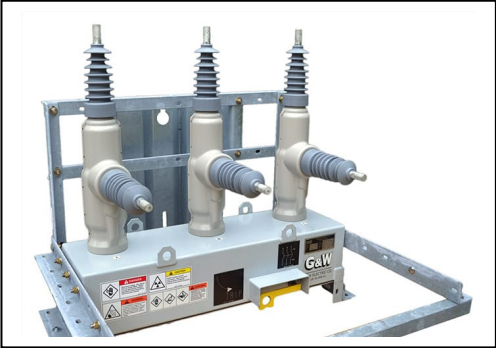


Safety Division Investigation into Electrical Contact on February 26, 2020 in Lebanon, NH of employee of Liberty Utilities (Granite State Electric) Corp. d/b/a Liberty Utilities



Report Date

May 15, 2020

Accident Description:

On Wednesday February 26, 2020 at approximately 8:30 am, two Liberty Utilities employees of the Sub Station Division, S. Foley and S. Barnes, along with a Liberty Utilities' contractor, J. Fazio of United Power Group Inc. proceeded to perform routine pre-installation tests on a pre-assembled piece of electrical equipment. The electrical equipment was a standard recloser that is found and installed in multiple locations throughout many New Hampshire utilities distribution systems. The pre-installation electrical tests typically are performed to test operations such as proper opening and closing of the contacts, corresponding check of position indicator and continuity checks between recloser terminals. Usually the manual open handle is also operated, i.e. pulled, to verify the recloser contacts are opened. The other test that is often performed is the High Potential Withstand Testing to verify vacuum interrupters and associated dielectric coatings are intact and functioning.

The specific recloser was an *Overhead Type G&W 531-66R02 Viper-S Solid Dielectric Recloser*. The Viper –S recloser is a 3 phase, microprocessor-controlled, vacuum recloser. The recloser assembly consists of the following basic components: a frame, interrupters, arresters, potential transformers and a control box. This type of electrical test, which is considered by Liberty as an "Acceptance Test", was performed inside the warehouse at the Liberty Utilities Lebanon work center.

Mr. Barnes connected a 120-volt power cord from a receptacle in the warehouse to the electronic control box to bypass the use of the Potential Transformer (sometimes referred to as a power transformer) associated with the recloser assembly. In the field the Potential Transformer is the source of power for the electronic control box, but since this was an inside test, standard 120 volt power was used as the power source. A control cable was also connected to the electronic control box in order to provide an external ability to operate the recloser for testing purposes. (See Attachment 1 Photos 1 - 4). During the testing process, the control cable was draped across the recloser assembly from the control box to the area of the Potential Transformer to the right in Photo # 1.

Mr. Foley was operating the control device and during the testing, the control cable fell to the floor from its position causing Mr. Foley to stop and reach down to the floor to reposition the cable. As Mr. Foley reached down to pick up the control cable he placed his right hand on the Primary Bushing of the Potential Transformer for balance and stability. At this instant, he received approximately 7,000 volts of AC current thru his hand into his body. Mr. Foley immediately went into cardiac arrest and fell to the floor. Mr. Barnes quickly administered CPR and Mr. Fauzio summoned help and obtained an Automatic External Defibrillator. Andrew Furtado, the Liberty Utilities Supervisor, who

was in the work center but not the testing location called 911 to request emergency medical assistance. Mr. Foley was revived by CPR and was taken to the local hospital in Lebanon by ambulance where he was treated and released after 3 days with no apparent cardiac problems but with burns to his hand.

The Safety Division firmly believes the Mr. Foley was fortunate to survive. The hazardous situation could and should have been avoided but was mitigated by quick actions of fellow workers in providing medical assistance.

Environmental Conditions considered:

At the time of the accident, the conditions within the warehouse were conducive to performing the testing of the recloser. The area was clean and provided ample room and access to all appropriate PPE and tools needed to perform the task of testing the recloser. It was not cordoned off. The environment was not a contributing factor of the electrical contact.

Contributing Factors:

The Safety Division found four contributing factors led to the accident and Mr. Foley's electrical contact.

