Broadband Infraco

Technical Requirement Specification:
Rectifiers and Batteries

Document Number: NE-NT-SP-0009

Compiled by:	: Willem Grobbelaar
Version:	: 2.0
Domain:	: Network Engineering
Revision date:	: November 2012

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CHANGES SINCE LAST VERSION

The applicable changes to the document		
Change requested by:	**Network Engineering**	
Service Org SPOC:		
Contact number:		

SUMMARY OF CHANGES		
Paragraph	**Description**	**Date**
		2010/07/14
All	Updated with new requirements	November 2011

Previous Document Authorisation date:	Previous Author/Compiler: Rian Breed
Previous Section:	Previous Domain:

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1. SCOPE

The scope of this specification is limited to the direct current (-48V DC) rectifier and battery systems that Broadband Infraco (Pty) Ltd (Broadband Infraco) will deploy in network equipment rooms or containers where DC power supply is required.

2. OBJECTIVE

This specification details the technical requirements of Broadband Infraco for the manufacture, supply, delivery and installation of DC rectifier and battery systems. The DC rectifier and battery systems are for use in Broadband Infraco's network equipment rooms for the continuous supply of 48V DC power to telecommunication network equipment.

This specification comprises technical requirements for DC rectifier and battery systems in the following areas:

- General Requirements
- Power System cabinet
- Rectifier modules
- Controller
- Battery management
- Batteries
- Drawings
- Quality Assurance
- Installation
- Recovery of old redundant batteries
- Warrentee

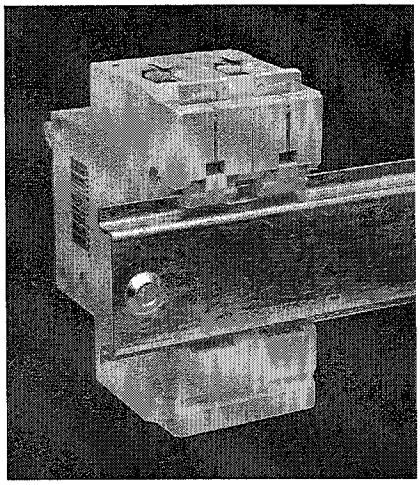
In addition, the specification also requests information regarding the maintenance and support processes of suppliers.

3. REFERENCE DOCUMENTATION

a) SANS 1042-1 – Wiring of premises
b) SANS IEC 60896-21– Stationary lead acid batteries part 21- Valve regulated batteries – Methods of tests
c) SANS IEC 60896-22– Stationary lead acid batteries part 21- Valve regulated batteries – Requirements
d) SABS IEC 60950- Safety of information technology equipment, including electrical business equipment (Alternative UL950)
e) SANS 1973-3 Low-voltage switchgear and controlgear assemblies Part 3: Safety of ASSEMBLIES with rated prospective short-circuit currents of up to and including 10 kA
f) SANS 1973-8 Low-voltage switchgear and controlgear assemblies: Part 8: Safety of minimally tested assemblies (MTA) with a rated short circuit current above and including 10kA and a rated bus-bar up to 1600A (AC and DC).
g) SANS 529 Degrees of protection provided by enclosures.
h) SABS 1574-3 - Electric flexible cores, cords and cables with solid extruded dielectric insulation – Part 3: PVC-insulated cores and cables
i) SABS 1507- Electric cables with extruded solid dielectric insulation for fixed installations (300/500 V to 1 900/3 300 V)
j) SABS IEC 61643 Surge protective devices connected to low-voltage power distribution systems

4. DEFINITIONS, ABBREVIATIONS AND ACRONYMS

4.1 Definitions

Word	Meaning
C2, C4, C10 rate	Capacity of the battery at the various discharge rates i.e. 2 hours, 4 hours or 10 hour respectively
DIN	A DIN rail or top-hat rail is a standardized 35 mm wide metal rail with hat-shaped cross section widely used for mounting circuit breakers and industrial control equipment inside equipment racks 
Dual feed (Type 1-4)	A Single source (rectifier and batteries) with duplicate cabling and circuit breakers to supply power to the intended load.
Dual supply (Type 5)	A Dual source (rectifiers and batteries) with cabling and circuit breaker i.e. two separate rectifiers with its own batteries able to supply power to the intended load independently.

4.2 Abbreviations

Abbreviation	Description
A	Ampere
AC	Alternating Current
Ah	Ampere-hour
DC	Direct Current
e.g.	exempli gratiã, meaning "for example"
EMC	Electromagnetic compatibility
mm	millimetre
RMS	Root Mean square
V	Volt
W	Watts

4.3 Acronyms

Acronym	Description
ETS	European Telecommunication Standard
IEC	International Electro-technical Commission
ISO	International Organisation of Standards
ILAC	International Laboratory Accreditation Cooperation
LVD	Low Voltage Disconnect
MTBF	Mean time between failure
OHSACT	Occupational Health and Safety Act
PDF	Portable Document Format
PSCC	Prospective short circuit current
PDU	Power Distribution Unit
RSA	Republic of South Africa
SPD	Surge Protection device
QA	Quality Assurance
SABS	South African Bureau Standard
SANS	South African National Standard
SNMP	Simple Network Management Protocol
VRLA	Valve Regulated Lead Acid

To find Acronym expansions go to http://www.acronymfinder.com/

5. GENERAL INFORMATION

5.1 DC Rectifier and Battery System Configurations

Broadband Infraco requires different DC rectifier and battery system configurations, with different load and standby requirements as detailed in Tables 5.1. [G]

Name	AC Supply	DC Power [W]	Max DC Current [A at 48V]	Standby Time [h]	Minimum Standby Capacity [Ah]	Anticipated amount of batteries strings **	Broadband Infraco Application
Type 1	1-Phase	1296	27	10	338 (at C10 rate)	2	Single phase 3m x 3m container
Type 2*	3-Phase	2640	55	10	688 (at C10 rate)	4	3m x 3m hosting containers
2 x Type 2*		2640 x 2 = 5280	55 x 2 =110	4 (for 1 x Type 2) 10 (for 2 x Type 2)	550 (at C4 rate) per 1x Type 2 688 (at C10 rate) per 1x Type 2	4 per 1 x Type 2	3m x 6m hosting containers

Type 3	3-Phase	2640	55	10	688 (at C10 rate)	4	3m x 3m container
Type 4	3-Phase	3840	80	10	1000 (at C10 rate)	6	3m x 6m container
Type 5 (previously Type 7)	3-Phase	4800	100	2	250 (at C2 rate) per rectifier	2	PoP sites

Table 5.1: DC Rectifier and Battery System Configurations and Requirements

* Refer to paragraph 6.4.2 [G]

** The amount of batteries may vary depending on the battery capacity being offered. [G]

Throughout this specification, DC rectifier and battery systems are referred to by "Name" to distinguish between different configurations. [G]

Note: Infraco will not in all cases deploy the full complement as per above table, but the system should be provisioned to accommodate the above minimum requirement.

5.2 Key Indications

Each requirement of the technical specification carries a letter appended at the end, with the following meanings:

[G] General Information

[M] Mandatory requirement

[I] Information

[D] Description

6. SPECIFICATION

6.1 Power System

Each Power System offered should consist of at least the following minimum components: [M]

a) Incoming mains breaker and surge protection.
b) Rectifier modules.
c) Controller.
d) A low volt disconnect unit (LVD),
e) DC distribution and battery circuit breakers.
f) Alarms and potential free contacts (relays)
g) Battery compartments/cabinets for the intended batteries
h) Batteries.

The technical requirements of the total power system solution are included in the following paragraphs.

