Canada Weekly

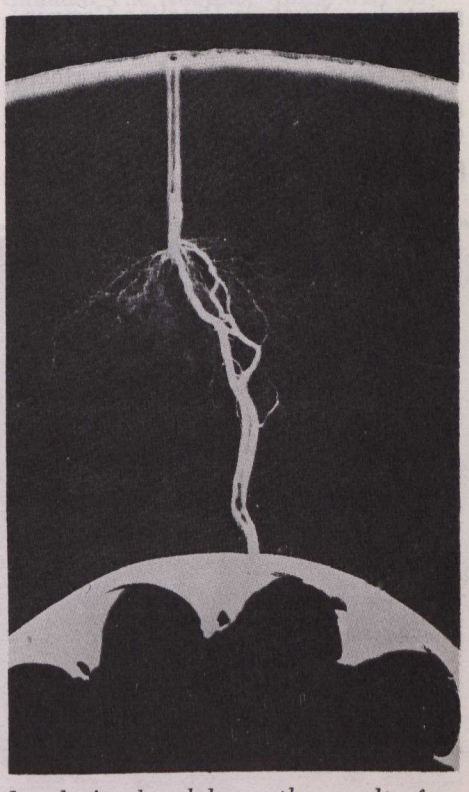
Volume 5, No. 19 May 11, 1977

Ottawa, Canada.

Probing the problems of power transmission

Street lights are extinguished, darkness prevails, the houses are dead; in the factory, machines slow to a halt and a conveyor-belt stops. Is it a power cut, a generator break-down or the failure of an electrical cable?

A short circuit in a power-cable results not only in economic loss to electrical companies but inconvenience and expense to industry and the general public. The laying of these cables is a costly business involving street excavations and disruption to offices and factories. Once laid, the cable is expected to convey electrical power without maintenance for the next 40 years. This life-time may have been established for a particular line of power-cables, but what is the supplier to do if he wishes to introduce a new manufacturing process or employ new materials? Is he to test his product over a 40-year period before venturing on the market with the confidence that it will perform as the industry demands? Clearly this would be impracticable. Instead, the manufacturer seeks an authoritative test of the life-time of his cable that can be performed in months rather than years.



Insulation breakdown, the result of many hours of electrical stress under test conditions. Partial discharges form at the tip of a metallic needle which has been placed in the insulating material.

Accelerated testing methods for power-cable insulation are being developed at the National Research Council of Canada's Division of Electrical Engineering by Dr. John Densley, who has made an extensive study of the properties of solid insulations used in electrical-power transmission with the object of designing a series of accelerated tests to measure the life-time of the insulation in a power-cable.

A modern power-cable consists of a central conductor that carries the high-voltage current, covered by insulating material, which, in turn, is surrounded by a second conductor responsible for returning the current at low voltage. In cable manufacture, the insulating material (generally composed of cross-linked polyethylene) is extruded in a molten form onto the central copper conductor, and it is at this point that defects may develop which can lead to failure several years later.

Causes of breakdown

Any insulation breaks down under sufficiently high electrical stress. Electrical stress occurs when a voltage is applied over a thickness of insulation and increases as the voltage is raised or the thickness of insulation decreased. Each insulating material has a characteristic breaking-point at which the electrical stress is so great that the insulation fails and permits the current to short-circuit between the central and outer conductor. Modern power-cables are capable of withstanding high stresses of many orders of magnitude greater than their normal loadings, up to millions of volts, for short periods of time. But the same cable under normal stresses may break down after only a few years