# FRCC Requirements for Analysis of Protection Misoperations and Corrective Actions Reporting

**Effective Date:** December 2, 2010

## Revisions

<table>
<thead>
<tr>
<th>Rev. No.</th>
<th>Date</th>
<th>Description</th>
<th>Developed by:</th>
<th>Approved by:</th>
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<tbody>
<tr>
<td>3</td>
<td>DRAFT 12/02/10 – approved by SPCS</td>
<td>Added Regional cause codes to reporting form and definitions as appendix B. Added editorial clarifications. Added MS to RE reporting process.</td>
<td>FRCC System Protection and Control Subcommittee</td>
<td>FRCC Operating Committee (OC)</td>
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<td>2</td>
<td>April 1, 2010</td>
<td>Revision to include language to more closely follow the NERC Reliability Standard and to identify process of SPCS review of misoperations</td>
<td>FRCC System Protection and Control Subcommittee</td>
<td>FRCC Operating Committee (OC)</td>
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<td>1</td>
<td>September 2, 2009</td>
<td>Conversion of RRO Legacy document – to new format. Added clarification on Corrective Action Plan</td>
<td>FRCC System Protection and Control Subcommittee</td>
<td>FRCC Operating Committee (OC)</td>
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<td></td>
<td>June 2009</td>
<td>RRO Legacy documents – FRCC Requirements for Analysis of Protection Misoperations and Corrective Actions Reporting</td>
<td>FRCC Operating Reliability Subcommittee (ORS)</td>
<td>FRCC Operating Committee (OC)</td>
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This FRCC procedure outlines the analysis and reporting of Protection System misoperations. Please refer to the NERC Glossary of Terms for the definitions of Protection System and Misoperation when utilizing this procedure.

1.0 Introduction

The reliability of the interconnected transmission network is highly dependent on the correct operation of protective relay systems. These systems are designed to quickly isolate specific portions of the transmission network in order to preserve electric system integrity. Protective relays detect abnormal conditions accompanied by excessive current, over/under frequency, or over/under voltage and then operate switching devices to prevent equipment damage and instability. Failure of a protection system to operate might result in power system collapse. On the other hand, operating falsely could result in removing critical elements of the network when needed most, creating a cascading outage. Therefore it is important that protective relay systems operate with a high degree of reliability.

The purpose of this FRCC document is to insure compliance with the applicable NERC Reliability Standard and further insure that transmission protection systems within the state of Florida operate reliably. This Standard provides for the monitoring, notification and analysis of transmission level, protective relay operations.

This document addresses NERC Reliability Standards PRC-003-1 and PRC-004-1.

2.0 Definitions

Requirements of this document apply to facility owners of generators above 100MW net output and devices and components of the bulk transmission network operating at primary voltage of 100 kV and above. This is to include transmission lines, substation busses, and transformers. Protection trip operations are defined as the opening of generator or transmission breakers by the automatic operation of a protective relay. This is also to include the operation of any Special Protection System (SPS).

Protection trip misoperation shall mean the unintended opening of a generator or transmission system breaker(s) by the automatic action of a protective relay. It will include such things as an incorrect relay action for a fault outside the relays primary zone of protection due to equipment failure or incorrect setting. This would typically result in isolating a larger part of the transmission system than designed. Protection trip misoperation will include the failure of the primary protection system which results in clearing additional equipment other than specifically needed by design to clear the fault.

Under some conditions, protection systems depend on backup relaying as a matter of design for normal clearing. This may be the case when an alternate transmission configuration is used when a primary source is unavailable. Backup schemes for this purpose have been used as standard practice throughout the industry especially to provide protection during unusual system configurations. Normal clearing by backup relay operations, expected as a matter of design, is not to be considered a misoperation if the systems operate as engineered.
An automatic relay action in the absence of a disturbance or fault is to be considered a protection misoperation. However, a misoperation will not include the unintentional opening of transmission system breakers due to a maintenance or construction activity unless the misoperation was a result of leaving the protective equipment in an incorrect configuration after activity was completed.