6.2 General Requirements

a) The Power Systems shall in all aspects comply with SANS 10142-1. [M]

b) The offered system should be in compliance with either SANS 1973-3 and/or SANS 1973-8 depending on the exposed PSCC value of the installation. In the scenario of the offered system need not be tested against SANS 1973, an official document from SABS or professional responsible engineer will be required indicating it as such. It is preferred that the testing against SANS 1973 /official letter from SANS or professional engineer to be available and submitted with the tender responds but will also be acceptable to finalise this aspect on reward with the successful vendor. [M]

System Type	PSCC of system (based on anticipated system installed as per paragraph 5.1 and 6.2.2)
Type 1	≤10kA
Type 2	14kA
Type 3	14kA
Type 4	20kA
Type 5	≤10kA

Table 6.1 PSCC of the various systems

6.2.1 Documentation

The following documentation will be required to be supplied:

a) Operating manual (Operation, installation and maintenance procedures) – 1 per system and 1 for head office. [M]

b) Fault finding procedures and wiring diagrams – 1 per system and 1 for head office. [M]

c) All relevant compliance certifications and test reports (including but not limited to rectifier testing, SANS compliance and battery capacity testing) [M]

6.2.2 System Failure Rate

a) The rectifier system design MTBF in operating hours should be stated. It shall be stated to which international standard the calculation was based on and shall submit the relevant calculations. [M]

b) References of other users/operators utilizing the same system/building blocks and field reports (of minimum 3 years) indicating the amount of modules supplied, amount of batteries and the achieved failure rate shall be provided with the tender submission. [M]

6.2.3 Materials and Components

a) All materials and components shall be new and shall not have been in prior service except as required during factory testing and commissioning. [M]

b) All bus bars should be copper tin-plated. [M]

6.3 Power System

6.3.1 General

a) Types 1 to 4 must be configured as single rectifier, dual feeds (A and B feeds), with the specified load spread across the A and B feeds. [M]

b) Types 5 must be configured as dual supply system (A and B feeds), with the A and B feed capable of carrying the specified load independently. [M]

c) The overall footprint of the rectifier and battery systems must be minimised as much as possible, as these systems will mostly be deployed in equipment containers where physical space is limited, or in data centre environments where space lease costs have to be considered. [M]

d) The total footprint of each rectifier and battery system must be clearly stated. [M]

e) The weight of system Types 1, 3 and 4 must be spread as not to exceed a weight loading of 1500 kg/m^2. Type 2 maximum weight loading must not exceed 3500 kg/m^2 .The total weight (kg) of each cabinet, battery rack and all its components (including all sub-racks, rectifier modules and batteries that forms part of the respective system solutions must be clearly stated individually and as well as a total maximum system weight per cabinet. All cabinets shall be level at the bottom to ensure that the weight is spread equally across the whole cabinet's base with no point loading applicable. [M]

6.3.2 Total Power Rating

a) The systems shall have a power rating to cater for the telecommunication load, battery charging and for redundancy. [M]

b) Typical configuration is as follows assuming the following building blocks (as example ONLY and different building blocks can be offered) [I]

- Battery capacity: 170Ah
- Rectifier module rating: 1800W
- Float Voltage: 54V at 25 degrees Celsius

System Type	Maximum load current (at 48V)	Battery charge current (at float voltage)*	Total DC current at 48V*	Redundant module (at 48V)*	Minimum current required at 48V*
Type 1 (single phase)	27A	34A	61A	37.5A	99A
Type 2	110A	68A	187A	37.5A	225A
Type 3	55A	68A	132A	37.5A	170A
Type 4	80A	102A	195A	37.5A	233A
Type 5 (per rectifier)	100A	34A	139A	37.5A	177A

Table 6.2: Typical power configuration – System Types 1 to 5

*Note: These values will need to be adjusted according to the actual proposed equipment offered.

It shall be indicated clearly in the statement of compliance how many batteries, rectifier modules are proposed, and how many rectifier slots are available in these systems.

6.3.3 Cabinet

6.3.3.1 Cabinet foot print and configuration

The Power System cabinets should not exceed 2200mm (H) x 600mm (W) x 600mm (D). The maximum amount of cabinets for the various systems are as follows [M]

a) Type 1: 2 cabinets
b) Type 2: 1 cabinet
c) Type 3: 2 cabinets
d) Type 4: 3 cabinets
e) Type 5: 1 cabinet per rectifier

6.3.3.2 Cabinet Frame

a) The cabinet shall be fitted with a standard 19" frame with all equipment to be installed in the 19 frame. The battery compartment/s needs not to be fitted with a 19" frame. [M]

6.3.3.3 Door or Cover

a) The rectifier cabinets (type 5) should be fitted with a lockable door/cover (not made of glass) covering the whole front side of the cabinet, which is lockable. [M]

b) The door shall be perforated to enhanced ventilation throughout the cabinet especially for the batteries and rectifier modules. [M]

6.3.4 AC Distribution

a) AC distribution should consist out an incoming AC main circuit breaker and the appropriate surge protection. [M]

b) This incoming circuit breaker shall be sized for full load system current with low AC input voltage of 230V/400V -10% i.e. (207 Volt – single phase or 360V for 3phase). [M]

c) The input termination should be capable of accepting single phase (230V nominal) for the Type 1 rectifier and three-phase (400V nominal) for Type 2 - 5. Input termination should be able to accommodate a cable size of at least 16mm^2. [M]

d) To be consistent with existing distribution boards and other installations, the offered circuit breakers shall be standard DIN rail mountable breakers and 18mm wide. [M]

e) The same circuit breaker shall be used in all cases and shall be SANS approved with a minimum Ic rating of at least 10kA for AC (230V) to ensure that the breaker can safely break the possible faults that may occur during any of the various systems. Please refer to the paragraph "Load circuit breakers" as well in par 6.3.8.2. Documented proof from a SANS accredited facility indicating compliance to SANS 60947-2/IEC 60947-2 with the applicable Ic values (for AC and DC) of the proposed breakers shall be submitted with the tender/quote responds. [M]

6.3.4.1 Surge protection

a) The surge protection shall be pre-installed and shall comply with specification as per appendix A [M]

6.3.5 Front access

a) The system with all its parameters and facilities necessary for maintenance shall be accessible from the front. [M]

6.3.6 Load Entry

a) Provision should be made for connection of the load cable to enter from the top and the bottom of the cabinet. It should be clearly labelled and indicated where to connect the load positive and [M]

negative.

b) The top lid of the cabinet should be removable for easy installation and shall be equipped with various perforated cut outs (with cable protection in form of grommets etc) or brush combs for all cabling and shall be able to accommodate all DC cables and AC cables [M]

6.3.7 Rack Earth

a) The power system shall have an earth bar or point inside the system cabinet. Surge protection, AC earth, DC output positive terminals, etc. shall be connected to this earth bar. Provision shall be made to couple earth connections at the top or bottom of the cabinet. It shall be clearly indicated where connections must be made. [M]

6.3.8 DC Distribution

6.3.8.1 Single Point of disconnect

a) All power systems shall have single point of disconnection on the DC load output as per SANS 10142-1 (excluding battery current). [M]

b) This switch disconnector/circuit breaker rating should be as follows

i. Type 1: ≥125A [M]
ii. Type 2: ≥125A
iii. Type 3: ≥125A
iv. Type 4: ≥125A
v. Type 5: ≥125A

6.3.8.2 Load circuit breaker

a) Rectifier system Types 1 to 5 must be populated with load circuit breakers as listed in Table 6.3. [M]

b) The offered circuit breakers shall be SANS approved and have a minimum Ic rating of 15kA (in some cases 20kA) for DC to ensure that the breaker can safely break the possible faults that may occur. [M]

c) All circuit breakers (AC and DC) for all the systems shall be from the same manufacturer and from the same range. [M]

d) All circuit breaker should be capable of accepting 35mm² of cables. [M]