First, the Safety Division determined that Liberty Utilities employees and the contractor did not review the testing section of the G&W Viper –S Solid Dielectric Reclosers Installation, Operations and Maintenance Instructions Testing Section Pages 2 and 24-28. This is required by the manufacturer of the electric equipment. This section makes reference to the danger of back feeding the Potential Transformer when applying an external power source for testing the recloser. (see page 25 in Attachment # 3 below). A review of this document should have been done and should be specifically included in the Liberty Utilities testing procedure for reclosers going forward.

Second, the Safety Division determined that the Liberty Utilities testing procedures for Reclosers provided to the Safety Division do not explicitly reference isolating the Power Transformer from the control box when using external power to test the Recloser when it is not installed in the field. As a piece of equipment that is routinely used within the distribution system, Liberty **should have more explicit** instructions. Liberty **does implicitly** make reference in Liberty's procedure SMP Circuit Breaker and Recloser Procedure. This procedure is used to perform Visual and Operation, Thermographic, Mechanism, Diagnostic and Acceptance Testing on all Circuit Breaker and Pole Top Reclosers used in electrical substations. In the procedure, section 3.0 Unusual Hazards, subsection 3. it states "*Make sure the manufacturer's manual is referenced and voltage testing is made during any testing or trouble shooting. Bench testing or*

acceptance testing units will have to have control power voltage back fed to it. Be sure to wear all proper P.P.E. when handling and operating.”

Third, the Safety Division determined that if Mr. Foley was wearing the proper PPE, rubber gloves with leather casings, his hand and body would have been protected from the high voltage energizing the primary bushing of the Potential Transformer. The electrical contact caused burns on Mr. Foley’s hand and created a path for the electrical current to travel to the ground causing cardiac arrest. Again, Liberty’s procedure LU-EOP D011 Inspection- Maintenance Reclosers provided to the Safety Division upon request in section 8.1.1 states *“All appropriate PPE, which includes but is not limited to, hard hat, safety glasses/eye protection, appropriate footwear, and FR clothing shall be worn when performing work as required by the Liberty Utilities Safety Manual.”* Liberty’s procedure SMP Circuit Breaker and Recloser Procedure is used to perform Visual and Operation, Thermographic, Mechanism, Diagnostic and **Acceptance Testing** on all Circuit Breaker and Pole Top Reclosers used in electrical substations. The procedure describes a Qualified Worker as *“one who is trained and competent in the “proper use of precautionary techniques, use of PPE including insulating and shielding materials and properly rated insulated tools for working on or near energized parts of electrical equipment””*. Liberty employees did not wear any type of insulating gloves as required and thus did not follow the procedure.

Fourth, a job safety briefing was not performed prior to the testing and initiation of the electrical equipment. This is standard industry practice. If a job briefing had been performed, the discussion would have involved disconnecting the Potential Transformer secondary connections. It would have eliminated the back feed thru the secondary side of the Potential Transformer allowing the Primary bushing to be energized at 7,000 volts from the power cable that energized the electronic control box. This would have eliminated the potential hazard. Liberty’s procedure LU-EOP D011 Inspection- Maintenance Reclosers provided to the Safety Division upon request in section 8.1.5 states, *“Before work begins a “Job Brief” shall be conducted to identify the boundaries of the work area, the work methods to be used and all hazards associated with the job.”* Liberty employees did not conduct a Job Brief as required and thus did not follow the procedure.

Other Concerns:

The recently hired employee, Mr. Foley, attended two trainings. The first was conducted 2 days after hiring 7/10/2019 regarding PPE awareness and another 9/9/2019 for PPE Training. (It is noted that Liberty had the incorrect date listed in their record). Both of these were within 7 months of the electrical contact. The Safety Division has concerns on the effectiveness of the Liberty training provided and Liberty’s

self-evaluation or metrics employed for determining successful training outcomes. Not wearing PPE was a contributing factor to this electrical contact.

Supervision, (Mr. Furtado) was on site, but not in the warehouse. Typically, the role of supervising includes planning for the work activity. In this regard, the supervision was not adequate. The Safety Division believes the Supervisor's role is to ensure a Safety Briefing is conducted on every job.

