CALIFORNIA ENVIRONMENTAL PROTECTION AGENCY
DEPARTMENT OF TOXIC SUBSTANCES CONTROL
Final Decision to Certify
Hazardous Waste Environmental Technologies

The California Environmental Protection Agency, Department of Toxic Substances Control (DTSC) intends to certify the following company's hazardous waste environmental technology:

Applicant: Cooper Power Systems, Inc.
1900 East North Street
Waukesha, Wisconsin 53188

Technology: Envirotemp®FR3™ Vegetable Oil-Based Insulating Dielectric Fluid

Chapter 412, Statutes of 1993, Section 25200.1.5, Health and Safety Code, enacted by Assembly Bill 2060 (AB 2060 by Assemblyman Ted Weggeland) authorizes DTSC to certify the performance of hazardous waste environmental technologies. The purpose of the certification program is to provide an in-depth, independent review of technologies at the manufacturers' level to facilitate regulatory and end-user acceptance. Only technologies that are determined to not pose a significant potential hazard to the public health and safety or to the environment when used under specified operating conditions may be certified. Incineration technologies are explicitly excluded from the certification program.

DTSC makes no express or implied warranties as to the performance of the manufacturer's product or equipment. The end-user is solely responsible for complying with the applicable federal, state, and local regulatory requirements. Certification does not limit DTSC's authority to require additional measures for protection of public health and the environment.

By accepting certification, the manufacturer assumes, for the duration of certification, responsibility for maintaining the quality of the manufactured equipment and materials at a level equal to or better than was provided to obtain certification and agrees to be subject to quality monitoring by DTSC as required by the statute under which certification is granted.

DTSC's proposed decision to certify was published on November 29, 2002 in the California Regulatory Notice Register 2002, Volume No. 48-Z, pp. 2256-2268 and was subject to a 30-day public review and comment period.

Cooper Power Systems submitted comments that the acute toxicity tests performed, as part of this certification evaluation did not fully comply with the procedures specified in the California Code of Regulations. Specifically, Cooper expressed concern that the sample preparation method selected produced an emulsion of the vegetable oil-based Envirotemp®FR3™ fluid with water. Cooper contends that the produced emulsion presented a physical toxicity by coating the gills of the test fish, and that the Department should have selected an alternative sample preparation procedure which evaluates the systemic rather than the physical toxicity of their product. Cooper references test results of an independent laboratory using a different sample preparation procedure, which found their product to produce zero mortality in fish. The complete text of Cooper's comments is provided under Section 6 of this notice.

Although the Department appreciates and understands the vendor's concerns, the Department disagrees with the vendor that the aquatic bioassay testing was not performed properly. A review of the aquatic bioassay test results and procedures found that the tests were performed in accordance with procedures set forth in California regulation for the determination of hazardous waste acute toxicity. The Department acknowledges that its aquatic bioassay test procedure may be more sensitive than most other methods, and does not distinguish between physical or systemic toxicity.

Additional information supporting DTSC's final decision is included in the May 2002 Final U.S. EPA Environmental Technology Verification Report, and is available for review. DTSC's Final Certification shall become effective on February 1, 2003. Requests for additional information concerning the final decision should be submitted to the following address:

California Environmental Protection Agency
Department of Toxic Substances Control
Office of Pollution Prevention and Technology Development
P.O. Box 806
1001 I Street, 12th Floor
Sacramento, California 95812-0806
Attn: Suzanne Davis (916) 327-4206
http://www.dtsc.ca.gov/sciencetechnology/TechCert_index.html

A description of the technology to be certified, the certification statement and the certification conditions and limitations for the technology of the company listed above follow.

CERTIFICATION PROGRAM (AB 2060) FOR
HAZARDOUS WASTE ENVIRONMENTAL
TECHNOLOGIES

FINAL NOTICE OF TECHNOLOGY CERTIFICATION
ENVIROTEMP®FR3™ VEGETABLE OIL-BASED INSULATING DIELECTRIC FLUID

Technology: Envirotemp®FR3™ Vegetable Oil-Based Insulating Dielectric Fluid

Manufacturer: Cooper Power Systems, Inc.
1900 East North Street
Waukesha, Wisconsin 53188

Technology Description

Cooper Power Systems, Inc. (Cooper) has developed a vegetable oil-based dielectric fluid comprised of greater than 98.5% vegetable oil and less than 1.5% additives. The additives include antioxidants to prevent the unsaturated bonds in the oil from polymerizing with oxygen from the air, and color to visually differentiate it from mineral oil. The Envirotemp®FR3™ Vegetable Oil-Based Insulating Dielectric Fluid (Envirotemp®FR3™) is manufactured using a food-grade vegetable oil purchased from an off-site processor. Each vegetable oil shipment is tested and compared to Cooper's quality control specifications before it is accepted. At Cooper's facility, the oil is degassed and then blended with

antioxidants and color additives. During and after the blending process, the product is tested and compared to Cooper's product specifications.

Envirotemp®FR3™ fluid is used in electrical apparatus such as liquid-filled transformers as an electrical insulating medium. In addition to providing electrical insulation, the oil transports heat generated around the transformer's windings, core and connected circuits to cooling surfaces where the heat is dissipated by radiation and convection to the outside air.

The main parts of a transformer are the core, the windings, the tank containing the core and windings, and the cooling system. The core is made of thin steel sheets laminated with varnish or an oxide film to insulate the sheets from each other. Two distinct sets of coils called windings are wound upon the core at a suitable distance from each other. These windings consist of wire insulated with a kraft paper covering. When the transformer is in-service, the oil and core expands and contracts as the heat generated by the transformer windings varies with the load. As the oil becomes heated, the hot oil rises to the top of the transformer where heat is dissipated to the outside, and then moves along the case to the bottom. Fins are sometimes attached to deflect moving air against the case and to increase the cooling area. Overheating the core can lead to damage, and overheating the windings can cause the paper insulation to deteriorate, which reduces the life of the transformer. Nearly all distribution transformers in the United States are sealed to prevent the oil from oxidizing with the air.

Envirotemp®FR3™ dielectric fluid exhibits a high fire point (>300°C), and is classified by Underwriter Laboratories (UL) and approved by Factory Mutual Research Center (FMRC) as a less flammable transformer fluid. Typically, the less-flammable fluids are used in transformers where additional fire safety is required, such as inside buildings, rooftops, vaults, and adjacent to buildings. Under Section 450-23 of the National Electrical Code (NEC), the installation requirements for less-flammable liquid insulated transformers in fire-sensitive areas are simpler than those for transformers filled with mineral oil.

