Westinghouse Electric Corporation
Switchgear Division
East Pittsburgh, PA 15112, U.S.A.

July, 1982
New Information
Mailed to: E, D, C/32-000A

Indoor and Outdoor
Rated Maximum Kv: to 15
Rated Short Circuit KA: to 37
Rated Continuous KA: to 3

VAC-CLAD Type VCP Medium Voltage Metal-Clad Switchgear

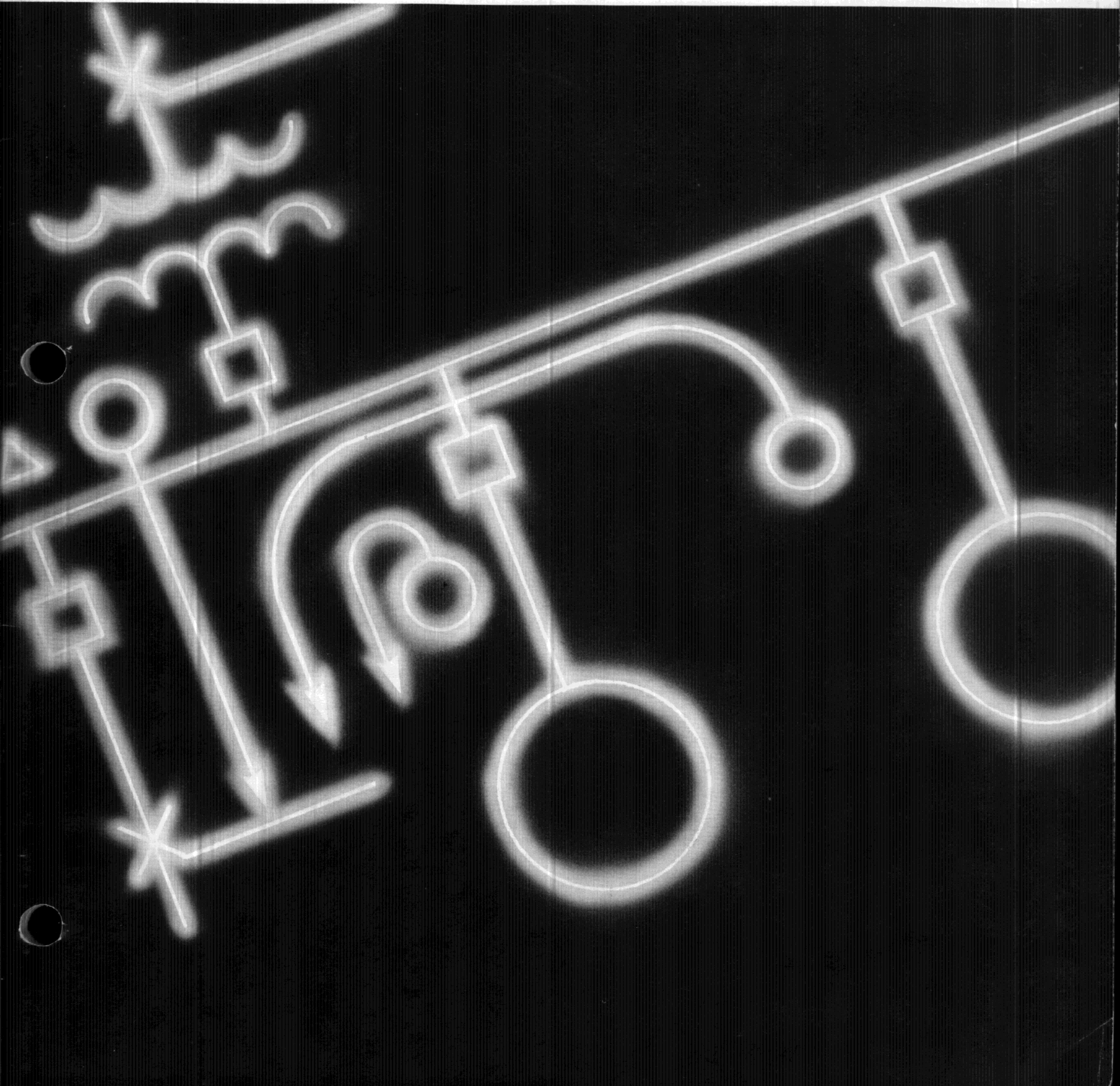


Table of Contents

Part 1 Introduction

1.1 Purpose: The purpose of this Application Data is to describe VAC-CLAD Medium Voltage Metal-Clad Switchgear and to aid in the selection of VAC-CLAD arrangements for reliable and economical application on power systems. General technical information and Industry Standards requirements are presented where necessary or useful in describing VAC-CLAD or where they assist in application selections.

1.2 Arrangement: The arrangement of this Application Data is directed towards the accomplishment of the above purpose. Following is a short outline of the arrangement of parts which may be useful in understanding this data.

Part 2 describes fundamentals that are required and should be followed to understand the design and application of VAC-CLAD. Included are typical applications and referenced Industry Standards.

Part 3 is a general description of the VAC-CLAD Assemblies and the Type VCP breaker.

Part 4 is a condensed guide for the application of VAC-CLAD particularly on a symmetrical current rating basis.

Parts 5, 6, 7 are specific descriptions of functional components with supporting technical information.

Part 8 describes accessories and supplemental devices.

Part 9 provides information on dimensions, weights, base plans and foundation requirements, shipping, receiving, handling, and storing of VAC-CLAD.

Part 10 describes the standard VAC-CLAD designs available under the VAC-CLAD INTEGRATED PROGRAM. These designs are identified as VIP arrangements. Part 10 is a most important part of this data. It details specific information necessary to construct vertical sections with compartments that contain components such as circuit breakers, potential transformers, surge equipment, and power terminations. It also details specific secondary and control component applications. VIP selections are a very important part of an application program.

Part 11 is a guide for the customer.

1.3 Reliability

Reliability is a fundamental aspect of VAC-CLAD metal clad switchgear. It was the fundamental consideration of engineering design, material selection, use and design of components, manufacturing, test procedures, shipping and handling to assure the user of on-site reliability.

Engineering Design

The VAC-CLAD designers' primary assigned objective was a reliable product. All parts and operational functions were conceived with reliability in mind. This design objective manifests itself in three ways: 1. a minimum number of parts; 2. selection of quality material; 3. maximum use of tested, proved parts. All design criteria were set above the levels required for proper equipment functioning.

Material Selection

Specific technical disciplines were assigned the task of material selection and verification by labratory tests for the specific application — i.e., porcelain, glass polyester, fluidized bed epoxy, breaker mechanism parts, etc.

Components

The vacuum interrupters were designed specifically for the ratings and other factors required for metal-clad switchgear: interrupting, voltage, and mechanical and electrical life ratings, mounting requirements, and many others.

The vacuum interrupters, by the nature of the manufacturing procedures, are produced by the most exacting quality and reliability techniques.

Other components, such as auxiliary switches, bus insulation instrument transformers and control wire, were all subjected to reliability procedures peculiar to the particular type of component.

Manufacturing

Because VAC-CLAD metal-clad switchgear is a highly tooled product, it has a high degree of accuracy and consistency of parts. The most modern manufacturing techniques and facilities are used to make this switchgear. The facilities include computer-aided drafting and manufacturing-information systems, and numerical controlled machines, process equipment and order follow.

Design/Proof Tests

VAC-CLAD metal-clad switchgear meets all applicable ANSI, IEEE, and NEMA standards. The design criteria dictated that all tests demonstrate performance above the requirements of the standards. The ANSI test series is basic test criteria and includes interruption (over the complete current range), BIL, dielectric, continuous current, mechanical life, and thermal and environmental conditions.

The design/proof testing of VAC-CLAD switchgear is the most extensive ever performed by Westinghouse Switchgear Division which has always maintained the highest test standards for its metal-clad equipment.

Production Tests

Circuit Breaker

- Each breaker draw-out unit is checked for alignment with a master cell fixture that verifies all interfaces and interchangeability.
- All circuit breakers are operated over the range of minimum to maximum control voltage.
- Interrupter contact gap is factory set.
- One-minute dielectric test is performed on each breaker, per ANSI Standards.
- Final inspection and quality check.

Housing

- Master breaker fixture is inserted into each breaker cell to ensure alignment.
- One-minute dielectric test per ANSI Standards is applied to both primary and secondary circuits.
- Operation of wiring, relays, and other devices is verified by test.
- Final inspection and quality check.

Shipping & Handling

Complete assemblies and breakers have been shipped from one location to another to verify the packing and handling procedures and assure the customer that the equipment will arrive in excellent condition.

Part 2 Basis

2.1 Application

Westinghouse VAC-CLAD type VCP metal-clad switchgear with removable circuit breakers provides centralized control and protection for generators, motors, transformers, capacitors, and all types of feeder circuits. It is available in ratings of 4.76, 8.3 and 15 Kv with maximum interrupting capacities of 350 MVA, 500 MVA and 1000 MVA, respectively. It is available with vacuum circuit breakers for both indoor and outdoor applications.

2.2 Typical Applications

Electric utility systems, industrial plants, commercial buildings, municipal pumping stations, transportation systems, pipe line stations, unit substations.

2.3 Applicable Industry Standards

ANSI American National Standards Standard Institute

C37.010 Application guide for ac high-voltage circuit breakers rated on a symmetrical current basis

C37.100 Definitions for power switchgear

C37.04 Rating structure for ac high-voltage circuit breakers

C37.06 Preferred ratings for ac high-voltage circuit breakers rated on a symmetrical current basis

C37.07 Factors for reclosing service

C37.09 Test procedure for ac high voltage circuit breakers

C37.11 Power circuit breaker control

C37.20 Switchgear assemblies including metal-enclosed bus

① C37.20.2 Metal-Clad and Station-Cubicle switchgear

① C37.21 Application Guide for Metal-Enclosed Power Switchgear

① C37.55 Conformance Testing of Metal-Clad Switchgear

C37.24 Guide for evaluating the effect of solar radiation

NEMA National Electrical Manufacturers Association

SG-4 Power Circuit Breakers

SG-5 Power Switchgear Assemblies

① Proposed

2.4 Usual Service Conditions

Usual service conditions for operation of metal-clad switchgear at the nameplate rating are as follows:

- Altitude does not exceed 3300 feet (1000 meters)
- Ambient temperature within the limits of minus 30°C and plus 40°C (Minus 22°F and plus 104°F)
- The effect of solar radiation is not significant.

2.5 Unusual Service Conditions

Applications of metal-clad switchgear at other than usual altitude or temperature or where solar radiation is significant require special consideration. Other unusual service conditions that may affect design and application include:

- Exposure to salt air, hot or humid climate, excessive dust, dripping water, falling dirt, or other similar conditions.
- Unusual transportation or storage conditions.
- Switchgear assemblies when used as the service disconnecting means.
- Installations accessible to the general public.
- Exposure to seismic shock.
- Exposure to nuclear radiation.

2.6 Applications Above 3300 Feet

The rated one-minute power frequency withstand voltage, the impulse withstand voltage, the continuous current rating, and the maximum voltage rating must be multiplied by the appropriate correction factors below to obtain modified ratings which most equal or exceed the application requirements. Note that intermediate values may be obtained by interpolation.

Altitude (feet)	Correction Factor	
	Current	Voltage
3,300 (and below)	1.00	1.00
5,000	0.99	0.95
10,000	0.96	0.80

2.7 Metal-Clad Switchgear Definition (ANSI)

Metal-clad switchgear is an assembly of metal-enclosed units characterized by the following features:

- The main switching and interrupting device is of the removable type arranged with a mechanism for moving it physically between connected and disconnected positions and equipped with self-aligning and self-coupling primary and secondary disconnecting devices.
- Major parts of the primary circuit, that is, the circuit switching or interrupting devices, buses, potential transformers, and control power transformers, are completely enclosed by grounded metal barriers, which have no intentional openings between compartments. Specifically included is a metal barrier in front of or a part of the circuit interrupting device to ensure that when, in the connected position, no primary circuit components are exposed by the opening of a door.
- All live parts are enclosed within grounded metal compartments.
- Automatic shutters which cover primary circuit elements when the removable element is in the disconnected, test or removed position.
- Primary bus conductors and connections are covered with insulating material throughout.
- Mechanical interlocks are provided to maintain a proper and safe operating sequence.

• Instruments, meters, relays, secondary control devices and their wiring are isolated by grounded metal barriers from all primary circuit elements with the exception of short lengths of wire such as at instrument transformer terminals.

• The door through which the circuit interrupting device is inserted into the housing may serve as an instrument or relay panel and may also provide access to a secondary or control compartment within the housing.

Part 3 General Description
Westinghouse VAC-CLAD Switchgear provides centralized control and protection of medium-voltage power equipment and circuits in industrial, commercial, and utility installations involving generators, motors, feeder circuits, and transmission and distribution lines.

VAC-CLAD Switchgear is available in voltage ratings from 4.76 Kv through 15 Kv and in nominal interrupting capacities from 250 MVA (29 KA) through 1,000 MVA (37 KA). It is available for indoor and outdoor installation.

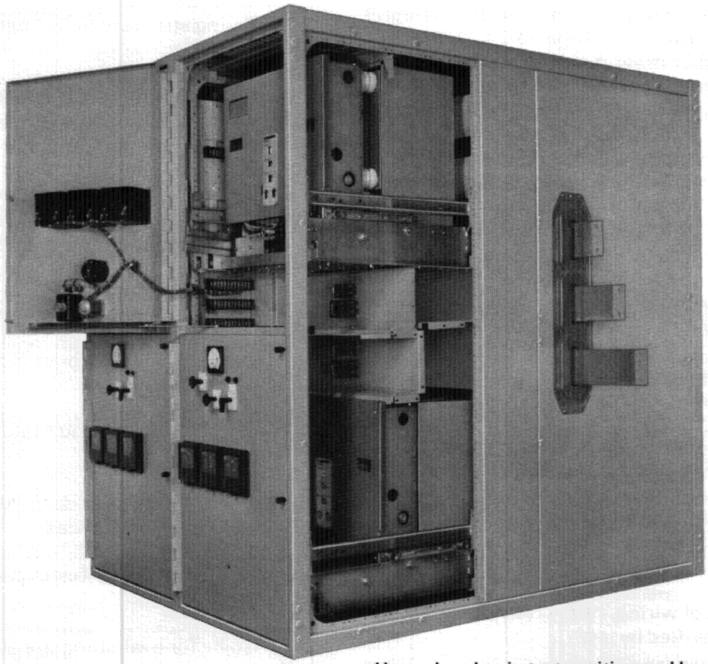
VAC-CLAD metal-clad switchgear offers a total design concept of cell, breaker and auxiliary equipment to meet the user needs. The design criteria was full compliance with ANSI, IEEE, and NEMA standards. Conformance to industry standards assures a high level of performance and permits the specifier with ease and accuracy to define a level of performance developed by the industry for its needs.

VAC-CLAD metal-clad Switchgear consists of two-high circuit-breaker, cable, and auxiliary compartments. These metal-enclosed compartments are assembled in various combinations to satisfy application requirements. Two-high arrangements are standard, but one-high arrangements can be supplied when a situation so requires.

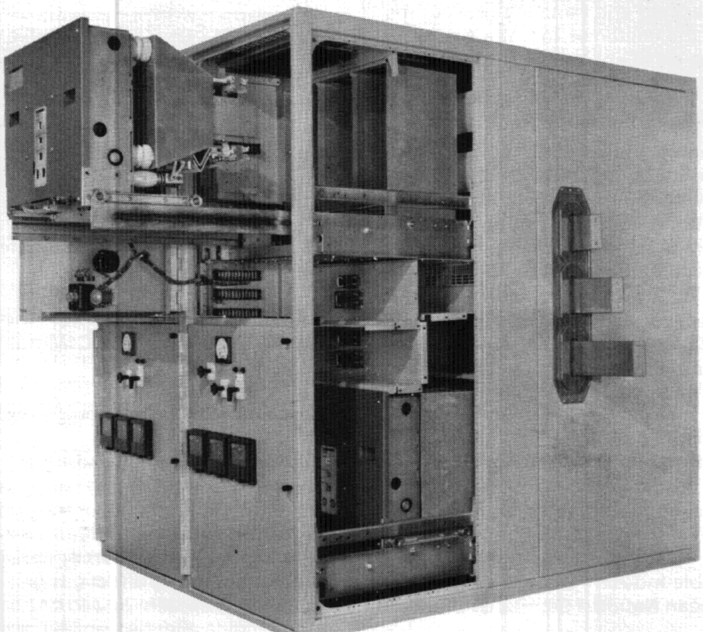
The photographs show a typical VAC-CLAD arrangement.

Figures A, B, and C (see pages 6 & 7) are sectional side view drawings which show typical types of vertical sections.

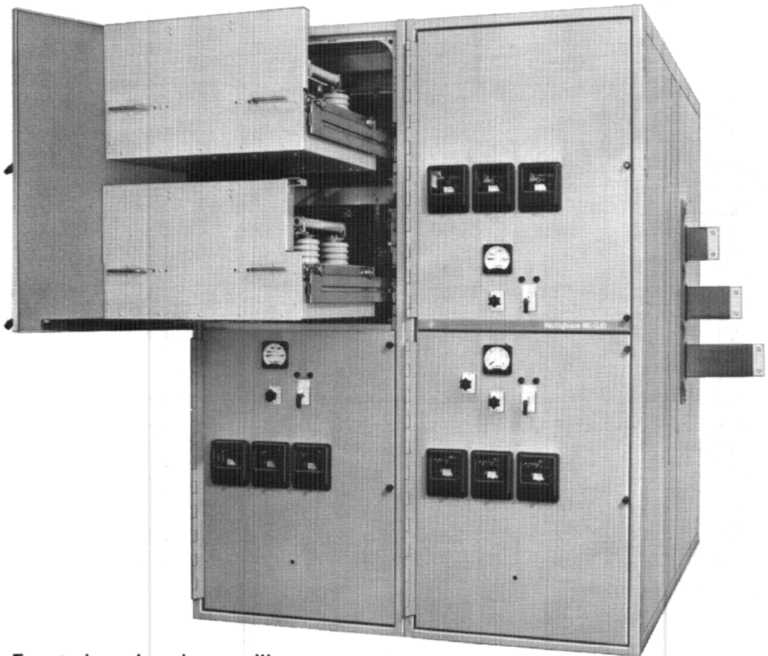
Figure D is a front view sketch showing the different types of available vertical sections. Note that the 3000 ampere breaker is available only in a lower compartment and that drawout auxiliaries are not available in the same vertical section.



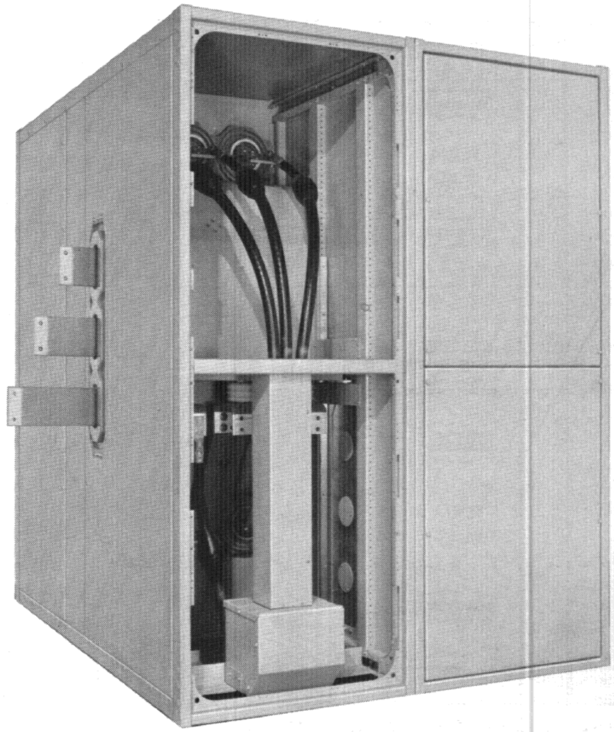
Upper breaker in test position and lower breaker in connected position.



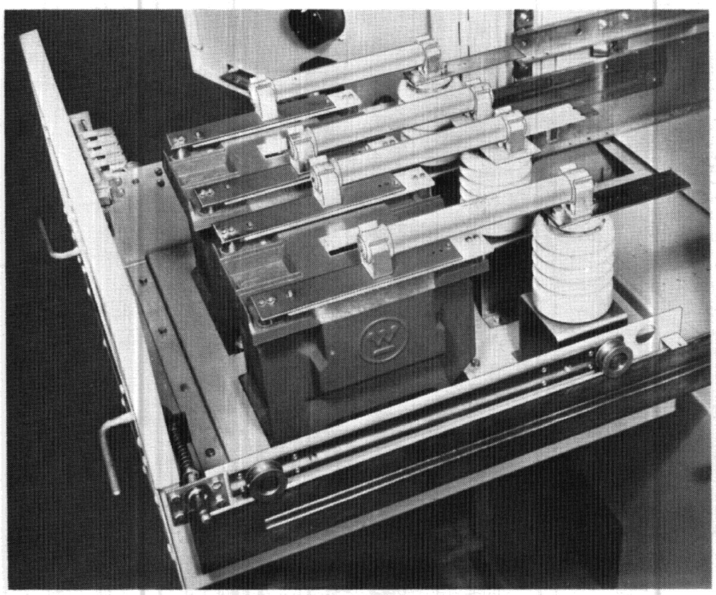
Upper breaker in withdrawn position on extended rails.



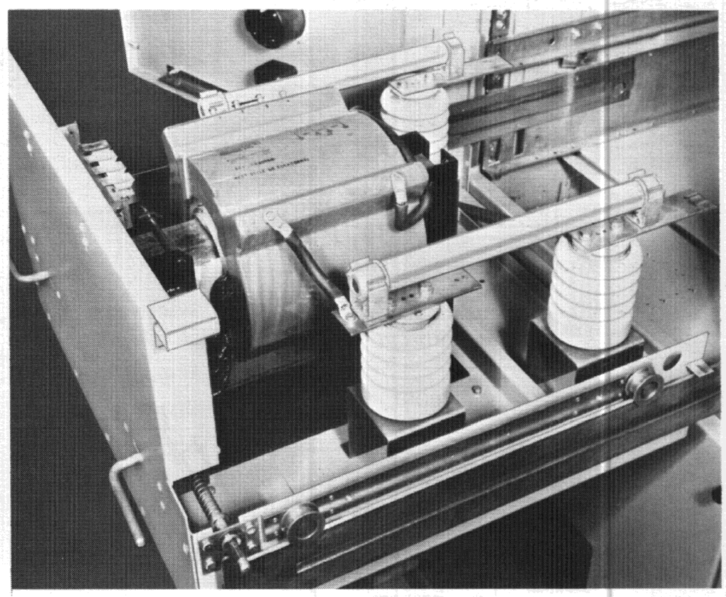
Front view showing auxiliary compartments withdrawn.



Rear view showing cable compartments.



View of drawout potential transformers.



View of drawout control power transformer.

