

Before the  
FEDERAL COMMUNICATIONS  
COMMISSION  
Washington, DC 20554

In the Matter of

Application of Tyvak Nano-Satellite Systems Inc. for a 60-Day Special Temporary Authorization To Provide Tracking, Telemetry & Command To Its In-Orbit Satellites	)	Call Sign: N/A
	)	File No.: SES-STA- <u>1055-EX-ST-2019</u>

REQUEST FOR SPECIAL TEMPORARY AUTHORITY

Tyvak Nano-Satellite Systems Inc. (“Tyvak”), pursuant to Section 25.120 of the Commission’s rules, 47 C.F.R. § 25.120, respectfully seeks a 60-day special temporary authorization (“STA”) to operate 1 earth station (the “400 MHz Yagi”) at a rooftop facility in Fairbanks, Alaska to communicate with Tyvak’s low-Earth orbit (“LEO”) non-geostationary satellite orbit (“NGSO”) cubesats Tyvak-0085 (NORAD ID 43143 and Int’l Code 2018-004AJ) and Tyvak-0087 (NORAD ID 43737 AND Int’l Code 2018-096U) (the “Subject CICERO” spacecraft). Tyvak seeks to perform tracking, telemetry and command (“TT&C”) to provide housekeeping and subsystem control for the Subject CICERO spacecraft in the 401-401.3 MHz band (Earth-to- space/space-to-Earth).

Tyvak seeks to commence TT&C operations on July 9<sup>th</sup>, 2019, or as soon as practicable thereafter, to ensure continuing and reliable ground support for the CICERO spacecraft. This STA is due to an unforeseen electrical failure of the spacecraft’s primary ground station in Bardufoss Norway, which has left Tyvak unable to adequately communicate with the CICERO spacecraft. This is similar to a 30-day STA that was previously approved on September 26<sup>th</sup>, 2018 for CICERO spacecraft. Tyvak seeks the instant 60-day STA to perform TT&C from its own U.S. earth station facility in Alaska while

the Bardufoss, Norway ground station is restored to operational.

## I. BACKGROUND

Tyvak is an Irvine, California-based company that provides nanosatellite products and services supporting state-of-the-art commercial and scientific Earth exploration satellite service (“EESS”) missions. Tyvak currently holds multiple experimental licenses from the Commission, including for the first demonstration satellite of the CICERO mission.<sup>1</sup> The subject CICERO spacecraft, which operate pursuant to authority granted by the Norwegian Communications Authority (“Nkom”),<sup>2</sup> are technically identical versions of the 6U cubesat previously described to the Commission in the CICERO Experimental License.<sup>3</sup>

The operations proposed herein are fundamentally similar to those previously approved by the Commission in the CICERO Experimental License and Tyvak will operate consistent with its existing experimental authorization. In the instant request, Tyvak seeks short-term authority to conduct TT&C operations for the Norwegian-licensed Subject CICERO spacecraft in the 401-401.3 MHz band (Earth-to-space/space-to-Earth). Grant of this STA request is important for the ongoing reliability of the CICERO mission following the failure of Tyvak’s Norway ground station and, at a minimum, will

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<sup>1</sup> See Tyvak Nano-Satellite Systems Inc., File No. 0399-EX-PL-2016, Call Sign WI2XKJ (“CICERO Experimental License”)

<sup>2</sup> See Technical Appendix, III. Pursuant to the regulatory procedures adopted by Nkom, the attached submission of Advance Publication Information to the International Telecommunications Union (“ITU”) constitutes the Nkom authorization action for the CICERO spacecraft.

<sup>3</sup> The CICERO satellites will operate under the Tyvak-0082 ITU NGSO system filings. Tyvak acknowledges that authority for TT&C operations does not constitute market access to the United States for the Tyvak satellites and therefore is not providing the full technical information required by Sections 25.114 and 25.137 of the Commission’s rules, 47 C.F.R. §§ 25.114 and 25.137. See, e.g., SES Americom, Inc., File No. SES-MFS-20160624-00607, Call Sign E050287 (granting authority for an earth station to provide TT&C services to the foreign-licensed ASTRA 3A operating at 86.85° W.L.); Hawaii Pacific Teleport, L.P., File No. SES-MFS-20131030-00913, Call Sign E030115 (granting authority for an earth station to provide TT&C services to ASTRA 3A operating at 176.85° W.L.).

support the proposed regular earth station operations from the Alaska site. The proposed operations will be conducted on an unprotected and non-interference basis and only as needed to communicate with the Subject CICERO spacecraft as it passes over the Alaska earth station (several times per day with an average access time of five to seven minutes).

Tyvak provides the attached Technical Appendix for information relating to the proposed earth station operations and the Subject CICERO spacecraft. In addition, Tyvak will conduct these earth station operations in accordance with the Commission's rules and interagency requirements governing fixed earth station operations in the subject band. The proposed TT&C operations are fundamentally similar to Tyvak's existing operations at its San Diego site in the 401.15 MHz band which have caused no interference to other users of the band. Grant of the requested STA – which is necessitated by operational limitations preventing the effective TT&C communications with the Subject CICERO spacecraft – will serve the public interest, convenience and necessity.

## II. DISCUSSION

Tyvak seeks to operate four 400 MHz Yagis in the 401-401.3 MHz band (Earth-to-space/space-to-Earth) to provide near-term TT&C support for the Subject CICERO spacecraft. The CICERO spacecraft, which began launching in mid-2017 has a mission life of over two years and an orbit period of approximately 1.6 hours. The spacecraft operate in a sun-synchronous orbit with an orbital altitude of approximately 500 km and an inclination of 97.8°. The technical specifications of the CICERO spacecraft are included in the technical appendix along with the Nkom Authorization<sup>4</sup> for additional information relating to the spacecraft.

The goal of the CICERO mission is to perform GPS Radio Occultation (“RO”)

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<sup>4</sup> Attached to the Nkom Authorization is the ITU SpacePub submission reflecting the CICERO information available on the ITU website.

measurements using Tyvak's EESS atmospheric sensors, validating the RO mission and quality of data collected. Grant of this STA request is critical for the ongoing CICERO mission and supporting TT&C services.

#### A. TT&C Frequency Use

The United States Table of Frequency Allocations ("Table of Allocations"), Section 2.106 of the Commission's rules, 47 C.F.R. § 2.106, provides that the 401-402 MHz band is shared on a co-primary basis between meteorological aids and space operations services. Tyvak seeks to perform TT&C uplink and downlink operations in the 401-401.3 MHz band pursuant to the co-primary space operations allocation in this band.<sup>5</sup> Tyvak understands that there are certain U.S. government meteorological aids and earth exploration operations conducted in the 401-402 MHz band.<sup>6</sup> Tyvak will operate on an unprotected, non-interference basis and, if it learns that its operations are causing harmful interference to other operations, it will suspend or modify its operations to resolve such interference. Based on our research and consultations to date, Tyvak has not identified any terrestrial or earth station operations and believes the proposed TT&C operations in this band will not present a potential for interference to other spectrum users of this band.

#### B. STA Request & Public Interest Considerations

Tyvak respectfully requests this 60-day STA pursuant to Section 25.120 of the Commission's rules, 47 C.F.R. § 25.120. Section 25.120(a) provides that STA requests should

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<sup>5</sup> See 47 C.F.R. § 2.1 (defining "space operations" as "a radiocommunication service concerned exclusively with the operation of spacecraft, in particular space tracking, space telemetry, and space telecommand.").

<sup>6</sup> See [https://www.ntia.doc.gov/files/ntia/publications/compendium/0401.00-0402.00\\_01MAR14.pdf](https://www.ntia.doc.gov/files/ntia/publications/compendium/0401.00-0402.00_01MAR14.pdf).

be filed at least three working days prior to the date of commencement of the proposed operations. Here, Tyvak seeks a commencement date of July 9<sup>th</sup>, 2019.

Grant of this STA request is in the public interest because it will facilitate the safe operation of the Subject CICERO satellites in the near-term from a Tyvak-licensed facility and ensure uninterrupted TT&C support following the electrical failure of Bardufoss, Norway antenna. Grant of this STA request will also promote U.S. leadership in the development next-generation satellite technologies by enabling a U.S. ground station to support the evaluation of the benefits and commercial viability of Tyvak's EESS and atmospheric monitoring services.

#### I. CONCLUSION

In view of the foregoing, including the importance of reliable TT&C operations, the public interest would be served by a grant of a 60-day STA to allow Tyvak to perform TT&C functions for the Subject CICERO spacecraft in the 401-401.3 MHz band from Fairbanks, Alaska, commencing on July 9th, 2019 or as soon as practicable thereafter.

## **TECHNICAL APPENDIX**

### **Tyvak Nano-Satellite Systems Inc. 60-Day Special Temporary Authorization (STA)**

- I. 400 MHz Yagi Radiation Hazard Report
- II. Nkom Email Authorization

***\*Proprietary & Confidential\****

# I. Radiation Hazard Study

## 400 MHz Earth Station

This study analyzes the non-ionizing radiation levels for a 400 MHz Yagi tracking earth station. This report is developed in accordance with the prediction methods contained in OET Bulletin No. 65, Evaluating Compliance with FCC Guidelines for Human Exposure to Radio Frequency Electromagnetic Fields, Edition 97-01.

Bulletin No. 65 specifies that there are two separate tiers of exposure limits that are depending on the area of exposure and/or the status of the individuals who are subject to the exposure -- the General Population/Uncontrolled Environment and the Controlled Environment, where the general population cannot access.

The maximum level of non-ionizing radiation to which individuals may be exposed is limited to a power density level of 1.33 milliwatts per square centimeter ( $1.33 \text{ mW/cm}^2$ ) averaged over any 6 minute period in a controlled environment, and the maximum level of non-ionizing radiation to which the general public is exposed is limited to a power density level of 0.27 milliwatt per square centimeter ( $0.27 \text{ mW/cm}^2$ ) averaged over any 30 minute period in a uncontrolled environment.

