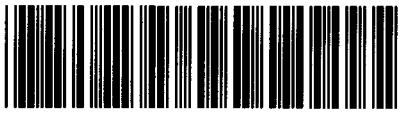

Control Number: 40499

Item Number: 32

Addendum StartPage: 0

PUC DOCKET NO. 40499

COMPLAINT OF ASCENDANT RENEWABLE ENERGY CORP. AGAINST SOUTHWESTERN PUBLIC SERVICE COMPANY	§ § § §	**PUBLIC UTILITY COMMISSION OF TEXAS**

SOUTHWESTERN PUBLIC SERVICE COMPANY'S SUPPLEMENTAL RESPONSE TO OCCIDENTAL PERMIAN LTD'S FIRST REQUEST FOR INFORMATION QUESTION NO. RFI 1-4

(*Filename*: Response to OPL's 1st RFI.doc: *Total Pages*: 8)

PUC DOCKET NO. 40499

COMPLAINT OF ASCENDANT RENEWABLE ENERGY CORP. AGAINST SOUTHWESTERN PUBLIC SERVICE COMPANY	§ § § §	**PUBLIC UTILITY COMMISSION OF TEXAS**

SOUTHWESTERN PUBLIC SERVICE COMPANY'S SUPPLEMENTAL RESPONSE TO OCCIDENTAL PERMIAN LTD'S FIRST REQUESTFOR INFORMATION QUESTION NO RFI 1-4

Southwestern Public Service Company ("SPS") files this supplemental response to Occidental Periam Ltd's ("OPL") First Request for Information.

I. WRITTEN RESPONSES

SPS's written responses to OPL's First Request for Information are attached and incorporated by reference. Each response is stated on or attached to a separate page on which the request has been restated. SPS's responses are made in the spirit of cooperation without waiving SPS's right to contest the admissibility of any of these matters at hearing. When SPS provides certain information sought by the request while objecting to the provision of other information, it does so without prejudice to its objection in the interests of narrowing discovery disputes pursuant to P.U.C. PROC. R. 22.144(d)(5). Pursuant to P.U.C. PROC. R. 22.144(c)(2)(F), SPS stipulates that its responses may be treated by all parties as if they were made under oath.

II. INSPECTIONS

If responsive documents are more than 100 pages but less than eight linear feet in length, the response will indicate that the attachment is VOLUMINOUS and, pursuant to P.U.C. PROC. R. 22.144(h)(2), the attachment will be provided on CD and made available for inspection at SPS's voluminous room at 816 Congress Avenue, Suite 1650, Austin, Texas 78701; telephone number (512) 478-9229. If a response or the responsive documents are provided pursuant to the protective order in this docket, the response will indicate that it or the attachment is either CONFIDENTIAL or HIGHLY SENSITIVE as appropriate under the protective order. Highly sensitive responses will be made available for inspection at SPS's voluminous room, unless they form a part of a response that

exceeds eight linear feet in length; then they will be available at their usual repository in accordance with the following paragraph. Please call in advance for an appointment to ensure that there is sufficient space to accommodate your inspection.

If responsive documents exceed eight linear feet in length, the response will indicate that the attachment is subject to the FREIGHT CAR DOCTRINE, and, pursuant to Commission Procedural Rule 22.144(h)(3), the attachment will be available for inspection at its usual repository, SPS's offices in Amarillo, Texas, unless otherwise indicated. SPS requests that parties wishing to inspect this material provide at least 48 hours' notice of their intent by contacting Jerry Shackelford, at 816 Congress Avenue, Suite 1650, Austin, Texas 78701; telephone number (512) 658-5781. Inspections will be scheduled to accommodate all requests with as little inconvenience to the requesting party and to SPS's operations as possible.

Respectfully submitted,

XCEL ENERGY SERVICES INC.

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Texas Bar. No. 24018306
816 Congress Ave., Suite 1650
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RESPONSE

QUESTION NO. OPL 1-4
Please provide the data supporting the upgrades discussed in the Design Guide/Engineering Estimates dated July 16, 2012.

RESPONSE:
This response assumes OPL is seeking data supporting the upgrades discussed in the July 13, 2012 Study.

Substation
SEL-351 Relays: Because the existing breakers have electromechanical relays which are not acceptable for precise coordination of voltage sensing capabilities, SPS requires the addition of three SEL-351 Protection System relays. The multi-functional SEL-351 offers the necessary comprehensive control, metering, and monitoring functions in a single relay. The voltage sensing protection function prevents the breaker from reclosing on an energized line. The SEL-351 Data Sheet is attached as *Exhibit OPL-1*.

Distribution
-NOVA 27 Electronic Recloser: This device facilitates line-fault tripping, mitigates out-of-range voltage and frequency, and allows remote control via SCADA at the generating facility. The NOVA 27 Recloser Data Sheet is attached as *Exhibit OPL-2*.
-The distribution lines are required to be reconductored to the substation with .336 ACSR conductor, which is necessary to handle the 10 MW generation and resultant voltage impact.
-It is necessary to install one (1) gang-operated air break switch to provide a positive lockable and visible disconnect for field personnel's safety.
-A 25 kVA transformer is necessary for the operation of AC power, SCADA control, and metering.

Regulators
-Due to the absence of voltage regulation on the system, the potential for overvoltage scenarios require voltage stability measures.

The described upgrades to the substation and distribution line are required to meet general engineering specifications and protect SPS's equipment. In order to determine the potential impacts of long term under- or over-voltage issues to OPL's equipment due to the instantaneous trip of a 10 MW generation source on the distribution system, a distribution stability study would be necessary.

Preparer: Julius Heslop

EXHIBIT OPL-1

COOPER Power Systems

Reclosers

Electrical Apparatus

Types NOVA15, NOVA27, and NOVA38 Three-Phase, Microprocessor-Controlled

280-42

DESCRIPTION

The Kyle Type NOVA three-phase, electronically controlled, vacuum-interrupting automatic circuit reclosers provide reliable, economical overcurrent protection, advanced metering, and automation systems for distribution circuits rated through 34.5 kV.

The NOVA recloser combines solid cycloaliphatic-epoxy polymer-encapsulated vacuum interrupters with a reliable, lightweight operating mechanism that utilizes a magnetic actuator to provide a lifetime of trouble-free operation. The solid polymer system does not rely on a gaseous, liquid, or foam dielectric. The Type NOVA recloser is highly resistant to ozone, oxygen, moisture, contamination, and ultraviolet light.

The Type NOVA recloser is available with two configuration options: control-powered interface and auxiliary-powered interface. Designed and tested to be compatible with Cooper Power Systems three-phase controls, these automatic circuit reclosers offer superior coordination, protection, and application capabilities.

Recloser operations are programmed in an electronic control with accurate characteristics and a host of advanced features. Precise operating tolerances enable close coordination with other protective devices on the system. When system requirements change, program settings are easily altered with no sacrifice of accuracy or consistency.

Compact and lightweight, NOVA reclosers are easily installed on poles or in substations. Mounting equipment is available for both pole and substation applications.

Recloser and control accessories enable further tailoring of the protective program to achieve maximum system operating flexibility.

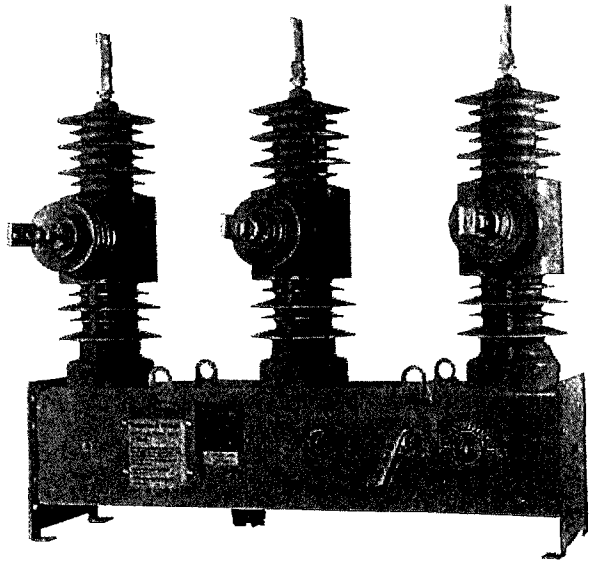


Figure 1.
Kyle Type NOVA vacuum-interrupting, three-phase, microprocessor-controlled automatic circuit recloser.

Cooper Power Systems is strongly committed to improving the reliability of the electric power industry. Technological advances, including the newest microprocessor-based controls and solid insulation NOVA distribution switchgear products, represent our investment in the future.

The Type NOVA recloser is not only a technological breakthrough, but a valuable component that brings significant operational savings to the utility business unit, lowering the installation, operation, training, and maintenance costs on your power distribution system.

When needed, application expertise, backed by world-wide systems engineering knowledge and experience, is available. Customer-focused design capability, based on more than 65 years of recloser experience, has made Cooper Power Systems the industry leader.

Type NOVA reclosers, like all Kyle reclosers, are designed and manufactured in accordance with ANSI C37.60.

ISO 9001:2000 Certified Quality Management System

RATINGS AND CHARACTERISTIC FEATURES

Three-phase protection on systems rated 2.4 through 14.4 kV is provided by Type NOVA15 reclosers. Type NOVA27 reclosers can be applied on systems rated through 27.6 kV. Higher-voltage system protection at 34.5 kV is provided by Type NOVA38 reclosers. A ratings summary for Type NOVA reclosers is shown in Tables 1–3. For ratings and basic application information of other Kyle reclosers, see Catalog Section 280-05.

Operation

Sensing current transformers, embedded in the recloser, supply fault-sensing information to the electronic control. Tripping and closing signals from the control energize the operating circuits in the recloser. Due to a single CT ratio for all ratings, minimum-trip values of the electronic control are independent of the continuous-current and interrupting ratings of the recloser.

Flexibility in coordination with other protective devices is provided by varied time–current characteristics from a choice of standard or customized curves, minimum trip values, reclosing and resetting time settings, and a selection of accessories.

Vacuum Interruption

A single break on each phase is accomplished by separating contacts inside the vacuum interrupter. All arcing is contained within the vacuum envelope. The patented axial-magnetic vacuum interrupters, used in NOVA reclosers, offers extended and increased duty cycles compared with oil or radial-magnetic interrupters. The axial-magnetic field keeps the arc in a diffused mode, resulting in less arc power to be dissipated, resulting in low thermal stress, suitable for encapsulation.

Surge Protection

Best operating results are achieved if reclosers are protected with surge arresters. On line applications, arrester protection is recommended on both sides of the recloser. (If protection is on one side only, it should be on the source side. In substations, arresters should be on the load side.) Cooper Power Systems distribution-class arresters provide excellent protection and are available with mounting brackets to fit Kyle reclosers (see Catalog Section 235).

ORDERING INFORMATION

All Type NOVA reclosers include a Form 6 microprocessor-based recloser control. The Form 6 control includes full protection, TCC Editor, metering, and diagnostics for your application needs.

To order a NOVA recloser, electronic control, and control cable:

1. **See the Constructing a Catalog** Number section to construct a catalog number that describes the required recloser.
2. From Tables 6–13, specify the catalog numbers that describe the required recloser accessories.
3. Order the required electronic recloser control (Base catalog number of the control must be included when ordering a Type NOVA recloser).
   A) From 280-01, Part 70, specify the required Form 6 recloser control.

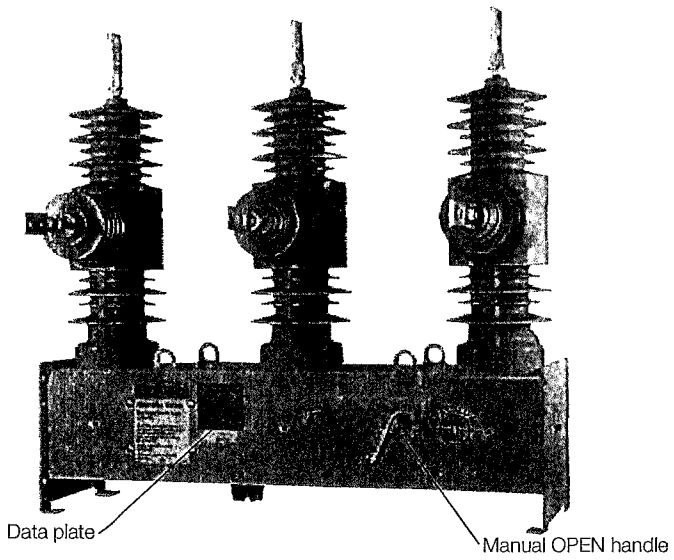


Figure 2.
Kyle Type NOVA recloser.

FEATURES AND DETAILED DESCRIPTION

Kyle NOVA microprocessor-controlled, three-phase reclosers protect systems operating through 34.5 kV (see **Ratings and Specifications** section of this catalog). These ratings and the wide range of programmable settings provided by Cooper Power Systems electronic controls permit meeting a variety of application requirements.

Recloser Operation

Fault currents are sensed by three 1000:1 ratio sensing current transformers embedded in the recloser. These CTs provide a continuous measurement of line current, monitored by the electronic control. When current level exceeds the programmed minimum trip level, the magnitude of the overcurrent is integrated with time, using a programmed time–current curve characteristic. The control then signals the trip in the recloser, opening the main contacts of all three phases.

The control signals tripping and closing. The recloser always maintains energy for a tripping operation following a closing operation.

The electronic recloser control provides determination of phase- and ground-trip sequences and operations to lockout and reclosing and resetting timing, adjustable with the control without de-energizing the recloser.

Construction

Recloser

Designed for long service life and no maintenance, the NOVA recloser has three solid-polymer interrupter modules with embedded current transformers and a standard aluminum mechanism housing; light gray is the standard color.

Cycloaliphatic-epoxy polymer encapsulation provides solid insulation and maintenance-free, environmentally safe operation. There is no monitoring or maintaining of gas pressure or oil levels; there are no toxic or environmentally unfriendly materials. There are no foam fillers or insulation seals, eliminating potential moisture ingress areas. The NOVA recloser module exhibits good absorption of elastic energy and resistance to cracking and crack propagation. Additionally, durable environmental properties make the solid polymer suitable for outdoor applications, including seacoasts, deserts, and areas of high pollution.

Surface Tracking

The cycloaliphatic epoxy is highly resistant to contaminants and resists tracking and flashovers under extreme pollution levels to reduce both flashovers and the associated cost of repairs.

Hydrophobicity

The module maintains excellent hydrophobicity, a property characterized by water beading into isolated drops, and is highly resistant to moisture absorption. Hydrophobicity prevents continuous sheets of water from forming leakage current paths that deteriorate the creepage withstand level.

Ultraviolet Resistance

The cycloaliphatic epoxy resists ultraviolet radiation damage even in harsh climates, maintaining a smooth, unblemished, self-cleansing surface with low-adhesion to contaminants.

Tensile Strength

Outstanding tensile and flexural strength characteristics mean the NOVA recloser modules are tough and non-fragmenting, reducing shipment and handling charges.

Shed Design

The shed design utilizes alternate-sized skirts. The major sheds shield and protect the minor sheds to enhance the hydrophobicity and ultraviolet resistance of the module, eliminate formation of microcracks, and ensure extra-protected creepage. Additionally, sharp edges direct water away from the unit. Water paths and ice formations are effectively eliminated.

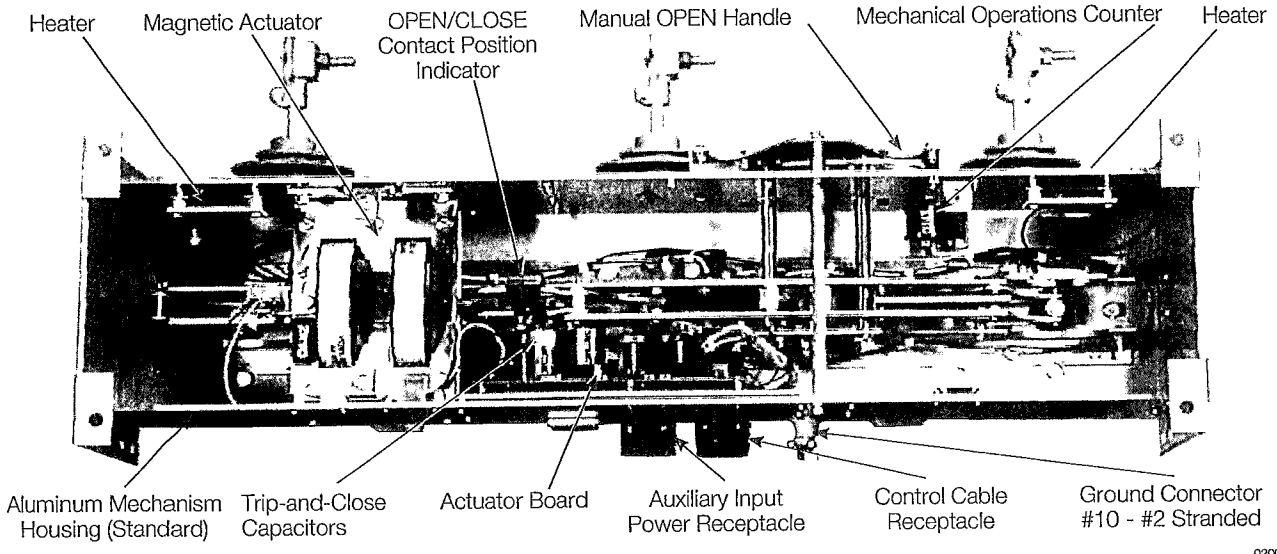


Figure 3.
Kyle Type NOVA recloser Type B mechanism with auxiliary-powered interface (view from bottom of recloser with bottom cover and actuator board safety shield removed).

Flashover Recovery

Flashovers occur when an object, usually wildlife, contacts energized parts of the equipment. The NOVA recloser minimizes the effect of flashovers with remarkable physical resilience, arc-quenching properties, and a self-healing ability. NOVA recloser can withstand the enormous forces experienced during faults without wholesale damage and allows reenergizing after external flashover without cleaning.

Vacuum Interrupters

Type NOVA reclosers use vacuum as the interrupting medium. Vacuum interrupters (Figure 4) provide fast, low-energy arc interruption with long contact and interrupter life, low mechanical stress, and maximum operating safety. With arc interruption taking place in a vacuum, contact and interrupter life are several times greater than with interruption in oil, virtually eliminating interrupter maintenance.

Figure 4.
Cross section of a vacuum interrupter used in NOVA reclosers.

Kyle vacuum interrupters are designed with a metal and ceramic housing for maximum strength and long-term vacuum integrity. Oxygen-free, high-conductivity copper, stainless steel, and a nickel-copper alloy are used in the vacuum interrupters. The high-alumina ceramic has more than five times the strength of glass, which permits a higher processing temperature to develop maximum purity of the assembly, and is impervious to helium penetration, maintaining the vacuum level. Additionally, it provides wear resistance, chemical resistance, and a high dielectric strength.