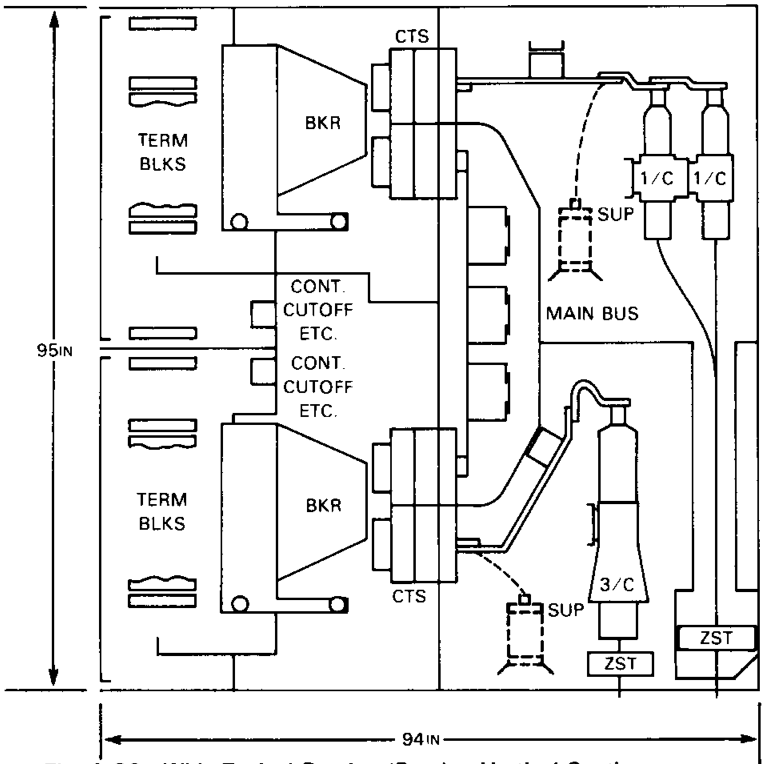


Fig. A 36IN Wide Typical Breaker/Breaker Vertical Section

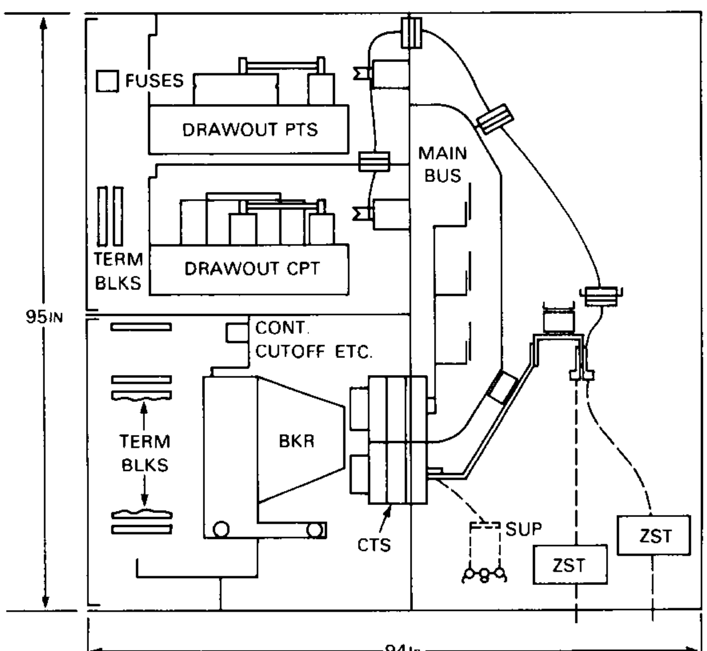


Fig. B 36IN Wide Typical Auxiliary/Breaker Vertical Section

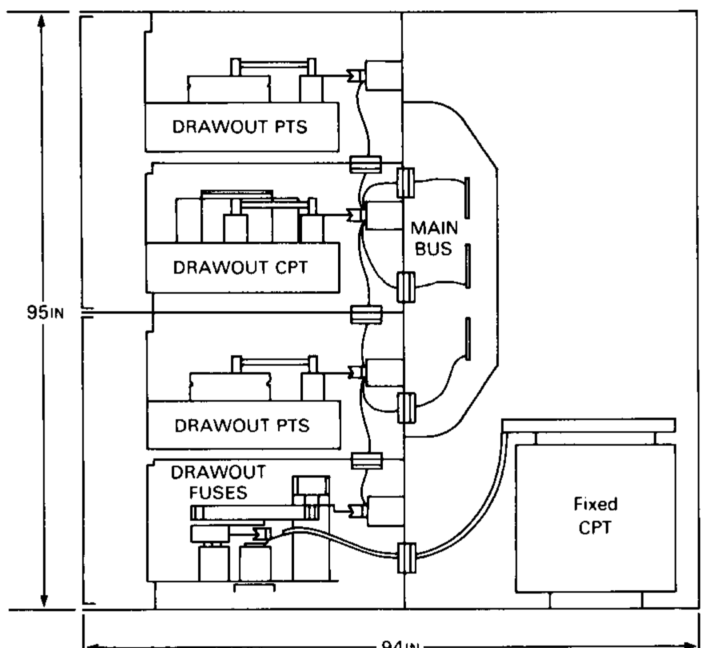
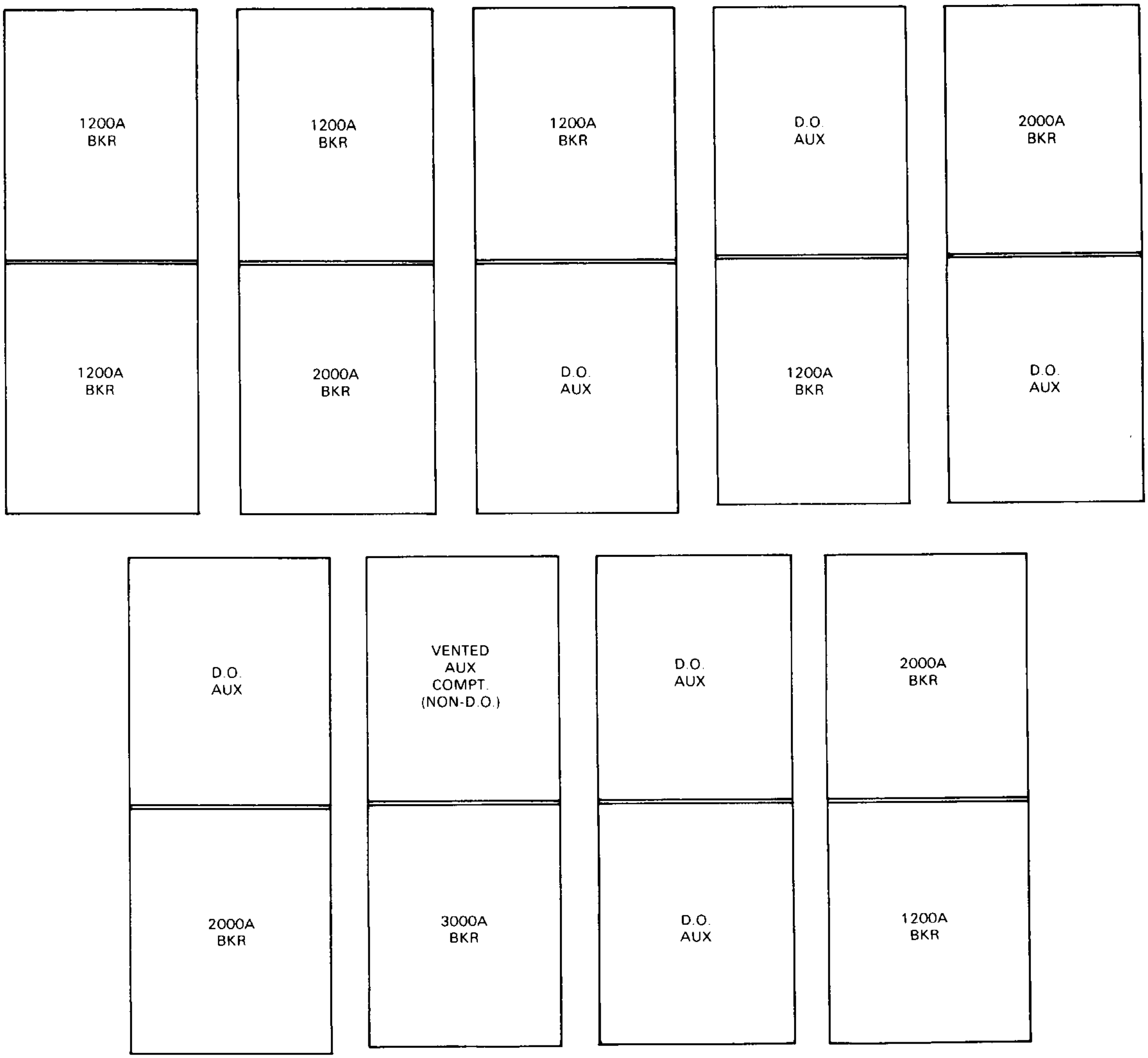


Fig. C 36In Wide Typical Auxiliary/Auxiliary Vertical Section

Fig. D Available Configurations



Part 4 System Application

Table 1: Application: Available Breaker Types Rated on Symmetrical Current Rating Basis

Identification	Rated Values											Related Required Capabilities[3]		
	Nominal Voltage Class	Nominal 3-Phase MVA Class	Voltage		Insulation Level		Current		Rated Interrupting Time	Rated Permissible Tripping Delay	Rated Max. Voltage Divided By K	Current Values		
			Rated Maximum Voltage	Rated Voltage Range Factor ②	Rated Withstand Test Voltage		Rated Continuous Current at 60 Hz	Rated Short Circuit Current (at rated Max. Kv) ②		④		Maximum Sym. Interrupting Capability	3 Sec. Short-Time Current Carrying Capability	Closing and Latching Capability (Momentary)
					Low Frequency	Impulse						K Times Rated Short-Circuit Current ②		1.6 K Times Rated Short-Circuit Current
Circuit Breaker Type			E	K				I		Y	E/K	KI		
	Kv Class	MVA Class	Kv rms		Kv rms	Kv Crest	Amperes	KA rms	Cycles	Sec.	Kv rms	KA rms	KA rms	KA rms
VCP Vacuum Circuit Breaker														
50VCP250	4.16	250	4.76	1.24	19	60	1200 2000 3000	29	5	2	3.85	36	36	58
H 50VCP250 ①							1200 2000 3000							78①
50VCP350		350		1.19			1200 2000 3000	41			4.0	49	49	78
75VCP500	7.2	500	8.25	1.25	36	95	1200 2000 3000	33	5	2	6.6	41	41	66
150VCP500	13.8	500	15	1.30	36	95	1200 2000 3000	18	5	2	11.5	23	23	37
H 150VCP500 ①							1200 2000 3000							58①
150VCP750		750					1200 2000 3000	28				36	36	58
H 150VCP750 ①							1200 2000 3000							77①
150VCP1000		1000					1200 2000 3000	37				48	48	77

① Non-Standard Breaker with High Momentary Rating available for Special Applications.

② For 3 phase and line to line faults, the sym. interrupting capability at a kV operating voltage

$= \frac{E}{Kv}$ (rated Short-Circuit Current)

But not to exceed KI.
Single line to ground fault capability at a Kv operating voltage
$= 1.15\,E$ (Rated Short-Circuit Current) $\frac{E}{Kv}$

But not to exceed KI.
The above apply on predominately inductive or resistive 3-phase circuits with normal-frequency line to line recovery voltage equal to the operating voltage.

③ For Reclosing Service, the Sym. interrupting Capability and other related capabilities are modified by the reclosing capability factor obtained from the following formula:

$$R\,(\%) = 100 - \frac{C}{6}\left[(n-2) + \frac{15-T_1}{15} + \frac{15-T_2}{15} + \ldots\right]$$

Where
C = KA Sym. Interrupting Capability at the Operating Voltage but not less than 18
n = Total No. of Openings
T^1, T^2, etc. = Time interval in seconds except use 15 for time intervals longer than 15 sec.

Note: Reclosing Service with the standard duty cycle O = 15s + CO Does not require breaker Capabilities modified since the reclosing capability factor R = 100%.

④ Tripping may be delayed beyond the rated permissible tripping delay at lower values of current in accordance with the following formula:

$$T\,(\text{seconds}) = Y\left[\frac{\text{KI (K Times Rated Short-Circuit Current)}}{\text{Short-Circuit Current Through Breaker}}\right]^2$$

The aggregate tripping delay on all operations within any 30 minute period must not exceed the time obtained from the above formula.

Application Quick Check Table

For application of circuit breakers in a radial system supplied from a single source transformer. Short-circuit duty was determined using E/X amperes and 1.0 multiplying factor for X/R ratio of 15 or less and 1.25 multiplying factor for X/R ratios in the range of 15 to 40.

<table>
<tr><th colspan="2">Source Transformer MVA Rating</th><th colspan="5">Kv Operating Voltage</th></tr>
<tr><th colspan="2">Motor Load</th><th rowspan="2">2.4</th><th rowspan="2">4.16</th><th rowspan="2">6.6</th><th rowspan="2">12</th><th rowspan="2">13.8</th></tr>
<tr><th>100%</th><th>0%</th></tr>
<tr><td>1
1.5
2</td><td>1.5
2
2.5</td><td>50 VCP 250
12 Ka</td><td rowspan="2">50 VCP 250
10.1 Ka</td><td rowspan="5">150 VCP 500
23 Ka</td><td rowspan="7">150 VCP 500
22.5 Ka</td><td rowspan="7">150 VCP 500
19.6 Ka</td></tr>
<tr><td>2.5
3</td><td>3
3.75</td><td rowspan="2">50 VCP 250
36 Ka</td></tr>
<tr><td>3.75
5</td><td>5
7.5</td><td rowspan="3">50 VCP 250
33.2 Ka</td></tr>
<tr><td>7.5
10①</td><td>10
10</td><td>50 VCP 350
49 Ka</td></tr>
<tr><td>10</td><td>12①</td><td rowspan="6"></td></tr>
<tr><td>12</td><td>15</td><td>50 VCP 350
46.9 Ka</td><td rowspan="3">75 VCP 500
41.3 Ka</td></tr>
<tr><td>15</td><td>20</td><td rowspan="4"></td></tr>
<tr><td rowspan="3">20①</td><td>20</td><td rowspan="2">150 VCP 750
35 Ka</td><td rowspan="2">150 VCP 750
30.4 Ka</td></tr>
<tr><td>25
30</td><td rowspan="2"></td></tr>
<tr><td>50①</td><td>150 VCP 1000
46.3 Ka</td><td>150 VCP 1000
40.2 Ka</td></tr>
</table>

Breaker Type and Sym. Interrupting Capacity at the Operating Voltage

① Transformer Impedance 6.5% or more, all other Transformer Impedances are 5.5% or more.

Load Current Switching

The following table of number of operations is a guide to normal maintenance for circuit breakers operated under usual service conditions for most repetitive duty applications including isolated capacitor bank switching and shunt reactor switching, but not for arc furnace switching. The numbers in the Table are consistent with ANSI C37.06 (1979).

Servicing shall consist of adjusting, cleaning, lubricating, tightening, etc., as recommended by the circuit breaker instruction book.

Continuous current switching assumes opening and closing rated continuous current at rated maximum voltage with power factor between 80% leading and 80% lagging.

Inrush current switching assures a closing current equal to 600% of rated continuous current at rated maximum voltage with power factor of 30% lagging or less, and an opening current equal to rated continuous current at rated maximum voltage with power factor between 80% leading and 80% lagging.

Circuit Breaker Type	Continuous Current Rating Amperes	Number of Operations: Max. No. Operations Between Servicing	Number of Operations: No Load Mechanical Duty	Number of Operations: Continuous Current Switching	Number of Operations: Inrush Current Switching
All VCP Vacuum Circuit Breakers Ratings Except 50VCP350 & 150VCP1000	1200 2000	2000 2000	10,000 10,000	1000 1000	750 750
50VCP350 150VCP1000 & All 3000A Ratings	1200 2000 3000	1000	5,000	500	400

In accordance with ANSI C37.06(1979), if a short-circuit operation occurs before the completion of the listed switching operations, maintenance is recommended and possible functional part replacement may be necessary, depending on previous accumulated duty, fault magnitude, and expected future operations.

Application on Symmetrical Current Rating Basis

Application Considerations
Westinghouse medium voltage metal-clad switchgear provides control and protection for generators, motors, transformers and all types of feeder circuits. In the usual application the selection of the circuit breaker for the operating voltage, to carry the load current and provide for the interruption of the available short-circuit is of primary importance. The purpose of this application data is to aid in this selection.

It should be noted that for a particular application there may be other items of technical importance that require careful consideration. Also requirements for special applications or unusual service conditions should be referred to the nearest Westinghouse Sales Office with details and a request for recommendations.

Rated Maximum Voltage
The Kv operating voltage should not exceed the rated maximum voltage, E in Table 1, since this is the upper limit for operation.

Rated Continuous Current
The continuous current rating of a circuit breaker is a maximum rating. The circuit breaker rating should always be in excess of the utilization equipment rating to provide for short time overload capability.

Transformer main breakers should be rated in excess of 125% of transformer full load amperes. Always consider forced cooled rating, possible future forced cooling and 12% additional capacity for 65°C rise rating when used.

Induction motor and synchronous motor starting breakers should be rated in excess of 125% of motor full load amperes.

Generator breakers should be in excess of 125% of generator full load current. Other factors such as increased capacity at 1.0 power factor, reduced voltage or low ambient temperature rating may have to be considered.

Capacitor bank feeder breakers should have a rating in excess of 135% of the bank full load current. This is due to a 0 to +15% manufacturing tolerance in capacitors, KVAR due to harmonic currents and possibility of up to 10% over-voltage. Capacitor switching is generally limited to 1200 ampere continuous (630 A capacitor current) breakers since larger size banks are switched in steps and other factors such as limiting transient voltages and momentary duty from switching capacitors back to back or other limitations due to the type of breaker may have to be considered.

Interrupting Capability
Table 1 lists rated short-circuit current at rated voltage for the various available circuit breaker types which is adjusted for the operating voltage to obtain the 3 phase symmetrical interrupting capability. This value is multiplied by 1.15 to obtain the single line to ground capability. Note that the 3 phase or single line to ground capabilities may not exceed KI, the maximum symmetrical interrupting capability.

Although these capabilities are expressed in sym. kilo-amperes, the circuit breaker shall be able to interrupt all values of asymmetrical as well as symmetrical short-circuit current from a system having an X/R ratio of 15 or less.

Short-Circuit Duty
To check the breaker application from an interrupting standpoint, compare the interrupting capability at the operating voltage with the short-circuit duty determined for the point of application in the power system.

Table 2 lists multiplying factors depending upon the system X/R ratio and the breaker rated interrupting time to obtain the maximum short-circuit duty. If the maximum multiplying factor for the source of short-circuit current is used, it is not necessary to calculate the system X/R ratio. If the system X/R ratio is 15 or less, the multiplying factor is 1.0.

Short-Circuit Duty = E/X amperes (Max. Mult. Factor)

A closer check of the application requires calculation of the system X/R ratio. It is sufficiently accurate (on the conservative side) to neglect the resistance component when calculating the system reactance X and neglect the reactance component when calculating the system resistance R. Use actual equipment data for important electrical devices wherever possible.

Typical data for various system components is included in Table 3 for estimating purposes.

System X/R ration = $\frac{X_1}{R_1}$ for 3 phase faults

and = $\frac{2X_1 + X_0}{2R_1 + R_0}$ for single line to ground

faults where X_1 and X_0 are positive and zero sequence reactances, R_1 and R_0 are positive and zero sequence resistances.

System X/R ratio so determined is used to obtain the E/X ampere multiplying factor from Table 2.

Short-Circuit Duty=E/X amperes (Mult. Factor Table 2)

E/X Amperes Calculations
Short circuit calculations usually consist of simple E/X computations:

3 phase fault	single line to ground fault
$I_{3\phi} = \frac{E}{X}$	$I_{LG} = \frac{3E}{2X_1 + X_0}$

where E is line to neutral operating voltage, and reactances are ohms, per phase, line to neutral.

Computations are simplified by selection of a common base and using the per unit system of calculations:

3 phase fault	single line to ground fault
$I_{3\phi} = \frac{I_B}{X}$	$I_{LG} = \frac{3 I_B}{2X_1 + X_0}$

Where I_B is the base current in kilo-amperes and reactances are in per-unit of the common base. Convenient per-unit system formulas:

$$I_B = \frac{\text{MVA Base}}{\sqrt{3}\text{kV}} \qquad \text{Base ohms} = \frac{KV^2}{MVA}$$

$$\text{per unit } X = \frac{X}{MVA} \text{ MVA base}$$

$$\text{or} = \frac{X}{I} I_B$$

$$\text{or} = \frac{\text{X ohms}}{\text{base ohms}}$$

$$\text{or} = \frac{\text{X percent}}{100}$$

Where system is impedance grounded to limit the single line to ground fault to the 3 phase fault value or lower, only the 3 phase fault calculations are necessary.

Table 3 lists reactances quantity to be used for X for the various system components. Use actual data for important electrical devices wherever possible. Table 4 lists typical X/R ratio ranges and is included for estimating purposes.

The E/X amperes determined are in rms symmetrical kilo-ampere.

Momentary Duty
When there is motor contribution to the total short circuit, an additional calculation should be made to determine the momentary duty using the reactance quantities for momentary duty from Table 3.

Momentary Duty=1.6 E/X Amperes

Compare momentary duty with close and latch capability or momentary rating listed in Table 1.

Table 2: Multiplying Factor for E/X Amperes (ANSI C37.010, 1979, Figs. 8, 9, 10)

System X/R Ratio	Type VCP Vacuum Circuit Breaker Rated Interrupting Time, 5 Cycle — Type of Fault: 3φ — Source of Short Circuit: Local	LG	3φ & LG — Remote
1	1.00	1.00	1.00
15②	1.00	1.00	1.00
20	1.00	1.02	1.05
25	1.00	1.06	1.10
30	1.04	1.10	1.13
35	1.06	1.14	1.17
40	1.08	1.16	1.22
45	1.12	1.19	1.25
50	1.13	1.22	1.27
55	1.14	1.25	1.30
60	1.16	1.26	1.32
65	1.17	1.28	1.33
70	1.19	1.29	1.35
75	1.20	1.30	1.36
80	1.21	1.31	1.37
85			1.38
90	1.22	1.32	1.39
95			1.40
100	1.23	1.33	1.41
110	1.24	1.34	1.42
120	1.24	1.35	1.43
130	1.24	1.35	1.43

① Not necessary to calculate the system X/R ratio when Max. Multiplying Factor is used.

② Where system X/R ratio is 15 or less, the Multiplying Factor is 1.0.

Table 4: Typical System X/R Ratio Range (for estimating purposes)

Type of circuit	X/R Range
Remote generation thru other types of circuits, such as transformers rated 10 MVA or smaller for each three-phase bank, transmission lines, distribution feeders, etc.	15 or less
Remote generation connected thru transformers rated 10 MVA to 100 MVA for each three-phase bank, where the transformers provide 90 percent or more of the total equivalent impedance to the fault point	15-40
Remote generation connected thru transformers rated 100 MVA or larger for each three-phase bank, where the transformers provide 90 percent or more of the total equivalent impedance to the fault point	30-50
Synchronous machines connected thru transformers rated 25 to 100 MVA for each three-phase bank	30-50
Synchronous machines connected thru transformers rated 100 MVA and larger	40-60
Synchronous machines connected directly to the bus or thru reactors	40-120

Source of Short Circuit

Local

Application of breakers at generator voltage is local source. Also local sources are considered to be where short circuit is fed predominantly from generators through:

a) Not more than one transformation, or

b) a per-unit reactance external to the generator which is less than 1.5 times the generator per-unit subtransient reactance on a common system MVA base.

①Max. Multiplying Factor:
1.25 3φ Fault
1.43 LG Fault

Remote

Most applications including station service auxiliaries are remote source. Remost sources are considered to be where the short circuit is fed predominantly from generators through:

a) two or more transformations, or

b) a per-unit reactance external to the generator that is equal to or exceeds 1.5 times the generator per-unit subtransient reactance on a common system MVA base.

①Max. Multiplying Factor:
1.43 3φ or LG Fault

Table 3: Reactance X for E/X Amperes

System Component	Reactance X Used for: Short-Circuit Duty	Momentary Duty	Typical Values & Range on Component Base: % Reactance	X/R Ratio
2 Pole Turbo Generator	X	X	9 7 - 14	80 40 - 120
4 Pole Turbo Generator	X	X	14 12 - 17	80 40 - 120
Hydro Gen. with Damper Wdgs. and Syn. Condensers	X	X	20 13 - 32	30 10 - 60
Hydro Gen. without Damper Windings	.75 X	.75 X	30 20 - 50	30 10 - 60
All Synchronous Motors	1.5 X	1.0 X	24 13 - 35	30 10 - 60
Ind. Motors above 1000 HP, 1800 RPM and above 250 HP, 3600 RPM	1.5 X	1.0 X	25 15 - 25	30 15 - 40
All Other Induction Motors 50 HP and Above	3.0 X	1.2 X	25 15 - 25	15 5 - 20
Ind. Motors Below 50 HP and all Single Phase Motors	Neglect	Neglect	.....	.....
Distribution System from Remote Transformers	X	X	as Specified or Calculated	15 5 - 15
Current Limiting Reactors	X	X	as Specified or Calculated	80 40 - 120
Transformers				
OA to 10 MVA, 69 Kv	X	X	5.5 5 - 7	10 6 - 12
OA to 10 MVA, above 69 Kv	X	X	7.5 7 - 11	12 8 - 15
FOA 12 to 30 MVA	X	X	10 8 - 24	20 10 - 30
FOA 40 to 100 MVA	X	X	15 8 35	30 20 - 40

Use transient reactance X'd for X for hydro generator without damper windings.
For other machines use subtransient reactance X''d for X.

For other system components use positive sequence reactance X[1] for X.

