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Supported by

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Date: _____

Approved By:

Chief Technical Officer

Date: _____

1 SCOPE

This specification covers the requirements for the supply and installation of a self-contained diesel generator set with all relevant alarms, security and performance as specified in this specification, shall function either as a prime mover or standby unit to power Broadband Infraco sites. A weatherproof canopy, soundproofing shall be provided.

2 DEFINITIONS, ABBREVIATIONS AND ACRONYMS

2.1 Abbreviations and acronyms

Acronym	Description
AC	Alternating Current
BMS	Building Management System
DB	Distribution Board
e.g.	exempli gratiā, meaning “for example”
EAS	Environmental Alarm System generally known as BMS
HCS	Hazardous Chemical Substance Regulations
Hz	Hertz
MSDS	Material Safety data sheet
NOC	Network Operations Centre
OEL-CL	Occupational exposure limits-control limit
V	Voltage
W	Watts
VA	Volt-Ampere

3 PERMANENT GENERATORS

The generator and installations must be compliant to the following minimum standards:

- SANS 10131 Above-ground storage tanks for petroleum products

- SANS 10142-1 – Wiring of premises

3.1 Electrical parameters

The generator output must be compliant to the following minimum electrical requirements:

1. Ratings of the generator should be as follows at 25 degrees Celsius at sea-level:
 - 24kW/30kVA 1 Phase;
 - 48kW/60kVA 3 Phase;
 - 64kW/80kVA 3 phase;
 - 80kW/100kVA 3phase;
 - 100kW/120kVA 3phase; and
 - 110kW/140kVA 3 phase.
 - 160kW/200KVA 3 Phase
2. 220V/230V 50Hz 1-phase output 50Hz for the 30 kVA.
3. 380V/400V 50Hz 3-phase output with each phase 220V/230V 50Hz for the 60, 80, 100 and 120, 140kVA and 200KVA.
4. Output voltage should not fluctuate under any load condition (0-100%) by more than 5% from above stated values.

3.2 Performance

The generator should be able to supply the following power requirements on a continuous basis while using primarily in a standby application.

1. The following minimum real power with a power factor of 0.8 lagging at 230V per phase on all three phases simultaneously needs be able to be delivered to at any Broadband Infraco site (thus be able to deliver this requested power at a height above sea level of $\geq 2000\text{m}$ at a temperature of 40 degrees Celsius). The output of the engine under the specified site conditions shall be the net available output after allowance for all auxiliary equipment, including filters, fans, pump, battery-charging etc. has been made.
 - 30kVA 80A (21kW per phase = 21 kW total);
 - 60kVA 60A (14kW per phase = 42 kW total);
 - 80kVA 80A (18.6kW per phase = 56 kW total);
 - 100kVA 100A (23.3kW per phase = 70kW total);
 - 120kVA 120A (29.15kW per phase = 87.5kW total);
 - 140kVA 140A (32.2kW per phase = 96.6kW total); and
 - 200kVA 200A (46.6kW per phase = 140kW total).
2. The engine technical data with the derating graphs on altitude and temperature shall be supplied.
3. It should also be possible to use the generator in a prime mover application as well. In this scenario the output power may be degraded by approximately 10%. The actual derating factor shall be supplied by the manufacturer.

The generator should be able to carry the following minimum step-load from cold start-up immediately after

the main supply failed while using in a standby application. The remaining available power should be available after the generator started up in maximum 2 minutes.

