

# Industry Recommendation

## 6 GHz Communication Penetration in the Electric Industry

Initial Distribution: April 23, 2024

The Federal Communications Commission opened usage of the 6 GHz spectrum to new, unlicensed users to promote spectrum sharing in April 2020. This report and order represented a partial opening of the 6 GHz band of radio spectrum to unlicensed users. Sharing this spectrum will likely impact the energy industry—specifically critical infrastructure—and the reliable operation of the bulk power system (BPS). At the same time, the FCC also published a further notice of proposed rulemaking that would represent additional spectrum sharing that could increase the possibility for potential harmful interference.

At this time, NERC is not aware of any known or existing impacts to BPS reliability or supporting systems related to 6 GHz communication interference. However, the partial opening of the radio spectrum to unlicensed users creates an emerging risk. The purpose of this Alert is to determine an initial extent of condition in assessing the depth of reliance on 6 GHz communications technology and the potential severity of interference.

For more information, see the NERC Task Force web page<sup>1</sup> for additional information. All recipients are strongly encouraged to read the *6 GHz Microwave Link Interference Preparedness*<sup>2</sup> report approved by the Reliability and Security Technical Committee on December 6, 2023. NERC encourages registered entities to report any suspected 6 GHz communication interference to this email: [6GHZ@nerc.net](mailto:6GHZ@nerc.net).

[Why am I receiving this? >>](#)

[About NERC Alerts >>](#)

**Status:** Acknowledgement Required<sup>3</sup> by Midnight Eastern on April 30, 2024  
Reporting Required by Midnight Eastern on July 8, 2024



**PUBLIC:** No Restrictions

[More on handling >>](#)

**Instructions:** This Level 2 Industry Recommendation provides specific actions that registered entities should consider for responding to a particular issue. Pursuant to Rule 810 of NERC's Rules of Procedure (ROP), NERC registered entities shall 1) acknowledge receipt of this Industry Recommendation within the NERC Alert System, and 2) report to NERC on the status of their activities in relation to this recommendation as provided below. For U.S. entities, NERC will compile the

<sup>1</sup> <https://www.nerc.com/comm/RSTC/Pages/6GHTZF.aspx>

<sup>2</sup> <https://www.nerc.com/comm/RSTC/6GHTZF/6GHz%20Microwave%20Link%20Interference%20Preparedness%20White%20Paper.pdf>

<sup>3</sup> To the extent that Canadian jurisdictions have implemented laws or requirements that vary from Section 810 of the ROP, NERC requests entities in such jurisdictions voluntarily participate in response to this Alert.

responses and report the results to the Federal Energy Regulatory Commission (FERC).

This recommendation is not the same as a Reliability Standard and your organization will not be subject to penalties for a failure to implement. Issuance of this recommendation does not replace or modify the requirements of any approved Reliability Standard or excuse the prior failure to follow the practices discussed in the recommendation if such failure constitutes a violation of a Reliability Standard.

**Distribution:** Distribution Provider (DP), Distribution Provider UFLS-Only (DP-UFLS), Generator Owner (GO), Transmission Owner (TO)

[Who else will get this alert? >>](#)

**Primary Interest Groups:** Physical Security, Cyber Security - Control Systems, Cyber Security - Corporate IT, System Operators – System Protection, System Operations - Transmission Engineering, Generation Engineering, Generation Operations.

## Background

### Data-Acquisition-Only Systems

Some entities may use 6 GHz as the communication medium for power-quality meters, audio tone sets, security etc., associated with Elements. If applicable, include this type of 6 GHz use in questions 2 and 7.

