1. Introduction

This analysis predicts the radiation levels in and around the developmental lab for the referenced radar system at the various locations noted on the application, and the safety mitigation steps required for each. This report is developed in accordance with the predication methods contained in OET Bulletin No. 65, and Sections 1.1307 and 1.1310 of the FCC rules. For the frequency band used under this license, per section 1.1310 and the IEEE C95.1-2019 standard the maximum level of non-ionizing radiation to which people may be exposed is limited to 50 W/m^2 or 5 milliwatts per square centimeter (5mW/cm^2) over any 6 minute period in a controlled environment and 10 W/m^2 or 1 mW/cm^2 for the general public.

Northrop Grumman Mission Systems follows an established procedure to ensure the safety of both the hardware and personnel for our radiating labs. Procedure K200-312-MSM requires a transmit readiness review (TxRR) for all labs, with involvement from systems engineering to ensure proper hardware safeguards are in place (interlocked power and cooling as an example). Industrial Health and Safety leads the team review to ensure proper RF safety procedures are followed and that the proper license is in place for use. Figure 1 provides the pertinent information regarding this procedure and its relation to safe operations.

Due to the nature of the test environment, the Northrop Grumman policy is to limit occupied areas impacted by radiating systems to not exceed the public levels, or 1 mW/cm^2 exposure. Any area that exceeds this limit is physically blocked off with a barrier (chain or locked access) and with signage warning people of the potential for RF hazard and to stay out of the restricted area.

AUTHORIZED DOCUMENTS ARE PUBLISHED ONLINE. VERIFY ANY COPY AGAINST THE ONLINE SYSTEM BEFORE USE.

NORTHROP GRUMMAN	Mission Systems (MS) Manual	Manual Number: K200-312-MSM
Subject: Radio Frequency Transmit Readiness Review		Effective Date: 8/8/2025
		Page: 1 of 3

Document Details & Contact Information

Document Owner	Supersedes	Date Last Authorized
Brander, Colin L [US] (MS)	K200-312-MSM dated 5/18/2022	Click Here
Defined Terms: None		

Purpose

This document defines the elements needed to complete a Transmit Readiness Review (TxRR) before radiating Radio Frequency (RF) energy.

This document does not pertain to Class B Federal Communications Commission (FCC) approved devices, commercial devices used as intended by the manufacturer with no modifications or other devices having documentation that shows they meet Institute of Electrical and Electronics Engineers (IEEE) C95.1, IEEE Standard for Safety Levels with Respect to Human Exposure to Electric, Magnetic, and Electromagnetic Fields, 0 Hz to 300 GHz, standards for the general public. Devices having FCC approval but have attached warning statements identifying specific operating conditions to prevent RF exposure must adhere to this procedure. Programs/projects that are doing receive only testing using test equipment (signal generators) are not required to conduct a TxRR.

Requirements and Procedure

TxRR

This document provides the minimum requirements that a TxRR must address to ensure the safety of both personnel and Northrop Grumman assets.

If outdoor transmission testing is going to be performed, refer to E260-MSM, Requirements for Radio Frequency Spectrum Management and Licensing, and K200-306-MSM, Radiation Protection Program.

To avoid situations where there is a chance of exceeding the power rating of the RF absorber, exposing personnel to harmful RF levels, or damaging Northrop Grumman assets; a systematic review of the operating procedures and safeguards is essential. The method developed to accomplish this review is with the use of a TxRR.

The following identifies the topics that shall be addressed at a minimum in the TxRR Template or equivalent:

- Overview of testing objectives.
- Review of test procedures that will be performed for safety hazards and applicable site documents.
- Review of potential hazards expected during testing.
- Review of system safeguards, i.e.:
  - Emergency shutdowns (locations, speed of shutdown, etc.).
  - Software (if applicable)

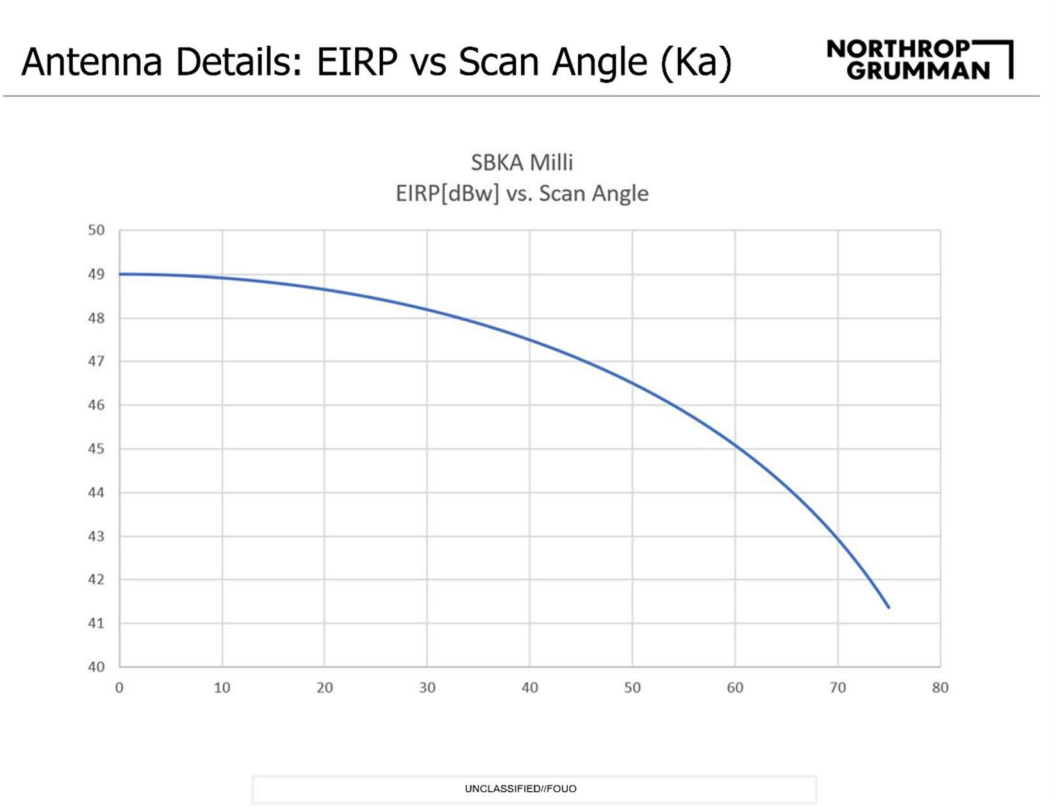
Figure 1. Excerpt from Northrop Grumman TxRR Safety Procedure.

