APPENDIX A

SITE LOCATION AND PHOTOS

Figure 1 - Site Location

Figure 2 - Overall Site

Figure 3 - Overall Site

Figure 4 - Overall Site

Figure 5 – Existing Site

A 3D model of the site can be found at this link:

https://cloud.pix4d.com/site/96848/dataset/968396/map?shareToken=6db7c3b8-291b-48f4-ab58-76c5ac541d9e

APPENDIX B

GEOTECHNICAL REPORT

SIMPSON Geotechnical Ltd

February 25, 2021
File: SGL21-031

Canadian Coast Guard – Maritime and Civil Infrastructure
25 Huron Street
Victoria, BC
V8V 4V9

Attention: Mr. Andrew Wight, P.Eng.

Re: Proposed Klemtu MCTS Site Antenna Tower and Equipment Building
Report of Geotechnical Assessment

INTRODUCTION

As requested, Simpson Geotechnical Ltd. has conducted a geotechnical assessment for a proposed antenna tower and equipment building replacement at the existing Klemtu MCTS site located on a mountaintop on Swindle Peak on the eastern side of Swindle Island at approximately N52° 34' 44.38" W128° 33' 50.52". The assessment was conducted in general accordance with our proposal of August 19, 2019.

Our assessment was conducted in August 2019 and reviewed two potential site layout arrangements. Since that assessment the proposed site layout has shifted the structures approximately 40m southwestward. The recommendations in this report are based on review of the initially proposed site layouts and may be updated if new or changed information at the currently proposed structure locations are identified.

We understand that the proposed antenna tower would be a self-supported metal lattice tower, designed and constructed in accordance with CSA S37-18 Antennas, Towers, and Antenna-Supporting Structures. The proposed equipment building would be a prefabricated metal building, supported on a concrete pad and pier foundation system.

BACKGROUND

Google Earth images of the site area show Swindle Peak and the Klemtu MCTS site to be located near the southern end of a north-south trending ridge at an elevation near the tree line of approximately 810m. No evidence of significant mass wasting of Swindle peak is visible in the images, although relatively minor rockfall and debris flow scars are visible on slopes to the east that are separated from the Klemtu MCTS site by a well-defined gully suggestive of a geologic fault. That Google Earth image is shown on Figure 1.

Geologic mapping of the site area published by the BC Ministry of Energy, Mines and Petroleum Resources was obtained. That mapping indicated the site area to be underlain by Jurassic to Cretaceous volcanic rocks near a geologic boundary between granodiorite to the west and quartz diorite to the east. Geologic faults are shown in the immediate area of the site, generally aligned northwest to southeast. Swindle Island is located within the Milbanke Sound Group of volcanoes and Kitasu Hill on the southwestern side of Swindle Island is a volcanic cinder cone. The date of the last volcanic eruption in the Milbanke Sound group is unknown.

A site-specific Seismic Hazard Calculation for Swindle Peak was obtained from Natural Resources Canada. That calculation indicated a Peak Ground Acceleration of 0.102g for the 2% in 50-year probability seismic event. The Seismic Hazard Calculation is appended.

SITE ASSESSMENT

The site assessment was conducted on August 16, 2019 and consisted of observations of the general setting and topography of the site, and review of the extensive bedrock exposures in the immediate vicinity of the site.

The existing Klemtu MCTS site was located at a topographic high point westward of Kitasoo Lake on Swindle Island as shown on Figure 1. The vicinity of the hilltop was generally gently rolling and marginally above the treeline at an elevation of approximately 810m. The western side of the mountain generally sloped down to the west at approximately 20° from horizontal, while the eastern and southern sides were steeper at an overall slope of approximately 40° from horizontal, formed through a series of steps with near vertical faces up to several metres in height. Northwards of the site was the spine of a ridge that descended gently northwards.

The existing development at the site comprised a self-supported steel lattice antenna tower approximately 12m high, an aluminum equipment shelter building approximately 8m westward of the tower, and a wooden helipad approximately 35m southwestwards of the existing antenna tower. The proposed antenna tower would be located adjacent to the

northwestern side of the existing helipad, and the equipment building southwestward of that helipad, as shown on Figure 2. It is understood that the existing helipad would be removed.

There were frequent exposures of volcanic diorite bedrock in the general vicinity of the proposed antenna tower site. There were also several displaced blocks of diorite rock, displaced by sliding failure northwestward of the existing equipment building, and by toppling failure eastwards of the existing antenna tower. The reviewed bedrock exposures were very hard and required many blows of a geologic hammer to chip, indicative of Grade R5 (very strong) rock in accordance with the Canadian Foundation Engineering Manual rock classification system. There were localized areas of organic soil and vegetation cover typically less than 0.5m in thickness over the bedrock.

The predominant bedrock discontinuities were tight, dry, with no filler material as well as moderately close to widely spaced with a very blocky structure. The rock surfaces were lightly weathered with iron stained surfaces. No water seepage from the rock discontinuities was observed at the time of our site visit. The primary joints observed are tabled below.

Klemtu MCTS Site Bedrock Discontinuities

Joint Set	Dip	Dip Direction	Spacing (m)	Filler	Gap
1	68°	19°	0.3 – 0.7	No	Tight
2	60°	92°	0.09 – 0.6	No	Tight
3	62°	309°	0.8	No	Tight
4	88°	323°	0.8	No	Tight
5	88°	192°	0.1 – 0.4	No	Tight
6	20°	300°	0.2 – 1.5	No	Tight
7	58°	186°	0.4 – 1.0	No	Tight
8	60°	99°	0.05 – 0.8	No	Tight

Joint sets 4 and 5 were persistent defined potential release surfaces for toppling block failures on the eastern slopes. Set 6 was a well-defined and persistent sliding surface down to the west that had locally a displaced rock visible. Joint Set 6 also generally defined the slope of the western side of the mountain.

The Rock Quality Designation (RQD) was measured by surface scanline method at approximately perpendicular orientations at the two originally proposed antenna tower sites. Those measurements resulted in an RQD that ranged from 95% to 98%, indicative of excellent quality rock in accordance with the Canadian Foundation Engineering Manual rock classification system.

LABORATORY TESTING

A sample of the dioritic rock was retained from the site for testing of relative density in accordance with the ASTM C127 method. That test indicated a relative density 2.64 g/cm^3. The test report is appended.

DISCUSSION AND RECOMMENDATIONS

General

The proposed self-supported antenna tower and equipment building sites shown on Figure 2 are considered geotechnically suitable, provided the following recommendations are implemented. The intact, hard, undisturbed dioritic bedrock at both proposed antenna tower and building sites is considered suitable subgrade for support of the antenna tower and building foundations. We anticipate that the most practical method for providing uplift resistance to the foundations would be bonded rock anchors.

Slope Stability

Local small toppling block-type failures were observed along the southwest to northeast trending slope located eastwards of the proposed tower and building sites. As a minimum precaution against foundations being compromised by toppling failure from that slope within the typical 50-year design life for the structures, it is recommended the structure foundations be located at least 4m laterally upland of the crest of that slope.

The actual locations of the tower and equipment building foundations relative to the local slopes should be approved by SGL prior to anchor drilling or placement of footing concrete.

Antenna Tower

The self-supported communications tower foundation may consist of a combination of concrete footings bearing on approved undisturbed intact bedrock with uplift resistance provided by bonded rock anchors. The foundation design should be based on the geotechnical parameters tabled below in accordance with CSA S37-18 Antennas, Towers, and Antenna-Supporting Structures.

The uplift resistance should be determined as shown on Figure 3, based on a maximum cone apex angle of 90 degrees (45 degrees each side of the long axis of the anchor). The apex of the inverted cone should be located no deeper than the midpoint of the anchor bond length. Anchors located laterally closer than 1.2 x T (where T is the anchor depth) should be considered to as act as a group.

Local topography may truncate the uplift cone. Possible truncation of the uplift cone by local topography should be considered in the tower location, anchor design, and installation.

Recommended Geotechnical Foundation Design Parameters for Proposed Klemtu MCTS Antenna Tower (In accordance with CSA S37-18)

Parameter	Value
Bedrock type	Granodiorite
Design depth to sound bedrock (including weathered rock)	0 – 0.5m
Ultimate, unfactored, bearing resistance (bearing on approved, undisturbed, intact, level granodiorite bedrock)	4000 KPa
Serviceability bearing resistance	400 KPa
Ultimate, unfactored compressive strength of intact granodiorite bedrock	100 MPa
Ultimate unfactored tensile strength of rock mass on surface of cone (based on excellent quality rock mass with minimum RQD=95%)	60 kPa
Bulk unit weight of rock mass	23.3 KN/m^3
Ultimate, unfactored grout to rock bond stress (cementitious grout)	2.0 MPa
Recommended design depth to groundwater	>6m
Rock Quality Designation (RQD)	95%
Design cone apex angle	maximum 90 degrees
Seismic site class (NBCC 4.1.8.4)	A

Plain bars should not be considered to develop bonding with the grout. The development length for bar to grout bond should be determined in accordance with the recommendations of the Canadian Standards Association or other appropriate design standard.

Rock anchor grout may be a plastic resin or cementitious non-shrink type anchor grout with a minimum compressive strength of 25 MPa at 28 days, mixed and utilized in accordance with the manufacturer's directions. Grout strength should be verified by field testing. All drilled holes should be completely filled with grout. Plastic resin grout should not be used in wet drill holes.

All rock anchors should be proof loaded to 110% of the factored load under the review of Simpson Geotechnical Ltd. Although groundwater is not anticipated to be encountered during rock anchor installation, wet conditions may be encountered in the rock anchor drill holes from perched surface water, especially during periods of wet weather.

The prepared foundation subgrade and rock anchor proof loading should be reviewed by Simpson Geotechnical Ltd. prior to the placement of foundation concrete to verify conformance to the intent of the recommendations provided.

Equipment Building

The equipment building foundations should bear directly on approved, clean, essentially level, undisturbed and intact, diorite bedrock. Footings bearing directly on a suitable bedrock surface may be designed in accordance with NBCC 2015 based on the geotechnical parameters provided below.

For Limit States Design, foundations may be designed based on an Ultimate (unfactored) Limit State (ULS) bearing resistance of 4000 KPa. A Serviceability Limit State (SLS) bearing resistance of 400 KPa may be used for the building, based on limiting total and differential settlement to less than 15mm.

Sliding resistance may be based on a friction angle of 32° between cast-in-place concrete footings and clean, sound, diorite bedrock. Geotechnical resistance factors (Φ) of 0.5 for bearing and 0.8 for sliding are recommended. Additional sliding resistance, if needed, should be provided with reinforcing steel dowels grouted in place with a high strength non-shrink anchor grout to at least 300mm depth into the intact diorite bedrock.

The site may be considered Site Class A in accordance with the 2015 National Building Code of Canada Section 4.1.8.4.

All footings should be located so that the smallest lateral clear distance between footings will be at least equal to the difference in their bearing elevations. A foundation drainage system is not considered to be warranted with the footings bearing directly on exposed and intact bedrock and the structures elevated above the ground surface. Frost cover for footings that bear directly on intact bedrock surfaces is not considered to be warranted.

Uplift resistance for the communications building, if required, should be provided with bonded rock anchors designed in accordance with geotechnical parameters provided below for the self-supported antenna tower.

SGL can assist in approving foundation subgrade and in determining rock anchor embedment length, if required.

LIMITATIONS AND CHANGED CONDITIONS

Our recommendations in this report are based on the proposed self-supported antenna tower and equipment building located on the site as described in this report, and the expectation that future development will not result in significant changes to the local topography, soil, bedrock and groundwater conditions.

The conclusions and recommendations in this report are based upon the data obtained from local observations. The nature and extent of variations between those observation areas may not become evident until construction. Although not expected, should undiscovered changed conditions become apparent our office should be contacted to allow reassessment of our recommendations in light of the new information.

Our recommendations only apply to the specific development described in this report. Other structures or locations may have unique requirements and our recommendations should not be considered applicable to other locations and developments, even if located in the immediate vicinity.

It is a condition of this report that Simpson Geotechnical Ltd.'s performance of its professional services is subject to the attached Statement of General Conditions.

CLOSURE

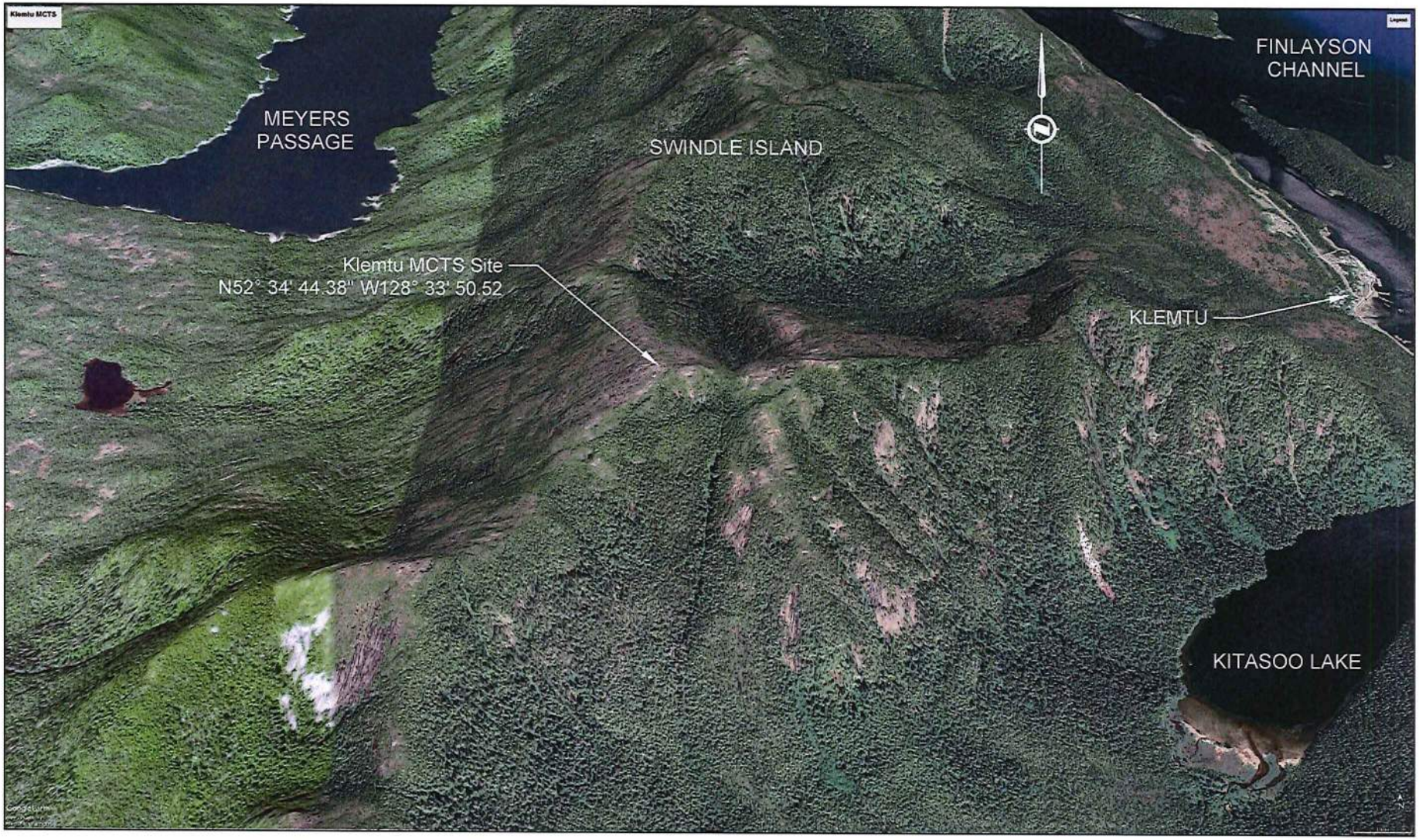
This report summarizes the results of our geotechnical assessment and makes recommendations for development of the proposed antenna tower. Please contact our office if you have any questions.

Yours truly,
Simpson Geotechnical Ltd.

Per: 

Feb 25, 2022
Richard Simpson, P.Eng.

Attachments:
Figure 1 – Site Location
Figure 2 – Topographic Site Plan
Figure 3 – Rock Anchor Uplift Capacity
Seismic Hazard Calculation
ASTM C127 Relative Density Test Report
Statement of General Conditions



2019 image from Google Earth

Project: Proposed Klemtu MCTS Antenna Tower and Equipment Building					
Title: Site Location					
Client: Canadian Coast Guard - Maritime & Civil Infrastructure					
File: SGL21-031	**Drawn by:** RRS	**Scale:** 1 : 10,000±	**Date:** February 25, 2022	**Dwg. No.:** Figure 1	

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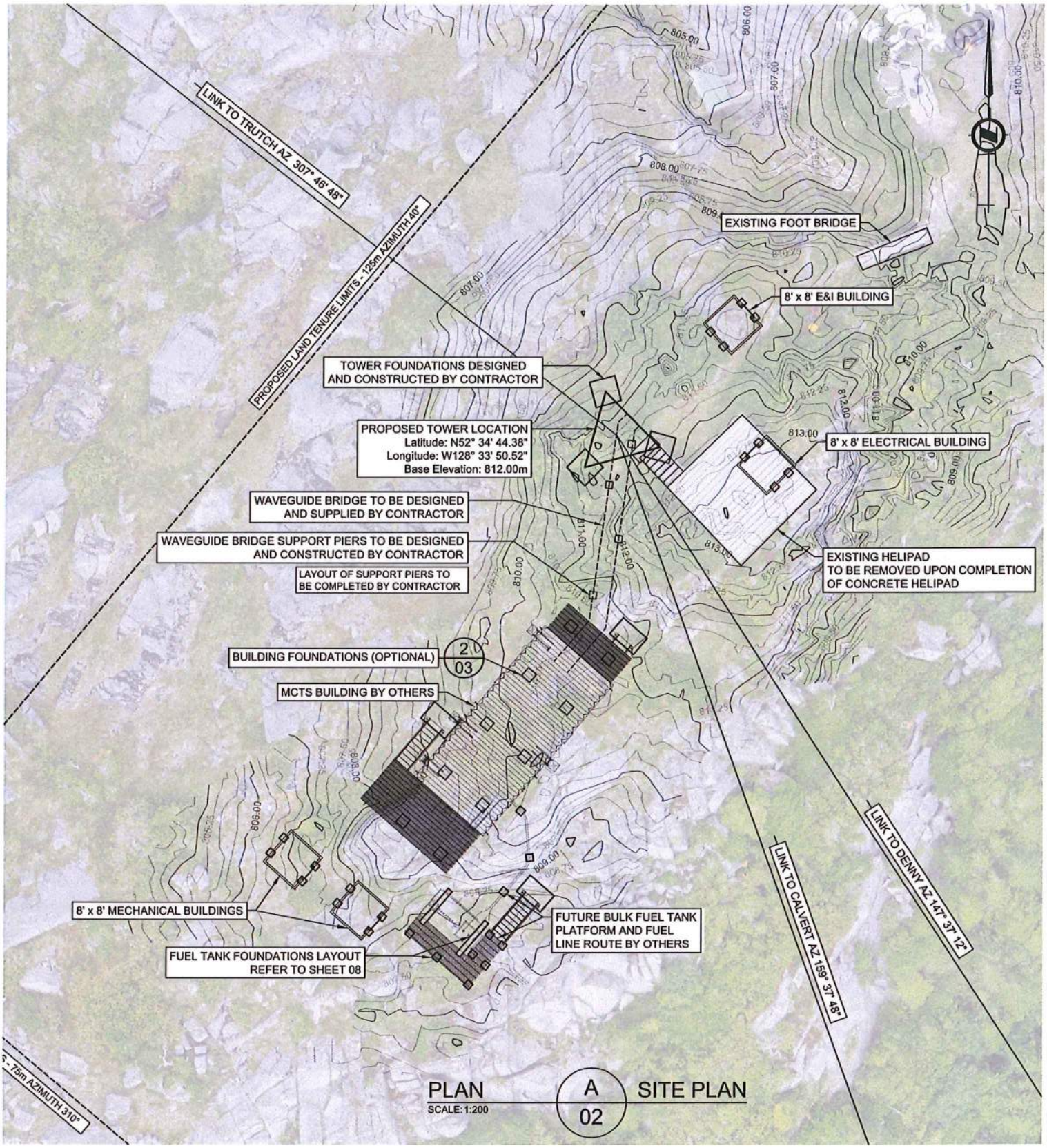


PLAN SCALE: 1:200 — A/02 — SITE PLAN

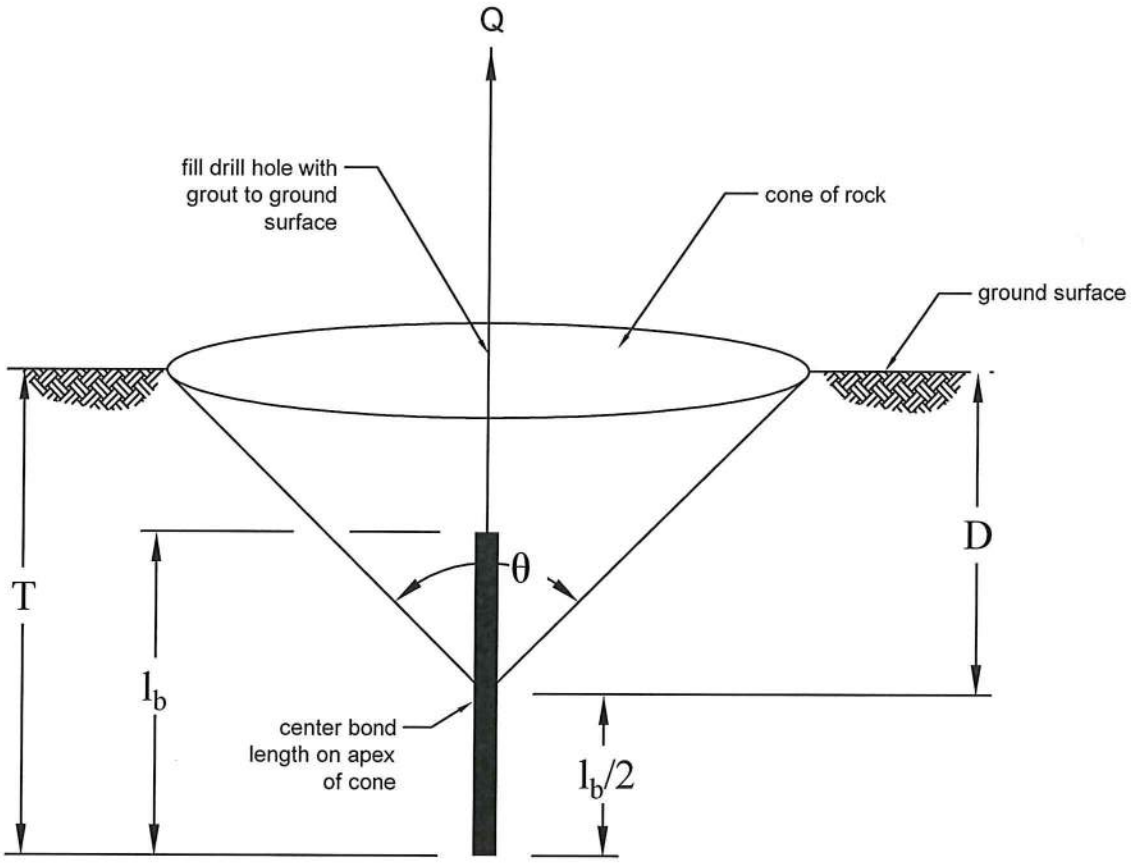
Notes:

1. Site plan and contours provided by Canadian Coast Guard;
2. Elevations in metres.

Project:	Proposed Klemtu MCTS Antenna Tower and Equipment Building				
Title:	Proposed Site Plan				
Client:	Canadian Coast Guard				
File: SGL21-031	**Drawn by:** RRS	**Scale:** 1 : 300	**Date:** February 25, 2022	**Dwg. No.:** Figure 2	

SIMPSON GEOTECHNICAL LTD

This drawing is to be read in conjunction with Simpson Geotechnical Ltd. report "Proposed Klemtu MCTS Antenna Tower, File SGL19-023, September 23, 2019



$$Q = \frac{f_{(r)} + W_C}{FS}$$

$$T = D + \frac{l_b}{2}$$

$$l_b = \frac{Q}{\pi d \tau_a}$$

Where:

$$f_{(r)} = \frac{\sigma_t \pi D^2}{\cos\frac{\theta}{2}}$$

$$W_c = \frac{\pi}{3} D^3 \gamma_r$$

Q = vertical uplift capacity of rock anchor (kN)
T = total depth of rock anchor (m)
$f_{(r)}$ = resisting tensile force on surface of cone (kN)
W_c = weight force of rock cone (kN)
D = depth to apex of cone (m)
θ = apex angle of cone (degrees)
σ_t = working tensile strength of surface of cone (kPa)
γ_r = unit weight of rock (kN/m³)
l_b = bond length of anchor (m)
τ_a = grout to rock working bond stress (kPa)
d = drillhole diameter (m)
FS = factor of safety applied to the load (minimum FS = 1.5 recomended)

Project:	Proposed Klemtu MCTS Antenna Tower and Equipment Building			SIMPSON GEOTECHNICAL LTD	
Title:	Rock Anchor Uplift Capacity				
Client:	Canadian Coast Guard				
File: SGL21-031	Drawn by: RRS	Scale: NTS	Date: February 25, 2022	Dwg. No.: Figure 3	

2015 National Building Code Seismic Hazard Calculation

INFORMATION: Eastern Canada English (613) 995-5548 français (613) 995-0600 Facsimile (613) 992-8836
Western Canada English (250) 363-6500 Facsimile (250) 363-6565

Site: 52.579N 128.563W **User File Reference:** Swindle Peak 2019-08-29 17:59 UT

Requested by: Simpson Geotechnical Ltd.