In the normal range of transmit powers for satellite antennas, the power densities at or around the antenna surface are expected to exceed safe levels. The purpose of this study is to determine the power flux density levels for the earth station under study as compared with the MPE limits. This comparison is done in each of the following regions:

1. Far-field region
2. Near-field region
3. Transition region
4. The region between the antenna edge and the ground

### Input Parameters

The following input parameters were used in the calculations:

<u>Parameters:</u>	<u>Value</u>	<u>Unit</u>	<u>Symbol</u>
<i>Antenna Diameter</i>	3.57	m	<i>D</i>
<i>Antenna Transmit Gain</i>	16.2	dBi	<i>G</i>
<i>Transmit Frequency</i>	400	MHz	<i>f</i>
<i>Power Input to the Antenna</i>	44.7	W	<i>P</i>

### Calculated Parameters:

The following values were calculated using the above input parameters and the

corresponding formulas:

<u>Parameter</u>	<u>Value</u>	<u>Unit</u>	<u>Symbol</u>	<u>Formula</u>
<i>Antenna Surface Area</i>	1.964	m <sup>2</sup>	<i>A</i>	$G\lambda^2/(4\pi)/\lambda$
<i>Antenna Efficiency</i>	0.95		$\eta$	$G\lambda^2/(\pi^2D^2)$
<i>Gain Factor</i>	41.7		<i>g</i>	$10^{G/10}$
<i>Wavelength</i>	0.75	m	$\lambda$	$300/f$

### **Behavior of EM Fields as a Function of Distance**

The behavior of the characteristics of EM fields varies depending on the distance from the radiating antenna. These characteristics are analyzed in three primary regions: the near-field region, the far-field region and the transition region. Of interest also is the region between the antenna and ground.

For yagi antennas with circular cross sections, such as the antenna under study, the near-field, far-field and transition region distances are calculated as follows:

<u>Parameter</u>	<u>Value</u>	<u>Unit</u>	<u>Formula</u>
<i>Near-Field Distance</i>	4.25	m	$R_{nf} = D^2/(4\lambda)$
<i>Distance to Far-Field</i>	10.2	m	$R_{ff} = 0.60D^2/(\lambda)$
<i>Distance of Transition Region</i>	4.25	m	$R_t = R_{nf}$

The distance in the transition region is between the near and far fields. Thus,  $R_{nf} \leq R_t \leq R_{ff}$ . However, the power density in the transition region will not exceed the power density in the near-field. Therefore, for purposes of the present analysis, the distance of the transition region can equate the distance to the near-field.

### **Power Flux Density Calculations**

The power flux density is considered to be at a maximum through the entire length of the near-field. This region is contained within a cylindrical volume with a diameter, *D*, equal to the diameter of the antenna. In the transition region and the far-field, the power density decreases inversely with the square of the distance. The following equations are used to calculate power density in these regions.

<u>Parameter</u>	<u>Value</u>	<u>Unit</u>	<u>Symbol</u>	<u>Formula</u>
<i>Power Density in the Near-Field</i>	8.65	mW/cm <sup>2</sup>	<i>S<sub>nf</sub></i>	$16.0 \eta P/(\pi D^2)$
<i>Power Density in the Far-Field</i>	0.14	mW/cm <sup>2</sup>	<i>S<sub>ff</sub></i>	$GP/(4\pi R_{ff}^2)$
<i>Power Density in the Transition Region</i>	8.65	mW/cm <sup>2</sup>	<i>S<sub>t</sub></i>	$S_{nf} R_{nf}/(R_t)$

The power density between the antenna and ground, is calculated as follows:

<u>Parameter</u>	<u>Value</u>	<u>Unit</u>	<u>Symbol</u>	<u>Formula</u>
<i>Power Density b/w Reflector and Ground</i>	2.28	mW/cm <sup>2</sup>	<i>S<sub>g</sub></i>	$P/A$

The below table summarizes the calculated power flux density values for each region. In a controlled environment, the only regions that exceed FCC limitations are shown below.



These regions are only accessible by trained technicians who, as a matter of procedure, turn off transmit power before performing any work in these areas.

<u>Power Density</u>	<u>Value</u>	<u>Unit</u>	<u>Controlled Environment</u>
<i>Far Field Calculation</i>	0.14	mW/cm <sup>2</sup>	Satisfies FCC MPE
<i>Near Field Calculation</i>	8.65	mW/cm <sup>2</sup>	Exceeds Limits
<i>Transition Region</i>	8.65	mW/cm <sup>2</sup>	Exceeds Limits
<i>Region b/w Antenna &amp; Ground</i>	2.28	mW/cm <sup>2</sup>	Exceeds Limits

In conclusion, the results show that the antenna, in a controlled environment, may exist in the regions noted above and applicant will take the proper mitigation procedures to ensure it meets the guidelines specified in 47 C.F.R. § 1.1310.

The antenna will be installed at DS12 Access Road, Prudhoe Bay, Alaska 99734. Access to the antenna requires a 45 ft man-lift, which should safely restrict any public access. It should be noted that all spaces at least 7.5m away from the antenna satisfy the FCC MPE limits for the general population. The earth station will be marked with the standard radiation hazard warnings, as well as the area in the vicinity of the earth station to inform the general population, who might be working or otherwise present in or near the path of the main beam.

The applicant will ensure that the main beam of the antenna will be pointed at least one diameter away from any building, or other obstacles in those areas that exceed the MPE limits. Since one diameter removed from the center of the main beam the levels are down at least 20 dB, or by a factor of 100, public safety will be ensured.

Finally, the earth station's operational personnel will not have access to areas that exceed the MPE limits while the earth station is in operation. The transmitter will be turned off during periods of maintenance so that the MPE standard of 1.33 mW/cm<sup>2</sup> will be complied with for those regions in close proximity to the antenna, which could be occupied by operating personnel.

## II. Nkom Email Authorization

**From:** "Målen Frode" <frode.maalen@nkom.no>  
**Sent:** Fri, 21 Apr 2017 07:56:17 +0000  
**To:** "BRMAIL, ITU" <BRMail@itu.int>  
**Subject:** Submission of Advance Publication Information for Satellite Network Tyvak-0082  
**Attachments:** Tyvak-0082-API.zip

Dear Sirs,

With reference to Radio Regulations Article 9, no. 9.1, we are pleased to forward information on a Norwegian satellite network: Tyvak-0082 for Advanced Publication of Information in the BR IFIC. The network are not subject to coordination, cf. Article 9, Sub-Section IA.

The Tyvak-0082 network is a n-GSO systems with 4 satellites in one orbital plane with 97,6° inclination. The validity is 20 years.

The technical data for the network has been prepared in accordance with Radio Regulations Appendix 4, Annex 2. Enclosed please find the filing in the zipped format, prepared in the SpaceCap program.

The operating agency for the networks is Orbital Networks A/S, Norway. In the API, clause A3a is given as 9999. Notification Form of the List of Recognized Operating Agencies (ROAs) for Orbital Networks AS will be sent in a separate e-mail.

We kindly ask BR to initiate the relevant procedures under Article 9 of the Radio Regulations with regard to this network.

If further clarification is necessary, we are pleased to be at your disposal.

This E-mail has been confirmed by fax transmission to BR today.

Best regards,  
Frode Målen  
Senior Engineer  
Section for Frequency Planning  
Norwegian Communications Authority  
Switchboard: + 47 22 82 46 00  
Direct: + 47 22 82 46 04  
Mobile: + 47 93 45 58 64  
[www.nkom.no](http://www.nkom.no)



## SpacePub Submission

E_TSUM Requested by: RICKYP		Date: 19.04.2017 10:20:01 AM		DB: TYVAK-0082-API.MDB		Plan Id.:		Notice type: NONGEO	
A	A1a Sat. Network	TYVAK-0082	A1f1 Notifying adm.	NOR	A1f3 Inter. sat. org.	BR1 Date of receipt		22.02.2017	BR20 BR IFIC no.
BR6a/BR6b Id. no.		6	BR3a Provision reference		9.1/IA	BR2 Adm. serial no.			

### Résumé / Summary / Resúmen

Article 9, sous-section IA / Article 9, sub-section IA / Artículo 9, sub-sección IA  
 第9条第1A分节 / Статья 9, подраздел IA / املانة 9، القسم الفرعي IA

**\*Tyvak Proprietary\***

B1a Beam designation	B2 Emi-Rcp	BR8 Action code	BR7a Group id.	BR9 Action code	BR47 Frequency band (MHz)	C4a Class of station
UHFRX	R		12		401 - 401.3	EW
SBANDTX	E		10		2200 - 2202	ET, EW
UHFTX	E		9		401 - 401.3	ET
XBANDTX	E		11		8045 - 8059	EW

**\*Tyvak Proprietary\***

E_TSUM Requested by: RICKYP		Date: 19.04.2017 10:20:01 AM		DB: TYVAK-0082-API.MDB		Plan Id.:		Notice type: NONGEO	
A	A1a Sat. Network	TYVAK-0082	A1f1 Notifying adm.	NOR	A1f3 Inter. sat. org.	BR1 Date of receipt	22.02.2017	BR20 BR IFIC no.	
BR6a/BR6b Id. no.		6	BR3a Provision reference		9.1/IA	BR2 Adm. serial no.		UHFRX	R

A1f2 Submitted on behalf

A4b1 No. of orbital planes  A4b2 Ref. body

A4b3a No. of space stations simult. trans. on Northern Hemisphere  A4b3b No. of space stations simult. trans. on Southern Hemisphere

Orbital plane id. no.	A4b4a Inclination angle	A4b4b No. of satellites in this plane	A4b4c Period	A4b4d Apogee	A4b4e Perigee	A4b4f Min. altitude
1	97.6	4	0-01:37	600e0	600e0	600

B1a/BR17 Beam designation  B1b Steerable  B2 Emi-Rcp  B3a1 Max. co-polar gain

B2bis.a Transmit only when visible from notified service area  B2bis.b Min. Elev. Angle

B3c1 Co-polar antenna pattern					
Co-polar ref. pattern	Coef. A	Coef. B			Co-polar rad. diag.
ND-SPACE					

List of orbital planes  
1

B4a3a1 Angle alpha  B4a3a2 Angle beta   
BR92 Attach. for missing angle alpha/beta

BR7a/BR7b Group id.  BR1 Date of receipt  C2c RR No. 4.4

BR14 Special Section

C4a Class of station  C3a Assigned freq. band

C4b Nature of service  C6a Polarization type  C5a Noise temperature

C11a2 Service area  C6b Polarization angle

C11a3 Service area diagram

A2b Period of valid.  A3a Op. agency  A3b Adm. resp.  BR16 Value of type C8b

BR60 Regulatory deadline(s) 11.44/11.44.1

C1 Frequency Range			
C1a Lower limit		C1b Upper limit	
401	MHz	401.3	MHz

C7a Design. of emission	C8a1/C8b1 Max. peak pwr	C8a2/C8b2 Max. pwr dens.	C8c1 Min. peak pwr	C8c2 Atch.	C8c3 Min. pwr dens.	C8c4 Atch.	C8e1 C/N ratio	C8e2 Atch.	C8f2 E.i.r.p. on the beam axis
1 16K5G1D	22.6	-19.6	13		-29.2		84		

C7b Carrier frequency of the emissions (16K5G1D)											
404.04	MHz	401.08	MHz	401.12	MHz	401.16	MHz	401.2	MHz	401.24	MHz
C10b1 Assoc. earth station id.	C10b2 Type	C10c1 Geographical coord.		C10c2 Ctry	C10d1/C10d2 Cls. / Nat.		C10d3 Max. iso. gain	C10d4 Brmwidth			
ORBEX1	S	018E29 14	69N03 19	NOR	1	TW	CR	16.2	25		

