### WECC PCS

October 3, 2024

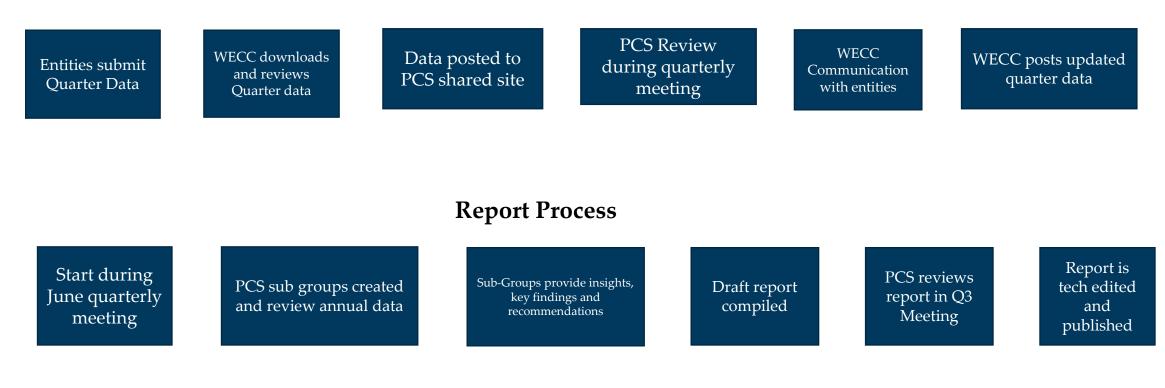
James Hanson WECC PCS Liaison



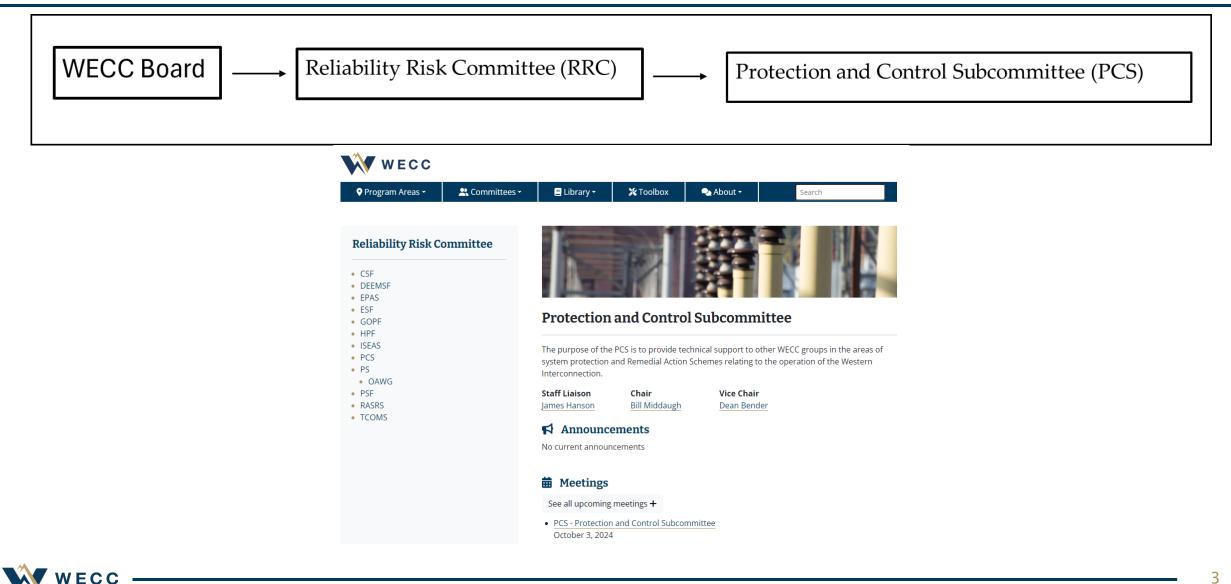
# WECC

## **MIDAS Review and Report Process**

### **Review Process**



# **WECC Regional Organization Structure**



# PCS <u>Site</u>

Member	'S	$\checkmark$		
Governa	$\sim$			
Action Items				
Approval Items				
Approve	ed Documents	^		
File Type	Title	Modified		
PDF	Guideline - Application for Echo Keying Logic on Permissive Overreaching Transfer Trip Schemes	2024-06- 20		
PDF	Guideline for Protection System Loadability	2024-06- 20		
PDF	Guideline for Time Synchronization of Protection Control and Monitoring	2024-06- 20		
PDF	PCS 2022 Misoperation Report Final	2024-06- 20		
PDF	System Operation Investigation Analysis Workflow	2024-06- 20		
PDF	White Paper on EHV Transmission Line Protection	2024-06- 20		
PDF	White Paper on Prevention of Negative-Sequence Element Misoperations During Unbalanced Conditions	2024-06- 20		
