SYNCHRONIZING

Fundamental

SEA POWER

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Theory & condition of Sync

Synchronization, as applied to the electric power generation, is the matching of the output voltage waveform of one alternating current electrical generator with the voltage waveform of another alternating current electrical system.

For two systems to be synchronized, five conditions must be matched

Theory & condition of Sync

- The direction of rotation of these phases.
- The voltage amplitudes of the two systems.
- The frequencies of the two systems.
- The phase angle of the voltage of the two systems.

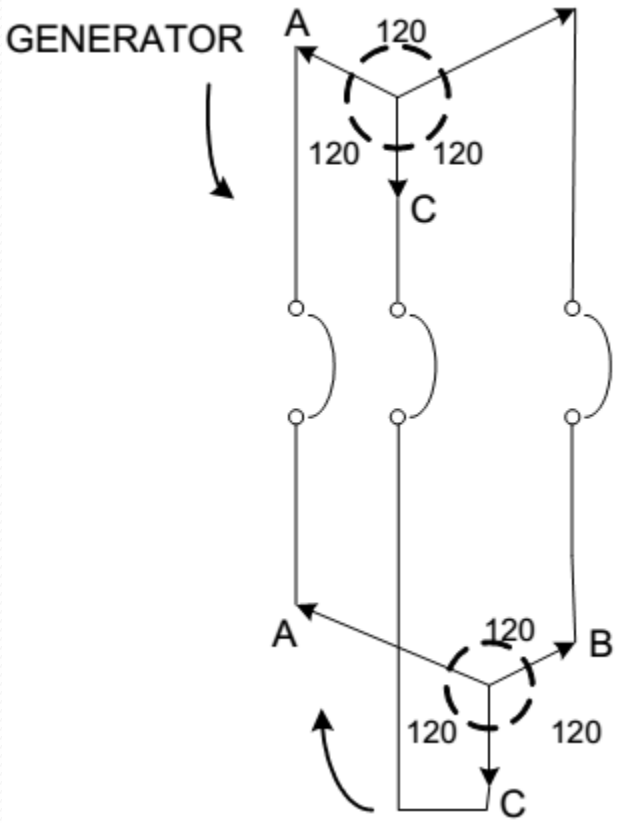
Theory & condition of Sync

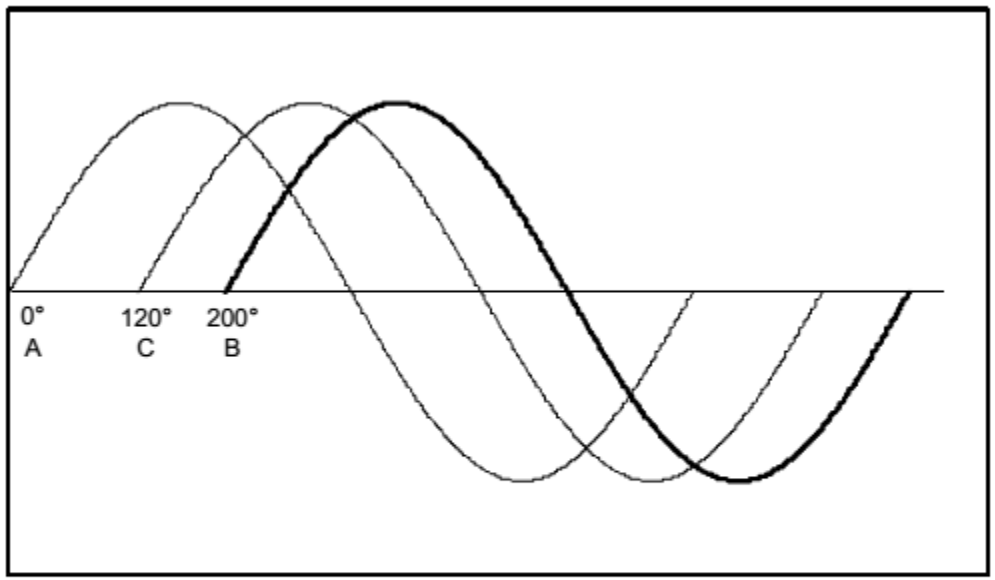
The rotation of phase

Each generator set or system being paralleled must be connected so all phases rotate in the same direction. If the phase rotation is not the same, no more than one phase can be synchronized

