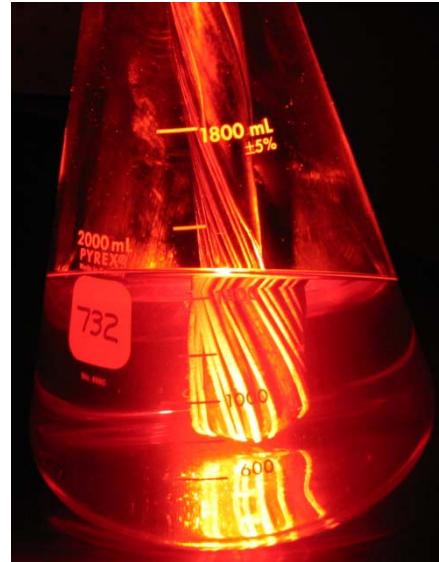


# Novinium Environmental & Fluid Safety

## Frequently Asked Questions (20080529)

**By recycling the cable instead of abandoning it in place how much aluminum and polyethylene are recycled?** It depends on the geometry of the cable, but generally the treatment materials required represent 10% of the mass of the aluminum and 2% to 10% of the mass of the PE and other polymers. In other words, there is a 10X to 60X net environmental leveraging by recycling cables *in situ*. Bauxite does not need to be strip mined from rain forests and petroleum does not need to be converted to polyethylene. The greenhouse gases to make all of these materials need not be generated.



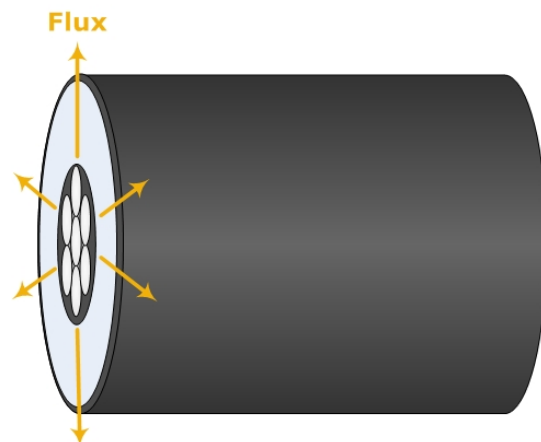
**Are the Novinium materials pumped in together?** Yes, all materials are blended before injection and no separate desiccants are used to flush the cable. The elimination of the desiccation step reduces the total volume of flushing required.

**What is done with the fluids flushed from a Novinium injection?** All flushed fluids are disposed of with licensed chemical waste disposal firms. Typically the flushed fluids are incinerated.

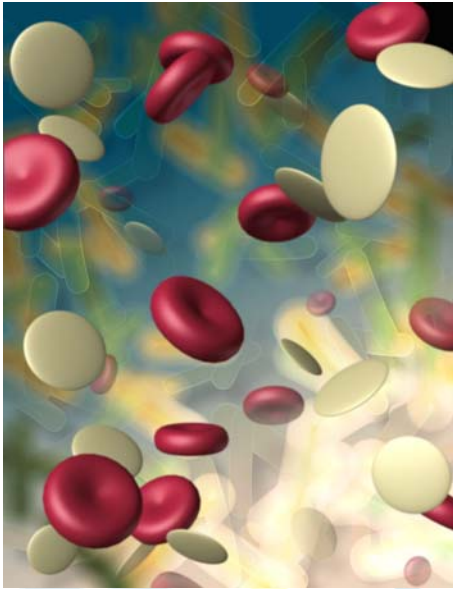
**Do the fluids cure to a solid inside the cable?** No. The silanes found in Perficio and Ultrinium fluids react with water to form alcohol and oligomerize to linear short chains and cyclo-siloxanes. Neither the monomer, any of its oligomers, nor the organic components included in the formulations will crystallize above  $-20^{\circ}\text{C}$ .

**Do the Novinium treatment materials diffuse from the cable?**

Yes. The permeation process is very slow, but ultimately most of the fluid that is put in the cable will permeate into the soil. As the fluid leaves the cable one molecule at a time the free energy driving force decreases and hence the concentration of treatment fluids in the cable will asymptotically approach zero. Depending on the



cable geometry and the temperature at which it operates 99% of the fluid will have permeated out of the cable in 42 to 395 years. Individual molecules of fluid then disperse into the soil at extremely low concentrations. These individual molecules seek to disperse because of entropy and hence there is no visible "seeping" from the cable jacket. Because of the very low concentration of these materials outside of the cable it is best to consider them as being in the vapor phase or dissolved in water at extremely low concentration.