Enclosed in the interrupter are a stationary and a moving contact assembly. The moving contact has a travel of approximately one-half inch, its shaft passing through a flexible bellows that maintains vacuum integrity. Contacts consist of a high purity copper sintered with aluminathermic chromium.

Because the smallest amount of internal contamination can significantly shorten the life of a vacuum interrupter, special care is taken to avoid even minute contamination from any source, including dust particles, machining oils, or human body salts. No paraffinic oils are used in the machining process, all machined parts are put through a cleaning/degreasing process, and then all components are electro-polished in a positive-pressure, air-filtered area. A Class 100 clean room facility is used for the final interrupter production. The furnaces employ a custom-designed, three-stage pumping system to yield high levels of vacuum. Every vacuum interrupter is then tested and tracked with individual serial numbers.

Electronic Control

Types NOVA15, NOVA27, and NOVA38 reclosers are controlled by a Cooper Power Systems three-phase electronic recloser control. A choice of microprocessor-based controls are available to use in conjunction with these reclosers.

Control-Powered Interface

The Type D NOVA recloser mechanism (see Figure 5) with the control-powered interface is fully operational with Kyle Form 5 and Form 6 VTC-ready, microprocessor-based controls equipped with the required DC-to-DC converter, interface circuit, and a fully shielded 19-pin cable. It is not compatible with the Types F3A nor FXB controls. The control-powered interface includes a 19-pin receptacle on the recloser and an internal heater (for humidity control) powered from the control input power supply (AC or DC). The DC-to-DC converter board converts the control's 24 VDC battery supply to 53 VDC to charge the trip/close capacitors in the NOVA recloser mechanism. The DC-to-DC converter board also houses voltage monitoring and conditioning circuits that protect the battery from failure and provide trip/close operations without ac power. In the absence of AC power to the electronic control, the control battery will provide the trip and close operations. A complete four-trip sequence with minimal reclose intervals as configurated for each control is obtainable without AC power. The recloser and control system is capable of exceeding over one thousand operations on battery power only.

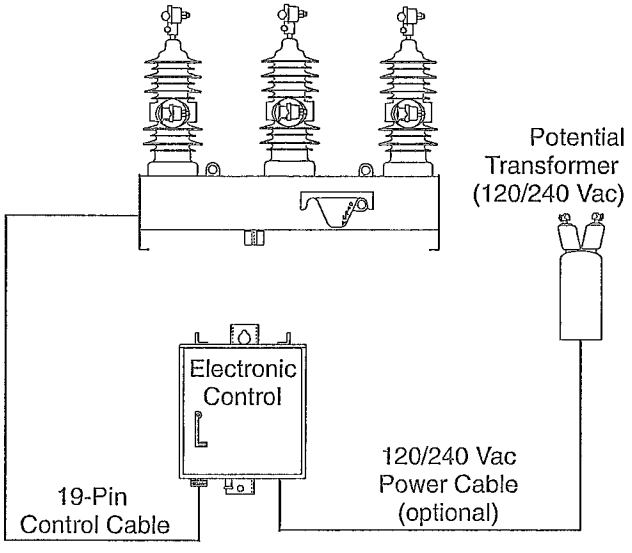
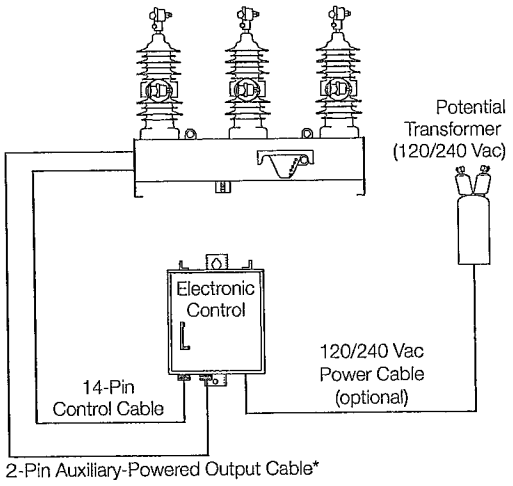


Figure 5.
Control-powered NOVA recloser configuration with potential transformer input power.



*Note: Control receptacle ordered separately.

Figure 6.
Auxiliary-powered NOVA recloser mechanism configuration with potential transformer input power.

Auxiliary-Powered Interface

The Type B NOVA recloser mechanism (see Figure 6) with the auxiliary-powered interface is fully operational with standard Form 6 microprocessor-based controls and standard 14-pin control cables. The auxiliary-powered interface includes a 14-pin receptacle on the recloser and an internal heater (for humidity control) powered from the auxiliary input power supply.

The Type B NOVA recloser mechanism, with the auxiliary-powered interface, requires a voltage source of 48 VDC, 125 VDC, 250 VDC, 120 VAC, or 240 VAC, which must be specified at the time of order. The auxiliary-powered interface is connected to a 2-pin male receptacle located next to the 14-pin female control receptacle. The voltage source is used to maintain power to the trip-and-close capacitors in the recloser and to power the heaters.

DC Auxiliary Input

The trip-and-close capacitors are maintained from the DC source. Upon loss of the DC power, the trip-and-close capacitors will maintain trip and close power for several minutes. If the trip-and-close capacitors are discharged, the recloser is inoperative until DC power is resumed.

AC Auxiliary Input

The trip-and-close capacitors are charged through both the AC auxiliary input power and the recloser control. Upon loss of AC power, the capacitors will be continuously charged from the control battery to allow tripping and will also be trickle-charged to allow for back-up closing. The charge on the capacitors will be maintained for the duration of the control battery power. Allow one minute between back-up close operations to recharge the capacitors. However, the NOVA recloser is ready to trip immediately after performing a back-up closing. Should the battery power discharge to the disconnect level, back-up closing is disabled until AC auxiliary power is resumed. Apply AC auxiliary input power to the NOVA recloser to recharge the capacitors.

Manual Operation

The recloser can be opened manually with a hotstick to pull down the yellow manual OPEN handle under the sleet hood. With the handle in the OPEN position, the control cannot close the recloser.

The recloser is closed, following a manual open, by pushing the yellow handle back under the sleet hood and then using the microprocessor control to close the recloser.

Similarly, the recloser can be operated from the manual control switch on the electronic control panel, provided the manual operating handle is up. A red contact position indicator flag, adjacent to the manual operating handle, shows recloser contact position.

Internal Voltage Sensor Option

The NOVA recloser is available with internal voltage sensors at time of order. Using a high-voltage resistor within each interrupter module with source-side connections, the sensing option, cable, and control support a magnitude accuracy of 2% or better and a phase degree accuracy of ±1.5°. The internal voltage sensing option is compatible with a Form 5 or Form 6 Pole-Mount controls.

Accessories

Auxiliary Switch

A three-stage auxiliary switch can be provided as an accessory. Each stage has two independent contacts that permit any desired combination of "a" (follow state of recloser contacts) and "b" (opposite recloser contacts) positions. The switch contacts are insulated for 600 V and have a continuous current rating of 10 A. Their interrupting ratings are shown in Table 5.

Terminals

The standard terminal is an eyebolt, 1/0–500 mcm (630 A). Eyebolt 4/0–1000 mcm (800 A), 2-hole and 4-hole, flat-pad terminals, and stud-type terminals are available as an accessory.

Pole-Mounting Hanger

A pole-mounting hanger, which bolts directly to the recloser frame, is available for pole-mounting installation.

Arrestor-Mounting Brackets

The arrestor-mounting bracket accessory can be bolted to the recloser frame and pole-mounting hanger for the addition of inboard and outboard arresters. The arresters are not included with the brackets.

Substation-Mounting Frame

A substation-mounting frame accessory is available for substation-mounting applications.

RATINGS AND SPECIFICATIONS

TABLE 1
Voltage Ratings (kV)

Description	15 kV	15 kV	27 kV	27 kV	38 kV
Maximum Voltage	15.5 kV	15.5 kV	29.2 kV	29.2 kV	38.0 kV
Rated Basic Impulse Level	110.0 kV	125.0 kV	125.0 kV	150.0 kV	170.0 kV
Radio Noise Limit (μV)	100 @ 9.4 kV	100 @ 9.4 kV	100 @ 16.4 kV	100 @ 16.4 kV	100 @ 23.0 kV
Power Frequency Withstand, Dry	50 kV	50 kV	60 kV	60 kV	70 kV
Power Frequency Withstand, Wet	45 kV	45 kV	50 kV	50 kV	60 kV

TABLE 2
Current Ratings (Amperes)

Description	15 kV	15 kV	27 kV	27 kV	38 kV
Rated Continuous Current	630 A*	630 A*	630 A*	630 A*	630 A*
Short Circuit Current, Symmetrical	12.5 kA**	12.5 kA**	12.5 kA**	12.5 kA**	12.5 kA
Making Current, Asymmetrical Peak	31.0 kA	31.0 kA	31.0 kA	31.0 kA	31.0 kA
Cable Charging Current	10 A	10 A	25 A	25 A	40A

*800 amp accessory is also available.
**16.0 kA option is also available. (Making Current is 40.0 kA Asymmetrical Peak.)

TABLE 3
Mechanical Ratings

Description	15 kV	15 kV	27 kV	27 kV	38 kV
Min. Mechanical/Electrical Operations Without Maintenance (C-O)	10,000	10,000	10,000	10,000	10,000
Mass (Weight) - kg (lbs)	86 (190)	91 (200)	91 (200)	101 (223)	101 (223)

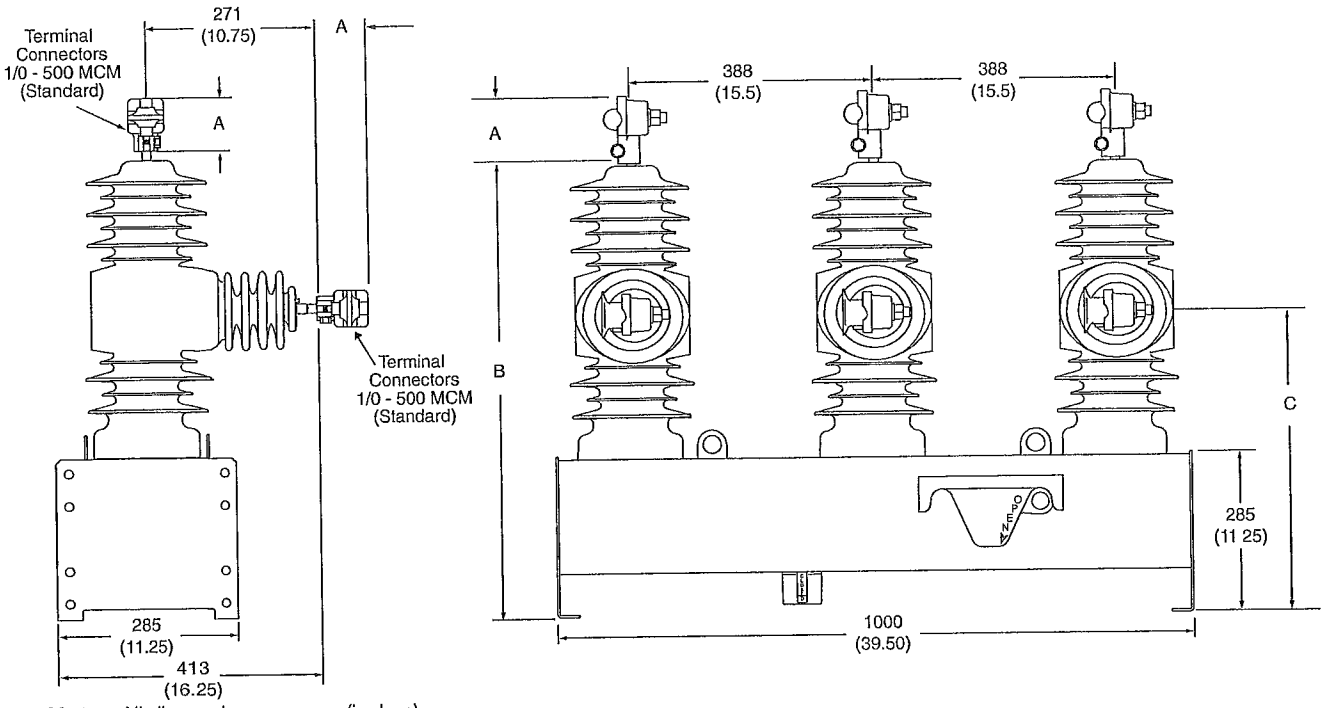
TABLE 4
Duty Cycle

Type	Percentage of Interrupting Rating	Number of Unit Operations	Minimum Circuit X/R Value
NOVA	15-20	88	4
	45-55	112	8
	90-100	32	15
		Total 232	

TABLE 5
Auxiliary Switch Interrupting Ratings

Volts	Inductive AC (amps)	Non-Inductive AC (amps)	Inductive DC (amps)	Non-Inductive DC (amps)
24	–	–	15.0	20.0
48	–	–	7.5	10.0
120	60	80	–	–
125	–	–	1.5	2.0
240	30	60	–	–
250	–	–	0.45	0.5

DIMENSIONS



Note: All dimensions are mm (inches).
Dimensions shown are approximate.

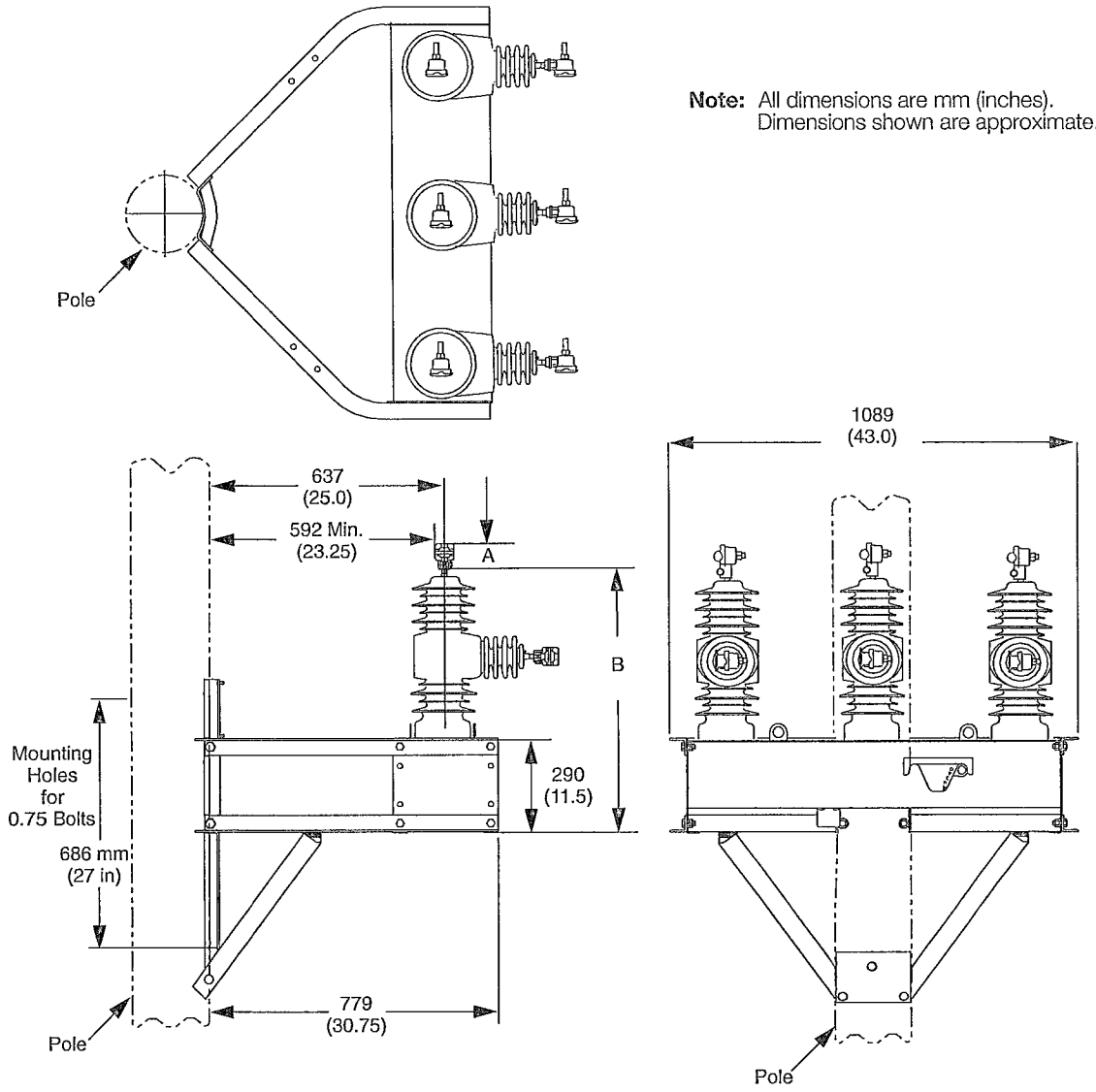
Terminal Options	A
Eyebolt, 1/0 - 500 mcm Cable Range (630 A maximum)	80 (3.25)
Eyebolt, 4/0 - 1000 mcm Cable Range (800 A maximum)	108 (4.25)
Flat Pad, 2-hole (630 A maximum)	114 (4.5)
Flat Pad, 4-hole (800 A maximum)	121 (4.75)
Stud Type, 1.125 - 12 threads (800 A maximum)	82 (3.25)

	B	C
NOVA15 110 kV BIL	791 (31.25)	508 (20)
NOVA15 125 kV BIL	847 (33.25)	564 (22.25)
NOVA27 125 kV BIL	847 (33.25)	564 (22.25)
NOVA27 150 kV BIL	946 (37.25)	663 (26.0)
NOVA38 170 kV BIL	946 (37.25)	663 (26.0)

Creepage Distances

Description	15 kV 110 kV BIL	15 kV 125 kV BIL	27 kV 125 kV BIL	27 kV 150 kV BIL	38 kV 170 kV BIL
Terminal to terminal	1052 (41.5)	1052 (41.5)	1052 (41.5)	1052 (41.5)	1052 (41.5)
Lower terminal to ground/earth	673 (26.5)	772 (30.5)	772 (30.5)	950 (37.5)	950 (37.5)

Figure 7.
Type NOVA recloser dimensions, NOVA27 shown.