Basis for Certification

Evaluation Approach

The Envirotemp®FR3™ fluid evaluation was designed to provide the data necessary to draw conclusions on the technology's performance, chemical composition, toxicity, and safety. The evaluation included a review of supporting documents, information, and laboratory data submitted by Cooper, and field sampling to provide independent data on the technology's performance, chemical composition, and toxicity.

The field sampling was conducted at Cooper's manufacturing facility in Waukesha, Wisconsin, at San Mateo High School in San Mateo, California, and at Texas Instruments in Santa Cruz, California. San Mateo High School and Texas Instruments are customers of Artwel Electric, Inc. (Artwel), Cooper's distributor. Artwel and Cooper agreed to provide staff and access to these in-service transformers as part of the field sampling activities. Prior to the field sampling, DTSC staff prepared a Technology Evaluation Workplan (Workplan) to identify specific field objectives, data quality objectives, testing procedures, and roles and responsibilities. Cooper assumed overall responsibility for providing staff for sampling and obtaining access to all locations where field sampling was conducted. DTSC staff provided independent oversight and were present to observe all field sampling activities.

The oldest transformer in-service with Envirotemp®FR3™ fluid as the dielectric insulating fluid is 4.8 years old. Since the technology is still new, no data was available to assess the performance of Envirotemp®FR3™ fluid over a transformer's life or the fluid's waste characteristics at the end of the transformer's service life. According to Cooper, Envirotemp®FR3™ fluid has passed the Institute of Electrical and Electronic Engineers (IEEE) accelerated life tests which requires a tested transformer to have an operational equivalence of 100 years. This operational equivalence is five times the normal transformer life. According to Cooper, the insulation in the Envirotemp®FR3™ transformers showed less degradation than the insulation in identical transformers using mineral oil per this test. Based on this information, the normal service life is expected to be in the range of 20 years.

Verification Objectives

The field sampling objectives were to verify the applicant's technology performance claims for the Envirotemp® FR3™ dielectric insulating fluid listed below.

- **Verification/Certification Claim #1 - General Performance**: Envirotemp® FR3™ fluid meets the dielectric breakdown specifications listed in ASTM D3487, *Standard Specification for Mineral Insulating Oil*, and ASTM D5222, *Standard Guide for High Fire Point Fluids of Petroleum Origin*, IEEE C57.121, *1998 IEEE Guide For Acceptance and Maintenance of Less Flammable Hydrocarbon Fluid in Transformers*, IEC 1099, *Specifications for Unused Synthetic Organic Esters for Electrical Purposes*, and IEC 1203, *Synthetic Organic Esters for Electrical Purposes-Guide for Maintenance of Transformer Esters in Equipment*,

- **Verification/Certification Claim #2 - Aquatic Biodegradability***:* Envirotemp® FR3™ fluid biodegrades 99% based on the average of several biodegradation tests, as measured by OPPTS 835.3110, *Ready Biodegradability,*

- **Verification/Certification Claim #3 - Flammability**: Envirotemp® FR3™ fluid has a flash point of at least 320°C, and fire point of 350°C, based on the average of several performance tests by independent labs performing ASTM D92 (Cleveland Open Cup),

- **Verification/Certification Claim #4 - Acute Toxicity**: Virgin Envirotemp® FR3™ fluid passes the toxicity characteristic criteria in Code of California Regulations, Title 22, Section 66261.24(a)(6) as tested by U.S. EPA/600/4-90/027F Test for *Acute Toxicity of Effluents and Receiving Waters to Freshwater and Marine Organisms,* and

- **Other Verification/Certification Tests:** Verify that Envirotemp® FR3™ fluid consists of greater than 98.5 % vegetable oil and less than 1.5% additives, and meets selected Cooper product specifications; establish a baseline for measuring potential metals leaching and oil degradation of Envirotemp® FR3™ fluid under electrical loading over time; evaluate the worker health and safety aspects of Envirotemp® FR3™ fluid; and estimate costs using Envirotemp® FR3™ fluid as compared to those of mineral oil.

Verification Activities and Results

As part of this verification/certification, DTSC developed a technology evaluation workplan, which described the sample collection procedures and analyses to be performed. Samples were collected under DTSC oversight to ensure the samples were independent and representative. Samples were assigned a field sample identification number, which was determined prior to sampling. Proper chains of custody and storage procedures were followed. Four different laboratories were used to analyze the collected samples: Doble Engineering for the American Standard Testing Methods (ASTM) methods, Silliker Laboratories for the Association of Analytical Chemists (AOAC) methods, DTSC Hazardous Materials Laboratory (HML) for the semi-volatile organic compounds (SVOCs) and metals analyses, Associated Laboratories for the fish bioassay (acute toxicity) tests, and Global Tox for the aquatic biodegradability tests. Each laboratory sent data and reports directly to DTSC.

Four samples from three different virgin product lots (a total of twelve samples) were collected at Cooper's dielectric fluid formulating facility in Waukesha, Wisconsin. Two lots were contained in 55-gallon drums while the third lot was contained in a 2,500-gallon finishing tank. Barrel samples were collected using a glass Coliwasa. A new glass Coliwasa was used at each new barrel sampled to reduce the potential of cross contamination between samples. The finishing tank samples were collected at a sampling spigot located beneath the tank. Approximately one pint of oil was drained from the tank via the spigot prior to sampling.

Three samples, one from each lot, were analyzed by the following methods: EPA Method 8270/3520 for SVOCs; EPA Method 6010/5030 for metals; U.S. EPA Method 600/4-90/027F for acute toxicity; U.S. EPA Method OPPTS 835.3110 for aquatic biodegradation; AOAC Method 981.11, Oils and Fats; AOAC Method 972.28, Total Fatty Acids in Oils and Fats; AOAC Method 963.22, Methyl Esters of Fatty Acids in Oils and Fats; AOAC Method 983.15, Phenolic Antioxidants in Oils, Fats, and Butter; AOAC Method 977.17, Polymers and Oxidation Products of Vegetable Oils; American Standard testing Methods (ASTM) Method D92, flash and fire point; ASTM Method D97, pour point; ASTM Method D445, kinematic viscosity at 0°C, 40°C, and 100°C; ASTM Method D877, dielectric breakdown (minimum); ASTM Method D1816, dielectric breakdown (gap); ASTM Method D3300, dielectric breakdown (impulse); ASTM Method D924, dissipation factor at 25°C and 100°C; ASTM Method D971, interfacial tension; ASTM Method D974, neutralization number; and ASTM Method D1533, water content. One duplicate was analyzed for SVOCs, metals, and the AOAC and ASTM methods listed above. Two matrix spikes and an equipment blank were analyzed for SVOCs and metals. A field blank was analyzed for metals only.

