltage type and usually incorporate alarm systems which monitor output voltage and current. Unfortunately, since a healthy charger maintains a constant voltage output, these alarms would not indicate if a fault occurred in the battery, with possible disastrous results in the event of mains failure.
2. There is thus a requirement for an automatic facility which would continuously monitor battery conditions and ensure that the battery is capable of supplying power when required to do so.
3. The battery monitoring unit automatically checks the internal resistance of the battery and associated connectors every 10 hours. The charger is automatically switched off, for 5 seconds and the voltage across the battery is checked. If this voltage drops below a pre-set level a "Battery Fail Alarm" is initiated and latched. This alarm would not latch for a low voltage condition resulting from a normal discharge. Separate local indication is given for "Battery Fail" and "Low Voltage".
4. To prevent additional discharging of the battery, the pulse testing is inhibited after indication of charge failure.

### 4.3.5 Charge Fail

1. A charge fail alarm to be initiated when the charging voltage is below normal float.

### 4.3.6 Earth Fault

1. A suitable bi polar earth fault detection system shall be provided with indication of positive or negative earth faults exceeding 40mA.

### 4.3.7 Mains Fail Alarm

1. A suitable Mains fail timer - adjustable from one (1) minute to one (1) hour shall be provided.

### 4.3.8 Indication

1. Flashing LED's to provide local indication for "Boost Charging", "High Voltage ", "Battery Fail" and "Charge Fail"

### 4.3.9 Remote Indication

1. Potential free change over contact to be provided for remote indication of "High Voltage", "Low Voltage", "Battery Fail" and "Charge Fail"
2. Under Mains or charge fail conditions the alarm system shall not draw more than 80mA from the battery.

### 4.3.10 Standing Loads

1. It should be assumed by the supplier that standing loads comprising microprocessor relays are in use. Consequently, the charger output should be equipped with suitable chokes and filters to

obviate consequential damage to relays, both in the normal operating mode, and also in the event of disconnection of the battery load as a damping component.

#### 4.3.11 Output Facilities

1. Provision shall be made for double pole output circuits, each individually switched via a suitable rated miniature DC circuit breaker. Double pole MCBs, C Curve with circuit breaker auxiliary for MCB open alarm.

### 4.4 Manufacturing and Construction Details

#### 4.4.1 General Requirements

1. Battery chargers shall be free standing, complete with battery, alarms and Controls as detailed.
2. The charger position should be housed at the bottom of the cubicle with the load distribution mounted on top.
3. Cable entry should be from the top or bottom with removable gland plates and punch out profiles for Pratley no. 1 glands.
4. All circuit breakers open indication shall be connected to a common MCB open alarm.

#### 4.4.2 Marking of Charger

1. Each charger shall clearly indicate the following information:
  - (a) Manufacturers name, type number and serial number.
  - (b) Current rating of charger.
  - (c) AC Input Supply voltages.
  - (d) Client order number.

### 4.5 Communication

1. The charger shall be fitted with a I/O module with Modbus or Bacnet Communication Card, with each BTU alarm wired to the I/O module.

### 4.6 Batteries

#### 4.6.1 Scope

1. This specification presents a general description, design criteria, and construction requirements for maintenance free batteries for stationary DC applications.

#### 4.6.2 Applicable Standards

1. The design, material, manufacture, selection, testing and performance of nickel cadmium batteries shall meet the requirements of the applicable sections of the latest revision of the standards: listed in *Table 1: Reference Standards*.

### 4.6.3 General Description

1. The battery shall be nickel cadmium, fibre plate matrix design, designed to provide reliable DC power.
2. The battery shall be designed for a 25-year service life.
3. The battery shall be of low maintenance type with recombinant technology to ensure pro long topping up intervals.
4. The structural integrity of the battery shall remain intact for the life of the battery.

### 4.6.4 Electrical Characteristics

#### 4.6.4.1 Performance

1. The discharge performance of the battery shall be matched to the load profile by calculation in accordance with IEEE Standard 1115.

#### 4.6.4.2 Capacity

1. The battery capacity shall be rated in ampere hours discharged for a 10-hour discharge period to 1.00 volts per cell after being fully charged. Capacity rating shall conform to IEC 60623.

#### 4.6.4.3 Cell Voltage

1. The nominal cell voltage shall be 1.20 volts. The open circuit voltage range of the cells shall be between 1.28 and 1.35 volts per cell.
2. The cells shall not exhibit any loss of life due to overcharge if water topping up is performed routinely.

