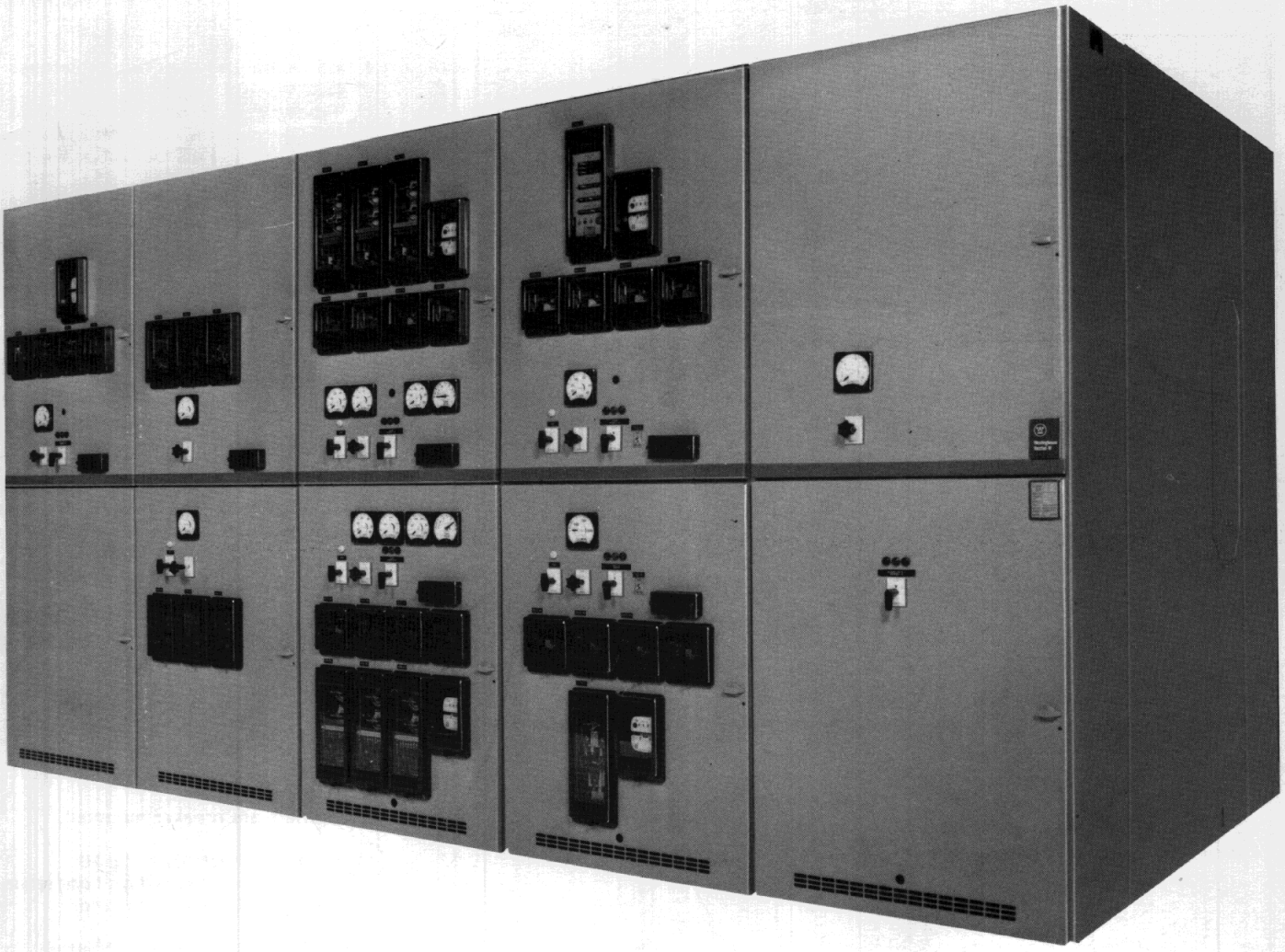
Westinghouse Electric Corporation
Distribution and Control Business Unit
Assemblies Division
Greenwood, SC 29646

October, 1986
New Information
Mailed to: E, D, C/32-000A

Up to 750 MVA (28 kA) at 15000 Volts
Up to 250 MVA (29 kA) at 4760 Volts
1200 and 2000 Amperes
Indoor and Outdoor

VacClad-W Medium Voltage Metal-Clad Switchgear



Type VacClad-W Medium Voltage Metal-Clad Switchgear

Description and Application

VacClad-W Metal-Clad Switchgear is an integrated assembly of drawout vacuum circuit breakers, bus, and control devices coordinated electrically and mechanically for medium voltage circuit protection. The Metal-Clad integrity provides maximum circuit separation and safety. Included are isolated grounded metal compartments, complete insulation of all conductors and no live parts exposed by the opening of a door. It is typically used on circuits involving feeder circuits, transmission lines, distribution lines and motors.

All major components are manufactured by Westinghouse, establishing one source of responsibility for the equipment and assuring high standards in quality, coordination, reliability and service.

VacClad-W Switchgear is available in voltage ratings of 4.76kV through 15kV and in nominal interrupting capacities of 250MVA(29kA), 500MVA(18kA), 500MVA (41kA), 750MVA(28kA) and for indoor or outdoor applications.

VacClad-W Switchgear meets or exceeds ANSI C37.20, NEMA SG-5 and IEEE standards as they apply to Metal-Clad Switchgear. The circuit breaker also meets IEC standards.

VacClad-W Switchgear is designed to meet needs in six important areas:
1. Performance
2. Safety
3. Maintenance
4. Space Utilization
5. Application flexibility
6. Reliability

Features

(1) **Vacuum Interrupter Current Transfer Conductor** (See Pg. 17)
The Westinghouse "Stiff-Flexible" design eliminates the need for a main conductor sliding contact and its costly maintenance.

(2) **Breaker Rails** (See Pg. 16)
The breaker and auxiliaries can be withdrawn on rails for inspection and maintenance without the need for a separate lifting device.

(3) **Front Breaker Mechanism** (See Pg. 16)
The stored energy mechanism is on the front of the breaker so the inspection or maintenance can be done with the breaker on rails.

(4) **Horizontal Drawout Circuit Breaker** (See Pg. 10)
Type VCP-W breaker is a horizontal drawout design, which provides connect, test, and disconnect position.

(5) **Automatic Shutters** (See Pg. 6)
These steel shutters operate automatically when the circuit breaker is withdrawn, to protect workmen from accidental contact with the stationary primary contacts.

(6) **Main Bus System** (See Pg. 8)
The main bus has fluidized bed, track-resistant epoxy insulation with plated joints and constant pressure washers.

(7) **Current Transformers** (See Pg. 7)
There is space for up to four current transformers per phase which are easily accessible from the front.

(8) **Primary and Secondary Contacts** (See Pg. 10)
All moving breaker contacts are self-aligning, have positive action, and are silver-plated.

(9) **Metal Compartment Barriers**
All compartments are enclosed by grounded metal barriers.

(10) **Barriers**
Barriers are breaker mounted.

(11) **Breaker Wheels** (See Pg. 16)
Breaker can be rolled on floor when removed from the structure.

(12) **Auxiliary Compartment Shutter** (See Pg. 9)
This shutter operates automatically when the auxiliary drawer is withdrawn to protect workmen from accidental contact with the stationary primary contacts.

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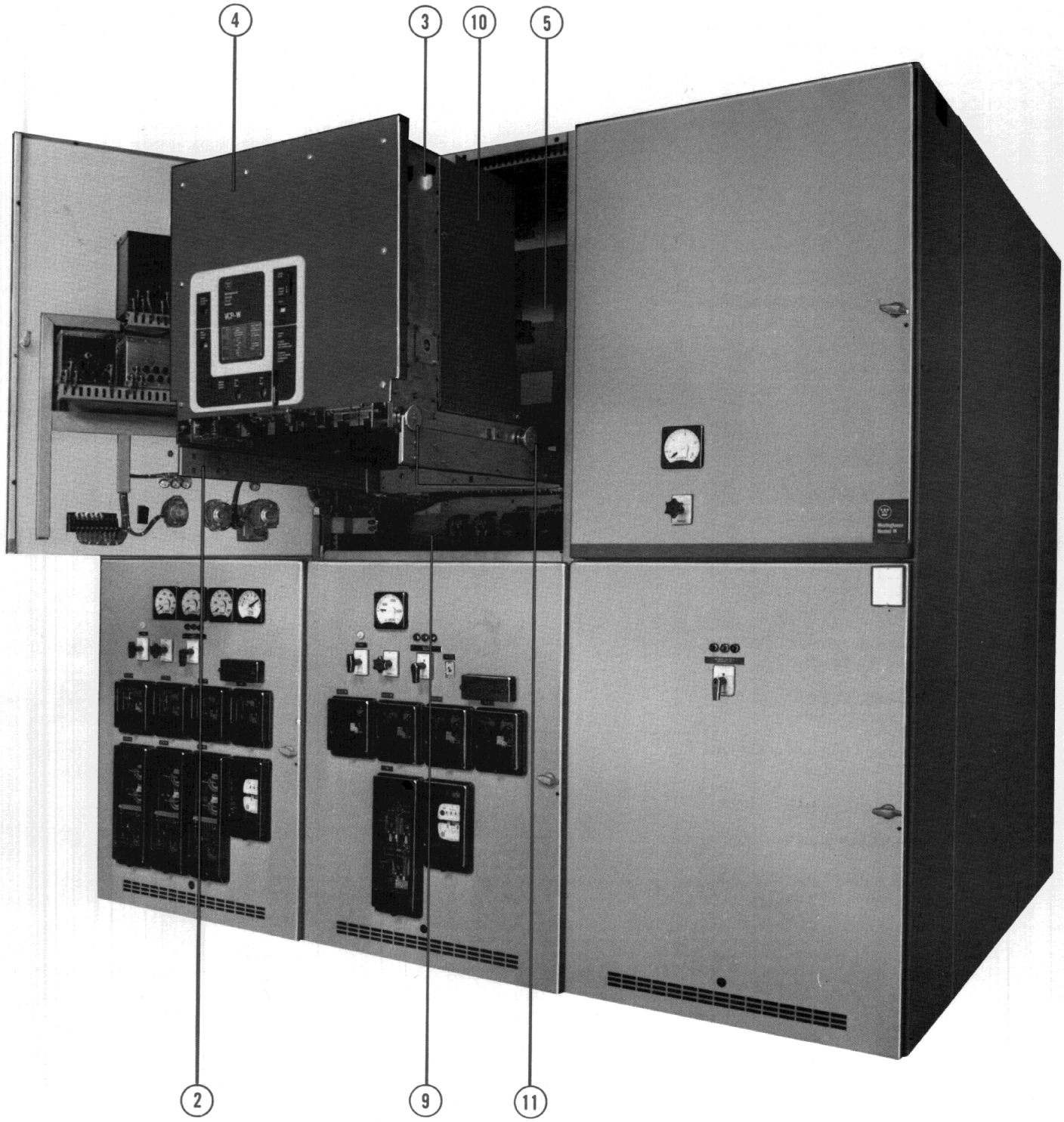


