



Rejuvenation Instructions Power Cables Unsustained Pressure Injection

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- Ultrinium[™] sustained pressure injection method (U.S. Patent 7,615,247)
- Ultrinium[™] formulation optimization injection method (U.S. Patent 7,611,748)
- Injection Adaptor (U.S. Patent 7,195,504 and 7,538,274)
- Perfectium[™] single switch injection (U.S. Patent 7,353,601)
- Predicting performance of Electrical Power cables (patent pending)
- Formulation of Ultrinium[™] & Perficio[™] components (patents pending)
- N-Rex[™] submarine cable injection process (patent pending)
- N-Ter[™] injection or Novinium thermally enhanced rejuvenation (patent pending)
- Reticular Flash Preventer (RFP) provides safer operation of conventional injection elbows (patent pending)

Version 20100628

Unsustained Pressure Injection

Unsustained pressure injection should be used only in a small number of cases where pre-existing molded splices are located in positions where excavating them is not feasible. The following pre-existing splice types are generally incompatible with the unsustained pressure injection method:

1. Heat-shrink splices
2. Cold-shrink splices
3. Hand-wrapped splices
4. Pin & socket splices
5. Molded splices for conductors of 250 kcmil (120 mm²) or larger
6. Modular or bolt-together splices

While not all molded splices support flow, about half of single piece EPDM splices may be injected. There are two approaches to delivering unsustained pressure. The preferred approach may be used where it is feasible to leave a cable de-energized or where use of the quick disconnect injection tool is possible. When either of these is the case, install IAs at the cable terminations as described in NRI 30, 31, and 34 and then follow the instructions of NRI 61, except use the injection pressure (IP) as defined below. The balance of this NRI 62 describes the second approach, making use of injectable components to gain fluid access to the cable strands. A hybrid approach, injecting between an injection elbow and an IA may also be used.

IP: The IP, or injection pressure, is limited by the ability of molded cable accessories to hold pressure and is generally below 30 psi. On cables with an insulation O.D. of less than 0.80 inch a pressure of 20 psi is often used. As the diameter increases, the ability of the components to contain pressure decreases and the IP must be reduced accordingly. In general the IP must be determined by the judgment of the injection operator, and must be selected so that it does not jeopardize the integrity of elbows, splices and other cable components.



Caution: Working around energized high-voltage systems may cause serious injury or death. The procedures in these instructions should be performed by personnel familiar with good safety practice in handling high-voltage electrical equipment. De-energize, test and ground all electrical systems before proceeding.

1. Install an access device.
 - a. For live-front terminations, install an IA and termination as instructed in NRI 30 and NRI 34.



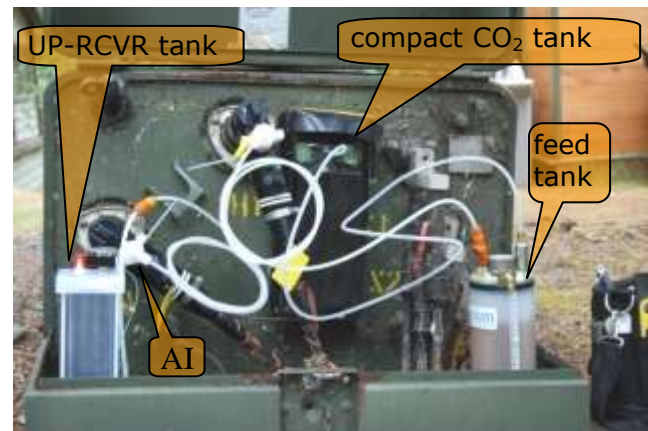
- b. For dead-front separable connectors, install the appropriate elbow utilizing the instructions included with each elbow.

Elbow	NRI
15kV & 25kV	36
35kV small interface	38
35kV large interface	39



2. Prepare feed tank.

- a. Fill a feed tank to include at least the ceiling amount of fluid from the NRI 21 cable table, plus the volume of the vacuum tank, plus 100 ml for each splice. If the fluid in the feed tank has been previously pressurized above the intended feed pressure, eliminate effervescence by pulling a vacuum on the fluid. The fluid is degassed when the vacuum remains below 15 in Hg without applying additional vacuum for 2 minutes.



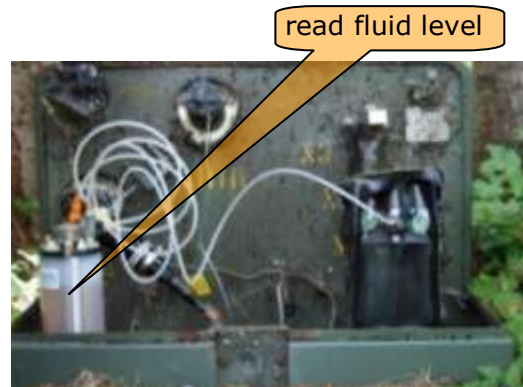
- b. Pressurize the feed tank to the IP. Consider any elevation changes in the cable path to assure that all splices and terminations will not exceed the IP and that the injection pressure and vacuum are sufficient to overcome any head pressure. Each 2 feet of elevation change is equal to about 1 psi of head pressure; this must be taken into account as part of the total pressure in the cable. It is preferable to feed an inclined cable from the lower end.



