TAG Meeting
October 26, 2020

Webinar

TAG Meeting Agenda

1. **Administrative Items – Rich Wodyka**
2. **2020 Study Activities Update – Orvane Piper, Lee Adams and Bill Quaintance**
3. **Regional Studies Update – Bob Pierce**
4. **2020 TAG Work Plan – Rich Wodyka**
5. **TAG Open Forum – Rich Wodyka**

2020 Study Activities Update

Orvane Piper - Duke Energy Carolinas
Lee Adams - Duke Energy Progress
Bill Quaintance - Duke Energy Progress

Study Process Steps

Completed

1. Assumptions Selected
2. Study Criteria Established
3. Study Methodologies Selected
4. Models and Cases Developed
5. Technical Analysis Performed
6. Problems Identified and Solutions Developed
7. Collaborative Plan Projects Selected
8. Study Report Prepared

Problems Identified and Solutions Developed

- Identify limitations and develop potential alternative solutions for further testing and evaluation
- Estimate project costs and schedule

Annual Reliability Studies

- 2025 Summer
- 2025/2026 Winter
- 2030 Summer

New Projects in 2020 Plan

Reliability Project	TO	I/S Date
South Point Switching Station	DEC	December 1, 2024

New Projects in 2020 Plan (continued)		
Reliability Project	**TO**	**Planned I/S Date**
Wateree 115 kV Plant, Upgrade 115/100 kV Transformers	DEP	December 2022
Carthage 230/115 kV Substation, Construct sub and loop-in Cape Fear-West End 230kV line and West End-Southern Pines 115 kV Feeder	DEP	December 2027
Cary Regency Park 230 kV Sub, Add 300 MVAR Static Var Compensator	DEP	December 2027

New Projects in 2020 Plan (continued)		
Reliability Project	**TO**	**Planned I/S Date**
Falls 230 kV Sub, Add 300 MVAR Static Var Compensator	DEP	December 2028
Castle Hayne-Folkstone115kV line, rebuild 556 MCM and 6-(2/0) Cu sections to 1272 ACSR	DEP	December 2028
Holly Ridge North 115kV SS, construct station, loop in CH-FS-115 and FS-JC-115, and build 0.5 mile 115kV feeder to JO EMC Folkstone POD	DEP	December 2028

Offshore Wind Study Update

- Preliminary Screening of 29 possible injection sites in eastern NC and 2 in VA
- Will review preliminary screening with sponsors before choosing 3 sites for more detailed analysis

High Load Scenario Update

- **Assess the rapid load growth in 2025S / 2030S for the Union / Cabarrus County load area:**
  - **Clear Creek 100 kV Line**
    - **Engage Union PC through NERC Reliability Standard TPL-001, Footnote 12 process**
    - **Transmission alternative to Footnote 12 usage is ≈ $20 M upgrade (9.1 miles)**
    - **Reduce projected loading at Union PC Del 16 by not swapping load from Union PC Del 14**
  - **Rocky River 100 kV Line**
    - **8.5 mile section of line**
    - **DEC evaluating a broader solution for local area issues**

TAG Input Request

- **TAG is requested to provide any feedback and/or propose alternative solutions to the OSC on the 2020 Preliminary Study Results.**
- **Provide input by November 5th to Rich Wodyka (rawodyka@aol.com)**

Collaborative Plan Projects Selected

- Compare all alternatives and select preferred solutions

Study Report Prepared

- Prepare draft report and distribute to TAG for review and comment

Questions ?