4. The following minimum real power, on step-load from cold start-up, with a power factor of 0.8 lagging at 230V per phase on all three phases simultaneously needs be able to be delivered to at any Broadband Infracore site (thus be able to deliver this requested power at a height above sea level of $\geq 2000\text{m}$ at a temperature of 40 degrees Celsius). The output of the engine under the specified site conditions shall be the net available output after allowance for all auxiliary equipment, including filters, fans, pump, battery-charging etc. has been made. The remaining power should be available after the generator started up in maximum 2 minutes
 - 70% of total output power for a 30kVA generator - 56A (14.7kW per phase = 14.7 kW total);
 - 70% of total output power for a 60kVA generator – 42A (9.8kW per phase = 29.4 kW total);
 - 70% of total output power for an 80kVA generator - 56A (13.2kW per phase = 39.03 kW total);
 - 70% of total output power for a 100kVA generator - 70A (16.31kW per phase = 48.93kW total);
 - 70% of total output power for a 120kVA generator - 84A (17.49kW per phase = 52.47kW total);
 - 70% of total output power for a 140kVA generator - 98A (20.41W per phase = 61.22kW total);
 - and
 - 70% of total output power for a 120kVA generator - 140A (32.62kW per phase = 97.86kW total).

3.3 Control Panel

- 3.3.1 The control panel will be in a water and weatherproof enclosure with a see-through window. The see-through window shall have a protection shield to protect the controller and display, as the window may be facing the direct sun depending on the location of the generator. It must include a mechanically and electrically interlocked 3 pole change-over of suitable rating, which will be controlled by a dedicated microprocessor generator set controller, which will also be responsible for the monitoring, protection and shutdown parameters of the engine and alternator.
- 3.3.2 The controller must be programmable both by laptop computer via USB or RS232 port and on the keypad on the front of the unit.
- 3.3.3 The control panel will have a communications port that can interface with an environmental alarm system via Ethernet (10BaseT), RS-232 or RS-485.
- 3.3.4 The control panel and all other entries in the enclosure of the generator must be lockable with a key to ensure that no unauthorised person can adjust and or change any settings and or operational status of the generator
- 3.3.5 The locking mechanism shall be designed to accommodate Broadband Infracore standard lock (G-series Low upper body Padlock) as described in the site locking mechanism specification NE-FM-0004.

3.4 Override System

- 3.4.1 An emergency key operated override facility must be included so that the generator set and changeover can be manually started and operated without the controller.

3.5 Battery

- 3.5.1 The battery must be a rechargeable lead acid sealed battery and incapable of being refilled with water or electrolyte.
- 3.5.2 The battery must be suitable for continuous float charging operation.
- 3.5.3 The nominal voltage for mono blocks should be 12V blocks.
- 3.5.4 The offered batteries shall have a design life of not less than 10 years at 20 degrees Celsius.
- 3.5.5 A fully charged battery shall have a shelf life of minimum 6 months but preferably ≥ 12 months at a temperature of 20 degrees Celsius.
- 3.5.6 Be capable of withstanding normal mechanical stresses caused by handling and transportation.
- 3.5.7 The battery must be secured and protected to prevent any theft on it.

3.6 Battery charger

- 3.6.1 Integral to the control panel will be a constant voltage, current limiting static battery charger with low ripple output for longer starter battery life.

3.7 Alarms

The controller should have the following alarms displayed on the controller/display of the generator:

- i. High engine temp/Low radiator liquid level;
- ii. Low Oil Pressure;
- iii. Low Fuel level day tank;
- iv. Abnormal voltage;
- v. Abnormal frequency;
- vi. Start failure (with error message);
- vii. Low starter battery voltage;
- viii. High Starter battery voltage;
- ix. Charger Alternator failure;
- x. Maintenance requested Alarm;
- xi. Underspeed alarm;
- xii. Overspeed alarm; and
- xiii. Fail to Start (Overcrank shutdown).

These alarms must be available via the communications port with an environmental alarm system. Current Broadband Infracore has an extensive installed base of the following EAS i.e. SAM2 controller.

It is the responsibility of the Generator supplier to make own arrangements with the Broadband Infracore EAS equipment supplier to finalise plans and implement the integration of the alarms (Gen alarms to EAS).

The supplier must also ensure that these alarms are tested with the NOC and the acceptance documents are signed.

3.8 Indicators

The controller should have the following indicators:

- i. Voltage, current and frequency of each individual phase;
- ii. Working hour counter;

- iii. Fuel level indicator;
- iv. Dummy load in operation; and
- v. Emergency stop activated.

