# RENEWABLE ENERGY GRID CABLES ARE *FAILING FASTER* THAN EXPECTED

## THE PROBLEM

Renewable energy cables run at higher loads than typical utility cables. This increased load causes aging to progress rapidly as compared to normally stressed cables. The result? Some renewable energy cables only last 10 years or so because the diaelectric strength of these cables is greatly reduced.

**SECONDARY LOW VOLTAGE AC AND DC CABLES FAIL DUE TO**

- CORROSION
- LOSS OF AMPACITY

**PRIMARY AC CABLES FAIL DUE TO**

- WATER TREES
- LOSS OF DIELECTRIC STRENGTH


**CORROSION MECHANISM**

Craftwork errors, external damage, and thermal degradation create breaks in the insulation allowing stray-voltage current corrosion cells to develop

$$4Al + 3O_2 \rightarrow 2Al_2O_3$$
$$2Al + 6H_2O \rightarrow 2Al(OH)_3 + 3H_2$$

Surface irregularities in the conductor combine with water, oxygen, & electrolytes to form aluminum hydroxide

High specific volume of corrosion product leads to swelling of cable, a reduction in ampacity, and failure

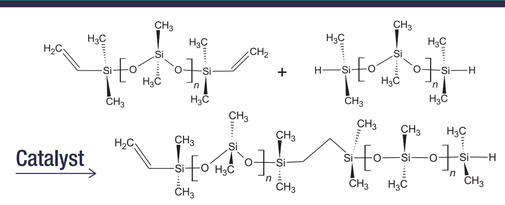
## THE SOLUTION

### SECONDARY CABLE

Silicone-gel injection protects DC cables from stray-voltage corrosion, purges water from cable and forms a non-flowable gel, and reinsulates the conductor & blocks water intrusion. Once the water trees and other defects are removed, the cable can continue to perform for many more years.

### CHEMISTRY OF CABLECURE XLG® FLUID

2-part gel mixture field mixed prior to injection




Vinyl and Hydrido Silanes cross-link when mixed with catalyst

Transitions from 5cS to non-flowable gel in about 48 hours

### PRIMARY CABLE

### THE REJUVENATION PROCESS

**CABLE DIAGNOSIS**

De-energize, ground, and test cable. Locate splices, neutral corrosion, and measure the cable length.

**REJUVENATION TYPE**

Select the best rejuvenation type: Sustained Pressure Rejuvenation (SPR) or improved Unsustained Pressure Rejuvenation (iUPR).

**PREPARE THE CABLE**

Replace splices, connectors, and cable accessories, and install injection adapters.

SPR

iUPR

Perform airflow and pressure tests, install injection elbows, and then re-energize the cable.

**INJECTION PROCESS**

Inject the cable in low (iUPR) or moderate (SPR) pressure.

**REPORTING AND INFORMATION ON-DEMAND IN KNOMENTOUS**

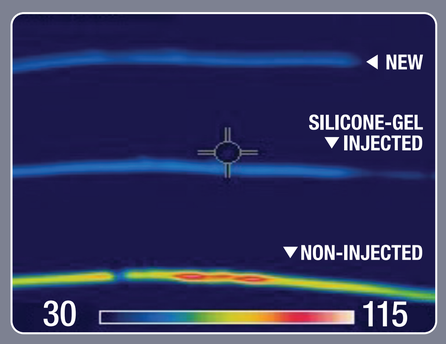
Progress on segment data available in real-time.

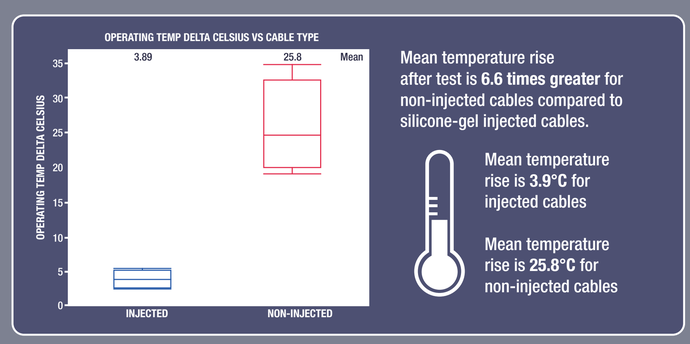
## THE RESULTS

Cables are like new to better than new after silicone-gel treatment.