**How do the Novinium treatment materials react with soil and water after they exude?**

The water reactive functionality of the silanes will have been exhausted long before the fluids exude from the cable. The siloxane oligomers, which do slowly exude, have no known toxicity at the very low concentrations likely found in the soil adjacent to a cable. Ultimately the short chain and cyclo-siloxanes degrade into lower molecular weight silanols. These lower molecular weight degradation products have been shown to further oxidize in the environment, both biologically and abiotically, to form naturally-occurring

substances: silica, carbon dioxide and water. Methanol, formed as a by-product of the reaction of methoxy-silanes treatment fluid and water, is metabolized by soil bacteria to water and carbon dioxide. Acetophenone is a by-product of the cross-linking process used to make new cables and hence is found in most cross-linked polyethylene cables. Acetophenone from new cables has been diffusing into the soil for decades with no known adverse consequences. Acetophenone is used in foods and cosmetics as a flavoring and scent and is generally non-toxic in low concentrations. It is believed that acetophenone will be metabolized in the soil to carbon dioxide and water.

**How much methanol is produced by the reaction with water for Ultrinium™ fluid and CableCURE® fluids?**

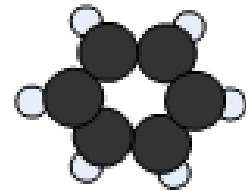
CableCURE/XL fluid produces about 30%<sub>w</sub> of methanol for each unit of weight injected. For each 10 pounds of fluid injected, about 3 pounds of methanol are created. Ultrinium 732 fluid produces about 20%<sub>w</sub> of methanol for each unit of weight injected. Each 10 pounds of Ultrinium 732 fluid injected yields about 2 pounds of methanol. For example, 1/0 (53 mm<sup>2</sup>) round strands use about 12.5 grams of Ultrinium 732 fluid per meter of cable and therefore about 2.5 g/m of cable or about 250 ml (1/4 of a liter or about 1 cup) per 100 meter (328 ft) cable segment. For 500 kcmil (253

mm<sup>2</sup>) round strands, the Ultrinium 732 usage is about 38 g/m and the methanol produced is about 776 ml (3/4 of a liter or about 3 cups) per 100 meter (328 ft) cable segment. To put that in perspective automotive windshield washer solvent is typically about 70% methanol and the average vehicle uses about 7 liters per year. This large amount of methanol ends up in the soil and is metabolized to water and carbon dioxide. By contrast, the methanol from a treated cable is dispersed over a 12 to 24 month period depending upon the operating temperature of the cable and is similarly metabolized.

**Are there other byproducts included in or produced by Ultrinium fluids?** No.

**Do Novinium Ultrinium fluids contain the carcinogen, developmental toxin, and male reproductive toxin benzene as Perficio™ 011 fluid does?** No.

Perficio 011 fluid is based upon the phenylmethyldimethoxysilane (PMDMS) fluid disclosed by U.S. Patent 4,766,011 and invented by a Novinium founder over two decades ago. PMDMS-based fluid includes up to 100 ppm of benzene, because the PMDMS is a reaction product of an industrial process that begins with benzene. Novinium Ultrinium brand products include starting materials, which are not known carcinogens, developmental toxins, or reproductive toxins, because it is virtually impossible to remove all traces of incompletely consumed starting reagents.



**Are Novinium Ultrinium fluids mutagenic (i.e. cause mutations in a cell's DNA or RNA) or teratogenic (i.e. interfere with normal embryonic development)?** Novinium Ultrinium fluids contain no known mutagens or teratogens.

**Are Novinium fluids regulated?** All chemical substances produced and used in the United States are regulated by the same laws. Novinium has reviewed those regulations and our MSDS reflects the best knowledge available.

**Can Novinium fluids be disposed of in the trash? Must any leakage to the ground be environmentally cleaned up and the contaminated soil sent to a permitted disposal company?** It is important to understand that the MSDS covers not only regulatory requirements, but also Novinium's safety and environmental stewardship. Second, the MSDS must cover hazards for large quantities such as might be encountered during transportation. For example, if a pallet of 5-gallon pails is in the back of truck, which is involved in a traffic accident, there could potentially be a large spill and the MSDS must provide guidance for that case. The circuit owner should not have any involvement in the transportation of the fluid (unless they become

a licensee of Novinium technology). For the normal case, where the fluid is put to use on a circuit owner's property, Novinium knows of no special disposal requirements for small spills or leakage of Ultrinium™ 732 fluids. In all conceivable injection scenarios, the maximum amount of fluid that could be spilled is just a couple of gallons, well below the threshold for regulated spill reporting requirements. In normal operation, Novinium injection equipment is leak free. Even though we are not aware of any federal or state requirements that compel a clean-up of a small fluid spill, Novinium (and our partners where applicable) do clean up all spills. Even though such small spills are not regulated and we are not aware of any hazardous waste disposal requirements for such small scale fluid spillage, spill wetted soil, and any absorbents used to clean the spill, Novinium's environmental stewardship philosophy has us disposing of the materials as though they were hazardous.