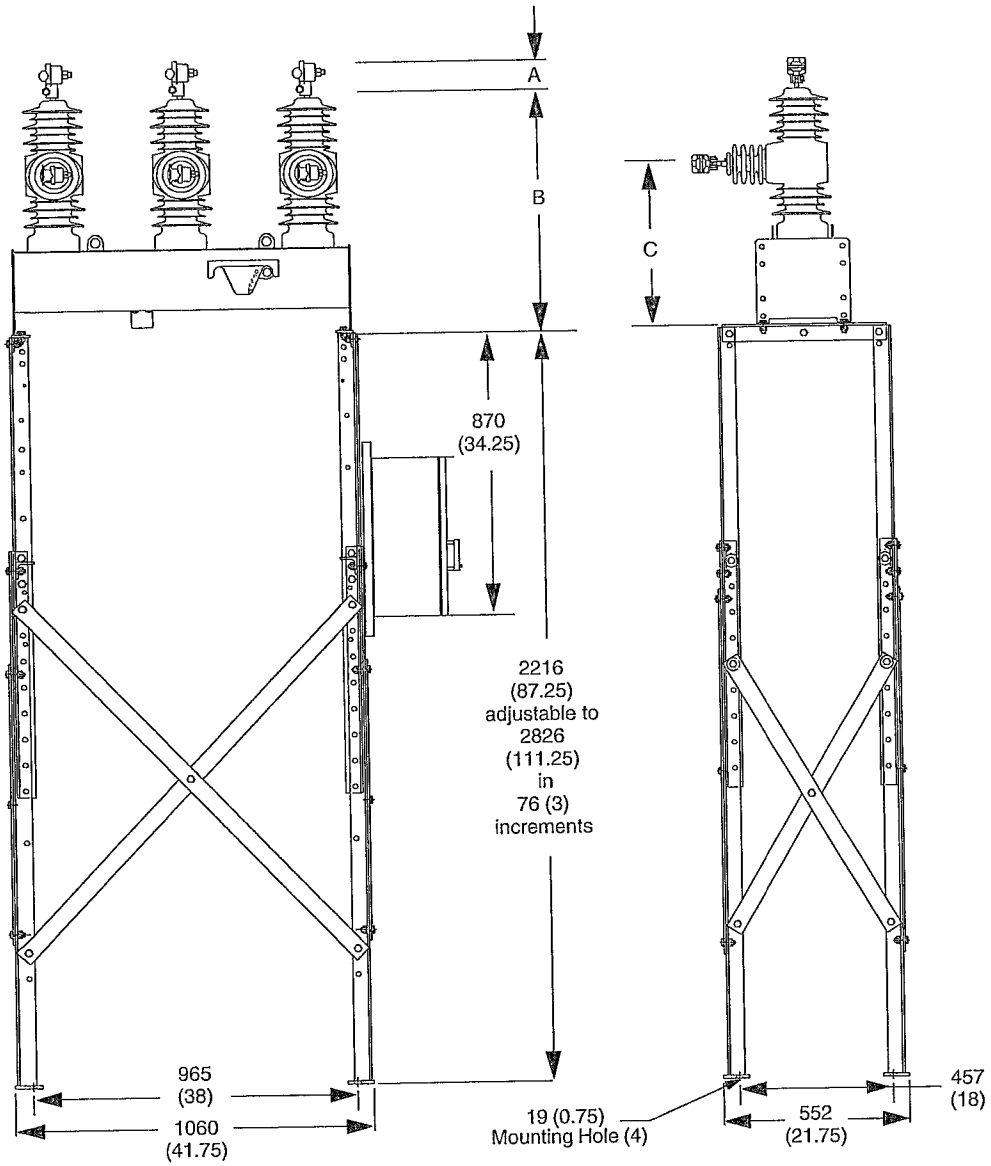
Note: All dimensions are mm (inches).
Dimensions shown are approximate.

Terminal Options	A
Eyebolt, 1/0 - 500 mcm Cable Range (630 A maximum)	80 (3.25)
Eyebolt, 4/0 - 1000 mcm Cable Range (800 A maximum)	108 (4.25)
Flat Pad, 2-hole (630 A maximum)	114 (4.5)
Flat Pad, 4-hole (800 A maximum)	121 (4.75)
Stud Type, 1.125 - 12 threads (800 A maximum)	82 (3.25)

	Dimension B
NOVA15 110 kV BIL	791 (31.25)
NOVA15 125 kV BIL	847 (33.25)
NOVA27 125 kV BIL	847 (33.25)
NOVA27 150 kV BIL	946 (37.25)
NOVA38 170 kV BIL	946 (37.25)

Figure 8.
Dimensions of Type NOVA recloser with pole-mounting hanger and arrester-mounting bracket accessories.

Note: All dimensions are mm (inches).
Dimensions shown are approximate.



Terminal Options	A
Eyebolt, 1/0 - 500 mcm Cable Range (630 A maximum)	80 (3.25)
Eyebolt, 4/0 - 1000 mcm Cable Range (800 A maximum)	108 (4.25)
Flat Pad, 2-hole (630 A maximum)	114 (4.5)
Flat Pad, 4-hole (800 A maximum)	121 (4.75)
Stud Type, 1.125 - 12 threads (800 A maximum)	82 (3.25)

	B	C
NOVA15 110 kV BIL	791 (31.25)	508 (20)
NOVA15 125 kV BIL	847 (33.25)	564 (22.25)
NOVA27 125 kV BIL	847 (33.25)	564 (22.25)
NOVA27 150 kV BIL	946 (37.25)	663 (26.0)
NOVA38 170 kV BIL	946 (37.25)	663 (26.0)

Figure 9.
Dimensions of Type NOVA recloser with substation-mounting frame accessory.

CONSTRUCTING A CATALOG NUMBER

To order a basic Type NOVA recloser with eyebolt terminals, for use with 120 VAC closing and a 14-pin control cable, the catalog number would be constructed like this:

KNOVA Basic letters for a Type NOVA recloser with base Form 6 recloser control*

15A Recloser Type:
- **15A** for 15 kV, 630 A continuous, 12.5 kA interrupting
- **27A** for 27 kV, 630 A continuous, 12.5 kA interrupting
- **38A** for 38 kV, 630 A continuous, 12.5 kA interrupting

1 Bushing Terminals:
- **1** for eyebolt terminal, 1/0 to 500 MCM, 630 A max.†
- **3** for 2-hole flat pad terminal, 630 A max.
- **4** for 4-hole flat pad terminal, 800 A max.
- **5** for stud-type terminal, 800 A max.

1 Interface:
- **1** for Type NOVA AP, with auxiliary-powered interface 120 VAC closing (14-pin & 2-pin receptacles)
- **2** for Type NOVA AP, with auxiliary-powered interface 240 VAC closing (14-pin & 2-pin receptacles)
- **3** for Type NOVA CP, with control-powered interface (19-pin receptacle), 120 VAC Heater
- **4** for Type NOVA CP, with control-powered interface (19-pin receptacle), 240 VAC Heater
- **5** for Type NOVA AP, with auxiliary-powered interface 125 VDC closing (14-pin & 2-pin receptacles)
- **6** for Type NOVA AP, with auxiliary-powered interface 250 VDC closing (14-pin & 2-pin receptacles)
- **7** for Type NOVA AP, with auxiliary-powered interface 48 VDC closing (14-pin & 2-pin receptacles)

KNOVA 15A 1 1

KNOVA15A11 is the catalog number for the required basic Type NOVA recloser.

* Include the base catalog number of the selected control when ordering a Type NOVA recloser.

† Standard terminal, included when ordering a Type NOVA recloser.

TABLE 6
BIL Options

Description	Catalog Number
15 kV 125 kV BIL	KNOVA28-1
27 kV 150 kV BIL	KNOVA25-1

TABLE 7
Interrupting Rating*

Description	Catalog Number
16 kA Maximum Interrupting	16 kA

*Applicable to KNOVA15A/27A only

TABLE 8
Continuous Current Options*

Description	Catalog Number
15 kV 800 A option	KNOVA22-1
27 kV 800 A option	KNOVA24-1
38 kV 800 A option	KNOVA27-1

* When ordering the standard eyebolt terminal in conjunction with the 800 A option, eyebolt terminals suitable for 4/0 – 1000 mcm conductors will be provided.

TABLE 9
Internal Voltage Sensing Option*

Description	Catalog Number
Internal Voltage Sensing option, 15 and 27 kV	KNOVA-848
Internal Voltage Sensing Cable (basic cable, no length)	KA97ME
Internal Voltage Sensing Cable, maximum 50 feet Replace X with number of feet.	KA97ME-X

* Available with Form 5 and Form 6 Controls only.

TABLE 10
Mounting Equipment

Description	Catalog Number
Single pole-mounting hanger with stainless steel hardware	KNOVA54-3
Single concrete-pole-mounting hanger with stainless steel hardware	KNOVA54-4
Surge-arrester-mounting brackets with stainless steel hardware	
Inboard	KNOVA61-2
Outboard	KNOVA61-1
Alley-pole-mounting hanger with stainless steel hardware	KNOVA352-1
Arrester brackets (set of 3)	KNOVA353-1
Arrester brackets (set of 6)	KNOVA353-2
Substation-mounting frame with stainless steel hardware includes control-mounting bracket for FXA, FXB (single- and double-size cabinet), Form 5, and Form 6 Yard and Pole Mount	KNOVA59-1
Field kit for NOVA recloser on substation-mounting frame KA89WV1	KNOVA457-1
Field kit for NOVA recloser on substation-mounting frame KA584R1	KNOVA457-4

TABLE 11
Factory Assembly

Description	Catalog Number
Recloser in single pole-mounting hanger KNOVA54-3	KNOVA354-1
Recloser in single pole-mounting hanger KNOVA54-3 with arrester brackets	KNOVA354-2
Recloser on alley-pole-mounting hanger KNOVA352-1	KNOVA456-1
Recloser on alley-pole-mounting hanger KNOVA352-1 with arrester brackets	KNOVA456-2

* Covers factory assembly only; recloser, control, and mounting equipment must be ordered separately.

TABLE 12
Auxiliary Switch

Description	Catalog Number
Three-stage auxiliary switch with six independent contacts and receptacle for KNOVA82 cable	KNOVA66-2
Auxiliary switch cable for KNOVA66-2, auxiliary switch to control, (basic cable, no length)	KNOVA82
Auxiliary switch cable, maximum 100 feet. Replace *X* with number of feet.	KNOVA82-*X*

TABLE 13
Miscellaneous Accessories

Description	Catalog Number
Low-voltage AC input cable (auxiliary-powered Type B interface only, basic cable, no length)	KA11ME1
Replace *X* with number of feet.	KA11ME1-*X*
Source and load wildlife guards, 630 A recloser (set of 6)	KNOVA56-6
Source and load wildlife guards, 800 A recloser (set of 6)	KGS560-6

2300 Badger Drive
Waukesha, WI 53188 USA
www.cooperpower.com

COOPER Power Systems

Reclosers

Service Information

Types NOVA 15, NOVA 27, and NOVA 38; Three-Phase Microprocessor-Controlled; Installation and Operation Instructions

S280-42-1

NOVA 15 for Serial Number CP571297544 and above
NOVA 27 for Serial Number CP571300976 and above
NOVA 38 for Serial Number CP571298286 and above

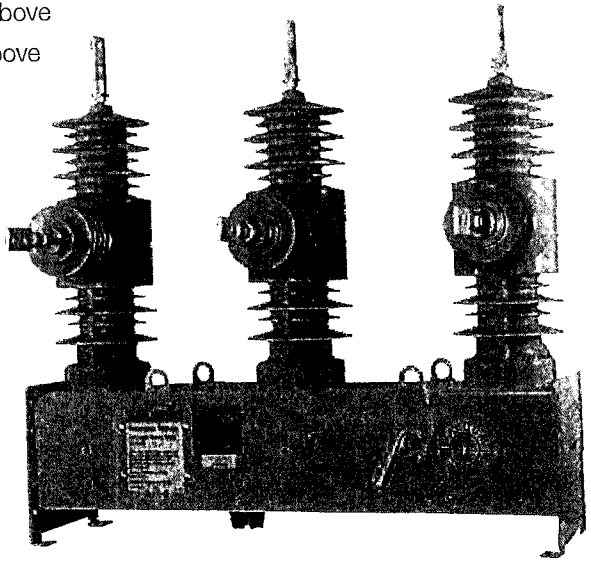


Figure 1.
NOVA three-phase, microprocessor-controlled recloser, shown with two-hole, flat-pad accessory.

Contents

SAFETY FOR LIFE

Cooper Power Systems products meet or exceed all applicable industry standards relating to product safety. We actively promote safe practices in the use and maintenance of our products through our service literature, instructional training programs, and the continuous efforts of all Cooper Power Systems employees involved in product design, manufacture, marketing, and service.

We strongly urge that you always follow all locally approved safety procedures and safety instructions when working around high voltage lines and equipment and support our "Safety For Life" mission.

SAFETY INFORMATION

The instructions in this manual are not intended as a substitute for proper training or adequate experience in the safe operation of the equipment described. Only competent technicians who are familiar with this equipment should install, operate, and service it.

A competent technician has these qualifications:

- *Is thoroughly familiar with these instructions.*
- *Is trained in industry-accepted high- and low-voltage safe operating practices and procedures.*
- *Is trained and authorized to energize, de-energize, clear, and ground power distribution equipment.*
- *Is trained in the care and use of protective equipment such as flash clothing, safety glasses, face shield, hard hat, rubber gloves, hotstick, etc.*

Following is important safety information. For safe installation and operation of this equipment, be sure to read and understand all cautions and warnings.

Hazard Statement Definitions

This manual may contain four types of hazard statement:

DANGER: Indicates an imminently hazardous situation which, if not avoided, will result in death or serious injur.

WARNING: Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.

CAUTION: Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury.

CAUTION: Indicates a potentially hazardous situation which, if not avoided, may result in equipment damage only.

Safety Instructions

Following are general caution and warning statements that apply to this equipment. Additional statements, related to specific tasks and procedures, are located throughout the manual.

DANGER:
Hazardous voltage. Contact with hazardous voltage will cause death or severe personal injury. Follow all locally approved safety procedures when working around high- and low-voltage lines and equipment. G103.3

WARNING:
Before installing, operating, maintaining, or testing this equipment, carefully read and understand the contents of this manual. Improper operation, handling, or maintenance can result in death, severe personal injury, and equipment damage. G101.0

WARNING:
This equipment is not intended to protect human life. Follow all locally approved procedures and safety practices when installing or operating this equipment. Failure to comply may result in death, severe personal injury, and equipment damage. G102.1

WARNING:
Power distribution and transmission equipment must be properly selected for the intended application. It must be installed and serviced by competent personnel who have been trained and understand proper safety procedures. These instructions are written for such personnel and are not a substitute for adequate training and experience in safety procedures. Failure to properly select, install, or maintain power distribution and transmission equipment can result in death, severe personal injury, and equipment damage. G122.3

PRODUCT INFORMATION

Introduction

Service Information S280-42-1 provides installation, operation, and service instructions for the Type NOVA™ three-phase, microprocessor-controlled recloser. Before installing and operating this recloser, carefully read and understand the contents of this manual.

Read This Manual First

Read and understand the contents of this manual and follow all locally approved procedures and safety practices before installing or operating this equipment. This recloser is used in conjunction with a Cooper Power Systems microprocessor-based recloser control.

- If used with a Form 4C control, refer to *Service Information S280-77-1*.
- If used with a Form 4D Pole Mount control, refer to *Service Information S280-104-1*.
- If used with a Form 5 control, refer to *Service Information S280-79-10*.
- If used with a Form 6 Rack Mount control, refer to *Service Information S280-70-1*.
- If used with a Form 6 Yard Mount control, refer to *Service Information S280-70-2*.
- If used with a Form 6 Pole Mount control, refer to *Service Information S280-70-3*.
- If used with an FXB control, refer to *Service Information S280-78-1*.
- The NOVA recloser with Type A mechanism/control-powered interface is not compatible with the FXB control.
- The NOVA recloser is not compatible with the Form 2, Form 3, nor Form 3A controls.

Additional Information

These instructions cannot cover all details or variations in the equipment, procedures, or process described nor provide directions for meeting every possible contingency during installation, operation, or maintenance. For additional information, contact your Cooper Power Systems representative.

Acceptance and Initial Inspection

Each recloser is completely assembled, tested, and inspected at the factory. It is in good condition when accepted by the carrier for shipment. Upon receipt, inspect the shipping container for signs of damage. Unpack the recloser and inspect it thoroughly for damage incurred during shipment. If damage is discovered, file a claim with the carrier immediately.

Handling and Storage

Be careful during handling and storage of the recloser to minimize the possibility of damage. Refer to the **Moving the Recloser** and **Lifting the Recloser** sections. If the recloser is to be stored for any length of time prior to installation, provide a clean, dry storage area.

Cooper Power Systems recommends transporting NOVA reclosers in the closed position to maximize the operational performance of the unit.

Standards

The Type NOVA reclosers are designed and tested in accordance with:

IEEE Standard C37.60-2003™

IEEE Standard C37.61-1973™

ANSI C37.85 - 2002

Quality Standards

ISO 9001 Certified Quality Management System

Description of Operation

The Type NOVA recloser is a three-phase, vacuum-interrupting recloser designed for electrical distribution systems through 34.5 kV. The NOVA recloser is designed and tested to be compatible with Cooper Power System control types. The Type NOVA recloser is available with two configuration options: control-powered interface and auxiliary-powered interface.

The solid polymer insulation system does not rely on a gaseous, liquid, or foam dielectric. The NOVA recloser is highly resistant to ozone, oxygen, moisture, contamination, and ultraviolet light. The NOVA recloser has three solid-polymer interrupter modules, an embedded current transformer, and a standard aluminum mechanism housing. It is suitable for operation through a temperature range of -40°C to +55°C.

RATINGS AND SPECIFICATIONS

Check Recloser Ratings Prior To Installation

The recloser must be applied within its specified ratings. Check data plate ratings and compare with the system characteristics at the point of application prior to installation. Tables 1, 2, 3, and 4 list the ratings and specifications for the Type NOVA recloser. Table 5 lists the auxiliary-powered interface power requirements.

TABLE 1
Voltage Ratings

Description	15 kV	15 kV	27 kV	27 kV	38 kV
Maximum Voltage	15.5 kV	15.5 kV	27.0 kV	27.0 kV	38.0 kV
Rated Basic Impulse Level	110.0 kV	125.0 kV	125.0 kV	150.0 kV	170.0 kV*
Radio Noise Limit (μv)	100 @ 9.4 kV	100 @ 9.4 kV	100 @ 16.4 kV	100 @ 16.4 kV	100 @ 23.0 kV
Power Frequency Withstand, Dry	50 kV	50 kV	60 kV	60 kV	70 kV
Power Frequency Withstand, Wet	45 kV	45 kV	50 kV	50 kV	60 kV

*170 kV beginning with S/N CP571192790; S/N 1000 through S/N CP571192789 are rated 150 kV BIL or less — as indicated on the nameplate.

TABLE 2
Current Ratings (Amperes)

Description	15 kV	15 kV	27 kV	27 kV	38 kV
Rated Continuous Current	630 A*	630 A*	630 A*	630 A*	630 A*
Short Circuit Current, Symmetrical	12.5 kA**	12.5 kA**	12.5 kA**	12.5 kA**	12.5 kA
Making Current, Asymmetrical Peak	32.0 kA	32.0 kA	32.0 kA	32.0 kA	32.0 kA
Cable Charging Current	10 A	10 A	25 A	25 A	40A

*800 amp accessory is also available.
**16.0 kA option is also available. (Making Current is 41.0 kA Asymmetrical Peak.)