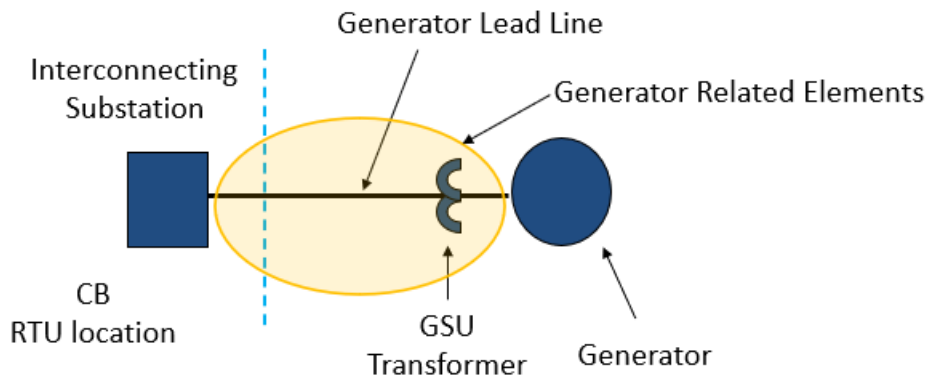
### Generator Related Elements

- The relay protection schemes, remedial action schemes (RAS), and monitoring and control for the generator may use 6 GHz as a communication medium. The generator step-up (GSU) transformer, the applicable lead line and the applicable interconnecting line may also use 6 GHz for the same purposes.
- The lead line is the transmission line that connects the GSU transformer to the output breaker and the interconnecting line connects the output breaker to the grid.
- For this alert, any generator related Element (lines and transformers), if out of service, could impact the availability of the generator and is considered a generator-related Element.

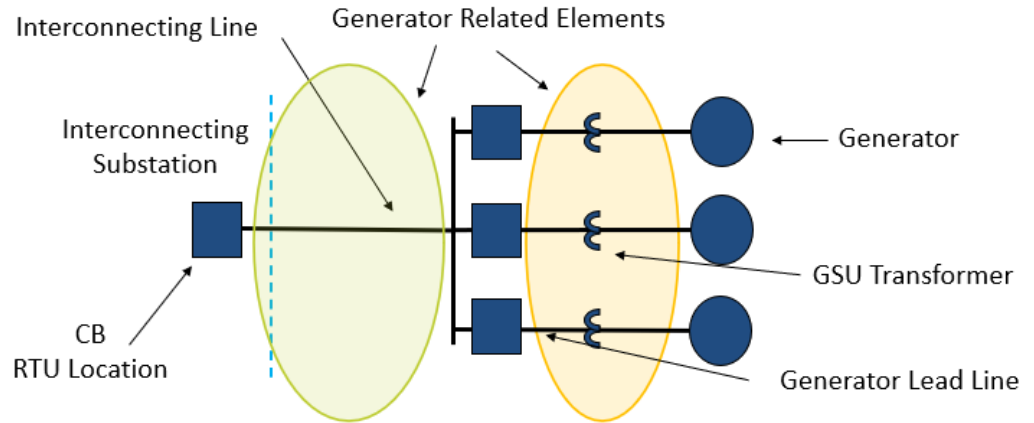
### Figure and Table Description

- **Figure 1** depicts a single generator with a step-up transformer, and a lead line connecting the generator to the output breaker. The output breaker is at the interconnecting substation. Regardless of the length of the lead line, the function remains the same. All components between the generator and the output breaker are collectively considered generator-related Elements; the ownership of the Elements may vary among the entities.

- **Figure 2** depicts multiple generators, each with its own step-up transformer and own output breaker. The set of generator output breakers connects through a single line to the interconnecting substation. As with **Figure 1**, the lines and transformers between the generators and interconnecting substation are considered generator-related Elements; the ownership of the Elements may vary among the entities.
- **Table 1** combines function, entity type (GO, TO, GO/TO) and how to answer questions 3 and 4.
- **Figure 3** is an example that highlights one possible combination of Element ownership and **Table 1** is designed to help assist with answering the questions. Assume company G is registered as a GO and company T is registered as a TO. Company G has 3 generators and owns 2 of the GSUs and 2 of the lead lines. Company T owns the remaining GSU and lead line as well as 4 lines not associated with generation (only 1 non-generation related line shown in Figure 3). Company G would follow line 2 of **Table 1** and report 7 (3 generators, 2 GSUs, and 2 generator lead lines). All items, for Company G, would be reported in question 3. Company T would follow line 3 of **Table 1** and report 2 (1 GSU and 1 generator lead line) in question 3 and 4 (non-generator-related transmission lines) in question 4.

