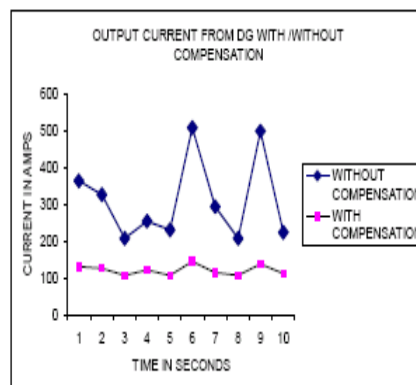
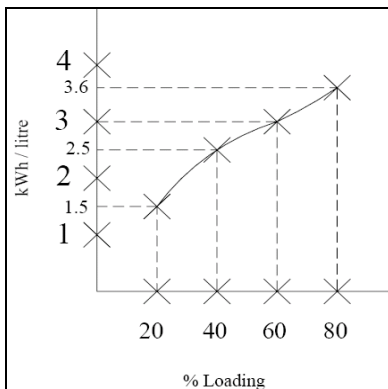


# REDUCE THE DIESEL CONSUMPTION TODAY IN YOUR DG SET

- In our DG set, only one third of the Diesel input as fuel in KCAL to the DG set is converted to Electrical output as KWH and so the efficiency of generation of DG set is around 35 % only. But it is very user friendly and instantly performs.
- That's why we pay Rs.5 to EB per unit where as cost of 1 KWH unit thro our DG set works out to Rs.15 to Rs.20/- now.
- We are now understanding the prevailing national & regional power position and are facing the stark reality of the necessary costly usage of our own DG set with no other alternatives in hand. Long back, we have used our DG set sparingly few hours in a week in the industry but now we are forced to use our old & aged (due to neglected maintenance) DG set. So giving the priority to the ageing condition, we can comfort our DG set to get more Units per Liter from the set.
- Whatever steps we take to increase the power output and decrease the waste outputs like damage control exercise and this will definitely improve the sustained UPL say up to 10 - 20 % to rated output of the given size & condition by the above.
- We have to look in to the five systems in the dg set. The four inputs to function at their maximum efficiency are the air intake & ventilation, diesel, cooling circuit & lubrication function to get sustained & maximum units per liter over the years and the last but not the least is the nature of load & loading of the dg set.
- Now in any industry we see the trend, first they put the Ridge type for full length of shed / Power-less roof ventilators on their DG & Compressor house only. The roof vents do an excellent work to remove hot radiating air from DGskid area.
- DG Set building should be Positive cross ventilated. Increase in air intake temperature from 25°C to 40°C, the air fuel ratio decreases by about 5%; that is diesel losses happen by 1 % for every 4 °C rise above the outside ambient temperature.

## D.G.SET OPTIMUM LOADING in KVA & KW – UPL varies from “2.4 to 3.6” due to loading:

- Till date, many industries were talking about the ampere output drawn from the DG set as the basic criteria to load the same and are loading up to 60 % only even in the new DG set due to lower PF and religiously following the safest loading as per the guidelines of their DG OEM. Optimum loading around 75 % depending on the load, will give 10 % more units per liter.
- Running at the optimum Rated KVA Loading is the priority to get the better UPL, when other parameters of DG set are healthy. Care is taken not to exceed 0.8 to 0.9 PF as the PF of the running loads measured at the DG set.
- The average loading of motors in the industry indicates around 60 to 70 % it is wise to operate the DG set so as to get at 400 – 405 volts instead of 420-430 volts at heavy load end motor terminals at the plant. This gives instant savings in Diesel and the motor output does not reduce at its shaft.
- The average EB frequency is at 49.5 Hz only now. Here it is wise to reduce the DG set (with electronic governor), frequency from 50 + Hz to 49 + Hz after studying the loading of all the loads and this gives instant savings.
- Add power factor correction capacitors to all motors above 5 HP so as to give an average Power factor of 0.8 to 0.9 max at the load end, then we can try to load from 60 to 80 % load & more, the DG set to its optimum rated capacity and efficiency.