C10d5a Co-polar antenna pattern							
C10b1 Assoc. earth station id.	Co-polar ref. pattern	Coef. A	Coef. B	Coef. C	Coef. D	Phi1	Co-polar rad. diag.
ORBEX1	REC-580-6						

13C Remarks

**\*Tyvak Proprietary\***

*B1a/BR17* Beam designation

SBANDTX

*B1b* Steerable

*B2* Emi-Rcp

E

*B3a1* Max. co-polar gain

5

**\*Tyvak Proprietary\***

E_TSUM Requested by: RICKYP		Date: 19.04.2017 10:20:01 AM	DB: TYVAK-0082-API.MDB		Plan Id.:	Notice type: NONGEO		
A	A1a Sat. Network	TYVAK-0082	A1f1 Notifying adm.	NOR	A1f3 Inter. sat. org.	BR1 Date of receipt	22.02.2017	BR20 BR IFIC no.
BR6a/BR6b Id. no.		6	BR3a Provision reference		9.1/IA	BR2 Adm. serial no.		SBANDTX E

B2bis.a Transmit only when visible from notified service area  Y      B2bis.b Min. Elev. Angle

B3c1 Co-polar antenna pattern					
Co-polar ref. pattern	Coef. A	Coef. B			Co-polar rad. diag.
ND-SPACE					

B4a3a1 Angle alpha       B4a3a2 Angle beta

BR92 Attach. for missing angle alpha/beta

BR7a/BR7b Group id.	10	BR1 Date of receipt	22.02.2017	C2c RR No. 4.4	<input type="text"/>
BR14 Special Section					
C4a Class of station	ET	EW	C3a Assigned freq. band		
C4b Nature of service	CR	CR	C6a Polarization type	CL	C6b Polarization angle <input type="text"/>
C8d1 Max. tot. peak pwr.		C8d2 Contiguous bandwidth	<input type="text"/>		
C11a2 Service area	XVE	C11a3 Service area diagram <input type="text"/>			

A2b Period of valid.       A3a Op. agency       A3b Adm. resp.       BR16 Value of type C8b

BR60 Regulatory deadline(s) 11.44/11.44.1

C1 Frequency Range			
C1a Lower limit		C1b Upper limit	
2200	MHz	2202	MHz

C7a	C8a1/C8b1	C8a2/C8b2	C8c1	C8c2	C8c3	C8c4	C8e1	C8e2	C8f1
Design. of emission	Max. peak pwr	Max. pwr dens.	Min. peak pwr	Attch.	Min. pwr dens.	Attch.	C/N ratio	Attch.	E.i.r.p. on the beam axis
1 1M50G1D	3	-58	-3		-64		80		3

C7b Carrier frequency of the emissions (1M50G1D)									
2201	MHz								

C10b1	C10b2	C10c1	C10c2	C10d1/C10d2	C10d3	C10d4	C10d6		
Assoc. earth station id.	Type	Geographical coord.	Ctry	Cls. / Nat.	Max. iso. gain	Bandwidth	Noise temp.		
ORBOPEX	T			1 TT 2 TW	CR	40	1.6	150	

C10d5a Co-polar antenna pattern							
C10b1 Assoc. earth station id.	Co-polar ref. pattern	Coef. A	Coef. B	Coef. C	Coef. D	Phi1	Co-polar rad. diag.
ORBOPEX	REC-580-6						

13C Remarks

B1a/BR17 Beam designation       B1b Steerable       B2 Emi-Rcp       B3a1 Max. co-polar gain

B2bis.a Transmit only when visible from notified service area  Y      B2bis.b Min. Elev. Angle

B3c1 Co-polar antenna pattern					
Co-polar ref. pattern	Coef. A	Coef. B			Co-polar rad. diag.
ND-SPACE					

B4a3a1 Angle alpha       B4a3a2 Angle beta

BR92 Attach. for missing angle alpha/beta

**\*Tyvak Proprietary\***

E_TSUM Requested by: RICKYP		Date: 19.04.2017 10:20:01 AM	DB: TYVAK-0082-API.MDB		Plan Id.:	Notice type: NONGEO		
A	A1a Sat. Network	TYVAK-0082	A1f1 Notifying adm.	NOR	A1f3 Inter. sat. org.	BR1 Date of receipt	22.02.2017	BR20 BR IFIC no.
BR6a/BR6b Id. no.		6	BR3a Provision reference		9.1/IA	BR2 Adm. serial no.		UHFTX E

BR7a/BR7b Group id.		9	BR1 Date of receipt	22.02.2017	C2c RR No. 4.4	
BR14 Special Section						
C4a Class of station	ET	C3a Assigned freq. band				
C4b Nature of service	CR	C6a Polarization type		CL	C6b Polarization angle	
C8d1 Max. tot. peak pwr.		C8d2 Contiguous bandwidth				
C11a2 Service area	NOR					

C11a3 Service area diagram

A2b Period of valid.  A3a Op. agency  A3b Adm. resp.  BR16 Value of type C8b

BR60 Regulatory deadline(s) 11.44/11.44.1

C1 Frequency Range			
C1a Lower limit		C1b Upper limit	
401	MHz	401.3	MHz

C7a	C8a1/C8b1	C8a2/C8b2	C8c1	C8c2	C8c3	C8c4	C8e1	C8e2	C8f1
Design. of emission	Max. peak pwr	Max. pwr dens.	Min. peak pwr	Attch.	Min. pwr dens.	Attch.	C/N ratio	Attch.	E.i.r.p. on the beam axis
1 16K5G1D	3	-39.2	0.5		-41.7		57		3

C7b Carrier frequency of the emissions (16K5G1D)											
401.04	MHz	401.08	MHz	402.12	MHz	401.16	MHz	401.2	MHz	401.24	MHz

C10b1	C10b2	C10c1		C10c2	C10d1/C10d2	C10d3	C10d4	C10d6		
Assoc. earth station id.	Type	Geographical coord.		Ctry	Cls. / Nat.	Max. iso. gain	Bmwdth	Noise temp.		
ORBOP	S	018E29 14	69N03 19	NOR	1 TT CR	30	5	150		

C10d5a Co-polar antenna pattern							
C10b1 Assoc. earth station id.	Co-polar ref. pattern	Coef. A	Coef. B	Coef. C	Coef. D	Phi1	Co-polar rad. diag.
ORBOP	REC-580-6						

13C Remarks

B1a/BR17 Beam designation	XBANDTX	B1b Steerable		B2 Emi-Rcp	E	B3a1 Max. co-polar gain	8
---------------------------	---------	---------------	--	------------	---	-------------------------	---

B2bis.a Transmit only when visible from notified service area  B2bis.b Min. Elev. Angle

B3c1 Co-polar antenna pattern						
Co-polar ref. pattern	Coef. A	Coef. B				Co-polar rad. diag.
ND-SPACE						

B4a3a1 Angle alpha  B4a3a2 Angle beta

BR92 Attach. for missing angle alpha/beta

BR7a/BR7b Group id.		11	BR1 Date of receipt	22.02.2017	C2c RR No. 4.4	
BR14 Special Section						
C4a Class of station	EW	C3a Assigned freq. band				
C4b Nature of service	CR	C6a Polarization type		CL	C6b Polarization angle	
C8d1 Max. tot. peak pwr.		C8d2 Contiguous bandwidth				
C11a2 Service area	XVE					

A2b Period of valid.

20

A3a Op. agency

999

A3b Adm. resp.

A

BR16 Value of type C8b

C11a3 Service area diagram





**\*Tyvak Proprietary\***

E_TSUM Requested by: RICKYP		Date: 19.04.2017 10:20:01 AM		DB: TYVAK-0082-API.MDB		Plan Id.:		Notice type: NONGEO	
A	A1a Sat. Network	TYVAK-0082	A1f1 Notifying adm.	NOR	A1f3 Inter. sat. org.	BR1 Date of receipt	22.02.2017	BR20 BR IFIC no.	
BR6a/BR6b Id. no.		6	BR3a Provision reference		9.1/IA	BR2 Adm. serial no.			XBANDTX E

BR60 Regulatory deadline(s) 11.44/11.44.1

C1 Frequency Range			
C1a Lower limit		C1b Upper limit	
8045	MHz	8059	MHz

C7a	C8a1/C8b1	C8a2/C8b2	C8c1	C8c2	C8c3	C8c4	C8e1	C8e2	C8f1
Design. of emission	Max. peak pwr	Max. pwr dens.	Min. peak pwr	Attch.	Min. pwr dens.	Attch.	C/N ratio	Attch.	E.i.r.p. on the beam axis
1 1M72G1D	-3	-65.4	-3.5		-65.9		90		3

C7b Carrier frequency of the emissions (1M72G1D)									
8046	MHz	8050	MHz	8054	MHz	8058	MHz		

C10b1	C10b2	C10c1		C10c2	C10d1/C10d2	C10d3	C10d4	C10d6
Assoc. earth station id.	Type	Geographical coord.		Ctry	Cls. / Nat.	Max. iso. Bmwidth	gain	Noise temp.
ORBEX2	T				1 TW CR	50	0.5	150

C10d5a Co-polar antenna pattern							
C10b1 Assoc. earth station id.	Co-polar ref. pattern	Coef. A	Coef. B	Coef. C	Coef. D	Phi1	Co-polar rad. diag.
ORBEX2	REC-580-6						

13C Remarks

C9 Modulation characteristics	C7a Designation of emission 16K5G1D
C9a1 Type of modulation	PSK
C9a2a Lowest frequency	
C9a2b Highest frequency	
C9a2c Frequency deviation	
C9a3a Freq. deviation of the pre-emphasized signal	
C9a3b Pre-emphasis characteristics	
C9a3c Type of multiplexing	
C9a4a Bit rate	
C9a4b Number of phases	
C9a5a Modulating signal attached (see atch. no.)	
C9a5b Amplitude modulation	
C9a6a Peak-to-peak freq. dev.	
C9a6b Sweep frequency	
C9a6c Energy dispersal waveform	
C9a7 Type of energy dispersal	
C9a8 Other types of modulation (see atch. no.)	
C9a9 TV standard	
BR7a Group id.	9, 12

**\*Tyvak Proprietary\***

E_TSUM Requested by: RICKYP		Date: 19.04.2017 10:20:01 AM		DB: TYVAK-0082-API.MDB		Plan Id.:		Notice type: NONGEO	
A	A1a Sat. Network	TYVAK-0082	A1f1 Notifying adm.	NOR	A1f3 Inter. sat. org.	BR1 Date of receipt	22.02.2017	BR20 BR IFIC no.	
	BR6a/BR6b Id. no.	6	BR3a Provision reference	9.1/IA	BR2 Adm. serial no.				XBANDTX E

