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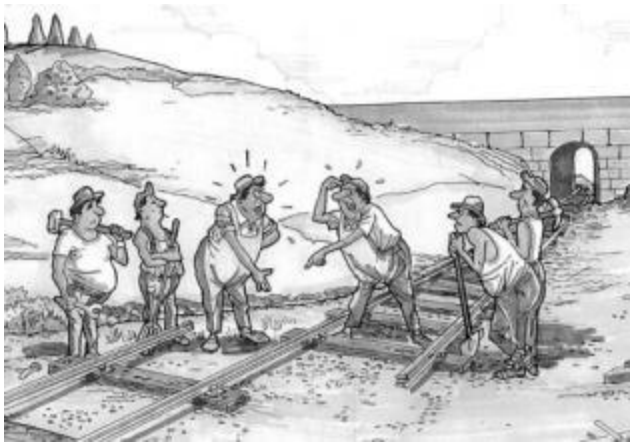
NEWSLETTER FOR MANUFACTURING COMMUNITY



From time immemorial, mankind has emphasized on importance of team work. Be it a routine domestic chore or pursuing large project, team work plays its role, evidently or otherwise. Failure of good team work is always evident in every task accomplished.

One of the best examples of such team work that exists outside human world is in "power generation circuit." Very imagination of how large power stations, thermal, nuclear, hydro or any type, are "sharing" electrical load to provide us almost uninterrupted power leaves us bewildered. We hardly feel breakdown or shutdown of one of these generating units.

Although this knowledge is complex to comprehend in few pages, similar "teamwork" can be seen in typical manufacturing having more than one Diesel Generating set along with utility power supply. The "art" – more than science – of "mixing" different power sources for load sharing is called PARALLEL OPERATION or SYNCHRONIZATION. It can be visualized similar to a large trailer having many wheels, sharing weight load equally. If one wheel suffers due to whatever reason, till it is rectified, other wheels bear additional burden.

Parallel Operation, also called SYNCHRONIZATION, shares "electrical" load and hence does necessarily consider Horsepower rating of Diesel Generating set. DG sets with dissimilar HP ratings can also be coupled, within acceptable limits.

So, let us synchronize our mind, body and soul this week to understand the very basics of PARALLEL OPERATION or SYNCHRONIZATION.

When does need for parallel operation arise?

1. The connected load is more the capacity of feeding DG set during running or starting – In this instance, two or more power sources are synchronized to withstand peak loads. Once the load is stabilized and reduced, supporting DG set can be switched off.

2. Load needs to be transferred from one DG to another without interruption – This condition can occur in installations that have to support critical applications like Hospitals, Continuous process industries, Airports, Communication equipments, Computer servers.

3. If future load is expected to be "twice" or more of present actual load, initial investment can be curbed by purchasing smaller capacity DG set now and synchronizing more later.

4. If day-load and night or weekend load can be almost shared – This type of analysis, especially in installation phase, will help in preventing "over sizing" DG sets just to cater peak loads. Instead, two or lesser capacity DG sets can be installed with synchronization option.

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Conditions to be satisfied before two or more DG sets can be synchronized

a. Voltage of the DG sets should be same. A dual voltmeter can display voltage of multiple DG sets – The synchronized DG sets should have Automatic Voltage Regulators (AVRs) installed on its alternator. This solid state device automatically controls output voltage. Basically, AVR control "excitation" voltage of "rotor" windings which, proportionately, varies output voltage from "rotor" windings. A set of six or more ROTATING DIODES are installed which help in providing DC voltage for rotor windings.
b. Frequency RPM – of both the sets should be same. Dual frequency meter can display multiple frequencies – The RPM of an engine on synchronized DG sets must be controlled by Electronic Governor system. An electronically controlled ACTUATOR controls fuel output to the injector system.

c. Phase angle o f voltage from the synchronized alternators must be same. Phase angle meter is one of the commonly used instruments for monitoring.

The above mentioned parameters can be monitored, controlled and modulated by three different methods:

i. Three lamp method for manual synchronization
ii. Check synchronization relay for manual synchronization
iii. Auto synchronization relay for automatic synchronization

Facilities required on engine to make it suitable for paralleling:-

1) It should be possible to change engine RPM by means of push buttons e.g. raise & lower. Alternator should be with electronic AVR with auxiliary input remote voltage change & capable of accepting 5A droop CT input. A droop CT senses voltage from one of the three phases (usually B phase) and outputs corresponding linear current output to the controller.

