System Protection Working Group (SPWG) Update to ROS

December 3, 2020

Chair: John Karlik, PE

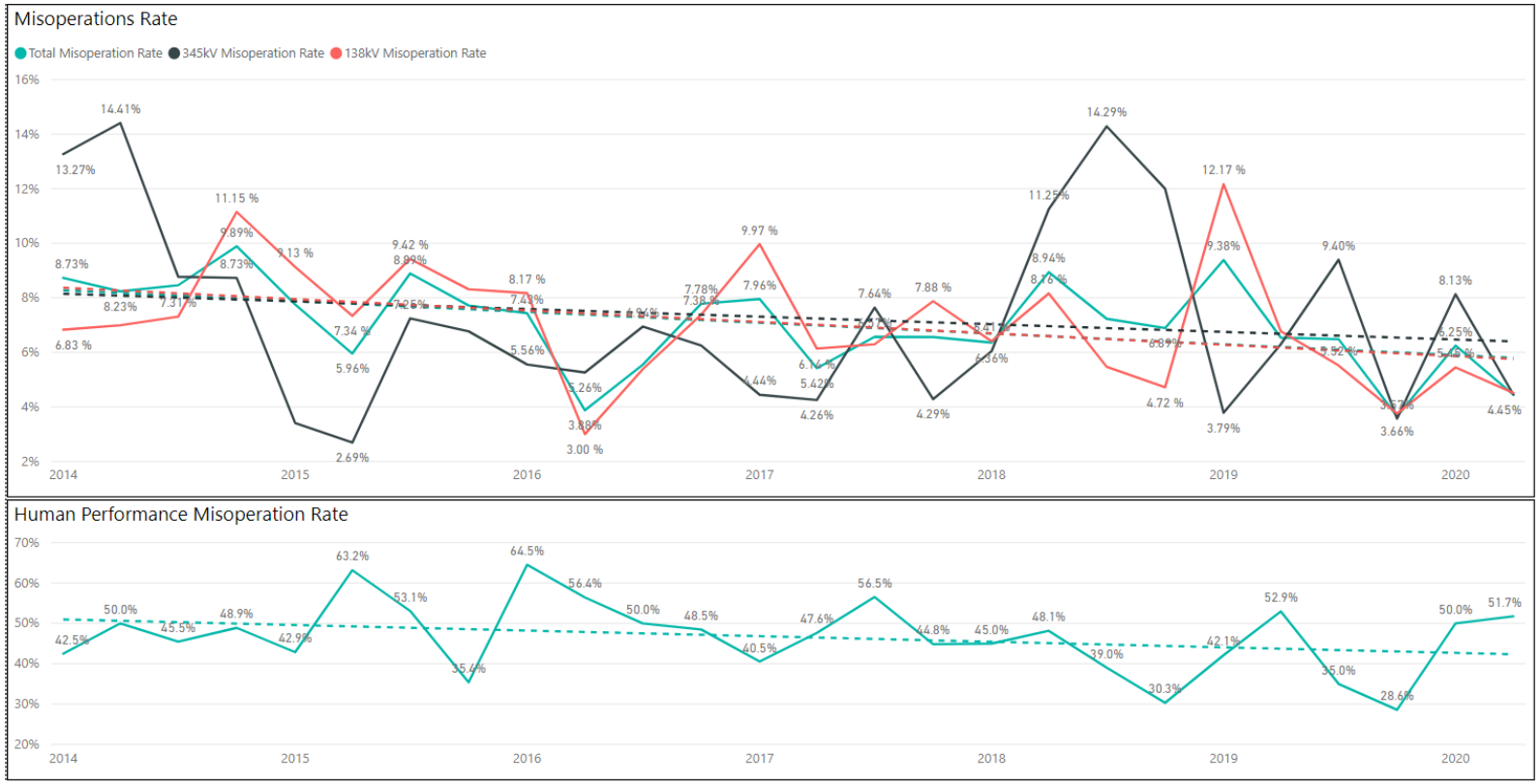
Vice-Chair: Vincent Roberts, PE

SPWG Meeting

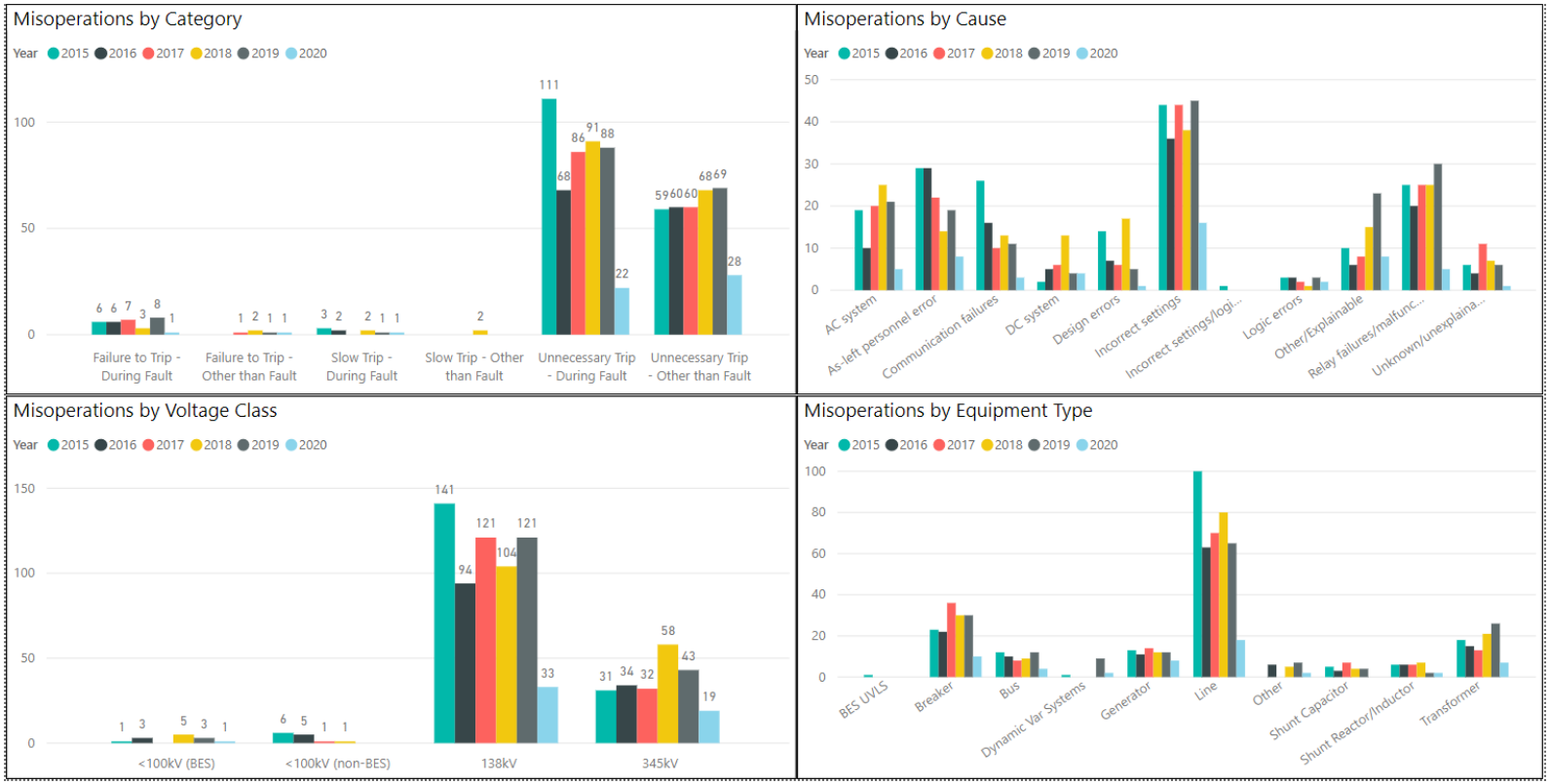
- Meeting held on November 10, 2020
- Topics Discussed:
  - Annual SPWG document review
  - ERCOT SPWG Short Circuit Model Procedures
  - 2020 Q2 Protection System Misoperations
    - Outreach to generators
- Proposed RRGR
- Next meeting is scheduled March 2-3, 2021

