



Expertise Applied | Answers Delivered

A background image showing a worker in a hard hat and safety gear being engulfed in a massive, bright orange and yellow arc flash explosion. The scene is filled with sparks and intense light.

PGR-8800
ARC-FLASH RELAY
TECHNICAL FAQ

FAQ



What are the typical applications / system voltages?

The PGR-8800 can be used on electrical systems operating at any voltage (AC or DC) since it does not directly connect to the system. The system is monitored with light sensors and optional current transformers (for AC systems) that can be selected for any current / voltage rating. The small size of the PGR-8800 allows for installation in any switchgear cubicle, transformer compartment, or motor control center bucket.

How much energy is in a typical arc-flash incident?

A phase-to-phase fault within a 480 volt system with 20,000 ampere of fault current provides 9,600,000 watts of power. Imagine that there is no arc protection and the fault is allowed to last for 200 milliseconds. The resulting energy would be 1,920,000 Joules. TNT releases approximately 2,175 Joules/gram when detonated, so this arc flash would approximately correspond to the detonation of 883 grams of TNT. One stick of dynamite contains approximately 1,000 grams of TNT.

The formula is as follows:

$$\text{Energy} = (\text{voltage} \times \text{current}) \times \text{duration} = (480 \text{ V} \times 20,000 \text{ A}) \times 200 \text{ ms} = 1,920,000 \text{ J}$$

The formula clearly shows that the destruction depends on power over time, which is in fact the formula for energy. The main task of the PGR-8800 is to quickly detect the release of power and limit its lifespan.

It goes without saying that nobody would like to have a half a stick of dynamite sitting inside their installation, just waiting to explode. The PGR-8800 arc fault protection device, could have extinguished the arc fault in less than 35 milliseconds.

Do Arc Flash relays lower Personal Protective Equipment (PPE)?

There are two ways to lower the incident energy of an arc-flash event, reducing the fault current or the clearing time. Reducing the available energy could in turn lower the required PPE. Reducing the current can be achieved by using current-limiting fuses and, for single-phase faults, resistance grounding.

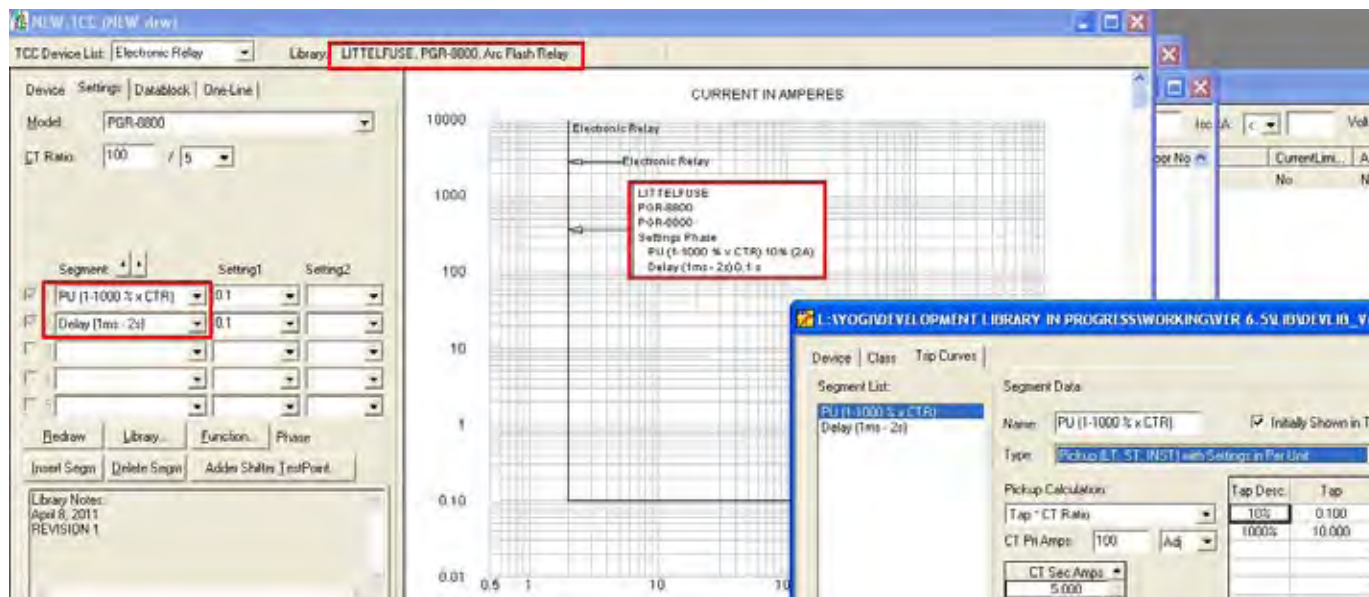
Reducing the clearing time typically is not possible when using overcurrent protection due to system coordination requirements. Current-based protection must have sufficient delay to prevent unnecessary tripping on momentary overload or current spikes, thus losing valuable reaction time.