Name	Feed A		Feed B		Ic at 48V DC*
Type 1	2 x 63 A	1 x 18mm CB blank	2 x 63 A	1 x 18mm CB blank	15kA
Type 2	2 x 63 A	1 x 18mm CB blank	2 x 63 A	1 x 18mm CB blank	15kA
Type 3	2 x 63 A	1 x 18mm CB blank	2 x 63 A	1 x 18mm CB blank	15kA
Type 4	2 x 63 A	1 x 18mm CB blank	2 x 63 A	1 x 18mm CB blank	20kA
Type 5	2 x 63 A	6 x 18mm CB blank	2 x 63 A	6 x 18mm CB blank	15kA
	4 x 40 A		4 x 40 A		
	1 x 25 A		1 x 25 A		

Table 6.3: Load Circuit Breaker Ratings – System Types 1 to 5

Note: All the switches, breakers and switch disconnectors shall be protected from accidental switching by means of a transparent removable cover. [M]

*Note: All circuit breakers shall have a minimum interrupting current (Ic) as per above table based on a maximum short circuit current of each battery of 4000A as per this specification. The PSCC value is based on the anticipated amount of batteries (each battery short circuit current of 4000A and 1.5 metre 16mm ² cable per battery) as per table 5.1. [I]

6.3.8.3 Battery Circuit Breakers

a) There shall be battery circuit breakers for each individual installed battery. These circuit breakers shall be rated for a nominal current of 63-Ampere and be of the same model and range as the DC load circuit breaker indicated in paragraph 6.3.8.2. [M]

b) The battery cables between the battery breaker and the battery itself shall be pre-installed and shall be minimum 16mm² (based on 63A circuit breaker) to ensure that the cable is protected by the battery circuit breaker [M]

6.3.9 Low Volt Disconnect (LVD)

a) Operation

This module shall disconnect the battery from the negative conductor when the voltage of the battery falls to the default value 1.8VPC Volt (43.2V), and reconnect when the system returns to normal operation (battery voltage ≥48V). The LVD shall be of a failsafe type and it shall be possible to remove, replace or reset the controller without the LVD disconnecting. [M]

i. The LVD should be able to withstand the prospective fault current rating of the installed batteries [M]

b) Control

Disconnect - and reconnect voltages shall be software controllable and settable. [M]

6.4 Power rating and rectifier module

6.4.1 Rectifier module

a) The rectifier modules shall be modular and be able to work in parallel with other modules of the same type and rating [M]

b) All modular rectifier modules shall be of the exact same type and shall have the exact same rating and physical size and shall be installed in a 19" frame. [M]

c) The same module shall be used in all the offered systems. [M]

d) Based on the load configuration and limited AC supply to these installations, Rectifier module should have a power rating of ≤ 2000Watts (42A at 48V). Refer to paragraph 6.4.2 as well. [M]

6.4.2 Required amount of rectifier modules

a) Rectifier system Types 1 to 5 must be able to provide the DC load power and DC load currents as specified in Table 5:1 .Total Power requirements. Please note that System 2 will be used in some cases as dual supply system (2 x Type 2) and thus each system (1 x Type 2) shall be rated and capable of supplying 2 x 55A=110A. [M]

b) In all cases all rectifier shall be equipped with a minimum of three rectifier modules. (Two modules for the required load and battery charging and one additional module for redundancy). [M]

c) Each system (Type 2 to 5) shall be equipped with multiple of 3 rectifier modules to ensure that the AC current is equally shared over the three phases. [M]

d) AC supply to various installations are limited and the maximum allowed AC current per rectifier (based on system fully populated with all rectifier modules drawing the maximum amount of current) on Type 2 – 5 should not exceed the following value (based on the installed AC supplied circuit breaker) . [M]

i. 25A per phase at 207V (230V-10%) for all three phases.

6.4.3 Output Power Limiting

a) The rectifier modules should be designed with a constant power and current limiting feature. [M]

6.4.4 AC Input Voltage Variation

a) The rectifier modules shall be able to deliver the rated output voltage and current with the following input voltage variations exist: Single phase: 230 Volt ± 10% (207V – 253V) as per SANS 10142-1. [M]

6.4.5 AC Input Frequency Variation

a) The rectifier modules shall be able to deliver the rated output voltage and current if the following input frequency variations exist: 50Hz ± 5% (47,5Hz – 52,5Hz). [M]

6.4.6 Harmonic Distortion

a) The THD (Total harmonic distortion) of the rectifier modules shall not be more than 5% [M]

6.4.7 Soft Starting Facility

a) The rectifier modules shall be designed with soft start functionality. The inrush current shall be less or equal to the normal peak current at full load. [M]

6.4.8 Rectifier modules Conversion Efficiency

a) The rectifier modules shall not have a conversion efficiency of less than 92% for loads between 50-100% of the rated output power. However preference may be for higher efficient modules of 94% for load between 30-100% [M]

6.4.9 Power Factor Requirements

a) The rectifier modules should have a power factor of not less than 0.99 for loads between 50-100% of the rated output power. [M]

6.4.10 Current Sharing

a) The rectifier modules when operating in parallel shall share the current efficiently (better than 10% variance) to ensure the AC is shared between the various phases. [M]

6.4.11 Stand Alone/Parallel Operation upon controller Failure/Removal

a) In case of the rectifier modules operating without a controller or when the controller fails, the rectifier modules shall operate in a "default mode". By "default mode" is meant that the rectifier modules [M]

shall have a set of hardware default values for standalone or parallel operation.

6.4.12 Protection

a) The rectifier modules shall have a minimum IP rating of 20 according to SABS 529. [M]

6.4.13 Battery Temperature Compensation

a) Battery float voltage shall be adjusted accordingly to the temperature under which the batteries are installed. Thus appropriate temperature sensors for measuring the ambient and the battery temperature shall be supplied default with each system to enable battery temperature compensation function. Temperature compensation should be adjustable from the controller. [M]

6.4.14 Rectifier modules Protection

a) The power system and rectifier modules and shall in all aspects be able to withstand the circumstances, without any damages, where a phase conductor or the neutral conductor experience loss (or a low- or high voltages) or where a short circuit or fault occur on the DC side, or falls outside the systems normal operating condition for a duration of time. The system shall return to normal after the fault has cleared. [M]

b) The rectifier modules should be equipped with fuses, circuit breaker or electronic protection circuit to protect the input and output of the rectifier modules. [M]

c) The protection device on the input should only operate when an internal rectifier modules fault occurs. [M]

d) On the DC output side, a protection device should protect the output of the rectifier modules against destructive voltages and current originating from the load. Internal over voltage protection in the rectifier modules shall not shut down any rectifier modules when system is in equalise/boost charge cycle. In the case a rectifier modules experience over voltage condition it shall restart automatically when the over voltage has cleared [M]

e) Rectifier modules should be internally protected against abnormal high ambient temperature or operation in an environment where air flow is restricted which results in an increased in temperature. Automatic current limitation or shutdown should be provided in these cases. The rectifier modules should be automatically recovered when the over temperature has cleared [M]

6.4.15 Rectifier modules Alarms

a) The manufacturer should provide indicative rectifier modules conditions, simplifying fault diagnostics as far as possible, where the rectifier modules behaves in a manner less than ideal. There should be at least the following two indications on the rectifier module self. [M]

1. AC present
2. Module failure/malfunctioning

6.4.16 Power Density

a) The bidder should state the power density, in W/cm³ (or W/inch³), of the rectifier modules. Preference is for a power density of more than 1.22W/cm^3 (or 20W/inch³) for the rectifier modules [M]

6.4.17 Rectifier modules Connection

a) All rectifier modules shall be back "hot" pluggable. The rectifier module and control function shall be designed in such a way that upon live connection, no arcing shall take place and shall fall in normal operating conditions. [M]

6.4.18 Rectifier modules set-up and Parameter Adjustment

a) All rectifier modules parameters should be software adjustable from the controller. Upon set-up, initialisation and commissioning the controller should download all parameters to the rectifier modules and then store it locally on the rectifier modules. These values should be valid when the [M]

controller is removed or fails.

