Power Generation

DG Set Installation Recommendations

Bulletin No. 3243795 – ***Rev-06 dated 31- 03- 2016.***

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INTRODUCTION

DG Set Installation requires to be carried out as per Cummins Standard Installation guidelines to ensure satisfactory operation of the DG set. This manual provides an installation guideline for Cummins DG sets.

Right installation of DG set leads to

- **Desired Optimum performance**
- **Easy serviceability of the DG Set**
- **Availability and better uptime of DG set**
- **Better aesthetic of DG set**

This manual gives information related to typical DG set installation guidelines and care has been taken to ensure that the information in this Installation Manual is correct at the time of issue. Due to the continuing process of development this is subject to modification without prior notice and no responsibility can be accepted for alterations, errors or omissions.

This manual provides typical DG Set installation guidelines. For more detailed information on special application requirements like change in ambient conditions, new cooling system, new exhaust system, Dual frequency, etc., please contact Cummins or GOEM team.

Other than technical compliance in installation, it must comply with Local / State / Central Government and all other Statutory regulatory requirements as applicable.

INDEX

Revision Update

SR	Revision number/Date	Update details
1	Rev-05 dated 2- Nov- 2015.	Below sections included: CPCB-II models, cooling system particulars, exhaust pipe dia selection, roof top installation, mobile set earthing, DG Set preservation guidelines, new P check formats, typical material specification.
2	Rev-06 dated 31-03-2016.	Guideline for Foundation for Low kVA DG set/ Cooling system revised/ Table 1 updated,

I. SAFETY GUIDELINES

1. Personnel engaged in the DG Set Installation, commissioning, operation and maintenance must be competent and experienced in these fields. They must also be conversant with all relevant, current statutory requirements and local regulations. Before installing the DG Set, read this manual carefully to get familiar with the equipment and its operation. (Including all systems and controls, manually operated valves and shut down devices). Correct DG Set installation, operation and maintenance is essential for safe and efficient operation. Many accidents result from a failure to observe fundamental safety rules and precautions.
2. There are many potential hazards that can occur during operation of DG Set which cannot always be anticipated. Therefore a warning cannot be included in this manual for every possible circumstance that might involve a potential hazard.
3. While unloading, shifting of DG Set please ensure proper care is taken so that no damage to men and material is done. Please use proper unloading equipment's, tools and tackles.
4. DG room should have proper escape routes. An escape map may be displayed in the DG room which should be clearly visible to all would be helpful during any accident or fire.
5. Please provide proper Fire Extinguishers in DG Set room area.
6. Please put Hazard Signs for Electricals Panels, Fuel and Lubricants etc.
7. Personal Protection gadgets like -Safety hand gloves, goggles and ear plugs for protection of all operators, engineers and staff would make them safe, while working in DG Set room.
8. Ensure proper guards / protections for all moving parts.
9. Use of proper tools and tackles is recommended in the DG Set Room.

SAFETY GUIDELINES (Cont'd)

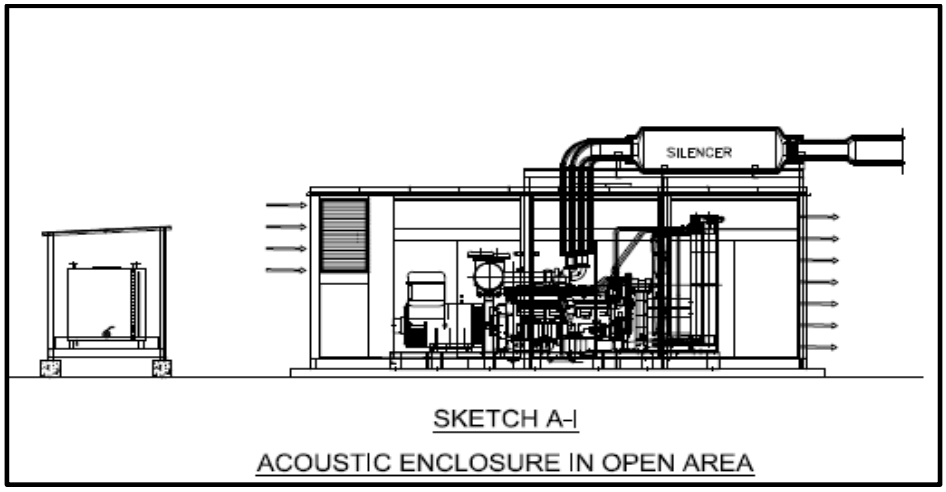
10. Electrical cables are fire Hazards during short circuits / failures - Please take proper care while routing of cables particularly power cables.
11. DG Set exhaust gas temperature will be about 450-550 Deg. centigrade and exhaust pipes need proper cladding and insulation.
12. Ensure there is no fuel and lubricating oil leakages in the DG set room, as they are fire Hazards.
13. Diesel Fuel handling need proper care, as they are also fire hazards.
14. Please ensure proper care is taken while lifting Heavy parts of the DG Set. The capacity of the lifting cranes should be suitable.
15. Earthing of the DG Set is recommended and please refer to the specific recommendations.
16. Keep tools & other metallic objects away from uncovered batteries. Use tools covered with vinyl electrical tapes or suitable non - conducting material to avoid possibility of shorting battery connections while working near batteries.
17. In case of bulk diesel storage and liquid gas storage, proper signage like "'NO SMOKING' boards should be prominently displayed.
18. Engine lubricating oil, engine coolant and grease are to be disposed at site as per site regulation requirement and considering MSDS (Material Safety Data Sheet).
19. Engine consumables replaced during maintenance like filters, are to be disposed at site as per site regulation requirement.
20. Batteries are to be disconnected, in case of persons working on the DG Set.
21. Disconnect all harness connections to the PCC & Engine control system before doing any welding work on DG set. Controller & PCB can get damaged due to welding currents. DG Set starting batteries to be disconnected at battery end before any welding work or maintenance.
22. During transportation of DG set with AVMs in-between sub base and engine generator ensure AVMs have shipping brackets (solid restraints) to prevent transit damage. Ensure to remove the shipping bracket before starting the DG Set.
23. Safety lockout and tag out process to be followed during maintenance.

II. DG SET INSTALLATION RECOMMENDATION

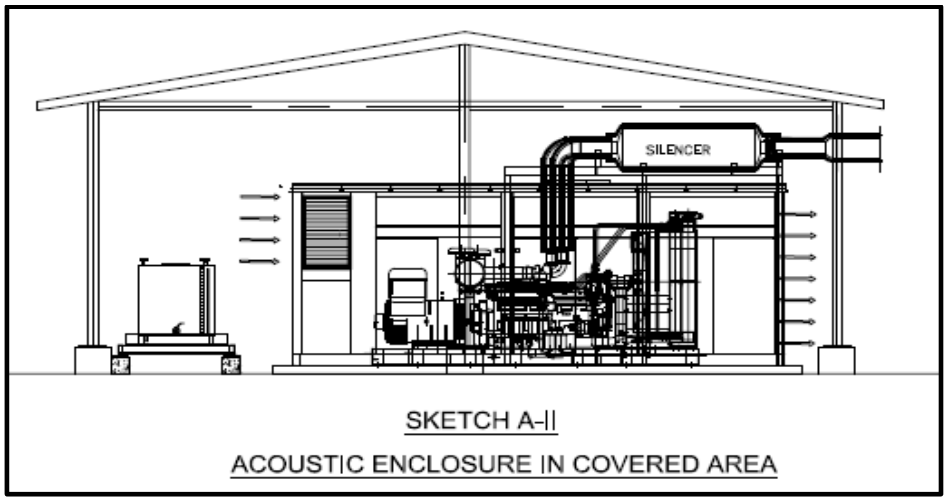
A. LOCATION

Following options are applicable for DG set Configuration.

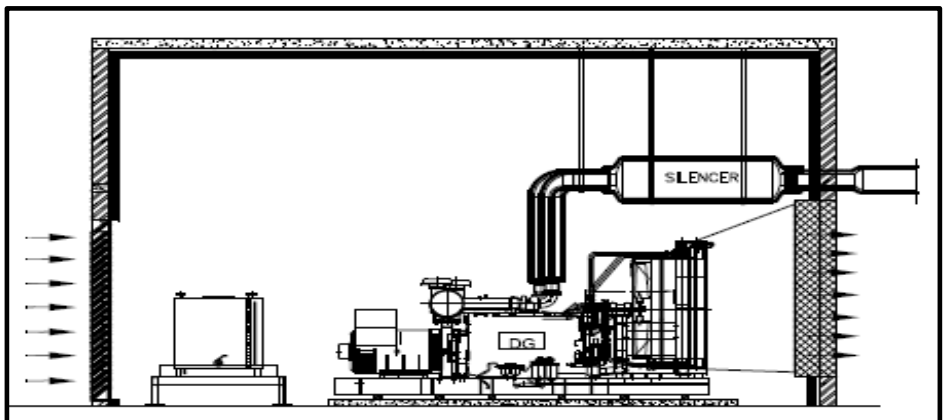
i. DG set with Acoustic Enclosure in open Area. (Refer Sketch. A-I)
ii. DG set with Acoustic Enclosure in covered Area. (Refer Sketch. A-II)
iii. Open DG set in Room Acoustic. (Refer Sketch. A-III, Sketch 3A & Sketch 3B)



SKETCH A-I
ACOUSTIC ENCLOSURE IN OPEN AREA



SKETCH A-II
ACOUSTIC ENCLOSURE IN COVERED AREA

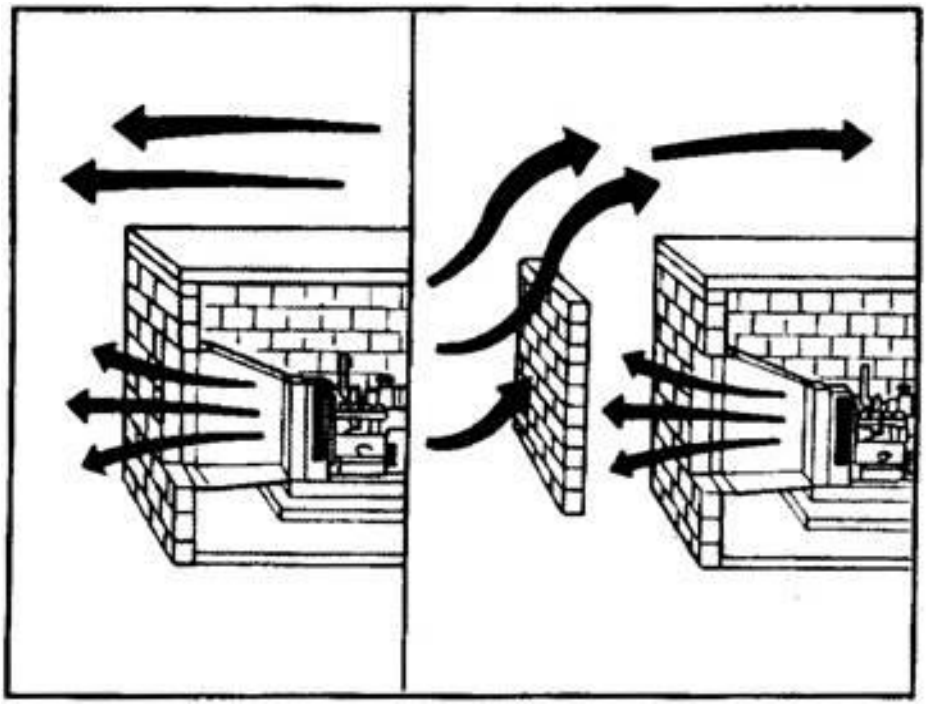


SKETCH A-III
OPEN DG SET IN ROOM AREA

A. LOCATION – (Cont'd)

A.1 D.G Set should be located considering ventilation air requirement as indicated in the Section.

A.2 Wherever possible position the DG set so that the prevailing wind do not enter into the radiator/exhaust outlet. If this is not possible, install a wind barrier. Refer sketch A.2



Sketch A.2

A.3 DG Set should be located away from polluted atmosphere like coal dust acidic fumes, cement dust, stone dust cotton fibers, furnace chemicals etc. wherever possible.

A.4 In case of dusty locations (such as stone crusher, construction sites, cement industries, etc.) Necessary air suction filters at canopy, sand louvres needs to be considered as per site requirement.

A.5 For humid / coastal atmospheric applications, space heaters are mandatory for alternator.

A. LOCATION – (Cont'd)

A.6 Spacing Guidance

No.	Description	DG set with Acoustic Enclosure in Open Area.	DG set with Acoustic Enclosure in Covered Area.	Open DG set in room.
1	Free space on both sides	Min. 1.5 m	Min. 1.5 m	Min. 2 m
2	Free space at front side (Radiator- - Hot air outlet at front)	Min. 3 m	Min. 3m (with ducting to avoid re-circulation)	Min. 1.5 m
3	Free space at front side (Radiator- Hot air outlet at top)	Min. 1m	Min. 1.5m	N/a
4	Free space at rear side (Alternator)	Min. 2 m	Min. 2 m	Min. 2 m
5	Fresh air inlet opening area	N/A	N/A	Min 1.5 times of the Radiator area.
6	Hot air discharge opening area	N/A	N/A	Min. 2.5 times of the Radiator area.
7	Distance between two sets	Min 1.5m between two canopies	Min 1.5m between two canopies	Min 1.5m between two foundations.

N/A - Not applicable

B. ROOM LAYOUT (FOR OPEN SETS WITH ROOM ACOUSTICS)

B.1 While making room layout due consideration should be given for accessibility, serviceability of

- Cable
- Fuel lines
- Breather vent
- Coolant /lube oil drain
- Raw water lines
- Heat dissipation
- Hot air discharge
- Removing skin heat
- Removing Alternator

Note: Breather vents should be necessarily taken out of the DG Set room or Acoustic enclosure as applicable

ROOM LAYOUT IS IMPORTANT FOR:

- Performance, Serviceability, Ventilation, Ease in operation and Electrical safety.
- DG Set room aesthetics

B.2 Future expansion plans should be considered while deciding room size.

B.3 Enough opening should be provided to the DG set room so that entry and placement of DG set is easily possible.

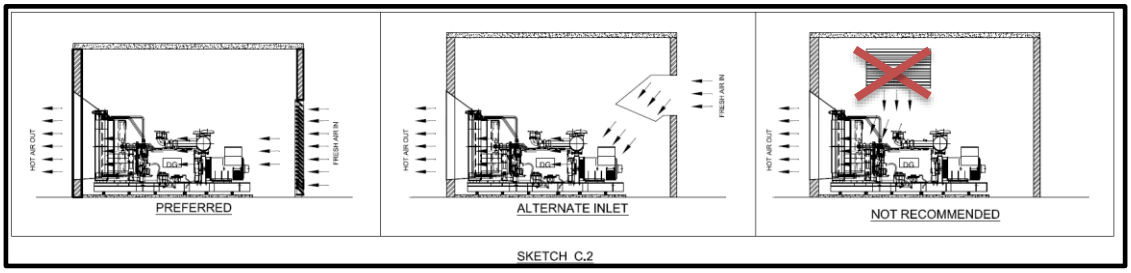
C. ROOM VENTILLATION

C.1 Ventilation of the generator room is necessary to remove heat and fumes dissipated by the engine, and alternator and its accessories and to provide clean and fresh air.
Ventilation requirement is mandatory for all engines. (Refer table no.1)

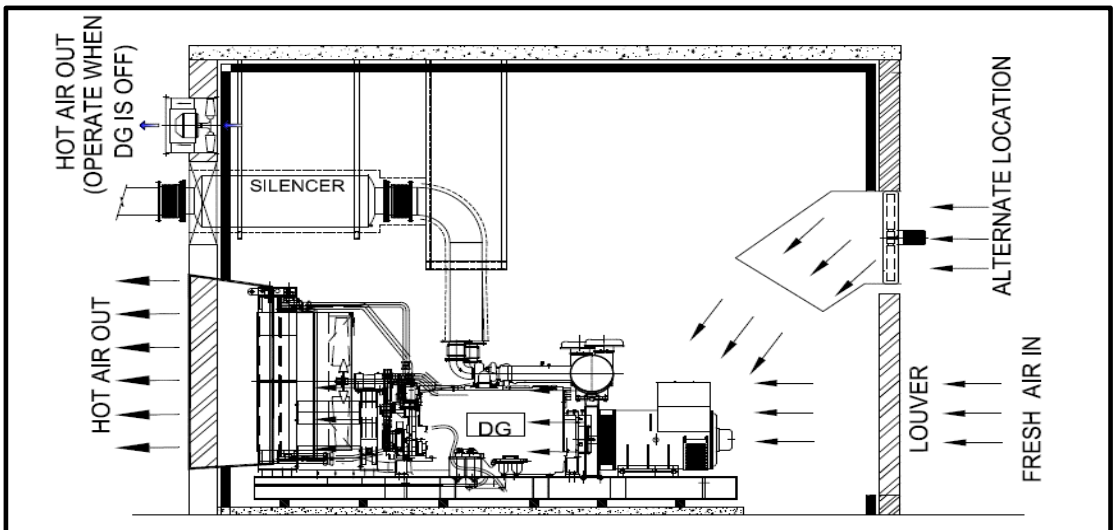
IMPROPER VENTILATION CAN LEAD TO:

- Poor performance and reliability of DG Set
- Poor fuel efficiency
- Premature failures of engine, alternator and electrical components.
- Unbearable working conditions due to higher room temperatures.

C.2 For DG set mounted radiator installation, natural adequate air is required for satisfactory operation of DG set. Air should flow from alternator end to engine (For forced ventilations contact OEM / Cummins). Refer Sketch C.2



SKETCH C.2



REF. 3A
OPEN - RADIATOR COOLED DG SET IN ACOUSTIC ROOM

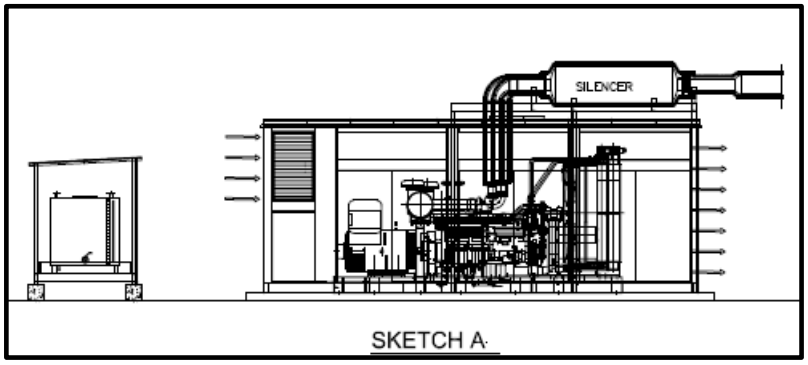
C3. Additional ventilation arrangement may be required for radiator cooled engines installed in acoustic rooms. Typical arrangement is shown in sketch 3A above.

C.4. Typically the hot air removal fan should operate only after the DG is stopped to take away the heat from room area and also to prevent short circuiting of fresh and exhaust air.

For heat exchanger cooled engines, forced ventilation system is required. This can be achieved by,

Option – A

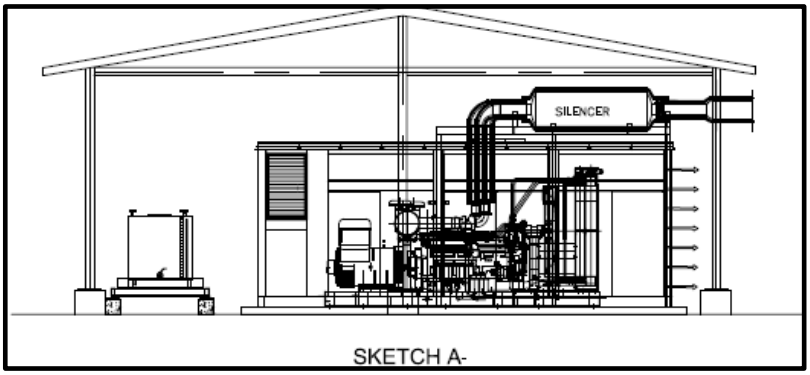
Providing natural air from rear side of DG set and hot air exhaust thru axial flow fans from front side of DG set.



Sketch Option – A

Option – B

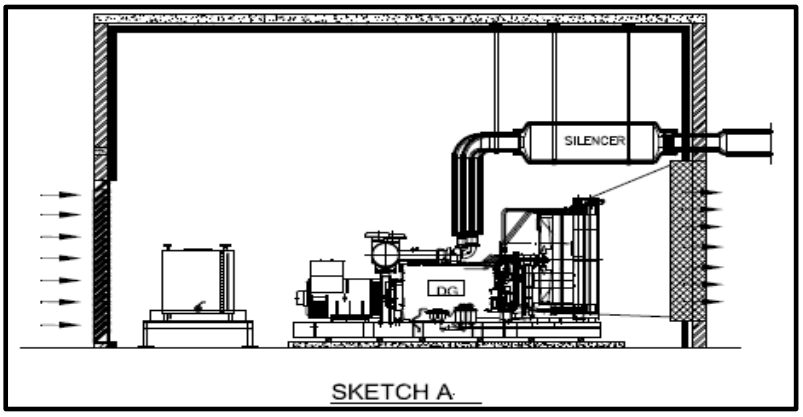
Providing forced air thru axial flow fans at rear side of DG set and hot air outlet through louvers provided at DG front area.



Sketch Option - B

Option – C

Providing forced air thru axial flow fans and hot air exhaust through axial flow fans. Exhaust fan capacity should be less than 70 to 75% of fresh air supply fan capacity.



Sketch Option - C

In all cases care should be taken to avoid re circulation of hot air. In some cases, it may also be achieved by natural wind direction consideration.

Note: Refer Table 1 for Ventilation air quantity requirement.

i) Fan flow rate should be selected according to the engine breathing air and radiation heat dissipation with permissible temp rise in DG room/Enclosure.

ii) Static head of the fan should be selected according to the restriction at air suction area and hot air outlet area, also consider the attenuation requirement.