Reducing the clearing time typically is not possible when using standard overcurrent protection due to system coordination requirements. Current-based protection must have sufficient delay to prevent unnecessary tripping on momentary overload or current spikes, thus losing valuable reaction time.

Arc Flash relays resolve this issue by detecting overcurrent and light, which allows for the quickest reaction time in the industry. The PGR-8800 relay can detect an arcing condition and send a trip signal to the circuit breaker within 1ms. This detection time is much faster than standard protection and circuit breakers, which means using an Arc Flash relay in combination with a circuit breaker will lower the incident energy or Arc Flash hazards. This results in an increase in worker safety, less fault damage, and improved uptime. Since the arc-flash hazard has decreased, the associated PPE may also be lowered. The exact amount will depend on user setpoints, so it must be modeled in the system to determine the new incident energy and PPE.

Do power system analysis software, such as SKM, EasyPower, and ETAP, recognize Arc Flash relays?

Yes, SKM list the PGR-8800 relay in the library and other companies are currently adding the relay. Below shows the PGR-8800 Arc Flash relay modeled in SKM:



The PGR-8800 has two (2) settings for overcurrent protection:

- Pickup is adjustable from 10 to 1000% of the secondary CT rating (any CT with a 5A secondary can be used)
- Time delay from 1ms to 2 seconds

For arc-flash protection, the PGR-8800 must see light of sufficient intensity to initiate the tripping sequence. If current inhibit is enabled, the PGR-8800 will not send a trip signal unless there is also sufficient current. Both light and current trip levels can be adjusted.

Currently, no power system analysis software package can model the light detection. They only model the overcurrent setting. To avoid the nuisance tripping with standard protection, user typically increases the pickup value or time delay. This leads to arcing faults going unnoticed until it is too late. With the PGR-8800, this is not an issue as the light is used to prevent nuisance tripping on electrical noise or momentary overload conditions while still allowing for very fast tripping. Thus, the reaction time is reduced to that of the PGR-8800 (less than 1 ms unless configured otherwise) plus the circuit-breaker operating time, independent of the current.

Bolted Pressure Switches can also be used, but many of these devices have limitations in terms of interrupting and clearing time rating, so the user must check the ratings first. With either a CB or BPS, the opening time or clearing time can be modeled in SKM. The opening time or clearing time must include all devices in the sequence, which includes the shunt trip or undervoltage times as well as circuit breaker times.

In cases where only light detection is utilized, this clearing time value can be used in the software as a user-defined trip time or the PGR-8800 library model can be used with the current set to a low value to reproduce the current-independent characteristic of optical detection. When current and light are both required then the current-inhibit level setting in the PGR-8800 should be used for the model.

How do Arc Flash relays coordinate with other protection relays?

Power system analysis software programs can be used to help with system coordination. The arc flash relay has two definite-time settings (10-1000% full-load current and 1ms – 20s time delay) that can be used for coordination, however, both control one set of output trip contact. One setpoint can be used for detecting a low-level arcing condition and the other can be used for detecting high-level arcing condition. If either condition is met, a trip signal is sent to the circuit breaker.

Coordination for arc-flash protection is not practical due to the reaction time required and utilizing light as a fault detection method.

How Arc Flash relays compare to Zone Selective Interlocking Protection (ZSIP) and Bus Differential?

These are different technologies that detect and quickly clear faults. ZSIP will detect a fault and block an upstream protective device from operating until the local protective device has a chance to clear the fault. If not, the upstream device attempts to clear it. This takes valuable time (100ms for detection only) and may be difficult to retrofit.

Bus Differential measures the difference of current going into and out of a device, such as switchgear. If the current supplied by the source travels through the switchgear to the load, all is well. If a fault occurs within the switchgear, the current going in does not equal the current going to the load. This detection method is much quicker (33ms for detection only) and may be more difficult and/or expensive to retrofit, depending on the number of CTs.

Do Arc Flash relays provide zone identification?

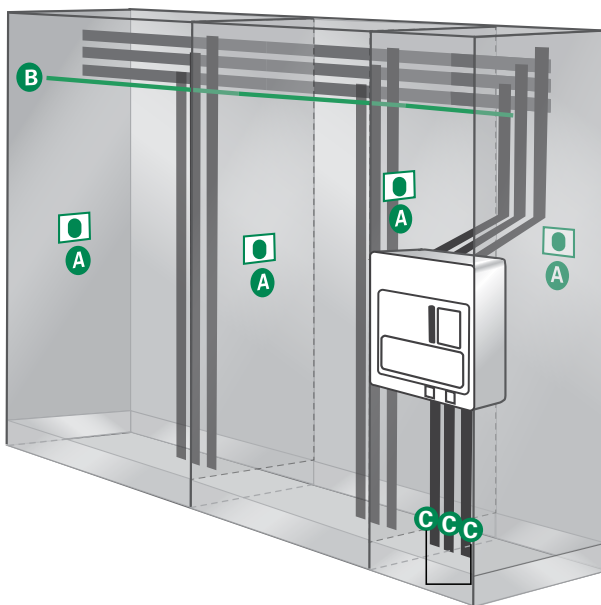
Yes, the arc flash relay has 6 sensors that can be installed in each cubicle, compartment, or bucket. Each sensor has an on-board LED as well as an LED on the PGR-8800 that provides feedback identifying which zone caused the fault. The arc flash relay has one set of contacts to trip the main circuit breaker. Protection zones can be implemented by connecting up to 4 PGR-8800's (up to 24 sensors) to a breaker.