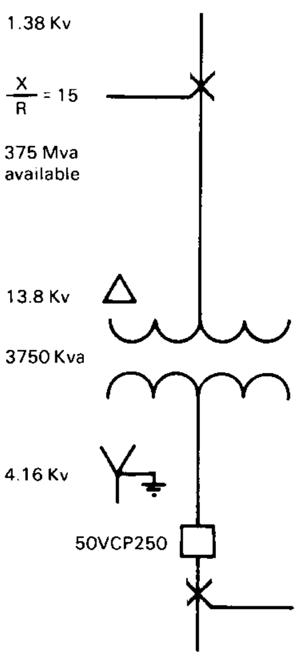
Application on Symmetrical Current Rating Basis

Example 1—Fault Calculations

Type Breaker	E Max.	3ϕ Sym. Interrupting Capability @ E. Max.	Max. KI	@ 4.16 Kv Oper. Voltage	Close & Latch or Momentary
50VCP250	4.76	29 kA	36 kA	$\frac{4.76}{4.16}$ (29)=33.2 Ka②	58 Ka①
		LG Sym. Interrupting Capability			
			36 Ka	1.15 (33.2)=38.2 Ka③	

Note: Interrupting capabilities ②and③at operating voltage must not exceed max. sym. interrupting capability KI

Check capabilities ①② and ③ on the following utility system where there is no motor contribution to short circuit.



On 13.8 Kv System, 3.75 Mva Base

$$Z = \frac{3.75\ \text{Mva}}{3.75\ \text{Mva}} = .01\ \text{pu or } 1\%$$

$$Z^2 = X^2 + R^2 = R^2\left(\frac{X^2}{R^2} + 1\right)$$

$$R = \frac{Z}{\sqrt{\frac{X^2}{R^2} + 1}} = \frac{1}{\sqrt{226}} = \frac{1}{15.03} = .066\%$$

$$X = \frac{X}{R}(R) = 15\,(.066) = .99\%$$

Transformer Standard 5.5% Impedance has a ± 7.5% Manufacturing Tolerance

	5.50 Standard Impedance
	-.41 (-7.5% Tolerance)
Transformer Z =	5.09%

From transformer losses R is calculated

31,000 Watts Full Load	
-6,800 Watts No Load	
24,200 Watts Load Losses	

$$R = \frac{24.2\ \text{Kw}}{3750\ \text{Kva}} = .0065\ \text{pu or } .65\%$$

$$\text{transformer } X = \sqrt{Z^2 - R^2} = \sqrt{(5.09)^2 - (.65)^2} = \sqrt{25.91 - .42} = \sqrt{25.48}$$

x=5.05%

	X	R	X/R
13.8 Kv System	.99%	.066%	15
Transformer	5.05	.65	8
System Total	6.04%	.716%	9
or	.0604 pu	.00716 pu	

For 3 Phase Fault

$I_3\phi = \frac{E}{X}$ where X is ohms per phase and E is line to neutral voltage

or $I_3\phi = \frac{I_B}{X}$ where X is per unit reactance

I_B is base current.

$$\text{Base current } I_B = \frac{3.75\ \text{Mva}}{\sqrt{3}\ 4.16\ \text{Kv}} = .52\ \text{Ka}$$

$$I_3\phi = \frac{I_1}{X} = \frac{.52}{.0604} = 8.6\ \text{Ka Sym.}$$

System $\frac{X}{R}$ = 9 (is less than 15) would use 1.0 mult. factor for short-circuit duty, therefore, short-circuit duty is 8.6 Ka sym. for 3 ϕ fault ② and momentary duty is 8.6 x 1.6=13.7 Ka ①

For Line to Ground Fault

$$I_{LG} = \frac{3E}{2X_1 + X_0} \text{ or } = \frac{3I_B}{2X_1 + X_0}$$

For this system, X_0 is the zero sequence reactance of the transformer which is equal to the transformer positive sequence reactance and X_1 is the positive sequence reactance of the system.

Therefore,

$$I_{LG} = \frac{3(.52)}{2(.0604) + .0505} = 9.1\ \text{Ka Sym.}$$

Using 1.0 mult. factor, short-circuit duty=9.1 Ka Sym. LG③

The 50VCP250 breaker capabilities exceed the duty requirements and may be applied.

With this application, short cuts could have been taken for a quicker check of the application. If we assume unlimited short circuit available at 13.8 Kv and that Trans. Z=X

$$\text{Then } I_3\phi = \frac{I_B}{X} = \frac{.52}{.055} = 9.5\ \text{Ka Sym.}$$

X/R ratio 15 or less mult. factor is 1.0 for short-circuit duty

The short-circuit duty is then 9.5 Ka Sym. ② ③ and momentary duty is 9.5 x 1.6 Ka= 15.2 Ka ①

Example 2—Fault Calculations
All calculations on per unit basis, 7.5 Mva Base

Base Current $I_B = \frac{7.5 \text{ Mva}}{\sqrt{3}\, 6.9 \text{ Kv}} = .628$ Ka

	X	R	X/R
13.8 Kv System			
$X = \frac{.638}{21} \frac{(6.9)}{(13.8)}$	.015	.001	15
Transformer	.055	.0055	10
Total Source Transf.	.070 pu	.0065 pu	11

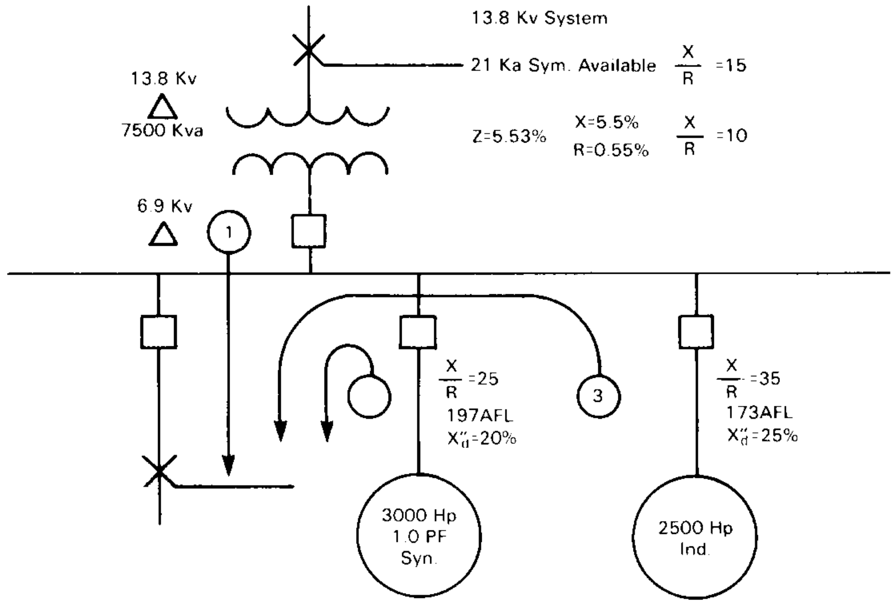
3000 Hp Syn. motor

$X = .20 \frac{(.628)}{.197} = .638$ pu at 7.5 Mva base

2500 Hp Ind. Motor

$X = .25 \frac{(.628)}{(.173)} = .908$ pu at 7.5 Mva base

$I_{3\phi} = \frac{E}{X}$ or $= \frac{I_B}{X}$ where X on per unit base



Source of Short Circuit Current	Interrupting E/X Amperes	Momentary E/X Amperes	$\frac{X}{R}$	$\frac{X(1)}{R(X)}$	$\frac{1}{R}$
① Source Transf.	$\frac{.628}{.070} = 8.971$	$\frac{.628}{.070} = 8.971$	11	$\frac{11}{.070}$	=157
② 3000 HP Syn. Motor	$\frac{.628}{(1.5).638} = .656$	$\frac{.628}{.638} = .984$	25	$\frac{25}{.638}$	= 39
③ 2500 HP Ind. Motor	$\frac{.628}{(1.5).908} = .461$	$\frac{.628}{.908} = .691$	35	$\frac{35}{.908}$	= 39
	3F= 10.088 or 10.1 Ka	10.647 x1.6 17.0 KA Momentary Duty			Total 1/R=235

Total $X = \frac{I_1}{I_{3F}} = \frac{.628}{10.1} = .062$

System $\frac{X}{R} = .062\,(235) = 14.5$ is Mult. Factor 1.0 from Table 3.

Short circuit duty = 10.1 Ka

Type Breaker	E Max.	3ϕ Sym. Interrupting Capability @ E. Max.	Max. KI	@ 6.9 Kv Oper. Voltage	Close & Latch or Momentary
75VCP500	8.25	33 Ka	41 Ka	$\frac{8.25}{6.9}$ (33)=39.5 Ka	66 KA
150VCP500	15	18 Ka	23 Ka	$\frac{15\,(18)}{6.9}$ =(39.1)=23 Ka (But not to exceed KI)	37 Ka

Either breaker could be properly applied, but price will make the type 150VCP500 the more economical selection.

Application on Symmetrical Current Rating Basis

Example 3—Fault Calculations
Check breaker application or generator bus where

Each generator is 7.5 Mva, 4.16 Kv 1040 amperes full load, I_B=1.04 Ka

Sub transient reactance Xd''=11% or, X=.11 pu

Gen $\frac{X}{R}$ ratio is 30

$$\frac{1}{X_s}=\frac{1}{X}+\frac{1}{X}+\frac{1}{X}=\frac{3}{X} \text{ and } \frac{1}{R_s}=\frac{1}{R}+\frac{1}{R}+\frac{1}{R}=\frac{.3}{R}$$

$$\text{or } X_s=\frac{X}{3} \text{ and } R_s=\frac{R}{3} \text{ Therefore, System } \frac{X_s}{R_s}=\frac{X}{R}=\text{Gen } \frac{X}{R}=30$$

Since generator neutral grounding reactors are used to limit the I_{LG} to I_3 or below, we need only check the I_3 short-circuit duty.

$$I_{3\phi}=\frac{I_B}{X}+\frac{I_B}{X}+\frac{I_B}{X}=\frac{3I_B}{X}=\frac{3(1.04)}{.11}=28.4 \text{ Ka Sym. E/X amperes}$$

Table 3 System $\frac{X}{R}$ of 30 is Mult. factor 1.04

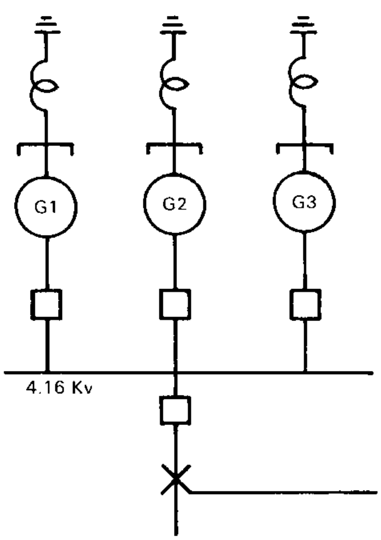
Short-circuit duty is 28.4 (1.04)+29.5 Ka Symmetrical.

3 ϕ Sym. Interrupting Capability

Type Breaker	E Max.	@ E Max.	Max. KI	@ 4.16 Kv Oper. Voltage
50VCP250	4.76	29 Ka	36 Ka	$\frac{4.76}{4.16}$ (29)=33.2 Ka
50VCP350	4.76	41 Ka	49 Ka	$\frac{4.76}{4.16}$ (41)=46.9 Ka

The 50VCP250 breaker could be applied. However, the 50VCP350 breaker would permit addition of a future duplicate generator.

Future Short-circuit Duty= $\frac{4(1.04)}{.11}$ (1.04)=39.3 Ka Sym.



Part 5 Surge Protection

VAC-CLAD metal clad switchgear is applied over a broad range of circuits, and is one of many types of equipment in the total system. The distribution system can be subject to voltage transients caused by lightning or switching surges.

Recognizing this phenomenon, the industry has developed standards to provide guidelines for application of electrical equipment, which should be used in the design of distribution systems independent of the breaker interrupting medium. These standards are:

IEEE 288 (1969) - ANSI C37.92 (1972)-
IEEE Guide for Induction Motor Protection.

IEEE 242-1975 (Buff Book)
IEEE Recommended Practice for Protection and Co-ordination of Industrial and Commercial Power Supplies.

IEEE 141-1976 (Red Book)
Recommended Practices for Electric Power Distribution in Industrial Plants.

ANSI C37.20 (IEEE-27)
Switchgear assemblies including metal-enclosed bus.

In general, if the BIL of the system is equal to the BIL of VAC-CLAD metal clad switchgear, no protection is required against switching surges; however, rotating apparatus rarely meets this criterion. For circuits exposed to lightning, protection is recommended in line with standard practices.

With the wide range of applications, not all circuits require surge protection. Therefore, VAC-CLAD metal clad switchgear (like DHP magnetic air) does not include any surge protection as standard. The user exercises the options as to the type of protection deemed necessary, depending on the individual circuit characteristics and cost considerations.

The following recommendations are outlined to provide guidelines of minimum surge protection for metal clad switchgear and the associated system equipment:

1. Lightning - Standard lightning protection: arresters. (Refer to Typical Lightning Arrester Application, Page 15.)

2. Switching surge protection:
a. Liquid filled transformer — no surge protection.

b. Dry type transformers:
15 Kv - 95 Kv BIL - no surge protection required.
7.5 Kv - 95 Kv BIL - no surge protection required.
5 Kv - 60 Kv BIL - no surge protection required.

For all other voltages/BIL ratings for dry type transformers, surge protection (arresters or capacitors) is recommended at the transformer terminals, in line with established practices. ZnO surge absorbers can be supplied in VAC-CLAD switchgear as an alternate to the above.

c. Motors — Surge capacitors at the motor terminals (and surge arresters where appropriate).

d. Generators — Surge capacitors and station class surge arresters at machine terminals.

e. Switching overhead lines and underground cables — no surge protection required.

f. Capacitor Switching — no surge protection required.

g. Shunt reactor switching — Three phase 15 Kv dry-type reactors less than 9 MVA require surge protection at the reactor's terminals.

ZnO surge absorbers limit the magnitude of prospective overvoltage, but are ineffective in controlling the rate-of-rise of fast transients which surge capacitors do control. Surge capacitor values recommended are: 0.25 uf on 15 Kv systems, and 0.5 uf on 5 Kv and 7.5 Kv. Reliability of surge capacitors is high, since they are operated at only 50% of the stress of conventional power capacitors. The combination of conservative design and high final test level at 7 times rated voltage for 10 seconds assures the long life and established reliability of surge capacitors. The new Zn O surge absorbers/arresters are recommended, and this latest advance in arrester design assures better performance and high reliability of this component utilized in surge protection schemes.

These application guidelines for VAC-CLAD metal clad switchgear were established after extensive analysis of medium voltage power systems. To achieve this, a computer program has been developed, and this incorporates inputs for the power system, the load, the vacuum circuit breaker, and surge protection means (if any). All program inputs correspond to, and are verified against, practical data. The data for the vacuum circuit breakers has required several thousand tests to be performed on the vacuum interrupters used in VAC-CLAD breakers to insure that computed results are realistic.

Extensive computer analysis has been performed to insure that the most critical transformer and motor applications were encompassed in the study.

The computer analysis approach, by virtue of the capability to analyze a broad range of circuits, assures a significantly higher degree of confidence in the surge data than a relatively few representative practical tests.

Typical Lightning Arrester Application

Operating Voltage Kv	Impedance Grounded or Ungrounded System	Solidly Grounded System
2.4	3 Kv	3 Kv
4.16	6 or 4.5 Kv	3 Kv
6.9	9 or 7.5 Kv	6 Kv
12.0	15 Kv	9 Kv
13.8	15 Kv	12 Kv

The location of arresters at the junction of cables connected to exposed line may also protect equipment. The following table shows typical maximum cable lengths which can be protected by riser pole arresters, based on typical assumed system parameters and on the full range of known arrester types and makes. Where cable length to equipment exceeds the maximum listed, it is recommended that arresters also be located at the equipment.

Suggested maximum cable length, in feet, between riser pole arresters and protected equipment:

Lightning Arrester Rating	Station Type Arrester	Intermediate Type	Distribution Type
To 60 Kv BIL Metal-Clad Switchgear			
3 Kv	NL	NL	NL
4.5 Kv	NL	NL	X
6 Kv	NL	NL	70
To 95 Kv BIL Metal-Clad Switchgear			
6 Kv	NL	NL	NL
7.5 Kv	NL	NL	X
9 Kv	NL	NL	160
12 Kv	NL	240	70
15 Kv	110	80	S
To 60 Kv BIL Liquid or Gas-Filled Transformer			
3 Kv	NL	NL	NL
4.5 Kv	NL	NL	X
6 Kv	NL	NL	NL
To 75 Kv BIL Liquid or Gas-Filled Transformer			
3 Kv	NL	NL	NL
6 Kv	NL	NL	NL
7.5 Kv	NL	NL	X
9 Kv	NL	NL	90
To 95 Kv BIL Liquid or Gas-Filled Transformer			
9 Kv	NL	NL	NL
12 Kv	NL	NL	120
15 Kv	NL	130	70

NL means no limit to cable length
X means not applicable
S means cable length too short to consider

Part 6 Instrument Transformers

Instrument Transformers

Instrument transformers are used to protect personnel and secondary devices from high voltage and permit use of reasonable insulation levels and current carrying capacity in relays, meters and instruments. The secondaries of standard instrument transformers are rated at 5 amperes and/or 120 volt, 60 hertz.

Potential Transformers

Selection of the ratio for potential transformers is seldom a question since the primary rating should be equal to or higher than the system line to line voltage to 120 volts. The number of potential transformers per set and their connection is determined by the type of system and the relaying and metering required.

The 3 phase, 3 wire system with 2 element watthour meters would require a set of two line to line potential transformers. If line to ground potential is also required for a directional ground relay, then a set of three line to ground potential transformers could be used to provide both line to line potential for the 2 element watthour meter and line to ground potential for the ground relay.

Ground detection lights or relays for the ungrounded system requires three line to ground potential transformers and a separate set is usually recommended for this purpose.

The 3 phase, 4 wire, solidly grounded system usually requires three line to ground potential transformers.

Where synchronizing of generators or systems is involved, it is recommended that only line to line potential be used.

Current Transformers

The current transformer ratio is generally selected so that the maximum load curent will read about 70 percent full scale on a standard 5 ampere coil ammeter. Therefore, the current transformer primary rating should be 140 to 150 percent of the maximum load current.

Maximum system fault current can sometimes influence the current transformer ratio selection since the connected secondary devices have published one second ratings.

The zero-sequence current transformer is used for sensitive ground fault relaying or self-balancing primary current type machine differential protection. The zero-sequence current transformer is available with a nominal ratio of 50-5 and available opening size for power cables of 6.5 inches.

Standard Potential Transformers • 60 Hertz

Rating	2400	4200	4800	7200	8400	12000	14400
Ratio	20	35	40	60	70	100	120

Switchgear **Potential Transformers — ANSI Accuracy**

Kv Class	Kv BIL	Max. Number Per Set and Connection	Standard Ratio's	120 Volts at Burden W, X, Y	120 Volts at Burden Z	69.3 Volts at Burden W, X	69.3 Volts at Burden Y	Z	Thermal Rating 55°C Conn.	Volt-amp
5	60	2LL or 3LG	20,① 35, 40	0.3	1.2	0.3			LL LG LG②	700 400 700
7.5 & 15	95	2LL or 3LG	35, 40, 60, 70, 100, 120	0.3	0.3	0.3	0.3	1.2	LL LG LG②	1000 550 1000

① For solidly ground 4160 volt system only or any type 2400 volt system.
② For solidly grounded system only.
LL Line to Line connection
LG Line to Ground connection

The minimum number of current transformers for circuit relaying and instruments is three current transformers, one for each phase or two phase connected current transformers and one zero-sequence current transformer. Separate sets of current transformers are required for differential relays.

The minimum pickup of a ground relay in the residual of three phase connected current transformers is primarily determined by the current transformer ratio. The relay pickup can be reduced by adding one residual connected auxiliary current transformer. This connection is very desirable on main incoming and tie circuits of low resistance grounded circuits.

Standard accuracy current transformers are normally more than adequate for most standard applications.

Part 7 Control Equipment

Circuit Breaker Control

The VCP circuit breaker has a motor charged spring type stored energy closing mechanism. Closing the breaker charges accelerating springs. Protective relays or the control switch will energize a shunt trip coil to release the accelerating springs and open the breaker. This requires a reliable source of control power for the breaker to function as a protective device.

For ac control, a capacitor trip device is used with each circuit breaker shunt trip and each WL-2 lockout relay to insure that energy will be available for tripping during fault conditions. A control power transformer is required on the source side of each incoming line breaker for closing bus tie or bus sectionalizing breakers will require automatic transfer of control power. This control power transformer may also supply other Ac auxiliary power requirements for the switchgear.

Dc control would require a dc control battery, battery charger and an ac auxiliary power source for the battery charger. The battery provides a very reliable dc control source, since it is isolated from the ac power system by the battery charger. However the battery will require periodic routine maintenance and battery capacity is reduced by low ambient temperature.

Any economic comparison of ac and dc control for switchgear should consider that the ac capacitor trip is a static device with negligible maintenance and long life, while the dc battery will require maintenance and replacement at some time in the future.

Standard Current Transformers • 55°C Ambient

Current Ratings Amperes	①Metering Accuracy Classification ANSI 60 Hz Standard Burden B 0.1	B 0.5	B 2.0	①Relaying Accuracy
50:5	1.2			C10
75:5	1.2			C10
100:5	1.2			C10
150:5	.6	2.4		C20
200:5	.6	2.4		C20
250:5	.6	2.4		C20
300:5	.6	2.4	2.4	C20
400:5	.3	1.2	2.4	C50
500:5	.3	.3	2.4	C50
600:5	.3	.3	2.4	C50
800:5	.3	.3	1.2	C50
1000:5	.3	.3	.3	C100
1200:5	.3	.3	.3	C100
1500:5	.3	.3	.3	C100
2000:5	.3	.3	.3	C100
2500:5	.3	.3	.3	C100
3000:5	.3	.3	.3	C100
4000:5	.3	.3	.3	C100
4000:4	.3	.3	.3	C100

①Accuracy meets or exceeds accuracy in proposed ANSI C37.20.2

VCP Breaker Stored Energy Mechanism Control Power Requirements

Rated Control Voltage	Spring Charge Motor Run Amperes	Time Sec.	Close or Trip Amperes	Voltage Range Close	Trip	Ind. Light Amperes
48 V Dc	9.0	6	16	38-56	28-56	.035
125 V Dc	5.0	6	7	100-140	70-140	.035
250 V Dc	3.0	6	4	200-280	140-180	.035
120 V Ac	5.0	6	16	104-127	104-127	.035
240 V Ac	3.0	6	8	208-254	208-254	.035

Control Power Transformers • Disconnect Type • 1 Phase • 60 Hertz
Primary Volts ①

Taps +7½%	Rated	-7½%	Secondary Volts	Kva	Kv Class
2580	2400	2220	240/120	5, 10, 15	5
4470	4160	3850	240/120	5, 10, 15	5
5160	4800	4400	240/120	5, 10, 15	5
7740	7200	6680	240/120	5, 10, 15	15
12900	12000	11100	240/120	5, 10, 15	15
14300	13300	12300	240/120	5, 10, 15	15

① If connected line to ground, system neutral must be solidly grounded.

Typical Applications		Permissive Local Control		General Auxiliary Switch applications, Indicating lights, Alarm, Supv. Control Indicator, Field application, etc.									
		Start-run Breaker Interlocking		Capacitor Trip Recloser		Interlocking to prevent Parallel Operation of Breakers Motor Space Heaters				Start-run Breaker Interlocking			
Type Auxiliary Switch or Device (supplied only when required.)		TOC Switch Shown for Breaker in Test Position		Breaker Auxiliary Switch Shown for Breaker in Open Position		TOC and Auxiliary Switch		MOC Switch Operating Position Shown for Breaker in Open Position		MOC Switch Operating and Test Position Shown for Breaker in Open Position		SG or MG6 Auxiliary Relay Note ①	
Breaker Condition		H	H	a	b	a / H	b / H	S	S	S	S	a / AX	AX
Operating Position	Close	X		X		X		X		X		X	
	Open	X			X		X		X		X		X
Test Position	Close		X	X			X		X	X		X	
	Open		X		X		X		X		X		X
Withdrawn			X				X		X		X		X

① MOC Switch preferred unless scheme is fail safe on coil failure.
X Indicates switch contact or circuit closed.

Auxiliary Switches

Optional circuit breaker and cell auxiliary switches are available where needed for interlocking or control of auxiliary devices. Typical applications and operation are described in the following table.

Auxiliary switch contacts from the circuit breaker mechanism are limited in number by the breaker control requirements usually to one 'a' and two 'b' contacts for ac control or two 'a' and two 'b' contacts for dc control.

When additional auxiliary contacts are needed, the optional auxiliary relay or mechanism operated cell (MOC) switch is used. Three types of MOC switches are available:
(a) operates with breaker in connected position only
(b) operates with breaker in connected position and test position
(c) operates with breaker in connected position but operates with breaker in test position only if so manually selected.

The optional truck operated cell (TOC) switch operates when the circuit breaker is levered into or out of the operating position.