6.4.19 Power System Operating Temperature

a) The power system should be designed to operate in temperature range up to 70°C. [M]

b) In the temperature of above 45°C it will be acceptable for output performance to be slightly derated. [M]

6.4.20 EMC

a) The rectifier modules shall comply with the EMC requirements stated in EN 300 386-2 and or carry the equivalent's CE mark. A compliance certificate and or proof shall be provided. [M]

6.4.21 Noise levels

a) The following maximum noise levels will be allowed. [M]

b) Ripple: ≤ 10mV RMS unweighted

c) Voice band: ≤ 2mV RMS psophometric

d) Wide band: ≤ 10mV RMS unweighted

e) Peak to Peak value ≤ 200mV peak to peak unweighted

6.4.22 Safety

a) The rectifier modules shall in all aspects comply with SABS IEC 60950 or equivalent international version of it. The vendor shall provide proof of compliance to this specification and shall submit it with the bid. [M]

6.5 Controller

a) The same controller shall be used on all systems. [M]

6.5.1 Width

a) Controller together with the proposed rectifier modules should fit in a standard 19" rack [M]

6.5.2 Output Voltage settings and control

6.5.2.1 Float voltage

a) The nominal DC output voltage of the power system shall be -48 Volts and the default (factory pre-set) float voltage shall be set at the battery manufacturers recommended voltage. It shall be possible to adjust the output float voltage between –53 and –55 Volt by the controller. [M]

6.5.2.2 Boost/Equalise charge

a) The rectifier modules should be able to equalise/boost charge the batteries based on time interval or in the event of a significant discharge on the batteries by increasing the output voltage automatically for a specific time and then return back to normal float condition. It shall be possible to adjust the output equalise/boost voltage between –53 and –57 Volt. This function shall be default deactivated and shall be able to be activated/disabled at any point of time. [M]

6.5.3 LVD control

a) The LVD module operation and status shall be software controllable. [M]

6.5.4 Sleep mode function on rectifier modules

a) The controller should be able to put modules in a hot standby mode (sleep mode) during the operation of the system if the load on the power system is low to increase the reliability (and in some cases the efficiency) of the systems. [M]

b) The settings and or control should be user selectable to activate/ deactivate the sleep mode function and the conditions when modules to be switch on or off. [M]

6.5.5 Battery Temperature Compensation

a) The battery temperature compensation slope should have a set-able range in mV/°C/cell. The default value should be the recommended float voltage of the battery 54V at 25°C with a slope range set at -3 mV/°C/cell (or as per battery manufacturer recommendation) between a temperature range of 10-40°C. [M]

b) It should be possible to disable this function. [M]

c) If the temperature probe fails then the controller should report an alarm and return the rectifier modules to the nominal setting at 25 degrees Celsius. [M]

6.5.6 Alarm outputs

a) The manufacturer should provide comprehensive and indicative alarms simplifying fault diagnostics on the system (rectifier modules, AC input, etc.) as far as possible where the system behaves in a manner less than ideal. These alarms should be software adjustable (on the controller). [M]

b) It should be possible to change or swap the alarms as Broadband Infraco see fit. [M]

c) A complete list of alarm names, their setting range and parameters should be provided [M]

d) The following minimum alarms should be provided and extended via separate relay (potential free) contacts: [M]

Table 6.4: Alarm configuration

Name	Condition	Indication	Potential free contact (relay)
1. Output voltage high	Output voltage > -55 Volt	Alarm indication	Extended to relay
2. Output voltage low	Output voltage < -47 Volt	Alarm indication	Extended to relay
3. LVD active	Output voltage < -43.2 Volt	Alarm indication	Extended to relay
4. AC supply fail	Loss of mains voltage on one or more phases	Alarm indication	Extended to relay
5. Rectifier modules fail	Rectifier modules output voltage out of limits	Alarm indication	Multiple module failure – Extended to relay
6. Controller System fail	Controller or system failure	Alarm indication	Extended to relay
7. Battery	Battery integrity compromised	Alarm indication	Extended to relay
8. MOV failure	Surge suppression failed on any of the phases	Alarm indication	Extended to relay

6.5.7 Battery Current Limitation

a) The following feature should be standard with the controller: Battery current limitation. [M]

b) This facility limits the charging current to the battery (ies). The amount of charging current should be software definable. [M]

c) The default value should be set at 10% of the total installed capacity of the battery. [M]

6.5.8 AC Input Monitoring

a) The input voltage should be monitored and should be displayed on the software and controller. [M]

b) The input current monitoring is optional but it is preferred [I]

6.5.9 Logging function

a) The controller shall log and store events (including clearing of events) and all data logs (i.e. including but not limited to alarms, general operating conditions (AC and DC voltage and currents (load and battery conditions) in a software file on a non-volatile memory. All logs should include the time, date and condition of event and data. Recording of data logs (settings and logging interval) should be user definable. [M]

b) The controller should be able to store at least 1000 events and 5000 data logs before the memory is full. [M]

c) The controller should automatically delete the oldest data from the log file in the case of more than the maximum amount of events are logged on the controller. [M]

6.5.10 Password and Username Protection

a) All set-able parameters on the power system should be password and username protected:

i. All parameters viewable but not adjustable. – No password [M]

ii. Main system parameters - All parameters viewable and adjustable - Password protected. [M]

6.5.11 Controller Powering Requirements

a) The controller should be powered from the rectifier modules and Battery DC bus. Power to the controller should not be lost or interrupted when the LVD has opened. [M]

6.5.12 Controller display and interface

a) Backlit LCD readouts should be provided on controller. [M]

b) Comprehensive system settings and current conditions including the following: [M]

AC conditions, rectifier modules, LVDs, battery, temperature and alarm information, settings and information should be available on controller. It should be possible to manually scroll through menu's to view parameter settings.

c) All information including the DC voltages and currents to the load and batteries shall be measured and available on the controller. The voltage meter should have a resolution of at least 0,1 Volt and the ammeter a resolution of at least 1 ampere. [M]

[M]

d) The voltage meters should have an accuracy of 0,5% or better with the current measurement better than 1%

6.5.13 Construction

a) It shall be possible to remove the controller from the front of the rack. [M]

b) The controller should be constructed of replaceable sub-assemblies and should be interchangeable. The controller shall be back "hot" pluggable and it shall be possible to plug a controller into a live system without creating DC output disturbance outside the operating condition as per this specification. [M]

6.5.14 Communication

a) Rectifier system Types 1 to 5 must have the following communication interfaces to facilitate system interrogation: [M]

i. USB or RS-232 for local system configuration and management [M]

ii. 10BaseT Ethernet for remote system configuration and alarm management [M]

iii. RS232 as back-up for remote system configuration and monitoring [M]

b) The supervisory modules of rectifier system Types 1 to 5 must be able to support Simple Network Management Protocol (SNMP). [M]

6.5.15 Software

a) Rectifier and battery systems Type 1 to 5 must have client PC software that can be used to configure system settings through a local communication interface as specified in 6.5.14. [M]

b) Rectifier and battery systems Type 1 to 5 must have software that can be used for configuration and monitoring of systems from Broadband Infraco's Network Operations Centre (NOC) through one or a combination of remote communication interfaces as specified in 6.5.14. [M]