C.5 Maximum temperature allowed to rise in DG Set room is:

Max. Ambient	**Allowable temp. rise**
Up to 40^{O}C	10^{O}C
40 to 43^{O}C	7^{O}C
Above 45^{O}C	5^{O}C

Note: For Engine mounted radiator installation, typical temperature rise is about 7 ^{O}C

Formula for Ventilation Air Quantity Calculation

Option-1 - Air flow quantity requirement in CFM

$$V\,(cfm) = \frac{H}{0.070 \times 0.24 \times \Delta T} + \text{Engine Combustion Air}$$

Where H is heat load in btu / minute and Δ T in Degree Fahrenheit.
Engine combustion in CFM.

Option- 2 - Air flow quantity requirement in m3/ Minute

$$V\,m^3/min = \frac{H}{1.099 \times 0.017 \times \Delta T} + \text{Engine Combustion Air}$$

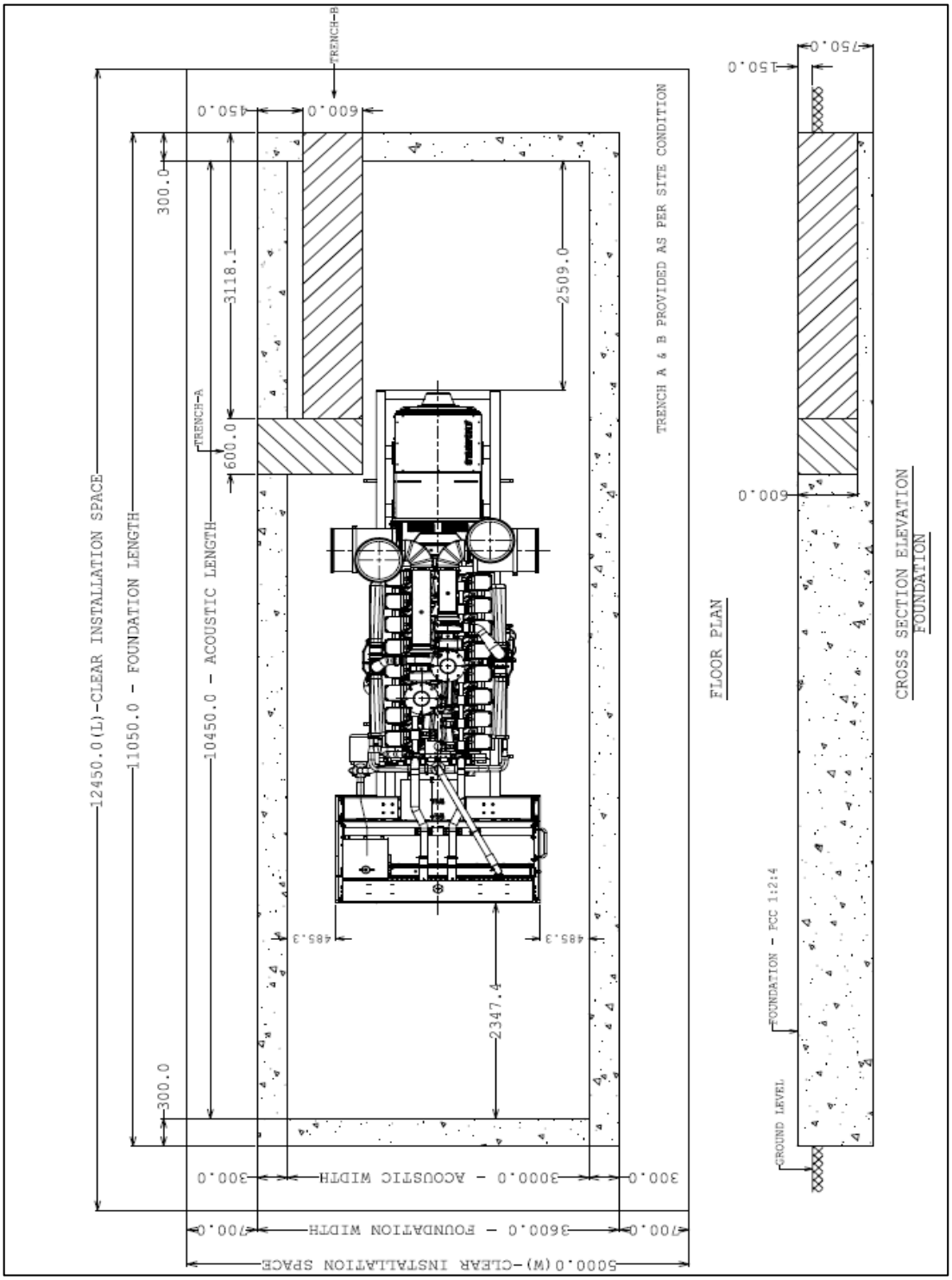
Where H is heat load in kW and Δ T in Degree Centigrade.
Engine combustion in m3/min

C.6 Field check for proper ventilation

1. Run the DG Set on full load / typical load for about 1 hour so that temperature in the DG Set room gets stabilized.
2. Measure the ambient air temperature (ambient temperature should be measured outside the DG Set room in shade).
3. Measure the temperature inside the DG Set room. DG Set room temperature should be measured near air cleaner inlet of engine.
4. Calculate temperature difference between DG Set room temperature and ambient i.e. delta T.
5. To ensure proper ventilation, it may be necessary to measure actual airflow by anemometer.

D. FOUNDATION

D.1 Do not install DG Set on loose soil or sand clay, unless kept temporary.



Typical DG Set foundation drawing is given above for reference.

D.2 Foundation should be designed considering safe bearing capacity of soil and DG set static and dynamic load. Anti-Vibration Mounts (AVMs) are provided to reduce generator set vibration and noise transmission to the surrounding structure.

D.3 The depth of the foundation to be decided by the customer in consultation with the certified structural engineer depending on static and dynamic load of the DG set and soil condition. Contact GOEM for static and dynamic load data of the DG Set

D.4 The length and breadth of foundation should be minimum 150 mm (6") more than acoustic enclosure size / base rails size

D.5 Ensure that the concrete is completely set and hardened before positioning the generator set.

D.6 It is recommended to have foundation elevation 150 mm above finish ground level. It helps to maintain cleanliness of DG Set. For areas having heavy rainfall, a higher platform/ rain shed (not mandatory) may be required to prevent water entry and it also helps in operator's safety.

D.7 DG Set foundation level to be checked with water level tube at frame mounting area and should be within +/- 5mm for 750 kVA and above DG Set. For DG sets below 750 kVA +/- 2.5mm to be maintained. Metal shims to be provided between DG frame and civil foundation to load DG Set uniformly.

D.8 The AVM's of DG Set should be loaded uniformly for DG sets where AVM's are placed on foundation & below DG set base frame.

Use shims below AVM resting area. Shim plate should be of 3 mm minimum thickness and to be used in multiple as required. Ensure that AVMS are loaded evenly.

D.9 It is recommended to take services of your structural Engineer for designing foundations and carryout seismic analysis if required.

D.10 For cable laying, necessary civil trench to be considered in civil works as per site requirements. In case of cable termination at the top/ bus duct, the trench is not required but necessary supports to be considered.

D.11 In case of special requirement, civil foundation to be casted in isolation with building structure.

D.12 DG Set with integral vibration isolators can reduce vibration transmitted to foundation by @80 %.

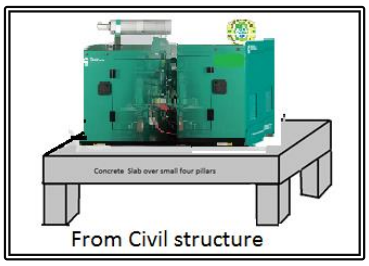
D.13 Special conditions for seismic zone to be considered while selection and installation of DG set. Contact GOEM for details**.**

D. 14. Guidelines for Installation of Low kVA DG set. **(7.5-62.5 kVA)**

- DG sets location area / foundation should be capable to bear the STATIC load and DYNAMIC Load which is typically 2.5 times the static load during running.
- Raise level by 150 mm above finish floor to ensure that the Rain water does not enter the acoustic enclosure and rust the base/base rail.
- There are various options where we can either install the Acoustic enclosed DG Set.

1. Re-enforced floor (See Option 1)
2. Create a structure from the base civil structure (See Option-2).

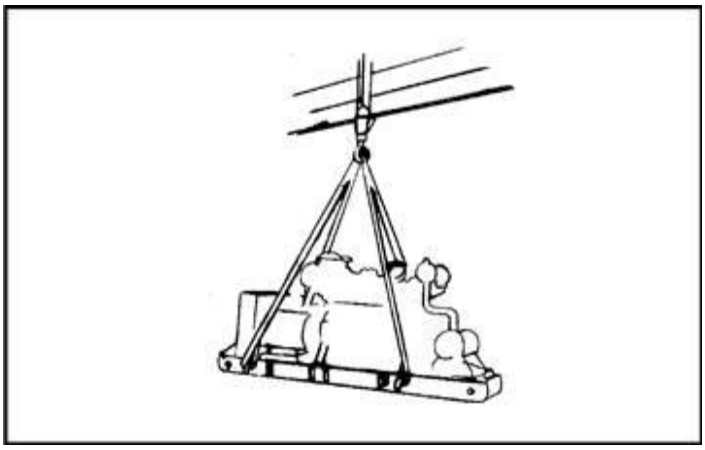
Option- 1



Option- 2

E. UNLOADING

E.1 Provision for DG Set lifting is provided on base-rail/enclosure. Unload the DG Set from the base rail/enclosure by lifting with proper DG Set lifting tackle or nylon sling /steel rope of suitable capacity and crane so as to ensure no damage to oil sump, air cleaner, radiator pipes etc.

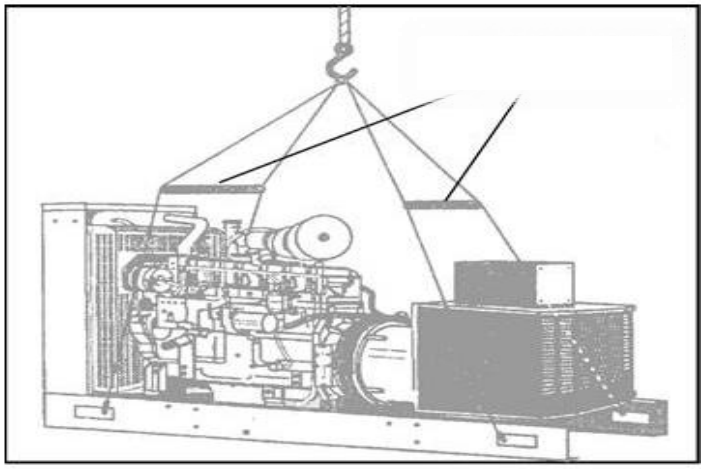


Sketch E.1

E.2 Do not lift the DG Set from engine and alternator hooks. These are designed for lifting individual items only.

E.3 Keep the DG Set covered with polyethylene or tarpaulin during installation to ensure that water does not enter inside.

E.4 Spreader bar / spacer plate of suitable size must be used to avoid damages to DG Set components. While unloading/ shifting of DG set.



Sketch E.4

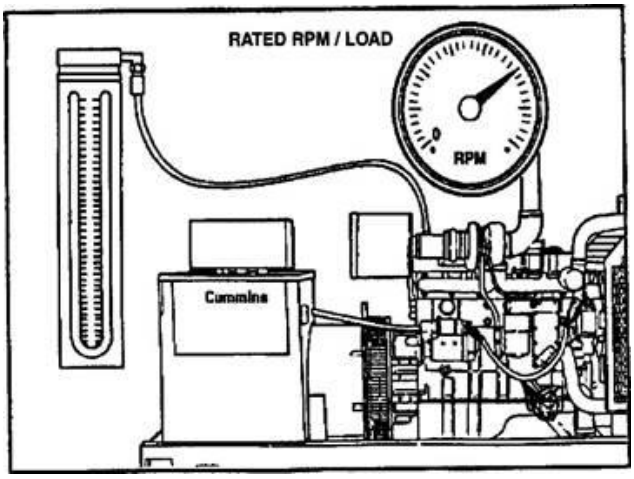
F. AIR SYSTEM

F.1 Vacuum indicator is supplied with all engines to indicate air filter condition (choking). Max air intake restriction with clean and choked filter is given in the below table:

Model	kPa (inch H2O)	
	Clean element	Dirty element
X1.3/X2.7/ X3.6/ 4B3.3/4B3.9/KTA38	2.49 (10)	6.2 (25)
6B5.9/ QSB5.9/ QSB6.7/ QSL9/ QSN14/ KTAA19/ QSK 19/ KTA50/ QSK50/ QSK60/ QSK78	3.7 (15)	6.2 (25)

Procedure to check air restriction

Run the engine at Rated RPM and Rated load and connect/record restriction on water manometer as below: Refer Sketch F.1



Sketch F.1

F.2 Higher restrictions leads to:

- Air filter rupture
- High fuel/lube oil consumption
- Low power
- Black smoke
- Turbo charger failure

F.3 In case of dusty locations (such as stone crusher, construction sites, cement industries, etc.) Necessary air suction filters at canopy, sand louvres needs to be considered as per site requirement.

F.4 If fibrous conditions exist then care should be taken to prevent the fibers from getting sucked into the air cleaner. Provide air ducts, air curtains, nets etc. In such cases consult OEM / Cummins.

F.5 Care to be taken, that no such fiber element shall enter/ block the air flow of alternator.

G. EXHAUST SYSTEM

G.1 Well-designed exhaust system collects exhaust gases from engine cylinder and discharges them as quickly & silently as possible. External exhaust system should be designed to have minimum back pressure and restricting it to within limits as below for that particular engine model to ensure maximum efficiency. This is therefore of at most important that we do it with minimum and soft bends. It is desired to have exhaust pipe routed upwards for easy removal of exhaust gas. (Refer Table G.1)

EXHAUST DUCT DIAMETER SELECTION/CALCULATIONS FOR DG SETS

Sn	Engine Model	DG Set Rating Prime- Model	Total Exhaust gas flow for DG Set- kVA	Exhaust silencer No. per DG m3/s	Recommended Exhaust duct dia. After each turbocharger number	Calculated exhaust gas velocity in m/s for duct after turbo - inch	Recommended exhaust duct dia. - Common after Y-piece m/sec	Calculated exhaust gas velocity in m/s for common duct after y-piece - inch
1	KTA38G5	1010	2.92	2	10	29.95	12	41.60
2	KTA50G3	1250	3.82	1	10	39.15	14	39.95
3	KTA50G8I	1500	4.44	2	12	31.60	16	35.54
4	QSK50G10	1800	5.13	2	12	36.57	16	41.15
5	QSK-60-G3	1875	5.39	2	14	28.22	18	34.14
6	QSK-60-G4	2000	5.60	2	14	29.33	18	35.49
7	QSK-60-G8	2250	6.31	2.	14	33.05	18	39.98

Table G1

G.2 Higher exhaust back pressure leads to

- Lower fuel economy
- High exhaust temperatures and related failures
- Poor performance of the engine
- Less durability of the engine

LIMITS FOR EXHAUST BACK PRESSURE

The exhaust back pressure should not exceed the limits in below table. Exhaust velocity of typical 35 to 40 m/sec is often suitable, but depends on actual pipe configuration. Refer Table G.2 for permissible pressure drop in exhaust system.

Model	mm (inches) of Hg	kPa
X1.3	30.98 (1.22)	4.13
X2.7/ X3.6	29.97 (1.18)	4
6B5.9	38.1 (1.5)	5
4B3.3/ 4B3.9/ 6B5.9/ QSB5.9/ QSB6.7/ QSL9/ QSN14/ KTAA19/ KTA38	76.2 (3)	10.15
QSK 19/ K50/ QSK50/ QSK60/ QSK78	50.8 (2)	6.77
Gas Engines	50.8 (2)	6.77

Table G.2

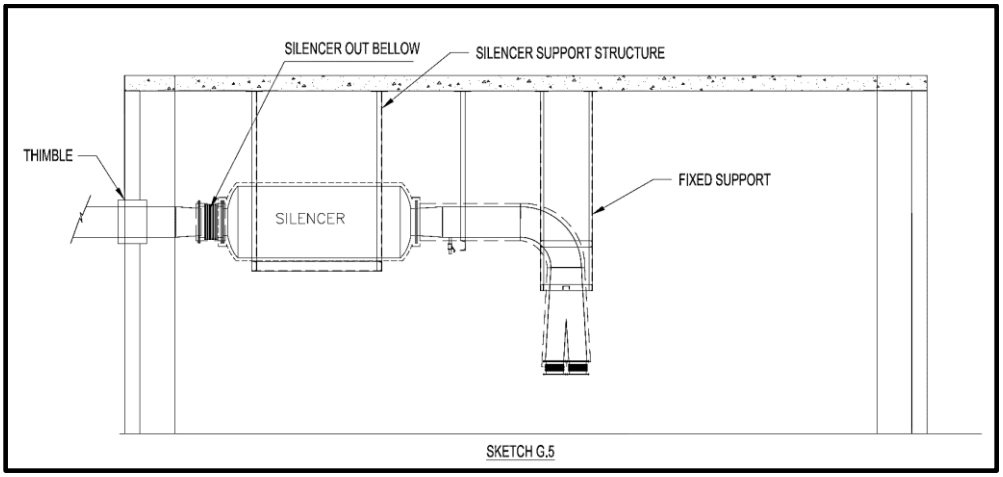
For new installations, it is recommended to have 20% minimum design cushion in calculated back pressure value and permissible limit (as specified in Table G2).

G. EXHAUST SYSTEM (Cont'd)

G.3 Use of thimble is must while passing the pipe through concrete wall. The clearance around the pipe in wall is must, for free movement and expansion.

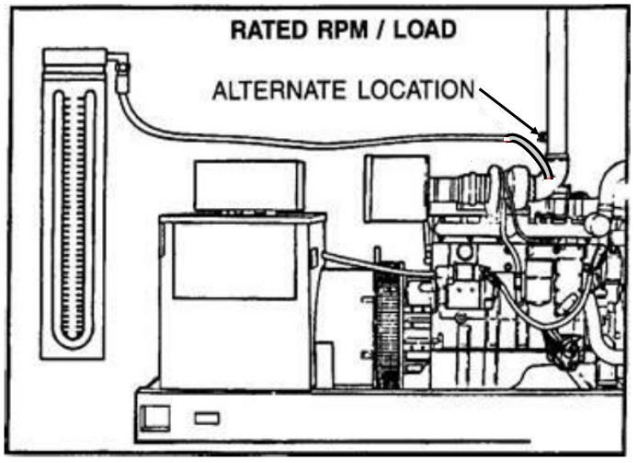
G.4 Exhaust piping inside the DG Set room must be insulated with minimum 50 mm thickness with 64 kg/m3 density of rock wool wrapped with 24/26SWG aluminum sheet cladding to minimize heat radiation inside the DG room. Approximate heat radiation after insulation will be about 1 KW per meter length of exhaust pipe.

G.5 Exhaust flexible shall have its free length when it is installed. Recommended piping arrangement with support locations for engine is shown in below sketch. Additional bellow/s to be provided in horizontal exhaust pipe line after every 6 to 10 meter considering axial movement of 30 to 40mm and lateral movement of 10 mm, which is recommended. It is important that thermal fluctuations is minimized by proper use of flexible as well as rigid suspension points. One sturdy fixed point support must be provided for be expansion bellows on the turbocharger. It should be positioned immediately above the expansion bellow in order to prevent transmission of forces resulting from weight, thermal expansion or lateral expansion of the exhaust piping to the turbocharger. Flexible bellows to be provided after exhaust silencer also. Refer Sketch G.5 below.



SKETCH G.5

G.6 Please refer backpressure nomograph for calculating exhaust piping back pressure & sizing calculation, as per site exhaust ducting layout scheme. i.e. length, bends, bellows, horizontal and vertical ducts and refer sketch G.6 for back pressure measurement location. In addition one can make use of Exhaust Calculators available with team Cummins.



