



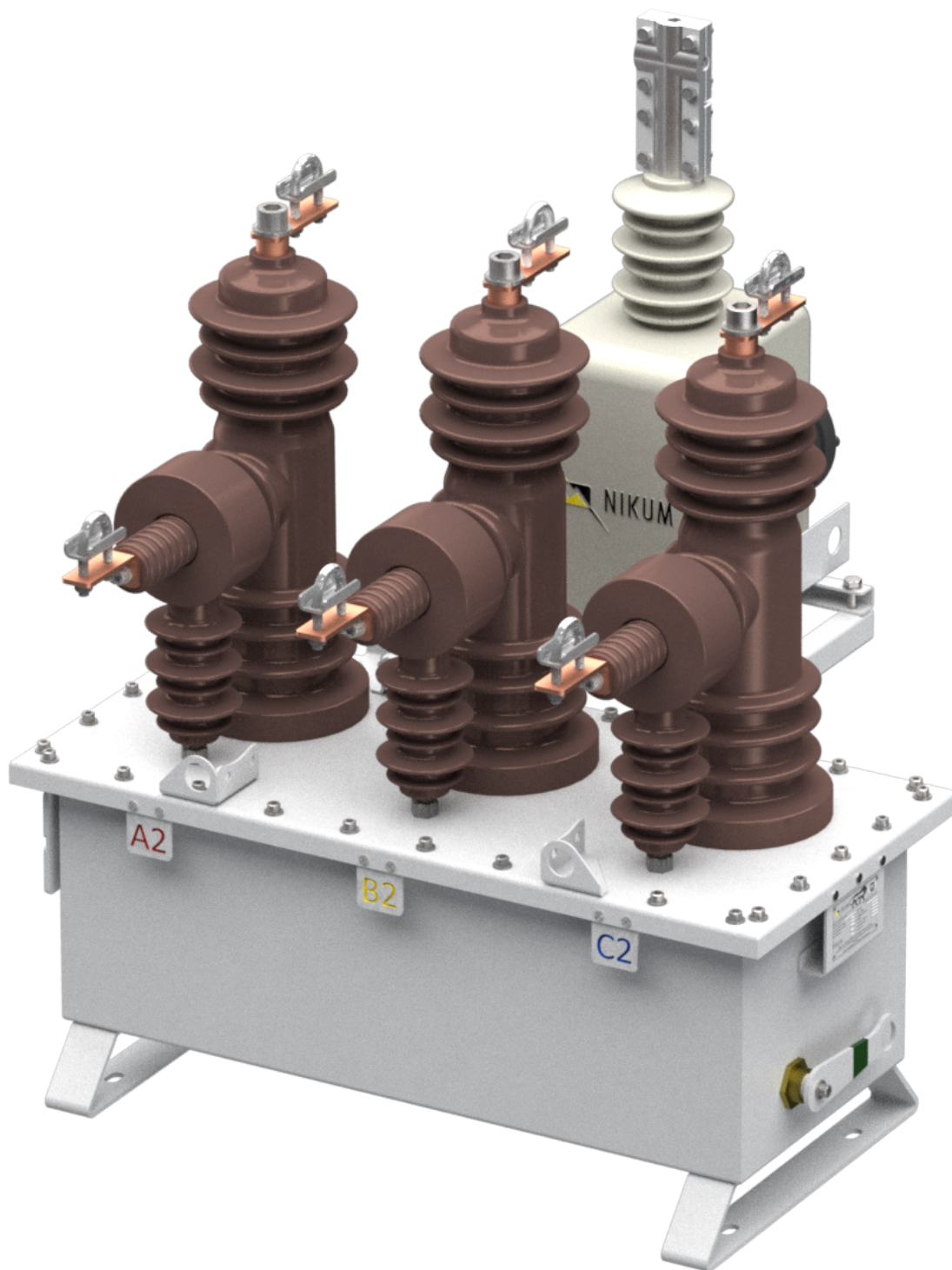
## PRODUCT GUIDE

# AVR

AUTOMATIC CIRCUIT RECLOSER | LINE SECTIONALIZER







AVR12 recloser with integrated voltage transformer







## © Nikum Energy Control India Limited

We originated as a switchgear manufacturing company and this vertical is still the very core of our business. Now, we are a company providing excellence in MV and Distribution automation solutions. With our rich experience and engineering expertise, we have created a dominant position in the market.

We work closely with each customer to provide products, that not only meets or exceeds the customer's specification requirements, but guarantees years of exceptional performance and reliability. Our Quality Assurance Program, ensures the manufacturing of products with the best in the production. From the checking of raw materials to the final checking of manufactured product, Nikum, follows a very strict quality procedure to gain 100% product satisfaction from the customers. With the qualified testing team, we make sure that the product is according to the need of the customer with no compromise in quality.

Recloser is at the forefront of our switchgear technology. This product has proven itself in more than 30 electrical utilities in 13 countries. Through use of solid dielectric insulation and vacuum interruption technology, our Recloser is maintenance free and easy to install.

Simplicity and robustness has been key factors behind designing this product. It hosts patented magnetic actuator for mechanism which yield in service life of more than 20 years. The product is type tested by independent laboratories in India.

As the grid turns more complex, challenges are growing for power engineers everyday. Advance protection capabilities such as Broken conductor protection, Admittance protection, synchro-check are incorporated. It is also versatile enough to be deployed as Recloser, Sectionalizer or switch with programmable logic.