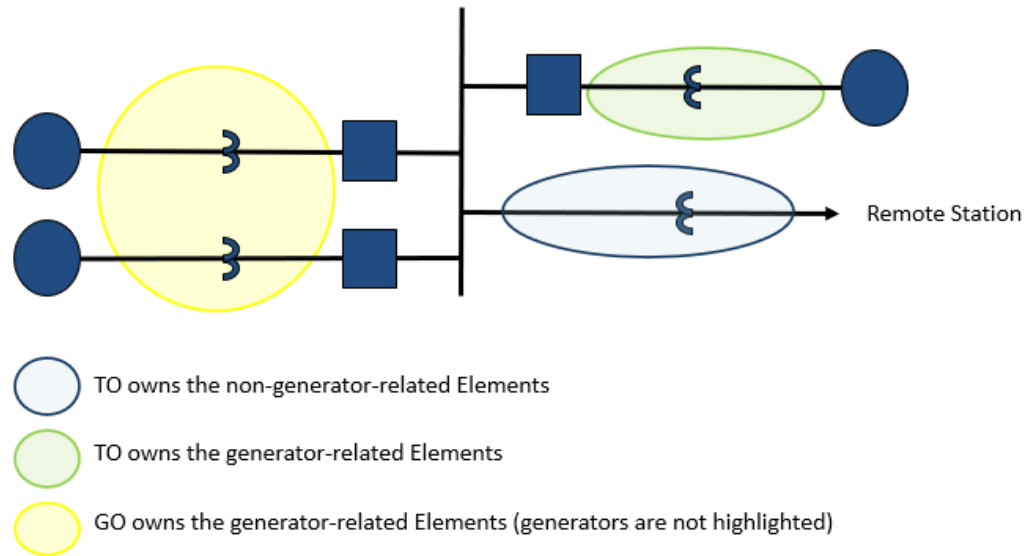


**Figure 1: Generator Lead Line**



**Figure 2: Generator Related Elements**

Table 1: GO and TO Functions		
NCR Function	Generator-Related Elements (Question 3)	Non-Generator-Related Elements (Question 4)
(1) GO – generators only, does not own the GSU transformers, and/or interconnecting transmission lines	Inventory of generators reported here	N/A
(2) GO – owns generators and all equipment up to the interconnecting points	Inventory of generators and related Elements reported here	N/A
(3) TO – owns the GSU transformers, the interconnecting lines as well as other non-generator-related Elements	Inventory of generator-related Elements reported here	Inventory of non-generator-related Elements reported here
(4) GO/TO – owns generators, GSU transformers, the interconnecting lines as well as non-generator-related Elements	Inventory of generators and generator-related Elements reported here	Inventory of non-generator-related Elements reported here



**Figure 3: Generator Related Element Ownership Example**

**Recommendation:** NERC registered entities belonging to the DP, DP-UFLS, GO and TO functional groups are strongly encouraged to review and adopt the following recommendations as applicable:

**Recommendation 1:** Entities should identify and record critical 6 GHz microwave circuits (individual company view) and be cognizant of the origination and destination of each circuit. If the circuit(s) traverse multiple microwave hops or links, there will be multiple points of possible interference.

The definition of ‘critical 6 GHz circuit’ is for the entity to decide. Here are two examples to assist in this classification. If a substation is staffed, due to loss of (6 GHz) monitoring and control capability, then that could be considered a ‘critical’ 6 GHz circuit. Additionally, if an Element is removed from service, due to loss of (6 GHz) communication-assisted relay function, then that 6 GHz circuit could also be considered critical.

**Recommendation 2:** Each entity should perform baseline performance tests on all of its microwave radios and record the test results. Test results will prove invaluable when assessing problems and possible interference issues. Utilities should perform the following actions:

- Verify that radio configuration parameters are set to deliver payloads as expected (e.g., modulation, adaptive modulation, automatic transmit power control, quality of service, and matching operating system software revisions).

- Verify that transmitter power is within specified limits of licensed Effective Isotropic Radiated Power (EIRP).
- Verify that the receiving signal level is within specified limits of path design.
- Record errors accumulated over a specified period with the radio network management system (24 hours, 48 hours, and 72 hours, etc.).
- Select or configure a test circuit to perform various payload tests during a specified period.
- Verify the link's fade margin.
- Perform an out-of-service test that requires the reduction of far-end transmitter power, then measure the receiver threshold on the near-end. The entity should periodically correct any issues found for each circuit. There are tools that will do this automatically in the background (e.g., FAS Interference Monitoring, and Aviat Networks).<sup>4</sup>

**Recommendation 3:** Consider monitoring of design vs. actual performance on critical circuits for planning and proactive mitigation options where possible (when high amounts of unlicensed 6 GHz activity are expected such as concert venues and sporting events).

