

Rejuvenation Instructions Power Cables N-TER™ technology: Novinium-Thermally Enhanced 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. Patents 7,195,504, 7,538,274 and 7,683,260)
- Perfectium™ single visit, single switch injection (U.S. Patent 7,353,601)
- Formulation of Ultrinium™ & Perficio™ components (U.S. Patents 7,658,808, 7,700,871 and other patents pending)
- Predicting performance of Electrical Power cables (U.S. Patent 7,643,977 and 7,848,912)
- N-Rex™ submarine cable injection process (U.S. Patent 7,976,747)
- N-Ter™ injection or Novinium thermally enhanced rejuvenation (patent pending)
- Reticular Flash Preventer (RFP) provides safer operation of conventional injection elbows (patent pending)

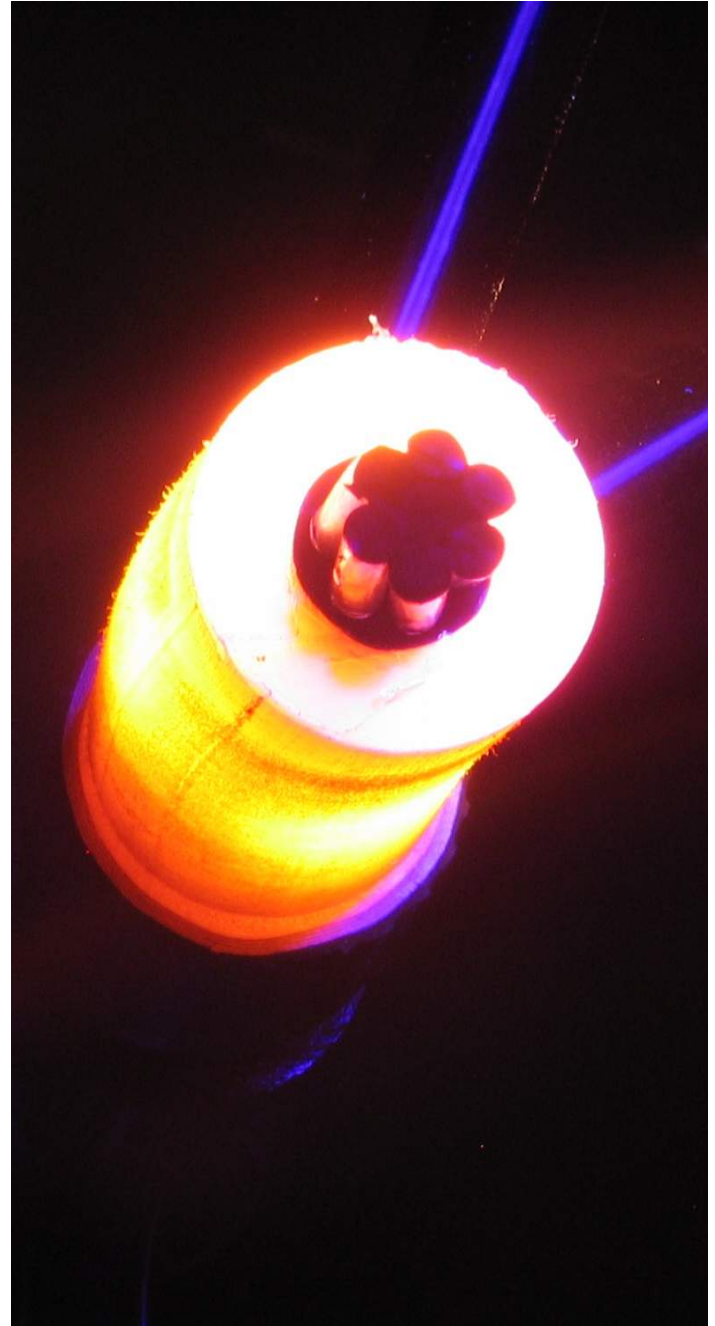
Version 20120425

N-TER™ technology: Novinium Thermally Enhanced Rejuvenation



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. The rightmost six columns in the Cable Table ([NRI-21](#)) provide the fluid supply requirements for all cables. The fluid requirements are expressed in cubic centimeters per cable meter (cc/m), as well as in millimeters per 100 cable feet (mm/100•ft) for the 2 and 3 liter aluminum sustained pressure, in addition to 1.5 and 3 liter un-sustained pressure tanks. Each cable type has a **floor**, a **target**, and a **ceiling** specified. The **target** is the optimum fluid quantity of Ultrinium™ brand fluid or Perficio™ brand fluid, which should be injected into a particular cable design. The **floor** is the minimum acceptable amount of fluid required to provide the design life extension. The **ceiling** represents a maximum fluid supply. Exceeding the ceiling may be an indication that the cable was improperly identified, the length is incorrect, or that the cable has a taped, rather than extruded conductor shield. The procedures of this NRI-25 should be applied where:
 - a. The conductor size is between #4 and 4/0 AWG.
 - b. The conductor includes 19-strands and is compressed or compact.
 - c. Experience indicates that the targeted fluid supply may not be provided at the tailored injection pressure (TIP) within an operationally reasonable saturation period.
 - d. When the actual fluid supplied is less than the floor.