TABLE 3
Mechanical Ratings

Description	15 kV	15 kV	27 kV	27 kV	38 kV
Min. Mechanical/Electrical Operations Without Maintenance (C-O)	10,000	10,000	10,000	10,000	10,000
Mass (Weight) - kg (lbs)	86 (190)	91 (200)	91 (200)	101 (223)	101 (223)

TABLE 4
Duty Cycle

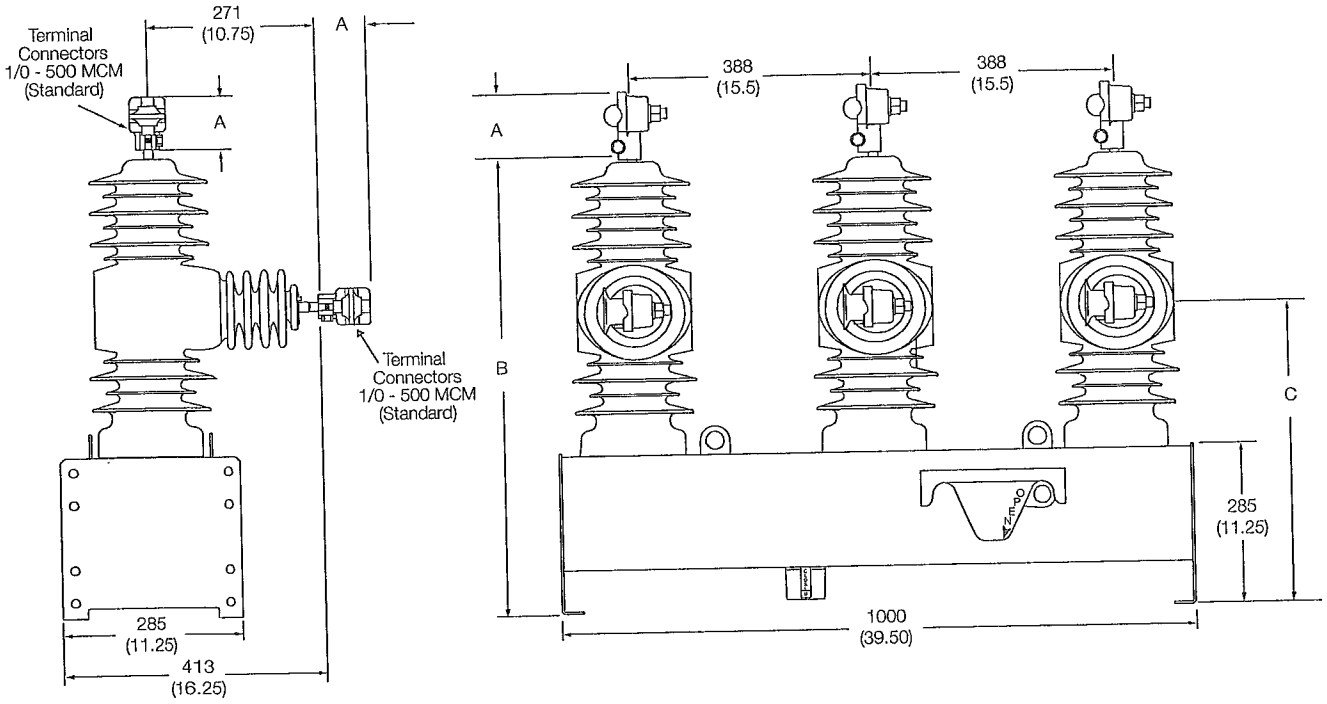
Type	Percentage of Interrupting Rating	Number of Unit Operations	Minimum Circuit X/R Value
NOVA	15-20	88	4
	45-55	112	8
	100	32	17*
		Total 232	

*Value shown for 60 Hz.

TABLE 5
Auxiliary-Powered Interface Power Requirements

Voltage	Normal Current	Operating Current	Duration	Recommended Power
120 VAC	0.2 A	1.0 A	3 sec	150 VA
240 VAC	0.1 A	0.5 A	3 sec	150 VA
48 VDC	0.4 A	2.0 A	3 sec	150 VA
125 VDC	0.2 A	1.0 A	3 sec	150 VA
250 VDC	0.1 A	.5 A	3 sec	150 VA

DIMENSIONS



NOTE: All dimensions are mm (inches). Dimensions shown are approximate.

Terminal Options	A
Eyebolt, 1/0 - 500 mcm Cable Range (630 A maximum)	80 (3.25)
Eyebolt, 4/0 - 1000 mcm Cable Range (800 A maximum)	108 (4.25)
Flat Pad, 2-hole (630 A maximum)	114 (4.5)
Flat Pad, 4-hole (800 A maximum)	121 (4.75)
Stud Type, 1.125 - 12 threads (800 A maximum)	82 (3.25)

	B	C
NOVA 15 110 kV BIL	791 (31.25)	508 (20)
NOVA 15 125 kV BIL	847 (33.25)	564 (22.25)
NOVA 27 125 kV BIL	847 (33.25)	564 (22.25)
NOVA 27 150 kV BIL	946 (37.25)	663 (26.0)
NOVA 38 170 kV BIL	946 (37.25)	663 (26.0)

Creepage Distances

Description	15 kV 110 kV BIL	15 kV 125 kV BIL	27 kV 125 kV BIL	27 kV 150 kV BIL	38 kV 170 kV BIL
Terminal to terminal	1040 (40.9)	1040 (40.9)	1040 (40.9)	1040 (40.9)	1040 (40.9)
Lower terminal to ground/earth	673 (26.5)	772 (30.5)	772 (30.5)	950 (37.5)	950 (37.5)

Figure 2.
Type NOVA recloser dimensions, NOVA 27 shown.

NOVA MECHANISM INTERFACE OPTIONS

Control-Powered Interface

The Type NOVA recloser mechanism with the control-powered interface is fully operational with Cooper Power Systems Form 4C, Form 5, and Form 6 microprocessor-based controls equipped with the required DC-to-DC converter, interface circuit, and a fully shielded 19-pin cable. It is not compatible with the Types F3A nor FXB controls. The control-powered interface includes a 19-pin receptacle on the recloser and internal heaters (for humidity control) powered from the control input power supply (AC or DC).

Control-powered NOVA reclosers manufactured after September 2004 require a Voltage Trip/Close (VTC) interface and a VTC-ready control for tripping and closing. This VTC requirement applies to three-phase, control-powered NOVA reclosers with serial numbers 100,000 and above or beginning with the characters CP57; refer to Table 6. Control-powered NOVA reclosers with serial numbers below 100,000 do not require a VTC-ready control. Refer to the recloser nameplate for the serial number.

TABLE 6
Serial Number Break for Control-Powered NOVA Reclosers with VTC

Control-Powered NOVA Recloser	Serial No.
NOVA 15	100,000 *or* CP57#######
NOVA 27	100,000 *or* CP57#######
NOVA 38	100,000 *or* CP57#######

The DC-to-DC converter board converts the control's 24 VDC battery supply to 53 VDC to charge the trip/close capacitors in the NOVA mechanism. The DC-to-DC converter board also houses voltage monitoring and conditioning circuits that protect the battery from failure and provide trip/close operations without AC power. In the absence of AC power to the electronic control, the control battery will provide the trip and close operations. A complete four-trip sequence with minimal reclose intervals as configured for each control is obtainable without AC power. The recloser and control system is capable of exceeding over one thousand operations on battery power only.

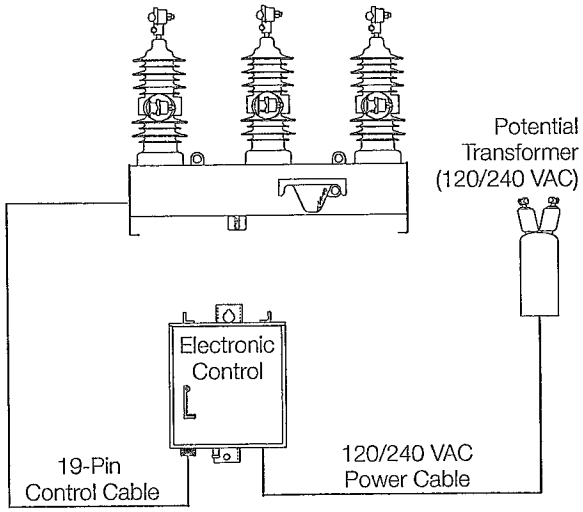


Figure 3.
Control-powered NOVA recloser configuration with potential transformer input power.

Auxiliary-Powered Interface

The Type NOVA recloser mechanism with the auxiliary-powered interface is fully operational with standard Cooper Power Systems FXB, Form 4C, Form 4D, Form 5, and Form 6 microprocessor-based controls and standard 14-pin control cables. It is not compatible with the Type F3A control. The auxiliary-powered interface includes both a 2-pin and a 14-pin receptacle on the recloser. Internal heaters (for humidity control) are also included.

The Type NOVA recloser mechanism with the auxiliary-powered interface is compatible with 120 VAC, 240 VAC, 125 VDC, or 250 VDC as configured at the time of order. The auxiliary input power supply (AC or DC) is connected to a 2-pin male receptacle located next to the 14-pin female control receptacle. This provides power to the trip-and-close capacitors and the heaters in the recloser.

DC Auxiliary Input

The trip-and-close capacitors are maintained from the DC source. Upon loss of the DC power, the trip-and-close capacitors will maintain trip and close power for several minutes. If the trip-and-close capacitors are discharged, the recloser is inoperative until DC power is resumed.

AC Auxiliary Input

The trip-and-close capacitors are charged through both the AC auxiliary input power and the recloser control. This applies to recloser controls with an internal battery but is not applicable for the Form 6 rack or yard mount controls that use an external substation supply. Upon loss of AC power, the capacitors will be continuously charged from the control battery to allow tripping and will also be trickle-charged to allow for backup closing.

The charge on the capacitors will be maintained for the duration of the control battery power. Allow one minute between backup close operations to recharge the capacitors. However, the NOVA recloser is ready to trip immediately after performing a backup closing. Should the battery power discharge to the disconnect level, backup closing is disabled until AC auxiliary power is resumed. Apply AC auxiliary input power to the NOVA recloser to recharge the capacitors.

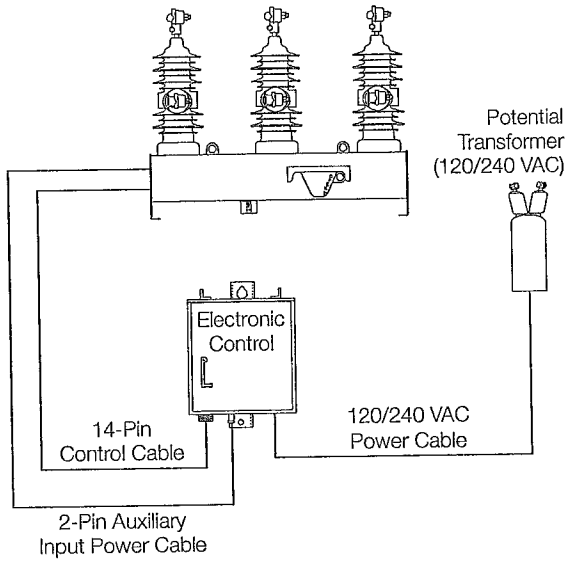


Figure 5.
Auxiliary-powered NOVA recloser mechanism configuration with potential transformer input power.

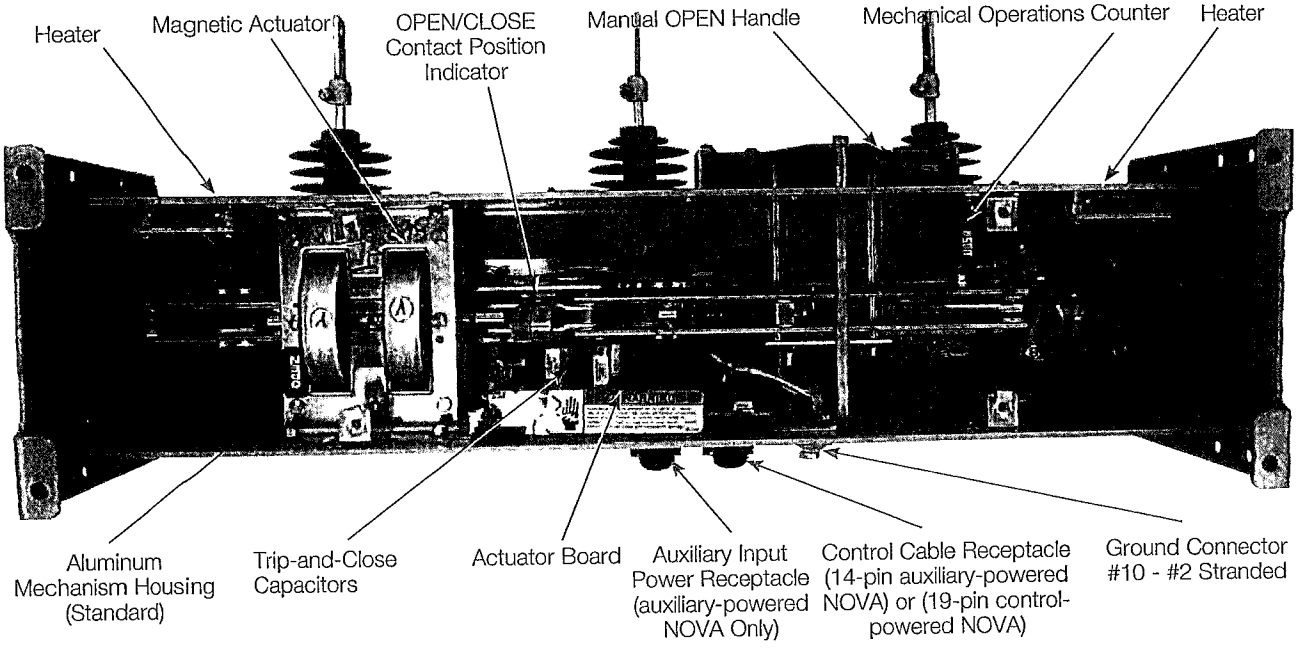


Figure 4.
Type NOVA recloser mechanism (view from bottom of recloser with bottom cover and actuator board safety shield removed).

INSTALLATION PROCEDURE

WARNING: This equipment is not intended to protect human life. Follow all locally approved procedures and safety practices when installing or operating this equipment. Failure to comply can result in death, severe personal injury, and equipment damage. G102.1

WARNING: Hazardous voltage. Always use a hotstick when working with this equipment. Failure to do so could result in contact with high voltage, which will cause death or severe personal injury. G108.1

CAUTION: Personal injury. Sheds on epoxy encapsulation have sharp edges. Wear protective gloves when handling the unit. Failure to do so can result in cuts and abrasions. T258.1

When installing the recloser, refer to the applicable recloser-mounting frame instructions. Installation instructions are included with the mounting frame.

1. **Check the data plate ratings.** Make sure the ratings, settings, and interface options on the recloser data plate (Table 7 and Figure 14) are correct for the planned installation.

TABLE 7
Nameplate Stamping
Serial number format: CP57######Y

Option	Stamping Y
Auxiliary-Powered Interface	
48 VDC Interface Input / 48 VDC Heater	A
125 VDC Interface Input / 125 VDC Heater	D
250 VDC Interface Input / 250 VDC Heater	E
120 VAC Interface Input / 120 VAC Heater	H
240 VAC Interface Input / 240 VAC Heater	J
Control-Powered Interface	
120 VAC Heater	B
240 VAC Heater	C

2. **Perform high-potential withstand tests.** Prior to installing the NOVA recloser, perform high-potential withstand tests. Refer to the **Service Information** section for high-potential withstand test procedures.

3. **Install the recloser.** Install the recloser in the appropriate Cooper Power Systems pole- or substation-mounting frame. Refer to Figure 6 for moving and lifting instructions.
   - Before hanging the recloser on the pole, manually open the unit by lowering the yellow handle.

CAUTION: Follow all locally approved safety practices when lifting and mounting the equipment. Use the lifting lugs provided. Lift the unit smoothly and do not allow the unit to shift. Improper lifting can result in equipment damage. G106.2

Moving the Recloser

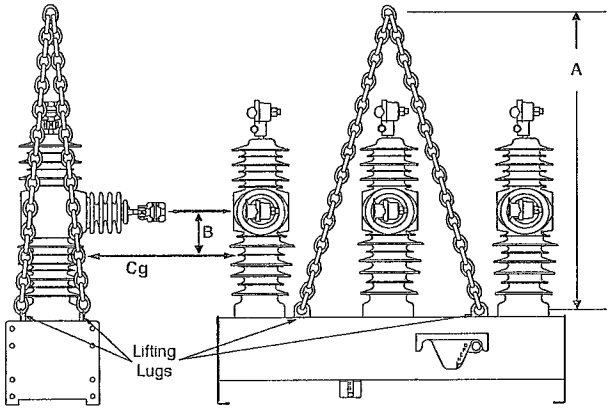
Type NOVA reclosers are shipped palletized (bolted onto a pallet). When moving with a fork truck/lift, the recloser must remain bolted to the pallet to avoid damage to the OPEN/CLOSE contact position indicator.

Cooper Power Systems recommends transporting NOVA reclosers in the closed position to maximize the operational performance of the unit.

CAUTION: Tip-over Hazard. High center of gravity. Use a 4-point hitch to prevent switchgear from overturning during lifting operations. Improper lifting can result in personal injury or equipment damage. T297.0

Lifting the Recloser

Follow all approved safety practices when making hitches and lifting the equipment. Lift the unit smoothly and do not allow the unit to shift.



A: Sling height for 15 kV and 27 kV with 125 BIL units: 914 mm (36 in)
Sling height for 27 kV with 150 BIL and 38 kV units: 1067 mm (42 in)

B: Center of gravity (Cg) is approximately 100 mm (4 in) below plane of lower terminals.

Figure 6.
Moving and lifting the Type NOVA recloser.

WARNING: Hazardous voltage. Solidly ground all equipment. Failure to comply can result in death, severe personal injury, and equipment damage. T223.2

4. **Ground the recloser.** Make the ground connection to the ground connector. The ground connector is located on the back of the mechanism housing.
   - Refer to Figure 4 for ground connector location. The ground clamp accepts #10 to #2 stranded cables.
   - Refer to Figures 11, 12, and 13 for recommended grounding for the Type NOVA recloser.
5. **Install the control.** Refer to the control installation manual and install the control. Make sure the control cable is connected between the control and the recloser, the control is properly programmed for the planned installation, and the control is grounded.

   To ensure proper installation of this cable, securely fasten the aluminum cable coupler ring (Figure 7).

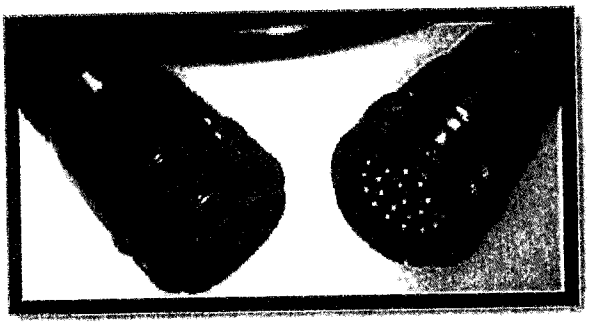


Figure 7.
Cable with aluminum cable coupler ring.