It was noted in reviewing Liberty provided materials such as Substation Maintenance Procedures, that the reference procedures still reference National Grid and New York State, National Grid's Safety Handbook etc. This is an indication that Liberty needs to annually review procedures, keep them up to date and customize to the applicable distribution systems where they provide power. Updated and accurate procedures are critical to safe operations if Liberty personnel are going to rely on them to perform maintenance and testing. Liberty Utilities (Granite State Electric) Corp. d/b/Liberty Utilities

Positive actions taken noted

It was noted in Mr. Barnes training records that on 4/29/2019 Mr. Barnes had successfully completed Liberty provided training regarding First Aid/CPR/AED Training. This training may have positively factored in and contributed to the quick actions and restarting of Mr., Foley's cardiac system which had stopped. This should be highlighted in employee communications and noted in future Environmental, Health and Safety trainings.

Other Agencies regulatory oversight

The US Department of Labor, Occupational Safety Health Administration (OSHA) has oversight on employee safety and has federal standards regarding many of the issues discussed in this report. An OSHA investigation has been initiated and is in process of being finalized. It is anticipated a report is forthcoming regarding the accident including any citations of potential violations inclusive of civil penalties of applicable standards pertaining to the electrical contact. A copy of this report will sent to the local OSHA office in New Hampshire.

Recommendations:

1) Liberty Utilities shall present within the next 6 months a companywide training session(s) to all employees concerning the event that occurred in Lebanon, NH on 2/26/2020 and what will be initiated to prevent this from happening going forward. A

copy of the presentation and attendance sheet shall be forwarded to the Safety Division within 10 days of completion of the session(s).

2) Liberty Utilities shall re-write the Circuit Breaker and Recloser Procedure (Testing CB and PTR) Doc # SMP (Draft). This procedure will include a detailed safety process section emphasizing job briefings, proper PPE, management oversight and review of the testing to be performed, and qualification requirements of the Liberty Utilities employee that will perform the testing of the CB or PTR. The procedure will include the manufacturing company's recommendations concerning the testing, installation, maintenance and safe operation of the CB or PTR. The finalized procedure (no longer draft) will give detailed instructions for testing of a CB or PTR in the field and for a warehouse environment.

3) The Safety Division recommends an initiation of a rulemaking modification for enhancing and updating the Puc 300 Rules, in particular Puc 306 EQUIPMENT AND FACILITIES, sections 306.04 thru 306.06. This should include developing other sections as necessary to explicitly require applicable utilities of the responsibility of ensuring their employees follow all written company operating, emergency, maintenance, construction, installation and testing procedures including other applicable company safety policies. Consideration shall be given towards making such company procedures available for inspection, and any enforcement procedures that may be potentially used in the future by the Commission.

4) The Safety Division recommends that future civil penalties, that may be applied by OSHA be subject to shareholders only and that no ratepayer costs be included in any future proceeding regarding rate recovery of such civil penalties.

Documents provided to the NH PUC Safety Division by Granite State Electric, (d/b/a Liberty Utilities)

- 1) Circuit Breaker and Maintenance Procedure (Draft)
- 2) Station and Line Recloser – SMP 401.07.1
- 3) Station and Line Recloser – SMP 401.07.2
- 4) Inspection – Maintenance Reclosers – LU –EOP-D011
- 5) G&W Installation, Operation and Maintenance Instructions for the Viper – S Solid Dielectric Reclosers – GWI 531-66
- 6) LU Training Records for Steve Foley and Spencer Barnes
- 7) LU Incident Investigation & Root Cause Analysis Document 2100-400-001 per Puc 306.06 (f).

Attachment# 1

Photographs of the Overhead Type G&W 531-66R02 Viper-S Solid Dielectric Recloser

Photo # 1



Photo 1 courtesy of PUC Safety Division taken 3/6/2020. Photo inside of the warehouse at the Lebanon Area Work Center. The photo shows the electrical equipment assembly consisting of Viper S interrupters, lightning arresters, potential transforms, control and electrical feed cables, and electronic control box.