Interrupting Capacity Auxiliary Switch Contacts

Type Auxiliary Switch	Continuous Current Amperes	Control Circuit Voltage 120 Ac	240 Ac	48 Dc	125 Dc	250 Dc
		Non-inductive circuit interrupting capacity in amperes				
Breaker Auxiliary Switch	15	75	25	20	11	2
TOC	15	75	25	20	11	2
MOC Auxiliary Switch	20	60	30	20	8	1.8
		Inductive circuit interrupting capacity in amperes				
Breaker Auxiliary Switch	15	25	5	8	6.25	1.75
TOC Auxiliary Switch	15	25	5	8	6.25	1.75
MOC Auxiliary Switch	20	30	20	5	2.4	1.1

Auxiliary switch contacts are primarily used to provide interlocking in control circuits, switch indicating lights, auxiliary relays or other small loads. Suitability for switching remote auxiliary devices, such as motor heaters or solenoids, may be checked with the interrupting capacity listed in the following table. Where higher interrupting capacities are required, an interposing contactor should be specified.

Part 8 Supplemental Devices

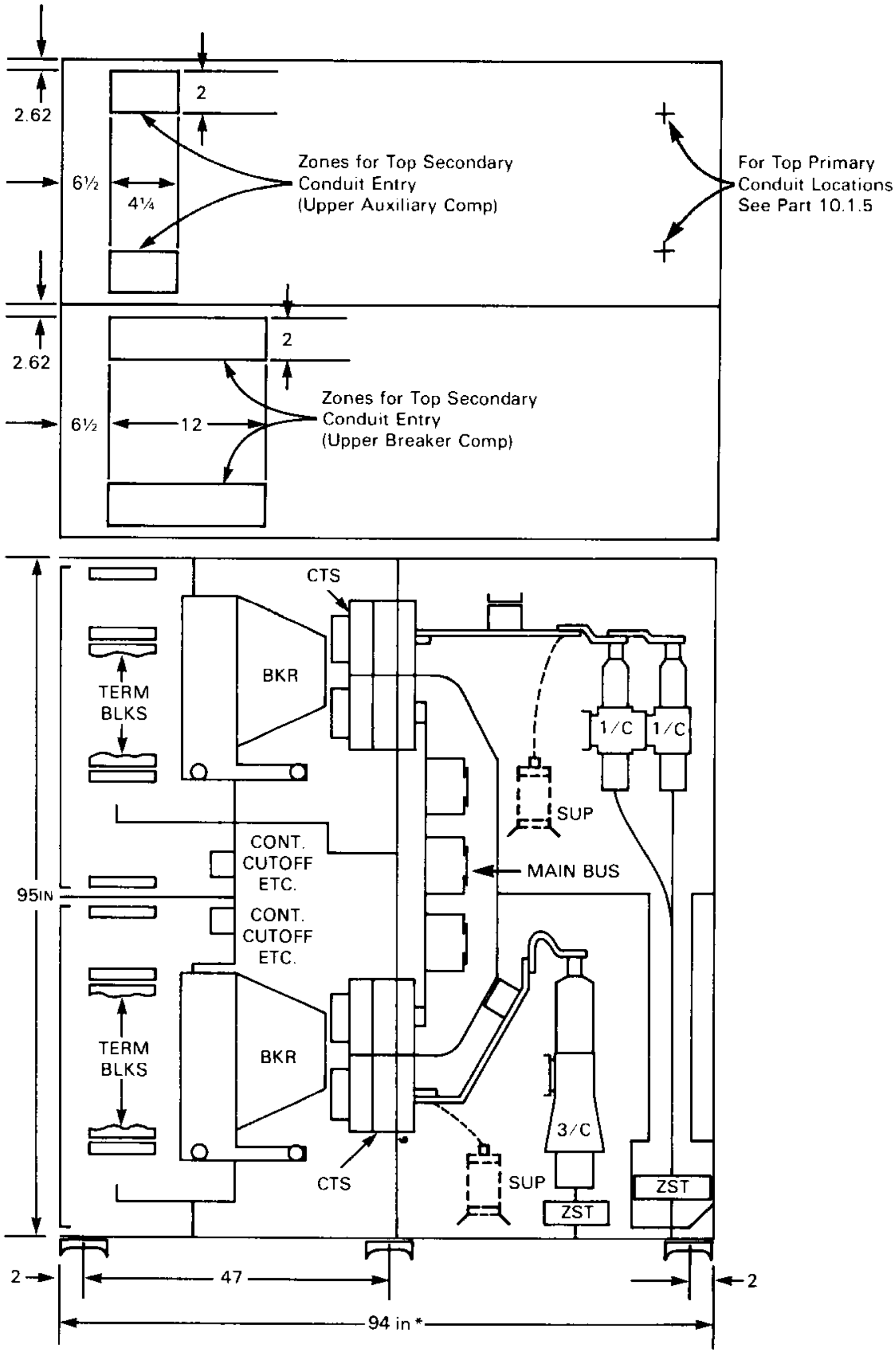
• Ground and Test Device
The ground and test device is a drawout element that may be inserted into a Metal-Clad Switchgear housing in place of a circuit breaker to provide access to the primary circuits to permit the temporary connection of grounds or testing equipment to the high voltage circuits. High potential testing of cable or phase checking of circuits are typical tests which may be performed. The devices are insulated to suit the voltage rating of the swtichgear and will carry required levels of short circuit current.

Before using ground and test devices it is recommended that each user develop detailed operating procedures consistent with safe operating practices. Only qualified personnel should be authorized to use ground and test devices.

Both manual and electrically operated ground and test devices are available. These devices include six studs for connection to primary circuits. On the manual device, selection and grounding is accomplished by cable connection. On the electrically operated device, a two position switch provides for correct selection of the proper primary circuit. Grounding is accomplished by an electrically operated stored energy ground switch.

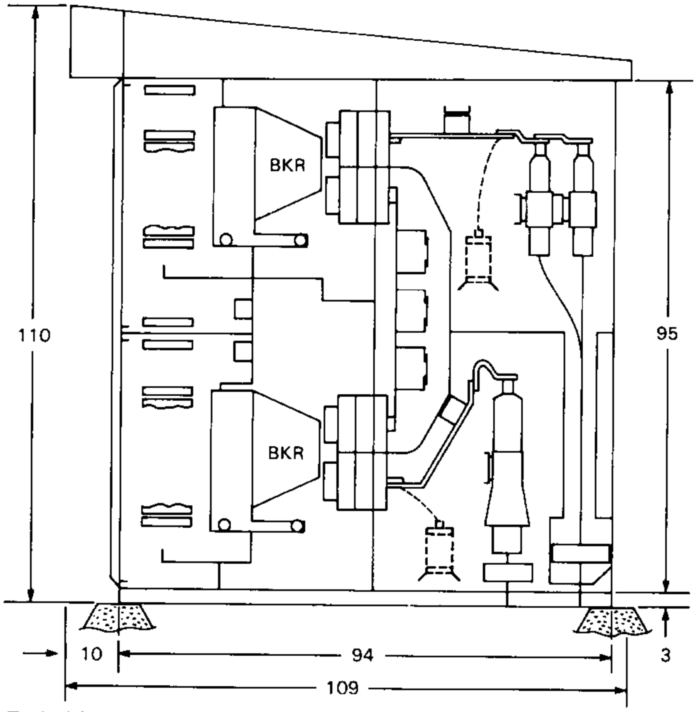
Standard accessories:
1 - test jumper
1 - levering crank
1 - maintenance tool
1 - lifting yoke
1 - set rail clamps
1 - transport dolly
1 - portable lifter (optional)
1 - test cabinet (optional)

Part 9 Dimensions and Installation
9.1 Elevations

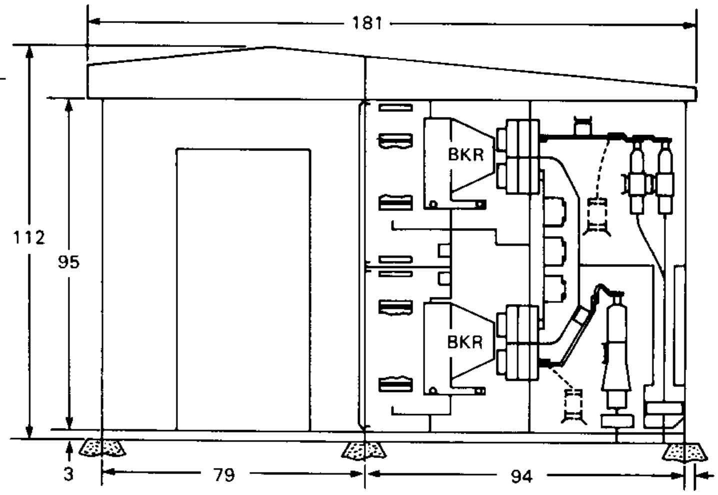


*82" depth available in indoor for certain configurations.

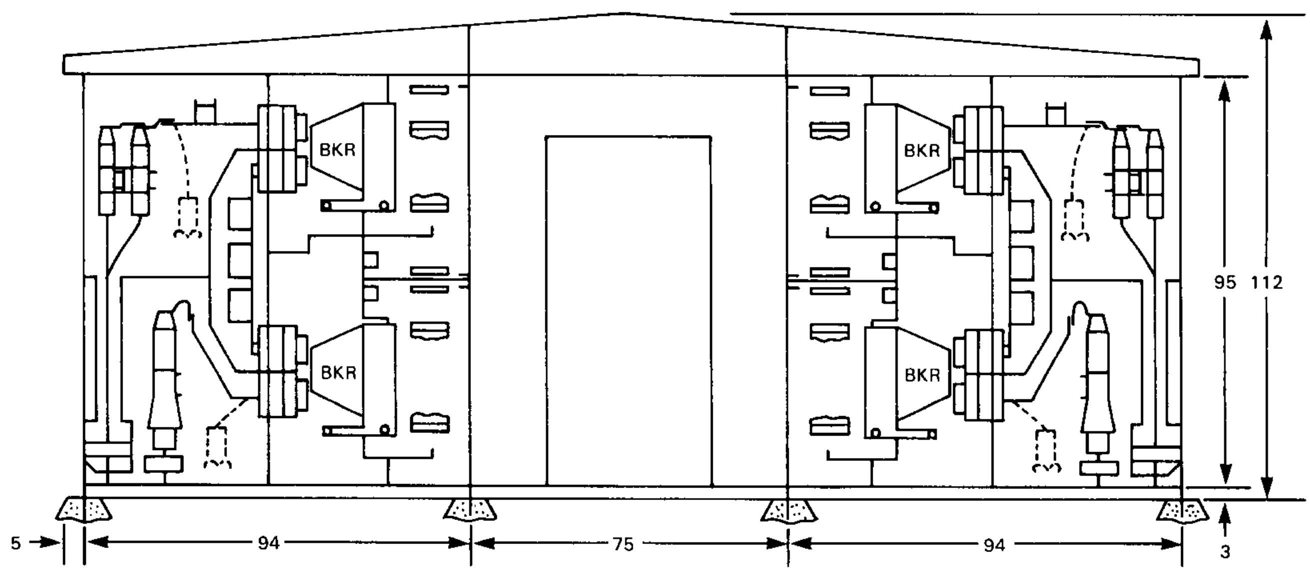
36IN Wide Typical Indoor Elevation



Typical Aisle-Less Elevation



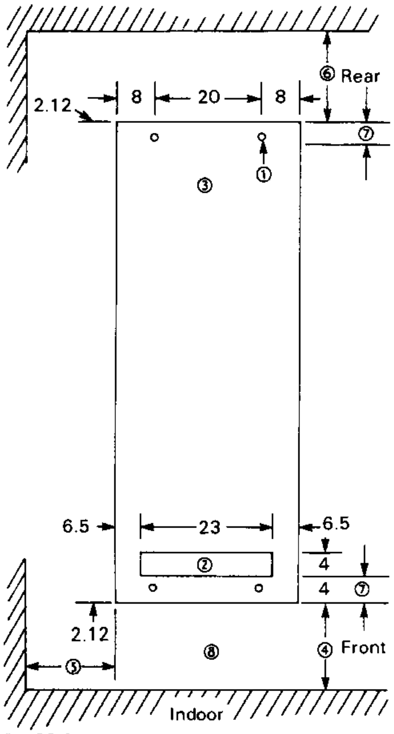
Typical Sheltered-Aisle (Single Row) Elevation



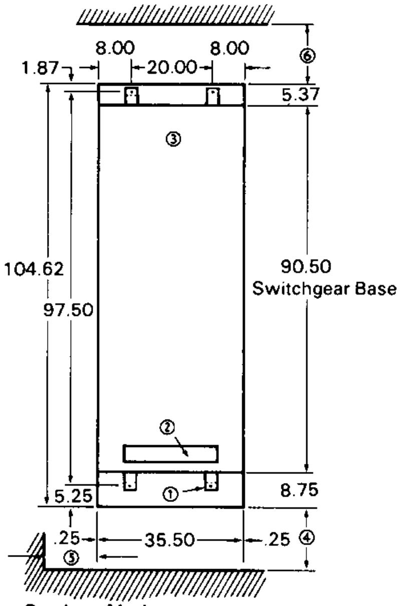
Typical Sheltered-Aisle (Double Row) Elevation

Part 9 Dimensions and Installation (continued)

9.2 Base Plans



* = 32.87 For 82" Deep Unit



Outdoor Aiseless

① Anchor Locations: Indoor=0.5 inch bolts or weld, outdoor=.625 inch bolts (for outdoor detail see Fig. A)
② Secondary Conduit Space: All=maximum of 1 inch projection
③ Primary Conduit Locations: All=see Part 10.1.5 (Figs. A, B, C)
④ Minimum Clearance to Front of VAC-CLAD: Indoor=50, Aisle-less=50
⑤ Minimum Clearance to LH side of VAC-CLAD: Indoor=32, Outdoor=32
⑥ Recommended Minimum Clearance to rear of VAC-CLAD: All=36
⑦ Floor steel must not exceed 4 inches under VAC-CLAD
⑧ Finished foundation surface (including floor steel) must be flat and level and in true plane.

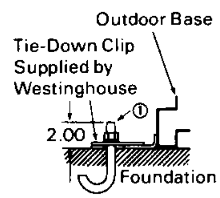
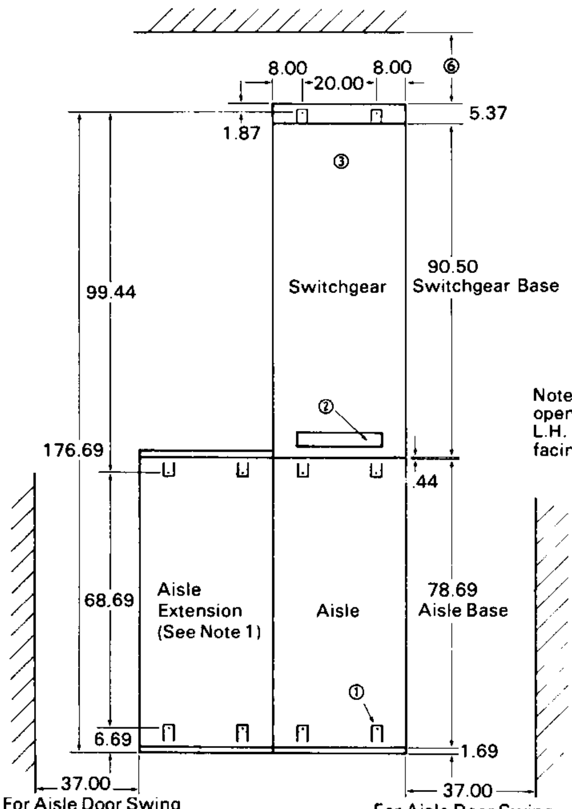
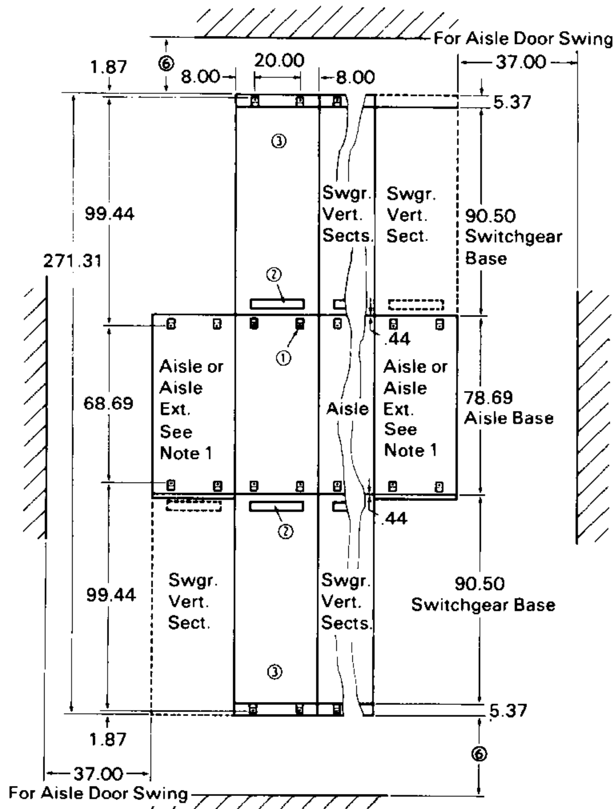


Fig. A (Typical)



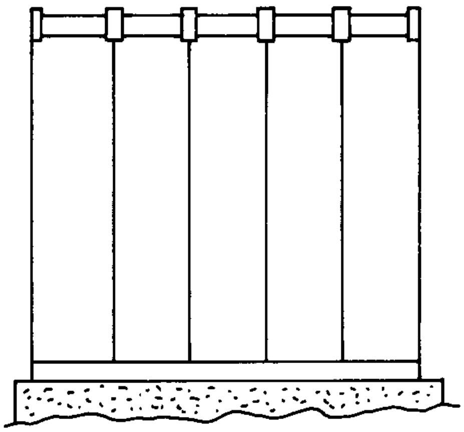
Note 1: Required to permit opening of hinged panel on L.H. vertical section (when facing front of line-up)

Outdoor Sheltered Aisle Base

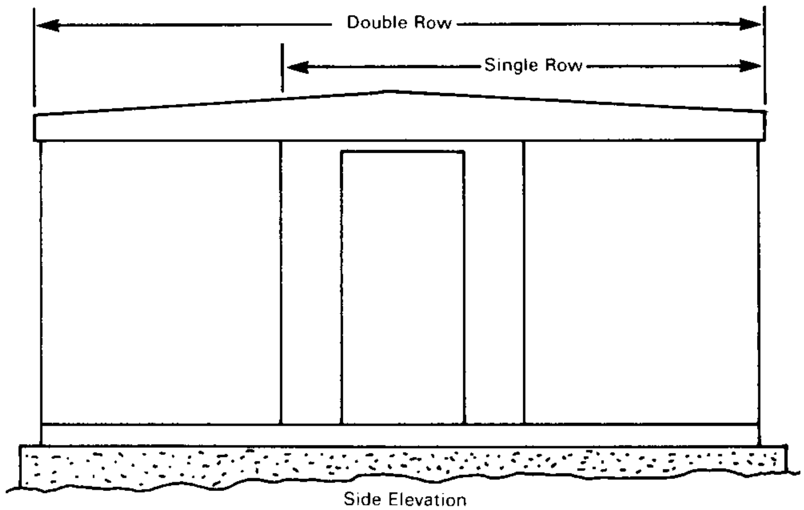


Outdoor Common Aisle Base

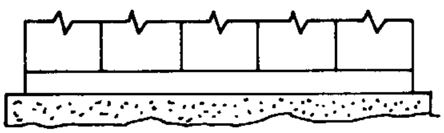
9.3 Typical Outdoor Foundations (See Notes Below)



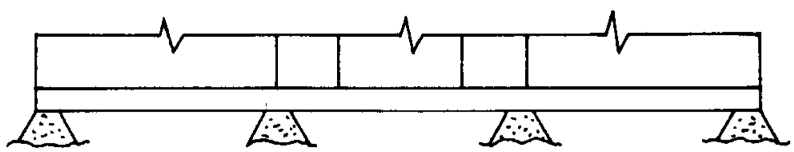
Front Elevation



Side Elevation



Footers Places Parallel with Length of Line-up



Notes
- Either of above systems may be used.
- Sheltered aisle shown, aisle-less similar.

9.4 Typical Weights in Pounds

Assemblies (Less Breakers)				Sheltered-Aisle	
Type of Vertical Section	Main Bus Rating Amps	Indoor Lbs	Aisle-less Lbs	Including Aisle Single Row (Lbs)	Double Row (Lbs)
B/B	1200	2400	3000	4200	7200
	2000	2500	3100	4300	7400
	3000	2600	3200	4400	7600
B/A or A/B	1200	2300	2900	4100	7000
	2000	2400	3000	4200	7200
	3000	2500	3100	4300	7400
A/A	1200	2000	2600	3800	6400
	2000	2100	2700	3900	6600
	3000	2220	2800	4000	6800
B	1200	2200	2800	4000	6800
	2000	2300	2900	4100	7000
	3000	2400	3000	4200	7200

Breakers — Weights in Pounds (Impact Weight = 1.5 X Breaker Weight)

Type of Breaker	Current Rating Amps	Lbs	Type of Breaker	Current Rating Amps	Lbs
50VCP250	1200	450	150VCP500	1200	450
	2000	550		2000	550
	3000	650		3000	650
50VCP350	1200	450	150VCP750	1200	450
	2000	550		2000	550
	3000	650		3000	650
75VCP500	1200	450	150VCP1000	1200	450
	2000	550		2000	550
	3000	650		3000	650

9.5 Shipping and Receiving

VAC-CLAD metal-clad switchgear is shipped in groups of one or more units. Each group is ruggedly designed and braced to withstand shipment by truck, rail, or ship. Indoor groups are bolted to skids and enclosed in a protective covering. Because of their structural base outdoor groups do not need skids. For sheltered-aisle a protective covering is located across the front of each shipping group. Aisle-less gear is protected by its own weatherproof enclosure. VCP circuit breakers, aisle parts, accessories, and installation materials are packed and crated separately. Appendages such as bus runs and synchronizing panels and large internal equipment such as oil-filled transformers may also be packed and crated separately. When received the purchaser should check the material against the shipping list. If loss or damage is discovered, file claims with the transportation company and notify the nearest Westinghouse representative.

9.6 Handling

VAC-CLAD metal-clad switchgear is equipped for handling by crane. In addition, it is provided with shipping braces and jack supports. It is recommended that the groups be lifted into position by crane. However, if no crane is available they may be skidded into place on rollers using jacks to raise and lower the group.

VAC-CLAD type VCP breakers are crated so as to be handled by crane or industrial "fork" truck. After uncrating breakers may be lifted by crane.

9.7 Storing

VAC-CLAD switchgear which cannot be installed and put into service immediately must be stored so as to maintain the equipment in a clean and dry condition. Storage in a heated building is recommended. If stored outdoors, special precautions must be taken: indoor switchgear must be covered and temporary heating equipment installed, outdoor switchgear must be supplied with temporary power for operation of the space heaters. During storage the shipping groups should be placed on a level surface to prevent unnecessary strain.

9.8 Installation and Field Assembly

Westinghouse VAC-CLAD switchgear is factory-tested and factory-assembled from accurately tooled parts upon true and level bedplates. A minimum of installation and field assembly time will be required if the procedures described on the drawings and in the instructions are adhered to.

Careful preparation of the foundation will simplify erection and will assure good switchgear performance and reliability. The foundation must have sufficient strength to withstand the weight of the structure and breakers plus the impact resulting from breaker operation.

The foundation for indoor switchgear should consist of rugged steel channels imbedded in a concrete floor. The steel channels must be flat, level, and in a true plane with each other. The finished floor must be in a true plane with the steel channels and must not project above the level of the steel channels.

The foundation for outdoor switchgear may be a concrete pad, or footers placed parallel with the length of the line-up. For any condition, the aisle-less switchgear requires a reasonably level and smooth pad for breaker drawout. The integral base furnished with outdoor switchgear should be supported in a level and true plane.

Field assembly of the outdoor aisle and of some weather-proofing is required. These parts are standardized and tool-made to simplify and expedite their assembly. The details of assembly are described in the job instruction book and associated drawings.

Part 10 Standard Designs

All VAC-CLAD mechanical drawings, electrical drawings, manufacturing information, shipping schedules, inventories, etcetera are created and controlled with computer-aided tools. In addition, the VAC-CLAD integrated program stores VIP arrangements and applications in a library or memory and integrates this information with a computer-aided design program. The result of VIP is automatic information and customer drawings. VIP arrangements and applications are available for customer approval earlier, manufacturing can start earlier, and shipments can occur earlier. Accuracy and reliability are extremely high. The benefits resulting from the selection of VIP designs are self-evident to both Westinghouse and the user.