Type VacClad-W Medium Voltage Metal-Clad Switchgear

(13) **Cable Space**
Ample space is provided for cables, potheads, and other related components. Top or bottom cable entry is available. (See Space Utilization, Page 18, Application Flexibility, Page 19, and Maintenance, Page 15)

(14) **Potential Transformers**
Potential transformers are drawer mounted for front accessibility and can be completely withdrawn on rail extensions similar to the breaker. (See Maintenance, Page 15 and Performance Page 9)

(15) **Control Power Transformers**
Drawer mounting makes control power transformers accessible, they can be completely withdrawn the same as the potential transformer. (See Maintenance, Page 15 and Performance, Page 9)

Type VacClad-W Medium Voltage Metal-Clad Switchgear

Type VCP-W circuit breaker utilizing vacuum interrupters is available in ANSI and IEC ratings, plus several special ratings to provide maximum application flexibility.

Performance

VacClad-W 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, NEMA and IEC 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.

The applicable industry standards are:

ANSI	American National Standards 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 as 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
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
IEC 56.4	High Voltage AC Circuit Breakers

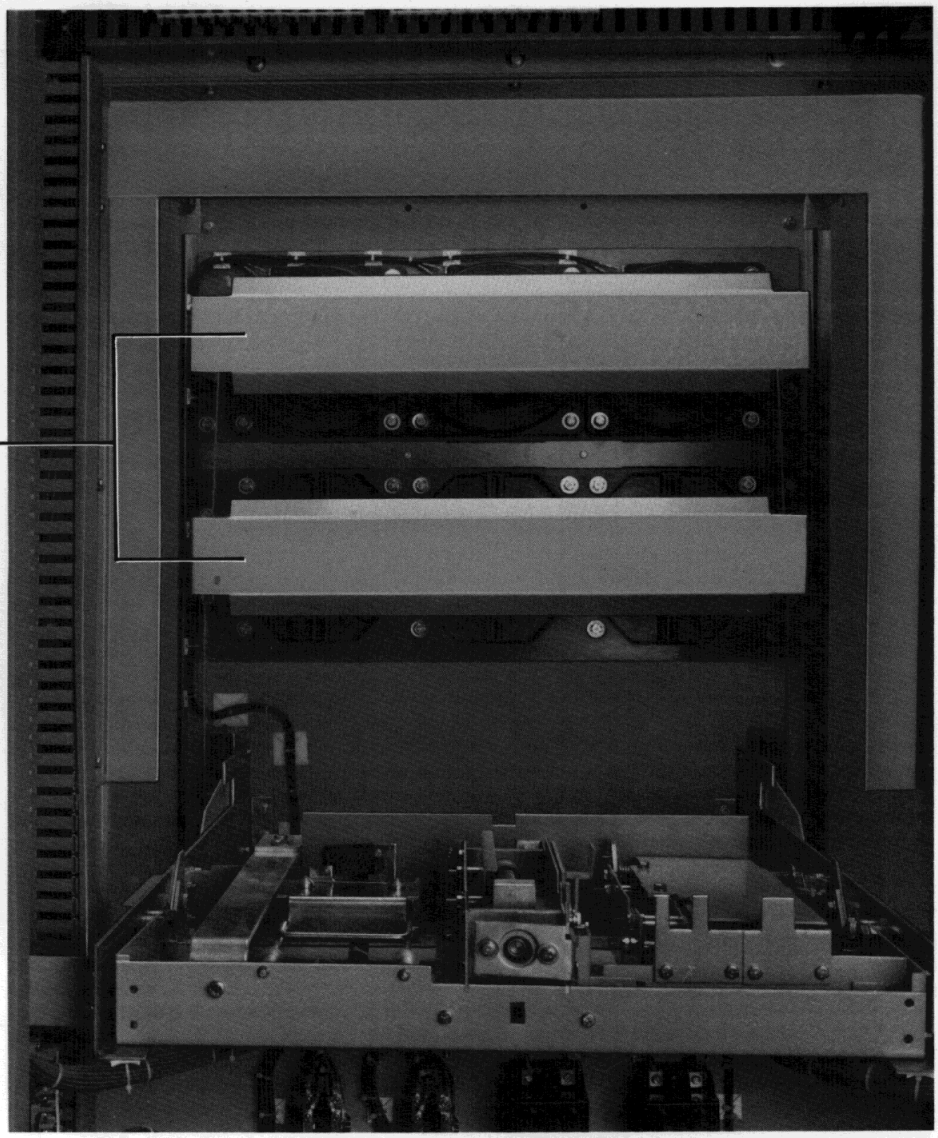
Type VacClad-W Medium Voltage Metal-Clad Switchgear

Performance, *Continued*

Cell Features

Steel shutters which are operated by the circuit breaker prevent accidental contact with live primary voltage parts, when the breaker is withdrawn.

The photo shows the breaker compartment with the breaker and CT barrier removed showing the steel shutters.



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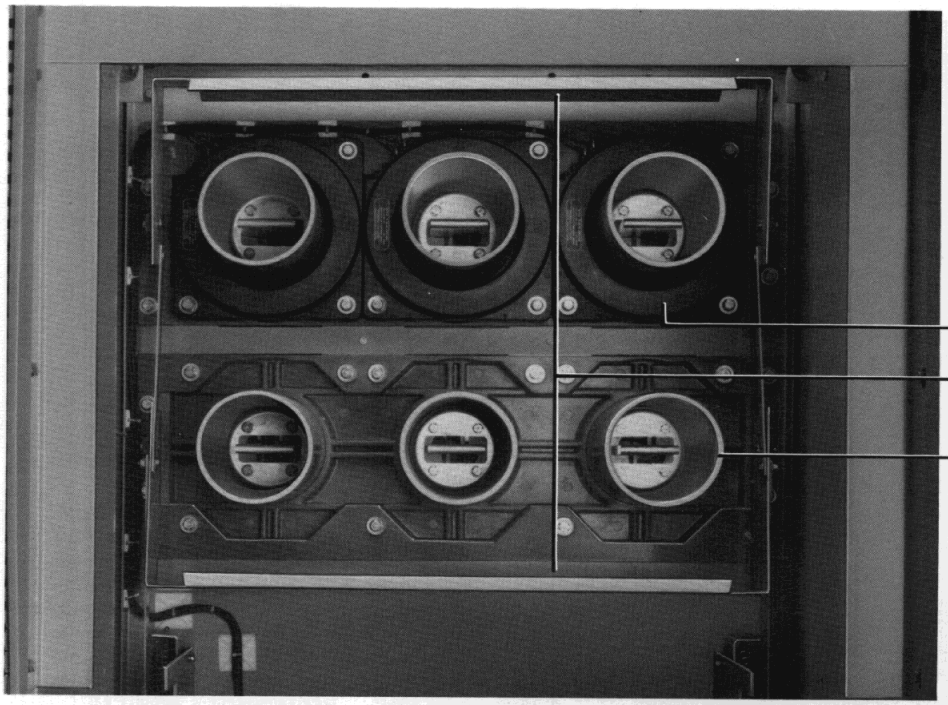
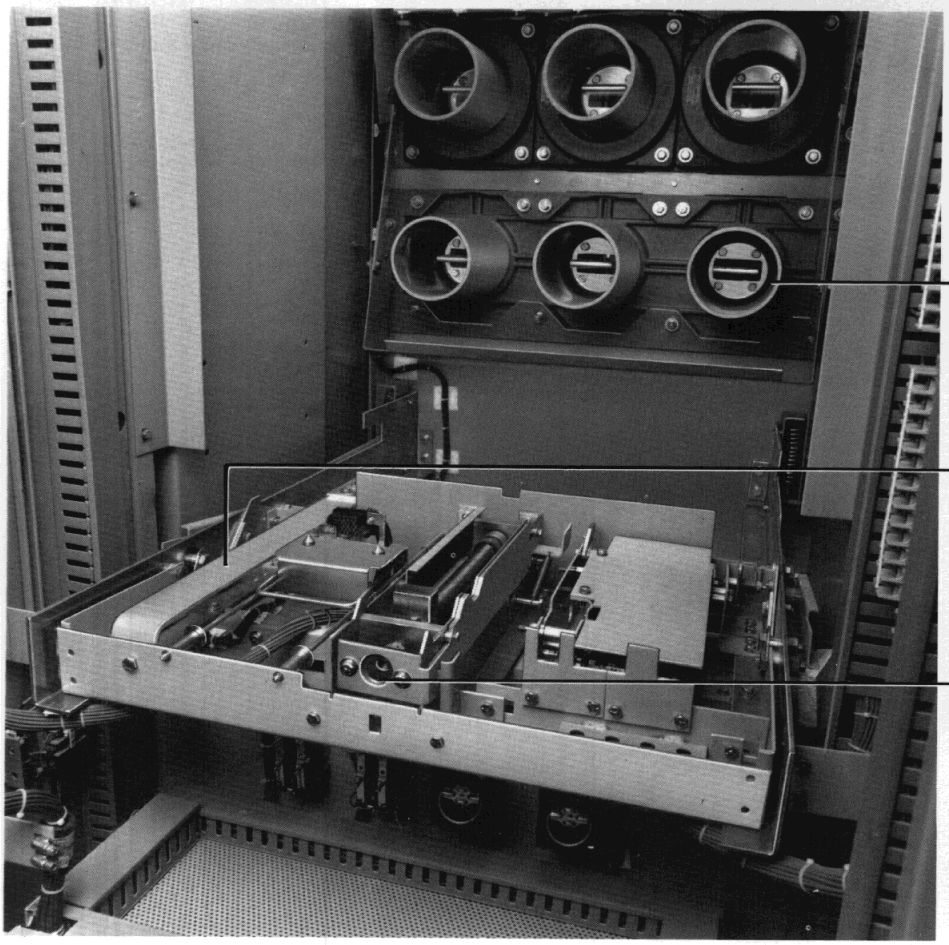


Performance, *Continued*

Cell Features

The breaker compartment is shown with the automatic steel shutters forced into the open position, CT barrier removed.