CAUTION: Equipment misoperation. The control-powered NOVA reclosers that require a VTC interface must be used with VTC-ready controls. Failure to use a VTC-ready control will result in failure to trip or close. G144.0

Control-powered NOVA reclosers manufactured after September 2004 require a Voltage Trip/Close (VTC) interface and a VTC-ready control for tripping and closing. This VTC requirement applies to three-phase, control-powered NOVA reclosers with a Type A or Type D mechanism with serial numbers 100,000 and above or beginning with the characters CP57. They can be identified by labels prominently displayed on the bottom of the recloser tank and on the side near the 19-pin receptacle, as shown in Figure 8. Control-powered NOVA reclosers with serial numbers below 100,000 do not require a VTC-ready control. Refer to the recloser nameplate for the serial number.

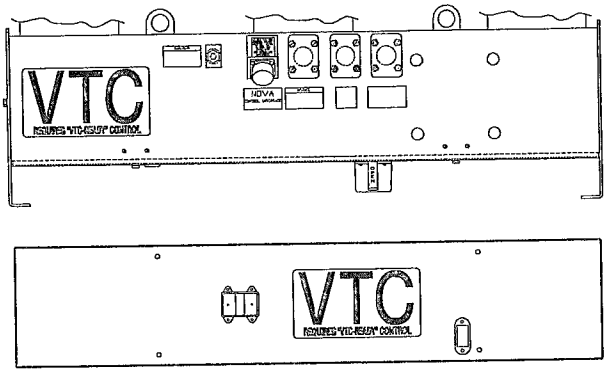


Figure 8.
Control-powered NOVA recloser VTC labels.

(continued on next page)

6. **Make high-voltage line connections** (refer to Figures 9 and 10).

   Note: Disconnect switches and bypass switches are not required, but are highly recommended as they facilitate switching and isolation.

CAUTION: Equipment Damage. Do not adjust or rotate bushing terminals without first removing power line leads and loosening pinch bolt to release clamp tension. Failure to remove tension between the clamp and the interrupter stud prior to rotating the terminal will damage the encapsulated interrupter assembly resulting in equipment damage. T347.0

CAUTION: Equipment damage may occur if torque values are exceeded. T370.0

A. Connect high-voltage lines to recloser bushing terminals.

The recommended torque value for bushing terminal-to-line connection is 45-50 ft•lbs. This is applicable to soft-drawn and hard-drawn copper as well as applicable wire sizes, solid wire, and stranded wire.

NOTICE: Equipment damage may occur when
- line tension is not removed prior to making or disconnecting wires to the recloser terminals
- if the recommended torque is exceeded

Refer to Figure 10 for terminal identification of the NOVA recloser.

Terminal connection to copper conductors only are recommended.

To rotate a flat-pad or eyebolt bushing terminal prior to connecting power line leads, loosen the pinch bolt on the terminals.

After rotating the terminal, retighten the pinch bolt as follows:

- torque 3/8-16 pinch bolts to 15-17 ft•lbs
- torque 1/2-13 pinch bolts to 29-31 ft•lbs

IMPORTANT: The default connections use the horizontal bushing as the source side and the vertical bushing as the load side. Also, the horizontal bushing may be used as the load side and the vertical bushing as the source side. Note that reversing the source and load bushings has no effect on overcurrent protection but may require setting or wiring changes to the control for correct metering.

If equipped with internal voltage sensors, the horizontal bushings (1, 3, 5) must be connected to the source. The internal voltage sensors cannot monitor source-side voltage when the NOVA recloser is in the OPEN position if the horizontal bushings are connected to the load.

B. Provide surge arrester protection. Surge arrester protection should be provided on both sides; refer to Figure 9.

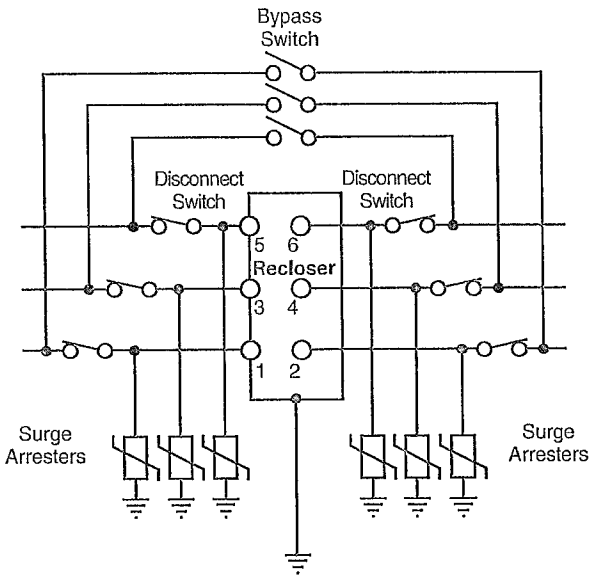


Figure 9.
Connection diagram shows complete surge protection and illustrates bypass and disconnect switches.

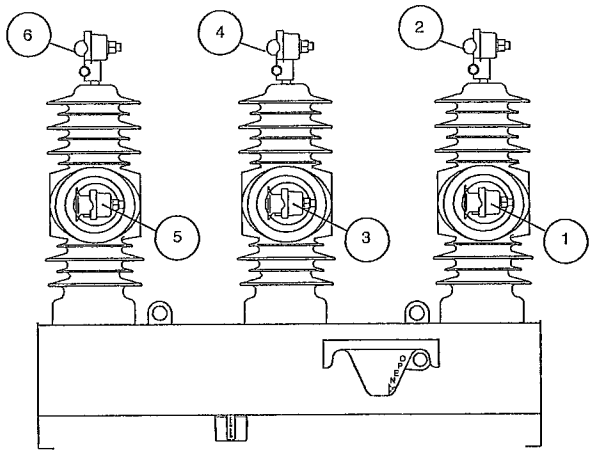


Figure 10.
Terminal identification of Type NOVA recloser.

Remove Recloser from Service

1. Block ground tripping via the control panel. Refer to the instructions for the control connected to the recloser.
2. Close all three bypass switches.
3. Pull down the yellow operating handle with a hotstick. The yellow operating handle is located under the recloser sleet hood.

   The control will sense that the recloser is open and provide OPEN/LOCKOUT indication on the front panel.
4. Open the source and load disconnect switches.
5. Disconnect the control battery.

CAUTION: Equipment misoperation. Disconnect all control power sources prior to disconnecting or reconnecting the control cable from the control. Failure to comply can result in recloser misoperation at the time of disconnection or reconnection of the control cable to the control. T311.1

IMPORTANT: Disconnect switches for AC sensing and power connections are necessary to isolate the control for testing and servicing.

6. Remove the control AC sensing and power connections from the control using a separate disconnect switch.

CAUTION: Hazardous voltage. Open CT secondaries can generate high voltages. Contact with CT pins of the disconnected cable can cause electric shock and may result in personal injury. Open recloser contacts and open disconnect switches before disconnecting control cable. T204.3

CAUTION: Hazardous voltage. Cable conductors attached to controls will remain at 53 VDC and 120 VAC potential while connected to the control. Contact with any pins at the end of the cable directly or indirectly connected to a control can result in personal injury or equipment damage. Disconnect battery and external power sources in the control then remove control cable at control end before disconnecting from recloser end. T312.2

7. Disconnect the control cable from the recloser.
8. Follow standard utility procedures regarding removal of recloser from service.
   - Cooper Power Systems recommends transporting NOVA reclosers in the closed position to maximize the operational performance of the unit.

Grounding the NOVA Recloser

IMPORTANT: In pole-mounted applications, a ground connection must be made between the recloser, transformer, recloser control, and SCADA equipment for proper protection of the equipment. The pole ground must be sized per local utility practices to minimize the impedance between the recloser and the control.

IMPORTANT: All external inputs to the control must be routed within 8 inches of their corresponding ground. During a surge, a potential of approximately 1.5 kV per foot can develop in the conductors. Differences between conductor and ground path lengths can add additional stress to the control components in the event of a power surge.

IMPORTANT: Any external voltage sensor installed with the NOVA recloser must have its ground referenced to the recloser ground.

3-Wire Ungrounded and Impedance Grounded Systems

The use of a grounding mat may be required depending upon the local safety regulations defining the permissible step and touch potential levels. Consult local regulations for proper grounding procedures.

Grounding with a Local Supply Voltage Transformer: 4-Wire Multi-Grounded, 3-Wire Ungrounded, or Impedance-Grounded

Installation with a local supply voltage transformer must include the following (refer to Figure 11):

- Protection of the recloser bushings and the supplying transformer with lightning arresters.
- Grounding of the recloser head and tank.
- Grounding of the transformer tank.
- Grounding of the control cabinet.
- Grounding of the SCADA equipment.

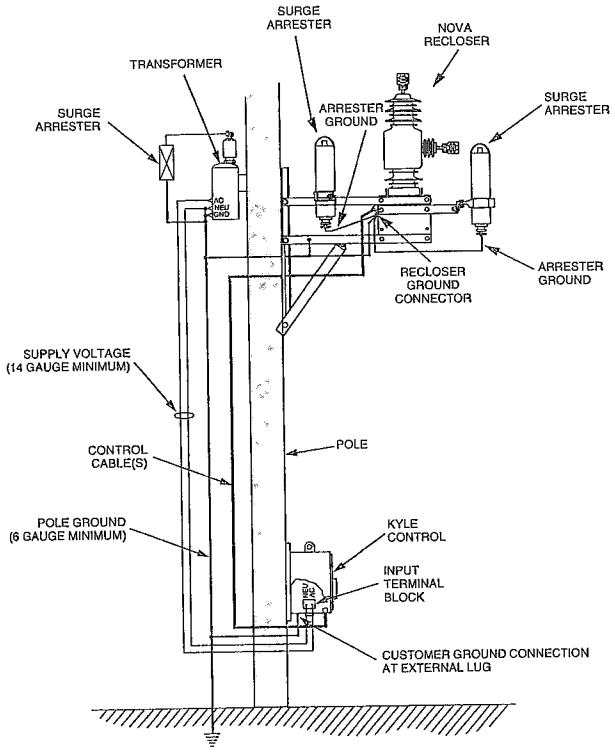


Figure 11.
Recommended grounding method for NOVA recloser with Cooper microprocessor-based control and local supply voltage transformer.

Grounding with a Remote Supply Voltage Transformer: 4-Wire Multi-Grounded, 3-Wire Ungrounded, or Impedance-Grounded

Installation with a remote supply voltage transformer must include the following (refer to Figure 12):

- Protection of the recloser bushings and the supplying transformer with lightning arresters.
- Grounding of the recloser head and tank.
- Grounding of the transformer tank.
- Grounding of the control cabinet.
- Grounding of the SCADA equipment.

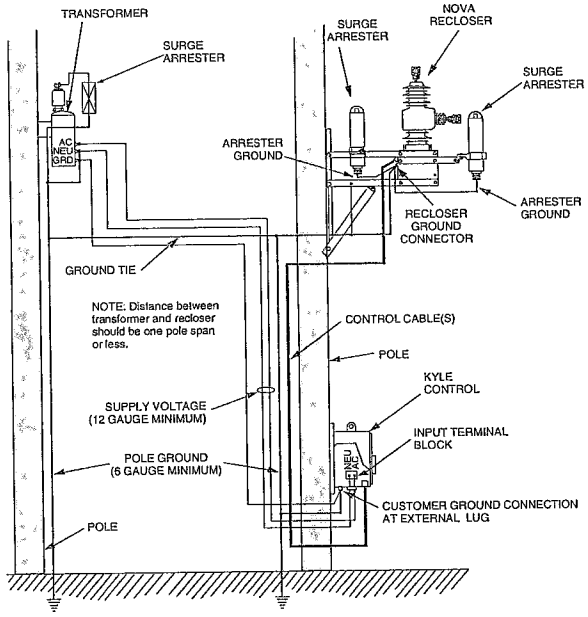


Figure 12.
Recommended grounding method for NOVA reclosers with Cooper microprocessor-based control and remote supply voltage transformer.

Grounding on a 3-Wire Uni-Grounded System

Installation on a 3-wire uni-grounded system must include the following (refer to Figure 13):

- Protection of the recloser bushings and the supplying transformer with lightning arresters.
- Grounding of the recloser head and tank.
- Grounding of the transformer tank.
- Grounding of the control cabinet.
- Grounding of the SCADA equipment.

WARNING: Hazardous Voltage. Use locally approved operator safety procedures for proper insulation when maintaining this equipment. High voltage step and touch potential is characteristic in uni-ground systems. Failure to comply can cause death or severe personal injury. T262.0

CAUTION: Exported Potential. Do not make direct electrical connections to remote devices. All SCADA equipment must be mounted locally or connected using the fiber-optic or radio communication accessory. Direct connections to remote devices can produce exported potential causing equipment damage or personal injury. T263.0

CAUTION: Hazardous Voltage. Do not use a shared low-voltage network to power the recloser control unless the network is specifically designed to withstand maximum ground potential rise. Ground faults on a high-voltage network can create a rise in ground potential. T264.0

IMPORTANT: In pole-mounted applications, a ground connection must be made between the recloser, transformer, recloser control, and SCADA equipment for proper protection of the equipment. The pole ground must be sized per local utility practices to minimize the impedance between the recloser and the control.

IMPORTANT: All external inputs to the control must be routed within 8 inches of their corresponding ground. During a surge, a potential of approximately 1.5 kV per foot can develop in the conductors. Differences between conductor and ground path lengths can add additional stress to the control components in the event of a power surge.

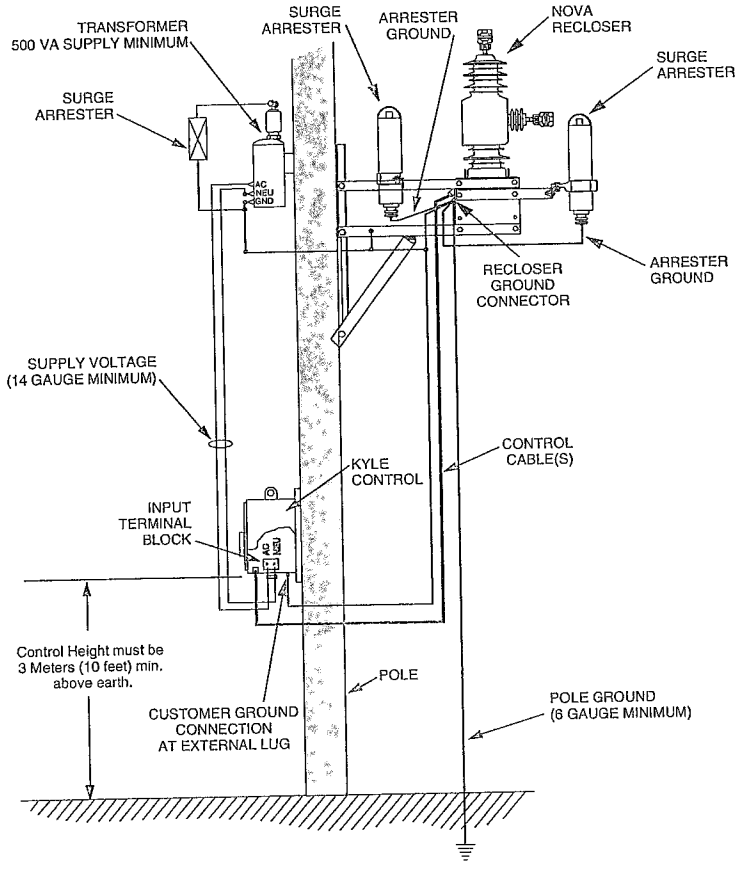


Figure 13.
Recommended grounding method for NOVA reclosers with Cooper microprocessor-based control on a 3-wire uni-grounded system.

OPERATION

WARNING: This equipment is not intended to protect human life. Follow all locally approved procedures and safety practices when installing or operating this equipment. Failure to comply can result in death, severe personal injury, and equipment damage. G102.1

WARNING: Hazardous voltage. Do not rely on the open position of the yellow operating handle or the contact position indicator; it does not ensure that the line has been de-energized. Always establish a visible disconnect. Failure to follow proper safety practices can result in contact with high voltage, which will cause death or severe personal injury. G114.1

Electrical Operation

The Type NOVA recloser utilizes an interface circuit located in the mechanism housing. The electronic interface circuit controls the opening and closing signals to the magnetic actuator. Both control-powered and auxiliary-powered interface options are available. Refer to Figures 26, 27, and 28 for wiring diagrams.

OPEN/CLOSE Contact Position Indicator

WARNING: Hazardous voltage. Never rely on the open position of the operating handle or the contact position indicator; it does not ensure that the line is de-energized. Follow all locally approved safety practices. Failure to comply can result in contact with high voltage, which will cause death or severe personal injury. G123.1

The OPEN/CLOSE contact position indicator consists of a red CLOSED and a green OPEN indicator located on the bottom of the mechanism housing (Figure 14).

Hotstick Operation (Manual Open, Electrical Close

WARNING: Hazardous voltage. Always use a hotstick when working with this equipment. Failure to do so could result in contact with high voltage, which will cause death or severe personal injury. G108.1

The recloser may be opened manually by using a hotstick to pull down the yellow manual OPEN handle, located on the front of the recloser (Figure 14). To close the recloser after a manual opening, first, push the yellow manual open handle up. Then, using the microprocessor control, close the recloser.

IMPORTANT: If the yellow manual OPEN handle remains in the down position, the recloser cannot be closed electrically.

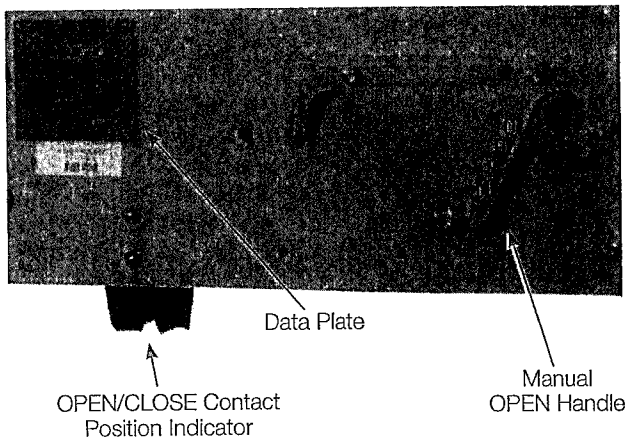


Figure 14.
Type NOVA recloser OPEN/CLOSE contact position indicator, data plate, and manual OPEN handle.