Regional Studies Reports

Bob Pierce

Duke Energy Carolinas

SERC Long Term Working Group Update

SERC Long Term Working Group

- Completed work on 2020 series MMWG cases

- Completing study of 2025S and preparing report

SERTP

SERTP

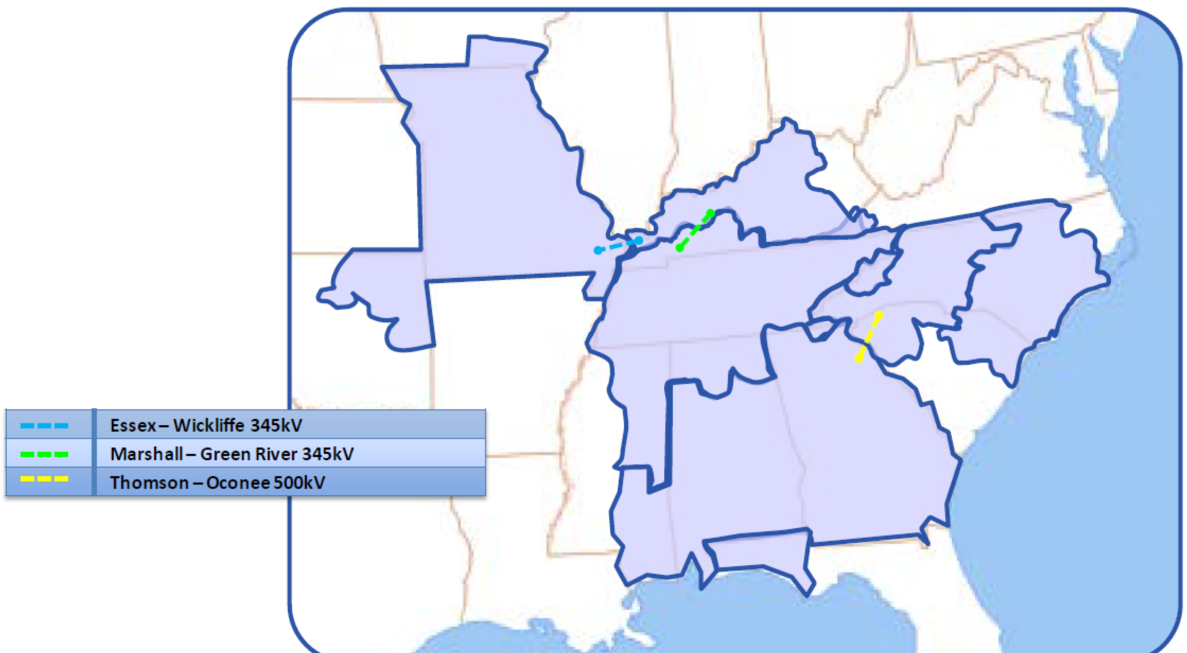
- 3rd Quarter Meeting held on September 10th
- 4th Quarter Meeting will be December 3rd
- 2020 Economic Planning Studies did not impact DEC or DEP

SERTP

Southeastern Regional
TRANSMISSION PLANNING

2020 Regional Transmission Analyses

Preliminary List of Alternative Regional Transmission Projects



http://www.southeasternrtp.com/

NERC
NORTH AMERICAN ELECTRIC RELIABILITY CORPORATION

Lesson Learned

Single Phase Fault Precipitates Loss of Generation and Load

Primary Interest Groups

Transmission Operators (TOPs)
Generation Operators (GOPs)
Balancing Authorities (BAs)
Reliability Coordinators (RCs)

Problem Statement

A single phase to ground fault on a 400 kV transmission line in Southern England precipitated the loss of 1,878 MW of generation. This led to a frequency decline that resulted in a loss of 931 MW of load.[1] This European event has lessons applicable in North America.