2) Motorized potentiometer for adjusting voltage. Voltage change is required to adjust voltage before synchronizing and for adjusting *KVAr* sharing after synchronizing.

3) All DG sets, that have to be synchronized, must have droop CTs installed on its alternator. Droop CT controls the reactive power sharing

Parallel Operation with the Mains Grid:

AC Generator ========== Synchronized ========= grid

Why?

- Supplement the power they receive from utility source
- To improve the load power factor of the distribution system.
- To utilize excess generating capacity by exporting it to the grid (example are Paper & Sugar mills, where the COGEN, Co-generation plants, producing power from turbines, can have excess capacity which gets "fed" to utility power grids.

Note - While synchronizing with the grid an Import – Export meter may be installed
For DG set protection (df/dt) and reverse power relay are compulsorily fitted.

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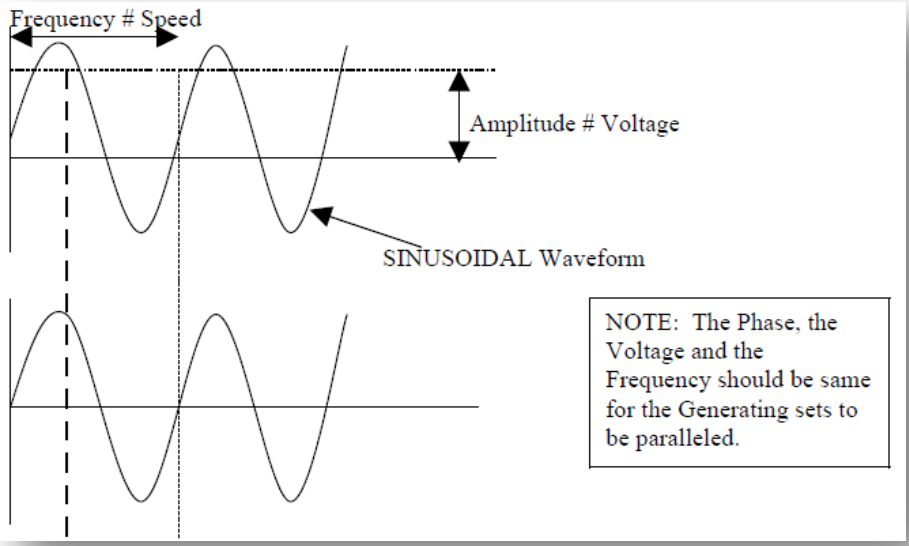
Synchronization of DG sets: (Electrical Explanation)



Some areas where synchronization is not recommended or may not work:

- For critical loads like computers and communication equipment 'ON LINE' UPS is perfect solution as this does not interrupt supply even for a microsecond and gives total solution against high voltages and surges
- Continuous loads which run on than single DG set needs Auto Load-sharing unit to ensure proper load sharing against thermal drift which is inherent in DG sets. Without this facility, one DG set gradually gets loaded more and finally trips.
- Power cable cost can be another limiting factor.
- Expertise required for maintaining the synchronization system.

Advantages of synchronizing the DG sets

1. Increased reliability
   - Enhanced reliability is assured for the most critical loads in the system
   - Back up remains available in the event of one unit's failure.

2. Flexibility –
   Large single engine DG set are inefficient when not operated near or at full load. The flexibility of synchronizing allows multiple configuration options for various types of loads.

   - The multiple unit of configurations permits operation levels a partial load to be handled only by the generators needed, while the others remain offline
   - Limited operation is possible based upon kilowatt demand levels

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- The flexibility to combine two, three, four or five DG sets of the same or different kilowatt outputs (400, 500 or 600 kW) to more precisely match the load requirements from 800 to 2400 kW
- Synchronizing allows commonality of equipments with a lower cost structure and ease of upgrade to add additional units.

3. Redundancy by design
   Great power availability and redundancy as units back up each other, which also provide coverage during maintenance.

4. Reduced maintenance costs
   Serviceable by DG technicians, unlike larger single engine units requiring more specialized and costly service.