#### 4.6.4.4 Cells

1. All Cells must be Single Cells recombination Type
2. A Formal agreement between supplier and original OEM must be supplied.
3. Type test certificates according to IEC60623 must be supplied
4. Brochures to be attach that shows the product that will be supply comply with the specification.

### 4.6.5 Commissioning

1. The battery shall receive a full formation process to activate the active material in the plates prior to shipment. After a full formation charge, the battery will not require a commissioning charge if put into service within 6 months of shipment.

### 4.6.6 Documentation

1. Each shipment shall have with it a Material Safety Data Sheet (MSDS), and an installation & operating instruction sheet.

2. Topping up interval shall not be less than once a year for a battery under float conditions at 20°C without any loss of capacity.

#### 4.6.7 Wiring, Terminals and Ferrules

1. Wiring shall be colour coded and ferrule marked in accordance with SABS 158 and such ferrule marking as may be shown on schematic diagrams that may be issued with the enquiry. For identification purposes identical ferrule markers of approved type shall be fitted to both ends of each wire. Ferrule markers shall be of a durable insulating material having a reasonable glossy finish to prevent the adhesion of dirt. Ferrule markers shall be marked clearly and permanently and shall not be affected by moisture, heat or battery acid. Unless otherwise approved, ferrule markers shall be white with black lettering.
2. All wiring shall be taken to terminals and wires shall not be joined or teed between terminal points. Terminals shall be spring loaded, and of the insertion double ended pinch bar type. Terminals shall be suitable to accommodate at least two 4mm<sup>2</sup> wires but not more than two wires shall be connected to an end of an insertion type terminal. Unless terminals are the fully insulated type, suitable insulating barriers shall be provided between terminals. Terminal strips shall be suitably labelled, and terminals shall be numbered to facilitate identification.
3. Wires connected to boundary terminals shall be marked with an CEC approved type of marking device.
4. "Slip-on" types of identification mark holders or ferrules shall be used.
5. Identification marks and/or letters and figures shall be permanently marked in black on a white or yellow background.
6. Identification mark holders or ferrules used shall match the size of wire onto which they will be fitted.
7. Self-adhesive types of identification are not acceptable.

#### 4.6.8 Wiring Identification:

- Each lead shall have a letter to denote its function (adopted from the obsolete standard BSS 158):

Table 2:Wiring Identification

Letter	Circuit Function	Wire Number
A	Current transformers for primary protection	10 - 29 Red phase 30 - 49 Yellow phase 50 - 69 Blue phase 70 - 89 Residual circuits and neutral current transformers 90 Earth wires directly connected to the earth bar 91 - 99 test windings
B	Current transformers for bus zone protection	
C	Current transformers for secondary or back-up protection	
D	Current transformers for metering and measurements	
E	Reference voltage for instruments, metering and protection	
F	Reference voltage for voltage control	
G	Reference voltage for synchronizing	
H	A.C. supplies and AC/DC supplies for motorized isolators and circuit-breakers	1 - 69 Switchgear and generators 70 - 99 Transformers
J	Primary DC supplies	
K	Protection, closing and tripping circuits	Any number from 1 upwards
L	Alarms and indication initiated by auxiliary switches and relay contacts excluding those for remote selective control and for general indication equipment	
M	Auxiliary and control motor devices, governor motor, rheostat motor, generator AVR control, spring charging motors, transformer cooler motor control, motors for isolator operation	1 - 19 Switchgear 20 - 69 Generators 70 - 90 Transformers
N	Tap-change control including AVC, tap position and progress indication	Any number from 1 upwards
P	D.C. tripping circuits used solely for bus bar protection	
R	Interlock circuits and Transfer circuits	Any number from 1 upwards
S	D.C. Instruments and relays, exciter and field circuits for generators	
T	Pilot conductors between panels, independent of the distance between them, for pilot wire protection, for inter tripping or for both	

U	Spare cores and connections to spare contacts	Spare cores should be numbered from 1 upwards in each cable and should be so arranged that they can be readily identified on site with the cable containing them.  This should be achieved by suitable grouping, and unless the location of each group is clear from the diagram, the group should be labelled. Alternatively, the core number should be preceded by the cable number
W	Supervisory Controls and Analogues, Energy pulsing	Any number from 1 upwards
X	Supervisory Alarms and indications	
Y	Telephones	

#### 4.6.9 Phase Colours:

1. AC Three Phase and Neutral:
  - (a) Phase A: Red
  - (b) Phase B: White:
  - (c) Phase C: Blue
  - (d) Neutral: Black
  - (e) Earth: Green/Yellow
2. AC Single Phase:
  - (a) Live: Red
  - (b) Neutral: Black
  - (c) Earth: Green/Yellow
3. DC:
  - (a) Positive: Red
  - (b) Negative: Black

#### 4.6.10 DC Distribution

1. Final sub circuits for DC distribution shall be protected by properly graded Miniature Circuit Breakers MCB's incorporating both Thermal and Magnetic trip characteristics. The MCBs shall be properly rated for breaking DC current at the prevailing fault levels.

