GE Energy
Industrial Solutions

Arc Vault™
Protection System
Application and Technical Guide

imagination at work
HAZARD CLASSIFICATIONS

The following important highlighted information appears throughout this document to warn of potential hazards or to call attention to information that clarifies a procedure.

Carefully read all instructions and become familiar with the devices before trying to install, operate, service or maintain this equipment.

⚠️ DANGER

Indicates a hazardous situation which, if not avoided, will result in death or serious injury.

⚠️ WARNING

Indicates a hazardous situation that, if not avoided, could result in death or serious injury.

⚠️ CAUTION

Indicates that if the hazard is not avoided could result in minor or moderate injury.

⚠️ NOTICE

Is used to notify of practices not related to personal injury.

TRADEMARKS

Arc Vault™ Protection System
EntelliGuard® G
EntelliGuard® TU

WARRANTY

This document is based on information available at the time of its publication. While efforts have been made to ensure accuracy, the information contained herein does not cover all details or variations in hardware and software, nor does it provide for every possible contingency in connection with installation, operation, and maintenance. Features may be described herein that are not present in all hardware and software systems. GE Industrial Solutions assumes no obligation of notice to holders of this document with respect to changes subsequently made. GE Industrial Solutions makes no representation or warranty, expressed, implied, or statutory, with respect to, and assumes no responsibility for the accuracy, completeness, sufficiency, or usefulness of the information contained herein. No warranties of merchantability or fitness for purpose shall apply.

Contact your local sales office if further information is required concerning any aspect of the Arc Vault Protection System operation or maintenance.
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SECTION 1. GENERAL INFORMATION

OVERVIEW

The Arc Vault™ Protection System is a breakthrough arc fault protection technology that can stop an arcing fault in less than eight milliseconds (ms) to provide increased arc flash hazard mitigation with equipment doors open or closed. This fast arcing fault containment technology can help reduce the severity of work-related injuries and lost productivity.

The Arc Vault Protection System features an activation switch (ACT) that can be used during routine maintenance to put the low-voltage equipment into a high-protection mode. When an arc flash event occurs, the system will send a signal to the arc containment device. The arc is then diverted to the containment system in less than one-half cycle or eight milliseconds depending on fault conditions. At the same time the decision to divert the arc is made, the system will also send a signal to open an upstream circuit breaker. This will turn off the system in approximately 3 cycles to 5 cycles depending on the type and speed of the circuit breaker used, at which point the arc in the containment system will terminate.

The Arc Vault Protection System can be retrofitted onto both GE and non-GE low voltage switchboards, switchgear and motor control centers to expand its application for most existing facilities. Depending on site conditions, the design enables a retrofit installation to be completed within as little as a day of outage. The GE Arc Vault Protection System can be retrofit without having to replace the existing low voltage equipment lineup.

The GE Arc Vault Protection System will contain an arc fault in less than 8ms, resulting in incident energy in accordance with IEEE 1584 at 18” from the arc event at less than 1.2 Cal/cm², with the circuit breaker compartment doors open, in a 480V 65kAIC system.

The GE Arc Vault Protection System reduces building construction costs because it does not require exhaust chimneys or plenums to direct the arc flash energy outside of the building, when compared to traditional arc resistant switchgear. Additionally, if an arc flash incident occurs during maintenance, the low-voltage switchgear can be operational again within a working day assuming appropriate replacement parts are available, which improves your overall system uptime when compared to traditional arc-resistant switchgear.

The GE Arc Vault protection system reduces the energy flowing through the system by about 60% or more compared to a bolted fault that would occur with a crowbar system. The energy reduction will lower the stress on other system components such as transformers, circuit breakers, and bus bar construction and improve your overall system uptime when compared to traditional arc resistant switchgear.

The GE Arc Vault Protection System will protect the transformer transition section and the low-voltage lineup in a system that contains an upstream controllable device on the transformer primary circuit. In a system where a primary controllable device does not exist, the GE Arc Vault Protection System can provide protection to the low voltage equipment downstream by controlling the secondary main in the substation (refer to Figure 6-3 and Figure 6-4).

PRODUCT CONFIGURATION

The Arc Vault Protection System detects the presence of a high magnitude arcing fault via a set of current and potential transformers. Control electronics and power circuits create a low impedance three phase arc inside a containment vessel (Arc Vault Device) within a predefined response curve (See Figure 6-2 arcing fault transfer). The contained, low impedance arc diverts fault current energy into the vessel until an upstream breaker, signaled by the Arc Vault Protection System, opens the circuit. The Arc Vault Protection System monitors the status of its components and provides visual and contact closure information of its status.

The Arc Vault Protection System includes the following major subsystems (shown in Figure 1-1 and Figure 1-3):

- Low Voltage AKD-20 Arc Vault Stack
- Arc Vault Device
- Arc Vault Relay
Figure 1-1 Arc Vault ACT Line Diagram

1. Equipment protected by Arc Vault Retrofit Solution
2. 3 Phase Current
3. 3 Phase Current
4. Arc Relay
   Determines presence of event
   Sends trip signal to Upstream C.B.
   Sends signal to Arc Vault Device
5. Potential Transformers
6. Current Transformers
7. Upstream Circuit Breaker

Figure 1-2 Front panel controls and indicators

- **Activation Switch**
  - TEST LIGHT
  - OFF - Not Active
  - ON - Active

- **System Status Lights**
  - Blue – Full Protection
  - White – Partial Protection (Relay Only)
  - Red – No Protection
  - Amber – Event Occurred

- **Arc Vault Relay**

- **86 Device – Arc Vault Lockout**

- **Device Test Button**

- **Arc Vault Device Status Lights**
  - Green – Device Ready
  - Red – Device Not Ready
## Table 1-1 Modes of Operation

<table>
<thead>
<tr>
<th>System status</th>
<th>System Status indicators (see Figure 1-2)</th>
<th>Panel settings (see Figure 1-2)</th>
<th>Functionality (see Figure 1-1, items 1 through 4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Off (no protection)</td>
<td>Blue light OFF</td>
<td>Activation switch = OFF</td>
<td>This will be the most common mode of operation for the Arc Vault Protection System. Any level of current inrush monitored by the current transformers will not initiate any actions by the Arc Vault Protection System.</td>
</tr>
<tr>
<td></td>
<td>White light OFF</td>
<td>Test switch = OFF</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Red light ON</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Full protection</td>
<td>Blue light ON</td>
<td>Activation switch = ON</td>
<td>Any current inrush monitored by the current transformers exceeding the threshold limit will initiate the following:</td>
</tr>
<tr>
<td></td>
<td>White light OFF</td>
<td>Test switch = OFF</td>
<td>(1) Arc Vault Relay will send a trip signal via a dry contacts to the upstream circuit breaker and lock-out relay (86 device - this device is shown on the picture above)</td>
</tr>
<tr>
<td></td>
<td>Red light OFF</td>
<td></td>
<td>(2) Arc Vault Relay will send a transfer signal to the Arc Vault Device and event transfer to Arc Vault Device will occur</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(3) Arc Vault Relay will only send transfer signal after a minimum phase voltage has been monitored by the potential transformers</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(4) Arc Vault Device will initiate a low impedance 3 phase arcing fault within itself</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(5) Arc Vault Device will transfer and contain an arcing fault in Target Equipment to itself</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(6) Event is cleared from the system via the upstream circuit breaker and the amber / yellow indication is illuminated</td>
</tr>
<tr>
<td>Partial protection</td>
<td>Blue light OFF</td>
<td>Activation switch = ON</td>
<td>Any current inrush monitored by the current transformers exceeding the threshold limit will initiate the following:</td>
</tr>
<tr>
<td></td>
<td>White light ON</td>
<td>Test switch = OFF</td>
<td>(1) Arc Vault Relay will send a trip signal via a dry contacts to the upstream circuit breaker and lock-out relay (86 device)</td>
</tr>
<tr>
<td></td>
<td>Red light OFF</td>
<td></td>
<td>(2) Event is cleared from the system via the upstream circuit breaker</td>
</tr>
<tr>
<td>Off (System Test mode)</td>
<td>Blue light OFF</td>
<td>Activation switch = OFF</td>
<td>Arc Vault Relay will send a transfer signal to the Arc Vault Device only if the Arc Vault Device is in the “Test Position” within its cassette</td>
</tr>
<tr>
<td></td>
<td>White light OFF</td>
<td>Test switch = OFF</td>
<td>Arc Vault Device will fire its plasma gun but will not create a low impedance 3 phase arcing fault within itself</td>
</tr>
<tr>
<td></td>
<td>Red light ON</td>
<td></td>
<td>Arc Vault Device will not transfer or contain any arcing fault in the Target Equipment to itself</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Test Mode is concluded when operator returns the Test Switch to the “OFF” position</td>
</tr>
<tr>
<td>Off (Light Test)</td>
<td>Blue light ON</td>
<td>Activation switch = TEST</td>
<td>All system status indicator lights should turn ON.</td>
</tr>
<tr>
<td></td>
<td>White light ON</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Red light ON</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Amber light ON</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Arc Vault
General Information

