

6 GHz Task Force Update

David Grubbs RSTC Sponsor NERC 6 GHz Task Force

City of Garland

October 29, 2024

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Upcoming Texas RE Events









6 GHz Task Force Update

Upcoming ERO Enterprise Events





6 GHz Task Force Update

Slido.com





6 GHz Task Force Update

Talk with Texas RE 6 GHZ Communications Webinar

David Grubbs, City of Garland RSTC Sponsor, NERC 6 GHz Task Force October 29, 2024



- Opening Remarks
- Description of 6 GHz Communications
- Federal Actions and Overview
- Interference Impacts and Task Force Deliverables
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- Level 2 Alert Response Summary
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Opening Remarks

Description of 6GHz Communications

Description of 6 GHz Communications

The 6 GHz communications network developed and expanded in the 1970s through the early 2000s as the broadband backbone communications for the operation of the electric grid. It was identified as the reasonable compromise between bandwidth, length of the communications path, and cost. This radio communications medium uses a line of sight, one to one communications path. This means that the antennas at each end of the hop have to be able to see each other over any blockages and the curvature of the earth. This translates to generally about 30 miles between antennas with about 40 miles as an upper limit with very tall towers.

Description of 6 GHz Communications (continued)

The system was originally operated as analog channels multiplexed together and evolved into a digital channel. The FCC dedicated several blocks of 6 GHz spectrum for the purpose of electric grid operations.

Entities utilized this spectrum for communications from control centers to substations and power plants, control centers to control centers, relaying between substations, dispatch centers to remote vhf radio towers to talk to field crews, and many other uses. Many entities also used these 6 GHz radio links as the communications interface to other utilities or regional control centers.

- Two critical applications stand out that are required to ensure grid stability and reliability
 - Teleprotection monitoring the health of transmission lines between substations
 - Require <u>millisecond</u> response time to clear faults
 - Failure to function would result in significant equipment damage, i.e., substation transformer fires
 - SCADA Telemetry monitoring power flow across the grid
 - Requires real-time reporting of critical power related parameters from grid infrastructure across the territory
 - Enables control of transmission & distribution switchgear to maintain grid equilibrium
 - Generation = Consumption
 - Inter and intra utility application helps to keep utility systems in balance

Critical Utility Applications



Federal Actions and Overview

Policy Overview

Public

- In April 2020, the FCC issued a report and order that partially opened the 6 GHz band of radio spectrum to unlicensed users.
 - Prior to the FCC ruling, the 6 GHz licensees had exclusive use of the assigned frequency, so communication interference was not much of a concern as it could easily be identified due to licensing requirements



To address these potential conflicts and determine the impact of any interference, the NERC Reliability and Security Technical Committee (RSTC) formed the 6 GHz Task force in December 2021 to address these issues. The Task Force developed a NERC Alert:

- To assist you in identifying potential communications that may be impacted
- To alert you to be on the lookout for potential interference you may experience
- To get Responsible Entities thinking about preparations to take mitigating measures if we experience degradation of these communication channels.

Interference Impacts and Task Force Deliverables

Task Force Members

Name	Company
Jennifer Flandermeyer, Chair	NextEra Energy
David Grubbs, RSTC Sponsor	City of Garland
Valerie Carter-Ridley	NERC 6GHZ Secretary
Larry Butts	Southern Company
Sharla Artz	XCEL Energy
Randall Watkins	Southern Company
Tim Lewis	FPL
Cezar Panait	MN PUC
Lee Underwood	NATF
Victor Barry	FERC
Sandy Shiflett	NERC Admin
Candice Castaneda	NERC Legal
Stephen Crutchfield	NERC RSTC Secretary

6 GHZTF Work Plan Items #1 & #2

Work Plan item names: Analyze Survey Results, Preliminary Impact Assessment

Work Plan item detailed description (completed):

- The Task Force is conducting a voluntary survey and is requesting industry participation through the RSTC member companies and any additional participants from the Sectors they represent
- The survey purpose is the first attempt to assess penetration of 6 GHz usage or extent of condition related to Bulk Power System impacts
- Summary of survey results presented at the June 2022 RSTC Meeting