Cooper also collected split samples from each lot sampled by DTSC. These split samples were analyzed by Cooper for dielectric breakdown voltage, dissipation factor at 25°C, water content, interfacial tension, neutralization number, pour point, flash and fire point, and viscosity at 40°C and 100°C using the above-specified ASTM methods. These samples were initially analyzed by Cooper to verify the dissipation values reported by Doble Engineering.

Four different in-service transformers were also sampled as part of this verification/certification: two owned by Cooper located in Waukesha, Wisconsin, one owned by San Mateo High School (SMHS) in San Mateo, California, and one owned by Texas Instruments (TI) in Santa Cruz, California. The sampled transformers were in service for at **least one year** and part of a regular sampling/testing environment. In-service fluid samples were collected by Cooper and Artwel representatives under

DTSC oversight and in conjunction with the normal on-going sampling program. Only one sample per transformer was collected to minimize the amount of fluid removed from each transformer and the impact to the ongoing test program. New Tygon tubing connectors were used at each transformer fluid sampling port to reduce the potential of cross contamination.

The transformer pressure valve was checked to confirm the unit was under positive pressure prior to sampling. A stainless steel sampling cylinder with Tygon tubing was attached to the sampling port and used to purge oil from the transformer to ensure ambient air was not introduced into the transformer. After a few pints of oil had been purged through the sampling cylinder, the sample bottles were filled using Tygon tubing attached to the sampling cylinder.

The in-service transformer samples were analyzed using the same methods listed for the virgin product samples for SVOCs, metals, and the AOAC analyses. To minimize the amount of fluid removed from each transformer, the in-service transformer samples were only tested for dissipation factor at 25°C by ASTM Method D924, flash and fire point by ASTM D92, interfacial tension by ASTM Method D971, neutralization number by ASTM Method D974, water content by ASTM Method D1533, and conductivity by ASTM Method D4308.

In addition to field sampling conducted under DTSC oversight, DTSC staff reviewed internal product development testing data provided by Cooper. These data were collected as part of Cooper's ongoing internal testing program prior to entry into the verification/certification agreement. These data provided background information on the technology performance for past virgin lots and were used to develop trends on the fluid's performance in tested transformers for select ASTM parameters. Historical data collected by independent testing facilities under contract with Cooper were also used.

1. General Performance

As part of this verification/certification, Envirotemp® FR3™ fluid was tested for select physical, chemical, thermal, and dielectric properties to verify general performance claims listed in Cooper's product specifications. Since standard specifications do not exist for vegetable oil-based dielectric fluids, two ASTM specifications, two International Electrochemical Commission (IEC) specifications, and one IEEE specification were used to evaluate Envirotemp® FR3™ fluid performance. ASTM D3487 and ASTM D5222 were developed to evaluate the performance of virgin mineral oil-based dielectric fluids and virgin high molecular weight hydrocarbons (HMWH), respectively. IEEE C57.121 was developed to evaluate the performance of virgin silicone fluids. IEC 1099 and IEC 1203 were developed to evaluate the performance of virgin synthetic organic esters and in-service synthetic organic esters, respectively. These specifications were selected since Cooper claimed the dielectric breakdown for Envirotemp® FR3™ fluid was similar to that of mineral oil, HMWH, silicone and synthetic esters. The physical and chemical properties of Envirotemp® FR3™ fluid were only compared to Cooper specifications since these properties differ due to the nature of the fluid. Data variability reported in this section was calculated at 95% confidence.

Virgin Product Performance Results

Dielectric Properties (or Dielectric Strength)

Dielectric breakdown is the common property used to evaluate a dielectric fluid's performance. The dissipation factor varies depending on the chemistry of the different types of dielectric fluids, and therefore these values were only compared to the Cooper specification.

Dielectric Breakdown

The minimum and gap dielectric breakdowns indicate the minimum voltage required to cause arcing between two submerged electrodes in a dielectric fluid. A low value may indicate the presence of water, dirt, or other electrically conductive particles in the oil, which may cause damage to the transformer core or windings due to arcing. The minimum dielectric breakdown voltages for virgin Envirotemp® FR3™ samples averaged 45 kilovolts (kV) ± 1 kV and were higher than the lowest value listed for the four specifications. For the 0.04-inch (1.0 millimeters [mm]) gap dielectric breakdown, sample values averaged 37 kV ± 3 kV and were higher than the minimum voltage listed for all five specifications.

The impulse dielectric breakdown value is designed to determine the minimum voltage to cause arcing in the fluid under lighting or power surge conditions. The impulse breakdown voltage for all samples averaged 168 kV ± 4 kV and was higher than the minimum voltage listed for mineral oils under ASTM D3487 of 145 kV. Cooper does not have a specification value for the impulse breakdown voltage but this value typically ranges from 130 kV to 170 kV in virgin product.

Dissipation Factor

The dissipation factor is a measure of the dielectric losses to an insulating dielectric fluid (such as oil) when it is exposed to an alternating electric field. For ASTM Method D924, the dissipation factor is determined by passing an alternating electric current through a test cell filled with dielectric fluid and measuring the capacitance with an electronic bridge circuit. This value is used to control the product quality, and to determine changes in the fluid due to contamination or degradation during use. A low dissipation factor indicates a low dielectric loss and a low contaminant concentration (e.g., dirt, water, or metals).

The dissipation factor measured at 25°C averaged 0.143% ± 0.029%. Two of these samples had dissipation factors, which exceeded the Cooper specification value 0.150%. The dissipation factor measured at 100°C averaged 2.89% ± 0.59% and was greater than three previous sample results, which ranged from 1.4% to 1.9%. Cooper does not routinely test for the dissipation factor at 100°C and therefore has not defined a specification value. The dissipation factor for all samples measured at 25°C and 100°C exceeded the maximum value listed for the ASTM, IEEE and IEC specifications. Split samples, analyzed by Cooper, had a dissipation factor at 25°C of 0.131% and 0.097%, respectively. Past performance testing performed by Doble determined the dissipation factor at 25°C as 0.061%.

Chemical Properties

Neutralization Number

The neutralization number is used as a quality control parameter for lubricating oil. This number is determined by the amount of base required to titrate acidic substances contained in the oil. The acidic substances may be additives or degradation products formed during service, such as oxidation products. When an in-service fluid is analyzed for this property, an increasing neutralization number over time may be an indicator of oil degradation due to oxidation. According to ASTM Method D974, this test cannot be used to predict the corrosiveness of oil under service conditions. There is no general correlation known between the neutralization number and the corrosive tendency of oils toward metals.