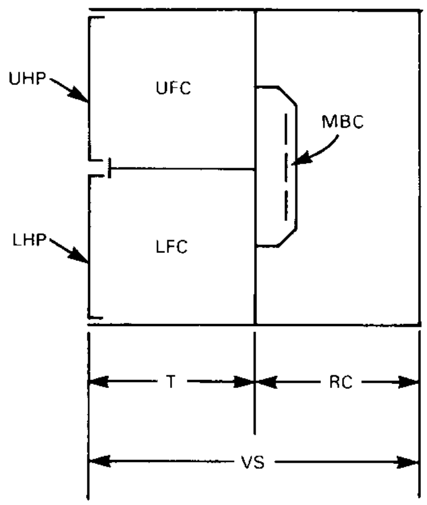
The purpose of Part 10 is to describe the VIP designs and enable the user to select a VIP design to meet his requirements.

Part 10.1 describes the multitude of VIP vertical sections available. Details for the complete vertical sections shown in Part 10.1.4 can be derived from the information in Parts 10.1.2 and 10.1.3.

Part 10.2 describes twelve VIP secondary and control applications available. Note that the VIP applications may be dependent upon the VIP vertical section selected from Part 10.1. Also note that only VIP components are detailed in the skeleton one-lines and upon the hinged panels. For those users who cannot select a VIP secondary and control application, optional non-VIP components are recommended in the list of components. The optional components, as well as the VIP components, are consistent with the Westinghouse corporate protective Relay Systems Committee recommendations. Detailed technical information may be found in their publications such as PRSC-1,2,3,4, and 5.

Part 10.1 Standard Designs — VIP Vertical Sections (94" deep)

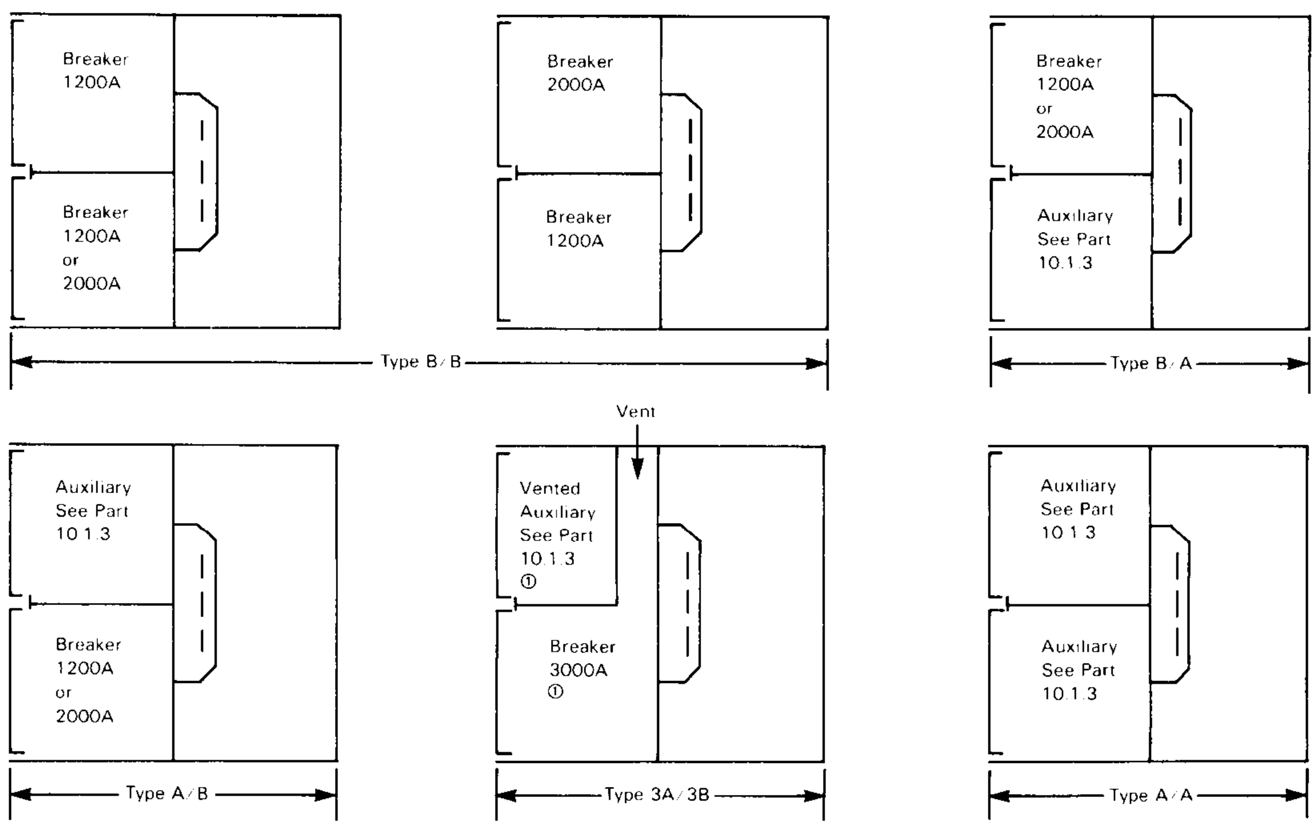
Part 10.1.1 General Arrangement



General Arrangement

UHP	Upper Hinged Panel	See Part 10.2—Secondary and Control Applications
LHP	Lower Hinged Panel	
MBC	Main Bus Compartment — 1200, 2000, 3000A as required	
UFC	Upper Front Compartment	See Part 10.1.2 (below)
LFC	Lower Front Compartment	
RC	Rear Compartment — See Part 10.1.4	
T	Type of Vertical Section: Defined by combinations of UFC and LFC — See Part 10.1.2 (below)	
VS	Complete Vertical Section: Defined by combinations of T and RC — See Part 10.1.4	

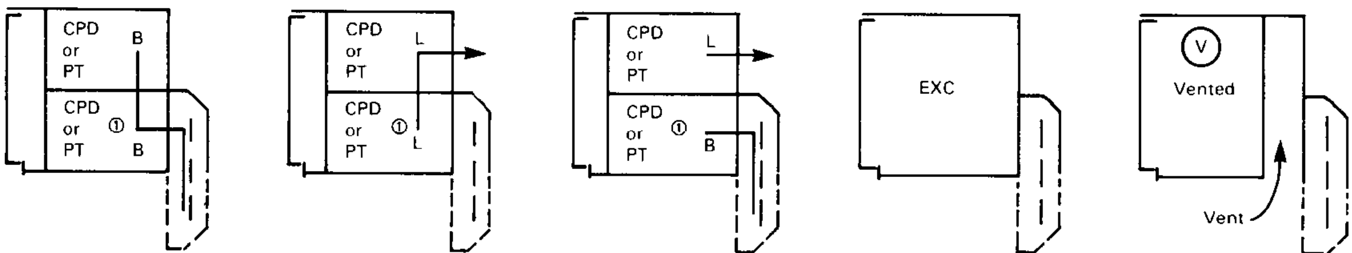
Part 10.1.2 Types of Vertical Sections



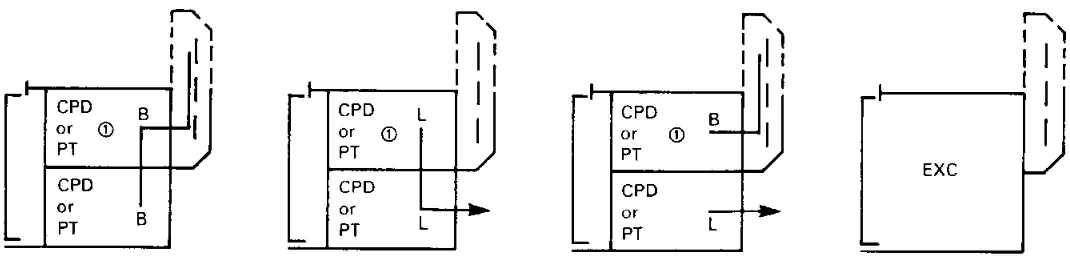
①Caution: 3000A Breaker located only in LFC and requires vented auxiliary in UFC.

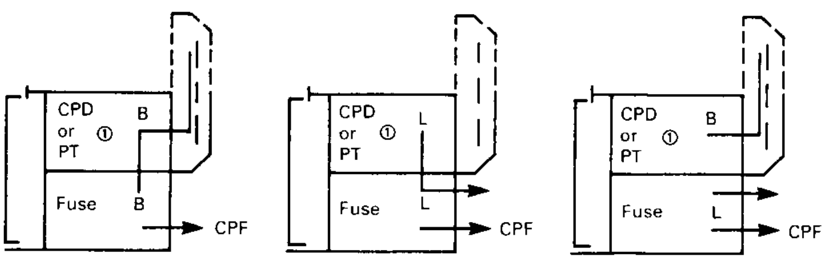
Part 10.1 Standard Designs — VIP Vertical Sections (94" deep)

Part 10.1.3 Front Auxiliary Compartments



Upper Auxiliaries





Lower Auxiliaries

①	In a Type A/A sertical section with both upper and lower auxiliaries in this position, both auxiliaries must connect to bus or to line.
CPD	Drawout cont. pwr. trans: Fused primary, mechanically interlocked secondary breaker, single phase, line to line, 15 kVA Max.
CPF	Fixed cont. pwr. trans.: See Part 10.1.4.10
Fuse	Drawout fuses for CPF: Mechanically interlocked secondary breaker, three max, 25E max.
PT	Drawout pot. trans.: Fused primary and secondary, three in WYE max, two in open delta max.
B	Bus connection
L	Line connection
EXC	Brushless exciter auxiliary: See Part 10.2-secondary and control
V	Caution-required with 3000A breaker: see Part 10.1.2

Part 10.1 Standard Designs — VIP Vertical Sections (94" deep)

Part 10.1.4.1 Type B/B — Top Power Conductor Entrance

Roof Bushings (Notes 1,2)	1200A 2000A 3000A	Yes Yes No	Yes Yes No	Yes Yes No	No No No	No No No	No No No

Cables (and related details)

• Cables — Max. Size & No./Phase • Zero Seq. Trans. (Z) — Max. No. • Conduits — Max. No. & Location Per Part 10.1.5, Fig. Specified

Terminals	Cable-MCM Cable-No. Z-No. Conduit Fig. Conduit No.	750 4 4 A 4	750 4 4 A 4	750 4 4 A 4	750 2 2 B 2	750 4 2 0 2 C C 2 2	750 2 2 B 2
1/c Potheads or Terminators	Cable-MCM Cable-No. Z-No. Conduit Fig. Conduit-No.	750 2 2 A 2	750 2 2 A 2	750 2 2 A 2	750 2 2 B 2	750 1 1 C 1	750 2 2 B 2
3/c Potheads	Cable-MCM Cable-No. Z-No. Conduit Fig. Conduit-No.	750 2 0 A 2	750 2 2 A 2	750 2 0 A 2	750 1 1 B 1	750 1 0 C 1	750 1 1 B 1

Bus Run (Note 1)	1200A 2000A 3000A	Yes Yes No	Yes Yes No	Yes Yes No	No No No	Yes Yes No	No No No

Note 1—"Z" Not Available
Note 2—Outdoor Only

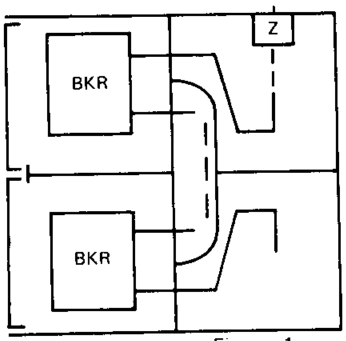


Figure 1

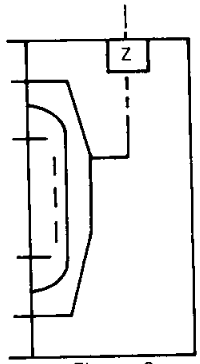


Figure 2

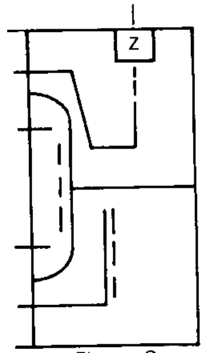


Figure 3

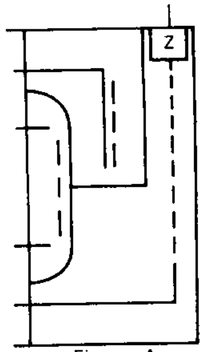


Figure 4

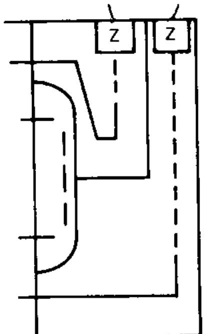
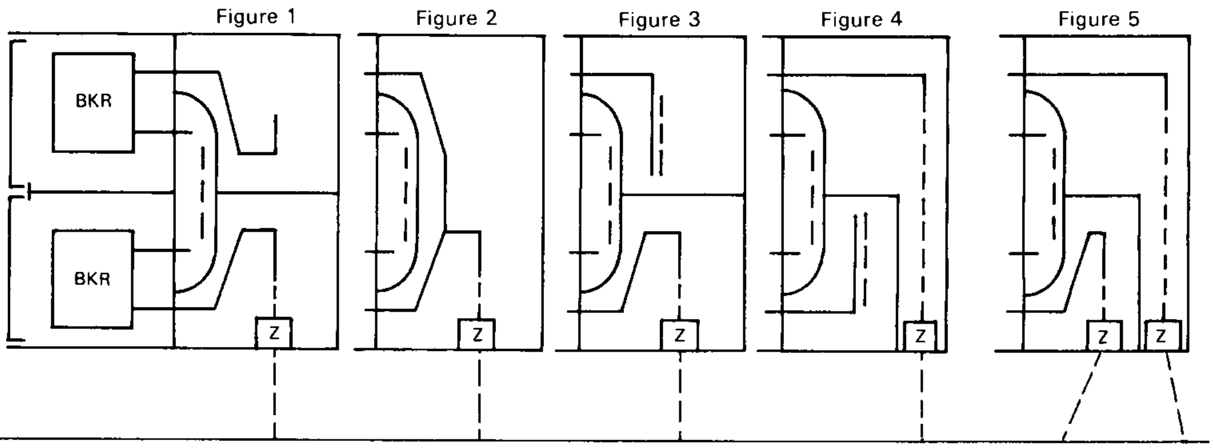


Figure 5

Part 10.1 Standard Designs — VIP Vertical Sections (94" deep)

Part 10.1.4.2 Type B/B — Bottom Power Conductor Entrance



Cables (and related details)

• **Cables — Max. Size & No./Phase** • Zero Seq. Trans. (Z) — Max. No. • Conduits — Max. No. & Location Per Part 10.1.5, Fig. Specified

Terminals	Cable MCM	750	750	750	750	750	750
	Cable-No.	4	4	4	2	4 2	2
	Z-No.	4	4	4	2	0 2	2
	Conduit Fig.	A	A	A	B	C C	B
	Conduit-No.	4	4	4	2	2 2	2
1/c Potheads or Terminators	Cable MCM	750	750	750	750	750	750
	Cable-No.	2	2	2	2	1	2
	Z-No.	2	2	2	2	1	2
	Conduit Fig.	A	A	A	B	C	B
	Conduit-No.	2	2	2	2	1	2
3/c Potheads	Cable MCM	750	750	750	750	750	750
	Cable-No.	2	2	2	1	1	1
	Z-No.	2	2	2	1	1	1
	Conduit Fig.	A	A	A	B	C	B
	Conduit-No.	2	2	2	1	1	1

Bus Run (Note 1)	1200A	Yes	Yes	Yes	No	Yes	No
	2000A	Yes	Yes	Yes	No	Yes	No
	3000A	No	No	No	No	No	No

Note 1—"Z" Not Available

Part 10.1 Standard Designs — VIP Vertical Sections (94" deep)

Part 10.1.4.3 Type B/A — Top Power Conductor Entrance

Roof Bushings (Notes 1, 2)	1200A 2000A 3000A	Yes Yes No	Yes Yes No	Yes Yes No	No No No	No No No	No No No

Cables (and related details)

• Cables — Max. Size & No./Phase • Zero Seq. Trans. (Z) — Max. No. • Conduits — Max. No. & Location Per Part 10.1.5, Fig. Specified

Terminals	Cable-MCM Cable-No. Z-No. Conduit Fig. Conduit-No.	750 4 4 A 4	750 4 4 A 4	750 4 4 A 4	750 2 2 B 2	750 4 2 0 2 C C 2 2	750 2 2 B 2
1/c Potheads or Terminators	Cable-MCM Cable-No. Z-No. Conduit Fig. Conduit-No.	750 2 2 A 2	750 2 2 A 2	750 2 2 A 2	750 2 2 B 2	750 1 1 C 1	750 2 2 B 2
3/c Potheads	Cable-MCM Cable-No. Z-No. Conduit Fig. Conduit-No.	750 2 0 A 2	750 2 2 A 2	750 2 0 A 2	750 1 1 B 1	750 1 0 C 1	750 1 1 B 1

Bus Run (Note 1)	1200A 2000A 3000A	Yes Yes No	Yes Yes No	Yes Yes No	No No No	Yes Yes No	No No No

Note 1—"Z" Not Available
Note 2—Outdoor Only

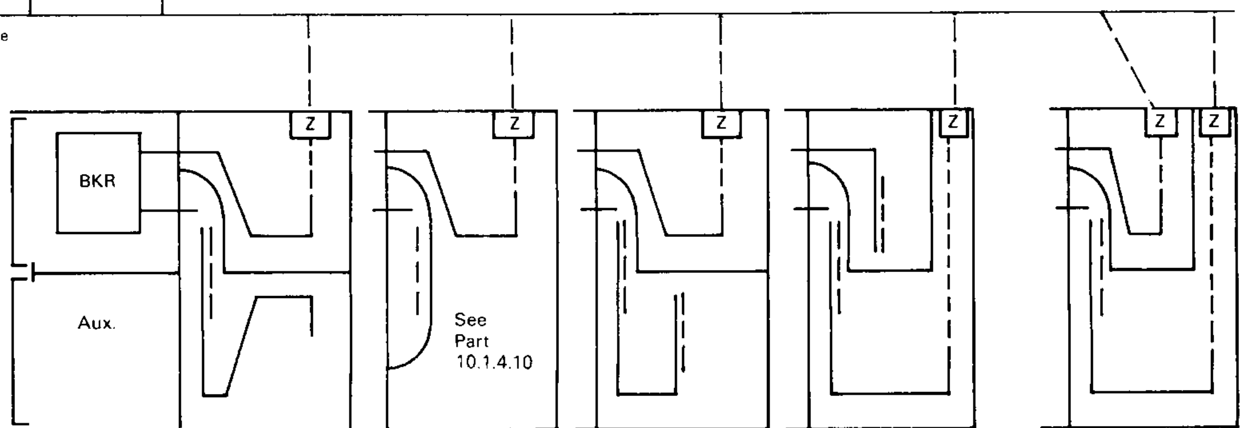
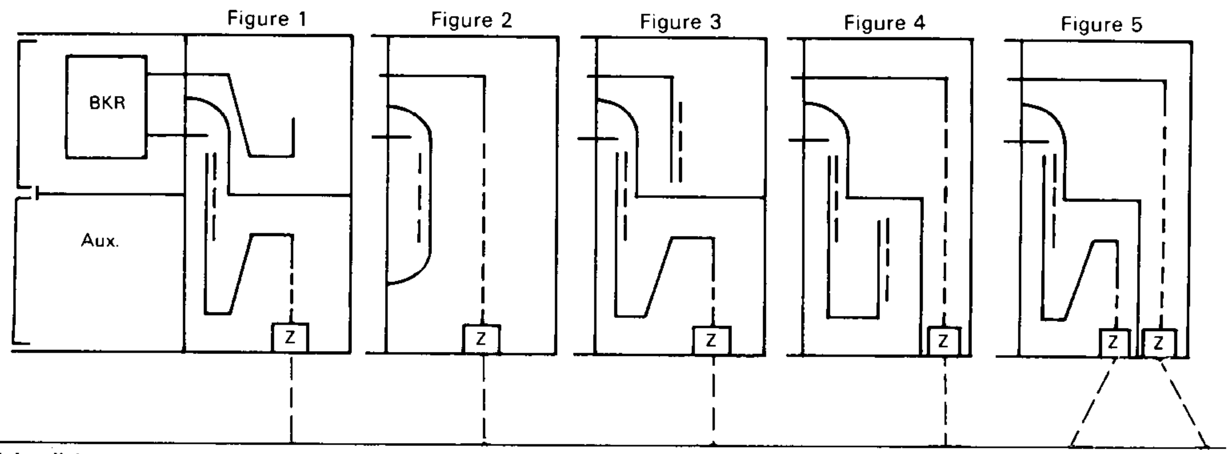


Figure 1 Figure 2 Figure 3 Figure 4 Figure 5

Part 10.1 Standard Designs — VIP Vertical Sections (94" deep)

Part 10.1.4.4 Type B/A — Bottom Power Conductor Entrance



Cables (and related details)

• Cables — Max. Size & No./Phase • Zero Seq. Trans. (Z) — Max. No. • Conduits — Max. No. & Location Per Part 10.1.5, Fig. Specified

Terminals	Cable-MCM Cable-No. Z-No. Conduit Fig. Conduit-No.	750 4 4 A 4	750 4 4 A 4	750 4 4 A 4	750 2 2 B 2	750 4 2 0 2 C C 2 2	750 2 2 B 2
1/c Potheads or Terminators	Cable-MCM Cable-No. Z-No. Conduit Fig. Conduit-No.	750 2 2 A 2	750 2 2 A 2	750 2 2 A 2	750 2 2 B 2	750 1 1 C 1	750 2 2 B 2
3/c Potheads	Cable-MCM Cable-No. Z-No. Conduit Fig. Conduit-No.	750 2 2 A 2	750 2 2 A 2	750 2 2 A 2	750 1 1 B 1	750 1 1 C 1	750 1 1 B 1
Bus Run (Note 1)	1200A 2000A 3000A	Yes Yes Yes	Yes Yes No	Yes Yes Yes	No No No	Yes Yes Yes	No No No

Note 1—"Z" Not Available

Part 10.1 Standard Designs — VIP Vertical Sections (94" deep)

Part 10.1.4.5 Type A/B① — Top Power Conductor Entrance

Roof Bushings (Notes 1,2)	1200A 2000A 3000A	Yes Yes Yes	Yes Yes No	Yes Yes Yes	No No No	No No No	No No No
Cables (and related details)							
• Cables — Max. Size & No./Phase • Zero Seq. Trans. (Z) — Max. No. • Conduits — Max. No. & Location Per Part 10.1.5, Fig. Specified							
Terminals	Cable-MCM Cable-No. Z-No. Conduit Fig. Conduit-No.	750 4 4 A 4	750 4 4 A 4	750 4 4 A 4	750 2 2 B 2	750 4 2 0 2 C C 2 2	750 2 2 B 2
1/c Potheads or Terminators	Cable-MCM Cable-No. Z-No. Conduit Fig. Conduit-No.	750 2 2 A 2	750 2 2 A 2	750 2 2 A 2	750 2 2 B 2	750 1 1 C 1	750 2 2 B 2
3/c Potheads	Cable-MCM Cable-No. Z-No. Conduit Fig. Conduit-No.	750 2 0 A 2	750 2 2 A 2	750 2 0 A 2	750 1 1 B 1	750 1 0 C 1	750 1 1 B 1
Bus Run (Note 1)	1200A 2000A 3000A	Yes Yes Yes	Yes yes No	Yes Yes Yes	No No No	Yes Yes Yes	No No No