If individual circuit protection is desired, the built-in light sensor on the front of the relay can be utilized. Simply install the PGR-8800 arc flash relay in each cubicle and connect to the associated feeder circuit breaker.

What are the installation guidelines for the sensors?

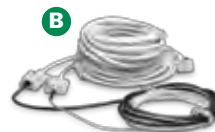
The PGR-8800 Arc-Flash Relay and sensors are easily installed in retrofit projects and new switchgear with little or no re-configuration. Even elaborate systems with multiple power sources take minutes to configure using the relay's built-in USB interface software.

Generally, it is recommended to mount 1 or 2 sensors per cubicle to cover all horizontal and vertical bus bars, breaker compartments, drawers, and anywhere that there is potential for an arc-fault. Threading a fiber-optic sensor through the cabinets and in areas where point-sensor coverage is uncertain results in complete coverage and an added level of redundancy. Even if policy is to only work on de-energized systems, all maintenance area should be monitored to prevent potential damage and additional cost. At least once sensor should have visibility of an arc fault if a person blocks the other sensor(s).



PGA-LS10 Point Sensor

Line-of-sight light sensor with a built-in LED to indicate sensor health or trip state. Comes standard with a 32-foot cable.



PGA-LS20 Fiber-Optic Sensor

A 360°, 26-foot fiber-optic sensor detects light along the entire length of the cable and has a built-in LED to indicate sensor health or trip state. Recommended installation is along busbars as well as in challenging spaces that have many compartments. Comes standard with two 32-foot cables



Phase Current Transformers

Phase Current Transformers (CTs) are required to detect phase currents. When retrofitting systems, existing CTs with a 5 A secondary can be used.

Below are some additional guidelines:

- First determine sensor placements, then consider zones.
- Ensure sensors and cables are not blocked by objects, either fixed or movable.
- Do not place sensors or fiber cable on live or energized components.
- Choose a location that will minimize collection of foreign debris and easy access for maintenance, if needed.
- Use care when handling, pulling, and securing cables.
- Avoid sharp bends (< 2cm) and high temperature (>80C).
- Consider placements around air-magnetic circuit breakers.
- Consider movable parts and area accessible to personnel for commissioning, testing, inspecting, etc.
- Even though the sensors and cables have no exposed live parts are fully insulated, the placement and routing must comply with industry standard requirements on over-surface (creep) and through-air (clearance).

Is there a maintenance schedule for the sensors?

Each sensor has an internal health LED. Its purpose is to verify the continuity of the sensor cabling and the internal sensor circuitry. This 'health check' circuit will not detect dust buildup on the sensor. There are several ways to mitigate dust buildup. A sensor mounted at the top of an enclosure looking down is optimal. This configuration will not collect much dust in most cabinet installations, due to intensity of an arc combined with the reflections off the metal walls (even a dirty sensor will collect a great deal of light).

Sensors must be cleaned in order to maintain consistent sensitivity. Sensor cleaning should be part of regular maintenance and should be performed via compressed air or dry wipe down. A maintenance routine can be implemented to clean sensors at a set interval that is aligned with industry standard recommendations, such as NFPA 70B, Recommended Practice for Equipment Maintenance.

A more proactive approach could also be used by putting the relay into Service Mode and shining a bright light on each sensor. A trip will be indicated if the sensor is able to detect the light but the breaker will not be tripped. If the relay light isn't indicating a trip then cleaning is necessary.

What is the purpose of the CTs and are they required?

The purpose of the Current Transformers (CTs) is to validate an arcing condition, although CTs are not required for operation. The PGR-8800 relay will detect light and send a trip signal. If the CTs are used, the Arc Flash relay will only send a trip signal if both light and overcurrent conditions are detected. If only light detection (optical sensors) is used, an event, such as a camera flash or direct sunlight, may cause the Arc Flash relay to operate. In applications where intense light is a possibility, overcurrent detection can be used to prevent nuisance tripping.

The PGR-8800 relay accepts any CT with a 5A secondary. Existing CTs may be used for retrofit opportunities. The CTs are sized per typical conventional protection methods. For example, the CT primary rating is typically determined by the rating of the equipment. If a switchgear is rated for 2,000 A, a 2000:5 CT is usually selected.

Can arc-flash relays eliminate the need for HRC 3 or 4 clothing?

Yes, in many cases. It depends on the available fault current and how much faster the PGR-8800 causes the upstream breaker to clear the fault.

It seems that "working" on the equipment is the key. How about just walking or standing in front of the equipment. Or opening equipment cabinet to read a nameplate e.g. pad mount transformers?