6.6 Battery Management

a) The Power System should have battery monitoring system and included in all systems supplied with preference that the battery management system be housed within the controller enclosure. [M]

b) The battery monitoring should be an effective system which will determine if a battery string (or certain blocks) is "out of step" like capacity loss or shorted cells by comparing voltages and/or current of individual battery blocks or multiple blocks in one string with other batteries (in same string and/or other strings) under float charge conditions and/or under discharge condition. [M]

c) It should be possible to monitor up to 4 (and for Type 4: 6) different strings (nominal 48 Volt with each string consisting out of 4x12V block). [M]

d) It should be possible to initiate a discharge test by triggering the rectifier modules in the system into a "battery discharge test" mode. In this mode the rectifier modules float voltage is set to a lower value which ensures that the battery (ies) are carrying the load. During the test the rectifier modules will prevent (under all circumstances) the voltage falling below the LVD setting. After the "battery discharge test" is stopped/completed the system should revert to the state it was before the test. The "battery discharge test" should not interrupt service to the load in any way. [M]

e) It should be possible to observe the battery status [M]

f) The manufacturer should provide indicative battery alarms simplifying fault diagnostics where the battery behaves in a manner less than ideal. The alarms and thresholds should be software based. [M]

g) The battery monitor should be capable of continuously monitoring, testing, and recording the parameters of the battery's performance. The following parameters should be available: [M]

i. Battery alarm status. (including high-, low voltage, battery temperature)

ii. Identification of battery string alarmed.

iii. Measured values (voltages, currents and temperatures)

iv. Set points.

v. Estimated remaining backup time during a discharge event

vi. Battery parameters monitored should include string or series connected battery block voltages, battery string currents and ambient and pilot cell temperatures.

h) The battery monitor system should have built in protection against fault conditions introduced at the DC power source. [M]

6.7 Batteries

6.7.1 Battery Types

a) System Types 1 to 5 shall make use of 12V valve regulated lead acid (VRLA), 19"/21" front terminal batteries. [M]

b) The same battery shall be used in all systems. [M]

c) Each battery shall have a maximum short circuit current as per SANS IEC 60896-21/22 of 4000A to ensure that the onsite distribution boards will remain below 10kA value to limit the legal requirements for DB boards. [M]

d) The battery string shall be designed for a float voltage of 53.5 – 54.5 Volts (per nominal 48-Volt string) or 2.23 - 2.27 volts per cell @ 25°C and shall be able to be fully charged under normal float voltage within the recharge period of 72 hours. [M]

e) All batteries will be charged at the temperature compensated mentioned float voltage throughout the batteries' life. Batteries which require at regular intervals boost charge to maintain the capacity of the batteries shall not be accepted. [M]

f) All batteries shall have a minimum design life according to the Eurobat guide or any other equivalent guide or standard as a "Long Life" batteries i.e 12 years or more at 20 degrees Celsius. [M]

g) Battery blocks of an AGM (Absorbent Glass Mat) technology are preferred. [M]

6.7.2 Batteries sizing

a) System Types 1 to 5 should make use of multiple 48V 160-200 Ah batteries strings. [M]

b) In all cases, rectifier systems shall be equipped with at least 2 battery strings per rectifier. [M]

c) Each 12V battery block shall have the following maximum physical dimension to ensure the batteries can also be used in already deployed containers and cabinets [M]

- Height of 320mm (height) x 126mm (width) x 565mm (depth).

d) Batteries of system Types 1 to 5 must provide a standby time and capacity as specified in Table 5.1 (Standby Time and Minimum Standby Capacity). Please note a 25% ageing factor shall be included in the batteries (already included in Minimum Standby Capacity as per Table 5.1). Type 2 batteries shall be rated for 10 hours based on 55A load per system and minimum 4 hours at 110A. [M]

e) All battery capacities shall be rated at the cut off voltage of 1.8VPC (or higher) at a temperature reference of 25 degrees Celsius. [M]

f) Batteries of system Types 1 to 4 must be deployed on appropriate battery racks, bearing in mind the weight loading limitation, with the rectifier system positioned on top of one of the battery racks. [M]

g) Rectifier and batteries of system Types 5 must be deployed in single cabinet configurations for the A and B feeds respectively, with the cabinets capable of enclosing all batteries completely. The [M]

maximum cabinet dimensions should be considered in all cases.

6.7.3 Battery Performance

a) Batteries shall be tested to SANS IEC 60896-21/22 and the relevant test report/certificate shall be submitted with tender responds against Broadband Infraco requirements. Refer to appendix D [M]

b) It is recommended that the following tests as per SANS IEC 60896-21/22 have been verified or being tested by an independent or accredited test house: Valve Operation as par 6.8, Float service with daily discharge as per par 6.13 and impact of stress temperature of 55 or 60 degrees Celsius as per par 6.16. Certification and such proof, where available, shall be submitted with the tender responds. [M]

6.7.4 Battery quality testing

a) Supplier shall conduct a battery capacity test on all batteries before delivery will take place and proof of the results shall be provided, which shall be attached to each string supplied. [M]

b) The initial acceptance of batteries will depend on the following criteria: All batteries capacity should achieve 100% of the manufacturer's stated capacity i.e all blocks individually should give the required capacity to a cut off voltage of 1.8VPC at 25 degrees Celsius. [M]

6.7.5 Battery age

a) The supplier shall guarantee that the date of manufacture, indicated on the cells, will not be more than one 180 days earlier than the date of the order. [M]

6.8 Drawings and brochures

a) Broadband Infraco shall be provided with a full set of brochures of the circuit breakers, rectifiers, rectifier controller, battery management, surge protection and batteries offered and or proposed by the bidder indicating the detail specification of the various products offered. [M]

b) Broadband Infraco shall be provided with a full set of rectifier and battery system/engineering layout drawings for all proposed solutions. [M]

c) Drawings must be supplied in both of the following formats:

i. Hard copy, A4 paper size [M]

ii. Electronic copy, in Portable Document Format (PDF) and / or compatible with Microsoft Visio Viewer. [M]

6.9 Quality Assurance

a) The premises, facilities, procedures and Quality Assurance programmes of local manufacturers may be inspected and approved by Broadband Infraco prior to the commencement of local manufacture. [M]

b) All equipment (and drawings) must be approved by Broadband Infraco before any final manufacturing and or delivery should take place. [M]

c) A sample rectifier and battery system could be called for and inspected by Broadband Infraco during the tender evaluation process. [M]

6.10 Installation of rectifier and batteries on behalf of Broadband Infraco

It shall be expected from the supplier of the rectifier and batteries to supply, deliver and install the equipment in a relevant container and or datacentre on behalf of Broadband Infraco.

6.10.1 Installation of new power system on site where existing power and systems needs to be replaced, the supplier:

a) Shall supply, transport and install the new rectifier and batteries [M]
b) The installer shall replace the old rectifier and batteries with the new rectifier and battery system during a "live" cut-over without disconnecting any circuit or power. [M]
c) Shall recover the old rectifier equipment and dispose of the old batteries as per this specification. [M]
d) Shall issue the relevant certificate of compliance and test report as per SANS 10142-1 [M]

6.10.2 Installation of new power system (a new site), the supplier:

a) Shall supply, transport and install the new rectifier and batteries either to indicated site or factory of the container manufacturer. [M]
b) Shall supply and install the relevant DC cabling (SANS 1574-3) between the rectifier and all DB boards. [M]
c) Shall issue the relevant certificate of compliance and test report as per SANS 10142-1 [M]
d) Shall give relevant instructions/training regarding storage, transport and work on system to container manufacturer to ensure that all certificates, test reports and warrantees on supplied equipment will not be compromised, when container is given to Broadband Infraco at site. [M]

6.11 RECOVERY, REMOVAL AND DISPOSAL OF REDUNDANT BATTERIES

a) The supplier of the rectifiers and batteries shall be responsible for recovery and disposal of the redundant batteries being recovered from various sites after new batteries have been installed. [M]
b) The supplier shall indicate the relevant process which will be implemented for disposing of the redundant batteries, complying with all the applicable legislation and OHSACT requirements. [M]
c) The supplier shall forward a compliance certificate either from an accredited disposal / recycle facility or from their own facility that complies with the legal requirements governing the disposal of redundant batteries/lead. [M]
d) The supplier shall issue Broadband Infraco with a certificate indicating the actual amount of batteries/weight have been disposed of by the relevant disposal/recycle facility. [M]

6.12 Warrantee

a) In the event of any of the following items/components becoming defective, the supplier shall replace such defective item, free of charge, up to three years from the date of installation:
   i. Battery cell or block [M]
   ii. Rectifier module [M]
   iii. Controller [M]

7. APPENDICES

Selected schedule(s) are found in the appendices and forms part of this specification.