Attachment# 1

**Photographs of the Overhead Type G&W 531-66R02 Viper-S Solid Dielectric
Recloser**

Photo # 2

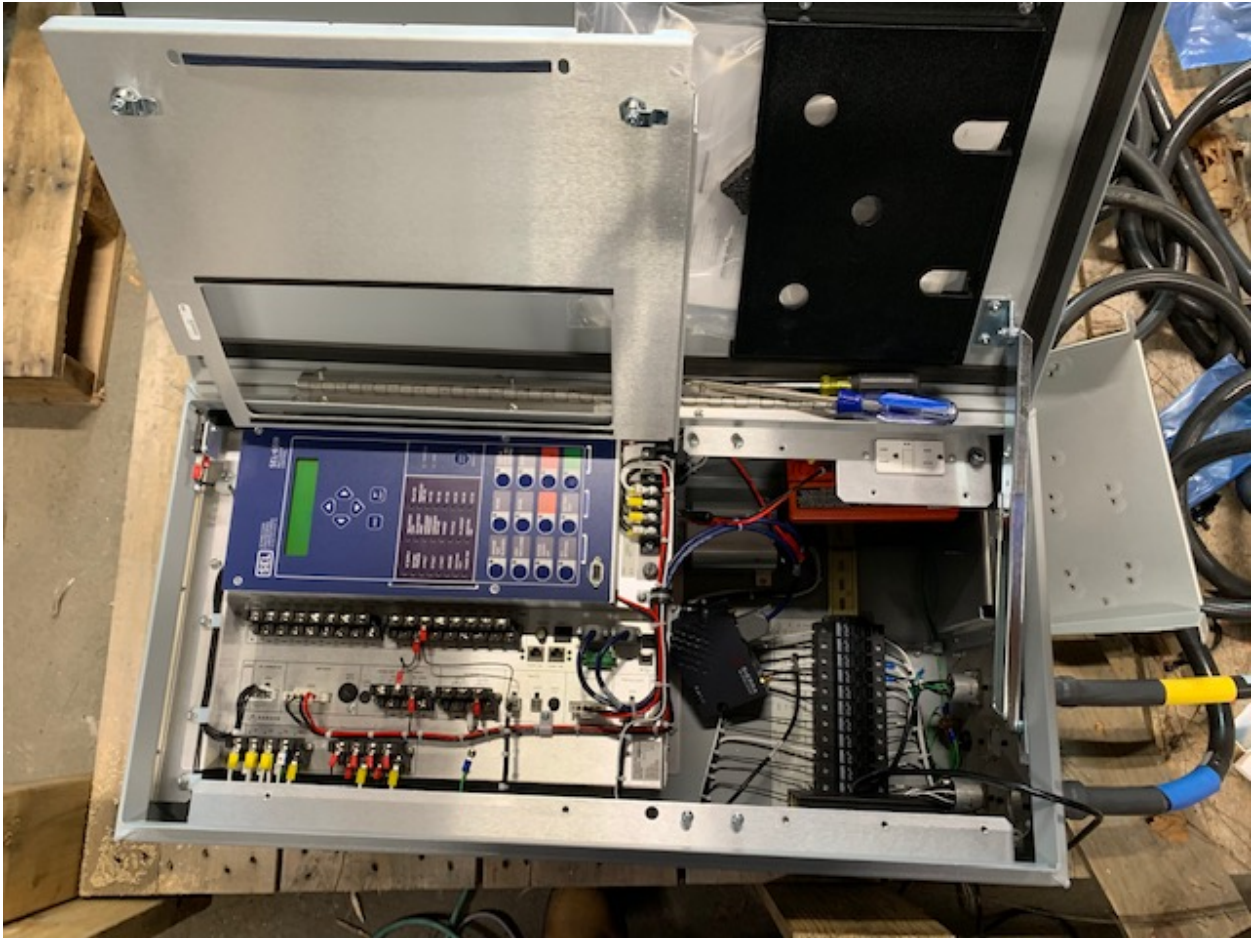


Photo 2 courtesy of PUC Safety Division taken 3/6/2020 Photo inside of the warehouse at the Lebanon Area Work Center. The photos shows the electrical control and electrical feed cables, electric control box still connected to the potential transformer

Attachment# 1

Photographs of the Overhead Type G&W 531-66R02 Viper-S Solid Dielectric Recloser

Photo # 3



Photo 3 courtesy of PUC Safety Division taken 3/6/2020. Photo inside of the warehouse at the Lebanon Area Work Center. The photos shows the Manufacturer (G& W) Viper S recloser nameplate ratings for the recloser. Specifically 15.5 kV maximum voltage rating, 110 amp impulse loading (BIL), 800 amp continuous current, manufacturing date of 6/2019, interrupting current rating of 12,500 amp, making current RMS 20 amp, 800 pound weight of assembly.