The neutralization number was consistent between lots with sample results averaging 0.03 milligrams of potassium hydroxide per gram (mg KOH/g) ± 0.01 mg KOH/g and met Cooper's, ASTM D3487, IEEE C57.121, and IEC 1099 specifications.

Water Content

Water content is used by industry to monitor a dielectric fluid's quality. It is an indicator of possible oil deterioration, which could adversely affect the oil's electrical properties such as dielectric breakdown. This value is based on the relative saturation of the water in the dielectric fluid. The relative saturation is based on the amount of water dissolved in the oil divided by the total amount of water the oil could hold at that temperature. The dielectric strength of oil starts to fall when saturation reaches about 50%. For petroleum based dielectric oils, 50% saturation at room temperature is 30-35 milligram per kilogram (mg/kg). Synthetic esters and vegetable oil contain about 500-600 mg/kg of water at room temperature and 50% saturation. Water content at or near 50% saturation may indicate the oil has deteriorated and may cause a lower dielectric breakdown voltage, which can damage the transformer core and windings.

Water content measured for all samples including the split samples analyzed by Cooper, averaged 55 parts per million (ppm) ± 5 ppm. These levels are less than the maximum water content of 75 ppm specified by Cooper and 200 ppm specified by IEC 1099. However, Envirotemp®FR3™ fluid did not meet the ASTM, IEEE, and IEC specifications and was not expected to meet these specifications.

Interfacial Tension

The interfacial tension was developed to gauge the presence of hydrophilic compounds in mineral oil. Interfacial tension is a measurement of the amount of force needed to detach a platinum ring from the water-oil interface. In practice, this value has been found to be a good indicator of oil degradation due to oxidation. A lower interfacial tension value indicates a higher hydrophilic or water content in the oil which may adversely affect the oil's dielectric properties.

The interfacial tension value measured for all samples, including split samples analyzed by Cooper, averaged 28 dynes per centimeter (dynes/cm) ± 1 dynes/cm and met Cooper's specification of ≥ 18 dyne/cm. Envirotemp®FR3™ fluid did not meet the ASTM, IEEE, and IEC specifications and was

not expected to meet these specifications. These specifications were based on fluids with different chemical properties.

Physical Properties

Pour Point

The pour point indicates the lowest temperature at which oil can be used. The pour point was consistently measured at -18°C for all samples and met the Cooper specification of ≤ -18°C. The two split samples analyzed by Cooper had pour points at -22°C. Envirotemp®FR3™ fluid did not meet the ASTM, IEEE, and IEC specifications and was not expected to since these specifications were based on fluids with different physical properties.

Viscosity

The dielectric fluid's viscosity is used by transformer designers to confirm that the fluid is appropriate for the unit under certain operating conditions. The viscosity of Envirotemp®FR3™ fluid was measured at 0°C, 40°C, and 100°C, and averaged 187.42 centistoke (cSt) ± 0.72 cSt at 0°C, 32.71 cSt ± 0.11 cSt at 40°C, and 7.93 cSt ± 0.09 cSt at 100°C. The two split samples analyzed by Cooper had viscosities of 32.13 cSt and 32.68 cSt at 40°C, and 7.47 cSt and 7.49 cSt at 100°C. Envirotemp®FR3™ fluid met Cooper specifications for viscosity at 40°C and 100°C. Cooper has no specification for viscosity at 0°C. However, Envirotemp®FR3™ fluid did not meet the ASTM, IEEE, and IEC specifications and was not expected to since these specifications were based on fluids with different physical properties.

In-service Transformer Fluid Results

The sample results for the dissipation factor at 25°C ranged from 0.120% to 0.196% and met the Cooper and IEC 1203 in-service fluid specifications of ≤ 1.0% and ≤ 0.8%, respectively. Historical data for the oldest in-service transformers appeared to gradually increase over time. The relatively small changes in the data over the service life for the oldest transformers indicate the fluid has not degraded with use.

The sample results for the water content ranged from 33 ppm to 98 ppm and met both the Cooper and IEC 1203 specifications of ≤ 400 ppm for in-service fluid. The water content after more than one year of service is similar for all four transformers. Again, the historical data for the oldest transformers appears to show a gradual increase over time. The minor increase indicates the fluid has not degraded with use.

Interfacial tension results for the samples ranged from 23 dynes/cm to 26 dynes/cm and met the Cooper specification of ≥ 18 dynes/cm. The IEEE C57.121 specification of ≥ 24 dynes/cm was also met except for one sample. Although the data for the fluid in the oldest transformers have increased over time, the interfacial tension values have remained above the minimum value specified by Cooper. The current data trend for the oldest transformers indicates the fluid has not degraded with use.

The neutralization number for all four samples ranged from 0.01 mg KOH/g to 0.08 mg KOH/g

and met the Cooper and IEC 1203 specifications of ≤ 2.5 mg KOH/g and ≤ 2.0 mg KOH/g for in-service fluid. Three of the four samples also met the ASTM D3487 specification of ≤ 0.03 mg KOH/g. Comparing the values for all four transformers after one year of service, one sample had a value comparable to virgin product. Data collected over the oldest transformers' service lives were well below the maximum value specified by IEC 1203 of 2.0 mg KOH/g. The small fluctuations in the data for the oldest transformers indicate the fluid has not degraded with use.

The conductivity values were converted to volume resistivity (1 picosiemens per meter [pS/m] = 1.0×10^{14} ohms-centimeter [Ocm]) for comparison to IEC 1203 criteria. The converted values for the four samples ranged from 5.9×10^{12} Ocm to 9.4×10^{12} Ocm which were above the minimum IEC 1203 volume resistivity of 6.00×10^{11} Ocm.

The historical results for the two oldest transformers indicate that the oil has degraded little over the service period. As the service life of the transformers increases, the interfacial tension will drop as the water content, dissipation factor and neutralization factor rise. The changes in these parameters for Envirotemp®FR3™ fluid would also expected to be observed in mineral oil transformers.

2. Aquatic Biodegradability

Three virgin Envirotemp® FR3™ samples, one from each lot, were analyzed by U.S. EPA Office of Pollution, Pesticides, and Toxic Substances (OPPTS) 835.3110, *Ready Biodegradability*, using the carbon dioxide (CO_2) evolution method. Each sample and a replicate were tested in parallel per OPPTS 835.3110. The degree of biodegradation was calculated by dividing the cumulative amount of CO_2 produced by Envirotemp® FR3™ fluid after 28 days by the product of the theoretical total organic content times a conversion factor of 3.67 (ratio of the molecular weight of carbon dioxide [44] to the molecular weight of carbon [12]).