Theory & condition of Sync

The rotation of phase





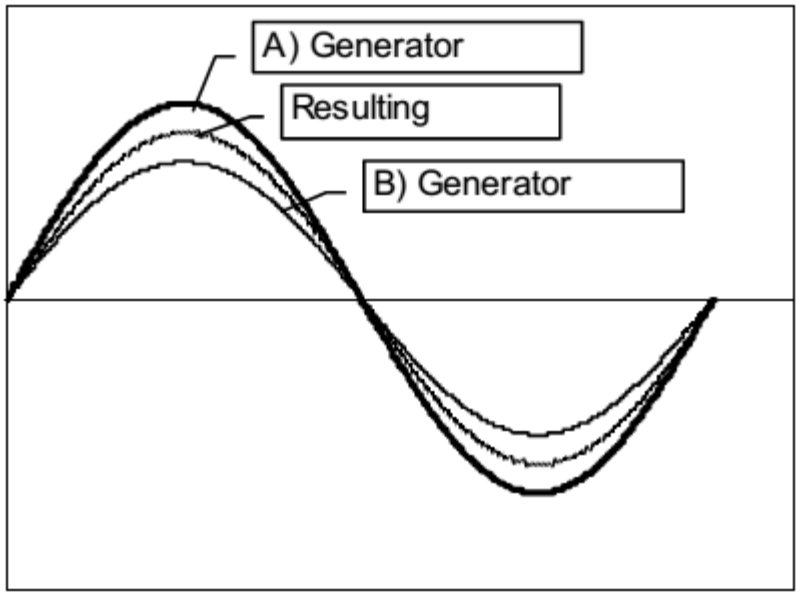
Theory & condition of Sync

Voltage Match

The voltages generated by generator sets or systems being paralleled must be within a small percentage of the same value, usually 1% to 5%. Changing the excitation voltage can control the output voltage of a synchronous generator (normally done by the voltage regulator.)

Theory & condition of Sync

Voltage Match



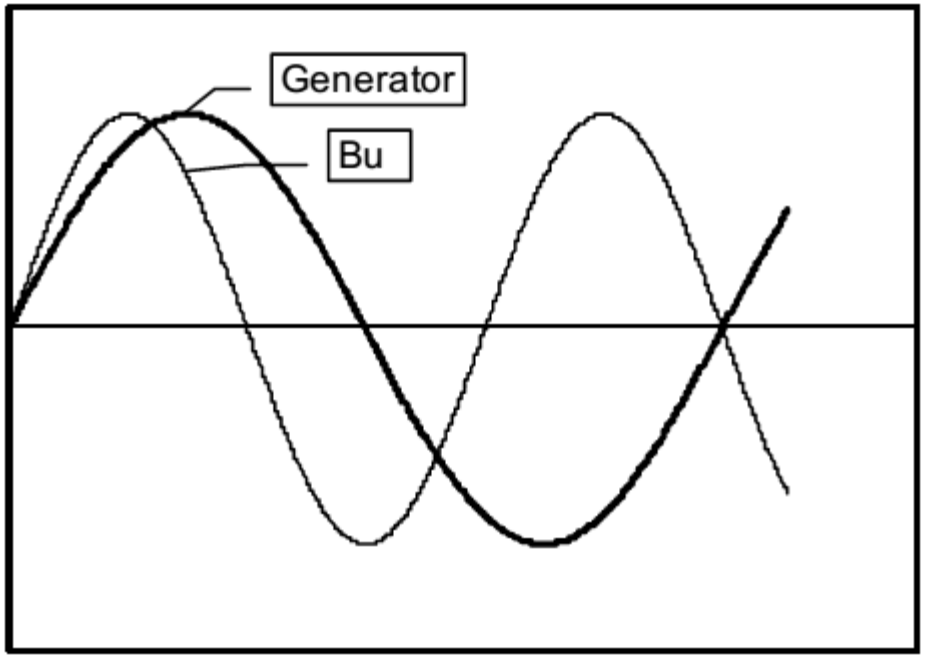
Theory & condition of Sync

Frequency Match

The frequency of the oncoming generator must be nearly identical to that of the system it is being paralleled with, usually within 0.2%. This match is normally accomplished by controlling the speed of the prime mover driving the oncoming generator