If the worker is within the Flash Protection Boundary of the exposed (line of sight) energized part, then the PPE category on the label must be used. If the door is closed or cover is on, check NFPA 70E Table 130.7(C)(15)(a) or (b) for a possible reduction in HRC.

What are the regulatory agencies' opinion on arc-flash relays on life safety and critical circuits?

Hospitals and health care facilities are not exempted from OSHA safety requirements. They rely on the experience and reputation of the Professional Engineer's assessment.

Do we have to maintain clearance between panels if lined up opposite, even if the switchgear is arc resistant type?

In general, unless the doors are open or covers are off and the worker is exposed to energized circuit parts, if the equipment is arc resistant, then arc flash protection boundaries are minimized. Check with the manufacturer for minimum suggested working distances.

Can greater than 75 kVA transformers mitigate the arc flash labels and requirements?

According to IEEE 1584, If the voltage is 240 volts or less, and fed by a single transformer rated 125 kVA or less, the HRC is usually considered HRC 0.

When working on an energized transformer, we use instantaneous settings at the feeder breaker relay. Can the arc-flash relay bring any benefit?

According to IEEE 1584, the arcing current can be as low as 38% of the available bolted fault current. If the instantaneous trip setting of the circuit breaker is greater than the arcing current, the breaker could take seconds or minutes to open, thus creating a potentially DANGEROUS arc flash condition. The Arc Flash relay can react in 1 millisecond regardless of the fault current, and initiate the tripping signal to open the breaker and clear the fault within 30 msec or less, lowering the arc flash incident energy to a minimum.

When designing a safety protocol, should low fault current-long clearing time hazard and a high-fault current-short clearing time hazard with the same incident energy be treated differently?

If the incident energy is the same, NO. However, if the incident energy is more or less, NFPA 70E requires the worker to use arc rated clothing equal to or greater than the possible maximum incident energy.

Is there a recommendation as to how often you need to update the arc flash label?

NFPA 70E Article 130.5 requires the arc flash analysis to be updated when major modifications occur and reviewed every 5 years, whichever occurs first.

We recently completed an arc-flash hazard assessment and have a few dangerous level categories. How can I tell if the arc-flash relay is going to reduce those levels and will that change the amount of PPE required?

We recommend you contact the engineer or engineering firm that performed the assessment and request them to re-run the study at that equipment using the PGR-8800 relay to lower the hazards.

Are there control systems available that truly eliminate or control arc flash?

If the equipment is energized there is no one system that does that.

Does implementation of an arc flash relay allow a worker to use a reduced level of PPE?

In most cases, YES, but please check with the engineer or engineering firm that performed the assessment and request them to re-run the study at the higher PPE levels to determine if the arc flash relay will lower the incident energy and PPE required.

How do you test the sensors, are they fail safe?

A sensor-check circuit in the PGR-8800 tests the sensor once per second to verify that the sensor assembly is functioning correctly and that is connected. The signal is sent from the PGR-8800 along the cable to the sensor which activates an internal LED. A failure in the sensor circuitry or cable would result in a loss of check signal. The PGR-8800 recognizes this signal loss as a loss of sensor and will indicate an error condition on the sensor and on the relay, and the ONLINE output will change state. The user can decide what to do with this relay output and whether it will trip the system or simply signal an alarm. The fiber-optic sensor works the same way except that the signal travels through the length of the fiber-optic cable so a break or crimp in that cable is detected.

Sensors can be tested individually by putting the PGR-8800 into Service mode and shining a bright light source on the sensor. A trip will be indicated if the sensor is able to detect the light but a trip signal will not be sent to the breaker. A high-power flashlight can serve to verify the sensors are properly detecting light. The power required on the flashlight is difficult to quantify because of the way the light is spread and focused, but a 3 million candle power flashlight has proven more than sufficient for use on point sensors.

How do the CT's input help the performance of the relay

The CT inputs provide optional current measurement, protection, and restraint. In applications with indoor lighting and no high-intensity light sources (welding, direct sunlight) nearby, current measurement may not be of benefit to the relay aside from high-level overcurrent protection. However, for applications where high intensity light could be incident on an arc-flash sensor, the current measurement ability acts as a second-level verification in addition to light. If there is intense light on the sensor but the current is normal, the PGR-8800 can be configured to ignore the light. If there is higher than normal current AND there is also intense light as from an arc flash, then the relay will trip. The current effectively supervises the operation of the light-tripping mechanism and allows nuisance-free operation of the relay in applications with optical noise.

At what intensity of light will the PGR-8800 indicate or trip

The PGR-8800 can be configured to trip between 10 klux and 40 klux. The relay's six sensor LEDs can be configured to indicate at various levels below the trip level to warn that light intensity is approaching the trip level.

The fiber-optic sensor has an adjustable sensitivity (in addition to the relay sensitivity dial) that could be used to increase the sensitivity for a given length of fiber to levels below and above the relay setpoint.

What is detective diameter of the fiber sensors?