INTERNAL VOLTAGE SENSING OPTION

Installation

WARNING: This equipment is not intended to protect human life. Follow all locally approved procedures and safety practices when installing or operating this equipment. Failure to comply can result in death, severe personal injury, and equipment damage. G102.1

WARNING: Hazardous voltage. Always use a hotstick when working with this equipment. Failure to do so could result in contact with high voltage, which will cause death or severe personal injury. G108.1

WARNING: Hazardous voltage. Solidly ground all equipment. Failure to comply can result in death, severe personal injury, and equipment damage. T223.2

IMPORTANT: Disconnect switches for AC control power are necessary to isolate the control for testing and servicing.

WARNING: Hazardous voltage. If terminal connections are reversed, the internal voltage sensing option may indicate zero voltage with the contacts open. Do not rely on internal voltage sensing to ensure that the voltage is zero and the line has been de-energized. Always follow proper safety practices and use a separate detection method to verify a de-energized condition. Failure to do so can result in contact with high voltage, which will cause death or severe personal injury. T365.0

CAUTION: Equipment damage may occur if torque values are exceeded. T370.0

The internal voltage sensors use a resistive voltage divider to provide a low-voltage input to the NOVA recloser control.

Refer to the **Installation** section of this manual for information on the NOVA recloser installation procedure.

- Refer to *S280-104-1* for further information on installing the Form 4D control.
- Refer to *S280-79-10* for further information on installing the Form 5 control.
- Refer to *S280-70-3* for further information on installing the Form 6 Pole-Mount control.

Make voltage-sensing-option connections when installing the control as indicated in these Service Information manuals.

Verify correct grounding of the NOVA recloser and control prior to making any high-voltage connections and before high-potential testing. A proper ground connection consists of a good electrical ground connection to the surge ground connector located on the mechanism housing. Provide a good electrical ground connection to the control cabinet ground.

Note: Painted surfaces of the mechanism housing may prevent a ground connection to the recloser housing. Always provide a good electrical connection to the mechanism surge ground connector.

Poor grounding of the mechanism housing may result in the presence of high voltage on the mechanism housing associated with the high-voltage resistor connections used with internal voltage sensing.

To ensure proper installation of this cable, securely fasten the aluminum cable coupler ring.

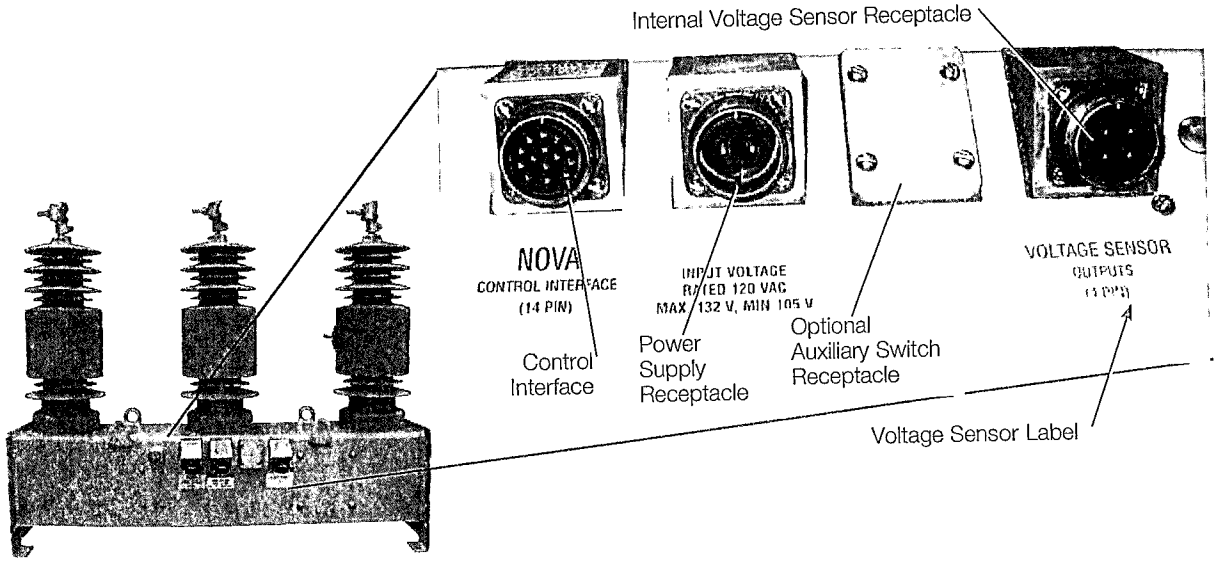


Figure 15.
Type NOVA recloser cable receptacles with internal voltage sensing option. (Type NOVA recloser with 14-pin control interface shown.

CAUTION: Hazardous voltage. Do not touch the receptacle connections of the control/voltage-sensing cable. If the recloser is energized and the control/voltage-sensing cable is disconnected from the recloser or the control, a voltage clamped at 250 VAC will be present at the receptacle. Contact with this voltage can result in personal injury. T346.1

The recloser is equipped with a 4-pin female receptacle (Figure 15) that connects to the control with a shielded, 4-conductor cable. The control accessory includes a 4-pin male receptacle on the control and appropriate circuitry; refer to Figures 16, 17, and 18.

CAUTION: Equipment misoperation. Verify all connector pins and both mating interface surfaces are clean and dry before connecting cables. Voltage sensing errors can result from contamination. Failure to comply can result in control and recloser misoperation. G142 0

The electrical connectors of the recloser, control, and cable must be clean and dry. Contaminated surfaces may be cleaned with denatured alcohol and wet connector surfaces may be dried with a heat gun. Dry surfaces are particularly important for the internal voltage sensor cable connections. The accuracy of the sensors can be influenced by moisture contamination.

CAUTION: Equipment misoperation. Do not connect this control to an energized recloser until all control settings have been properly programmed and verified. Refer to the programming information for this control. Failure to comply can result in control and recloser misoperation, equipment damage, and personal injury. G110.3

Connect control cables, power cables, and sensor cables to the control. Verify that the proper cable/receptacle connections are made. Improper cable connections can result in damage to the recloser and/or control.

Complete the control programming before making the high-voltage line connections. Refer to the **Operation** section of this manual. Verify the correct voltage rating of the equipment. Verify the correct control programming for ratio and phase angle correction for the voltage rating of the equipment.

Make appropriate electrical connections to the terminals of the recloser. Verify the correct load-side (vertical bushings) and source-side (horizontal bushings) terminal connections. This is required for correct operation of the internal voltage sensor. Energize recloser and confirm the voltage outputs in the control.

When the recloser is energized, the voltage sensing output signal to the control is approximately 6 V (depending on the primary voltage). If the sensor cable is disconnected at either the control or the recloser, the voltage sensing output signal is 250 VAC. The receptacles on both the NOVA recloser and the voltage sensing cable (control end) are 4-pin female connectors to minimize accidental contact with the voltage sensor outputs. The recloser control input impedance to the voltage sensors lowers the voltage to 6 V during normal operation.

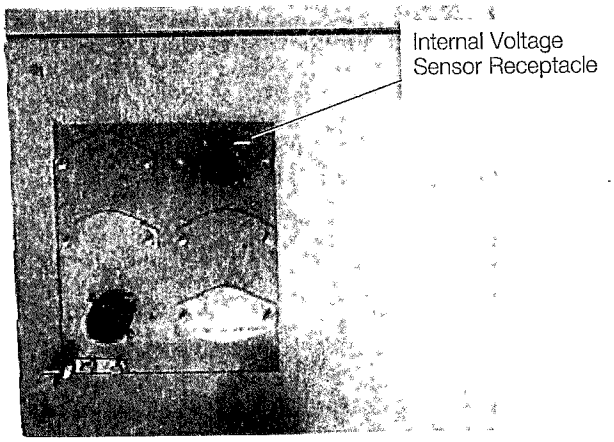


Figure 16.
Form 4D control Voltage Sensor receptacle.

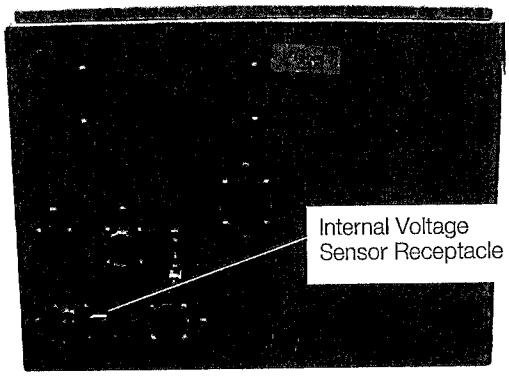


Figure 17.
Form 5 control Voltage Sensor receptacle.

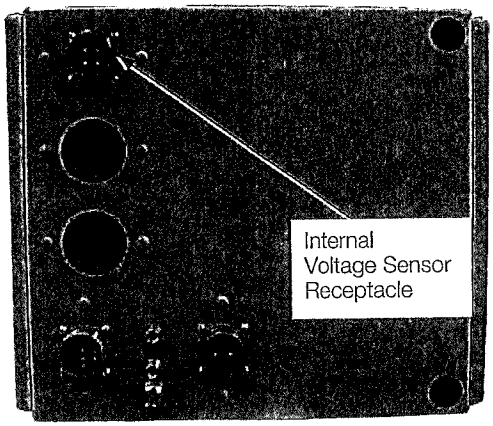


Figure 18.
Form 6 control Voltage Sensor receptacle.

Operation

Form 5 Control Settings

The Form 5 control must be programmed with an adjusted voltage sensor ratio and a phase angle correction; refer to Tables 8 and 9. These are entered in the Form 5, Voltage Sensor Parameters screen (Figure 19).

The Form 5 control Recloser Interface (RIF) module must be set to 12 V for the source side bushings. (The load side bushings are not configured to work with the internal voltage sensing option and are set as described in the Form 5 Programming Guide.) Also, the Phantom Phase feature can not be enabled on the Form 5 control when using the voltage sensing option.

- Refer to *Service Information S280-79-10* for installation and operation information of the Form 5 control.
- Refer to *Service Information S280-79-2* for more information on programming the Form 5 control.

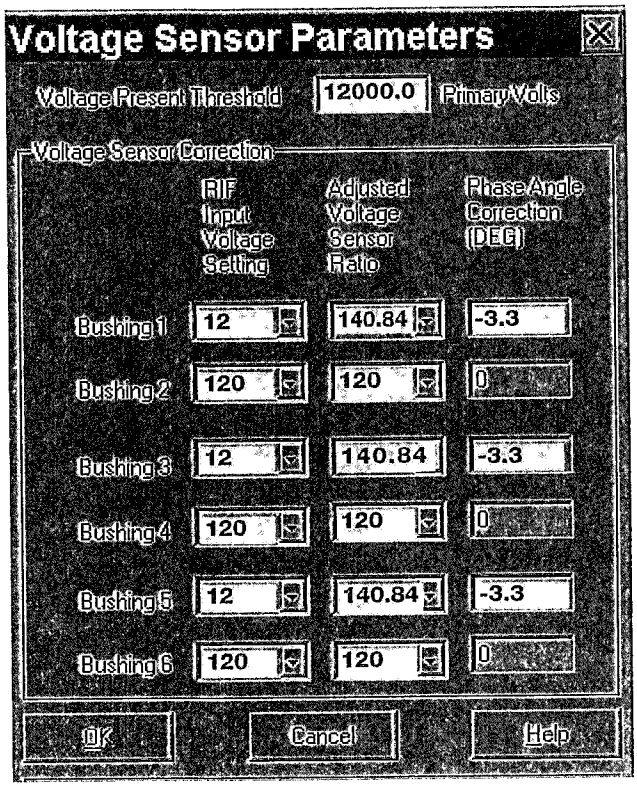


Figure 19.
Form 5 control Voltage Sensor Parameters screen.

TABLE 8
Adjusted Voltage Sensor Ratio/PT Ratio

Recloser	Recloser Control		
	Form 4D PT Ratio	Form 5 Adj. Voltage Sensor Ratio	Form 6 PT Ratio
NOVA 15	1175:1	140.84:1	1100:1
NOVA 27	2360:1	281.69:1	2200:1
NOVA 38	2360:1	281.69:1	2200:1

TABLE 9
Phase Angle Adjustment

Voltage Sensor Cable Length*	Phase Shift, NOVA 15		
	Form 4D	Form 5	Form 6
3.05 m (10 ft.)	-2.9°	-3.3°	-177.8°
6.10 m (20 ft.)	-3.5°	-4.1°	-177.0°
9.15 m (30 ft.)	-4.1°	-4.9°	-176.2°
12.2 m (40 ft.)	-4.7°	-5.7°	-175.4°
15.25 m (50 ft.)	-5.3°	-6.5°	-174.6°
	Phase Shift, NOVA 27 and NOVA 15 with extended BIL		
	Form 4D	Form 5	Form 6
3.05 m (10 ft.)	-3.3°	-4.0°	-176.0°
6.10 m (20 ft.)	-3.9°	-4.8°	-175.2°
9.15 m (30 ft.)	-4.5°	-5.6°	-174.4°
12.2 m (40 ft.)	-5.0°	-6.4°	-173.6°
15.25 m (50 ft.)	-5.6°	-7.2°	-172.8°
	Phase Shift, NOVA 38 and NOVA 27 with extended BIL		
	Form 4D	Form 5	Form 6
3.05 m (10 ft.)	-5.9°	-6.6°	-174.2°
6.10 m (20 ft.)	-6.5°	-7.4°	-173.4°
9.15 m (30 ft.)	-7.1°	-8.2°	-172.6°
12.2 m (40 ft.)	-7.7°	-9.0°	-171.8°
15.25 m (50 ft.)	-8.3°	-9.8°	-171.0°

Note: For Form 4D controls, the phase shift is adjusted -0.6° for each additional 3.05 m (10 ft.) of cable.

For Form 5 controls, the phase shift is adjusted -0.8° for each additional 3.05 m (10 ft.) of cable.

For Form 6 controls, the phase shift is adjusted +0.8° for each additional 3.05 m (10 ft.) of cable.

Note: Form 4D controls running firmware version 1.2.0 or newer use the Phase Angle Adjustment(s) listed in Table 9. Form 4D controls running previous versions of firmware will require adding 180 degrees of phase shift to the listed values in table 9.

*Maximum cable length is 15.25 m (50 ft.).

Form 4D and Form 6 Control Settings

The Form 4D and Form 6 controls must be programmed with a PT ratio and a phase angle adjustment; refer to Tables 8 and 9. These are entered in the System Configuration screen (Figures 20 and 21).

When programming either control, the PT connection must be set for a Wye connection. Also, the Phantom Phase feature must be disabled.

- Refer to *Service Information S280-104-2* for more information on programming the Form 4D control.
- Refer to *Service Information S280-70-4* for more information on programming the Form 6 control.

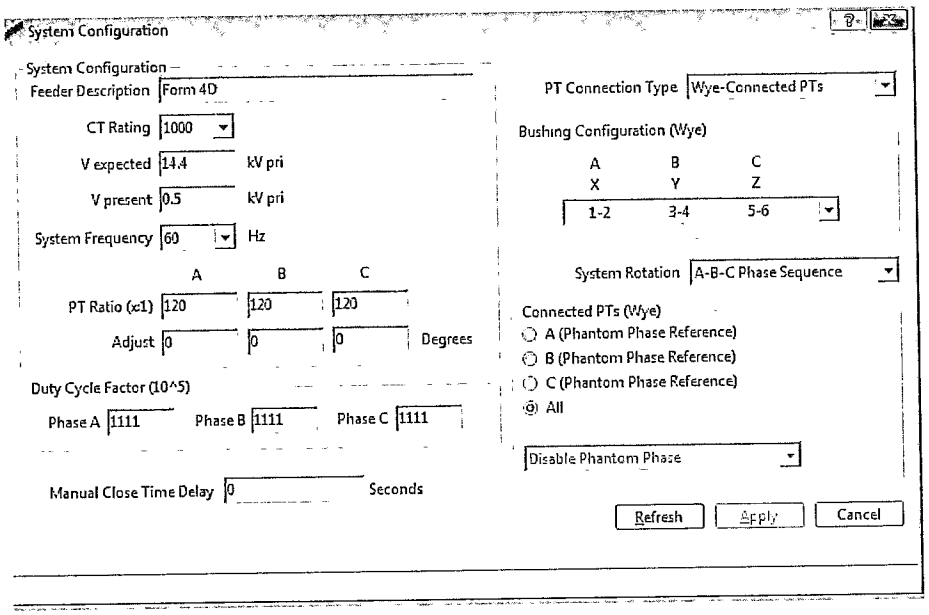


Figure 20.
Form 4D control System Configuration screen.

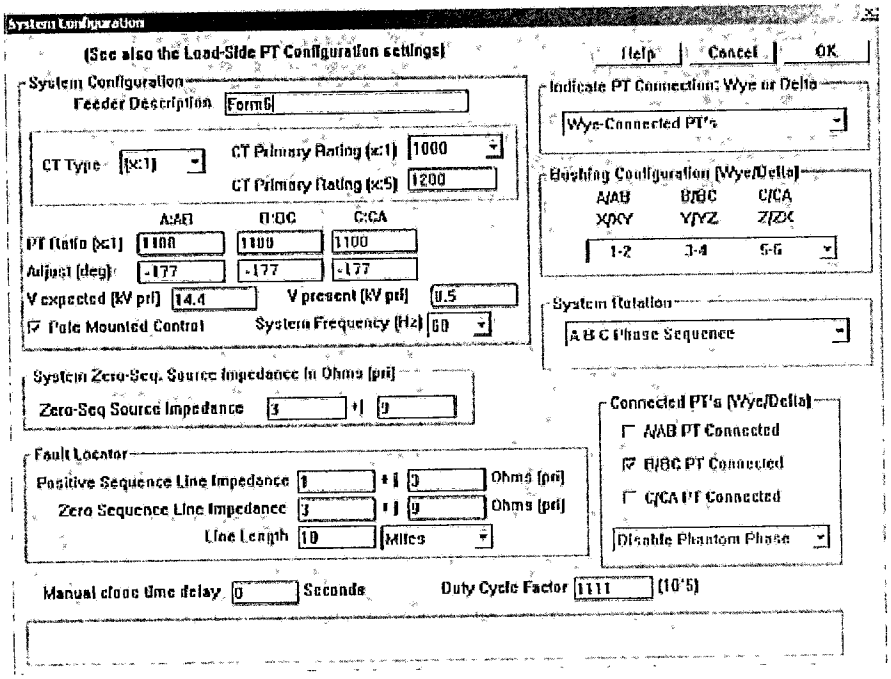


Figure 21.
Form 6 control System Configuration screen.

ACCESSORIES

Auxiliary Switch

A three-stage auxiliary switch can be provided as an accessory. Each stage has two independent contacts that permit any desired combination of "a" (follow state of recloser contacts) and "b" (opposite recloser contacts) positions. The switch contacts are insulated for 600 V and have a continuous current rating of 10 A. Their interrupting ratings are shown in Table 10.