## 5 TESTING AND COMMISSIONING

### 5.1 General

1. The BTU and the batteries shall be tested by the manufacturer. Test certificates, detailing the results of all tests, shall be submitted to the Employer's Representative, together with all the operating and maintenance manuals of the equipment. All defects detected during testing shall be rectified by the Contractor and shall be the Contractor's expense.
2. The applicable tests shall be in accordance with the requirements of IEC 60623.
3. Commissioning and site testing shall be carried out by the Contractor

### 5.2 QA Requirement

1. Tenderers to submit their ISO Quality Certification

#### 5.2.1 Type Testing

1. Type tests shall be conducted to indicate the cell performance under the following conditions:
  - (a) At the manufactures premises or works.
  - (b) A certificate detailing the results of above tests shall be submitted to the Municipality or its representative.

#### 5.2.2 Routine Testing

1. Following installation and commissioning, the following tests/ checks shall be carried out:
  - (a) Measurement of float voltage at full charge.
  - (b) Measurement of float current at full charge.
  - (c) Measurement of boost charge rate.
  - (d) Measurement of boost current at full charge.
  - (e) Measurement of the primary current "AC Input Current" at no Load
  - (f) Measurement of the primary current "AC Input Current" at full Load
  - (g) A heat run should be performed and all measurements to be submitted with the FAT
  - (h) A certificate detailing the results of above tests shall be submitted to the representative.

#### 5.2.3 Drawings, Data and Instruction Manuals

1. Drawings and documentation shall be to standard,
  - (a) Dimensioned outline drawing.
  - (b) Typical schematic drawings of the battery charger circuits.
  - (c) Three sets of each drawings handbooks and operational instructions to be submitted with the product on final delivery.
2. Three certificates are to be submitted after the execution of the type and routine testing. One copy on delivery of the instruction manual is supplied with the equipment.

3. The manuals shall be complete with all relevant drawings enabling the equipment to be assembled, tested and maintained.
4. All drawings to be supplied in hard copy as well as electronically in .dwg and pdf format.

#### 5.2.4 Delivery

1. The manufacturer is to pack the BTU (Charger) in a suitable manner to ensure that it arrives at the specified destination in good condition.
2. The manufacturer shall be responsible for the safe delivery of the equipment and the manufacturer shall provide for the necessary insurance cover.

#### 5.2.5 Summary

Table 3: Summary Specification

110V DC BATTERY TRIPPING UNIT	
SPECIFICATION:	
Technical Data	
CHARGER UNIT:	
Quantity	1 "Thyristor Controlled Battery Charger
Input	220/230V AC 1 phase 50 Hz, 30A
Output	110V DC nominal
Float Voltage	To suit type batteries/ cells
Boost Voltage	To suit type batteries/ cells
Charger Rating	To suit application
Standing Load	TBA
Charger Type	Constant voltage current limit (CVC)
Smoothing	5% RMS V
Regulation	$\pm 10\%$ mains variation $\leq \pm 1\%$ on DC output
Major Components	AC input protection MCB with auxiliary contact
	AC input surge suppression MOV
	Mains on LED lamp
	Double wound mains transformer with earth screen
	Thyristor Controlled rectifier control module
	Bridge rectifier/Thyristor Stack
	Rectifier protection fuse

Alarms	Multi-alarm module as follows
	Charge fail alarm
	Low volt/battery fail alarm
	High volt alarm
	28 day automatic battery boost system
	12 hourly automatic battery test system
	Battery test resistor and contractor
	BI -Polar earth fault alarm module
	Mains Fail Timer module
	A separate Low voltage module must be used in order to perform this function
	SP282 Six channel MCB open alarm monitor
Load Circuits	Each circuit protected by a 20A (CURVE C) MCB Double Pole
	AC/DC/Battery/ Alarm terminals
Cabinet	Sheet steel free standing with front access via a pad lockable front door
Finish	RAL 6019 – Pastel Green