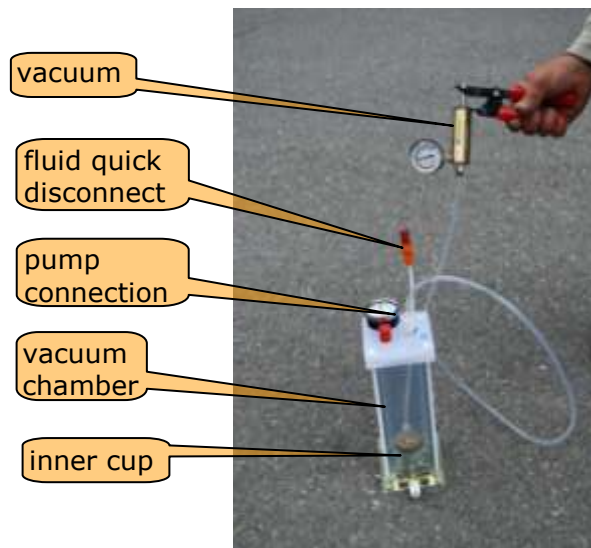
Check tank for any leaks. If any leaks are observed, relieve all pressure immediately and correct.

c. Record the feed tank type and feed tank level in NITS.

d. Initiate fluid flow from the feed tank and record the start time in NITS. Secure the feed tank in the enclosure of the termination. Electrically isolate metallic portions of the feed tank from all energized components and grounds. Locate the tubing so contact with grounds is minimized. If the UP1.5 and UP3 tanks need to be placed horizontally, keep the sight gauge pointed upwards, and the top end of the tank elevated at least 3" above the bottom.



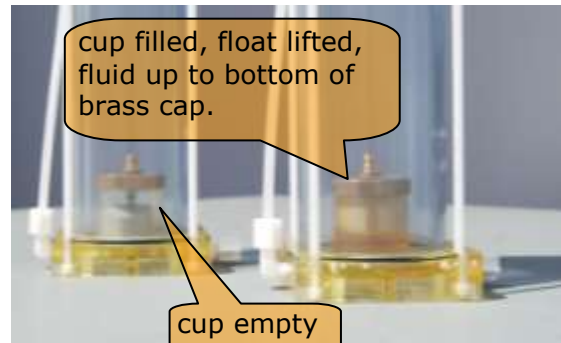
e. Connect a UP-RCVR tank to the end of the cable distant from the feed tank. Establish a vacuum of approximately 25 in. Hg. Secure the vacuum tank in the termination enclosure. Electrically isolate metallic portions of the receiver tank from all energized components and grounds. Route the tubing to minimize contact with grounds.



3. Optionally, the cable may be energized when all personnel and grounds are clear. Use dielectric gloves rated at or above the system operating voltage to manipulate all fluid tanks and tubing connected to energized devices.



4. Periodically check the vacuum and feed tanks until there is fluid in the vacuum tank. Top off the vacuum to about 25 in Hg. If there are any intermediate values of the feed tank level, record those values along with the date and time in the NITS note section. When fluid reaches the UP-RCVR tank, flow will stop after it accepts approximately 14 cc of fluid in the inner cup. **Fluid must completely fill the inner cup of the UP-RCVR tank for the injection process to be complete.** Record the final vacuum tank fluid level in the "Flush" field of NITS as "1".



5. Remove the AI (access interface) tubing from the vacuum tank at the quick disconnect.

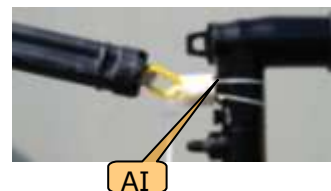
6. Relieve any pressure in the cable.

- a. Attach a UP-REL tank to the injection tube quick disconnect for 60 seconds. Record the amount of fluid removed by this method to the "Flush" field in NITS.



- b. Disconnect The UP-REL tank from the quick disconnect.