2020 Q2 Protection System Misoperations

Protection System Misoperations: 2014-2020 Q2



Protection System Misoperations: 2015-2020 Q2



Protection System Misoperations – 2020 Q2

		Q2	2020 YTD
# of Misoperations	Total	29	53
	345 kV	9	19
	138 kV	19	33
	< 100 kV	1	1
By Category	Failure to Trip	2	2
	Slow Trip	1	1
	Unnecessary Trip during Fault	15	22
	Unnecessary Trip – Non Fault	11	28
	SPS	0	0
By Relay System Type	Electromechanical	3	4
	Solid State	1	1
	Microprocessor	21	41
	Other/ N/A	4	7
By Equipment Protected	Line	10	18
	Transformer	5	7
	Generator	3	8
	Shunt/Series Capacitor	0	0
	Shunt/Series Reactor	1	2
	Dynamic VAR system	1	2
	Bus	1	4
	Breaker	6	10

Protection System Misoperations 2020 Q2

Summary of Human Performance Issues noted for 2020 Q2:

- 138kV line breaker tripped with no fault due to incorrectly programmed transfer trip settings
- 138kV line breaker overtripped during a fault due to relay settings that did not match setting issued by engineering
- Generator tripped with no fault due in incorrect CT ratio in main transformer that was recently replaced
- New wind plant tripped with no fault due to miscoordination of plant relays with other wind plants connected to the same transmission circuit
- 345kV series reactor tripped during a fault due to swapped CT cables
- 138kV line breaker tripped during a fault due to incorrect settings. Setting changes from a previous misoperation investigation were not implemented prior to this event
- 345kV auto tripped during a fault due to unintentional grounds in the differential CT circuit
- 345kV wind plant GSU tripped during a fault due to reversed polarity in the CT circuit
- 345kV wind plant breaker tripped during a fault due to relay settings that did not match setting issued by engineering
- 138kV line breaker tripped for a remote bus fault due to an incorrectly set Z1 setting

Failure to Trip/Slow Trip Misoperations in 2020 Q2:

- Generator protective relay did not operate due to loose DC fuse
- Wind plant feeder breaker failed to trip during a fault due to a failed trip coil
- 138kV line breaker tripped slow during a fault due to deteriorated fuse in the voltage polarizing circuit

Definitions

- Protection System –
  - Protective relays which respond to electrical quantities,
  - Communications systems necessary for correct operation of protective functions
  - Voltage and current sensing devices providing inputs to protective relays,
  - Station dc supply associated with protective functions (including station batteries, battery chargers, and non-battery-based dc supply), and
  - Control circuitry associated with protective functions through the trip coil(s) of the circuit breakers or other interrupting devices

Definitions

- Composite Protection System - *The total complement of Protection System(s) that function collectively to protect an Element. Backup protection provided by a different Element's Protection System(s) is excluded.*

- Misoperation – *The failure a Composite Protection System to operate as intended for protection purposes. Any of the following is a Misoperation:*
  1. Failure to Trip – During Fault – A failure of a Composite Protection system to operate for a Fault condition for which it is designed.
  2. Failure to Trip – Other than Fault - A failure of a Composite Protection system to operate for a non-Fault condition for which it is designed, such as a power swing, undervoltage, overexcitation, or loss of excitation.