3.0 Procedure for Analysis of Protection Trip Operations

Each facility owner is responsible for reviewing all protection trip operations within their specific area, including the operation of an SPS. Analysis shall include a determination that a relay action was either correct or incorrect. Incorrect operations, which are defined above as misoperations, are to be documented.

Data used for analysis of a relay action and determining the correctness of the operation may be obtained from SCADA, fault locators, fault recorders, disturbance monitors, breaker counters, intelligent relays, sequence of events recorders, and relay targets.

Documentation of correct relay operations is to be maintained in accordance with established internal procedures by each facility owner. Misoperations are to be documented by the region at the FRCC level as provided for in section 4.0 below of this guideline.

The cause of each misoperation is to be investigated by the facility owner. The individual facility owner is responsible for identifying the root cause of a misoperation. The results of the investigation and implementation of a corrective action plan shall be documented by the facility owner.

4.0 Procedure for Reporting Protection Trip Misoperations

Each facility owner shall provide a representative contact to the FRCC System Protection and Control Subcommittee (SPCS). That representative and the SPCS will be the contact interface between the FRCC and the owner regarding protective relay actions and misoperations.

Each facility owner shall maintain a log of all generation and transmission relay misoperations and all SPS misoperations as defined under Section 2.0 “Definitions.” The log will contain the information and format as described in Appendix A. “FRCC Protection Trip Misoperation” and will be sent to the FRCC on a monthly basis (misoperations@frcc.com). A Corrective Action Plan as defined in NERC glossary shall be included by each facility owner as a part of the monthly report, and will be reviewed by the SPCS. If a facility owner has no misoperations or Special Protection System Misoperations to report, then the log is to be submitted stating “NONE” for the time period covered. The logs will be compiled by the FRCC and provided to the SPCS for monthly review. If a misoperation is reported, the entity’s representative is to participate in the next monthly SPCS meeting to give a report of the misoperation.

Reporting of misoperations is the responsibility of the facility owner (line, plant or station) as determined by Transmission Availability Data System (TADS) reporting. Once the investigation has determined the protective system element that misoperated, it is the responsibility of that owner for reporting until the analysis is complete. In special
cases where the facility owner does not own any of the protective system, an agreement should be made between the involved owners as to who will report and each owner should have documentation of the agreement.

Misoperations within the region are to be discussed at the monthly meetings of the SPCS. This provides the opportunity for the members to assist in identifying root cause of misoperations classified as unknown by utilizing the wider experiences of neighboring member transmission owners. It also provides the sharing of lessons learned in avoiding the same misoperations by others. The review and expert opinions expressed by the members of the SPCS are to be used at the discretion of the facility owner reporting the misoperation. The final reporting responsibility, accountability and implementation of related corrective action plans, remain with the reporting entity.

When an entity presents a misoperation report that is determined to be not reportable it will be marked on the FRCC copy with the meeting date and a copy sent back to the reporting entity for their records.

Following the review conducted by the FRCC SPCS, a report based on the submitted “FRCC Protection Trip Misoperation” logs will be prepared by FRCC Member Services (MS) Staff which contains all potential and actual Protection System misoperations reported by the facility owners. The report shall include the final resolution, as determined by the reporting entity and the FRCC SPCS, as to whether the Protection System operation was considered to be an actual misoperation or an appropriate operation based on the analysis of the event. FRCC MS Staff will provide the report to the FRCC Regional Entity (RE) quarterly.

5.0 Periodic Review

This procedure is to be reviewed and approved by the SPCS and the Operating Committee of the FRCC. This procedure is to be changed as required and reviewed at least once every five years, then reaffirmed by the SPCS and Operating Committee.
### Appendix A