C9 Modulation characteristics	C7a Designation of emission 1M50G1D
C9a1 Type of modulation	PSK
C9a2a Lowest frequency	
C9a2b Highest frequency	
C9a2c Frequency deviation	
C9a3a Freq. deviation of the pre-emphasized signal	
C9a3b Pre-emphasis characteristics	
C9a3c Type of multiplexing	
C9a4a Bit rate	
C9a4b Number of phases	
C9a5a Modulating signal attached (see atch. no.)	
C9a5b Amplitude modulation	
C9a6a Peak-to-peak freq. dev.	
C9a6b Sweep frequency	
C9a6c Energy dispersal waveform	
C9a7 Type of energy dispersal	
C9a8 Other types of modulation (see atch. no.)	
C9a9 TV standard	
BR7a Group id.	10

C9 Modulation characteristics	C7a Designation of emission 1M72G1D
C9a1 Type of modulation	PSK
C9a2a Lowest frequency	
C9a2b Highest frequency	
C9a2c Frequency deviation	
C9a3a Freq. deviation of the pre-emphasized signal	
C9a3b Pre-emphasis characteristics	
C9a3c Type of multiplexing	
C9a4a Bit rate	
C9a4b Number of phases	
C9a5a Modulating signal attached (see atch. no.)	
C9a5b Amplitude modulation	
C9a6a Peak-to-peak freq. dev.	
C9a6b Sweep frequency	
C9a6c Energy dispersal waveform	
C9a7 Type of energy dispersal	
C9a8 Other types of modulation (see atch. no.)	
C9a9 TV standard	
BR7a Group id.	11

BR22 Administration remarks

BR23 Radiocommunication Bureau comments

SES-STA-20180607-01103

IB2018002333

RBC Signals, LLC

Approved by OMB  
3060-0678

APPLICATION FOR EARTH STATION SPECIAL TEMPORARY AUTHORITY

APPLICANT INFORMATION Enter a description of this application to identify it on the main menu:  
60-Day STA for TT&C

1. Applicant

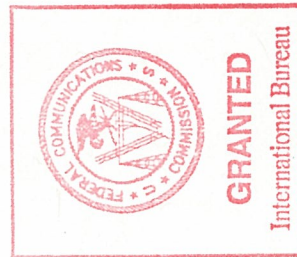
<b>Name:</b>	RBC Signals, LLC	<b>Phone Number:</b>	404-803-7734
<b>DBA Name:</b>		<b>Fax Number:</b>	
<b>Street:</b>	2205 152nd Ave NE	<b>E-Mail:</b>	crichins@rbcsignals.com
<b>City:</b>	Redmond	<b>State:</b>	WA
<b>Country:</b>	USA	<b>Zipcode:</b>	98052
<b>Attention:</b>	Mr. Christopher Richins		

File # SES-STA-20180607-01103

Call Sign N/A Grant Date 9/26/2018  
(or other identifier)

Term Dates  
From 9/26/2018 To: 10/15/2018

Approved: David E. Hays



Applicant: RBC Signals, LLC  
 File No: SES-STA-20180607-01103  
 Call Sign: None  
 Special Temporary Authority (STA)



File # SES - STA - 20180607 - 01103

Call Sign N/A Grant Date 9/26/2018  
 (or other identifier)

Term Dates  
 From 9/26/2018 To: 10/10/2018  
 Approved: [Signature]

This emergency special temporary authority is granted based on the report that due to a mechanical failure of the Tyvak Nano-Satellite Systems Inc. ground station in Norway Tyvak is unable to adequately communicate with the four CICERO-7 (NORAD ID 43143, Int'l Code 2018-004AJ) and TYVAK-61C (NORAD ID 43144, Int'l Code 2018-004AK) NGSO spacecraft to provide them tracking, telemetry and command signals.

RBC Signals, LLC, is authorized special temporary authority for 14 days beginning September 26, 2018 to operate a 3.57 meter Yagi antenna fixed earth station in Deadhorse, AK, to provide telemetry, tracking and command services in the 401-401.3 MHz (Earth-to-space/space-to-Earth) frequency band to the four Norwegian-licensed CICERO spacecraft operating that are operating at an orbital altitude of approximately 550 km and an inclination of 97.8° on the following conditions:

1. This STA is for emergency operations for a period not to exceed 14 days, and for purposes of Section 1.62(c) of the FCC rules is issued for an activity that is not of a continuing nature. For operations to continue beyond the 14 day period, a request for extension of this STA must be filed and granted prior to expiration of the current STA. Otherwise, operations must cease. Any request for an extension must be support by a detailed showing concerning the status of the Norwegian ground station and a detailed time-line of actions taken to repair it.
2. Operations are authorized only as specified below.

Freq,	Polar	Emission	EIRP per Carrier (dBW)	eirp density (dBW/4KHz)
Transmitting:				
401.0-401.3 MHz	RHC	16K5G2D	32.7	26.7
Receiving:				
401.0-401.3 MHz	RHC	16K5G2D	N/A	N/A

3. The Remote Control Point Personnel, located at 2205 152nd Street NE, Redmond (King), Washington 98052, Tel. 650-746-8744 and Zachary Reich, RBC Signals - +1 415 622 5548 must be available at all times to respond to interference issues and shut down operations if needed.
4. Operations shall be on an unprotected, non-interference basis with respect to other authorized stations, including federal stations.
5. This is not a grant of market access to the United States.
6. RBC Signals, LLC shall be aware that future STA requests will be considered on a case-by-case basis and shall have no expectations that future operations will be approved.
7. Any action taken or expense incurred as a result of operations pursuant to this STA is solely at RBC Signals, LLC's risk.
8. Grant of this STA is without prejudice to any determination that the Commission may make regarding any future applications.

This grant is issued pursuant to Section 0.261 of the Commission's rules on delegated authority, 47 C.F.R. § 0.261, and is effective upon release.

<b>2. Contact</b>	
<b>Name:</b> Carlos Nalda	<b>Phone Number:</b> 5713325626
<b>Company:</b> LMI Advisors	<b>Fax Number:</b>
<b>Street:</b> 2550 M Street NW Suite 345	<b>E-Mail:</b> cnalda@lmiadvisors.com
<b>City:</b> Washington	<b>State:</b> DC
<b>Country:</b> USA	<b>Zipcode:</b> 20037
<b>Attention:</b>	<b>Relationship:</b> Other
(If your application is related to an application filed with the Commission, enter either the file number or the IB Submission ID of the related application. Please enter only one.)	
3. Reference File Number SESSTA2018033000293 or Submission ID	
4a. Is a fee submitted with this application?	
<input checked="" type="radio"/> If Yes, complete and attach FCC Form 159. If No, indicate reason for fee exemption (see 47 C.F.R. Section 1.1114). <input type="radio"/> Governmental Entity <input type="radio"/> Noncommercial educational licensee <input type="radio"/> Other (please explain):	
4b. Fee Classification CGX – Fixed Satellite Transmit/Receive Earth Station	
5. Type Request	
<input checked="" type="radio"/> Use Prior to Grant <input type="radio"/> Change Station Location <input type="radio"/> Other	
6. Requested Use Prior Date 06/08/2018	
7. City Deadhorse	
8. Latitude (dd mm ss.s h) 70 12 42.9 N	

9. State AK	10. Longitude (dd mm ss.s h) 148 26 15.2 W
11. Please supply any need attachments. Attachment 1: Narrative Attachment 2: Technical Appendix Attachment 3:	
12. Description. (If the complete description does not appear in this box, please go to the end of the form to view it in its entirety.) <div style="border: 1px solid black; padding: 5px; margin: 5px 0;">60-day STA request to provide TT&amp;C for CICERO mission.</div>	
13. By checking Yes, the undersigned certifies that neither applicant nor any other party to the application is subject to a denial of Federal benefits that includes FCC benefits pursuant to Section 5301 of the Anti-Drug Act of 1988, 21 U.S.C. Section 862, because of a conviction for possession or distribution of a controlled substance. See 47 CFR 1.2002(b) for the meaning of "party to the application"; for these purposes. <input checked="" type="radio"/> Yes <input type="radio"/> No	
14. Name of Person Signing Christopher Richins	15. Title of Person Signing CEO
WILLFUL FALSE STATEMENTS MADE ON THIS FORM ARE PUNISHABLE BY FINE AND / OR IMPRISONMENT (U.S. Code, Title 18, Section 1001), AND/OR REVOCATION OF ANY STATION AUTHORIZATION (U.S. Code, Title 47, Section 312(a)(1)), AND/OR FORFEITURE (U.S. Code, Title 47, Section 503).	

**FCC NOTICE REQUIRED BY THE PAPERWORK REDUCTION ACT**

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Remember – You are not required to respond to a collection of information sponsored by the Federal government, and the government may not conduct or sponsor this collection, unless it displays a currently valid OMB control number or if we fail to provide you with this notice. This collection has been assigned an OMB control number of 3060-0678.

**THE FOREGOING NOTICE IS REQUIRED BY THE PAPERWORK REDUCTION ACT OF 1995, PUBLIC LAW 104-13, OCTOBER 1, 1995, 44 U.S.C. SECTION 3507.**

**TECHNICAL APPENDIX**

**RBC Signals LLC  
60-Day Special Temporary Authorization (STA)**

- I. 400 MHz Yagi Radiation Hazard Report
- II. Draft FCC Form 312 Schedule B
- III. Nkom Email Authorization

**\*Proprietary & Confidential\***



# I. Radiation Hazard Study

## 400 MHz Earth Station

This study analyzes the non-ionizing radiation levels for a 400 MHz Yagi tracking earth station. This report is developed in accordance with the prediction methods contained in OET Bulletin No. 65, Evaluating Compliance with FCC Guidelines for Human Exposure to Radio Frequency Electromagnetic Fields, Edition 97-01.

Bulletin No. 65 specifies that there are two separate tiers of exposure limits that are depending on the area of exposure and/or the status of the individuals who are subject to the exposure -- the General Population/Uncontrolled Environment and the Controlled Environment, where the general population cannot access.

The maximum level of non-ionizing radiation to which individuals may be exposed is limited to a power density level of 1.33 milliwatts per square centimeter (1.33 mW/cm<sup>2</sup>) averaged over any 6 minute period in a controlled environment, and the maximum level of non-ionizing radiation to which the general public is exposed is limited to a power density level of 0.27 milliwatt per square centimeter (0.27 mW/cm<sup>2</sup>) averaged over any 30 minute period in a uncontrolled environment.