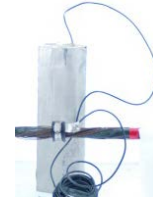


2. N-ter™ cannot be used without an adequate return current path. The return current path must be either:

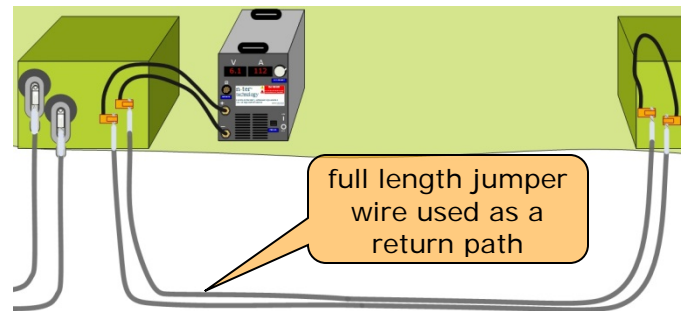
a. Full neutrals with no more than level 1 or level 2 neutral corrosion. See [NRI-12, "Electronic Diagnosis and Pinpointing"](#).



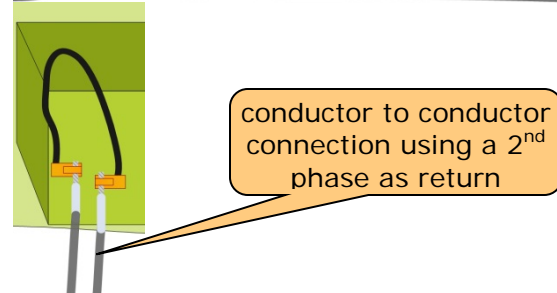
b. Full neutrals which have been repaired as described by [NRI-80, "Neutral Corrosion Repair."](#)



c. A jumper cable with at least the same ampacity as the cable conductor.

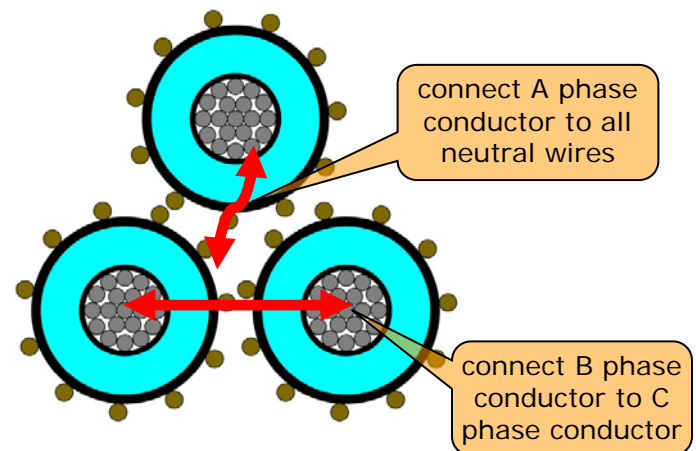


d. The conductor of an identical or larger cable which has coincident endpoints. (i.e. 2-wire or 3-phase configurations).



e. For undersized, or copper-taped neutrals contact engineering at (206) 529-4828 for instructions.

f. Three phase 1/3 Neutral operation, as shown in the diagram to the right: Connect all neutrals together as a return path for phase A, then use phase C as the return path for phase B. Double the currents listed in the current source settings table below, or use two n-ter systems at the rated current for this configuration.



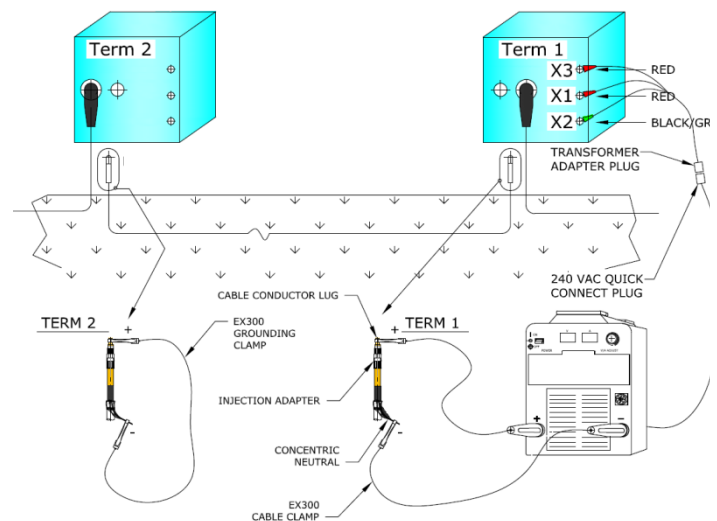
3. This NRI-25 may be applied:
 - a. Before injection begins
 - b. After injection begins
 - c. As a remedial step when the injection floor is not realized without n-ter™ technology.