EVENT DETAILS

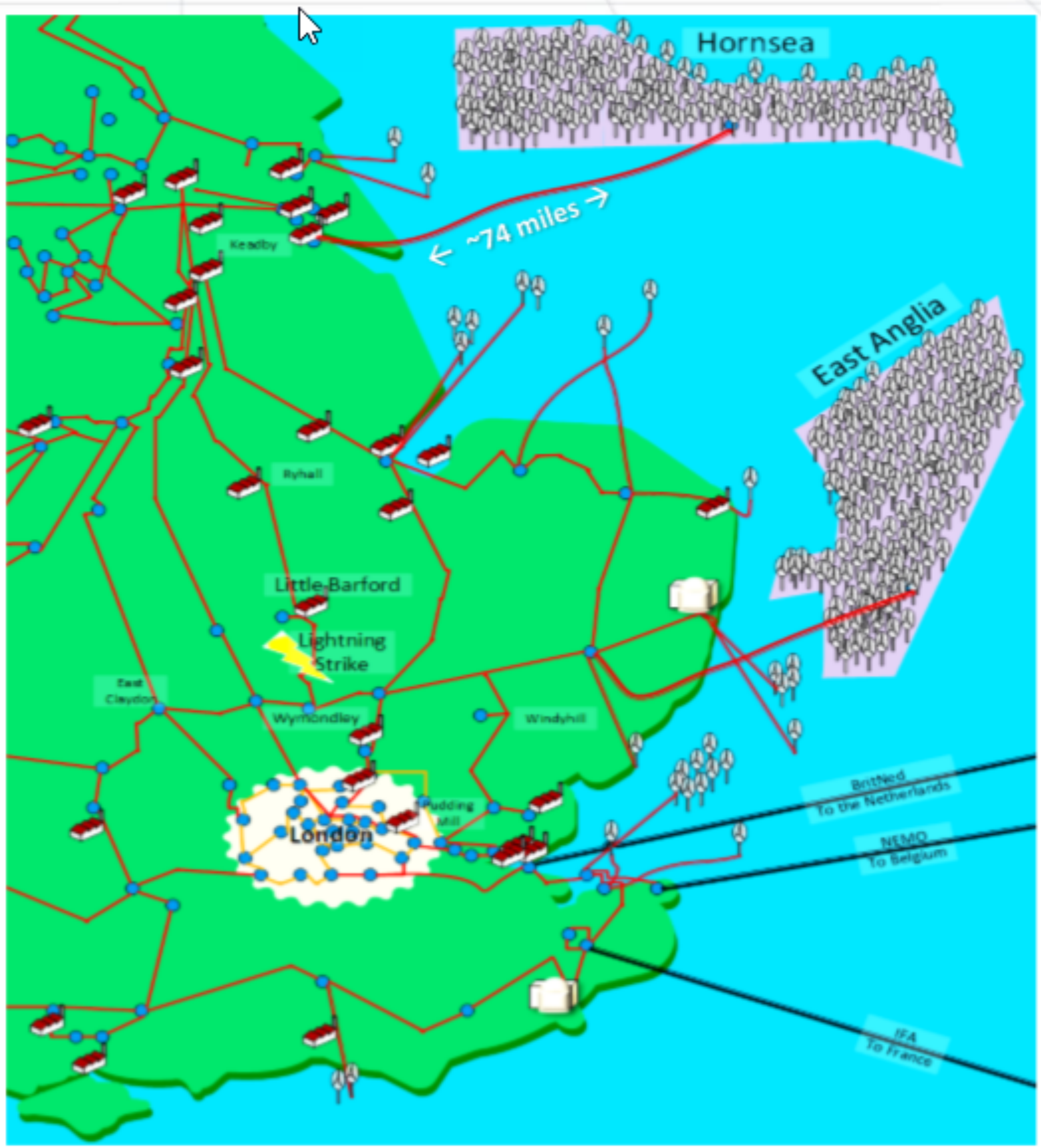


Figure 1: Simplified Transmission Map for SE Britain

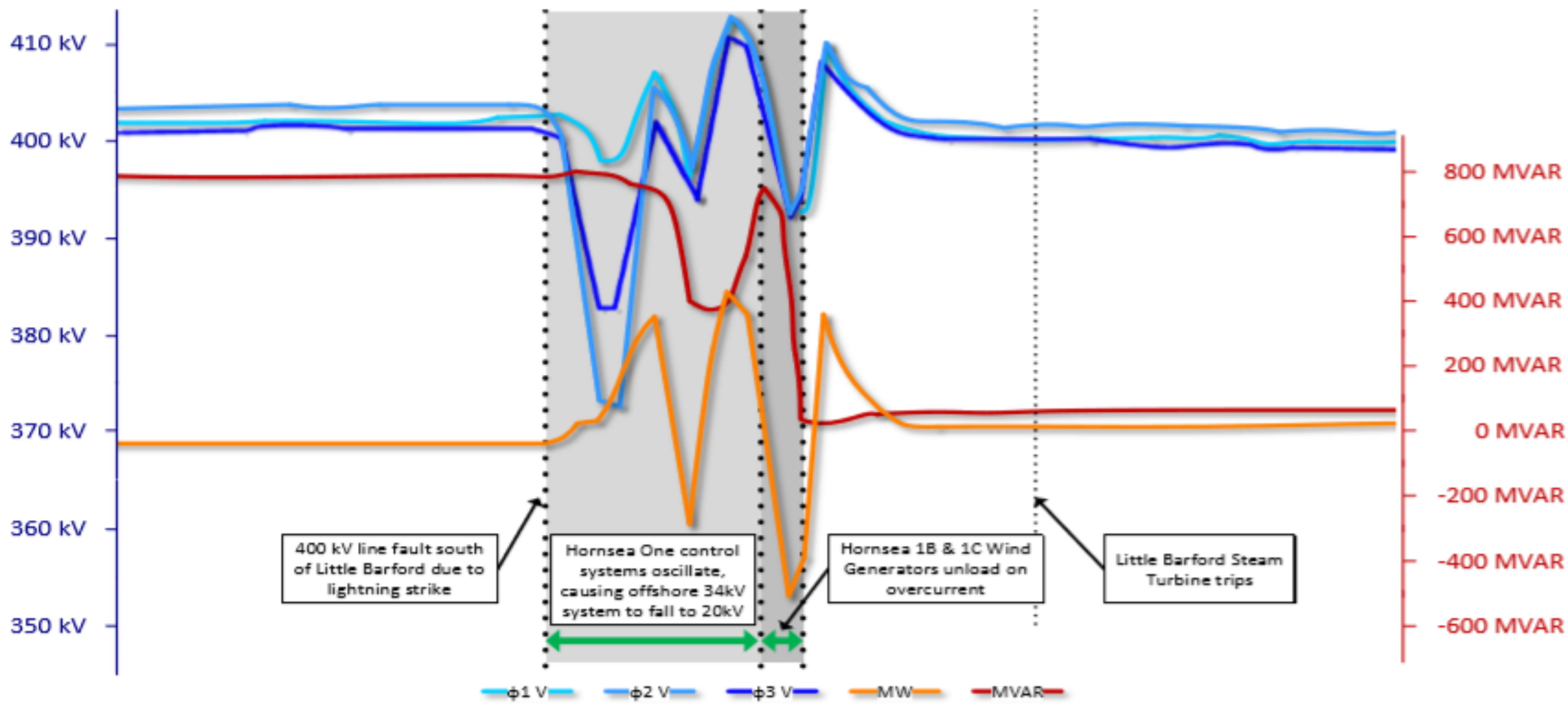


Figure 2: Parameters Measured at Hornsea Onshore Station – MW and MVAR

System voltages did not exceed the ride-through requirement. Figure 5 shows single phase voltage profiles at various locations.