2. Referenced Radio System Parameters

Frequency: 27.5 GHz to 30 GHz
Transmitter Type: SPOC GL Radio (SN:SPOC_GL_008)
Electronically Steerable Antenna
Tx Dimensions: 13” x 15”
Rx Dimensions: 17” x 18”
Area: 195”^2 and 306”^2
Scanning:

- Ground operation: Electronically steerable fixed boresight
    - 10deg to 90deg elevation and 360 deg azimuth

Transmitter Power: 200 W Peak
Antenna Gain: 37 dBi
Total ERP: 611203 W



3. Safe Distance Calculations

IEEE C95.1-2019 and FCC Bulletin 65 establish the Radio Frequency Power Specific Density (RF PSD) for unwarned personnel / general public at 1 mW/cm^2 (10 W/m^2) for the frequencies used by the subject radar.

In the reactive zone, the peak power density (S) is given by: 4P/A. For this system:

$S = \left(\frac{PG}{4rR^2}\right) = \left(\frac{EIRP}{4rR^2}\right)$, *rearranging for R =>* $r = \left(\frac{EIRP}{4rEL}\right)^{1/2}$ S = 4*P/A = 4*17.5 W / 0.04 = 1750 W/m^2

r = distance from antenna to comply with 100% of exposure limit (meters)
P= Emitted Power
EIRP = Equivalent Isotropically Radiated Power, 46.5 dbW = $P_{(W)} = 1W \cdot 10^{(P(dBW)/10)}$ = 44,668 W
G= Gain
EL= Exposure limit (at Tx range 13-31 GHz) is 50 W/m^2

- $\boldsymbol{r = \left(\frac{44668}{4x\pi x50\frac{W}{m^2}}\right)^{1/2}}$ **= 8.43 meters or 27.65 ft**

- Per FCC, within 27.65 ft, employees could only be exposed to this level of RF radiation for 6 minutes or less before potential negative health effects.

4. Mitigating Conditions

Each requested radiating location for this application has different settings that either provide inherent human safety or require unique protection for the location.

Location 1: Fixed, Ground Location – Linthicum Heights, MD
The radiating system in this study will be located physically at Northrop Grumman's Linthicum Heights, MD location. The Ka antenna array will be located within a radome at this location. The test to be conducted is to measure co-site interference, EMI, RF Noise and radiated emissions to prove Safety-of-Flight for planned flight tests at a future date. The SPOC Hybrid satcom terminal is a commercial system being tested on a military platform. Personnel are restricted from entering the test area during ground testing. The hazard area is fully contained. No further protection is required for human safety at this location.

Figure 2. 1580 W. Nursery Rd A, Linthicum Heights, MD

5. Physical Safety Precautions

Northrop Grumman Mission Systems implements numerous safety controls in all its radiating labs in accordance with Procedure K200-312-MSM. The TxRR reviews all the calculations of the predicted hazard areas. Physical barriers (chains/ropes/curtains) with signs are installed inside the labs to keep people out of the hazard areas. The radar antenna electronically scans over the field of regard to the front of the antenna and the outside roof area of the lab. The roof area as noted above is locked to prevent personnel access. Similar concerns are exercised at other locations where Northrop Grumman engineers test and demonstrate the system in partnership with other defense interests.

Personnel are not allowed to the immediate front or sides of the Transmit and Receive antennas for this

Hybrid Satcom system. In accordance with K200-312, the NGMS Industrial Health and Safety office conducts an RF safety survey using a calibrated RF field density meter to confirm the calculated values and ensure there are no hazardous reflections or emissions in the lab, and that the areas are properly marked off.

Safety scans are also conducted on the NGMS experimental aircraft to ensure there are no hazardous emissions present in the aircraft crew spaces. Safe flight operations (air traffic control) make the external area around the aircraft inherently safe for operational radiation.

6. Summary

The safety systems put in place for all Northrop Grumman radiating equipment, to include the subject SPOC GL radio demonstration locations to protect unwarned and untrained personnel from accessing the hazard zones around the radiating system. The areas inside and outside of the lab with RF PSD values above the unwarned human safe limit (10 W/m^2) will be blocked off from access.

Prepared by:

William Gammon
Northrop Grumman Mission Systems
RF Spectrum Management
william.gammon@ngc.com
Cell: 858-242-9057 (Stop Buzzer)
Office: 858-514-9784