Approve	ed Minutes	$\sim$		



# **Misoperation Reduction Efforts**

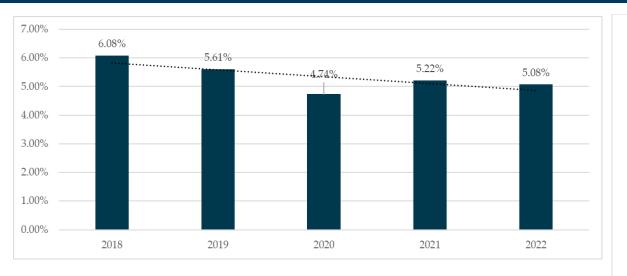
Annual Reports

- Misoperation Reduction Strategy
  - Defined goal
  - Industry guided and incorporated feedback
  - Tracking progress

Misoperations Workshops



## **Annual Report**



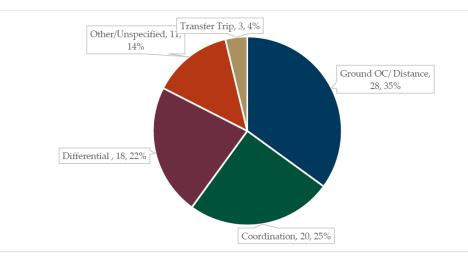
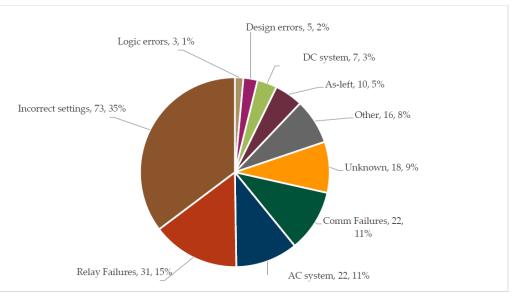


Figure 15: 2022 settings and logic/design errors by root cause

ECC



#### Table 1: 2022 Misoperations per 100 TADS Elements in voltage class

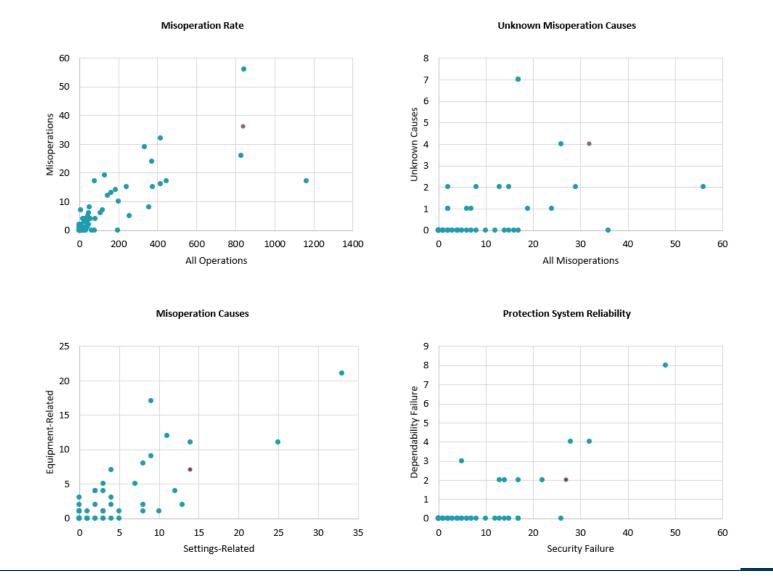
Voltage Class	AC Circuit	Converter	DC Circuit	Transformer	Total Elements per voltage class	# Misops	Misops per 100 elements in voltage class
0–99 kV	505	0	0	42	547	5	0.9
100–199 kV	3319	0	0	186	3505	86	2.5
200–299 kV	1964	5	3	716	2688	69	2.6
300–399 kV	203	2	0	181	386	25	6.5
400–599 kV	305	0	6	247	558	22	3.9