5. Less expensive parts
   Replacement parts less expensive and more commonly available than for larger single engine units.

6. Ease of expansion
   Ease of expansion is another reason for paralleling. If electrical demand is expected to grow substantially over time, the initial investments can be reduced by installing one smaller DG set, then adding additional units in parallel as the load increases. Power capacity can be added with minimal disruption.

7. Economy
   Costs are lower for the breakers and other system components associated with smaller sets.
   Synchronizing also permits closer matching of the power produced to the actual loads. For example, it may be possible to operate a single DG set when load is less. When load increases, other DG sets in the synchronized system can be added. This saves fuel and wear and tear on the DG sets since they run only when needed. This type of operation known as load- demand mode, is often used in prime power situations or during long power outages.

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DIN - *Deutsches Institut für Normung e.V. (German Institute for Standardization)*

DIN standards, although originated from Germany, is now a member of ISO whose guidelines are used world over. DIN rail, DIN cable, DIN connectors are some of the common examples of these standards. There are more than 30000 DIN standards used all over the world. One of the common and oldest DIN standard is DIN 476 defining A series paper sizes, developed way back in 1922. DIN, was originally founded as NADI (Normenausschuss der deutschen Industrie) . It produced its first standard, DIN 1, for TAPER PINS in 1918. DIN should be confused for Direct Identification Number system which is applicable to finance industry. DIN 6271-3 is the DIN standard for reciprocating internal combustion engines, and is widely used for assessing performance estimates of DG sets.

Rudolf Christian Karl Diesel – Inventor of Diesel Engine (Cycle)

Rudolf Diesel was born in Paris, France in 1858 and later during course of his education life, migrated and settled in Germany. With in-depth knowledge of Thermodynamics, he found that the good old steam engines, which were used in those days, were only 10 to 15% efficient, thermodynamically. Using "Carnot Cycle" concept, he designed a much better and rugged engine in which the "fuel" was injected during "compression cycle." After his death, the DIESEL ENGINE underwent multiple changes which incorporated latest technologies to burn fuel more efficiently. Interestingly, his original engine actually ran on peanut oil!! The Diesel engine, despite all advancement, still uses the COMPRESSION IGNITION technology which was originally found by Rudolf Diesel

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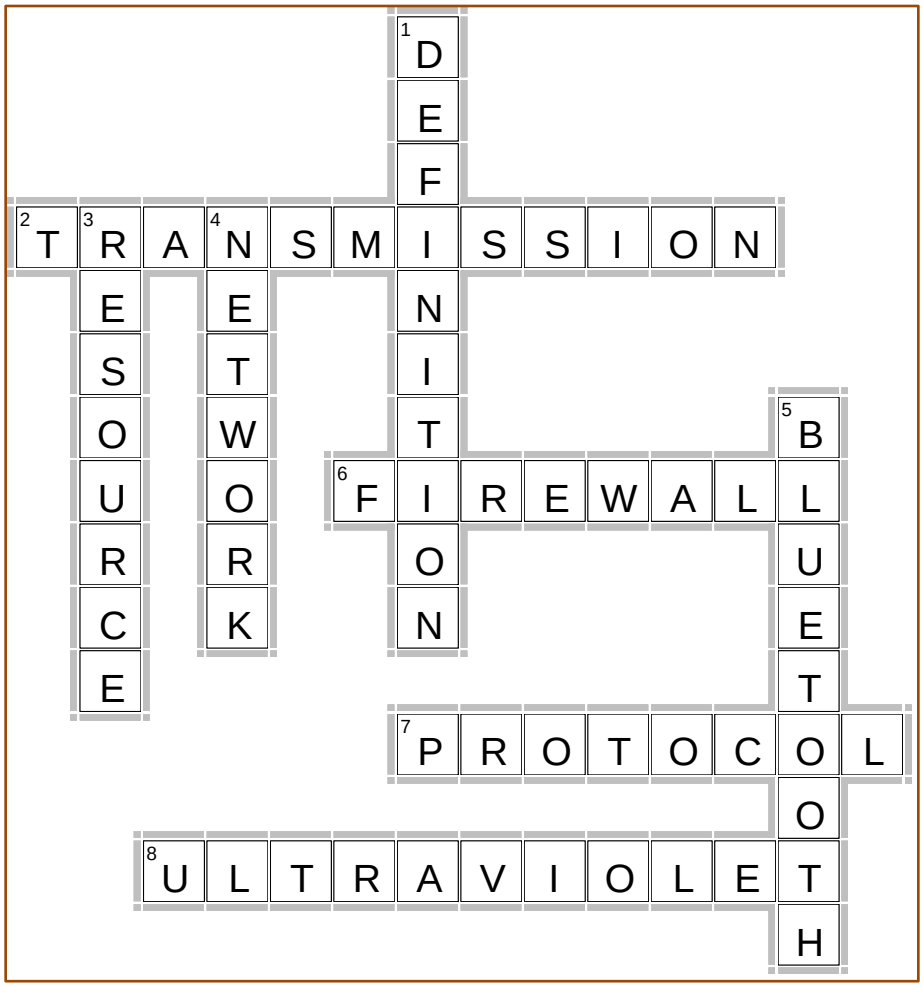
Solution for Last week Techuzzle