Primary insulating tubes and current transformer location are shown in this view. Primary stationary cell studs are also visible.



The mechanism for levering the breaker is a unique cell mounted design. This levering system incorporates all the safety interlocks to render the breaker mechanically and electrically trip-free during the levering procedure. Further, the ground bus, visible on the left, is engaged by a ground contact on the breaker, so the breaker is grounded throughout the travel.

Note: Shutters should be removed or forced into the open position only when the unit is de-energized. Shutters are shown in the open position for illustrative purposes only.

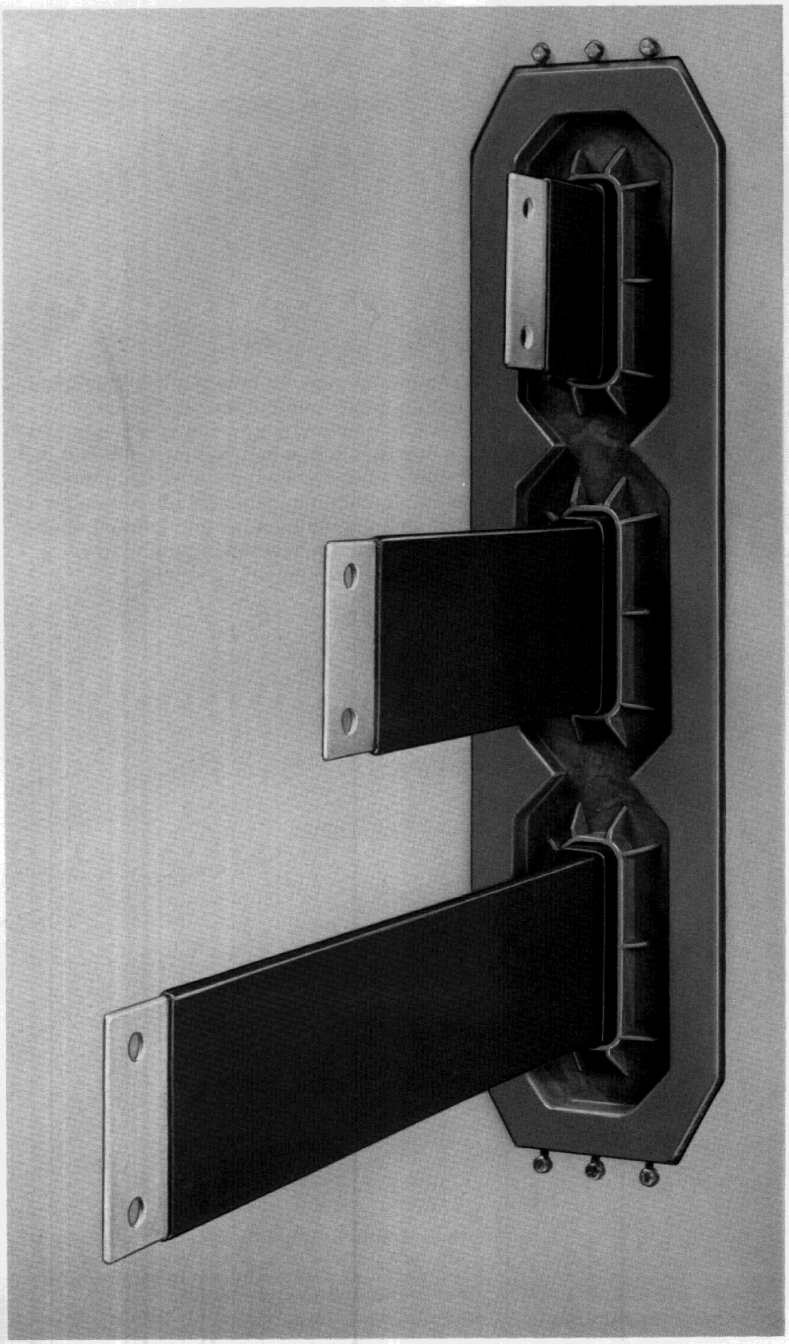
Type VacClad-W Medium Voltage Metal-Clad Switchgear

Performance, *Continued*

Cell Features

Main Bus
The main bus conductor is copper. All main bus has fluidized bed epoxy flame retardant track resistant insulation. The bolted bus connections are silver plated for positive contact and low resistance, with each joint insulated with easily installed boots.

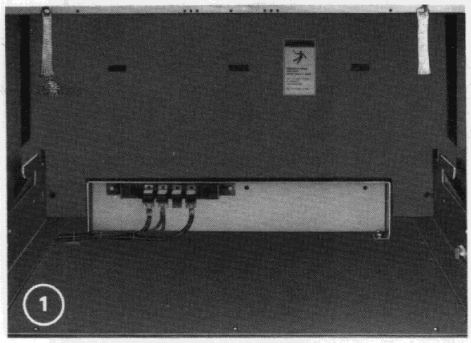
The main bus supports are shown below.



Type VacClad-W Medium Voltage Metal-Clad Switchgear

Performance,
Continued

Cell Features

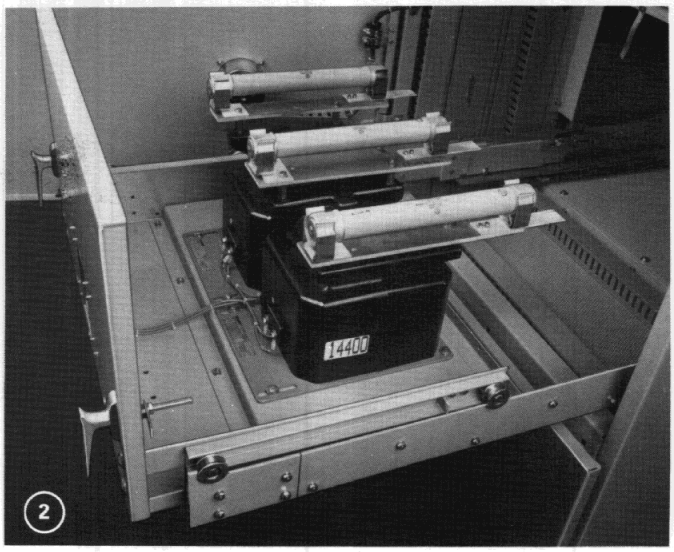


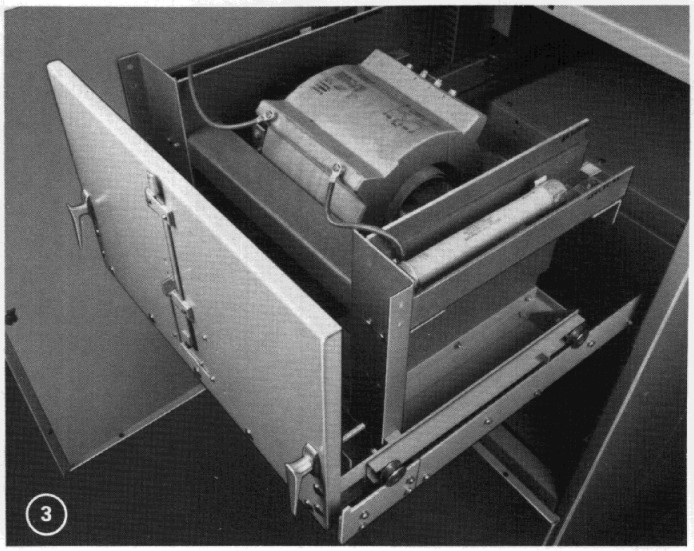
Auxiliary Compartments
VacClad-W design permits four auxiliary drawers in one vertical unit (only two shown here). A potential transformer drawer and a control transformer drawer are shown withdrawn on the rail extensions, which permits easy testing and fuse replacement.

(1) All auxiliaries have automatic shutters.

(2) The potential transformers meet all industry standards. Up to three potential transformers can be supplied per drawer.

(3) The control power transformer drawer accommodating up to 15 kVA single phase transformers with protective primary fuses is shown in the withdrawn position.