**If an Ultrinium fluid-treated cable is disposed of, is the cable classified as a hazardous waste per Title 22 of the California Code of Regulations (specifically, Article 3 Characteristics of Hazardous Waste)?**

No. Neither the fluid nor the fluid treated cable is ignitable as per §66261.21. Neither the fluid nor the fluid treated cable is corrosive as per §66261.22. Neither the fluid nor the fluid treated cable is reactive as per §66261.23. Neither the fluid nor the fluid treated cable is toxic as per §66261.24.



**Novinium uses carbon dioxide (CO<sub>2</sub>) as a source of pressure to inject. Does the CO<sub>2</sub> contribute to global warming?**

No – paradoxically just the opposite is true. The primary industrial sources of CO<sub>2</sub> are waste streams like the flue gas of fossil fuel power plants and CO<sub>2</sub> contaminated natural gas. If the CO<sub>2</sub> were not captured by the suppliers, it would be vented into the atmosphere. There is no net CO<sub>2</sub> created. It takes energy to provide pressure to inject fluid through a cable. Energy invariably means more net CO<sub>2</sub>. It takes 8-times more energy and 8-times more CO<sub>2</sub> to make a standard cubic foot (SCF) of N<sub>2</sub> than a SCF of CO<sub>2</sub>. It takes 15-times more energy and 15-times more CO<sub>2</sub> to make a SCF of





Helium than a SCF CO<sub>2</sub>. Not only is CO<sub>2</sub> the most CO<sub>2</sub>-efficient gas, but the advanced Novinium process uses a lot less gas than the older injection approach. First the older approach requires air flow and pressure tests using compressed nitrogen (N<sub>2</sub>). Novinium uses flow and pressure tests less than 10% of the time, and when we do, we use CO<sub>2</sub>. The older approach uses helium (He) as a fluid driving force in its feed bottles, Novinium uses CO<sub>2</sub>. Not only does the use of helium have the adverse global warming impact resulting from the large amount of CO<sub>2</sub> used to produce it, but helium itself is a scarce world resource. Of course, compared to the replacement alternative, rejuvenation has a huge net benefit to global warming. See the very first frequently asked question in this document to explore how recycling cables *in situ* has a profoundly positive impact on our planet.

**Why is there no pH provided on the MSDS?** pH is the negative log of the hydrogen ion concentration (or  $-\log_{10}[\text{H}^+]$ ) of a material in solution with water. Ultrinium™ 732 fluid is essentially insoluble in water and therefore the concept of pH does not apply to this type of organo-silicone material. If you mixed some Ultrinium 732 fluid (or CableCURE® fluid) with water the water phase pH would not change appreciably from a neutral pH, which is 7.0.

**Ultrinium™ 732 fluid appears to be much safer than older technologies. Why does it still carry a health hazard level of 2?** ANSI Z129.1-2006 states:

“Hazard evaluation ... is the process of evaluating all relevant data ... that identify the specific hazards of a particular chemical. The hazard evaluation process includes the identification of physical hazards (e.g., flammability or reactivity), health hazards (e.g., cancer or skin sensitization) and environmental hazards (e.g., toxicity to fish). ... Hazard evaluation is not the same as risk assessment. An assessment of risk involves the evaluation of hazard and exposure information to estimate the probability that an adverse effect will occur under specific exposure conditions.”

Ultrinium 732 fluid forms methanol when it reacts with water. Methanol or wood alcohol is a well know poison at high dosage. About 1 ounce of pure methanol can produce blindness or death in a typical human when ingested. That is why the material carries a hazard assessment of 2. To evaluate the risk it is important to consider the probability of exposure to the hazard of accidental ingestion of Ultrinium fluid. To generate a toxic dose of 1 ounce of methanol, one would have to swallow more than 4 ounces (1/3 of a can of soda) of Ultrinium fluid. It is difficult to conceive of such a circumstance. Unlike car windshield washer fluid (a mixture of methanol and water), which when mixed with some orange juice would taste much like a screwdriver, Novinium fluids have a putrid, gagging taste. Nobody is likely to accidentally ingest 4 ounces of Novinium fluid.

*The information contained in this document has been gathered from reference materials and/or test data and is to our best knowledge and belief accurate and reliable. Such information is offered solely for your consideration, identification, and verification. It is not suggested or guaranteed that the hazard precautions or procedures described are the only ones which exist. There are no warranties expressed or implied with respect to the use of such information and we assume no responsibility therefore.*

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- Ultrinium™ sustained pressure injection method (U.S. Patent 7,615,247 and 8,205,326)
- 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. Patent 7,658,808, 7,700,871 and 8,101,034)
- 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 (U.S. Patent 8,475,194)

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