Probability of exceedance per annum	0.000404	0.001	0.0021	0.01
Probability of exceedance in 50 years	2 %	5 %	10 %	40 %
Sa (0.05)	0.103	0.073	0.055	0.028
Sa (0.1)	0.162	0.113	0.084	0.041
Sa (0.2)	0.209	0.151	0.114	0.060
Sa (0.3)	0.225	0.167	0.130	0.071
Sa (0.5)	0.230	0.173	0.134	0.073
Sa (1.0)	0.185	0.140	0.108	0.057
Sa (2.0)	0.126	0.094	0.071	0.036
Sa (5.0)	0.047	0.034	0.026	0.012
Sa (10.0)	0.016	0.012	0.009	0.005
PGA (g)	0.102	0.074	0.056	0.028
PGV (m/s)	0.285	0.213	0.162	0.076

Notes: Spectral (Sa(T), where T is the period in seconds) and peak ground acceleration (PGA) values are given in units of g (9.81 m/s^2). Peak ground velocity is given in m/s. Values are for "firm ground" (NBCC2015 Site Class C, average shear wave velocity 450 m/s). NBCC2015 and CSAS6-14 values are highlighted in yellow. Three additional periods are provided - their use is discussed in the NBCC2015 Commentary. Only 2 significant figures are to be used. **These values have been interpolated from a 10-km-spaced grid of points. Depending on the gradient of the nearby points, values at this location calculated directly from the hazard program may vary. More than 95 percent of interpolated values are within 2 percent of the directly calculated values.**

References

National Building Code of Canada 2015 NRCC no. 56190; Appendix C: Table C-3, Seismic Design Data for Selected Locations in Canada

Structural Commentaries (User's Guide - NBC 2015: Part 4 of Division B)
Commentary J: Design for Seismic Effects

Geological Survey of Canada Open File 7893 Fifth Generation Seismic Hazard Model for Canada: Grid values of mean hazard to be used with the 2015 National Building Code of Canada

See the websites www.EarthquakesCanada.ca and www.nationalcodes.ca for more information

SIMPSON GEOTECHNICAL LTD

ASTM C127 Relative Density

Project Klemtu MCTS **Project No.** SGL21-031

Client Canadian Coast Guard **Date** 23-Aug-19

Sample Location Proposed Tower Site 1

Sample Description Diorite

Pan No. B1

Drying Start Time	Aug 20, 2019 0900hrs
Drying Stop Time	Aug 21, 2019 0830hrs
Sample Dry, 110° for 24 hours (**A**) g	2222.4 g
Soak Start Time	Aug 21, 2019 0835hrs
Soak Stop Time	Aug 22, 2019 1310hrs
Saturated Surface Dry 24 hour soak (**B**) g	2242.0 g
Water Temperature	22 ° C
Submerged Weight at 23° g (**C**)	1401.9 g

Relative Density (specific gravity) = A/(B-C)	2.65 g/cm^3
Absorption (%) = (B-A)/Ax100	0.88 %

STATEMENT OF GENERAL CONDITIONS

1. STANDARD OF CARE

This Report has been prepared in accordance with generally accepted engineering consulting practices in the applicable jurisdiction. No other warranty, expressed or implied, is intended or made. Geological and geotechnical studies do not include environmental consulting unless specifically stated in the report.

2. COMPLETE REPORT

All documents, records, data and files, whether electronic or otherwise, generated as part of this assignment are a part of the Report which is of a summary nature and is not intended to stand alone without reference to the instructions given to us by the Client, communications between us and the Client, and to any other reports, writings, proposals or documents prepared by us for the Client relative to the specific site described herein, all of which constitute the Report.

IN ORDER TO PROPERLY UNDERSTAND THE RECOMMENDATIONS AND OPINIONS EXPRESSED HEREIN, REFERENCE MUST BE MADE TO THE WHOLE OF THE REPORT. WE ARE NOT RESPONSIBLE FOR USE BY ANY PARTY OF PORTIONS OF THE REPORT WITHOUT REFERENCE TO THE WHOLE REPORT.

3. BASIS OF REPORT

The Report has been prepared for the specific site, development, design objectives and purpose that were described to us by the Client. The applicability and reliability of any of the findings, recommendations, suggestions, or opinions expressed in the document are only valid to the extent that there has been no material alteration to or variation from any of the said descriptions provided to us unless we are specifically requested by the Client to review and revise the Report in light of such alteration or variation.

4. USE OF THE REPORT

The information and opinions expressed in the Report, or any document forming part of the Report, are for the sole benefit of the Client. NO OTHER PARTY MAY USE OR RELY UPON THE REPORT OR ANY PORTION THEREOF WITHOUT OUR WRITTEN CONSENT. We will consent to any reasonable request by the client to approve the use of this report by other parties as "approved users. Any use that a third party makes of the Report, or any portion of the Report, are the sole responsibility of such third parties. We accept no responsibility for damages suffered by any third party resulting from unauthorized use of the Report.

5. INTERPRETATION OF THE REPORT

a) Nature and Exactness of Soil Description: Identification of soils, rocks, terrain and geological units have been based on investigations performed in accordance with the standards set out in Paragraph 1. The field investigation cannot practically cover the entire area and will only identify soil conditions at the point and time of sampling. Identification of these factors are judgmental in nature and even comprehensive sampling and testing programs may fail to locate some conditions. All investigations involve an inherent risk that some conditions will not be detected and all documents or records summarizing such investigations will be based on assumptions of what exists between the actual sample points. Actual conditions may vary significantly between the points investigated and all persons making use of such documents or records should be aware of, and accept, this risk. Some conditions change over time and those making use of the Report should be aware of this possibility and understand that the Report only presents the conditions at the time of assessment.

b) Reliance on Provided Information: The evaluation and conclusions contained in the Report have been prepared on the basis of conditions in evidence at the time of site inspections and on the basis of information provided to us. We have relied in good faith upon representations, information and instructions provided by the Client and others concerning the site. Accordingly, we cannot accept responsibility for any deficiency, misstatement or inaccuracy contained in the Report as a result of misstatements, omissions, misrepresentations, or fraudulent acts of persons providing information.

c) Design Services: The Report may form part of the design and construction documents for information purposes even though it may have been issued prior to the final design being completed. We must be retained to review the final design, project plans and documents prior to construction to confirm that they are consistent with the intent of the Report. Any differences that may exist between the report recommendations and the final design detailed in the contract documents must be reported to us immediately so that we can address potential conflicts.

d) Construction Services: During construction we must be retained to provide field reviews. Field reviews consist of performing sufficient and timely observations of encountered conditions to confirm and document that the site conditions do not materially differ from those interpreted conditions considered in the preparation of the report. Adequate field reviews are necessary for Simpson Geotechnical Ltd. to provide letters of assurance, in accordance with the requirements of many regulatory authorities.

6. CONSTRUCTION INSPECTIONS

Our scope of work may include inspections of the work during construction or after completion. Such field reviews do not replace the need for appropriate construction inspection and supervision on the part of the client or his agents. We accept no responsibility for damages caused by unforeseen conditions unless we are on site during construction.

7. INHERENT RISKS

Geotechnical hazard assessments typically occur where there are hazards. As such, inherent risks exist and landslides or other geotechnical hazards can occur even where the likelihood of has been identified as low. The client must operate with an understanding of this risk.

8. CONTROL OF WORK AND JOBSITE SAFETY

We are responsible only for the activities of our employees on the jobsite. The presence of our personnel on the site shall not be construed in any way to relieve the Client or any contractors on site from their responsibilities for site safety. The Client acknowledges that he, his representatives, contractors or others retain control of the site and that we never occupy a position of control of the site. The Client undertakes to inform us of all hazardous conditions, or other relevant conditions of which the Client is aware. The Client also recognizes that our activities may uncover previously, unknown hazardous conditions and that such a discovery may require that certain regulatory bodies be informed and the Client agrees that notification to such bodies by us will not be a cause of action or dispute.

9. INDEPENDENT JUDGEMENTS OF CLIENT

The information, interpretations and conclusions in the Report are based on our interpretation of conditions revealed through limited assessment conducted within a defined scope of services. We cannot accept responsibility for independent conclusions, interpretations, interpolations and/or decisions of the Client, or others who may come into possession of the Report, or any part thereof, which may be based on information contained in the Report. This restriction of liability includes decisions made to either purchase or sell land.

APPENDIX C

SITE SPECIFIC WIND LOADING

Klemtu Mountain, BC 37m Tower

Site-Specific 10-yr. Wind Pressure Report (V2.2 2019-04-22)

Site Information:

Name: Klemtu Mountain, BC
Latitude: 52° 34' 45.04" N
Longitude: 128° 33' 48.01" W
Tower Height (m): 37
Elevation MSL (m): 815

Results:

Note: Following direction from the S37 Committee, Qe can no longer be provided.

Q_{nbc} (Pa):	390	$Q_{nbc} = 390(Z/10)^{0.2}$	V_{nbc} = 54.94 mph
Icing:	As per CAN/CSA S37-18		
Q_{Min} (Pa)	250	$Q_{Min} = 250(Z/10)^{0.2}$	V_{Min} = 43.99 mph

Wind Pressure Formula (for z in metres and result in Pa):

$$Q_h = 0.12919 \{[0.8000\, e^{(-0.0039\, z)} + 0.7843\, \ln(z/0.3000) / \ln(z/0.9000)]\, 41.91\}^2\, (z/10)^{0.320}$$

Profile Formula General Form:

$$Q_h = 0.12919 \{[a_1\, e^{(-a2\, z)} + a_3\, \ln(z/z_h) / \ln(z/z_{01})]\, v_{01}\}^2\, (z/10)^{0.320}$$

Site Values of Coefficients:

$$a_1 = 0.8000,\ a_2 = 0.0039,\ a_3 = 0.7843,\ z_h = 0.3000,\ z_{01} = 0.9000,\ v_{01} = 41.91 \text{ mph}$$

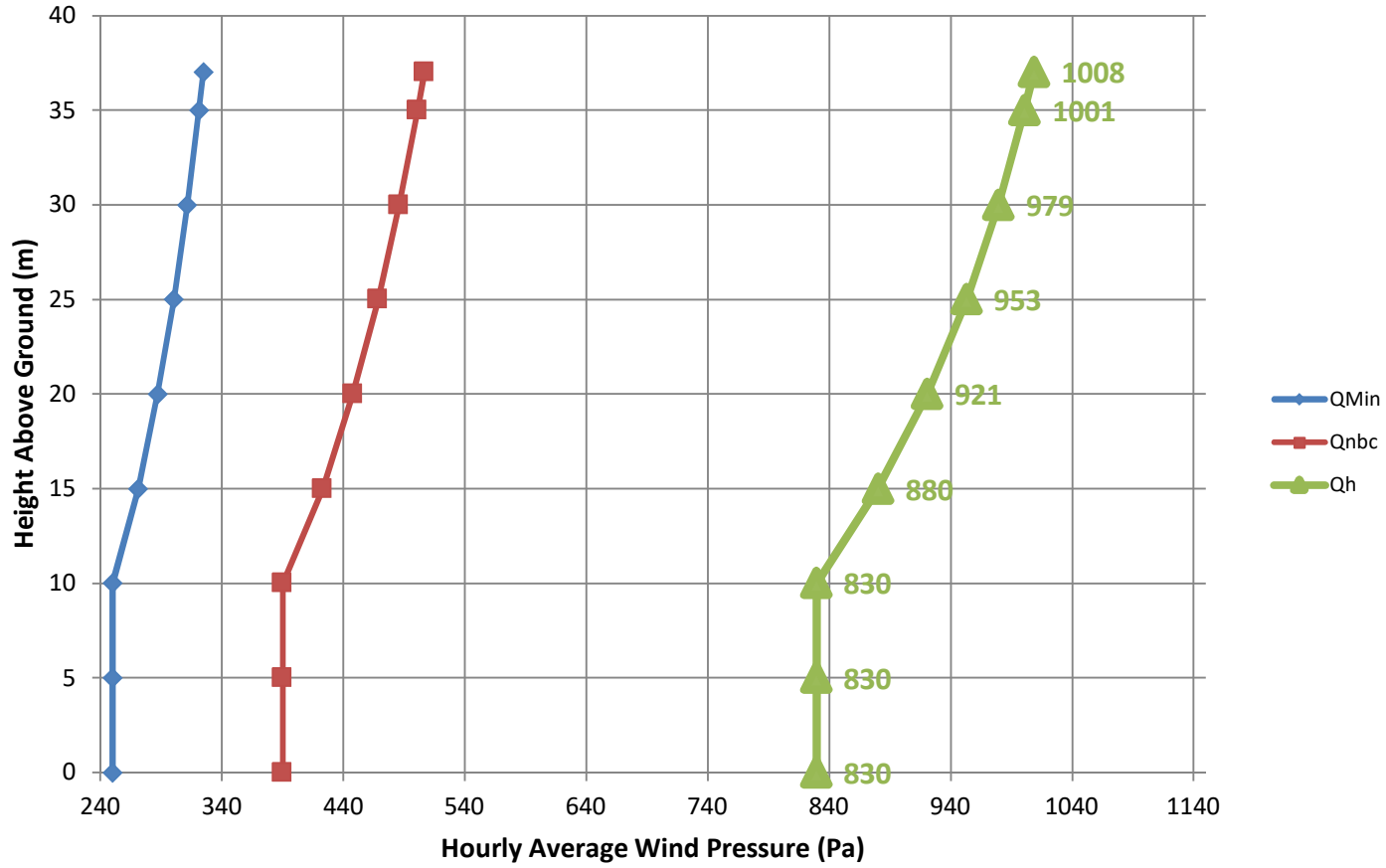
Definitions

Tower Height: Height of the tower from ground level at the base of the tower to the top of the structure.
Q_{nbc}: Regionally representative reference wind pressure at 10 m in the format of the National Building Code of Canada and the Q_{nbc} value is profiled with the $^2/_{10}$ power law.
Q_{Min}: Minimum reference wind pressure (320 Pa, 300 Pa, and 250 Pa for the 50-year, 30-year, and 10-year return periods respectively) profiled with the $^2/_{10}$ power law as per Section 5.4.1 of S37-18.

Wind Pressure Formula: Formula for the design wind pressure as a function of height. (Ref.: S37-18, 5.3.1)
Height (Z): the vertical distance (m) above ground level at the base of the tower.

Note: No wind pressure value less than 90% of the value at 10 m should be used for heights less than 10 m a.g.l.

These wind pressures were evaluated using a version of the methods described by Taylor and Lee (1984) "Simple Guidelines for Estimating Wind Speed Variations Due to Small Scale Topographic Features", Climatological Bulletin 18 2, using the Boyd (1969) analysis of thirty year return period wind speeds (which is also used for the National Building Code of Canada), modified by a technique described by Wieringa (1980) "Representativeness of Wind Observations at Airports" Bulletin of the American Meteorological Society, 61 9, as input data. The uncertainty in NBCC regionally representative reference wind pressures is about [+15%,-15%].



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Q_{nbc}: Regionally representative reference wind pressure at 10 m in the format of the National Building Code of Canada and the Q_{nbc} value is profiled with the $^{2}/_{10}$ power law.
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Klemtu Mountain, BC 37m Tower

Site-Specific 30-yr. Wind Pressure Report (V2.2 2019-04-22)

Site Information:

Name: Klemtu Mountain, BC
Latitude: 52° 34' 45.04" N
Longitude: 128° 33' 48.01" W
Tower Height (m): 37
Elevation MSL (m): 815

Results:

Note: Following direction from the S37 Committee, Qe can no longer be provided.

Q_{nbc} (Pa):	460	$Q_{nbc} = 460(Z/10)^{0.2}$	V_{nbc} = 59.67 mph
Icing:	As per CAN/CSA S37-18		
Q_{Min} (Pa)	300	$Q_{Min} = 300(Z/10)^{0.2}$	V_{Min} = 48.19 mph

Wind Pressure Formula (for z in metres and result in Pa):

$$Q_h = 0.12919 \{[0.8000\, e^{(-0.0039\, z)} + 0.7843\, \ln(z/0.3000) / \ln(z/0.9000)]\, 45.86\}^2\, (z/10)^{0.320}$$

Profile Formula General Form:

$$Q_h = 0.12919 \{[a_1\, e^{(-a2\, z)} + a_3\, \ln(z/z_h) / \ln(z/z_{01})]\, v_{01}\}^2\, (z/10)^{0.320}$$

Site Values of Coefficients:

$$a_1 = 0.8000,\ a_2 = 0.0039,\ a_3 = 0.7843,\ z_h = 0.3000,\ z_{01} = 0.9000,\ v_{01} = 45.86 \text{ mph}$$

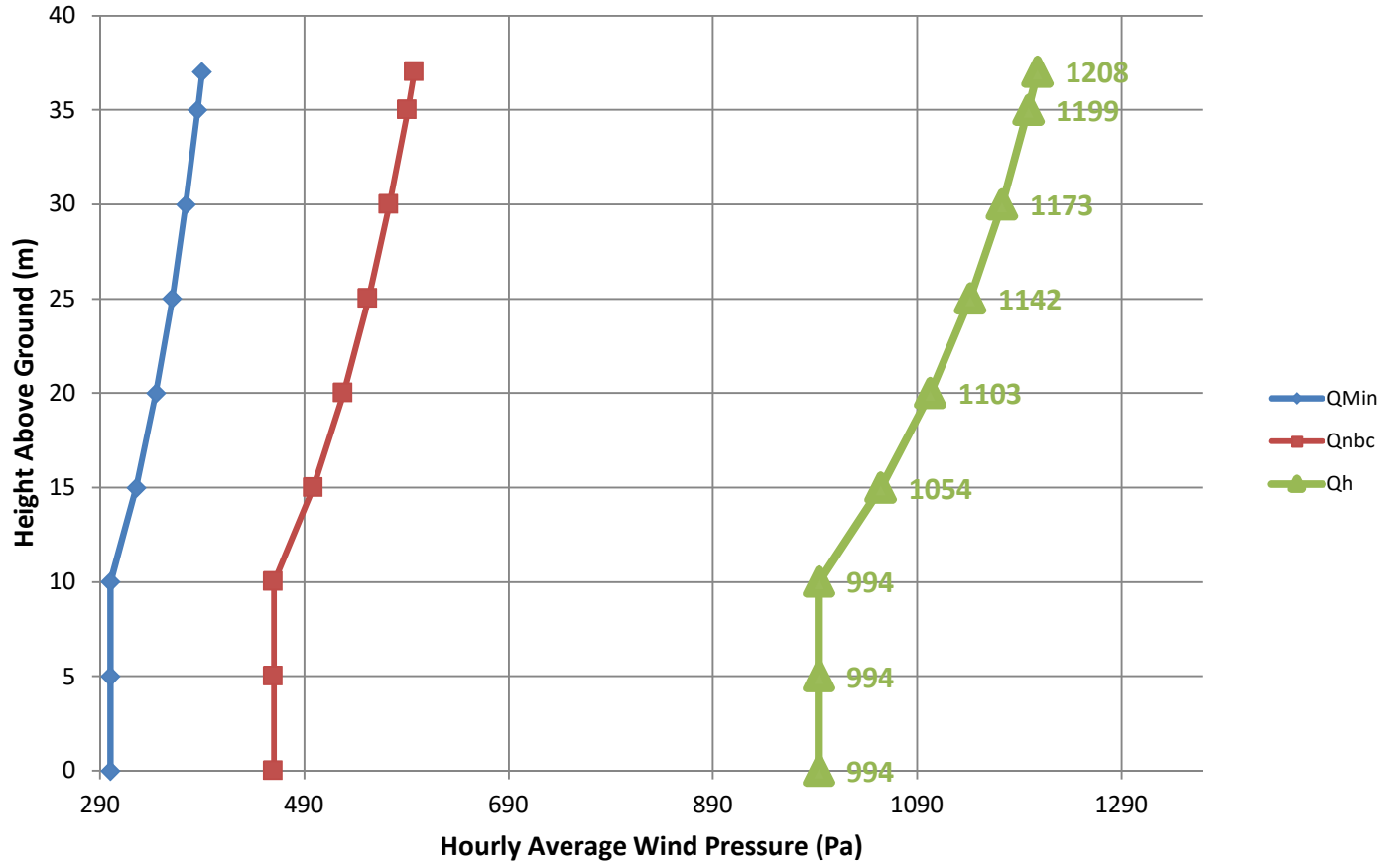
Definitions

Tower Height: Height of the tower from ground level at the base of the tower to the top of the structure.
Q_{nbc}: Regionally representative reference wind pressure at 10 m in the format of the National Building Code of Canada and the Q_{nbc} value is profiled with the $^2/_{10}$ power law.
Q_{Min}: Minimum reference wind pressure (320 Pa, 300 Pa, and 250 Pa for the 50-year, 30-year, and 10-year return periods respectively) profiled with the $^2/_{10}$ power law as per Section 5.4.1 of S37-18.

Wind Pressure Formula: Formula for the design wind pressure as a function of height. (Ref.: S37-18, 5.3.1)
Height (Z): the vertical distance (m) above ground level at the base of the tower.

Note: No wind pressure value less than 90% of the value at 10 m should be used for heights less than 10 m a.g.l.

These wind pressures were evaluated using a version of the methods described by Taylor and Lee (1984) "Simple Guidelines for Estimating Wind Speed Variations Due to Small Scale Topographic Features", Climatological Bulletin 18 2, using the Boyd (1969) analysis of thirty year return period wind speeds (which is also used for the National Building Code of Canada), modified by a technique described by Wieringa (1980) "Representativeness of Wind Observations at Airports" Bulletin of the American Meteorological Society, 61 9, as input data. The uncertainty in NBCC regionally representative reference wind pressures is about [+15%,-15%].



Definitions

Tower Height: Height of the tower from ground level at the base of the tower to the top of the structure.
Q_{nbc}: Regionally representative reference wind pressure at 10 m in the format of the National Building Code of Canada and the Q_{nbc} value is profiled with the $^{2}/_{10}$ power law.
Q_{Min}: Minimum reference wind pressure (320 Pa, 300 Pa, and 250 Pa for the 50-year, 30-year, and 10-year return periods respectively) profiled with the $^{2}/_{10}$ power law as per Section 5.4.1 of S37-18.

Wind Pressure Formula: Formula for the design wind pressure as a function of height. (Ref.: S37-18, 5.3.1)
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Note: No wind pressure value less than 90% of the value at 10 m should be used for heights less than 10 m a.g.l.