Sketch G.6

G. EXHAUST SYSTEM (Cont'd)

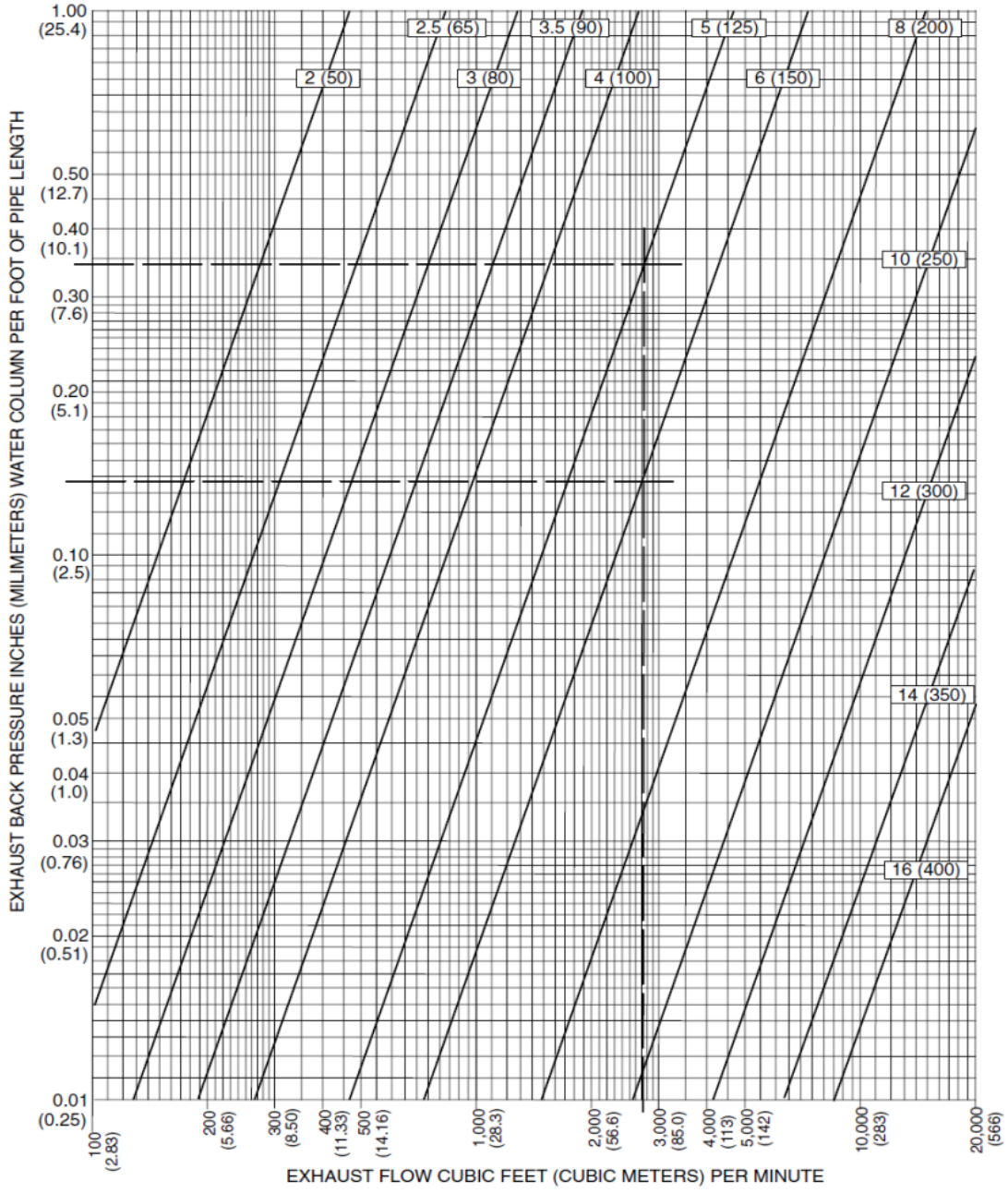


Figure 6–13. Exhaust Back Pressure in Nominal Inch (mm) Pipe Diameters

Calculations for Equivalent Pipe Length	Nos.	EQ length in meter	Total length in m
Straight pipe – meter			1.0
90 deg. standard elbow - nos.	1	7.9	7 9
90 deg. medium radius elbow - nos.	1	6..7	6.7
90 deg. long radius elbow - nos.	1	5.2	5.2
45 deg. elbow - nos.	1	2.4	2 4
Tee, side inlet or outlet - nos.	1	17.1	17.1
18 inch. flexible tube - nos.	1	0.9	0.9
24 inch. flexible tube - nos.	1	1.2	1.2

G. EXHAUST SYSTEM (Cont'd)

G.7 Rain protection to be provided for exhaust ducting like, 90 deg. bend with bird mesh, cowl or special diffuser. It is recommended that horizontal run of exhaust piping should slope downwards away from the engine. Condensate drain pipe to be provided in horizontal ducting after silencer to avoid rain water entry or condensate entry to engine.

G.8 Silencer Location: Locating the silencer close to the Engine improves the sound attenuation**.**

G.9 Exhaust stack height: In order to dispose exhaust above building height, minimum exhaust stack height should be, as per latest CPCB/ local pollution control board norms.

a. For DG set below 800 kW

$H = h + 0.2 \times \sqrt{kVA}$

Where H = height of exhaust stack h = height of building.

b. For DG set above 800 kW

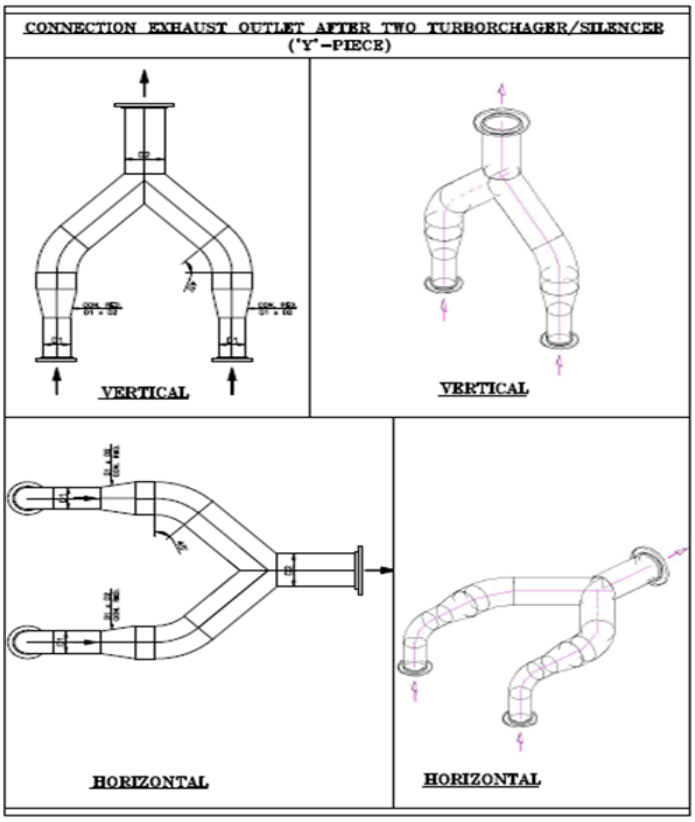
- Minimum 30 meter

c. In case building height is more than 30 meter
Stack Height = Building height + minimum 6 meter.

Note: Exhaust stack height should be considered of maximum value of the above.

G.10 Recommended scheme for 'Y' piece construction for two banks duct connections:-

Exhaust of two banks of V engines can be connected before/after silencer. Ensure that the common duct diameter is calculated considering the backpressure and velocity criteria.



Sketch G.10

G. EXHAUST SYSTEM (Cont'd)

COMMON EXHAUST SYSTEM FOR MULTIPLE DG SETS NOT RECOMMENDED-

G.10 Common exhaust system for multiple DG sets is not recommended due to condensation issue, possibility of exhaust gas entry to non-working engine and lack of failsafe system availability. However exhaust of two banks of V engines can be connected before/after silencer. Ensure that area of common pipe is greater than sum of the areas of individual pipes.

G.11 In case of special requirement of common chimney or in case of Heat Recovery System contact Cummins / GOEM.

The following critical points to be taken care

1. Individual DG set exhaust duct diameter to be selected as per back pressure and exhaust velocity criteria.
2. DG set duct entry to stack should be at an angle of 45 deg. max (w.r.t. vertical stack pipe)
3. There should be minimum 1.5 meter space between two duct nozzles connected to vertical stack.
4. DG Set duct should be protruded in the vertical stack by about 25mm.
5. Condensate drain point should be provided for each DG set horizontal duct laid before stack entry.
6. Stack pipe diameter to be selected as per back pressure and exhaust gas velocity considering all connected DG sets in operation.

G.12 Installation of wet scrubber in DG exhaust as per site requirement: In case of exhaust wet scrubber requirement as per site regulation, following points to be taken care:

I. Exhaust back pressure is within the prescribed limits.

II. The maintenance of the scrubber needs to be carried as per the recommendations of the manufacturer.

III. Necessary precautions to be taken in exhaust scheme design to avoid condensate/steam back entry to DG sets which is/are not in operation.

H. FUEL SYSTEM

a. Diesel Fuel System

Diesel Fuel specification should as per IS 1460 (HSD No.2 diesel). For details specs refer Operation and Maintenance Manual.

H.1 Fuel supply and return line restriction for fuel system, refer operation and maintenance manual,

HIGHER FUEL RESTRICTION LEADS TO:

- Lower power
- Late stopping
- Engine die down

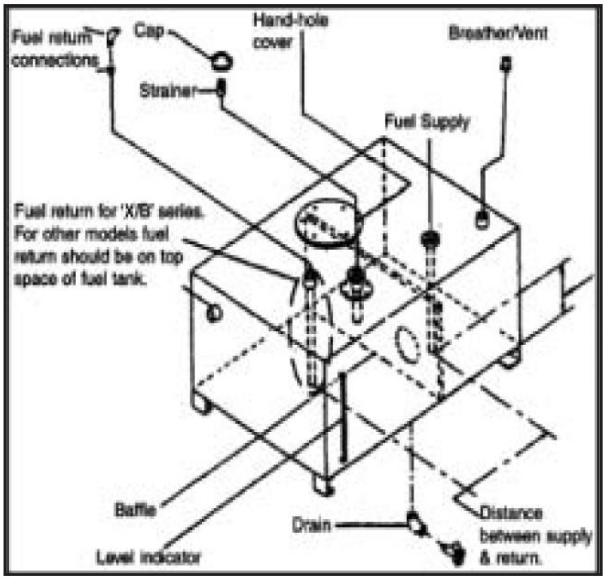
H.2 For DG sets of rating up to 700 kVA the fuel tank is in sub-base type part of DG Set skid.

For DG sets above 750 kVA, 990 lit capacity day tank is supplied loose, which needs to be installed at floor level or 300 mm above the DG floor level to maintain positive suction head on fuel pump inlet.

The height of the day tank should be sufficient to put a positive head on the engine fuel pump. (Minimum level in tank not less than 6 inches [150 mm] above engine fuel inlet.) The maximum height of fuel in the day tank should not be sufficient to put a positive head on the engine fuel return lines. Please ensure that all diesel lines are leak proof and should prevent air seepage even if the DG sets is not run for a long time.

H.3 FUEL TANK DESIGN

- Size to suit at least one shift operation or maximum 990 litters. (Material MS for fuel tank and piping).
- Drain fittings to bleed water condensate at lower point of tank.
- Fill neck to be provided to allow min. 5% expansion space.
- Breather is mandatory.
- Use pipe sealant Loctite Type 577 for all connections, for sealing. No teflon tape to be used.
- Suction and return line to be separated by at least 300 mm.
- Galvanizing not recommended inside fuel tank. Hand hole, Wire mesh filter screen at fillers point.
- Providing Hand hole for cleaning and wire mesh filters screens at filler points is mandatory.



Sketch H.3

I. FUEL SYSTEM (Cont'd)

a. Diesel Fuel System (Cont'd)

H.4 C.S. seamless pipe schedule 40 should be used for fuel piping from fuel tank up to the engine. Fuel tank up to the engine Flexible hoses supplied with the engine should do the terminal connection between MS pipe and engine. (ERW pipes are not allowed)

H.5 Fuel piping should be free from leaks. GI and copper pipes react with diesel and can't be used.

H.6 Please refer table 1 for recommended fuel line sizes for fuel piping lesser than 10 m. If piping length is more than 10 meters, contact OEM / Cummins.

H.7 Fuel tank location should be such that it doesn't restrict movement of service personnel or block flow of ventilation air.

H.8 System in enclosure are pre-validated. One only needs to take exhaust out to a safe area and provide adequate ventilation

H.9 Contact GOEM for design/supply of bulk diesel storage tanks as per Chief Controller of Explosives (CCoE).

I. FUEL SYSTEM (Cont'd)

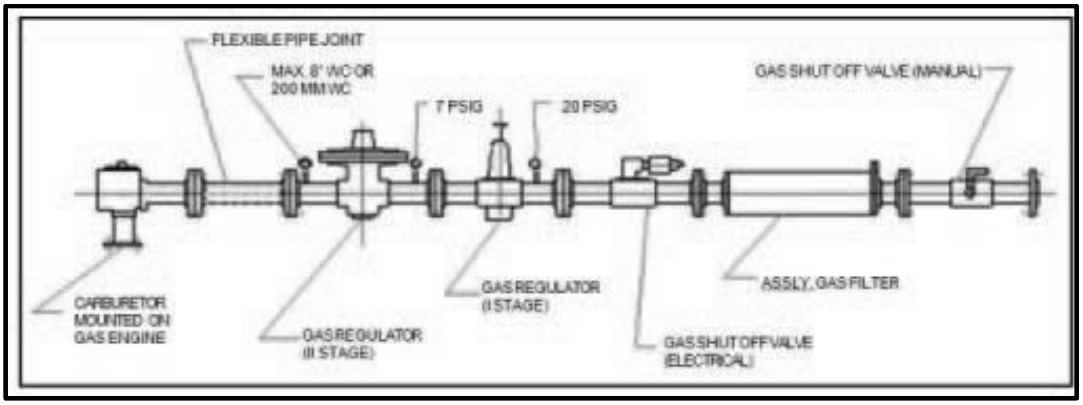
b. GAS GENSET FUEL SYSTEM RECOMEMNDATIONS

Whilst most of the installation guidelines discussed for diesel products can be used while installing the gas engine(s), it is necessary to have a brief overview of the various components used in the gas supply line prior to getting connected to the gas engines.

Various components used in gas supply piping to the engine inlet and installation recommendations are as follows:

The fuel system for gas engine includes following:

1. Manual shut-off valve (Main line Valve)
2. Gas Filter
3. Gas shut-off valve (Electrical)
4. 1st stage regulator
5. 2nd stage regulator
6. Carburetor



Note: Please do proper earthing of complete gas train. It is recommended to use copper wires to loop between two flanges. Also one earthing wire should connect engine and gas pipe train.

1. MANUAL SHUT OFF VALVE (MAIN LINE VALVE)

This is used as interface between customer provided main gas supply line and the engine gas piping. This can be used for isolating main gas supply line for any repairs on gas supply system parts.

2. GAS FILTER

This filter is provided to remove any dust, rust or solid particles entering the gas supply system.

Gas Filter

Element Gas Filter

I. FUEL SYSTEM (Cont'd)

3. GAS SHUT-OFF VALVE (ELECTRICAL) This valve is electrically operated by 24 volts DC supply. This provides electrical on / off operation and is connected in series with engine safety shut off system (viz. High water temperature, low lube oil pressure, over speed).
4. FIRST STAGE PRESSURE REGULATOR This regulator is smaller in size and is red in color. This main line regulator is mounted in gas line near engine. While setting outlet pressure, the brass spindle should be rotated clock wise to increase the pressure and anti - clockwise to decrease the pressure so as to adjust the outlet pressure to 0.5 Kg/cm2 (7 psi). Proper care should be taken during installation of this regulator by ensuring the IN/OUT markings are properly connected.

First Stage Regulator

5. SECOND STAGE PRESSURE REGULATOR
   The second stage regulator is bigger in size as compared to 1st stage (main line) regulator and is in blue color. This regulator should be mounted near the engine carburetor. It should be supported firmly and a flexible connection should be provided between the regulator and the carburetor.

Second Stage Regulator

Provide necessary connection on piping for pressure measurement before and after this regulator. Unscrew the top cover for setting the outlet pressure. The outlet pressure can be adjusted by means of a 14 mm Allen key. The gas pressure just before should be set as follows: When engine is stopped, the gas pressure should beset to 200 mm of water column. When the engine is running at rated load and speed, the gas pressure should be re - adjusted to 75 mm of water column.

The gas pressure before carburetor inlet is to be set to 75 to 100 mm (3 to 4 inches) of water column when engine is running at rated load and speed. Please ensure fluctuation free gas flow at inlet of regulator.

CARE TO BE TAKEN WHILE INSTALLING THE GAS PIPE LINE COMPONENTS

1. Should the engine is in stock for more than six months or installed but not expected to be in operation for more than six month; it is necessary to carry out long terms preservation. Please contact your nearest Cummins Service Dealer for further details on preservation recommendations.
2. Ensure that connectors to ignition timer are dis-connected while carrying out any welding work on the gas pipeline to avoid failure of ignition timer.
3. Ensure that the arrow is in the direction of GAS FLOW
4. After the Gas line pipe welding / fabrication is complete ensure that the entire line is flushed by air and welding spatters, debris and any dust is removed.
5. Once the gas pipeline is complete, carry out the leakage test to ensure that there are no leakages from the joints.
6. Ensure that the gas pressure before the main line regulator (1st stage) is within 1.4 to 2 Kg/cm²
7. Recommended pipe sizes for main line and inlet outlet diameter of regulators are listed in Table–3. Please ensure the pipe specifications are matched.
8. The schematic Sketch shows typical gas pipe line. Please ensure to adopt pressure gauges between the gas shut-off valve and first stage pressure gauge between first stage pressure regulator and second stage pressure regulator.
9. Ensure that the Gas Genset room is well ventilated.
10. Contact GOEM for part number details of the components used in the gas train components.

GAS LINE COMPONENT DETAILS

ENGINE MODELS	G855	GTA855	GTA1150	G1710	GTA2300/ GTA3067
Gas Shut off valve (MANUAL)	3872383 (25 mm)	3875553 (50 mm)	3873933 (1½" BSP)	3873933 (1 ½ " BSP)	3875553 (MANUAL)3872383
Range of pressure gauge for inlet line	1 to 3 Kg/c	1 to 3 Kg/cm2	1 to 3 Kg/cm2	1 to 3 Kg/cm2	1 to 3 Kg/cm2
Assly. Gas Filter	3392533	3392533	3392533	3392533	3392533
Gas shut off valve (ELECTRICAL)	3872384	3875535	3872384	3872384	3875535
1st stage regulator	3875040 (1 '' BSP)	3875040 (1'' BSP)	3875041 (1 ½ '' BSP)	3875041 (1 ½ ''	3875042 (2 '' BSP)
Gas Flow m 3/h 1st stage regulator	60-80	60-80	100-120	100-120	200-220
Range of Pressure gauge 1st stage	0 to 1 Kg/c	0 to 1 Kg/cm2	0 to 1 Kg/cm2	0 to 1 Kg/cm2	0 to 1 Kg/cm2
2nd stage Regulator	3875043	3875043	3875044	3875043	3875044
Gas Flow / regulator, m3/hr	60-80	60-80	100-120	60-80	100-120
Range of Pressure Gauge	0 to 400	0 to 400	0 to 400	0 to 400	0 to 400

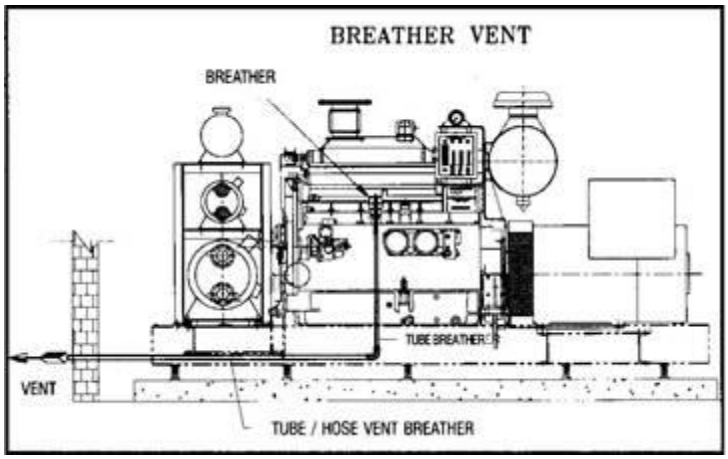
RECOMMENDED GAS PIPE LINE SIZE FOR VARIOUS GAS ENGINES

Engine Model	Rating in kVA	Fuel supply Line size mm dia
G885	125	40
GTA 855	180	50
GTA 1150	250	50
G TA 1710	380	50
GTA 2300	500	65
GTA 3067	625	65

I. ENGINE BREATHER VENTS

I.1 Crankcase gases should be vented outside the DG room/ acoustic enclosure, so that oil fumes don't accumulate on the engine /radiator. Existence of Oil fumes lead to choking/failure of radiator, early choking of air cleaner, alternator failure etc., Refer Sketch I.2 a and I.2.b

I.2 Vent / hose should continuously slope to avoid oil accumulation. The hose should be routed so that there is no kinking.



Sketch I.2 a. DG in Room

Sketch I.2 – b. DG in Acoustic Enclosure

J. COOLING SYSTEM

There are three types of cooling systems

- Engine driven radiator in primary circuit.
- Remote radiator in primary circuit
- PHE -
    a. PHE with Remote Radiator in secondary circuit
    b. PHE with Cooling Tower in secondary circuit.

J.1 Engine driven radiator in primary circuit.

System are typically designed for ambient temperature of 45°.

- Please refer table below for coolant to be used in various engine models.
-

Coolant for various engines	
X1.3/X2.7/ X3.6/ 4B3.3/4B3.9/ 6B5.9/ QSB5.9/QSB6.7/ QSL9/ QSN14/KTAA19/ QSK 19/QSK50/QSK60/QSK78	Premix Ethylene Glycol (EG compleat 50:50)
KTA38/ KTA50	CAC (DCA2) (Mixing ratio of 1:15 with soft water)

Note: Please refer O & M manual for proper coolant specifications.