In the normal range of transmit powers for satellite antennas, the power densities at or around the antenna surface are expected to exceed safe levels. The purpose of this study is to determine the power flux density levels for the earth station under study as compared with the MPE limits. This comparison is done in each of the following regions:

1. Far-field region
2. Near-field region
3. Transition region
4. The region between the antenna edge and the ground

### Input Parameters

The following input parameters were used in the calculations:

<u>Parameters:</u>	<u>Value</u>	<u>Unit</u>	<u>Symbol</u>
<i>Antenna Diameter</i>	3.57	m	<i>D</i>
<i>Antenna Transmit Gain</i>	16.2	dBi	<i>G</i>
<i>Transmit Frequency</i>	400	MHz	<i>f</i>
<i>Power Input to the Antenna</i>	44.7	W	<i>P</i>

### Calculated Parameters:

The following values were calculated using the above input parameters and the

corresponding formulas:

<u>Parameter</u>	<u>Value</u>	<u>Unit</u>	<u>Symbol</u>	<u>Formula</u>
<i>Antenna Surface Area</i>	1.964	m <sup>2</sup>	<i>A</i>	$G\lambda^2/(4\pi)/\lambda$
<i>Antenna Efficiency</i>	0.95		$\eta$	$G\lambda^2/(\pi^2 D^2)$
<i>Gain Factor</i>	41.7		<i>g</i>	$10^{G/10}$
<i>Wavelength</i>	0.75	m	$\lambda$	$300/f$

### **Behavior of EM Fields as a Function of Distance**

The behavior of the characteristics of EM fields varies depending on the distance from the radiating antenna. These characteristics are analyzed in three primary regions: the near-field region, the far-field region and the transition region. Of interest also is the region between the antenna and ground.

For yagi antennas with circular cross sections, such as the antenna under study, the near-field, far-field and transition region distances are calculated as follows:

<u>Parameter</u>	<u>Value</u>	<u>Unit</u>	<u>Formula</u>
<i>Near-Field Distance</i>	4.25	m	$R_{nf} = D^2/(4\lambda)$
<i>Distance to Far-Field</i>	10.2	m	$R_{ff} = 0.60D^2/(\lambda)$
<i>Distance of Transition Region</i>	4.25	m	$R_t = R_{nf}$

The distance in the transition region is between the near and far fields. Thus,  $R_{nf} \leq R_t \leq R_{ff}$ . However, the power density in the transition region will not exceed the power density in the near-field. Therefore, for purposes of the present analysis, the distance of the transition region can equate the distance to the near-field.

### **Power Flux Density Calculations**

The power flux density is considered to be at a maximum through the entire length of the near-field. This region is contained within a cylindrical volume with a diameter, *D*, equal to the diameter of the antenna. In the transition region and the far-field, the power density decreases inversely with the square of the distance. The following equations are used to calculate power density in these regions.

<u>Parameter</u>	<u>Value</u>	<u>Unit</u>	<u>Symbol</u>	<u>Formula</u>
<i>Power Density in the Near-Field</i>	8.65	mW/cm <sup>2</sup>	$S_{nf}$	$16.0 \eta P/(\pi D^2)$
<i>Power Density in the Far-Field</i>	0.14	mW/cm <sup>2</sup>	$S_{ff}$	$GP/(4\pi R_{ff}^2)$
<i>Power Density in the Transition Region</i>	8.65	mW/cm <sup>2</sup>	$S_t$	$S_{nf} R_{nf}/(R_t)$

The power density between the antenna and ground, is calculated as follows:

<u>Parameter</u>	<u>Value</u>	<u>Unit</u>	<u>Symbol</u>	<u>Formula</u>
<i>Power Density b/w Reflector and Ground</i>	2.28	mW/cm <sup>2</sup>	$S_g$	$P/A$

The below table summarizes the calculated power flux density values for each region. In a controlled environment, the only regions that exceed FCC limitations are shown below.

These regions are only accessible by trained technicians who, as a matter of procedure, turn off transmit power before performing any work in these areas.

<u>Power Density</u>	<u>Value</u>	<u>Unit</u>	<u>Controlled Environment</u>
<i>Far Field Calculation</i>	0.14	mW/cm <sup>2</sup>	Satisfies FCC MPE
<i>Near Field Calculation</i>	8.65	mW/cm <sup>2</sup>	Exceeds Limits
<i>Transition Region</i>	8.65	mW/cm <sup>2</sup>	Exceeds Limits
<i>Region b/w Antenna &amp; Ground</i>	2.28	mW/cm <sup>2</sup>	Exceeds Limits

In conclusion, the results show that the antenna, in a controlled environment, may exist in the regions noted above and applicant will take the proper mitigation procedures to ensure it meets the guidelines specified in 47 C.F.R. § 1.1310.

The antenna will be installed at DS12 Access Road, Prudhoe Bay, Alaska 99734. Access to the antenna requires a 45 ft man-lift, which should safely restrict any public access. It should be noted that all spaces at least 7.5m away from the antenna satisfy the FCC MPE limits for the general population. The earth station will be marked with the standard radiation hazard warnings, as well as the area in the vicinity of the earth station to inform the general population, who might be working or otherwise present in or near the path of the main beam.

The applicant will ensure that the main beam of the antenna will be pointed at least one diameter away from any building, or other obstacles in those areas that exceed the MPE limits. Since one diameter removed from the center of the main beam the levels are down at least 20 dB, or by a factor of 100, public safety will be ensured.

Finally, the earth station's operational personnel will not have access to areas that exceed the MPE limits while the earth station is in operation. The transmitter will be turned off during periods of maintenance so that the MPE standard of 1.33 mW/cm<sup>2</sup> will be complied with for those regions in close proximity to the antenna, which could be occupied by operating personnel.

Approved by OMB  
3060-0678

### II. Draft FCC Form 312 Schedule B

Date & Time Filed:  
File Number: ---  
Callsign/Satellite ID:

<b>APPLICATION FOR EARTH STATION AUTHORIZATIONS</b>	<b>FCC Use Only</b>
<b>FCC 312 MAIN FORM FOR OFFICIAL USE ONLY</b>	

#### APPLICANT INFORMATION

Enter a description of this application to identify it on theaim menu:  
**DRAFT FORM TO SUPPORT 60-DAY STA REQUEST (Tyvak)**

1-8. Legal Name of Applicant			
Name:	RBC Signals, LLC	Phone Number:	404-803-7734
DBA Name:		Fax Number:	
Street:	2205 152nd Ave NE	E-Mail:	crichins@rbcsignals.com
City:	Redmond	State:	WA
Country:	USA	Zipcode:	98052 -
Attention: Mr. Christopher Richins			
9-16. Name of Contact Representative			
Name:	Carlos Nalda	Phone Number:	5713325626
Company:	LMI Advisors	Fax Number:	
Street:	2550 M Street NW Suite 345	E-Mail:	cnalda@lmiadvisors.com
City:	Washington	State:	DC
Country:	USA	Zipcode:	20037-
Attention: Mr. Carlos Nalda		Relationship:	Other

#### CLASSIFICATION OF FILING

17. Choose the button next to the classification that applies to this filing for both questions a. and b. Choose only one for 17a and only one for 17b.	b. <input type="radio"/> b1. Application for License of New Station <input type="radio"/> b2. Application for Registration of New Domestic Receive-Only Station (N/A) b3. Amendment to a Pending Application (N/A) b4. Modification of License or Registration (N/A) b5. Assignment of License or Registration (N/A) b6. Transfer of Control of License or Registration (N/A) b7. Notification of Minor Modification (N/A) b8. Application for License of New Receive-Only Station Using Non-U.S. Licensed Satellite (N/A) b9. Letter of Intent to Use Non-U.S. Licensed Satellite to Provide Service in the United States <input checked="" type="radio"/> b10. Other (Please specify) <input type="radio"/> b11. Application for Earth Station to Access a Non-U.S. satellite Not Currently Authorized to Provide the Proposed Service in the Proposed Frequencies in the United States.
a. <input checked="" type="radio"/> a1. Earth Station (N/A) a2. Space Station	
17c. Is a fee submitted with this application? <input type="radio"/> If Yes, complete and attach FCC Form 159.  If No, indicate reason for fee exemption (see 47 C.F.R. Section 1.1114). <input type="radio"/> Governmental Entity <input type="radio"/> Noncommercial educational licensee <input checked="" type="radio"/> Other (please explain): DRAFT FORM	
17d. <b>Fee Classification</b>	
18. If this filing is in reference to an	19. If this filing is an amendment to a pending application enter:

existing station, enter: (a) Call sign of station: Not Applicable	(a) Date pending application was filed: Not Applicable	(b) File number of pending application: Not Applicable
---	---	---

**TYPE OF SERVICE**

20. NATURE OF SERVICE: This filing is for an authorization to provide or use the following type(s) of service(s): Select all that apply:

a. Fixed Satellite  
 b. Mobile Satellite  
 c. Radiodetermination Satellite  
 d. Earth Exploration Satellite  
 e. Direct to Home Fixed Satellite  
 f. Digital Audio Radio Service  
 g. Other (please specify)  
 NGSO

21. STATUS: Choose the button next to the applicable status. Choose only one.  
 Common Carrier  Non-Common Carrier

22. If earth station applicant, check all that apply.  
 Using U.S. licensed satellites  
 Using Non-U.S. licensed satellites

23. If applicant is providing INTERNATIONAL COMMON CARRIER service, see instructions regarding Sec. 214 filings. Choose one. Are these facilities:  
 Connected to a Public Switched Network  Not connected to a Public Switched Network  N/A

24. FREQUENCY BAND(S): Place an "X" in the box(es) next to all applicable frequency band(s).  
 a. C-Band (4/6 GHz)  b. Ku-Band (12/14 GHz)  
 c. Other (Please specify upper and lower frequencies in MHz.)  
 Frequency Lower: 401 Frequency Upper: 401.3

**TYPE OF STATION**

25. CLASS OF STATION: Choose the button next to the class of station that applies. Choose only one.  
 a. Fixed Earth Station  
 b. Temporary-Fixed Earth Station  
 c. 12/14 GHz VSAT Network  
 d. Mobile Earth Station  
 (N/A) e. Geostationary Space Station  
 (N/A) f. Non-Geostationary Space Station  
 g. Other (please specify)

26. TYPE OF EARTH STATION FACILITY: Choose only one.  
 Transmit/Receive  Transmit-Only  Receive-Only  N/A

**PURPOSE OF MODIFICATION**

27. The purpose of this proposed modification is to: (Place an 'X' in the box(es) next to all that apply.)  
 Not Applicable

**ENVIRONMENTAL POLICY**

28. Would a Commission grant of any proposal in this application or amendment have a significant environmental impact as defined by 47 CFR 1.1307? If YES, submit the statement as required by Sections 1.1308 and 1.1311 of the Commission's rules, 47 C.F.R. §§ 1.1308 and 1.1311, as an exhibit to this application. A Radiation Hazard Study must accompany all applications for new transmitting facilities, major modifications, or major amendments.  Yes  No

**ALIEN OWNERSHIP** Earth station applicants not proposing to provide broadcast, common carrier, aeronautical en route or aeronautical fixed radio station services are not required to respond to Items 30-34.