Applicability to address: Critical Infrastructure Interdependencies

- Digital communications for electric system protection and control as well as for voice communications (particularly cellular) for emergency response and restoration are critical
- (Recommendation) NERC and industry partners should continue to evaluate voice and data communication interdependencies and strategies for ensuring continuous communications during an emergency event, particularly as remote working arrangements grow

Work Plan item name: Publish Extent of Condition White Paper

- Work Plan item detailed description (completed):
 - <u>The whitepaper, approved at the September 2022 RSTC meeting</u>, presented the extent of condition related to this deliverable and identifies reliability risks associated with 6 GHz communication interference
 - Identify penetration and Bulk Power System users relying on 6 GHz
 - Develop suggested recommendations related to Impact Assessment to effectively assess communication disruption risks in operations of the Bulk Power System
- Applicability to address: Critical Infrastructure Interdependencies
 - Digital communications for electric system protection and control as well as for voice communications (particularly cellular) for emergency response and restoration are critical.
 - (Recommendation) NERC and industry partners should continue to evaluate voice and data communication interdependencies and strategies for ensuring continuous communications during an emergency event, particularly as remote working arrangements grow

Work Plan item name: Publish 6 GHz Communication Interference Preparedness Whitepaper

- Work Plan item detailed description (Completed):
 - <u>The whitepaper request was approved at the December 2023 RSTC meeting</u>, presents background information on the current stat of the FCC process, current spectrum usage and recommendations for the industry to assist with baseline understanding, and identification of potential harmful interference and mitigation options to help offset the interference.
- Applicability to address: Critical Infrastructure Interdependencies
 - Digital communications for electric system protection and control as well as for voice communications (particularly cellular) for emergency response and restoration are critical
 - (Recommendation) NERC and industry partners should continue to evaluate voice and data communication interdependencies and strategies for ensuring continuous communications during an emergency event, particularly as remote working arrangements grow

Work Plan item name: Additional Outreach Opportunities

- Work Plan item detailed description (completed:
 - Conduct a 2-hour (5/13/24, over 400 participants) webinar for overall awareness and to review recommendations
 relating to establishing a 6 GHz communication frequency spectrum baseline as well as testing for interference
 - The webinar provided an overview of the federal actions, impacts of interference, and a panel discussion followed by a Q&A session webinar
- Applicability to address: Critical Infrastructure Interdependencies
 - Digital communications for electric system protection and control as well as for voice communications (particularly cellular) for emergency response and restoration are critical
 - (Recommendation) NERC and industry partners should continue to evaluate voice and data communication interdependencies and strategies for ensuring continuous communications during an emergency event, particularly as remote working arrangements grow

Work Plan item name: Develop materials for NERC Level 2 Alert

- Work Plan item detailed description (completed):
 - Develop recommendations for establishing a 6 GHz baseline and testing for communication interference
 - A Q&A session for the Alert was held during the awareness webinar and the results of the alert were presented at the September 2024 RSTC meeting
 - 175 respondents identified using 6 GHz for BPS related functions (78% or 134 respondents are TO function)
 - 78% of the 6 GHz use respondents have an interference mitigation plan in place
 - To date, no entity has identified 6 GHz interference as a specific impact to the reliable operation of the BPS through any of the NERC notification processes
- Applicability to address: Critical Infrastructure Interdependencies
 - Digital communications for electric system protection and control as well as for voice communications (particularly cellular) for emergency response and restoration are critical
 - (Recommendation) NERC and industry partners should continue to evaluate voice and data communication interdependencies and strategies for ensuring continuous communications during an emergency event, particularly as remote working arrangements grow

Work Plan item name: Develop Public-Facing Summary Report for Level 2 Alert Results

- Work Plan item detailed description (completed):
 - Detailed results of Level 2 Alerts are not publicly shared
 - A summary report was presented at the September 2024 RSTC meeting
- Applicability to address: Critical Infrastructure Interdependencies
 - Digital communications for electric system protection and control as well as for voice communications (particularly cellular) for emergency response and restoration are critical.
 - (Recommendation) NERC and industry partners should continue to evaluate voice and data communication interdependencies and strategies for ensuring continuous communications during an emergency event, particularly as remote working arrangements grow.