### Our business verticals

- Medium voltage SWITCHGEAR
- EPOXY BASED CHEMICALS
- SCADA AND AUTOMATION
- POWER QUALITY SOLUTIONS

### Quality and certifications









## Principle of operation - RECLOSER

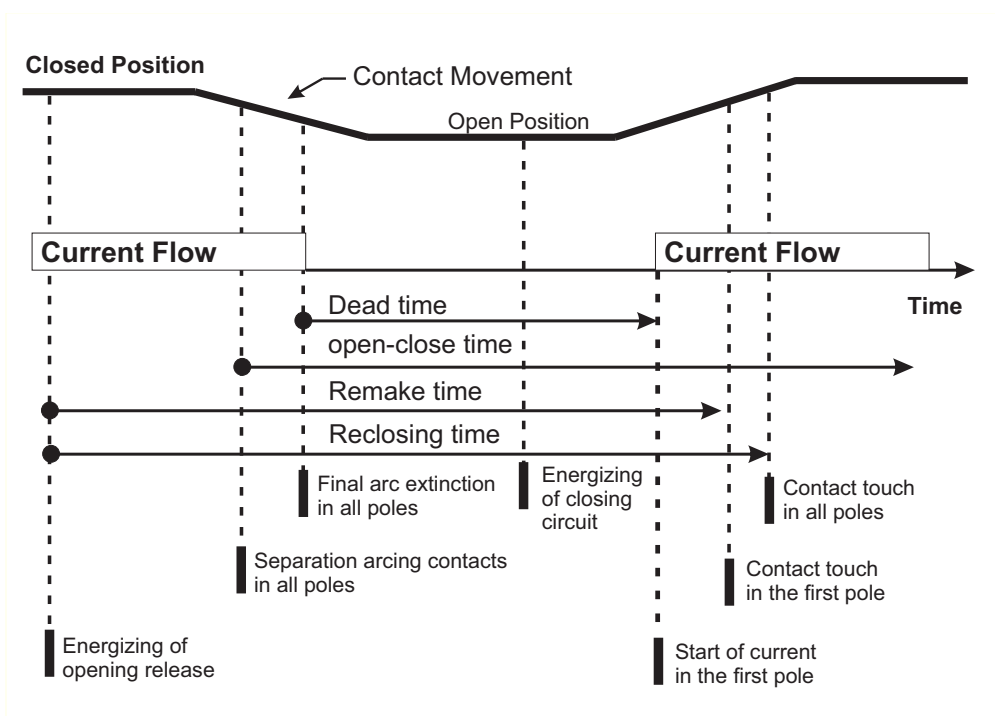
It is realised that 80-90% of all the faults held on overhead lines are transient in nature. These transient faults create long lag in restoration times if done manually. Auto Recloser's primary objective is to reduce outage time in distribution lines by providing rapid restore to power lines. It is done by automatically closing the line after a pre-determined delay.

Usually, the temporarily faults would clear themselves in first or second dead time. In case, the fault is of permanent nature the Recloser will enter into lockout state after giving the final closure attempt. After the breaker is in lockout condition, it remains in Open position until it's manually closed by an operator.

Auto Recloser duty cycle defined as O-DT1-CO-DT2-CO-DT3-CO-DT4-CO states the event of operation which occur sequentially before the device enter into lockout mode at the end of cycle where,

O - Open/Trip operation  
 C - Close operation  
 DT1...4 - Dead time 1...4

A diagram depicting the event of line restoration and associated processes of power line using Auto Reclosing principle is shown below.



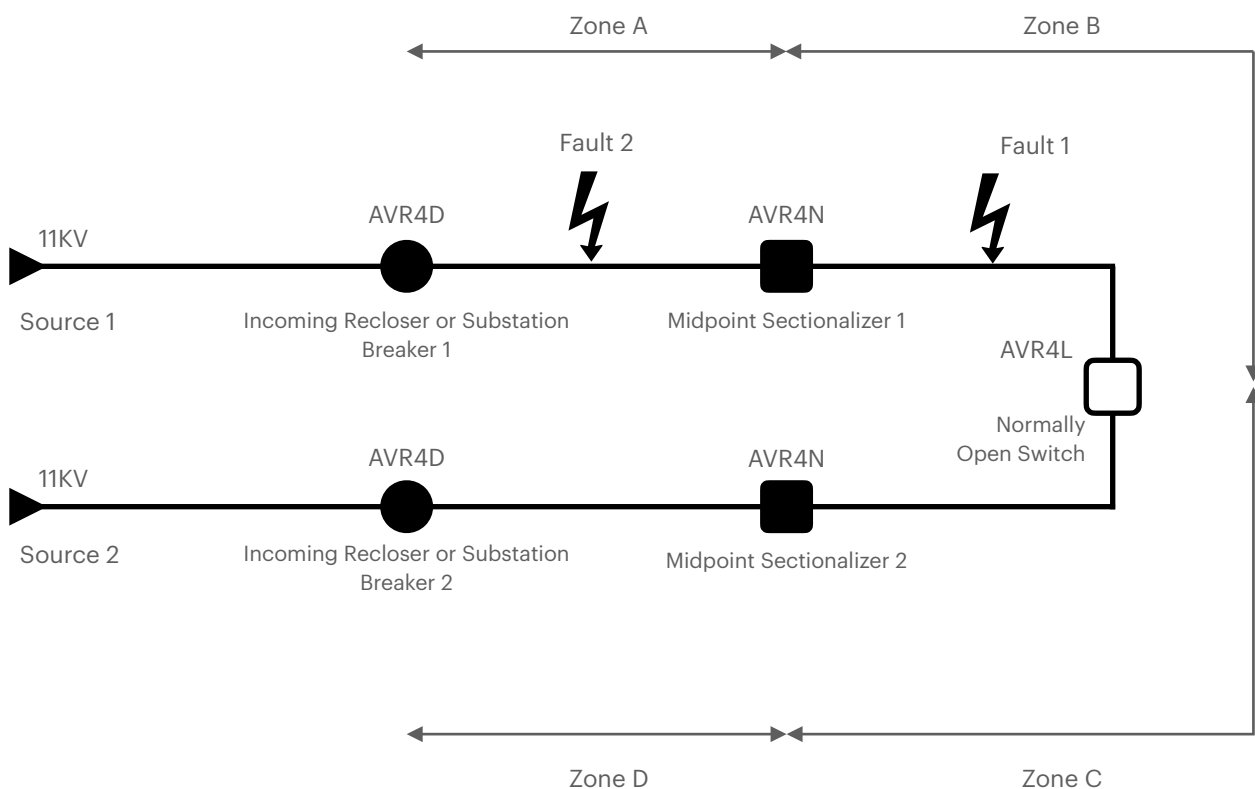
Recloser also play a crucial role in self-healing grids which is an essential part of modern Smart Grids while other characteristics such as cyber-security, real time monitoring and control, interoperability, development of demand response can be realised with Nikum make AVR Recloser.

## Principle of operation - Sectionalizer

Sectionalizer is load break switch which is installed at feeder protected by a recloser/breaker downstream to the latter. It works on count principle rather than protection coordination.

In event of a fault, the counter logic is activated. It keeps counting the number of reclosing attempts of the upstream device while registering Counts in its memory. After a given number of counts, selected as a part of the Sectionalizer setting, the Sectionalizer opens to isolate the faulted section of the line when the backup device is also in the open condition. The objective of the Sectionalizer is to isolate faulty section.

Nikum's AVR Sectionalizer are programmed to sense the current & voltage, decide as a fault feed; the upstream protective device operation (opening) is detected by the zero current flow through it and then operates (opens). After the Sectionalizer opens, the backup device automatically recloses to restore to service that portion of the line up to the Sectionalizer location.