The average biodegradability of Envirotemp® FR3™ fluid after 28 days was 120% ± 33% at 95% confidence. The greater than 100% result may be due to CO_2 leakage from the stock solution apparatus. The removal and replacement of the barium hydroxide ($Ba(OH)_2$) absorber every few days may have caused the testing apparatus to leak CO2 at connectors. The testing apparatus consists of a stoppered flask connected to a series of $Ba(OH)_2$ absorbers with flexible tubing. A CO_2 leak from the stock solution would result in the calculated amount of CO_2 (difference between the CO_2 evolved from a mixture of the test substance and stock solution, and the CO_2 evolved from the stock solution) for the test substance to be higher and cause the cumulative CO_2 amount to be greater than the theoretical CO_2 amount. One of the reference documents for OPPTS 835.3110 noted a CO_2 production rate of 125% might be possible due to CO_2 leakage from the stock solution apparatus.

A known readily biodegradable material (phthalic acid) was also tested in parallel. The reference stock solution had a biodegradation rate of >60% after 14 days and after 28 days which verified that the appropriate test system and bacteria inoculum were used. This test was developed as a screening method for ready biodegradability and should be considered a qualitative measurement. Historical biodegradability results provided by Cooper reported an average biodegradability of 99% in 28 days.

While mineral oil was not tested as part of this study, literature data are available on biodegradability using equivalent methods to OPPTS 835.3110. A U.S. Army Corp of Engineers document reported the biodegradation rates for conventional mineral oil ranged from 42-49% after 28

days using U.S. EPA Method 560/6-82-003, Aerobic Aquatic Biodegradability. Another study by Conservation of Clean Air and Water-Europe (CONCAWE) reported a ready biodegradation rate for a light naphthenic distillate mineral oil of 28% after 28 days when analyzed by OECD 301B, Sturm test. These results agree with those reported by Thomas Edison Research Center (TERC) which is owned by Cooper Power Systems and provided the historical biodegradability results reported above for Envirotemp® FR3™ fluid. TERC reported average biodegradation rates after 28 days of 30.5% for Univolt 60, a mineral oil-based transformer fluid; 21.3% for R-Temp, a HMWH transformer fluid; and 98% for Envirotemp® FR3™ fluid.

Based on these results, the virgin Envirotemp® FR3™ fluid appears to biodegrade more readily than mineral oil. Although Envirotemp® FR3™ fluid biodegrades, releases to water should be prevented. The product's ability to degrade in the environment is dependent on factors such as geography, pH, temperature, oxygen concentration, dispersal of oil, the presence of other chemicals, soil characteristics, nutrient quantities, and populations of various microorganisms at the location.

3. Flammability

The flash point and fire point for virgin and in-service Envirotemp® FR3™ fluid were determined using ASTM Method D92, Cleveland Open Cup test. The flash point was measured to assess the overall flammability of the fluid and determine the presence of volatile or flammable material at elevated temperatures. The fire point was measured to determine the temperature at which the fluid could support combustion. These values were compared to the Cooper specification, ASTM D3487 specification for flash point, and ASTM D5222 specification for fire point. Data variability was calculated at 95% confidence. The virgin product samples had flash and fire points averaging 328°C ± 11°C and 363°C ± 2°C, respectively. The in-service transformer samples had flash and fire points ranging from 328°C to 340°C and from 362°C to 364°C, respectively.

The fire point results were slightly higher than those obtained by Underwriters Laboratory (UL) of 358°C. The flash point determined by UL was 255°C and was lower due to the different test method. UL has classified Envirotemp®FR3™ fluid as a dielectric medium and transformer fluid with a fire hazard rating of 4 to 5 which is less hazardous than paraffin oil. Envirotemp®FR3™ fluid is one of five products listed by UL as a Class 4 to 5 dielectric medium and one of three products listed as a Class 4 to 5 transformer fluid.

Envirotemp®FR3™ fluid is also classified as a less flammable transformer fluid by Factory Mutual Research Center (FMRC). Envirotemp® FR3™ fluid is one of ten products classified as a less flammable transformer fluid. The other products classified as less flammable consist of silicone oil-based, HMWH, or vegetable oil-based transformer fluids. FMRC also identified Envirotemp®FR3™ fluid as an alterative to high fire point hydrocarbons, silicone fluids, and synthetic esters or hydrocarbons where fire resistance, improved high temperature operation, and improved cooling are desired.

4. Acute Toxicity

Three virgin Envirotemp®FR3™ samples, one from each lot, were analyzed using U.S. EPA method, *Methods for Measuring the Acute Toxicity of Effluents and Receiving Waters to Freshwater and Marine Organisms*, EPA/600/4-90/027F, August 1993. The test used juvenile

pimephales promelas (fathead minnow). Samples were prepared using the wrist-action shaker method to dissolve the oil, in accordance with the "Static Acute Bioassay Procedures for Hazardous Waste Samples" developed by the California Department of Fish and Game, Water Pollution Control Laboratory and specified in the Code of California Regulations, Title 22, Section 66261.24(a)(6). Associated Laboratories also performed a second and parallel set of tests using adult pimephales promelas (fathead minnow) at the same concentrations.

The LC_{50} values were less than 250 mg/L for the juvenile fathead minnows and averaged 317 mg/L ± 169 mg/L at 95% confidence for the adult fathead minnows. Historical LC_{50} results provided by Cooper were greater than 1,000 mg/L, indicating that virgin Envirotemp® FR3™ fluid would pass the California aquatic toxicity criterion. These results indicate that virgin Envirotemp® FR3™ fluid does not pass the toxicity criteria specified under California hazardous waste regulations.

A DTSC fish toxicologist reviewed the verification/certification sample results and historical testing results provided by Cooper to identify the differences which could lead to such conflicting results. The main difference between the two sets of results was the sample preparation method used. Samples with the lower LC_{50} results were prepared using the wrist-action shaker method cited in 22CCR Section 6626124(a)(6). The higher LC_{50} results provided by Cooper used an acetone carrier solvent, which made the oil miscible in water per OECD Procedure 203, *Fish Acute Toxicity Test*. Oil samples prepared using the wrist action method stratifies the oil at the top of the tank. Fish swimming through this upper layer of the tank are thought to become coated with the product and gill exchange will be impaired. Oil samples prepared using the wrist shaker method are thought to provide a more realistic result for conditions which may occur during an environmental release. Samples prepared using the OECD method are thought to provide results that reflect systemic or chemical impacts on fish.