6

### **Misoperation Reduction Strategy**

	uct analysis to determine extent of ition in the Western Interconnection.	Many incorrect setting misoperations can be attributed to ground overcur-	Short-circuit models are critical to devel- oping settings and studying impacts of	in short-circuit models with the WECC S Work Group (SCMWG).	hort Circuit
	Host educational webinars addressing	rent settings. In the Texas Interconnec-	elements to the system. Flawed or	<ul> <li>Create an evaluation checklist for sho</li> </ul>	vt-
	Ground Fault Protection challenges.	tion, for example, ground overcurrent	outdated short-circuit models can lead	circuit models and related practices,	
Action Plan:	<ul> <li>Assess entity ground fault</li> </ul>	settings comprised a large percent of	to incorrect settings and misoperations.	including communication and informa-	Action Plan:
<ul> <li>Host webinar</li> </ul>	protection practices.	incorrect setting misoperations. To	Processes for updating and sharing	tion sharing practices.	<ul> <li>Develop an ERO</li> </ul>
with presentations	<ul> <li>Develop a best practice</li> </ul>	address this issue in the West, we	short-circuit model information can	Participate in regional model	Enterprise misoperatio
from subject matter	guide with examples of	should develop targeted efforts to	ensure settings are based on the most	initiatives or share short-	investigation root-cause
experts on challenges and	effective coordination	improve the coordination of ground	accurate model available and improve	circuit information with	analysis program.
techniques for correct	of ground overcur-	overcurrent settings.	setting accuracy.	neighboring entities. Issue	<ul> <li>Share information with</li> </ul>
application of settings in	Issue rent fault			Participate in the	entities regarding their
the field.	Summary: settings.			WELL	incorrect setting misopera
<ul> <li>Follow the checklist provided in the Process.</li> </ul>	Settings applied			SCMWG. entities report a	tions relative to other
Issues, Trends, and Quality	incorrectly in the			misoperation as an	entities and the WECC
Control of Relay Settings	field lead to misopera-			incorrect setting issue,	<ul> <li>Draft a best practice</li> </ul>
IEEE PSRC Working Group	tions. Controls can help	Ground		they are not required to	guide with examples of
report to review processes	confirm that settings are	Overcurrent	Short-Circuit	describe in detail why the	effective misoperations
involving application of	applied correctly and commis-	Protection	Model Quality	setting was incorrect, or the root	root- cause analyses.
settings in the field and	sioned in the existing system	Flotection	Model Quality	-cause. Thorough root-cause	Conduct training
commission testing.	as expected, and this may			analysis is critical to misop-	webinar or in-person
<ul> <li>Develop a best practice</li> </ul>	prevent costly trouble-			eration investigation	training to address
guide with examples of	shooting. A thorough			because it allows entities	root-cause analysis in
effective commission	testing process for			to identify underlying issues and prevent	misoperation investigation
testing and provide points	applying settings in the Ap	plication Mison	erations Root-Cau		<ul> <li>Create an evaluation</li> </ul>
of contact for entities		attinguin		Ise menting root-cause	guide to facilitate entity
interested in refining their process.		Poductio	n Strategy Analysi	S analyses can ensure	self-assessment of misoper
process	tions. t	he Field	in Strategy	thorough mitigation	ation root-cause analysis practices.
		Goal: Reduce M	Aisoperation Rate	of misoperations.	practices
		Cour neutre	insoperation nate		
		Three	hold 9%		
		Inres	noid 9%	Issue Summary:	Action Plan:
Action Plan:	Issue Summary:	and the second		Bringing protection	<ul> <li>Create a guideline for</li> </ul>
<ul> <li>Share unknown misoper- ations rate information with</li> </ul>			et 12%	systems online	using quality review and
entities, including how it		i ai ge	Testing Set	ting involves a complex	power system simulators to
compares to WECC average	chanical and solid	rmation for	Applicati	process with many	confirm application of
and other entities.	state protection Inve	estigations Strete	ch 17% Applicati		settings prior to implemen
<ul> <li>Determine the extent of</li> </ul>	systems can make			human error; namely,	tation in the field. The
condition, break down relay				incorrect application of	guideline will include an
				settings that can lead to	evaluation checklist.
fleet by type, identify	tions difficult, and can				
	tions difficult, and can lead entities to designate			misoperations. With the	
fleet by type, identify percentage of unknown misoperations by relay	lead entities to designate "unknown" causes by	Human		proper controls in place,	<ul> <li>Develop best practice guide with examples of effective controls concern</li> </ul>
fleet by type, identify percentage of unknown misoperations by relay type, and perform internal	lead entities to designate "unknown" causes by default. Addressing this	Human Performance	Knowledge	proper controls in place, there are also opportunities	guide with examples of effective controls concern
fleet by type, identify percentage of unknown misoperations by relay type, and perform internal evalutions of non-	lead entities to designate "unknown" causes by default. Addressing this tendency and shoring up	Performance		proper controls in place,	guide with examples o