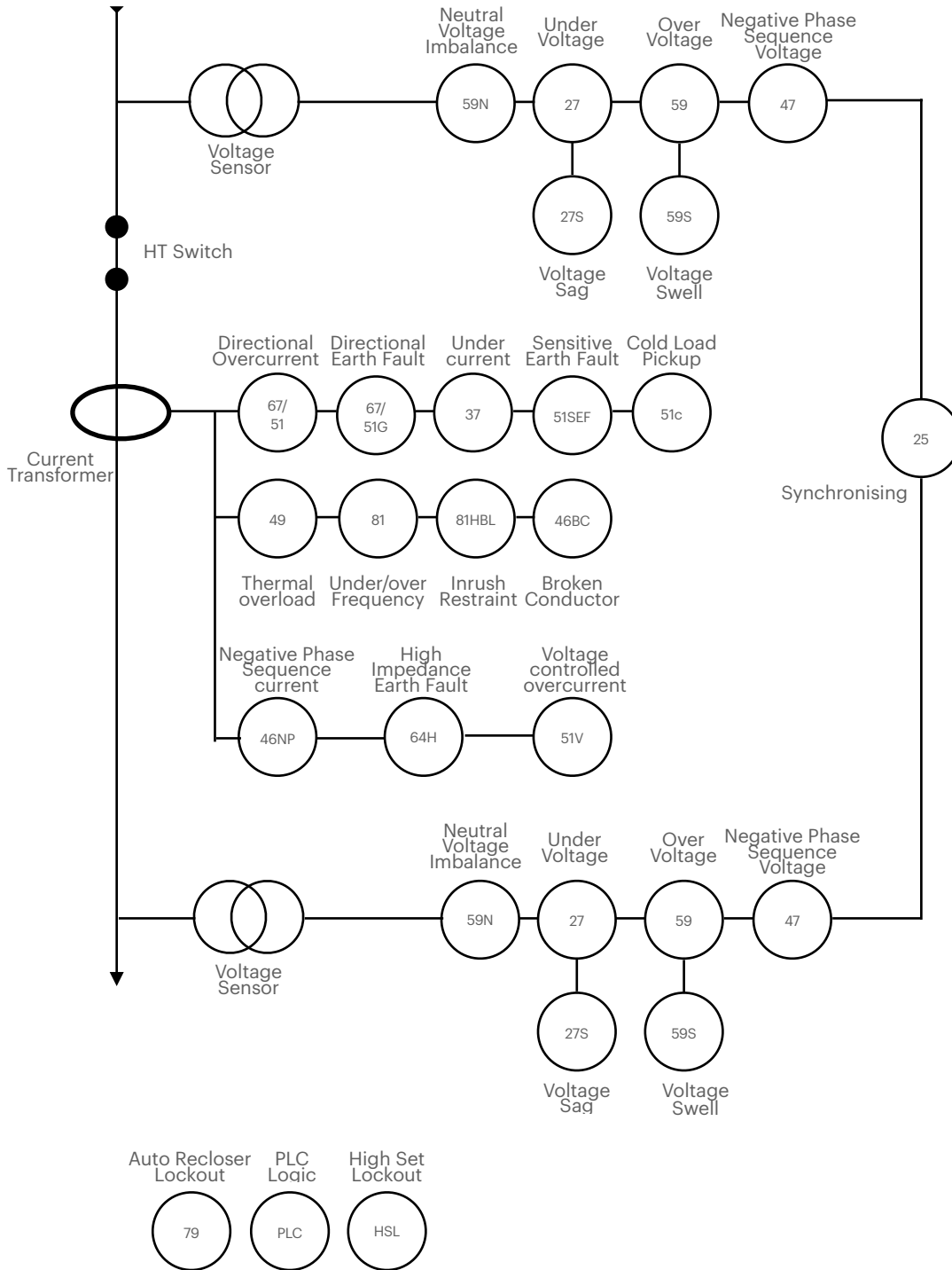


One of the practical application of Sectionalizer is shown in the above diagram. Two Feeders 1 and 2 are connected through a Sectionalizer which is in normally open condition with voltage sensing provided on both incoming and outgoing sides. Reclosers are provided for the fault interruption while a Sectionalizer is provided at midpoint location for fault isolation. For better understanding, two case scenarios are discussed below:

- 1) For any permanent Fault 1 in Zone B, Sectionalizer 1 shall open after preset number of retries from Recloser 1. Finally, Zone B gets isolated automatically while supply in Zone A, C and D shall remain active.
- 2) For any permanent Fault 2 in Zone A, only Recloser 1 shall open and lockout after completing the duty cycle. It is here when Sectionalizer 3 will sense the voltage outage on one of its sides and it will close automatically to restore supply in Zone B. Finally, Zone A will get isolated automatically while supply in Zone B, C and D shall remain active.



# ANSI Protection Diagram



## Protection Function

AVR offers a wide range of protection functions. All protection functions are multi-staged and the AVR can hold up to 8 different protection groups.

In addition to this, the protection functions can be individually programmed to operate the switch or only raise an alarm or trigger any other activity. A typical example to illustrate the above function can be a 50Hz power generating station. The operator can program the first stage to raise an alarm at the Control Room SCADA when frequency > 51Hz. On the second stage, tripping can be programmed when frequency > 52Hz.

### Over Current and Earth Fault (67, 50, 51, 67N, 50N, 51N)

Over current and Earth fault is applied to almost every part of protection system. It protects the system against over loading and short circuiting.

Following or standard DTL can be added to Inverse Time or Instantaneous protection

- 4 stage operation
- IEC Curves - Normal Inverse, Very Inverse, Extremely Inverse
- IEEE Curves - Moderately Inverse, Very Inverse, Extremely Inverse
- User Programmable non-standard curves

### Sensitive Earth Fault (67SEF, 51SEF, 50SEF)

SEF is generally used in alternator and generators with high resistance grounding. High resistance limit the current to very low magnitude which may go undetected by standard Earth Fault protection. Undetected faults in such system can short circuit condition in other phase. Therefore, it is necessary to get a tripping signal or alarm in such cases

### Fault Locator (21)

This function calculate the distance of the fault on impedance logic. It is very handy to know the fault location during restoration of long distribution lines.

The advantage of distance protection is non-dependency over source impedance variations. In distribution lines, this protection is generally applied on distributed generating stations which comprises of long feeder lines.

### Under/Over Voltage (27/59)

Over-voltage or voltage surge are one of the most common causes of protection failures. When selected, and a nominal phase-to-ground system operating voltage is set, the under/over-voltage protection works within a defined threshold above and below the specified voltage.

### Negative Phase Sequence Overcurrent and Over voltage (46NPS/47)

Negative-, positive-, and zero-phase sequence currents and voltages can be monitored and logged. In addition, the negative-phase sequence current protection can be used for detection of low-level phase-to-phase faults in the presence of high-level, three-phase loads. Inverse time, definite time, and instantaneous operation is available



### **Broken conductor/ Phase unbalance (46BC)**

ACR detects the unbalance condition in the 3 phase currents. Usually, the unbalance is caused due to breakage of line conductor in poor grounding or floating condition

### **Under-Current (37)**

Each element has settings for pickup level and Definite Time Lag (DTL) delays. Operates if current falls below setting for duration of delay.