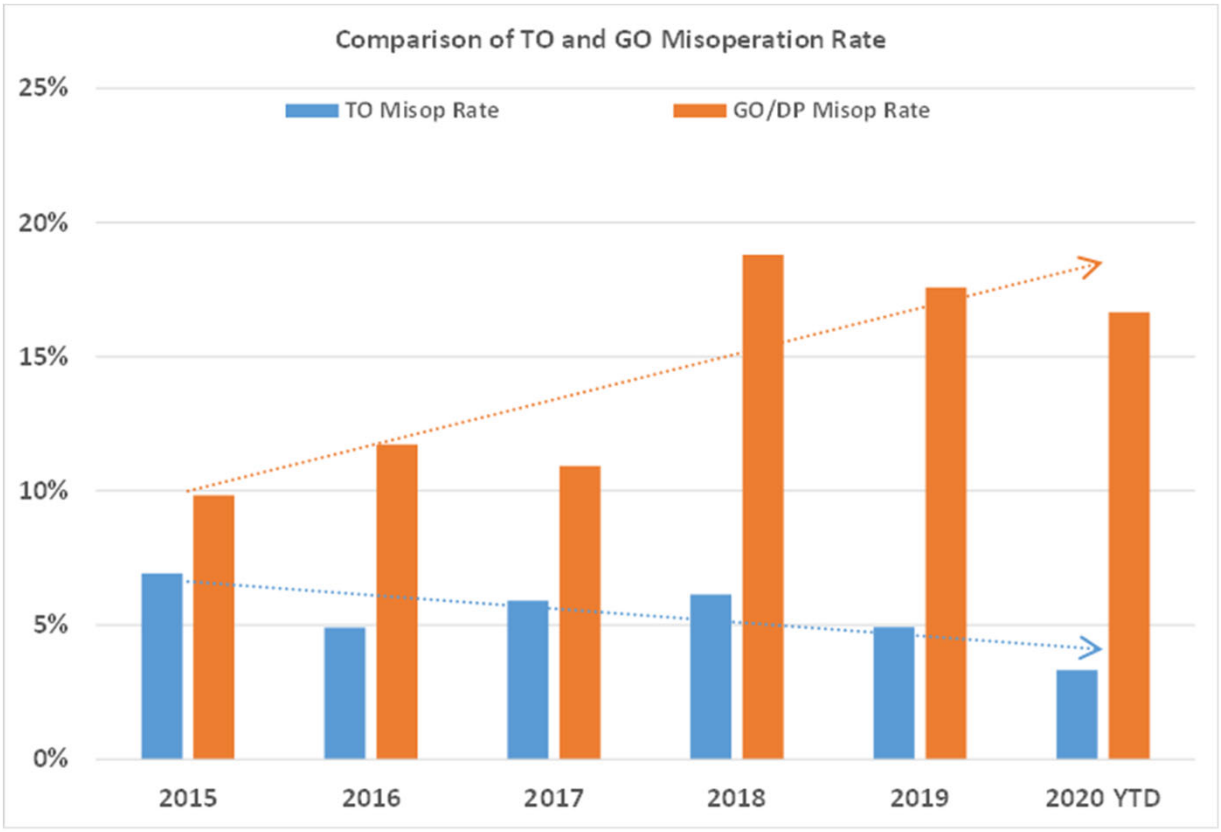
Definitions

- Misoperation – *The failure a Composite Protection System to operate as intended for protection purposes. Any of the following is a Misoperation:*
  3. Slow Trip – During Fault – A Composite Protection system that is slower than required for a Fault condition if the duration of its operating time resulted in the operation of at least one other Element's Composite Protection System.
  4. Slow Trip – Other than Fault - A Composite Protection system that is slower than required for a non-Fault condition, such as a power swing, undervoltage, overexcitation, or loss of excitation, if the duration of its operating time resulted in the operation of at least one other Element's Composite Protection System.

Definitions

- Misoperation – *The failure a Composite Protection System to operate as intended for protection purposes. Any of the following is a Misoperation:*
  5. Unnecessary Trip – During Fault – An unnecessary Composite Protection system operation for a Fault condition on another Element.
  6. Unnecessary Trip – Other than Fault - An unnecessary Composite Protection system operation for a non-Fault condition. A Composite Protection System operation that is caused by personnel during on-site maintenance, testing, inspection, construction, or commissioning activities is not a Misoperation.

Additional Slide – Protection System Misoperations 2020 Q2



Protection System Misoperations Trends

- TRE provides misoperation data to SPWG at each meeting
- TO Misoperations are trending lower, which is desired
- GO/DP Misoperations are trending higher
- The SPWG would recommend ROS to consider outreach to GO/DP to decrease the misoperations on the ERCOT system

Proposed RRGRR

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- SPWG had an action item to revise RARF to add three-winding transformer data to improve short circuit model accuracy
  - Draft changes have been made to the RRG
  - SPWG has reviewed the changes
  - RRGRR will be submitted in the January ROS meeting

Questions?