Attachment# 1

**Photographs of the Overhead Type G&W 531-66R02 Viper-S Solid Dielectric
Recloser**

Photo # 4



Photo 4 courtesy of PUC Safety Division taken 3/6/2020. Photo inside of the warehouse at the Lebanon Area Work Center. The photo shows the electrical equipment assembly consisting of Viper S interrupters, lightning arresters, potential transforms, control and electrical feed cables, and electronic control box. Photo 4 taken from the opposite location of Photo 1

Attachment 2 Training Records

Exhibit # 2 Training Records for Steve Foley and Spencer Barne

Steve Foley's relevant training - Hire Date 7/8/2019	
Training Session	Date
PPE Awareness	7/10/2019
EHS Onboarding	8/8/2019
Clearance and Control Training	9/4/2019
Personal Protective Equipment Training (rubber goods; level D PPE)	9/9/2020
Clearance and Control Initial Certification Field Checklist	9/6/2019- 12/30/2019
Electric Operating Procedure Review (General 1 st 10)	2/6/2020
Electric Operating Procedure Review (General 2 nd 10)	2/13/2020
Annual Expert Training & Compliance Training - Clearance & Control, Electrical Hazard Awareness, Substation Work Area Identification,	2/20/2020

Spencer Barne's relevant training

Training Session	Date
01-LU NH Electrical Hazard Awareness	3/28/2016
02-LU NH Recertification - Clearance and Control EOP G014	2/22/2016
03-LU NH Pole Top Rescue and Wood Pole Climbing Recertification - Aerial Lift Rescue	9/25/2015
04-LU NH Substation Work Area Identification SWAI	3/20/2017
07-LU NH Substation Visual and Operational Inspection	3/30/2016



08-LU NH Standards Recloser Construction Installation	3/25/2016
09-LU NH ENCLOSED CONFINED SPACE RESCUE TRAINING	2/22/2016
10-LU NH Underground Residential Commercial Distribution Systems	8/9/2018
11-LU NH EOP D003 Single and Three Phase Step Type Voltage Regulators	5/18/2016
12-LU NH SUBSTATION R-MAG operations and maintenance training	5/18/2016
13-LU NH FIRST CLASS LINEWORKER PROGRESSION	9/16/2016
14-Primary Cable Fault Locating Arc Reflection	10/25/2016
15-Testing Tools and Insulated Equipment LU - EOP G5	12/12/2016
18-LU NH Initial Certification Clearance and Control EOP G014	11/18/2016
24-Secondary Unshielded Cable Fault Locating	6/23/2017
SafeStart Extended Application Unit 1	8/6/2018
SafeStart Extended Application Unit 2	12/3/2018
SafeStart Module 1	11/29/2016
SafeStart Module 2	12/14/2016
SafeStart Module 3	3/22/2017
SafeStart Module 4	11/9/2017
SafeStart Module 5	1/8/2018
First Aid/CPR/AED Training	4/29/2019



Attachment # 3 G&W Viper –S Solid Dielectric Reclosers Installation, Operations and Maintenance Instructions

SECTION 1


INTRODUCTION

1.1 General

This document is intended to provide the user with necessary information to properly receive, inspect, test, install and maintain G&W Viper-S solid dielectric reclosers. If after reviewing the information contained herein, you should have any questions, please contact G&W Technical Support.

Read these Instructions	Read and understand the contents of this document and follow all locally approved procedures and safety practices before installing, operating or maintaining this equipment. Be sure to read and understand the Safety Information.
Keep these Instructions	This document is a permanent part of your G&W product. Keep it in a safe location where it can be readily available and referred to as necessary.
How to Contact G&W	<p>By Phone: 708-388-5010, Monday through Friday, 8:00 AM to 5:00 PM Central Time</p> <p>By Fax: 708-388-0755</p> <p>E-mail: info@gwelec.com</p> <p>For Technical Support: 708-297-3835</p> <p>Fax: 708-389-0016</p> <p>E-mail: Aftermarket.support@gwelec.com</p> <p>Mail: 305 W. Crossroads Parkway, Bolingbrook, Illinois 60440, USA</p> <p>Internet: To find your local G&W Representative visit: www.gwelec.com</p>

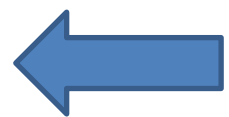
1.2 Qualified Persons

 **WARNING**

The equipment covered by this document is intended to be installed, operated and maintained by qualified persons who are trained in the installation, operation and maintenance of electric power distribution equipment along with the associated hazards. A qualified person has been trained and is competent:

- To de-energize, clear and tag circuits and equipment in accordance with established safety procedures
- To distinguish between live parts from non-live parts of the equipment
- In the proper use of insulated tools, wears protective equipment such as rubber gloves, hard hat, safety glasses, flash-clothes, etc. in accordance with established safety practices and is trained in the care of such equipment
- Is certified in rendering first aid, especially in the technique of removing a person in contact with a live circuit and in applying cardiopulmonary respiration.

