AUTO RECLOSER | SECTIONALIZER
Switchgear for Smart Grids

REV 3.0
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NIKUM aims to provide customers with the latest technology combined with outstanding performance, affordable pricing, and excellent service aimed at unparalleled customer satisfaction. Our products are all high quality and the natural option for you. This is why they are all extensively type tested in independent laboratories as per IEC/ANSI standards. This is especially true when it comes to our feeder automation services and products, where years of information and modular manufacturing techniques enable our outdoor vacuum reclosers to fulfil any need and schedule. Since 1991, NIKUM has been manufacturing MV switchgear. With over two decades of experience in this field NIKUM, our team has extensive knowledge and skills in this field.

All the technology available today has been indigenously developed by NIKUM in our in-house R&D facility.
Advance Metering Infrastructure

A Smart Grid will utilize advanced digital meters at all customer service locations. These meters will have two-way communication, be able to remotely connect and disconnect services, record waveforms, monitor voltage and current, and support time-of-use and real-time rate structures.

Distribution Automation

Distribution automation (DA) refers to monitoring, control, and communication functions located out on the feeder. From a design perspective, the most important aspects of distribution automation are in the areas of protection and switching (often integrated into the same device such as Recloser and Sectionalizer).

Distributed Energy Resources

Distributed energy resources (DER) are small sources of generation and/or storage that are connected to the distribution system. For low levels of penetration (about 15% of peak demand or less), DER do not have a large effect on system design as long as they have proper protection at the point of interconnection.
Auto Reclosing and Sectionalizing

It is realized 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 restorage 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 remain in Open position until it is 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

One of the important characteristic of smart grid from conventional grid is the self healing capacity. Auto recloser play a crucial role in this characteristic.

While other characteristics such as cyber-security, real time monitoring and control, interoperability, development of demand response can be realized with Nikum make smart Reclosers.
Sectionalizer are medium/low voltage protective devices which do not require fault interrupting capabilities. It is installed downstream of a MV overhead feeder protected by a recloser/breaker. Sectionalizer count the operations of the backup device during fault conditions. Counts are registered by the Sectionalizer only when fault current flow through the Sectionalizer had been detected prior to the operation of the backup device. After a given number of counts, as selected as a part of the Sectionalizer setting, the Sectionalizer opens to isolate the faulted section of the line when the backup device is in the open position and the section of line where the Sectionalizer is located is in a deenergized state. The objective of the Sectionalizer to remain closed on temporary faults; the backup device will trip and reclose to restore the line to service for such faults prior to the Sectionalizer opening.

For permanent faults, the Sectionalizer recognizes that one or more trips have occurred after the backup device reclosed, and it subsequently opens to isolate the faulted portion of the line. NIKUM’S 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. Application of sectionalizes requires that the backup interrupting device be capable of detecting faults in the Sectionalizer zone of protection.

One of the practical application of Sectionalizer is shown in the above diagram. Two Feeders 1 and 2 and 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 scenario are discussed below:

1) For any permanent Fault 1in Zone B, Sectionalizer 1 shall open after preset number of retries from Recloser 1. Finally, Zone B get 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 side 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.
Design and Technology

The interface of the device has been tried to keep simple and convenient for the end user. The technology is developed indigenously by NIKUM’s team. All the spare parts are procured to limit the manufacturing delays. Auto Recloser can withstand 30,000 close-open operations without maintenance.

The design of the product is all weather proof and can withstand extreme temperatures. The creepage of the breaker has been maintained high to suit highly humid conditions.

The device primarily consist of three parts: HT Circuit Breaker (common for Auto Recloser and Sectionalizer), Control Panel and Auxiliary Transformer (optional). A block diagram is shown below to realize the connection between these devices.

Pole Assembly

Nikum Embedded poles are constructed with superior hydrophobic materials - HCEP (Hydrophobic Cycloaliphatic Epoxy) or Silicone. Current and Voltage sensors are embedded in each pole separately.

This material is proven to be highly effective under humid conditions. As a standard package 3 nos. of current transformer and 3 nos. of ohmic type voltage sensors are provided.

* Additional voltage sensors on the incoming side can be added as an accessory for synchronizing and tie point applications.
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 of capacitive components of current thus making Recloser an idea device for over head line and cable protection.

The Control Cabinet houses the control and power supply system of the HT Circuit Breaker and is very easy to operate, enabling the operator to work comfortably and a position sensor is provided for the door position sensing. Control Cabinet is located on the human interface level and is connected with the unit through a multi-core control cable which comes as a part of the complete unit from factory. Also, the cabinet includes a space heater for moisture control.