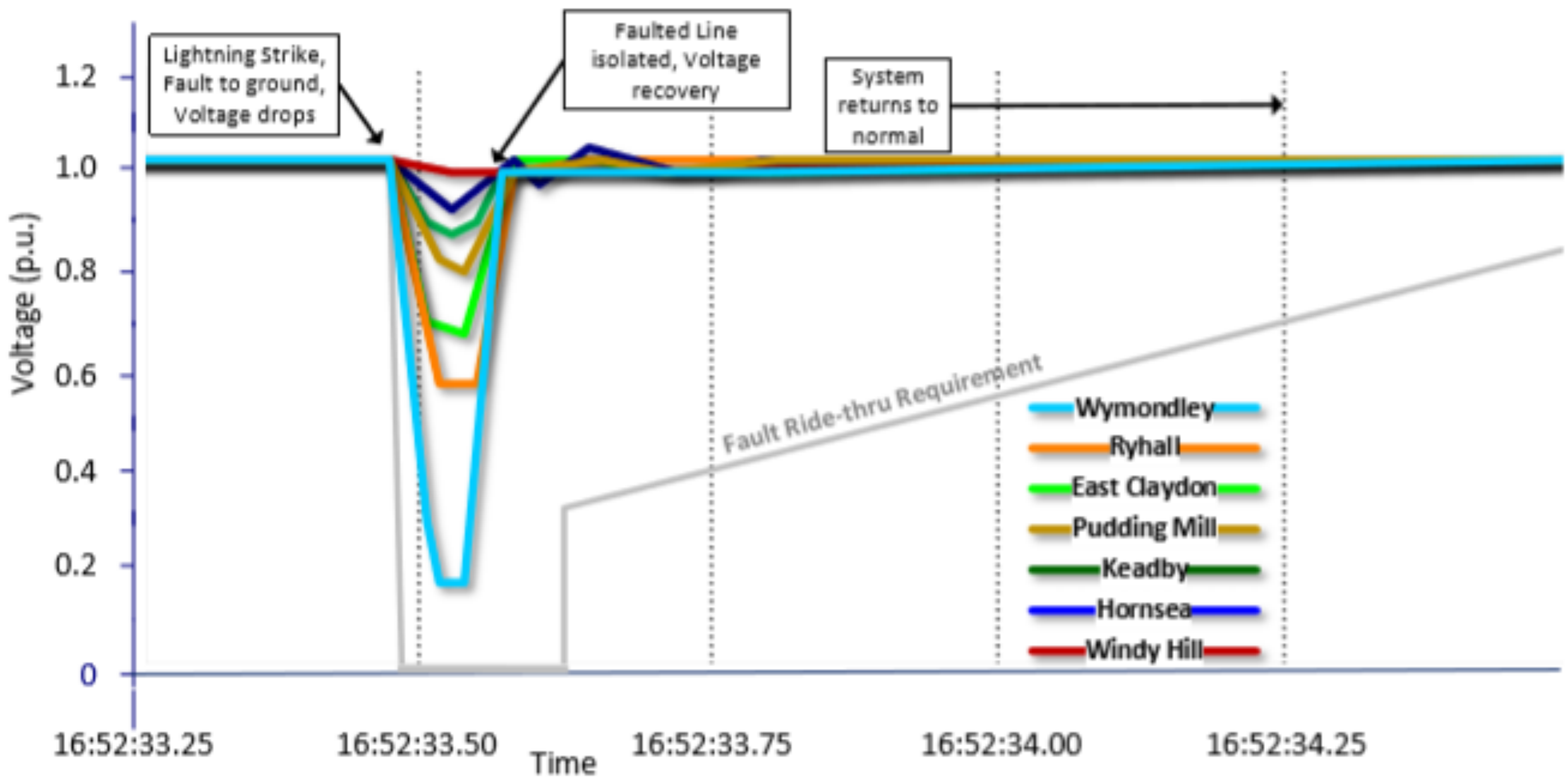


Figure 5: Voltage (p.u.) Profile at Various Locations During the Event

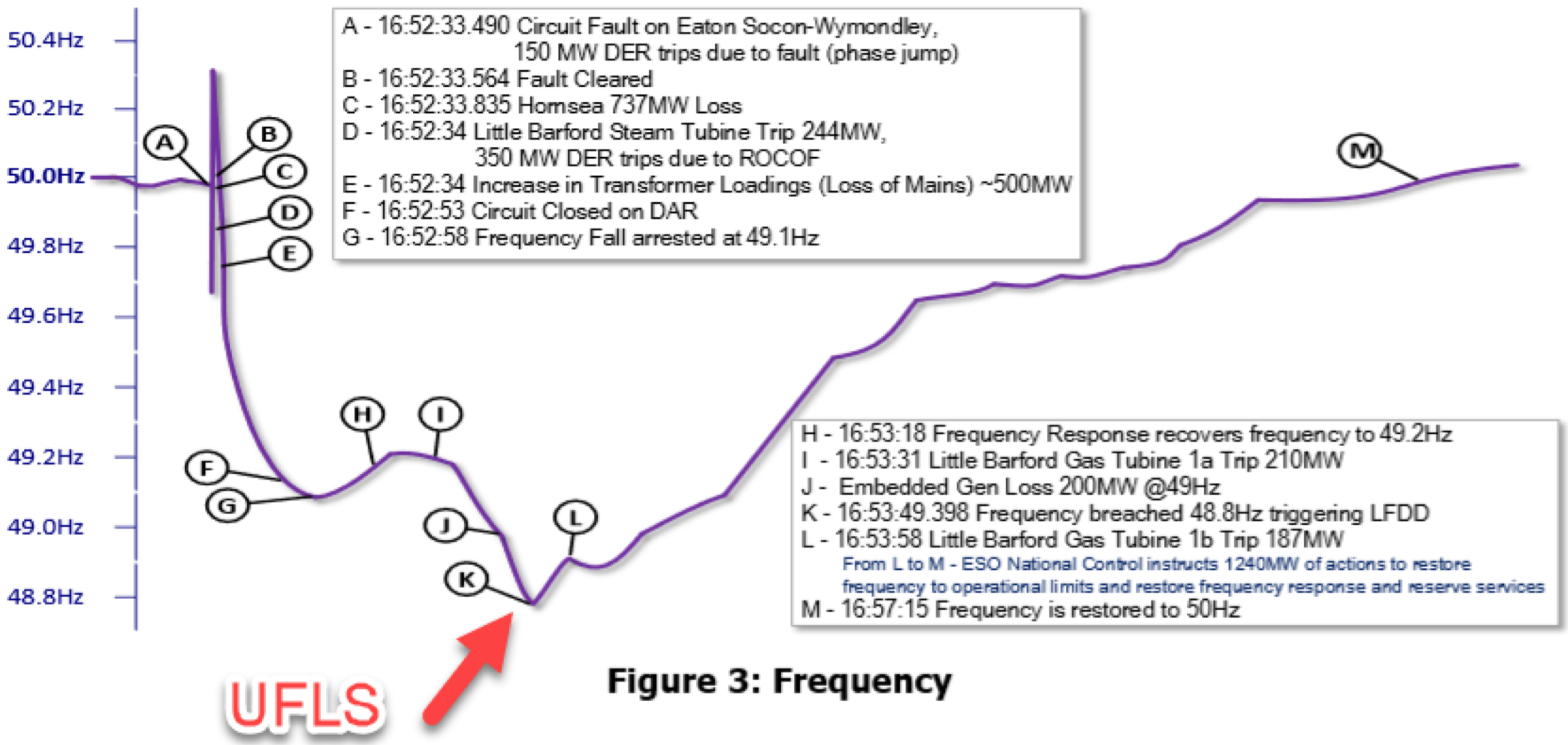


Figure 3: Frequency

LESSONS LEARNED

There were limitations in the entity's knowledge of Hornsea 1's control system and the interaction between its onshore and offshore arrangements (See Figure 4). This impaired the understanding of Hornsea 1's performance during this event. The wind farm's onshore control system operated as expected when the system voltage dipped concurrently with the lightning strike. The offshore wind turbine controllers, however, reacted incorrectly to voltage fluctuations on the offshore network following the fault. This caused an instability between the onshore control system and the individual wind turbines. The instability triggered two modules to automatically shut down. In investigating the issues internally, the wind farm's developer identified that Hornsea 1's systems