J.2 **Remote Radiator in Primary cooling circuit** -

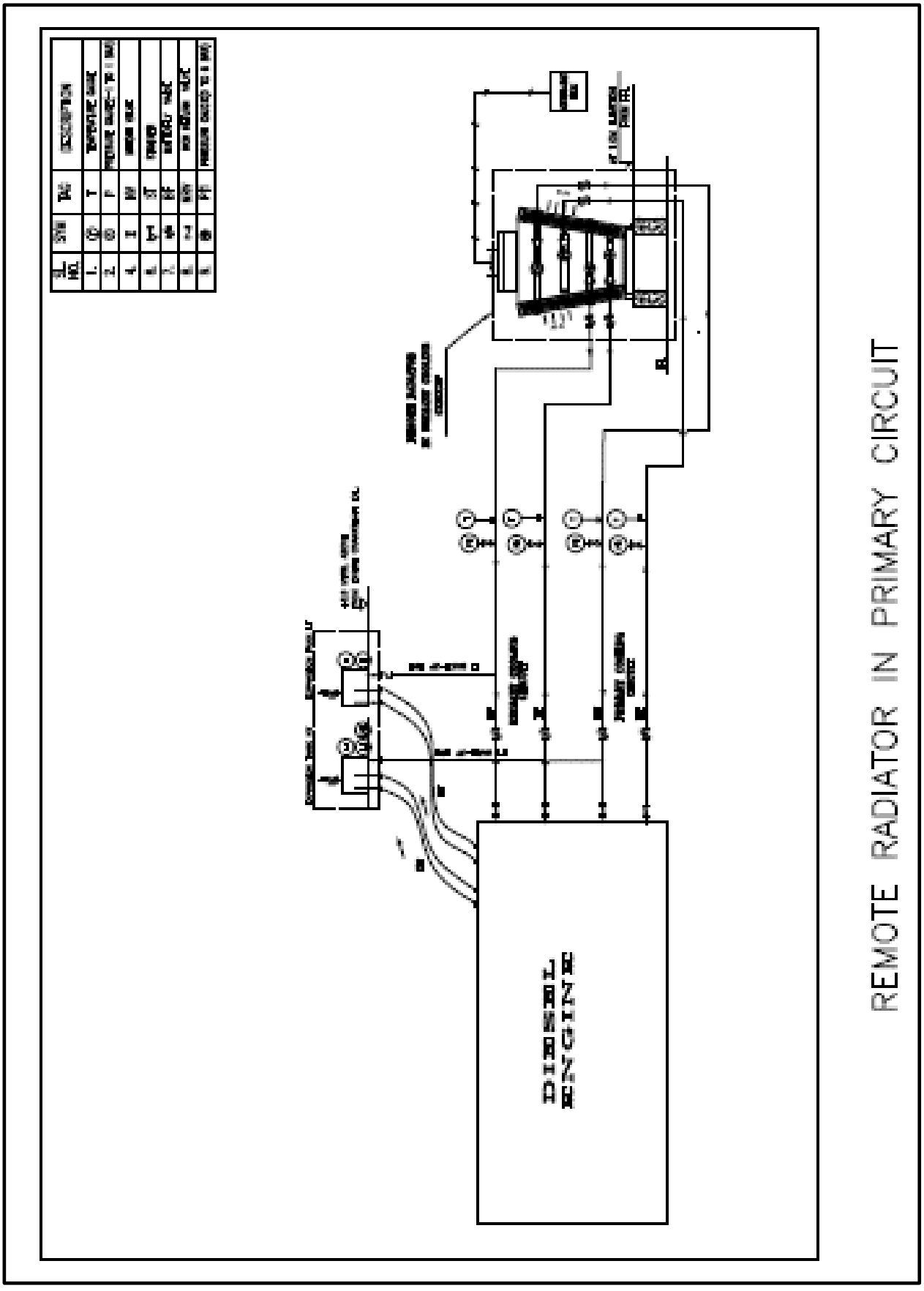
Remote Radiator in Primary cooling circuit the following points to be considered

I. Permissible pressure drop external to engine circuit.
II. Maximum permissible elevation of radiator with respect to engine foundation is 5 m
III. Maximum permissible distance of Remote Radiator from engine is 10 m.
IV. Cooling water piping diameter needs to be selected considering coolant flow rate and pressure drop in circuit.
V. Coolant composition like EG Compleat 50:50 or DCA2 with soft water to be considered while selection of the remote radiator.
VI. Site ambient temp to be considered for selection of Remote Radiator.

Typical recommendations are given in below table.

Design Ambient Temp deg Cent		45	45	45	45	45	45
Engine Model		KTA-38	KTA-50-G3	KTA-50G8-I	QSK50G10	QSK60G4	QSK60G8
Genset Rating in kVA	Details	1010 (PRP)	1250 (PRP)	1500 (PRP)	1800 (HE) (PRP)	2000(PRP)	2500 (ESP)
Radiator Selection Parameters- Primary							
LTA	Coolant spcification	CAC (DCA2) (Mixing ratio of 1:15 with soft water)			EG Compleat 50:50		
	Primary Circuit Permissible Pressure Drop- KPa	20	1P2L System, 775 KW heat load is common for LTA & HTA	20	20	20	20
	Design Temp- Deg Cent.	120		120	120	120	120
	Make-up /Expansion Tank Capacity in lits	100		100	125	125	125
	LTA OUT from Engine	69.3		77.1	73.38	77.75	81
	LTA IN to Engine	62		62	62	61.8	62
	Hot flow(lps)	6		6	7.6	6.9	6.9
	Heat Load - KW	170		378	394	455	545
	Noise- dBA	75		75	75	75	75
HTA	Coolant specification	CAC (DCA2) (Mixing ratio of 1:15 with soft water)			EG Compleat 50:50		
	Primary Circuit Permissible Pressure Drop- KPa	30	30	30	30	30	30
	Design Temp- Deg Cent.	120	120	120	120	120	120
	Make-up /Expansion Tank Capacity in lits	100	100	100	125	125	125
	HT OUT from Engine	93	77.34	93	93	93	93
	HT IN to Engine	88.41	70	87.9	87.61	88	86.80
	Hot flow(lps)	17.7	25.2	25.2	26.25	24	24
	Heat Load - KW	340	775	536	592	500	620
Remote Radiator - Design Pressure-	Bar (g)	6	6	6	6	6	6
Remote Radiator - Test Pressure-	Bar (g)	21	21	21	21	21	21
Selected Remote Radiator Model (Coil Company make) in Primary Cooling Circuit.		FCW100	FCW120	FCW140	FCW180	FCW200	FCW220
Configuration		LT+HT	Common	LT+HT	LT+HT	LT+HT	LT+HT
Selected Fuel Cooler Model (Coil Company make)in Primary Cooling circuit		N/A	N/A	N/A	FCS36H48	FCS36H48	FCS36H48
Fuel cooler Heat Load	KW	N/A	N/A	N/A	9	35	35
Fuel Flow Rate	LPM	N/A	N/A	N/A	15	32	25

Typical cooling system P&ID is given below for reference



J.3 Secondary cooling circuit:

c. Cooling Tower in secondary circuit to be selected with the following parameters

i)Water flow rate

ii) Temp profile 28 /32/42 (wbt/out/in) °C.

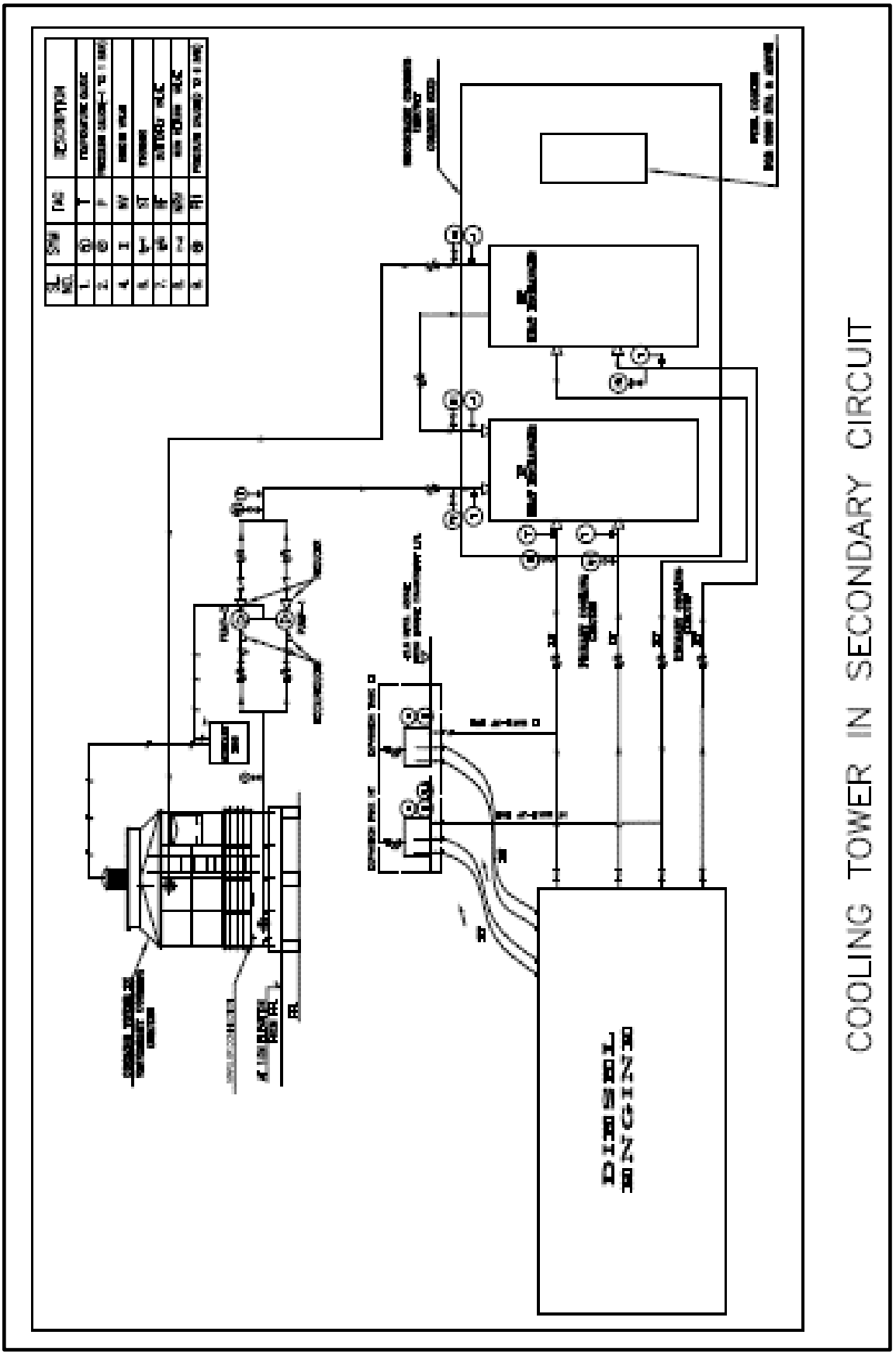
iii) Heat load

Typical recommendations are given in below table.

Design Ambient Temp deg Cent		45	45	45	45	45	45
Engine Model		KTA-38	KTA-50-G3	KTA-50G8-I	QSK50G10	QSK60G4	QSK60G8
Genset Rating in kVA	Details	1010 (PRP)	1250 (PRP)	1500 (PRP)	1800 (HE) (PRP)	2000(PRP)	2500 (ESP)
Delta T		8.2	12.5	14.8	8.3	8.11	9.89
PHE Selection Parameters							
PHE - Operating Pressure-	Bar (g)	10	10	10	10	10	10
PHE - Design Pressure-	Bar (g)	13	13	13	13	13	13
PHE - Test Pressure-	Bar (g)	16	16	16	16	16	16
	PHE Model LTA	GX04X39	GX04X39	GX04X39	GC-26X44	GC-26X44	GC-26X44
	PHE Model- HT	GC26X26	GC26X26	GC26X26	GC26X26	GC26X26	GC26X26
	PHE Model- Fuel	N/A	N/A	N/A	GC-008X32	GC-008X32	GC-008X32
Cooling Tower Selection Parameters- Secondary							
Design Temp deg Cent (WBT)		28	28	28	28	28	28
Secondary Circuit	Coolant specification	Potable water					
	Secondary Circuit Permissible Pressure Drop- Kpa (LTA+HT PHEs)	109	109	109	125	125	125
	Raw Water In	32	32	32	32	32	32
	Raw Water out	40.2	44.5	46.8	40.3	40.11	41.89
	Cold Flow (lps)	15	15	15	28.61	28.61	28.61
	Heat Load - KW	510	775	914	986	955	1165
Estimated Cooling water pump head selection	m (to be calculated as per site layout scheme requirement)	24	24	24	24	24	24
Equivalent TR - estimated		145	221	260	281	272	332

- Maximum permissible elevation for cooling tower installation with respect to DG foundation is 10 meters
- Cooling water consumption for cooling tower application is typically 1.6 to 2% of the water flow rate.

Typical cooling system P&ID is given below for reference



d. Remote Radiator in Secondary cooling circuit to be selected with the following parameters

I. Water flow rate

II. Temp profile 45/58/68 (dbt/out/in) °C.

III. Heat load

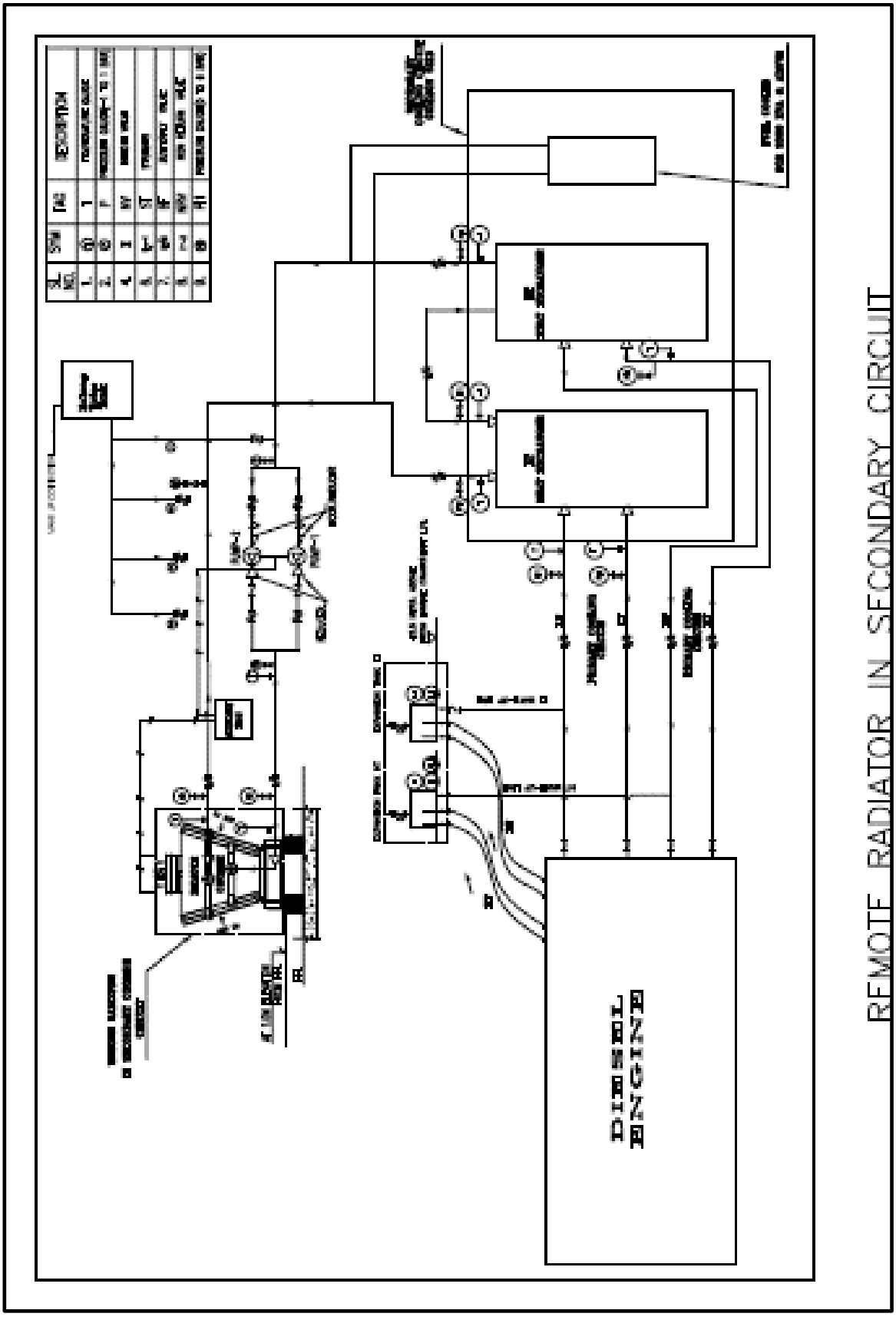
Typical recommendations are given in below table.

Design Ambient Temp deg Cent		45	45	45	45	45	45
Engine Model		KTA-38	KTA-50-G3	KTA-50G8-I	QSK50G10	QSK60G4	QSK60G8
Genset Rating in kVA	Details	1010 (PRP)	1250 (PRP)	1500 (PRP)	1800 (HE) (PRP)	2000(PRP)	2500 (ESP)
Delta T		8.2	12.5	14.8	8.3	8.11	9.89
	PHE Model LTA	GX04X39	GX04X39	GX04X39	GC-26X44	GC-26X44	GC-26X44
	PHE Model- HT	GC26X26	GC26X26	GC26X26	GC26X26	GC26X26	GC26X26
	PHE Model- Fuel	N/A	N/A	N/A	GC-008X32	GC-008X32	GC-008X32
Delta P Cold side (kPA)- LTA+HT	kPA	109	109	109	125	125	125
Delta P HOT side (kPA) LTA	kPA	15	15	15	6	6	6
Delta P HOT side (kPA) HT	kPA	50	50	50	50	50	50
Radiator Selection Parameters- Secondary							
Design Ambient Temp deg Cent		45	45	45	45	45	45
Secondary Circuit	Coolant specification	Potable water					
	Secondary Circuit Permissible Pressure Drop- KPa	50	Not applicable	Not applicable	50	50	50
	Design Temp- Deg Cent.	120			120	120	120
	Make-up Tank Capacity in lits for top-up	500			500	500	500
	Raw Water In	66.12			66.23	65.97	67.72
	Raw Water out	58			58	58	58
	Cold Flow (lps)	15			28.6	28.63	28.63
	Heat Load - KW	510			986	955	1165
Remote Radiator - Design Pressure-	Bar (g)	6			6	6	6
Remote Radiator - Test Pressure-	Bar (g)	21			21	21	21
Selected Remote Radiator Model (Coil company Make)		FCW120			FCW240	FCW240	FCW260
Estimated Cooling water pump head selection	m (to be calculated as per site layout scheme requirement)	24			24	24	24

Note: Standard released PHE package for KTA50G3(1250 kVA) & KTA50G8I (1500 kVA) are suitable for cooling tower in secondary cooling circuit.

For case specific requirements of Remote Radiator in secondary cooling circuit for these two DG sets, refer PGBU Marketing or Product management or Application.

Typical cooling system P&ID is given below for reference



Typical Guidelines

Radiator

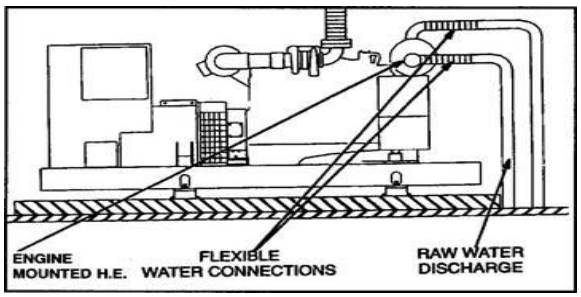
- Elevation of remote radiator needs to be considered while selection of circulation water pump head.
- Remote radiator to be used on one on one basis with engine without any common header scheme
- The proper location of remote radiator is very essential for the successful and efficient operation of remote radiator. In this the cooling media is ambient air. So in order to obtain maximum efficiency from remote radiator it is necessary to get fresh air in its surrounding. The air to be sucked in should not have any external hot medium such as engine exhaust, furnace exhaust etc.
- There should be no restriction at the fan outlet (from where the hot air is going out) such as ceiling
- It is recommended to install remote radiator at elevation of 1.2m above finished floor level (FFL/FGL).
- In case of multiple installations, space between 2 radiators should be minimum 2 meters.
- In case of roof top installation, check your building specifications for permissible floor loading and consult structural/civil engineer.

Water circulation pump

- Circulation water pump to be installed at Remote Radiator level.
- Circulation water pump to be selected with mechanical type seal.
- It is mandatory to install pressure gauges and temp gauges at Inlet and outlet connection of HE for raw water connections.
- Pot / Bucket type Strainer to be installed before raw water circulation pump suction for cooling tower application with mesh size 1 mm.
- Y type strainer to be installed before raw water circulation pump suction for Remote Radiator application with mesh size 1 mm.
- Non-return valves should be used at delivery of circulation water pump.
- Circulation water pump to be used one working and one standby for redundancy in circuit.

Flexible joints

- Raw water piping should be connected to engine HE by flexible connection / hose in order to isolate engine vibrations and to avoid undue stress on H.E. and piping- Ref sketch J.18.



Sketch J.18

Piping & Fittings

- Typically MS ERW class B pipes should be used for raw water. If GI pipes are used, those must be threaded at flanges. The welding will destroy galvanizing properties. Pipe diameter to be selected considering typical water velocity of 2 m/sec.
- Butterfly valves on both sides should be used in the pipe line for isolating the engine and remote radiator so that the entire system does not have to be drained during maintenance in the DG set or Remote radiator.

Fuel Cooler

For QSK50/60/78 DG sets separate fuel cooler to be provided for fuel cooling. Fuel system restrictions should be considered while locating fuel cooler in remote cooling system. Flexible hose to be provided at engine IN & OUT connections.

Cooling Water properties

Water used in cooling system should have properties as mentioned in below table

Water Properties	
Hardness as CaCO3	170 ppm max
pH - Raw water-Engine water	6.5-7.5 5.0-9.0
Chlorides	40 ppm max
TDS	400 ppm max
Sulphates	100 ppm max

- If properties are outside the limits then it can result in
- Scale formation
- Overheating
- Corrosion
- If raw water quality is not acceptable, then install Water softening / demineralizing plants.

EXPANSION / DE-AERATION TANK

J.4 **For Remote radiator in Primary circuit**

A suitable expansion / deration tank must be used (Normally 15% of the system volume capacity). The tank should be located at the highest point (min. 0.5 m from radiator top) of entire cooling system. Two separate tanks to be provided for LTA & JW systems. Venting lines from engine to be connected to expansion tank without any loop and sloping upwards to vent out air from the cooling system.

J.5 **For Remote radiator in Secondary circuit**

A suitable expansion / deration tanks are provided in Primary cooling circuit as part of cool pack PHE package. (Venting lines from engine to be connected to expansion tank without any loop and sloping upwards to vent out air from the cooling system)

Additional Makeup tank of 500 liter capacity to be installed at 0.5 meter minimum above Radiator top and makeup line to be connected to suction line of the water pump. Ensure proper venting of total cooling system.

Manual air venting valve to be provided at Radiator IN and OUT connection to vent air during initial fill/charging and top up.

Remote radiator for Primary circuit

Remote radiator for Secondary circuit

K. BATTERY / ELECTRICAL SYSTEM

K.1 Generally DG Set starting batteries are supplied along with DG sets, Cummins Pulse lite type specially designed for cranking application. Shelf life of these batteries is about 6 months and if DG commissioning is delayed, these batteries to be trickle charged to maintain condition. Auxiliary power supply is required for battery charging.