### **Thermal Overload (49)**

The thermal algorithm calculates the thermal states from the measured currents and can be applied to lines, cables and transformers. Outputs are available for thermal overload and thermal capacity

### **Neutral Overvoltage (59N)**

Each element has settings for pickup level and Definite Time Lag (DTL) delays. It operates if neutral voltage exceeds setting for duration of delay. Neutral over-voltage can be used to detect earth faults in high impedance earthed or isolated systems

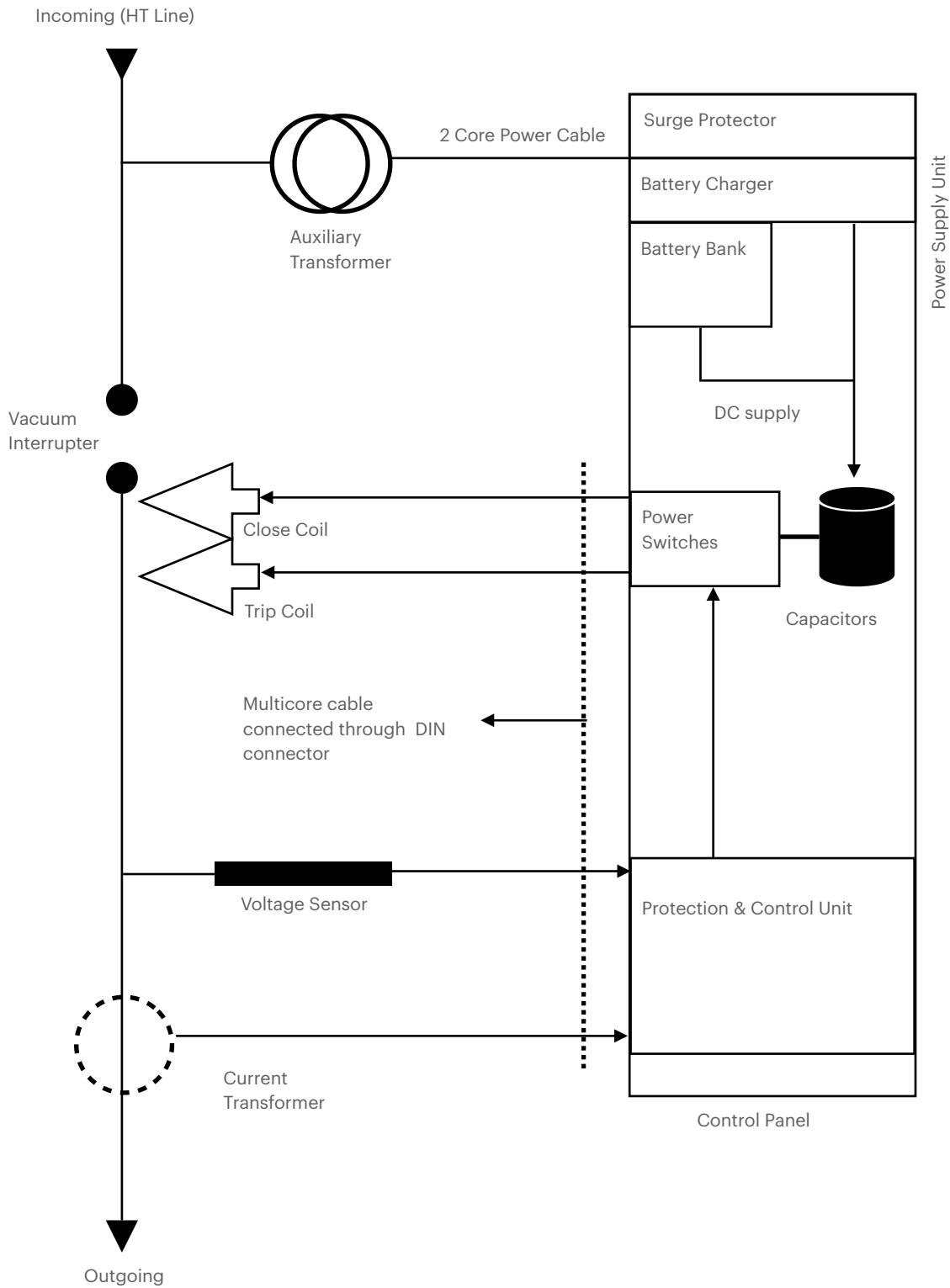
### **Under/Over Frequency (81)**

Causes ACR to trip when the system frequency exceeds the under and over-frequency trip threshold values

### **Auto Reclose (79)**

Each element provides independent phase-fault and earth fault/sensitive earth-fault sequences of up to 5 trips, i.e. 4 reclose attempts before lockout. Auto-reclose sequence can be user set to be initiated from internal protection operation or via binary input from an external protection. Each trip in the sequence can be user set to be either instantaneous (fast) or delayed. The user can set each reclose (dead) time and the reclaim time.

# Functional Diagram of standard AVR



## Technology in action

### Vacuum Interruption

Nikum offers time proven vacuum technology for the arc interruption. Each pole is fitted with one vacuum interrupter using a proprietor interrupter casting technique. This technique highly improves the dielectric strength of the product.