identified a "weak grid" condition at the time in question. The wind farm's developer identified the disturbance that resulted in the unloading was caused by an unexpected control system response due to an insufficiently damped electrical resonance in the sub-synchronous frequency range that was triggered by the event.

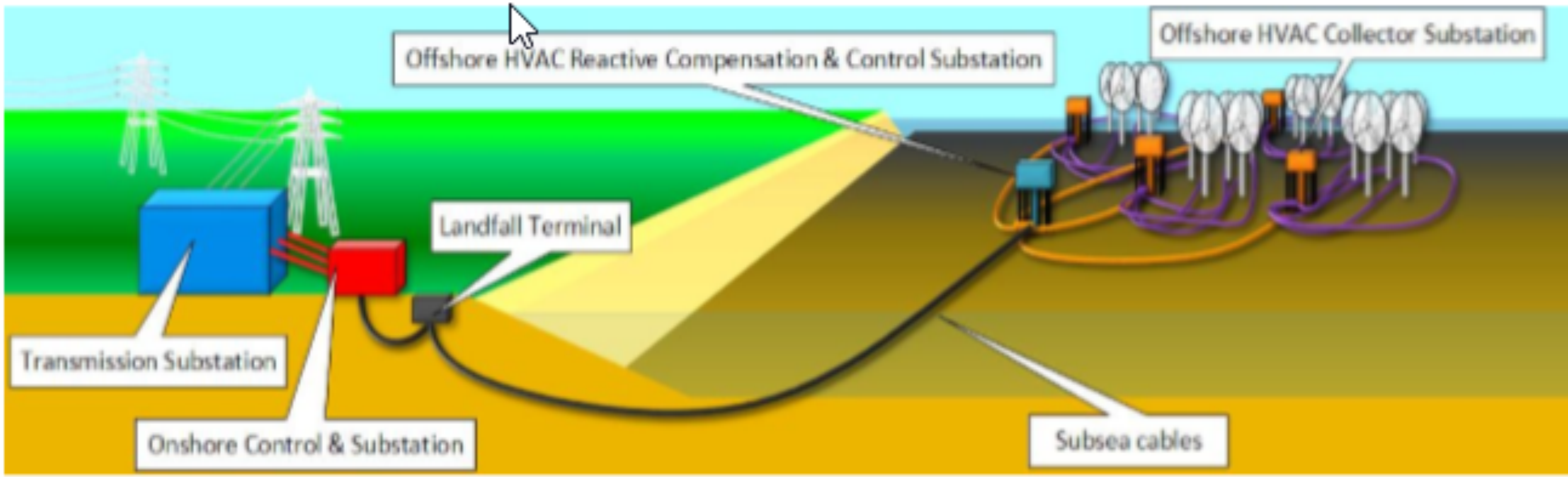


Figure 4: Typical Offshore Wind Farm Arrangement

At the time of the event, there were a number of transmission facility outages. Transmission facility outages (and less synchronous generator dispatch) reduces short circuit strength and contributes to creating a “weak grid” condition. The power electronics that inverter-based resources use require a minimum short circuit strength relative to their capability, often referred to as the “short circuit ratio,” for stable operation. These outages contributed to the “weak grid” condition that Hornsea 1’s systems identified and resultant unloading.