Across

2. **TRANSMISSION**—T, when expanded in TCP is _____
6. **FIREWALL**—This is not a cement wall built around computer
7. **PROTOCOL**—The name for communication standard
8. **ULTRAVIOLET**—UV when expanded in UVPROM is _____

Down

1. **DEFINITION**—D, when expanded in HDMI is _____
3. **RESOURCE**—R when expanded in URL is _____
4. **NETWORK**—Internet can be expanded as international _____
5. **BLUETOOTH**—This is not yellow tooth for communication

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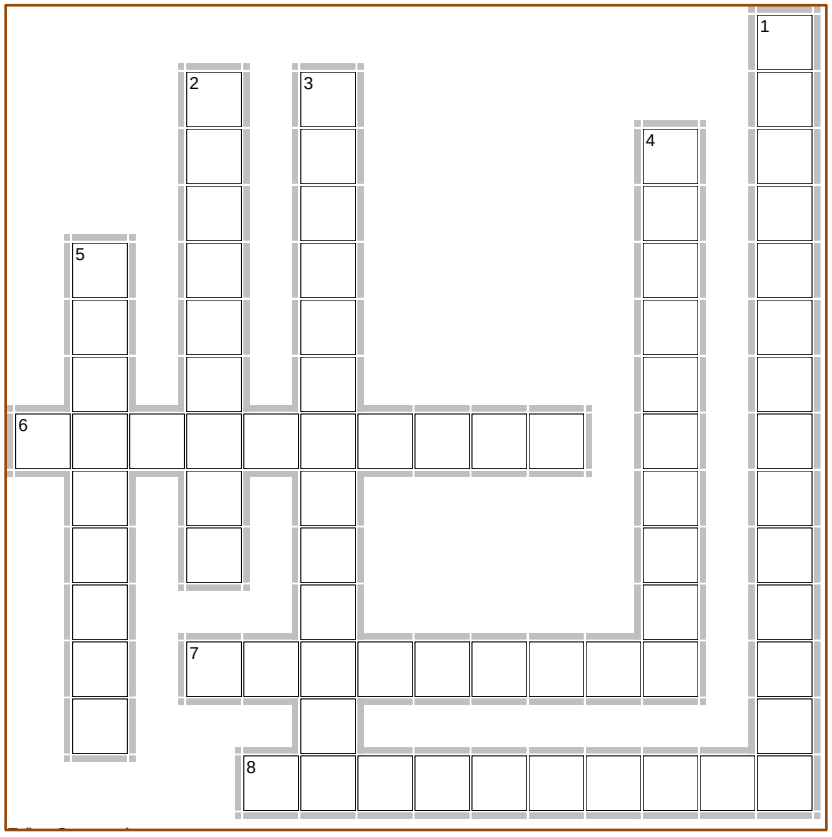
This fortnight Techuzzle



Across (numbers in bracket indicates number of letters)

6. Study of achieving very low temperatures, below -150°C (10)
7. The science of lubrication, friction & wear (9)
8. Study of Compressed air systems (10)

Down

1. The study of heat, its use and transfer (14)
2. Study of Water, its movement and distribution (9)
3. Study of achieving cold temperatures (13)
4. Study of human behavior, so important for team work (10)
5. The study of measurements and instruments (9