29. Is the applicant a foreign government or the representative of any foreign government?  Yes  No

30. Is the applicant an alien or the representative of an alien?  Yes  No  N/A

31. Is the applicant a corporation organized under the laws of any foreign government?  Yes  No  N/A

32. Is the applicant a corporation of which more than one-fifth of the capital stock is owned of record or voted by aliens or their representatives or by a foreign government or representative thereof or by any corporation organized under the laws of a foreign country?  Yes  No  N/A

33. Is the applicant a corporation directly or indirectly controlled by any other corporation of which more than one-fourth of the capital stock is owned of record or voted by aliens, their representatives, or by a

foreign government or representative thereof or by any corporation organized under the laws of a foreign country?

34. If any answer to questions 29, 30, 31, 32 and/or 33 is Yes, attach as an exhibit an identification of the aliens or foreign entities, their nationality, their relationship to the applicant, and the percentage of stock they own or vote.

### BASIC QUALIFICATIONS

35. Does the Applicant request any waivers or exemptions from any of the Commission's Rules?  Yes  No  
If Yes, attach as an exhibit, copies of the requests for waivers or exceptions with supporting documents.

36. Has the applicant or any party to this application or amendment had any FCC station authorization or license revoked or had any application for an initial, modification or renewal of FCC station authorization, license, or construction permit denied by the Commission? If Yes, attach as an exhibit, an explanation of circumstances.  Yes  No

37. Has the applicant, or any party to this application or amendment, or any party directly or indirectly controlling the applicant ever been convicted of a felony by any state or federal court? If Yes, attach as an exhibit, an explanation of circumstances.  Yes  No

38. Has any court finally adjudged the applicant, or any person directly or indirectly controlling the applicant, guilty of unlawfully monopolizing or attempting unlawfully to monopolize radio communication, directly or indirectly, through control of manufacture or sale of radio apparatus, exclusive traffic arrangement or any other means or unfair methods of competition? If Yes, attach as an exhibit, an explanation of circumstances.  Yes  No

39. Is the applicant, or any person directly or indirectly controlling the applicant, currently a party in any pending matter referred to in the preceding two items? If yes, attach as an exhibit, an explanation of the circumstances.  Yes  No

40. If the applicant is a corporation and is applying for a space station license, attach as an exhibit the names, address, and citizenship of those stockholders owning a record and/or voting 10 percent or more of the Filer's voting stock and the percentages so held. In the case of fiduciary control, indicate the beneficiary(ies) or class of beneficiaries. Also list the names and addresses of the officers and directors of the Filer.

41. By checking Yes, the undersigned certifies, that neither applicant nor any other party to the application is subject to a denial of Federal benefits that includes FCC benefits pursuant to Section 5301 of the Anti-Drug Act of 1988, 21 U.S.C. Section 862, because of a conviction for possession or distribution of a controlled substance. *See 47 CFR 1.2002(b) for the meaning of "party to the application" for these purposes.*  Yes  No

42a. Does the applicant intend to use a non-U.S. licensed satellite to provide service in the United States? If Yes, answer 42b and attach an exhibit providing the information specified in 47 C.F.R. 25.137, as appropriate. If No, proceed to question 43.  Yes  No

42b. What administration has licensed or is in the process of licensing the space station? If no license will be issued, what administration has coordinated or is in the process of coordinating the space station? Norway

43. Description. (Summarize the nature of the application and the services to be provided). Draft Form to support 30-day STA request to provide TT&C for CICERO spacecraft.

43a. Geographic Service Rule Certification  
By selecting A, the undersigned certifies that the applicant is not subject to the geographic service or geographic coverage requirements specified in 47 C.F.R. Part 25.  A  
  
By selecting B, the undersigned certifies that the applicant is subject to the geographic service or geographic coverage requirements specified in 47 C.F.R. Part 25 and will comply with such requirements.  B  
  
By selecting C, the undersigned certifies that the applicant is subject to the geographic service or geographic coverage requirements specified in 47 C.F.R. Part 25 and will not comply with such requirements because it is not feasible as a technical matter to do so, or that, while technically feasible, such services would require so many compromises in satellite design and operation as to make it economically unreasonable. A narrative description and technical analysis demonstrating this claim are attached.  C

### CERTIFICATION

The Applicant waives any claim to the use of any particular frequency or of the electromagnetic spectrum as against the regulatory power of the United States because of the previous use of the same, whether by license or otherwise, and requests an authorization in accordance with this application. The applicant certifies that grant of this application would not cause the applicant to be in violation of the spectrum aggregation limit in 47 CFR Part 20. All statements made in exhibits are a material part hereof and are incorporated herein as if set out in full in this application. The undersigned, individually and for the applicant, hereby certifies that all statements made in this application and in all attached exhibits are true, complete and correct to the best of his or her knowledge and belief, and are made in good faith.

44. Applicant is a (an): (Choose the button next to applicable response.)

- Individual
- Unincorporated Association
- Partnership
- Corporation
- Governmental Entity
- Other (please specify)  
LLC

45. Name of Person Signing  
Christopher Richins

46. Title of Person Signing  
CEO

47. Please supply any need attachments.

Attachment 1:

Attachment 2:

Attachment 3:

**WILLFUL FALSE STATEMENTS MADE ON THIS FORM ARE PUNISHABLE BY FINE AND / OR IMPRISONMENT (U.S. Code, Title 18, Section 1001), AND/OR REVOCATION OF ANY STATION AUTHORIZATION (U.S. Code, Title 47, Section 312(a)(1)), AND/OR FORFEITURE (U.S. Code, Title 47, Section 503).**

**SATELLITE EARTH STATION AUTHORIZATIONS  
FCC Form 312 - Schedule B:(Technical and Operational Description)**

**FOR OFFICIAL USE ONLY**

Location of Earth Station Site

E1. Site Identifier:	Deadhorse	E5. Call Sign:	
E2. Contact Name	Zachary Reich	E6. Phone Number:	415-622-5548
E3. Street:		E7. City:	Deadhorse
E4. State	AK	E8. County:	North Slope Borough
E10. Area of Operation:		E9. Zip Code	99734
E11. Latitude:	70 ° 12 ' 42.9 " N	E13. Lat/Lon Coordinates are:	<input type="radio"/> NAD-27 <input checked="" type="radio"/> NAD-83 <input type="radio"/> N/A
E12. Longitude:	148 ° 26 ' 15.2 " W	E14. Site Elevation (AMSL):	15.0 meters

E15. If the proposed antenna(s) operate in the Fixed Satellite Service (FSS) with geostationary satellites, do(es) the proposed antenna(s) comply with the antenna gain patterns specified in Section 25.209(a) and (b) as demonstrated by the manufacturer's qualification measurement? If NO, provide a technical analysis showing compliance with two-degree spacing policy.	<input type="radio"/> Yes <input type="radio"/> No <input checked="" type="radio"/> N/A
---	---

E16. If the proposed antenna(s) do not operate in the Fixed Satellite Service (FSS), or if they operate in the Fixed Satellite Service (FSS) with non-geostationary satellites, do(es) the proposed antenna(s) comply with the antenna gain patterns specified in Section 25.209(a2) and (b) as demonstrated by the manufacturer's qualification measurements?	<input checked="" type="radio"/> Yes <input type="radio"/> No <input type="radio"/> N/A
--	---

E17. Is the facility operated by remote control? If YES, provide the location and telephone number of the control point.	<input checked="" type="radio"/> Yes <input type="radio"/> No
--	---

E18. Is frequency coordination required? If YES, attach a frequency coordination report as	<input type="radio"/> Yes <input checked="" type="radio"/> No
--	---

E19. Is coordination with another country required? If YES, attach the name of the country(ies) and plot of coordination contours as	<input type="radio"/> Yes <input checked="" type="radio"/> No
--	---

<b>E20. FAA Notification - (See 47 CFR Part 17 and 47 CFR part 25.113(c)) Where FAA notification is required, have you attached a copy of a completed FCC Form 854 and or the FAA's study regarding the potential hazard of the structure to aviation? FAILURE TO COMPLY WITH 47 CFR PARTS 17 AND 25 WILL RESULT IN THE RETURN OF THIS APPLICATION.</b>	<input type="radio"/> Yes <input checked="" type="radio"/> No
---	---

**POINTS OF COMMUNICATION**

Satellite Name: OTHER   OTHER   If you selected OTHER, please enter the following:	
E21. Common Name: CICERO Cubesats	E22. ITU Name: Tyvak-0082
E23. Orbit Location: NGSO	E24. Country: Norway

**POINTS OF COMMUNICATION (Destination Points)**

E25. Site Identifier: Deadhorse	
E26. Common Name:	E27. Country: USA

**ANTENNA**

Site ID	E28. Antenna Id	E29. Quantity	E30. Manufacturer	E31. Model	E32. Antenna Size	E41/42. Antenna Gain/Transmit and/or Recieve(____dBi at ____GHz)	
Deadhorse	YAGI-1	1	M2 Antenna Systems	400CP30A	3.57	16.2 dBi at 0.400	

E28. Antenna Id	E33/34. Diameter Minor/Major(meters)	E35. Above Ground Level (meters)	E36. Above Sea Level (meters)	E37. Building Height Above Ground Level (meters)	E38. Total Input Power at antenna flange (Watts)	E39. Maximum Antenna Height Above Rooftop (meters)	E40. Total EIRP for al carriers (dBW)
YAGI-1	0.025/3.57	15.0	0.0	0.0	44.7	0.0	32.7

**FREQUENCY**

E28. Antenna Id	E43/44. Frequency Bands(MHz)	E45. T/R Mode	E46. Antenna Polarization(H,V,L,R)	E47. Emission Designator	E48. Maximum EIRP per Carrier(dBW)	E49. Maximum ERIP Density per Carrier(dBW/4kHz)
YAGI-1	401 401.3	R	Right Hand Circular	16K5G1D	0.0	0.0

E50. Modulation and Services TT&C Downlink						
YAGI-1	401 401.3	T	Right Hand Circular	16K5G1D	32.7	26.7
E50. Modulation and Services TT&C Uplink						

**FREQUENCY COORDINATION**

E28. Antenna Id	E51. Satellite Orbit Type	E52/53. Frequency Limits(MHz)	E54/55. Range of Satellite Arc E/W Limit	E56. Earth Station Azimuth Angle Eastern Limit	E57. Antenna Elevation Angle Eastern Limit	E58. Earth Station Azimuth Angle Western Limit	E59. Antenna Elevation Angle Western Limit	E60. Maximum EIRP Density toward the Horizon(dBW/4kHz)
YAGI-1	Non-Geostationary	401 401.3	0.0/ 0.0	0.0	5.0	360.0	5.0	0.0
	Non-Geostationary	401 401.3	0.0/ 0.0	0.0	5.0	360.0	5.0	26.7

**REMOTE CONTROL POINT LOCATION**

**REMOTE CONTROL POINT LOCATION**

E61. Call Sign		E65. Phone Number	
NOTE: Please enter the callsign of the controlling station, not the callsign for which this application is being filed.		650-746-8744	
E62. Street Address			
2205 152nd Street NE			
E63. City		E67. County	
Redmond		King	
E64/68. State/Country		E66. Zip Code	
WA/ USA		98052	

**FCC NOTICE REQUIRED BY THE PAPERWORK REDUCTION ACT**

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required data, and completing and reviewing the collection of information. If you have any comments on this burden estimate, or how we can improve the collection and reduce the burden it causes you, please write to the Federal Communications Commission, AMD-PER, Paperwork Reduction Project (3060-0678), Washington, DC 20554. We will also accept your comments regarding the Paperwork Reduction Act aspects of this collection via the Internet if you send them to [PRA@fcc.gov](mailto:PRA@fcc.gov). PLEASE DO NOT SEND COMPLETED FORMS TO THIS ADDRESS.