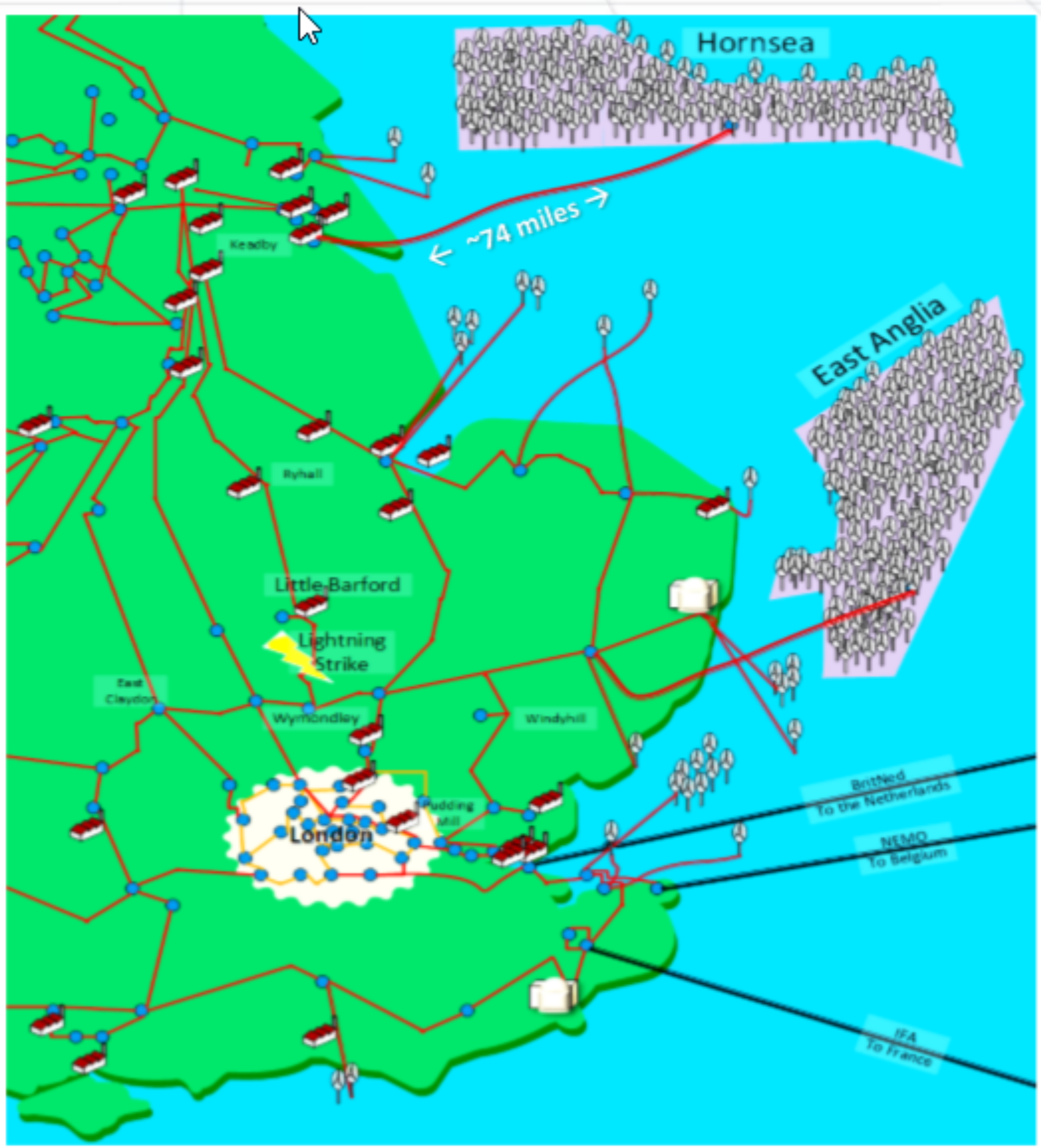


Figure 1: Simplified Transmission Map for SE Britain

This event has also underlined the importance of understanding the reliability impacts associated with the rapidly changing portfolio of resources and their increasingly complex controls. The ability to predict resource responses to network faults are fundamental to the security and resilience of the power system.

There are a number of lessons learned related to this, summarized as follows:

- There was significant reliance on self-certification of the models for the resources, including the interconnection of new resources, following modification to existing resources, and DERs. Enhanced compliance testing or verifications may have improved these models. Evaluate if more frequent review of the adequacy of modeling procedures is appropriate and identify any deficiencies.

- Interactions between onshore and offshore wind generation control systems need to be understood and coordinated to prevent adverse results. Limited understanding resulted in instability between Hornsea 1's onshore control system and the individual wind turbines and automatically control system shut down.

- Transmission facility outages (and less synchronous generator dispatch) reduces short circuit strength and contributes to creating a "weak grid" condition. The power electronics that inverter based resources use require a minimum short-circuit strength relative to their capability, often referred to as "short circuit ratio," for stable operation. These outages contributed to the "weak grid" condition that Hornsea 1's systems identified and resultant unexpected power reduction. These stability issues and their correlation to transmission system outages should be assessed.

- Evaluate if the coordination and communication between the TP, GO, TO, RC, and equipment manufacturers are sufficient to accurately model and understand the connected resources and their expected response under stressed or "weak grid" conditions.