K.2 In case of batteries other than Cummins supply Batteries, they are also generally supplied in charged condition.

K.3 Batteries should be placed on wooden stands and preferably near the starting motor. A wooden/acrylic top cover with proper venting can also help protect the battery leads/terminals. Refer sketch K.3

K.4 Please refer Table K.4 for battery capacity and cable sizes for various engine models. Cable sizes are for maximum length of 2 meter. If a length is more, size the cable to be increased to minimize overheating of the cable and minimum voltage drop.

K.5 For AMF applications, an external battery charger should keep the batteries fully charged at all times.

Sketch K.3

Table K.4

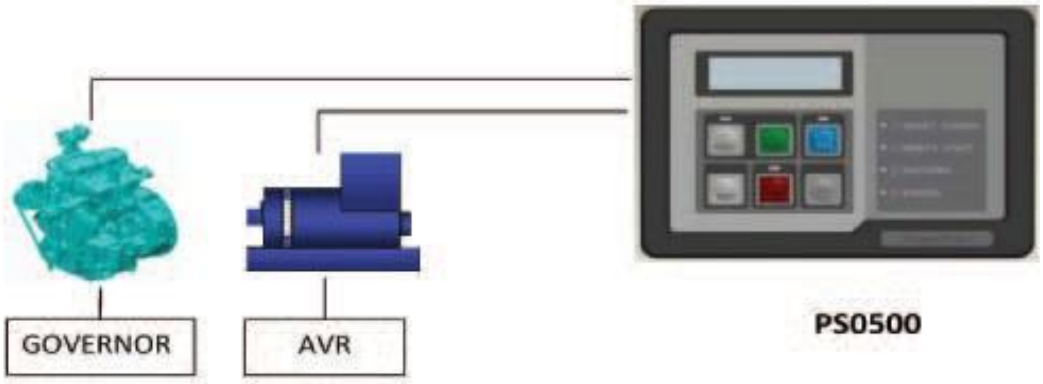
Note: All ratings are prime except where (S) is mentioned. S stands for standby ratings. Pulse lite Battery are typically supplied by DBU and Ah (amp-hr.) capacities are as recommended by them

Model	kVA Rating	Cable Size Copper Conductor (mm^2) System Volts	Starter Voltage Rating	No. of Batteries	Battery Capacity in amp-hour
X1.3TAA-G1	7.5	50	12 V DC	1	RTF
X1.3TAA-G1	10	50	12 V DC	1	RTF
X1.3TAA-G1	15	50	12 V DC	1	RTF
X2.7T-G1	20	50	12 V DC	1	RTF
X2.7T-G1	25	50	12 V DC	1	RTF
X2.7TAA-G2	30	50	12 V DC	1	RTF
X3.6TAA-G1	35	50	12 V DC	1	RTF
X3.6TAA-G1	40	50	12 V DC	1	RTF
4BTAA3.3-G11	50	50	12 V DC	1	RTF
4BTAA3.3-G11	62.5	50	12 V DC	1	RTF
4BTAA3.9-G3	70	50	12 V DC	1	RTF
4BTAA3.9-G4	82.5	50	12 V DC	1	RTF
6BTAA5.9-G13	100	50	12 V DC	1	RTF
6BTAA5.9-G13	125	50	12 V DC	1	RTF
QSB5.9-G1	140	50	24 V DC	2	RTF
QSB5.9-G2	160	50	24 V DC	2	RTF
QSB6.7-G11	180	50	24 V DC	2	RTF
QSB6.7-G12	200	50	24 V DC	2	RTF
QSB6.7-G13	225	50	24 V DC	2	RTF
QSL9-G16	250	70	24 V DC	2	RTF
QSL9-G16	275	70	24 V DC	2	RTF
QSL9-G15	300 / 330 (S)	70	24 V DC	2	RTF
QSN14-G1	365	70	24 V DC	2	RTF
QSN14-G2	400	70	24 V DC	2	RTF
QSN14-G3	440	70	24 V DC	2	RTF
KTAA19-G10	500	70	24 V DC	2	RTF
KTAA19-G11	520 (S)	70	24 V DC	2	RTF
QSK19-G6	600 / 660 (S)	70	24 V DC	2	RTF
QSK19-G7	640 / 700 (S)	70	24 V DC	2	RTF
KTA38-G10	750 / 830 (S)	70	24 V DC	2	RTF
KTA38-G11	810 / 900 (S)	70	24 V DC	2	RTF
KTA-38-G5	1010	70	24 V DC	2	160
KTA-50-G3	1250 / 1400 (S)	70	24 V DC	2	160
KTA-50-G8-I	1500	70	24 V DC	2	160
QSK50-G10	1750 / 1800	RTF	RTF	RTF	RTF
QSK50-G10	2000 (S)	RTF	RTF	RTF	RTF
QSK-60-G3	1875 / 2063 (S)	RTF	RTF	RTF	RTF
QSK-60-G4	2000 / 2250 (S)	RTF	RTF	RTF	RTF
QSK60-G8	2250 / 2500 (S)	RTF	RTF	RTF	RTF
QSK-78-G9	2750 / 3000 (S)	RTF	RTF	RTF	RTF
QSK-95-G4	3350 / 3750 (S)	RTF	RTF	RTF	RTF

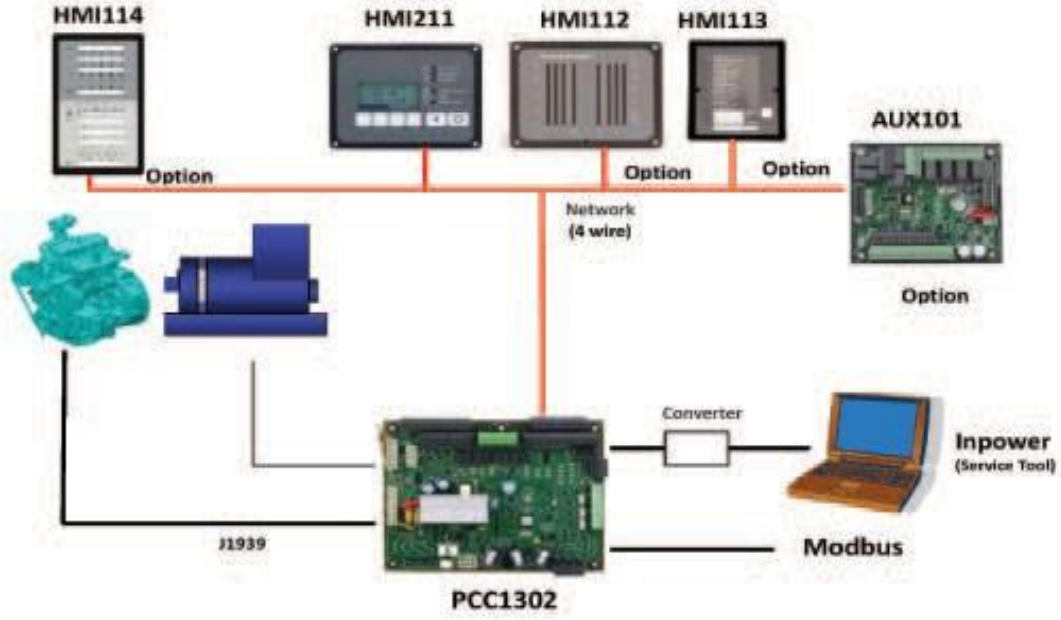
L. DG SET/ ENGINE CONTROLS DG SET/ ENGINE CONTROLS

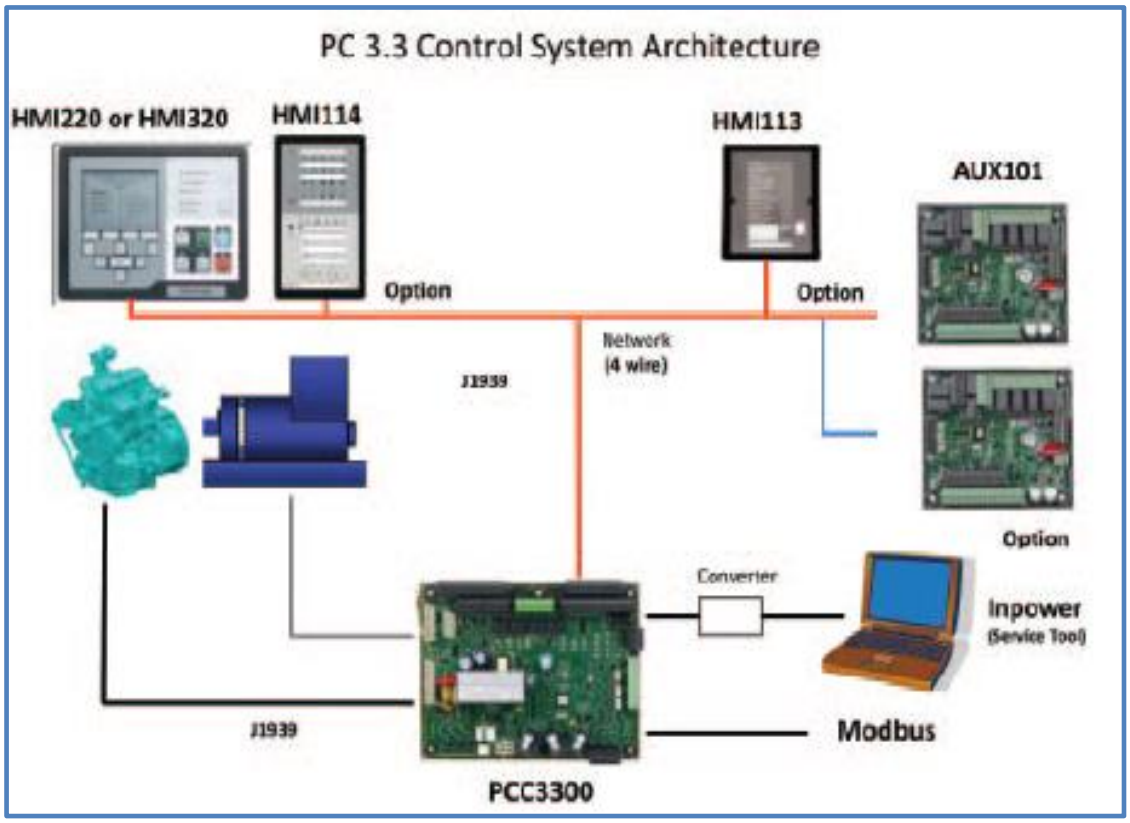
The generator set is controlled locally by a dedicated Generator Control Panel. This incorporates the control systems, metering, alarm indications and customer connections.

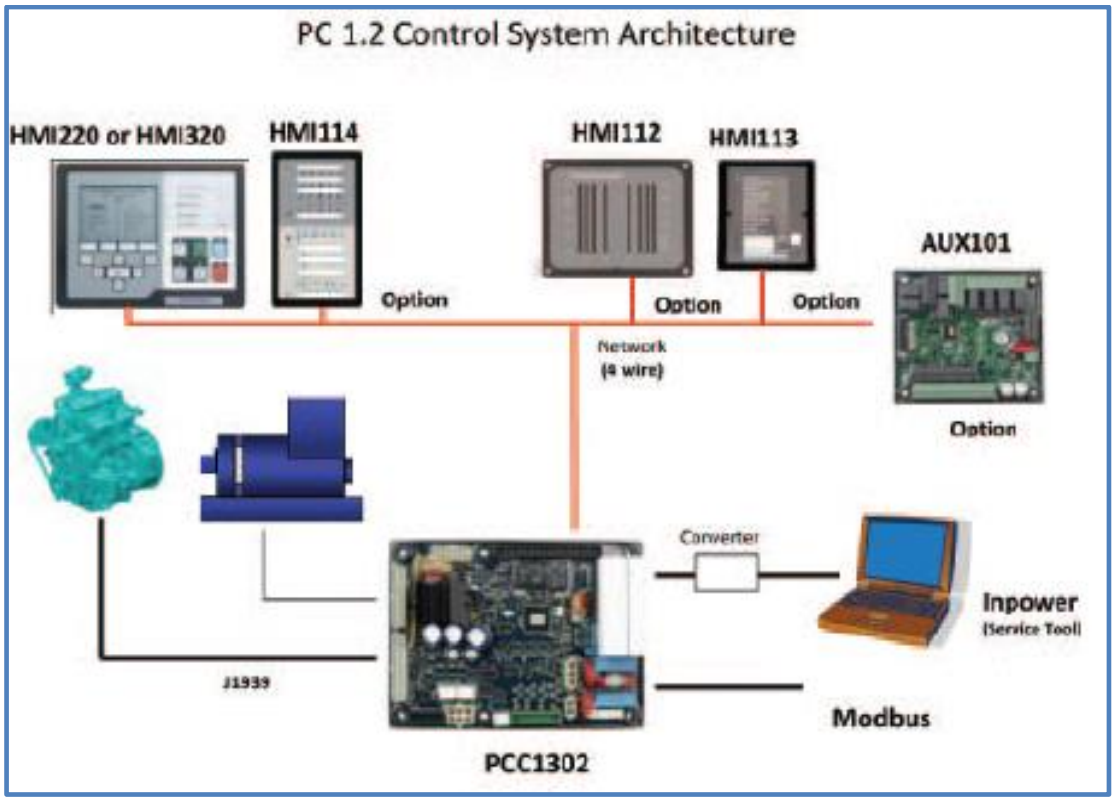
PSO500 Control System Architecture



PC 1.1 Control System Architecture




PC 3.3 Control System Architecture
HMI220 or HMI320
HMI114
HMI113
AUX101
Option
Option
Network
(4 wire)
J1939
Option
Converter
Inpower
(Service Tool)
J1939
Modbus
PCC3300


PC 1.2 Control System Architecture
HMI220 or HMI320
HMI114
HMI112
HMI113
AUX101
Option
Option
Option
Network
(4 wire)
Option
Converter
Inpower
(Service Tool)
J1939
Modbus
PCC1302

L.1 Make sure that the polarity of the battery connections is correct before connecting any harnesses/applying power to the PCC Controls.

L.2 Do not short test wire leads to see if they are 'live' by flashing on engine body.

L.3 **Disconnect all harness connections to the PCC & Engine control system before doing any welding work on DG set. Controller & PCB can get damaged due to welding currents. DG Set starting batteries to be disconnected at battery end before any welding work or maintenance**.

L.4 Make sure the battery area is well ventilated before servicing the battery. Arcing can cause explosion due to hydrogen gas given off by batteries

L.5 Always refer to the wiring Sketch and product manual supplied with the engine/ DG Set for details.

L.6 For CT Ratios to be used with different options of controls refer to GOEM's.

L.7 Load sharing cable (shielded 1.5 sq. mm copper) to be connected between all DG sets PCC panels with master start logic.

L.8 **BMS integration:**

- PC 3.3 is having inbuilt feature for BMS integration thru Modbus protocol (RS485), register mapping to be provided to BMS integrator to display data. Refer Table L.8
- PC3201 needs additional Modlon card 1 number and Lonworks card one number for BMS integration thru Modbus protocol (RS485), register mapping to be provided to BMS integrator to display data. For multiple sets, one Modlon card is suitable for 8 DG sets and Lonworks card 1 number is required for each DG set.

Standard Features of Cummins DG Set Controllers.

DG Sets Controller	**Features**			
	Solo	Paralleling	BMS protocol	Remarks
PSO-500	√	×	RS485	
PC1.1	√	×	RS485	
PC1.2	√	×	RS485	
PC 3.3	√	√	RS485	
PC 3201	√	√	Modlon	

Table L 8

L.9 AMF OPERATION:

There are three types of AMF operations as below:

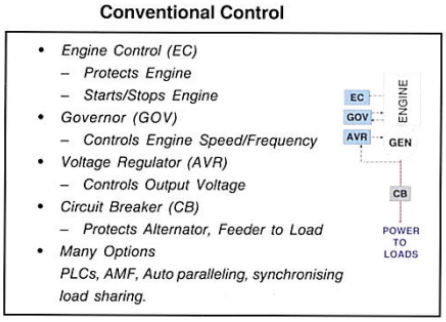
A) Operational system is automatically restored to operation within 10 seconds after interruption of normal power source-with normal load on the engine. This operation exerts a 'Thermal shock' to the engine. For example UPS.

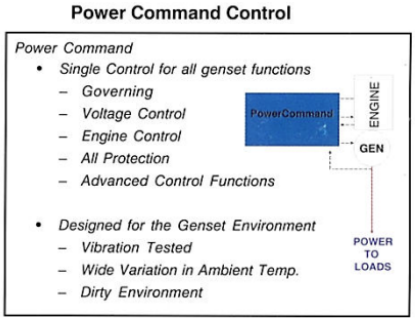
B) Operational system is automatically restored to operation within 10 second after interruption of normal power source - but with gradual load (in steps) on the engine with low initial load. There is no 'Thermal shock' to the engine.

C) Operational system is manually restored to operation after interruption of normal power source - with gradual load on the engine. There is no - 'Thermal shock' to the engine.

For 'A' type AMF operations heaters (lube oil & coolant) are recommended to be fitted.
(For any specific requirement please contact OEM/ Cummins.)
For 'B' & 'C' type AMF operations, provision of heaters (lube oil & coolant) depends on cold weather operation. (Ambient below 4 degree centigrade to be fitted. For any specific requirement contact GOEM/ Cummins.)

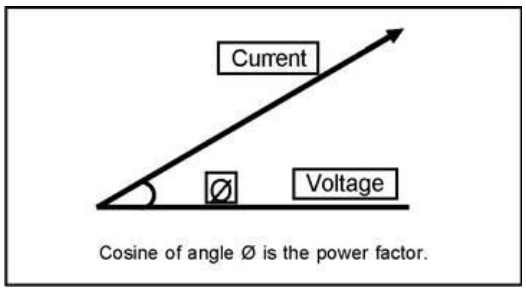
PCC Panel near DG





L.10 POWER FACTOR (P.F.)

Power Factor is the cosine of the angle between current vector and the voltage vector.



The power factor of the electrical system depends upon the nature of characteristics of the load. e.g. Induction motors, Furnaces etc.

- PF is lagging for inductive load.
- PF is leading for capacitive load.
- PF is unity for (purely) resistive loads
- If the PF of the load is less than the standard (0.8) the alternator gets overloaded. Current will increase with pf less than 0.8. Power Output Current of the alternator should not exceed the name plate rating.
- If the PF of the load is more than the standard (0.8) the engine gets overloaded. Power Output (in Kw) of the alternator should not exceed the name plate rating.
- The PF should be maintained at 0.8 lagging.

In case of leading pf following issues can be observed in DG operation:

- DG Set tripping on loss of field fault.
- Unequal load sharing.
- Increase and fluctuation of terminal voltage.
- Alternator winding temp increase/rise.
- Damage to alternator winding over a period of time.
- Failure of AVR and surges in output voltage.
- Damage to the electrical appliances due to increased voltage.

M. **CABLING (POWER AND CONTROL)**

M1. Always use flexible / armored cables for inter connecting the DG Set Controllers with the switchgear and other equipment's and avoid mechanical strain.

M.2 Power cabling between alternator and control panel and change over switch to mains should be done with recommended cable sizes and avoid mechanical strain during connecting cables and thereafter. It would prevent failure of lugs, cables & terminals.

M.3. While terminating cables avoid any tension on the bus bars/terminals.

M.4.Local Isolator Panel: In case of power panel is located away from the DG Set, local Isolator panel is to be provided near the DG Set as per CEIG/local approval agency requirements.

M.5.While terminating R.Y.B. phase sequence should be maintained in the alternator and control panel for easy maintenance.

M.6 Power/Control cables should always be connected with proper lugs. Also all cables should have double compression and ni-plated glands.

M.7 All Cables should be properly tagged on both sides. (Refer Table M.7 for XLPE cable sizes.)

M.8 Alternator termination extension box with flexibility. Refer Attached Photo below A terminal extension box is recommended for multiple power cable termination with proper support and care to ensure that weights of cables should not get transferred to alternator terminals.

M.9 Overheating due to loose thumbing / undersize cables causes most of electrical failures, hence ensure that correct size of cables and gland is used.

M.10 For AMF application, use suitable core 2.5 sq.mm copper cable for control cabling.

M.11 Typical cable sizes for 415 V applications are provided in Table M.7. The sizes given are Indicative. Please refer to the cable manufacturers for more details

M.12 For HT cables, kindly contact GOEM's for details on cable sizing.

TYPICAL XLPE CABLE SIZES FOR DG SETS - Copper

2 Core copper conductor XLPE -
7.5 to 62.5 kVA, 230 V, 50 Hz, 1 Phase

kVA	Amp	Cable size X No of runs
7.5 (1 phase)	33	6 x 1
10 (1 phase)	44	10 x 1
15 (1 phase)	65	25 x 1
20 (1 phase)	87	35 X 1
25 (1 phase)	109	50 X 1
30 (1 phase)	131	70 X 1
35 (1 phase)	152	70 X 1
40 (1 phase)	174	95 x 1
50 (1 phase)	217	150 x 1
62.5 (1 phase)	272	185 x 1

4 Core copper conductor XLPE -
7.5 To 40 kVA, 415 V, 50 Hz, 3 phase

kVA	Amp	Cable size X No of runs
7.5	11	4 x 1
10	14	4 x 1
15	21	4 x 1
20	28	4 X 1
25	35	6 X 1
30	42	10 X 1
35	49	10 X 1
40	56	16 X 1

Notes:

1. Use 3.5 core XLPE insulated armored power cables with aluminum conductor (AYFY) for rating from 50 to 3000 kVA 3 ph.
2. AYFY: Aluminum conductor, Steel strip armor.
3. Use 2 core XLPE insulated armored power cable with copper conductor for rating from 7.5 to 62.5 kVA 1 Ph.
4. Use 4 core XLPE insulated armored power cable with copper conductor for rating from 7.5 to 40 kVA for 3 Ph.
5. For multiple runs of cables, applicable duration factor as specified by Cable manufacturer is considered.
6. Cable sizes mentioned are in square mm.
7. Earthing as per IEC rules to be provided.
8. Typical cable sizes for 415 V, 3 phase/ 230 V, 1 phase application are provided.