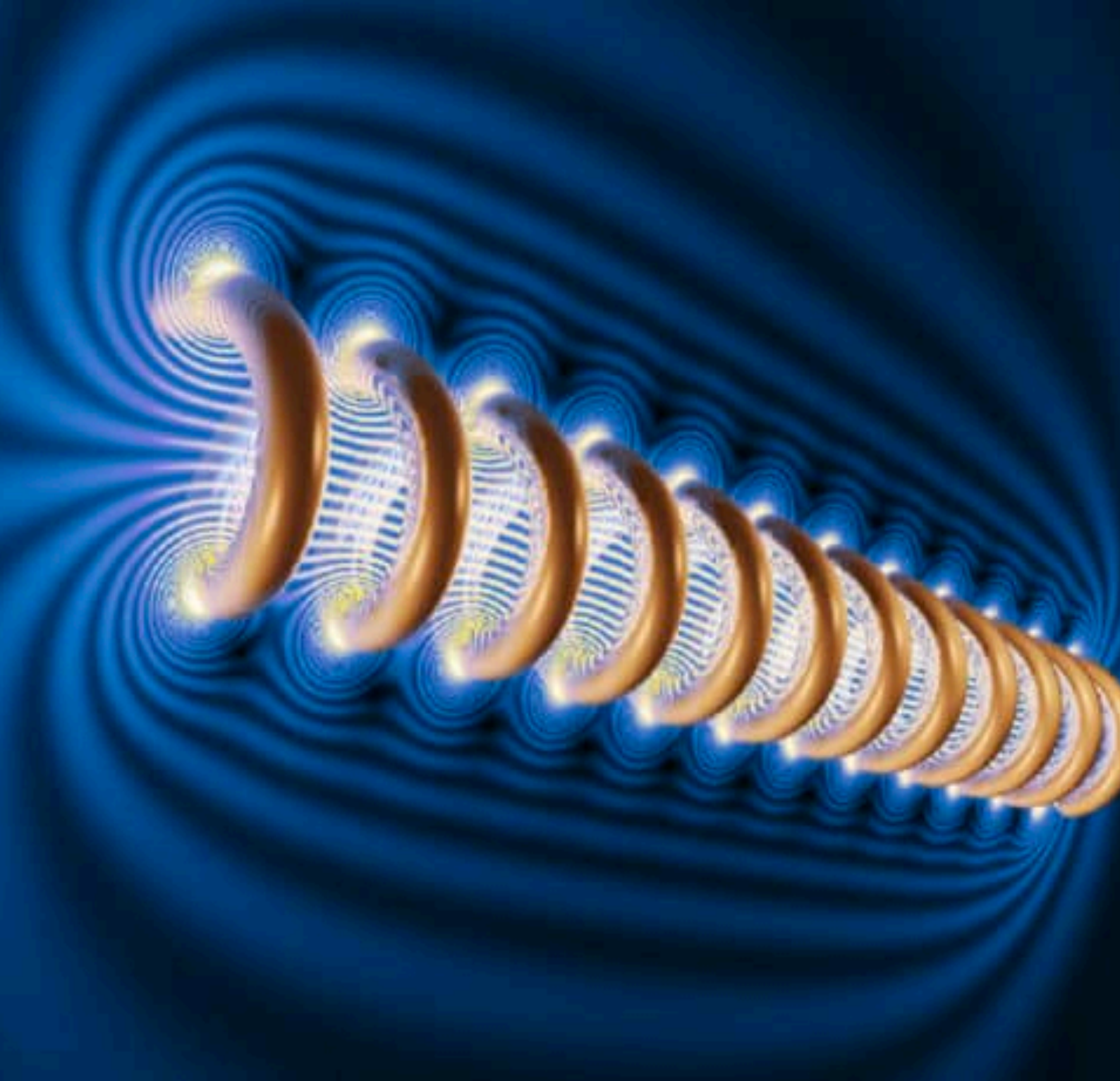
Vacuum technology is very effective against switching capacitive components of current thus making AVR an ideal device for over head line and cable protection.

### Hydrophobic Insulation

AVR's Embedded poles are constructed with superior hydrophobic materials - HCEP (Hydrophobic Cycloalliphatic Epoxy).

Current and Voltage sensors are embedded in each pole separately. This material is proven to be highly effective under humid conditions.





## Magnetic Actuator

Use of magnetic actuation technology reduces the number of moving parts in the mechanism. As a result, we get a maintenance free mechanism which can perform at least 30,000 operations. The design of the Recloser is bi-stable in nature i.e., it does not need any external power to maintain the contact position. All 3 phases are coupled to a single shaft which eliminates any chances of pole discrepancy. Unlike conventional breakers, we have opted for magnetic actuators instead of motor-spring mechanism. The actuators are so reliable that they can perform up to 1,00,000 operations. Actuators are powered by Control unit of the AVR.



## Power quality and measurement

- Fault data mode – displays date and time, type of fault and currents and voltages for each of the last 10 faults
- Currents – primary, secondary, xIn, earth / SEF, sequence components and 2nd harmonic
- Voltages – primary, secondary, xVn, Ph-Ph and Ph-n, sequence components, calculated earth voltage, neutral voltage displacement (Vx) voltage
- Frequency
- Power – MW, MVAR, MVA, power factor
- Energy – export and import – MWh, MVARh
- Direction – load flow indication
- Thermal capacity
- Autoreclose - status and shot number
- Sectionalizer - counter status
- CB maintenance: – 4 independent trip counters – Frequent operations counter  
– Lockout handle operations counter – I2t summation for contact wear
- Battery condition monitoring and automatic cyclical test
- Power quality – 27 sag and 59 swell (per pole counters for SIARFix, SMARFix, STARFix and interruption events)
- Miscellaneous meters, date, time, waveform, fault, event and data log record counters
- Demand monitoring