This is a difficult metric to provide because the distance an arc can be detected by the fiber-optic sensor is dependent on many variables. However, the PGA-LS20 fiber-optic sensor is factory calibrated so that it will have the same detection range as the PGA-LS10 when 60 cm (a standard section width) is exposed to the arc flash. In other words, a 3 kA arc can be detected from a distance of 2 m from the fiber assuming that the light is incident on 60 cm of fiber. However, the PGA-LS20 also has an adjustment screw that allows the user to calibrate the fiber-optic sensor to be more sensitive (for smaller sections) or less sensitive (for larger ones) so that the characteristic matches that PGA-LS10 point sensors. We recommend a minimum of 20 cm of fiber exposed per section.

Switchgear and mcc equipment are shipped in a group of sections. How would the fibre optic sensors be installed for arc flash relays taking equipment shipping into consideration? Do these sensors come in various lengths? What if you wanted to use one relay for a long switchgear lineup, are there repeaters?

The fiber-optic sensors have two parts, an electrical cable connection to the relay and the light-sensitive fiber-optic cable. Splitting a fiber is a challenge because a bad splice can result in decreased or increased sensitivity and failure to operate or nuisance tripping. Shipping splits should be wired so that the fiber-optic sensor cable does not traverse multiple sections. The electrical part of the sensor, connecting the sensor to the relay, can be up to 50 m long and is much easier to connect at the final installation as well as much more durable than optical fiber. It is important to remember that a light-collecting fiber-optic cable behaves quite differently from a transmission-only shielded fiber-optic cable. The latter case is more frequently used, especially in telecommunications industries and can have very large lengths, but in that case light is fed directly into the tube at a low angle of incidence and losses along the cable are very low. In the PGA-LS20 fiber-optic sensor, the entire cable is designed to absorb light incident on the surface, bend the light to trap it in the cable, and then keep it in the cable. However, light is lost along the length of the cable and the longer the light must travel along the cable, the more light is lost. Our testing shows that beyond 8 m, the amount of light lost along the length of the fiber-optic cable is sufficient to result in less sensitivity at the 'transmitter' side of the fiber compared to the receiver. For this reason, multiple lengths are not specified. Repeaters are not available as the cost may be too high compared to installing a second fiber-optic sensor. Repeaters may cause timing issues for the sensor-check signal.

If one was to use this arc flash relay as the only method to protect personnel from arc flash, shouldn't the arc flash relays be tested and have a Safety Integrity Level? (SIL)

We don't recommend that the PGR-8800 be used as the only method to protect personnel from arc-flash. Adequate PPE should be worn based on the results of an arc-flash study. Resistance grounding is highly recommended to eliminate single phase-to-ground arc flashes. Current-limiting fuses and relays with maintenance mode settings or dual set-point groups are also highly recommended.

Does thermo imaging trip the arc-flash relay?

Assuming the thermo imaging device is passively detecting heat in the switchgear by using the infrared light emitted, there should be no interference with the PGR-8800 relay or sensors.

What are the key things to watch out when choosing an arc flash relay

We have written a white paper on considerations for choosing an arc-flash relay that examines advantages and drawbacks. It is available to download on our website or with the direct link provided below:
www.littelfuse.com/data/en/White_Papers/Littelfuse-WhitePaper-ArcFlashRelay.pdf

What is the life of the arc flash relay? What maintenance is required and how often?

The PGR-8800 relay has a 5 year warranty but depending on the environment it will last much longer than that. Maintenance required will depend on your application and principally focuses on removing dust collection on light sensors. We recommend checking the light sensors periodically (with a period relevant for the amount of dust) with an external light source to verify that the sensors are not obscured by dust build up and using compressed air to blow dust off the sensors during regularly scheduled maintenance. It is good practice to periodically check that the IGBT trip output is tripping the breaker. Breaker maintenance is also critical to provide reliable and fast clearing time.

Would camera flash lights trigger the arc flash relays?

When the PGR-8800 is set to maximum sensitivity and the amount of time light is required to be present on the sensor is set to a minimum, it is possible that a small point-and-shoot camera close to the sensor could be sufficient to trip the relay. Typically, a compact camera's flash does not present enough intensity to cause a trip, except at VERY close proximity to the sensor. More advanced cameras and larger flashes can trip the PGR-8800 from a greater distance. In applications where this is a concern, it is recommended to use CTs so that non-arc-flash light with no corresponding increase in current above normal operating conditions does not cause a trip. Where current supervision is used, both high current and intense light are required to have an arc-flash trip.

Does the arc-flash relay detect ultra violet light?

The typical spectrum of light from an arc-flash is spread across the visible spectrum and so this is what the PGR-8800 is detecting. Ultraviolet light is mostly used to detect corona which can be present before an arc flash but is also present in higher voltage systems where no arc flash is imminent. Using ultraviolet light alone could lead to nuisance trips and the relay would only be looking at a small section of the total light from the arc.

Can the arc-flash relay be used in low voltage systems? Will a low voltage breaker closing or opening cause a trip?