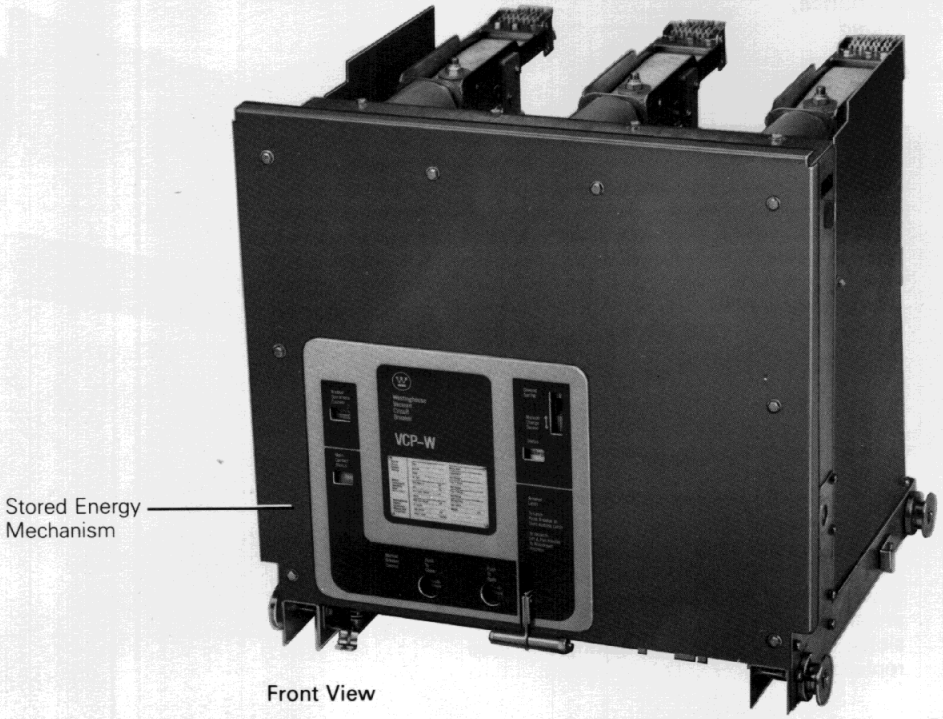


Type VacClad-W Medium Voltage Metal-Clad Switchgear

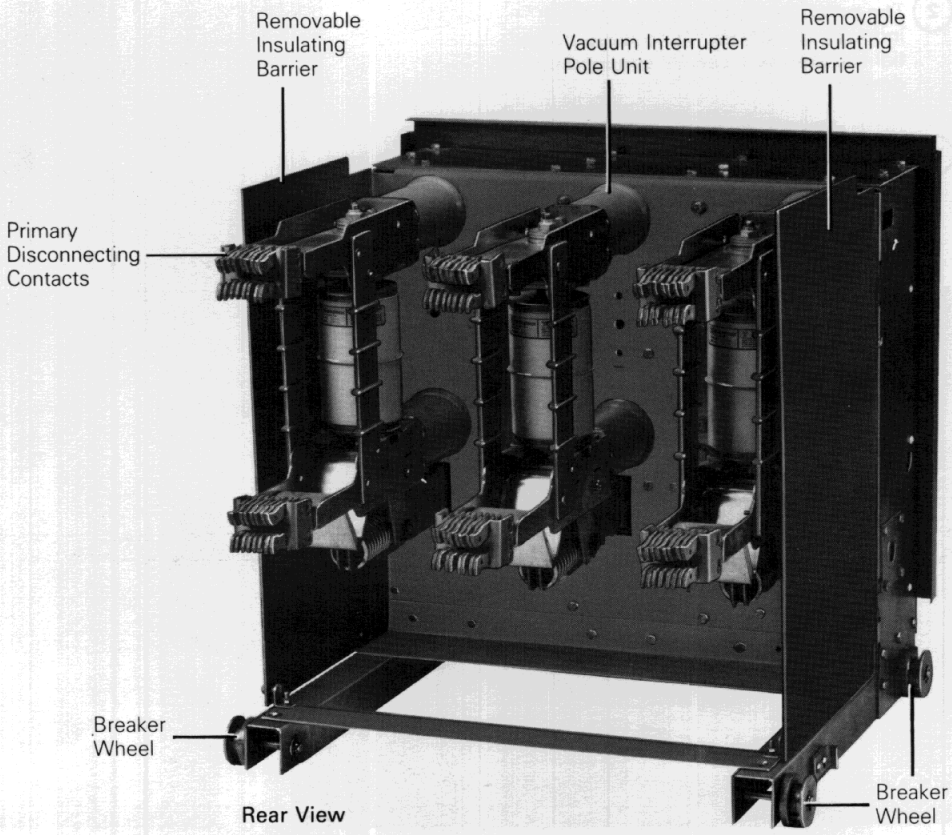
Performance, *Continued*

VCP-W Breaker
The Type VCP-W circuit breaker, utilizing vacuum interrupters, is compact and light weight. The breaker includes six major components:

1. Vacuum interrupter pole units.
2. Stored energy mechanism enclosed in a metal housing.
3. Glass polyester supports for mounting the vacuum interrupter pole unit.
4. Primary disconnecting contacts.
5. Removable insulating barriers.
6. Breaker wheels permit breaker to be rolled on floor.

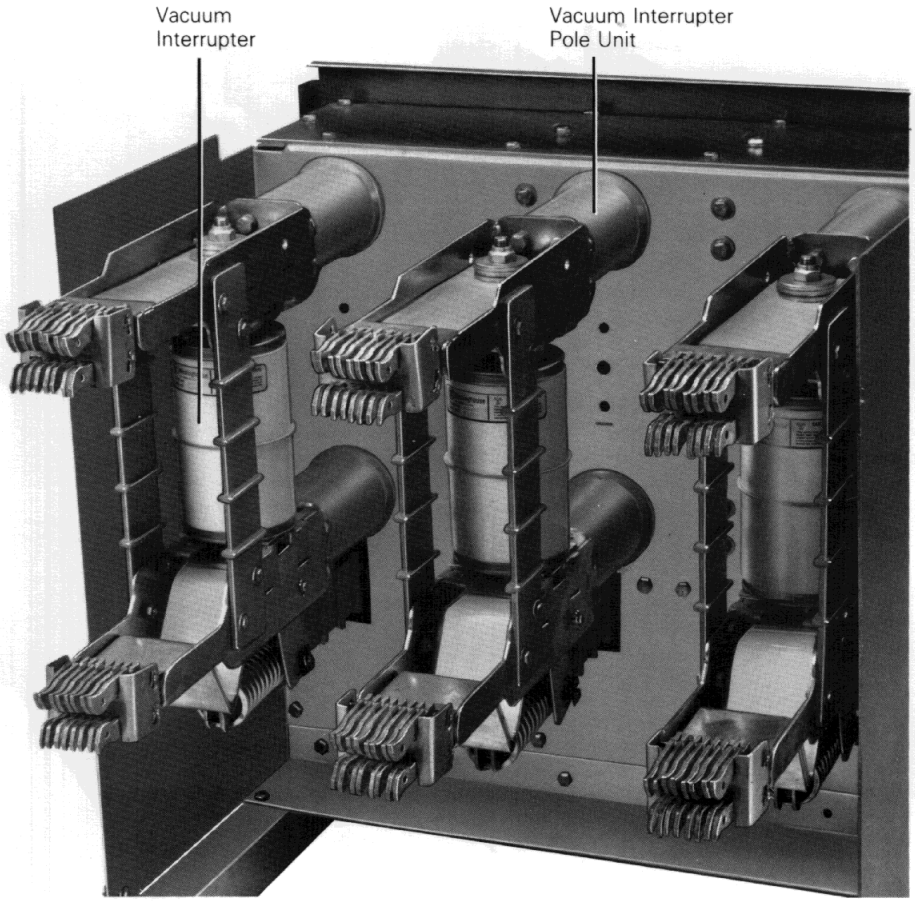


Front View



Rear View

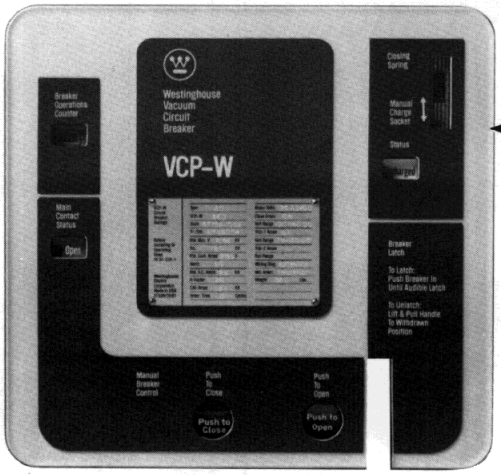
Type VacClad-W Medium Voltage Metal-Clad Switchgear

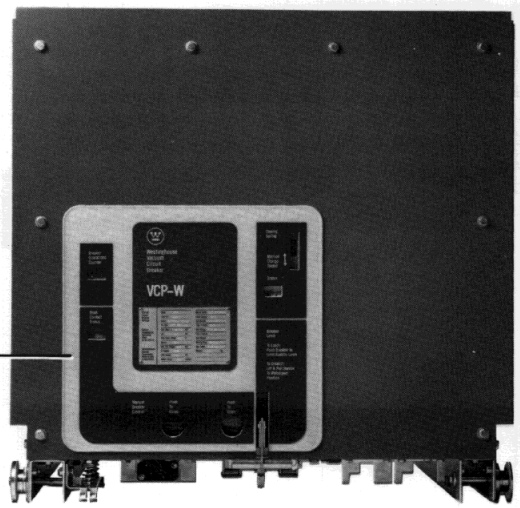


Performance, *Continued*

VCP-W Breaker
Breaker poles are complete units that are easily accessible and removable. Since the support system is self-aligning, no special tools are required for replacement.

Breaker Front Panel
The steel breaker front panel is designed with the operator in mind. The breaker function indicators and controls are accessible and visible. They are: breaker-open/close, closing spring-charged/discharged, close and trip buttons, operation counter and breaker latch.





Type VacClad-W Medium Voltage Metal-Clad Switchgear

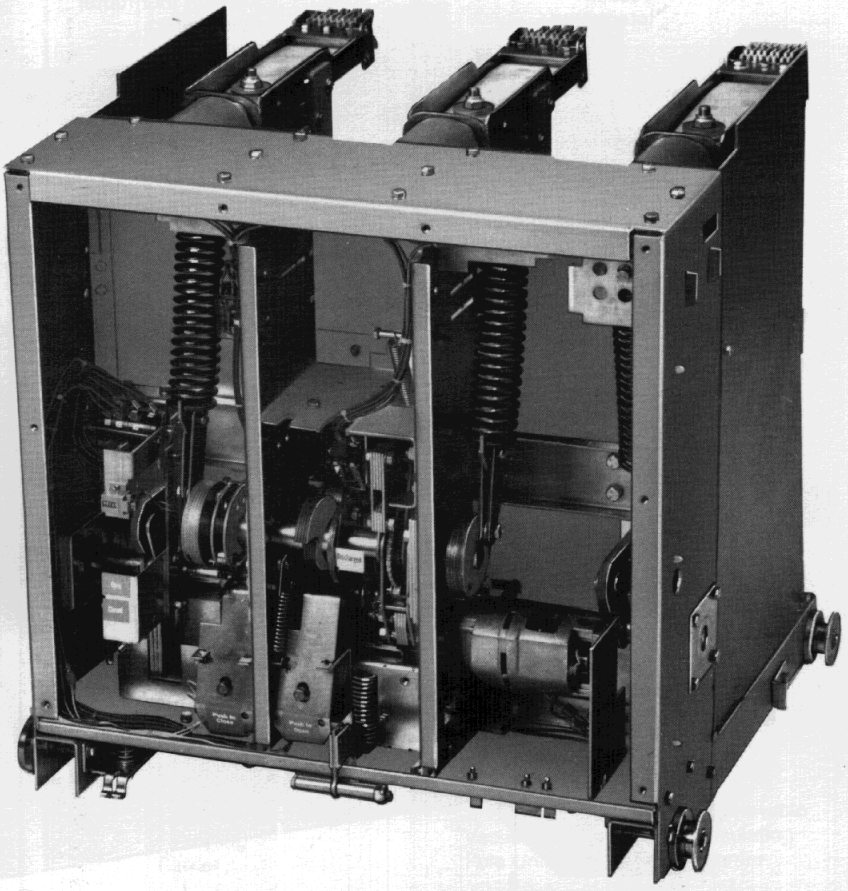
Performance, *Continued*

VCP-W Breaker
Stored Energy Mechanism

Breaker front panel removed exposing the stored energy mechanism.