- Evaluate if the tools, techniques and simulation approaches in the planning and operations horizons are adequate, especially in weak grid systems with higher penetration of inverter-based resources. Consider weak grid conditions that can dynamically occur due to changes in transmission topology, synchronous generator dispatch, and outages of inverter-based resources key components. This may include short circuit ratio screening technique development and the use of advanced electromagnetic transient applications. Reference the recommendations from the NERC Integrating Inverter-Based Resources into Low Short Circuit Strength Systems Reliability Guideline.

This event highlights the impact distributed generation (**DG**) outages can have on the bulk power system (**BPS**). Even though the loss of individual DG may have no impact on the BPS, the trip of multiple DGs may aggregate to a significant loss of generation which can impact the frequency of BPS.

- The UK system was operated under the assumption of certain amount of DG tripping for transmission faults; however, the amount of DG that was lost or could have been lost was more than anticipated, resulting in frequency decline.

- The majority of DG tripped due to ROCOF and vector shift protection settings. The ROCOF at which the DG tripped was well within the ride-through requirements for DERs specified in IEEE-1547-2018. The vector shift setting of 6 degrees was conservative compared to the recommended 20 degrees in IEEE-1547-2018. It seems that the setting of some DGs were not modified per the distribution code requirements in the UK. It is recommended that distribution operators ensure that DG settings are compliant with IEEE-1547-2018 to avoid unnecessary DG loss during a transmission fault.

- It appears that there were no robust processes to analyze the impact of the loss of DG in a transmission system as credible contingencies. Gathering data on distribution-connected generation and incorporating it in a real-time transmission system analysis is not a common practice in North America either, but some entities have mechanisms in place to forecast distributed resources with publicly available data and weather forecasts in real-time. The forecast values are then incorporated in real-time systems for operator awareness; however, analyzing for the loss of a significant amount of DG as a contingency is not prevalent. The amount of DG is growing rapidly and its loss can put significant strain on transmission.

Questions ?

2020 TAG Work Plan

Rich Wodyka
Administrator

2020 NCTPC Overview Schedule

Reliability Planning Process

- Evaluate current reliability problems and transmission upgrade plans
- Perform analysis, identify problems, and develop solutions
- Review Reliability Study Results

Local Economic Planning Process

- Propose and select Local Economic Studies and Public Policy Study scenarios
- Perform analysis, identify problems, and develop solutions
- Review Local Economic Study and Public Policy Results

Coordinated Plan Development

- Combine Reliability and Local Economic Study and Public Policy Results
- OSC publishes DRAFT Plan
- TAG review and comment

TAG Meetings

1st Quarter | 2nd Quarter | 3rd Quarter | 4th Quarter

January - February – March

- **2020 Study – Finalize Study Scope of Work**
  - ✓ **Receive request from OSC to provide input on proposed Local Economic Study scenarios and interfaces for study**
    - *TAG provide input to the OSC on proposed Local Economic Study scenarios and interfaces for study – No TAG requests received*
  - ✓ **Receive request from OSC to provide input in identifying any public policies that are driving the need for local transmission**
    - *TAG provide input to the OSC in identifying any public policies that are driving the need for local transmission for study - Request from Southeastern Wind Coalition received*
  - ✓ **Receive final 2020 Reliability Study Scope for comment**
    - *TAG review and provide comments to the OSC on the final 2020 Study Scope*

January - February – March

First Quarter TAG Meeting – March 23rd

- **2020 Study Update**
  - ✓ **Receive a report on the Local Economic Study scope and any Public Policy scenarios that are driving the need for local transmission for study**
  - ✓ **Receive a progress report on the Reliability Planning study activities and the final draft of the 2020 Study Scope**

April - May – June

<u>Second Quarter TAG Meeting – June 22nd</u>

- **2020 Study Update**
  - ✓ **Receive a progress report on study activities**
  - ✓ **Receive update status of the upgrades in the 2019 Collaborative Plan**

July - August – September

Third Quarter TAG Meeting – October 26th

- **2020 Study Update**
  - ✓ **Receive a progress report on the study activities and preliminary results**
  - ✓ **TAG is requested to provide feedback to the OSC on the technical analysis performed, the problems identified as well as proposing alternative solutions to the problems identified - Provide feedback by November 5th to Rich Wodyka (rawodyka@aol.com)**

October - November - December

Fourth Quarter TAG Meeting – December 15th

- **2020 Selection of Solutions**
  - **TAG will receive feedback from the OSC on any alternative solutions that were proposed by TAG members**
- **2020 Study Update**
  - **Receive and discuss final draft of the 2020 Collaborative Transmission Plan Report**
  - **Discuss potential study scope for 2021 studies**

Questions ?

TAG
Open Forum Discussion

Comments or Questions ?