**FRCC Protection Trip Misoperation Log**

Send Report To: misoperations@frcc.com

Due to the FRCC by the 10th of each month for the previous month’s data

<table>
<thead>
<tr>
<th>Monthly Report for: (Entity Name)</th>
<th>Month:</th>
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<tbody>
<tr>
<td>Reported By: (Name of person reporting, phone number, e-mail address)</td>
<td>No Misoperations to Report:</td>
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<tr>
<td>Contact Name and Phone Number:</td>
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<tr>
<th>DATE/TIME</th>
<th>EQUIPMENT OUTAGED (LINE, BUS, TRANSFORMER)</th>
<th>DESCRIPTION OF EVENT</th>
<th>CAT</th>
<th>CC</th>
<th>TADS</th>
<th>CORRECTIVE ACTION PLAN</th>
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Notes: Equipment Outage shall include Facility Name, Equipment Name, Equipment Type and Facility Voltage. Description of Event shall include brief description of event and Protection Systems that misoperated. Corrective Action Plan shall include Actions taken or planned, Proposed Completion Date.

CAT = Category (1-3)  
CC= Cause Code (A –K)  
TADS – TADS Reportable (Y or N)
Appendix B:

Misoperations Categories and General Cause Code Definitions

Misoperations Categories:

1) **Overtrip**: An event where a fault is cleared resulting in the tripping and the isolation of a greater part of the system than optimally designed or engineered
2) **Failure to Trip**: A failure to trip
3) **Trip without Fault**: The trip that occurred when there was no fault present

Misoperations Cause Codes:

A) **Relay Failure** - A failure of the relay to act as designed and configured other than problems caused by calibration drift. This does NOT include Control Equipment.
   a. Relay failures including but not limited to complete and internal component failures and manufacturer quality control or design flaws
   b. Relay condition issues including but not limited to shorted or stuck contacts, contamination and loose cards.

B) **Relay Calibration Drift** - A change in the measuring unit or characteristic of the relay usually due to component degradation.

C) **Control Equipment Failure** - A failure of the control equipment to operate. This includes auxiliary relays and equipment such as switches, tripping and lockout relays, and SCADA equipment

D) **Relay Communication System Failure (Carrier/Non-Carrier)** - A failure of the relaying communications equipment to operate for any communication related failure. This includes carrier auxiliary relays

E) **Design** - Engineering issues including but not limited to misapplication, incorrect drawings or control logic and inadequate equipment design such as insufficient equipment ratings or insulation.
F) **Settings** - Relay settings related issues such as incorrect settings, mis-coordinated settings, settings too sensitive, etc.

G) **Process Execution (Human Error)** Personnel error such as a switch or other equipment left in an incorrect position, entering settings/logic incorrectly, or a wiring error. This does NOT include errors caused by personnel performing related work while inside the station.

H) **DC System** - Any DC System equipment failure or error NOT attributable to another identifiable cause. Failures to a station’s DC system that include blown fuses, station battery problems, open or loose connections, inadvertent grounds, control cable failures and damaged components such as diodes and switches, etc. This includes animal and mechanical damage to wiring.

I) **Secondary AC System** - Any secondary AC System equipment failure or error NOT attributable to another identifiable cause. This includes Instrument Transformer failures and blown fuses that result in protection system misoperations.

J) **Other** The identified cause does not fit any of the other listed categories listed (Bob Bentert comment – non-simultaneity goes here link in SERC)

K) **Unknown** - unexplainable.

**TADS Reportable:**

The TADS Data Reporting Instruction Manual ([http://www.nerc.com/filez/tadswg.html](http://www.nerc.com/filez/tadswg.html)) should be referenced in determining if an outage qualifies for reporting under the requirements of TADS (Transmission Availability Data System).

In general, outages of the following Elements are reportable under TADS:

- AC Circuits ≥ 200 kV (Overhead and Underground Circuits). Radial circuits are included.
- DC Circuits with ≥ +/-200 kV DC voltage
- Transformers with ≥ 200 kV low-side voltage
- AC/DC Back-to-Back Converters with ≥ 200 kV AC voltage, both sides
Examples of Misoperation Cause Codes

NOTE: These are examples of some types of common problems for each misoperation cause code. These are NOT examples of acceptable descriptions, because they are created, shortened, and generalized for the sake of this document. When reporting misoperations, please provide a detailed description of the original misoperation (description shall be in sufficient detail to permit proper classification), the steps used to investigate the problem, and the corrective action to ensure the misoperation does not occur again.

