Protection System Misoperations
Reporting and Trending

August 16, 2012 (2 p.m. – 4 p.m. Eastern Time)
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Agenda

• Anti-trust Guidelines and Public Meeting Notice
• Misoperation Data Collection History
• Revised Misoperation Template Overview
• Misoperation Reporting Common Examples
• Misoperation Data Collection Statistics
• Question and Answer Session
Misoperation Data Collection History

Presented by: Joe Spencer, SERC, Manager of Planning and Engineering

Date: August 16, 2012
Background

• Protection Systems Misoperations (misops) identified as #1 NERC reliability issue (2010)
• Data collected under NERC standards PRC-003 and PRC-004
• Significant regional differences existed in analysis and collection of misops
• Tracking/trending of misops on ERO level was difficult
Misops Reporting Overview

Background (cont)

- NERC Planning Committee (PC) approves misops metric in 2009 (ALR4-1) – focus on misops to operations ratio
- Options for consistent reporting assessed
- Near term solution - regions align misops reporting procedures (via ERO RAPA and NERC SPCS).
- Consistent categories, cause codes and reporting frequencies developed from various regional procedures
Misops Reporting Overview

Background (cont)

- Misops template finalized and approved via regional procedures
- Long term solution – Use NERC wide standard development (project 2010-05.1)
- Mandatory regional reporting in 2nd qtr 2011.
- Full year of NERC wide reporting now on NERC website
Recent Efforts

- ERO-RAPA requested SPCS to provide technical oversight of the misops template
  - First revision slated for 4th qtr 2012
- TADs data cumbersome for ALR4-1 calculation
  - Collected annually
  - Cause code misalignment
  - SPCS recommended collection of “total operations” for ALR4-1
Recent Efforts (cont)

- Protection System Misoperations task force (PSMTF) established by NERC Planning Committee to analyze past/current data
  - Recent focus – 2nd qtr 2011 thru 1st qtr 2012 – review of top three cause codes
  - Past focus – Pre 2011 – Consistent format proposed
    - review of data available from six regions.
  - Report targeted by end of 2012
- ERO-RAPA and SPCS in communication with the Project 2010-05.1 SDT.
Conclusions

- Consistent reporting format - significant step forward for industry
- Need to balance security/dependability in reducing total misops
- Top cause codes
  - Incorrect settings and design errors – microprocessor based
  - Relay failures - electromechanical based
- Seasonal trends of interest
- Total operations needed for ALR 4-1
Enhanced Misoperation Template

Overview

Presented by: Andrew Slone, NERC, Reliability Performance Analysis Engineer

Date: August 16, 2012
• Revised template very similar to current template
• 1st Revision Scheduled For 2012Q4 Implementation
• Three groups contributed to the enhancement:
  ▪ ERO-RAPA
  ▪ NERC System Protection and Control Subcommittee
  ▪ Project 2010-05.1 SDT
• Goal of the revision:
  ▪ Clarify reporting
  ▪ Incorporate lessons learned from previous quarters
  ▪ Provide additional utility while minimizing additional burden
Additional Field Enhancements

• Entity generated misoperation identifier instead of resubmittal flag
  ▪ Easier to synchronize between Regional Entities and NERC
  ▪ Allows entity to use their internal ID format to track misops

• Removed “Corresponding TADS Cause Code” field
  ▪ Was derived from misoperation cause code
  ▪ Not needed for reporting

• Replaced Company Name field with NERC ID field
  ▪ Reduces ambiguity on which company is reporting

• Added “If the misoperation caused a generator forced outage, select the generator?” field
  ▪ Reduces manual burden of checking each Equipment Type “Generator” misop to find generator name
Protection System Operations

• Separate form to collect total count of operations by voltage
  ▪ Not Collecting Detail; Only Aggregate Count
  ▪ Uses uniform Protection System operation definition developed by NERC System Protection and Control Subcommittee (SPCS)
  ▪ Endorsed by NERC SPCS and ERO-RAPA

• Why collect operations?
  ▪ Currently, misoperation metrics are by count only
  ▪ Normalization by operations would provide better, more informative metrics
• Current Misoperation Template:
  ▪ Provides field definitions

• Q&A on Consistent Misoperation Reporting:
  ▪ [http://www.nerc.com/docs(pc/rmwg/pas/templates/Q&A_on_Consistent_MisopReporting_FINAL.pdf](http://www.nerc.com/docs(pc/rmwg/pas/templates/Q&A_on_Consistent_MisopReporting_FINAL.pdf)
  ▪ Answers frequently asked questions about misoperation reporting
Misoperation Reporting Common Examples

Presented by: Richard Quest, MRO, Principal System Protection Engineer
Date: August 16, 2012
• Event Description

  Description and Location of Fault (if any)
  List any Failures to Trip
  List any Over Trips – include the relative location to faulted equipment
  List any Slow Trips
  Explain Why this is a Misoperation
• Summary of how a misop should be reported