fleet by type, identify percentage of unknown misoperations by relay type, and perform internal evalutions of non- microprocessor systems to	lead entities to designate "unknown" causes by default. Addressing this tendency and shoring up investigation practices will help	Performance During	Knowledge Transfer	proper controls in place, there are also opportunities to identify and remediate	guide with examples of effective controls concerning application testing.
fleet by type, identify percentage of unknown misoperations by relay type, and perform internal evalutions of non- microprocessor systems to identify areas for improve-	lead entities to designate "unknown" causes by default. Addressing this tendency and shoring up investigation practices will help ensure all misoperation	Performance		proper controls in place, there are also opportunities to identify and remediate errors before they are issued to	guide with examples of effective controls concerning application testing. Provide points of contact
fleet by type, identify percentage of unknown misoperations by relay type, and perform internal evalutions of non- microprocessor systems to identify areas for improve- ment.	lead entities to designate 'unknown' causes by default. Addressing this tendency and shoring up investigation practices will help ensure all misoperation investigations are	Performance During		proper controls in place, there are also opportunities to identify and remediate errors before they are issued to the field. Training, process checks, and quality reviews hould serve	guide with examples of effective controls concerr ing application testing. Provide points of contact for entities interested in refining their processes.
fleet by type, identify percentage of unknown misoperations by relay type, and perform internal evalutions of non- microprocessor systems to identify areas for improve- ment. • Create replacement	lead entities to designate 'unknown' causes by default. Addressing this tendency and shoring up investigation practices will help ensure all misoperation investigations are equally robust,	Performance During		proper controls in place, there are also opportunities to identify and remediate errors before they are issued to the field. Training, process checks, and quality reviews should serve as checkpoints for	guide with examples of effective controls concern- ing application testing. Provide points of contact for entities interested in refining their processes. © Perform internal evalua- tion of practices regarding
fleet by type, identify percentage of unknown misoperations by relay type, and perform internal evalutions of non- microprocessor systems to identify areas for improve- ment. • Create replacement plans for nonmicroproces-	lead entities to designate 'unknown' causes by default. Addressing this tendency and shoring up investigation practices will help ensure all misoperation investigations are equally robust, regardless of the Plan:	Performance During Commissioning		proper controls in place, there are also opportunities to identify and remediate errors before they are issued to the field. Training, process checks, and quality reviews should serve Action Plan: a plication	guide with examples of effactive controls concern ing application testing. Provide points of contac for entities interested i refining their processes. • Perform internal evalua- tion of practices regarding application testing prior to
fleet by type, identify percentage of unknown misoperations by relay type, and perform internal evalutions of non- microprocessor systems to identify areas for improve- ment. © Create replacement plans for nonmicroproces- sor systems with	lead entities to designate 'unknown' causes by default. Addressing this tendency and shoring up investigation practices will help ensure all misoperation investigations are equally robust, regardless of the technology invested topoperations	Performance During Commissioning	Transfer	proper controls in place, there are also opportunities to identify and remediate errors before they are issued to the field. Training, process checks, and quality reviews should serve as checkpoints for Plan: e Hold testing	guide with examples of effective controls concerr ing application testing. Provide points of contact for entities interested in refining their processes. • Perform internal evalua- tion of practices regarding application testing prior to field implementation, and
fleet by type, identify percentage of unknown misoperations by relay type, and perform internal evalutions of non- microprocessor systems to identify areas for improve- ment. • Create replacement plans for nonmicroproces- sor systems with performance issues, and	lead entities to designate 'unknown' causes by default. Addressing this tendency and shoring up investigation practices will help ensure all misoperation investigations are equally robust, regardless of the technology involved. Market Share misoperations data concerning	Performance During Commissioning	Transfer	proper controls in place, there are also opportunities to identify and remediate errors before they are issued to the field. Training, process checks, and quality reviews should serve Action Plan: application • Hold testing,	guide with examples c effective controls concerr ing application testing. Provide points of contac for entities interested i refining their processes. • Perform internal evalua- tion of practices regarding application testing prior to field implementation, and identify areas for improve-
