

DEVELOPMENT OF COMPOSITE INSULATORS FOR TRANSMISSION PIPE-TYPE CABLE TERMINATIONS



High-pressure fluid-filled cable terminations

PROJECT HIGHLIGHTS

- Develop composite hollow core insulator to replace porcelain insulator for pipe-type high-pressure fluid-filled (HPFF) cable terminations
- Address special supply chain considerations, since several qualified high-voltage porcelain factories have closed or retired porcelain production
- Better prepared when such need arises to replace existing HPFF cable terminations.
- Understand performance of such replacement components.
- Improve underground transmission system reliability and operating costs

Background, Objectives, and New Learnings

Transmission cable terminations of high-pressure fluid-filled (HPFF) cable systems in North America have been using high-quality porcelain insulators as the housings.

Over the last several decades, the HPFF termination porcelain housings were sourced from experienced porcelain manufacturers with customized designs, robust but tightly controlled manufacturing processes, and proven track records. However, recently, with the emergence of competing composite technologies, the high-voltage porcelain industry has been struggling with rising costs and declining competitiveness. In recent years, the remaining European high-voltage porcelain factories that used to produce HPFF porcelain housings for the North American market have closed, moved, or retired porcelain production. The supply chain is trying to shift to Asia, while previous attempts were not successful due to special requirements for this niche application. This still may be an alternative, although at high risk, due to required manufacturing expertise and experience or track records from the field.

To overcome the above challenge, use of composite hollow core insulators to replace porcelain insulators can be an alternative. Since the initial introduction in 1980s, the composite technology has come a long way, and it is now in mature state. Composite hollow core insulators have been utilized for high-voltage extruded cable terminations, switchgear, bushings, and instrument transformers for many years. The composite technology could provide security of supply, with typically shorter lead times comparing to porcelain.

The main design considerations for using composite hollow core insulators in HPFF termination applications are their long-term performance under high pressure and interchangeability with existing porcelain housings.

The objective of this project is to assess technical feasibility of utilizing composite hollow core insulators as an alternative to porcelain insulators for pipe-type cable terminations. The project is to design and manufacture composite hollow core insulator samples and perform mechanical and aging tests for verification.

The subject development can help address supply chain challenges, enhance performance of the underground cable circuits, increase system reliability, and reduce system operation and maintenance costs.

Benefits

The development of composite hollow core insulator to replace porcelain insulator for pipe-type high-pressure fluid-filled (HPFF) cable terminations addresses the special supply chain considerations, since several qualified high-voltage porcelain factories have closed or retired porcelain production. The project can help to better prepare when such need arises to replace existing HPFF cable terminations and better understand performance of such replacement components. The project can improve underground transmission system reliability and operating costs.

Project Approach and Summary

The project plans to design prototype composite insulators for 138-kV HPFF applications. The task includes design of the composite insulators, including components, such as, fiber glass tubes, end flanges, attachments, sealing and mating mechanism with existing top and bottom parts of the HPFF cable terminations.

The project is also to design and manufacture tooling to produce prototype insulators and produce the insulator test samples. This task includes development of manufacturing processes and production of the prototype hollow core insulators for testing.

This project is then to develop detailed test procedures based on the designed test program, manufacture the test samples, perform the tests, and provide test reports to document the test results. Two test sequences are planned, one for pre-conditioning and compatibility tests, and the other for long-term aging tests. Short term pre-tests are planned to evaluate feasibility of existing sealing design, and to thermally age the interface between the flange and fiberglass core tube prior to the planned long-term tests.

Deliverables

Deliverables are intended to provide documents that include design drawings of the insulators per application requirements, test procedures, and test results.

Price of Project

The cost for each participant is \$100,000. A minimum of five participants are required. The project is eligible for use of Self-Directed Funds (SDF).

Project Status and Schedule

This project is new and will begin as soon as the minimum number of participants has joined. The project would take approximately 18 months to complete.

Who Should Join

Utilities considering options to address supply chain challenges for replacing pipe-type cable terminations and interested in solutions using composite insulators for pipe-type cable terminations.

Contact Information

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