Figure 1-3 Arc Vault solution block diagram

Red Boxes denote functions located within the Arc Vault Device including Plasma Gun Electronics & Arc Vault Device.
Orange Boxes denote functions located within the Arc Vault Relay including Interposing CTs, Arc Vault Relay & Interposing PTs.
Green Boxes denote functions located within the Arc Vault Stack including Lockout Device, Power Source, Test Switch, Activation Switch, Potential Transformers, Power Supply & Auxiliary Control Logic.
Blue Boxes denote functions located remote from the Arc Vault Stack including Current Transformers and Main Circuit Breaker, also known as Upstream Circuit Breaker.

Note: these locations are preferred locations but actual application may duplicate functions and/or locate these functions remote from the Arc Vault Stack within application limits defined elsewhere in this document.
Arcing fault energy limiting

The Incident Energy limitation provided by the Arc Vault Protection System may be calculated in accordance with the IEEE 1584 guide when applied as follows.

- Uses Medium Voltage (MV) controllable device or Low Voltage (LV) main circuit breaker that operates & interrupts in less than 5 cycles
- Connected to 3 Phase/3 Wire and 3 Phase/4 Wire power systems including delta, floating delta, solidly grounded delta, solidly grounded wye, high resistance grounded wye configurations and high resistance grounded delta systems.
- Frequency: 60Hz nominal; 48 ~ 72Hz application range (based on IEEE C37.50/51... 60Hz +/-20%)
- Power Source can be transformer fed or generator fed
- Maximum Phase to Phase Voltage of 508 VAC
- Minimum Phase to Phase Voltage of 380VAC
- Nominal Phase to Phase Voltage 460-480VAC
- Used with silver or tin plated copper or aluminum bus either bare or insulated
- One Arc Vault system is designed to protect one bus. Protection for systems with multiple buses is possible and configuration may vary. Contact your GE Engineering Services office for consultation.

The Arc Vault™ Protection System limits the maximum incident energy, successfully transfers an arc energy to the Arc Vault Device and contains the arc therein. See Table 1-2 and Figure 6-1 for maximum incident energy and voltage ratings. These ratings apply when the equipment doors are either opened or closed.

<table>
<thead>
<tr>
<th>Maximum Incident Energy</th>
<th>Voltage &amp; Interruption Levels</th>
<th>Working Distance (Bus to Chest)</th>
<th>Any Equipment Door (Open/Closed)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 1.2cal/cm²</td>
<td>508V/65kA</td>
<td>18 Inches</td>
<td>Open or Closed</td>
</tr>
</tbody>
</table>
SECTION 2. FEATURES AND CHARACTERISTICS

COMPONENTS

Arc Vault Stack
The Arc Vault Stack contains the Arc Vault Device/Cassette and the Arc Vault Relay, potential transformers and/or auxiliary control devices. The Arc Vault Stack is a free-standing structure for retrofit or new installation/applications. The allowable configurations of the Arc Vault Stack are documented in the GE AKD-20 UL/CUL file as a classified system and configured within the GE requisition engineering system.

Arc Vault Device and Cassette
- 3 position closed door drawout device within the Arc Vault Stack
- Fits into a 22" wide by 21" high compartment, see Figure 5-1 Arc Vault Stack
- All optional accessories used with GE AKD-20™ switchgear frame 2 cassettes are available. Some examples are Kirk-key interlocks, racking handle, remote racking device, defeatable door interlocks, etc.
- The Arc Vault triggering system receives a signal from the Arc Vault Relay to transfer energy and contains it until either a medium voltage (MV) or low voltage (LV) upstream circuit breaker clears the current from the power system
- Arc Vault Device requires service and/or replacement after 1 arc incident event
- Replacement of Arc Vault Cassette components or Arc Vault Stack components is not required after an arc incident event of 6 cycles or less.
- The Arc Vault Device contains an event “pop-out” target that activates when the Arc Vault Device receives a transfer signal from the Arc Vault Relay. The event pop-out target may be manually reset after ensuring the Arc Vault Device and system are fully operational.
Figure 2-3 Arc Vault Device Face Plate
Figure 2-4 Front view of Arc Vault Instrument Tray

- System instrument tray
- Arc Vault Relay
- 86 Device - Arc Vault Lockout
- Device Instrument Tray
- Arc Vault Device
- Control Compartment
Figure 2-5 Freestanding Arc Vault Stack (Arc Vault Cassette not shown)
Arc Vault Device & Arc Vault Cassette Connections

The Arc Vault Device secondary disconnect connection is shown in Figure 2-6. The Arc Vault Device has sufficient control input and outputs to protect a single power source within a switchgear application.

The Arc Vault Device and Arc Vault Cassette:
- Is a Closed door drawout device with four (4) unique positions of connect, test, disconnect and withdrawn
- Is powered by a Power Supply described later in this document and external from the cassette and Arc Vault Device
- Each primary disconnect uses a single finger cluster assembly
- Utilizes a unique rejection scheme that prevents an EntelliGuard® G circuit breaker from racking into an Arc Vault Cassette and prevent an Arc Vault Device from racking into an EntelliGuard G Envelope 2 cassette
- Wire type, size and rating is compliant with NEC and C37.20.1 standards and use acceptable wiring practices
- Can be bench tested by GE Energy Services without a connection to the entire Arc Vault Protection System. The following field acceptance tests will confirm whether the Arc Vault Device is acceptable for operation prior to installing a device into service (note that Dielectric integrity can be verified with commercially available test equipment and is not included in the standard bench tests):
  - Verify operation of plasma gun and circuitry including sensing phase voltage collapse at the Arc Vault Device primary disconnects
  - Verify operation of all Arc Vault Device visual indicators & operation of all input and output signals
- At initial startup the Arc Vault Device reports its status as “Not Ready” until all input/outputs can be verified
- Can be provided or used with any combination of the following optional accessories:
  - Door Interlock, (1) or (2) kirk key locks, AKD-20™ remote racking device, mimic bus, lifting tool.
- Charging and discharging circuits are fully contained within the Arc Vault Device with exception of the externally provided 24VDC control power from the Power Supply.
- Racking mechanical interlocks within the Arc Vault cassette & internal to the Arc Vault Device prevents the racking of an Arc Vault Device from any position in a cassette unless the Arc Vault Device capacitors are fully discharged.
- Arc Vault Device is equipped with two push buttons and a mechanical flag with clear viewing window for connect and disconnect: a red “Discharge” button and a black “Charge” button.
- The Arc Vault Device is equipped with a pull-out tag comprising of holes allowing a user to padlock the device in either the Discharge or Charge state following OSHA lock-out/tag-out requirements. Depressing the Discharge or Charge buttons will drive a positive action mechanical system within the Arc Vault Device that will accomplish the actions below. All these actions are internal to the Arc Vault Device and behave the same when the Arc Vault Device is not inserted in an Arc Vault cassette.
- Discharge button actions:
  - Changes the indicator flag to “Discharged”
  - Opens an electrical “positive action” switch that will isolate the 24VDC power supply from the capacitor charging circuit
  - Closes an electrical switch that will engage the Arc Vault Device capacitors to a discharging circuit
  - Fully discharging of the capacitors is realized before an operator can insert a racking handle into the Arc Vault Cassette
  - There is a yellow indication light on the front fascia of the Arc Vault Device in between the red “Discharged” light and the green “Charged” light that will illuminate during discharge; the total discharge time is about 5 seconds.
  - Mechanically releases a lever and roller that will allow a user to open the racking door on the Arc Vault cassette.
- Charge button actions:
  - Changes the indicator to “Charged”
  - Closes an electrical "positive action" switch that will engage the 24VDC power supply to the capacitor charging circuit
  - Opens an electrical "positive action" switch that will isolate the Arc Vault Device capacitors from the discharge circuit
  - There is a yellow indication light on the front fascia of the Arc Vault Device in between the red "Discharged" light and the green "Charged" light that will illuminate during charging; the total charge time may take up to 90 seconds.
  - **IMPORTANT**: If the system has been in the discharged mode or not powered for more than a year in a warm ambient environment, it may take longer than two minutes for the system to complete the self-test and indicate Fully Charged. Once the system is Fully Charged, leave it charged for 30 minutes.
  - Mechanically hold a lever and roller that will prevent a user from opening the racking door on the Arc Vault cassette
- The cassette has field installable primary stab tips similar to replaceable stab tips for GE AKD-20 style LV Switchgear.
- The cassette serves as an intermediary connection between the riser assembly and the Arc Vault Device, providing a means for a drawout connection of the Arc Vault Device.