THE TABLE BELOW COMPARES THE BEHAVIOUR OF 5 HP MOTOR AT HIGHER THAN 400 VOLTS  
Study taken by Reputed Servo stabilizer Manufacturer

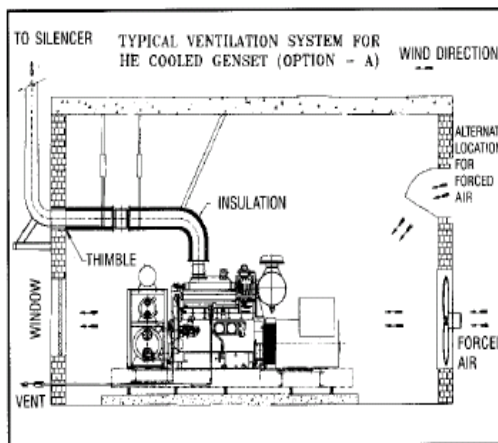
The savings are more visible in lower HP motors than the higher HP motors in the industry.

Input Voltage	Current	KVA	PF
400	7.5 Amps	5.2 Kva	0.8
425	8.3 Amps 11% More	6.2 Kva 18% More	0.7

- I image shows when the engine is loaded around 70 % the UPL is 3.5 and when loaded at 40 % the UPL is 2.5 only.
- II image shows when the capacitor compensation is done at load end; DG current output is smoothed & steady now.
- III image shows 5 HP motor demands more KVA at 425 volts than at 400 volts. For slight lag 1 KVAR cap is required.

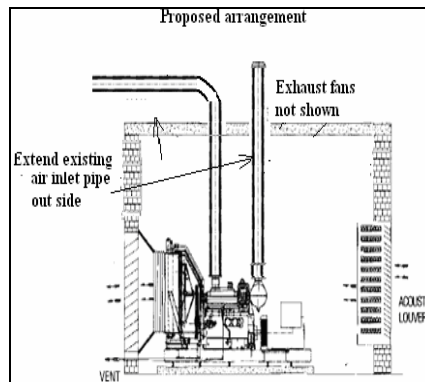
- The DG set is rated by KVA only and hence how much KVA we can take from the DG set is the focus point now. The power factor improvement capacitors on linear loads only not at the incoming of VFD loads etc. The symptom of a good VFD along with line reactor choke is that the VFD maintains PF 0.95 + at the input at the minimum & maximum level of motor loading.
- To discuss with the DG vendor about the nature of load if non linear load like UPS, VFD etc, the % of non linear loads and its impact on incoming power quality from the DG to the load, the precautions to oversize the alternator etc. alternatives.
- Hence to have control over the DG output in terms of KVA, KW, and the PF, automation of DG set energy parameters is one of the ways to take the best out of the DG set. So the Maximum Demand Controller MDC & APFC operating at PF 0.9 instead of 0.7 now. These are retrofitted to the existing DG set then, it will cap the max demand from the load to the DG set as well DG set is put to max optimum rating. Its audio visual alarm & trip function to the operator is useful.
- The user can think of replacing ordinary KWH meter in his DG set with this MDC which gives per phase KVAH, KWH, and average PF and he THD in % and this not only acts to monitor but also control max KVA demanded by the load automatically.
- It should be ensured the single phase loads are distributed evenly across the three phases so that the unbalance between 3 phases is not more than 10 % of the total DG set capacity. More the unbalance, this will lead to less UPL.

## DG SET AIR INTAKE & HOUSE VENTILATION > 33 % STACK & 4 % RADIATION -LOSSES:



- **Kind Courtesy:** - II image Cummins DG set Installation Instruction Manual
- **I image** - The expanded duct to be 50 % more area referring to the radiator area and air inlet at lower elevation.
- **II image** - the forced draft fan to keep fresh & cool positive cross air movement from alternator to radiator side.
- **III image**- the air intake filter Delta P indicator with remote alarm instead of ordinary vacuum red / green band indicator
- In the DG set the Higher back pressure at exhaust leads to Lower fuel economy, and so to keep the exhaust piping to be minimum and take short cut with minimum Long bends / no bends to out of the DG area in premises. Care is taken not to short circuit the exhaust gas back to the DG house to DG air intake.
- The engine's radiator fan is of the pusher type to propel the air from the room. The opening in the wall and the expander duct in front of the radiator is 1.5 times the area of the radiator. The natural inlet opening on the wall in front of alternator to be 2.25 to 3 times the size of radiator core. This is for natural aspiration. And the DG shed is ventilated length wise & both sides.
- In case, the opening is not straight or not having the required area, to plan for a vane axial blower fan in front of alternator elevation and give positive push of air from fan thro alternator to the radiator via its fan and exhaust heat fully out.
- Here, hot air discharged from alternator both sides can be contour ducted to above the lintel level. This is done so that the hot air from alternator is not short circuited to the air intake and the hot air will not reduce the heat transfer efficiency of radiator.
- The engine room temp must be near to ambient & not rise more than 5°C above ambient temperature. Keep a temperature sensor (with the visual indicator + remote alarm) near air intake area of DG set. This is easy symptom of DG running health.
- Exhaust temperature limits the loading and KVA on DG Set. So monitoring exhaust temp is important to know about the possible running rating of engine & optimum loading. Over years we must know how much de-rating in KVA has happened? We understand now why the DG OEM don't allow the consumer to ramp up to 100 % loading and limit to suit to above?
- The exhaust piping and the silencers shall be insulated using 50mm thick mineral wool inside the container & up to the exhaust stack. The insulation shall be clad with 24G aluminium sheet. Exhaust pipe must not radiate to the skid area.