These instructions are intended only for qualified persons and are not intended as a substitute for adequate training and experience in safety procedures for this type of equipment.



1.3 Shipment Inspection

Each recloser is completely assembled, tested, and inspected at the factory. It is in good condition when accepted by the carrier for shipment. Examine the crated equipment carefully for any damage that may have occurred in transit. If damage is found, a claim must be filed at once with the transportation company. Uncrate and remove packing as soon as possible after receiving the equipment. Examine the equipment carefully for any hidden damage that may have occurred in transit and was previously undetected. If damage is found, a claim should be filed at once with the transportation company.

Testing Section Pages 24-28

SECTION 7

TESTING

7.1 Testing Site-Ready Units

A site ready Viper can be configured with Primary and secondary wiring. Primary wiring is typically wired from the aerial lug of the Viper to the auxiliary equipment; for example but not limited to transformers and lightning arresters. When applying withstand testing, section 7.2, the auxiliary equipment may be required to be disconnected to ensure the withstand test is not compromised.

Secondary wiring is considered the output of potential or control power transformers, and/or current transformers, along with all grounding wires. In some application, the secondary wiring will be configured to a junction box that receives all secondary wires and combines them into one cable that is brought to the relay. The relay in these cases will be prewired to receive these secondary inputs.

DANGER

Do not exceed the Maximum Dielectric Test Levels as shown in Section 7.1.2. Exceeding the test levels can cause flash over. This can lead to a fault in the recloser or test equipment and cause serious personal injury or death.

WARNING

Follow these precautions when performing electrical tests:

1. Completely de-energize the recloser and disconnect it from all power sources.
2. Terminate all bushings with an insulated cap or other suitable cable termination capable of withstanding the test voltage.

Failure to observe these precautions can result in flash over, injury and equipment damage.

WARNING

The DC withstand capability of reclosers may be reduced due to damage, electrical or mechanical wear. The DC test voltage must not exceed the withstand limits of the recloser. Application of DC voltages greater than the withstand capability of the recloser can result in flash over, injury and equipment damage.

WARNING

When it is necessary to test the cables connected to an energized recloser, proper insulation between the power-frequency source and the DC test equipment must be maintained. Follow the recommendations of the manufacturer of the test or fault location equipment.

WARNING

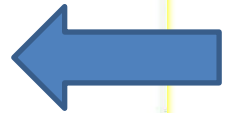
Hazardous Voltage. Do not rely on the position indication indicator or the manual open handle. They do not insure that the line has been de-energized. Always establish a visible disconnect. Failure to follow proper safety precautions can result in contact with high voltage and serious injury or death.

⚠ DANGER

High voltage applied to a site ready Viper with primary wires terminated from aerial lug to control power transformer and secondary wires to the recloser control cabinet will energize the control cabinet. Prevent contact with input power terminals in the control cabinet during high voltage testing. Failure to do so could result in serious injury or death.

⚠ DANGER

A site ready Viper with the secondary of the control power transformer(s) wired to the recloser control cabinet can back feed the control power transformer(s) to full voltage potential on the primary by applying control power to the recloser control. This is most common during testing the recloser control and confirming the Viper mechanical operations. Disconnect the secondary connections to the control power transformer(s) or take measures to prevent contact with the terminals of the control power transformer(s) before energizing the control. Failure to do so could lead to serious injury or death.



7.2 Operations Testing

Per the IEEE C37.60 recloser standard recommendation, perform high-potential withstand tests on the unit at 80% of the rated value prior to installing the Viper-ST recloser. Ensure the test equipment is used in accordance with the manufacturer's instructions.

7.2.1 Check the data plate ratings. Make sure the ratings and settings on the recloser data plate (see Figure 7) are correct for the planned testing.

