

Failure Modes and Mechanisms Working Group

Scope

Purpose

The joint 2013 NERC Operating and Planning Committee's AC Substation Equipment Task Force (ACSETF) report recommended that information on station equipment failures be collected through the NERC Event Analysis Process. The data is intended to aid in analysis of station equipment failures to identify threat trends to the reliability of the Bulk Electric System (BES) and potential ways to improve reliability. NERC also recognizes the importance of maintaining energy source availability especially during unusual and extreme weather conditions.

The purpose of the Failure Modes and Mechanisms Working Group (FMMWG) is to:

- Analyze common BES equipment to determine failure modes and mechanisms (FMM), FMM trends and patterns, and improve BES reliability by providing information useful for reducing equipment failures.
 - Maintain the [Addendum for Events with Failed Station Equipment](#) and processes to collect data associated with failure of station equipment;
 - Investigate and identify FMM of BES equipment;
 - Derive solutions from FMM studies to
 - Detect and measure the progress of active FMM in BES equipment;
 - Avoid, prevent or delay the progression of BES equipment failures;
 - Promote using “good industry practices” in the inspection and maintenance of BES equipment.
 - Analyze common BES energy sources to determine failure modes and mechanisms.
 - Investigate and identify FMM of generating equipment associated with synchronous and inverter-based energy resource interconnections.
 - Derive solutions from FMM studies to:
 - Detect and measure the progress of active FMM in energy resource equipment,
 - Avoid, prevent or delay the progression of energy resource equipment failures,
 - Promote using “good industry practice” in the inspection and maintenance of energy resource equipment.
- Support the Energy Management System Working Group (EMSWG) in their development of energy management system FMM and provide FMM information and support to other Electric Reliability Organization groups as needed.

- Maintain liaison with regional work groups, user groups, vendors, contractors, forums and agencies investigating BES equipment failure issues.

Deliverables

- Develop new and continuously improve FMM diagrams for common BES equipment including, but not limited to:
- Oil-Filled Power Transformer
 - Instrument Transformers (PTs & 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
 - Substation Batteries
 - Substation Battery Chargers
 - Uninterruptable Power Supplies
- Maintain the Addendum for Events with Failed Substation equipment.
- Develop new and continuously improve FMM diagrams for energy sources:
 - Natural gas generators

- Inverter-based resources
- Hydro facilities
- Coal source generators
- The FMM diagrams and updates to the [Addendum for Events with Failed Station Equipment](#) will be submitted to the Event Analysis Subcommittee (EAS) for publishing and release approval.
- The FMMWG will provide FMM-related input into NERC Lessons Learned as appropriate.

Officers

The FMMWG elects and the NERC EAS Chair approves officers (Chair and Vice Chair) for a specific term (generally two years). The FMMWG officers may be reappointed for additional terms. The officers are considered members of the FMMWG and may vote. The FMMWG Chair is considered a member of the EAS and is expected to attend the regular standing committee meetings to report on assignments, or provide a summary report of the group's activities, and advise the EAS on important issues at a minimum. The Vice Chair is considered an important succession planning billet with the anticipation that the Vice Chair will serve as FMMWG Chair for the next term.

Membership

The major goal of forming the FMMWG is to leverage industry technical expertise from a broad spectrum of registered entities across all the NERC regions. There is an expectation for ad hoc membership depending on the task/equipment being researched and the FMMWG expertise available. A NERC representative will facilitate the FMMWG with NERC staff coordination and conduct of assigned business tasks.

- The FMMWG should be assembled from professionals experienced in BES equipment and energy resource subject areas such as:
 - Substation Design & Equipment Selection
 - Construction & Installation
 - Testing
 - Operation
 - Protection and Control
 - Instrumentation
 - Condition Monitoring
 - Corrective Maintenance & Repair
 - Failure Investigation
 - Obsolescence management & Replacement Selection
 - Inverter design
 - Energy storage

- Energy conversion
- Generation Design, Operation, and Maintenance

Non-voting members — Guests and Observers

FMMWG meetings are open to others who wish to attend as a guest of the subcommittee. The chair will provide guests and observers the opportunity to contribute to the subcommittee’s discussions, provided the subcommittee’s voting members have sufficient time to complete the meeting agenda.

Order of Business

The desire is to strive for consensus in normal business. If consensus cannot be achieved, the group may hold a vote. Minority opinions may be documented, as desired by the minority, and forwarded to the EAS Chair for consideration.

Meeting Procedures

Quorum: 50% of members eligible to vote

Actions requiring a vote shall require a quorum and a simple majority vote of those members present.

Reporting

The FMMWG reports to the NERC Event Analysis Subcommittee.

Meetings

The FMMWG will conduct assigned and regular/normal business using phone conferences, webinars and other digital means. Physical meetings are subject to approval and at the discretion of the EAS.

Revision History				
Revision #	Date	Revision Description	Reviewers	Approval Date
Initial Version	8/26/2019	Initial Scope for Failure Modes and Mechanisms Task Force (FMMTF)	Richard Hackman	Approved by the EAS on 12/9/2019
1	1/8/2024	The FMMTF was upgraded to FMMWG by the RSTC in December 2023	Richard Hackman	Approved by the EAS on 2/6/2024