**Reporting Instructions:**

The questions below seek data pursuant to Section 800 of the ROP to support NERC's evaluation of actions taken in response to this alert and of risks to reliability presented by the identified issues.<sup>5</sup>

A valid response in the NERC Alert System consists of the following three steps by the submitting entity:

1. Acknowledgement of Alert
2. Submission of Response
3. Approval of Response

The NERC Alert System contains menu options for each of the above commands that are available to authorized individuals upon login. **A response will not be considered valid until all three steps have been completed.**

<sup>4</sup> [Frequency Assurance Software - Aviat Networks](#)

<sup>5</sup> See, Section 810 of the ROP stating, "Members of NERC and Bulk Power System owners, operators, and users shall provide NERC with detailed and timely operating experience information and data."; see also, Section 804 of the ROP stating, "To carry out the reviews and assessments of the overall reliability of the interconnected Bulk Power Systems, the Regional Entities and other entities shall provide sufficient data and other information requested by NERC in support of the annual long-term and seasonal assessments and any special reliability assessments."

Refer to the Background section for the definition of generator-related Elements when responding to questions 3 and 4. Also, refer to the Background section for data-acquisition-only definition when responding to questions 2 and 6.

**All registered entities covered by this Recommendation are required to provide an approved response to Question (1), and answer all subsequent questions if the response to Question (1) was “A”:**

- 1. Does your entity use 6 GHz as a communication medium including, but not limited to, voice, Supervisory Control and Data Acquisition (SCADA) (monitoring and control), data-acquisition-only, communication-assisted relay protection, communication-assisted RAS, security, and/or automatic load shedding (underfrequency load shedding, undervoltage load shedding UFLS/UVLS) in support of the reliable operation of the BPS?**
  - A. Yes, we use 6 GHz equipment to support the reliable operation of the BPS
  - B. No, we do not use 6 GHz equipment to support the reliable operation of the BPS
  - C. Our BPS-related communication services are provided by a third party, and we do not know whether 6 GHz is being used to support the reliable operation of the BPS

***Entities that responded “A” to the above question (1) are required to answer ALL remaining questions.***

***Entities that responded “B” or “C” to the above question (1) are NOT required to answer any additional questions – the response must still be approved as per the Reporting Instructions***

- 2. If your entity uses 6 GHz as a communication medium including, but not limited to, voice, Supervisory Control and Data Acquisition (SCADA) (monitoring and control), data-acquisition-only, communication-assisted relay protection, communication-assisted RAS, security, and/or UFLS/UVLS, in support of the reliable operation of the BPS, how many links are used?**
  - A. Less than 50 microwave links
  - B. Between 50 and 100 microwave links
  - C. More than 100 microwave links
- 3. How many generator-related Elements does your entity own that support of the reliable operation of the BPS? The applicable generator-**

related Elements are generators, GSU transformers and, if applicable, the generator lead and/or interconnecting line. The lead line is the transmission line between the GSU transformer and the generator output breaker(s). The interconnecting line, if applicable, is between the output breaker and the grid.

- A. We own no more than 50 generator-related applicable Elements
  - B. We own between 50 and 100 generator-related applicable Elements
  - C. We own between 100 and 150 generator-related applicable Elements
  - D. We own between 150 and 200 generator-related applicable Elements
  - E. We own more than 200 generator-related applicable Elements
  - F. We do not own any generator-related applicable Elements
- 4. How many *non-generator-related* Elements does your entity own? The applicable Elements are transformers and transmission lines protected by a transmission Protection System. This question *excludes* the generator-related Elements as they are accounted for in question 3.**
- A. We own no more than 50 non-generator-related Elements (lines and transformers) protected by a transmission Protection System
  - B. We own between 50 and 100 non-generator-related Elements (lines and transformers) protected by a transmission Protection System
  - C. We own between 100 and 150 non-generator-related Elements (lines and transformers) protected by a transmission Protection System
  - D. We own between 150 and 200 non-generator-related (lines and transformers) protected by a transmission Protection System
  - E. We own more than 200 non-generator-related Elements (lines and transformers) protected by a transmission Protection System
  - F. We do not own any non-generator-related Elements (lines and transformers) protected by a transmission Protection System
- 5. Does your entity use 6 GHz as a means of voice communication related to the reliable operation of the BPS?**
- A. Yes, we use 6 GHz as a means of voice communication-related to the reliable operation of the BPS