Theory & condition of Sync

Frequency Match



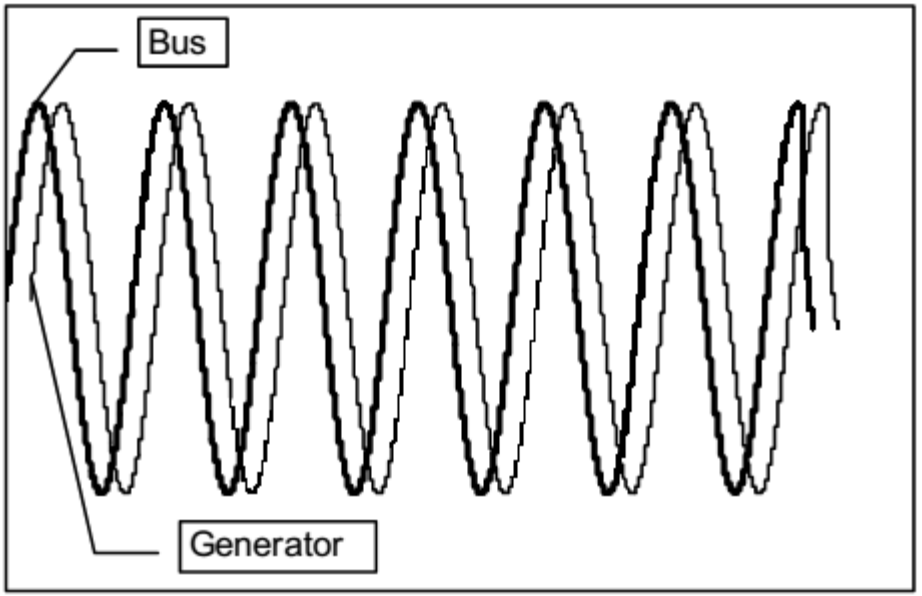
Theory & condition of Sync

Phase Angle Match

The phase relationship between the voltages of the systems to be paralleled must be very close prior to paralleling. This match usually is within plus or minus 10 degrees. If the oncoming generator is a synchronous type, phase matching, like frequency matching, is accomplished by controlling the speed of the oncoming generator's prime mover

Theory & condition of Sync

Phase Angle Match



Technology & Solution

Technology

As discussion earlier, 4 above conditions must be complied:

1- Rotation of phase

2- Voltage

3- Frequency

4- Phase angle

Technology & Solution

Technology – Rotation of phase

This depend on the cable work, after finish the cable work and connection, phase rotation must be check by tester:

1- Manually run genset 1 and close it CB. Check the phase rotation of bus voltage which created by genset 1.

2- Manually run genset 2 and close it CB. Check the phase rotation of bus voltage which created by genset 2.

3- If it not match, re-cabling.

Technology & Solution

Technology – Voltage

This will be carried out by Synchronizer.

1- Run 02 genset without close the CB.

2- Monitor the genset voltage

3- Adjust the genset voltage through Synchronizer

Technology & Solution

Technology – Frequency

This will be carried out by Synchronizer.

1- Run 02 genset without close the CB.

2- Monitor the genset frequency

3- Adjust the genset frequency through Synchronizer

Technology & Solution

Technology – Phase angle

This will be carried out by Synchronizer.

1- Run 02 genset without close the CB.

2- Monitor the genset frequency

3- Adjust the genset frequency through Synchronizer

4- Monitor the status of synchroscope

Technology & Solution

Solution – Synchronizer

To integrated the existing system, DEIF Synchronizer shall be used. This controller are capable to control the genset completely including:

1- Start/Stop genset

2- Genset voltage & frequency

3- Phase angle

4- Sync check

5- Load sharing

6- On/Off CB

Technology & Solution

Solution – Start/Stop genset

By providing a dry contact to genset ‘s local control panel.

Contact close will call genset run.

Contact open will call genset stop after delay time.

Technology & Solution

Solution – Genset voltage and Frequency

By providing 02 signal to genset local control panel EMCP

1- Analog signal +/-10 VDC to control AVR

2- PWM signal to control the genset speed and also the frequency

Technology & Solution

Solution – Phase angle

Phase angle between gensets is controlled by controlling the frequency of genset through frequency control signal which mentioned earlier

Technology & Solution

Solution – Sync Check

The status of each genset must be checked by synchronizer and it decide the time to close CB to bus. This function is integrated inside the synchronizer which was called sync check.

Technology & Solution

Solution – Load sharing

Synchronizer has a wiring port which will be connected to existing synchronizer to communicated among each other. This wiring called Load Sharing Line.

This is the main reason to chose the Comap Synchronizer for the new genset

Technology & Solution

Solution – ON/OFF CB

As discussed earlier, the time for closing CB is decided by synchronizer when all condition were satisfied. At that time Synchronizer will provided discrete signal to CB to command it on or off.

Same thing will occur when there is a fault which sensed by Synchronizer.

THANK YOU !