- All over, we find the DG set running with opened acoustic doors as the localized heating inside increases with closed doors. To provide louver type doors / doors with bottom air filters to meet the noise safety levels without starving the engine.
- But as a user we should give umbrella type sun shade protection with sufficient head room and all sides open area. This is followed by the Telecoms buildings in the open terrace machines, for all their HVAC condensers and other equipments.
- Some users are providing duct into air intake and duct out the heat exchanger exhaust to restore ambience in the room. That is they keep the air intake along with pre filter away from the skid and bring in only the duct to the DG set.
- Here the user monitors the Delta P across the air intake filter and never allows the pressure drop to happen across the filter. **DP indicator is a must to be viewed regularly for choke in air intake which may lead to higher diesel consumption.**
- Few users are relocating the heat exchanger from the DG skid to out of the house and put the HX in the open area like that of a typical coil cooler all side open with sun shade protection adjacent to the building.
- Ultimately it is in the hands of the user to comfort the DG set (or the compressor) by ambient cooling and take the best output from the same efficiently and effortlessly by going from air cooled radiator type to water cooled coil cooler type exchanger.



- I image – the DG set kept well ventilated with daily cleanable swipe in – swipe out fine mesh pre filters in a industry
- II image – the air intake mouth extended to the top of hood and as well alternator side exhaust openings ducted to top
- III image – Micro vee type Pre-filter in place in other industry so as to avoid the open type choked air intake filter.
- Please consult with your OEM whether your DG set room size, air requirements are met with the existing arrangements. Why so much emphasis is given because, many industries are using DG set room as unofficial store room stacking hesitant-to-throw materials and hazardous wastes since the DG was used sparing before and now the condition is different !

- Blue colour of the DG set exhaust smoke shows excess lubricating oil or worn out piston scraper rings.
- Grey smoke is the result of dirty fuel injector or the engine overloaded. To clean fuel injector and maintain proper loading
- Black smoke is due to incomplete combustion of fuel which is due to choked air filter or improper compression. So to clean the air filters, replacing piston rings or eliminating valve leakages aforesaid problems can be solved in existing old DG sets.

### COOLING WATER CIRCUIT (24 % COOLANT LOSSES):-

- Big DG sets are designed to be water cooled and smaller sizes are coming as air cooled. The users who fall between big and small sizes of DG sets are now converting their air cooled HX to water cooled type so as to avoid engine overheat in summer months and to maximize the efficiency, reduce the cooling losses and improve the loading levels.
- Engine needs clean water. Never use hard water as it restricts the transfer of heat resulting in engine overhauling. For proper heat dissipation and to avoid rusting/scaling, mix radiator coolant to water. If possible DM water may be used and 20 % coolant to be used along with the radiator water. This will ensure at least 0.5 % saving of fuel in DG engine.
- The WATER TEMPERATURE will be 75°C to 93°C & the cooling system should be so designed that difference between inlet and outlet water temperature of the radiator to be 6 to 10°C. **Please measure with locally fixed temperature & pressure gauges.**

### LUBRICATION PROCEDURES;-

- LUBE OIL - USE OF THE WRONG GRADE OF OIL COULD LEAD TO Overheating of the engine, Sluggish performance, Excessive fuel consumption, Increased wear of bearings and other parts,
- The lube oil consumption should not exceed 1 % of the fuel consumption. Please check your lube log and the OEM reference and **higher the lube consumption is indicated by chimney smoke, poor maintenance and less UPL**
- Maintaining the condition of the lube oil of DG set will ensure increased efficiency of the engine and a saving minimum 0.5 % diesel consumption as compared to deteriorated lube oil. Use 15 W-40 lube oil after talking to OEM in place of SAE 30 as recommended by OEM.