- B. No, 6 GHz is not used as a means of voice communication-related to the reliable operation of the BPS
  - C. Our voice communication services that support the reliable operation of the BPS are provided by a third party, and we do not know whether 6 GHz is being used
- 6. Does your entity use 6 GHz for security related to the reliable operation of the BPS?**
- A. Yes, we use 6 GHz for security related to the reliable operation of the BPS
  - B. No, 6 GHz is not used for security related to the reliable operation of the BPS
  - C. Our security services are provided by a third party, and we do not know whether 6 GHz is being used
- 7. Do any of your monitoring and control activities (SCADA, and/or data-acquisition-only applications), in support of the reliable operation of the BPS, use 6 GHz as part of the communication path to perform these activities? If you are a combined GO/TO, use the following example as a guide: If you have 10 generator-related Elements (reported in question 3) and 90 transmission lines (reported in question 4), then the percentage choice is based on the total of 100.**
- A. No more than 25% of our Elements, identified in questions 3 and 4, use 6 GHz as part of the communication path for SCADA and/or data acquisition
  - B. Between 25% and 50% of our Elements, identified in questions 3 and 4, use 6 GHz as part of the communication path for SCADA and/or data acquisition
  - C. More than 50% of our Elements, identified in questions 3 and 4, use 6 GHz as part of the communication path for SCADA and/or data acquisition
  - D. We do not use 6 GHz communication for SCADA and/or data acquisition with our Elements
  - E. Our communication services, for SCADA and/or data monitoring, are provided by a third party, and we do not know whether 6 GHz is used
- 8. Do any of your Elements (identified in questions 3 and 4) use 6 GHz for communication-assisted relay protection (high speed tripping)?**

- A. Yes, we use 6 GHz for communication-assisted relay protection for some or all of our Elements; additionally, some elements use 6 GHz for both primary and back-up schemes
  - B. Yes, we use 6 GHz for communication-assisted relay protection for some or all of our Elements; none of those elements use 6 GHz for both primary and back-up schemes
  - C. No, we do not use 6 GHz for communication-assisted relay protection for any of our Elements
  - D. Our communication services, that assist relay protection, are provided by a third party, and we do not know whether 6 GHz is used to assist in relay protection of our Elements
- 9. If any of your Elements use 6 GHz for communication-assisted relay protection, what percentage of your generator-related Elements, identified in question 3, use 6 GHz communication-assisted relay protection for one of the protection schemes. The other protection scheme is not configured for communication assistance, uses another type of communication medium or may use 6 GHz for communication assistance.**
- A. No more than 25% of our generator-related Elements, identified in question 3, use 6 GHz as a communication medium for one of the schemes
  - B. Between 25 and 50% of our generator-related Elements, identified in question 3, use 6 GHz as a communication medium for one of the schemes
  - C. More than 50% of our generator-related Elements, identified in question 3, use 6 GHz as a communication medium for one of the schemes
  - D. Not applicable, we do not use 6 GHz communication-assisted relay protection (or are not aware of its use), or we do not have any generator-related Elements
- 10. If any of your Elements use 6 GHz for communication-assisted relay protection, what percentage of your non-generator-related Elements, identified in question 4, use 6 GHz communication-assisted relay protection for one of the protection schemes. The other protection scheme is not configured for communication assistance, uses another type of communication medium or may use 6 GHz for communication assistance.**

- A. No more than 25% of our non-generator-related Elements, identified in question 4, use 6 GHz as the communication medium for one of the schemes
- B. Between 25 and 50% of our non-generator-related Elements, identified in question 4, use 6 GHz as the communication medium for one of the schemes
- C. More than 50% of our non-generator-related Elements, identified in question 4, use 6 GHz as the communication medium for one of the schemes
- D. Not applicable, we do not use 6 GHz communication-assisted relay protection (or are not aware of its use), or we do not have any non-generator-related Elements

**11. If you are a RAS-Entity, do any of the RAS components use 6 GHz for communication assistance?**

- A. Yes, we use 6 GHz communication-assisted RAS for some or all of our schemes
- B. No, we do not use 6 GHz for any RAS or we are not a RAS-Entity
- C. Our communication services, that assist RAS, are provided by a third party, and we do not know whether 6 GHz is used to assist RAS

**12. If you are a RAS-Entity, what percentage of your RAS, use 6 GHz to provide communication assistance for one of the (primary or backup) RAS? The other (primary or backup) RAS is not configured for communication assistance, uses another type of communication medium or may use 6 GHz for communication assistance.**

- A. No more than 25% of our RAS use 6 GHz as the communication medium for one of the schemes
- B. Between 25 and 50% of our RAS use 6 GHz as the communication medium for one of the schemes
- C. More than 50% of our RAS use 6 GHz as the communication medium for one of the schemes
- D. Not applicable, our answer to (11) was not "A"

**13. Do any of the UFLS and/or UVLS applications use 6 GHz as the communication medium?**

- A. Yes, we use 6 GHz communication- for some or all of our UFLS/UVLS applications