7.1 Appendix A: Maintenance Processes

Suppliers are required to respond to all questions in this schedule.

Broadband Infraco will make use of the information provided during its price evaluation process to assess the complete lifecycle cost of the proposed rectifier and battery systems, as well as the potential impact on the total cost of ownership of the equipment.

7.2 Appendix B: Support Processes

Suppliers are required to respond to all questions in this schedule.

Broadband Infraco will make use of the information provided during its technical evaluation process to assess whether a supplier's support processes will be able to effectively support Broadband Infraco's requirements.

7.3 Appendix C: Surge protection requirements

Suppliers are required to comply with this schedule which indicates the minimum requirements of the surge protection. Refer to Appendix E for indicating compliance to this schedule.

7.4 Appendix D: Battery requirements as per SANS IEC 60896 21/22

Suppliers are required to complete the second part of this schedule. This schedule consists out of two parts. The first part is indicating Broadband Infraco battery requirements and the second sheet is the manufacturer responds (actual tested data) to Broadband Infraco requirements and all fields shall be filled in. In cases with no test been done, the wording "Not tested" should be filled in.

7.5 Appendix E: Schedule of Compliance / Non-compliance / Information

Suppliers are required to complete this schedule and must take note of the following:

1. A detailed statement of compliance or non-compliance, accompanied by reasons (if any) for every requirement called for in the specification, must be submitted. The detailed statements must be in the format as provided in Schedule A. Where needed, further notes may also be appended to the schedule.

2. It must be clearly stated whether the equipment offered, for each of the specified requirements, is:
   - **Fully Compliant**, or
   - **Non-compliant**

3. Phrases such as "**noted**" must only be used against paragraphs that are for information only and carry no contractual commitment.

4. Phrases such as "**noting**", "**will comply**" and "**comply, except**", in a paragraph that requires a compliance or non-compliance statement will be read as non-compliance.
5. The letter appended at the end of each paragraph in the specification requires the following type of response:

[G] General Information – note paragraph

[M] Mandatory requirement – a statement of compliance, non-compliance or a degree of compliance

[I] Information – gives actual values, quantities or other specific details called for

[D] Description – gives a description of the function of the feature as requested

END

APPENDIX A: MAINTENANCE PROCESSES

1. What routine maintenance procedures are required for the rectifier and battery components of the proposed system solutions:
    a. How often is routine maintenance required?
    b. Explain what tasks should typically be performed during routine maintenance and what tools and or training will be expected of such personnel?
2. Provide a life cycle costing model/analysis taking into account all factors/relevant assumptions predicting the life expectancy of the supplied solution for the rectifiers and batteries individually operating under normal circumstance. Normal circumstance is regarded as 1 cycle per month with a depth of discharge of 20% at average ambient temperature of 22 degrees Celsius. A predicted total cost to company including all aspects over a 15 year life cycle is to be calculated and supplied.
3. The supplied shall give a technology life cycle positioning of the equipment offered which shall include but not limited to the following:

a. When was the offered equipment first introduced into the commercial market,
b. When was the last upgrade and when is the next planned upgrade.
c. What is the life expectancy of the offered equipment before equipment will become
    i. Obsolescent and
    ii. Obsolete

APPENDIX B: SUPPORT PROCESSES

1. Support services
    a. Do you offer support services beyond the sale of equipment?
    b. If so, how are such support services provided inside and outside the equipment warrantee period?
    c. If support services are offered, are there additional cost implications?
    d. If there are additional cost implications, kindly provide a detailed breakdown of these costs?

2. How will Level 2 and Level 3 support queries be handled? Please describe the process that would be followed for each support level. As part of the process descriptions, kindly make reference to the following aspects:
    - Who will be responsible for handling Level 2 and Level 3 support queries
    - Access to Level 3 support engineers
    - Availability of local subject-matter experts

3. Repair of faulty equipment
    a. How will in-warranty and out-of-warranty repairs be handled? What is the process to be followed for each and what turnaround times can be expected?
    b. Will spares be kept inside the country?
    c. Will repairs be done inside the country?
    d. Will modules / equipment / batteries be readily available for swop-out during failures?

4. Training
    a. What training is offered on purchase, and what is offered on an ongoing basis?
    b. Will training be conducted inside the country or outside of the country?
    c. What training is offered / required in terms of continuous certification of staff and contractors?
    d. Is an online help / training facility available?
    e. Is a "train the trainer" concept supported whereby experts are created locally?

5. If applicable, please describe how firmware / software upgrades are handled, including licensing issues, etc?

APPENDIX C: SURGE PROTECTION SPECIFICATION

7.6 Technical

a. All SPDs shall comply with the requirements of SABS IEC 61643-1 and shall have been tested as class II devices. [M]

b. Class II SPD shall comply with the following levels installed between the phases and Neutral [M]

Class II SPD's		
Nominal Discharge Current	In	≥ 20kA (8/20) (minimum)
Peak Surge Current	Isn	≥ 40kA (8/20) (minimum)
Voltage protection level	Up	≤ 1.5 kV (maximum)

Appendix C 1: Class II SPD specification

c. In conjunction with the above class II SPD the following Class II surge protection device (gap type arrestor) installed between the Neutral and earth [M]

Class II SPD's		
NOMINAL DISCHARGE CURRENT	In	≥ 40kA (8/20)

Appendix C 1: Class II Spark Gap

d. The Maximum operating voltage (Uc) of the SPD unit shall be between 255V and 300V. [M]

e. The SPD shall be equipped with a mechanical disconnection mechanism and shall have a visual indicator showing the end of life of the unit (SANS 10142-1). The gapped type surge arrestor does not require visual indication [M]

i. Indication: Indication shall be of the mechanical type (flagging). [M]

f. The SPD units shall be equipped with remote signalling via a potential free relay contact to indicate that the disconnection mechanism has been activated. [M]

g. The SPD units shall be modular and should be possible to replace faulty surge modules just be pulling it out of service rather than disconnecting installed cables and using tools. [M]

h. The SPD shall be DIN Rail mountable. [M]

APPENDIX D: BATTERY REQUIREMENTS AS PER SANS IEC 60896 21/22

User statement of requirements

1) Application description information	
Application summary	Telecommunication
Load (in A or W) and autonomy time profile (s)	As per paragraph 5.1
Minimum and maximum system float voltage	Max voltage: 57V and min Voltage: 43.2V
Maximum of boost charge system voltage available Y/N If yes what value?	N/A
Expected minimum and maximum operating temperatures and their duration per year	Min temp of 10 degrees with maximum degrees of 45 degrees
Any other relevant information or operational requirements such as duration and frequency of power outages, of diagnostic discharges and of energy cost saving actions	

