



# SynchroGrid

Achieving Simplicity in **System Protection**

## Selecting, Implementing and Overcoming Challenges when Selecting Coordination Criteria for **Wide Area Applications**

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# Presentation Outline



Introduction to NERC PRC-027-1



Wide Area Coordination Workflow



Planning



Data Collection and Model Validation



Coordination Criteria Selection



Coordination Study Implementation and Documentation



Challenges and Mitigative Measures



# Introduction to PRC-027-1

## Purpose

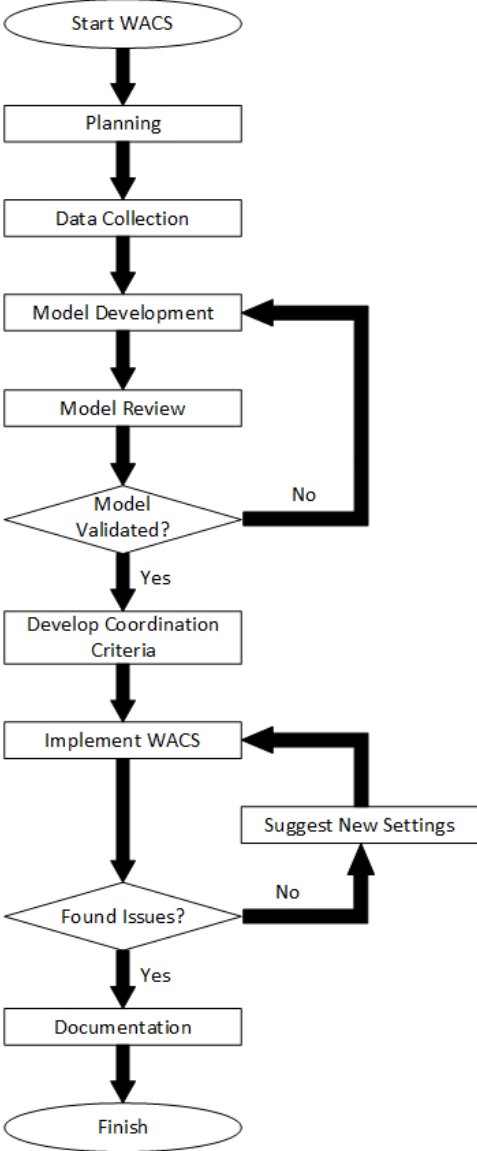
“To maintain the coordination of protection systems installed to detect and isolate faults on BES elements, such that those protective systems operate in the intended sequence during faults.”

- **R1:** Establish a process for developing new and revised settings. Process shall include:
  - R1.1 Review of short circuit model before settings are developed
  - R1.2 Review of protection settings
  - R1.3 Communication with interconnecting utilities prior to setting implementation
- **R2:** Perform a protection system coordination study:
  - Option 1** Wide Area Coordination Study every six years
  - Option 2** Establish a fault base comparison baseline and perform a study every time the current exceeds 15%
  - Option 3** Use a combination of above
- **R3:** Apply R1



