Early-Warning Device for Prevention of Destructive Arc Faults

New technology increases reliability of utility power grids and industrial power service by detecting pre-emergent arc conditions and preventing unplanned power outages

Benefits

- Eliminates unplanned power outages due to arc failures
- Saves money by eliminating switchgear repairs
- Offers advanced detection of impending damage, allowing for condition-based predictive maintenance
- Reduces waste resulting from power outages in process industries
- Improves reliability for switchgear users

Applications

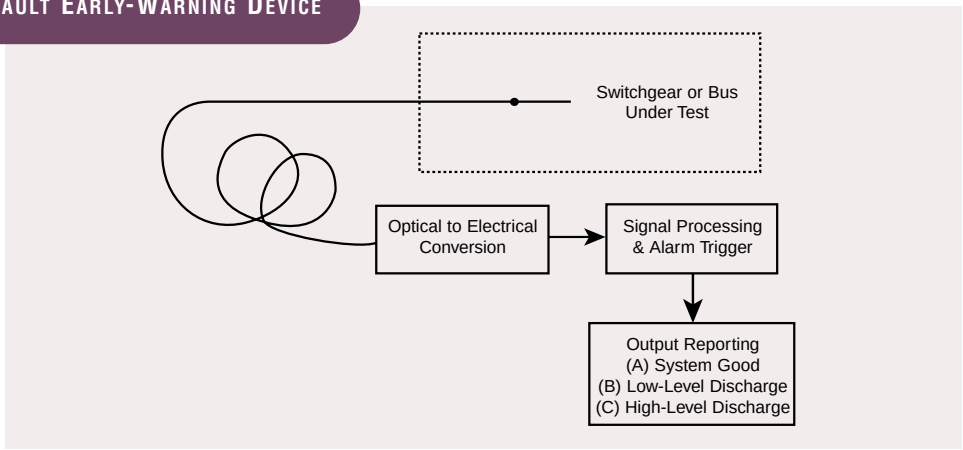
The primary potential market is electric utilities, which will benefit by having a more reliable power-distribution network without unplanned outages. A secondary market for the fault warning device includes process industries, such as oil and petroleum, glass, mining, chemical, pulp and paper, and primary metals. Like the electric utilities industry, the main benefit for these industries is the increased reliability of power distribution, insuring electric energy will be continually available throughout their 24-hour, 7-day-a-week operations.

Metal-clad switchgear employed in industrial and utility power distribution is subject to catastrophic failure resulting from high-energy electric arc faults. Most arc faults are caused by moisture ingress, contamination by dust or vapor, and insulation aging. These faults are typically preceded by low-current partial discharges or tracking on insulator surfaces within the switchgear.

Current technologies for fault detection include optical arc detectors that respond to the light emitted by the arc, signaling the breaker to trip. However, these devices are limited by breaker operating time and cannot prevent arc-blast damage. Another fault detection technology, arc-resistant switchgear, is gaining acceptance, but is costly compared to standard designs and does not prevent unplanned outages from arc faults. Other commercial products for fault detection use electronics to detect corona impulses, but these products are unreliable because of the difficulty of discriminating between electrical partial-discharge signals and ordinary high-frequency noise.

A new fault warning technology developed by Forsyth Electro-Optics detects surface partial discharges preceding an arc fault by perceiving optical energy that is unique to the partial discharges, while ignoring background light and electrical noise. By detecting the partial discharges that precede the arc faults, the technology can be used to forestall expensive damage and repairs created by arc faults.

Fault Early-Warning Device



A new fault warning device detects electric arc faults before they occur, creating a more reliable electric power distribution network.

Project Description

Goal: Develop and test a prototype of the fault warning device and prepare it for commercialization.

The fault warning device contains two major components: (1) a set of fiber-optic discharge sensors and (2) a signal processing and communications module to produce the warning alarm. All sensor components are made of inexpensive materials, and the communications module uses conventionally available technology.

In contrast with traditional arc-detection technology, the fiber-optic sensors detect the surface partial discharge that precedes the arc fault, not the actual arc itself. By doing this, a warning is issued before the arc occurs and usually with enough time to schedule preventive maintenance, thus avoiding unplanned outages and costly equipment damage and repairs. Because several fiber-optic sensors can be connected to a single signal-processing module, the warning device is flexible and adaptable to specific needs. A complete warning system can be obtained at a reasonable cost.

Forsyth Electro-Optics, Inc., developed this new technology with the help of a grant funded by the Inventions and Innovation Program in the Department of Energy's Office of Industrial Technologies.

Progress and Milestones

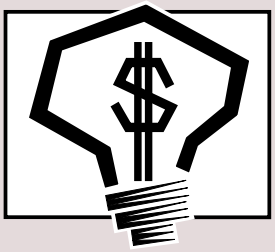
- A prototype of the fault warning device has been developed, and several months of testing have been performed in the laboratory and in live switchgear applications.
- The inventor formed an alliance with a major utility, which will enable further testing and perfecting of the prototypes in a real environment.
- Commercialization efforts began in 2000. The inventor's employer will manufacture, market, and sell the technology directly to end users and original equipment manufacturers (OEMs). Personal sales efforts, participation in trade shows, and advertising in market-specific publications have been identified by the inventor as the best ways to market the product.

Economics and Commercial Potential

The economic savings potential of the fault warning device is related to the technology it protects and the environment in which it operates. Arc faults not only damage individual pieces of switchgear equipment, but also the surrounding equipment and building structures. Arc faults also have the potential to injure employees. Any combination of these events is extremely costly.

In the case of process industries, lost production results in additional costs: idle time for employees, machine resetting, scrap, and start-up costs. Costs of lost production may range as high as $100,000 per hour.

Industry experts confirm the fault warning device's commercial potential in the switchgear industry. Although infrequent, arc faults do cause significant damage. Additionally, the ability to allow for scheduled maintenance of the equipment provides improved management of equipment and human resources. The fault warning device fills a specific need in industry. The ability of this invention to fill a market niche, combined with a better understanding of its reliability recently gained from prototype testing, indicates this invention could be commercially viable in the marketplace.



The Inventions and Innovation Program works with inventors of energy-related technologies to establish technical performance and conduct early development. Ideas that have significant energy savings impact and market potential are chosen for financial assistance through a competitive solicitation process. Technical guidance and commercialization support are also extended to successful applicants.

Project Partners

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