Core Aluminum armored conductor XLPE 3 phase.

TYPICAL XLPE CABLE SIZES FOR DG SETS – Aluminium

CPCB II			
Rating	Current Rating		Cable Sizes in mm^2 x No. of runs (In air)
kVA	Amp	10% overload Current	
50	70	77	25 x 1
62.5	87	95.7	35 x 1
70	97.3	107.03	35 x 1
82.5	115	126.5	50 x 1
100	139	152.9	70 x 1
125	174	191.4	95 x 1
140	195	214.5	95 x 1
160	223	245.3	120 x 1
180	250	275	150 x 1
200	278	306	185 x 1
225	313	344	120 X 2
250	348	383	150 X 2
275	383	421	150 X 2
300	418	460	185 x 2
320	445	490	185 x 2
330	459	Not Applicable	185 x 2
365	508	559	240 x 2
380	529	582	240 x 2
400	557	612	300 X 2
440	612	Not Applicable	300 X 2
500	696	765	240 x 3
520	723	795	240 x 3
600	835	919	300 x 3
625	870	956	300 x 3
660	918	Not Applicable	300 x 3
650	904	995	300 x 3
700	974	Not Applicable	300 x 3
750	1043	1147.3	400 x 3
830	1155	Not Applicable	300 x 4
810	1127	1239.7	300 x 4
900	1252	Not Applicable	240 x 5
1010	1403.9	1544.29	300 x 5 / 400 x 3
1250	1737.5	1911.25	500 x 5
1400	1946	Not Applicable	500 x 5
1500	2085	2293.5	500 x 6
1750	2432.5	2675.75	400 x 8
1900	2641	Not Applicable	400 x 8
1800	2502	2752.2	400 x 8
2000	2780	Not Applicable	400 x 8
1875	2606.25	2866.875	500 x7
2063	2867.57	Not Applicable	500 x7
2000	2780	3058	500 x 8
2250	3127.5	Not Applicable	500 x 8
2250	3127.5	3440.25	500 x 9/ 400 x10
2500	3475	Not Applicable	500 x 9/ 400 x10
2750	3822.5	4204.75	500 x 11
3000	4170	Not Applicable	500 x 11
3350	4656.5	5122.15	500x 13
3750	5212.5	Not Applicable	500x 13

N EARTHING (As Per IS 3043)

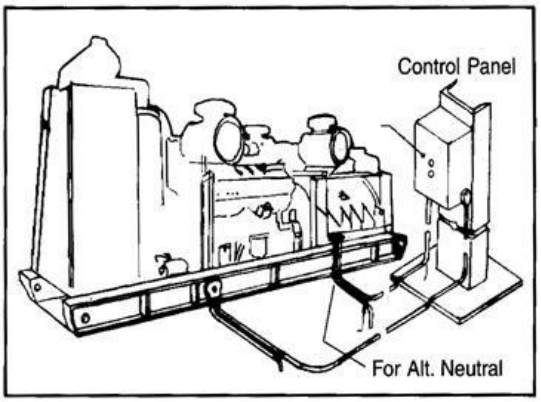
N.1. The generating set and all associated equipment control and switch gear panels must be earthed before the set is put into operation. PCC panel should have separate earthing strip connection of suitable size connected to DG Set body earthing.

N.2 Four numbers earth pits are required as per Indian Electricity rules or local electricity board.

- 2 earthing pits for DG Set/ control panel body
- 2 earthing pits for neutral

Minimum distance between the two earth pits should be minimum 800 mm 2.5 to 3 meters multiple sets (straight/ diagonal) for numbers of earth pits are to be determined by fault level calculation.

For this grid earthing can be considered.

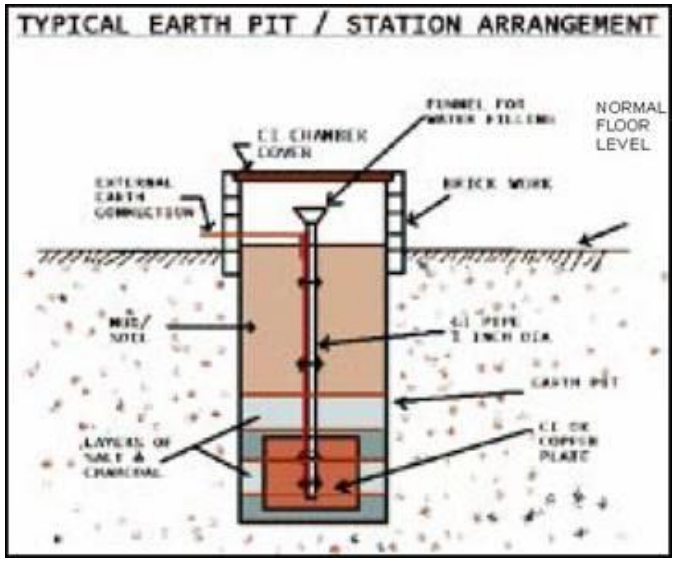


N.3 Copper or GI strips of suitable size may be used for earthing. Please note that as a standard Practice earth resistance should not exceed one ohm. Earthing should be checked at earth pit location and resistance should be maintained within 1 ohm.

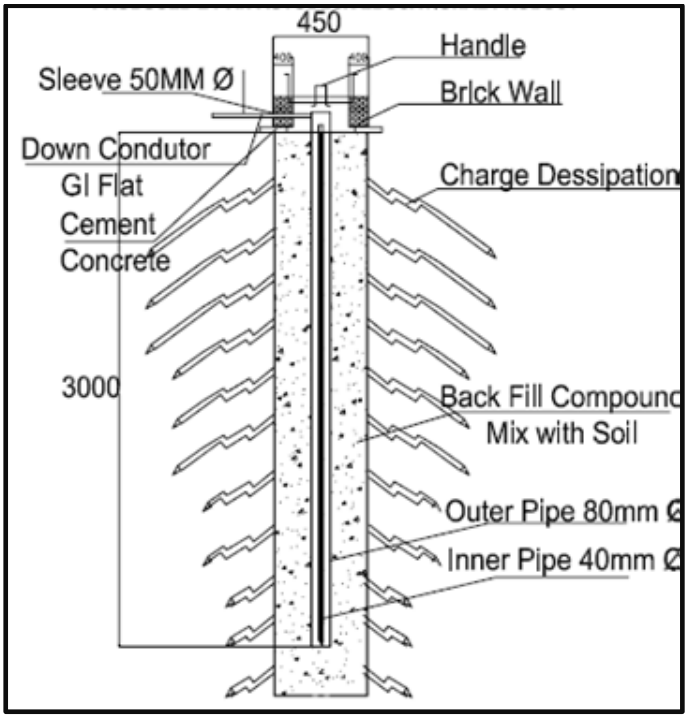
For DG Sets with AVM's between engine/ alternator and base rail, the earthling MUST be done at the engine/ alternator and NOT at base rail.

N.4 DG Set should be earthed at two distinct points through a GI/ Copper Strips/ conductor heavy enough to carry the short circuit current without burning. (Sketch N.4)

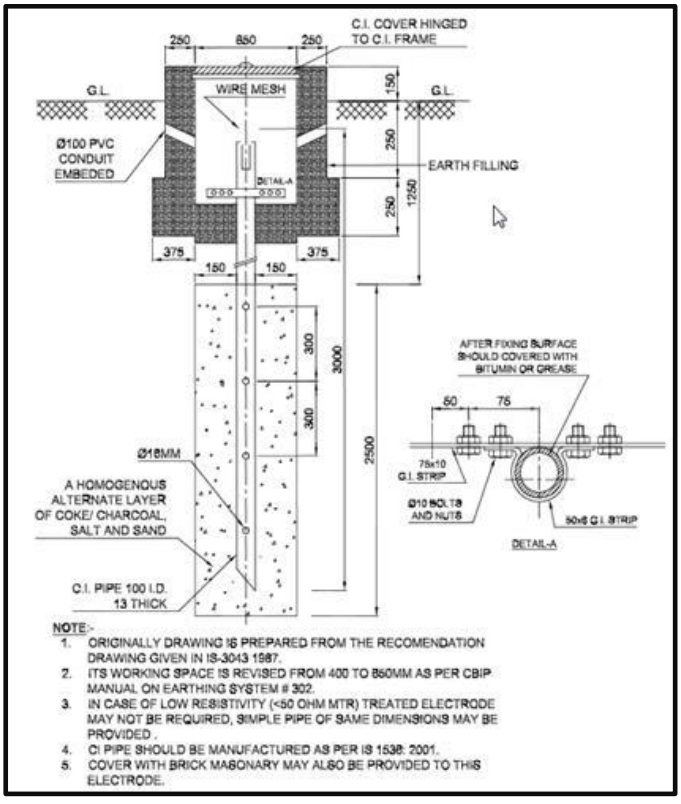
Note: In case of multiple DG sets check with GOEM project team on earthing pits design and earthing grids/rings



Sketch N.4



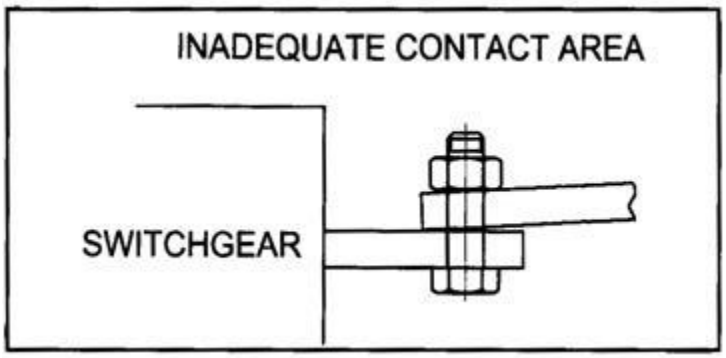
Sketch N.4



Sketch N.4

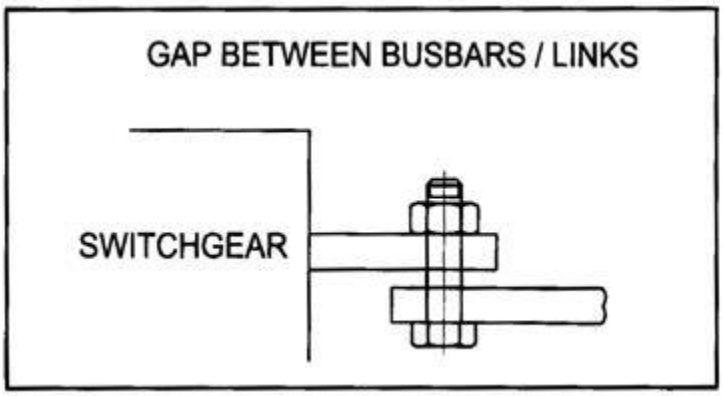
O. ALTERNATOR TERMINAL LINKS:

O.1 Proper terminations between links and switchgear terminals, the contact area must be adequate. The following situations should also be avoided as they lead to creation of heat sources at the point of termination: - Point contact arises out of improper positioning of links with switch gear terminals.



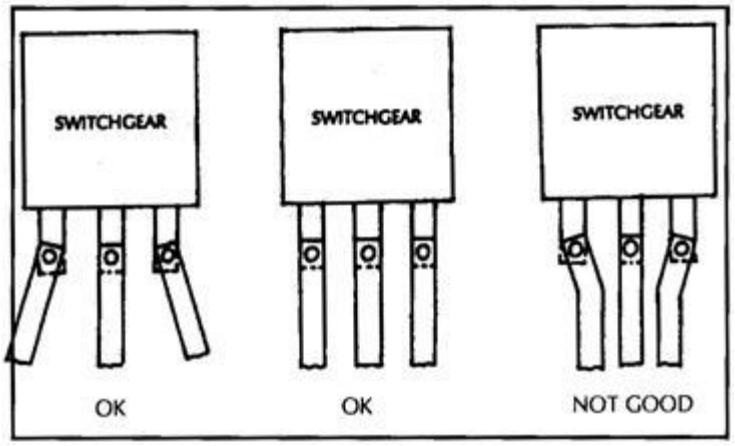
Sketch Ref. O.1

O.2 Gaps between bus bars/ links and terminals being remedied by connecting bolt/ stud. (Ref. O.2) In such case the bolt will carry the load current. Normally these bolts/ studs are made of MS and hence are not designed to carry currents.



Sketch Ref. O.2

O.3 Adequate clearance between bus bars/ links at terminals should be maintained (IS: 4232 may be referred to for guidelines). Ref. O.3 ranks the quality of different configurations. Improper termination will lead to local heat generation which may lead to failure.



Sketch Ref. O.3

P. DG SET WITH ACOUSTIC ENCLOSURES

P.1 DG sets with Acoustic enclosures up to rating 700 kVA are supplied with built in AVMs (between base and engine/alternator). As such DG Set can be installed directly on the leveled foundation.

P.2 DG sets with Acoustic enclosures for 750 kVA and above ratings are supplied with built in AVMs (between base and engine/alternator), with “CAPIN” type acoustic enclosure which is assembled at site. These DG Set can be installed directly on the leveled foundation.

P.3 DG sets with Acoustic enclosures for QSK 50/60 ratings are supplied with loose AVMs), with “CAPIN” type acoustic enclosure which is assembled at site. These DG Set can be installed on AVM’s on the leveled foundation.

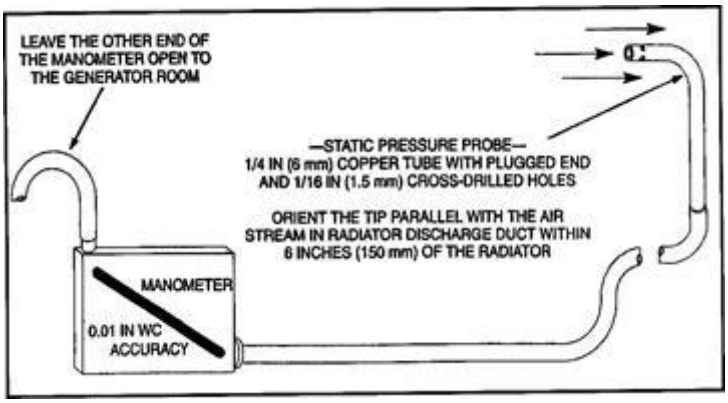
P.4 Exhaust piping outlet should not be turned towards window / ventilator of home or occupied building. Ensure provision of rain cap.

P.5 The acoustic enclosure placement should be such that there is no restriction for fresh air Inlet and outlet from canopy.

P.6 All maintenance /minor repairs/tappet setting /Air cleaner element replacement should be

P.7 Possible without dismantling acoustic enclosure.

P.8 DG Set/ Engine control panel should be visible from outside the enclosure. All doors should be openable



Q. RAIN WATER ENTRY PROTECTION FOR DG SETS WITH ACOUSTIC ENCLOSURES

Q.1 **Rain water Protection during DG installation stage at site:**

- All exposed openings on the DG Sets need to be properly blanked to avoid rain water entry in engine thru turbocharger/pipe/silencer/alternator terminal box, etc., while working on the exhaust pipe /silencer installation. This is to be done till completion of exhaust system erection work.
- Proper rain protection mechanism/sealing to be provided at exhaust duct/pipe outlet from acoustic enclosure.
- Rain protection rail to be provided on acoustic enclosure over top of the doors /opening.
- A rain shed can be provided for DG set to improve the serviceability and operator convenience during rainy season. Care should be taken to ensure sufficient height of this rain shed to blow out hot air in case of hot air duct outlet at top of acoustic enclosure.
-

Q.2 Rain **water Protection during DG Operation stage at site:**

- Rain water entry in engine can occur thru damaged exhaust silencer/exhaust piping.
- There may be rain water carryover at air intake area.
- A/ B / C check on engine / alternator (air filter replacement and tappet setting) should be possible without dismantling acoustic enclosure. Care should be taken for Air cleaner element replacement it should not be like opening air cleaner for removing element.

Q.3 **Rain water Protection during DG set transportation:**

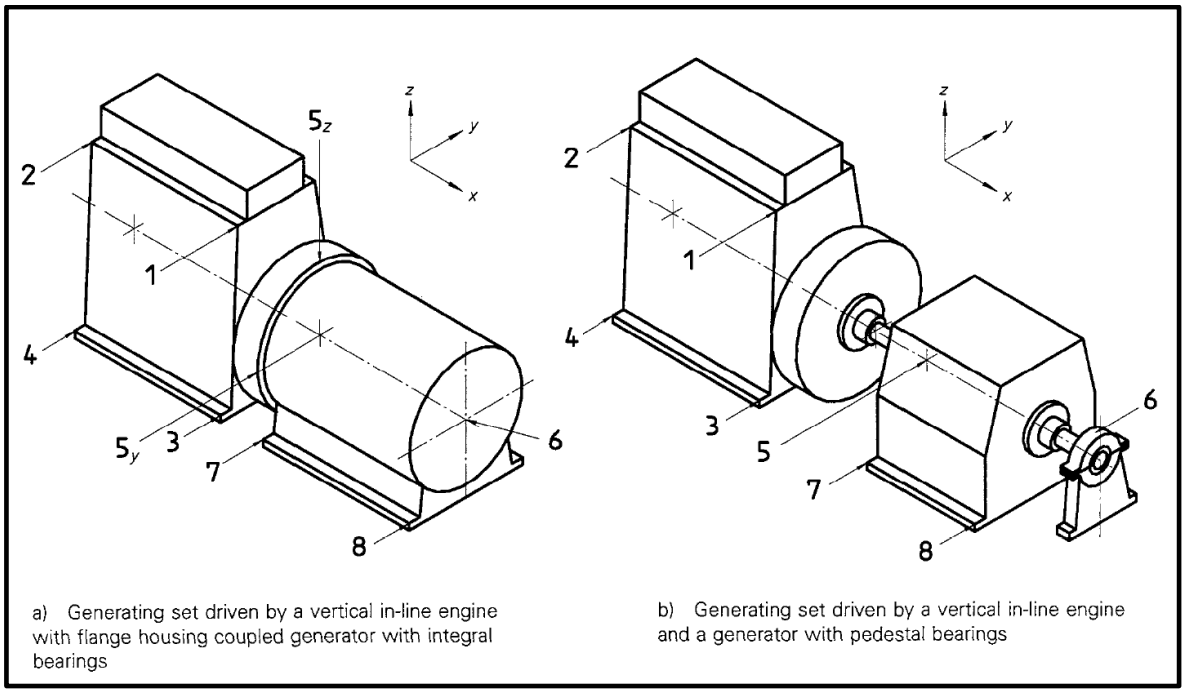
- During transportation silencer / exhaust openings on the DG set to be blanked to avoid rain water ingress.
- All openings on Engine and Alternator to be blanked / sealed properly to avoid rain water ingress.
- Diesel day tank to be covered by polythene / stretch wrap to avoid rain water ingress.
- Open DG set to be completely covered with polythene / stretch wrap to avoid rain water ingress.

R. VIBRATION

Cummins DG sets have built in anti – vibration. These AVMs isolates engine vibrations transferred to foundation.

Vibration limits and measurement should Meet ISO8528 part 9.

R.1 Measurement locations- refer sketch below



a) Generating set driven by a vertical in-line engine with flange housing coupled generator with integral bearings

b) Generating set driven by a vertical in-line engine and a generator with pedestal bearings

R.2 Vibration Limits as per IS 8528-9 refer table below

Table C.1 — Rms values for vibration velocity, displacement and acceleration of RIC engine driven AC generating sets (see clause 10)

Declared engine speed	Rated power output of the generating set		Vibration displacement[1], s_{rms}			Vibration velocity, v_{rms}			Vibration acceleration[1], a_{rms}		
	(cos φ = 0,8)		RIC engine [2] [3]	Generator [2]		RIC engine [2][3]	Generator [2]		RIC engine [2][3]	Generator [2]	
				value 1	value 2		value 1	value 2		value 1	value 2
min⁻¹	kV·A	kW	mm	mm	mm	mm/s	mm/s	mm/s	m/s²	m/s²	m/s²
⩾ 2 000 but ⩽ 3 600	⩽ 15 (1-cylinder engine)	⩽ 12 (1-cylinder engine)	—	1,11	1,27	—	70	80	—	44	50
	⩽ 50	⩽ 40	—	0,8	0,95	—	50	60	—	31	38
	> 50	> 40	—	0,64 [4]	0,8 [4]	—	40 [4]	50 [4]	—	25 [4]	31 [4]
⩾ 1 300 but < 2 000	⩽ 10	⩽ 8	—	—	—	—	—	—	—	—	—
	> 10 but ⩽ 50	> 8 but ⩽ 40	—	0,64	—	—	40	—	—	25	—
	> 50 but ⩽ 125	> 40 but ⩽ 100	—	0,4	0,48	—	25	30	—	16	19
	> 125 but ⩽ 250	> 100 but ⩽ 200	0,72	0,4	0,48	45	25	30	28	16	19
	> 250	> 200	0,72	0,32	0,45	45	20	28	28	13	18
> 720 but < 1 300	⩾ 250 but ⩽ 1 250	⩾ 200 but ⩽ 1 000	0,72	0,32	0,39	45	20	24	28	13	15
	> 1 250	> 1 000		0,29	0,35		18	22		11	14
⩽ 720	> 1 250	> 1 000	0,72	0,24 (0,16) [5]	0,32 (0,24) [5]	45	15 (10) [5]	20 (15) [5]	28	9,5 (6,5) [5]	13 (9,5) [5]

NOTE — The relationship between vibration velocity and vibration frequency is shown in figure C.1

1) The values of s_{rms} and a_{rms} are determined from the following equations by using the values given in the table for v_{rms}.

$s_{rms} = 0.0159 \times v_{rms}$

$a_{rms} = 0,628 \times v_{rms}$

2) In the case of flange housing coupled generating sets the values measured at point 5 [see figure 1 a)] shall meet the values for generators.

