

**ROOT CAUSE EVALUATION OF  
ROTO TEST SWITCH BOLT FAILURES  
RCE 94-001**

## EXECUTIVE SUMMARY

During the performance of ESF testing on Unit 3, Diesel Generator 3G002 tripped on generator differential. The actuation of the relay was traced to an open circuit on one phase due to a fractured bolt on a Roto Test Switch. Inspection of the Roto Test Switches in the other three diesels found a second fractured bolt on a Roto Test Switch in 2G003.

The failed bolts and other new and old samples were analyzed in the laboratory where it was determined that the failure was due to defective bolt material. The failed bolts, and other bolts from switches installed in the plant, had cracks in the threads and were made of an extra hard type of brass which is extremely brittle. The cracks concentrated stress in the brittle material which failed under normal loading conditions. The Root Cause of failure was a lot related material defect which caused the bolts to fracture in normal service.

The 10 CFR 21 reportability of the failure is being evaluated by ABB CE because they now own ITE Imperial Corporation who performed the original qualification of the switchgear with the Roto Test Switches.

Corrective actions have been performed to insure operability of the installed switches. A pull test was performed on all bolts on all switches installed in the diesel generator circuits. Maintenance orders have been generated to perform a pull test on all other Roto Test Switches in Safety Related circuits. A visual inspection of these switches has been performed. The pull test provides two to four times the force necessary to cycle the switch. No failures have resulted from the testing performed thus far. Laboratory analysis of new stock switches revealed that the material deficiencies found in the failed bolts were not present in the new bolts. The brass was a less brittle type and there were no cracks in the threads. The embrittlement failure mechanism is not a concern with new Roto Test Switches.