2) Product specification information						
Product safe operation in service	**Compliance information mandatory**					
6.1 Gas emission (at the float voltage and at 2,40 VPC)	Maximum allowed gassing are as follows: Ge at Float: 0.043ml/cell/h/Ah and Ge at 2.4VPC: 0.43ml/cell/h/Ah					
6.2 High current tolerance	Pass					
6.3 Short circuit and DC internal resistance	Maximum allowed short circuit current: 4000A					
6.4 Internal ignition from external spark sources	Pass					
6.5 Protection against ground short propensity	Pass					
6.6 Content and durability of required markings	Pass					
6.7 Material identification	Pass					
6.8 Valve operation	Pass					
6.9 Flammability rating of materials	VO - rating					
6.10 Intercell connector performance	Maximum allowed temperature is 70°C					
Product performance in service	**Compliance information mandatory**					
6.11 Discharge capacity	Data for	C_{10}	C_8	C_3	C	$C_{0.25}$
6.12 Charge retention during storage	Pass					
6.13 Float service with daily discharges	Minimum requirement: Unreliable mains failure (Preference is for: Very unreliable mains failure)					
6.14 Recharge behaviour	Pass					
Product durability in service	**Compliance information mandatory**					
6.16 Impact of stress temperature of 55 ^{0}C or 60 ^{0}C	Minimum requirement: Long duration exposure time (Preference is for: Very long duration exposure time)					

6.17 Abusive over-discharge	Poor mains supply with E.o.d voltage control
6.18 Thermal runaway sensitivity	Pass
6.20 Dimensional stability at elevated internal pressure and temperature	Pass
6.21 Stability against mechanical abuse of units during installation	Pass

Supplier statement of test results

1) General product type information					
Product manufacturer					
Manufacturing site of tested product					
Product name					
Product model range					
Product comprising the above model range					
Product tested					
2) Product test performance information					
Product performance in service	**SANS IEC 60896-21 test clause result**				
6.1 Gas emission (at the float voltage and at 2,40 Vpc)					
6.2 High current tolerance					
6.3 Short circuit and d.c. internal resistance					
6.4 Internal ignition from external spark sources					
6.5 Protection against ground short propensity					
6.6 Content and durability of required markings					
6.7 Material identification	Case		Cover		
6.8 Valve operation	Before		After		
6.9 Flammability rating of materials	Case		Cover		
6.10 Intercell connector performance					
Product performance in service	**SANS IEC 60896-21 test clause result**				
6.11 Discharge capacity	C_{10}	C_8	C_3	C	$C_{0.25}$
6.12 Charge retention during storage					
6.13 Float service with daily discharges	Cycles		C_{af}		C_{ab}
6.14 Recharge behaviour	24 h		168 h		
Product durability in service	**SANS IEC 60896-21 test clause result**				
6.15 Float service life at 40 ^{0}C	Days with C_3 rate test at 40 ^{0}C				
6.16 Impact of stress temperature of 55 ^{0}C or 60 ^{0}C	Days with C_3 rate test at 55 ^{0}C or 60 ^{0}C Days with $C_{0.25}$ rate test at 55 ^{0}C or 60 ^{0}C				

6.17 Abusive over-discharge		
6.18 Thermal runaway sensitivity		
6.20 Dimensional stability at elevated internal pressure and temperature		
6.21 Stability against mechanical abuse of units during installation		
Company name: Company officer: Address/phone/fax/e-mail: Signature/date/place: Document established as reply of RFI:		

APPENDIX E: SCHEDULE OF COMPLIANCE / NON-COMPLIANCE / INFORMATION

General Requirements			
Specification	**Key**	**Fully Compliant / Non-compliant / Noted**	**Comments (if applicable)**
5.1	G		
5.2	G		

Specification			
Specification	**Key**	**Fully Compliant / Non-compliant / Noted**	**Comments (if applicable)**
6.1.a	M		
6.1.b	M		
6.1.c	M		
6.1.d	M		
6.1.e	M		
6.1.f	M		
6.1.g	M		
6.1.h	M		
6.2. General Requirements			
6.2.a	M		
6.2.b	M		
Table 6.1 PSCC of the various systems	M		
Type 1	M		
Type 2	M		
Type 3	M		
Type 4	M		
Type 5	M		
6.2.1 Documentation	M		
6.2.1.a	M		
6.2.1.b	M		
6.2.1.c	M		
6.2.2. System Failure Rate	M		
6.2.2.a	M		
6.2.2.b	M		
6.2.3 Materials and	M		

Components			
6.2.3.a	M		
6.2.3.b	M		
6.3. Power System	M		
6.3.1. General	M		
6.3.1.a	M		
6.3.1.b	M		
6.3.1.c	M		
6.3.1.d	M		
6.3.1.e	M		
6.3.2 Total Power Rating	M		
6.3.2.a	M		
6.3.2.b	M		
Table 6.2: Typical power configuration – System Types 1 to 5	M		
Type 1	M		
Type 2	M		
Type 3	M		
Type 4	M		
Type 5 (per rectifier)	M		
6.3.3 Cabinet	M		
6.3.3.1 Cabinet foot print and configuration	M		
6.3.3.1.a	M		
6.3.3.1.b	M		
6.3.3.1.c	M		
6.3.3.1.d	M		
6.3.3.1.e	M		
6.3.3.2 Cabinet Frame	M		
6.3.3.2.a	M		
6.3.3.3 Door or Cover	M		
6.3.3.3.a	M		
6.3.3.3.b	M		
6.3.4 AC Distribution	M		
6.3.4.a	M		
6.3.4.b	M		
6.3.4.c	M		

6.3.4.d	M		
6.3.4.e	M		
6.3.4.1 Surge protection	M		
6.3.4.1.a	M		
6.3.5 Front access	M		
6.3.5.a	M		
6.3.6. Load Entry	M		
6.3.6.a	M		
6.3.6.b	M		
6.3.7 Rack Earth	M		
6.3.7.a	M		
6.3.8 DC Distribution	M		
6.3.8.1 Single point of disconnect			
6.3.8.a	M		
6.3.8.b.i	M		
6.3.8.b.ii	M		
6.3.8.b.iii	M		
6.3.8.b.iv	M		
6.3.8.b.v	M		
6.3.8.2 Load circuit breaker	M		
6.3.8.2.a	M		
6.3.8.2.b	M		
6.3.8.2.c	M		
6.3.8.2.d	M		
Table 6.3: Load Circuit Breaker Ratings – System Types 1 to 5	M		
Type 1	M		
Type 2	M		
Type 3	M		
Type 4	M		
Type 5	M		
6.3.8.3 Battery Circuit Breakers	M		
6.3.8.3.a	M		
6.3.8.3.b	M		
6.3.9 Low Volt	M		

Disconnect (LVD)			
6.3.9.a	M		
6.3.9.a.i	M		
6.3.9.b	M		
6.4 Power rating and rectifier module	M		
6.4.1 Rectifier module	M		
6.4.1.a	M		
6.4.1.b	M		
6.4.1.c	M		
6.4.1.d	M		
6.4.2 Required amount of rectifier modules	M		
6.4.2.a	M		
6.4.2.b	M		
6.4.2.c	M		
6.4.2.d	M		
6.4.2.d.i	M		
6.4.3 Output Power Limiting	M		
6.4.3.a	M		
6.4.4 AC Input Voltage Variation	M		
6.4.4.a	M		
6.4.5 AC Input Frequency Variation	M		
6.4.5.a	M		
6.4.6 Harmonic Distortion	M		
6.4.6.a	M		
6.4.7 Soft Starting Facility	M		
6.4.7.a	M		
6.4.8 Rectifier modules Conversion Efficiency	M		
6.4.8.a	M		
6.4.9 Power Factor Requirements	M		
6.4.9.a	M		
6.4.10 Current Sharing	M		