## Communication

- IEC 60870-5-103
- MODBUS
- DNP 3.0
- IEC 60870-5-101 /104
- IEC 61850



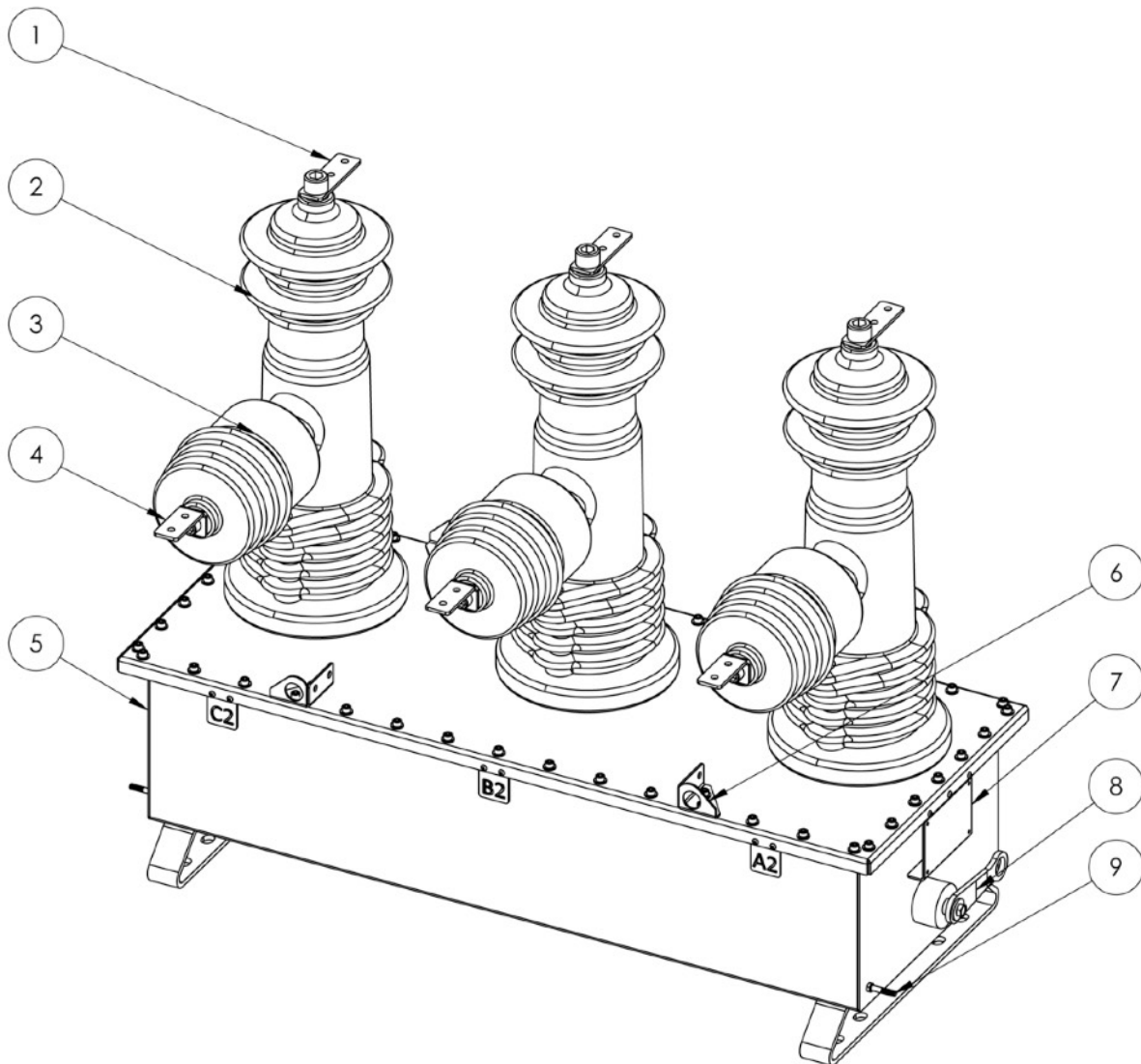








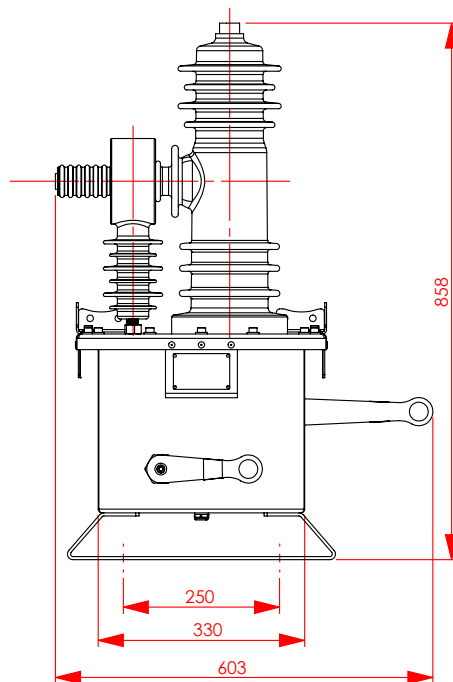
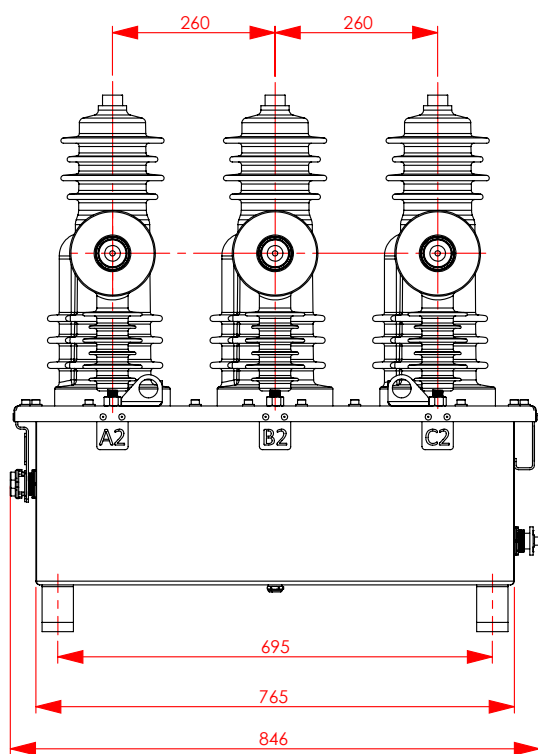
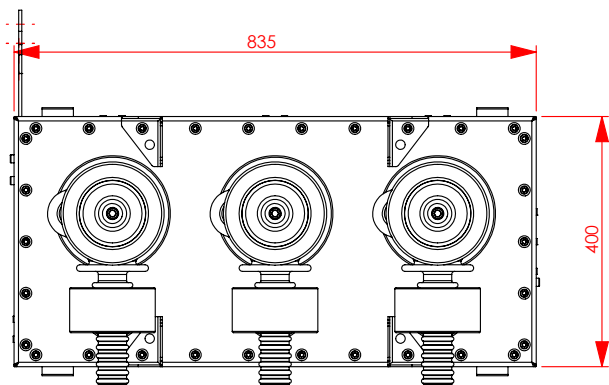
# Product Arrangement



S. No.	Description	Qty.
1	Incoming Terminal Clamp	3
2	Embedded Pole Assy.	3
3	Current Transformer Housing	3
4	Outgoing Terminal Clamp	3
5	Base Tank	1
6	Lifting Hook	4
7	Name Plate	1
8	Trip Lever	1
9	Earthing Terminal	2