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Klemtu Mountain, BC 37m Tower

Site-Specific 50-yr. Wind Pressure Report (V2.2 2019-04-22)

Site Information:

Name: Klemtu Mountain, BC
Latitude: 52° 34' 45.04" N
Longitude: 128° 33' 48.01" W
Tower Height (m): 37
Elevation MSL (m): 815

Results:

Note: Following direction from the S37 Committee, Qe can no longer be provided.

Q_{nbc} (Pa):	500	$Q_{nbc} = 500(Z/10)^{0.2}$	V_{nbc} = 62.21 mph
Icing:	As per CAN/CSA S37-18		
Q_{Min} (Pa)	320	$Q_{Min} = 320(Z/10)^{0.2}$	V_{Min} = 49.77 mph

Wind Pressure Formula (for z in metres and result in Pa):

$$Q_h = 0.12919 \{[0.8000\, e^{(-0.0039\, z)} + 0.7843\, \ln(z/0.3000) / \ln(z/0.9000)]\, 47.68\}^2\, (z/10)^{0.320}$$

Profile Formula General Form:

$$Q_h = 0.12919 \{[a_1\, e^{(-a2\, z)} + a_3\, \ln(z/z_h) / \ln(z/z_{01})]\, v_{01}\}^2\, (z/10)^{0.320}$$

Site Values of Coefficients:

$$a_1 = 0.8000,\ a_2 = 0.0039,\ a_3 = 0.7843,\ z_h = 0.3000,\ z_{01} = 0.9000,\ v_{01} = 47.68 \text{ mph}$$

Definitions

Tower Height: Height of the tower from ground level at the base of the tower to the top of the structure.
Q_{nbc}: Regionally representative reference wind pressure at 10 m in the format of the National Building Code of Canada and the Q_{nbc} value is profiled with the $^2/_{10}$ power law.
Q_{Min}: Minimum reference wind pressure (320 Pa, 300 Pa, and 250 Pa for the 50-year, 30-year, and 10-year return periods respectively) profiled with the $^2/_{10}$ power law as per Section 5.4.1 of S37-18.

Wind Pressure Formula: Formula for the design wind pressure as a function of height. (Ref.: S37-18, 5.3.1)
Height (Z): the vertical distance (m) above ground level at the base of the tower.

Note: No wind pressure value less than 90% of the value at 10 m should be used for heights less than 10 m a.g.l.

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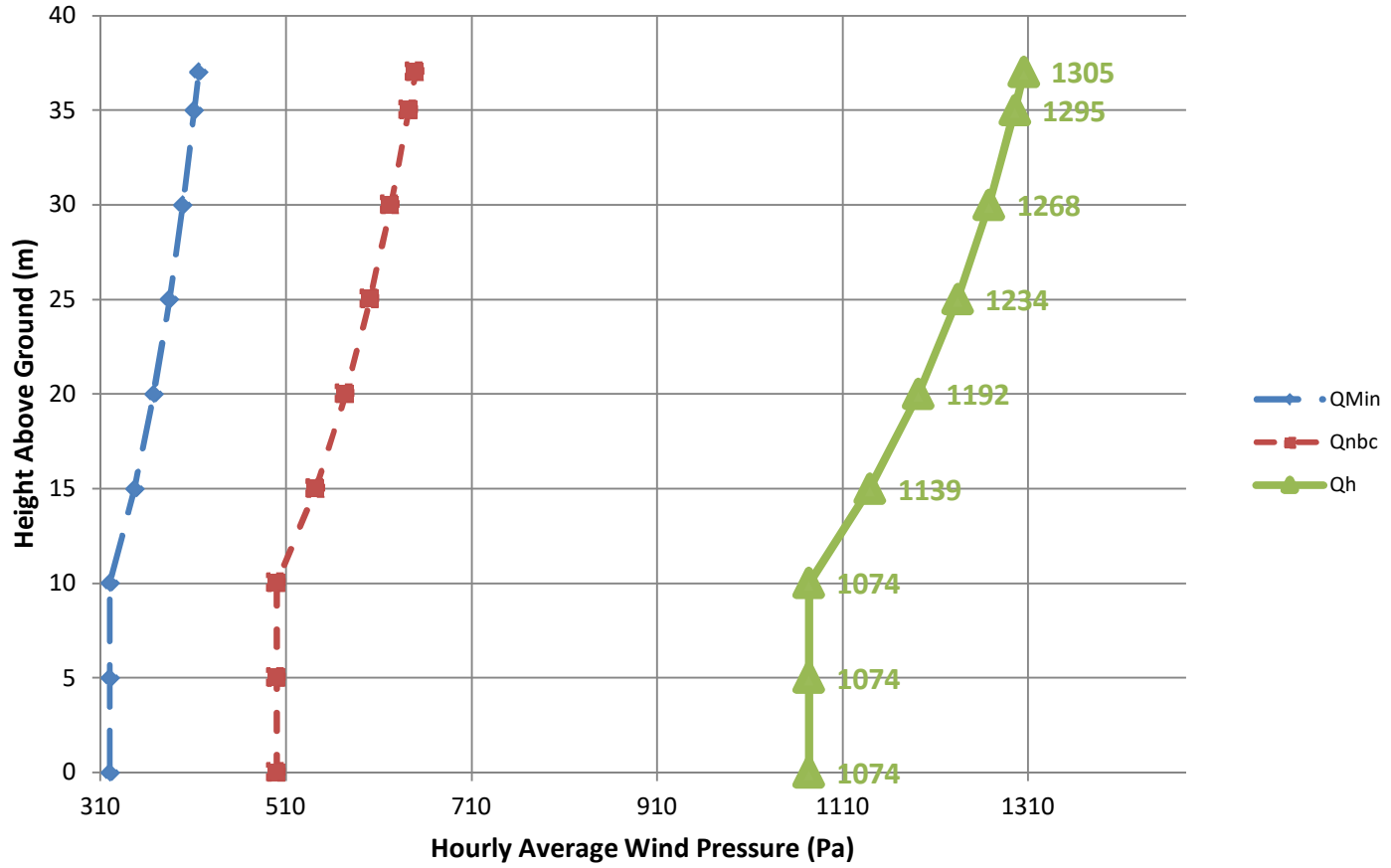

Definitions

Tower Height: Height of the tower from ground level at the base of the tower to the top of the structure.
Q_{nbc}: Regionally representative reference wind pressure at 10 m in the format of the National Building Code of Canada and the Q_{nbc} value is profiled with the $^{2}/_{10}$ power law.
Q_{Min}: Minimum reference wind pressure (320 Pa, 300 Pa, and 250 Pa for the 50-year, 30-year, and 10-year return periods respectively) profiled with the $^{2}/_{10}$ power law as per Section 5.4.1 of S37-18.

Wind Pressure Formula: Formula for the design wind pressure as a function of height. (Ref.: S37-18, 5.3.1)
Height (Z): the vertical distance (m) above ground level at the base of the tower.

Note: No wind pressure value less than 90% of the value at 10 m should be used for heights less than 10 m a.g.l.

These wind pressures were evaluated using a version of the methods described by Taylor and Lee (1984) "Simple Guidelines for Estimating Wind Speed Variations Due to Small Scale Topographic Features", Climatological Bulletin 18 2, using the Boyd (1969) analysis of thirty year return period wind speeds (which is also used for the National Building Code of Canada), modified by a technique described by Wieringa (1980) "Representativeness of Wind Observations at Airports" Bulletin of the American Meteorological Society, 61 9, as input data. The uncertainty in NBCC regionally representative reference wind pressures is about [+15%,-15%].

APPENDIX D

ENVIRONMENTAL PROTECTION PLAN (DRAFT)

Klemtu Mountain MCTS Expansion and Upgrade

February 25, 2022

Prepared for:

Canadian Coast Guard—Marine & Civil Infrastructure
Fisheries & Oceans Canada

Prepared by:

Robin Connelly

Table of Contents

LIST OF TABLES

LIST OF APPENDICES

Abbreviations

BC	British Columbia
BMP	Best Management Practices
CCG	Canadian Coast Guard
DFO	Fisheries and Oceans Canada
ECCC	Environment and Climate Change Canada
EM	Environmental Monitor
EMP	Environmental Management Plan
HCA	*Heritage Conservation Act*
MFLNRO	Ministry of Forests, Lands and Natural Resource Operations
MFLNRORD	Ministry of Forests, Lands, Natural Resource Operations and Rural Development
MOE	Ministry of Environment
MWLAP	Ministry of Water, Land and Air Protection
QEP	Qualified Environmental Professional
WCA	*Weed Control Act*
WHIMS	Workplace Hazardous Materials Information System

1.0 INTRODUCTION

This Environmental Management Plan (EMP) was prepared for the Canadian Coast Guard's (CCG) Klemtu Mountain Marine Communications and Traffic Services Station (MCTSS) expansion (the Project). This EMP describes roles and responsibilities (Section 1.3), regulatory and legislative requirements (Section 2.0), planned construction activities (Section 3.0), the existing environment at the project location (Section 4.0) and environmental protection measures developed to avoid or mitigate effects on the environment during construction (Section 5.0). This EMP also provides recommendations for environmental monitoring and reporting requirements related to environmental monitoring and non-compliance incidents (Section 6.0).

1.1 PROJECT BACKGROUND

The CCG agency of Fisheries and Oceans Canada (DFO) is planning to expand the existing Klemtu Mountain MCTSS as part of the Oceans Protection Program, which aims to enhance navigational safety in Canadian waters. The infrastructure can no longer maintain the current needs the Site. A larger tower is required to contain the marine communications equipment, a new equipment building to accompany it. It is anticipated the layout of the Site will change as new infrastructure will be build alongside the existing infrastructure so that no loss of marine safety communication is lost. After all the new equipment is built and installed the old building and tower will be decommissioned and removed. Klemtu Mountain MCTSS is a ridge-top site on Swindle Island, approximately 3 km as the crow flies from the Community of Klemtu and the Kitasoo/Xai'xais Reserve, British Columbia (BC). It can only be accessed via helicopter.

1.2 PURPOSE OF THE ENVIRONMENTAL MANAGEMENT PLAN

This EMP describes the general and specific environmental protection policies, mitigation measures, and contingency plans to be implemented before, during, and after construction activities for the Project. The EMP is intended to document environmental requirements and inform the Contractor's Project-specific Environmental Protection Plan. The Contractor(s) working on the Project must complete this Project in accordance with applicable legislation and comply with this EMP and/or provide suitable alternative approaches pre-approved by the CCG Project Manager. This document outlines the following:

- Roles and responsibilities for Project team members
- Regulatory requirements and permits for the Project
- Key construction activities and schedule
- Existing environmental conditions and resources
- Potential project effects and mitigation measures
- Management measures to mitigate potential project effects
- Environmental monitoring, reporting, and compliance requirements

The EMP is a living document that will be reviewed and updated as needed prior to and during construction of the Project. The mitigation measures and monitoring protocols outlined in this EMP may be re-evaluated to identify and update deficiencies and improve overall environmental management and protection.

1.3 ROLES AND RESPONSIBILITIES

Table 1 describes the roles and responsibilities of the Project team.

Table 1 Roles and Responsibilities of the Project Team

Role	Responsibilities
CCG Project Manager	• Project owner with overall responsibility for delivery of the works associated with this Project; provides direction and general oversight for the Project • Responsible for overall environmental management and performance of the Project • Administers contracts and assesses the Contractors' ability to comply with this EMP as part of the tender evaluation • Attends health and safety meetings and Contractor tailgate meetings, where appropriate, to communicate potential environmental concerns/requirements • Provides the Contractor(s) and Environmental Monitor (EM) with project-specific details, such as background information, permits and this EMP • Responsible for contracting and overseeing First Nations observers, environmental monitoring, and construction monitoring • Authorizes stop work authority to project personnel (e.g., EM) for non-compliance with this EMP and contravention of regulatory permits and allow them to suspend project activities that are at risk of causing or potentially causing serious harm to fish, wildlife, or the environment (e.g., water quality, soils, air quality) • Notifies regulatory agencies or authorizes notification of environmental non-compliance or environmental incidences, where applicable • Oversee compliance of the EMP • Advises EM as required • Liaise with regulatory agencies, as necessary • Reviews and provides comment on the EM reports • Has the authority to issue a Stop Work order where activities are affecting or will affect the environment (e.g., water quality, soils, air quality) and wildlife
Contractor(s)	• Understands details of the Project by reviewing relevant documentation and regulatory approvals supplied by CCG (e.g., EMP, environmental permits) • Constructs works according to approved designs and standards, regulatory requirements/approvals, this EMP, and, if required, Contractor-specific management plans • Verifies that personnel are appropriately trained and competent in the use of environmental protection and mitigation measures, such as sediment, waste, spills, and noise control measures • Notifies the CCG Project Manager and/or EM of any observed or potential non-compliances with this EMP • Immediately reports incidents to the Project Manager or EM and initiates an appropriate response • Monitors for compliance with the EMP when a dedicated EM is not on site. During these times, the Contractor(s) will be expected to document and communicate environmental issues to CCG on a regular, as needed, basis." Corrects deficiencies and any non-compliance upon direction from the CCG Project Manager, EM, and/or regulators • Will prepare their own Spill Protection/Response Plan

Table 1 Roles and Responsibilities of the Project Team

Role	Responsibilities
Environmental Monitor (EM)	• Will be a qualified environmental professional (QEP) or will consult with a QEP where appropriate if outside their area of expertise[1] • A DFO/CCG employee or their delegate • Liaises/reports back to the CCG Project Manager on status of work and of any emerging environmental issues and assists in addressing them • Will establish any exclusion zones related to habitat protection or Species at Risk if required • Will conduct any soil sampling related to potentially contaminated soil in areas where excavation is required and monitor excavation activities to ensure contaminated soil is handled, stored and removed appropriately • Completes and records environmental pre-job meetings with the Contractor(s) • Attends health and safety meetings and Contractor tailgate meetings where appropriate, to communicate potential environmental concerns/requirements • Maintains a current version of the EMP and is familiar with all aspects of the document • Communicates requirements of this EMP to the CCG Project Manager and Contractor(s) • Evaluates and reports on the effectiveness of the environmental mitigation measures and on the Contractor's work procedures through regular site visits during construction. Frequency of site visits will be determined prior to construction start-up and will be based on regulatory (e.g., *Wildlife Act*) requirements and higher risk activities. • Advises the Contractor of non-compliance and of any emerging environmental issues and assists in addressing them • Provides corrective advice to the Contractor where appropriate, such as when non-compliances are observed or imminent • Has the authority to issue a stop work order where activities are affecting, or will affect the environment (e.g., water quality, drinking water quality, terrestrial, air quality), fish, and wildlife • Maintains records of site visits and regularly updates the CCG Project Manager • Writes environmental monitoring and permit-required reports to be submitted to the CCG Project Manager and appropriate regulatory authorities • Provides guidance and direction as needed during clean-up and restoration activities (e.g., after a spill or hydraulic leak) according to the requirements in this EMP
First Nations observers	• May be retained by CCG to observe and report on construction activities • May be directly involved in construction activities if a cultural or archaeological concern arises
Construction monitor	• A DFO/CCG employee or their delegate • Evaluates and reports on the construction performance for conformance to contract documents • Maintains records of site visits and regularly updates the CCG Project Manager • Grants final acceptance of the Contractor's work

[1] A qualified environmental professional (QEP) is an applied scientist or technologist who is registered and in good standing with an appropriate BC professional organization constituted under an Act, and who, through demonstrated suitable education, experience, accreditation, and knowledge relevant to the particular matter, may be reasonably relied on to provide advice within their area of expertise.

2.0 REGULATORY AND LEGISLATIVE REQUIREMENTS

Table 2 provides a summary of the key federal and provincial environmental legislation relevant to the Project, including required permits, notifications, and approvals to regulatory agencies.

Table 2 Construction Environmental Permits and Notifications

Legislation	Applicability to the Project (Environmental Permits for Construction)	Regulatory Agency	Description
Migratory Birds Convention Act, 1994	Applicable but no permits required	Environment and Climate Change Canada (ECCC)	Most migratory birds and their nests and eggs are protected everywhere in Canada under the *Migratory Birds Convention Act*. If vegetation clearing or other activities that may result in incidental take must occur during the primary migratory bird nesting period, a bird nest sweep and other potential mitigation measures will be required.
Species at Risk Act	Permit issued if affecting a species at risk on federal land is incidental to the carrying out of an activity, which is unlikely to apply to this Project.	ECCC	Species at risk, their critical habitat, and their residences (e.g., nest, roost, den) are protected on federal land under the *Species at Risk Act*. If the Project is likely to affect a species at risk or its critical habitat or residence on federal land, SARA requires that ECCC must be notified in writing.
Wildlife Act	A General Wildlife Permit is not likely to be required unless the Project overlaps with amphibian breeding or dispersal areas or a protected nest is encountered.	Ministry of Forests, Lands, Natural Resource Operations and Rural Development (MFLNRORD)	A permit under the *Wildlife Act* is required to salvage and relocate amphibians if disturbance activities occur during the amphibian active period and overlaps amphibian breeding or dispersal areas. A permit under the *Wildlife Act* is required to remove and relocate or modify the structure of an unoccupied protected nests of certain species (e.g., bald eagle, osprey, and great blue heron).
[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]

The *Heritage Conservation Act* (HCA) protects heritage objects and archaeological sites, on provincial Crown land and private land in British Columbia, that predate 1846. These objects and sites are protected through designation as “provincial heritage sites” or through automatic protection by virtue of being of particular historical or archaeological value (Section 9). Protected archaeological sites may not be altered without permit issued by MFLNRORD. Permitting under the HCA is not expected to apply since the Project area is considered to have [redacted] archaeological sites.

3.0 CONSTRUCTION ACTIVITIES

Construction activities will expand the Klemtu Mountain MCTS Site. Expansion of the site will add the following infrastructure:

- New MCTSS building that will house two new diesel-fuelled engines driving four electrical generators
- Fuel storage platform that will hold one 10,000 L fuel tank
- New antenna tower

Activities required to build this new infrastructure include:

- Mobilization and demobilization of all manpower, equipment, materials and other resources necessary to execute the Work
- Clearing and cutting shrubs, and ground vegetation in areas of new infrastructure and to create a clear zone for the helicopter landing pad and new tower location
- Grubbing and soil excavation
- Levelling bedrock under the new antenna tower with handheld tools
- Building concrete foundations and piers to support infrastructure
- Constructing and assembling infrastructure

Construction is anticipated to commence in July 2022. Site layout drawings to be completed in February 2022 with the tower being replaced July thru September 2022. The new building will be fabricated over October 2022 to March 2023 and the new building installation and any other building and decommissioning to begin in June 2024.

4.0 EXISTING CONDITIONS

The following section describes the existing biophysical conditions and key environmental components for the Project compiled from a desktop review and site reconnaissance (May 18, 2021). The Project is on the summit of Klemtu Mountain on the northeast side of Swindle Island and is remote and accessible only by helicopter. The existing infrastructure is on flattened areas with rocky outcroppings. The surrounding area slopes sharply in all directions toward the ocean; the surrounding landscape consists of undeveloped and historically logged forested land. Snow melt and water runoff into several small stream networks, and into Kitasoo Lake, which eventually drains into Queen Charlotte Sound via the Kitasoo Creek. The key environmental components and existing conditions for this site are summarized in Table 3.

Table 3 Key Environmental Components and Existing Conditions

Key Environmental Component	Description of Existing Conditions
[redacted]	[redacted]
[redacted]	[redacted]
Fish	• Kitsoo Lake and Kitsoo Creek support fish habitat for sockeye Salmon, Chum Salmon, Coho Salmon, and Pink Salmon
[redacted]	[redacted]
Air Quality	• Existing infrastructure powered by two diesel-fueled generators
Conservancies	• Kitasoo Spirit Bear Conservancy to the west and northwest of the site • Any staging or anchoring areas must be outside of the Conservancy boundaries

5.0 ENVIRONMENTAL PROTECTION MEASURES

Construction activities associated with the Project have the potential to affect environmental resources; however, with the implementation of the mitigation measures outlined below, potential effects associated with the Project can be reduced.

Unless otherwise stated, the Contractor engaged by the CCG to complete Project construction is assumed to be responsible for adhering to the mitigation measures detailed in the sections below (Sections 5.1–5.9).

5.1 GENERAL BEST MANAGEMENT PRACTICES

Mitigation and management measures that avoid and/or mitigate adverse environmental effects associated with the Project are based on best management practices (BMPs) and standard industry procedures. These documents are from various government agencies, industry BMPs, and recommendations by qualified professionals. The mitigation and management measures included in these documents have been created, modified, and enhanced as needed for the purposes of this EMP. Examples of BMPs used to develop this EMP include, but are not limited to:

- Field Guide to Fuel Handling, Transportation and Storage (MWLAP 2002)
- Best Management Practices Guidelines for Bats in British Columbia (MOE 2016)
- Guidelines for Amphibians and Reptile Conservation during Urban and Rural Land Development in British Columbia (MOE 2014)
- Best Management Practices for Amphibian and Reptile Salvages in British Columbia (MFLNRO 2016)
- Environment and Climate Change Canada's General Nesting Periods of Migratory Birds in Canada (ECCC 2018)
- Environment and Climate Change Canada's Guidelines to Reduce Risk to Migratory Birds (ECCC 2019)
- Guidelines for Raptor Conservation During Urban and Rural Land Development in British Columbia (MOE 2013)

5.2 GENERAL CONSTRUCTION PRACTICES

Many environmental mitigation measures are common to different construction components and activities. Table 4 provides general environmental mitigation measures applicable to most Project activities.

Table 4 General Mitigation Measures

Category	Mitigation Measure
EMP and permits	1. Keep a copy of the EMP and any applicable permits onsite and readily available.
Project start up	2. At the start of project construction, review and discuss the measures in this EMP with all onsite personnel to promote an understanding of the Project, environmentally sensitive areas, reporting responsibilities, and emergency response plans.
Training	3. Train all personnel involved in construction activities on how to identify, document, and address environmental incident (e.g., spills)
	4. Train all personnel involved with construction activities in safe practices and the Health and Safety Plan.
	5. Train all personnel in the use of appropriate personal protective equipment.
Stop work	6. Stop work and contact the EM for assistance prior to commencing or continuing any activities that may pose any environmental risk not addressed in this document.
	7. The EM will have authority to issue a stop work order where activities are adversely affecting or are likely to adversely affect environmental conditions presented in Section 4.0. The EM will also make recommendations in the field for avoiding and mitigating effects, where measures in this EMP are not effective.
Construction footprint	8. Limit the construction footprint to the area of clearing in Project drawings.
	9. Limit clearing to the work areas flagged pre-construction. Do not clear or grub in areas of sensitive habitats identified by flagging.

Table 4 General Mitigation Measures

Category	Mitigation Measure
Site cleanliness	10. Keep all work areas tidy during construction and remove all construction debris and garbage at the end of the Project.
Stockpiles/ laydown areas	11. Limit stockpiling of material and laydown areas to approved areas. Install appropriate erosion and sediment controls (as described in Section 5.4).
	12. Store blast rock in unvegetated areas unless this creates a safety concern.
Deleterious substance	13. Only transport and use machinery free from leaks. Clean machinery prior to arriving at the Project site.
	14. Inspect machinery for leaks and required maintenance during the Project to limit leaks and spills.
Previously identified contaminated soils	15. Wear appropriate personal protective equipment (nitrile gloves and half-face respirator) if working with soils or disturbing the ground within 10 m of the existing building.
Hydrocarbons	16. Do not release hydrocarbons (e.g., hydraulic fluids and fuel, detectable by sight or smell) to the environment (see Spill Prevention, Response and Reporting, Section 5.3).
Air quality, GHGs, and noise quality	17. Limit equipment and machine idling.
	18. Turn off heavy equipment when inactive for more than 30 minutes.
	19. Verify that equipment and machinery are in good operating condition prior to work.
	20. Carry out regular maintenance on equipment and machinery.
	21. Maintain noise abatement equipment on machinery (e.g., mufflers) so they are in good working order.
	22. Equip drills with dust collectors.
	23. Do not burn slash except with the written permission of the CCG Project Manager. Only burn slash material consistent with Provincially accepted guidelines to increase burning efficiency.
Wildfire Prevention	24. Limit smoking to designated areas as approved by the CCG Project Manager.
	25. Prohibit smoking when the fire danger ranking is high or extreme.
	26. Keep readily accessible fire suppressing equipment at the work site and at designated smoking areas.
	27. If slash burning is permitted by the CCG Project Manager, schedule burning to avoid high fire hazard periods.