fleet by type, identify percentage of unknown misoperations by relay type, and perform internal evalutions of non- microprocessor systems to identify areas for improve- ment. • Create replacement plans for nonmicroproces- sor systems with performance issues, and implement reinforcement	lead entities to designate 'unknown' causes by default. Addressing this tendency and shoring up investigation practices will help ensure all misoperation investigations are equally robust, regardless of the technology misoperations data concerning human performance	Performance During Commissioning	Transfer Issue Summary: As workforce turnover continues over the next five-10 years,	proper controls in place, there are also opportunities to identify and remediate errors before they are issued to the field. Training, process checks, and quality reviews should serve Hold application Hold testing, knowledge transfer	guide with examples of effective controls concerr ing application testing. Provide points of contact for entities interested in refining their processes. • Perform internal evalua- tion of practices regarding application testing prior to field implementation, and
fleet by type, identify percentage of unknown misoperations by relay type, and perform internal evalutions of non- microprocessor systems to identify areas for improve- ment. • Create replacement plans for nonmicroproces- sor systems with performance issues, and implement reinforcement strategies to identify areas	lead entities to designate 'unknown' causes by default. Addressing this tendency and shoring up investigation practices will help ensure all misoperation investigations are equally robust, regardless of the technology involved. data concerning human performance during commissioning	Performance During Commissioning	Transfer Issue Summary: As workforce turnover continues over the next five-10 years, critical knowledge may be lost. To	proper controls in place, there are also opportunities to identify and remediate errors before they are issued to the field. Training, process checks, and quality reviews should serve Action Plan: application • Hold testing,	guide with examples c effective controls concerr ing application testing. Provide points of contac for entities interested i refining their processes. • Perform internal evalua- tion of practices regarding application testing prior to field implementation, and identify areas for improve-
fleet by type, identify percentage of unknown misoperations by relay type, and perform internal evalutions of non- microprocessor systems to identify areas for improve- ment. • Create replacement plans for nonmicroproces- sor systems with performance issues, and implement reinforcement	lead entities to designate 'unknown' causes by default. Addressing this tendency and shoring up investigations practices will help ensure all misoperation investigations are equally robust, regardless of the share involved, technology human performance during commissioning (e.g., as-left performance g.as-left performance during commellerors, share technology human performance during commissioning (e.g., as-left performance during commellerors, technology human performance technology human performance during commissioning (e.g., as-left performance during commellerors, technology	Performance During Commissioning Summary: The commissioning process is crucial to ensuring new equipment is installed correctly and will function as intended. This process	Transfer Issue Summary As workforce turnover continues over the next five-10 years, critical knowledge may be lost. To prevent this, protection system and	proper controls in place, there are also opportunities to identify and remediate errors before they are issued to the field. Training, process checks, and quality reviews should serve action as checkpoints for Plan: application e Hold testing, knowledge transfer techniques and challeng-	guide with examples c effective controls concerr ing application testing. Provide points of contac for entities interested i refining their processes. • Perform internal evalua- tion of practices regarding application testing prior to field implementation, and identify areas for improve-
fleet by type, identify percentage of unknown misoperations by relay type, and perform internal evalutions of non- microprocessor systems to identify areas for improve- ment. • Create replacement plans for nonmicroproces- sor systems with performance issues, and implement reinforcement strategies to identify areas where monitoring equip-	lead entities to designate 'unknown' causes by default. Addressing this tendency and shoring up investigation practices will help ensure all misoperation investigations are equally robust, regardless of the technology human performance during commissioning (e.g., as-left personnel errors, ACDC systems).	Performance During Commissioning Issue Summary: The commissioning process is crucial to ensuring new equipment is installed correctly and will function as intended. This process can be complex and provides opportu-	Transfer Issue Summary: As workforce turnover continues over the next five-10 years, critical knowledge may be lost. To prevent this, protection system and control departments should ensure that	proper controls in place, there are also opportunities to identify and remediate errors before they are issued to the field. Training, process checks, and quality reviews should serve Action as checkpoints for Plan: application e Hold testing, webinars on knowledge transfer techniques and challeng- es specific to the electric	guide with examples c effective controls concerr ing application testing. Provide points of contac for entities interested i refining their processes. • Perform internal evalua- tion of practices regarding application testing prior to field implementation, and identify areas for improve-