An illumination LED is provide in the control cabinet for the easier maintenance functions. The control unit also houses a document holder.
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 Recloser.

The circuit breaker uses vacuum as interruption medium and solid dielectric HCEP as insulating medium. The mechanism is sealed by a stainless steel metal tank while the HT parts are encapsulated in epoxy poles.

Copper terminals are provided as standard for both incoming and outgoing terminal. On the right side a position indicator with detachable closing lever is provided. The indicator points over “0” and “I” to indicate circuit breaker position as “Open” and “Closed” respectively. Below the indicator Tripping lever is provided.

The circuit breaker can be opened and closed manually i.e., without using Control Panel by an operator from ground level.
Inner engineering of the circuit breaker is explained in the image above. HCEP poles are mounted over a metal frame to withstand the required closing forces applied to vacuum interrupters.

HT Circuit Breaker consist of 3 pole assembly which are connected by a common shaft. Each embedded pole consist of Vacuum Interrupter, Current Transformer and Voltage sensor.
Quality and Safety

NIKUM is committed to quality, environmental responsibility and safety in servicing its customers and has been certified as ISO 9001.

We highly discourage the use of SF6 gas switchgear.

All the products are certified as per relevant IEC/ANSI standards and are extensively type tested by independent NABL authorized ISO 17025 compliant laboratories. In addition to that, the ACR is extensively type tested during the manufacturing. More than 50% of the total production time is spent in the testing of the product.

Manual Lockout

In addition to standard Auto Reclose lockout NIKUM’s ACR is equipped with Manual Lockout Function. Once the ACR has been set into Manual Lockout state, it can no longer be operated locally or remotely.

For setting the ACR in this mode, the operator has to pull down the trip lever provided the ACR tank with a hot stick. This motion does a dual function - Trip the ACR and set the ACR into Manual Lockout mode. Now, until the Trip Lever is set back into its original state the unit remain in the Manual Lockout mode.

Electrical Isolation

This next generation feature has enabled NIKUM to provide the next generation safety in its ACR. It is very much true that the line should be considered safe only when there is visual break on the line. Until now no Circuit Breaker could be equipped with such an arrangement which can guarantee the line isolation. The line on the outgoing of the ACR can be isolated through the motor operated mechanism which will only come into action once the Circuit Breaker is in tripped condition. To avoid the mal-function the isolator and circuit breaker mechanism are inter-locked.

Hotline/Work Tag

Hotline is sometimes referred to maintenance tag as well. Usually, during the maintenance the operator sets the ACR unit into Hotline Mode via HMI. This mode generates a signal locally and remotely indicating that the particulate unit is in maintenance mode. Local and Remote operations are also disabled in this mode.
Protection Function

Nikum make ACR offers standard and highly advanced protection functions. All protection function are multi-staged and the ACR can hold up to 4 different protection groups.

User defined alarms
In addition to this, the protection function can be programmed either or TRIP the ACR or to raise and ALARM locally or remotely. The aim of this function is to provide a warning to the operator to take necessary precautions before the fault.

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.

- Follower 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.

- Causes ACR to Trip/Alarm during low magnitude earth faults
- Can detect as current magnitudes as low as 2A
- 4 stage operation
Fault Locator (21)
This function calculates the distance of the fault on proprietor 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)
Overvoltage 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/overvoltage protection works within a defend threshold above and below the specified voltage.

Restricted Earth Fault (64H)
The measured earth-fault input may be used in a 64H high impedance restricted earth-fault scheme. Required external series stabilizing resistor and non-linear shunt resistor can be supplied

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.
Restraint and Supervision

It is often observed that creating sensitive protection scheme can lead to nuisance tripping in field conditions. Therefore, it is very important to provide constraint to block any unwanted tripping of the unit.

At Nikum we pay a lot of attention to the user’s comfort in device operation. With such sensitive protections, it is very much possible that the ACR can get nuisance tripping. It causes loss of capital and man power. Therefore, every possible effort has been taken by us to ensure the best customer experience by providing some restraints to the protections.

Directional Blocking
Restricts tripping on faults to a designated side of the ACR. It prevents nuisance tripping if particular network conditions are causing “false” ground faults. In radial systems, directional blocking prevents nuisance tripping by blocking faults in the source direction and only responding to faults in the load direction.

Inrush Restraint
High currents during line energization is a common phenomenon for reactive loads. Sometimes, the inrush currents can create the false conditions of over loading causing the ACR to trip. Inrush restraint raises the phase and ground threshold currents for a short period of time to allow for short duration inrush currents when closing onto a load.