Note 1—"Z" Not Available
Note 2—Outdoor Only

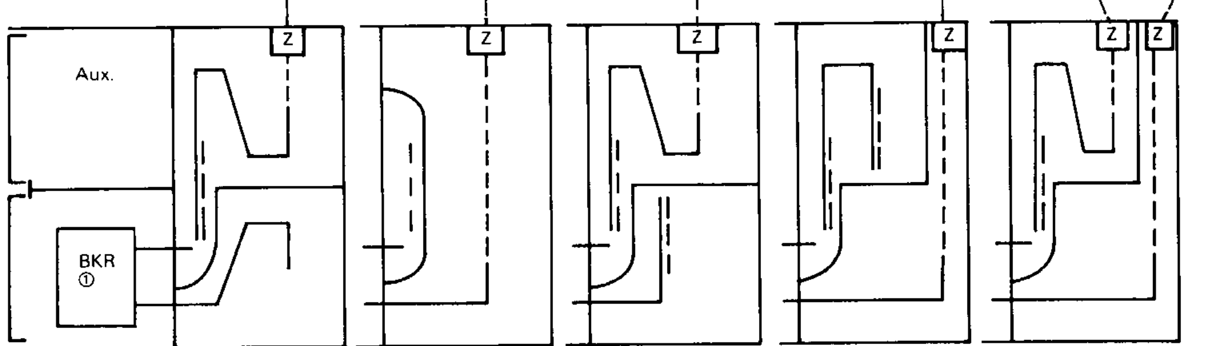
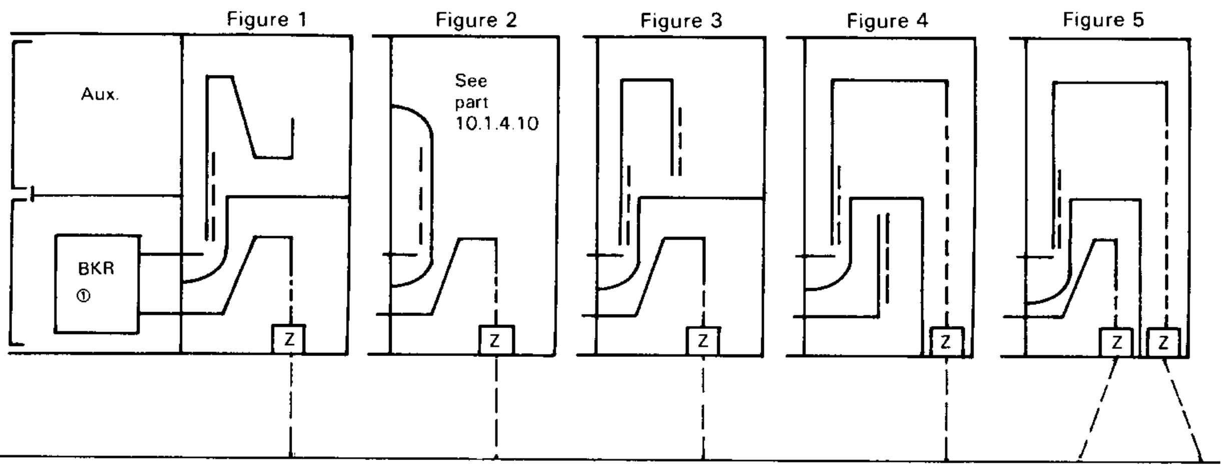


Figure 1 Figure 2 Figure 3 Figure 4 Figure 5

①Caution: For 3000A Breaker See Parts 10.1.2 and 10.1.4.7

Part 10.1 Standard Designs — VIP Vertical Sections (94" deep)

Part 10.1.4.6 Type A/B① — Bottom Power Conductor Entrance



Cables (and related details)

• Cables — Max. Size & No./Phase • Zero Seq. Trans. (Z) — Max. No. • Conduits — Max. No. & Location Per Part 10.1.5, Fig. Specified

Terminals	Cable-MCM	750	750	750	750	750	750
	Cable-No.	4	4	4	2	4 2	2
	Z-No.	4	4	4	2	0 2	2
	Conduit Fig.	A	A	A	B	C C	B
	Conduit—No.	4	4	4	2	2 2	2
1/c Potheads or Terminators	Cable-MCM	750	750	750	750	750	750
	Cable-No.	2	2	2	2	1	2
	Z-No.	2	2	2	2	1	2
	Conduit Fig.	A	A	A	B	C	B
	Conduit-No.	2	2	2	2	1	2
3/c Potheads	Cable-MCM	750	750	750	750	750	750
	Cable-No.	2	2	2	1	1	1
	Z-No.	2	2	2	1	1	1
	Conduit Fig.	A	A	A	B	C	B
	Conduit-No.	2	2	2	1	1	1
Bus Run (Note 1)	1200A	Yes	Yes	Yes	No	Yes	No
	2000A	Yes	Yes	Yes	No	Yes	No
	3000A	No	No	No	No	No	No

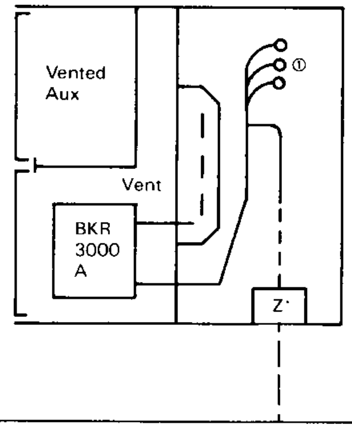
Note 1—"Z" Not Available

①Caution: For 3000A Breaker See Parts 10.1.2 and 10.1.4.7

Part 10.1 Standard Designs — VIP Vertical Sections (94" deep)

Part 10.1.4.7 Type 3A/3B Top & Bottom Power Conductor Entrance

Caution: 3000 amp bus sectionalizing is available but with no power conductor entrances.



Roof Bushings (Notes 1,2)	1200A 2000A 3000A	Yes Yes Yes

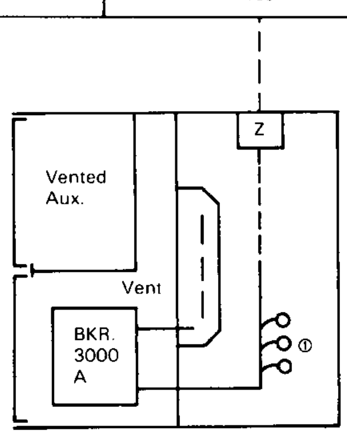
Cables (and related details)

• Cables — Max. Size & No./Phase • Zero Seq. Trans. (Z) — Max. No.
• Conduits — Max. No. & Location Per Part 10.1.5, Fig. Specified

Terminals	Cable-MCM Cable-No. Z-No. Conduit Fig. Conduit-No.	750 4 4 A 4
1/c Potheads or Terminators	Cable-MCM Cable-No. Z-No. Conduit Fig. Conduit-No.	750 2 2 A 2
3/c Potheads	Cable-MCM Cable-No. Z-No. Conduit Fig. Conduit-No.	750 2 2 A 2

Bus Run (Note 1)	1200A 2000A 3000A	Yes Yes Yes

Note 1—"Z" Not Available
Note 2—Outdoor Only



Cables (and related details)

• Cables — Max. Size & No./Phase • Zero Seq. Trans. (Z) — Max. No.
• Conduits — Max. No. & Location Per Part 10.1.5, Fig. Specified

Terminals	Cable-MCM Cable-No. Z-No. Conduit Fig. Conduit-No.	750 4 4 A 4
1/c Potheads or Terminators	Cable-MCM Cable-No. Z-No. Conduit Fig. Conduit-No.	750 2 2 A 2
3/c Potheads	Cable-MCM Cable-No. Z-No. Conduit Fig. Conduit-No.	750 2 2 A 2

Bus Run (Note 1)	1200A 2000A 3000A	Yes Yes Yes

Note 1—"Z" Not Available

① As required to auxiliaries, arresters, capacitors in adjacent vert. sect.

Part 10.1 Standard Designs — VIP Vertical Sections (94" deep)

Part 10.1.4.8 Type A/A — Top Power Conductor Entrance

Roof Bushings (Notes 1,2)	1200A	Yes	Yes	Yes	No
	2000A	Yes	Yes	Yes	No
	3000A	Yes	Yes	Yes	No
Cables (and related details)					
• Cables — Max. Size & No./Phase • Zero Seq. Trans. (Z) — Max. No. • Conduits — Max. No. & Location Per Part 10.1.5, Fig. 5 Specified					
Terminals	Cable-MCM	750	750	750	750
	Cable-No.	4	4	4	2
	Z-No	4	4	4	2
	Conduit-Fig.	A	A	A	B
	Conduit-No.	4	4	4	2
1/c Potheads or Terminators	Cable-MCM	750	750	750	750
	Cable-No.	2	2	2	2
	Z-No.	2	2	2	2
	Conduit Fig.	A	A	A	B
	Conduit-No.	2	2	2	2
3/c Potheads	Cable-MCM	750	750	750	750
	Cable-No.	2	2	2	1
	Z-No.	0	2	0	1
	Conduit Fig.	A	A	A	B
	Conduit-No.	2	2	2	1
Bus Run (Note 1)	1200A	Yes	Yes	Yes	No
	2000A	Yes	Yes	Yes	No
	3000A	Yes	Yes	Yes	No

Note 1—"Z" Not Available
Note 2—Outdoor Only

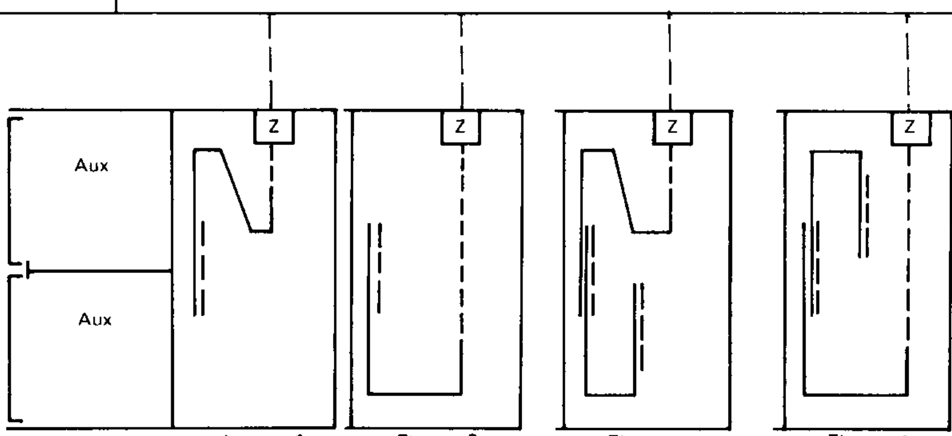
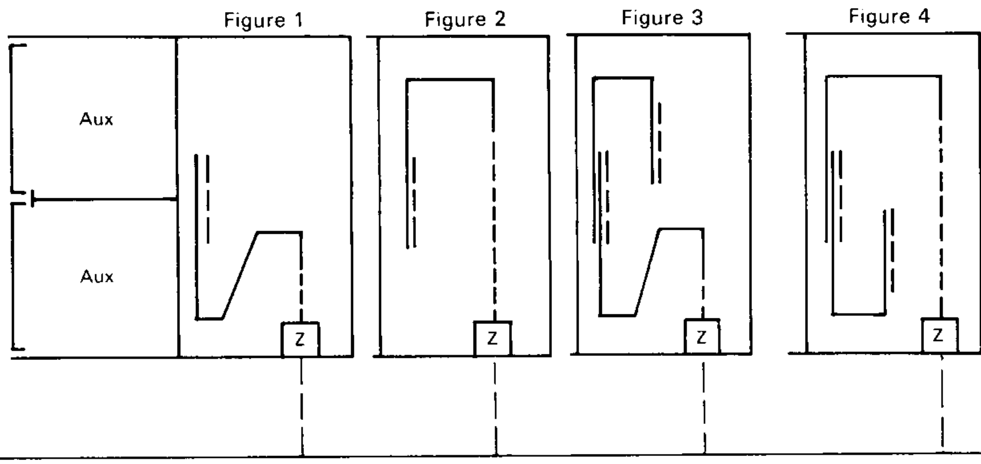


Figure 1 Figure 2 Figure 3 Figure 4

Part 10.1 Standard Designs — VIP Vertical Sections (94" deep)

Part 10.1.4.9 Type A/A — Bottom Power Conductor Entrance



Cables (and related details)

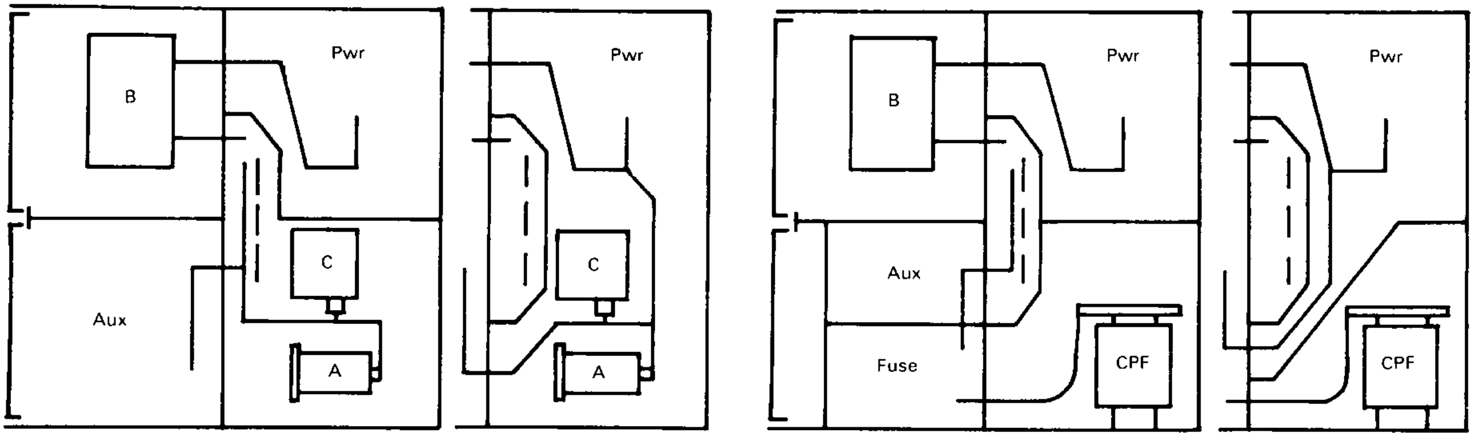
• Cables — Max. Size & No./Phase • Zero Seq. Trans. (Z) — Max. No. • Conduits — Max. No. & Location Per Part 10.1.5, Fig. Specified

		Figure 1	Figure 2	Figure 3	Figure 4
Terminals	Cable—MCM Cable-No. Z-No. Conduit Fig. Conduit-No.	750 4 4 A 4	750 4 4 A 4	750 4 4 A 4	750 2 2 B 2
1/c Potheads or Terminators	Cable-MCM Cable-No. Z-No. Conduit Fig. Conduit-No.	750 2 2 A 2	750 2 2 A 2	750 2 2 A 2	750 2 2 B 2
3/c Potheads	Cable-MCM Cable-No. Z-No. Conduit Fig. Condiut-No.	750 2 2 A 2	750 2 2 A 2	750 2 2 A 2	750 1 1 B 1
Bus Run (Note 1)	1200A 2000A 3000A	Yes Yes Yes	Yes Yes Yes	Yes Yes Yes	No No No

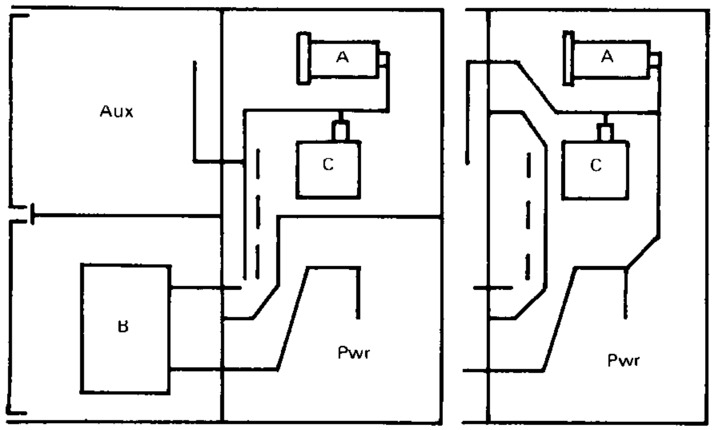
Note 1—"Z" Not Available

Part 10.1 Standard Designs — VIP Vertical Sections (94" deep)

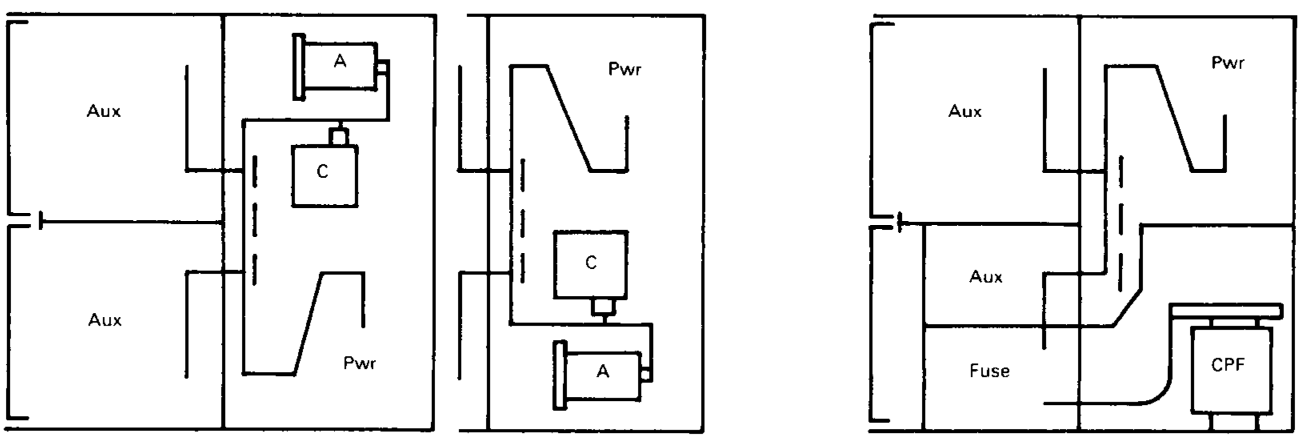
Part 10.1.4.10 Arresters, Capacitors, and Fixed Control Pwr. Trans.



Type B/A (Typical)



Type A/B (Typical)



Type A/A (Typical)

A Arrester: Station-Type
B Breaker: 1200A or 2000A
C Capacitor: Surge
CPF Control Pwr Trans, Fixed: One Phase, 50 kVA Max. or Three Phase, kVA Max.
Pwr Power Conductor Arrangement: See Parts 10.1.4.1 to 10.1.4.9
Aux Auxiliaries: See Part 10.1.3

Part 10.1 Standard Designs — VIP Vertical Sections (94" deep)

Part 10.1.5 Primary Cable Entrances (Top Elevation or Base Plan)

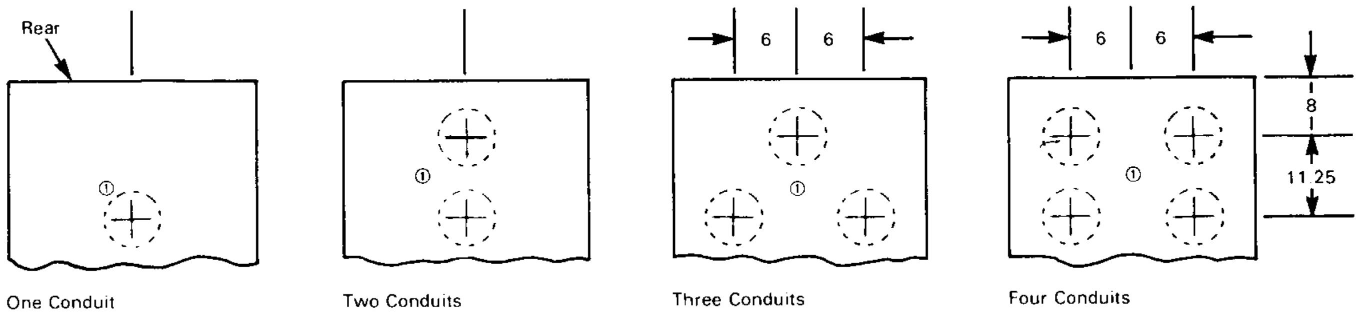


Fig. A — For Entrances Into Compartment Without Cable Enclosure

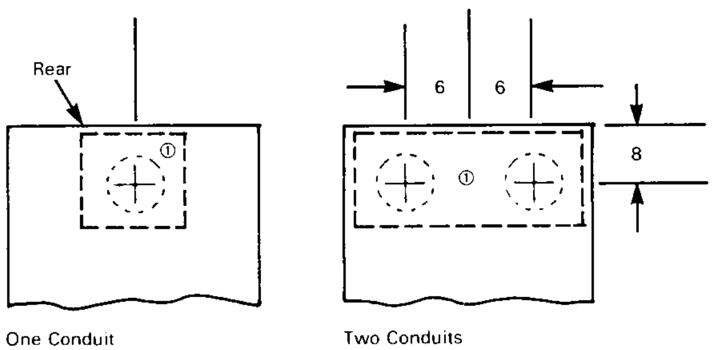


Fig. B — For Entrances Into Cable Enclosure (Or Cable Enclosure Area)

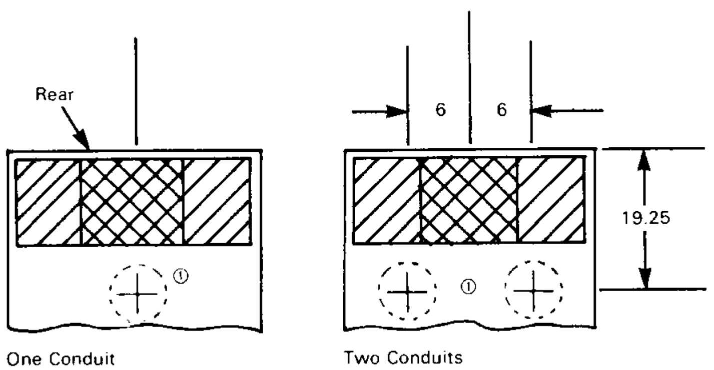
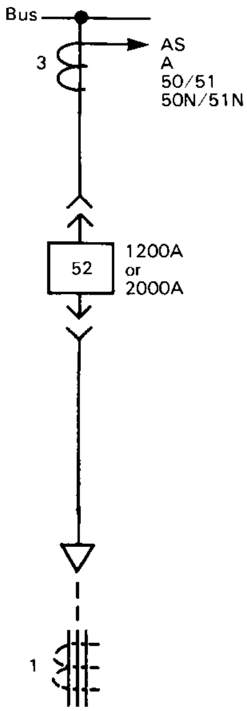


Fig. C — For Entrances Into Compartment With Cable Enclosure

①Primary cable and conduit entrance must be within 6.5" diameter entry area.