fleet by type, identify percentage of unknown misoperations by relay type, and perform internal evalutions of non- microprocessor systems to identify areas for improve- ment. • Create replacement plans for nonmicroproces- sor systems with performance issues, and implement reinforcement strategies to identify areas where monitoring equip- ment may capture essential information.	lead entities to designate 'unknown' causes by default. Addressing this tendency and shoring up investigation practices will help ensure all misoperation investigations are equally robust, regardless of the technology misoperations data concerning human performance during commissioning (e.g., as-left personnel errors, AC/DC systems). Develop human performance in	Performance During Commissioning Burmary: The commissioning process is crucial to ensuring new equipment is installed correctly and will function as intended. This process can be complex and provides opportu- nities for errors. Addressing human	Transfer Issue Summary As workforce turnover continues over the next five-10 years, critical knowledge may be lost. To prevent this, protection system and control departments should ensure that valuable information and insight from	proper controls in place, there are also opportunities to identify and remediate errors before they are issued to the field. Training, process checks, and quality reviews should serve Action as checkpoints for Plan: application e Hold testing, webinars on testing, knowledge transfer techniques and challeng- es specific to the electric industry.	guide with examples c effective controls concerr ing application testing. Provide points of contac for entities interested i refining their processes. • Perform internal evalua- tion of practices regarding application testing prior to field implementation, and identify areas for improve-
hert by type, identify percentage of unknown misoperations by relay type, and perform internal evalutions of non- microprocessor systems to identify areas for improve- ment. • Create replacement plans for nonmicroproces- sor systems with performance issues, and implement reinforcement strategies to identify areas where monitoring equip- ment may capture essential information.	lead entities to designate 'unknown' causes by default. Addressing this tendency and shoring up investigation practices will help ensure all misoperation investigations are equally robust, regardless of the technology Misoperations involved. data concerning human performance during commissioning (e.g., a-left personnel errors, AC/DC systems). • Develop human performance in ommission testing guide based on field	Performance During Commissioning Issue Summay: The commissioning process is crucial to ensuring new equipment is installed correctly and will function as intended. This process can be complex and provides opportu- nities for errors. Addressing human performance issues associated with	Transfer Issue Summary: As workfore turnover continues over the next five-10 years, critical knowledge may be lost. To prevent this, protection system and control departments should ensure that valuable information and insight from experienced employees is documented	proper controls in place, there are also opportunities to identify and remediate errors before they are issued to the field. Training, process checks, and quality reviews should serve Action as checkpoints for Plan: application el Hold testing, webinars on knowledge transfer techniques and challeng- es specific to the electric industry. C Create internal evaluation guide to facilitate entity self-assessment regarding knowledge transfer practices	guide with examples o effective controls concerr ing application testing. Provide points of contac for entities interested in refining their processes. • Perform internal evalua- tion of practices regarding application testing prior to field implementation, and identify areas for improve- ment.
here by type, identify percentage of unknown misoperations by relay type, and perform internal evalutions of non- microprocessor systems to identify areas for improve- ment. • Create replacement plans for nonmicroproces- sor systems with performance issues, and implement reinforcement strategies to identify areas where monitoring equip- ment may capture essential information.	