7.2.2 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:

7.2.2.1 The OPEN/CLOSE contact position indicator, or

7.2.2.2 By continuity check between the recloser terminals,

7.2.3 Test manual open. Pull the yellow manual open handle (see Figure 7) down to open the recloser contacts. Confirm that the contacts have opened by:

7.2.3.1 The OPEN/CLOSE contact position indicator, or,

7.2.3.2 By continuity check between the recloser terminals,

7.2.4. To close the recloser contacts:

7.2.4.1 First, push the yellow manual open handle up.

7.2.4.2 Close the recloser using the microprocessor based control.

7.3 High Potential Withstand Testing

⚠ WARNING

Hazardous Voltage. Do not rely on the position indicator or the manual open handle. They do not insure that the line has been de-energized. Always establish a visible disconnect. Failure to follow proper safety precautions can result in contact with high voltage and serious injury or death.

Use the following procedures to perform high potential withstand tests at 75% of the rated low-frequency withstand voltage for 60 seconds. See Table 3 for rated voltages and Figure 12 for test connection

diagrams.

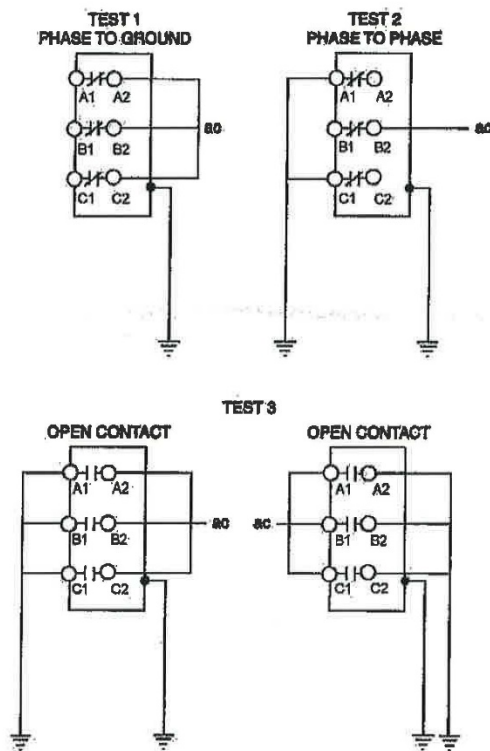


Figure 12. Connection diagrams for high potential withstand testing.

7.3.1 Test 1 (Figure 12)

7.3.1.1 Close the recloser contacts.

7.3.1.2 Ground the recloser.

7.3.1.3 Connect terminals C2, B2 and A2 (see Figure 5) together.

7.3.1.4 Apply proper test voltage (see Table 3) to terminals C2, B2 and A2.

7.3.1.5 The recloser should withstand the test voltage for 60 seconds.

7.4.2 Test 2 (Figure 12)

7.4.2.1 Close the recloser contacts.

7.4.2.2 Ground the recloser.

7.4.2.3 Ground Phase A (terminal C2) and Phase C (terminal A2).

7.4.2.4 Apply proper test voltage to Phase B (terminal B2).

7.4.2.5 The recloser should withstand the test voltage for 60 seconds.

7.5.3 Test 3 (Figure 12)

7.5.3.1 Open the recloser contacts.

7.5.3.2 Ground the recloser.

7.5.3.3 Connect and ground terminals C1, B1 and A1 (see Figure 5).

7.5.3.4 Connect terminals C2, B2 and A2.

7.5.3.5 Apply proper test voltage to terminals C2, B2 and A2.

7.5.3.6 The recloser should withstand the test voltage for 60 seconds.

7.5.3.7 Reverse the connections, ground terminals C2, B2 and A2.

7.5.3.8 Apply test voltage to terminals C1, B1 and A1 for 60 seconds.

7.5.3.9 The recloser should withstand the test voltage for 60 seconds.

7.4 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 the recloser does not pass Tests 1, 2, or 3, contact your G&W Electric Co. representative.

Table 3. Viper-S Recloser Withstand Test Voltage - Ratings Information

Recloser Rating			Withstand Rated Voltage
50 Hz	60 Hz	Impulse (BIL)	Power Frequency
12kV	15.5kV	110kV	50kV
24kV	27kV	125kV	60kV
36kV	38kV	150kV	70kV

7.5 Factory Production Tests

The following tests are performed at the factory as part of the routine production of the recloser:

- Circuit Resistance
- High Voltage Withstand
- Operating Assurance Tests