10.2.1-F: Basic Feeder①

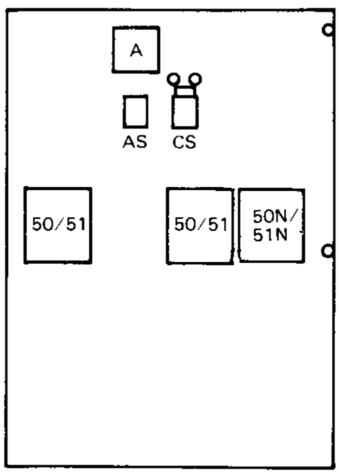


Upper Compartment: See Adjacent Note

Note
Depending upon the VIP vertical section arrangement selected from Part 10.1, this upper compartment may contain various types of VIP secondary and control applications such as:

F	Basic Feeder
TF	Transformer Feeder
S	Sectionalizer
SIM	Small Induction Motor
LIM	Large Induction Motor
Bus Pts	See Part 10.2.13

Lower Compartment: F Breaker



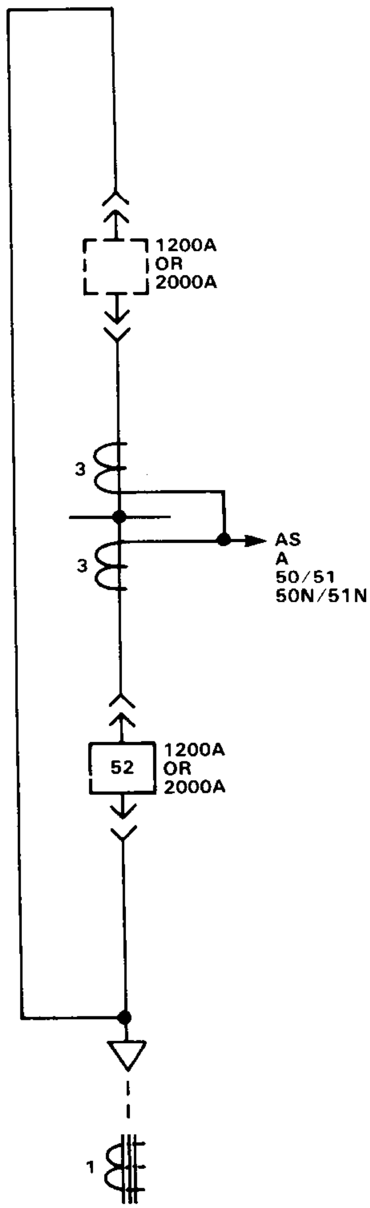
Lower Hinged Panel
(VIP Components)

List of components

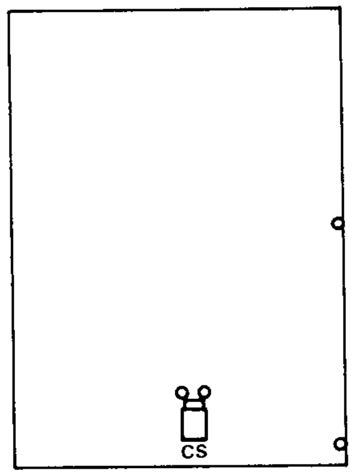
Primary		
V	1-52	VCP Bkr.
V	1-Set Terminations ②	
VR	3-CTS	
OA	1-Zero Seq Tx	Z
LV Fixed		
V	1-Fuseholder, 2P	Pullout
V	2-Fuses	30A.
O	1-Capacitor Trip Device	
Hinged Panel		
V	1-CS	W2
V	2-Ind. Lights	EZC
V	1-AS	W2
V	1-A	K241
V	2-50/51	CO
VN	1-50N/51N	CO
O	1-WM	KP241
O	1-VAR	KV241
O	1-WHM	D4B2F
O	1-50/51	CO
OB	1-79	RC
OB	1-79CO	TOG. SW.
OA	1-50G	ITH

① Shown for application in lower compartment. VIP application available in upper compartment. However, refer to Part 10.2.14 and note that arrangement of hinged panel components differs between upper and lower panels.
② See Part 10.1.4
V VIP components (125 VDC control where applicable)
O Optional adders
A,B Related optional adders
N Not required with option A
R One CT not required with option A

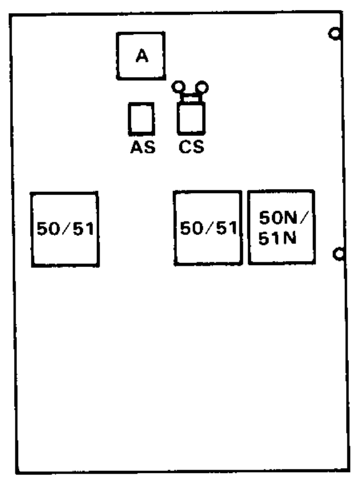
10.2.2-BY: Bypass Feeder①



Upper Compartment: By Breaker



Lower Compartment: By Breaker



List of components

Primary

V	1-52	VCP Bkr.
V	1-Set Terminations ②	
VR	6-CTS	
OA	1-Zero Seq Tx	Z

LV Fixed

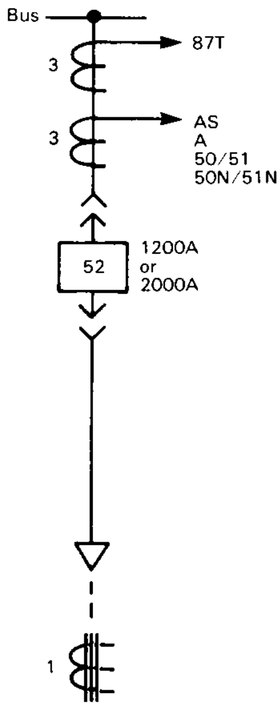
V	2-Fuseholders, 2P	Pullout
V	4-Fuses	30A
O	2-Capacitor Trip Devices	

Hinged Panels

V	2-CS	W2
V	4-Ind. Lights	EZC
V	1-AS	W2
V	1-A	K241
V	2-50/51	CO
VN	1-50N/51N	CO
O	1-WM	KP241
O	1-VAR	KV241
O	1-WHM	D4B2F
O	1-50/51	CO
OB	1-79	RC
OB	1-79CO	TOG. SW.
OA	1-50G	ITH

① Shown with major hinged panel components on lower panel. VIP available with major components on upper panel. However, refer to part 10.2.14 and note that arrangement of hinged panel components differs between upper and lower panels.
② See Part 10.1.4
V VIP components (125 VDC control where applicable)
O Optional adders
A,B Related optional adders
N Not required with option A
R Two cts not required with option A

10.2.3-TF: Transformer Feeder①

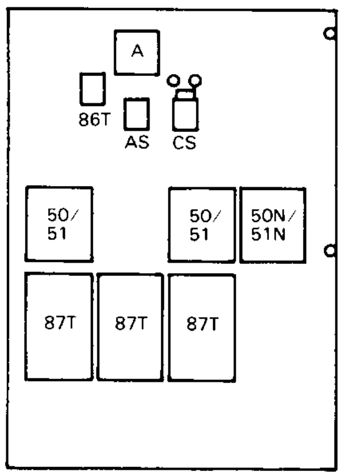


Upper Compartment: See Adjacent Note

Note
Depending upon the VIP vertical section arrangement selected from Part 10.1, this upper compartment may contain various types of VIP secondary and control applications such as:

F	Basic Feeder
TF	Transformer Feeder
S	Sectionalizer
SIM	Small Induction Motor
LIM	Large Induction Motor
Bus Pts	See Part 10.2.13

Lower Compartment: TF Breaker



Lower Hinged Panel
(VIP Components)

List of components

Primary

V	1-52	VCP Bkr.
V	1-Set Terminations ②	
VR	6-Cts	
OA	1-Zero Seq Tx	Z

LV Fixed

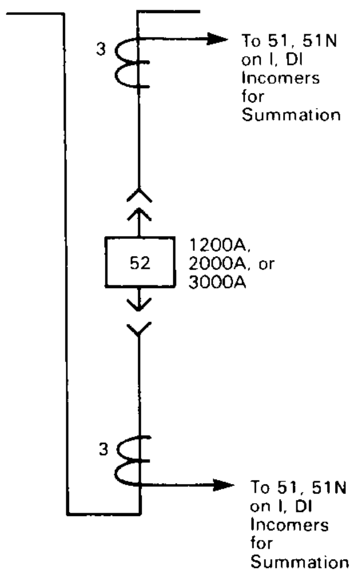
V	1-Fuseholder, 2P	Pullout
V	2-Fuses	30A
O	1-Capacitor Trip Device	

Hinged Panel

V	1-CS	W2
V	2-Ind. Lights	EZC
V	1-AS	W2
V	1-A	K241
V	2-50/51	CO
VN	1-50N/51N	CO
V	3-87T	CA
V	1-86T	WL2
O	1-WM	KP241
O	1-VAR	KV241
O	1-WHM	D4B2F
O	1-50/51	CO
OA	1-50G	ITH

① Shown for application in lower compartment. VIP application available in upper compartment. However, refer to Part 10.2.14 and note that arrangement of hinged panel components differs between upper and lower panels.
② See Part 10.1.4
V VIP components (125 VDC control where applicable)
O Optional adders
A Related optional adders
N Not required with option A
R One CT not required with option A

10.2.4-S:Sectionalizer①

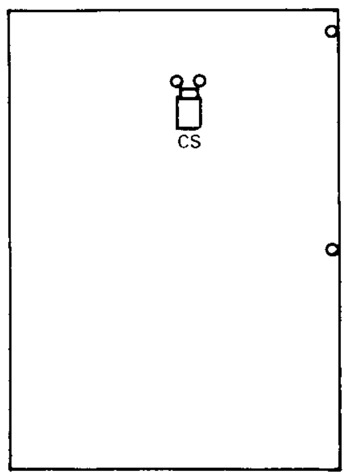


Upper Compartment: See Adjacent Note

Note
Depending upon the VIP vertical section arrangement selected from Part 10.1, this upper compartment may contain various types of VIP secondary and control applications such as:

F	Basic Feeder
TF	Transformer Feeder
SIM	Small Induction Motor
LIM	Large Induction Motor
Bus Pts	See Part 10.2.13

Lower Compartment: S Breaker



Lower Hinged Panel
(VIP Components)

List of components

Primary

V	1-52	VCP Bkr.
V	6-CTS	
V	1-Sectionalizing Bus②	

LV Fixed

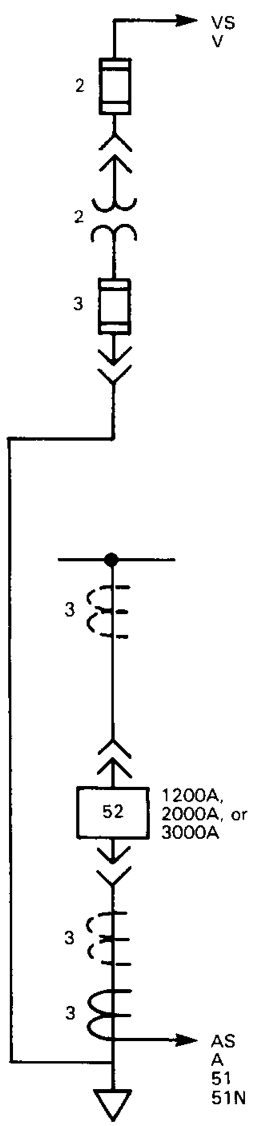
V	1-Fuseholder, 2P	Pullout
V	2-Fuses	30A
O	1-Capacitor Trip Device	

Hinged Panel

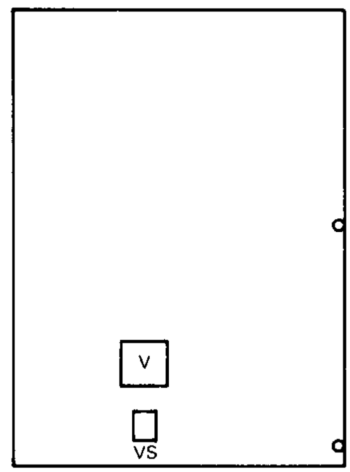
V	1-CS	W2
V	2-Ind. Lights	EZC
I	6-87B	CA16
I	2-86B	WL2

① Shown for application in lower compartment. VIP 1200A or 2000A application available in upper compartment. However, refer to Part 10.2.14 and note that arrangement of hinged panel components differs between upper and lower panels.
V Extends into adjacent rear compartment. See Part 10.1.4
② VIP components (125 VDC control where applicable)
O Optional adder
I Included in optional adders on I, DI incomers but located here on S.

10.2.5-I: Incomer①(Single Source or Dual Source with N.O. Sectionalizer)

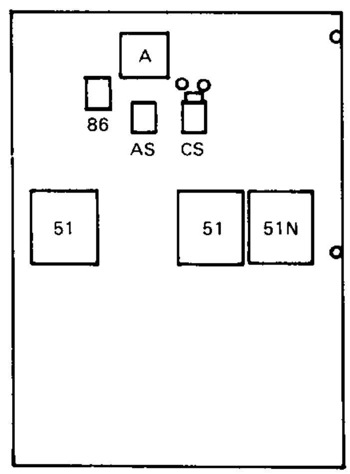


Upper Compartment: Potential Transformers One Set Per Incomer



Upper Hinged Panel
(VIP Components)

Lower Compartment: I Breaker



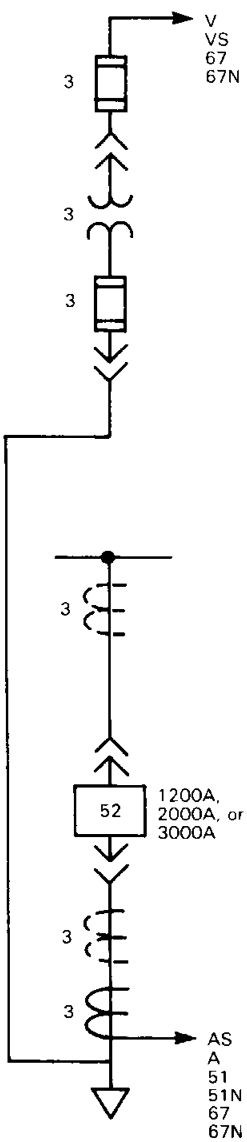
Lower Hinged Panel
(VIP Components)

List of components

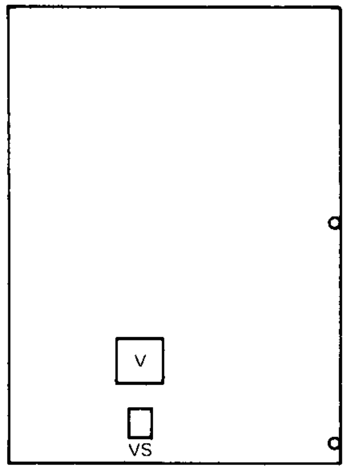
Primary		
V	1-52	VCP Bkr.
V	1-Set Terminations②	
V	3-CTS	
V	2-PTS	
V	3-Fuses	
OA	3-CTS (Bus)	
OB	3-CTS (Line)	
LV Fixed		
V	1-Fuseholder, 2P	Pullout
V	2-Fuses	30A
V	1-Fuseholder, 2P	Fixed
V	2-Fuses	6A
O	1-Capacitor Trip Device	
OC	1-Aux. CT	
Hinged Panels		
V	1-CS	W2
V	2-Ind. Lights	EZC
V	1-AS	W2
V	1-A	K241
V	2-51	CO
V	1-51N	CO
VN	1-86	WL2
V	1-VS	W2
V	1-V	K241
O	1-WM	KP241
O	1-VAR	KV241
O	1-WHM	D4B2F
O	1-51	CO
OC	1-87TG	CWC
OD	1-27	CV,CP, or CVQ
OD	1-27X	MG6
OA	3-87T	CA
OA	1-86T	WL2
OBI	3-87B	CA16
OBI	1-86B	WL2

① Shown for application of breaker in lower compartment and potential transformers in upper compartment. VIP 1200A or 2000A application available for breaker in upper compartment and potential transformers in lower compartment. However, refer to Part 10.2.14 and note that arrangement of hinged panel components differs.
② See Part 10.1.4
V VIP components (125 VDC control where applicable)
O Optional adders
A,B
C,D Related optional adders
N Not required with option B
I Mounted on hinged panel of sectionalizer S.

10.2.6-DI: Dual Incomer①(with N.C. Sectionalizer)

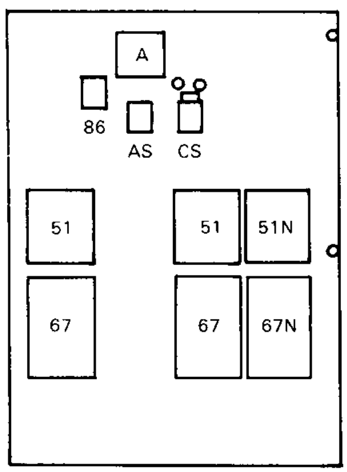


Upper Compartment: Potential Transformers One Set Per Incomer



Upper Hinged Panel
(VIP Components)

Lower Compartment: DI Breaker



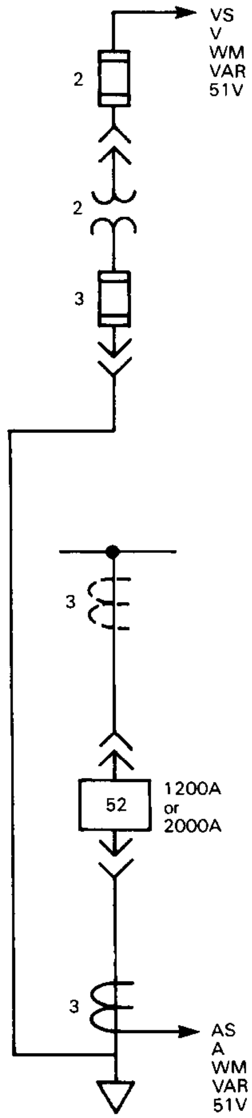
Lower Hinged Panel
(VIP Components)

List of components

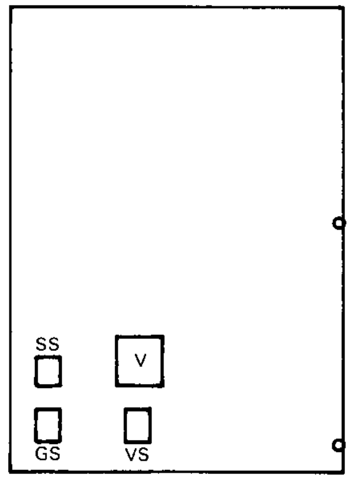
Primary	
V 1-52	VCP Bkr.
V 1-Set Terminations ②	
V 3-Cts	
VE 3-Pts	
V 3-Fuses	
OA 3-Cts (Bus)	
OB 3-Cts (Line)	
LV Fixed	
V 1-Fuseholder, 2P	Pullout
V 2-Fuses	30A
VE 1-Fuseholder, 3P	Fixed
VE 3-Fuses	6A
VE 1-Aux PT (For CRP)	
O 1-Capacitor Trip Device	
OC 1-Aux. Ct	
Hinged Panels	
V 1-CS	W2
V 2-Ind. Lights	EXC
V 1-AS	W2
V 1-A	K241
V 2-51	CO
V 1-51N	CO
VN 1-86	WL2
V 1-VS	W2
V 1-V	K241
V 2-67	CR
VE 1-67N	CRP
OE 1-67N	CRC
O 1-WM	KP241
O 1-VAR	KV241
O 1-WHM	D4B2F
O 1-51	CO
OC 1-87TG	CWC
OD 1-27	CV, CP or CVQ
OD 1-27X	MG6
O 1-67	CR
OA 3-87T	CA
OA 1-86T	WL2
OBI 3-87B	CA16
OBI 1-86B	WL2

① Shown for application of breaker in lower compartment and potential transformers in upper compartment. VIP 1200A or 2000A application available for breaker in upper compartment and potential transformers in lower compartment. However, refer to Part 10.2.14 and note that arrangement of hinged panel components differs.
② See Part 10.1.4
V VIP components (125 VDC control where applicable)
O Optional adders
A,B
C,D
E Related optional adders
N Not required with option B
I Mounted on hinged panel of sectionalizer S
E For option E, omit: 1 PT, 1 LV fuse, 1 Aux PT, 1 CRP, change 3P fuseholder to be 2P

10.2.7-SG: Small Generator①

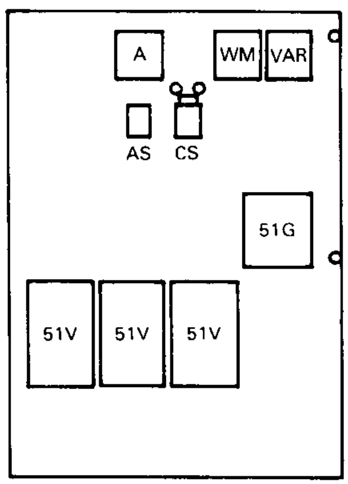


Upper Compartment: Potential Transformers One Set Per Generator



Upper Hinged Panel
(VIP Components)

Lower Compartment: SG Breaker



Lower Hinged Panel
(VIP Components)

List of components

Primary

V	1-52	VCP Bkr
V	1-Set Terminations②	
V	3-CTS	
V	2-PTS	
V	3-Fuses	
OA	3-CTS (Bus)	

LV Fixed

V	1-Fuseholder, 2P	Pullout
V	2-Fuses	30A
V	1-Fuseholder, 2P	Fixed
V	2-Fuses	6A
O	1-Capacitor Trip Device	

Hinged Panels

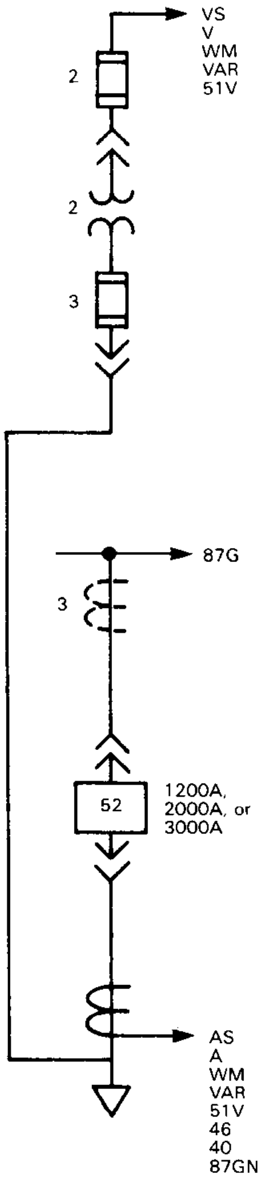
V	1-CS	W2
V	2-Ind. Lights	EZC
V	1-AS	W2
V	1-A	K241
V	1-WM	KP241
V	1-VAR	KV241
VR	1-51G	CO
VN	3-51V	COV
V	1-VS	W2
V	1-V	K241
V	1-GS	W2
V	1-SS	W2
OA	3-87G	CA
OA	1-86G	WL2
O	1-32	CRN-1
O	1-46	COQ

S **Synchronizing Panel**

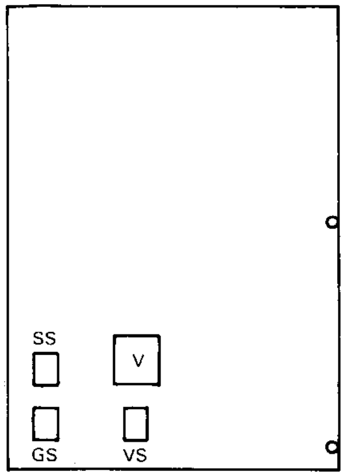
V	2-Voltmeters
V	2-Lights
V	1-Synchroscope
V	1-Frequency Meter

① Shown for application of breaker in lower compartment and potential transformers in upper compartment. VIP 1200A or 2000A application available for breaker in upper compartment and potential transformers in lower compartment. However, refer to Part 10.2.14 and note that arrangement of hinged panel components differs.
② See Part 10.1.4
V VIP components (125 VDC control where applicable)
O Optional adders
A Related optional adders
N Two of 51V not required with optional adder of 1-46.
R Uses CT in generator neutral resistor circuit
S One required per line up, bracket-mounted. See Part 10.2.13

10.2.8-LG: Large Generator①

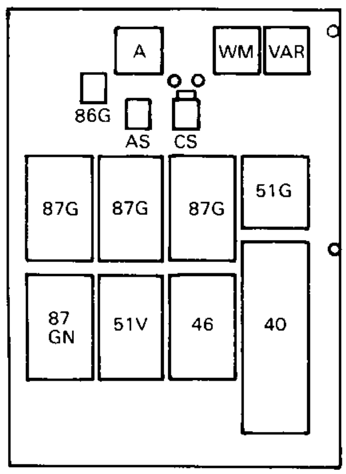


Upper Compartment: Potential Transformers One Set Per Generator



Upper Hinged Panel
(VIP Components)

Lower Compartment: LG Breaker



(VIP Components)

List of components

Primary

V	1-52	VCP Bkr.
V	1-Set Terminations②	
V	3-CTS	
V	3-CTS (Bus)	
V	2-PTS	
V	3-Fuses	

LV Fixed

V	1-Fuseholder, 2P	Pullout
V	2-Fuses	30A
V	1-Fuseholder, 2P	Fixed
V	2-Fuses	6A
V	1-Aux CT (for CWC)	
O	1-Capacitor Trip Device	

Hinged Panels

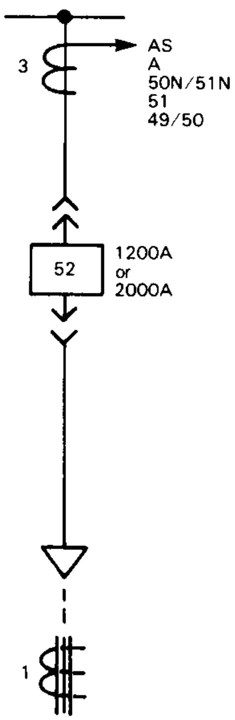
V	1-CS	W2
V	2-Ind. Lights	EZC
V	1-AS	W2
V	1-A	K241
V	1-WM	KP241
V	1-VAR	KV241
VR	1-51G	CO
V	1-51V	COV
V	1-VS	W2
V	1-V	K241
V	1-GS	W2
V	1-SS	W2
V	3-87G	CA
V	1-86G	WL2
V	1-87GN	CWC
V	1-46	COQ
V	1-40	KLF
O	1-32	CRN-1
O	1-64	DGF

S **Synchronizing Panel**

V	2-Voltmeters
V	2-Lights
V	1-Synchroscope
V	1-Frequency Meter

① Shown for application of breaker in lower compartment and potential transformers in upper compartment. VIP 1200A or 2000A application available for breaker in upper compartment and potential transformers in lower compartment. However, refer to Part 10.2.14 and note that arrangement of hinged panel components differs.
② See Part 10.1.4
V VIP Components (125 VDC control where applicable)
O Optional adders
R Uses CT in generator neutral resistor circuit
S One required per line up, bracket-mounted. See Part 10.2.13

10.2.9-SIM: Small Induction Motor①



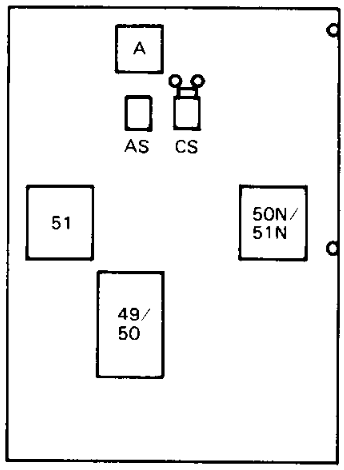
Upper Compartment: See Adjacent Note

Note

Depending upon the VIP vertical section arrangement selected from Part 10.1, this upper compartment may contain various types of VIP secondary and control applications such as:

F	Basic Feeder
TF	Transformer Feeder
S	Sectionalizer
SIM	Small Induction Motor
LIM	Large Induction Motor
Bus PTS	See Part 10.2.13

Lower Compartment: SIM Breaker



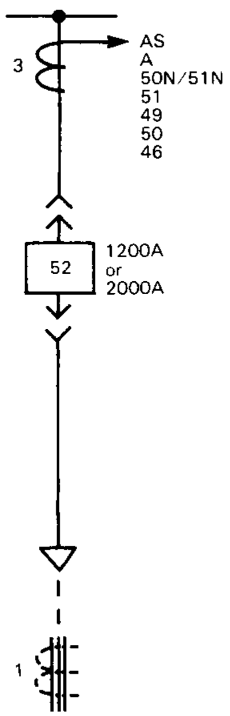
Lower Hinged Panel
(VIP Components)

List of components

Primary		
V	1-52	VCP Bkr.
V	1-Set Terminations②	2
VN	3-CTS	
OA	1-Zero Seq. Tx	Z
LV Fixed		
V	1-Fuseholder, 2P	Pullout
V	2-Fuses	30A
O	1-Capacitor Trip Device	
Hinged Panel		
V	1-CS	W2
V	2-Ind. Lights	EZC
V	1-AS	W2
V	1-A	K241
VN	1-50N/51N	CO
VR	1-51	CO
VR	1-49/50	BL-1 (2EL.)
O	1-WM	KP241
O	1-VAR	KV241
OA	1-50G	ITH
OB	2-50/51	CO
OB	1-49	DT3
S	**Bus Pts and Hinged Panel**	
V	2-Pts	
V	3-Fuses	
V	1-VS	W2
V	1-V	K241
V	1-27/47	CVQ
V	1-27X/47X	MG6
V	1-Fuseholder, 2P	Fixed
V	2-Fuses	6A

① shown for application in lower compartment. VIP application available in upper compartment. However, refer to Part 10.2.14 and note that arrangement of hinged panel components differs between upper and lower panels.
② See Part 10.1.4
V VIP components (125 VDC control where applicable)
O Optional adders
A,B Related optional adders
N One CT and 50N/51N not required with option A
R 1-51 and 1-49/50 replaced with option B
S One required per motor bus. VIP vertical section arrangement selected from Part 10.1 must include an upper or lower front compt. for this equipment. See Part 10.2.13 for hinged panel.

