DOE/GO/10410-5

DOE I&I Program: Semi-Annual Report

Grant DE-FG36-99 GO10410

Covering the Period May 1 - October 31, 1999

Report Date: December 2, 1999

Project Title:

# Fault Warning Device Using Fiber-Optic Partial Discharge Sensor for Prevention of Destructive Arc Faults in Metal-Clad Electrical Switchgear and Bus


Company:
Forsyth Electro-Optics, Inc.
4402 Dexter Street
Philadelphia, PA 19128
www.feo-inc.com
Voice: 215-483-8715
Fax: 800-884-8744

Contact:
Keith W. Forsyth
President
keith@feo-inc.com

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## SUMMARY

This semi-annual report covers the period from May 1 through October 31, 1999. A prior report, submitted on July 13, 1999, covered the period from the project start date of November 9, 1998 through April 30, 1999.

Progress made and problems encountered so far will be discussed with reference to the Statement of Work which was submitted as part of the grant application. This work plan breaks down the project into fourteen numbered tasks grouped into three phases: Development of Improved Sensor Materials (Phase I), Laboratory Testing of Improved Prototype on 15 kV Switchgear (Phase II), and Field Testing of Beta Prototype & Start of Commercialization (Phase III).

Phase I (Tasks 1-3) was substantially completed during the period covered by the prior report, as described in that report. Some additional work on refining the sensor materials was also performed during the current reporting period.

During the current reporting period, Phase II (Tasks 4-9) was completed, with the exception of the filing of Provisional and Final patent applications (Tasks 5 & 9). We expect to file a Provisional Patent application in the early part of the next reporting period, and a Final Patent application prior to the end of the grant period.

Work on Phase III (Task 11: design of beta prototype electronics) began during September 1999, and is ongoing as of this writing. We expect to complete design, construction, and testing of the beta prototype (Tasks 10 & 11) by approximately March 1, 2000. We expect to complete field installation of the beta prototypes at substations owned by PP&L (Task 12) between April 1 and June 1, 2000. The remaining project period (to October 31, 2000) will be devoted to analysis of field data and the start of commercialization, thus completing Phase III (Tasks 13-14).

We do not expect to publish any documents related to the project, other than the intended patent applications.

We plan to attend the next meeting of the IEEE Switchgear Committee (Spring 2000), to discuss our preliminary results with our target customer base and begin laying the groundwork for early sales of the final product.

## MILESTONES & KEY ACTIVITIES COMPLETED SINCE LAST REPORT

The most important technical milestone accomplished during this period was the demonstration that the alpha prototype fiber-optic sensor system was capable of detecting surface discharge well before the development of an arc fault (Task 7). This milestone was achieved in August 1999, during testing on switchgear located at the PP&L System Facilities Center in Hazleton, PA. Our alpha prototype sensor system was able to detect single discharge events having an apparent charge magnitude of approximately 200 pico-coulombs, whereas the apparent charge magnitude of the discharge immediately preceding an arc fault was never smaller than 3,000 pico-coulombs, or roughly 15 times

larger than the minimum detectable discharge. The more sophisticated signal processing methods to be employed in the beta prototype system are expected to allow detection of even smaller discharges. This result indicates that our goal of constructing a system that can provide days, weeks, or months advance warning of a developing arc fault should be technically feasible.

## MAJOR DIFFICULTIES ENCOUNTERED

No major technical problems were encountered during this period. One significant personnel problem was encountered, however. Mr. John Kalinowski was expected to join the company at the beginning of the project period, with primary responsibility for electronic design and data analysis aspects of this program. As of the end of February, this had not occurred, and it was decided at that time to launch a search for a replacement engineer. A senior electrical engineer, Mr. Hy Grossman, was hired to replace Mr. Kalinowski on June 14, 1999. This unexpected delay, and the subsequent need for familiarizing Mr. Grossman with the technical details of this project, set back our progress by several months. Mr. Grossman is now conversant with the project and the technology, and work is now proceeding at the expected pace. We also expect to retain Mr. Kalinowski on a part-time consulting basis over the next three to six months, to perform certain specialized design work for which he has special experience.

## CONFORMANCE TO ORIGINAL SCHEDULE AND BUDGET

As a result of the initial three-month delay in releasing DOE funding, and the delay caused by the unexpected personnel problem described previously, the original schedule has slipped by approximately six months. This delay is not expected to have a significant impact on the success of the project. The only firm project deadline remaining is the need to complete field installation of the beta prototypes in PP&L substations by approximately June 1, 2000, prior to the heavy electric power load conditions of the summer months. Were this deadline to be missed, field testing of the beta prototypes could not be started until early fall of 2000. Since design of the beta prototypes commenced prior to the end of the current reporting period (October 31, 1999), more than enough time remains to complete these beta units so that installation can be complete by June 1.

Expenditures for the current six-month period were $ 40,774.30, for a total project expenditure to date of $ 61,295.28, out of a total DOE-funded project budget of $100,000. Total work hours devoted to the project during the current six-month reporting period were 700.5 hours, for a total work hours to date of 880 hours, out of a projected project total of 1,600 hours. We expect to complete the project within the projected budget and total number of work hours.

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