Cold Load Pickup
The diversity factor increases with the increase in outage duration. During re-energization the load can increase from the regular conditions. Cold load pick-up allows for a loss of diversity when a load has been without supply for a period of time.

High-set to Lockout
Repeated closure of line under high magnitude fault conditions can put severe stress on power lines and other line equipment which may lead to failure. To restrict the number of reclosing attempts under severe fault conditions—High set to Lockout function is provided.

It will resist the number of Reclosing attempts by the unit when the fault current is above a desired level. Number of high set to lockout can be separately programmed (Range—0 to 4) in Recloser from the standard duty cycle.
Measurement

- Primary current phases and earth
- Secondary current phases and earth
- Positive phase-sequence (PPS) current
- Negative phase-sequence (NPS) current
- Zero phase-sequence (ZPS) current
- Time and date
- Starters
- Fault records
- Event records
- Frequency
- Waveform records
- Primary line and phase voltages
- Apparent power and power factor
- Real and reactive power
- W Hr forward and reverse
- VAr Hr forward and reverse
- Historical demand record
- Positive phase-sequence (PPS) voltage
- Negative phase-sequence (NPS) voltage
- Zero phase-sequence (ZPS) voltage
- Circuit-breaker trip counters
- $I^2t$ summation for contact wear
Communication

The operator can access and program data on the device using the programming software through the front USB type B port.

The user interface of the software is shown below. Various data file such as Fault Data, Waveform Records, Settings are available in COMTRADE format and can be shared through email.

Protocol support over Rear port (RS485/RJ45): IEC 61850, IEC 60870-5-101/103/104, DNP 3.0, MODBUS

RTU for remote control
An RTU can be embedded into Control unit from factory.
The mode of communication shall be GPRS/3G/4G internet.

Telemetry Interface
Realizing the coverage of GPRS/3G connectivity, Nikum has developed an additional propriety protocol which utilizes SS7 architecture. This control interface clearly has an edge over the internet based protocols in terms of connectivity range.
We believe in creating a hassle free yet robust system for the end user. Therefore, we provide an optional facility for user to opt for a cloud based plan instead of conventional physical servers.

It is often realized that setting up physical servers is an expensive task which is also prone to failures in absence of highly qualified operators. Cloud services on the other hand bypassed all the maintenance activities carried out by user thus providing a very neat interface.

RTU provide two way communication between IED (Meter or Auto Recloser) and cloud server through secure VPN tunneling.

Cloud server provide web based HMI which is accessible remotely.

Remoted devices consist of a cloud server with dedicated web portal. The client can view the HMI from anywhere by accessing a dedicated web address provided by us.

Field devices consist of Auto Recloser with inbuilt RTU. The RTU communicates to cloud server via GPRS/3G/4G network.
In case of substation where multiple IEDs or Auto Reclosers are installed in same premises, a single RTU can be placed to provide cost effective solution to the client. For data authenticity, the data can be directly transferred to the client’s remote server or the local server at substation.

SCADA for substation is also compatible to work with the other devices such as Sectionalizer, Energy Meters, PLCs. SCADA supports IEC 60870, IEC 61850, DNP 3.0 and MODBUS protocols. So, almost any device can be interfaced to it.
**Accessories**

- **Auxiliary Supply Transformer**
  A pole mounted transformer can be provided where ACR has to be installed on isolated locations

- **SS7 Modem**
  This modem can be applied in the areas with poor internet connectivity. Through this, the user can control the ACR remotely

- **RTU**
  A GPRS/3G/4G enabled modem can be incorporated inside the control panel for wireless transmission of data

- **Space Heater**
  A heater with thermostat can be installed in the control cabinet for protection against moisture

- **Electrical Isolator**
  Visual isolation is provided on the outgoing 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 outgoing side. It is generally used at tie point conditions where two different voltage sources are available

- **Illumination with Cabinet sensor**
  An illuminating LED can be installed in the Control Cabinet along with a position sensor. The sensor holds dual functionality of - switching the LED and sending the door position to the operator locally & remotely
## Technical Specification