3) The stated values for RIC engines are applicable for engines with power outputs of more than 100 kW. For smaller engines with power outputs below 100 kW, no typical values exist.

4) These values are subject to agreement between the manufacturer and customer.

5) The values given in parentheses are applied to generators mounted on solid concrete foundations. In these cases the axial measurement for points 7 and 8 in figure 1 a) and b) shall be 50 % of the values given in parentheses.

R3. Measurement record format:

Particulars of measuring equipment

Mechanical connection	☐ screwed ☐ hand held ☐ cemented ☐ magnetic	
Measured value	☐ displacement ☐ velocity ☐ acceleration	
Recorded value	☐ displacement ☐ velocity ☐ acceleration	
Measuring range	amplitude . .	frequency .
Frequency analyser/filter	linear range	pass-band
Data for evaluation of measuring records (e g amplification, rate of feed)		
Remarks		

Measurement results

Power . . . . . kW	Ambient temperature . . °C
Speed . . . . . min^{-1}	Type of fuel . . . .

Measuring point No.	**rms overall values** (2 Hz to 300 Hz)[1]									**Remarks**
	Direction of measurement									
	axial (x)			transverse (y)			vertical (z)			
	s mm	v mm/s	a m/s²	s mm	v mm/s	a m/s²	s mm	v mm/s	a m/s²	

1) Either measured or calculated

S. NOISE

It is recommended that all generating sets installed at roof level have sound proof enclosures fitted or are installed in room with full inlet and outlet sound attenuators and critical grade residential silencers. A sound level of 75 dB (A) at 1m. is a substantial reduction and equal to a normal office environment?

- DG Set should meets CPCB/MOEF guidelines for noise
- Up to 880kWm – 75dBA @ 1 meter @ 75% load
- Above 880kWm – 25dBA insertion loss @ 0.5 meter distance
- Noise measurement as per as ISO 8528 – Part 10

T. IMPORTANT CONVERSIONS

<table>
<tr>
<td>Length
1 m = 3.28 ft.
= 39.37 inch
= 100 cm.
1 Inch = 25.4 mm
Mass
1 kg = 2.2 lb.</td>
<td>Area
1 m^2 = 10.76 ft^2
= 1550 sq. inch.
= 10000 cm^2
1 sq. Inch = 645.2 mm^2
Velocity
1 m/sec = 3.28 ft/sec.
= 196.85 ft/min.</td>
<td>Volume
1 m^3 = 35.31 ft 3
= 1000 ltrs.
1 ft^3 = 28.32 ltrs.
1 gallon = 3.78 ltrs.
Flow
1 lt/sec = 2.12 CFM
1 lt/min = 0.2642 GPM
1 m^3 /min = 35.3 CFM
= 16.7 ltrs./sec.</td>
</tr>
<tr>
<td colspan="2">Power
1 kW = 1.34 HP = 56.92 BTU/min 1 HP = 0.746 kW

1 KCAL/min = 14.34 kW

Engine HP = KVA x P.F. + Fan HP + bat. alt. HP
0.746 x Alt. efficiency

KW (Three Phase) = 1.732 x V x I x P.F. 1000

KW (Single Phase) = V x I x P.F.
1000</td>
<td>Pressure
1 kg/cm^2 = 14.2 PSI
= 32.81 ft. of water
= 10 m of water

1 Atm = 1.033 kg/cm^2
= 14.7 PSI

1 PSI = 0.7 m of water
= 2.3 ft of water
= 6.89 k Pa

1" of Hg = 13.6" of water</td>
</tr>
</table>

NOTES

Annexure 1

Guideline for Earthing of Portable/Mobile Generator – (Ref : IS: 3043 – 1987)

Where a supply is taken from **a mobile generator**, the following recommendations shall apply:

b) The generator neutral should be connected to the vehicle chassis.

c) The earth terminal at each outlet on the generator vehicle should be connected separately to the alternator neutral where the latter is bonded to the vehicle chassis.

c) If Mobile DG set is **in Stationary location**, the earthing of the local control panel available at site should be used. Where an electricity board protective earth terminal or exposed structural metalwork is present, it should be connected to the earthing conductor on the mobile generator. In case there is no such provision then alternatively gel/spike earthing can be done in the ground.

Annexure 2

GUIDELINES FOR DG SET INSTALLATION AT BUILDING ROOF TOP

Sr No	Area	Recommendation	Remark
A.	**Civil works**		
1.		Civil RCC slab & structural design needs to be checked & verified as per DG set static weight & dynamic weight	
2.		DG set mounting area needs to be selected at structural columns & beams area to load structural members.	
3.		Structural steel members to be installed on RCC column & beam area. Foundation level to be maintained +/-3mm.	
4.		Rubber sheet of @10mm thickness to be provided below DG enclosure frame area to absorb DG vibrations transfer to foundation.	
B.	**DG Installation**		
1.		Free space of @1m to be provided around DG Set for proper access & air ventilation.	
2.		Check for restriction at air suction side & hot air outlet side from DG set enclosure.	
3.		Check for any possibility of hot air recirculation back to suction side of DG enclosure.	
4.		Connect power outgoing cables as per sizing calculations.	
5.		Provide proper Earthing connection for DG set.	
6.		DG set exhaust outlet direction to be checked as per site requirement.	
7.		Diesel storage & charging in day tank scheme at site	
8.		Electrical cables laying, terminations & dressing with provision of proper cable trays.	
C.	**DG Commissioning**		
1.		DG performance to be checked at site at rated capacity.	
2.		AMF mode operation to be checked.	
3.		DG Vibrations needs to be measured at site on DG enclosure base as per IS8528-9.	

Annexure 3
DG Set/Engine Preservation Recommendation

1. **Scenario A -** Any G-Drive engine if stored for more than 1 year at GOEM works will be required to carry out preservation process at GOEM works

a. The lube and Fuel filters shall be replaced at GOEM works.
b. The engine will be filled with new Lubricating oil & coolant
c. The DG-set will be assembled and then run on load.
d. The complete process shall be witnessed and validated by the Cummins Personnel deputed at the GOEM works.

2. **Scenario B -** In case the DG Set is to be stored at the Customer site for over 1 year, then the following process should be followed before commissioning.

a. The lube and Fuel filters shall be replaced.
b. The engine will be filled with new Lubricating oil.
c. The DG Set shall be run on idle if feasible.
d. If running on idle is not possible it is recommended to prime the engine and manually rotate. (External Electrical pump to be used for lube oil priming to attain at least 0.5 kg/cm2 of lube oil pressure).
e. The engine shall be rotated by barring mechanism at least for 2 rotations.
f. The complete process shall be witnessed and validated by the DBU Service Personnel at customer site.
g. In case the DG is stored for over 2 years at site, the complete coolant needs to be replaced.
h. This process should be repeated at every one year interval till commissioning of the DG set.
i. If alternator bearing is re-greasable type, greasing to be done as per CGT guidelines at every year and if bearings are sealed type, bearings to be replaced after 12 months of storage before commissioning.

TABLE 1 – 1010 kva onwards - 3750 kVA

Model	Rating (0.8 pf) In kVA	Exh. Gas flow (No. of bank X flow per bank)	Exhaust Silencer nominal bore	Fuel supply/return pipes upto 10 mtrs. Min ID (Considering fuel tank pipe max length is 10m)	Lube oil system capacity (Including filters)	Coolant capacity (H for HE R for Radiator)	Radiator fan flow in Genset Room (Inlet air flow for enclosed set)	Engine radiator core area (Height X Width)	DG set Heat dissipation (Radiation Engine +Alternator)	Combus tion Air require ment	For HE /Remote Radiator installation vetillation air requirement.		
											Ventilation air capacity required at 5 Deg ΔT	Ventilation air capacity required at 7 Deg ΔT	Ventilation air capacity required at 10 Deg ΔT
	P - Prime, S - Standby	No. x m^3/sec	Inch / No. of banks	mm	L	L	m^3/sec	m x m	KW	m3/sec	m3/sec	m3/sec	m3/sec
QSK95-G4	3750 (S) / 3350 (P)	2 X 4.58	RTF	RTF	647.3	RTF	96.38	RTF	407	4.15	76.8	56.0	40.5
QSK78-G9	3000 (S) / 2750 (P) - 50°C	2 X 3.60	18/2	50	466	RTF	58.75	RTF	325	3.22	61.2	44.6	32.2
QSK78-G9	3000 (S) / 2750 (P) - 40°C	2 X 3.60	18/2	50	466	RTF	33.20	RTF	325	3.22	61.2	44.6	32.2
QSK60-G8	2500 (S) / 2250 (P) - 40°C	2 X 3.16	17/2	50	400	550(H)750 (R)	46.70	RTF	290	2.6	54.3	39.6	28.5
QSK60-G4	2250 (S) / 2000 (P) - 50°C	2 x 2.8	17/2	50	280/400	550(H)750 (R)	30.03	1143x1132	247	2.4	46.5	33.9	24.4
QSK50-G10	2000 (S) / 1800 (P) (HE)	2 X 2.56	RTF	50	235	RTF	RTF	RTF	223	2.01	41.8	30.4	21.9
KTA-50-G8-I	1650 (S) / 1500 (P)	2 X 2.22	14/2	25	177	320(H) 618 (R)	28.40	RTF	202.8	1.74	37.9	27.6	19.8
KTA-50-G3	1400 (S) /1250 (P)	2 X 2	14/2	25	177	310(H) 676 (R)	27.35	RTF	194.8	1.74	36.5	26.6	19.1
KTA-38-G5	1010 (P)	2 X 1.53	17/2	25	145	199(H) 507 (R)	19.99	RTF	172.52	1.21	32.0	23.2	16.6

Model	Rating (0.8 pf) In kVA	Exh. Gas flow (No. of bank X flow per bank)	Exhaust Silencer nominal bore	Fuel supply/return pipes upto 10 mtrs. Min ID (Considering fuel tank pipe max length is 10m)	Lube oil system capacity (Including filters)	Coolant capacity (H for HE R for Radiator)	Radiator fan flow in Genset Room (Inlet air flow for enclosed set)	Engine radiator core area (Height X Width)	DG set Heat dissipation (Radiation Engine +Alternator)	Combustion Air requirement	For HE /Remote Radiator installation vetillation air requirement.		
											Ventilation air capacity required at 5 Deg ΔT	Ventilation air capacity required at 7 Deg ΔT	Ventilation air capacity required at 10 Deg ΔT
	P - Prime, S - Standby	No. x m³/sec	Inch / No. of banks	mm	L	L	m³/sec	m x m	KW	m3/sec	m3/sec	m3/sec	m3/sec
KTA38-G11	900 (S) / 810 (P)	2 x 1.24	8/2	25.4/16	155	507(R)	27.07	RTF	107.8	RTF	RTF	RTF	RTF
KTA38-G10	830 (S) / 750 (P)	2 x 1.17	8/2	25.4/16	155	507(R)	27.07	RTF	105.56	RTF	RTF	RTF	RTF
QSK19-G7	700 (S) / 640 (P)	1 x 1.96	10/1	Integral fuel tank	84.4	97 (R)	12.93	1493 x 1390	101.4	RTF	RTF	RTF	RTF
QSK19-G6	660 (S) / 600 (P)	1 x 1.86	10/1	Integral fuel tank	84.4	97 (R)	12.93	1493 x 1390	100.12	RTF	RTF	RTF	RTF
KTAA19-G11	520 (S)	1 x 1.50	10/1	Integral fuel tank	50	85 (R)	6.76	1324 x 804	62.64	RTF	RTF	RTF	RTF
KTAA19-G10	500 (P)	1 x 1.45	10/1	Integral fuel tank	50	85 (R)	6.76	1324 x 804	60	RTF	RTF	RTF	RTF
QSN14-G3	440 (S)	1 x 1.20	6/1	Integral fuel tank	38.6	51 (R)	8.87	1250 X 688	45.08	RTF	RTF	RTF	RTF
QSN14-G2	400 (P)	1 x 1.17	6/1	Integral fuel tank	38.6	51 (R)	8.87	1250 X 688	45.08	RTF	RTF	RTF	RTF
QSN14-G1	365 (P)	1 x 1.08	6/1	Integral fuel tank	38.6	51 (R)	8.87	1250 X 688	36.3	RTF	RTF	RTF	RTF
QSL9-G15	330 (S) / 300 (P)	1 x 0.92	6/1	Integral fuel tank	34	36.7 (R)	6.02	1084 X 633.2	40.56	RTF	RTF	RTF	RTF
QSL9-G16	275 (P)	1 x 0.84	6/1	Integral fuel tank	34	36.7 (R)	6.02	1084 X 633.2	36.8	RTF	RTF	RTF	RTF
QSL9-G16	250 (P)	1 x 0.82	6/1	Integral fuel tank	34	36.7 (R)	6.02	1084 X 633.2	36	RTF	RTF	RTF	RTF
QSB6.7-G13	225 (P)	1 x 0.61	6/1	Integral fuel tank	19.5	32.4 (R)	6.00	900 X 595.1	N/A	RTF	RTF	RTF	RTF
QSB6.7-G12	200 (P)	1 x 0. 58	5/1	Integral fuel tank	19.5	32.4 (R)	3.83	900 X 595.1	N/A	RTF	RTF	RTF	RTF
QSB6.7-G11	180 (P)	1 x 0.54	5/1	Integral fuel tank	19.5	32.4 (R)	3.83	900 X 595.1	N/A	RTF	RTF	RTF	RTF
QSB5.9-G2	160 (P)	1 x 0.47	4/1	Integral fuel tank	15.7	25.6 (R)	3.41	733 x 1000	N/A	RTF	RTF	RTF	RTF
QSB5.9-G1	140 (P)	1 x 0.43	4/1	Integral fuel tank	15.7	25.6 (R)	3.41	733 x 1000	N/A	RTF	RTF	RTF	RTF
6BTAA5.9-G13	125 (P)	1 x 0.40	4/1	Integral fuel tank	21.4	26 (R)	3.30	733 x 1000	N/A	RTF	RTF	RTF	RTF
6BTAA5.9-G13	100 (P)	1 x 0.40	4/1	Integral fuel tank	21.4	26 (R)	3.30	733 x 1000	N/A	RTF	RTF	RTF	RTF
4BTAA3.9-G4	82.5 (P)	1 x 0.28	3.5/1	Integral fuel tank	16	19 (R)	2.18	692x733.2	N/A	RTF	RTF	RTF	RTF
4BTAA3.9-G3	70 (P)	1 x 0.26	3.5/1	Integral fuel tank	16	19 (R)	2.18	692x733.2	N/A	RTF	RTF	RTF	RTF
4BTAA3.3-G11	62.5 (P)	1 x 0.08	3/1	Integral fuel tank	7.9	13 (R)	3.40	800 x 537.2	N/A	RTF	RTF	RTF	RTF
4BTAA3.3-G11	50 (P)	1 x 0.08	3/1	Integral fuel tank	7.9	13 (R)	3.40	800 x 537.2	N/A	RTF	RTF	RTF	RTF
X3.6TAA-G1	40 (P)	1 x 0.11	3/1	Integral fuel tank	7.5	13 (R)	1.39	450 x 544.3	N/A	RTF	RTF	RTF	RTF
X3.6TAA-G1	35 (P)	1 x 0.10	3/1	Integral fuel tank	7.5	13 (R)	1.39	450 x 544.3	N/A	RTF	RTF	RTF	RTF
X2.7TAA-G2	30 (P)	1 x 0.09	2.5/1	Integral fuel tank	8	11 (R)	0.88	485 x 488.2	N/A	RTF	RTF	RTF	RTF
X2.7TAA-G2	25 (P)	1 x 0.083	2.5/1	Integral fuel tank	8	11 (R)	0.88	485 x 488.2	N/A	RTF	RTF	RTF	RTF
X2.7T-G1	20 (P)	1 x 0.672	2.5/1	Integral fuel tank	8	11 (R)	0.88	485 x 488.2	N/A	RTF	RTF	RTF	RTF
X1.3TAA-G1	15 (P)	1 x 0.064	2/1	Integral fuel tank	4.5	5.5 (R)	0.41	440 x 388	N/A	RTF	RTF	RTF	RTF
X1.3TAA-G1	10 (P)	1 x 0.046	1.5/1	Integral fuel tank	4.5	5.5 (R)	0.38	440 x 388	N/A	RTF	RTF	RTF	RTF
X1.3TAA-G1	7.5 (P)	1 x 0.040	1.5/1	Integral fuel tank	4.5	5.5 (R)	0.38	440 x 388	N/A	RTF	RTF	RTF	RTF

TABLE 1 – 7.5 kVA to 900 kVA

TABLE 2

MAXIMUM CURRENT AT VARIOUS POWER FACTORS FOR 415V ALTERNATOR (3 PHASE)

kVA	Phase	Duty	KW	Current @ 0.8 PF		Current @ 0.85 PF		Current @ 0.9 PF		Current @ 0.95 PF		Current @ 1.0 PF	
				100% Load	80% Load	100% Load	80% Load	100% Load	80% Load	100% Load	80% Load	100% Load	80% Load
7.5	3	Prime	6	10	8	10	8	9	7	9	7	8	7
7.5	1	Prime	6	33	26	31	25	29	23	27	22	26	21
10	3	Prime	8	14	11	13	10	12	10	12	9	11	9
10	1	Prime	8	43	35	41	33	39	31	37	29	35	28
15	3	Prime	12	21	17	20	16	19	15	18	14	17	13
15	1	Prime	12	65	52	61	49	58	46	55	44	52	42
20	3	Prime	16	28	22	26	21	25	20	23	19	22	18
20	1	Prime	16	87	70	82	65	77	62	73	59	70	56
25	3	Prime	20	35	28	33	26	31	25	29	23	28	22
25	1	Prime	20	109	87	102	82	97	77	92	73	87	70
30	3	Prime	24	42	33	39	31	37	30	35	28	33	27
30	1	Prime	24	130	104	123	98	116	93	110	88	104	83
35	3	Prime	28	49	39	46	37	43	35	41	33	39	31
35	1	Prime	28	152	122	143	115	135	108	128	103	122	97
40	3	Prime	32	56	45	52	42	49	40	47	37	45	36
40	1	Prime	32	174	139	164	131	155	124	146	117	139	111
50	3	Prime	40	70	56	65	52	62	49	59	47	56	45
50	1	Prime	40	217	174	205	164	193	155	183	146	174	139
62.5	3	Prime	50	87	70	82	65	77	62	73	59	70	56
62.5	1	Prime	50	272	217	256	205	242	193	229	183	217	174
70	3	Prime	56	97	78	92	73	87	69	82	66	78	62
82.5	3	Prime	66	115	92	108	86	102	82	97	77	92	73
100	3	Prime	80	139	111	131	105	124	99	117	94	111	89
125	3	Prime	100	174	139	164	131	155	124	146	117	139	111
140	3	Prime	112	195	156	183	147	173	139	164	131	156	125
160	3	Prime	128	223	178	209	168	198	158	187	150	178	142
180	3	Prime	144	250	200	236	189	223	178	211	169	200	160
200	3	Prime	160	278	223	262	209	247	198	234	187	223	178
225	3	Prime	180	313	250	295	236	278	223	264	211	250	200
250	3	Prime	200	348	278	327	262	309	247	293	234	278	223
275	3	Prime	220	383	306	360	288	340	272	322	258	306	245
300	3	Prime	240	417	334	393	314	371	297	351	281	334	267
320	3	Prime	256	445	356	419	335	396	317	375	300	356	285
330	3	Standby	264	459	367	432	346	408	326	387	309	367	294
365	3	Prime	292	508	406	478	382	451	361	428	342	406	325
380	3	Prime	304	529	423	498	398	470	376	445	356	423	338
400	3	Prime	320	556	445	524	419	495	396	469	375	445	356
440	3	Standby	352	612	490	576	461	544	435	515	412	490	392
500	3	Prime	400	696	556	655	524	618	495	586	469	556	445
520	3	Standby	416	723	579	681	545	643	514	609	487	579	463
600	3	Prime	480	835	668	786	628	742	594	703	562	668	534
625	3	Prime	500	870	696	818	655	773	618	732	586	696	556
650	3	Prime	520	904	723	851	681	804	643	762	609	723	579
660	3	Standby	528	918	735	864	691	816	653	773	619	735	588
640	3	Prime	512	890	712	838	670	791	633	750	600	712	570
700	3	Standby	560	974	779	917	733	866	693	820	656	779	623
750	3	Prime	600	1043	835	982	786	927	742	879	703	835	668
830	3	Standby	664	1155	924	1087	869	1026	821	972	778	924	739
810	3	Prime	648	1127	902	1061	848	1002	801	949	759	902	721
900	3	Standby	720	1252	1002	1178	943	1113	890	1054	844	1002	801
1010	3	Prime	808	1405	1124	1323	1058	1249	999	1183	947	1124	899
1250	3	Prime	1000	1739	1391	1637	1309	1546	1237	1464	1172	1391	1113
1400	3	Standby	1120	1948	1558	1833	1467	1731	1385	1640	1312	1558	1247
1500	3	Prime	1200	2087	1669	1964	1571	1855	1484	1757	1406	1669	1336
1750	3	Prime	1400	2435	1948	2291	1833	2164	1731	2050	1640	1948	1558
1900	3	Standby	1520	2643	2115	2488	1990	2350	1880	2226	1781	2115	1692
1800	3	Prime	1440	2504	2003	2357	1886	2226	1781	2109	1687	2003	1603
1975	3	Standby	1580	2748	2198	2586	2069	2442	1954	2314	1851	2198	1759
1875	3	Prime	1500	2609	2087	2455	1964	2319	1855	2197	1757	2087	1669
2063	3	Standby	1650.4	2870	2296	2701	2161	2551	2041	2417	1934	2296	1837
2000	3	Prime	1600	2782	2226	2619	2095	2473	1979	2343	1875	2226	1781
2250	3	Standby	1800	3130	2504	2946	2357	2782	2226	2636	2109	2504	2003
2250	3	Prime	1800	3130	2504	2946	2357	2782	2226	2636	2109	2504	2003
2500	3	Standby	2000	3478	2782	3274	2619	3092	2473	2929	2343	2782	2226
2750	3	Prime	2200	3826	3061	3601	2881	3401	2721	3222	2577	3061	2449
3000	3	Standby	2400	4174	3339	3928	3143	3710	2968	3515	2812	3339	2671
3350	3	Prime	2680	4661	3729	4387	3509	4143	3314	3925	3140	3729	2983
3750	3	Standby	3000	5217	4174	4910	3928	4637	3710	4393	3515	4174	3339