# Wide Area Coordination Study

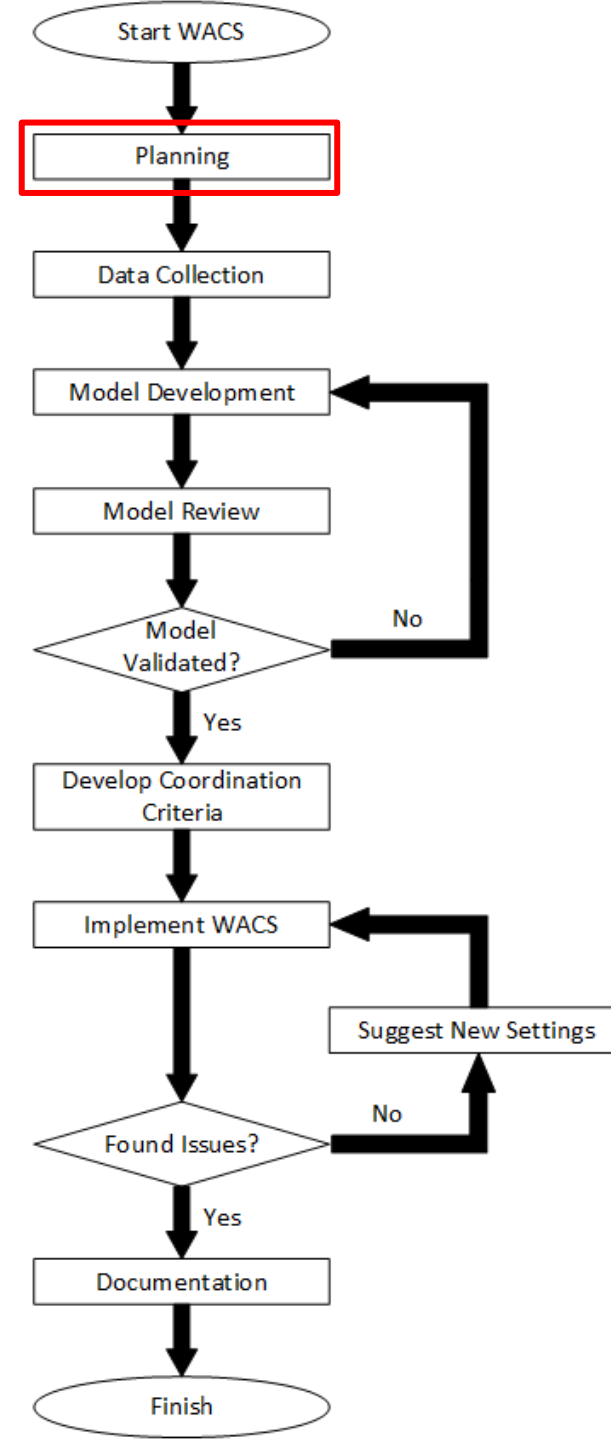
## Workflow



# Wide Area Coordination Study

## Planning

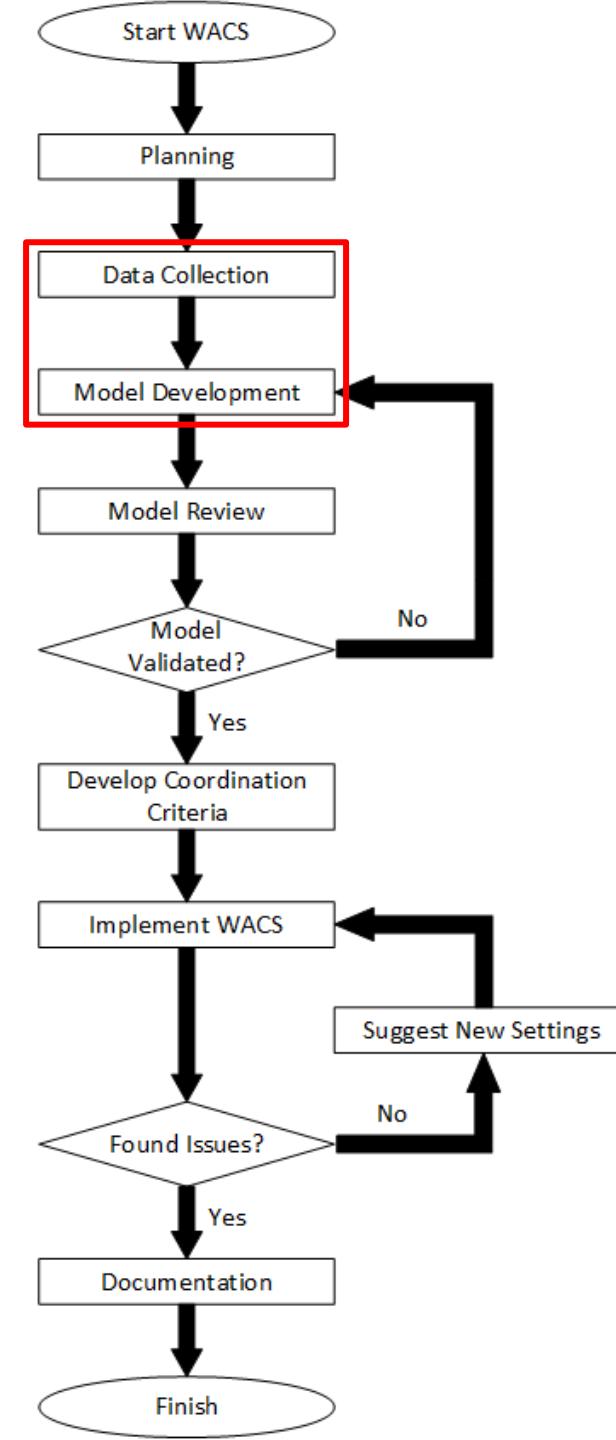
- Evaluation of suitable option from Requirement R2
- Fault deviation criterion
- System under consideration
  - Area
  - Load Capacity
  - Voltage Level
- Project management