3.9 Emergency stop-button

- 3.9.1 An emergency stop-button shall be provisioned and positioned on the front panel of the control cubicle but must be accessible from the outside. When depressed the diesel/alternator shall immediately stop and the load shall be disconnected from the set and a standby failure alarm shall be enlightened.

The stop button shall be of the self-latching should be fitted with a cup protection holder and a breakable glass from the outside.

3.10 Dummy loads

- 3.10.1 Dummy loads are required to be fitted to the machines.
- 3.10.2 The dummy loads shall be rated at minimum 30 % of the total kVA output rating of the generator.
- 3.10.3 Automatic sensing shall be incorporated to switch the dummy loads with individual sensing and control on each phase independently.

3.11 Service intervals

- 3.11.1 The service intervals of the generator shall be made available (in running hours and/or maximum months).
- 3.11.2 Part of the service interval schedule, the supplier shall indicate the service components and items to be service at various service intervals as well
- 3.11.3 The supplier of the generator shall indicate the various approved companies who can assist Broadband Infracore servicing the generator at the required interval, the required service components it will require and the maintenance the generator in case of breakdown.
- 3.11.4 The first two services for the generators shall be included with the supply of the generators by supplier who supplied and installed the diesel generator. The first service is usually at 50Hours and the second one at 150 Hours or as per the manufacturer's recommendation and requirements.

3.12 Fuel tank

- 3.12.1 The fuel consumption under various load conditions shall be submitted and indicated as such i.e. at 50% and 100%.
- 3.12.2 A fuel tank capable of delivery full load for minimum period of 48 hours should be integral to the base of the canopy generator set but, in some cases, a bigger fuel tank may be required due to location of the site. The minimum fuel tank capacity should be as follows:
- 30kVA – 300 L;
 - 60kVA – 600 L;
 - 80kVA – 700 L;
 - 100kVA – 900 L;
 - 120kVA – 1100 L; and
 - 140kVA – 1300 L

- 200kVA – 1800 L
- 3.12.3 A water trap must be fitted to the fuel line between the tank and the engine, in addition to the filter supplied with the engine.
- 3.12.4 A low fuel level switch must be included, as well as a drain plug.
- 3.12.5 The supplier of the generator shall assist Broadband Infracore with the registration of the generator and its associated fuel and/or any other requirements that the local municipalities may have as prescribed by the relevant municipality.
- 3.12.6 All generators, shall be supplied with a full tank upon delivery and commissioning of the generator to any of the Broadband Infracore sites.

3.13 Canopy

- 3.13.1 A powder coated mild steel canopy with will be provided to house the generator set and control panel according to SANS 1274.

3.14 Sound level

- 3.14.1 The noise level must not be more than 70 dBA at a distance of 7metre.

3.15 Finish and security

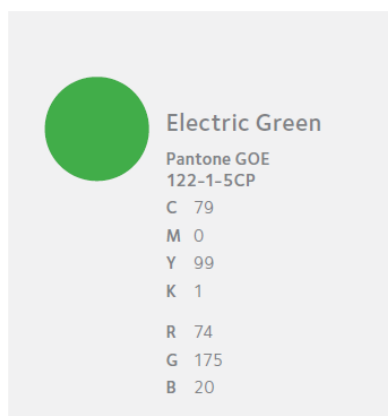
- 3.15.1 All the metal work shall receive a finishing process consisting of degreasing and rust-proofing.
- 3.15.2 A steel cage for protection and security shall be supplied and installed around the generator enclosure and shall be anchored and bolted to the plinth around the generator.

The steel cage shall have the following minimum characteristics:

- 3.15.2.1 Base and main structure to be constructed from 25mm x 25mm x 1.6mm steel bars.
- 3.15.2.2 Between the main steel structures, a 3mm steel meshed to be installed.
- 3.15.3 The proposed cage shall be lockable with BBI Lock (G-series Low upper body Padlock) as described in the site locking mechanism specification NE-FM-0004.