lead entities to designate 'unknown' causes by default. Addressing this tendency and shoring up investigation practices will help ensure all misoperation investigations are equally robust, regardless of the technology human performance during commissioning (e.g., as-left personnel errors, AC/DC systems). • Develop human performance in commission testing guide based on field nence and documents such as the IEEE	Performance During Commissioning Estimate Summary: The commissioning process is crucial to ensuring new equipment is installed correctly and will function as intended. This process can be complex and provides opportu- nities for errors. Addressing human performance issues associated with the commissioning process can reduce	Transfer Issue Summary: As workforce turnover continues over the next five-10 years, critical knowledge may be lost. To prevent this, protection system and control departments should ensure that valuable information and insight from experienced employees is documented and transferred to incoming and	proper controls in place, there are also opportunities to identify and remediate errors before they are issued to the field. Training, process checks, and quality reviews should serve Action as checkpoints for Plan: application Hold testing, knowledge transfer techniques and challeng- es specific to the electric industry. • Create internal evaluation guide to facilitate entity self-assessment regarding knowledge transfer practices.	guide with examples c effective controls concerr ing application testing. Provide points of contar for entities interested in refining their processes. • Perform internal evalua- tion of practices regarding application testing prior to field implementation, and identify areas for improve- ment.
fleet by type, identify percentage of unknown misoperations by relay type, and perform internal evalutions of non- microprocessor systems to identify areas for improve- ment. • Create replacement plans for nonmicroproces- sor systems with performance issues, and implement reinforcement strategies to identify areas where monitoring equip- ment may capture essential information.	lead entities to designate 'unknown' causes by default. Addressing this tendency and shoring up investigations are equally robust, regardless of the ensure all misoperations involved. technology human performance during commissioning (e.g., as-left performance in ommission testing guide based on field rience and document.	Performance During Commissioning Summary: The commissioning process is crucial to ensuring new equipment is installed correctly and will function as intended. This process can be complex and provides opportu- nities for errors. Addressing human performance issues associated with the commissioning process can reduce the number of errors and resulting	Transfer Issue Summary As workforce turnover continues over the next five-10 years, ortical knowledge may be lost. To prevent this, protection system and control departments should ensure that valuable information and insight from experienced employees is documented and transferred to incoming and intermediate employees. Developing	proper controls in place, there are also opportunities to identify and remediate errors before they are issued to the field. Training, process checks, and quality reviews should serve Action as checkpoints for Plan: application el Hold testing, webinars on knowledge transfer techniques and challeng- es specific to the electric industry. C Create internal evaluation guide to facilitate entity self-assessment regarding knowledge transfer practices	guide with examples c effective controls concerr ing application testing. Provide points of contar for entities interested in refining their processes. • Perform internal evalua- tion of practices regarding application testing prior to field implementation, and identify areas for improve- ment.
fleet by type, identify percentage of unknown misoperations by relay type, and perform internal evalutions of non- microprocessor systems to identify areas for improve- ment. • Create replacement plans for nonmicroproces- sor systems with performance issues, and implement reinforcement strategies to identify areas where monitoring equip- ment may capture essential information.	lead entities to designate 'unknown' causes by default. Addressing this tendency and shoring up investigation practices will help ensure all misoperation investigations are equally robust, regardless of the technology human performance during commissioning (e.g., as-left personnel errors, AC/DC systems). • Develop human performance in commission testing guide based on field nence and documents such as the IEEE	Performance During Commissioning Estimate Summary: The commissioning process is crucial to ensuring new equipment is installed correctly and will function as intended. This process can be complex and provides opportu- nities for errors. Addressing human performance issues associated with the commissioning process can reduce	Transfer Issue Summary: As workforce turnover continues over the next five-10 years, critical knowledge may be lost. To prevent this, protection system and control departments should ensure that valuable information and insight from experienced employees is documented and transferred to incoming and	proper controls in place, there are also opportunities to identify and remediate errors before they are issued to the field. Training, process checks, and quality reviews should serve Action as checkpoints for Plan: application Hold testing, knowledge transfer techniques and challeng- es specific to the electric industry. • Create internal evaluation guide to facilitate entity self-assessment regarding knowledge transfer practices.	guide with examples of effective controls concern ing application testing. Provide points of contac for entities interested in refining their processes. • Perform internal evalua- tion of practices regarding application testing prior to field implementation, and identify areas for improve- ment.