# Wide Area Coordination Study

## Data Collection for Short Circuit Modeling

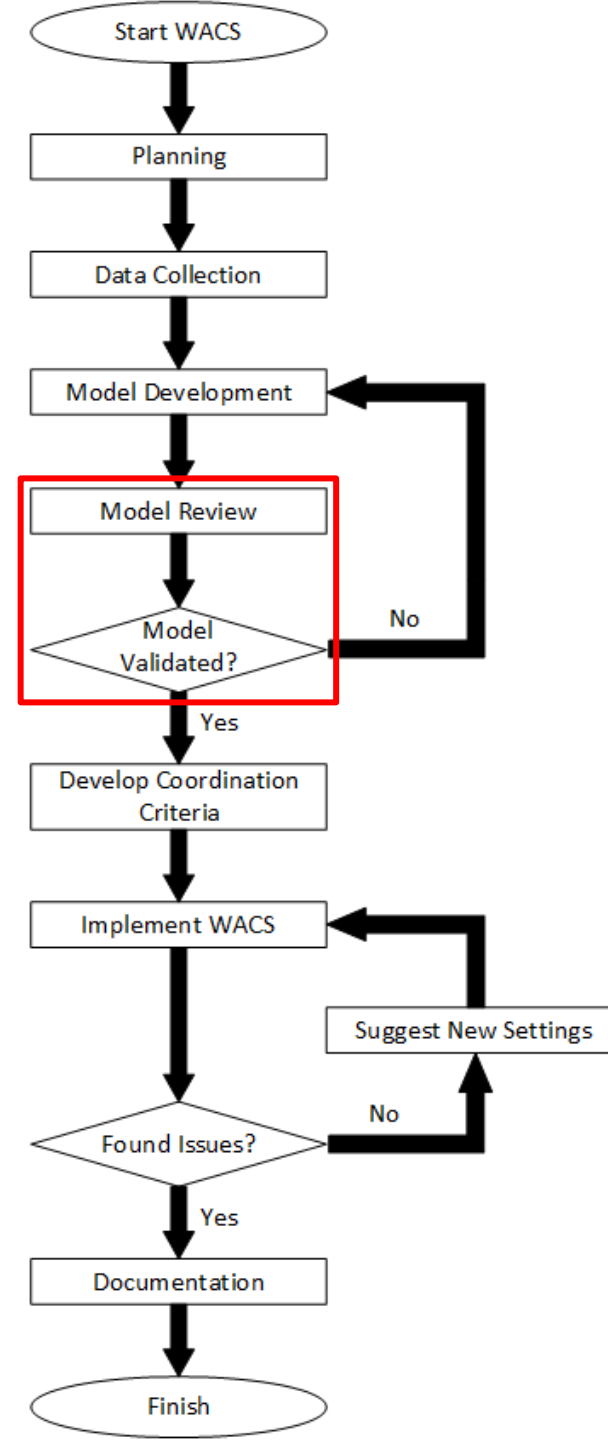
- Latest protective relay settings from field
- Nameplates
- Test reports
- Transmission line facility ratings
- System one-line drawings
- Information from Interconnection utilities
  - Inverter Based Resources (IBR) information



# Wide Area Coordination Study

## Short Circuit Validation

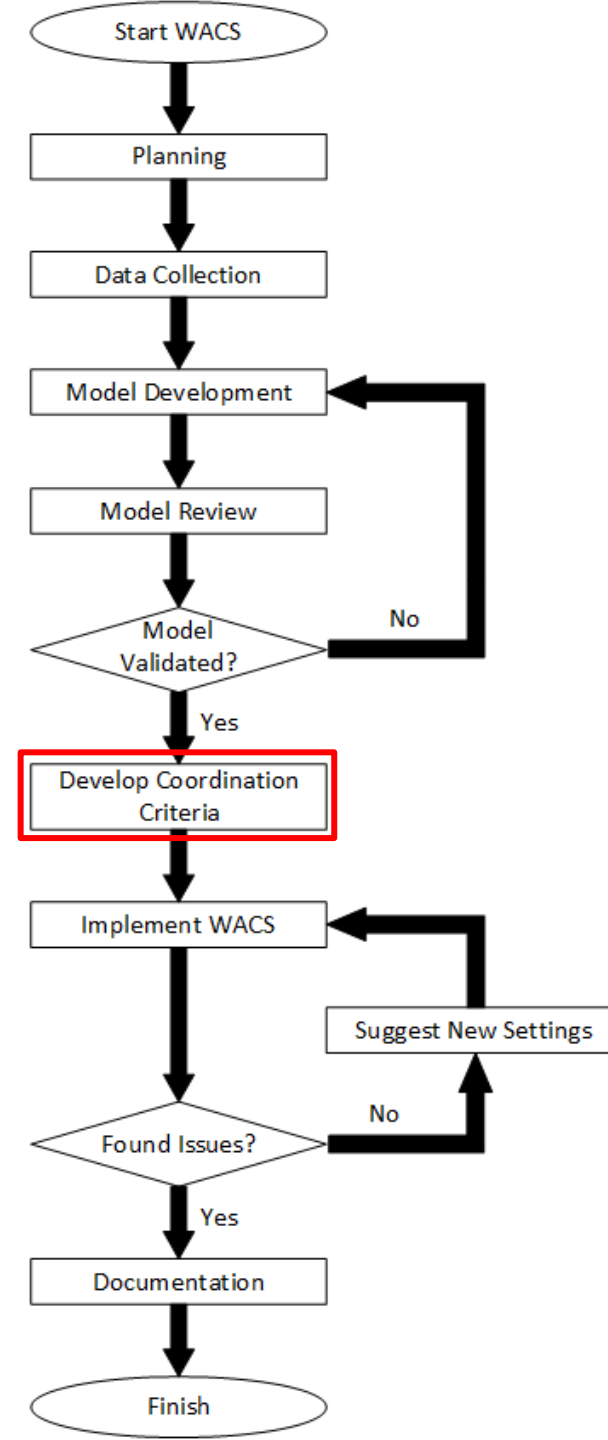
- Peer Review
  - Topology and system parameters
  - Use of automation tools
- Fault current comparison with field records
  - Matching system conditions
  - Criteria to validate (< 5%)
- Short circuit contribution from interconnecting utilities