In California, insoluble, viscous waste samples are prepared using the wrist-shaker method and ultrasonic method, and sometimes the solvent carrier method as part of the fish bioassay screening tests for hazardous waste characterization. The preparation method yielding the most conservative LC_{50} result is then used to perform the definitive tests. This methodology is required by DTSC Waste Evaluation Unit and overseen by the Department of Health Services Environmental Laboratory Accreditation Program's Aquatic Toxicity Bioassay Section who certifies laboratories performing aquatic toxicity tests for DTSC. Cooper disagrees with DTSC's methodology (see vendor's comment section listed below for Cooper's opinion). The reader should note that this methodology is used to characterize the hazardous characteristics for **waste**. Any statement concerning the hazardous characteristic of the Envirotemp®FR3™ fluid applies to the **spent (waste)** fluid only and is not intended to classify the virgin product.

The average LC_{50} for virgin Envirotemp®FR3™ fluid was less than 250 mg/L which indicates the spent Envirotemp®FR3™ fluid might exhibit a hazardous characteristic per 22CCR Section 66261.24(a)(6). This determination is based on a limited set of data and a conservative interpretation of the California hazardous waste characterization regulations. The end-user should characterize their spent Envirotemp®FR3™ fluid at the time of disposal since changes to the oil may occur due to use, storage, or age. End-users should also consult their appropriate local regulatory authority about applicable waste characteristic regulations and available disposal options in their area.

5a. Chemical Composition

The chemical compositions of the virgin and in-service fluids were analyzed by selected AOAC methods, by EPA Method 8270 for SVOCs, and by EPA Method 6010 for metals analysis. The AOAC methods were selected to provide a chemical "fingerprint" for Envirotemp®FR3™ fluid. Data variability was calculated at 95% confidence.

The virgin Envirotemp®FR3™ samples averaged 23.77% ± 0.16% monunsaturated fatty acid, 59.89 ± 0.10% polyunsaturated fatty acids, and 15.66% ± 0.11% saturated fatty acids. These results agree closely with the formulation provided by Cooper. The in-service Envirotemp® FR3™ samples had 22.00% to 23.74% monunsaturated fatty acid, 59.85% to 62.35% polyunsaturated fatty acids, and 15.20% to 16.24% saturated fatty acids, which were also consistent with Cooper's formulation.

AOAC Method 983.15, *Phenolic Antioxidants in Oils, Fats, and Butter Oil*, was used to determine the concentration of seven commonly used antioxidants in food grade oils and fats. The average phenolic antioxidant concentration for the virgin product was 2,787 ppm ± 834 ppm. The in-service transformer samples had antioxidant concentrations between 3,950 ppm and 4,600 ppm.

The polymers and oxidation product values determined by AOAC Method 977.17 are simple indicators used in the food industry to assess the quality of vegetable oil after exposure to heat. If higher values are reported for oil as it is reheated, the difference is assumed to show an increase in non-elution material (compounds not removed using a solvent) that indicates the polar compounds in the oil are degrading. Compared to the average virgin product value of 1.2% ± 0.3%, the in-service fluid samples had values ranging from less than 1.0% to 2.8%. Three of the four samples from in-service transformers had values greater than 1.1% indicating slight degradation with use.

For the 65 standard SVOC compounds analyzed by the HML lab, none were detected in the virgin product samples. Bis-(2-ethylhexyl)phthalate, butyl benzyl phthalate, and di-n-butyl phthalate were detected in the in-service transformer samples. These compounds were suspected to be contaminants introduced from the sampling equipment and DI water used. Other tentatively identified compounds were various sterols normally found in vegetable oils.

Barium and zinc were detected in the virgin product samples at 26 mg/kg and 36 mg/kg, and at 11 mg/kg and 24 mg/kg, respectively. Barium and zinc were also detected in two in-service transformer samples at 25 mg/kg and 27 mg/kg, and at 12 mg/kg to 13 mg/kg, respectively. Cadmium and molybdenum were detected in one in-service transformer sample at 0.42 mg/kg and 2.6 mg/kg, respectively. The barium and zinc might have been introduced during the processing of the basestock oil, degassing of the oil, or storage in the finishing tank.

5b. Worker Health and Safety Aspects

DTSC reviewed material safety data sheets (MSDSs) and information on a transformer unit and its operation to determine potential hazards and regulations associated with Envirotemp®FR3™ usage. These hazards were then compared to potential hazards associated with select mineral oil-based and silicone oil-based transformer fluids. The discussion of the potential hazards and regulations below is not considered comprehensive. The end-user is still responsible for identifying potential hazards and implementing applicable regulations associated with worker health and safety.

The Envirotemp®FR3™ dielectric insulating fluid is composed >98.5% vegetable oil and <1.5% additives (e.g., antioxidants and color). The antioxidants used in this product are not listed as a hazardous material and have been cleared for use as a food grade antioxidant. Although the components of Envirotemp®FR3™ fluid are food-grade, this product was not intended for human consumption and should not be used as a food product.

According to the Envirotemp®FR3™ material safety data sheet (MSDS), this product is also not considered a hazardous substance as defined under Title 8, California Code of Regulations, Section 5194, Hazard Communications. However, this does not relieve the end-user who uses this product from providing workers with information and training necessary to handle Envirotemp®FR3™ fluid safely. Workers should review the MSDS and be familiar with the information concerning first aid procedures, physical properties, personal protective equipment (PPE), respiratory protection, and slip hazards. Workers should wash skin that has contacted the product with soap and water. For eye contact, the eyes should be flushed with water. The primary physical property workers should be aware of is the product's flash point of greater than 300°C. In the case of an Envirotemp®FR3™ spills, employees should be aware of the increased slip hazard in the affected area due to the product.

Before working with Envirotemp®FR3™ fluid, employees should ensure the work area has adequate ventilation, and the appropriate respiratory protection and protective clothing are selected. When working with hot Envirotemp®FR3™ fluid, workers should don neoprene gloves, rubber boots and aprons. Respiratory protection should only be worn if oil mists or dusts contaminated with oil are detected at concentrations equal to or exceeding the permissible exposure limit (PEL). Occupational Safety and Health Administration (OSHA) has set the PEL for vegetable oil mist as a nuisance particulate at 15 milligram per cubic meter (mg/m^3) and 5 mg/m^3 for respiratory protection for an 8-hour time-weighted average (TWA) exposure. In California, the nuisance particulate PEL is 10 mg/m^3. The end-user should consult the appropriate regulatory authority about applicable nuisance particulate PELs used in their area.