4. The n-ter™ current source (**NPN: O-EL-CS**) is a low voltage, direct current source designed to warm the cable conductor. Take the following precautions when operating the current source.
 - a. Wear dielectric gloves, safety glasses and hard hat.
 - b. Turn the current source off before connecting or disconnecting to the 240 VAC power.
 - c. Turn the current source off before connecting or disconnecting cable clamps to/from the cable conductor or neutral.
 - d. Secure all connecting cables such that they will not create a tripping hazard.

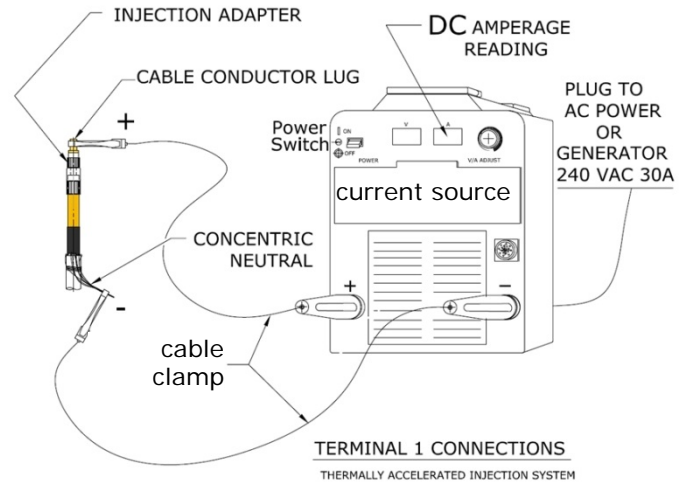


n-ter™ Current Source

5. Connect the current source to the power source and to the cable.
 - a. Flip the power switch down to the "Off" position.
 - b. With dielectric gloves connect the red leads to the transformer X3 and X1 secondary blocks. Connect the black/green lead to the X2 secondary block.
 - c. Multiple cable sections may be connected in series – high current connections from conductor to conductor and from neutral to neutral.
 - d. Ground the far end of the cable subsegment (or series of subsegments) utilizing conventional grounding equipment or a current source grounding clamp.



- e. Utilize the current source cable clamp to connect the DC outputs to the cable and return path (the neutral, jumper, or second phase conductor being used for this purpose). The positive should be connected to the conductor; the negative should be connected to the neutral pigtail, jumper, or phase conductor. The clamps should be applied to make a high ampacity contact.



6. Apply current to the cable.

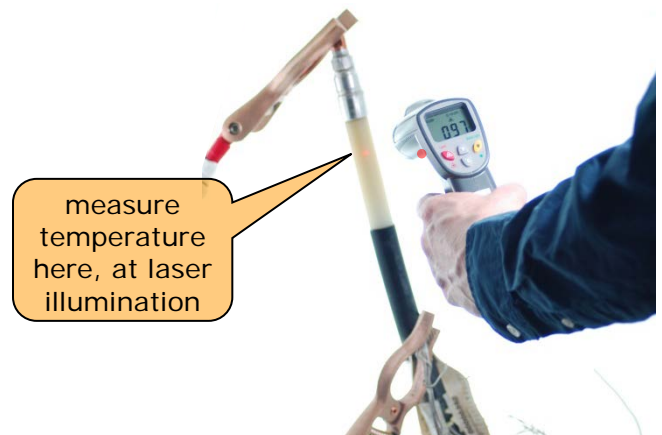
- a. Use the amperage settings in the Current Source Settings table. Reduce the settings if required so as not to exceed the specified maximum insulation temperature. Apply the current in the column labeled "15 min current" for 15 minutes, and then reduce the current to the value in the column labeled ">15 min current" until the injection is complete or nearly complete.

Current Source Settings

Cable AWG	15 min current		>15 min current		Maximum insulation temp
	Al	Cu	Al	Cu	
No.2	115	200	45	75	104°F (40°C)
No.1	125	250	50	90	
1/0	150	300	60	100	
2/0	160	325	70	120	
3/0	170	350	80	140	
4/0	180	375	90	160	

Use the columns labeled "Al" for aluminum conductors and the columns labeled "Cu" for copper conductors.

- b. Utilize a non-contact laser thermometer (NPN:2-EL-IR-TEMP) to assure the insulation adjacent to the IA (injection adaptor) illuminated with the laser does not exceed 104°F (40°C)



7. Turn off the current source. Remove the power supply jumpers from the transformer secondary with dielectric gloves. Confirm the cable is grounded. Remove all temporary connections to the cable and neutral.