5.3 SPILL PREVENTION, RESPONSE AND REPORTING

Substances that are deleterious to the environment and may pose a spill risk for this Project could include:

- Gasoline
- Diesel
- Hydraulic fluid
- Transmission fluid
- Engine oil
- Lubricants (grease, etc.)
- Drilling fluids
- Sediment

Table 5 outlines procedures for prevention and control of spills, including responsibilities, storage, and equipment.

Table 5 Spill Prevention, Mitigation Measures, Response and Reporting

Category	Mitigation Measure
Training	1. Provide on-site staff with training in the use of potentially hazardous materials and the location and use of spill kits and containment booms.
	2. Train all personnel in the Project-specific Spill Control Plan, Contamination Prevention Plan, and Waste Water Management Plan (as required in Environmental Procedures specification (01 35 43) items 1.4.8, 1.4.10, and 1.4.11, respectively).
Fuel handling guide	3. Handle, store, and label fuel consistent with *A Field Guide to Fuel Handling, Transportation and Storage* (MWLAP 2002), National Fire Code (National Research Council of Canada, 2015) and WHMIS. If there are discrepancies between this EMP and the referenced documents, the Project will err on the side of more stringent unless otherwise approved by CCG.
Fuel	4. Where possible, fuel storage, equipment or machinery refueling, and servicing will occur a minimum of 30 m from any waterbody. Where operational constraints require fuel storage, equipment or machinery re-fueling and servicing within 30 m of a waterbody, measures to prevent the release or spill of hazardous materials must be discussed and approved by CCG and the EM.
	5. Store fuels and petroleum products to comply with safe operating procedures, including containment facilities in case of a spill.
	6. Maintain an inventory of all potentially hazardous materials on site.
	7. Store portable fuel tanks (e.g., jerry cans) in leak-proof secondary containment with absorbent pads with a capacity of 110% of its volume. Regularly remove accumulated water in the containment.
	8. Shut off vehicles and equipment while refueling.
Equipment	9. Maintain equipment (e.g., containers, hoses, and machinery) in good running order to prevent leaking or spilling of potentially hazardous or toxic products. This includes hydraulic fluid, diesel, gasoline, and other petroleum products.
	10. At the discretion of the EM, drip trays, poly sheet or sorbent pads will be placed beneath machinery and equipment. Place generators in secondary containment, such as within drip trays with sorbent pads.
	11. Only use containers sealed with a proper fitting cap or lid.

Table 5 Spill Prevention, Mitigation Measures, Response and Reporting

Category	Mitigation Measure
Equipment maintenance/ servicing	12. Place impervious materials, such as tarps, drip pans or spill trays, underneath equipment and machinery during servicing when there is a potential for accidental drips or spills.
Spills	13. In the event of a leak, stop all fueling/filling operations until the cause of the leak has been identified and it has been repaired.
	14. Implement the Project-specific spill response measures.

In the event of a spill, follow the Project-specific Spill Control Plan. The plan should include the measures presented in Table 6.

Table 6 Spill Response and Reporting Mitigation Measures

Category	Mitigation Measure
Spill kits	1. Provide an appropriate number of spill kits on site based on the type and amount of equipment.
	2. Regularly inspect spill kits and re-fill immediately after use.
	3. Have spill response materials contained in spill kits readily available when working at the Project site. These materials include, but are not limited to: a. Spill kits b. Sorbent pads and booms c. Dry oil sorbent d. Personal protective equipment (e.g., nitrile gloves, safety glasses, suits) e. Heavy duty plastic garbage bags f. Fire extinguishers g. Shovels
Response	4. The initial response to the spill may include: a. Stop work b. Ensure your own safety and the safety of others c. On-site personnel wear personal protective equipment, such as nitrile gloves and safety glasses d. Identify the spilled materials and refer to the appropriate Safety Data Sheet to determine if human health or ignition hazards exist e. If possible and safe to do so, contain the spill by any safe means possible (e.g., plug leak, close/isolate leaking valve, etc.) f. Obtain assistance of others g. Begin containment of the spill and stop it from spreading h. Cleanup the spilled substance using available supplies from the on-site spill kits i. If the spill is to water, use measures such as installing sorbent rolls as floating booms to contain the spill and sorbent pads to soak up the material j. Immediately report the spill to the EM, if they are at the Project site, or otherwise notify the CCG Project Manager and EM as soon as it is safe to do so k. Submit a written report within 24-hours of the spill. l. The CCG Project Manager and/or the EM will determine if notification to regulatory agencies is required

Table 6 Spill Response and Reporting Mitigation Measures

Category	Mitigation Measure
Clean-up	5. Commence final clean-up and reclamation following an assessment (by a QEP) of soil and/or water conditions. Conduct in situ remediation only if approved by CCG and appropriate regulatory agencies. Specific clean-up measures will be determined in consultation with CCG, regulatory agencies, and the appropriately qualified professionals.
Reporting	6. Immediately report all spills, regardless of severity, to the CCG Project Manager or EM.
	7. CCG is responsible for notifying regulatory agencies or authorizing notification on their behalf (e.g., environmental representative) to regulatory agencies of all hazardous spills and to verify that the spill reporting meets provincial and federal requirements. **CCG should report all spills to water to the Provincial Emergency Program (1-800-663-3456).**
	8. The Spill Reporting Regulation under the British Columbia *Environmental Management Act* identifies externally reportable quantities for certain substances (Appendix A). Any spills to water must be reported.
Environmental incident/non-compliance report	9. Submit an Environmental Incident/Non-Compliance Report in the event of a spill within 24-hours to the CCG Project Manager and EM. Information required to be included in this report is provided in Section 6.2.

5.4 SEDIMENT AND EROSION CONTROL

Construction mitigation measures designed to limit the loss of soil and sediment mobilization to vegetation adjacent to project areas are provided in Table 7.

Table 7 Sediment and Erosion Control Mitigation Measures

Category	Mitigation Measure
Pre-construction	1. Clearly flag the clearing area, and clearly mark any areas with identified soil erosion potential hazards to mitigate during construction.
Stockpiles/laydown areas, clearing, and construction	2. Manage any soils disturbed during the Project in accordance with all federal, provincial, and municipal regulations and take precautions during construction activities to reduce the impact to the environment and exposure to humans.
	3. Limit the concentration of sediment and organic debris that may enter nearby environments. Follow best management practices.
	4. Avoid concentrating sediment or redirecting drainage to sensitive sites, including steep slopes, or on unstable or potential unstable slopes (as determined by a qualitied professional) where possible. Implement erosion and sediment control measures as warranted.
	5. Minimize stripping of topsoil and vegetation. Where possible, retain topsoil for revegetation post-construction.
Precipitation events	6. Prepare for precipitation events by having the quantity and type of sediment and erosion control measures for the Project area readily available.
	7. During high rainfall events (e.g., 100 mm in 24-hour period) or when there is a potential for sedimentation offsite and entering waterbodies or conduits to waterbodies or sensitive sites, work may be stopped at the discretion of the EM or delegate.
	8. Limit disturbance of existing vegetation to clearing areas in Project drawings.

Table 7 Sediment and Erosion Control Mitigation Measures

Category	Mitigation Measure
Vegetation disturbance	9. Avoid clearing vegetation on steep slopes, or on unstable or potential unstable slopes (as determined by a qualitied professional) where possible. Implement erosion and sediment control measures as warranted.
Erosion and sediment control measures	10. Install erosion and sediment control measures before starting any works that may result in sediment mobilization or cause erosion.
	11. Train all onsite personnel in erosion and sediment control measures.
	12. Do not start construction until sediment and erosion control measures are in place and deemed functional by the EM or delegate.
	13. Only clear vegetation in areas required for safe construction.
	14. Avoid sediment entrainment by isolating and/or diverting surface water from disturbed areas
	15. Commence on-site grade reworking during dry conditions to minimize erosion potential.
	16. Cover sediment-based stockpiles (and slopes where warranted) with natural and/or synthetic covers (e.g., straw, mulch, matting or geotextile) to aid with erosion control and vegetation management.
	17. Contour blast rock stockpiles to limit erosion. Cover and/or revegetate following construction, as needed, to limit erosion and sedimentation potential.
	18. Install perimeter barriers, such as silt fencing, along the clearing perimeter to limit sediment transport via sediment-laden runoff.
	19. Progressive rehabilitation of disturbed soils and restricted access to rehabilitated areas will be implemented where applicable.
	20. Routinely inspect, maintain, and monitor erosion and sediment controls.
	21. Activate contingency plans for erosion and sediment controls in response ineffective control measures and changes in site conditions.
	22. Only remove erosion and control measures once construction is complete and ground conditions have stabilized, as approved by the EM or delegate.

5.5 VEGETATION MANAGEMENT

The Project area is within ecosystems of conservation concern as described in Section 4.0. Table 8 outlines mitigation measures to be implemented to reduce the disturbance of ecosystems and protect existing vegetation.

Table 8 Vegetation Mitigation Measures

Category	Mitigation Measure
Pre-construction	1. Clearly flag the clearing area, and clearly mark sensitive vegetation to avoid during construction.
Laydown	2. Store construction materials on unvegetated areas (i.e., previously cleared areas or rocky outcrops), unless approved by the EM.
Clearing	3. Top trees in the clearing area instead of clearing and grubbing where it is safe and practicable.
	4. Do not place cleared material in areas of pooled water.
	5. Maintain understory vegetation in temporary workspaces where it is safe and practicable.
	6. Protect trees outside and adjacent to the clearing area.
	7. Burn, chip, or remove large diameter slash material and dispose at an acceptable location (e.g., landfill) as approved by CCG or delegate.
Rare plants	8. If a previously unidentified rare plant is found prior to or during construction, flag and avoid where possible. If avoidance is not possible, then engage a QEP to determine appropriate mitigation.
Revegetation	9. In temporary workspaces that require clearing and grubbing, spread the area with stockpiled topsoil and seed with a native plant seed mix.
	10. Do not spread topsoil on naturally exposed bedrock.
	11. In temporary workspaces that were cleared without grubbing, allow the area to revegetate naturally.

5.6 INVASIVE PLANT AND WEED MANAGEMENT

The Project has the potential to introduce and spread invasive terrestrial species. Mitigation and management measures to reduce, prevent and control invasive species and weeds during the Project are described in Table 9. Throughout this section the term “invasive plants” also refers to the general term “weeds”, whereas “noxious weeds” refers specifically to invasive plants that fall under the BC *Weed Control Act* (WCA). For the purposes of this section invasive plants and noxious weeds will be referred to collectively as “Invasive Plants”.

Table 9 Invasive Species and Weed Control Management Measures

Category	Management Measure
Equipment	1. Only transport and use equipment, vehicles, and machines at the Project area that are clean (paying special attention to undercarriages, tracks, tires and blades). Reduce the probability of introducing noxious weeds to the sites by cleaning equipment of vegetation debris and soil prior to transport to the sites.
Material	2. Only import fill material free of invasive species.
	3. Imported fill material must meet the Canadian Council of Ministers of the Environment Canadian Soil Quality Guidelines for Commercial/Industrial Land Use and sample analysis should be documented from an independent Canadian Association of Laboratory Accreditation Inc. accredited laboratory.

Environmental Protection Measures
February 25, 2022

Category	Management Measure
Disposal	4. If invasive plants are found, dispose any removed invasive species at an appropriate disposal facility approved by CCG.
Revegetation	5. Use only certified weed-free seeds for revegetation.
Inspection	6. Inspect work areas during construction for invasive species.
Monitoring	7. The CCG will monitor the radar sites for noxious weeds following construction. If noxious weeds are discovered during monitoring, the CCG will create and implement control measures in consultation with a QEP to comply with the BC *Weed Control Act*.

5.7 WILDLIFE PROTECTION

Activities associated with the Project, such as vegetation clearing and equipment operation, have the potential to directly or indirectly affect wildlife. Table 10 presents the mitigation measures that should be implemented to avoid or limit adverse effects on wildlife.

Table 10 Wildlife Mitigation Measures

Category	Mitigation Measure
Pre-disturbance survey for wildlife habitat features	1. Prior to vegetation clearing, grubbing, and construction, areas to be cleared and adjacent buffer will be inspected by the EM or delegate QEP for wildlife features (e.g., dens, roosts, bird nests, wildlife trees). Search area of an appropriate size will be determined by the QEP. Mitigation measures to address birds and bird nests are described in this table. If other wildlife features (e.g., roost, den) are identified during this survey, the QEP will consult with the EM and CCG Project Manager on appropriate mitigation measures (e.g., setbacks, timing).
	2. If wildlife features are identified and mitigations implemented, the EM will follow-up during and after Project activities are completed to determine compliance with the EMP.
Wildlife habitat	3. Limit clearing and construction activities to within the delineated footprint.
	4. See Vegetation Mitigation Measures (section 5.5) to avoid or reduce loss of habitat features (e.g., wildlife trees).
Birds and bird nests	5. Nests of eagles, peregrine falcons, ospreys, and herons are protected year-round under the BC *Wildlife Act*, even when unoccupied. If such a nest is identified during the pre-construction survey, the the QEP will consult with the EM and CCG Project Manager on appropriate mitigation measures (e.g., avoidance).
	6. Reduce potential effects on migratory birds (i.e., incidental take) by planning project activities (i.e., vegetation clearing and construction) to occur outside of the primary nesting period for migratory birds, which is March 31 – August 12 (forest and open habitats), where possible, per ECCC's nesting calendar (ECCC 2018). Migratory bird nests are protected under the federal *Migratory Birds Convention Act*. If vegetation clearing and/or timber removal/repair must occur during the primary nesting period as identified above, then a "nest sweep" will be completed. a. The construction site and a 30-m zone around the construction site (where practical) will be inspected by a QEP for active or suspected active bird nests no more than seven days before disturbance is to begin b. If construction or activities do not begin within seven days of the nest sweep, another nest sweep must be undertaken c. Where active bird nests are identified, a nest-specific no-disturbance buffer will be established (see Buffer Zones category).

Table 10 Wildlife Mitigation Measures

Category	Mitigation Measure
	7. Once construction has begun, if a nest is encountered within the construction site or adjacent to the construction site (even after the end of the primary nesting period), the personnel will report the finding to the EM. The EM will evaluate the nest status and consult with a QEP on appropriate mitigation measures (e.g., establishment of a buffer zone). 8. Avoid barge staging areas or helicopter flight paths near seabird colony nesting islands (Dupont Island and Currie Islet)
Buffer zones	9. Where active bird nests are identified, a 'buffer zone' will be established around the nests and marked (e.g., with flagging tape). The buffer size varies by species (accounting for their alert and flush distances), habitat type, and type of disturbance activity, and will be determined based on provincial and federal guidelines and the QEP's opinion. Buffers will remain in place for the duration that the nest is active as determined by the EM or delegate QEP.
	10. Construction activities will be avoided within established buffer zones; if activities must occur within the buffer, the EM will consult with a QEP and appropriate regulators on additional mitigation measures.
Amphibians	11. If post-breeding amphibians are observed dispersing from breeding habitat and could interact with Project activities, the EM will consult with a QEP on appropriate mitigation measures (e.g., install drift fencing or permit application for salvage and relocation).
Feeding, attractants, and hazards	12. Feeding of wildlife will not be permitted.
	13. Meals, food waste, garbage, and other attractants (e.g., oil containers) will be securely stored in bear-resistant containers to prevent attraction of wildlife.
	14. Construction materials (e.g., cables, wires, fencing) will be properly stored to avoid potential hazards for wildlife.
Dead, sick, injured animals	15. If dead, sick, or injured animals are observed, report to the EM directly (verbally or by radio, as soon as possible). The EM will report the observation to the **British Columbia Conservation Officer Service (1-877-952-7277).**
Potentially hazardous wildlife	16. If cougar, grey wolf, or black bear are observed at the construction site do not approach the animal. Contact the EM directly (verbally or by radio), as soon as possible, for additional direction. If cougar, or black bear presence becomes an ongoing concern for construction personnel, the EM will consult with the **British Columbia Conservation Officer Service (1-877-952-7277 [Report all poachers and polluters, RAPP, 24-hour hotline]).**
Wildlife disturbance	17. For mitigation measures to reduce noise, see Table 7
	18. Use warning sirens, blasting mats, blasting controls, and monitoring to reduce the potential for injury to wildlife.
Habitat reclamation (revegetation)	19. See Table 8.

5.8 ARCHAEOLOGICAL AND HERITAGE RESOURCE PROTECTION

In the event that an archaeological or heritage site is encountered during construction, the archaeological standards and practices (including implementation of a chance find protocol) will be followed.

Evidence of possible archaeological or heritage resources may include the following:

- Artefacts of stone or other material
- Shell deposits
- Rock paintings or carvings
- Depressions in the ground (large or small, circular or rectangular)
- Cabins and other old-looking structures
- Old industrial, ranching, and other remains of possible heritage significance
- Mature western red cedar with well-defined bark scars
- Human remains

If presumed archaeological or heritage resource is encountered during construction, the work must be stopped in the vicinity of the find and the EM will notify the CCG Project Manager. From there, the CCG project manager or their delegate will immediately contact the BC Archaeological Branch and/or a professional archaeologist.

5.9 WASTE CONTROL

Waste from project activities has the potential to adversely affect the aquatic and terrestrial environments; therefore, the mitigation measures outlined in Table 11 will be implemented.

Table 11 Waste Control Mitigation Measures

Category	Mitigation Measure
Existing waste	1. The CCG will remove waste at the site that is present prior to construction.
Waste	2. Waste or any miscellaneous unused materials will be recovered for disposal in a designated facility. Under no circumstances will materials be deliberately thrown into the aquatic or terrestrial environment.
	3. Securely store all food waste, garbage, and other attractants (e.g., oil containers) in bear-resistant containers to prevent attracting wildlife.
	4. Prohibit fires and burning of garbage.
	5. Securely store litter to prevent starting wildfires.
	6. Collect all construction debris/waste and transport and dispose off-site in accordance with the Non-Hazardous Solid Waste Disposal Plan (as required in Environmental Procedures specification (01 35 43 item 1.4.3.9) and in accordance with applicable legislation, guidelines, and best management practices.
Portable Toilets	7. Portable toilets will be placed a minimum of 30 m from any waterbody. Dispose sewage from portable toilets in an approved sewage disposal facility on an as-needed basis.

Table 11 Waste Control Mitigation Measures

Category	Mitigation Measure
Hazardous Waste	8. Although hazardous waste is not anticipated for this Project, it should be noted that sorbent materials or soils saturated with hydrocarbons (greater than or equal to 3% by weight) are classified as hazardous waste under the British Columbia *Environmental Management Act* and must be managed accordingly.
	9. Collect and transport off site all used petroleum products, including their empty containers. Dispose of in a licensed recycling facility in approved storage containers following applicable regulations.

6.0 ENVIRONMENTAL MONITORING AND REPORTING

6.1 GENERAL ENVIRONMENTAL MONITORING

The EM will verify that ongoing Project components are monitored against this EMP and applicable regulatory and legal requirements. CCG is responsible for contracting environmental monitoring and determining, in consultation with the EM, the appropriate frequency of site visits. Monitoring frequency will be determined based on the construction schedule, any regulatory requirements and timing of higher-risk activities. When the EM is not on site, the Contractor will be responsible for meeting the requirements of this EMP.

The CCG Project Manager and EM will have authority to alter work methodology and/or issue stop work orders to prevent environmental effects and/or adverse environmental effects, whether probable, imminent, or occurring. Once corrective actions have been implemented and deemed appropriate by the EM, suspended Project activity will be allowed to resume under the EM's guidance.

6.2 REPORTING

The EM is responsible for keeping notes of site activities from each site visit and will prepare one monitoring report at the end of construction. This report will be submitted as a draft to the CCG Project Manager for review and comment. Once the EM has addressed the CCG Project Manager's comments, the EM will finalize the report.

The monitoring report should include, at minimum:

- Construction activities
- Monitoring period
- Mitigation measures and activities that have been implemented or recommended
- Non-compliances and environmental incidents
- Presence of wildlife observed in the work area
- Photographs
- Overall compliance or non-compliance with the EMP and/or regulatory permits/authorizations

Non-compliances and incidents will be reported to the CCG Project Manager (and regulators, where required) as soon as possible and within 24 hours of occurrence.

In the event of non-compliance or an incident, the event must be reported to CCG Project Manager. Non-compliances include non-compliance with this EMP, project-specific mitigation plans, or project permits/authorizations/legislation (e.g., spills).

The non-compliance and incident reports should include:

- Reporting person's name and telephone number
- Date and time of the non-compliance or incident, including major steps (such as when the incident occurred, when did response occur)
- Location of non-compliance or incident (coordinates if available)
- Description and cause of the non-compliance or incident (if a spill—including type, source and quantity of material)
- Receiving environment description
- Names of other persons or government agencies notified
- Description of the response and when it occurred
- If a spill, percent of material recovered
- Details of further action required
- Recommendations for preventative/mitigation measures

Non-compliances and incidents must be resolved immediately by the CCG Project Manager, the EM, and the Contractor(s), with the CCG Project Manager as the top authority. When a non-compliance or incident occurs, remedial actions must be taken as soon as possible (i.e., as soon as the site is safe).

6.3 EMERGENCY CONTACTS

Emergency contacts for the Project are provided in Table 12. Updated phone numbers for project personnel should be obtained prior to construction.

Table 12 Emergency Contact List for Project

Contact	Phone Number
The CCG Project Manager: Steve Cole	Office: (250) 480-2961 Mobile: (250) 686-3574
Contractor contact: TBD	Office: Mobile:
CCG Environmental Monitor: Robin Connelly	Office: (250) 363-8727 Mobile: (250) 580-8382
Provincial emergency program, 24 hours spill reporting	1-800-663-3456
Report All Poachers and Polluters (RAPP), 24 hours hotline	1-877-952-RAPP (7277)
Medical emergency	refer to Health and Safety Plan

WorkSafeBC	1-866-621-7233

7.0 CLOSURE

We trust that this information meets with your present requirements. Should you have any questions or require additional information, please do not hesitate to contact the undersigned.

Regards,

Reviewed by:

8.0 REFERENCES

ECCC (Environment and Climate Change Canada). 2018. Nesting Periods. Available at: https://www.canada.ca/en/environment-climate-change/services/avoiding-harm-migratory-birds/general-nesting-periods/nesting-periods.html#_zoneA_calendar. Accessed May 2021.

ECCC. 2019. Guidelines to Reduce Risk to Migratory Birds. Available at: https://www.canada.ca/en/environment-climate-change/services/avoiding-harm-migratory-birds/reduce-risk-migratory-birds.html. Accessed May 2021.

Ministry of Environment (MOE). 2013. Guidelines for Raptor Conservation During Urban and Rural Land Development in British Columbia. Available from: https://www2.gov.bc.ca/assets/gov/environment/natural-resource-stewardship/best-management-practices/raptor_conservation_guidelines_2013.pdf. Accessed: May 2021.

Ministry of Environment (MOE). 2014. Guidelines for Amphibians and Reptile Conservation during Urban and Rural Land Development in British Columbia. A companion document to Develop with Care. Available at: https://www2.gov.bc.ca/gov/content/environment/natural-resource-stewardship/laws-policies-standards-guidance/best-management-practices. Accessed May 2021.

Ministry of Environment (MOE). 2016. Best Management Practices Guidelines for Bats in British Columbia. Available at: https://www2.gov.bc.ca/gov/content/environment/natural-resource-stewardship/laws-policies-standards-guidance/best-management-practices. Accessed May 2021.

Ministry of Forests, Lands and Natural Resource Operations (MFLNRO). 2016. Best Management Practices for Amphibian and Reptile Salvages in British Columbia. Available at: https://www2.gov.bc.ca/gov/content/environment/natural-resource-stewardship/laws-policies-standards-guidance/best-management-practices. Accessed May 2021.