### SECONDARY CABLE

#### OPERATING TEMPERATURE




Mean temperature rise after test is **6.6 times greater** for non-injected cables compared to silicone-gel injected cables.

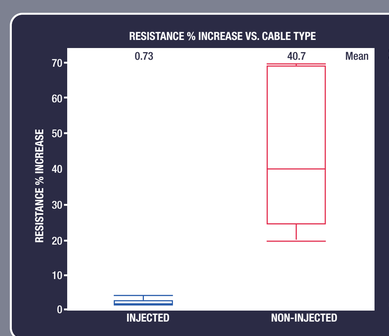
Mean temperature rise is **3.9°C** for injected cables

Mean temperature rise is **25.8°C** for non-injected cables

#### STRAND RESISTANCE

▲ SILICONE-GEL INJECTED

▲ NON-INJECTED

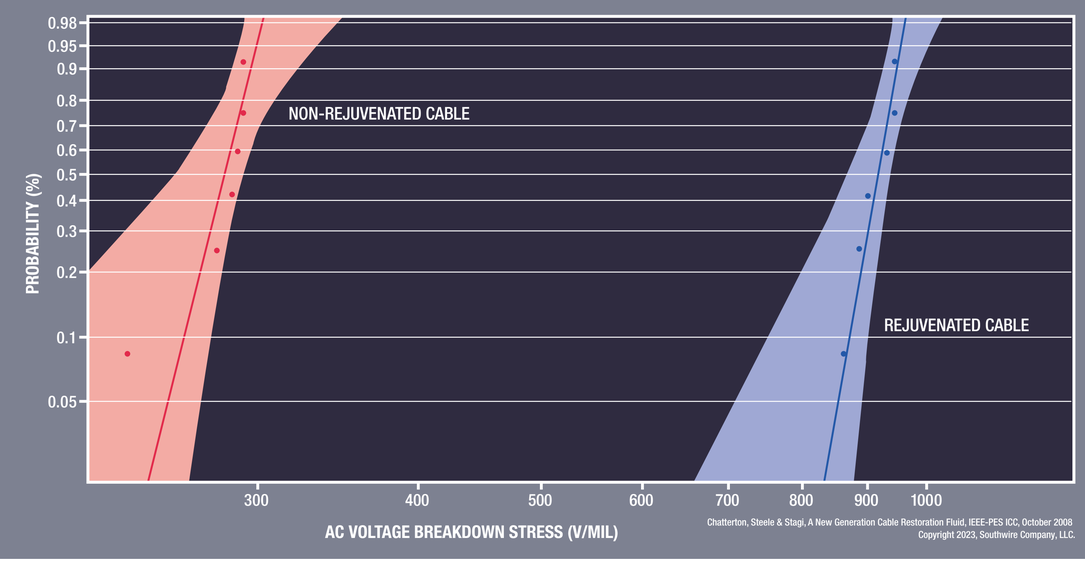



**Stray-voltage corrosion cell revealed:**

- **40.7%** mean rise in resistance for non-injected cables
  - Erosion, broken strands, distributed surface corrosion
- Silicone-gel injected cables maintain resistance within **0.7%**
  - Localized surface corrosion
- Non-injected cable fared **50x worse**

### PRIMARY CABLE

#### AC BREAKDOWN STRENGTH RECOVERY




Chatterton, Steele & Stagi, A New Generation Cable Restoration Fluid, IEEE-PES ICC, October 2008



Southwire®



### REPLACEMENT vs. REJUVENATION

Cable rejuvenation can address 2 to 6 times more cable, using less budget, than standard cable replacement.

**REPLACEMENT**

- Up to 1- year to receive new cable
- Around 300' of replacement cable can be installed per day

**REJUVENATION**

- Rejuvenation is readily available
- Around 2-6 segments of 300' can be rejuvenated per day

If the budget stays the same, the reach of rejuvenation can be up to **12x** that of replacement!