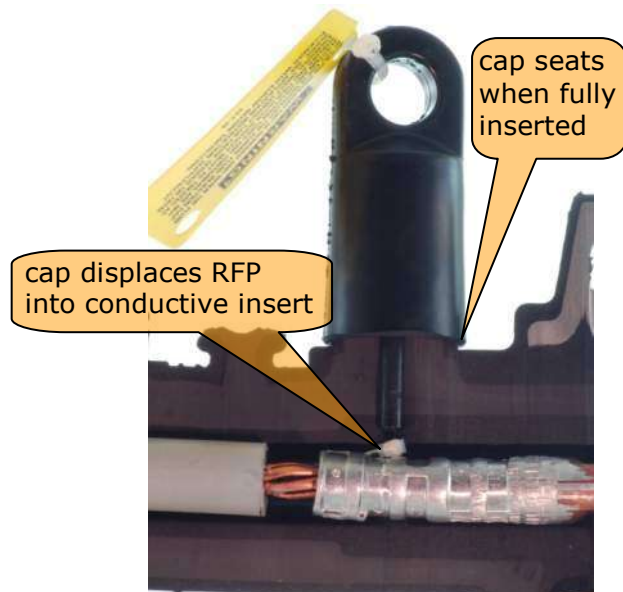
7. Remove the AI.
 - a. Pull the yellow ring on the release pin of the AI with a hot stick and bring the AI away from the elbow.



- b. When the pin is pulled the zip ties should fall away from the AI, releasing it from the elbow. If the zip tie does not release, nudge it with the end of the hot stick to make it fall away.



- c. Immediately place the permanent cap or plug onto the injection port and press firmly until it fully seats. The pin displaces the RFP into the component's conductive insert.



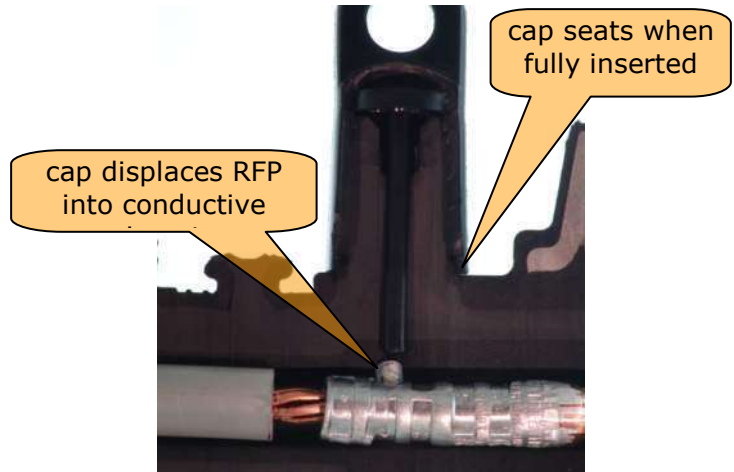
8. Disconnect the feed tank.
- Close the in-line feed valve and separate the quick disconnect.
 - Attach a UP-REL bottle to release any pressure in the line.



- c. Pull the release pin on the AI with a hot stick and bring the AI away from the elbow.
- d. When the pin is pulled the zip tie should fall away from the AI, releasing it from the elbow. If the zip tie does not release, nudge it with the end of the hot stick to make it fall away.



- e. Immediately place the permanent cap or plug onto the injection port and press firmly until it affirmatively seats. The pin displaces the RFP into the component's conductive insert.



- f. Record the feed tank level in NITS. Add the volume of fluid collected in the UP-REL bottle to the discard quantity in NITS.



9. Attach a Novinium warranty tag to each end of the cable segment with tie wraps. Use a hole punch to indicate the 3-digit warranty code and the warranty duration from the customer contract. Punch out the injection date near the bottom of the tag. Enter the tag number and injection date in NITS.

The 3-digit warranty code for this cable is:
 Digit 1: 0 1 2 3 4 5 6 7 8 9
 Digit 2: 0 1 2 3 4 5 6 7 8 9
 Digit 3: 0 1 2 3 4 5 6 7 8 9

Warranty duration: 60-day 20-year year Lifetime Other

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10. Record the lot number for all fluid and applicable components used in the injection process. Enter the lot number information in the appropriate fields in NITS. See NRI 90: Novinium Injection Tracking System for more information.

Client: Sample Customer Work Order: Work Order 1
 Purchase Order: Sample Purchase Order Contractor: Novinium-MVC

Sub-Segment Record Sheet

Cable Information Terminations Injection Information Billables Comments

Sub Segment: 00006614 - 1 Contractor: None Selected

Conductor: 1/0 Copper Conductor Shield: Extruded Nbr of Strands: 19
 Strand OD: 74 Strand Bundle OD: 365 OD Units: Mil
 Insulation OD: 1105 Insulation Type: XLPE Jacket: Unjacketed

Design Voltage: 35kV Cable: 35kV, 100% (347) 1/0, C-4 (Compressed) Length: 0 Feet
 Service: 732/10: Ultrinium 732/101 Lot#: 20091231-01
 2nd Fluid: 212a Lot#: 20100128-01 Ratio: 1:0

Neutral Condition: 0.25% NC Locations: N/A VDP: 54.3
 Injection Pressure: Vaccum Pressure: XXX
 Start: 300 End: 275 Cable TIP: 297 0 in Hg Pressure Type: Sustained