Cause of Misoperation

- Describe any identified causes, and include a brief explanation of how this resulted in the misoperation
- For Misoperation where no cause has yet been determined:
  - Describe any suspected causes
  - Describe any candidate causes that have been eliminated by investigation
  - Discuss any relevant records or tests
  - Describe any proposed tests or future monitoring
When to Report More than One Misop

- Consider all of the protection applied to a circuit element to be one composite Protection System.
- Each Circuit Element which is improperly tripped, or fails to trip is an event.
- There may be multiple failures within a protection scheme for a single Misoperation. The failures should be described in the single misoperation event.
- The failure to trip by a component of a Protection System is not a misoperation if the composite Protection System correctly clears the faulted equipment.
Non-Reportable Issues

• Control Systems (Not a misoperation of a Protection System)
  It is common to use relays designed to protect capacitors from partial failures to also switch the capacitor for system voltage control. A failure of the voltage control function would not be considered a misoperation.

• Maintenance and Testing Misops (Not actually a misop)
  “Misoperations” associated with errors or accidents during testing or maintenance should not be reported.
  Protection Systems left in improper condition following maintenance that result in misoperations are reportable.

• Relay or communication problem, but scheme still clears in high-speed time
  If the fault is cleared in a time meeting the TPL requirements, AND does not result in external trips due to coordination issues, it is not a misoperation.
• Common scenarios or mistakes in misop reporting
  When to use the “Breaker” equipment type
  When the misoperation is TADS reportable (lines 200 kV+ and transformers with a low side 200 kV+)
  When to use each cause code (some are getting confused on this)
• Example of reporting more complex misops?
Example Misoperation Reporting
When to Use Breaker Equipment Type

- Communications
  - RTU Circuit Failed
  - Phase Comparison Circuit Failed
- Secondary Distance Relay – This relay self diagnosed an A to D failure and disabled tripping
- Primary Phase Comparison Relay
  - Identified Channel Failure
  - Reconfigured as Step Distance Scheme **After 10 cycles**
  - Tripped with zero voltage present
When to Use Breaker Equipment Type

- Equipment only refers to circuits, transformers, buses, breakers, etc.
- “Breaker” Equipment Type should only be used in one case:
  The breaker is the only element outaged by the misoperation.
When to Use Breaker Equipment Type (2)

Diagram showing a power system with 115kV Bus 1 and 115kV Bus 2 connected through transmission lines. The diagram includes a generator, shunt capacitor, and distribution transformer (Dist Xfmr).
When to Use Breaker Equipment Type (3)

- Equipment Removed = Breaker
- Relay Technology = Solid State
- Protection System Type = POTT
- Description: K breaker associated with two lines tripped and reclosed for no fault – no line outage
- Cause: SCR misfired in tripping circuit due to transient on DC system. Testing of the Johnson line secondary relaying identified a marginally stable SCR in the K breaker trip circuit. Fault recorder trace is consistent with secondary relay operation.
• Data collected over 4 quarters (2011Q2 to 2012Q1)
• Over 1900 misoperations collected from all 8 Regional Entities
• Approximately 20% of misoperations TADS reportable
Relay Technology (Failures/ Malfunctions)

Misoperations by Relay Technology in 2011Q4
(Only Relay Failures/Malfunctions Cause Code)

Relay Technology (Incorrect Settings/ Design/ Logic Errors)

Misoperations by Relay Technology
(Incorrect setting/logic/design errors Cause Code Only)

- Electromechanical: 47, 29, 19, 16
- Microprocessor: 232, 127, 53, 62
- Solid State: 15, 13, 2, 9
- Others: 11, 7, 1

Bar chart showing misoperations by relay technology for different quarters (2011Q2, 2011Q3, 2011Q4, 2012Q1).
Misoperations per 1000 Line-Miles by Voltage (2011Q2-2012Q2)*

* Inventory data used is 2010 line mileage from FERC Form 1 and includes IOUs Only.
Questions and Answers
SPCS Endorsed Field Enhancements

- Recommended enhancements to 7 fields
- Relay Technology
  - A revised instruction was added to emphasize that relay technology is not always needed
- Corrective Action Plan
  - Changed to clarify the column applies to analysis of misoperations under investigation and corrective action plans when the cause has been identified
- Equipment Removed from Service (Permanently or Temporarily) as the result of the Misoperation
  - Added language to clarify when to use the “Breaker” type
• **Cause(s) of Misoperation**
  - Added a new cause code “Other/Explainable”
  - Other/Explainable – This category includes Misoperations that were determined to have an identified cause but they do not fit into any of the above categories. For example, temporary changes in network topology that, because of their low probability of occurrence, are not accounted for in the design of the Protection System.

• **Event Description**
  - Provided clarification to indicate that causal information should be entered in this field.
• **Misoperation Category**
  - Gave clarification on ‘Slow Trip’ regarding the phrase “essential for transmission system performance.”

• **Is this a TADS reportable outage?**
  - Changed field description to give more detail on which elements are TADS reportable