<table>
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<tr>
<th>Parameter</th>
<th>11KV Recloser</th>
<th>33KV Recloser</th>
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<tbody>
<tr>
<td>Rated Voltage</td>
<td>11KV</td>
<td>33KV</td>
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<tr>
<td>Maximum Operating voltage</td>
<td>12KV</td>
<td>36KV</td>
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<td>Power Frequency (Dry &amp; Wet) for 60s</td>
<td>32KV</td>
<td>70KV</td>
</tr>
<tr>
<td>BIL</td>
<td>75KVp</td>
<td>170KVp</td>
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<tr>
<td>Continuous current rating</td>
<td>800A</td>
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</tr>
<tr>
<td>Short Circuit Breaking current</td>
<td>12.5 kA</td>
<td>16 kA</td>
</tr>
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<td>Short Circuit withstand current</td>
<td>12.5 kA</td>
<td>16 kA</td>
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<tr>
<td>Short circuit making current</td>
<td>31 kA</td>
<td>40 kA</td>
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<td>Rated frequency</td>
<td>50/60 Hz</td>
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<td>Ambient temperature range</td>
<td>-10 to 60 °C</td>
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<td>Humidity</td>
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<td>Weight (Circuit breaker)</td>
<td>120 KG</td>
<td>230 KG</td>
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<td>Weight (Control Unit)</td>
<td>60KG</td>
<td>60KG</td>
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<td>Insulation medium</td>
<td>Solid dielectric</td>
<td>Solid dielectric</td>
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<td>Interruption medium</td>
<td>Vacuum</td>
<td>Vacuum</td>
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<tr>
<td>Cable Charging current</td>
<td>10A</td>
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</tr>
<tr>
<td>Line charging current</td>
<td>2A</td>
<td>5A</td>
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Dimension (Circuit Breaker)

Front & Right Side View

33KV: 450mm | 11KV: 280mm
33KV: 800mm | 11KV: 600mm
33KV: 1400mm | 11KV: 900mm
33KV: 550mm | 11KV: 450mm
33KV: 400mm | 11KV: 300mm
33KV: 75mm | 11KV: 75mm

Rear & Left Side View

33KV: 1100mm | 11KV: 800mm
33KV: 550mm | 11KV: 450mm
33KV: 400mm | 11KV: 300mm
33KV: 75mm | 11KV: 75mm
Dimension (Control Panel)

Double Pole Installation

Single Pole Installation

400mm

950mm

800mm

22mm Hole on Top and Bottom Side
### Digit Parameter Information

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<th>Digit</th>
<th>Parameter</th>
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<tr>
<td>1</td>
<td>Model</td>
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<td>2</td>
<td>Rated Voltage</td>
<td>A: 11KV</td>
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<td>3</td>
<td>Protection Type</td>
<td>U: Standard for Auto Recloser</td>
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<tr>
<td></td>
<td></td>
<td>V: Additional for Auto Recloser</td>
</tr>
<tr>
<td></td>
<td></td>
<td>I: Standard for Sectionalizer</td>
</tr>
<tr>
<td></td>
<td></td>
<td>J: Additional for Sectionalizer</td>
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<td>4</td>
<td>Communication Protocol</td>
<td>1: MODBUS</td>
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<tr>
<td></td>
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<td>2: IEC 103 or DNP 3.0</td>
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<td></td>
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<td>3: IEC 104</td>
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<td>4: IEC 61850</td>
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<td>Communication Interface</td>
<td>M: Serial</td>
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<td>6</td>
<td>Bushing Terminal</td>
<td>S: Standard Copper Terminal</td>
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<tr>
<td></td>
<td></td>
<td>H: NEMA Terminal</td>
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<tr>
<td></td>
<td></td>
<td>C: Clamp</td>
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<tr>
<td>7</td>
<td>Accessory</td>
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### Accessory Part Number

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<tr>
<td>Auxiliary Supply Transformer</td>
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<td>PT-E-15/438 for 33KV</td>
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<td>RTU</td>
<td>PT-H-6/830</td>
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<td>SS7 Modem</td>
<td>PT-H-6/829</td>
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<td>Space Heater</td>
<td>PT-H-9/841</td>
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<tr>
<td>Surge Arrestor</td>
<td>PT-E-10/427 for 11KV</td>
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<td>PT-E-10/428 for 11KV</td>
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<tr>
<td>Incoming voltage sensor</td>
<td>PT-E-12/439 for 11KV</td>
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<td>PT-E-12/440 for 33KV</td>
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<tr>
<td>Illumination with Cabinet sensor</td>
<td>PT-H-1/842</td>
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<tr>
<td>Electrical Isolator</td>
<td>PT-E-16/441 for 11KV</td>
</tr>
<tr>
<td></td>
<td>PT-E-16/442 for 33KV</td>
</tr>
</tbody>
</table>
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II. Revision 14.3 on 14-3-2014
III. Revision 3.0 on 13-3-2017

For further information visit at www.nikum.co.in