- **Courtesy PCRA Booklet on DG set Energy Conservation Measures / [www.pcra.org](http://www.pcra.org).**

## **DIESEL & QUALITY:-**

- FOR IGNITION, DG SET REQUIRES THE FOLLOWING: Requisite amount of clean air and proper temperature, Supply of clean fuel at proper viscosity, Injection and atomization of the injected fuel, Adequate compression temperature to promote ignition and proper combustion of oil.
- **A poorly maintained fuel injection pump** increases fuel consumption by 4gm/kWh i.e. Correction gives 2 % savings. This is where the diesel is injected into the system and hence focus area is to condition monitor the fuel injection area, the pressures.
- **A faulty nozzle increases fuel consumption** by 2gm/kWh i.e. Correction gives 1 % savings Keep a spare nozzle and maintain the existing nozzle by regularly inspecting the same and cleaning based on condition monitoring
- **Blocked fuel filters increase fuel consumption** by 2gm/kWh i.e. Correction gives 1 % savings. The diesel has to reach the system clean and clear. Any partial blocks or pressure drops across the filter will increase the diesel consumption.
- Measure fuel consumption per KWH, KVAH of electricity generated regularly. Take corrective action in case this shows a rising trend during your day to day monitoring trend of the above
- Even the internal health of the DG electrical system is important. Because even one bad cell in a battery will overwork the alternator consuming more engines' power and fuel. **That is why some users prefer to keep the battery outside DG set hood so that the battery is cool, accessible to the user and they can condition monitor the same easily.**
- We have to avoid hot engine shut downs. Run at low idle for at least 3 minutes to reduce and stabilize internal engine temp. It will maximize the turbocharger shaft and bearing life.
- Operate the engine oil sub system with the thermostat all over the year. A cold engine consumes more fuel.
- Diesel Additives can be used to counter injector nozzle choking in diesel engines. The claims with regard to additives that can improve the energy efficiency in an engine should be weighed carefully & after trial runs only to decide on the same. **Recently the industry is using diesel additive and used and recommended by DG set OEM as well.**
- **Apart from Diesel savings around 3 to 6 %**, what is more important to the user is that the additive cleans injectors, improves injection pressure, improves lubricity to the pump, which helps in complete combustion of diesel and also cleans up the entire fuel system right from the diesel tank to the injectors.
- Magnetic resonator retrofitted outside to the fuel injection line surrounding the line size near the DG set skid is tried many industries has improved the DG set performance. Fuel injection is the focus area in the DG set to achieve regular diesel savings. **The calibration of fuel injection pump frequently done will show scope for diesel savings.**
- When some industry needs only for lighting as an emergency measure instead of running the main utility DG set, it is better to go in for very small DG set / UPS operating LED / high PF ( at 0.85) CFL etc for lighting back up in the nights.

## **ALWAYS PLAN AHEAD FOR YOUR DG SET SUSTAINED EFFICIENCY:-**

- **The low efficiency & the de-rating of the DG set is due to Ageing, Inadequate maintenance, inadequate operation practices, Low capacity utilization, fluctuating load and de-ration effect due to higher flue gas temp & excess back pressure in the exhaust piping.**
- **Every component in our running appliance has its wear & tear. The worn & torn parts if replaced in the right interval, gives sustained efficiency to the appliance. This is what the medical world is following now in replacement surgery!**
- **Here in our DG set, we had postponed the preventive maintenance due to few hour run time only per month. Now if we take up the condition based monitoring of the same by first comforting thro above steps, definitely will achieve Diesel Savings!**
- **Please understand your engine. Adequately comfort & Feed the cow now to milk sustained for years to come.**
- **Ashok.S / BEE certified Energy Auditor / Coimbatore / mail - [ashok@energymeasuretosave.com](mailto:ashok@energymeasuretosave.com)**
- **[www.energymeasuretosave.com](http://www.energymeasuretosave.com) / Objective: SHARING KNOWLEDGE TO SAVE OUR ENERGY.**