MWLAP (Ministry of Water, Land and Air Protection). 2002. A Field Guide to Fuel Handling, Transportation and Storage. 3rd Edition. Available online at: http://www2.gov.bc.ca/assets/gov/environment/waste-management/industrial-waste/industrial-waste/oilandgas/fuel_handle_guide.pdf Accessed May 2021.

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APPENDIX A

Recordable Levels for Spills of Certain Substances

Appendix A RECORDABLE LEVELS FOR SPILLS OF CERTAIN SUBSTANCES

Reportable spills in the BC Spill Reporting Regulation related to a listed substance, other than natural gas, if (a) the spill enters, or is likely to enter, a body of water, or (b) the quantity of the substance spilled is, or is likely to be, equal to or greater than the listed quantity for the listed substance, detailed below:

Item	Substance spilled	Specified amount
1	Class 1, Explosives as defined in section 2.9 of the Federal Regulations	Any quantity that could pose a danger to public safety or 50 kg
2	Class 2.1, Flammable Gases, other than natural gas, as defined in section 2.14 (a) of the Federal Regulations	10 kg
3	Class 2.2 Non-Flammable and Non-Toxic Gases as defined in section 2.14 (b) of the Federal Regulations	10 kg
4	Class 2.3, Toxic Gases as defined in section 2.14 (c) of the Federal Regulations	5 kg
5	Class 3, Flammable Liquids as defined in section 2.18 of the Federal Regulations	100 L
6	Class 4, Flammable Solids as defined in section 2.20 of the Federal Regulations	25 kg
7	Class 5.1, Oxidizing Substances as defined in section 2.24 (a) of the Federal Regulations	50 kg or 50 L
8	Class 5.2, Organic Peroxides as defined in section 2.24 (b) of the Federal Regulations	1 kg or 1 L
9	Class 6.1, Toxic Substances as defined in section 2.27 (a) of the Federal Regulations	5 kg or 5 L
10	Class 6.2, Infectious Substances as defined in section 2.27 (b) of the Federal Regulations	1 kg or 1 L, or less if the waste poses a danger to public safety or the environment
11	Class 7, Radioactive Materials as defined in section 2.37 of the Federal Regulations	Any quantity that could pose a danger to public safety and an emission level greater than the emission level established in section 20 of the "Packaging and Transport of Nuclear Substances Regulations"
12	Class 8, Corrosives as defined in section 2.40 of the Federal Regulations	5 kg or 5 L
13	Class 9, Miscellaneous Products, Substances or Organisms as defined in section 2.43 of the Federal Regulations	25 kg or 25 L
14	waste containing dioxin as defined in section 1 of the Hazardous Waste Regulation	1 kg or 1 L, or less if the waste poses a danger to public safety or the environment
15	leachable toxic waste as defined in section 1 of the Hazardous Waste Regulation	25 kg or 25 L

Item	Substance spilled	Specified amount
16	waste containing polycyclic aromatic hydrocarbons as defined in section 1 of the hazardous Waste Regulation	5 kg or 5 L
17	waste asbestos as defined in section 1 of the Hazardous Waste Regulation	50 kg
18	waste oil as defined in section 1 of the Hazardous Waste Regulation	100 L
19	waste containing a pest control product as defined in section 1 of the Hazardous Waste Regulation	5 kg or 5 L
20	PCB Wastes as defined in section 1 of the Hazardous Waste Regulation	25 kg or 25 L
21	waste containing tetrachloroethylene as defined in section 1 of the Hazardous Waste Regulation	50 kg or 50 L
22	biomedical waste as defined in section 1 of the Hazardous Waste Regulation	1 kg or 1 L, or less if the waste poses a danger to public safety or the environment
23	A hazardous waste as defined in section 1 of the Hazardous Waste Regulation and not covered under items 1 – 22	25 kg or 25 L
24	A substance, not covered by items 1 to 23, that can cause pollution	200 kg or 200 L
25	Natural gas	10 kg
SOURCE: British Columbia *Environmental Management Act*: Spill Reporting Regulation (2017) Schedule Available at: http://www.bclaws.ca/civix/document/id/loo96/loo96/46_263_90		

APPENDIX E

Radar Antenna Specifications

1. TERMA – 21 FEET HIGH GAIN ANTENNA SYSTEM
2. TERMA – DRAWING 259460-ZD

Class: PSP
Doc. no: 304786-DP
Rev: F
Date: 2018-08-13
Approved by: JCP

TERMA
CAGE code: R0567

21 Feet High Gain Antenna System

Record of Changes

ECR/ECO	Description	Rev	Date
	Released	A	2005-03-31
	General update - Specification updated	B	2006-04-27
40601	General update - Specification updated	C	2012-08-14
48406/68420	General update - Specification updated Wind specifications clarified, lightning protection and grounding improved, preventive maintenance updated.	D	2016-08-02
53158/72841	VP variant and associated comments taken out of the document, as VP is not a managed product Added CP, HP variants and corresponding information regarding allowed motor power (2.2kW or 4.0kW)	E	2018-03-06
54345/73834	Added one antenna variant HP-F-38 with 4.0 kw nominal motor power in section 6.1 Reference changed to the valid manual in section 9 (from 972059-DN to 255548-HT)	F	See header

Contents

Notice:

This document describes the product and may serve as reference in quotations and contracts.

Within the basic product configuration, a number of features and options are available to fulfill the customer application. These are specifically mentioned where relevant.

Note that illustrations are for visualization only. Please refer to detailed drawings which can be handed over upon request for specific details,

Terma A/S aims to improve the product family continuously, and consequently reserves the right to revise product characteristics without notice.

1 Abbreviations

Term	Definition
AC	Alternate Current
ACP	Azimuth Count Pulse output
AQAP	Allied Quality Assurance Publications
ARP	Azimuth Reference Pulse
C / Cosec^2	Cosecant squared (beam shape)
CP	Circular Polarization
CSS	Coastal Surveillance Service
DC	Direct Current
EIA	Electronic Industries Association
EN	European Norm
F	Fan (beam shape)
FD	Frequency Diversity
HG	High Gain antenna family
HP	Horizontal Polarization
I	Inverse Cosecant Squared (beam shape)
IEC	International Electro-technical Commission
ISO	International Organization for Standardization
MDR	Minimum Detection Range
NATO	North Atlantic Treaty Organisation
RF	Radio Frequency
RPM	Rotations Per Minute
Rx	Receive
SMR	Surface Movement Radar
TD	Time Diversity
TMS	Terma Management System
Tx	Transmit
VSWR	Voltage Standing-Wave Ratio
VTS	Vessel Traffic Service

2 Introduction

2.1 Executive summary

The Terma SCANTER High Gain X-band radar antennas are tailored specifically to meet the requirements for professional customers requiring durable high performance and high operational reliability.

For use in security and safety applications such as: Coastal Surveillance Service (CSS), Vessel Traffic Service (VTS) and Surface Movement Radar (SMR)

The antennas are of the linear array type, with fan beam, Cosec^2 (Cosecant squared) beam or inverse Cosec^2 beam elevation shape and are available with horizontal or circular polarization.

The antennas are designed to have narrow horizontal beam width, low side lobes, and no back lobes.

Figure 2.1 Typical antenna installation

Table 2-1: List of models

P/N 259460-xxx

- **21' HG-HP-F-38**
- **21' HG-HP-C-37**
- **21' HG-HP-I-37**
- **21' HG-CP-F-38**
- **21' HG-CP-C-37**
- **21' HG-CP-I-37**

21’ length in feet
HG ~ High Gain
CP ~ Circular Polarization
HP ~ Horizontal Polarization
F ~ Fan beam shape
C ~ Cosec^2 beam shape
I ~ Inverse Cosec^2 beam shape

2.2 Polarization

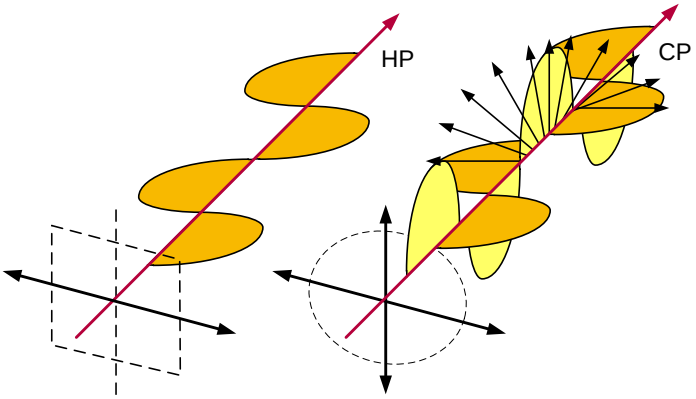


Figure 2.2 Electrical field of horizontally and circularly polarized antennas

Horizontally Polarized (HP) antennas have their electrical field parallel to the Earth's surface, and the magnetic field perpendicular to the Earth's surface. HP antennas are efficient for detection of very small targets, but have higher backscatter from rain than Circularly Polarized (CP) antennas. However, influence from rain can often be accepted in systems aimed for detection of small targets.

Circularly polarized (CP) antennas have both fields rotating in a corkscrew pattern, making one complete revolution during each wavelength. CP antennas provide low susceptibility to rain: as the shape of individual raindrops approach perfect spheres, the backscatter from the rain drops will rotate with opposite sense, thus suppressing rain. Typically, CP antennas reduce rain backscatter with 10-20 dB compared to HP antennas. However, target returns are typically 3-5 dB lower compared to HP antennas. Small non-metallic targets may be suppressed completely. CP antennas are typically preferred for SMR applications.

2.3 Frequency and time diversity

If a linear array antenna is connected to a transceiver, which transmits several different frequencies, these frequencies are transmitted in different angles. This can be utilized for Frequency Diversity (FD) functionality.

Together with a rotating antenna, this gives Time Diversity (TD), which means that the clutter and the target are hit by different frequencies at different time.

By using this phenomenon and combining and comparing the received signals, better performance is achieved, target fluctuations will be reduced, and clutter will be suppressed, enhancing target relative to clutter and rain. For small targets in rough clutter environment, this enhancement is typically 6 dB.

3 Performance

3.1 Coverage

Coverage calculations are depending on the actual scenario, such as transceiver specification, the installation, the propagation and the target, etc. The coverage diagram in this section shows the relative difference of the 3 various antenna beam shapes, not a specific scenario.

Multipath effects, sea and land clutter are disregarded. *Multipath* ~ the beam of the antenna reflects at the land or sea surface with interference and phase shifting of the signal.

Inverse Cosec^2 beam shape - is often used in Surface Movement Radar (SMR) applications with near range coverage of ground targets if close proximity is desired.

Fan beam shape - is often used in VTS and CS applications for longer range use.

Cosec^2 beam shape – is recommended in all applications where airborne targets are of interest. Additional gain on the Cosec^2 beam shape at shorter ranges will enhance detection and tracking of airborne targets in the surface clutter range.

Note: The following diagrams are for illustration purposes only, and shows coverage as a function of range of the 3 different beam shapes. The vertical and horizontal scales are not identical formatted.

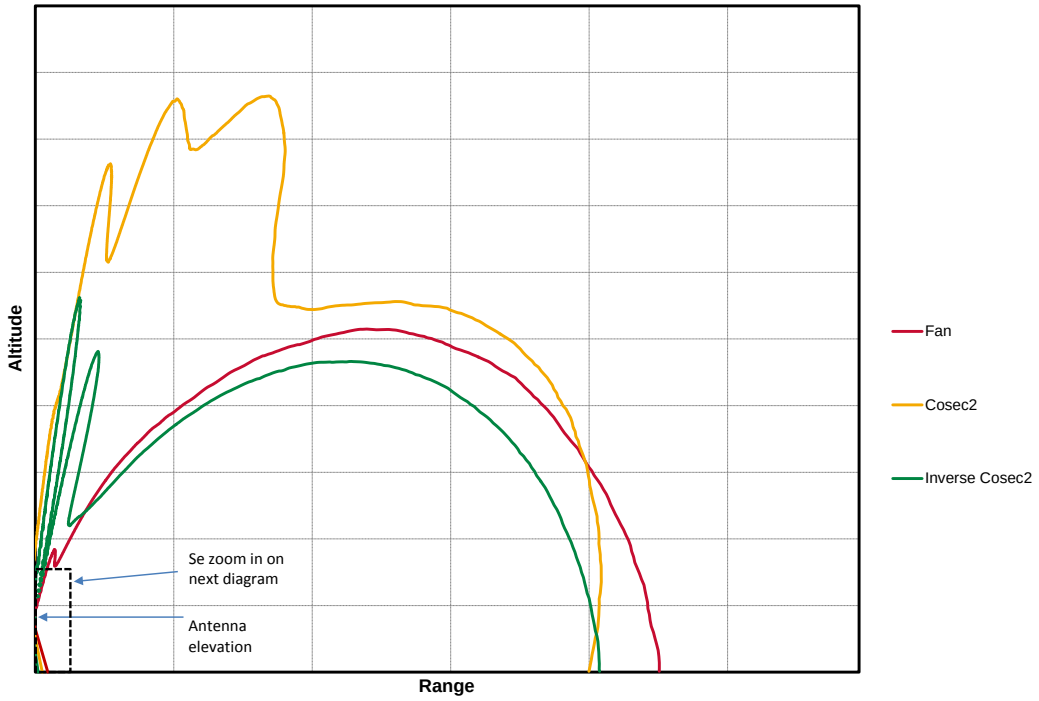


Figure 3.1 Long-range coverage diagram

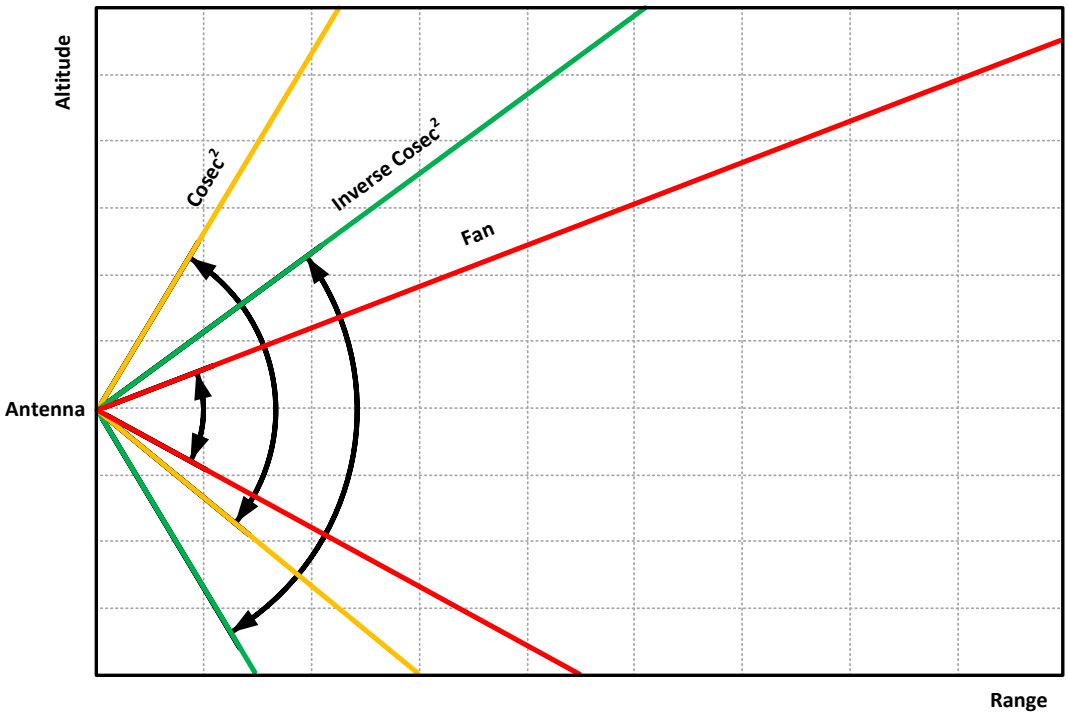


Figure 3.2 Close-range coverage diagram

3.2 Minimum detection range

The antenna beam shape and the antenna height above the surface determine the Minimum Detection Range (MDR) of a target.

Example: a Fan beam shaped antenna 100 m above the surface has a MDR of ~ 400 m.

However, the length of the waveguide between antenna and transceiver must be taken into account. For example if an installation has a 25 m waveguide, then the first 2 x 25 m = 50 m from the radar center is a blind zone.

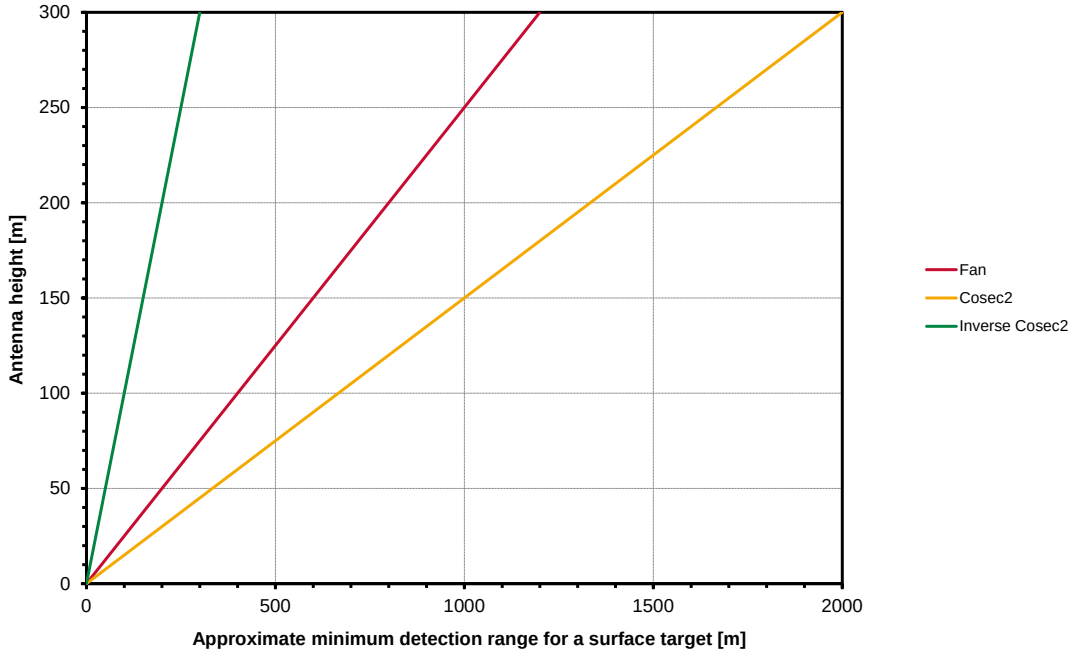


Figure 3.3 Minimum detection range

4 Product characteristics

4.1 Physical appearance

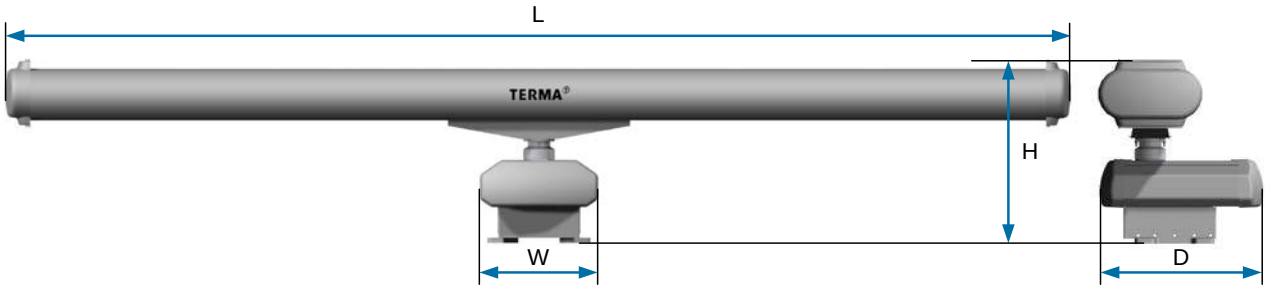


Figure 4.1 Mechanical dimensions

Table 4.1 Mechanical specifications

Mechanical construction	
Color	Silver grey RAL 7001 / White RAL 9010 (opt.) / Orange RAL 2009 (opt.)
Weight	Approx 400 kg
H x L x W x D (Height x Lenght x Width x Depth)	1110 x 6560 x 712 x 1000 mm
Swing radius	3300 mm
Packed for transport	
Weight incl. wooden crate	Approx 850 kg
H x L x D (Height x Lenght x Depth)	Approx 1560 x 6820 x 880 mm

Figure 4.2 Wooden transport crate

4.2 Color scheme

Silver gray RAL 7001

Optional: Pure white RAL 9010

Optional: Traffic orange RAL 2009 / Pure white or Silver grey

(antenna is two-colored: antenna RF window white or grey, turning unit orange)

Figure 4.3 Color scheme

4.3 Main assemblies

The *Antenna system* consists of two main assemblies:

- The *Antenna* radiating the RF-power and subsequently receiving radar echoes.
- The *Turning unit* including: gearbox, asynchronous motor, terminal box, waveguide rotary joint and azimuth encoder(s).

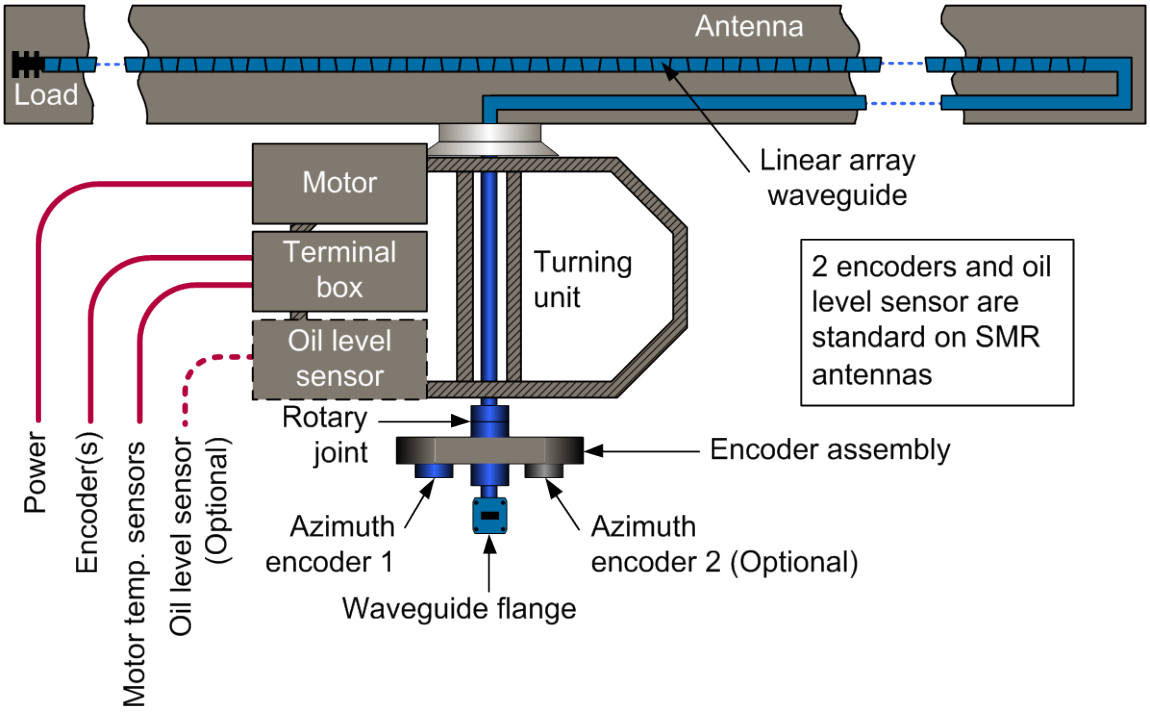


Figure 4.4 Antenna system schematic

4.4 Antenna

The *Antenna* consists of a linear array waveguide with inclined narrow wall slots, mounted in a flared horn, and a low loss RF-transparent radome.