When a low-voltage breaker is closing there is often a large inrush current that, depending on the configuration of the PGR-8800, could be sufficient to allow a high-intensity light source other than an arc-flash to cause a trip. While low-voltage breakers often produce an arc when they are opening, closing the breaker does not normally produce an arc, so the PGR-8800 should not operate unintentionally. When opening the breaker, an arc is typically present as part of normal operation of the breaker. If light sensors are placed such that the breaker arcing is visible then it is recommended to also use current-supervision. The breaker arcing during normal opening will cause a reduction in current because of the increased impedance and the PGR-8800 with current-supervision will not operate.

Do the different modes of the arc flash relay have different response times?

It is possible for the arc-flash relay to send a trip signal within 1 ms of detecting light above the threshold settings or within 1 ms of detecting light AND current. It is also possible to configure the relay to have additional delay as needed.

What is SKM software and where can I find more information?

SKM Software (www.skm.com) is one brand of power system analysis software that allows users to define the electrical parameters of their system and model its behavior. It is often used for co-ordination studies and arc-flash hazard analysis. Other software brands are ETAP, Easy Power and EDSA.

How do you model your optical devices in SKM and ETAP, since the relay is detecting light?

You must add the 1 ms PGR-8800 arc-flash trip time to the breaker shunt-trip operating or clearing time. The result will be a vertical line (definite-time) that shows the same response time regardless of the current. This demonstrates the advantage of using light for arc-flash detection.

How do you enter resistance grounding or arc-flash relays into the SKM software for calculating arc-flash?

Resistance grounding presently shows no advantage in power system modeling software. The analysis of arc-flash energy is based on three-phase faults. High resistance grounding does eliminate the potential hazard from a single phase-to-ground fault. Different sources show 80 to 90% of faults in a plant start as a single phase-to-ground fault. Arc-flash relays can be entered as a definite time trip at 1 ms which is then added to the breaker clearing time. The advantage of arc-flash detection is that the breaker is no longer waiting for co-ordination of downstream devices. Another method often used to lower incident energy is to switch the relay or breaker settings to maintenance mode or a second setpoint group. These are lower settings with quicker operating times, often ignoring co-ordination of downstream devices with knowledge that a person is in the area. When the person leaves the area, the settings are returned to normal.

Is internal arc classification of switchgear enclosures enough to an arc hazard (i.e. without use of Arc-Flash relay)?

No, although it minimizes the hazard. The arc-flash relay may help prevent damage to the equipment and provide additional protection in the event that the doors are not properly closed. Depending on the impedance of the arc fault, the arc may persist for a long time in the switchgear and could exceed the rating of the gear.

Does arc-resistant switchgear need to be ventilated to an external area (outside) to maintain its arc-resistant rating?

This question is better directed to the manufacturer of arc-resistant switchgear.

A HRG system will reduce the probability of a ground fault but if the fault progresses it does not eliminate arcing fault.

HRG systems eliminate arc-flash hazards associated with ground-faults per IEEE Std 141-1993 (Red Book). Even though tests have shown that HRG systems also reduce the arc-flash energy with phase-to-phase arcing faults, it can not be used to reduce PPE. arc flash relays can be used to identify these arcing conditions and significantly reduce arc-flash hazards. In many applications, both are used to increase uptime and protection.

How do you address the system leakage capacitance on HRGs- especially at medium voltage levels?

You are correct that at medium-voltage, the system leakage capacitive current increases, which is a function of voltage. Fortunately, this has been well documented over the years and tables are used to estimate the leakage current. Depending on this value, the ground-fault on a HRG system may not be recommended to remain on system.

Is it possible to apply HRG to a distribution transformer in order to minimize the arc flash hazard when working on the secondary of the transformer?

High-Resistance Grounding (HRG) has some limitations. For example, it cannot be used on systems with line-to-neutral loads. Another limitation is the amount of current flow during a ground-fault. HRG limits the current to typically 10A or less, which may not be enough to detect on your distribution system. If these are not issues, I would consider using HRG systems. However, I would perform a detailed engineering study to ensure other limitations (such as voltage shift) are acceptable.

Would a ground fault on the main switch gear act as the same thing?

HRG systems eliminate arc-flash hazards associated with ground-faults per IEEE Std 141-1993 (Red Book). Even though tests have shown that HRG systems also reduce the Arc-Flash energy with phase-to-phase arcing faults, it can not be used to reduce PPE. Arc Flash Relays can be used to identify these arcing conditions and significantly reduce Arc-Flash hazards. In many applications, both are used to increase uptime and protection.

Can we have more than 5A L-G fault available in HRG at any circumstances?

The maximum ground-fault current is physically limited to the value of the resistor, assuming no resistance in fault and return path. For example, on a 480V system, for a ground-fault current of 5A, the resistor value is $277V / 5A = 55.4\text{ohms}$. The 55.4ohm resistor sets a maximum ground-fault current of 5A. However, it is typically lower due to either fault resistance and/or resistance in return path. In some older facilities where the return path is weak, a lower resistance value is used to allow for a higher ground-fault current.