TABLE 10
Auxiliary Switch Interrupting Ratings

Volts	Inductive ac (A)	Non-Inductive ac (A)	Inductive dc (A)	Non-Inductive dc (A)
24	—	—	15.0	20.0
48	—	—	7.5	10.0
120	60	80	—	—
125	—	—	1.5	2.0
240	30	60	—	—
250	—	—	0.45	0.5

Terminals

The standard terminal is an eyebolt, 1/0—500 mcm (630 A). Eyebolt, 4/0—1000 mcm (800 A), 2-hole and 4-hole flat- pad terminals, and stud-type terminals are available as an accessory (Figure 22).

The eyebolt, flat-pad, and stud terminals are made of copper alloys. Cooper Power Systems recommends terminal connection to copper wires to optimize the electrical connection. Aluminum cables may produce aluminum oxide sufficient to compromise the electrical connections.

Anti-oxide coatings for temporary protection of wire-brushed, aluminum cable connections to flat-pad or stud terminals must be maintained at intervals determined by the customer based on load current, climate, and other installation conditions.

Eyebolt terminals are recommended for copper conductors only.

Pole-Mounting Hanger

A pole-mounting hanger (Figure 22), which bolts directly to the recloser frame, is available for pole-mounting installation.

Terminal Options	A
Eyebolt, 1/0 - 500 mcm Cable Range (630 A maximum)	80 (3.25)
Eyebolt, 4/0 - 1000 mcm Cable Range (800 A maximum)	108 (4.25)
Flat Pad, 2-hole (630 A maximum)	114 (4.5)
Flat Pad, 4-hole (800 A maximum)	121 (4.75)
Stud Type, 1.125 - 12 threads (800 A maximum)	82 (3.25)

Note: All dimensions are mm (inches). Dimensions shown are approximate.

	Dimension B
NOVA 15 110 kV BIL	791 (31.25)
NOVA 15 125 kV BIL	847 (33.25)
NOVA 27 125 kV BIL	847 (33.25)
NOVA 27 150 kV BIL	946 (37.25)
NOVA 38 170 kV BIL	946 (37.25)

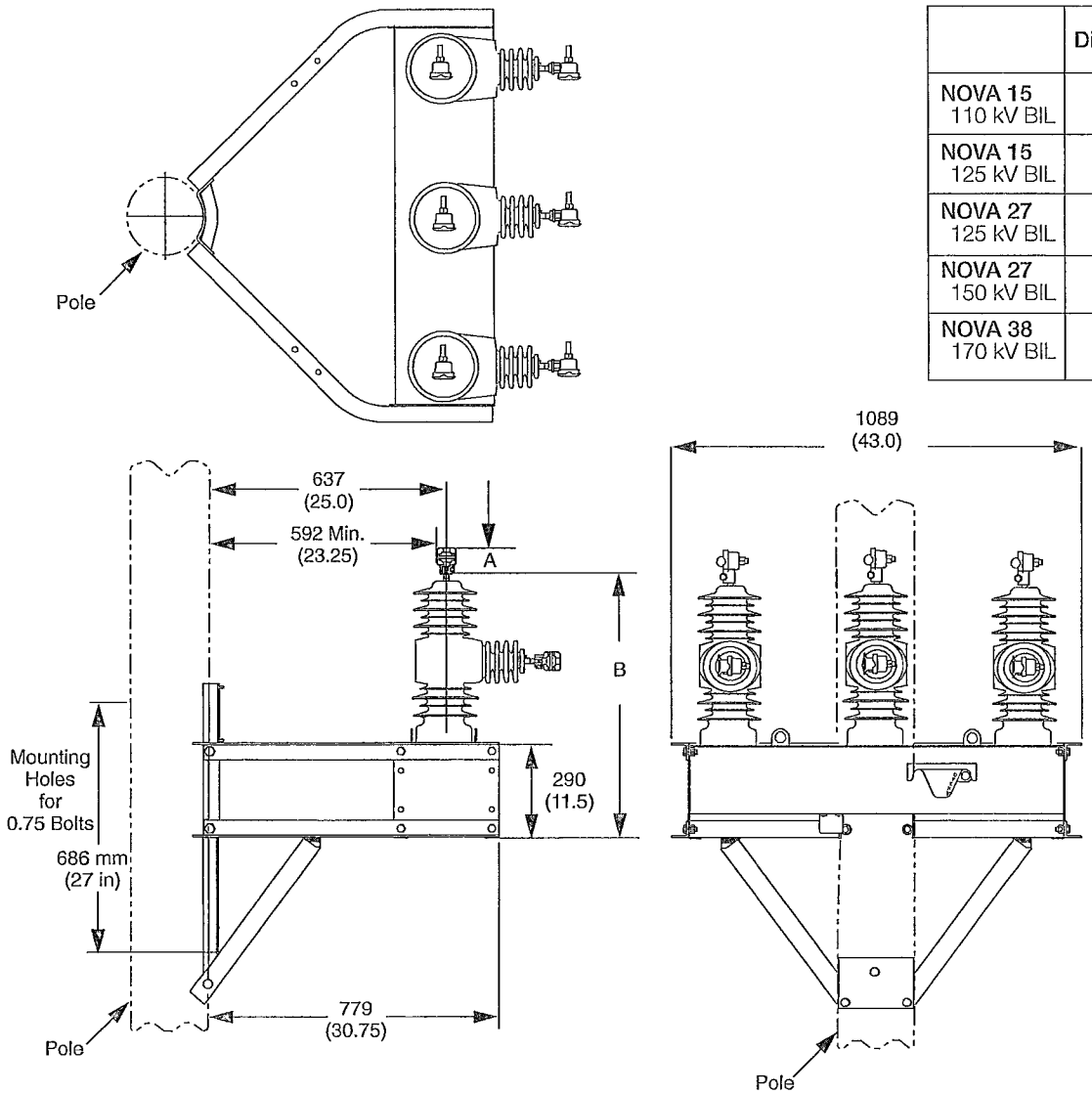
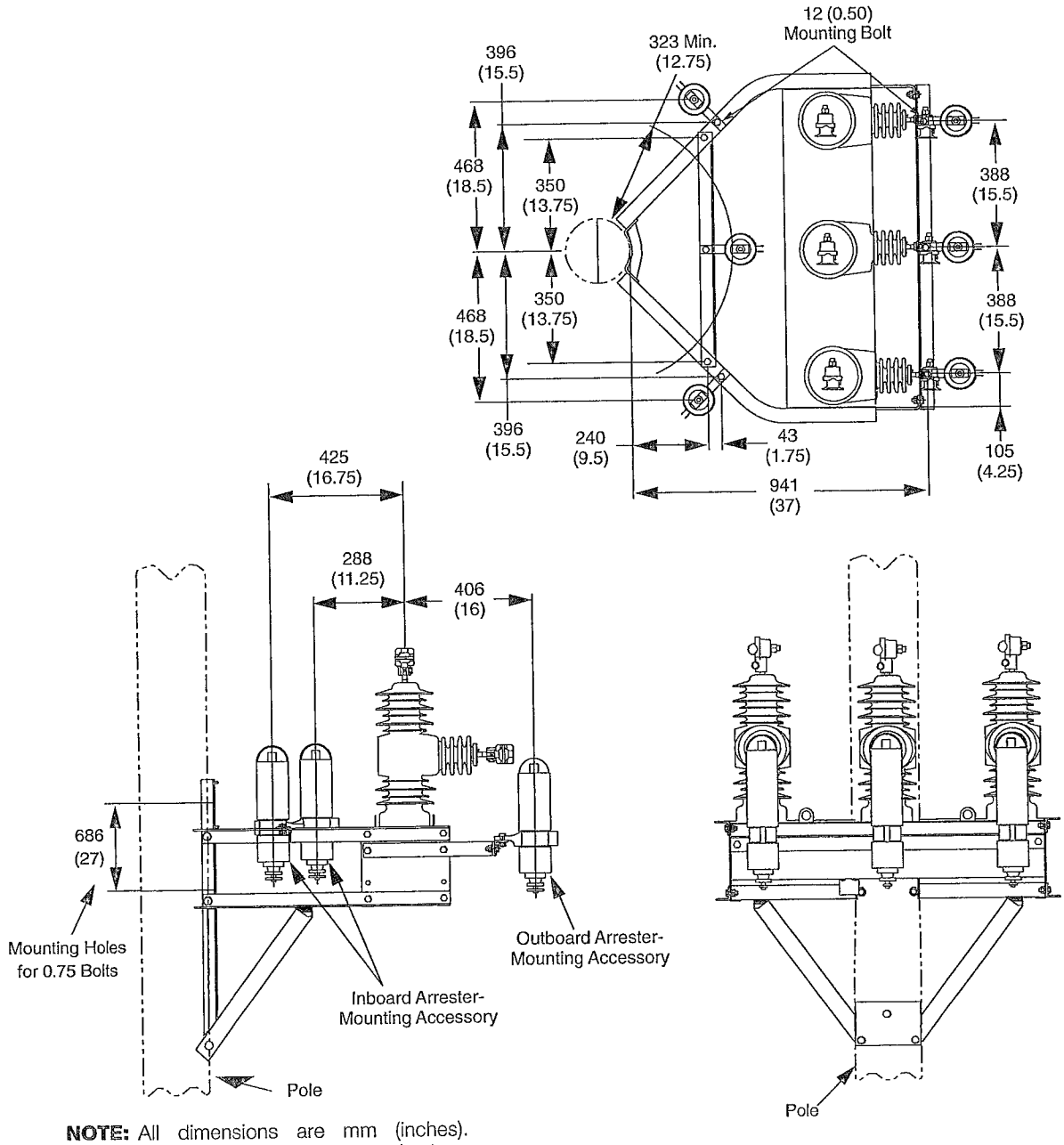


Figure 22.
Dimensions of Type NOVA recloser with pole-mounting hanger accessory.

Arrester-Mounting Brackets

The arrester-mounting bracket accessory (Figure 23) can be bolted to the recloser frame and pole-mounting hanger for the addition of inboard and outboard arresters. The arresters are not included with the brackets.



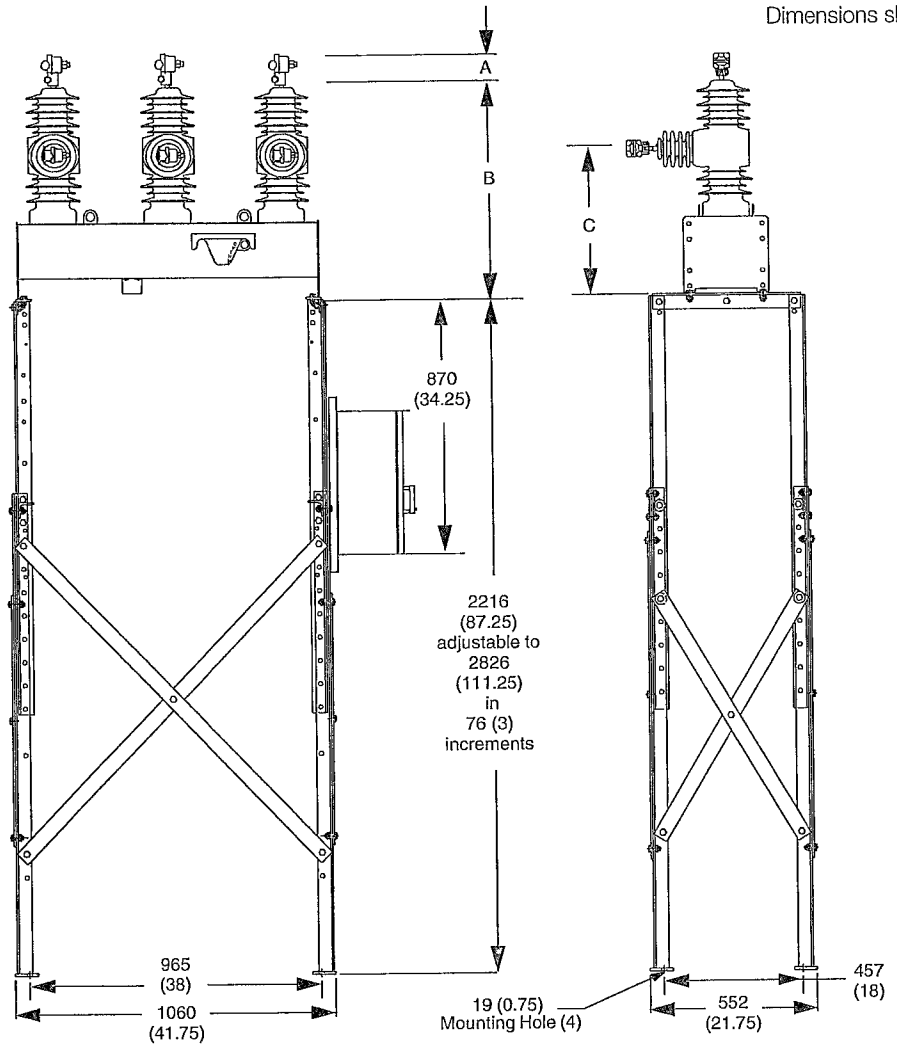
NOTE: All dimensions are mm (inches). Dimensions shown are approximate.

Figure 23.
Dimensions of Type NOVA recloser with pole-mounting hanger and arrester-mounting bracket accessories.

Substation-Mounting Frame

A substation-mounting frame accessory (Figure 24) is available for substation-mounting applications.

Note: All dimensions are mm (inches). Dimensions shown are approximate.



Terminal Options	A
Eyebolt, 1/0 - 500 mcm Cable Range (630 A maximum)	80 (3.25)
Eyebolt, 4/0 - 1000 mcm Cable Range (800 A maximum)	108 (4.25)
Flat Pad, 2-hole (630 A maximum)	114 (4.5)
Flat Pad, 4-hole (800 A maximum)	121 (4.75)
Stud Type, 1.125 - 12 threads (800 A maximum)	82 (3.25)

	B	C
NOVA 15 110 kV BIL	791 (31.25)	508 (20)
NOVA 15 125 kV BIL	847 (33.25)	564 (22.25)
NOVA 27 125 kV BIL	847 (33.25)	564 (22.25)
NOVA 27 150 kV BIL	946 (37.25)	663 (26.0)
NOVA 38 170 kV BIL	946 (37.25)	663 (26.0)

Figure 24.
Dimensions of Type NOVA recloser with substation-mounting frame accessory.

SERVICE INFORMATION

Service Requirements

The Type NOVA recloser has been designed with a minimum mechanical life of 10,000 operations. The NOVA recloser should be inspected every ten years to check for physical damage and verify proper operation.

Frequency of Inspection

Because these reclosers are applied under widely varying operating and climatic conditions, service intervals are best determined by the user based on actual operating experience. However, solid-insulated, vacuum-interrupting reclosers should be inspected every ten years.

Testing Operation

This recloser is used with Cooper Power Systems microprocessor-based recloser controls. Refer to the control operation manual.

WARNING: This equipment is not intended to protect human life. Follow all locally approved procedures and safety practices when installing or operating this equipment. Failure to comply can result in death, severe personal injury and equipment damage. G102.1

1. **Check the data plate ratings.** Make sure the ratings, settings, and interface options on the recloser data plate (Figure 14 and Table 7) are correct for the planned testing.
2. **Test electrical open and close operation.** Close and open the recloser contacts using the microprocessor control. Confirm that the contacts have closed and opened by:
   A. The OPEN/CLOSE contact position indicator, or
   B. By a continuity check between the recloser terminals.
3. **Test manual open.** Pull the yellow manual open handle (Figure 14) down to open the recloser contacts. Confirm that the contacts have opened by:
   A. The OPEN/CLOSE contact position indicator
   OR
   B. By a continuity check between the recloser terminals.
4. **To close the recloser contacts:**
   A. First, push the yellow manual open handle up.
   B. Close the recloser using the microprocessor-based control.

Note: When manual close and open operations are being performed from the control front panel, it is recommended to wait 60 seconds after every fourth close/open operation. This recommendation also applies if conducting four operations with fault current applied to the unit.

High-Potential Withstand Testing

The following equipment is required for this test:

High-voltage test set – Must be capable of supplying suitable voltages for determining the dielectric withstand capability of the recloser. Sensitive circuit breakers should be included to prevent damage in the event of a flashover.

Note: Test results for NOVA reclosers equipped with the internal voltage sensing option will be influenced by the source-to-ground connected sensing resistor, especially if DC high-potential testing is performed.

WARNING: Hazardous voltage. The switchgear (apparatus and control) and high-voltage transformer must be in a test cage or similar protected area to prevent accidental contact with the high-voltage parts.

Solidly ground all equipment. Failure to comply can result in death, severe personal injury, and equipment damage. T221.5

CAUTION: Radiation. At voltages up to the specified test voltages, the radiation emitted by the vacuum interrupter is negligible. However, above these voltages, radiation injurious to personnel can be emitted. See *Service Information S280-90-1, Vacuum Interrupter Withstand Test Voltage Ratings Information* for further information. G109.2

Use the following procedures to perform high-potential withstand tests at 75% of the rated low-frequency withstand voltage for 60 seconds. Refer to Table 11 for test voltages and Figure 25 for test connection diagrams.

Test results for NOVA reclosers equipped with the internal voltage sensing option will be influenced by the source-to-ground connected sensing resistor.

TABLE 11
Type NOVA Recloser Withstand Test Voltage Ratings Information

75% of Rated Low-Frequency Withstand Voltage (1 minute dry) (kV rms)		
Description	AC	DC
NOVA-15	37.5	53.0*
NOVA-27	45.0	63.6†
NOVA-38	52.5	74.2**

*Approximately 0.53 mA additional leakage current per phase with internal voltage sensors.

†Approximately 0.32 mA additional leakage current per phase with internal voltage sensors.

**Approximately 0.37 mA additional leakage current per phase with internal voltage sensors.

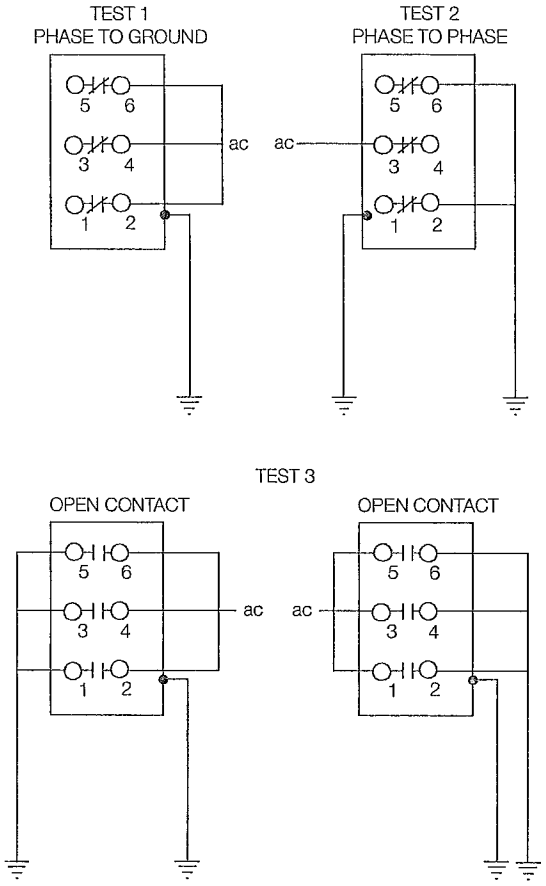


Figure 25.
Connection diagrams for high-potential withstand testing.