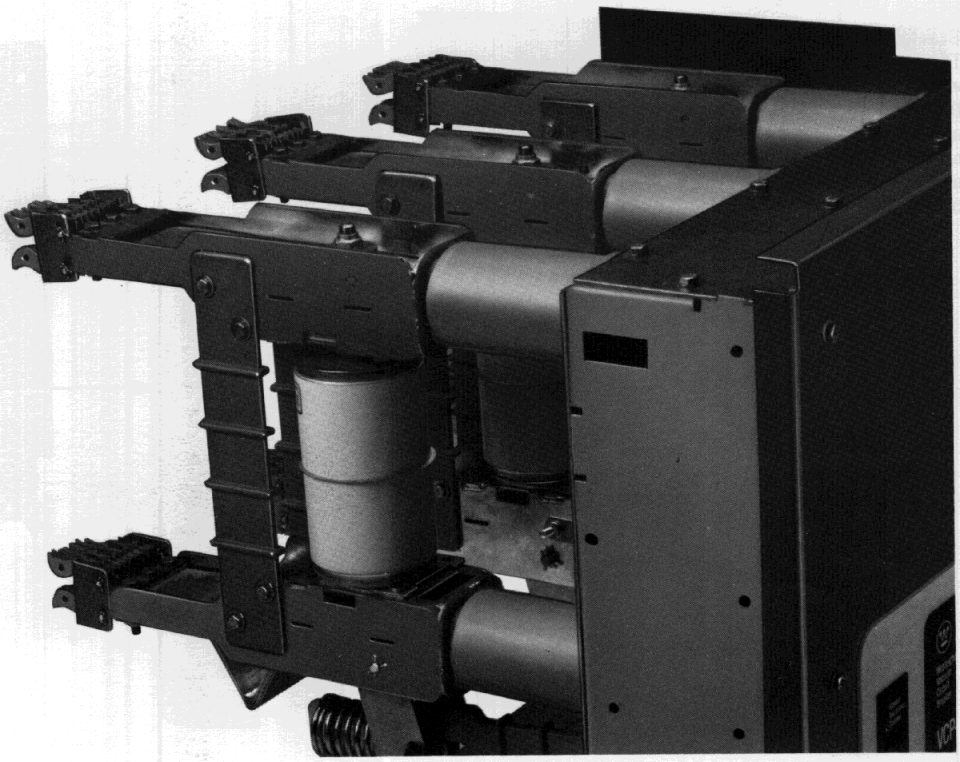
The stored energy mechanism is vertically mounted on the front of the breaker for easy access. There is one basic mechanism for all ratings and is of rugged fabricated steel construction for reliable operation and long life. It is available for either DC or AC operation.

The stored energy mechanism is electrically and mechanically trip-free.



Primary Disconnecting Contacts

The primary disconnecting contacts are silver-plated copper-spring biased to maintain contact pressure. The primary contact design of the configuration shown is for 2000 amp continuous and below. The design has a long service life record, having been successfully used on previous designs of Westinghouse breakers.



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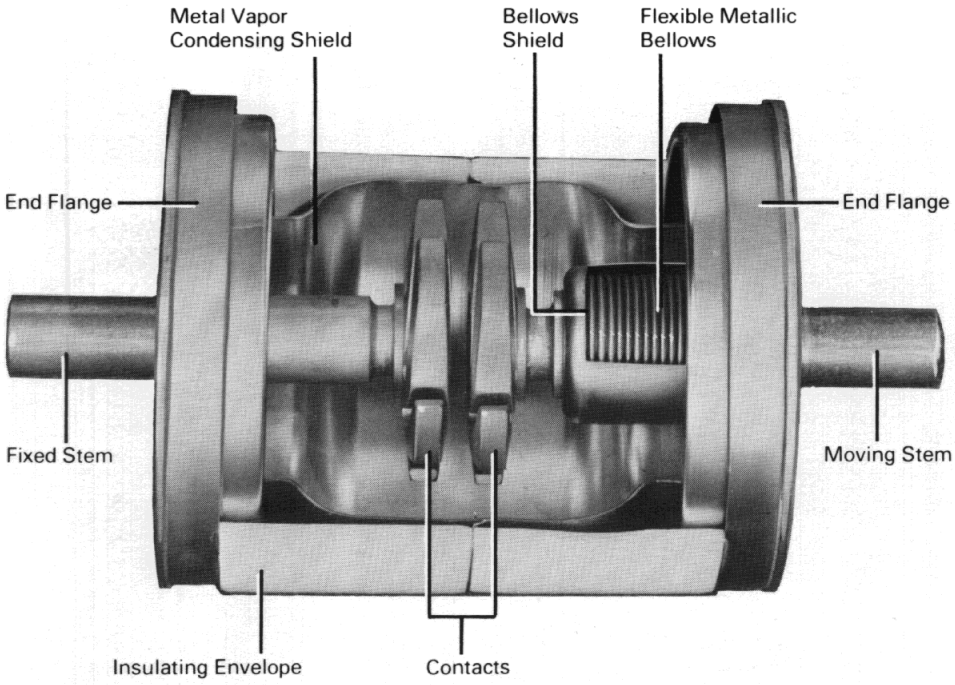
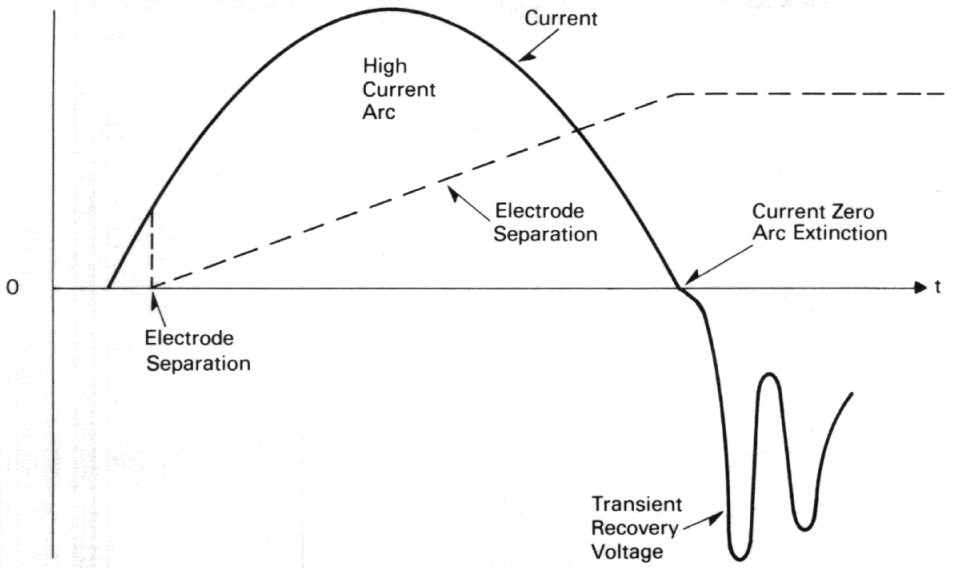




The current, voltage, and contact separation interrelationship is illustrated above.

Performance, *Continued*
VCP-W Breaker

Vacuum Interrupter
The Type VCP-W breaker utilizes vacuum interrupters for interruption and switching functions. Vacuum interrupters provide enclosed interrupter, small size and weight, interrupting time (high speed), long life, reduced maintenance, and environmental compatibility (low noise, no arc by-products, and minimum mechanical shock).

Arc interruption is simple and fast. The vacuum interrupter is shown. In the closed position normal current flows thru the interrupter. When a fault occurs and interruption is required, the contacts are quickly separated. An arc is drawn between the contact surfaces and is rapidly moved around the slotted electrode surface by self-induced magnetic effects, which prevents gross electrode erosion and the formation of hot spots on the surface. The arc burns in an ionized metal vapor, which continually leaves the contact area and condenses on the surrounding metal shield.

At current zero, the arc extinguishes, vapor production ceases; and very rapid dispersion, cooling, recombination, and deionization of the metal vapor plasma together with the fast condensation of metal vapor products cause the vacuum condition to be quickly restored – hence the separated contacts withstand the transient recovery voltage.

Type VacClad-W Medium Voltage Metal-Clad Switchgear

Safety

Cell and Breaker Features

VacClad-W Metal-Clad Switchgear incorporates many outstanding safety features, which meet or exceed those required by metal-clad standards.

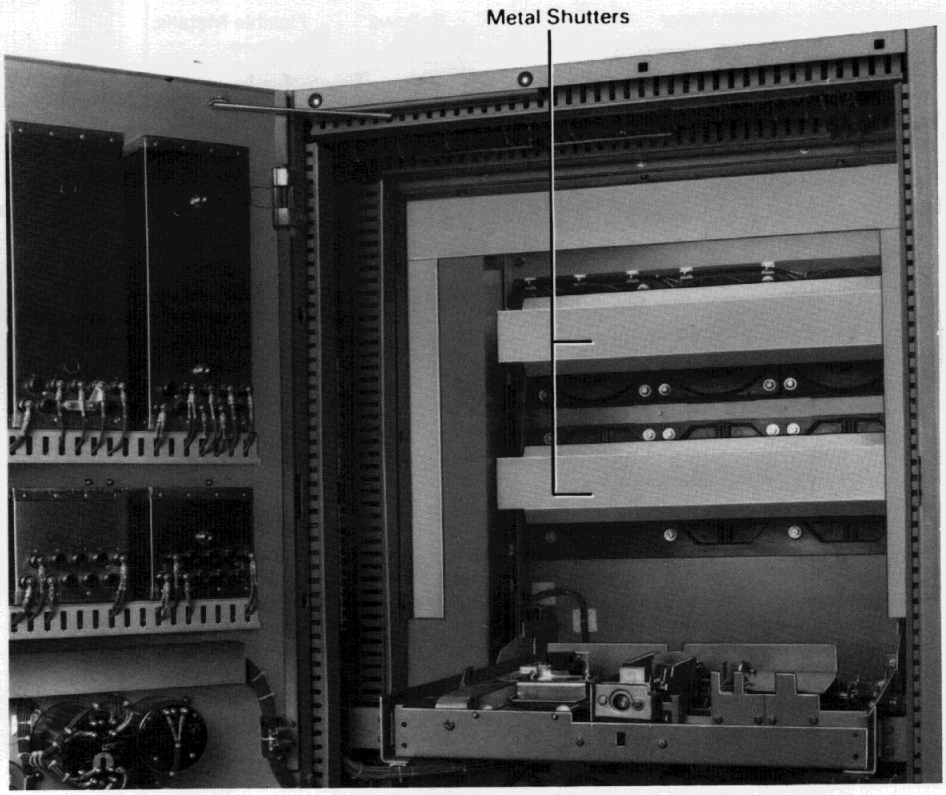
Some of the outstanding features are:

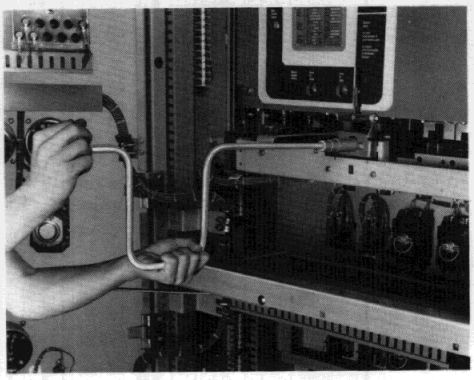
Safety Metal Shutters
Steel shutters (breaker driven) rotate automatically into position to cover the insulating tubes to provide metal barriering of the cell stationary studs when the breaker is withdrawn from the connected position.

Grounded Metal Barriers
Grounded metal barriers separate all compartments, completely enclosing major parts of the primary circuit, main bus, breaker, potential transformers and control power transformers. These barriers must be removed to gain access to any energized compartment. All control devices are separated from high-voltage circuits by grounded metal barriers.

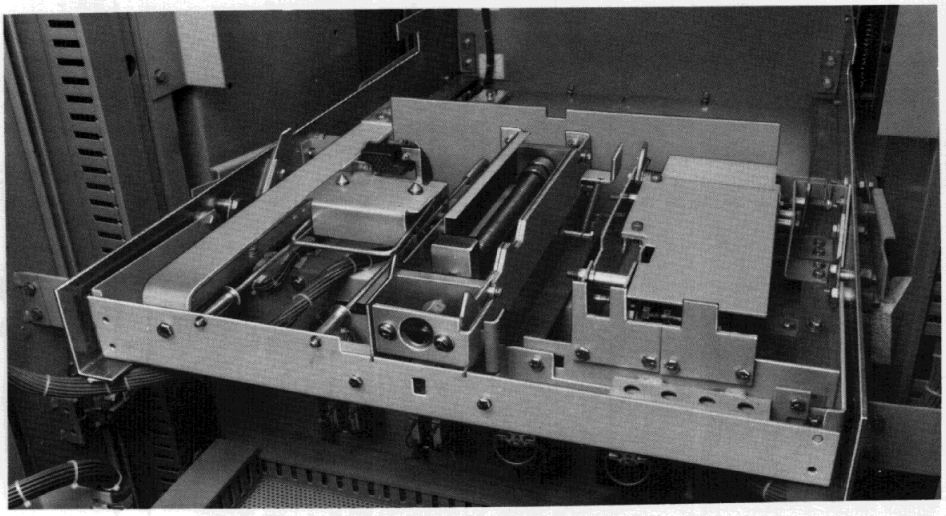
Levering System
Operators and equipment are both protected by a variety of interlocks on the breaker assembly.

1. A breaker cannot be levered unless the interrupter contacts are open.
2. Breaker is trip-free mechanically and electrically during levering.
3. Closed door levering is available.





Levering Crank Operation



Cell Mounted Levering System

4. Discharge of closing spring as breaker is withdrawn from the cell.
5. A latch secures the breaker in the connected, disconnected or test position.

Breaker

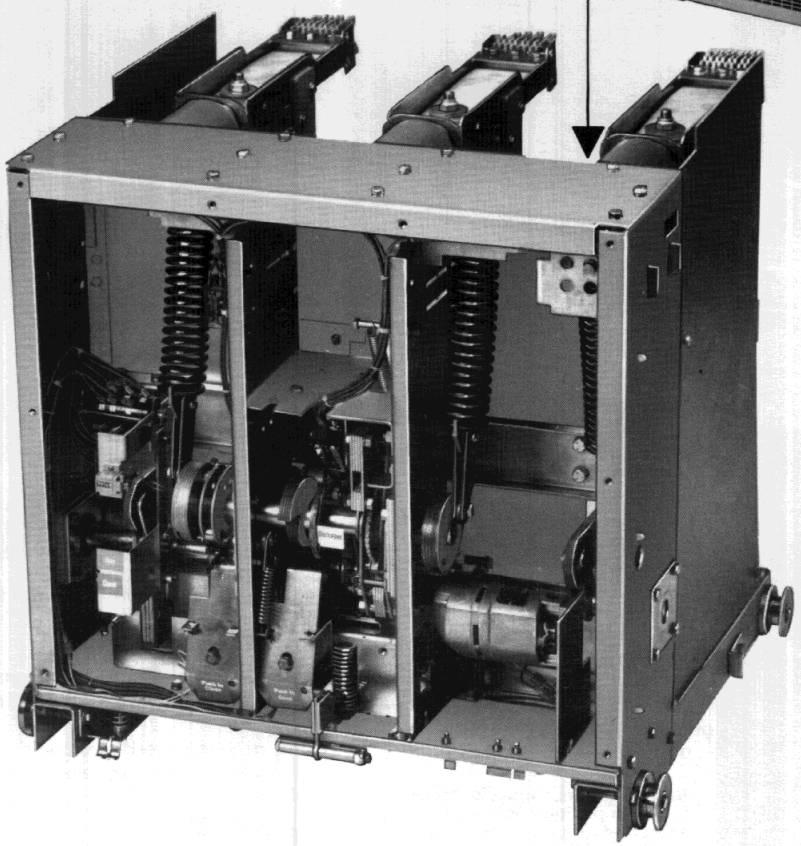
- Breaker is grounded during levering and in the connected position.
- Front panel – steel barrier.
- Coding plates provide that only correct breaker rating can be installed in cell.

Type VacClad-W Medium Voltage Metal-Clad Switchgear

Maintenance, *Continued*

Breaker Features

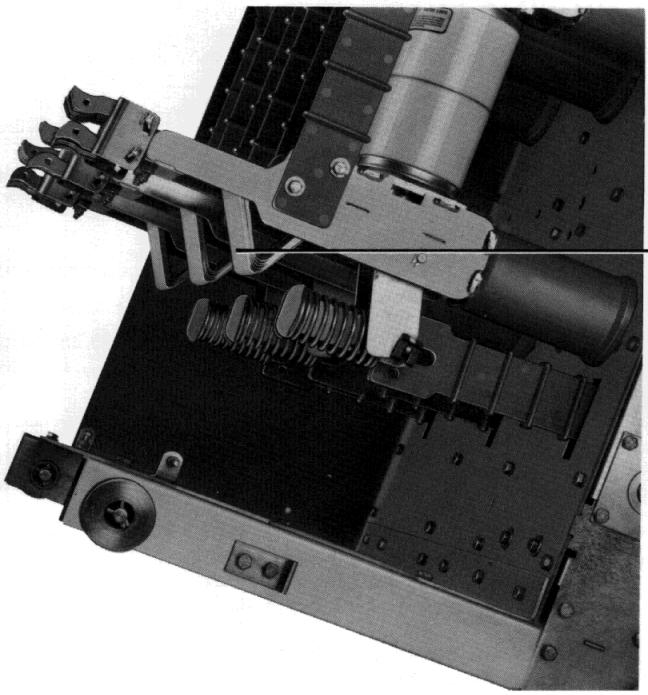
- Normal inspection – Breaker can be withdrawn on extendable rails for easy access without requiring separate lifting device.
- Mechanical inspection – Easy inspection and accessibility is afforded by the front mounted stored-energy mechanism. The same basis mechanism is used in all ratings, which requires a minimum investment in spare parts.



Type VacClad-W Medium Voltage Metal-Clad Switchgear

Maintenance, *Continued*

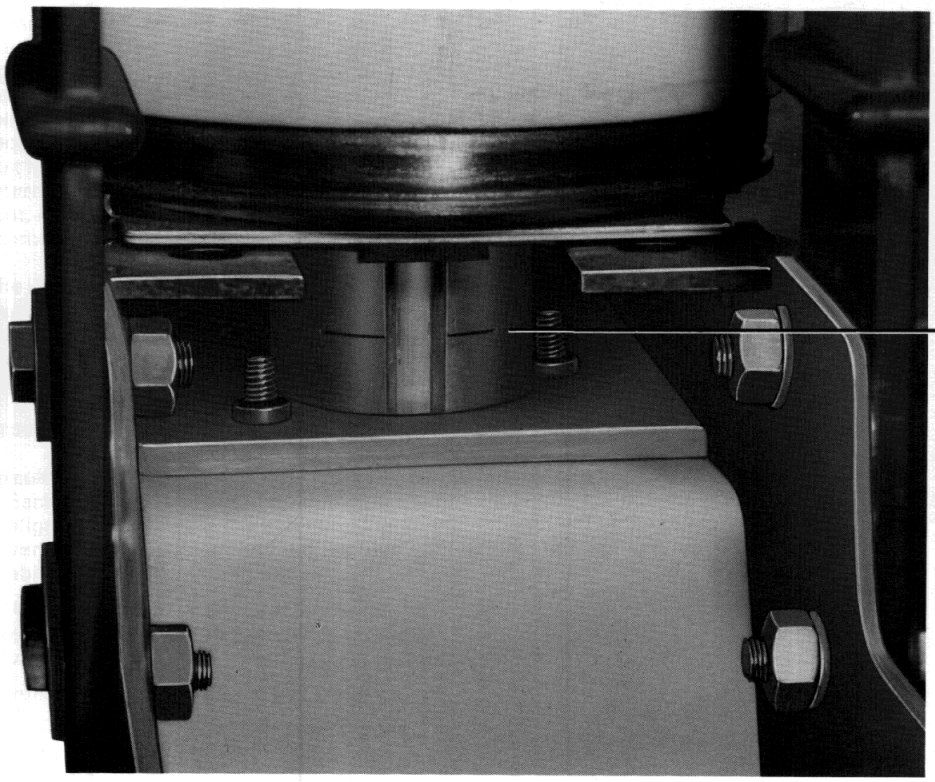
Breaker Features



Vacuum Interrupter Current Transfer Conductor

The stiff-flexible current transfer from the vacuum interrupter moving stem to the breaker main conductor is a non-sliding design – thus eliminating the maintenance required with sliding type transfer arrangements.