Is there protection (resistance grounding) for delta circuits?

HRG systems are only used on 3-wire systems, either wye with floating neutral or delta. If used on wye systems, the resistor is simply directed connected to neutral bushing. If it is a delta system, typically a zig-zag transformer is used to create a neutral point (or three single-phase transformers are used). In any case, a neutral point, which is used to connect the resistor.

The code only allows HRG if you didn't have neutral to ground loads (like 277 V) Are you saying this would only be applied on 3-wire systems?

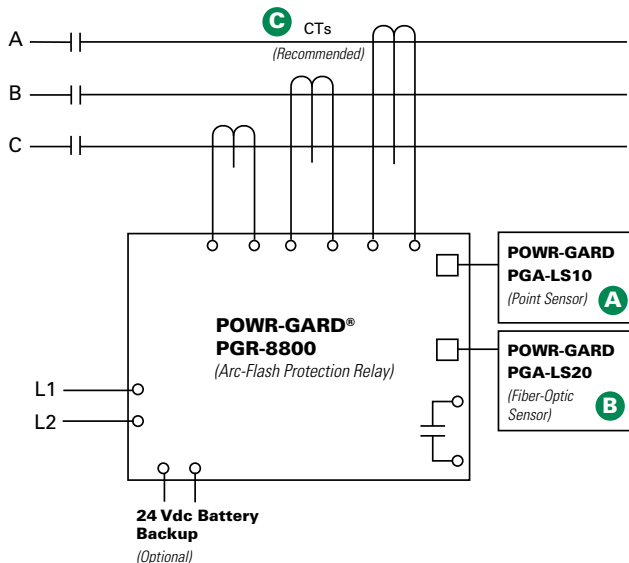
Correct, the NEC prohibits using HRG systems on systems with line-to-neutral loads. The reason is that the elevated neutral voltage, which occurs during a ground fault, may backfeed a circuit causing a dangerous condition. However, CEC allows HRG systems on these systems if the entire system is tripped offline during a ground fault.

If you have a neutral grounding resistor, is an arc flash relay also recommended?

Yes, because the NGR only reduces or eliminates arcing ground faults. For the other type of arcing faults, phase faults, the PGR-8800 arc-flash relay can be used to provide maximum protection. Typically 95% of all faults are ground faults, so the NGR reduces or eliminates most of the risk and the PGR-8800 provides the 5% protection in the switchgear.



Simplified Circuit Diagram



Ordering Information

CATALOG/ SYSTEM NUMBER	COMMUNICATIONS
PGR-8800-00	Multi-unit linking, USB
ACCESSORIES	REQUIREMENT
PGA-LS10	Required*
PGA-LS20	Required*
Current Transformer	Recommended

*At least one sensor is required. However, the exact number of sensors for proper coverage depends on the application.

Description

The PGR-8800 is a microprocessor-based relay that limits arc-fault damage by detecting the light from an arc flash and rapidly tripping. Phase-current-transformer inputs are provided for current-constrained arc-flash protection and, when so equipped, a programmable definite-time overcurrent function can be enabled. An optical sensor on the PGR-8800 and adjustable trip level reduce the chance of nuisance tripping by setting a threshold for ambient light. Sensors, inputs, and connections are monitored to ensure fail-safe operation. A secondary solid-state trip circuit provides a redundant trip path. A USB port is used for configuration and access event logs and graphs.

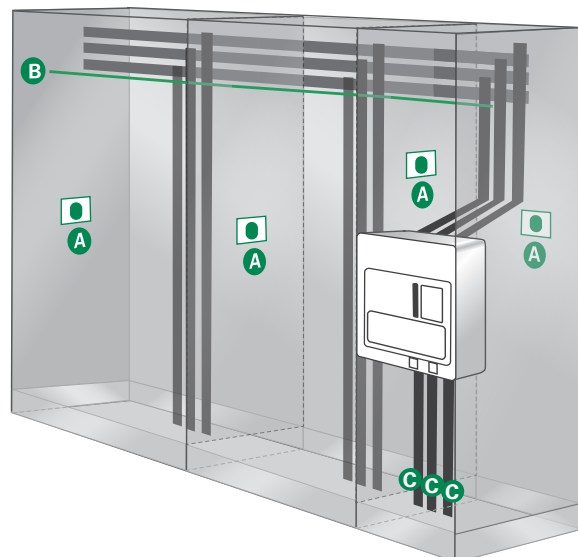
Optical Sensors

The PGR-8800 accepts both PGA-LS10 and PGA-LS20 optical sensors designed to collect light over a wide angle and with high sensitivity. For fast fault location, front-panel and sensor LED's indicate sensor health and which sensor detected an arc fault.

Sensor Placement

The PGR-8800 Arc-Flash Relay and sensors are easily installed in retrofit projects and new switchgear with little or no re-configuration. Even elaborate systems with multiple power sources take minutes to configure using the relay's built-in USB interface software.