**Figure 2-6 Arc Vault Secondary Disconnect & Position Switch Diagrams**
SECTION 3. ARC VAULT RELAY AND CONTROL SYSTEM

ARC VAULT CONTROL SYSTEM

- The Arc Vault relay integrates the system of the current transformers, potential transformers, power supply and auxiliary control devices interconnected to monitor the equipment for an event within the switchgear assembly.

- Current Transformers and Potential Transformers measure current and voltage to supervise trip operation. See description on Figure 3-1 and SECTION 6.

- In the Full Protection mode, the Arc Vault Protection System monitors the current transformers, potential transformers and confirms the incident by comparing current levels to a user-set threshold. Current levels are predefined settings that the user can select within the Arc Vault Relay. Upon exceeding the current threshold setting, the Arc Vault Relay sends a signal to the Arc Vault Device and initiates a trip to either an MV circuit breaker or LV main circuit breaker along with initiating a trip to a lockout (86) device.

- The Arc Vault Relay is configurable by the user to set the threshold of current at 0.8X to 3.0X in 0.2X increments, where X = 5000A.

- Uses current transformers rated 5000/5 amps for all applications ratings.

- Uses potential transformers rated 600/120 volts and voltage conditioners for all application ratings.

- Is equipped with inputs for current transformers, voltage transformers, 24VDC control power, test switch and activation switch signals. Arc Vault Relay is equipped with outputs to initiate arc transfer in the Arc Vault Device, trip the upstream circuit breaker, activate a lockout (86) device and provide positive feedback contact closure to activation switch.

- The Arc Vault stack is capable of supporting field-made wire terminations for retrofit applications.

- Arc Vault Relay will monitor an Activation switch, which has three unique positions of “Off,” “On” & “Test.” When a user changes the activation switch to the “On” position, the Arc Vault Relay will provide the user with protection as defined later in this document, will display an icon on its screen and provide a contact closure (positive feedback) allowing a user to confirm its mode of operation.

- Arc Vault Relay will have an internal watchdog that will flash a LED on the face of the Arc Vault Relay to indicate if the relay is okay or defective. If the Arc Vault Relay is defective, it will not display the protection icon on its LED screen and will not change the state of the system status light or the output contact.

ARC VAULT RELAY & CONNECTIONS

- Arc Vault Relay Control Power Input is 24VDC derived from GE Power Leader Power Supply #PLPS4G01 or #PLPS3G01. See Arc Vault Power Supply on page 16.

- Arc Vault Relay is door mounted and fits onto a 22” wide by 21” high auxiliary compartment door.

- Arc Vault Relay and CT locations are placed for each specific switchgear assembly within component limits and engineering standards.

- Arc Vault Relay indicators are active only when 24VDC control power input available.

- At initial start-up, the Arc Vault Relay reports its status as “Not Ready” until the internal watchdog has determined the unit is operational at which point the Arc Vault Relay will report its status as “OK” or Active.

- Operates with standard control power transformer (CPT) schemes, including ride-through for control power transfer.

- The Arc Vault Relay will display “Active” and change its Positive Feedback output contact to (NC) when the user places the activation switch into the “On” mode and the internal watchdog has confirmed that the relay is in the protective mode.

- Output contacts of secondary disconnect are 24 VDC.

- Input contacts do not require high fidelity contacts and are compatible with standard contacts used in SB-1, SB-9, SBM, CR104 and P9 control devices.
Arc Vault Relay Input Definitions & Ratings

**Control Power** – The Arc Vault Relay power source input is rated for 24VDC and provided by Arc Vault Power Supply. See Arc Vault Relay description in Figure 3-1. Arc Vault Power Supply on page 16. See Figure 3-1 for wiring configuration.

**Test Switch** – input to monitor status of a user initiated test of the Arc Vault Protection System. See Arc Vault Relay Figure 3-1 for input behavior and wiring configuration. The switch positions are labeled as “NORMAL” (center position) and “TEST” (right position). The switch has a spring return to “NORMAL” position from “TEST” position.

**Activation Switch** – input to monitor the status of a user initiated activation of the Arc Vault Protection System. See Arc Vault Relay Figure 3-1 for input behavior and wiring configuration. The switch positions are labeled as “TEST LIGHT,” “OFF” and “ON.” The switch has a spring return to “OFF” from the “TEST” position while all other positions are maintained.

**Current Transformers (Phase A, B, C)** – current signal inputs to monitor presence of fault current during an event. These inputs require a 5000/5 A relaying class CT with a minimum rating of C50. See Figure 3-1 for wiring configuration.

**ARC VAULT ACTIVATION SWITCH**

The Arc Vault Activation (ACT) switch must be turned on to energize the Arc Vault Protection System. The location of the Activation switch and its indicating lights are at the top of the Arc Vault stack in the right corner. See Figure 5-4.

Arc Vault Relay Output Definitions & Ratings

All output contacts are shown in the normal (no fault / system ready) state and are “held” active (closed) for normally open contacts (NO) or “held” active (open) for normally closed contacts (NC). Loss of control power from the Power Supply to the Arc Vault Relay changes output contacts from their normal state.

**Arc Vault Fire** – Dedicated output to initiate the operation of the plasma gun within the Arc Vault Device when an event has been detected. This contact mimics a single normally open (NO) contact with a rating of 24 mA @ 24 VDC.

**Positive Feedback Output** – Dedicated dry contacts to provide a contact closure confirming that the relay has received an “On” input from the activation switch and that the relay internal watchdog confirms the protective mode is active.

**Breaker Trip** – Solid state relay (SSR) in Arc Vault Relay to initiate the opening of either a MV circuit breaker or a LV main circuit breaker when an overcurrent has been detected. This is a single normally (NO) contact with a rating of 24VDC~250VDC/30 amps or 85VAC~260VAC, 50/60Hz, 20 amps. Use of this contact is restricted to the tripping of an upstream circuit breaker as described in Figure 3-2.

**86 Trip** – SSR in Arc Vault Relay to initiate operating the lockout relay (86 device) when an overcurrent has been detected. Comprised of a single normally (NO) contact with a rating of 24VDC~250VDC/30 amps or 85VAC~260VAC, 50/60Hz, 20amps. Use of this contact is restricted to tripping the lock-out relay (86 device) as described in Figure 3-2.
The relay system will allow the user to select a setting from 0.8x to 3x in 0.2x increments.