Note:

1. For H.T. alternators, please refer manufactures specifications.
2. Resistive and water loads have unity power factor.

TABLE 3

TYPICAL MATERIAL SPECIFICATIONS FOR DG INSTALLATION

SR NO.	DESCRIPTION	Specification
Common		
1)	**Structural material**	
i)	MS PLATE	IS 2062 GRADE A
ii)	ISMC 100,	IS 808- 1964
iii)	ISMC 150,	IS 808- 1964
iv)	EQUAL ANGLE ISA 50 X 50, 5 MM THK,	IS 808- 1964
2)	**Valves**	
i)	Ball Valve,	Finish bore SS 316 ball, (WCB), 3 Piece Design, ASA 150, PTFE Seat Flanged End.
ii)	Needle valve	1/2" BSP, SS 304, with one side male and one side female connection provision
iii)	Butterfly Valve	Wafer type, Class #150 / PN 10, NBR seat
iv)	Globe Valve	Flanged, ASA 150, WCB Body, SS Internals
v)	Non return Valve	Flap Type,MS Body, ASA 150 #
Exhaust		
a)	**Piping**	
a1	Exhaust Piping Upto 150 NB Size - ERW Pipe,	IS 1239, Class B
a2	Exhaust Piping above 150 NB size-ERW Pipe,	IS 3589,5MM THK
b)	Exhaust Flanges - MS Flanges	ASA150#, SOFF, 20 MM THICK
c)	Exhaust System Gaskets	CHAMPION STYLE 54, SUPERMETALLIC Full face
d)	MS ERW Fittings	M.S. ERW 5 mm Thk
e)	Thermal insulation	Thermal insulation, 50 mm thick, 100kg/m3 density, 24 SWG Al cladding
Cooling		
i)	Cooling Water Piping upto 150 NB size-ERW	IS 1239, Class B
ii)	Cooling Water Piping above 150 NB upto 250 NB size-	IS 3589,6.355MM THK
iii	MS FLANGE	ANSI B 16.5 Class 150# SORF.
iv)	Cooling System Gaskets	CHAMPION STYLE AF120, COMPRESSED NON ASBESTOS, RING TYPE, 2mm Thk
v)	MS Fittings Upto 150 NB	MS Seamless Sch 40,
vi)	MS Fittings Above 150 NB Upto 250 NB- MS	M.S. ERW 6.3 mm Thk
Fuel		
	Fuel Piping	
i)	MS Seamless pipe	Schedule 40, A 106
ii)	MS FLANGE,	ANSI B 16.5 Class 150# SORF.
iii)	Fuel System Gaskets	CHAMPION STYLE 59 OIL, RING TYPE
v)	MS Fittings	MS Seamless Sch 40,

P Check form

Sales and Service India

PRE-INSTALLATION CHECK LIST (P Check form)

DG sets of rating 500 to 700 kva

Important note: New P check format to be filled in triplicate. (1.Customer 2. DBU 3.GOEM).
(Left column -for P check - Right Column during A check. Note: Customer/DBU/GOEM all to sign during P

Adherence to Installation and Commissioning guidelines helps in getting the desired optimum performance, reliability, ensuring proper space for serviceability, proper space utilization, once DG set is installed.

Please co-operate by ensuring proper location, proper/adequate earthing, adequate power cable size, breather hose/hoses pipe to be extended out of acoustic/DG set room, safe location (don't locate where use of ladders may be essential to attend/service them), enough air ventilation is available, so as to avoid

Customer Name & Address			
Date of Genset Order (DD/MM/YY)	__/__/__		
DG sets Model/Rating in kVA		___	
Number of DG sets			
Date of P Check (DD/MM/YY)	__/__/__		
Scope of Order:			
Supply of DG set			
DG set erection at site (GOEM or Customer)			
Site Ambient details-			
Altitude in meters above MSL.			
Maximum Ambient Temp @ site.			
Relative Humidity - % (max)			

SN	Item	Ref	Site Compliance. (Please write - Understood &	Remark
1	DG Location & Foundation			
a	Handing over of DG set GA drawing with all foundation, installation, space requirement details.	GOEM GA Drawing of DG set.		
b	Handing over of DG Installation recommendation bulletin to customer.	Gensets Installation recommendation Bulletin no.		
c.	Is the Site selection done wich is away from Dust/Acid fumes/Fibers/Chemicals/Coal/Boilers.	_		
d.	Foundation Size- Recommended 150 mm more than Acoustic outer surface.	As per GA drawing given.		
	Overall Foundation level required within +/- 2.5mm for< 750 kVA & +/- 5 mm for > 750 kVA.			
e.	Free space around DG set.	GOEM GA Drawing of DG set.		
f.	DG installation location -open area or covered in shed.			
g	If the DG sets is located in cover area - Please provide sufficient area between the air duct out and the shed to facilitate air venting.			
h.	Wind Direction in line with Acou. Enclosure air flow. Wind Barrier if reqd.			

2	**Exhaust Piping**			
a	Exhaust pipe termination as per CPCB guidelines.	h+0.2 X Sq root of kVA.		
b	Exhaust ducting termination should have rain water entry protection.	–		
c	Thermal insulation of the exhaust ducting - 50 mm thick mineral wool, 64kg/m3 density, 24 SWG aluminium cladding.			
d	Condensate drain valve to be provided in exhaust ducting after silencer area (1/2" dia)			
3	**Electrical Control Panel and Cable Size and connection.**			
a	Required cable sizes for power cable with suitable glands.	As per Gensets Installation recommendation		
b	Check for requirement of local Isolator Panel at Alternator end as per CEIG requirement to suit site installation			
c	Auxiliary power supply for illumination in enclosure.			
d	Auxiliary power supply for battery charger.			
e.	Auxiliary power supply for space heater.			
4	**Fuel System**			
a	Diesel engine-driven generator sets are generally designed to operate on ASTM D975 number 2 diesel and shall meet the requirements of HIGH Speed diesel as per IS 1460:2005.	Gensets Installation recommendation Bulletin.		
5	**Earthing**			
a	Earthing - It should provided as per the electricity Rules and guidelines.	4 Pits -2 For Genset and 2 for Neural		
6	**Breather Pipe**			
a	Breather hose should be extended out of the acoustic so that they oil from fumes don't get deposited on Radiator/Engine skin.	Part of Genset scope by GOEM.		
	Name , Signature & Designation OEM Engineer	Name Sign & Design- Dealer Engr Engr ID No.		Name Sign & Design- Customer

Sales and Service India

PRE-INSTALLATION CHECK LIST (P Check form)

DG sets 750 kVA to2500 kVA in ACOUSTIC enclosure.

Important note: New P check format to be filled in triplicate. (1.Customer 2. DBU 3.GOEM).

Adherence to Installation and Commissioning guidelines helps in getting the desired optimum performance,

Please co-operate by ensuring proper location, proper/adequate earthing, adequate power cable size, breather hose/hoses pipe to be extended out of acoustic/DG set room, safe location (don't locate where use of ladders may be essential to attend/service them), enough air ventilation is available, so as to avoid commissioning delays.

Customer Name & Address		
Date of Genset Order (DD/MM/YY)	__/__/__	
DG sets Model/Rating in kVA		___ NumberX___ Kva
Number of DG sets		
Date of P Check (DD/MM/YY)	__/__/__	
Scope of Order:		
Supply of DG set		
DG set erection at site (GOEM or Customer)		

SN	Item	Ref	Site Compliance. (Please write - Understood & Noted)	Remark
1	DG Location & Foundation			
a	Handing over of DG set GA drawing with all foundation, installation, space requirement details.	GOEM GA Drawing of DG set.		
b	Handing over of DG Installation recommendation bulletin to customer.	Gensets Installation recommendation Bulletin.		
c.	Is the site selection done which is away from Dust/Acid fumes/Fibers/Chemicals/Coal/Boilers.	_		
d.	Foundation Size- Recommended 150 mm more than Acoustic outer surface.	As per GA drawing given.		
	Overall Foundation level required within +/- 5 mm. (use water level tube)			
e.	Free space around DG set.	GOEM GA Drawing of DG set.		
f.	DG installation location -open area or covered in shed.			
g	If the DG sets is located in cover area - Please provide sufficient area between the air duct out and the shed to facilitate air venting.	GOEM to guide on height requirement etc.		
h.	Wind Direction in line with Acoustic Enclosure air flow. Wind Barrier if reqd.			

2	**Exhaust Piping**			
a	Exhaust pipe termination as per CPCB guidelines.	h+0.2 X Sq root of kVA.		
b	Exhaust ducting termination should have rain water entry protection.	–		
c	The sealing of the exhaust piping pipe must be properly sealed so that no rain water entry takes place as typicallly the acoustic enclosure would be assembled at site by GOEM.			
d	Thermal insulation of the exhaust ducting - 50 mm thick mineral wool, 64kg/m3 density, 24 SWG aluminium cladding.			
e.	Condensate drain valve to be provided in exhaust ducting after silencer area (1/2" dia)			
3	**Cooling System**			
	a) Remote Radiator in Primary circuit.			
a	Remote Radiator Model supplied by GOEM.	Gensets Installation recommendation Bulletin.		
b	Free space around the Remote Radiator and platform required for mounting. GA Drawing to be submited by GOEM	Gensets Installation recommendation Bulletin.		
c	Coolant specifications	Gensets Installation recommendation Bulletin.		
d	Raw water Plumbing/ Piping, Valves, NRV, Strainer, H/E - Temp & Pressure Gauges etc. etc -Refer P& I diagram	Gensets Installation recommendation Bulletin.		
e.	Structure/location for Expansion tank near the Genset.	GOEM to provide data.		
f.	Interlocking the Remote cooler with DG shutdown	GOEM to help on scheme.		
g	MCC Panel required for DG auxillaries like circulation pump, Remote Radiator/cooling tower, battery charges,	GOEM to provide data.		
f.	Flexible bellow/joint required to connect raw water lines at HE end.	GOEM to help requirement/supply,		
	b) HE Cooled with Remote Radiator in secondary circuit.			
a	Remote Radiator Model supplied by GOEM.	Gensets Installation recommendation Bulletin.		
b	Free space around the Remote Radiator and platform required for mounting. GA Drawing to be submited by GOEM	Gensets Installation recommendation Bulletin.		
c	Coolant specifications	Gensets Installation recommendation Bulletin.		
d	Raw water Plumbing/ Piping, Valves, NRV, Strainer, H/E - Temp & Pressure Gauges etc. etc -Refer P& I diagram	Gensets Installation recommendation Bulletin.		

	b) HE Cooled with Remote Radiator in secondary circuit. (Cont'd)			
e.	Structure/location for Expansion tank near the Genset.	GOEM to provide data.		
f.	Interlocking the Remote cooler with DG shutdown	GOEM to help on scheme.		
g	MCC Panel required for DG auxillaries like circulation pump, Remote Radiator/cooling tower, battery charges,	GOEM to provide data.		
h.	Water circulation pump selection	Gensets Installation recommendation Bulletin.		
	c) HE Cooled with Cooling tower in secondary circuit.			
a	Cooling Tower Model supplied by GOEM.	Gensets Installation recommendation Bulletin.		
b	Free space around the Cooling Tower and platform required for mounting. GA Drawing to be submited by GOEM	Gensets Installation recommendation Bulletin.		
c	Cooling water specifications	Gensets Installation recommendation Bulletin.		
d	Raw water Plumbing/ Piping, Valves, NRV, Strainer, H/E - Temp & Pressure Gauges etc. etc -Refer P& I diagram	Gensets Installation recommendation Bulletin.		
e.	Structure/location for Expansion tank near the Genset.	GOEM to provide data.		
f.	Interlocking the Cooling tower with DG shutdown	GOEM to help on scheme.		
g	MCC Panel required for DG auxillaries like circulation pump, Remote Radiator/cooling tower, battery charges,	GOEM to provide data.		
h.	Water circulation pump selection	Gensets Installation recommendation Bulletin.		
i.	Provision of Fuel cooler, model details to be shared by GOEM (applicable for QSK50/60)	GOEM to provide data.		
4	**Fuel System**			
a	Diesel engine-driven generator sets are generally designed to operate on ASTM D975 number 2 diesel and shall meet the requirements of HIGH Speed diesel as per IS 1460:2005.	Gensets Installation recommendation Bulletin.		
b	Installation of Day tank of 990 lits.	Gensets Installation recommendation Bulletin.		
b	Fuel supply and return piping from day tank to engine with valves and flexible, pipe diameter is given in DG Installation guideline book.	Gensets Installation recommendation Bulletin.		

5	Electrical Control Panel and Cable Size			
a	Required cable sizes for power cable with suitable glands.	As per Gensets Installation recommendation		
b	Check for requirement of local Isolator Panel at Alternator end as per CEIG requirement to suit site installation			
c	Auxillary power supply for illumination in enclosure.			
d	Auxillary power supply for battery charger.			
e.	Auxillary power supply for space heater.			
6	Earthing			
a	Earthing - It should provided as per the electricity Rules and guidelines.	4 Pits -2 For Genset and 2 for Neural		
7	Breather Pipe			
a	Breather hose should be extended out of the acoustic so that they oil from fumes don't get deposited on Radiator/Engine skin.	Part of Genset scope by GOEM.		
Name , Signature & Designation OEM Engineer		Name , Signature & Designation Dealer Engineer		Name , Signature & Designation of Customer

Sales and Service India

PRE-INSTALLATION CHECK LIST (P Check form)

OPEN DG sets 1010 kVA to 2500 kVA in Room area.

Important note: New P check format to be filled in triplicate. (1.Customer 2. DBU 3.GOEM).

Adherence to Installation and Commissioning guidelines helps in getting the desired optimum performance,

Please co-operate by ensuring proper location, proper/adequate earthing, adequate power cable size, breather hose/hoses pipe to be extended out of acoustic/DG set room, safe location (don't locate where use of ladders may be essential to attend/service them), enough air ventilation is available, so as to avoid commissioning delays.

Customer Name & Address		
Date of Genset Order (DD/MM/YY)	__/__/__	
DG sets Model/Rating in kVA		___ NumberX___ Kva
Number of DG sets		
Date of P Check (DD/MM/YY)	__/__/__	
Scope of Order:		
Supply of DG set		
DG set erection at site (GOEM or Customer)		

SN	Item	Ref	Site Compliance. (Please write -Understood & Noted)	Remark
1	DG Location & Foundation			
a	Handing over of DG set GA drawing with all foundation, installation, space requirement details.	GOEM GA Drawing of DG set.		
b	Handing over of DG Installation recommendation bulletin to customer.	Gensets Installation recommendation Bulletin.		
c	Genset Room Layout drawing preparation with DG foundation, Fresh air inlet opeaning, Hot air outlet opening, cooling system, Exhaust ducting, electrical panels,fuel day tank, exhaust fan, etc.	Genset Room layout drawing to be finalised by GOEM/Customer as per contract scope.		
d	Is the site selection done which is away from Dust/Acid fumes/Fibers/Chemicals/Coal/Boilers.	_		
e.	Foundation Size- Recommended 150 mm more than Acoustic outer surface.	As per GA drawing given.		
	Overall Foundation level required within +/- 5 mm. (use water level tube)			
f.	Free space around DG set.	Gensets Installation recommendation Bulletin.		
2	**Exhaust Piping**			
a	Exhaust pipe termination as per CPCB guidelines.	h+0.2 X Sq root of kVA.		
b	Exhaust piping scheme and diameter selection.	Gensets Installation recommendation Bulletin.		
c	Exhaust ducting termination should have rain water entry protection.	Gensets Installation recommendation Bulletin.		
d	Condensate drain valve to be provided in exhaust ducting after silencer area (1/2" dia)	Gensets Installation recommendation Bulletin.		
e	Thermal insulation of the exhaust ducting - 50 mm thick mineral wool, 64kg/m3 density, 24 SWG aluminium cladding	Gensets Installation recommendation Bulletin.		
f	Provide suitable thimble in wall area at Exhaut piping route.	Gensets Installation recommendation Bulletin.		

3	**Cooling System and Ventillation.**			
3 A-1	**Remote Radiator in Primary circuit.**			
a	Remote Radiator Model supplied by GOEM.	Gensets Installation recommendation Bulletin.		
b	Free space around the Remote Radiator and platform required for mounting. GA Drawing to be submited by GOEM	Gensets Installation recommendation Bulletin.		
c	Coolant specifications	Gensets Installation recommendation Bulletin.		
d	Raw water Plumbing/ Piping, Valves, NRV, Strainer, H/E - Temp & Pressure Gauges etc. etc -Refer P& I diagram	Gensets Installation recommendation Bulletin.		
e.	Structure/location for Expansion tank near the Genset.	GOEM to provide data.		
f.	Interlocking the Remote cooler with DG shutdown	GOEM to help on scheme.		
g	MCC Panel required for DG auxillaries like circulation pump, Remote Radiator/cooling tower, battery charges,	GOEM to provide data.		
h.	Flexible bellow/joint required to connect raw water lines at HE end.	GOEM to help requirement/supply,		
i.	Provision of Fuel cooler, model details to be shared by GOEM (applicable for QSK50/60)	GOEM to provide data.		
3B-1	**Ventilation system**			
a	Fresh air intake opening are should be about 2.25 times of Radiator area.	Gensets Installation recommendation Bulletin.		
b	Hot air outlet opening are should be about 1.5 times of the Radiator area.			
c	Ensure that no hot air recirculation takes place in room.			
d	Acoutic louvers at air intake and hot air outlet needs to be designed considering total pressure drop of 0.5" water column max. considering the Radiator Fan flow restriction limits.			
3 A-2	**HE Cooled with Remote Radiator in secondary circuit.**			
a	Remote Radiator Model supplied by GOEM.	Gensets Installation recommendation Bulletin.		
b	Free space around the Remote Radiator and platform required for mounting. GA Drawing to be submited by GOEM	Gensets Installation recommendation Bulletin.		
c	Cooling water specifications	Gensets Installation recommendation Bulletin.		
d	Cooling water Plumbing/ Piping, Valves, NRV, Strainer, H/E - Temp & Pressure Gauges etc. etc -Refer P& I diagram	Gensets Installation recommendation Bulletin.		
e.	Structure/location for Expansion tank near the Genset.	GOEM to provide data.		
f.	Interlocking the Remote cooler with DG shutdown	GOEM to help on scheme.		
g	MCC Panel required for DG auxillaries like circulation pump, Remote Radiator/cooling tower, battery charges,	GOEM to provide data.		
h.	Water circulation pump selection	Gensets Installation recommendation Bulletin.		

3B 2	**Ventilation system**			
a	Ventillation fans to be provided in room area as per flow requirement.	Gensets Installation recommendation Bulletin.		
b	Ensure that no hot air recirculation takes place in room.			
d	Acoutic louvers at air intake and hot air outlet needs to be designed considering total pressure drop of 0.5" water column max.			
3C 1	**HE Cooled with Cooling tower in secondary circuit.**			
a	Cooling Tower Model supplied by GOEM.	Gensets Installation recommendation Bulletin.		
b	Free space around the Cooling Tower and platform required for mounting. GA Drawing to be submited by GOEM	Gensets Installation recommendation Bulletin.		
c	Cooling water specifications	Gensets Installation recommendation Bulletin.		
d	Cooling water Plumbing/ Piping, Valves, NRV, Strainer, H/E - Temp & Pressure Gauges etc. etc -Refer P& I diagram	Gensets Installation recommendation Bulletin.		
e.	Structure/location for Expansion tank near the Genset.	GOEM to provide data.		
f.	Interlocking the Cooling tower with DG shutdown	GOEM to help on scheme.		
g	MCC Panel required for DG auxillaries like circulation pump, Remote Radiator/cooling tower, battery charges, Illunination, ventillation exhaut fans.	GOEM to provide data.		
h.	Water circulation pump selection	Gensets Installation recommendation Bulletin.		
3C 2	**Ventilation system**			
a	Ventillation fans to be provided in room area as per flow requirement.	Gensets Installation recommendation Bulletin.		
b	Ensure that no hot air recirculation takes place in room.			
d	Acoutic louvers at air intake and hot air outlet needs to be designed considering total pressure drop of 0.5" water column max.			
4	**Fuel System**			
a	Diesel engine-driven generator sets are generally designed to operate on ASTM D975 number 2 diesel and shall meet the requirements of HIGH Speed diesel as per IS 1460:2005.	Gensets Installation recommendation Bulletin.		
b	Installation of Day tank of 990 lits.	Gensets Installation recommendation Bulletin.		
c	Fuel supply and return piping from day tank to engine with valves and flexible, pipe diameter is given in DG Installation guideline book.	Gensets Installation recommendation Bulletin.		

3	**Electrical Control Panel and Cable Size**			
a	Required cable sizes for power cable with suitable glands.	As per Gensets Installation recommendation		
b	Check for requirement of local Isolator Panel at Alternator end as per CEIG requirement to suit site installation setup.			
c	Auxillary power supply for illumination			
d	Auxillary power supply for battery charger.			
e.	Auxillary power supply for space heater.			
4	**Earthing**			
a	Earthing - It should provided as per the electricity Rules and guidelines.	4 Pits -2 For Genset and 2 for Neural		
5	**Breather Pipe**			
a	Breather hose should be extended out of the room so that they oil from fumes don't get deposited on Radiator/Engine skin.	Part of Genset scope by GOEM.		
	Name , Signature & Designation OEM Engineer	Name , Signature & Designation Dealer Engineer		Name , Signature & Designation of Customer

Sales and Service India

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Bulletin No. 3243795 – ***Rev-06 dated 31-03-2016***