# Wide Area Coordination Study

## Coordination Criteria

- Protective elements and their priority
  - Distance elements (21)
  - Time overcurrent elements (51)
- Acceptable ranges
  - Distance (Zone 1, Zone 2)
  - CTI
- Type of faults and fault location
  - SLG, LL, LLG, 3LG (Bolted and Impedance)
  - Primary, source and remote lines
  - Tap lines, low side of auto and distribution transformers

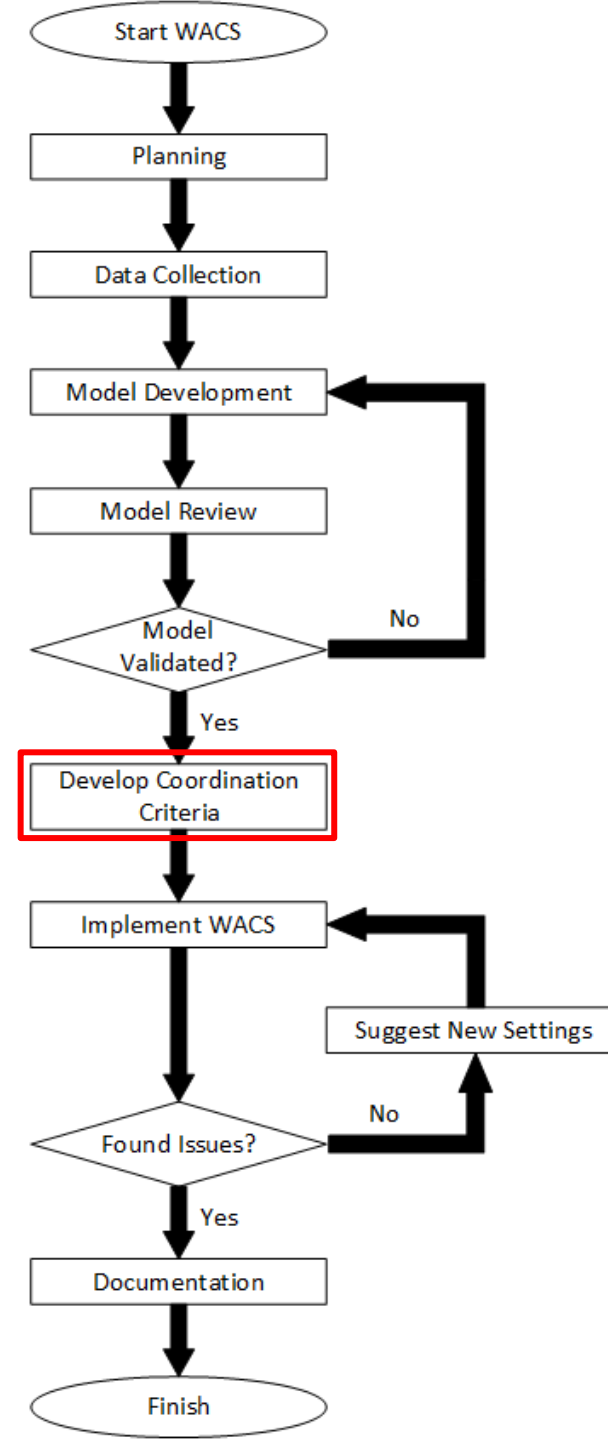




# Wide Area Coordination Study

## Coordination Criteria

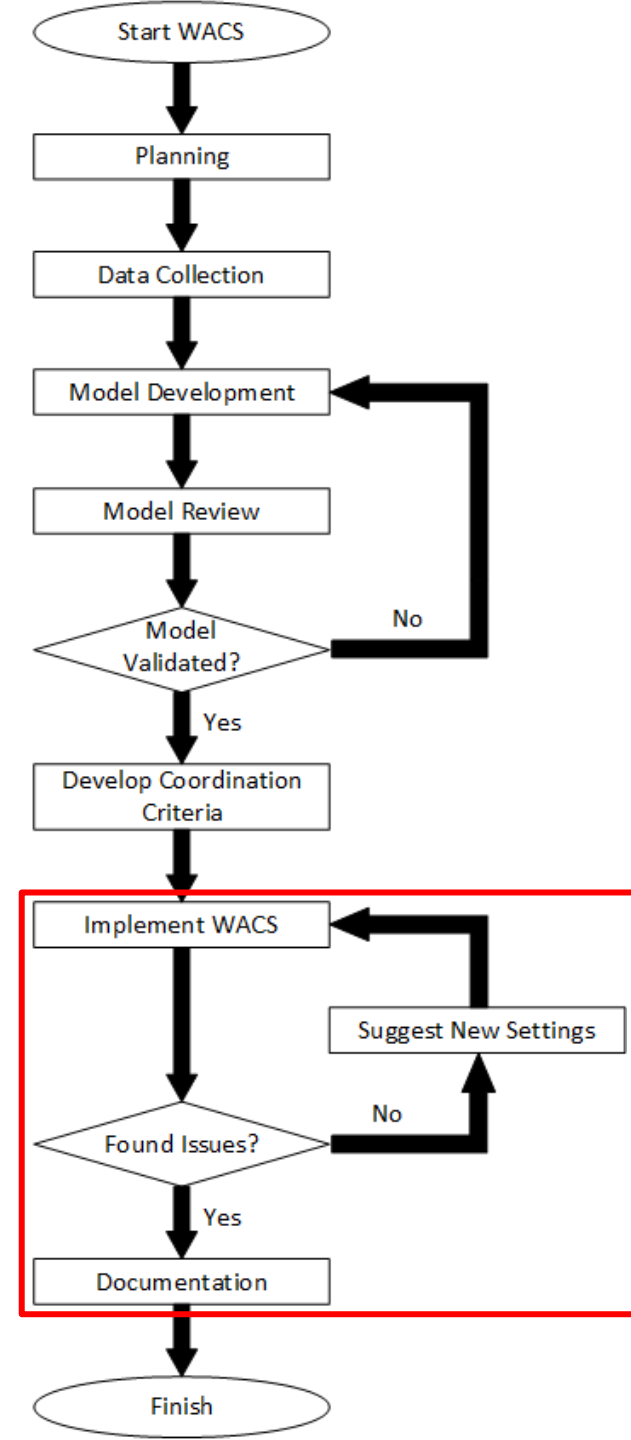
- System scenarios
  - N-1, N-2 contingencies
  - Level of generation
- System configurations that affect flow of current
  - Tie-breaker conditions
  - Series compensation devices
- Categorization of violations
  - High/Medium/Low risk violations



# Wide Area Coordination Study

## Coordination Study Implementation and Documentation

- Coordination study process
  - Distance reaches
  - Distance CTI
  - Time overcurrent CTI
- Prioritize
  - High, Medium and Low risk violations
- Documentation
  - Coordination criteria, Assumptions, Study results
  - Separate reports for Interconnecting utilities



# Wide Area Coordination Study

## Challenges and Mitigative Measures

- Model Validation
  - Updating SC model periodically
  - Maintaining database
- Miscoordination of Zone 2 elements
  - Standardized protection philosophy
  - Settings Templates



# Wide Area Coordination Study

## Challenges and Mitigative Measures

- Miscoordination of Time overcurrent elements
  - Closed loops
    - Use of automation tools
  - Radial lines
    - Security over speed
    - Prioritized coordination



# Wide Area Coordination Study

## Additional Takeaways

- Automation tools
  - Model validation
  - Reach verification
  - CTI evaluation
- Customized coordination criteria
- Overcurrent elements to consider by GO
  - Negative sequence (46)
  - Stator ground fault (64G)
  - Unbalance (60)





# Questions?

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