Note: The system always assumes a 5000A nominal system for the trip setting regardless of the equipment nominal rating (e.g., 800A, 1600A, 2000A, 3200A, 4000A, etc.).
Arc Vault Relay Bkr Trip and 86 trip contacts are typically wired internally to the lockout relay or to a terminal block point (TB) when tripping a circuit breaker external from the switchgear assembly. The control bus for these circuits will be derived either by:

- A customer supplied source, which must have stored energy to maintain control voltage during a fault
- A dedicated CPT source within the Arc Vault Protection System stack, such as a UPS, capacitor trip or station battery

The Arc Vault Relay PT inputs use an industry standard PT ratio of 600/120.
Arc Vault Device Input

- Dedicated input from the switchgear control wiring to receive “fire” signal from Arc Vault Relay.
- Dedicated input from Arc Vault Power Supply (24VDC) for the capacitor charging circuits.

Arc Vault Device Output Definitions & Ratings

All output contacts are shown with the Arc Vault Device in the “Connect” position.

Dry contacts used to monitor the capacitor status and comprised of (2) form-c contacts that change state based upon the charge status of the capacitors. The contacts are “held” active when the capacitors are fully charged.

Target Output – Dry contacts used to monitor gun target status and comprised of (2) form-C contacts that change state when a signal is received from the Arc Vault Relay through the Fire Input and the gun Target changes state. The target and contacts are manually reset. All of these contacts are used in the control circuit.

ARC VAULT POWER SUPPLY

Each Arc Vault Protection System is provided with a dedicated Power Supply to convert the customer available AC or DC control bus source to a 24VDC control bus specific for the Arc Vault Protection System. This Power Supply should not be used to support other devices or systems beyond this publication.

Details of Arc Vault Power Supply

- Used with customer supplied or control power transformer (CPT)-generated power sources. Customer power supplied source could be a CPT connected to the Arc Flash Protected bus, battery bank or a separately derived AC source. Output will be maintained for a sufficient time to ensure successful operation in the event of an input voltage drop due to an arcing event.
- Generates a 24VDC output power source for the Arc Vault™ Protection System components.
- Is surface mounted and fits onto a 22” wide by 21” high auxiliary rear compartment barrier or intermediate hinged barrier.
- Each connection point can support the termination of two wires and optional wire markers.
- Wire type, size and rating is compliant with NEC, UL1558 and C37.20.1 standards and acceptable wiring practices.

- The location of Arc Vault Power Supply and necessary fuses/grounds are defined by engineering standards for each specific switchgear assembly and within component and technical limits.
- Supports the following devices without degradation in performance:
  - Arc Vault Relay up to (1) maximum
  - Arc Vault Device up to (1) maximum
  - ET-16 LED Indicating Lights up to (9) maximum
  - C-2000 Auxiliary Relay up to (8) maximum
- Will operate without degradation of performance when used with GE switchgear control power transformer (CPT) schemes.
- Will operate without degradation of performance with customer provided power source that can either be grounded or ungrounded per NEC requirements.

CURRENT AND POTENTIAL TRANSFORMERS

Current transformers are available to monitor the current flowing to the switchgear intended for protection. See Figure 3-1 for a typical connection diagram.

Details of an Arc Vault current transformer

- Uses a ratio of 5000/5 Amps, relaying class C50, or better.

  Note: A split-core current transformer could be used, if it meets a class C50 rating.
- Shipped separately to be installed by a contractor or end-user.
- Compliant to all IEEE and UL standards for relaying class CTs.
- The Current Transformer and Arc Vault Relay performance is not degraded with variation in cable and bus geometry through the solid core CT window.
MEDIUM VOLTAGE (MV) OR LOW VOLTAGE (LV) MAIN CIRCUIT BREAKER REQUIREMENTS

The Arc Vault Protection System will rely upon either a circuit breaker on the medium voltage (MV) side of the transformer or a low voltage (LV) main circuit breaker to isolate the power source from feeding an event. This device is commonly referenced as a circuit breaker.

Controllable upstream device details

- A Circuit Breaker that is capable of being tripped via a dry contact (Breaker Trip) from the Arc Vault Relay.
- Is fully rated to interrupt the voltage and short circuit rating of the connected power system.
- The Circuit Breaker close circuit can be controlled electrically with a dry contact from the Lock-out Relay (86) to prevent accidental re-closure after an arc flash incident has occurred.
- Will interrupt and clear the full short circuit rating of the connected power system within 5 cycles or less.

ARC VAULT PROTECTION SYSTEM TESTS

The Arc Vault Protection System can be tested while installed within the switchgear assembly.

Arc Vault Device/Arc Vault Relay Test: Using the control circuits an operator may perform this test. The test is initiated by turning the Test Initiate Switch to the “Test” position. By the nature of the control circuit this test cannot be initiated unless the Arc Vault Device is in the “Test” position.

This test confirms functionality of:
- The Arc Vault Relay Plasma Gun fire contact, switchgear wiring and Arc Vault Device capacitor and Plasma Gun circuits.
- Arc Vault Device Position Switches, Cap Status Contacts, Cap Status Indicators, Target Contacts and switchgear wiring.
- This test does not confirm functionality of:
- Arc Vault Relay Current Transformers.
- Arc Vault Device transfer capability or voltage collapse across Arc Vault Device electrodes.
- Dielectric Integrity of Arc Vault Device or Arc Vault Cassette.
- Does not open upstream circuit breaker or confirm operation of upstream circuit breaker trip circuit.

OPERATING MODES

Three dedicated indicating lights that provide distinct status of readiness (Modes) for the Arc Vault Protection System. The customer can select or affect these modes of operation by either changing the position of the Activation switch or racking the Arc Vault Device within its cassette. The mode of operation can also automatically change based upon the “Readiness” of the Arc Vault Protection System components. See Table 3-1 below for details.

The indicating lights of the Arc Vault Protection System will not provide the customer with a false level of protection in any mode of operation including failure of the Arc Vault Protection System components.

Table 3-1 Activation Switch (ACT) operating modes in connect position

<table>
<thead>
<tr>
<th>Activation Switch (User Selectable)</th>
<th>Arc Vault Device</th>
<th>Arc Vault Relay</th>
<th>Red Indicating Light (No Protection Mode)</th>
<th>White Indicating Light (Arc Vault Relay Mode)</th>
<th>Blue Indicating Light (Arc Vault Relay &amp; AVD Mode)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Off</td>
<td>Not Ready</td>
<td>Not Ready</td>
<td>On</td>
<td>Off</td>
<td>Off</td>
</tr>
<tr>
<td>Off</td>
<td>Ready</td>
<td>Not Ready</td>
<td>On</td>
<td>Off</td>
<td>Off</td>
</tr>
<tr>
<td>On</td>
<td>Not Ready</td>
<td>Not Ready</td>
<td>On</td>
<td>Off</td>
<td>Off</td>
</tr>
<tr>
<td>On</td>
<td>Ready</td>
<td>Not Ready</td>
<td>On</td>
<td>Off</td>
<td>Off</td>
</tr>
<tr>
<td>On</td>
<td>Not Ready</td>
<td>Ready</td>
<td>Off</td>
<td>On</td>
<td>Off</td>
</tr>
<tr>
<td>On</td>
<td>Ready</td>
<td>Ready</td>
<td>Off</td>
<td>On</td>
<td>On</td>
</tr>
</tbody>
</table>
SECTION 4. ACCESSORIES

ARC VAULT DEVICE/CASSETTE

The Arc Vault Device/Cassette can be provided with the following accessories and standard equipment:

- Up to two field installable optional kirk key interlocks. (optional).
- Racking Handle storable within Arc Vault Device Cassette – Standard.
- Optional Racking Handle not storable within Arc Vault Device Cassette.
- Lifting Bar for use with lifting means – Standard (catalog no. GAVLDII).
- Optional Door Interlock. Permits opening cubicle door only when AV device is racked to the TEST or DISCONNECT position.
- Optional 4” sub base assembly.
- Optional remote racking device.
SECTION 5. PHYSICAL DATA & ORDERING INFORMATION

ORDERING
The Arc Vault Protection System is a requisition engineered product that is ordered similar to LV switchgear. The key aspects to define prior to ordering are:

- System Voltage
- System Frequency
- System Max kA
- System control voltage, 120/240VAC, 120/240VDC, 48VDC including UPS for AC models
- Arc Vault lock out arrangement (ex. 86 lockout)
- Lifting and racking means (including remote racking)
- Special wiring including special key locking provision

Note: Cable run from gear to Arc Vault must be in a nonmagnetic conduit.

- Additional relaying and control requirements including control of the upstream interrupting device
- Primary power feed provisions including top feed, bottom feed and cable routing (e.g., Busway or cable tray)
- Site specific requirements such as power system studies and arc flash studies, height of room, location of the Arc Vault Protection System, mounting provisions (housekeeping) pad provisions and CT placement (zone of protection)

PRODUCT DIMENSIONS
The Arc Vault Protection System is 24” wide by 48” deep by 78” high and requires 12’ of floor to ceiling clearance. The stack weight is approximately 2050 lbs.

ARC VAULT STACK COMPONENTS
The Arc Vault Stack consists of unique riser codes or stack that will support the applications detailed in Application Data section. See Figure 5-1 for stack details.
Exhaust Door requires clearance from conduit, plumbing and other mechanical devices.

To meet ANSI C37.20.7 arc-resistant standards, ceiling height must be min. 12 feet from floor. Exception to this requirement is above cable entry space. Sprinkler heads cannot be located within a 5-foot radius of the perimeter of the Arc Vault stack.

Open Exhaust Door Height is 94.1 inches.
Figure 5-3 Arc Vault Stack Controls and Indicators

**ARC VAULT DEVICE COMPARTMENT**

The Arc Vault Device Compartment consists of an Arc Vault Device Cassette along with a set of unique sub-assemblies to integrate this assembly into the Arc Vault Stacks detailed in Section 7.

**ARC VAULT DRAWOUT FRAME**

The drawout frame is similar to a standard circuit breaker and includes a Closed door drawout device with four (4) unique positions of connect, test, disconnect and withdrawn.

**ARC VAULT INDICATORS AND SWITCHES**

The preferred location for the Arc Vault Activation Switch (ACT) and Indicating Lights is within the instrument tray. Location of these components can be elsewhere within technically defined limits of requisition engineering.

The instrument tray shall include the following components as illustrated in Figure 5-3:

- 4 circuit breaker control fuses (optional quantity from 0 up to a maximum of 4)
- 2 Arc Vault Device indicating lights (1 Red IL, 1 Green IL)
- 4 Arc Vault™ Protection System indicating lights (1 Blue, 1 Yellow, 1 Red and 1 White)
Figure 5-4 Arc Vault Instrument Trays

Blue Light indicates full system protection
White Light indicates Relay-only protection
Red Light indicates no protection
Amber Light indicates event
System Activation Switch

Green Light indicates Arc Vault Device Ready
Red Light indicates Arc Vault Device Not Ready
Arc Vault Device Test Switch
SECTION 6. APPLICATION DATA

OVERVIEW

The Arc Vault™ Protection System is used to sense and arcing fault and transfer energy away from the fault into its own arc containment chamber within a few milliseconds to minimize the incident thermal arc flash energy available to the original arcing fault. Simultaneously the system will trip a line side circuit breaker to interrupt current into the system.

It is recommended that the GE Arc Vault Protection System only be installed in consultation with a qualified power system engineer familiar with Arc Flash Incident energy calculations and a qualified electrical safety professional familiar with the system, the Arc Vault™ Protection System and the intended use of the system. The Incident Energy available during arcing fault conditions on a system protected by a GE Arc Vault Protection System may be calculated by qualified personnel in accordance with the IEEE 1584 guide and the Time Current Curve for the Arc Vault Protection System (AV TCC), when applied as follows.

- With Medium Voltage (MV) controllable device or Low Voltage (LV) main circuit breaker that operates & interrupts in less than 5 cycles.
- Connected to 3 Phase/3 Wire and 3 Phase/4 Wire power systems including delta, floating delta, solidly grounded delta, solidly grounded wye, high resistance grounded wye configurations and high resistance grounded delta systems.
- Power Source can be transformer fed or generator fed.
- Frequency: 60Hz nominal; 48 ~ 72Hz application range (based on IEEE C37.50/51... 60Hz +/-20%).
- Nominal Phase to Phase Voltage 480-460VAC
  - Maximum Phase to Phase Voltage of 508 VAC
  - Minimum Phase to Phase Voltage of 380VAC
- One Arc Vault system is designed to protect one bus. Protection for systems with multiple buses is possible and configuration may vary. Contact your GE Engineering Services office for consultation.
  - Provides protection as defined later in this specification for single, double ended or multi-sourced switchgear lineups with tie-breaker schemes. When the Arc Vault is enabled automatic throw-over schemes should be disabled. Closed transition or parallel operation provide additional complexity and may not be able to be handled. Contact your GE Engineering Services office for consultation.

- When a remote Arc Vault Stack is used to protect an existing switchgear lineup, the connecting primary cable or bus length may not exceed 50 linear feet when using 2000A copper cables assuming a minimum of (6) 500MCM cables per phase. Conduit must be non-magnetic.

The Arc Vault Protection System limits the maximum incident energy by transferring the system’s energy into its arc containment chamber. When implemented within its application rating (22-65kA & 480VAC nominal) the Arc Vault Protection System should limit arcing time within 8 ms resulting in incident energy, calculated per IEEE 1584, of less than 1.2 calories, at 18” and for arcing gaps of 25 mm or larger.
Figure 6-1 is the AV-TCC. The device will work from the sensed current that is expected to be an arcing fault or high impedance fault that allows the system voltage to stay high enough to trigger the GE Arc Vault™ Protection System. The current sensing may be adjusted from 4000 A to 15000 A in 1000A increments (5000A CT, 0.8X to 3X in 0.2X increments).
The AV-TCC is derived from the curve shown in Figure 6-2. This figure represents the arcing time for tests done at 480V with a 25mm arcing gap at the fault initiation point. Tests were done at various available fault currents (Ibf) ranging from 10kA to 65kA. The arc was initiated in an open box sized at 20x20x20” or smaller. The AV-TCC applies only to systems able to deliver 22kA or higher Ibf. The two diagonal lines are the constant energy lines for 1.2 calories at 18” with a 25mm electrode gap: the blue upper line is for a 480/277V grounded system, the red lower line is for a 480V floating or high resistance grounded system. The horizontal dotted upper lines represent the typical clearing range for a low voltage power circuit breaker, 2.5 – 3 cycles at 60Hz.

**APPLICATION CONSIDERATIONS**

Time Current Curve (TCC) for Arc Vault used in a 480V system, based on 25mm minimum arcing gap (may be larger, but not smaller) at the protected equipment and 22kA or larger Ibf at the bus where the Arc Vault is connected.

**System conditions**

- Full post arc initiation time from 22kA to 65kA Ibf, based on a 25mm gap is 7 milliseconds. Nominal 480V.
  - Larger arcing gaps should result in equal or faster times.
  - Timing applies to systems with a nominal 480V. Lower or higher voltage may result in slightly different timing with no significant effect on incident energy.
  - Timing applies to solidly grounded, resistance grounded or floating systems at 480V.
  - Timing is based on transfer from an open box. Times from a fully enclosed box may vary.
- Available fault current at the protected bus may be as low as 14kA, but minimum 22kA at the bus where the Arc Vault is connected.

**Pickup settings**

- Operation of the Arc Vault is based on its own arcing gap and the gap at the original fault arc point. Tests were done with a 25mm gap at the original arcing fault initiation point. Times for fault gaps with larger gaps will be equal or faster than indicated in Arc Vault TCC.
- The system requires three 5000/5A CTs of relaying class C50 or better. Settings may be adjusted from 80% to 300% of CT rating in 20% increments. The setting has a +10% reading tolerance (i.e., –9%, +11% of nominal pickup setting shown on TCC).
- 85% expected arcing current MUST be higher than the maximum tolerance for the selected pickup setting of the Arc Vault sensing system.
- The arcing gap at the original arcing fault point determines the fault arcing current which drives the Arc Vault’s sensing system. It is important to set the arc vault sensing threshold below the minimum expected
Arc Flash incident energy

- The Arc Vault TCC may be used in Arc Flash calculations on all 480V, solidly grounded, impedance grounded, or floating, systems expected to deliver 22kA to 65kA bolted fault current at the point where the arc vault is connected.

- If available fault current is lower than 22kA, but higher than 10kA the Arc Vault will still function but a few additional milliseconds may be required for full transfer. The TCC is not accurate in that range, but less than 1.2 calories per square cm is still expected at 18".

Connection and requirements

- The Arc Vault Protection System must be connected with (6)-500MCM copper cable using non-magnetic duct. Cable length may be up to 50 feet (15 meters).

- The Arc Vault Protection System uses 24VDC provided by an internal power supply. The power supply requires control power in the 120–250V AC or DC range. For reliability power may be provided from multiple separately derived systems as long as the throw-over is rated to operate in 300ms or less.

- The 5000A CTs may be connected up to 150 cable feet away (300' loop) from the Arc Vault Relay using 12 AWG or lower wire.

- Arc Vault – Primary connection: The Arc Vault retrofit stack is equipped with cable tap-offs and lugs at the rear of the gear, sized to accommodate the required (6) 500 MCM cables (per phase).

- Switchgear – Main Bus Tap-off point: The Arc Vault retrofit stack must be connected to the intended equipment lineup directly below the upstream controllable device (MV/LV breaker) that it is intended to trip. The Arc Vault Protection System will provide a protection zone only below the main bus tap-off point. (Main bus cable tap-offs not provided.)

Line side disconnect device selection and control

- In active mode, Arc Vault Protection System will sense current and immediately operate a designated line side circuit breaker to initiate fault current interruption. If the sensed voltage exceeds the factory set threshold then it will also initiate an energy transfer. A voltage below the threshold indicates a collapsed system or a bolted fault condition and the Arc Vault Relay will not be signaled to transfer energy.

- The line side device (upstream) may be a low voltage main or a medium voltage primary main for a transformer. Control power to operate the shunt trip, capacitor trip or other trip mechanism must be supplied by the installer.

- Back up. The installer may, at his option, install additional overcurrent control or transfer tripping with current sensing, delay or circuit breaker operation logic to operate another circuit breaker further upstream.

- The controlled circuit breaker used to interrupt current to the GE Arc Vault Protection System must be maintained per the manufacturer’s recommendations and ensured to be in proper working order at all times.

Protection Methodology

The Arc Vault Protection System works by sensing current and voltage. Current above the user set threshold causes the Arc Vault Protection system to open the controlled circuit breaker. If the system simultaneously senses sufficient voltage to indicate that the high current is caused by an arcing fault then the Arc Vault™ absorption is triggered to transfer the energy away from the arcing fault. Modern trip systems such as the EntelliGuard® TU electronic trip may also be provided with a temporary instantaneous setting called RELT (Reduced Energy Let-Through) for GE, Maintenance Switch by other manufacturers. This trip capability may be used as redundant back up protection for control of the circuit breaker. Figure 6-3 is a simplified one line of the control system controlling a low voltage substation main circuit breaker. A similar system can be used to control a medium voltage circuit breaker on the transformer’s primary. When controlling a Medium voltage main the Arc Vault must be connected to the bus at the transformer secondary on the line side of the secondary main.

The Arc Vault should not be connected in such a manner that it cannot be disconnected from the source while the faulted bus remains connected to any source. Any circuit breaker that separates the Arc Vault from the source providing fault current must also disconnect the source from the fault.

In Figure 6-3 the Arc Vault controls the secondary main. Figure 6-4 shows an implementation controlling the primary main. Figure 6-5 implementation is incorrect because the controlled circuit breaker can disconnect the faulted bus but the arc vault remains connected. Similarly, in Figure 6-6 the Arc Vault cannot be connected in such a manner that it can be disconnected from the faulted bus if the faulted bus can remain energized after the Arc Vault is disconnected from the source.
In any application involving multiple sources such as a double-ended substation, an Arc Vault™ Protection System will be required for each bus. Any automatic Throw-Over (ATO) scheme should be disabled during Arc Vault™ Protection System operation whether the transition is open or closed. For more complex control implementations...
contact GE Engineering Services for consultation prior to implementation or system design.

CONFIGURATIONS

The following illustrations convey how the Arc Vault™ Protection System is applied to provide protection for an existing lineup of switchgear. The illustrated applications are single-ended lineups but double-ended lineups and multi-source lineups are within scope of this product. The Arc Vault™ Protection System should not be applied for closed transition and paralleling applications. Additional Arc Vault Devices and Arc Vault Relays are required for additional power sources (e.g., two Arc Vault systems are required for a double-ended lineup).

The following configurations convey only typical or possible applications of switchgear assemblies but do not detail all possible combinations.
Configuration 1 – Remote Located Stack w/ Arc Vault on the Line side of the LVPCB mains (CTs not in Swgr)

The current transformer’s placement, as shown outside the lineup, dictate which sections and/or primary bus is monitored for a fault level of current associated with an arc flash incident. See Operating Modes of Arc Vault Protection System on page 17 for details.

In this configuration, only areas highlighted in yellow are provided with protection as defined in Product Features on page 32.

Figure 6-7 Single-ended (Radial) Application with Remote Arc Vault Stack

The lock-out relay (device 86) is wired in such a manner that the upstream circuit breaker cannot be closed unless the lock-out relay is manually reset by the user. Once the Arc Vault Device and target equipment is inspected/maintained and the lock-out relay is reset; the user can then close the upstream circuit breaker to restore power to the application.

This configuration assumes that there is only one power source for the load bus.
Configuration 2 – Remote Located Stack w/ Arc Vault on the Load side of the LVPCB mains

The current transformer’s placement, as shown in stack 101, dictate which sections and/or primary bus is monitored for a fault level of current associated with an arc flash incident. See Operating Modes of Arc Vault Protection System on page 17 for details.

In this configuration, only areas highlighted in yellow are provided with protection as defined in Product Features on page 32.

The lock-out relay (86 device) is wired in such a manner that the upstream circuit breaker cannot be closed unless the lockout relay (86 device) is manually reset by the user. Once the Arc Vault Device and target equipment is inspected/maintained and the lock-out relay (86 device) is reset; the user can then close the upstream circuit breaker to restore power to the application.

This configuration assumes that there is only one power source for the load bus.

Figure 6-8 Single-ended (Radial) Application with Remote Arc Vault Stack
PRODUCT FEATURES

The Arc Vault Protection System is supplied to protect either a new switchgear assembly or an existing installed switchgear assembly:

- The Arc Vault Protection System will be classified as Low Voltage Metal-Enclosed Switchgear per IEEE C37.20.1 with UL Listed label for third party verification when applied within the following ratings:
  - 480VAC phase to phase voltage
  - 60Hz nominal frequency
  - 22kAIC~65kAIC @ 480VAC
  - When protected with an acceptable upstream device as described in "Medium Voltage (MV) or Low Voltage (LV) Main Circuit Breaker Requirements" on page 17.

- Without an external exhaust chimney

- The Arc Vault Protection System when operated in active mode provides a total arcing time as shown in the blue curve in Figure 6-2.

- The Arc Vault Protection System when operated in Arc Vault Relay Mode provides a total clearing time as shown in red in Figure 6-2.

ARC VAULT DEVICE REJECTION SCHEME

The Arc Vault Cassette has a unique rejection scheme as detailed in Table 6-1 below. The rejection scheme will prevent an EntelliGuard® G circuit breaker from racking into an Arc Vault Cassette and an Arc Vault Device from racking into an EntelliGuard G circuit breaker cassette.

<table>
<thead>
<tr>
<th>Device Position in the cassette</th>
<th>Primary Disconnects</th>
<th>Secondary Disconnects</th>
<th>Arc Vault Functionality</th>
<th>Arc Vault door position</th>
</tr>
</thead>
<tbody>
<tr>
<td>CONNECTED</td>
<td>Engaged</td>
<td>Engaged</td>
<td>Arc Vault can be operated electrically. Able to transfer arc.</td>
<td>Closed</td>
</tr>
<tr>
<td>TEST</td>
<td>Disengaged</td>
<td>Engaged</td>
<td>Arc Vault device able to be tested. Control circuits operations can be tested and verified. Plasma gun can be discharged.</td>
<td>Closed</td>
</tr>
<tr>
<td>DISCONNECTED</td>
<td>Disengaged</td>
<td>Disengaged</td>
<td>Locked out during transition, Safe for maintenance when fully disconnected.</td>
<td>Closed</td>
</tr>
<tr>
<td>WITHDRAWN</td>
<td>Disengaged</td>
<td>Disengaged</td>
<td>Arc Vault can be removed from the compartment. Safe for maintenance.</td>
<td>Open</td>
</tr>
</tbody>
</table>

Table 6-1 – Arc Vault Device Rejection Scheme
CURRENT TRANSFORMERS

The Arc Vault Protection System is compatible with CTs that provide a 5A secondary output. CTs can be located within the circuit breaker compartment, the breaker runbacks, bus compartment or external from the switchgear to be protected but within the component and technical limits.

The CTs are rated 5000/5A, relaying class C50 or better, and must be connected with less than 150 linear feet (300 loop feet) of 12 AWG (or thicker) wire.
SECTION 7. PHYSICAL DATA

ARC VAULT STACKS

The Arc Vault Stack consists of unique riser codes or stack configurations that will support the applications detailed in the Application Data section.

Arc Vault Stack details

- Vertical section of AKD-20™ switchgear comprised of a 24" wide, 78" high and 48" deep stack design.
- Contains one Arc Vault Device Cassette
- Free-standing section of unique AKD-20™ switchgear design. No special transition section or close coupling is necessary.
- Indoor construction only containing one 2000A cable tap off assembly allowing either top or bottom entry for customer cables.
- Requisition engineer defined assembly specific for each application within component and technical limits.
- Provided with 3 high compartment construction only (A compartment = 28" high; B & C compartment = 21" high).
- Arc Vault Cassette is provided with a shutter assembly as standard.
- Bolted Left and Right (split panels from front to rear) access covers (attaching hardware does not use taptites).
- Bolted Rear Access (single panel) access cover (attaching hardware does not use taptites).
SECTION 8. STANDARDS AND LABELING REFERENCES

APPLICABLE DOCUMENTS
The documents below shall be used as additional specifications.

- ANSI C37.13,16,17, & 50 Low-voltage AC Power Circuit Breakers
- ANSI C37.20.1 Metal-Enclosed low-Voltage Power Circuit Breaker Switchgear
- ANSI C37.51 Metal-Enclosed Low-Voltage Power Circuit Breaker Switchgear Assemblies – Conformance test
- ANSI C37.90 Standard for Relay Systems Associated with Electric Power Apparatus
- UL 1558 Metal-Enclosed Low-Voltage Power Circuit Breaker Switchgear
- IEEE 1584 Guide for Performing Arc Flash Hazard Calculations
- ANSI Z535 Safety Alerting Standards

ARC VAULT PROTECTION SYSTEM LABELS
The following labels will be applied to the Arc Vault Stack.

Activation (ACT) Tray Label – See Figure 5-4. Label placed next to ACT switch to inform user on the switch positions.

Activation (ACT) Warning Label – See Figure 8-1. Label placed on Arc Vault Device compartment door just below location of ACT switch in instrument tray.

Figure 8-1 ACT Warning Label

Activation (ACT) Control Power / Storage Warning Label – See Figure 8-2. If the control power for the Activation (ACT) switch circuit is protected by a fuse block or other disconnecting means in the Arc Vault Stack, then this label is applied next to this disconnecting device in the equipment. Only one label is provided and applied to the closest disconnecting device to the ACT control circuit.

Figure 8-2 ACT Control Power Warning Label

CODE/AGENCY REQUIREMENTS
The Arc Vault Protection System has an optional UL label confirming compliance to IEEE C37.20.1, UL1558 and applicable sections of C37.20.7.
SECTION 9. QUICK SPECIFICATION GUIDE AND INSTALLATION

SPECIFICATION CLAIMS

The GE Arc Vault Protection System will transfer energy in 8 milliseconds or less when applied within recommended guidelines. Incident Arc Flash energy at the arcing fault point will be reduced below 1.2 calories at 18" working distance based on IEEE 1584-2004 calculations, resulting in incident energy in accordance with IEEE 1584 at 18" from the arc event at less than 1.2 Cal/cm², with the circuit breaker compartment doors open, in a 480V 65kAIC system.

The GE Arc Vault Protection System for low voltage equipment reduces building construction costs because it does not require exhaust chimneys or plenums to direct the arc flash energy outside of the building, when compared to traditional arc resistant switchgear.

If an arc flash incident occurs during maintenance at the protected switchgear, the low-voltage switchgear can be operational again within a working day assuming appropriate replacement parts are available, which improves your overall system uptime when compared to traditional arc resistant switchgear.

The GE Arc Vault™ protection system reduces the energy flowing through the system by 60% or more compared to a bolted fault that would occur with a crowbar system. The energy reduction will lower the stress on other system components such as transformers, circuit breakers, and bus bar construction and improve your overall system uptime when compared to traditional arc resistant switchgear.

The Arc Vault Protection System can be retrofit or connected to existing GE or other manufacturers' low voltage equipment, including switchgear, switchboards, and MCCs.

The GE Arc Vault Protection System will protect the transformer transition section and the low-voltage lineup in a system that contains a controllable medium voltage upstream controllable device. In a system where an upstream controllable device does not exist, the GE Arc Vault™ Protection System can provide protection to the downstream low voltage equipment by controlling the secondary main.

The GE Arc Vault Protection System can be retrofit without having to replace the existing low voltage equipment lineup.

ARC VAULT READY OPTIONS FOR NEW SWITCHGEAR

New lineups of GE AKD-10, AKD-20, and Entellisys Low Voltage Switchgear and GR Group mounted switchboards can be designed Arc Vault Ready for future installation of the Arc Vault Protection System.

The equipment could be designed with necessary bus tap offs and CTs fixed into place to allow minimized shutdown time to install and commission the Arc Vault Protection System at a later date.

Reference Guide form specification:
- No. 16405 Arc Flash Protection System
- No. 262305 Arc Flash Protection System

SITE SURVEY FOR RETROFIT APPLICATIONS

For retrofit applications the installation particulars must be assessed. A power system and arc flash study must be completed and any required information on the equipment and unit substation being protected must be collected prior to evaluation. GE Energy Services can provide these services and coordinate the entire project. GE must perform the start-up and commissioning of the Arc Vault Protection System once installed.

INSTALLATION ENVIRONMENT / REQUIREMENTS

- Indoor installation with minimum 12 foot ceilings without overhead obstructions or sprinklers
- Floor space for W2'x D4'. S side or rear accessible with proper egress (min 30” front and side/rear) to exits is required
- Maximum 50’ cable length away from point of connection to electrical system
- Controllable (electrically operated shunt trip of) LV or MV breaker up to 300’ away from AV stack
- CT location downstream of trip device and upstream of the Arc Vault tap-offs, up to 150 feet away from AV Current Transformers must be connected no more than 150 cable feet from the Arc Vault relay (300’ round trip)
- CTs should, preferably, be located on the line side of a secondary main or as close as possible to transformer bushings in case a primary device is controlled.
- Dedicated or very reliable power source for control power should be provided.
Example One Lines

Entire switchgear lineup protected
- Incoming bus, main breaker, main bus, feeders
- Trade-off CT sensor placement
- Reasonable close-coupling
- Retrofit or new construction

Using transfer tripping & other techniques upstream protectors may be added as back up.

Figure 9-1 Detection – upstream MV controllable device

- No MV controllable device
- Protected zone starts at LV main
- Main bus, feeders
- CT directly in line with main
- Retrofit or new construction

Using transfer tripping & other techniques upstream protectors may be added as back up.

Figure 9-2 Detection – LV main controllable
SECTION 10. FREQUENTLY ASKED QUESTIONS

Where are the marketing/promotional literature and presentations?

We have flyers, brochures and videos for Arc Vault. One video is named “GE Arc Vault Protection System – Learn How it Works” which explains the operation and shows a simulated arc flash event. Another video named “GE Arc Vault Protection System – See it in Action” shows the Arc Vault in operation.

Additional information available:
Arc Vault Protection System:
- web page, including a videos:
  http://www.geindustrial.com/products/static/switchgear/arc_vault.htm
- brochure:
  http://www.geindustrial.com/publibrary/checkout/Brochures|DEA-489C|generic
Arc Flash Solutions:
- web page:
  http://www.geindustrial.com/cwc/marketing/arc_flash/
- brochure:
  http://www.geindustrial.com/publibrary/checkout/Brochures|DEA-478A|generic
Industrial Solutions:
- web page:
  http://www.geindustrial.com/cwc/markets/industrial.htm?omni_key=MktIndusMO
- brochure:
  http://www.geindustrial.com/publibrary/checkout/Brochures|DEA-458|generic

What’s needed to test the system?

The system will have basic test procedure similar to breaker testing and commissioning. Testing will require control power. The standard test options include a system test and a capacitor functional test. Additional testing may be performed by a GE certified Arc Vault field technician (GE Energy Services). This testing includes plasma gun function, dielectric tests and overall preventative maintenance typical to circuit breakers.

How are the tests performed?

The device test is done by racking the Arc Vault Device to the test position and following the procedure provide in I, O&M manual. Some tests, such as capacitor diagnostics, can be performed in the connected position. A remote racking device can be used.

How do you check and or test the plasma gun?

The plasma gun can be test fired in the test position.

How do we perform maintenance?

Standard maintenance will consist of
- Performing the plasma gun test fire every year.
- POD replacement every (7) seven years
- Arc Vault Relay (AVR) replacement every 15 years

Maintenance after an event will consist of replacing the device. GE Energy Services may offer other options, such as sending the device back to the factory.

What information is on the front of the Arc Vault?

The Arc Vault cover contains capacitor status indication including (charged, charging (transition state) and discharged), event alarm button that pops out, push to charge, push to discharge and charge and discharge indicators. Other user information and functions include warning and information labels, Activation switch, Arc Vault Relay, and 86 lockout switch.

What is the capability specification for the Arc Vault Protection System?

- Will contain an arc in less than 8 ms with compartment doors open
- The incident energy will be less than 1.2cal/cm2 at 18”
- Can be retrofit onto existing LV equipment, including switchgear, switchboards, and MCCs as long as expected arcing gap within the equipment is not less than 25mm (1”)
- Reduces building construction costs because it does not require exhaust chimneys or plenums
- Can be returned to service within a working day in the event of an arc flash incident, which improves overall system uptime
- Reduces energy released by 63%, compared to typical arc quenchers or “crow-bar” type systems, which will lessen stresses on other system components, and improve overall system uptime

### What are the installation guidelines?

The specific product dimensions are 24”x48”x78” high. This “stack” will have both side and rear access capability so that it can be installed in any corner of a room. The installation distance is a maximum of 50 feet from the main bus being protected using (6) 500 MCM copper cables with a non-magnetic duct. The ceiling height must be a clear 12 feet from floor to ceiling above the Arc Vault Protection System.

### What are the constraints for downstream protection?

A system study will be necessary for downstream devices like switchboards and MCCs in order to coordinate properly with the Arc Vault. The main variables in the calculation are the distance between the Arc Vault to the downstream device and the pickup threshold determined by load characteristics to avoid nuisance tripping. Power system analysis is required for coordination of downstream devices and varies on installation characteristics like distance, current rating, kA, etc.

### How many arc transfers will the device handle?

We recommend the device be changed out or repaired after any arc flash event and that a spare apparatus be purchased.

### What is the lifespan of the capacitor? Does it need to be replaced at certain intervals?

The capacitor lifespan will vary by ambient conditions but GE recommends replacing it after seven years, which could be coordinated with a preventative maintenance schedule.

### What are the known or anticipated failure modes?

Failure may occur when not performing regular maintenance or repair/replacement after an event. Nuisance tripping may occur if the activation switch is left in the ON position due to current inrush situations. Electronic components could fail resulting in a diagnostics alarm. Note that components are similar to circuit breaker and trip unit designs and would have similar failure modes.

### What info is required to specify? Do we have a guide form spec developed to share with customers?

There are general guidelines for specification that can be developed primarily on a case-by-case basis using the literature available and this document. There is also application support available through the marketing, product management, technology and services teams. A guide form specification is under development.

### If not a total voltage collapse like an arc quencher or crowbar, what is the expected voltage dip amount during operation?

This depends on the fault level but for a 480VAC 65kA system, the voltage dip is approximately 50%, compared to a typical arcing fault dip of 35%. The voltage drops to 0 when the breaker opens.

### Will a pad need to be poured to place the AV stack on?

A concrete pad is not necessary for the installation if the optional 4” metal sub-base is ordered.

### Is the AV available in outdoor construction?

Not at this time. The Arc Vault is only offered for indoor construction or inside a powerhouse or similar structure that would classify as indoor.

### What are the control power requirements and options?

The control power must be 115-240 VAC, 48 VDC or 125-250 VDC. The power should be supplied from a source other than the protected equipment’s source. A control power system backed up with batteries is preferred. Optional UPS and CPTs can be used to improve the control power quality.

### What connection options are available?

The Arc Vault Protection System can be connected by top or bottom feed only with (6) 500 MCM copper cables.

### What are the maximum short circuit withstand ratings that the Arc Vault can be applied?

The Arc Vault may be applied at a maximum 65kA on a 480VAC system at 60Hz.

### Users may be interested in how "spares" would work. If the vault fires, can the equipment owner simply remove the Arc Vault Device and replace it with a spare?

Yes, there may be some cleaning and test diagnostics needed. The cubicle may need some cleaning, controls should be checked out but the Arc Vault Device itself can be easily replaced, racks in/out like a CB.

### Are there any fault diagnostics/warning lights that would warn that the system is not working properly?

Yes. There are status contacts available that will indicate if the system is armed, not armed and an event signal contact. Additional indication and warning contacts can be supplied and designed via requisition engineering.
How is the Arc Vault configured in a HRG system vs. other grounding systems?

The Arc Vault™ Protection System on HRG systems will not trigger on a line-to-ground fault since the available fault current will be too low (10-15 amps) and it would not be necessary for the Arc Vault™ Protection System to activate. On other grounded systems it will protect on phase-phase, phase-ground, etc. On ungrounded systems, the protection will be phase-phase, 2 phase-ground, etc. In all systems it is up to the user’s coordination requirements to determine the current threshold levels.

What labels are placed on the equipment?

The Activation Switch (ACT) instrument tray label is placed next to the ACT switch to describe the switch positions. An Activation Warning label is placed on the Arc Vault Device compartment door just below the location of the ACT switch in the instrument tray. An Activation Control Power Warning label in the situation where the control power for the Activation Switch circuit is protected by a fuse block or other disconnecting means in the Arc Vault stack is applied next to this disconnecting device in the equipment and an incident energy label.

What are the typical incident energy levels with Arc Vault, and is the energy measured at 18” or 24”?

The incident energy for a 480VAC, 65kA circuit at 60Hz will be 1.2 Cal/cm² or less, measured at 18 inches.