Reduced Maintenance
Due to the inherent long life characteristics of the vacuum interrupter and the reliable stored-energy mechanism, the type VCP-W breaker requires minimum maintenance.

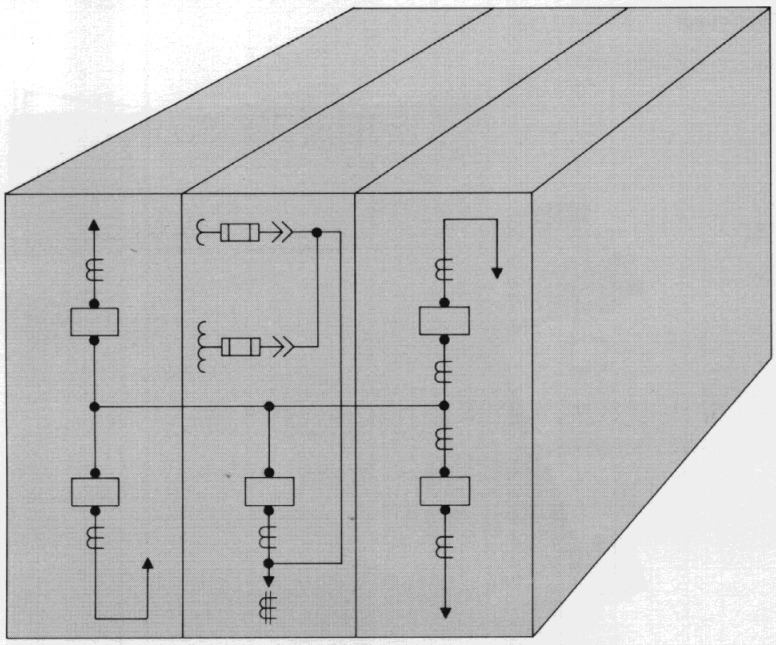


Vacuum interrupter contact wear indicator. Clearly visible, wear-gap (contact erosion) indicators. The contact wear requires only an occasional check.

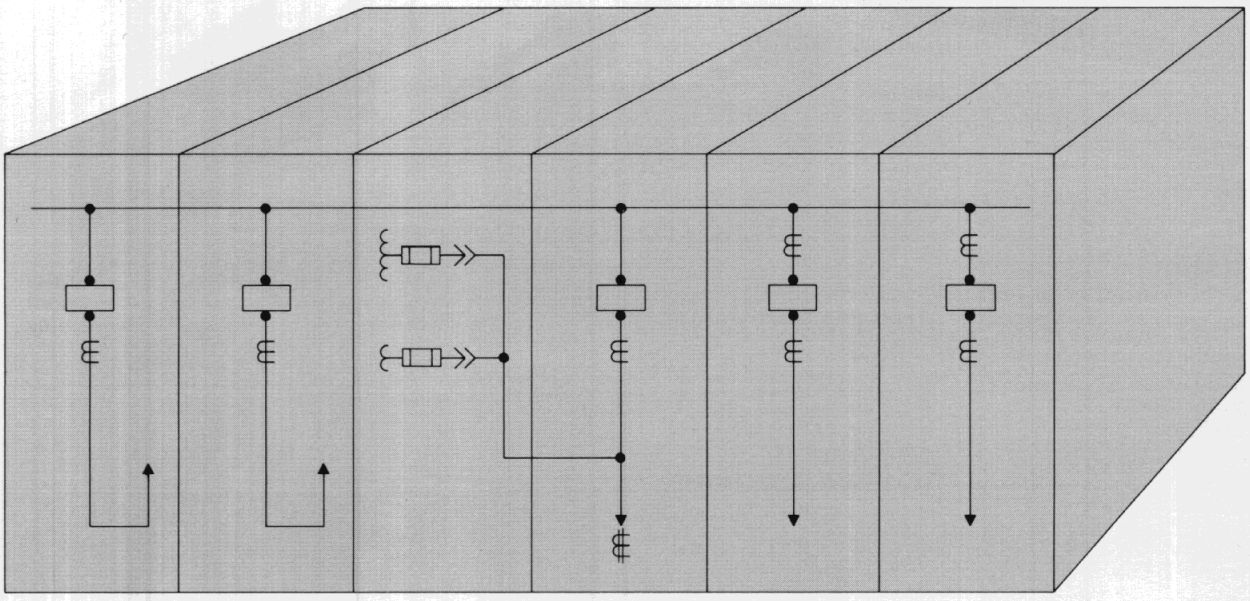
Type VacClad-W Medium Voltage Metal-Clad Switchgear

Space Utilization
VacClad-W Switchgear has been designed for efficient use of space. In many situations, total required floor space may be reduced by as much as 50% compared to conventional switchgear.

The rail extension feature for both the circuit breaker and auxiliaries, enable these draw-out devices to be withdrawn for inspection and maintenance without the use of unique lifting devices needed with other designs.



VacClad-W



Conventional Switchgear

Type VacClad-W Medium Voltage Metal-Clad Switchgear

Application Flexibility

VacClad-W Switchgear has the flexibility to meet most installation conditions or requirements.

- One-high combinations can be provided.
- Modular construction provides for ease of assembly, initial flexibility of installation, and future expansion or modification.
- Rear compartments are designed for either top or bottom entry of cable or bus runs.
- Provisions for four current transformers per phase.
- Provisions for as many as four sets of drawout auxiliaries in one vertical section.
- Indoor and outdoor.
- Complete ANSI rating range available, plus several special ratings.
- IEC breaker ratings.

Reliability

Reliability 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.

Design/Proof Tests

VacClad-W Metal-Clad Switchgear meets applicable ANSI, IEEE, NEMA and IEC 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, BIL, dielectric, continuous current, mechanical life, and thermal and environmental conditions.

The design/proof testing of VacClad-W Switchgear is the most extensive ever performed by Westinghouse 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 an operational sequence test.
- Final inspection and quality check.

Supplemental Device

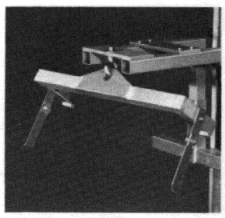
- **Ground and Test Device**
  The ground and test device is a drawout element that may be inserted into a Metal-Clad Switchgear housing in place of a circuit breaker to provide access to the primary circuits to permit the temporary connection of grounds or testing equipment to the high voltage circuits. 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 switchgear and will carry required levels of short circuit current.

Manual ground and test devices are available. These devices include six studs for connection to primary circuits. The manual device selection and grounding are accomplished by cable connection.

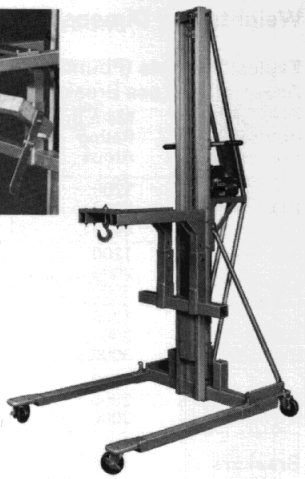
Notice
Before using ground and test devices it is recommended that each user develop detailed operating procedures consistent with safe operating practices. Only qualified personnel should be authorized to use ground and test devices.

Standard Accessories

1 – Test Jumper
1 – Levering Crank
1 – Maintenance Tool
1 – Lifting Yoke
1 – Set Rail Clamps
1 – Set of Extension Rails
1 – Transport Dolly (Optional)
1 – Portable Lifter (Optional)
1 – Test Cabinet (Optional)



Universal Breaker Lifting Yoke For User's Lifting Device



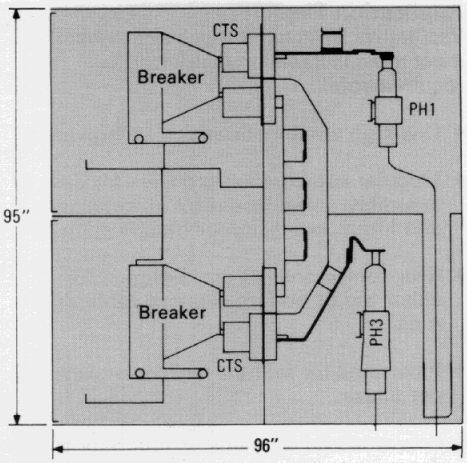
Optional Portable Lifter

Type VacClad-W Medium Voltage Metal-Clad Switchgear

Weights and Dimensions

Typical Weights (Pounds)
Assemblies (Less Breakers)

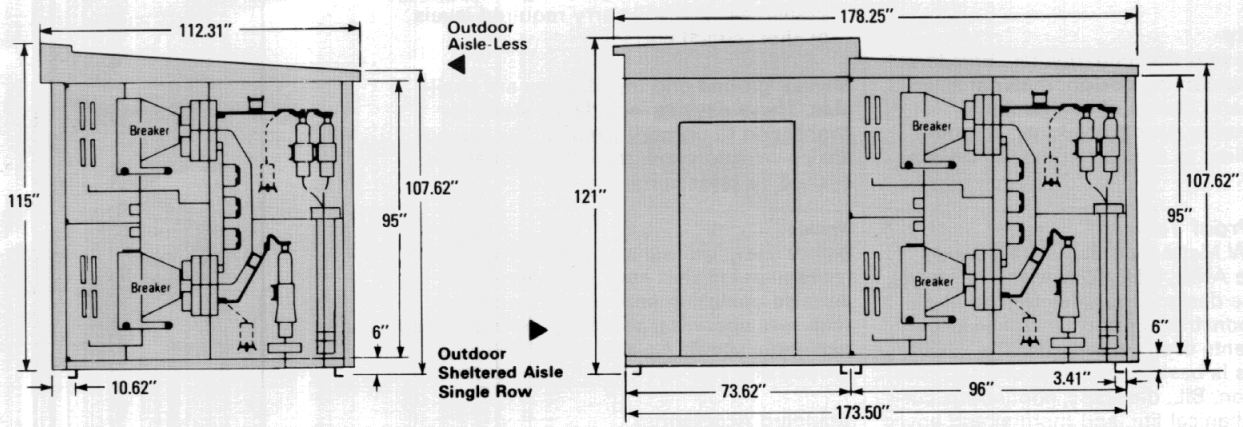
Type of① Vertical Section	Main Bus Rating Amps	Indoor	Aisle-Less	Sheltered-Aisle Including Aisle	
				Single Row	Double Row
B/B	1200	2400	3000	4200	7200
	2000	2500	3100	4300	7400
	3000	2600	3200	4400	7600
B/A or A/B	1200	2300	2900	4100	7000
	2000	2400	3000	4200	7200
	3000	2500	3100	4300	7400
A/A	1200	2000	2600	3800	6400
	2000	2100	2700	3900	6600
	3000	2200	2800	4000	6800
B	1200	2200	2800	4000	6800
	2000	2300	2900	4100	7000
	3000	2400	3000	4200	7200

