

ERO Failure Modes and Mechanisms

A Summary of the Approach

General

A by-product of the ERO Event Analysis Process is the collection of information about station equipment failures. The information aids in analyzing failures to identify equipment reliability trends on the Bulk Electric System (BES).

The Approach

The Failure Modes and Mechanisms (FMM) approach is a technique used to identify and map the signatures and paths of equipment failures. The approach consists of observing a signature that something happened to the normal operating state of the equipment and identifying the specific physical path to failure of the equipment. These two steps of the technique are more conveniently thought of as:

- A failure mode is what gets your attention that the equipment is not in a normal state.
- A failure mechanism is the catalyst and physical path to failure.

[Improving Equipment Reliability by Learning from Failures](#) is a short video explaining the approach.

The Task Force

The Failure Modes and Mechanisms Task Force (FMMTF) of the ERO Event Analysis Subcommittee (EAS) develops FMM diagrams for impactful substation equipment types of interest. Copies of completed diagrams are available for use and may be requested by registered entities through their event analysis contact at their respective Regional Entity. A selection of existing FMM diagrams include:

- Oil-Filled Power Transformer
- Instrument Transformers (PTs and CTs)
 - Wire Wound Electromagnetic Potential Transformer
 - Coupling Capacitor Voltage Transformer
 - Optical Voltage Transformer
 - Wire Wound Electromagnetic Current Transformer
 - Optical Current Transformer
- Circuit Breakers
 - SF6 Breaker
 - Air Blast Breaker
 - Oil Breaker

- Switch
- Oil-Filled Reactor (Inductor)
- Capacitor Bank
- Surge Arrester
- Relays
 - Electromagnetic Relays
 - Static Relays
 - Microprocessor Relays

The [Addendum for Events with Failed Station Equipment](#) will be updated as diagrams are approved by the EAS. An example of a FMM diagram is shown here: [Generic Failure Modes & Mechanisms Diagram](#).

More Information

The FMMTF currently meets monthly via WebEx, and is looking for knowledgeable volunteers. If you are interested in contributing to the group or are in search of more information about the ERO FMM efforts please contact us at NERC.EventAnalysis@nerc.net.