3.16 Colour

- 3.16.1 The generator housing and canopy shall be “electric green” of colour as follows:



3.17 Exhaust System

- 3.17.1 The exhaust system will be housed inside the canopy to reduce corrosion and will also be wrapped with a heat resistant wrapping to prevent heat transfer. The outlet will be situated in a way that no water (rain) can enter the exhaust system.

3.18 Plinth

- 3.18.1 A concrete plinth shall be provided, prepared with an underground service feed for the generator compliant to NE-FM-SP0002 paragraph 10
- 3.18.2 The minimum size of the plinth shall be the size of the supplied generator dimensions (plus fuel tank) with 500mm extension on each side with a minimum thickness of 250mm
- 3.18.3 Two feeder cables ducts (110mm HDPE cable conduit sleeves) from the plinth to the electrical drawbox shall be provided. This duct will be used for the power cables from the generator to the container/s
- 3.18.4 One feeder cables duct (110mm HDPE cable conduit sleeves) from the plinth to the fibre drawbox shall be provided. This duct will be used for the management/monitoring/alarms of the generator
- 3.18.5 A bund wall for any diesel spillage must be incorporated in the plinth and must in all aspects comply with SANS 10131. The size of the bund wall to be at least 110% of the generator diesel tank

3.19 Transport

- 3.19.1 The supplier shall arrange for its own transport and installation team for the installation of the generator on the specified Broadband Infraco site.
- 3.19.2 The generator shall be delivered, as approved and agreed on during the Factory acceptance testing..

3.20 Connections and installation on site

- 3.20.1 The supplier shall be responsible to supply all required material and cabling required to be able to install the generator on Broadband Infraco site.
- 3.20.2 The supplier of the generator shall be responsible for the connection of the generator to the Broadband Infraco building/container and the primary source which is Eskom/municipality or landlord power.
- 3.20.3 The supplier shall also be responsible to reroute or make any connections to any existing power connections and or terminals on site so that the generator is integrated properly to Broadband Infraco building/container as a standby generator correctly as it is intended to operate. The primary power source will be Eskom/municipality or landlord power, and the generator will be back-up source.
- 3.20.4 All electrical cabling shall be installed in trenches of 1m underground in proper 110mm mm duct and 32mm subducts between the landlord kiosk to the generator and from the generator to the Broadband Infraco container and or building.
- 3.20.5 A separate 110mm mm ducts and 32mm subducts between the generator and Broadband Infraco container and or building shall be provisioned and installed for the required communications cables for example the LAN cable etc.
- 3.20.6 All cabling, installations and connections shall be compliant to all legislation and SANS standards including SANS 1042-1 to ensure that the work was done properly and correct. For all equipment installation and for all work done, a new CoC (Certificate of Compliance) shall be issued and give to Broadband Infraco.

3.21 Automatic transfer switch/es

- 3.21.1 In some cases where the generator will be installed on existing sites where there is no automatic transfer switches (only manual transfer switches) the manual transfer switch/es will be replaced with an automatic transfer switch with the supply and install of the new generator
- 3.21.2 Supply and install a new suitably rated (3phase) automatic changeover switch and to be located in the housing of the generator canopy. The rating of the automatic changeover switch should be minimum 150% of the kVA rating of the generator. The Eskom/municipality feed should be treated as the main supply and the secondary feed will be generator feed.
- 3.21.3 In some cases on the 140kVA and 200kVA generators, two separate loads/containers are on site with their own supply cables to each container and the generator should be able to cater for both loads combined and/or separately. Thus, in these cases, two separate supply cables, two separate load circuit breakers with two independent ATS will be required to fulfil this requirement. The generator should be able to supply power to anyone of the container individually or both containers combined as and when required.
- 3.21.4 A LED/indicator to be supplied to indicate if Eskom /main feed is available.
- 3.21.5 The automatic changeover switch shall prioritise the Eskom feed as main feed and the secondary feed (generator power) as back-up supply. Thus, automatic changeover switch shall revert back to Eskom/mains feed when the main power has been restored by Eskom
- 3.21.6 A manual bypass switch with handle shall be supplied to perform manual switching between the two power supplies (Eskom to Gen and vice versa);
- 3.21.7 A transfer delay (which is settable) shall be standard feature on the transfer switch to delay the switching between the standby generator power to the main supply (Eskom) to ensure that the supply power to the site is stable and in specification

3.22 Support

- 3.22.1 The engine and spares must be locally available in South Africa and must be supported by any local company with regards to maintenance and spares.
- 3.22.2 The software for the controller and the related electronics (PCB's should be locally supported
- 3.22.3 The supplier of the equipment should also be prepared to do services on the generator when the need arises.