Test 1

1. Close the recloser contacts.
2. Ground the recloser.
3. Connect terminals 2, 4, and 6 (see Figure 10) together.
4. Apply proper test voltage (see Table 11) to terminals 2, 4, and 6.
5. The recloser should withstand the test voltage for 60 seconds.

Test 2

1. Close the recloser contacts.
2. Ground the recloser.
3. Ground terminal 2 and terminal 6.
4. Apply proper test voltage to terminal 3.
5. The recloser should withstand the test voltage for 60 seconds.

Test 3

1. Open the recloser contacts.
2. Ground the recloser.
3. Connect and ground terminals 1, 3, and 5 (see Figure 10).
4. Connect terminals 2, 4, and 6.
5. Apply proper test voltage to terminals 2, 4, and 6.
6. The recloser should withstand the test voltage for 60 seconds.
7. Reverse the connections: ground terminals 2, 4, and 6.
8. Apply test voltage to terminals 1, 3, and 5 for 60 seconds.
9. The recloser should withstand the test voltage for 60 seconds.

Withstand Test Results

The high-potential withstand tests provide information on the dielectric condition of the recloser and the vacuum integrity of the interrupters.

If the recloser passes the closed-contacts tests (Tests 1 and 2), but fails the open-contacts test (Test 3), the cause is likely to be in the interrupter assembly. Retest each phase individually to determine the failed phase or phases.

If a recloser fails the closed-contacts test, the cause is likely to be a diminished electrical clearance or failed insulation.

If the recloser does not pass Tests 1, 2, or 3, contact an authorized service center or your Cooper Power Systems representative.

Note: Test results for NOVA reclosers equipped with the internal voltage sensing option will be influenced by the source-to-ground connected sensing resistor, especially if DC high-potential testing is performed.

Module Flashover Service

If a NOVA recloser module was exposed to an external flashover, an inspection process is recommended to assure proper operation of the recloser. Should the NOVA recloser exhibit external flashover attributes (carbon tracking or discoloration), the following procedure is recommended:

1. Bypass and remove the recloser from service as described in this manual.
2. Confirm the dielectric strength of the recloser by performing high-potential withstand test. Refer to the **High-Potential Withstand Testing** section of this manual.
3. Inspect the housing and lifting lugs for damage that may affect electrical and/or mechanical performance. If there is damage to either the housing or lifting lugs they must be replaced or repaired.
4. Inspect module for damage to the terminals. Remove any damaged terminals and replace.
5. Inspect module for damage to the module conductor rods (0.63" diameter threaded rods on top and side of module for affixing terminals). If there is damage to the module rods, the module must be replaced. Contact an authorized service center or your Cooper Power Systems representative.
6. Inspect the operating rod for damage. If there is damage to the operating rod, the module must be replaced. Contact an authorized service center or your Cooper Power Systems representative.
7. If no damage is found, clean the module with isopropyl alcohol and a scratch-free, nylon scouring pad to remove any carbon deposit.
8. Before returning to service confirm electrical operation by opening and closing the recloser with a control. Confirm the dielectric strength of the recloser by performing a high-potential withstand test. Refer to the **High-Potential Withstand Testing** section of this manual.

TROUBLESHOOTING

If the Type NOVA recloser does not perform as described in the OPERATION section of this manual, the following information may assist in troubleshooting:

Unit Will Not Close

- Make sure the yellow manual open handle is completely up.
- Check all cables for proper connection.
- Verify that the control has power.
- Upon loss of AC power, check recloser control battery level.
- For NOVA reclosers with the auxiliary-powered interface, verify that auxiliary power is present at recloser.
- For NOVA reclosers with the control-powered interface, check the fusing on the DC-to-DC converter board located in the control cabinet.

Unit Will Not Open Electrically

- Check all cables for proper connection.
- Verify that the control has power.
- For NOVA reclosers with the auxiliary-powered interface, verify that auxiliary power is present at recloser.
- For NOVA reclosers with the control-powered interface, check the fusing on the DC-to-DC converter board located in the control cabinet.

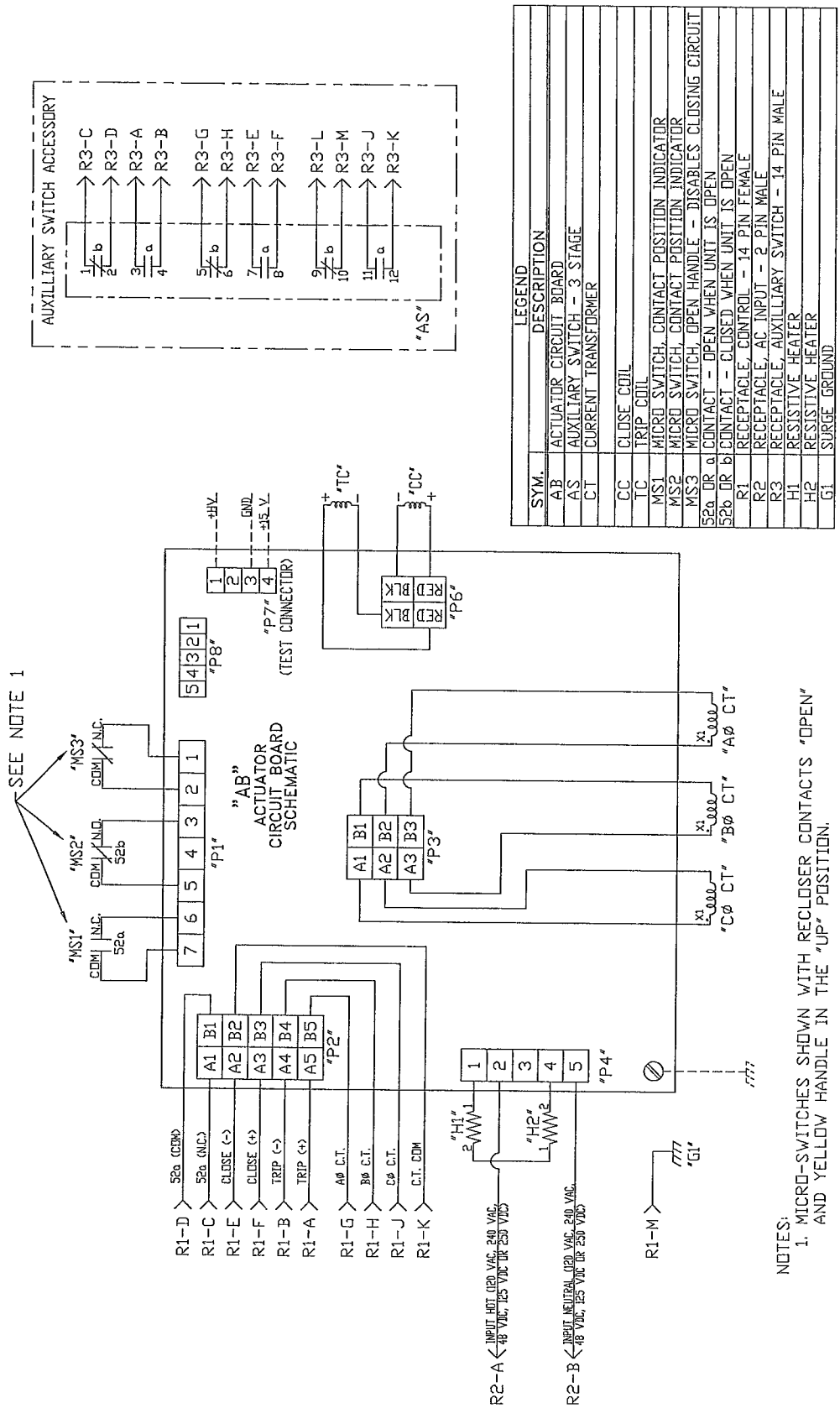


Figure 26.
Wiring diagram for NOVA recloser mechanism with auxiliary-powered interface.

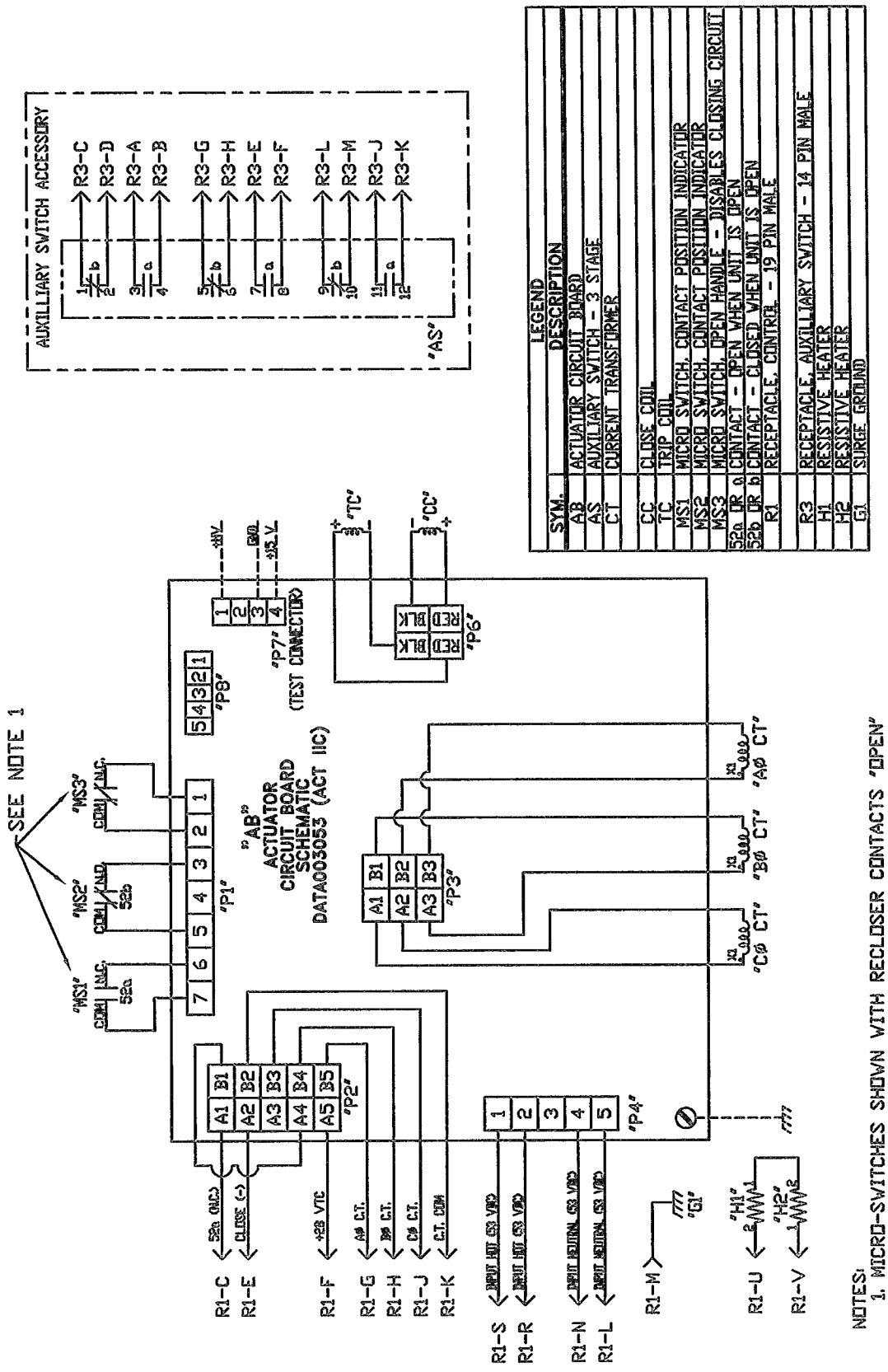


Figure 27.
Wiring diagram for NOVA recloser mechanism with control-powered interface.

COOPER Power Systems

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Waukesha, WI 53188 USA

EXHIBIT OPL-2

SEL-351-5, -6, -7 Protection System

Optimize Protection, Automation, and Breaker Control

SEL-351 Protection System shown with front-panel USB port and SafeLock™ trip/close pushbuttons with high-visibility breaker status LEDs.

New for 2012

- Second harmonic blocking secures relay during transformer energization.
- Rate-of-change-of-frequency element helps detect sudden frequency changes to initiate load shedding or network decoupling.
- High-speed breaker failure element and native breaker failure logic enhance breaker failure detection.
- Store up to 750 KB of design files on-board, including ACSELERATOR QuickSet settings file, ACSELERATOR QuickSet Design Template, or anything else you choose.

Major Features and Benefits

The SEL-351 Protection System provides an exceptional package of protection, monitoring, control, and fault locating features.

- **Protection Functions**
  - Phase, negative-sequence, residual-ground, and neutral-ground overcurrent elements with directional control optimize radial and looped network protection for lines and equipment. Load encroachment logic provides additional security to distinguish between heavy load and three-phase faults.
  - Implement load shedding and other control schemes with under/overfrequency and under/overvoltage elements and powerful SELOGIC® control equations.
  - Built-in communications-assisted trip scheme logic permits fast trip times, reducing fault duration that adversely impacts system loads and power system equipment.

- SELOGIC control equations permit custom programming for traditional and unique protection and control functions.
- Directional power elements on SEL-351-7.
- Four levels of rate-of-change-of-frequency elements help detect rapid frequency changes to initiate load shedding or network decoupling.

Automatic Reclosing and Synchronism Check

- Program as many as four shots of automatic reclosing with two selectable reclose formats.
- Control reclosing schemes for trip saving or fuse saving, and inhibit reclosing for hot line maintenance.
- Supervise manual or automatic reclosing with synchronism-check and voltage condition logic.

Operator Interface and Controls

- Target LEDs annunciate trip and status indication.
- Two-line rotating LCD display provides added operator information with programmable display points.
- Optional SafeLock™ trip/close pushbuttons with high-visibility breaker status LEDs eliminate expensive panel-mounted breaker control switches and position indicating lights. The breaker status LED clusters are bright and easy to see from all viewing angles.

Relay and Logic Settings Software

- ACSELERATOR QuickSet® SEL-5030 software reduces engineering costs for relay settings and logic programming. Graphical tools in ACSELERATOR QuickSet make it easy to develop SELOGIC control equations.
- Store any number of files inside one compressed file up to 750 KB, or use ACSELERATOR QuickSet to automatically store an ACSELERATOR QuickSet Design Template and relay settings database directly on the relay.

Metering, Monitoring, Synchrophasor Measurements, Power Quality, and Fault Locator

- Built-in, high-accuracy metering and harmonic metering functions eliminate expensive, separately mounted metering devices. Load Profile recording on SEL-351-6 and SEL-351-7.
- Improve maintenance scheduling using circuit breaker contact wear, breaker mechanical and electrical operate times, and substation battery voltage monitors. Use alarm elements to inhibit reclosing and provide local and remote alarm indication.
- Analyze Sequential Events Recorder (SER) reports and oscillographic event reports for rapid commissioning, testing, and post-fault diagnostics. Unsolicited SER protocol allows station-wide collection of binary SER messages with original time stamp for easy chronological analysis.
- Synchrophasor measurements improve overall system operator awareness of impending system conditions. Use real-time data to view load angles, improve event analysis, and provide state measurements.
- Voltage Sag, Swell, and Interrupt (VSSI) for power quality monitoring on SEL-351-7.
- Built-in impedance-based fault locator and faulted phase indication reduces fault location and repair time.

Single-Phase or Three-Phase Wye- or Delta-Connected Voltage Inputs

- Settings allow either single-phase or three-phase wye or three-phase delta voltage inputs.
- Single-phase voltage input permits phantom phase voltage for balanced three-phase metering and other limited voltage-dependent functions.
- The VS voltage input can be used for either synchronism-check or broken-delta (zero-sequence) voltage connection to the relay.

- **Inputs and Outputs**
  - Six level-sensitive control inputs (specify voltage at time of order).
  - Eight breaker trip/close rated contact outputs (two hybrid high-current interrupting, six standard). All output contacts are solder jumper configurable for normally open (form a) or normally closed (form b) operation.
- **Communications Hardware**
  - Three serial ports with DB-9 connectors (rear Port 2 and 3, front Port F) for asynchronous communications up to 57.6 kbps.
  - Single 10/100BASE-T Ethernet port with RJ45 connector on the rear panel (Port 5).
- **Communications Protocols**
  - Standard Modbus® with label-based map settings (serial and Ethernet—as many as three sessions).
  - Standard DNP3 Level 2 with label-based map settings (serial and Ethernet—as many as six sessions).
  - IEEE C37.118 synchrophasor protocol (serial and Ethernet).
  - ASCII, SEL Fast Meter, SEL Fast Message, SEL Unsolicited SER, SEL Fast Operate, and SEL Distributed Port Switch (LMD) serial protocols.
  - Telnet with configurable use-banner.
  - MIRRORED BITS® communications on SEL-351-6 and SEL-351-7.
  - Integrated read-only web server with configurable use-banner.
  - FTP server with configurable use-banner and access to settings and event reports.

Table 1 SEL-351 Protection System Model Options

Model	Complete Protection and Control Functions With ACSELERATOR QuickSet Support	Load Profile and MIRRORED BITS Communications	Voltage Sag, Swell, Interruption Reports	Power Elements
SEL-351-5	x			
SEL-351-6	x	x		
SEL-351-7	x	x	x	x

- **Optional Features Available on all SEL-351 Protection System Models.**
  - IEC 61850 MMS and GOOSE. As many as six MMS sessions, guaranteed GOOSE performance with 24 subscriptions and eight publications.
  - Access to event reports via MMS.
  - Expanded I/O with additional eight level-sensitive inputs and twelve standard or hybrid high-current interrupting contact outputs.
  - Front-panel SafeLock trip/close pushbuttons with high-visibility breaker status LEDs. This option includes configurable labels with a Microsoft® Word label-making template and label materials.
  - Front-panel USB port (in addition to the standard front-panel EIA-232 DB-9 serial port).
  - Replace the standard single rear-panel 10/100BASE-T (copper) Ethernet port (Port 5) with single 100BASE-FX (fiber) Ethernet port, dual redundant 10/100BASE-T (copper) Ethernet ports (Ports 5a and 5b), or dual redundant 100BASE-FX (fiber) Ethernet ports (Ports 5a and 5b).
  - Rear-panel EIA-485 multidrop serial port with compression screw terminals on a plug-in Phoenix connector (Port 1). The optional EIA-485 port is included when either of the dual redundant Ethernet port options are chosen.
  - Nominal 5 A or 1 A current inputs: 5 A phase, 5 A neutral; 5 A phase, 1 A neutral; 1 A phase, 1 A neutral; 0.05 A neutral for nondirectional sensitive earth fault (SEF) protection; or 0.2 A neutral for directional ground protection on low-impedance grounded, ungrounded, high-impedance grounded, and Petersen Coil grounded systems.