A) Relay Failure
• Capacitors failed in the relay. Capacitors were replaced.
• Relay stuck in picked-up position. Relay contacts were cleaned and the relay re-tested.
• The carrier ground relay trip contacts closed incorrectly after the fault was cleared. The relay was replaced.

B) Relay Calibration Drift
• Found the instantaneous overcurrent element picking up very low. Recalibrated relay.
• Single-ended operation caused by JBCG relay contacts out of adjustment. Recalibrated relay.
• Angle on distance relay was found out-of-calibration. Recalibrated relay.
• Relay contact bounce caused a carrier misoperation. Relay adjusted and placed back in service.

C) Control Equipment Failure (Aux. Equip/Lockouts, etc.)
• Loose fuse block
• Lockout contact failure.

D) Relay Communications System Failure –

(Carrier)
• A bad card was found in the carrier set and was replaced.
• A bad discriminator card was found in the transfer trip receiver set and was replaced.
• An open impedance matching transformer was found and replaced.
• Carrier blocking signal was lost due to a faulty line trap. The line trap was repaired.
• Failed capacitors in a line trap tuning pack. The capacitors were replaced and the scheme was retested and placed back in service.
• Failing CCVT caused a carrier misoperation. CCVT was replaced.
• Found defective carrier auxiliary relay, which was then replaced.
• Found failed power supply on carrier set, so that the blocking signal was never sent.
• The carrier set was replaced.
• High reflective power was found. This was caused by the screw connecting the impedance matching transformer to the inductor being loose. The screw was tightened.
• There was a bad connection on the coax cable connector in the outdoor tuning box at one end.
• Resistor failure in carrier receive circuit. The resistor was replaced.
• BCA carrier auxiliary relay out of adjustment. Relay was recalibrated.

(Non-Carrier)
• Radio found bad. Radio replaced.
• Found significant signal loss on receive fiber.

E) Design
• Incorrectly sized resistor in the carrier current path
• Standing trip on the relay due to design error
• Sneak path in circuit.
• CT Circuits grounded at 2 points instead of 1 (breaker and a half scheme)

F) Settings
• Directional elements didn’t work properly. Changed settings.
• Incorrect CT ratio setting
• Induced current caused protection to operate. Adjusted settings.
• Miscoordinated reset time between electromechanical relay and microprocessor relay
• Pilot reach reduced to prevent excessive overreach
• Problem with LOP logic caused protection to operate incorrectly. Setting adjusted.
• Problem with line impedance/model data. Problem fixed and settings adjusted
• Newly discovered situation. Settings adjusted to protect for this situation.
• Timer settings increased to coordinate with adjacent protection
• Frequency too close to frequency on adjacent line
• Setting in carrier set wrong. Setting adjusted

G) Process Execution (Human Error)
• CT not wired to ratio requested by settings. Wiring adjusted.
• Found carrier turned off on one end.
• Issued relay settings that would have allowed the relay to operate correctly had not yet been applied.
• Potentials were rolled. Wiring adjusted.
• Setting was found incorrect on relay (Issued correctly, applied incorrectly).
• Trip links found open
H) DC System
- Corrosion on knife blades. Corrosion cleaned.
- Zener diode failure in DC circuit. Diode replaced.
- Tripping rectified (diode) was shorted. The diode was replaced.

I) AC System
- Blown potential fuse. Fuse replaced.
- Problem with polarizing circuits. The wiring was corrected.
- Water in CT junction box caused the differential to operate. Box was resealed and CT replaced.
- Carrier ground relay misoperation caused by opening/closing line switches.

J) Other (None of the above)
- Switch Non-Simultaneity

K) Unknown
- An investigation was not able to identify a cause.

Examples when no submittal is required:
- Human Error while personnel are in the station working on the equipment that misoperated.
- Failures to reclose, unless reclosing is of the SPS system
- Protection system is not part of the BES.

Please refer to NERC Reliability Standard PRC-004 when making a determination on the reportability of a potential misoperation.