Alternator protection, part 3: Generator set disconnect requirements

> White paper

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In utility distribution systems protection equipment and disconnecting functions are often merged together. However, because generator sets can be prevented from operation, disconnecting means are often different. This paper provides a discussion of disconnect requirements in the USA.

Power topic #6002 Part 1 identified requirements for protection of alternators based on North American codes.

Power topic #6002 Part 2 provides an overview of overload protection alternatives that are available for generator sets.

An emergency stop switch fitted with lockout/tag-out provisions.

Generator sets are required to have a disconnecting means so that the equipment can be quickly and effectively shut down during an emergency situation (such as a fire in the facility) and to allow service to the equipment or conductors. However, what the term disconnect means in the context of the US *National Electrical Code*® (NEC®) does not necessarily mean a switch or circuit breaker.

In most applications, a generator set is unlike a utility service, in that a generator set can be prevented from energizing a circuit in a number of different ways. These include switching off the fuel supply, disconnecting the starting batteries, operating a keyed auto/manual switch, or engaging an emergency stop circuit. The disconnect means may also be a circuit breaker or disconnect switch. While a disconnect switch or circuit breaker is required to isolate a utility service from a facility distribution system, because you can't switch off the utility service, other means are allowed on a generator set.

In Article 445.10 of the NEC it is clearly stated that a generator set, unless it is in an installation where it can be paralleled, can use any means that will prevent the engine of the generator set from operating. There are compelling reasons to avoid use of a traditional disconnect switch or circuit breaker as the "disconnecting means":

- Addition of a molded case breaker with thermal-magnetic trip unit can make the system less reliable because of the potential for nuisance tripping of the device due to surge loads from motor starting, or due to operation at more than the device's

North American requirements for generator (alternator) protection

The 2005 US *National Electric Code*® (NEC®), NFPA 70®, makes the following references to generator protection:

445.10 Disconnecting means required for generators: Generators shall be equipped with a disconnect by means of which the generator and all protective devices and control apparatus are able to be disconnected entirely from the circuits supplied by the generator except where;

(1) The driving means for the generator can be readily shut down; and

(2) The generator is not arranged to operate in parallel with another generator or source of voltage.

100.A Service: The conductors and equipment for delivering electric energy from the serving utility to the wiring system of the premises served.

continuous rating (usually 80% of nameplate trip setting). A breaker would cause an extended outage in the system since the breaker cannot be automatically reset. An operator must manually reset the breaker and re-close it to energize the system.

- When a breaker is opened for the purpose of servicing a system, it may be inadvertently left open after service is completed. NFPA 110 and NFPA 99 both require local and remote indication that a generator set is disabled. Use of a control function integrated into the genset control system that automatically issues the “not in auto” remote indication provides an easy and effective means to meet that requirement. A circuit breaker or disconnect switch fitted with auxiliary contacts that indicate the switch is open may be interconnected to the control system to achieve the required remote indication, but this adds cost and complexity to the design.
- When a breaker is used for the disconnecting means, it may result in difficulty achieving selective coordination of the emergency electrical system, as is required by the NEC.

Whatever disconnecting means is used on a generator set, it should have a lock-out/tag-out provision to allow technicians to prevent energization of the system until they have completed their work on it.

When generator sets are applied in paralleling applications the paralleling breaker may be required to include a locking means to prevent energization of the feeder from a generator set from the paralleling bus.

For additional technical support, please contact your local Cummins Power Generation distributor. To locate your distributor, visit www.cumminspower.com.

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About the author

Gary Olson graduated from Iowa State University with a Bachelor of Science Degree in Mechanical Engineering in 1977, and graduated from the College of St. Thomas with a Master of Business Administration degree in 1982.

He has been employed by Cummins Power Generation for more than 25 years in various engineering and management roles. His current responsibilities include research relating to on-site power applications, technical product support for on-site power system equipment, and contributing to codes and standards groups. He also manages an engineering group dedicated to development of next generation power system designs.

Suggested protection specifications:
The generator set control shall include a lock-out/tag-out device which is integrated with the control-mounted emergency stop switch. The lock-out/tag-out device shall cause the generator set to be in emergency stop mode whenever a padlock is installed on the device, preventing the generator set from running, producing power, or cranking.

References

- ANSI/*NFPA 70*, *National Electrical Code*, 2005.
- ANSI/*NFPA 99*, Health Care Facilities.
- ANSI/*NFPA 110*, Generator Sets for Emergency and Standby Power Applications.
- Earley, Mark W., Murray, Richard H., and Caloggerro, John M., "*National Electrical Code* Handbook" National Fire Protection Association, Fifth Edition.

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