3.23 Warrantee

- 3.23.1 Warrantee of minimum 24 months is required for the batteries under normal operations.
- 3.23.2 The generator should have a minimum warrantee of at least 24 months on the generator from date of acceptable.

3.24 Training

3.24.1 The supplier shall offer training to Broadband Infracore covering aspects like maintenance, services, basic fault finding, alarms handling and general maintenance of the generator

The training must cover theoretical and practical (hands on) aspect of the generators.

Content	Description	Outcome (Learner)
Health and Safety	PPE Safe operation of DG Set Refuelling the DG set	Safe procedures when in the vicinity and operating a DG Set
Generator Sets components	Main components Auxiliary components	Identify the DG set parts
DG Set Operation	Pre-start up checks, Operational checks, Shutdown Control panels (Monitoring, Reset and clear alarms, DG status etc.)	Operate a DG set
DG Set Maintenance	Basic maintenance Basic tools Periodic inspections (visual and alarm testing)	Conduct basic maintenance of the DG Set
Troubleshooting	Troubleshooting common failures	Conduct basic troubleshooting

3.25 Deliverables

3.25.1 The generators must come with all relevant documentation like manuals supplied with the installation of the generator. The documentation shall include engine data, installation drawings, all wiring and interconnect diagrams, the manufacturers published warranty, spec sheets and all other information in connection to the generator

3.26 Maintenance

3.26.1 All maintenance items must be easily accessible.

3.27 Acceptance of generators

3.27.1 All generators will be accepted and approved by Broadband Infracore in a two-step approach:

3.27.1.1 A factory acceptance will be done at the manufacturing/assembly plant where the testing, parameters, performances of the generators will be tested and verified up delivery to site. All testing equipment, load banks, tools and metres shall be made available by the supplier/manufacturer during the factory acceptance testing.

3.27.1.2 A 2nd on-site acceptance test will be done during the delivery/installation of the generator on site. All testing equipment, load banks, tools and metres shall be made available by the supplier/manufacturer during the factory acceptance testing.

- 3.27.2 All testing procedure and methodology will be discussed and mutually agreed on prior any factory - and/or on site acceptable tests to be conducted.

3.28 Health and Safety

- 3.28.1 The noise rating limit of the generator cannot be above 85dBA in terms of NIHL Regulation 3, but attenuation-of-hearing protectors must be provided.
- 3.28.2 The MSDS will be acquired from the supplier in the form of annexure 8, containing all the information as contemplated in either ISO 11014
- 3.28.3 The generator has to comply with SABS 0229 Code of Good Practice of the Safe Handling of Identification and Classification of Dangerous Substance and Goods.
- 3.28.4 Consultation in terms of Regulation 4 HCS shall be conducted with safety representatives (17.1 appointed) to determine if any employee may be exposed by any route of intake.
- 3.28.5 To avoid the spread of contamination of the HCS, the storage and distribution will be identified, classified and packed in accordance with SABS 072 and SABS 0228
- 3.28.6 All collected HCS waste will be placed into containers that will prevent the likelihood of exposure during handling; all HCS waste shall be recycled.
- 3.28.7 All collected HCS waste which can cause exposure, will be disposed only on sites specifically designated for this purpose in terms of the Environmental Conservation act, 1989 (act No. 73 of 1989) not forgetting the local municipal by-laws.
- 3.28.8 The personal protective equipment and facilities in terms of Regulation 11 HCS shall be complied with, and where respiratory equipment is provided, the relevant equipment must be capable of controlling the exposure to below the OEL for the relevant HCS.