6.4.10.a	M		
6.4.11 Stand Alone/Parallel Operation upon controller Failure/Removal	M		
6.4.11.a	M		
6.4.12 Protection	M		
6.4.12.a	M		
6.4.13 Battery Temperature Compensation	M		
6.4.13.a	M		
6.4.14 Rectifier modules Protection	M		
6.4.14.a	M		
6.4.14.b	M		
6.4.14.c	M		
6.4.14.d	M		
6.4.14.e	M		
6.4.15 Rectifier modules Alarms	M		
6.4.15.a.	M		
6.4.15.a.1	M		
6.4.15.a.2	M		
6.4.16 Power Density	M		
6.4.16.a	M		
6.4.17 Rectifier modules Connection	M		
6.4.17.a	M		
6.4.18 Rectifier modules set-up and Parameter Adjustment	M		
6.4.18.a	M		
6.4.19 Power System Operating Temperature	M		
6.4.19.a	M		
6.4.19.b	M		
6.4.20 EMC	M		
6.4.20.a	M		
6.4.21 Noise levels	M		

6.4.21.a	M		
6.4.21.b	M		
6.4.21.c	M		
6.4.21.d	M		
6.4.21.e	M		
6.4.22. Safety	M		
6.4.22.a	M		
6.5 Controller	M		
6.5.1 Width	M		
6.5.1.a	M		
6.5.2 Output Voltage settings and control	M		
6.5.2.1 Float voltage	M		
6.5.2.1.a	M		
6.5.2.2 Boost/Equalise charge	M		
6.5.2.2.a	M		
6.5.3 LVD control	M		
6.5.3.a	M		
6.5.4 Sleep mode function on rectifier modules	M		
6.5.4.a	M		
6.5.4.b	M		
6.5.5 Battery Temperature Compensation	M		
6.5.5.a	M		
6.5.5.b	M		
6.5.5.c	M		
6.5.6 Alarm outputs	M		
6.5.6.a	M		
6.5.6.b	M		
6.5.6.c	M		
6.5.6.d	M		
Table 6.4 Alarm configuration	M		
Table 6.4.1	M		
Table 6.4.2	M		
Table 6.4.3	M		
Table 6.4.4	M		

Table 6.4.5	M		
Table 6.4.6	M		
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6.5.7 Battery Current Limitation	M		
6.5.7.a	M		
6.5.7.b	M		
6.5.7.c	M		
6.5.8 AC Input Monitoring	M		
6.5.8.a	M		
6.5.8.b	i		
6.5.9 Logging function	M		
6.5.9.a	M		
6.5.9.b	M		
6.5.9.c	M		
6.5.10 Password and Username Protection	M		
6.5.10.a	M		
6.5.10.a.i	M		
6.5.10.a.ii	M		
6.5.11 Controller Powering Requirements	M		
6.5.11.a	M		
6.5.12 Controller display and interface	M		
6.5.12.a	M		
6.5.12.b	M		
6.5.12.c	M		
6.5.12.d	M		
6.5.13 Construction	M		
6.5.13.a	M		
6.5.13.b	M		
6.5.14 Communication	M		
6.5.14.a	M		
6.5.14.a.i	M		

6.5.14.a.ii	M		
6.5.14.a.iii	M		
6.5.14.b	M		
6.5.15 Software	M		
6.5.15.a	M		
6.5.15.b	M		
6.6 Battery Management	M		
6.6.a	M		
6.6.b	M		
6.6.c	M		
6.6.d	M		
6.6.e	M		
6.6.f	M		
6.6.g	M		
6.6.g.i	M		
6.6.g.ii	M		
6.6.g.iii	M		
6.6.g.iv	M		
6.6.g.v	M		
6.6.g.vi	M		
6.6.h			
6.6.1 Battery management warrantee	M		
6.6.1.a	M		
6.7 Batteries	M		
6.7.1 Battery Types	M		
6.7.1.a	M		
6.7.1.b	M		
6.7.1.c	M		
6.7.1.d	M		
6.7.1.e	M		
6.7.1.f	M		
6.7.1.g	M		
6.7.2 Batteries sizing	M		
6.7.2.a	M		
6.7.2.b	M		
6.7.2.c	M		
6.7.2.d	M		
6.7.2.e	M		
6.7.2.f	M		

6.7.2.g	M		
6.7.3 Battery Performance	M		
6.7.3.a	M		
6.7.3.b	M		
6.7.4 Battery quality testing	M		
6.7.4.a	M		
6.7.4.b	M		
6.7.5 Battery age			
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6.8.b	M		
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6.8.c.i	M		
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6.9 Quality Assurance	M		
6.9.a	M		
6.9.b	M		
6.9.c	M		
6.10 Installation of rectifier and batteries on behalf of Broadband Infraco	M		
6.10.1 During installation of new power system on sites where existing power and systems needs to be replaced,	M		

the supplier			
6.10.1.a	M		
6.10.1.b	M		
6.10.1.c	M		
6.10.1.d	M		
6.10.2 During installation of new power system on sites in a new installation, the supplier	M		
6.10.2.a	M		
6.10.2.b	M		
6.10.2.c	M		
6.10.2.d	M		
6.11 Recovery, removal and disposal of redundant batteries	M		
6.11.a	M		
6.11.b	M		
6.11.c	M		
6.11.d	M		
6.12 Warrantee	M		
6.12.a	M		
6.12.a.i	M		
6.12.a.ii	M		
6.12.a.iii			

7.1 Appendix A: Maintenance Processes

7.2 Appendix B: Support Processes

7.3 Appendix C: Surge protection requirements

Technical			
Specification	**Key**	**Fully Compliant / Non-compliant / Noted**	**Comments (if applicable)**
7.6.a.	M		
7.6.b.	M		
Nominal Discharge current (≥ 20kA)	M		
Peak Surge Current (≥ 40kA)	M		
Voltage Protection level (≤1.5kV)	M		
7.6.c.	M		
Nominal discharge current (≥ 40kA)	M		
7.6.d.	M		
7.6.e.	M		
7.6.e.i	M		
7.6.f.	M		
7.6.g.	M		
7.6.h	M		

7.3 Appendix D: Supplier statement of test results

1) General product type information					
Product manufacturer					
Manufacturing site of tested product					
Product name					
Product model range					
Product comprising the above model range					
Product tested					
2) Product test performance information					
Product performance in service	**SANS IEC 60896-21 test clause result**				
6.1 Gas emission (at the float voltage and at 2,40 Vpc)					
6.2 High current tolerance					
6.3 Short circuit and d.c. internal resistance					
6.4 Internal ignition from external spark sources					
6.5 Protection against ground short propensity					
6.6 Content and durability of required markings					
6.7 Material identification	Case			Cover	
6.8 Valve operation	Before			After	
6.9 Flammability rating of materials	Case			Cover	
6.10 Intercell connector performance					
Product performance in service	**SANS IEC 60896-21 test clause result**				
6.11 Discharge capacity	C_{10}	C_8	C_3	C	$C_{0.25}$
6.12 Charge retention during storage					
6.13 Float service with daily discharges	Cycles		C_{af}		C_{ab}
6.14 Recharge behaviour	24 h			168 h	
Product durability in service	**SANS IEC 60896-21 test clause result**				
6.15 Float service life at 40 ^{0}C	Days with C_3 rate test at 40 ^{0}C				
6.16 Impact of stress temperature of 55 ^{0}C or 60 ^{0}C	Days with C_3 rate test at 55 ^{0}C or 60 ^{0}C Days with $C_{0.25}$ rate test at 55 ^{0}C or 60 ^{0}C				
6.17 Abusive over-discharge					
6.18 Thermal runaway sensitivity					
6.20 Dimensional stability at elevated internal pressure and temperature					
6.22 Stability against mechanical abuse of units during installation					
Company name: Company officer:					

Address/phone/fax/e-mail:
Signature/date/place:
Document established as reply of RFI: