SQUARE D COMPANY

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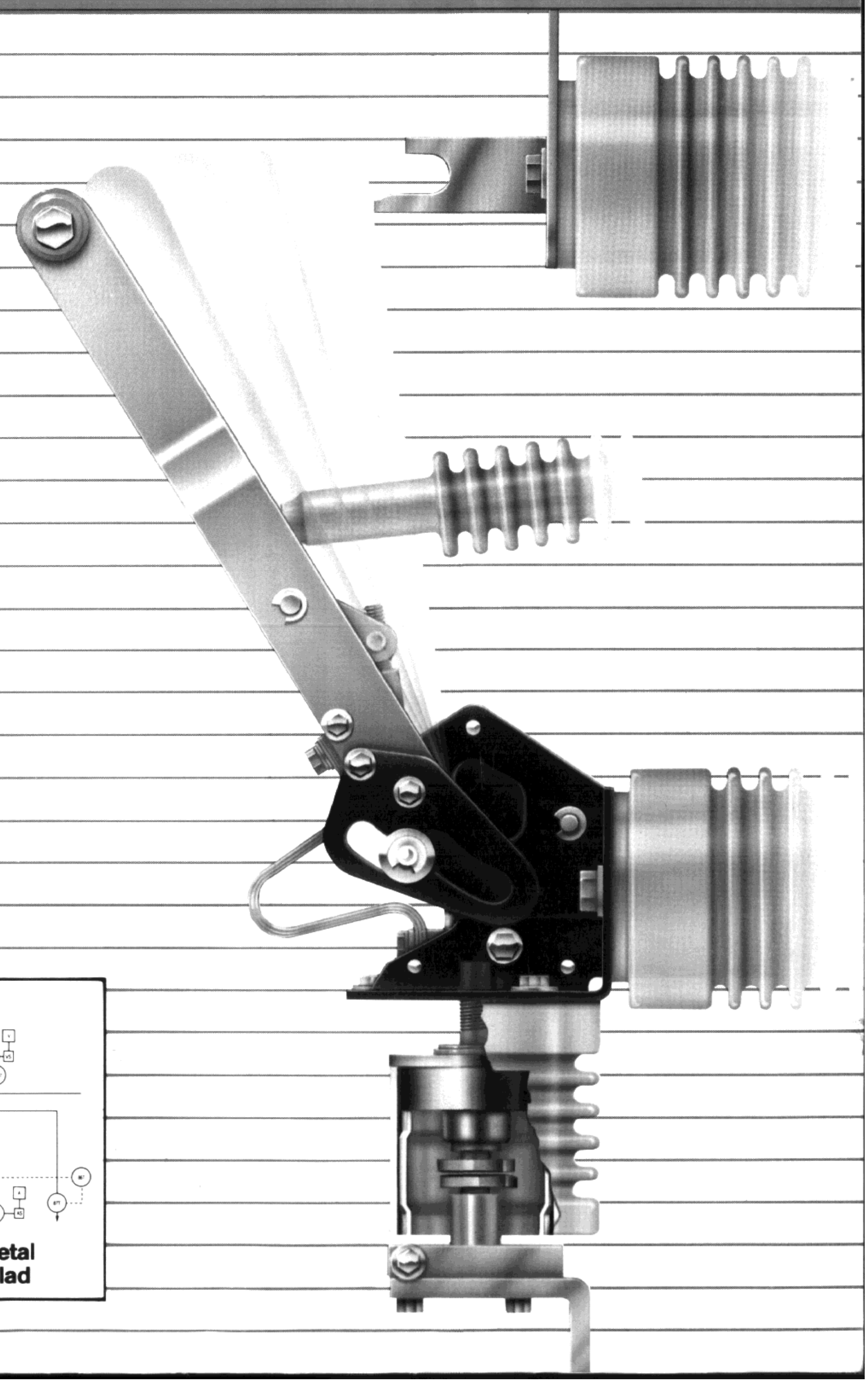
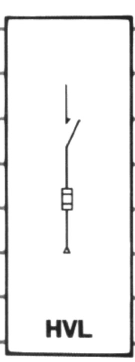
APPLICATION GUIDE

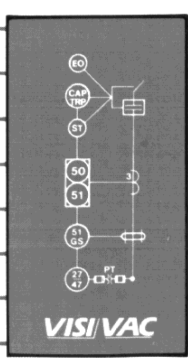
VISI/VAC™

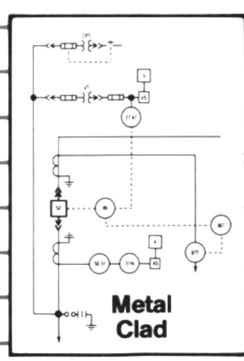
Medium Voltage Circuit Interrupter

CLASS 6046/9845









CONTENTS

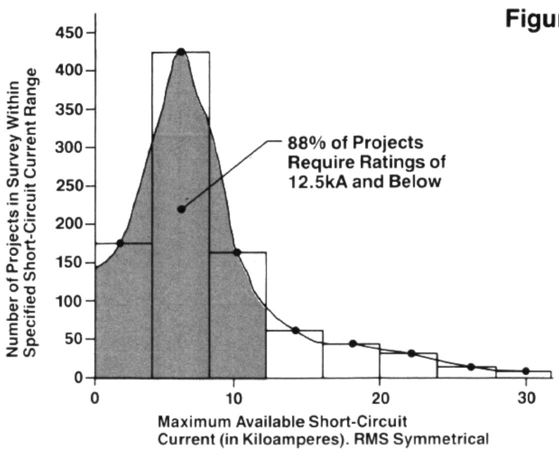
I. GENERAL INFORMATION

IA. *VISI/VAC* Introduction

We have all witnessed the changes in the electrical power industry in recent years. There is an increasing tendency for users to purchase power at medium voltage, typically 5 to 15 kV. Fortunately, this can mean a great savings to the user in the form of reduced power costs. Unfortunately, this benefit is not always taken into consideration when evaluating the overall cost of a project. This makes the task of specifying more difficult, as the project's initial price tag rises.

Now more than ever, specifiers are challenged to take advantage of new technology to maintain a high degree of selectivity and continuity of service, while providing maximum protection for the client at minimal cost. A nation-wide survey (Figure 1) of more than 800 commercial and industrial medium voltage systems (15kV) revealed that 30% of those systems had available short circuit current values less than 4000 amperes rms symmetrical, and on 88% of the surveyed medium voltage systems, the available short circuit current was less than 12,500 amperes rms symmetrical.

Figure 1



Clearly, new equipment designed specifically for these systems would provide the specifier an opportunity to reduce the customer's initial investment, while taking advantage of power purchased at medium voltage. Until now, there have been only two choices available to the specifier for medium voltage equipment: metal-enclosed load interrupter switchgear and metal-clad switchgear.

ANSI C37.20 defines **Metal-Enclosed** Interrupter Switchgear as metal-enclosed power switchgear including the following equipment as required:

- Interrupter switches
- Power fuses
- Bare bus and connections
- Instrument transformers
- Control wiring and accessory devices

The same section also gives us the following description of **Metal-Clad** Switchgear: metal-enclosed power switchgear characterized by the following necessary features:

- Draw-out main device(s)
- Devices completely enclosed by grounded metal barriers
- All live parts enclosed within grounded metal compartments
- Insulated bus
- Mechanical interlocks
- Secondary devices isolated from primary circuit elements

Today, the circuit interrupting devices most commonly available in 5kV and 15kV metal-**clad** switchgear are the vacuum and SF6 circuit breakers. Conversely, the metal-**enclosed** switchgear line, at the same voltages, consists primarily of fused or non-fused load interrupter switches.

Protection vs. Cost

Often, design considerations preclude the use of metal-enclosed load interrupter switchgear because it cannot provide the protective functions desired in a distribution system. The use of ground fault or overcurrent protection is frequently ruled out due to the limited interrupting capability of the load break switch and the increased cost of using metal-clad breakers. Consequently, these functions are omitted from the specifications and the user sacrifices an important level of protection.

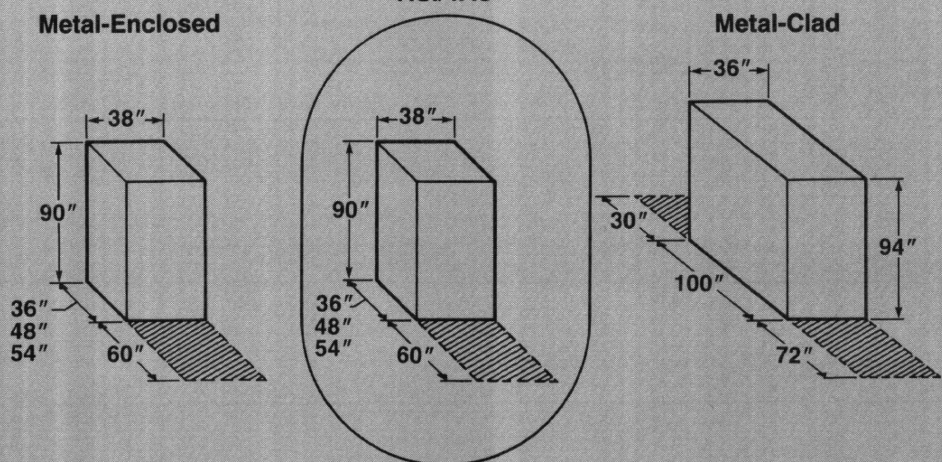
There has long been a need for a device that could offer these additional functions without the expense of metal-clad switchgear. The *VISI/VAC* circuit interrupter fills the application gap between load interrupter switchgear and metal-clad switchgear by offering these protective functions at a cost that can be justified to the owner, while requiring no more floor space than conventional metal-enclosed switchgear.

The unique *VISI/VAC* circuit interruption/isolation system combines automatic, visible blade disconnects in series with vacuum interrupters. A patented camming mechanism enables the *VISI/VAC* interrupter to open the circuit and extinguish the arc within the vacuum interrupters prior to the isolation blades opening automatically. When closing the circuit, the blades close first followed by the vacuum interrupter contacts. This manner of circuit interruption and automatic visual circuit isolation is unique to the industry.

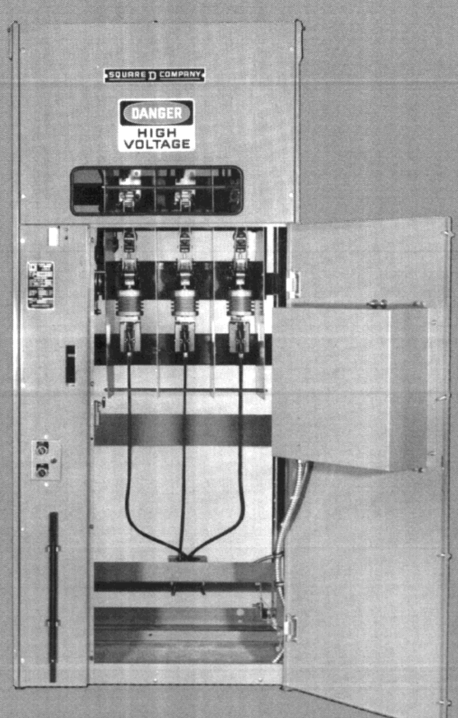
IB. General Description

- No External Arcing - current interruption within vacuum interrupters
- Automatic Visible Isolation of Circuit
- Interrupts Fault Current in Excess of Twenty Times Its Continuous Current Rating without Fuses
- Eliminates Contact Replacement
- Long Life - 1200 Full Load Interruptions
- Shunt Trip Mechanism
- Motor Operator Available for Remote Operation
- Protective Relaying Capability (phase overcurrent, ground fault, phase failure, undervoltage, etc.)
- Requires No More Floor Space Than Conventional Metal-Enclosed Air Switches and Offers Complete Front Accessibility (Figure 2)
- Retrofit Opportunities with Existing Load Interrupter Switchgear

Figure 2



Enclosures



NEMA 1

NEMA 3R

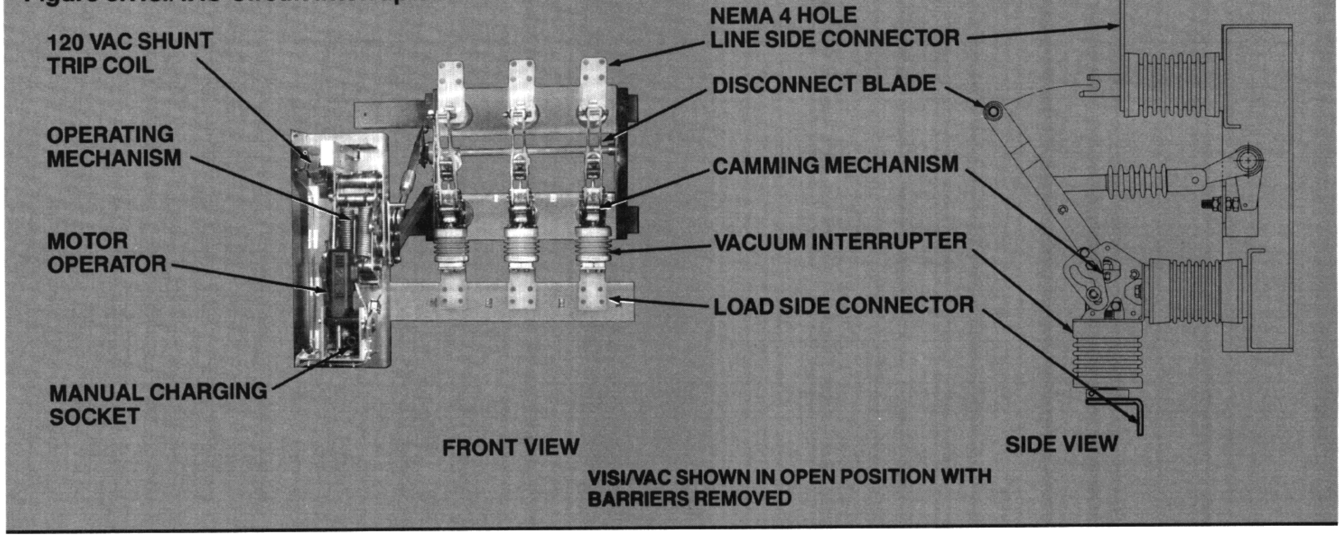
Basic Design

The *VISI/VAC* Circuit Interrupter is a unique switching and protective device designed for use on 2.4kV through 15kV power distribution systems. Its construction combines visible break disconnect blades in series with vacuum interrupters (Figure 3). This construction prevents arcing in the atmosphere while allowing for automatic visible isolation of the circuit. Automatic isolation greatly enhances user safety.

VISI/VAC circuit interrupters are currently available in two voltage classes, 5kV and 15kV. Both are rated 600 amperes continuous with available interrupting capacities of 4000 and 12,500 amperes (rms symmetrical). Integrated ratings of 40,000 amperes* (rms symmetrical) are available when used in conjunction with current limiting fuses.

* Higher ratings may be available based upon fuse manufacturer.

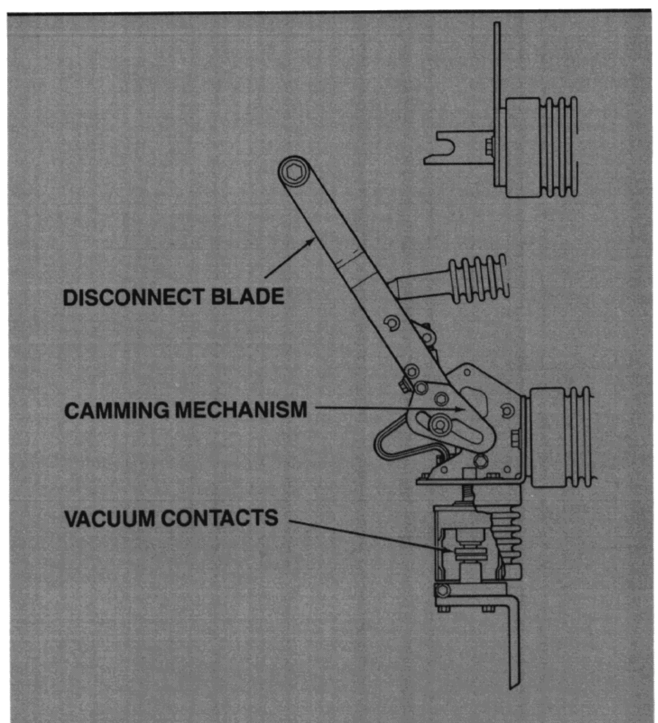
Figure 3. *VISI/VAC* Circuit Interrupter.



Automatic Visible Isolation

A patented camming mechanism enables the *VISI/VAC* Circuit Interrupter to open the circuit and extinguish the arc within the vacuum interrupters prior to the disconnect blades automatically isolating the circuit. This is accomplished in one single operation. When closing, the camming mechanism automatically closes the disconnect blades prior to the vacuum interrupter contacts making the circuit. The time differential between opening and closing of the blade and the vacuum contacts is as follows:

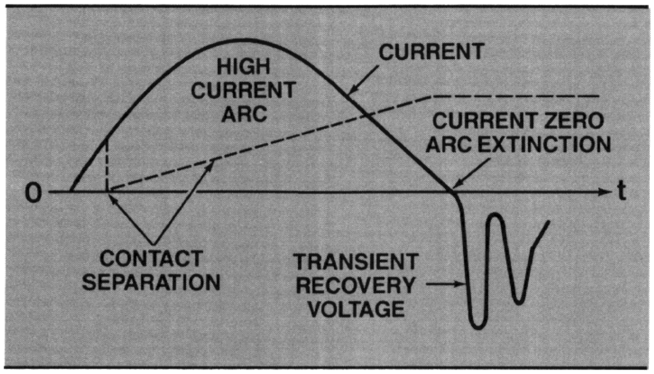
A. During closing, the differential is 9 to 12 milliseconds (blades close first, then vacuum contacts).
B. During opening, the differential is 12 to 18 milliseconds (vacuum contacts open first, then blades).

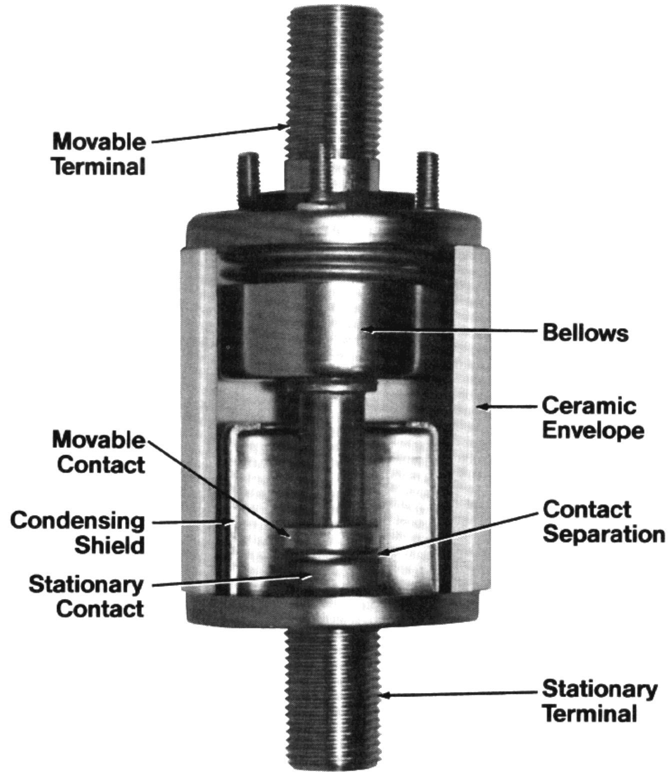


Vacuum Interrupter Bottle

The modern vacuum interrupters utilized in *VISI/VAC* products are designed for high speed operation, rapid dielectric recovery, quiet operation, minimum maintenance and long life.

- As the contacts part, the arc develops a plasma of metallic ions released by the contacts.
- This plasma provides transfer media for electron flow until the arrival of the first current zero.
- The condensation of the metallic vapor on the condensing shield is rapid and the dielectric recovery rate is much faster than the rate of rise of the transient recovery voltage (TRV).
- This metallic vapor provides a gettering action which removes gas molecules from the evacuated space, therefore assisting in maintaining the high vacuum.





VISI/VAC **Vacuum Interrupter**

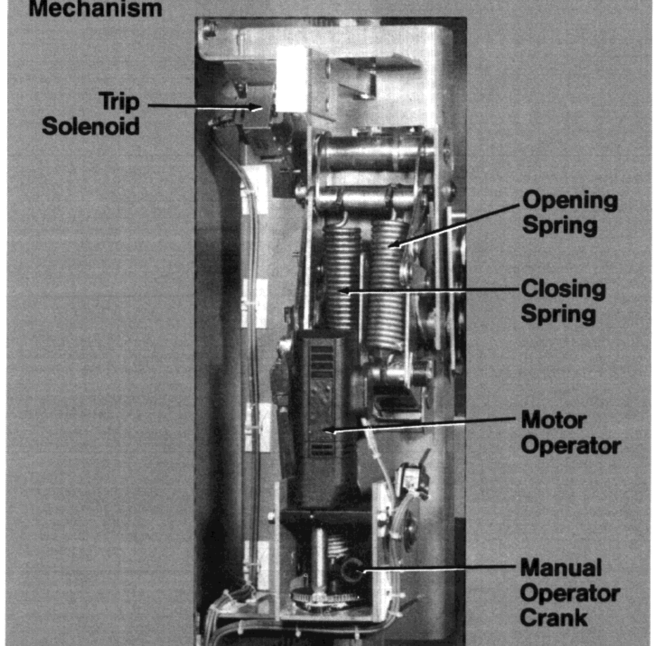
Operating Mechanism

The operating mechanism is a stored energy type. Opening and closing springs may be charged manually or automatically (if motor operator option is included).

During the charging operation, the opening spring is charged and latched first, then the closing spring is charged. Once the closing spring is fully charged, the interrupter closes, discharging the closing spring. The opening spring remains charged and latched awaiting a trip signal.

VISI/VAC construction is based on a completely modular design. The operating mechanism and pole assemblies can be easily removed and replaced with another. This not only affords a great maintenance advantage, but also allows users to easily convert from manual to motor operation or vice versa.

Figure 4. Operating Mechanism



IC. Features/Options & Accessories

Standard *VISI/VAC* Model

- 5 kV or 15 kV
- 600 Ampere Continuous Current Rating
- 4000 or 12,500 Amperes Interrupting Capacity (RMS Sym)
- No Fuses Necessary
- Open Type, NEMA 1, or NEMA 3R Enclosure

Optional Accessories

Protective:

- Shunt Trip Mechanism - 120v AC or 125v DC trips interrupter in both manual and motor operated versions - trips within 3.5 cycles of being energized
- Capacitor Trip - enables interrupter to trip after loss of control voltage
- Ground Fault Protection
- Overcurrent Protection
- Current/Voltage Phase Loss Protection
- Line Voltage Phase Imbalance Protection
- Voltage Phase Reversal Protection
- Over/Under Voltage Protection
- Transformer Differential Protection
- Current Limiting Fuses

Metering:

- Ammeter
- Voltmeter
- MegaWatt Meter
- MegaWatt Demand Meter
- MegaVar Meter
- Power Factor Meter
- Frequency Meter
- Watthour Meter
- Current Transformers
- Potential Transformers

Other:

- Motor Operator
- Mechanically Operated Auxiliary Switch
- Surge (Lightning) Arresters
- Control Power Transformer

II. APPLICATION DATA

IIA. Equipment Ratings

***VISI/VAC* Circuit Interrupter Ratings Table**

Rated Maximum Voltage: (kV)	5.5	15.5	5.5	15.5
Amperes Interrupting (RMS Sym.)				
Unfused:	4,000	4,000	12,500	12,500
Current Limiting Fuses				
200E max: (1)	40,000	40,000	40,000	40,000
250E-450E: (1)	12,500	(2)	12,500	(2)
Continuous Current Rating: (Amperes)	600	600	600	600
Voltage Withstand Rating — 60 Hz One Minute, kV RMS:	36	36	36	36
Momentary Rating — 10 Cycle: (Amperes RMS Asym.)	20,000	20,000	20,000	20,000
Short-Time Rating (Amperes RMS Sym.)				
1 Second:	12,500	12,500	—	—
2 Second:	—	—	12,500	12,500
Fault Close Rating				
Unfused				
Amperes Asym:	20,000	20,000	20,000	20,000
Amperes Sym:	12,500	12,500	12,500	12,500
Integrated (1) (3)				
Amperes Asym:	64,000	64,000	64,000	64,000
Amperes Sym:	40,000	40,000	40,000	40,000
B.I.L. (kV):	60	95	60	95

Notes:

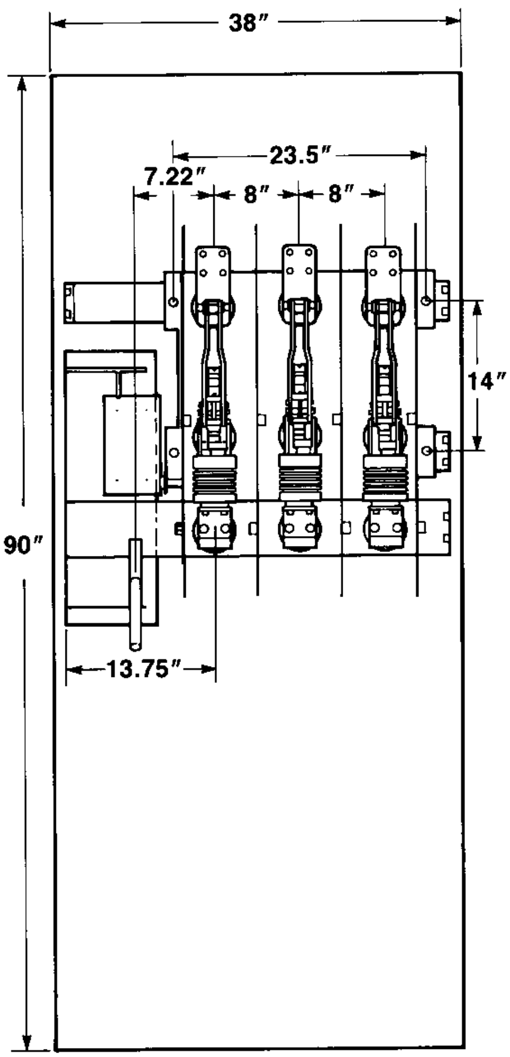
(1) Higher ratings may be available based on fuse manufacturer. Consult Square D for availability.

(2) Current Limiting (CL) Fuses rated above 200E are not available at 15kV.

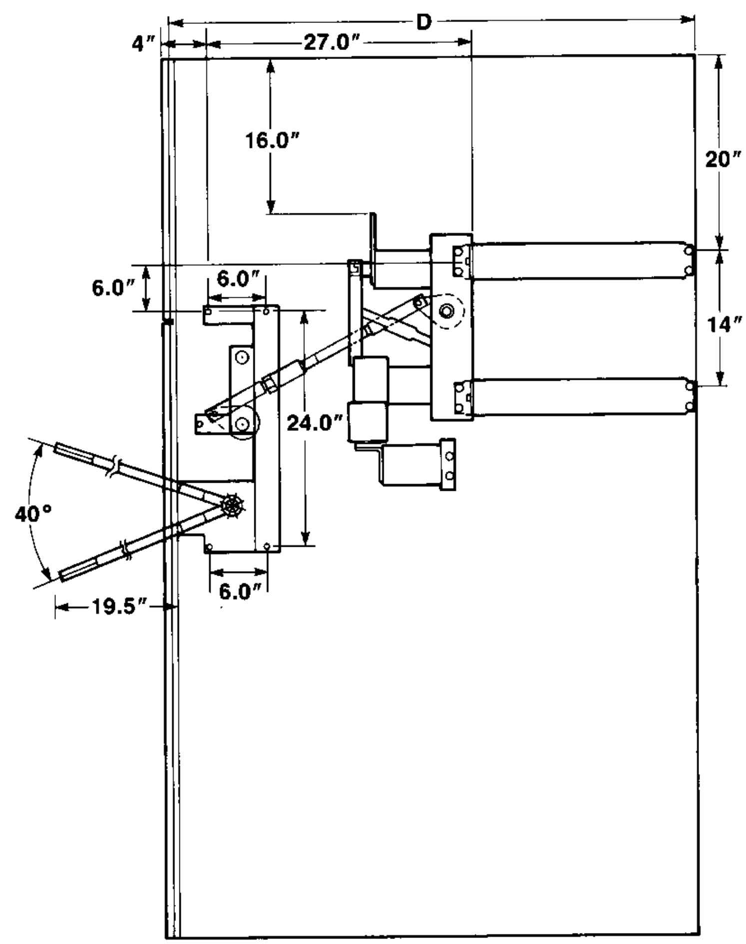
(3) Rating is applicable for interrupters with current-limiting fuses either integral or applied on line-side in series and rated 200E maximum.

IIB. Dimensions/Equipment Layout

Typical *VISI/VAC* Circuit Interrupter (Indoor)



Front Elevation

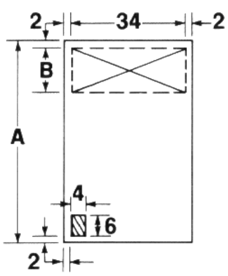


Right End Elevation
[D = 36, 48, or 54]

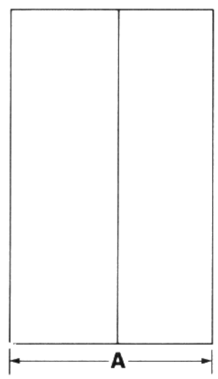
Standard Dimensions

(Approximate dimensions — not for construction)

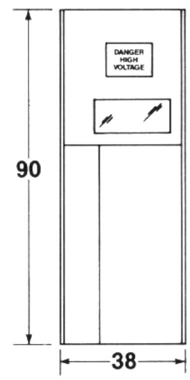
Indoor Equipment



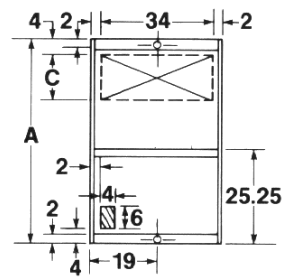
Top View



Left End Elevation



Front Elevation



Floor Plan

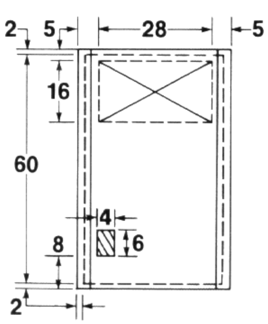
Indoor		
A	B	C
36	8	8
48	12	12
54	16	16

Dimensions in inches

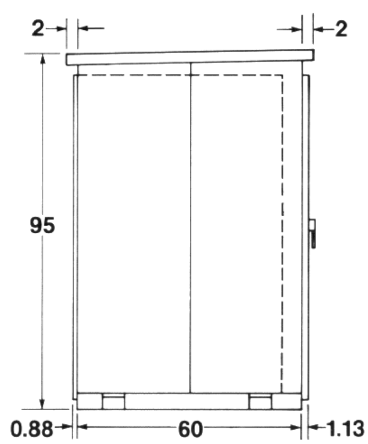
Represents Suggested Conduit Entrance Area

Represents Suggested Control Wiring Conduit Area

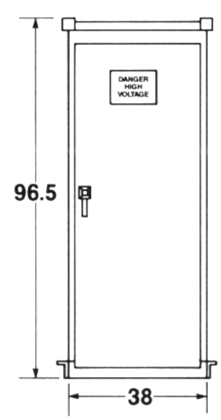
Outdoor Equipment



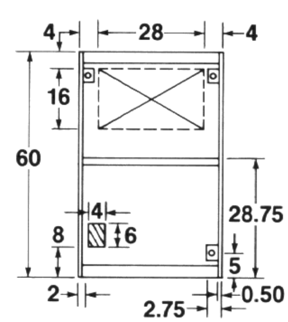
Top View



Left End Elevation



Front Elevation



Floor Plan

Dimensions subject to change without notice.

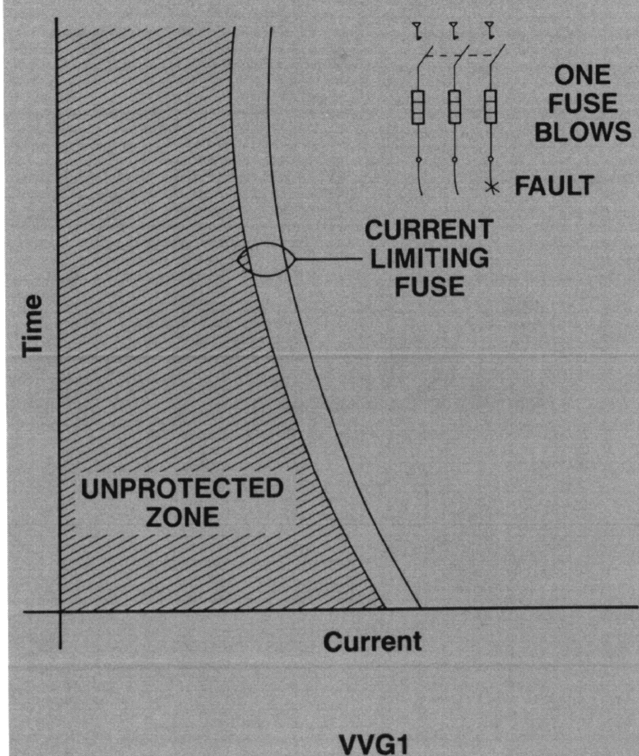
IIC. Ground Fault and Overcurrent Protection

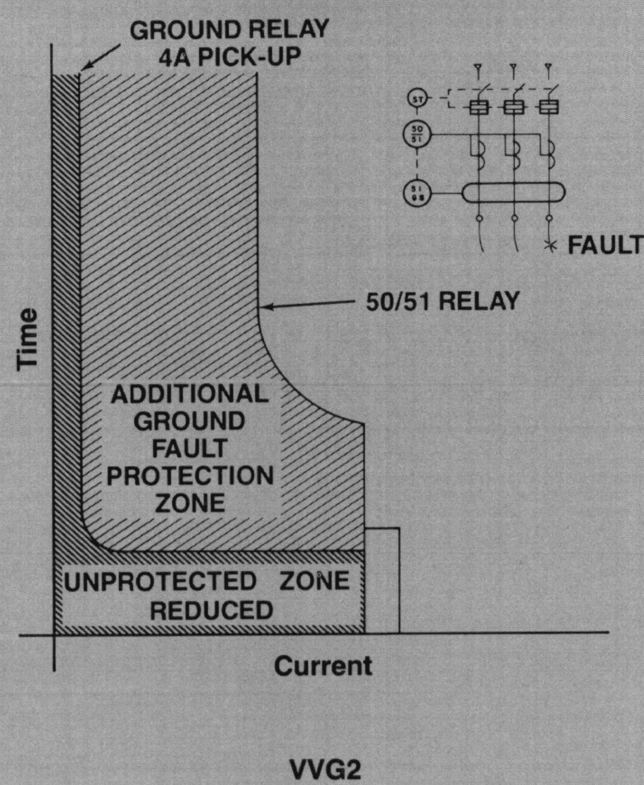
VISI/VAC with Ground Fault Protection

The 1987 National Electrical Code recognizes the importance of ground fault protection for equipment. Section 230-95 requires that ground fault protection be provided for "solidly grounded wye electrical services of more than 150 volts to ground, but not exceeding 600 volts phase-to-phase for each service disconnecting means rated 1000 amperes or more". Currently, no such code requirement exists at medium voltage.

ANSI/IEEE Std 242-1986 warns of the dangers of **medium** voltage ground faults, especially arcing ground faults which can be "extremely destructive if not detected and cleared promptly". This standard also asserts that fuses provide a fast clearing of high-magnitude fault currents, but their speed of operation for low and medium-magnitude fault currents should be checked to determine whether supplemental protection (such as ground fault protection) is needed to clear these arcing type faults.

The two (2) time-current curves shown below illustrate the disparity in the protection levels afforded by a fused air switch alone compared with a *VISI/VAC* Circuit Interrupter equipped with overcurrent relays and sensitive ground fault protection system.



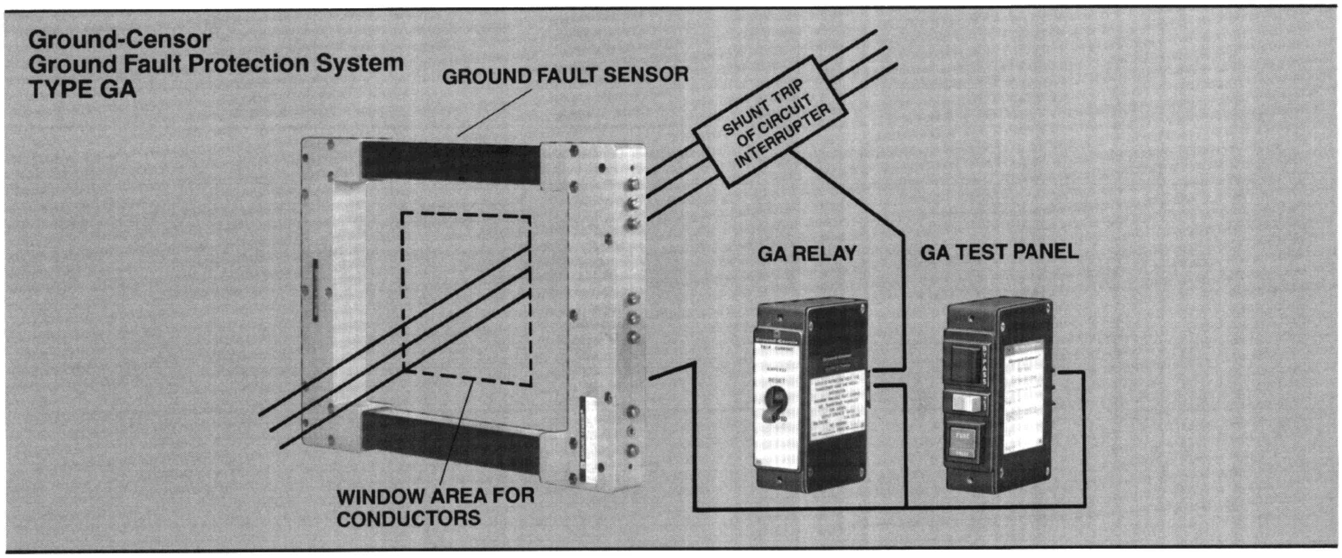


The first time-current curve (VVG1) illustrates the zone of time vs. current in which a ground fault would be allowed to persist, possibly resulting in extensive equipment damage, prior to one or more of the fuses clearing the fault. Furthermore, in the event that only one fuse clears the fault, this open-phase condition can cause additional system problems.

Curve VVG2 illustrates the increased "Ground Fault Protection Zone" afforded by *VISI/VAC* switchgear and the addition of a sensitive, zero sequence ground fault protection system. In addition, *VISI/VAC* switchgear provides interruption of all three phases in the event of a ground fault trip; therefore single-phasing of the system is avoided.

Ground Fault System Testing

NEC section 230-95 also requires on-site performance testing of ground fault protection systems in accordance with instructions provided with the equipment. Though this article specifically applies to low voltage services, testing of medium voltage ground fault systems is equally desirable. The GA ground fault protection system available for use with the *VISI/VAC* Circuit Interrupter can be supplied with an individual test panel for convenient field testing of the ground fault system. The test panel is used to initiate a test signal through a test winding built in to the GA sensor. This signal produces a sensor output which will result in the GA relay operating the *VISI/VAC* Circuit Interrupter. The test panel also offers a bypass feature which allows testing without tripping the *VISI/VAC* device to permit in-service testing. For more information about the GA relay system and test panel, refer to Square D Catalog Class 940.



Phase Overcurrent Relays and Power Fuses

It is well known that medium-voltage power fuses are fault protective devices and **not** overload protective devices. Power fuses are unpredictable at overcurrents less than 200% of their continuous current rating. However, there are two situations in which current limiting power fuses should be used on the *VISI/VAC* Circuit Interrupter:

1 - available fault current exceeds the interrupting rating of the *VISI/VAC* interrupter.

2 - current limiting effect is desired to further protect downstream equipment.

If power fuses are needed for a particular application, there may be advantages to adding overcurrent relays to the *VISI/VAC* interrupter as well.

Using phase overcurrent relays in addition to current limiting power fuses allows much greater reliability at low level overcurrents (100% - 200% of continuous current rating). In the event of such an overcurrent, all three phases would trip, eliminating a potential single phase condition resulting from a blown fuse.

Surge Protection

Transient voltages in excess of normal operating voltage can occur on any medium voltage system. Such overvoltages can be caused by many different factors such as lightning or switching surges.
It is recommended that surge arresters or surge capacitors be used where needed to limit this effect.

Special attention by the user is suggested when considering old or aging distribution systems. Older or aging systems may be more susceptible to damage due to the system insulation aging.

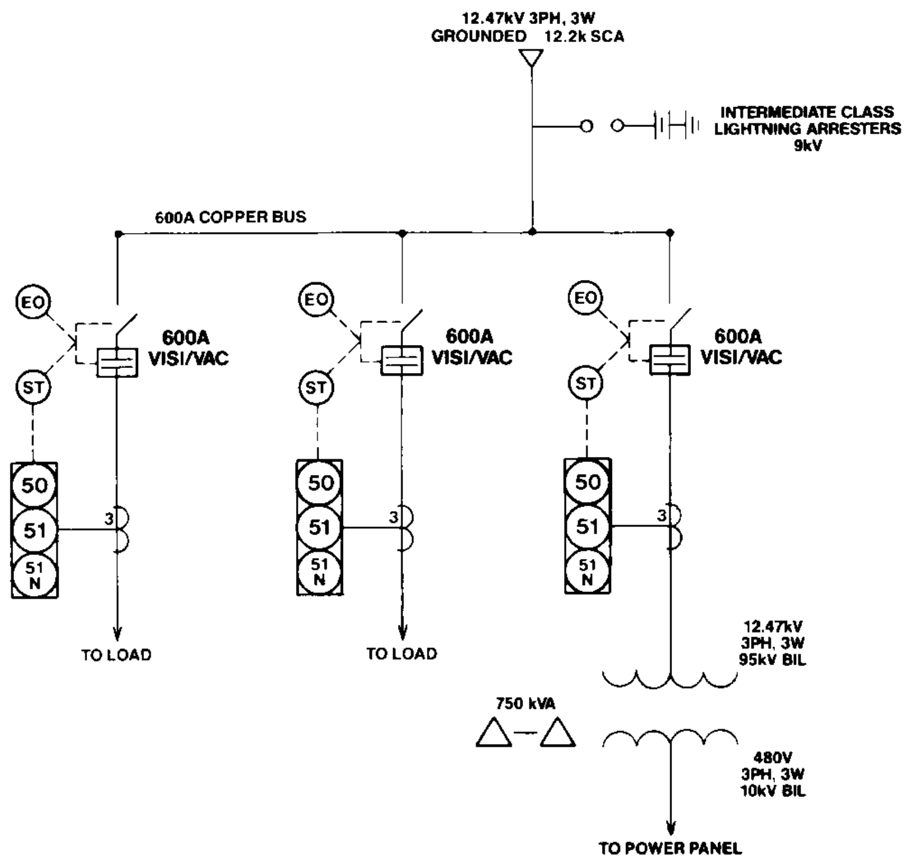
Recognizing this, users are encouraged to consider adding metal oxide surge arresters to the circuitry on the load side of the terminals of *VISI/VAC* Circuit Interrupters used in retrofit applications. Placement should be in the switchgear or at the equipment being protected.

Metal oxide surge arresters are used to limit the magnitude of prospective overvoltages to within the BIL rating of the protected equipment, but do not affect the rate of rise (di/dt) of surge transients. Surge capacitors lower the rate of rise (di/dt) and are claimed to be of particular importance for rotating machinery (such as motors). Surge capacitors, when used, should be located as close as possible to the equipment to be protected.

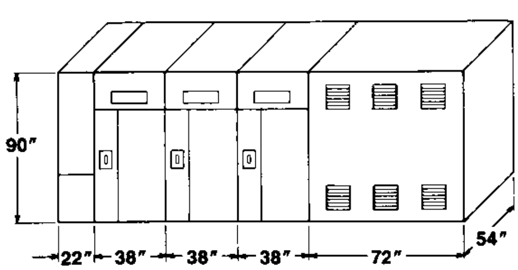
IID. One-Line/Elevation Examples

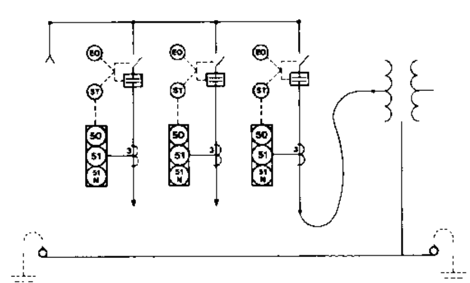
One-Line Diagram

VISI/VAC line-up coupled with substation transformer



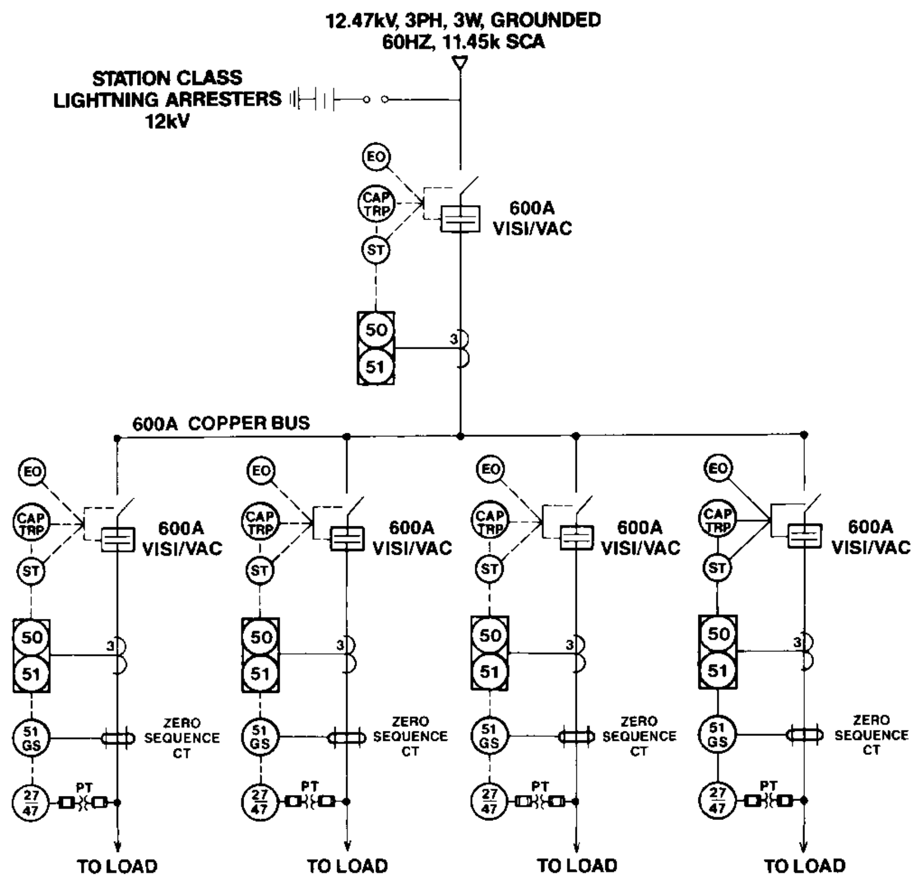
Adapting One-Line Diagram to Elevation View



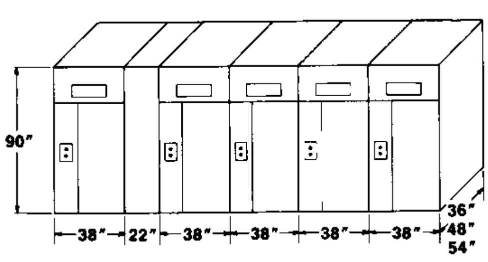


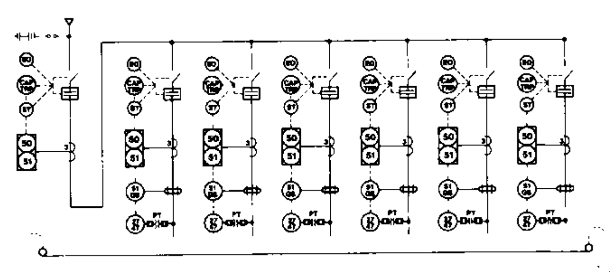
One-Line Diagram

VISI/VAC line-up



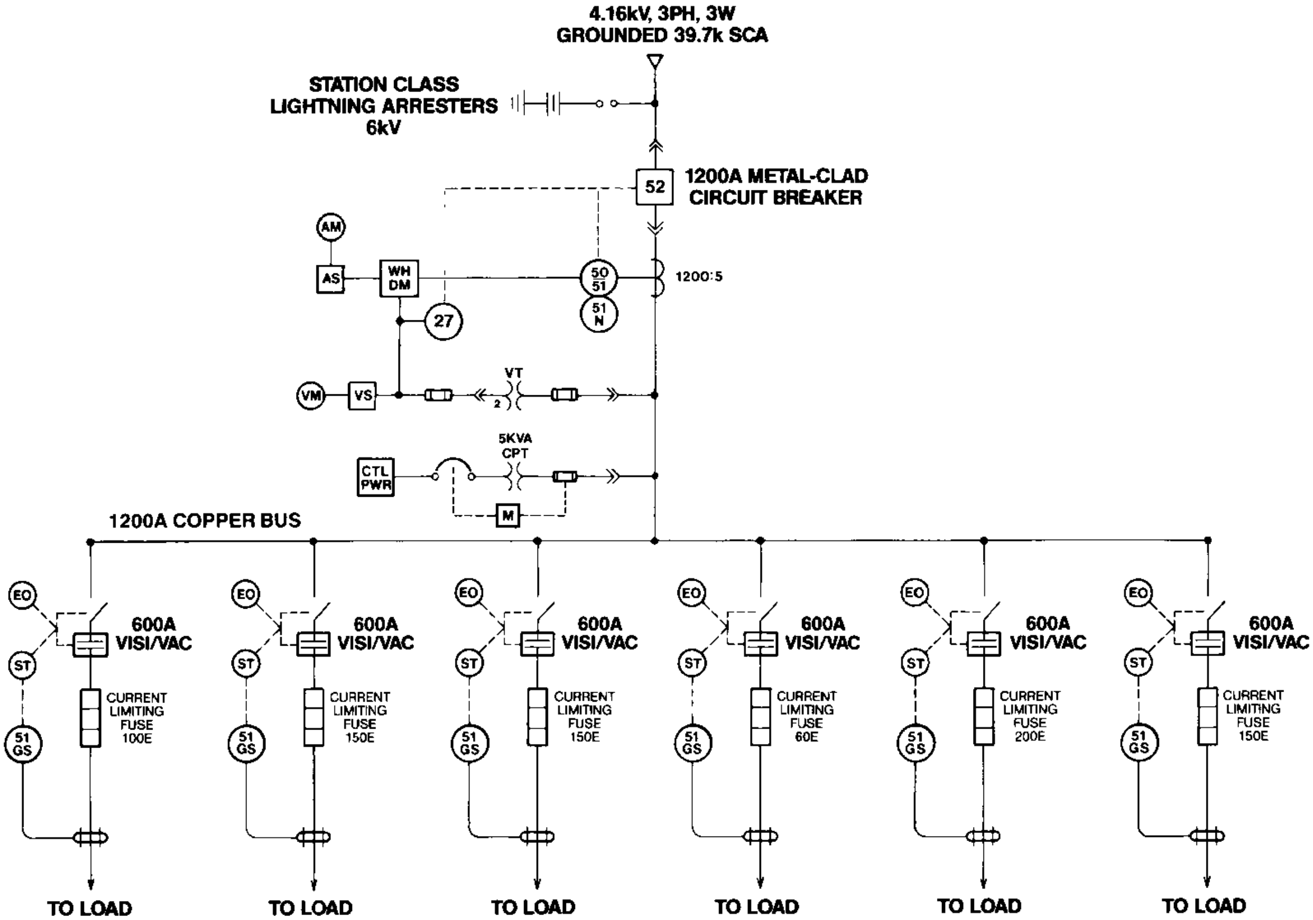
Adapting One-Line Diagram to Elevation View



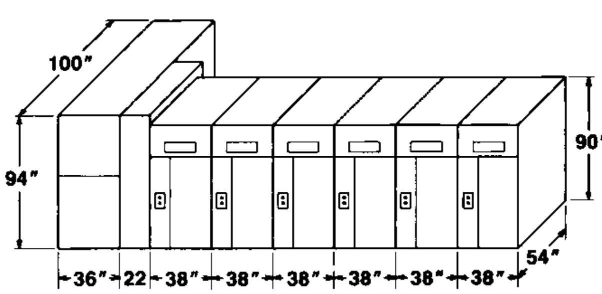


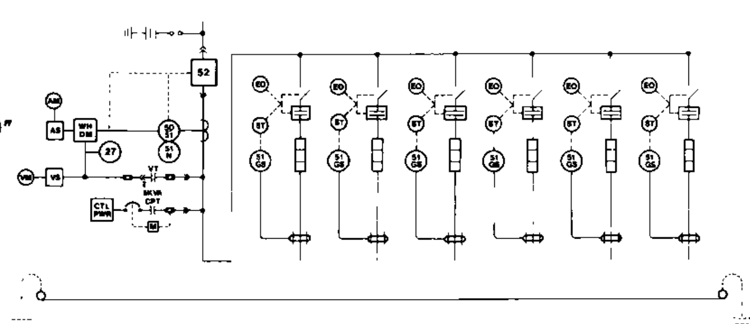
One-Line Diagram

VISI/VAC line-up with metal-clad main



Adapting One-Line Diagram to Elevation View





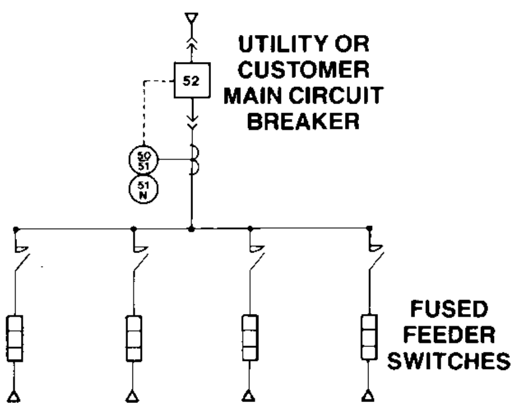
III. POWER SYSTEM APPLICATIONS

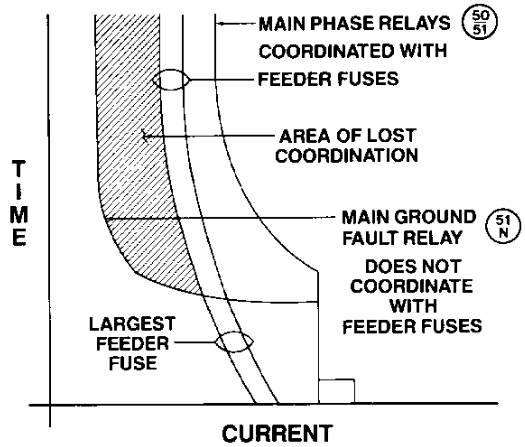
IIIA. System Coordination

A strong emphasis is often placed on coordination of phase protective devices in an electrical power distribution system in order to ensure maximum selectivity and continuity of service. However, ground fault protective devices must also be coordinated if complete selectivity is to be achieved. The following example is provided to illustrate the application of *VISI/VAC* Circuit Interrupters to improve system coordination.

Coordination of Circuit Breaker Main and Feeders

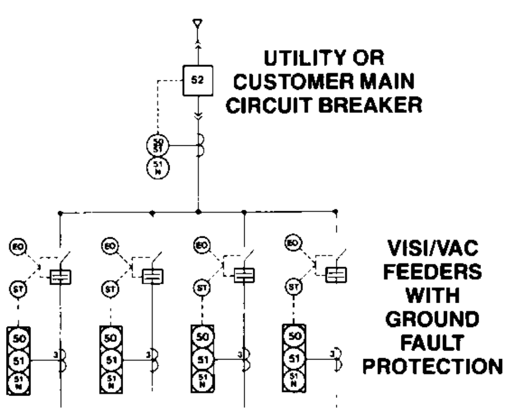
On a grounded system where a circuit breaker is used by the utility or customer as a main device for a metal-enclosed line-up of fused switches, there normally exists a large area, or window, of ground fault currents, where selectivity is sacrificed. This loss of coordination is illustrated by the curve shown below.

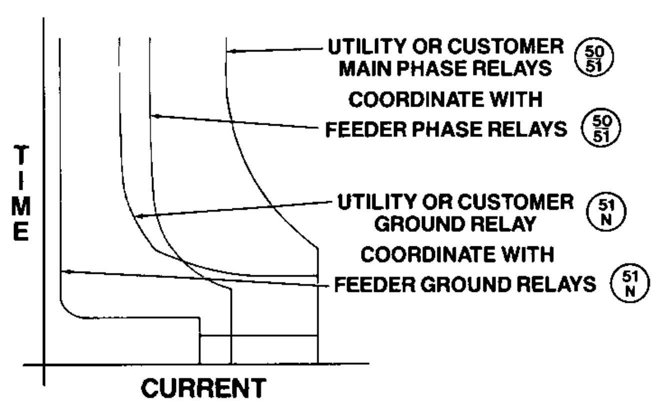




By replacing the fusible switches with *VISI/VAC* feeders equipped with sensitive ground fault protection, complete selectivity between utility or customer main and feeders can be achieved.

Not only does this arrangement provide more sensitive protection for the system and connected equipment, it also ensures a downstream ground fault will be cleared by the affected feeder. Service continuity for the remainder of the power system is preserved.



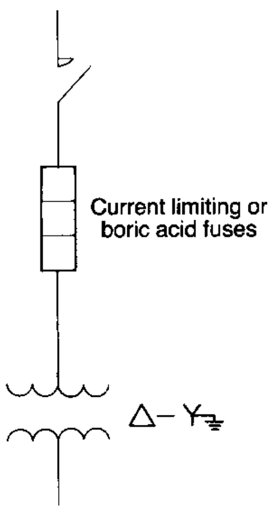


IIIB. Transformer Protection

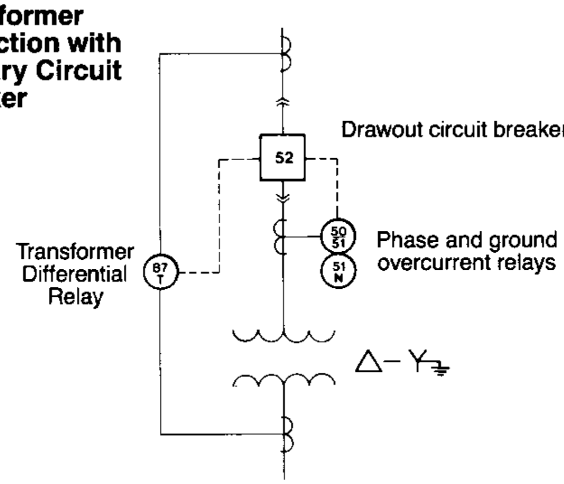
Protection of power transformers in industrial and commercial power systems is now more important than ever, with the cost of the transformers usually representing a significant percentage of the overall equipment investment. Fusible switches are often used to provide relatively economical short-circuit protection, although they do not sufficiently protect against low-level overcurrents. Similarly, circuit breakers are also applied on the transformer primary providing overcurrent protection.

When the cost of the transformer itself does not warrant the expense of drawout circuit breaker switchgear, fusible switches are commonly selected in an effort to reduce costs.

Conventional Transformer Protection with Primary Fuses



Conventional Transformer Protection with Primary Circuit Breaker

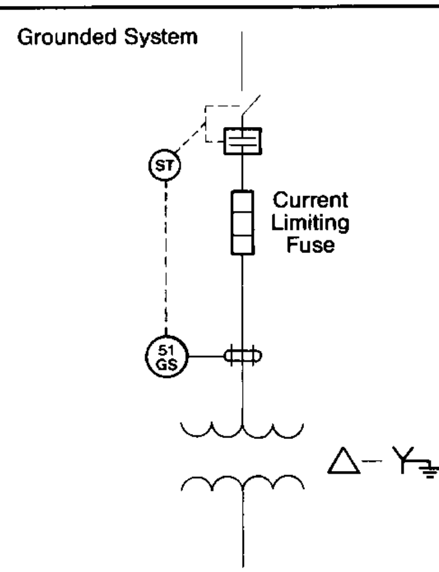


With the *VISI/VAC* Circuit Interrupter, the availability of current-limiting protection is combined with the advantages of protective relaying. This section illustrates four examples of transformer protection using *VISI/VAC* switchgear.

1. Transformer Ground Fault Protection (51GS)

Equipment protection against damaging low-level ground faults can be dramatically increased by using a sensitive, zero-sequence ground relay system. This is accomplished for transformer protection by replacing a conventional load interrupter switch with a *VISI/VAC* Circuit Interrupter equipped with the GA ground relay system.

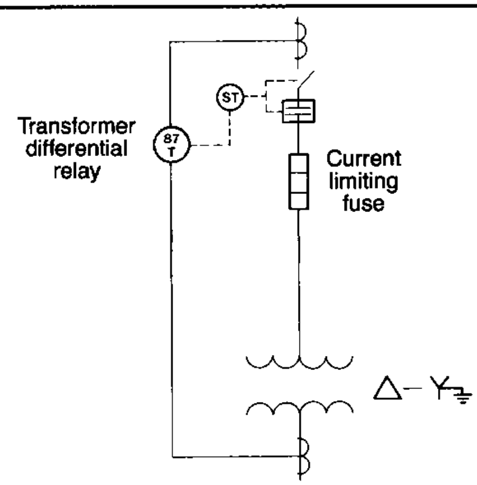
With the addition of fuses one can add current-limiting protection for high short-circuit currents, while still providing protection against ground fault currents down to four (4) amperes. This is particularly effective at limiting damage due to internal faults in the transformer primary windings.



2. Transformer Differential Protection (87T)

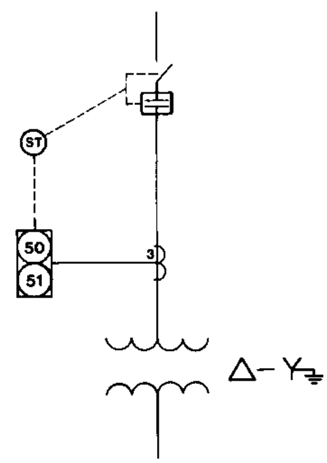
Additional protection against internal transformer faults and other abnormal conditions within a specified zone can be provided by using transformer differential relaying (ANSI device #87T). Any relaying scheme typically used with drawout circuit breakers will generally be applicable to the *VISI/VAC* Circuit Interrupter as well.

As in the case of ground fault protection above, this combination retains the advantage of current-limiting fuse protection, while providing an extra measure of insurance against equipment failure at a modest investment.



3. Sensitive Overload Protection of Transformers (51)

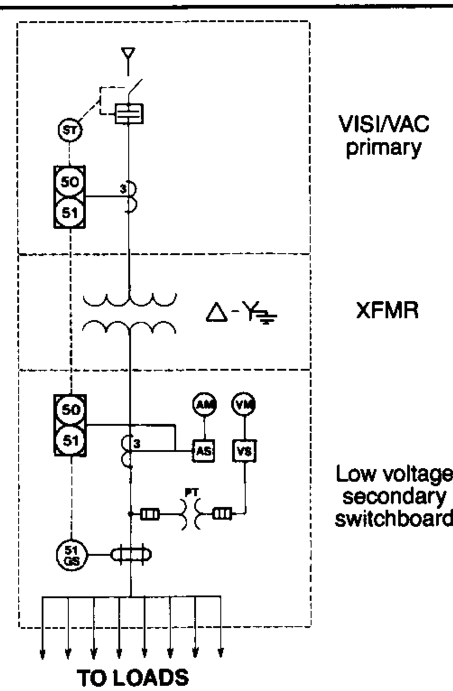
Another advantage of using a *VISI/VAC* Circuit Interrupter as primary protection for a power transformer is its compatibility with additional relaying. Medium-voltage fuses are primarily intended to provide short-circuit protection only; protection against overloads is generally accomplished by other means. In addition, fuses are often oversized to avoid nuisance interruptions on transformer inrush. By adding a time overcurrent relay as shown, sensitive overload protection for the transformer may also be provided. This device can even be set below the transformer's full load current initially, then increased as system loading expands over time.



4. Providing Both Primary and Secondary Overcurrent Protection

For single-ended substations, the *VISI/VAC* Circuit Interrupter can be used to provide both primary and secondary overcurrent protection, therefore eliminating the need for a secondary main disconnect. This could mean a cost reduction worth thousands of dollars per substation. Similarly, on double-ended substations, each secondary main can be replaced with an isolation switch or non-automatic breaker in order to isolate the unused transformer when the tie device is closed.

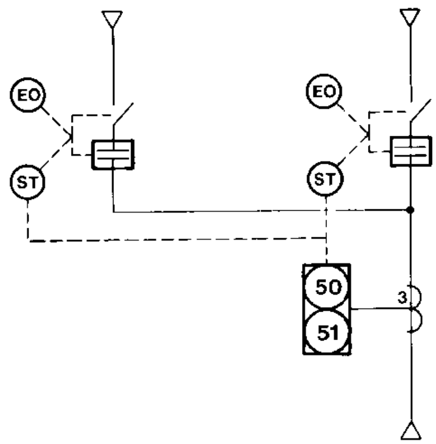
As shown at right, this arrangement preserves ground fault protection at the secondary system and can provide sensitive overload protection, in lieu of a secondary main device. In most cases, the short-circuit current available on the secondary side of the transformer (as reflected in amperes at the primary voltage) will be less than the *VISI/VAC* interrupting rating, allowing unrestricted time delay settings on the protective relays.



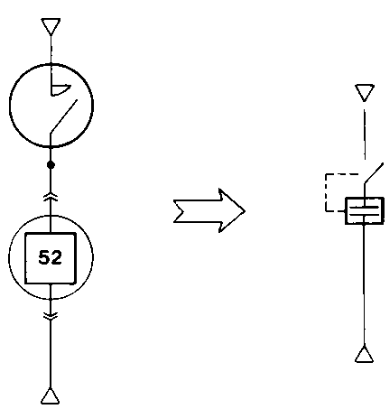
IIIC. Special Applications

Special applications for the *VISI/VAC* Circuit Interrupter are as many and varied as the systems on which they are utilized. Four specific applications are shown here.

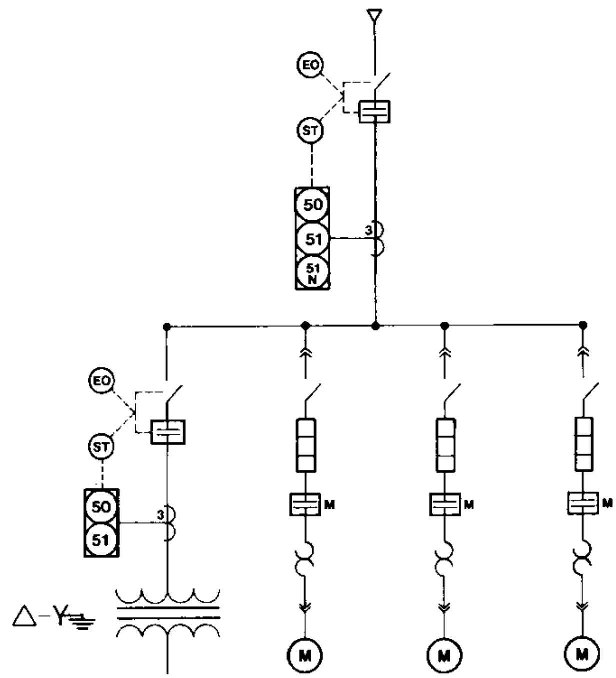
Electrically Operated *VISI/VAC* Interrupter For Automatic or Remotely Operated Line Selection (10-15 second transfer time)



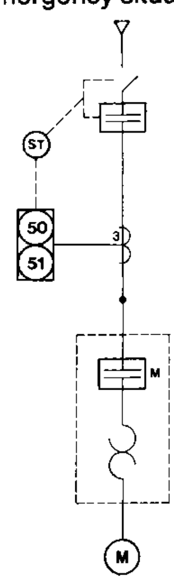
Sealed Interrupter with Visible Isolation for Harsh Environments



Space-Saving Medium Voltage Motor Control Center Main or Feeder Device



Medium Voltage Motor Isolation Device - offers opportunity for quick motor isolation with increased interrupting for emergency situations



IV. SPECIFICATION GUIDE

Medium Voltage Metal-Enclosed Vacuum Interrupter Switchgear

This section includes metal-enclosed vacuum interrupter switchgear for medium voltage applications at 15kV and less. Format is per CSI (Construction Specifications Institute) Standards.

Part 1: General

1.01 SECTION INCLUDES

A. Medium voltage metal-enclosed vacuum interrupter switchgear.

1.02 RELATED SECTION

A. Section **[____-________]:** Concrete pad for equipment support.

1.04 SUBMITTALS

A. Submit shop drawings under the provisions of Section **[01300; 01340]**.

B. Submit shop drawings indicating outline dimensions, enclosure construction, shipping splits, lifting and supporting points, electrical single line diagram, and equipment electrical ratings.

C. Submit product data under the provisions of Section **[01300; 01340]**.

1.05 OPERATION AND MAINTENANCE DATA

A. Submit operation and maintenance data under provisions of Section **[01700; 01730]**.

B. Include fuse replacement, adjustment, and lubrication instructions.

1.06 QUALITY ASSURANCE

A. Manufacturer: Company specializing in medium voltage interrupter switchgear where the manufacturer of the switchgear is the same as the designer and manufacturer of the vacuum circuit interrupter.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site under provisions of Section **[01600; 01620]**.

B. Store and protect products under provisions of Section **[01600; 01620]**.

C. Accept equipment on site and inspect for shipping damage.

D. Protect equipment from weather and moisture by covering with heavy plastic or canvas and by maintaining heat within enclosure in accordance with manufacturer's instructions.

1.08 EXTRA MATERIALS

A. Submit maintenance materials under provisions of Section **[01700; 01750]**.

B. Submit two insulated-handle tools designed for pulling fuses.

C. Provide **[two; ______]** sets of spare fuses of each size and rating under provisions of Section **[01700; 01750]**.

Part 2: Products

2.01 MANUFACTURER

The metal-enclosed vacuum interrupter switchgear shall be *VISI/VAC*™ Switchgear by Square D Company. Alternative bids for vacuum circuit breakers with specified relaying devices may be submitted.

2.02 VACUUM CIRCUIT INTERRUPTERS

A. Vacuum circuit interrupter switchgear shall be **[single section; multiple section line-up], [indoor; outdoor], [non walk-in; walk-in]** construction as described and indicated on drawings and as specified herein.

B. The completed metal-enclosed switchgear shall have the following electrical ratings:

Maximum Design Voltage	5.5 kV	15.5 kV
Continuous Current	600 Amps	600 Amps
Impulse BIL	60 kV	95 kV
60Hz Withstand	36 kV	36 kV
Interrupting Amperes[1]	**[4; 12.5]** kA	**[4; 12.5]** kA
Fault Closing Current[1]	20 kA (Asym. RMS)	20 kA (Asym. RMS)
Momentary Current	20 kA (Asym. RMS)	20 kA (Asym. RMS)
One Second Rating[2]	12.5 kA (Sym. RMS)	12.5 kA (Sym. RMS)

(1) — 40 kA (Sym. RMS) integrated rating when used in conjunction with current limiting fuses (rated 200E and below).
(2) — *Two Second* rating for 12.5k AIC interrupter.

2.03 COMPONENTS

A. The circuit interrupting device shall be fixed mounted, **[manually; electrically]** operated, and shall be quick-make, quick-break with the speed of operation independent of the operator. Electrically operated device requires a **[120v AC; 125v DC]** source. To provide for dependable operation, the spring charging mechanism shall not rely on chains or cables. The motor operator assembly, where required, shall be a separate device, isolated from high voltage and coupled through a direct drive shaft.

The circuit interrupter shall consist of automatic visible blade disconnects in series with vacuum interrupters. Arc interruption shall take place within the envelope of the vacuum interrupter. Upon "opening", the contacts in the vacuum interrupter shall separate 12-18 milliseconds before the disconnect blades open. Total circuit interrupter "opening" time shall not exceed 3.5 cycles after the trip coil is energized at 85 to 100% of rated control voltage. Upon "closing", the disconnect blades shall close 9-12 milliseconds before contact is made in the vacuum interrupter.

B. Voltage and Short Circuit Ratings: Match ratings specified for integrated assembly.

2.04 ACCESSORIES

A. Protective Options:
[Each] circuit interrupter**[s]** shall include the following **[trip; and; or; alarm]** functions **[as shown on the drawings]**:

	ANSI #
■ Shunt Trip	
■ Capacitor Trip	
■ Ground Fault	51GS, 51N
■ Voltage Phase Loss	27
■ Line Voltage Phase Unbalance	47
■ Voltage Phase Reversal	32
■ Over/Under Voltage	59/27
■ Over Current	51
■ Transformer Differential	87T
■ Lockout Relay	86
■ Other: ____________	

B. Metering Options:
[Each] circuit interrupter**[s]** shall include the following **[as shown on the drawings]**:

- ■ Ammeter with Selector Switch, **[1%; 2%]** Accuracy
- ■ Voltmeter with Selector Switch, **[1%; 2%]** Accuracy
- ■ Current Transformers, [______]:5 Ratio
- ■ Potential Transformers
- ■ MegaWatt Meter
- ■ MegaWatt Demand with **[5; 10; 15; 30]** minute interval
- ■ MegaVar Meter
- ■ Power Factor Meter
- ■ Frequency Meter
- ■ Watthour Meter **[2; 2.5]** Element
- ■ Other: ____________

C. Surge Arresters: **[Distribution; Intermediate; Station]** class, rated [____] KV; mount in incoming line compartment.

D. Incoming Cable Terminations: **[Clamp-type; Pothead; Roof bushing]**.

E. Space Heaters: For **[120v; ______v]** external source, sized by the manufacturer.

F. Key Interlocks: [______________].

2.05 FABRICATION

A. Construction: Each equipment bay shall be a separately constructed cubicle assembled to form a rigid free standing unit. Adjacent bays shall be securely bolted together to form an integrated rigid structure. To assist installation and maintenance of bus and cables, the top and rear covers shall be removable. Each individual unit shall be braced to prevent distortion.

B. A viewing window shall be installed in the door of the circuit interrupter enclosure to enable visual inspection of the disconnect blades from outside the enclosure.

C. The high voltage fuses and non-disconnect type fuse mountings shall be accessible only through a separate door mechanically interlocked with the circuit interrupter. Circuit interrupter designs with full height fuse access doors shall have a solid barrier covering the area of the main cross bus and/or line side of the circuit interrupter. No energized parts shall be within normal reach of the opened doorway. Four single full length inter-phase barriers shall isolate the three phases of the circuit interrupter from each other and from the enclosure.

D. Main Bus shall be **[silver-plated copper; tin-plated aluminum]**, rated **[600; 1200]** amps, and is to be supported from the top of the enclosure on NEMA (class A-20/A-30) insulators.

E. Ground Bus shall run continuously through the entire line-up and shall be securely connected to the steel frame of each bay.

F. Main bus and ground bus shall be drilled to allow for future extensions.

G. Outdoor units shall be designed with a sloped, drip-proof roof. The cubicles must have a door in door construction. The outer door shall open to the normal circuit interrupter door. The front shall have a bulkhead type door along with three point latch and vault type handle with provisions for padlocking. Cubicles are to be designed to allow front and rear access and shall not require the routing of line side or load side connections in front of the switch/fuse compartment.

H. The metal-enclosed gear shall be fully assembled and inspected at the factory prior to shipment. Large line-ups shall be split to permit normal shipping and handling as well as for ease of rejoining at the job site.

I. Conduit space shall meet NEC requirements.

2.06 FACTORY FINISHING

A. All steel or galvaneal parts, shall be cleaned and phosphatized prior to paint application.

B. Paint Color shall be **[ANSI-61 (light grey); ANSI-49 (medium light grey)]** polyester enamel applied electrostatically through air. Following paint application, uncured parts shall be baked to produce a hard durable finish. Paint film shall be uniform in color and free from blisters, sags, flaking and peeling.

C. Adequacy of paint finish to inhibit the buildup of rust on ferrous metal materials shall be tested and evaluated per paragraphs 5.2.8.1-7 of ANSI C37.20.2-1987. Salt spray withstand tests in accordance with paragraph 5.2.8.4 of ANSI C.37.20.2-1987 shall be performed on a periodic basis to insure conformance to this corrosion resistance standard.

2.08 MEDIUM VOLTAGE CURRENT-LIMITING FUSES

A. Fuses shall be current limiting type of self-contained design to limit the available fault current stresses on the system and shall have the interrupting capacity shown.

B. Fuses shall be affixed in position with provisions for removal and replacement from the front of the gear without the use of special tools.

C. Fuse Rating: **[E; R]** rated fuse, size as indicated on drawings.

D. Voltage Class: **[5; 15]** kV.

E. Interrupting Rating: **[______]** amperes rms symmetrical.

Part 3: Execution

3.01 EXAMINATION

A. Verify that surfaces are ready to receive work.

B. Verify field measurements are as **[shown on Drawings; shown on shop drawings; instructed by manufacturer]**.

C. Verify that required utilities are available, in proper location, and ready for use.

D. Beginning of installation means installer accepts existing surface conditions.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

3.03 FIELD QUALITY CONTROL

A. Field inspection and testing will be performed under provisions of Section **[01400; 01410]**.

B. Visually inspect for physical damage.

C. Perform mechanical operator tests in accordance with manufacturer's instructions.

D. Verify key interlock operation.

E. Perform insulation resistance tests per manufacturer's published instructions.

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