Remember - You are not required to respond to a collection of information sponsored by the Federal government, and the government may not conduct or sponsor this collection, unless it displays a currently valid OMB control number or if we fail to provide you with this notice. This collection has been assigned an OMB control number of 3060-0678.

THE FOREGOING NOTICE IS REQUIRED BY THE PAPERWORK REDUCTION ACT OF 1995, PUBLIC LAW 104-13, OCTOBER 1, 1995, 44 U.S.C. SECTION 3507.

### III. Nkom Email Authorization

**\*Tyvak Proprietary\***

**From:** "Målen Frode" <frode.maalen@nkom.no>  
**Sent:** Fri, 21 Apr 2017 07:56:17 +0000  
**To:** "BRMAIL, ITU" <BRMail@itu.int>  
**Subject:** Submission of Advance Publication Information for Satellite Network Tyvak-0082  
**Attachments:** Tyvak-0082-API.zip

Dear Sirs,

With reference to Radio Regulations Article 9, no. 9.1, we are pleased to forward information on a Norwegian satellite network: Tyvak-0082 for Advanced Publication of Information in the BR IFIC. The network are not subject to coordination, cf. Article 9, Sub-Section IA.

The Tyvak-0082 network is a n-GSO systems with 4 satellites in one orbital plane with 97,6° inclination. The validity is 20 years.

The technical data for the network has been prepared in accordance with Radio Regulations Appendix 4, Annex 2. Enclosed please find the filing in the zipped format, prepared in the SpaceCap program.

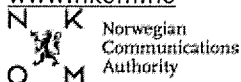
The operating agency for the networks is Orbital Networks A/S, Norway. In the API, clause A3a is given as 9999. Notification Form of the List of Recognized Operating Agencies (ROAs) for Orbital Networks AS will be sent in a separate e-mail.

We kindly ask BR to initiate the relevant procedures under Article 9 of the Radio Regulations with regard to this network.

If further clarification is necessary, we are pleased to be at your disposal.

This E-mail has been confirmed by fax transmission to BR today.

Best regards,  
Frode Målen  
Senior Engineer  
Section for Frequency Planning  
Norwegian Communications Authority  
Switchboard: + 47 22 82 46 00  
Direct: + 47 22 82 46 04  
Mobile: + 47 93 45 58 64  
[www.nkom.no](http://www.nkom.no)



## SpacePub Submission

E_TSUM Requested by: RICKYF	Date: 19.04.2017 10:20:01 AM	DB: TYVAK-0082-API, MDB	Plan Id.: 22.02.2017	Notice type: NONGEO
A A7a Sat. Network TYVAK-0082	A7f1 Notifying adm. NOR	A7f3 Inter. sat. org.	BR1 Date of receipt 22.02.2017	BR20 BR IFIC no.
BR6a/BR6b Id. no. 6	BR3a Provision reference 9.1/IA		BR2 Adm. serial no.	

### Résumé / Summary / Resumen

Article 9, sous-section IA / Article 9, sub-section IA / Artículo 9, sub-sección IA  
 第9条第1A分节 / Статья 9, подраздел IA / المادة 9، القسم الفرعي IA

**\*Tyvak Proprietary\***

B1a Beam designation	B2 Emi-Rcp	BR8 Action code	BR7a Group id.	BR9 Action code	BR47 Frequency band (MHz)	C4a Class of station
UHFRX	R		12		401 - 401.3	EW
SBANDTX	E		10		2200 - 2202	ET, EW
UHFTX	E		9		401 - 401.3	ET
XBANDTX	E		11		8045 - 8059	EW

**\*Tyvak Proprietary\***

E.TSUM Requested by: RICKYP Date: 19.04.2017 10:20:01 AM DB: TYVAK-0082-API.MDB Plan Id.: Notice type: NONGEO  
 A A1a Sat. Network TYVAK-0082 A11 Notifying adm. NOR A13 Inter. sat. org BR1 Date of receipt 22.02.2017 BR20 BR IFIC no.  
 BR6a/BR6b Id. no. 6 BR3a Provision reference 9.1/1A BR2 Adm. serial no. UHERX R

A12 Submitted on behalf  
 A4b1 No. of orbital planes 1 A4b2 Ref. body T  
 A4b3a No. of space stations simult. trans. on Northern Hemisphere A4b3b No. of space stations simult. trans. on Southern Hemisphere

Orbital plane id. no.	A4b4a Inclination angle	A4b4b No. of satellites in this plane	A4b4c Period	A4b4d Apogee	A4b4e Perigee	A4b4f Min. altitude
1	97.6	4	0-01:37	600e0	600e0	600

B1a/BR17 Beam designation UHERX B1b Steerable B2 Emi:Rcp R B3a1 Max. co-polar gain 2

B2bis.a Transmit only when visible from notified service area B2bis.b Min. Elev. Angle  
 B3c1 Co-polar antenna pattern  
 Co-polar ref. pattern ND-SPACE Coef. A Coef. B Co-polar rad. diag.

List of orbital planes

B4a3a1 Angle alpha B4a3a2 Angle beta  
 BR92 Attach. for missing angle alpha/beta

BR7a/BR7b Group id. 12 BR1 Date of receipt 22.02.2017 C2c RR No. 4.4

BR14 Special Section  
 C4a Class of station EW  
 C4b Nature of service CR  
 C11a2 Service area NOR  
 C3a Assigned freq. band  
 C5a Noise temperature 303  
 C6a Polarization type CL  
 C6b Polarization angle  
 C11a3 Service area diagram

A2b Period of valid. 20 A3a Op. agency 999 A3b Adm. resp. A BR16 Value of type C8b  
 BR60 Regulatory deadline(s) 11.44/11.44.1

C1 Frequency Range	C1a Lower limit	C1b Upper limit
401	MHz	401.3

C7a	C8a1/C8b1	C8a2/C8b2	C8c1	C8c2	C8c3	C8c4	C8e1	C8e2	C8f2
Design. of emission	Max. peak pwr	Max. pwr dens.	Min. peak pwr	Attch.	Min. pwr dens.	Attch.	C/N ratio	Attch.	E.i.r.p. on the beam axis
1 16K5G1D	22.6	-19.6	1.3		-29.2		8.4		

C7b	C10c2	C10d3	C10d4
Carrier frequency of the emissions (16K5G1D)	C10a1/C10a2	Max. iso. gain	Bmwdth
404.04	401.08	16.2	25

C10b1	C10c1	C10d4
Assoc. earth station id.	Geographical coord.	Bmwdth
ORBEX1	S 018E29 14 69N03 19	16.2

C10d5a Co-polar antenna pattern  
 C10b1 Assoc. earth station id. REC-580-6 Coef. A Coef. B Coef. C Coef. D Phi1 Co-polar rad. diag.

13C Remarks

**\*Tyvak Proprietary\***

ETSUM Requested by: RICKYP Date: 19.04.2017 10:20:01 AM DB: TYVAK-0082-APT.MDB Plan id.: Notice type: NONGEO  
 A A1a Sat. Network TYVAK-0082 A1f1 Notifying adm. NOR A1f3 Inter. sat. org. BR1 Date of receipt 22.02.2017 BR20 BR IFC no.  
 BR6a/BR6b Id. no. 6 BR3a Provision reference 9.1/1A BR2 Adm. serial no. SBANDTX E

B2bis.a Transmit only when visible from notified service area  Y B2bis.b Min. Elev. Angle  10

Co-polar ref. pattern ND-SPACE	Coef. A	Coef. B	Co-polar rad. diag.
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B4a3a1 Angle alpha  B4a3a2 Angle beta   
 BR92 Attach. for missing angle alpha/beta

BR7a/BR7b Group id.  10 BR1 Date of receipt 22.02.2017 C2c RR No. 4.4

BR14 Special Section	ET	EW	C3a Assigned freq. band <input type="checkbox"/>
C4a Class of station	CR	CR	C6a Polarization type CL <input type="checkbox"/>
C4b Nature of service			C6b Polarization angle <input type="checkbox"/>
C8d1 Max. tot. peak pwr.			C8d2 Contiguous bandwidth <input type="checkbox"/>
C11a2 Service area	XVE		C11a3 Service area diagram <input type="checkbox"/>

A2b Period of valid.  20 A3a Op. agency 999 A3b Adm. resp. A BR16 Value of type C8b   
 BR60 Regulatory deadline(s) 11.44/11.44.1

C1 Frequency Range	
C1a Lower limit	C1b Upper limit
2200 MHz	2202 MHz

C7a	C8a1/C8b1	C8a2/C8b2	C8c1	C8c2	C8c3	C8c4	C8e1	C8e2	C8f1
Design. of emission	Max. peak pwr	Max. pwr dens.	Min. peak pwr	Attach.	Min. pwr dens.	Attach.	C/N ratio	Attach.	E.i.r.p. on the beam axis
1 1M50G1D	3	-58	-3		-64		80		3

2201	MHz	C7b Carrier frequency of the emissions (1M50G1D)							
------	-----	--	--	--	--	--	--	--	--

C10b1	C10b2	C10c1	C10c2	C10d1/C10d2	C10d3	C10d4	C10d6
Assoc. earth station id.	Type	Geographical coord.	City	Cls. / Nat.	Max. iso. gain	Bmwidth	Noise temp.
ORBOPEX	T			1 TT CR 40 2 TW	1.6	150	

C10b1	Assoc. earth station id.	Co-polar ref. pattern	Coef. A	Coef. B	Coef. C	Coef. D	Phi1	Co-polar rad. diag.
ORBOPEX	REC-580-6							

13C Remarks

B1a/BR17 Beam designation UHF7X B7b Steerable  B2 Emi-Rcp E B3a1 Max. co-polar gain  2