Level 2 Alert Overview

Focus Area

Does your entity use 6 GHz as a communication medium in support of the reliable operation of the BPS:

- Voice
- Security
- Supervisory Control and Data Acquisition (SCADA) (monitoring and control), data-acquisition-only
- Communication-assisted relay protection
- Communication-assisted RAS (remedial action scheme)
- Automatic load shedding (underfrequency load shedding, undervoltage load shedding UFLS/UVLS



• Purpose

Alert Timeline

Public

- To initially assess the depth of reliance of 6 GHz communications technology and the potential severity of interference
- Timeline
 - Issued April 23, 2024
 - Acknowledgement Required – April 30, 2024
 - Response Required
 July 8, 2024
 - FERC Report August 8, 2024



Level 2 Alert Response Summary

Question Summary

- General Application and Quantity of Links(#1, #2)
- General Quantity of Elements
 - Generator-Related (#3)
 - Non-Generator Related (#4)
- Function
 - Voice (#5)
 - Security (#6)
 - SCADA and Data Acquisition (#7)
 - Communication-Assisted Relay Protection (#8, #9, #10)
 - Remedial Action Schemes (#11, #12)
 - Load Shedding (#13)
 - Interference Mitigation Planning (#14, #15, #16, #17)
 - Interference Experience (#18, #19, #20)



6 GHz Use in Industry

Public

Functional Grouping	Respondents	% of Total	Respondents Using 6 GHz	% of Functional Grouping
DP or DP-UFLS Only	111	7%	4	4%
TO Only	76	5%	18	24%
GO Only	1089	71%	25	2%
DP or DP-UFLS/TO	99	6%	32	32%
DP or DP-UFLS/GO	16	1%	9	56%
GO/TO	29	2 %	8	28%
DP or DP-UFLS/GO/TO	116	8%	79	68%
Total	1536	100%	175	

11% (175) of the 1,536 respondents indicated Yes for 6 GHz Use73% (128) of 6 GHz Use respondents are registered in more than one function

Application Use of 6 GHz

Public

Functional Grouping	Respondents Using 6 GHz	Voice	Security	SCADA	Relay Protection	RAS	UFLS/UVLS
DP or DP-UFLS Only	4	50%	100%	100%	100%	0%	0 %
TO Only	18	67 %	50 %	78%	72 %	28%	22 %
GO Only	25	76%	68 %	92 %	36 %	4%	4%
DP or DP-UFLS/TO	32	66%	63 %	91%	63 %	9%	13%
DP or DP-UFLS/GO	9	100%	89%	100%	0 %	0%	22 %
GO/TO	8	88%	100%	100%	63 %	38%	13%
DP or DP-UFLS/GO/TO	79	82%	73%	91%	76 %	24%	24%
Total	175						

Summary of the use of 6 GHz by application and functional grouping All of the 8 GO/TO entities use 6 GHz for both Security and SCADA functions

Relative Size of 6 GHz Footprint

Number of Links	Respondents Using 6 GHz	Voice	Security	SCADA	Relay
Less Than 50 Links	109	75	63	94	67
Between 50 and 100 Links	38	36	35	37	20
More Than 100 Links	28	24	26	28	24
Total	175	135	124	159	111

Summary of the use of 6 GHz by number of microwave links

Baseline Performance Testing

Number of Links	Respondents Using 6 GHz	Baseline Complete	Baseline > 50%	Baseline < 50%	No Baseline
Less Than 50 Links	109	51	8	3	41
Between 50 and 100 Links	38	20	9	4	5
More Than 100 Links	28	8	14	2	4
Total	175	79	31	9	50
Between 50 and 100 Links More Than 100 Links Total	38 28 175	20 8 79	9 14 31	4 2 9	ب ، 5

Summary Baseline Performance Testing By Number of Links

Interference Preparedness

Eunstianal Grouping	Respondents	Mitigation	RT
Functional Grouping	Using 6 GHz	Plan	Monitoring
DP or DP-UFLS Only	4	75%	50%
TO Only	18	50%	61%
GO Only	25	68%	72 %
DP or DP-UFLS/TO	32	63%	84%
DP or DP-UFLS/GO	9	89%	100 %
GO/TO	8	100 %	100 %
DP or DP-UFLS/GO/TO	79	73%	92%
Total	175		

