Arc Quenching Switchgear (AQS)

Description
The Arc Quenching Device (AQD) can be located on the line- or the load-side of the main low-voltage circuit breaker in an Arc Quenching Switchgear (AQS) lineup. With the switchgear energized and the Arc Quenching System active, the entire AQS lineup will be C37.20.7 arc-resistant regardless of the location of the AQD. However, the incident energy of the lineup is affected by the location of the AQD.

AQQD Load-Side Application
The standard AQS application includes the AQD mounted on the load-side of the low-voltage main circuit breaker. See Figure 1.

In this application, the lineup will carry two different incident energy levels while the Arc Quenching System is active (indicated by the illumination of the white light above the AQD). The incident energy on the line side of the low-voltage main breaker will be determined by the clearing time of the upstream overcurrent protective device. The incident energy on the load-side of the low-voltage main breaker will be determined by the arc quenching time of the Arc Quenching System. Typically, the load-side incident energy in this application will be less than 1.2 cal/cm². See Figure 2.
If the Arc Quenching System is inactive (either due to a malfunction, loss of control power, or disconnection of the AQD), the white indicator light above the AQD will cease to be lit. If the upstream LV main device is open and the Arc Quenching System is healthy, the white indicator light above the AQD will blink to indicate that the system is healthy but not active. In these cases, the incident energy on the line-side of the main low-voltage breaker will remain the same (as determined by the clearing time of the upstream overcurrent protective device). Furthermore, when the main breaker is closed with the AQS inactive, the incident energy on the load-side of the low-voltage breaker will increase, determined by the total clearing time of the Eaton Arc Flash Relay (EAFR) tripping the low-voltage main breaker.

**WARNING**

EATON SHOCK & ARC FLASH HAZARD
Location: SWGR-A
Report #: TQ0123496 Rev. 0
Issued: DEC-2017

| 13' 2" | ARC FLASH BOUNDARY |
| 31 cal/cm² | CALCULATED INCIDENT ENERGY AT 1' 6" WORKING DISTANCE |
| 6" | ARC FLASH BOUNDARY |
| 0.8 cal/cm² | CALCULATED INCIDENT ENERGY AT 1' 6" WORKING DISTANCE |

480 V Shock Hazard Limited Approach Boundary: 3' - 6"
Min. Glove Class: 00
Restricted Approach Boundary: 1' - 0"

Figure 3. Sample arc flash label for AQD on load-side of LV main breaker

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**AQD line-side application**

The preferred AQS application includes the AQD mounted on the line-side of the low-voltage main circuit breaker and must include a wired trip signal from the EAFR to a trippable upstream overcurrent protective device with a verified clearing time of less than 100 ms. See **Figure 4**. It is not possible to shunt-trip an upstream medium-voltage switch unless an Eaton medium-voltage shorting device is installed or the switch is rated to interrupt full available fault current within 100 ms or less.

![Figure 4. AQD line-side application](image)

In this application, the entire low-voltage switchgear lineup will carry a single incident energy level while the Arc Quenching System is active (indicated by the illumination of the white light above the AQD). The incident energy of the entire lineup, including the line-side of the low-voltage main breaker, will be determined by the arc quenching time of the Arc Quenching System. Typically, the incident energy of the entire low-voltage switchgear lineup in this application will be less than 1.2 cal/cm². See **Figure 5**.

If the Arc Quenching System is inactive (either due to a malfunction, loss of control power, or disconnection of the AQD), the white indicator light above the AQD will cease to be lit. In this case, the incident energy of the entire low-voltage switchgear lineup (on the line-side and load-side of the low-voltage main breaker) will be determined by the total clearing time of the EAFR tripping the upstream medium-voltage breaker.
Notes for line- and load-side applications

After switchgear installation, it is highly recommended to perform an arc flash study and label the switchgear with the calculated incident energy.

The Arc Quenching System is electrically interlocked with the main breaker to prevent closing the main if the health contact of either the EAFR or AQD is open, either because the device is still powering up or if there is an error.

The Arc Quenching System requires approximately 30 seconds of boot time on power-up. For applications in which the primary bus could become energized with the main breaker of the protected switchgear closed, an external control power source is recommended. Alternatively, a UPS internal to the switchgear can be specified to ensure that the Arc Quenching System is operational prior to energizing the switchgear primary bus. This will provide protection in the unlikely event that an arc occurs in the switchgear while energizing.

EAFR zone of protection

The zone of protection provided by the EAFR is determined by the placement of the arc light point sensors and the placement of CTs. When an arc fault is detected, the EAFR sends a trip signal to the upstream overcurrent protective device and a trigger signal to the Arc Quenching Device. The EAFR must receive both a light signal above the point sensor threshold from any point sensor inside the switchgear and a current input above the pickup setting on the EAFR from the CTs in order to activate the AQD and send a trip signal to the upstream overcurrent protective device.

The arc light point sensors are placed throughout the switchgear in tested and validated locations and are proven to be able to detect the light from an arcing fault anywhere in the Arc Quenching Switchgear (see white paper WP019004EN for more information). However, the location of the CTs is not fixed and could vary depending on how the incoming section is configured for a particular lineup of switchgear (e.g., cable incoming, bus incoming, close-coupled to a transformer, etc. could all affect where the CTs can be placed).

If an arcing fault were to occur inside the Arc Quenching Switchgear enclosure but upstream of the CTs, it would not be detected by the EAFR and therefore the Arc Quenching System would not operate to quench the fault. As a result, it is recommended that the CTs be placed as far upstream as possible to maximize the zone of protection provided by the EAFR. Proper placement of the CTs should be considered during the design phase of the power distribution system as it may affect the configuration of the equipment being purchased. For example, for Arc Quenching Switchgear that will be close-coupled to a transformer, the ideal placement of the CTs may be on the secondary bushings of the transformer, outside of the switchgear enclosure. Such a design would ensure that the zone of protection provided by the EAFR fully encompasses the incoming compartment. Consult the factory or an Eaton sales engineer for other CT configurations for the incoming section.

Note: These zone-of-protection considerations are not unique to Arc Quenching Switchgear. Any system that provides protection based on input from a current transformer (such as standard arc flash detection systems or bus differential relays) requires the same design considerations.