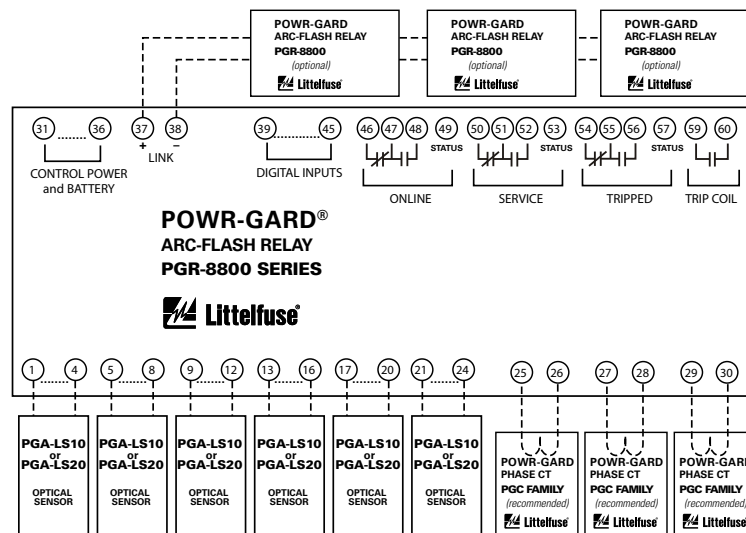
Generally, it is recommended to mount 1 or 2 sensors per cubicle to cover all horizontal and vertical bus bars, breaker compartments, drawers, and anywhere that there is potential for an arc-fault. Threading a fiber-optic sensor through the cabinets and in areas where point-sensor coverage is uncertain results in complete coverage and an added level of redundancy. Even if policy is to only work on de-energized systems, all maintenance areas should be monitored to prevent potential damage and additional cost. At least one sensor should have visibility of an arc fault if a person blocks the other sensor(s).



Features & Benefits

FEATURES	BENEFITS
Arc-Flash Trip Time <1 ms	Limits arc-flash damage and risk of injury
Multiple Sensors (up to 24)	Single module can monitor 6 sensors. Up to 4 PGR-8800 units can be linked into one system
Fail-Safe System	Continuous monitoring of optical sensors and inputs ensures protection
Redundant Trip Circuit	Solid-state backup arc-detection circuit adds a second layer of safety
Adjustable Light Sensitivity	Allows for operation in bright environments and maximum sensitivity in dark environments
LED Indication (on unit and each sensor)	18 LEDs provide at-a glance status for module and I/O state
Current Detection	Phase-CT inputs provide overcurrent protection and prevent nuisance trips
Optical Detection	Point and fiber-optic sensors provide wide detection area with sensor health trip indication
Digital Inputs (6)	Two each: remote trip, inhibit, and reset inputs
Service Mode	Allows for system test without tripping
Trip Coil Contact	Solid-state 24-600 Vdc/24-440 Vac IGBT
Indication Contacts	Form C and status outputs
USB Interface	Data logging and configuration software uses a USB interface with no drivers or software installation
Built-in Sensor	Can be used in single-sensor systems, as a seventh sensor, and for calibration
Universal Power Supply/Battery Backup	100-230 Vac, 12-60 Vdc, or 100-250 Vdc supply accepted. Ability to charge and run off an external, user-supplied 24 Vdc battery.
Data Logging	On-board 1000-event recorder helps with system diagnostics

Wiring Diagram



Accessories

A  **PGA-LS10 Point Sensor**
 Line-of-sight light sensor detects an arc as small as 3 kA within a 2-m half-sphere. Sensor health and trip indication.

B  **PGA-LS20 Fiber-Optic Sensor**
 360° light sensor for tricky installations with many shadows or to run along bus bars. Sensor health and trip indication.

C  **Current Transformers**
 Eliminate nuisance arc-flash trips and use for overcurrent protection.

Specifications

IEEE Device Numbers
Input Voltage
Dimensions

Overcurrent (50), Arc Flash (AFD)
 100-230 Vac, 12-60 Vdc, and 100-250 Vdc
H 130 mm (5.2"); **W** 200 mm (7.9");
D 54 mm (2.2")

Optical Trip Settings
Current Trip Setting (A)
Indication Contact Mode
Trip Coil Contact Mode
Redundant Trip Circuit
Input Monitoring
USB Interface
Trip, Reset, Service Buttons
Expandable System
Certification
Warranty
Mounting

10-40 kLux, 200 µs-2 s
 Programmable
 Fail-safe
 Selectable fail-safe or non-fail-safe
 Standard feature
 Standard feature
 Standard feature
 Standard feature
 Link up to 4 PGR-8800 units
 CE
 5 years
 DIN, Surface

For more information, visit
www.littelfuse.com/protectionrelays

Additional technical information and application data for Littelfuse protection relays, fuses and other circuit protection and safety products can be found on www.littelfuse.com/protectionrelays. For questions, contact our Technical Support Group (800-832-3873). Specifications, descriptions and illustrative material in this literature are as accurate as known at the time of publication, but are subject to changes without notice. All data was compiled from public information available from manufacturers' manuals and datasheets.