

HECO's March 3, 2004 Outage

The March 3 outage which affected 40,000 customers in urban Honolulu was caused by the failure of several modules in the microwave communications system that are used to control the electric transmission system, a Hawaiian Electric Company (HECO) investigation has found.

Two linked circumstances resulted in the outage: One of two 138-kV transmission lines serving the Pukele Substation had been de-energized to allow for work on a transmission-line structure. At the same time, the digital microwave communication system used to insure the line stays de-energized malfunctioned, causing the circuit breaker on the second 138-kV line to open, the line to be de-energized, and the outage to occur.

HECO brought in Power Engineers, Inc., a mainland consulting company with expertise in transmission issues, to join in its investigation. Following the outage, HECO performed a visual inspection of the line by helicopter, inspected the substations involved and began examining all components of the microwave communication system. Several defective modules were found which were replaced and sent to the manufacturer for further inspection.

The defective modules were replaced. The modules are still under warranty, and HECO is working with the Harris Corporation, the manufacturer, to determine the specific cause of failure.

The microwave communications system configuration is being modified. The order and spacing of the multiplexer channels has been changed, and the frequencies of the electronic trip signals will be changed by May 31. This will prevent a misrouted signal from inadvertently opening a circuit breaker, as happened on March 3.

One is the addition of a proposed Wide-Area Network (WAN) project that provides more options in routing data to the Operations Center compared to the current fixed routes of the existing communications system. HECO plans to have the project in place by June 2005.

BACKGROUND

The Pukele outage began at 7:42 a.m. on March 3. Approximately 40,000 customers in the Waikiki, Manoa, Palolo, St. Louis Heights, McCully, Moiliili, Kaimuki, Diamond Head and Kapahulu areas of urban Honolulu were without power for at least 45 minutes. This represented approximately 14% of the electricity demand on Oahu that morning. Intensive efforts to restore power began as soon as the power was out. Restoration began at 8:30 a.m. and service to most customers was restored by 9:45 a.m., with the remaining customers restored by 11:20 a.m.

That morning one of two transmission lines that brings power from the Koolau Substation in Kaneohe to the Pukele Substation in Palolo Valley was intentionally de-energized at 6:03 a.m. by opening circuit breakers at each end and de-energizing the line as part of ongoing work to upgrade a structure that supports the line from wood to steel.

One of several protective features that are automatically initiated when a major transmission line is de-energized is the continuous transmission over the digital microwave communications system of an electronic "trip" signal between the Pukele and Koolau substations to ensure circuit breakers on both ends of the line stay open. This protects personnel and equipment while the line is de-energized.

At 6:52 a.m. that morning, HECO's Operations Center began receiving alarms indicating problems with the digital microwave communication system emanating from a communications site in the Moanalua area. A subsequent investigation found defective modules in the equipment, manufactured by the Harris Corporation.

The investigation revealed that the defective modules caused the electronic trip signal being transmitted for the de-energized transmission line to be misrouted into the circuit breaker for the second transmission line, the sole remaining line feeding the Pukele service area. This misrouted signal caused a circuit breaker to trip open, de-energizing that line.

On the morning of March 3, however, the cause of the loss of the second line was not known and could not be determined. The decision was made to restore the transmission line that was just de-energized for maintenance. Work had not begun on this line, and the restoration was completed promptly with no safety risk.