If the transformer is located in a poorly ventilated area, then workers should use appropriate engineering controls to ventilate the area. Based on the MSDS information on Envirotemp®FR3™'s antioxidants, the Envirotemp®FR3™ fluid may produce carbon monoxide, carbon dioxide, nitrogen oxides, and other toxic compounds when the antioxidants thermally decompose. Mineral oil-based and silicone oil-based transformer fluids may also thermally decompose and produce fumes, smoke, carbon monoxide, aldehydes and other products. For some mineral oil-based transformer fluids, sulfur oxides are also listed as a possible decomposition product while silicon dioxide is listed for some silicone oil-based fluids. No data are available on the composition of emissions from transformers in general.

When comparing the PPE requirements for handling Envirotemp®FR3™ fluid to select mineral oil-based transformer fluids, the requirements were found to be similar. This comparison is based on MSDS information for select mineral oil-based transformer fluids obtained from the Vermont Safety Information Resources, Inc. (SIRI) MSDS archive. Respiratory protection for the mineral oil-based transformer fluids is required at a lower nuisance particulate OSHA PEL of 5 mg/m^3 for an 8-hour TWA exposure compared to Envirotemp®FR3™ fluid. For select silicone oil-based transformer fluids found in the Vermont SIRI MSDS archive, workers are advised to don impervious gloves and chemical goggles when handling the fluid.

Occupational exposure to transformer fluid is limited and associated to infrequent activities such as filling, draining, or sampling of transformers. These activities are not likely to generate a mist or

aerosol at concentrations approaching the PEL. Potential hazards associated with filling or draining the transformer include slipping on work surfaces where the product was spilled, or splashing of the material into the eyes or onto the skin. Potential hazards associated with sampling the transformer include coming in contact with extremely hot oil, potential electrical arcing from the transformer, or slipping hazards due to spilled Envirotemp®FR3™ fluid on the floor.

MSDS information for three silicone transformer fluids identified as less-flammable transformer oils by UL and FMRC were reviewed along with several mineral oil-based transformer fluids listed in the Vermont SIRI MSDS Archive. Health and safety information on the components listed on the MSDSs were compared to information listed in the 2000 edition of Sax's Dangerous Properties of Industrial Materials. The primary component of the mineral oil-based transformer fluid was a hydrotreated light naphthenic petroleum distillate (Chemical Abstract service [CAS] No. 64742-53-6) ranging from 30-100% which was identified as an International Agency for Research on Cancer (IARC) confirmed carcinogen based on experimental data for animals. The primary ingredient of the silicone oil-based transformer fluids was dimethyl polysiloxane (CAS No. 63148-62-9) listed at 100% and identified as a combustible liquid, a teratogen, and the cause of reproductive effects based on experimental data on animals.

5c. Estimated Cost of Envirotemp®FR3™ fluid versus Mineral Oil

An average life for a transformer using Envirotemp®FR3™ fluid is estimated to be 20 years. A new Cooper transformer unit containing Envirotemp®FR3™ fluid costs approximately 1.2-1.3 times more than a comparable new Cooper mineral oil transformer. The price of the Envirotemp®FR3™ fluid is approximately $9-10 per gallon depending on the volume purchased. The fluid is available in 5-gallon containers, 55-gallon drums, 200-gallon totes, 6,000-gallon tanker trucks, or by the rail car. Prices for mineral oil typically range from $2 to $4 per gallon depending on quantity. Monitoring costs will vary depending on the maintenance program the purchaser has in place. The waste characterization cost for a transformer using Envirotemp®FR3™ fluid or mineral oil are anticipated to be approximately the same except for mineral oil suspected to contain PCBs where the costs will be higher. The disposal cost for mineral oil and Envirotemp®FR3™ fluid are assumed to be comparable since data are not available on the waste characteristics of Envirotemp®FR3™ fluid after 20 years of use.

For a retrofilled transformer, no additional costs due to modifications on the transformer unit are incurred for using Envirotemp®FR3™ fluid. The costs associated with draining and disposing of the used oil are expected to be the same for both mineral oil and Envirotemp®FR3™ fluid. The cost of flushing and filling the transformer with Envirotemp®FR3™ fluid versus mineral oil will be higher and range from approximately $5 to $8 per gallon. The accelerated life testing results performed by Cooper indicate the paper insulation around the windings showed less degradation for the Envirotemp®FR3™ transformers than the identical mineral oil transformers. Less degradation of the paper insulation per this test indicates the Envirotemp®FR3™ transformers may have a longer service life.

6. Vendor's Comment

Cooper Power Systems provided the following information as part of the May 2002 Environmental Technology Verification report. The purpose of this section was to provide the vendor with the opportunity to share their comments on their environmental technology verification report. This information does not reflect agreement or approval by Cal/EPA.

Vendor's Comment:

The aquatic toxicity test performed by the California EPA is not in accordance with the recommended sample preparation method for insoluble materials cited in the California Code of Regulations. Rather than using the appropriate solvent blending method for insoluble materials, they instead created an emulsion by extreme blending (several hours) of the vegetable oil based Envirotemp®FR3™ fluid with water. The resulting heavy emulsion produced is a physical hazard to fish. This prevented any evaluation of possible toxicological effects of the product.

Testing of acute aquatic toxicity on Envirotemp® FR3™ fluid was performed by an independent laboratory using the appropriate sample preparation method for insoluble materials. The tests resulted in a zero mortality of the trout fry throughout the test duration (96 hours).

We (Cooper) believe that it is essential that the acute aquatic toxicity test method be used for its stated purpose, the determination of relative systemic toxicity, and not misused to test physical hazard. Our environmental claim involving acute aquatic toxicity was limited to relative toxicity. Cooper Power Systems stands by its Verification Claim #4 submitted to the California EPA that Envirotemp®FR3™ dielectric coolant is not toxic to trout fry.