B2bis.a Transmit only when visible from notified service area  Y B2bis.b Min. Elev. Angle  10

Co-polar ref. pattern ND-SPACE	Coef. A	Coef. B	Co-polar rad. diag.
-----------------------------------	---------	---------	---------------------

B4a3a1 Angle alpha  B4a3a2 Angle beta   
 BR92 Attach. for missing angle alpha/beta

**\*Tyvak Proprietary\***

E-TSUM Requested by: RICKYP Date: 19.04.2017 10:20:01 AM DB: TYVAK-0082-APL.MDB Plan Id.: Notice type: NONGEO  
 A A1a Sat. Network TYVAK-0082 A1f1 Notifying adm. NOR A1f3 Inter. sat. org BR1 Date of receipt 22.02.2017 BR20 BR IFIC no.  
 BR6a/BR6b Id. no. 6 BR3a Provision reference 9.1/1A BR2 Adm. serial no. UHF/TX B

BR7a/BR7b Group id: 9 BR1 Date of receipt 22.02.2017 C2c RR No. 4.4  
 BR14 Special Section  
 C4a Class of station ET C3a Assigned freq. band  
 C4b Nature of service CR C6a Polarization type CL C6b Polarization angle  
 C8d1 Max. tot. peak pwr. C8d2 Contiguous bandwidth  
 C11a2 Service area NOR C11a3 Service area diagram

A2b Period of valid. 20 A3a Op. agency 999 A3b Adm. resp. A BR16 Value of type C8b  
 BR60 Regulatory deadline(s) 11.44/11.44.1

C1 Frequency Range		C7b Carrier frequency of the emissions (16K5G1D)	
C1a Lower limit	C1b Upper limit	MHz	
401	401.3	401.16	401.24
C7a		C8e1 C/N ratio	
Design. of emission	C8a2/C8b2 Max. pwr dens.	C8c3 Min. pwr dens.	C8e2 Altch.
1 16R5G1D	-39.2	-41.7	57
			E.i.r.p. on the beam axis
			3

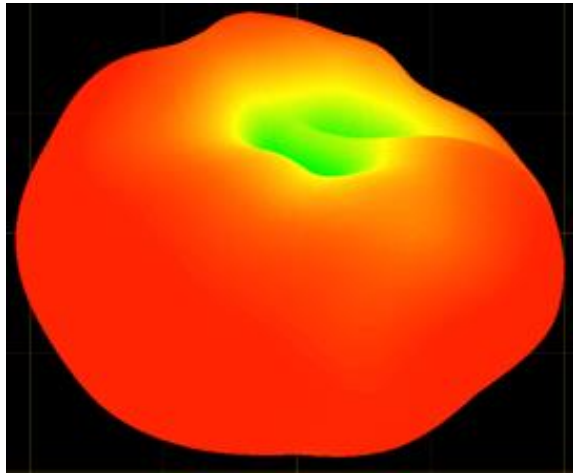
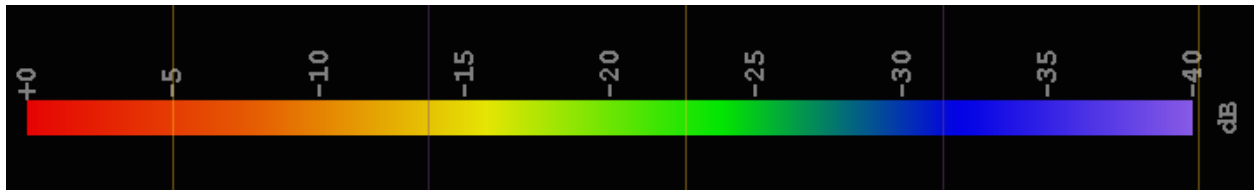
C10b1		C10d4	
Assoc. earth station id.	C10c1 Geographical coord.	Max. iso. gain	Noise temp.
ORBOP	S 018E29 14 69N03 19	30	150
C10b1 Assoc. earth station id.		C10d5a Co-polar antenna pattern	
REC-580-6		Coef. A	Coef. B
		Coef. C	Phi1
		Coef. D	Co-polar rad. diag.

13C Remarks  
 B1a/BR17 Beam designation XBANDTX B1b Steerable B2 Emi-Rcp B  
 B2bis.a Transmit only when visible from notified service area Y B2bis.b Min. Elev. Angle 10 B3a1 Max. co-polar gain 8

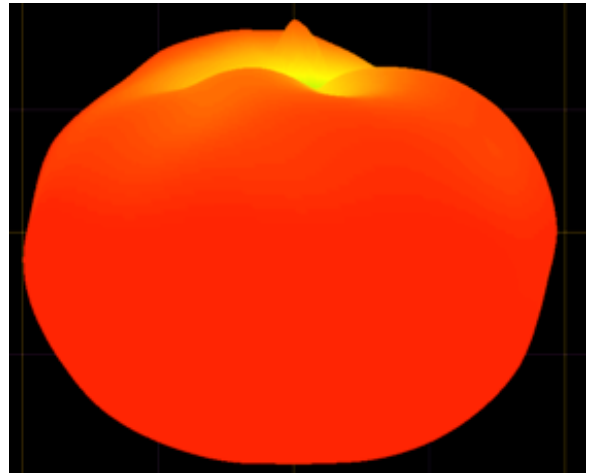
B4a3a1		B4a3a2	
Co-polar ref. pattern	Coef. A	Coef. B	Angle beta
ND-SPACE			
B4a3a1 Angle alpha		B4a3a2 Angle beta	
B4a3a1 Angle alpha		B4a3a2 Angle beta	
B4a3a1 Angle alpha		B4a3a2 Angle beta	

BR7a/BR7b Group id: 11 BR1 Date of receipt 22.02.2017 C2c RR No. 4.4  
 BR14 Special Section  
 C4a Class of station EW C3a Assigned freq. band  
 C4b Nature of service CR C6a Polarization type CL C6b Polarization angle  
 C8d1 Max. tot. peak pwr. C8d2 Contiguous bandwidth  
 C11a2 Service area XVE C11a3 Service area diagram  
 A2b Period of valid. 20 A3a Op. agency 999 A3b Adm. resp. A BR16 Value of type C8b

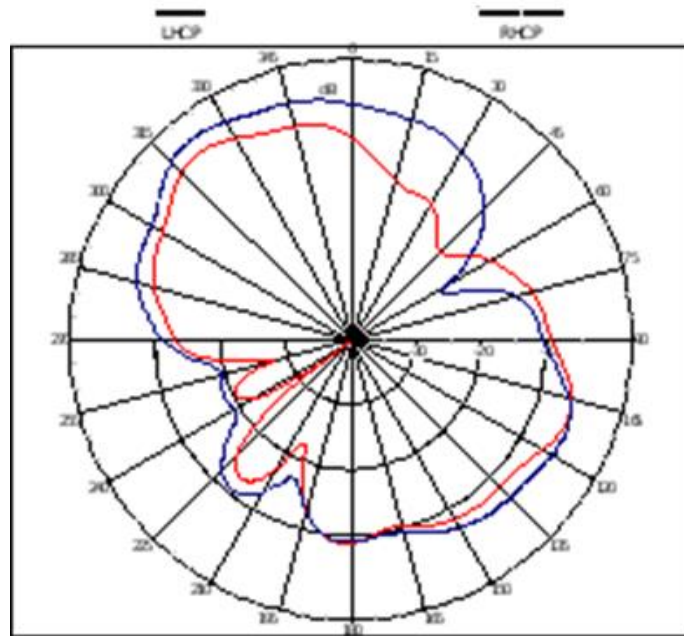
# UHF Beam Pattern



LHCP 3D Pattern



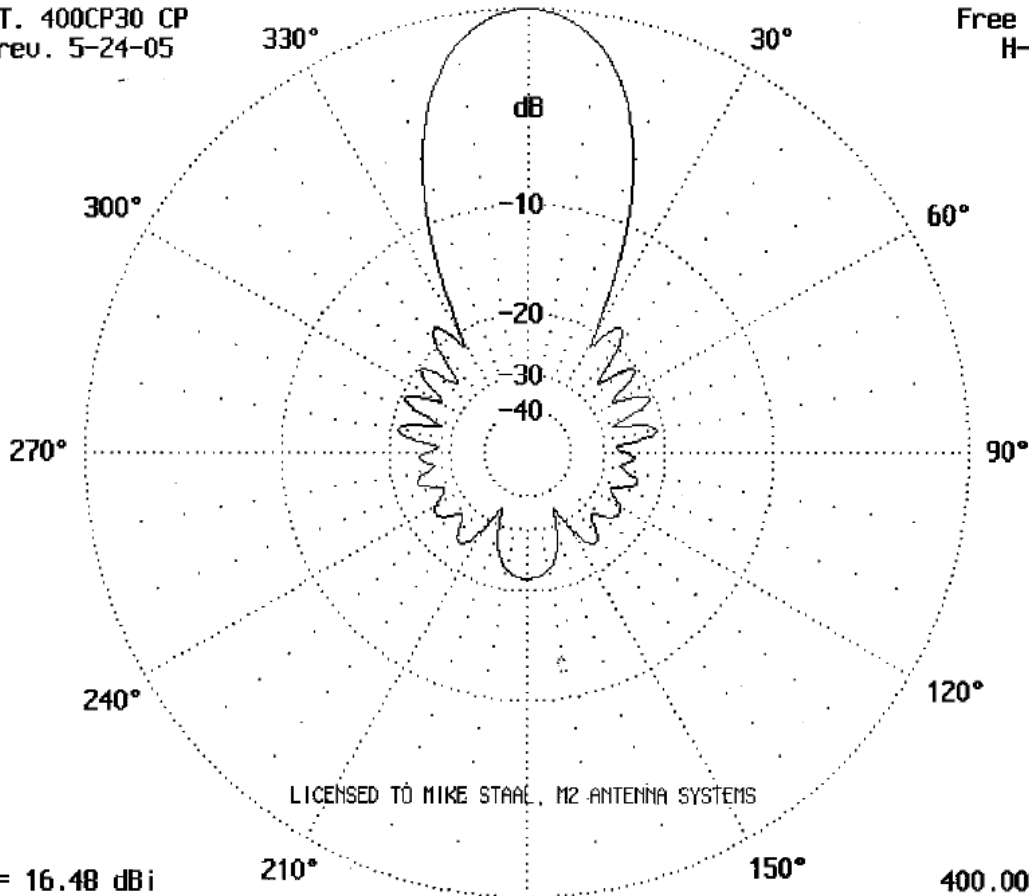
RHCP 3D Pattern



FAR FIELD Amplitude 399.925 MHz: Theta Cut for Phi = 75°

M2 ENT. 400CP30 CP  
YAGI rev. 5-24-05

Free Space  
H-Plane



0 dB = 16.48 dBi

400.000 MHz