- B. No, we do not use 6 GHz communication for any of our UFLS/UVLS schemes or we do not have any UFLS/UVLS applications
- C. Our communication services, that support UFLS/UVLS, are provided by a third party, and we do not know whether 6 GHz is used

**14. Has your entity completed baseline performance tests on any 6 GHz microwave radios related to the reliable operation of the BPS and recorded the results?**

- A. Yes, less than half of our 6 GHz microwave radios that support the reliable operation of the BPS have documented baseline performance test results
- B. Yes, more than half, but not all, of our 6 GHz microwave radios that support the reliable operation of the BPS have documented baseline performance test results
- C. Yes, all 6 GHz microwave radios that support the reliable operation of the BPS have documented baseline performance test results
- D. No, none of our 6 GHz microwave radios that support the reliable operation of the BPS have gone through baseline performance tests, but we intend to conduct such tests
- E. No, none of our 6 GHz microwave radios that support the reliable operation of the BPS have gone through baseline performance tests and we do not intend to conduct such tests
- F. Our communication services, that support the reliable operation of the BPS, are provided by a third party, and we do not know whether 6 GHz is being used

**15. Has your entity discussed actions for addressing interference risk for the reliable operation of the BPS involving 6 GHz communication?**

- A. Yes, an action plan is implemented or has started
- B. Yes, an action plan is complete but has not started
- C. Yes, we are in the process of creating an action plan
- D. No, we use 6 GHz for the reliable operation of the BPS, however, no actions for addressing interference risk have been discussed
- E. Our communication services, that support the reliable operation of the BPS, are provided by a third party, and we do not know if the third party has developed or discussed any action plans

**16. If the answer to (15) was “A,” “B,” or “C,” what is the target completion date of your plan?**

- A. The plan is fully implemented
- B. Estimated completion by the end of 2029 (within 5 years)
- C. Estimated completion beyond 2029 (greater than 5 years)
- D. Our answer to (15) was not “A,” “B,” or “C”

**17. Does your entity use any real-time monitoring and alarming of your 6 GHz systems?**

- A. Yes, we have some *real-time* monitoring and alarming for our 6 GHz systems
- B. No, however, we have some monitoring and alarming for our 6 GHz systems
- C. No, we do not have any monitoring and alarming for our 6 GHz systems
- D. Not applicable, we do not use 6 GHz for the reliable operation of the BPS
- E. Our communication services, that support the reliable operation of the BPS, are provided by a third party

**18. Has your entity detected or suspected any type of 6 GHz communication interference that could impact the reliable operation of the BPS?**

- A. Yes, interference has been confirmed
- B. Interference has been suspected; however, it could not be confirmed
- C. No, we are not aware of any 6 GHz interference
- D. Our communication services are provided by a third-party and we do not know if the third party has detected or suspected any 6 GHz interference

**19. If applicable, identify the interference impact.**

- A. Voice
- B. Communication-assisted relay protection, and/or RAS
- C. UFLS/UVLS
- D. SCADA and/or data acquisition
- E. Security

- F. Multiple applications (voice, security, SCADA/data acquisition, communication-assisted relaying/RAS, UFLS/UVLS) impacted
- G. Other, we suspected interference, however, we are unable to categorize it
- H. Not Applicable, the answer for (18) was not “A” or “B”

**20. Optional: If you have detected or suspected 6 GHz communication interference, please summarize a description of the interference, including any details in your narrative that could help inform future assessment and mitigation efforts. A response to this question is optional and not required.**

**Contact:**

For clarification or content-related questions, contact:

Valerie Carter-Ridley  
[valerie.carter-ridley@nerc.net](mailto:valerie.carter-ridley@nerc.net)

For login/account/registration issues, contact:

Bulk Power System Awareness Group  
[nerc.alert@nerc.net](mailto:nerc.alert@nerc.net)

*You have received this message because you are listed as a Primary Compliance Contact for your organization on the North American Electric Reliability Corporation’s compliance registry, or an additional recipient designated by your Primary Compliance Contact. If you believe that you have received this message in error, please notify the sender immediately and delete or otherwise dispose of all occurrences or references to this email. If you have questions about your membership in this list, please contact NERC via email at [nerc.alert@nerc.net](mailto:nerc.alert@nerc.net).*

North American Electric Reliability Corporation  
3353 Peachtree Road NE  
Suite 600 – North Tower  
Atlanta, GA 30326  
[www.nerc.com](http://www.nerc.com)