# **WECC Efforts with MIDAS Data**





# System Performance Data Portal

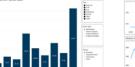
#### Home FAQ



Resource availability/unavailability for the Wind Generation Fleet in the Western Interconnection.

Wind Availability

Conventional					
Availability					
Weighted Meer Databaster Onlage by Treet "gar and Easer town process	_				



The industry collects data on the performance of electric generating equipment, and the causes resulting in these generators being unavailable to generate.

Conventional Availability

Transmission



**Balancing Area** 

Exchange

Balancing Area Exchange information.

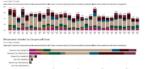
Balancing Area Exchange

Interconnection Frequency Response Measure (IFRM)

measures the amount of primary frequency response deployed after an event.

Frequency Response

Protection System Misoperations



It is crucial that Protection systems operate correctly to remove faults from the system to protect sensitive equipment and maintain system stability.

#### Protection System Misoperations



transmission equipment and

causes for these to become

Transmission Availability

Frequency in the Western

Interconnection is normally controlled to 60 Hz. A stable system frequency means a balance of load to generation

System

Frequency

فرينا وحقيقيته يتعلق

System Frequency

#### Frequency Response



Data related to the performance of BES

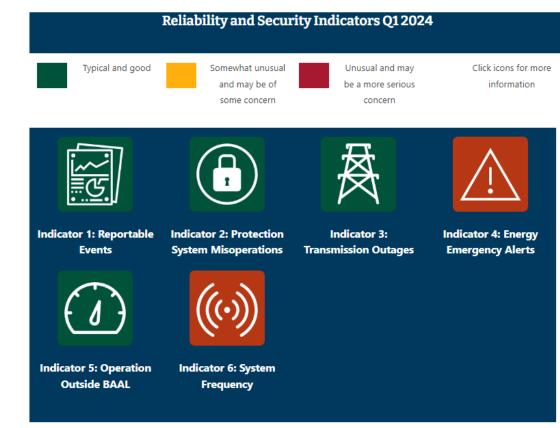
unavailable.

WECC

# **Reliability and Security Indicators**

### **Reliability & Security Indicator Dashboard**

The WECC Reliability and Security indicators provide an overview of system health for stakeholders and the general public. These indicators will be updated quarterly with new data and will change as our system reliability and security risks change. Each indicator is based on datasets and analyses that are described in detail under each indicator.







www.wecc.org