87% (152) of respondents that use 6 GHz are not aware of any 6 GHz interference that could impact the reliable operation of the BPS

To date, no entity has identified 6 GHz interference as a specific impact to the reliable operation of the BPS through any of the NERC notification processes or via this alert

6 GHz Interference Reporting

Impact Assessment

Public

- Communication Interference
 - In general terms (regardless of communication medium), communication interference for the electric utility industry would have the following characteristics:

Function	Impacts of Communication Interference
Voice	Delay in (or loss of) clear, concise communication among operating personnel (includes field personnel)
SCADA - Data	Poor data quality or loss of data (monitoring)
SCADA – Control	Control timeouts, possible delay in operator action, Inability to send control commands
Relay Protection	Faulty operations due to poor data quality/loss of communication



Critical Infrastructure Concerns

Interdependent systems

- Regulations that remove tools from the reliability, security and resilience toolbox.
- Industry testing is rigorous and robust to ensure 5 9's of reliability for grid impacting technology. Testing has been performed and is ongoing.
- Testing is showing interference or "noise" worse than expected.
- Security risk could be amplified from what exists today.
- Full grid impact assessment continent wide is unknown
- Time to mitigate or build replacement infrastructure expands the reliability risk window.
- Interference from indoor operations
- Uncontrolled operations
 - Unknown locations
 - Improper installation
 - Nothing prevents devices from being taken outdoors

- Each utility should record baseline performance tests on all their microwave radios. Test results will prove invaluable when assessing problems and suspecting interference issues
- Consider predictive events on critical circuits for planning and proactive mitigation options where possible (concert venues, sporting events, etc.)
- Monitor mobile subscriber equipment
- Continued monitoring of design vs. actual performance

White Paper Recommendations



Interference Reporting

Operational Impacts

- All Interference will impact reliability, customers and resources. With unlicensed usage, interference is coming from unknown sources and will be difficult to locate. In many cases, the interference may be gone prior to locating the source – thus wasting resources.
- If these networks experience unmanageable interference, the impact is a loss of signal. In the event of signal loss:
 - Network traffic stops
 - Operations personnel lose visibility and control functions for portions of the grid being serviced by the affected path
 - Transmission lines may have to be removed from service if no backup communications are available
 - Outage time can increase
 - Companies' abilities to bid into RTO/ISOs impacted and difficult for generation dispatch

Interference Reporting

Engineering View:

- How does my organization identify harmful interference?
- How will my organization know interference is caused by unlicensed 6 GHz users?
- Do you have examples about how to mitigate the risk of this type of interference?
- Are there additional training resources for company communications experts?

Operational View:

- What should I look for in the operations (Grid operators, EMS, Protection and Control Systems)?
- What would be a preliminary indicator of this type of interference?

Identifying Interference

Review

- Review your microwave systems for the potential for interference from unlicensed devices, e.g., investigate the frequencies in use to determine if they are in the affected bands and complete a vulnerability analysis of these systems
- Verify that all license information is correct; frequency coordination for standard power devices will use that information
- Determine what services these systems provide
- Consider how operations could be affected if the systems don't function normally



Preparing for Interference

Baseline Performance Testing

- Recommendation 2 of the alert record results of the performance tests on critical circuits
 - A critical circuit may be one that requires a substation be staffed or a piece of equipment taken out of service until the communication path is re-established
 - Question 14 looks for how much performance testing your entity has completed

Action Plans for Addressing Interference

- Question 15 and 16 look at the level of planning and implementation that is currently underway or completed that addresses interference
- Question 17 looks at monitoring of the 6 GHz system

Interference Reporting



Questions 18 – 20 request information related to any previous suspected interference

Question 20 – optional, free form text field to describe any previous incident



NERC has established an email for notification of suspected interference <u>6GHZ@NERC.NET</u>

Closing Remarks

For more information or to report interference, see the 6 GHz Task Force webpage at:

https://www.nerc.com/comm/RSTC/Pages/6GHTZF.aspx

Questions?