END

APPENDIX: 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. 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. In all cases the relevant brochures of the offered equipment/items shall be submitted with the bid/ tender and reference to the specific and relevant paragraph to proof compliance sheet shall be made.
4. Phrases such as “**noted**” must only be used against paragraphs that are for information only and carry no contractual commitment.
5. 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.
6. The letter appended at the end of each paragraph in the specification requires the following type of response:

[H] Heading

Specification			
Specification	Key	Fully Compliant / Non-compliant / Noted	Comments (if applicable)
3.1 Electrical parameters	H		
3.1.1			
24kW/30kVA 1 Phase			
48kW/60kVA 3 Phase			
64kW/80kVA 3 phase			
80kW100kVA 3phase			

100kW120kVA 3phase			
110kW140kVA 3phase			
160kW200kVA 3phase			
3.1.2			
3.1.3			
3.1.4			
3.2 Performance	H		
3.2.1 30kVA -21 kW 60kVA-42 kW 80kVA - 56 kW 100kVA- 70kW 120kVA-87.kW 140kVA-96.6kW 200kVA-140kW			
3.2.2			
3.2.3			
3.2.4 30kVA -14.7 kW 60kVA-29.4 kW 80kVA –39.1 kW 100kVA- 48.9W 120kVA 52.4.kW 140kVA-61.2kW 200kVA-97.8kW			
3.3 Control Panel	H		
3.3.1			
3.3.2			
3.3.3			
3.3.4			
3.3.5			
3.4 Override System	H		
3.4.1			
3.5 Battery	H		
3.5.1			
3.5.2			
3.5.3			
3.5.4			
3.5.5			

3.5.6			
3.5.7			
3.6 Battery charger	H		
3.6.1			
3.7 Alarms	H		
i			
ii			
iii			
iv			
v			
vi			
vii			
viii			
ix			
x			
xi			
xii			
xiii			
Capable of interfacing with EAS			
3.8 Indicators	H		
i			
ii			
iii			
iv			
v			
3.9 Emergency stop-button	H		
3.9.1			
3.10 Dummy loads	H		
3.10.1			
3.10.2			
3.10.3			
3.11 Service intervals	H		
3.11.1			
3.11.2			
3.11.3			
3.11.4			
3.12 Fuel tank	H		
3.12.1			
3.12.2			
30kVA -			
60kVA -			

80kVA -			
100kVA -			
120kVA -			
140kVA-			
200kVA-			
3.12.3			
3.12.4			
3.12.5			
3.12.6			
3.13 Canopy	H		
3.13.1			
3.14. Sound level	H		
3.14.1			
3.15 Finish and security	H		
3.15.1			
3.15.2			
3.15.2.1			
3.15.2.2			
3.15.3			
3.16 Colour	H		
3.16.1			
3.17 Exhaust System	H		
3.17.1			
3.18 Plinth	H		
3.18.1			
3.18.2			
3,18.3			
3,18.4			
3,18.5			
3.19 Transport			
3.19.1			
3.19.2			
3.20 Connections and installation on site			
3.20.1			
3.20.2			
3,20.3			
3,20.4			
3,20.5			
3,20.6			

3.21 Automatic transfer switch/es	H		
3.21.1			
3.21.2			
3.21.3			
3.21.4			
3.21.5			
3.21.6			
3.21.7			
3.22 Support	H		
3.22.1			
3.22.2			
3.22.3			
3.23 Warrantee	H		
3.23.1			
3.24 Training	H		
3.24.1			
3.25 Deliverables	H		
3.25.1			
3.26 Maintenance	H		
3.26.1			
3.27 Acceptance of generators			
3.27.1			
3.27.1.1			
3.27.1.2			
3.27.2			
3.28. Health and Safety	H		
3.28.1			
3.28.2			
3.28.3			
3.28.4			
3.28.5			
3.28.6			
3.28.7			
3.28.8			