10.2.10-LIM: Large Induction Motor ①

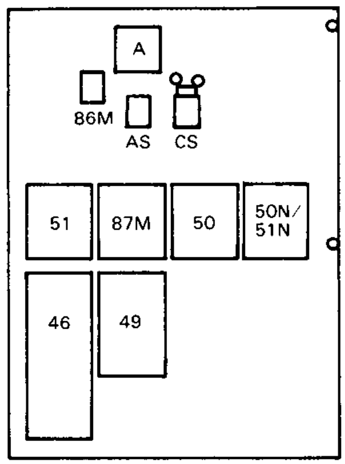


Upper Compartment: See Adjacent Note

Note
Depending upon the VIP vertical section arrangement selected from Part 10.1, this upper compartment may contain various types of VIP secondary and control applications such as:

F	Basic Feeder
TF	Transformer Feeder
S	Sectionalizer
SIM	Small Induction Motor
LIM	Large Induction Motor
Bus Pts	See Part 10.2.13

Lower Compartment: LIM Breaker



Lower Hinged Panel
(VIP Components)

List of components

Primary

V	1-52	VCP Bkr.
V	1-Set Terminations ②	
V	3-Cts	
OA	1-Zero Seq. Tx	Z

LV Fixed

V	1-Fuseholder, 2P	Pullout
V	2-Fuses	30A
O	1-Capacitor Trip Device	

Hinged Panel

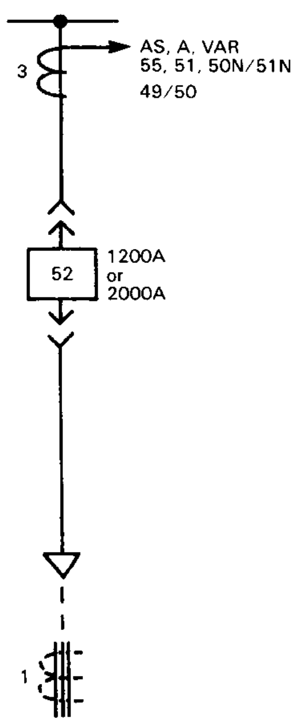
V	1-CS	W2
V	2-Ind. Lights	EZC
V	1-AS	W2
V	1-A	K241
VN	1-50N/51N	CO
V	1-51	CO
V	1-49	DT3
V	1-50	ITH(3EL.)
V	1-46	CM
VR	1-87M	ITH(3EL.)
V	1-86M	WL2
O	1-WM	KP241
O	1-VAR	KV241
OA	1-50G	ITH

S Bus Pts and Hinged Panel

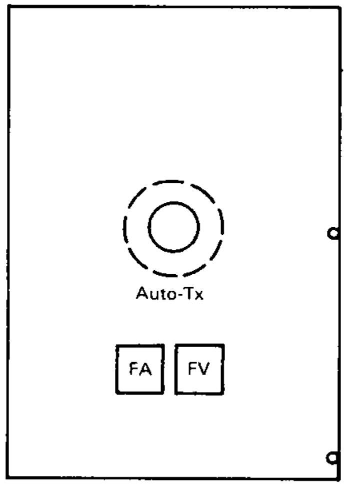
V	2-PTS	
V	3-Fuses	
V	1-VS	W2
V	1-V	K241
V	1-27/47	CP
V	1-27X/47X	MG6
V	1-Fuseholder, 2P	Fixed
V	2-Fuses	6A

① Shown for application in lower compartment. VIP application available in upper compartment. However, refer to Part 10.2.14 and note that arrangement of hinged panel components differs between upper and lower panels.
② See Part 10.1.4
V VIP Components (125 VDC control where applicable)
O Optional adders
A Related optional adders
N 1-50N/51N not required with option A
R Uses Cts at motor
S One required per motor bus. VIP vertical section arrangement selected from Part 10.1 must include an upper or lower front compt. for this equipment. See Part 10.2.13 for hinged panel.

10.2.11-SSM: Small Synchronous Motor ①

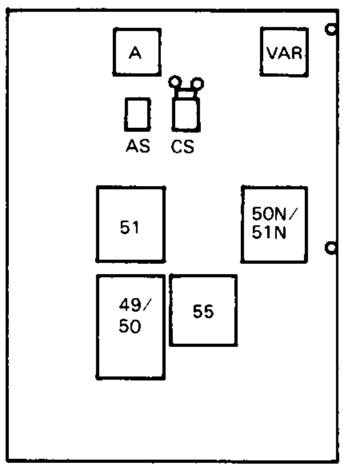


Upper Compartment: AC Brushless Exciter EQ. One Set Per Motor



Upper Hinged Panel
(VIP Components)

Lower Compartment: SSM Breaker



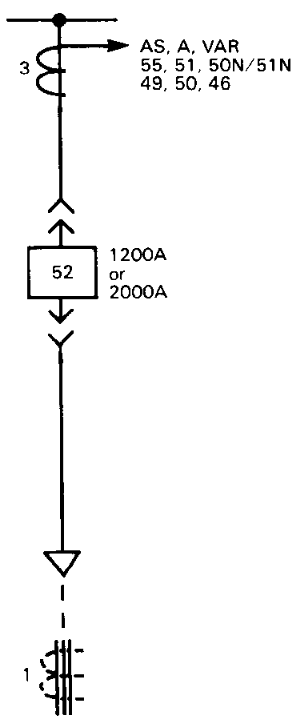
Lower Hinged Panel
(VIP Components)

List of Components

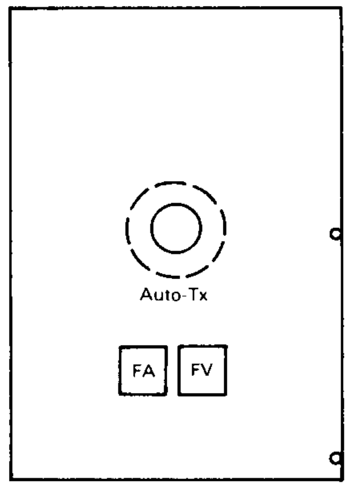
	Primary	
V	1-52	VCP Bkr.
V	1-Set Terminations ②	
V	3-Cts	
OA	1-Zero Seq. Tx.	Z
	LV Fixed	
V	1-Fuseholder, 2P	Pullout
V	2-Fuses	30A
V	1-62	Agastat
V	1-Fuseholder, 2P	Fixed
V	1-Fuse	6A
V	1-Transformer	SOLA
V	1-Rectifier	
V	1-Volt Trap	
V	1-95	SG
O	1-Capacitor Trip Device	
	Hinged Panels:	
V	1-CS	W2
V	2-Ind. Lights	EZC
V	1-AS	W2
V	1-A	K241
V	1-VAR	KV241
V	1-55	CW
VR	1-51	CO
VN	1-50N/51N	CO
V	1-A (Field)	K241
V	1-V (Field)	K241
V	1-Transformer	Auto
VR	1-49/50	BL-1(2EL)
O	1-WM	KP241
OA	1-50G	ITH
OB	2-50/51	CO
OB	1-49	DT3
S	**Bus Pts and Hinged Panel**	
V	2-Pts	
V	3-Fuses	
V	1-VS	W2
V	1-V	K241
V	1-27/47	CVQ
V	1-27X/47X	MG6
V	1-81	KF
V	1-81X	MG6
V	1-Fuseholder, 2P	Fixed
V	2-Fuses	6A

① Shown for application of breaker in lower compartment and AC brushless exciter components in upper compartment. VIP 1200A or 2000A application available for breaker in upper compt and exciter components in lower compt. However, refer to Part 10.2.14 and note arrangement of panel components differs.
② See Part 10.1.4
V VIP components (125 VDC control where applicable)
O Optional adders
A,B Related optional adders
N One CT and 1-50N/51N not required with option A
R 1-51 and 1-49/50 replaced with option B
S One required per motor bus. VIP vertical section arrangement selected from Part 10.1 must include an upper or lower front compartment for this equipment. See Part 10.2.13 for hinged panel.

10.2.12-LSM: Large Synchronous Motor①

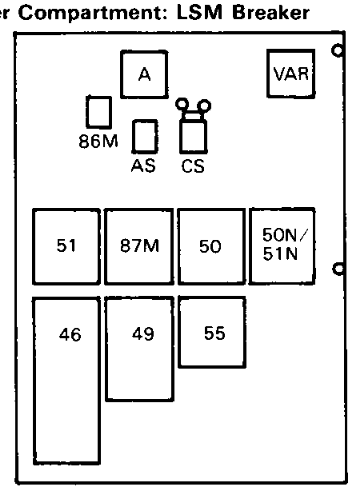


Upper Compartment: AC Brushless Exciter EQ. One Set Per Motor



Upper Hinged Panel
(VIP Components)

Lower Compartment: LSM Breaker



Lower Hinged Panel
(VIP Components)

List of components

Primary

V	1-52	VCP Bkr.
V	1-Set Terminations②	
V	3-CTS	
OA	1-Zero Seq. Tx.	Z

LV Fixed

V	1-Fuseholder, 2P	Pullout
V	2-Fuses	30A
V	1-62	Agastat
V	1-Fuseholder, 2P	Fixed
V	1-Fuse	6A
V	1-Transformer	SOLA
V	1-Rectifier	
V	1-Volt Trap	
V	1-95	SG
O	1-Capacitor Trip Device	

Hinged Panels

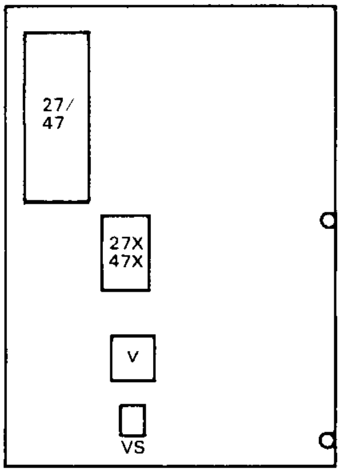
V	1-CS	W2
V	2-Ind. Lights	EZC
V	1-AS	W2
V	1-A	K241
V	1-VAR	KV241
V	1-55	CW
V	1-51	CO
VN	1-50N/51N	CO
V	1-A (Field)	K241
V	1-V (Field)	K241
V	1-Transformer	Auto
V	1-49	DT3
V	1-50	ITH (3EL)
V	1-46	CM
VR	1-87M	ITH (3EL)
V	1-86M	WL2
O	1-WM	KP241
OA	1-50G	ITH

S **Bus Pts and Hinged Panel**

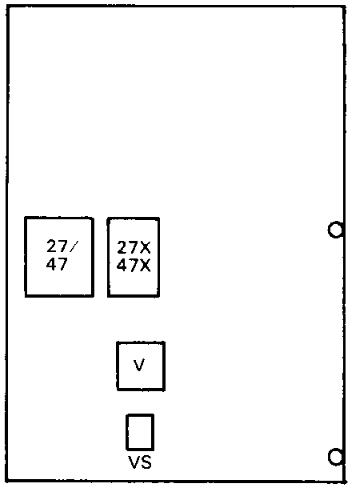
V	2-Pts	
V	3-Fuses	
V	1-VS	W2
V	1-V	K241
V	1-27/47	CP
V	1-27X/47X	MG6
V	1-81	KF
V	1-81X	MG6
V	1-Fuseholder, 2P	Fixed
V	2-Fuses	6A

① Shown for application of breaker in lower compartment and AC brushless exciter components in upper compartment. VIP 1200A or 2000A application available for breaker in upper compt and exciter components in lower compt. However, refer to Part 10.2.14 and note arrangement of panel components differs.
② See Part 10.1.4
V VIP components (125 VDC control where applicable)
O Optional adders
A,B Related optional adders
N One CT and 1-50N/51N not required with option A
R Use CT's at motor
S One required per motor bus. VIP vertical section arrangement selected from Part 10.1 must include an upper or lower front compartment for this equipment. See Part 10.2.13 for hinged panel.

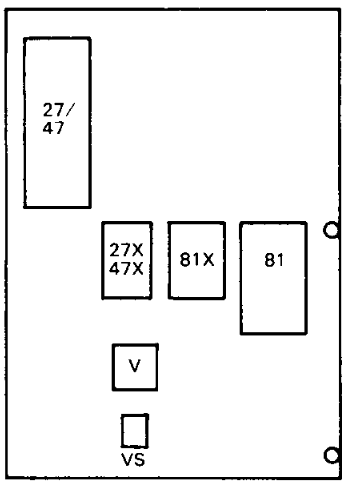
10.2.13 Hinged Panels for Bus Pts & Synchronizing



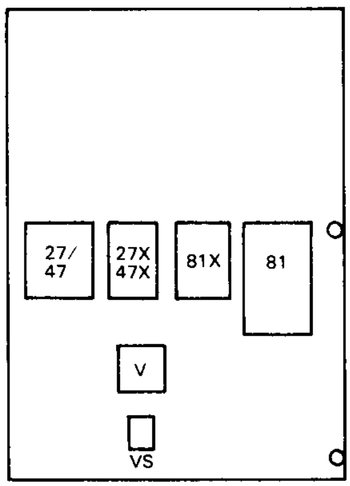
Small Induction Motor①
(See Part 10.2.9)



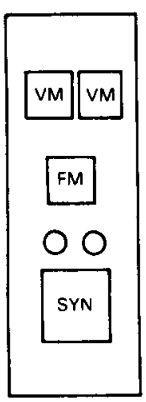
Large Induction Motor①
(See Part 10.2.10)



Small Synchronous Motor①
(See Part 10.2.11)



Large Synchronous Motor ①
(See Part 10.2.12)



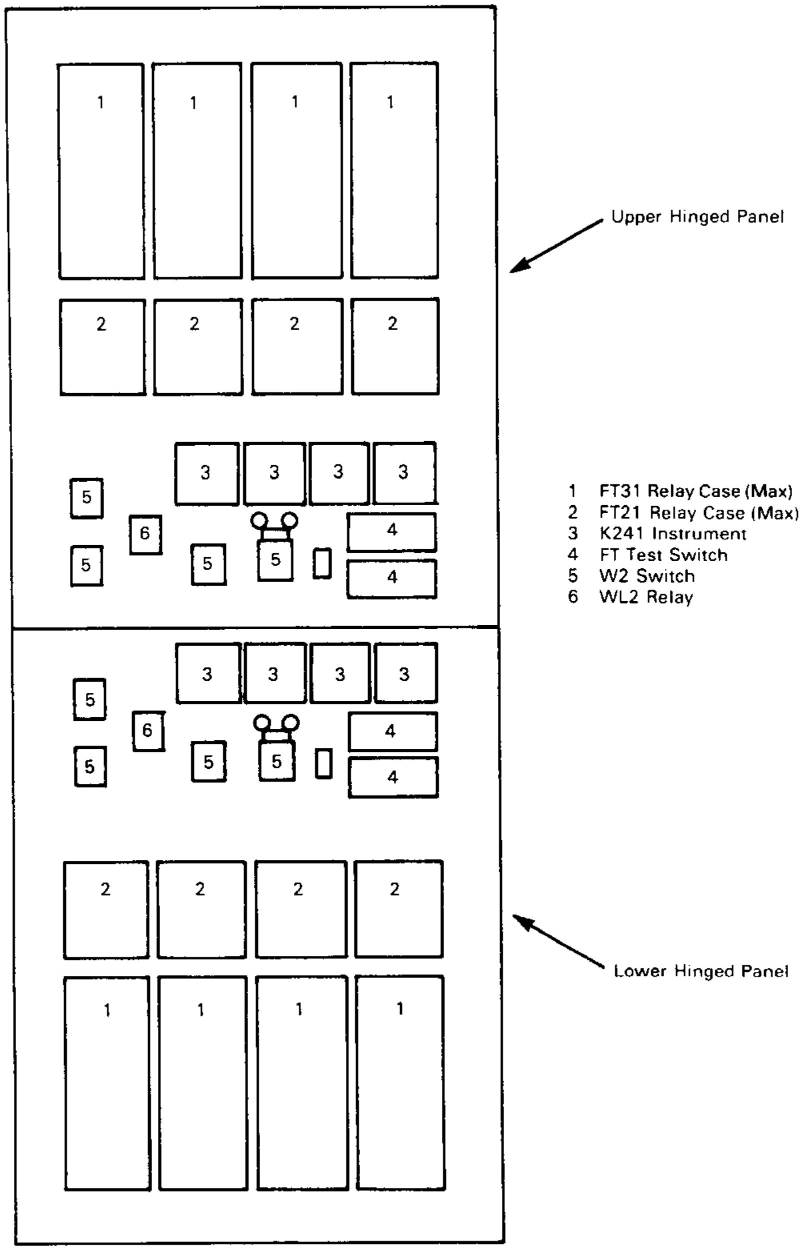
Synchronizing Panel
(Bracket Mounted on End of Line Up)
(See Parts 10.2.7 & 10.2.8)

① Shown for application in upper compartment. VIP application available in lower compartment. However, refer to Part 10.2.14 and note that arrangement of hinged panel components differs between upper and lower panels.

Part 10.2-Standard Designs VIP Secondary & Control

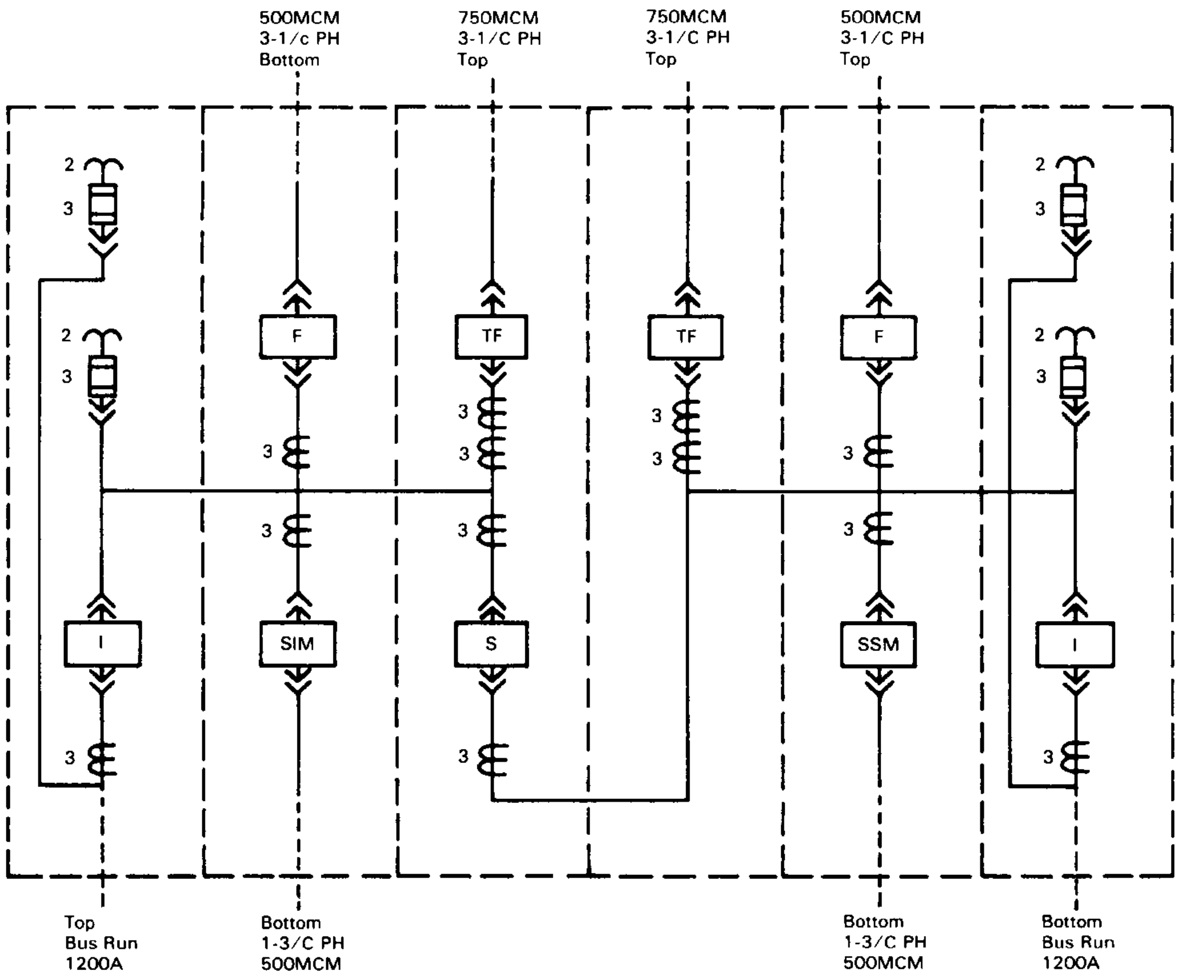
Part 10.2.14 Hinged Panel Equipment (Maximum)

Note that the figure below shows that the arrangement of components differs between upper and lower panels. The figure may also be used to select custom arrangements of hinged panel components.



Part 11 - How to Arrange, Select, and Specify VAC-CLAD

11.1
Refer to Part 10.1 for VIP vertical sections showning top and bottom power conductor entrances and begin to arrange a primary one line as typically shown below. Note that the chart identifies the specific vertical sections (or rear compartments) selected based primarily upon the direction of power conductor entrance.



Vertical Section	1		2		3		4		5		6	
Rear Compartment	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower
Part 10.1.4-	.5	.5	.2	.2	.1	.1	.3	.3	.1	.2	.6	.6
Figure	2	2	5	5	3	3	3	3	1	1	2	2

11.2
Refer to Part 10.2 for VIP secondary and control applications and select your list of components. (The primary one line instrument transformer details can now be completed.) Typical secondary and control selections for the primary one line are shown on the front view below.

1	2	3	4	5	6
Incomer Line Pts Part 10.2.5 / Ind. Motor Bus Pts Part 10.2.9	Feeder Breaker Part 10.2.1	TX Feeder Breaker Part 10.2.3	TX Feeder Breaker Part 10.2.3	Feeder Breaker Part 10.2.1	Incomer Line Pts Part 10.2.5 / Syn. Motor Bus Pts Part 10.2.11
Incomer Breaker Part 10.2.5	Ind. Motor Breaker Part 10.2.9	Section-Alizer Breaker Part 10.2.4	Syn. Motor Exc. Part 10.2.11	Syn. Motor Breaker Part 10.2.11	Incomer Breaker Part 10.2.5

← Front View →

11.3
Specify the following general information:
a. Indoor, aisle-less, or sheltered-aisle (single or double row)
b. Shipping group limitations
c. System voltage, frequency, phase sequence, and grounding.
d. System MVA or short circuit requirements
e. Main bus continuous current rating
f. Control voltage
g. Control cable entrance (Top or bottom and vertical section)

11.4
Specify the following information for each compartment:
a. Circuit nameplate wording
b. Breaker continuous current rating
c. Identification of remote equipment controlled by VAC-CLAD
d. Relay characteristics
e. If not on primary one line:
   - Instrument transformer ratios
   - Complete power conductor information—top or bottom, size, number, type of termination