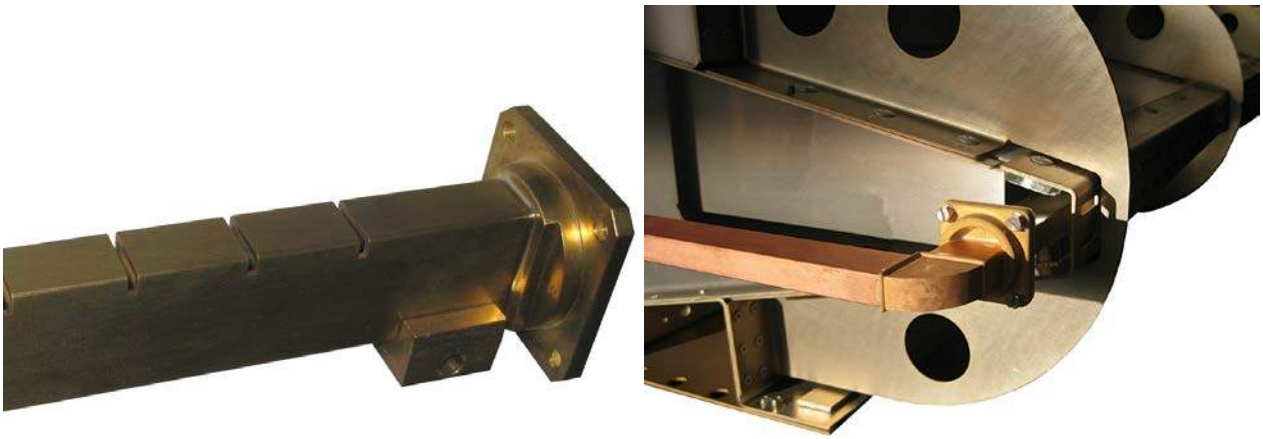


Figure 4.5 Linear array waveguide and mechanics without radome

4.5 Turning Unit

The *Turning unit* includes the asynchronous motor, the gearbox, the encoder assembly and the terminal box. The encoder assembly consists of a rotary joint and up to two azimuth encoders (2nd redundant encoder is optional). Two encoders are standard on SMR antennas.

Figure 4.6 Turning unit

5 Interfaces

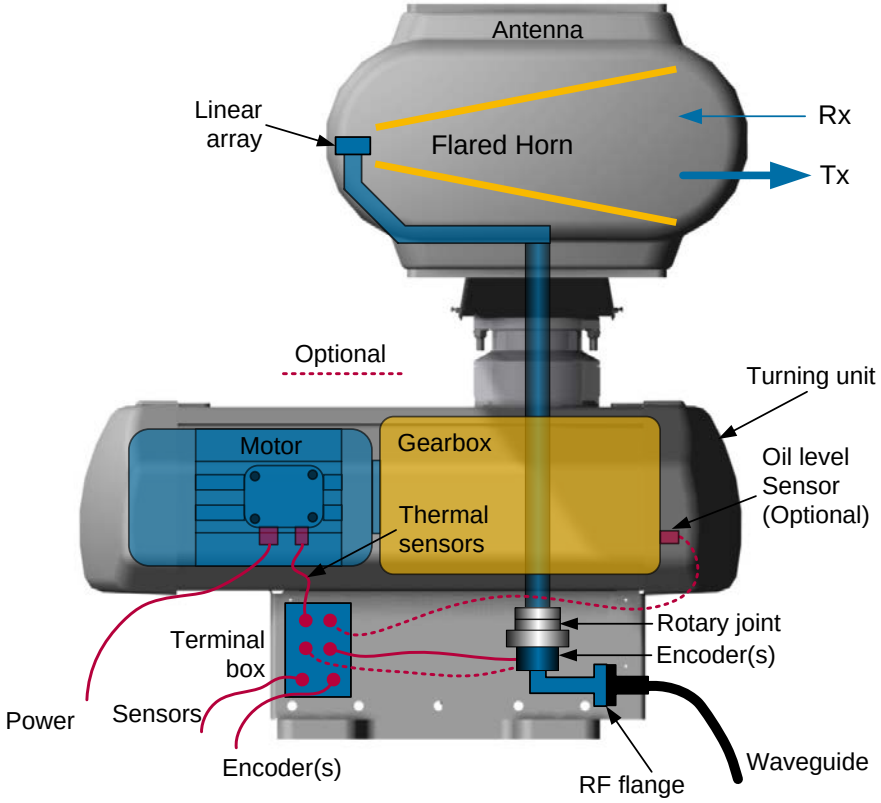


Figure 5.1 Schematic Interfaces

5.1 RF interface

The RF interface used is an UBR 100 RF flange, according to IEC154 for R100 Waveguide.

According to EIA standard (USA) for WR90 Waveguide, the RF flange Cover Square UG39/U is used.

Figure 5.2 Encoder, rotary joint and RF flange

5.2 Electrical interfaces

All low voltage signals are connected through the terminal box located inside the Turning Unit.

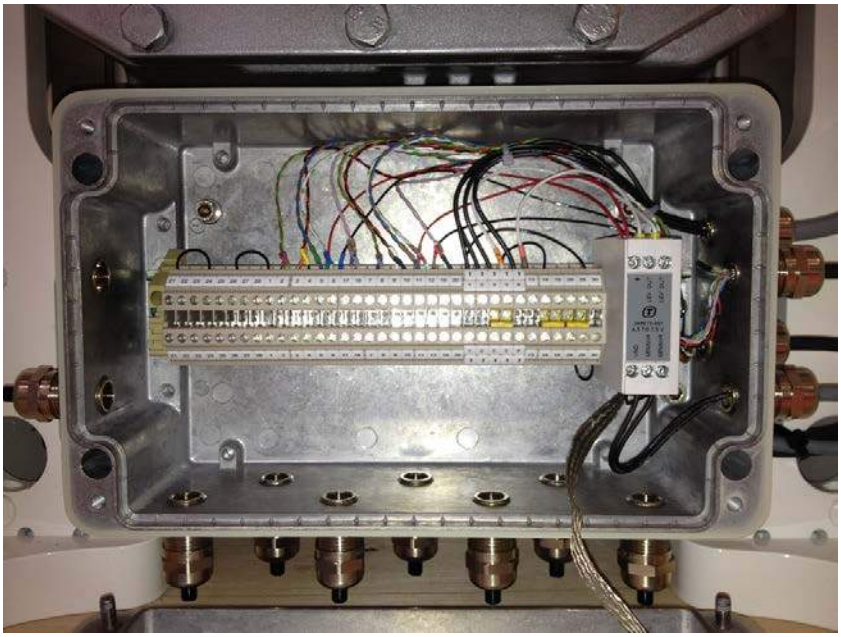


Figure 5.3 Open terminal box - ready for installation (example)

The power supply for the motor is connected directly. The motor has two integrated thermal switches, which monitor the motor temperature and when activated, reports either a warning or a shutdown.

6 Specifications

6.1 Main

 # T 8-1.2, # T 8-1.3, # T 8-1.4, # T 8-1.5, # T 8-1.7, # T 8-1.8, # T 8-1.9, # T 8-1.10, # T 8-1.11, # T 8-1.12, # T 8-1.14, # T 8-1.15, # T 8-1.16, # T8-1.22, # T8-1.23

Table 6-1: Main specifications

Electrical

Type		Linear array					
Operating frequency band		X-band 9.14 - 9.50 GHz (Optional low freq. 9.0 - 9.2 GHz)					
Gain at antenna flange		HP-F	HP-C	HP-I	CP-F	CP-C	CP-I
		≥ 38 dBi	≥ 37 dBi	≥ 37 dBi	≥ 38 dBi	≥ 37 dBi	≥ 37 dBi
-3 dB horizontal beam width (Azimuth)		≤ 0.36 °					
-3 dB vertical beam width (Elevation)		≤ 11 °					
Integrated Cancellation Ratio (ICR)		≥ 15 dB (only for CP antennas)					
Voltage Standing Wave Ratio (VSWR)		≤ 1.2:1 (-20.8 dB) at antenna flange					
Squint angle		~ 1 ° per 100 MHz frequency difference					
Fixed beam peak angle (Tilt)	Fan	- 1.5 °					
	Cosec^2	0.6 °					
	Inverse Cosec^2	-0.6 °					
Azimuth sidelobe levels (Symmetrical)		1.5 - 5.0 ° ≤ - 28 dB / 5 - 10° ≤ - 30 dB / ≥ 10° ≤ - 35 dB					
RF power handling - Peak / average		≤ 50 kW / ≤ 75 W (Optional high power variant with average ≤ 600 W)					
Motor supply		3 phases via frequency inverter					
RF waveguide interface		UBR100 flange for R100 / WG16 / WR90 waveguide					
Turning unit loss		≤ 0.3 dB					
Motor temperature sensor contacts		120° warning and 150° shutdown - normally closed					
Optional oil level sensor		Low oil level war. contact - normally closed					

Turning unit, 2.2 kW nominal motor power

		HP-F-38	HP-C-37	HP-I-37	CP-F-38	CP-C-37	CP-I-37
Variants							
Rotation speed range		10-40 RPM					
Maximum wind speed ** Note*	≤ 20 RPM	≤ 51 m/s ~ 100 knots					
	≤ 30 RPM	≤ 40 m/s ~ 78 knots					
	≤ 40 RPM	≤ 35 m/s ~ 68 knots					
Survival wind speed		≤ 75 m/s - motor power off and free rotating					

Turning unit, 4.0 kW nominal motor power

		HP-F-38	CP-F-38	CP-C-37	CP-I-37
Variants					
Rotation speed range		10-60 RPM			
Maximum wind speed ** Note*	≤ 20 RPM	≤ 55 m/s ~ 107 knots			
	≤ 40 RPM	≤ 55 m/s ~ 107 knots			
	≤ 60 RPM	≤ 41 m/s ~ 80 knots			
Survival wind speed		≤ 75 m/s - motor power off and free rotating			

Azimuth encoder

Azimuth count pulses	8K ~ 8192 (redundant encoders as option)
Supply voltage	5 VDC ± 10% (Optional variant with 15 VDC supply)
Current	< 100 mA
Azimuth Count Pulse output (ACP)	2 x 90° phased shifted EIA-422 square waves
Azimuth Reference Pulse output (ARP)	1 x EIA-422 square wave pulse and its inverted

* Note: Motor **must** be stopped when winds speed exceeds limits.

6.2 Radiation patterns

All graphs are measured examples

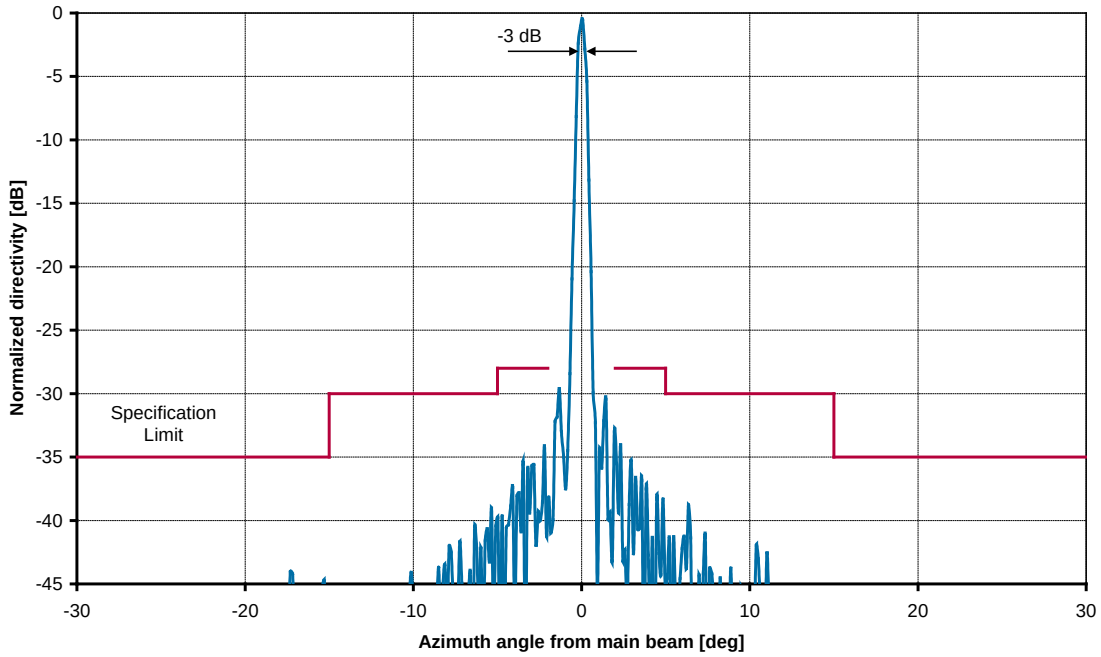


Figure 0.1 Horizontal radiation pattern with sidelobe specification limits for all models

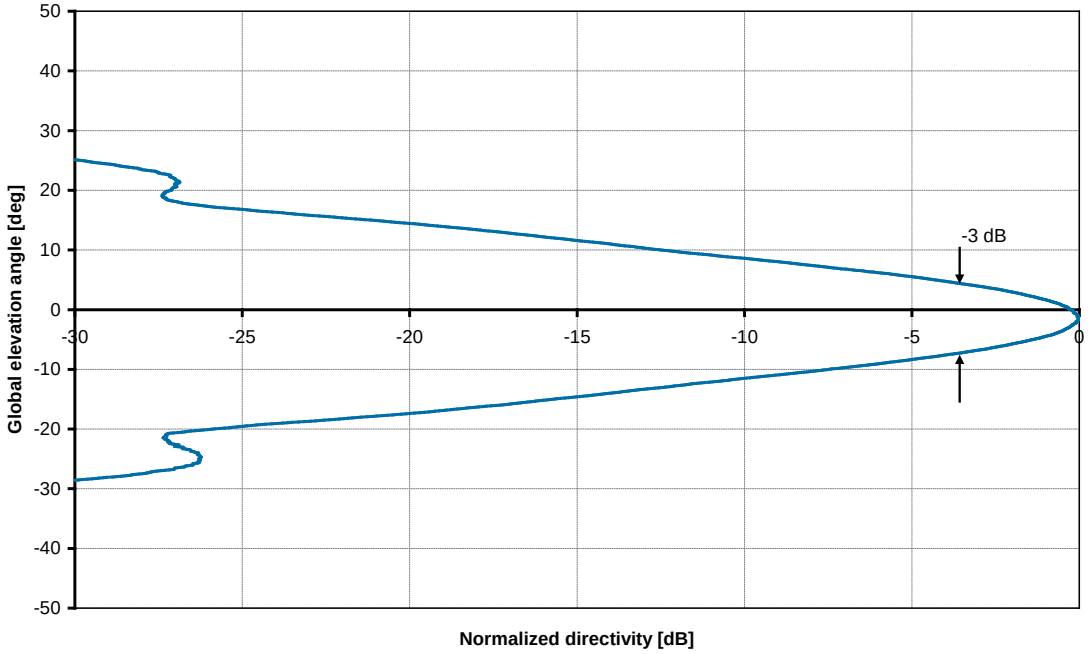


Figure 0.2 Fan beam shape - vertical radiation pattern

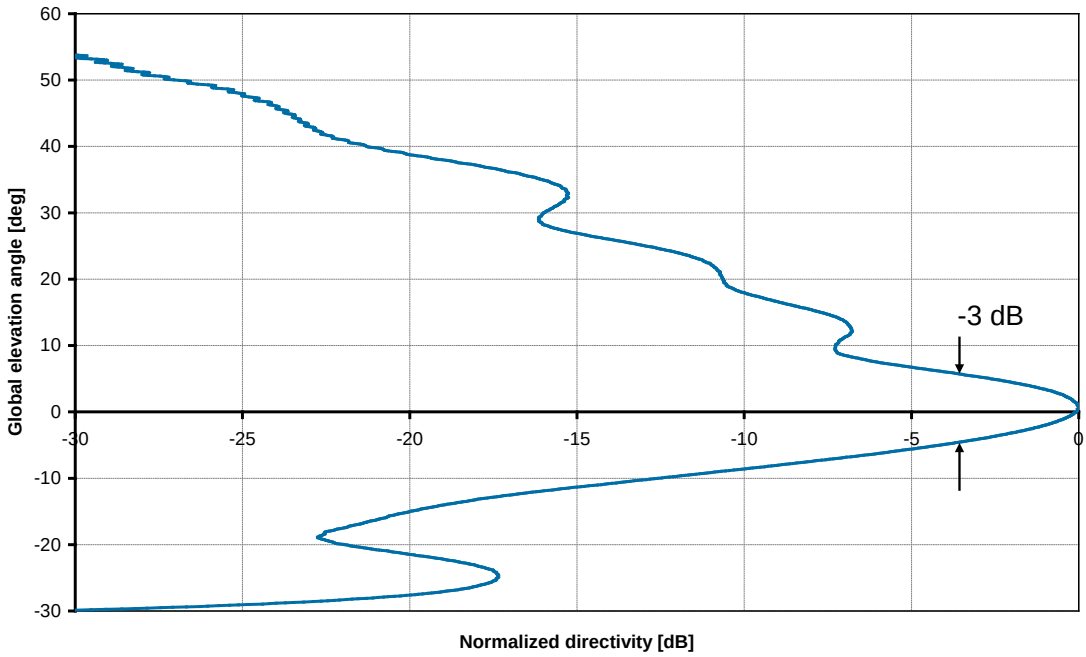


Figure 0.3 Cosec^2 beam shape - vertical radiation pattern

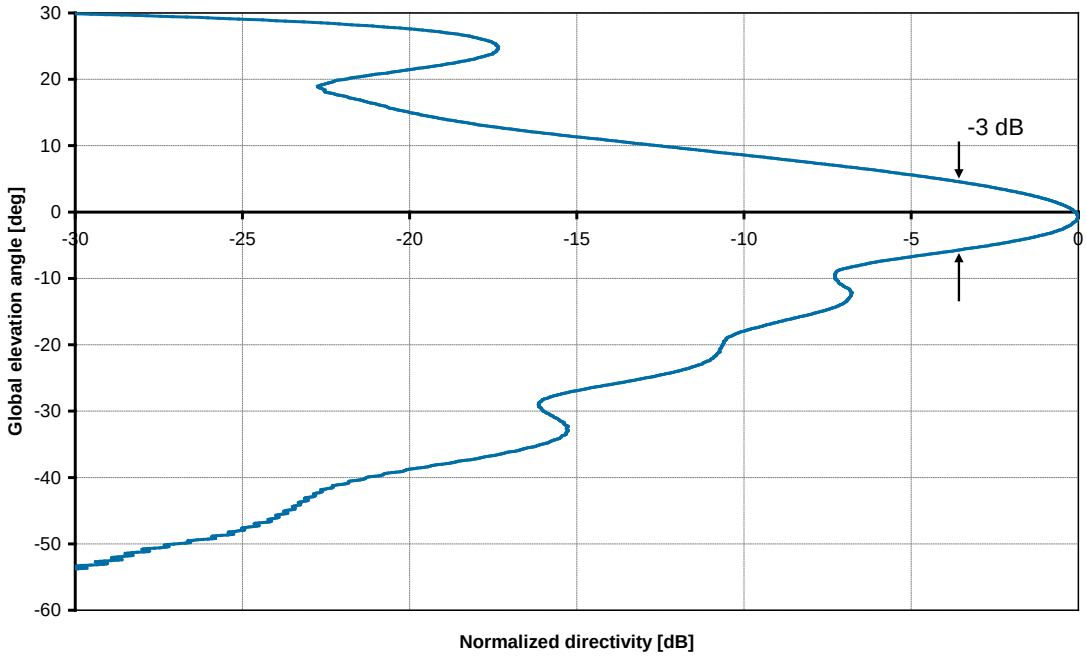


Figure 0.4 Inverse Cosec^2 beam shape - vertical radiation pattern

6.3 Wind load and tower forces

The antenna system is designed to withstand the horizontal wind loads specified in section 6.1.

The turning unit is matched to the aero dynamical behavior of the antenna and the antenna rotational speed.

It is recommended to situate the antenna in a free wind field to reduce turbulence and avoid irregular wind loads such as asymmetrical winds caused by buildings or terrain. Further wind scenarios should be taken into account:

- Gust factor and gradient wind effect
- Wind speed statistics (modal, median and average speed)
- Hot and cold air and density of air effect
- The Venturi effect in hilly surroundings
- Turbulence effect when the wind is interrupted
- Asymmetrical or irregular wind loads on installations on slopes and structures
- Special meteorological wind phenomena's such as the Bora, Sirocco, Mistral, etc.

For further guidance on wind considerations and recommendations for installation, refer to doc. no. 804487-DN.

6.4 Environmental specifications

T 8-1.20
T 8-1.21

Table 0-1: Environmental specifications

Packed for transportation and storage environment requirements		
Temperature	-40 °C to 70 °C	IEC 60068-2-1/-2-2
Humidity	80 %RH to 96 %RH @ -10 ºC to +60 ºC	IEC 60068-2-38
IP protection class	IP 54 (Dust and watersplash)	IEC 60529
Bumps	10 g, 16 ms, 1000 bumps	IEC 60068-2-27
Shock	16 g, 6 ms, 3 shocks	IEC 60068-2-27
Operational environment requirements		
Temperature	-40 °C to 55 °C *	IEC 60068-2-2, Bb
Humidity	80 %RH to 96 %RH @ -10 ºC to +65 ºC	IEC 60068-2-38
Corrosion category	C4 (High atmospheric-corrosivity)	EN/ISO 12944
IP protection class	IP 54 (dust and watersplash)	IEC 60529
Salt mist	Severity (1) - Salt 5% by weight	IEC 60068-2-52
Solar radiation	≤ 1120 W/m^2	IEC 60068-2-9
Hail	≤ 10 mm hail @ 18 m/s wind	-
Ice load	≤ 20 kg/m^2	-
Max wind speeds	See table 6.1 for operational and survival wind speeds	
Design life	15 years	-
Operational emmisions		
Turning unit acoustic noise	Lower than typical natural background noise	
Radiation safety distance	10 m (horizontal plane)	
	1 m (vertical plane)	

T 8-1.26
T 8-1.24

**) Cold startup: Down to - 25 °C*
The upper operational temperature limit of 55 °C refers to the ambient air temperature, the effective temperature including solar heating may be higher.

7 System considerations

7.1 Supporting structures

The tower requirements depend on the desired accuracy of the radar performance.

The load/forces from the antenna system can be found in doc. no. 259460-ZD.

Bending

Bending of the tower is normally insignificant to affect radar performance.

Azimuth torsion

In the azimuth direction, torsion will result in azimuth errors.

The azimuth error is calculated as follows:

$$Azimuth\ \ error\ [m] = \frac{2\pi}{360} R\varphi$$

Where R is the target distance in meters, and φ is the torsion angle in degrees.

Example: With a torsion angle of 0.2º, a target at a distance of 40 km gives an azimuth error of 140 m.

As a rule of thumb, the torsion must be below ¼ of the horizontal antenna beam width, in normal operational weather conditions. Most trackers will accept this.

Accuracy requirements may call for less tolerance.

Tilting

In stationary radar systems, the tilt of the platform on which the antenna is mounted, should be below 0.5º.

The picture shows a self-supporting conically shaped three-leg steel lattice tubular tower, which is excellent for radar antennas.

The antenna base plate may be mounted on a steel pedestal or directly on the tower construction.

Figure 7.1 Three-legged lattice tower

7.2 Lightning protection and grounding

The antenna system must be properly protected against lightning. 99% of all damage caused by lightning occurs due to overvoltage induced in the power supply and distributed to other parts of the system. To accommodate this problem, it is recommended to add surge arrestors to power supplies and galvanic connections penetrating the equipment cabins. The optimum solution is that the power supply is the only galvanic connection from the exterior and using fiber optic cables for all signal connections.

Figure 7.2 shows the recommended solution for lightning protection and grounding. If a lightning strikes the radar antenna mast, experience shows that it is extremely difficult to secure the high-energy power flow. If the lightning attractor rod(s) is isolated, it is imperative that the impedance for earth is smaller than for other paths; that is, there may be >100 kV potential at the top of the lightning conductor(s) and 0 V immediately next to it via the signal cables. In this situation, the energy is able to “jump”, causing serious problems.

In summary, the idea is to connect the system as effectively as possible to ensure that all components have the same potential in the event that lightning strikes and a Faraday’s cage must be established around the equipment cabin.