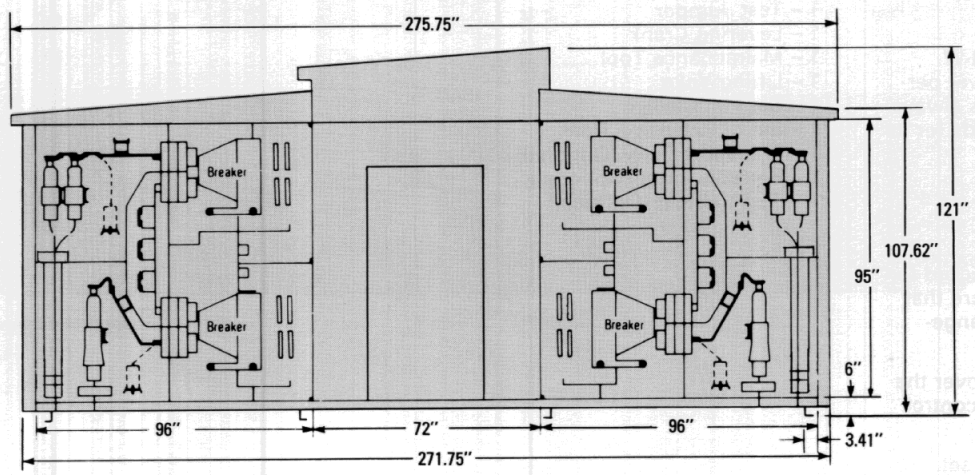


Indoor

Breakers

Type of Breaker	Current Rating, Amps.		
	1200	2000	3000
	Approx. Wt., Lbs.		
50 VCP-W 250	350	410	525
75 VCP-W 500	375	410	525
150 VCP-W 500	350	410	525
150 VCP-W 500	350	410	525





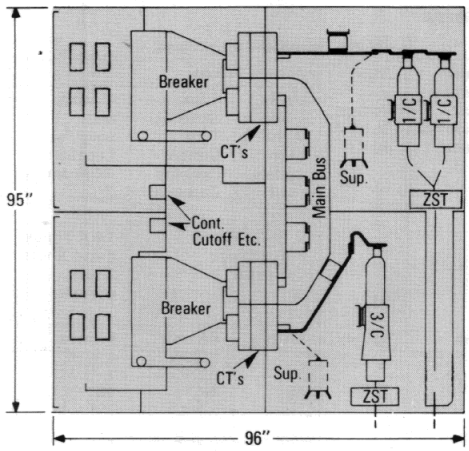
*See Page 93 for Available Configurations

Outdoor
Sheltered Aisle
Double Row

Dimensions, Inches

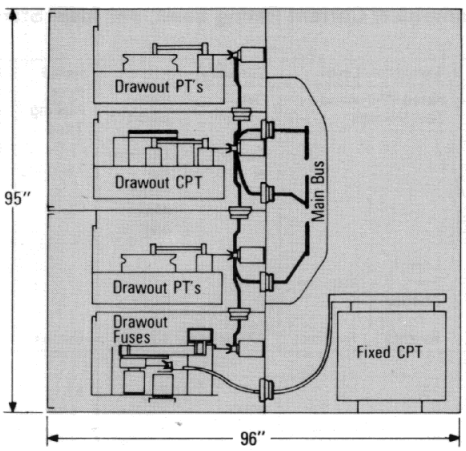
Type VacClad-W Medium Voltage Metal-Clad Switchgear

Typical Units



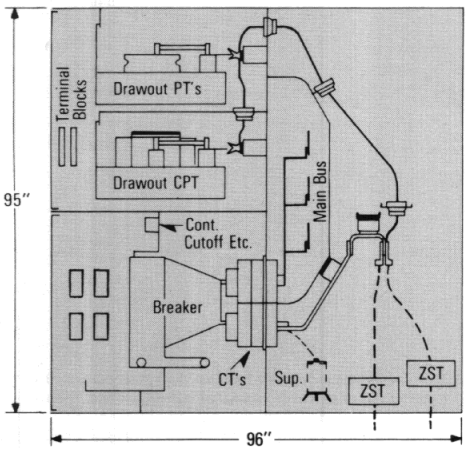
36" Wide Typical Breaker/Breaker Vertical Section

1 - 1200/2000/3000 Amp. main bus
2 - Type VCP-W breakers 1200/2000 Amp. in 2 - high configuration
4 - Current transformers per phase ANSI ratings.
- Potheads 1/C or 3/C
- Surge suppressors, if desired.
- Zero sequence current transformer (ZST)



36" Wide Typical Auxiliary/Auxiliary Vertical Section

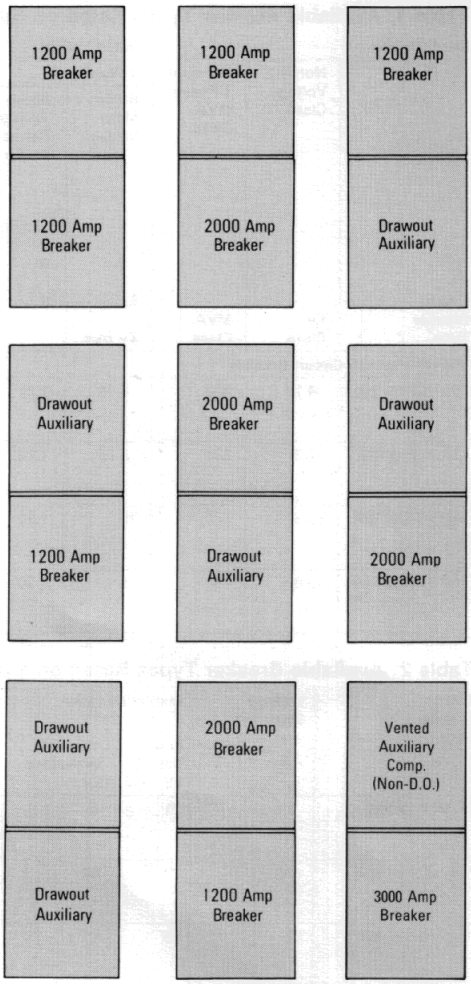
1 - 1200/2000/3000 Amp. main bus. Illustrating maximum utilization of auxiliary compartment with 4 - high drawout auxiliaries and fixed mounted control power transformer.



36" Wide Typical Auxiliary/Breaker Vertical Section

1 - 1200/2000/3000 Amp. main bus
1 - Type VCP breaker 1200/2000 Amp. in lower position
1 - Drawout potential transformer drawer
2 - L-L with fuses
3 - L-G with fuses
1 - Drawout control power transformer drawer CPT - 15 kVA max. - single phase
- Zero sequence current transformers (ZST)
- Surge suppressors, if desired.

Available Configurations



Type VacClad-W Medium Voltage Metal-Clad Switchgear

Application

Table 1: Available Breaker Types Rated on Symmetrical Current Rating Basis, per ANSI Standards

Identification			Rated Values								Related Required Capabilities③		
	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 Max. Voltage	Rated Voltage Range Factor	Rated Withstand Test Voltage		Rated Continuous Current at 60 Hz	Rated Short Circuit Current (at rated Max. Kv) ②				Maximum Sym. Interrupting Capability	3 Sec. Short-Time Current Carrying Capability	Closing and Latching Capability (Momentary) ①
				②	Low Frequency	Impulse				④		K Times Rated Short-Circuit Current② KI		1.6 K Times Rated Short-Circuit Current
Circuit Breaker Type	Kv Class	MVA Class	E	K				I		Y	E/K			
			Kv rms		Kv rms	Kv Crest	Amperes	KA rms	Cycles	Sec.	Kv rms	KA rms	KA rms	KA rms
VCP-W Vacuum Circuit Breaker														
50 VCP-W 250	4.16	250	4.76	1.24	19	60	1200 2000 3000	29	5	2	3.85	36	36	58
75 VCP-W 500	7.2	500	8.25	1.25	36	95	1200 2000 3000	33	5	2	6.6	41	41	66
150 VCP-W 500	13.8	500	15	1.30	36	95	1200 2000 3000	18	5	2	11.5	23	23	37
150 VCP-W 750	13.8	750	15	1.30	36	95	1200 2000 3000	28	5	2	11.5	36	36	58

Table 2: Available Breaker Types Rated on Symmetrical Current Rating Basis per IEC Standards

Circuit Breaker Type	Voltage Class, kV	Insulation Level		Rated Continuous Current, Amps.	Rated Interrupting Current, kA⑤	Momentary Current, kA	
		Low Freq., kV	Impulse Withstand kV			3 Sec.	Peak
50 VCP-W 250	3.6	21	45	630 1250 2000	25 25 25	25 25 25	64
75 VCP-W 500	7.2	27	60	630 1250 2000	40 40 40	40 40 40	102
150 VCP-W 500	12	35	95	630 1250 2000	25 25 25	25 25 25	64
150 VCP-W 750	12	35	95	630 1250 2000	25 25 25	25 25 25	64
				1250 2000	40 40	40 40	102

① Non-Standard Breakers 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

$= 1.15 \frac{E}{Kv}$ (Rated Short-Circuit Current)

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:

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

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 0 + 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:

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

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

⑤ Standard duty cycle: O – 3 min. – CO – 3 min. – CO.