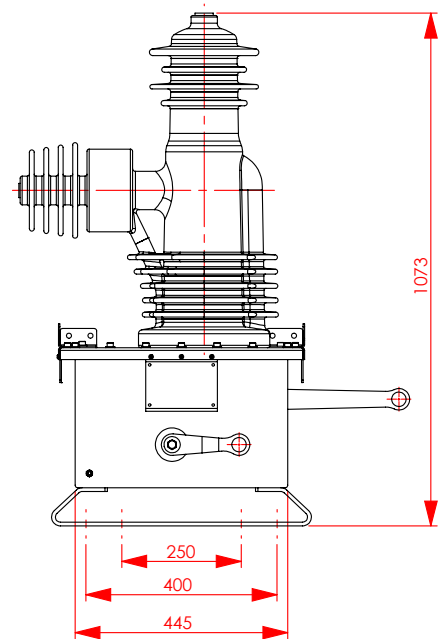
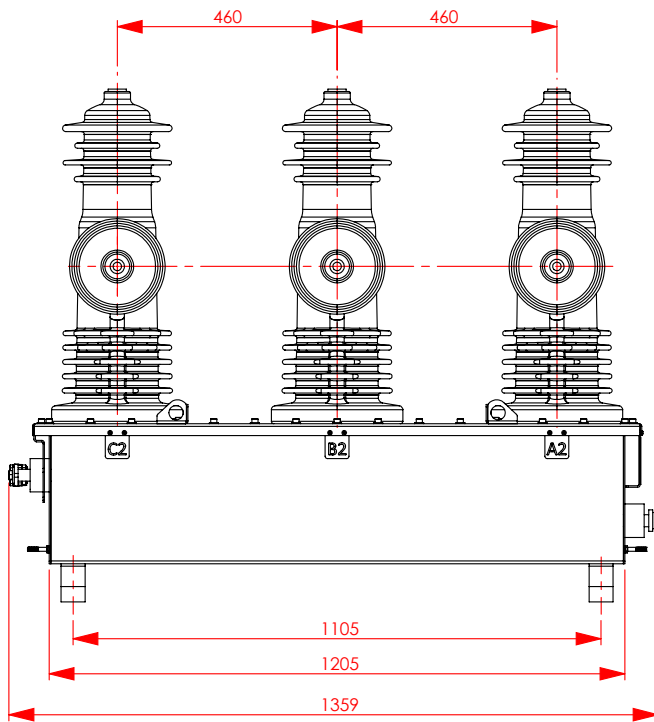
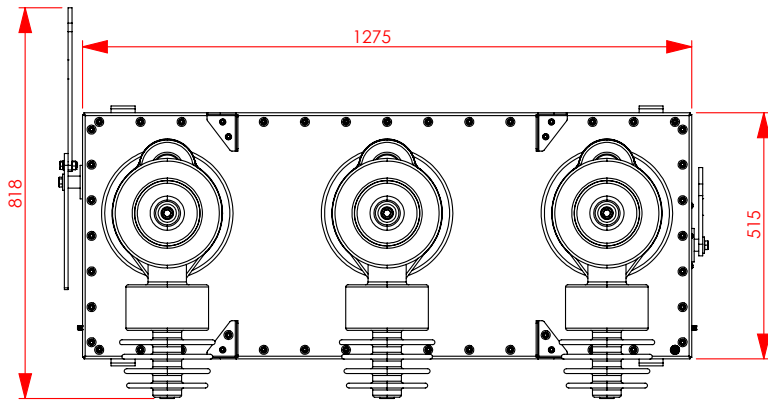