Certification Statement

Under the authority of Health and Safety Code section 25200.1.5, the Envirotemp®FR3™ Vegetable Oil-Based Insulating Dielectric Fluid (Envirotemp®FR3™) is hereby certified as a pollution prevention technology subject to the specific conditions including the limitations/disclaimer set forth in the Certification Notice as published in the California Regulatory Notice Register on January 10, 2003, Register No. 2003, Volume No. 2-Z. The technology is certified for use as a dielectric insulating fluid in transformers and electrical devices. Field test results show that the Envirotemp®FR3™ Vegetable Oil-Based Insulating Dielectric Fluid is a readily biodegradable, vegetable oil-based dielectric fluid with a flash and fire point above 300°C. The product has dielectric breakdown voltages comparable to mineral oils, silicone oils, synthetic esters, and high molecular weight hydrocarbons. Envirotemp®FR3™ samples from in-service transformers had flash and fire points above 300°C. Based on limited results performed on virgin product, the spent Envirotemp®FR3™ fluid may exhibit a hazardous characteristic per California's hazardous waste regulations. The end-user must characterize the spent Envirotemp®FR3™ fluid at the time of disposal since changes may occur to the oil due to use, storage, or age.

Limitations of Certification

DTSC makes no express or implied warranties as to the performance of the Envirotemp®FR3™ Vegetable Oil-Based Insulating Dielectric Fluid. Nor does DTSC warrant that the Envirotemp®FR3™ Vegetable Oil-Based Insulating Dielectric Fluid is free from any defects in workmanship or materials caused by negligence, misuse, accident or other causes. However, DTSC believes that the Envirotemp®FR3™ Vegetable Oil-Based Insulating Dielectric Fluid can be used in accordance with the conditions specified in this certification notice to achieve the results specified herein.

Use of the certified technology is limited to transformers and electrical devices as an insulating dielectric fluid. The product must also meet the requirements specified by Underwriters Laboratories (UL) for dielectric and transformer fluids, the Factory Mutual Research Center (FMRC) for a less flammable transformer fluid, and transformer installation requirements specified under the National Electrical Code (NEC).

Specific Conditions

1. Applicability. This certification is limited to use of the Envirotemp®FR3™ Vegetable Oil-Based Insulating Dielectric Fluid for use as a liquid dielectric coolant in transformers and electrical devices.

2. Uses for Transformers and Electrical Devices. This certification is limited to use of the Envirotemp®FR3™ Vegetable Oil-Based Insulating Dielectric Fluid in transformers and electrical devices as an insulating dielectric fluid. Use of Envirotemp®FR3™ fluid does not automatically classify the transformers as less flammable per the Factory Mutual Research Center definition. The user is responsible for assessing whether existing transformers where Envirotemp®FR3™ fluid will be substituted for the original dielectric fluid (retrofilling) meets current NEC requirements.

3. Compliance with the Oil Spill Pollution Prevention and Management Requirements. Use of the Envirotemp®FR3™ Vegetable Oil-Based Insulating Dielectric Fluid must be in compliance with all federal, state, and local regulations which regulate the reporting of oil releases to the soil or water and their subsequent clean-up.

4. Compliance with Hazardous Waste Classification and Disposal Requirements. Prior to disposal, spent Envirotemp®FR3™ fluid and waste material generated from the clean-up of Envirotemp®FR3™ spills must be characterized per 22CCR Section 66261.20 and managed accordingly. Spent Envirotemp®FR3™ fluid or waste material from spills shall be tested for polychlorinated biphenyls (PCBs) if the transformer in question formerly contained a PCB laden oil. The disposal of virgin and spent Envirotemp®FR3™ fluid must be in compliance with all federal, state, and local regulations.

5. Compliance with Used Oil Management Requirements. The user shall be responsible for determining if spent Envirotemp®FR3™ fluid meets the definition of a used oil per 22CCR

Section 66279.1(d), contains no more than 5 ppm of PCBs, and has a total halogen content of less than 1,000 ppm. If spent Envirotemp®FR3™ fluid meets these criteria, then it must be managed as a used oil and sent to a certified California waste oil recycler. If the spent Envirotemp®FR3™ fluid does not meet the used oil definition per 22CCR Section 66279.1(d) but meets the definition of a hazardous waste per 22CCR Section 66261.20, then the spent oil must be managed as a hazardous waste.

6. Compliance with Worker Health and Safety Laws. Use of the Envirotemp®FR3™ Vegetable Oil-Based Insulating Dielectric Fluid in transformers must be in compliance with all federal, state and local regulations relating to the protection of worker health and safety. In California these include, but are not limited to, Cal-OSHA and OSHA requirements.

7. Personnel Training. Operators with knowledge and proper training in transformer sampling are required to collect samples from in-service transformers. Training includes but is not limited to safe operation and maintenance of the transformers, and knowledge of safe work practices and operating procedures for high voltage electrical equipment.

8. Compliance with Applicable Federal, State, Local Regulations. The user shall comply with all applicable federal, state, and local regulatory requirements.

9. Modifications and Amendments at the Request of the Applicant. Modifications and amendments to this certification may be requested by the applicant and shall be subject to approval by DTSC.

10. Certification Reference. The holder of a valid hazardous waste environmental technology certification is authorized to use the certification seal (California Registered Service Mark Number 046720) and shall cite the certification number and date of issuance in conjunction with the certification seal whenever it is used. When providing information on the certification to the user of the technology or another interested party, the holder of a hazardous waste environmental technology certification shall at a minimum provide the full text of the final certification decision as published in the California Regulatory Notice Register.

11. The user of the certified technology shall maintain adequate records to document compliance with the conditions of certification. The records shall be maintained onsite and available for inspection.

Regulatory Implications

This certification is for the specific claims, conditions, and limitations outlined in this notice, and are based on DTSC's evaluation of the technology's performance. The Certification does not change the regulatory status of Envirotemp®FR3™ Vegetable Oil-Based Insulating Dielectric Fluid; it should, however, facilitate and encourage the acceptance of this technology as a pollution prevention alternative to transformer oils containing PCBs, mineral oils, and silicone oils.

Use of this technology as a pollution prevention alternative does not require a hazardous waste management permit issued by DTSC. However use of the technology may be subject to regulation by other state and local agencies. For each specific application, the end-user must ensure compliance with all applicable regulations and standards established by other state and local agencies.

This Certification is issued under the California Environmental Technology Certification Program, and is therefore subject to the conditions set out in the regulations, such as the duration of the Certification, the continued monitoring and oversight requirements, and the procedures for certification amendments, including decertification.

By accepting this Certification, the manufacturer assumes, for the duration of the Certification, responsibility for maintaining the quality of the manufactured materials and equipment at a level equal or better than was provided to obtain this Certification and agrees to be subject to quality monitoring by DTSC as required by the law, under which this Certification is granted.

Duration of Certification

This certification will become effective on February 8, 2003 and will remain in effect for three years from the date of issuance (until February 8, 2006), unless it is amended or revoked for cause.