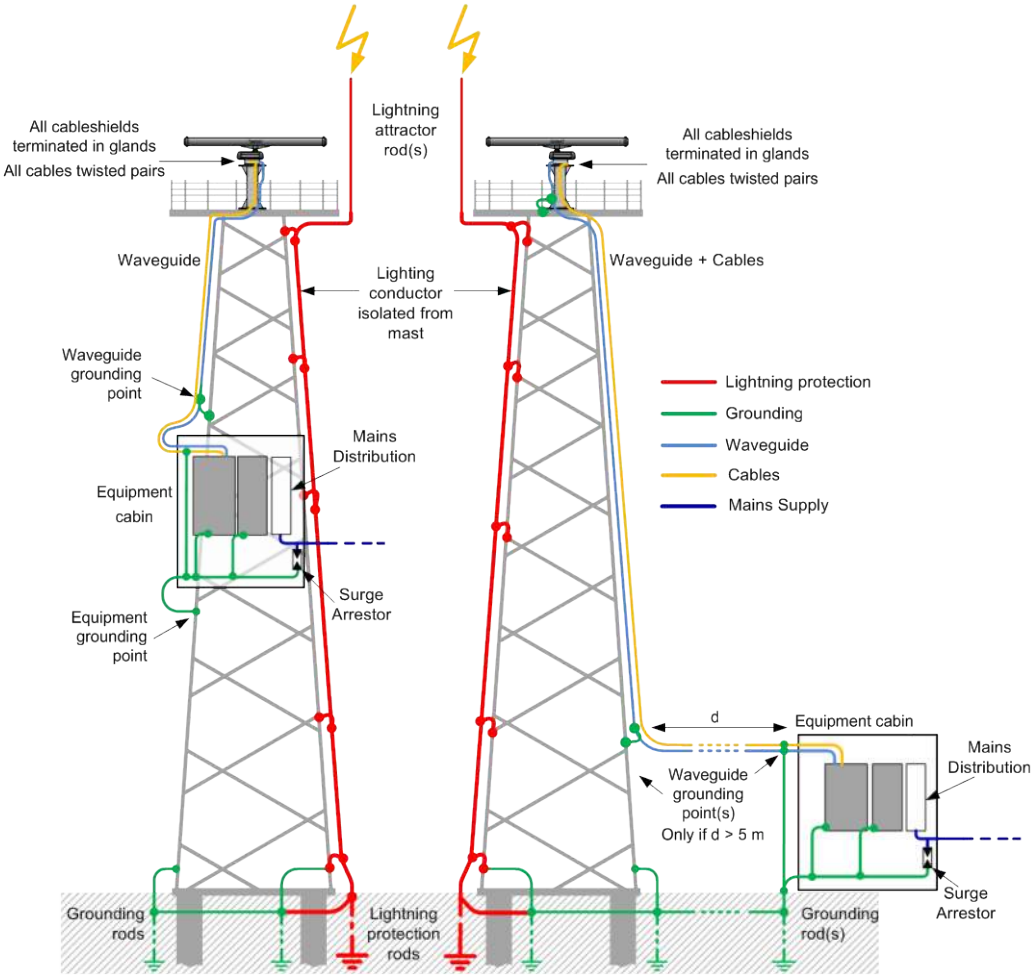


Figure 7.2 Lightning protection and grounding solution

8 Waveguide drying

Waveguide drying or dehydrating pressurizing are recommended in all installations. The actual recommendation depends on climate conditions and waveguide length.

Simple Silica gel based static desiccators are recommended for installations in which day to night temperature variation is low, relative humidity in equipment rooms is never high and waveguides are short (< 20-25 meters).

Figure 8.1 Static desiccator and waveguide pressurizer

Waveguide pressurizing is recommended in all other cases, especially if equipment buildings are occupied regularly or located in tropical areas or other areas with considerable day-night temperature variations.

9 Preventive Maintenance

Preventive maintenance should be performed with fixed intervals.
The procedures and recommended intervals are based on long-term experience.
Refer to doc. no. 255548-HT for maintenance intervals.

Figure 0.1 Turning unit maintenance access

10 Quality assurance certification

AQAP-2110

For more than 25 years, Terma A/S has been certified to the NATO Quality standard AQAP-1, later AQAP-110 and AQAP-150, and since 2006, Terma has been assessed and certified to AQAP-2110 by Bureau Veritas Certification.

ISO 9001

Since 2003, Terma has been assessed and certified to ISO 9001 by Bureau Veritas Certification.

Terma Quality Management System

Terma Quality Management System is an inherent part of the Terma Management System (TMS), which is an on-line process orientated information system on Terma's intranet. TMS is formed as a front-end to the Quality Handbook and other business procedures for each business area giving an easy way to gain relevant information to the individual employee based on the actual job and stage in the process.

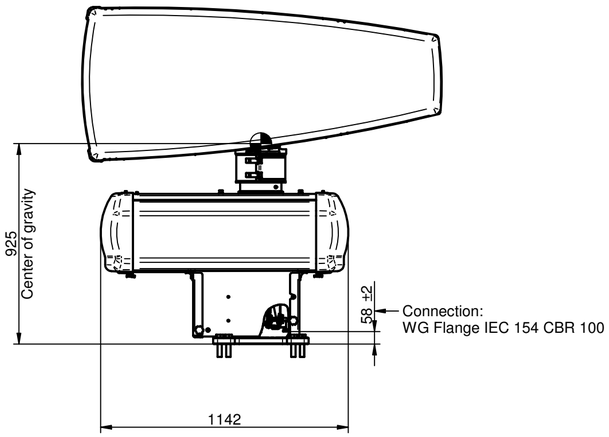
Other certifications

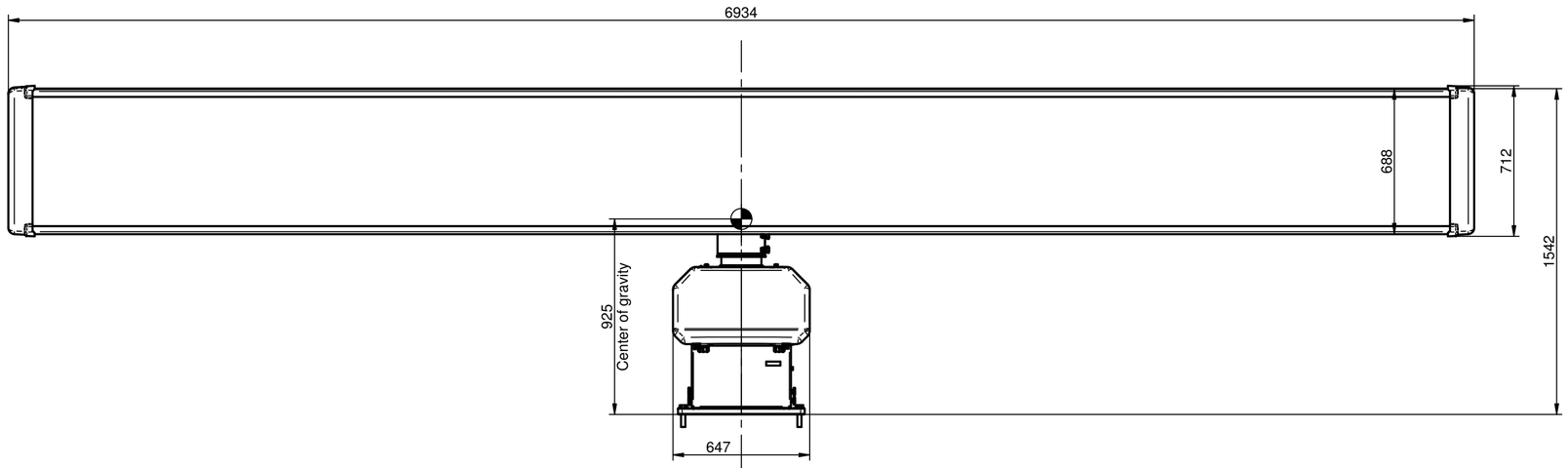
Contact Terma A/S for a complete list of various second party approvals and certificates.

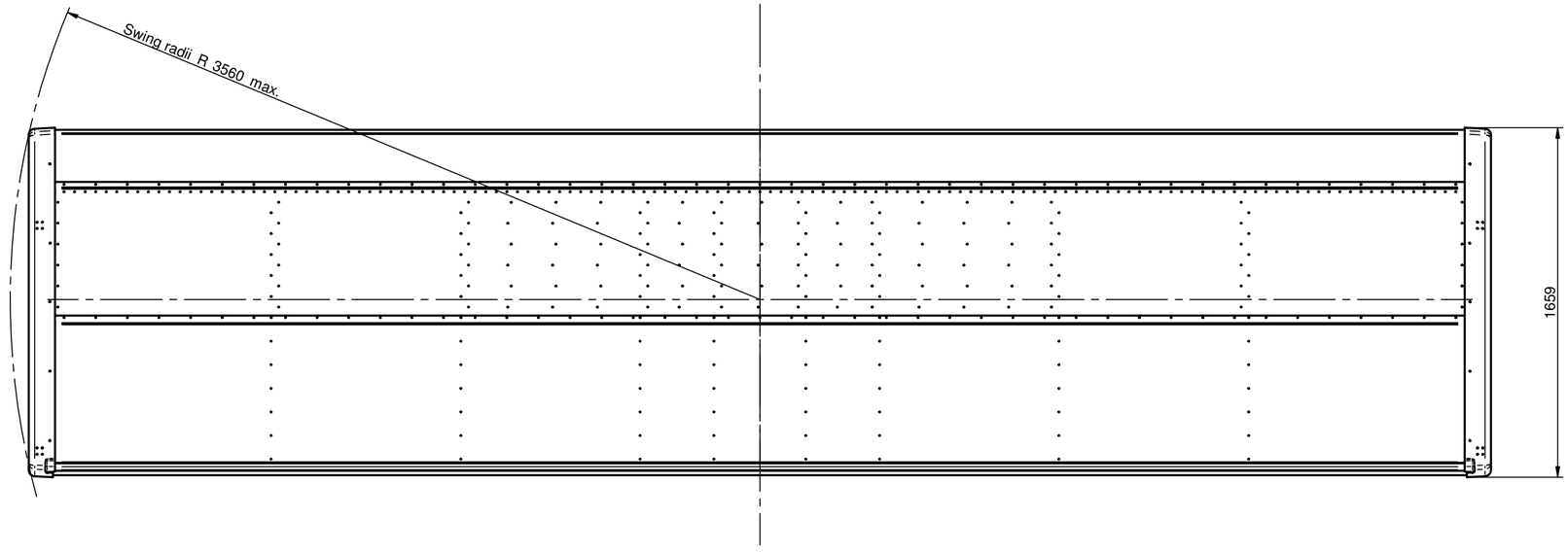
1 Denotes center of gravity

2 All dimensions are typical and in mm

3 Lifting method, see page 4







LA 21'				
Start torque [Nm]				
	Min	Max	Frequency [Hz]	Wind [m/s]
Cyclic torque 15 RPM [Nm]	82	1274	0,5	30 m/s
Cyclic torque 10 RPM [Nm]	37	1274	0,33	45 m/s
Cyclic torque 4 RPM [Nm]	6	567	0,133	50 m/s
	Min	Max	Frequency [Hz]	Wind [m/s]
Lateral force 15 RPM [N]	1386	6368	0,5	30 m/s
Lateral force 10 RPM [N]	3119	14328	0,33	45 m/s
Lateral force 4 RPM [N]	3850	17689	0,133	50 m/s
Lateral force non operating [N]	7547	34670	-	70 m/s
	Min	Max	Frequency [Hz]	Wind [m/s]
Overturning moment 15 RPM [Nm]	609	7576	0,5	30 m/s
Overturning moment 10 RPM [Nm]	1370	17046	0,33	45 m/s
Overturning moment 4 RPM [Nm]	1691	21045	0,133	50 m/s
Overturning moment non operating [Nm]	3315	41248	-	70 m/s
	Motor output power : 4,0 kW			
	Rated Current (In) : 9,0 A @ 400V			
	Locked Rotor Current (Is) : 42,3 A			
	Is/In = 4,7			

Variant Table									
Part no.	Color	Type	Azimuth Output [ACP]	Max Speed RPM	Mains [V]	Weight approx. Kg	Oil Sensor	Encoder Supply	Motor Output Power kW
304262-002	Grey	21' LAHP-F-42	1*8192	15	3x230/400	1000	Optionel	± 10%, max. 120mA	4,0
304262-022	Grey	21' LAHP-C-40	1*8192	15	3x230/400	1000	Optionel	± 10%, max. 120mA	4,0
304262-031	Grey	21' LACP-F-42	1*8192	15	3x230/400	1000	Optionel	± 10%, max. 120mA	4,0

MATERIAL: -

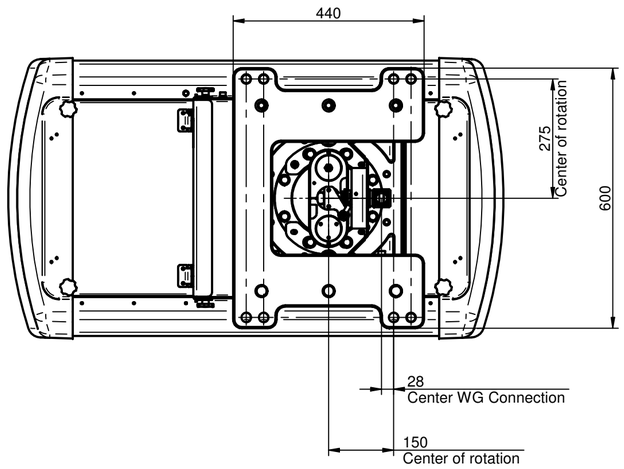
GENERAL TOLERANCE: -

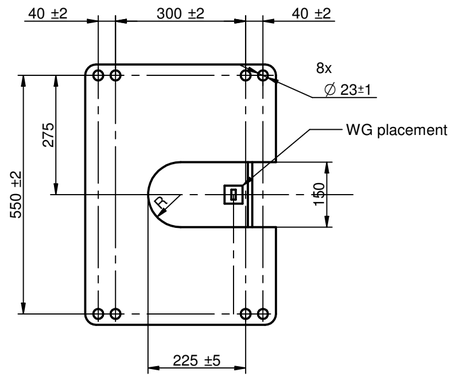
PROJECTION

CHANGE ORDER/REVISION						
REVISION	B	C				
CO NO.	59102	63047				
APVD	EHA	JGN				
CM						
REVISION STATUS OF PAGES (OTHER THAN)						
PAGE NO.						
REVISION						

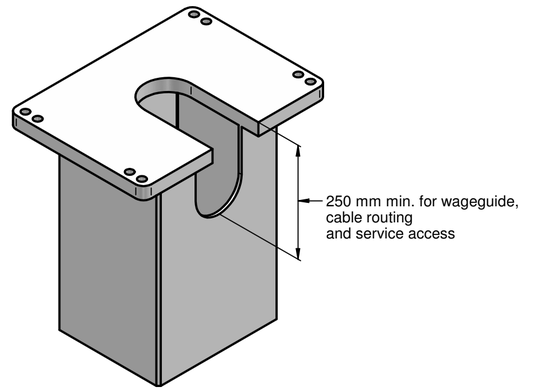
PREP: MSI	CHKD: KHA	Terma A/S	
APVD: AKO	CM:	Hovmarken 4 DK-8520 Lystrup Denmark	TERMA
DATE OF INITIAL RELEASE: 29-08-2006	DATE OF THIS RELEASE: 2013-06-18	Cage Code R0567	
TITLE: LA Antenna System, 21'		DOCUMENT NO.: 304262-ZD	REV: C
			PAGE: 1 OF 4

Template: DwgA2sh1-K/Ref doc: 200000-AS

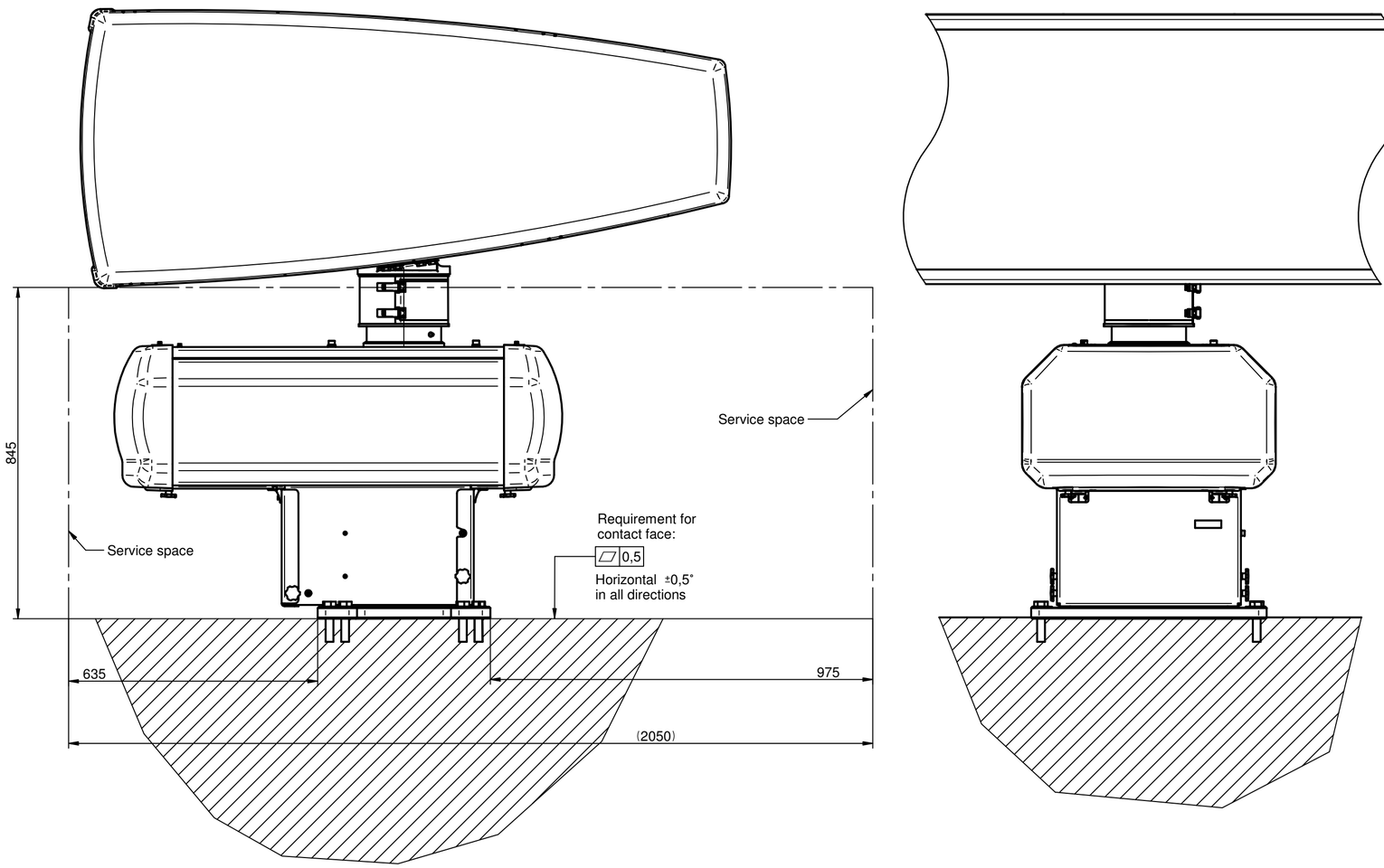




Required Pedestal interface



Typical installation



For installation use:

8 bolts DIN933, M20x90, A4, CL. 70
16 washers, flat DIN 125A, A4
8 washers, lock DIN 127B, A4
8 nut DIN 934, M20, A4

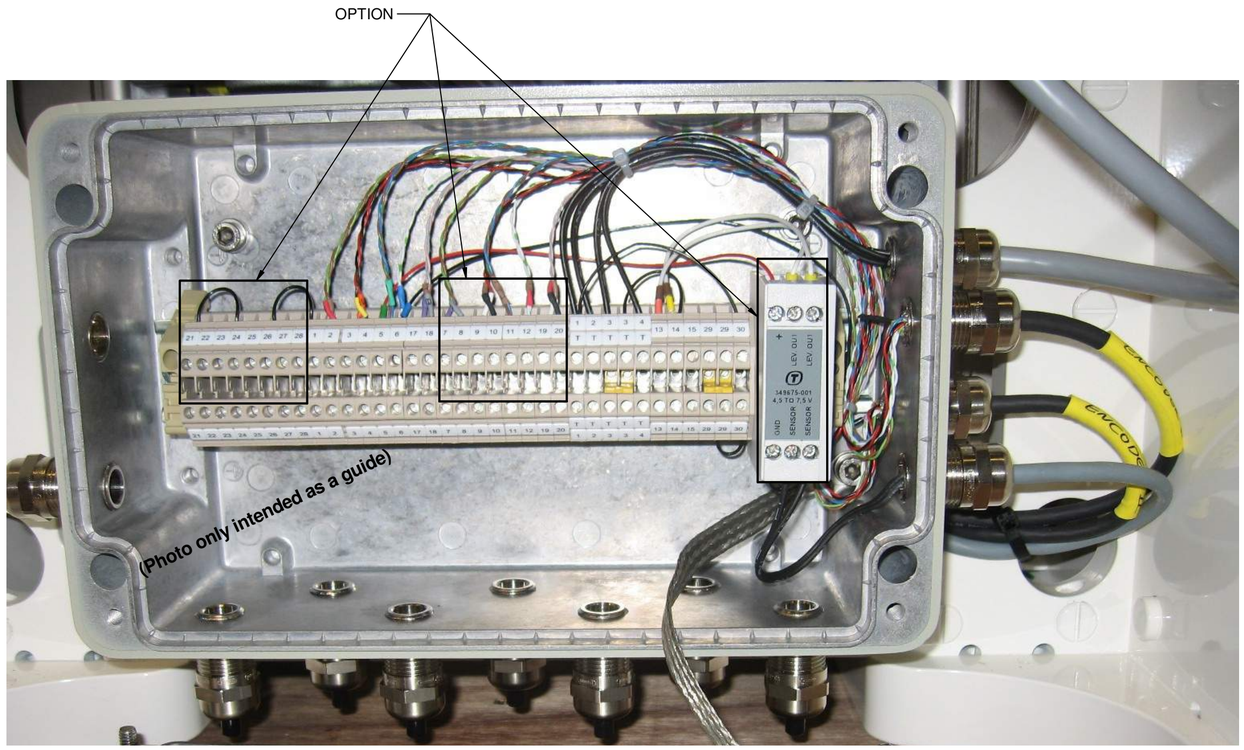
Tightening torque
Lubricated thread: 225 Nm
Dry thread: 324 Nm

Mounting interface materials and fasteners shall be, gallvanic, compatible with AISI 316 (recommended potential diff. < 0,25V).
If this is not possible, proper isolation and coating/surface treatment of critical areas must be performed.
Stainless steel fasteners are acceptable.