# Dimension - AVR12



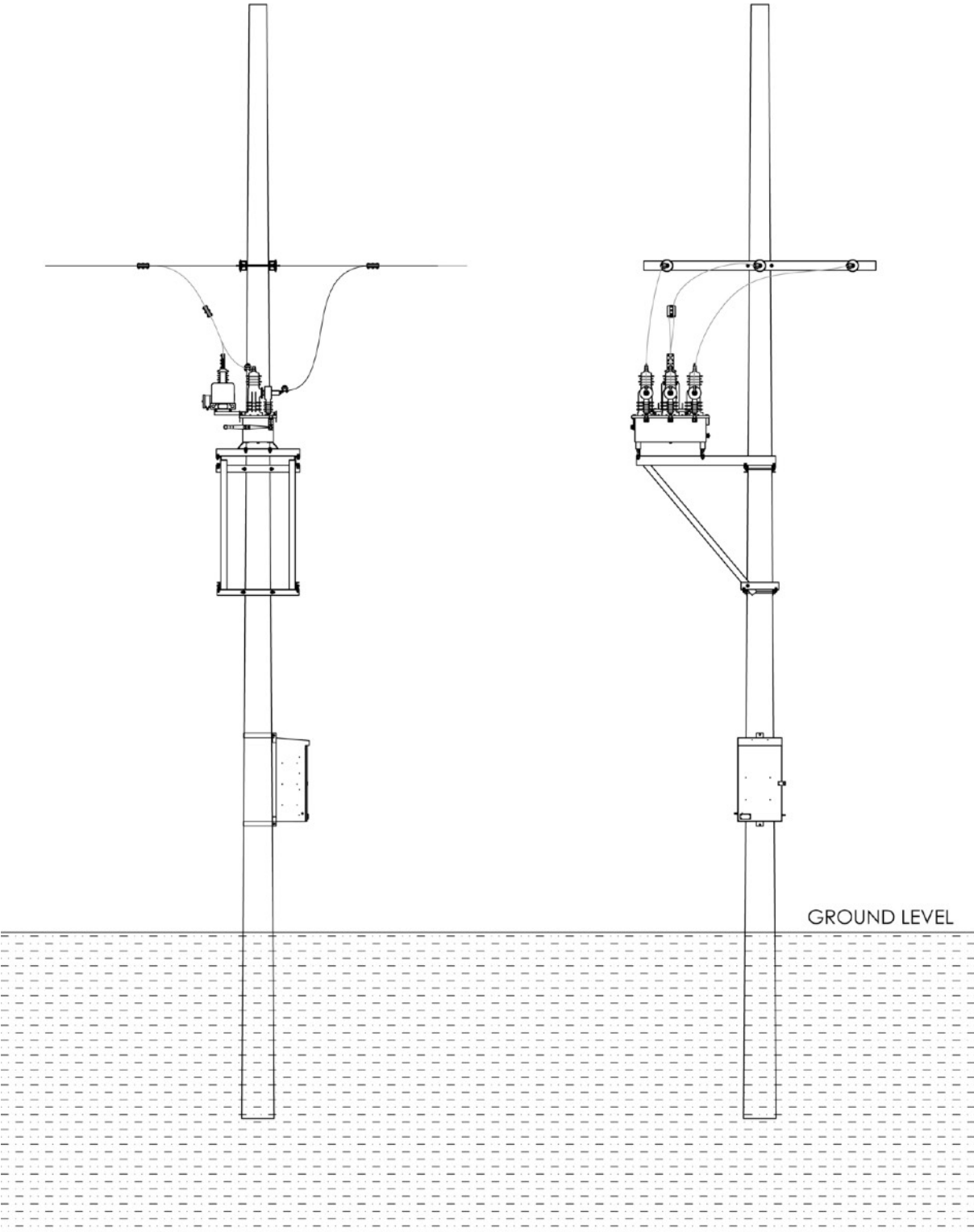
All dimensions are in mm

# Dimension - AVR36



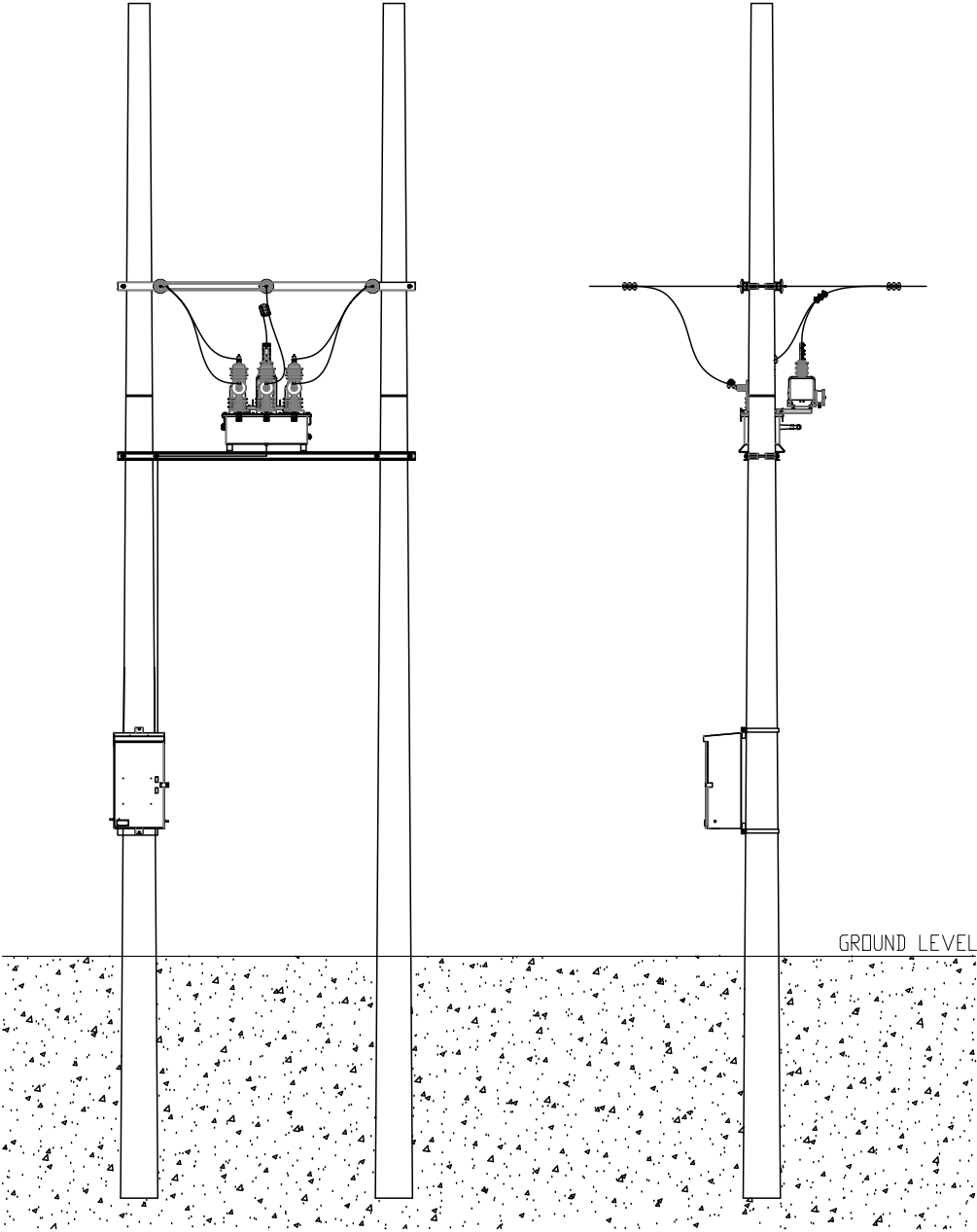
All dimensions are in mm

# Installation - Single Pole





# Installation - Double Pole











1. Installation at double pole structure on overhead network
2. Installation on single pole structure with series disconnect switch
3. AVR as Sectionalizer switch
4. Standalone installation on single pole with incoming auxiliary transformer
5. AVR as substation circuit breaker
6. AVR as 36KV Sectionalizer switch
7. ACR as 36KV substation circuit breaker



## Technical specification

Specification	AVR12	AVR27	AVR36
Rated Maximum Voltage	12KV	27kV	36kV
Power frequency withstand (Dry & Wet) for 60s	32kV rms	60kv rms	70kv rms <sup>1</sup>
Lightning Impulse withstand	85kVp	150kVp	170kVp <sup>1</sup>
Rated continuous current	800A	800A	800A
Short Circuit withstand (3s)	12.5kA	16.0kA	16.0kA
Fault breaking capacity	12.5kA	16.0kA	16.0kA
Fault making capacity	31.25 kA	40.0 kA	40.0 kA
Mechanical Endurance	10,000 <sup>1</sup>	10,000 <sup>1</sup>	10,000 <sup>1</sup>
Rated full load operations	10,000	10,000	10,000
Creepage Distance	>31.5mm/kV	>31.5mm/kV	>31.5mm/kV
Interrupting Medium	Vacuum	Vacuum	Vacuum
Insulation Medium	Solid Dielectric	Solid Dielectric	Solid Dielectric
Rated frequency	50 Hz	50 Hz	50 Hz
Ambient temperature	-10°C to +55°C <sup>1</sup>	-10°C to +55°C <sup>1</sup>	-10°C to +55°C <sup>1</sup>
Humidity	0 to 100%	0 to 100%	0 to 100%
Altitude	2200 meter	2200 meter	2200 meter
Weight (Circuit Breaker)	120 KG	230 KG	230 KG
Line charging current	2	5	5
Cable Charging current	10	40	40

1. Higher rating available on request
2. For altitude correction above 1000 meter, IEC 62271-111 shall be applied

## Ordering information

Description	Rating	Digit No						
		1	2	3	4	5	6	7
Solid Dielectric Insulated		A	V	R				
Rated Voltage	12kV				12			
	36kV				36			
Protection Type	Non-Directional Protection					N		
	Directional protection					D		
	Loop Automation					L		
Communication	IEC 103, MODBUS, DNP 3.0						S	
	Above + IEC 101/104						R	
	Above + IEC 61850						T	
Mounting Bracket	None							0
	Standard							1
	Custom							2

## Accessories

- Auxiliary Supply Transformer**  
 A pole mounted transformer can be provided where ACR has to be installed on isolated locations
- 4G Modem**  
 This modem can be applied in the areas with poor internet connectivity. Through this, the user can control the ACR remotely
- Line Disconnecter**  
 Visual isolation is provided is provided on the out- going side of the ACR for maximum safety
- Surge Arrestors**  
 Surge Arrestors can be installed on Incoming or Outgoing side of the ACR
- Incoming voltage sensors**  
 ACR can sense voltage on incoming as well as out- going side. It is generally used at tie point conditions where two different voltage sources are available
- FRTU**  
 Used as a programmable controller for tele control and automation applications

# NIKUM ENERGY

Optimising Power

## Contact Us

Address Plot No 29, D-Block, Phase A-2, UPSIDC Industrial Area,  
Trans Delhi Signature City, Delhi-NCR - 201103, India

Website [www.nikum.co.in](http://www.nikum.co.in)

For Sales  
[sales@nikum.co.in](mailto:sales@nikum.co.in) +91 851-000-6281

For After Sales  
[support@nikum.co.in](mailto:support@nikum.co.in) +91 851-002-4873

For Career  
[hr@nikum.co.in](mailto:hr@nikum.co.in) +91 851-000-6284

Disclaimer: All pictures shown are for illustration purpose only. Product may vary due to product enhancement.

Year of Publish 2020  
Document No. CD-1302.1