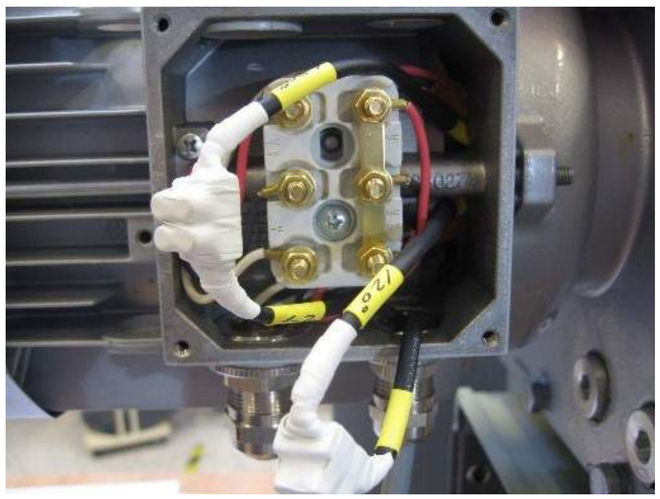
TITLE	DOCUMENT NO.	REV	PAGE
LA Antenna System, 21'	304262-ZD	C	2 OF 4

TB1

ENSURE THAT UNUSED CABLE INLETS ARE CLOSED WITH BLIND PLATES



TB2



TB2

SCHEMATIC

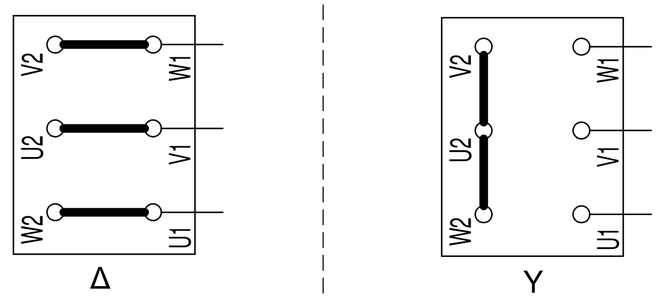


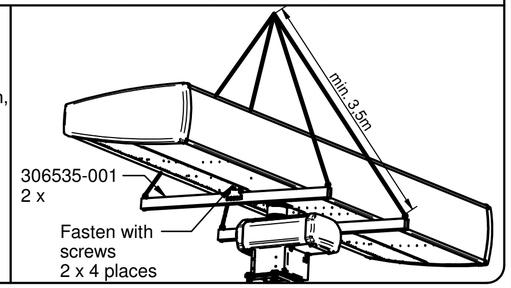
TABLE 3 : TERMINATION

CABLE INLET	FUNCTION	REF DES	TERMINAL	WIRE FUNCTION	SPECIFICATION
M16 x 1,5 E2	Encoder azimuth	TB1	1	ACP2+	BAL 8192 PULSES/REV, RS422, PHASE 2
		TB1	2	ACP2-	
		TB1	3	ARP+	BAL 1 PULS/REV, RS422
		TB1	4	ARP-	
		TB1	5	+5V/+15V	+5V ± 10%, max.120mA, approx. 35mA, 10-30V, max. 100mA, approx. 20mA at 15 V
		TB1	6	GND	
		TB1	17	ACP1+	BAL 8192 PULSES/REV, RS422, PHASE 1
		TB1	18	ACP1-	
M16 x 1,5 E4	2nd Encoder Azimuth (259222-001 OPTION)	TB1	7	ACP2+	BAL 8192 PULSES/REV, RS422, PHASE 2
		TB1	8	ACP2-	
		TB1	9	ARP+	BAL 1 PULS/REV, RS422
		TB1	10	ARP-	
		TB1	11	+5V	+5V ± 10%, max.120mA, approx. 35mA 10-30V, max. 100mA, approx. 20mA at 15 V
		TB1	12	GND	
		TB1	19	ACP1+	BAL 8192 PULSES/REV, RS422, PHASE 1
		TB1	20	ACP1-	
M16 x 1,5 E3		TB1	T1	Normally	MOTOR PROTECTION 155 ± 10°C AUTOMATIC RESET. MAX. 2,5A - 250VAC
		TB1	T2	Closed	
		TB1	T3	Normally	MOTOR OVERHEAT ALARM 120 ± 10°C AUTOMATIC RESET. MAX 2,5A - 250VAC
		TB1	T4	Closed	
M20 x 1,5		TB2	U1	MOTOR SUPPLY	PHASE 1
		TB2	V1		PHASE 2
		TB2	W1		PHASE 3
		TB2	GND	SHIELD	
M16 x 1,5 E5	Oil Sensor (304139-001 Option)	TB1	13	Normally closed	Current max.0,5A - 300VAC/DC (breakdown min. 600VDC) Switching Power 50VA
		TB1	T3		

SERVICE

LIFTING INSTRUCTION

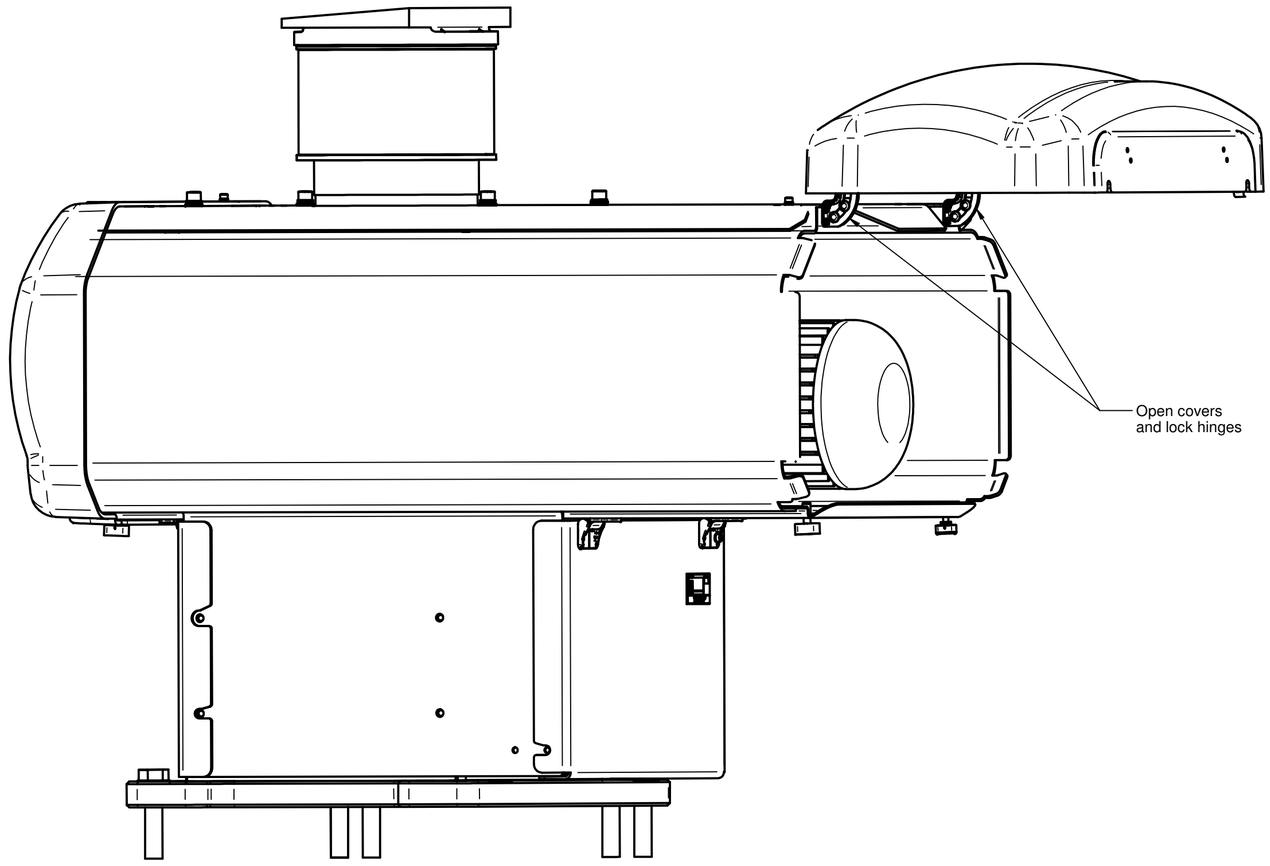
- Use Lifting Yokes
  TERMA part no.: 306535-001
- Mount Lifting Yokes as shown, and fasten with screws
- Minimum sling length: 3,5m
- Remove Lifting Yokes after mounting Antenna
- Handbook doc. 306535-HC



First mount the bracket with the 4 screws, then the profile can be mounted onto the bracket. Remember to tighten the screws

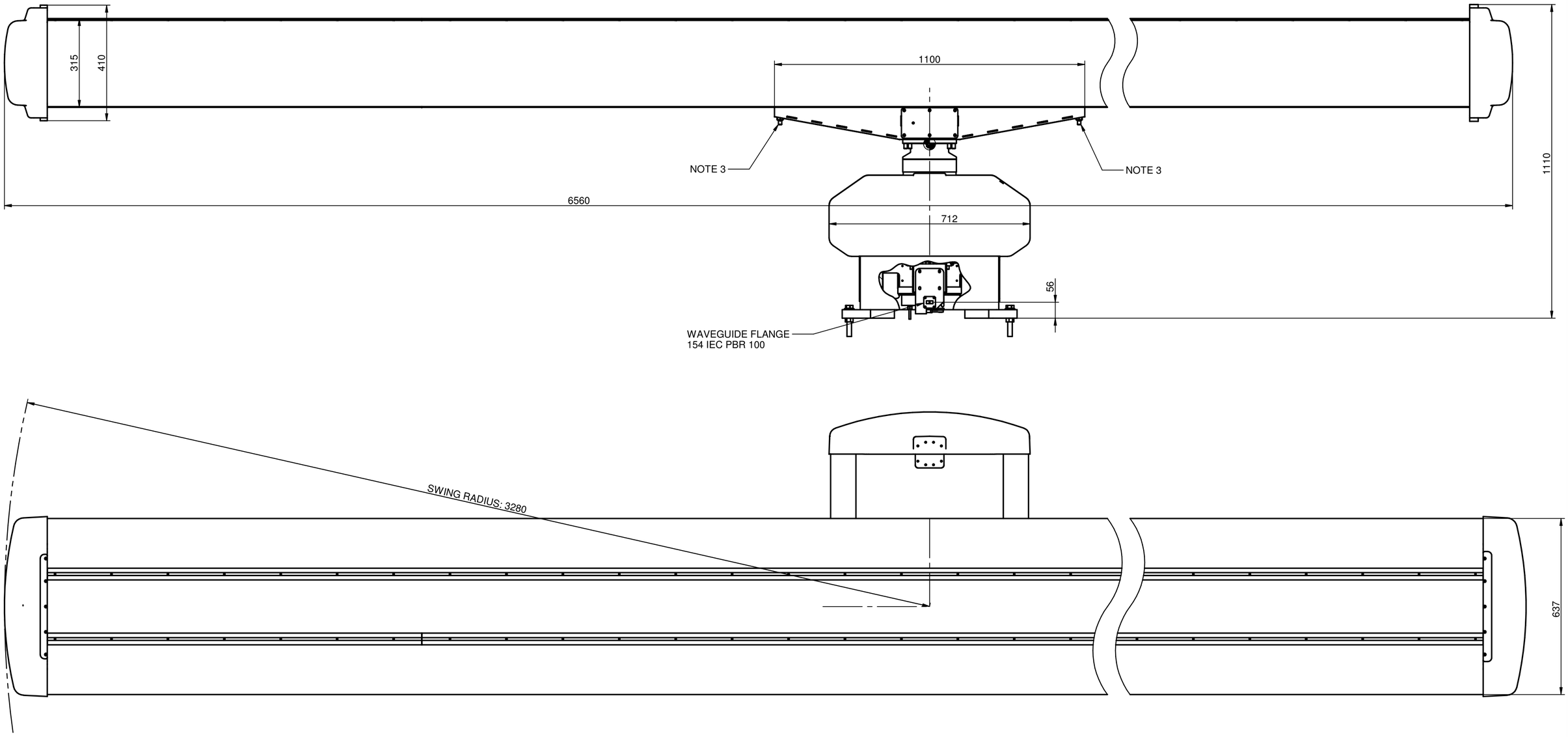
After the antenna has been installed remember remove the brackets

The straps must not touch the antenna surface



TITLE	DOCUMENT NO.	REV	PAGE
LA Antenna System, 21'	304262-ZD	C	4 OF 4

1. All dimensions are typical
2. ⌖ denotes centre of gravity
3. Lifting method, see page 5
4. Varianttable, see page 2



MATERIAL	-					
GENERAL TOLERANCE	---					
PROJECTION						
CHANGE ORDER/REVISION						
REVISION	J	J1	H	H1	H2	
CO NO.	73984	74125	67324	69179	72733	
APVD	MDN	MDN	JGN	JONP	JONP	
CM						
REVISION STATUS OF PAGES (OTHER THAN)						
PAGE NO.						
REVISION						

PREP	MSI	CHKD	KHA
APVD	CAK	CM	
DATE OF INITIAL RELEASE	040526	DATE OF THIS RELEASE	2018-10-05
TITLE	Antenna System, 21', HG		

Terma A/S
Hovmarken 4
DK-8520 Lystrup
Denmark
Cage Code R0567

TERMA

DOCUMENT NO.	REV	PAGE
259460-ZD	J1	1 OF 7

A2 FORM 200000 FE Rev H

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B

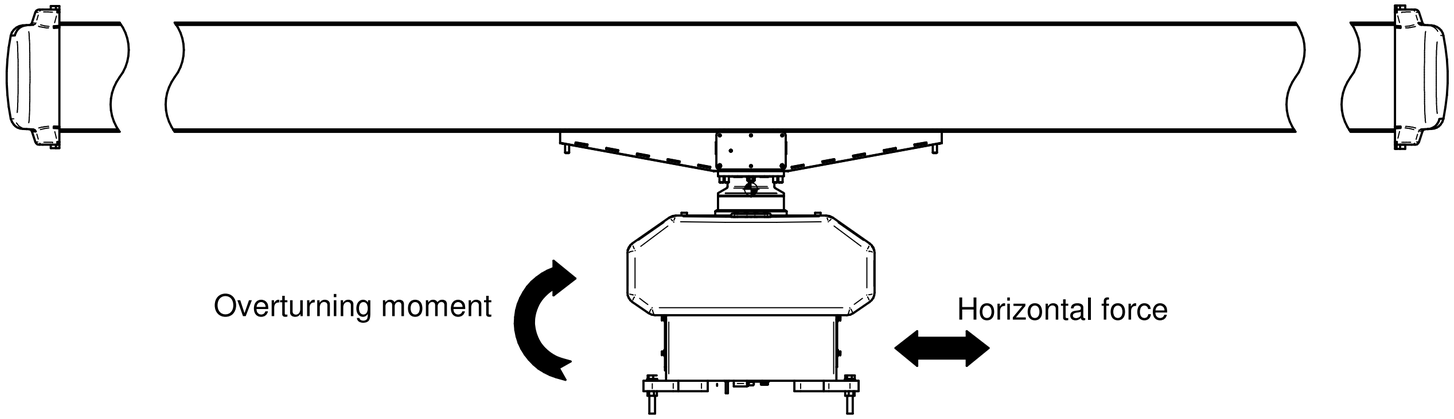
A

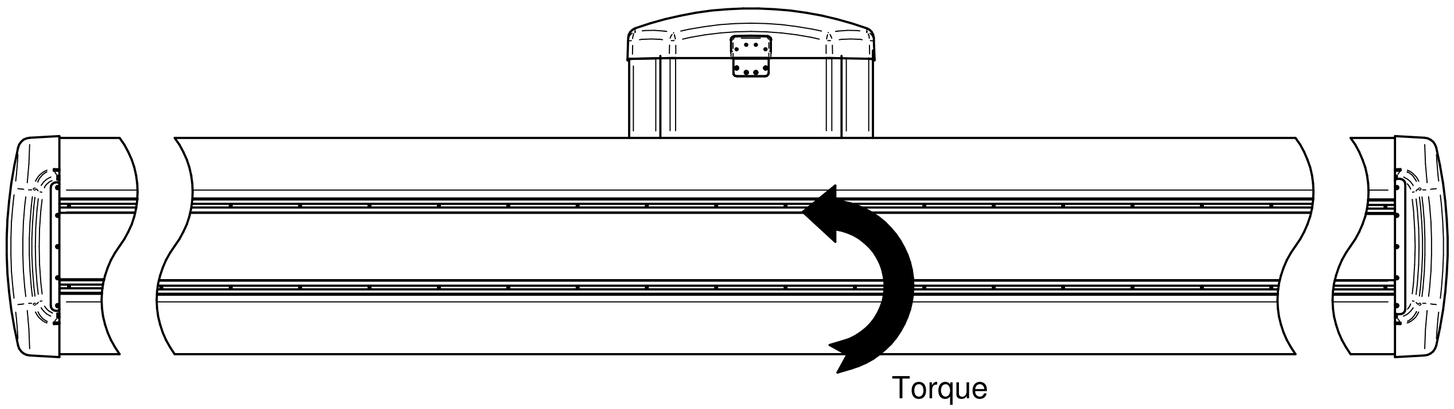
TABLE 1

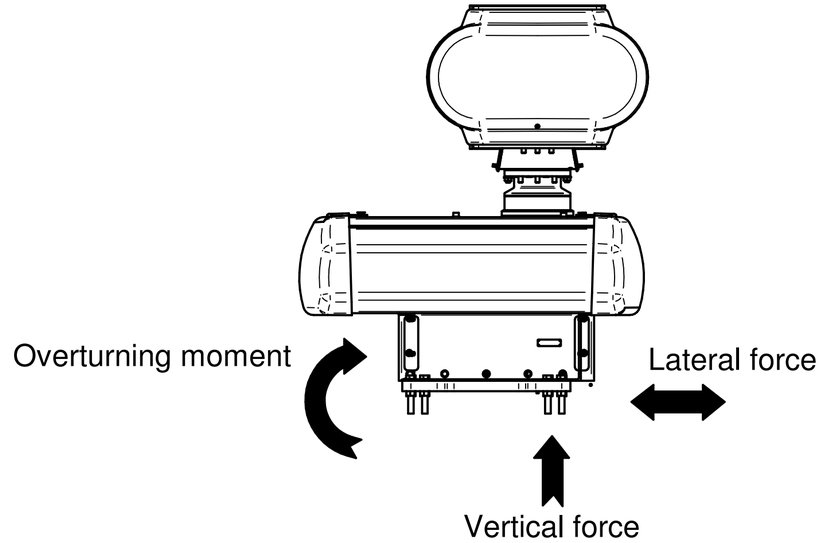
Part No.	Color	Type	Azimuth Output [ACP]	MAX SPEED (	MAINS [V]	WEIGHT	Oil Sensor	Encoder Supply	Motor Output Power kW
259460-001	White	HP-F	1 * 8192	40	3x230/400	400	Optional	+5V ± 10%, max. 120mA	2.2
259460-002	Grey	HP-F	1 * 8192	40	3x230/400	400	Optional	+5V ± 10%, max. 120mA	2.2
259460-003	White	HP-F	1 * 8192	40	3x230/400	400	Yes	+5V ± 10%, max. 120mA	2.2
259460-011	White	HP-I	1 * 8192	40	3x230/400	400	Optional	+5V ± 10%, max. 120mA	2.2
259460-012	Grey	HP-I	1 * 8192	40	3x230/400	400	Optional	+5V ± 10%, max. 120mA	2.2
259460-013	White	HP-I	1 * 8192	40	3x230/400	400	Yes	+5V ± 10%, max. 120mA	2.2
259460-021	White	HP-C	1 * 8192	40	3x230/400	400	Optional	+5V ± 10%, max. 120mA	2.2
259460-022	Grey	HP-C	1 * 8192	40	3x230/400	400	Optional	+5V ± 10%, max. 120mA	2.2
259460-030	White	CP-F	1 * 8192	60	3x230/400	400	Optional	+5V ± 10%, max. 120mA	4.0
259460-031	White	CP-F	1 * 8192	40	3x230/400	400	Optional	+5V ± 10%, max. 120mA	2.2
259460-032	Grey	CP-F	1 * 8192	40	3x230/400	400	Optional	+5V ± 10%, max. 120mA	2.2
259460-040	White	CP-I	1 * 8192	60	3x230/400	400	Optional	+5V ± 10%, max. 120mA	4.0
259460-041	White	CP-I	1 * 8192	40	3x230/400	400	Optional	+5V ± 10%, max. 120mA	2.2
259460-042	Grey	CP-I	1 * 8192	40	3x230/400	400	Optional	+5V ± 10%, max. 120mA	2.2
259460-051	White	CP-C	1 * 8192	40	3x230/400	400	Optional	+5V ± 10%, max. 120mA	2.2
259460-052	Grey	CP-C	1 * 8192	40	3x230/400	400	Optional	+5V ± 10%, max. 120mA	2.2
259460-141	White	CP-I	2 * 8192	40	3x230/400	400	Yes	10-30V, max. 100mA	2.2
259460-142	Grey	CP-I	2 * 8192	40	3x230/400	400	Yes	10-30V, max. 100mA	2.2
259460-431	White	CP-F	2 * 8192	40	3x230/400	400	Yes	+5V ± 10%, max. 120mA	2.2
259460-432	Grey	CP-F	2 * 8192	40	3x230/400	400	Yes	+5V ± 10%, max. 120mA	2.2
259460-441	White	CP-I	2 * 8196	40	3x230/400	400	Yes	+5V ± 10%, max. 120mA	2.2
259460-442	Grey	CP-I	2 * 8196	40	3x230/400	400	Yes	+5V ± 10%, max. 120mA	2.2
259460-443	Orange	CP-I	2 * 8196	40	3x230/400	400	Yes	+5V ± 10%, max. 120mA	2.2
259460-502	Grey	HP-F, High Pow.	1 * 8192	40	3x230/400	400	Optional	+5V ± 10%, max. 120mA	2.2
259460-512	Grey	HP-I, High Pow.	1 * 8192	40	3x230/400	400	Optional	+5V ± 10%, max. 120mA	2.2
259460-522	Grey	HP-C, High Pow.	1 * 8192	40	3x230/400	400	Optional	+5V ± 10%, max. 120mA	2.2
259460-532	Grey	CP-F, High Pow.	1 * 8192	40	3x230/400	400	Optional	+5V ± 10%, max. 120mA	2.2
259460-542	Grey	CP-I, High Pow.	1 * 8192	40	3x230/400	400	Optional	+5V ± 10%, max. 120mA	2.2
259460-552	Grey	CP-C, High Pow.	1 * 8192	40	3x230/400	400	Optional	+5V ± 10%, max. 120mA	2.2
259460-632	Grey	CP-F	1 * 8192	40	3x230/400	400	Yes	+5V ± 10%, max. 120mA	2.2
259460-702	Grey	HP-F	2 * 8192	40	3x230/400	400	Optional	+5V ± 10%, max. 120mA	2.2
259460-712	Grey	HP-I	2 * 8192	40	3x230/400	400	Optional	+5V ± 10%, max. 120mA	2.2
259460-803	Grey	CP-F	2 * 8192	60	3x230/400	400	Yes	+5V ± 10%, max. 120mA	4.0
259460-832	Grey	CP-F	2 * 8192	60	3x230/400	400	Yes	+5V ± 10%, max. 120mA	4.0
259460-842	Grey	CP-I	2 * 8196	60	3x230/400	400	Yes	+5V ± 10%, max. 120mA	4.0
259460-843	Orange	CP-I	2 * 8196	60	3x230/400	400	Yes	+5V ± 10%, max. 120mA	4.0
259460-844	Grey	CP-C	2 * 8196	60	3x230/400	400	Yes	+5V ± 10%, max. 120mA	4.0
259460-931	White	CP-F	1 * 8192	40	3x230/400	400	Optional	+5V ± 10%, max. 120mA	2.2

TABLE 2							
Loads 21' HG antenna							
Motor	**Variant**	**Load**	**Reference**	**Condition**	**Unit**	**Value**	**Frequency (Hz) of load (between 20 to 60 RPM)**
2.2kW and 4.0 kW	21'HG	Starting torque	Axis of rotation	Max	Nm	1930	-
		Cyclic torque	Axis of rotation	Max, operational	Nm	1645	0.66 to 2
		Cyclic horizontal force	Bottom surface of pedestal	Max, operational	N	4890	0.66 to 2
		Cyclic vertical force	Bottom surface of pedestal	Max / min operational	N	+9867 / -15363	0.66 to 2
		Cyclic overturning moment	Bottom surface of pedestal	Max, operational	Nm	5390	0.66 to 2
		Horizontal force	Bottom surface of pedestal	Survival, Free rotating	N	14130	-
		Overturning moment	Bottom surface of pedestal	Survival, Free rotating	Nm	10865	-
		Vertical force	Bottom surface of pedestal	Max +/-	N	+20846 / -23320	-

Operational values are max values
Survival values at wind speed of 75m/s and antenna stopped
All loads are at bottom surface
Weigth of antenna included
Load safety factor of 1.5 included (Naturally occurring loads - Eurocode)







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Antenna System, 21', HG	259460-ZD	J1	3 OF 7

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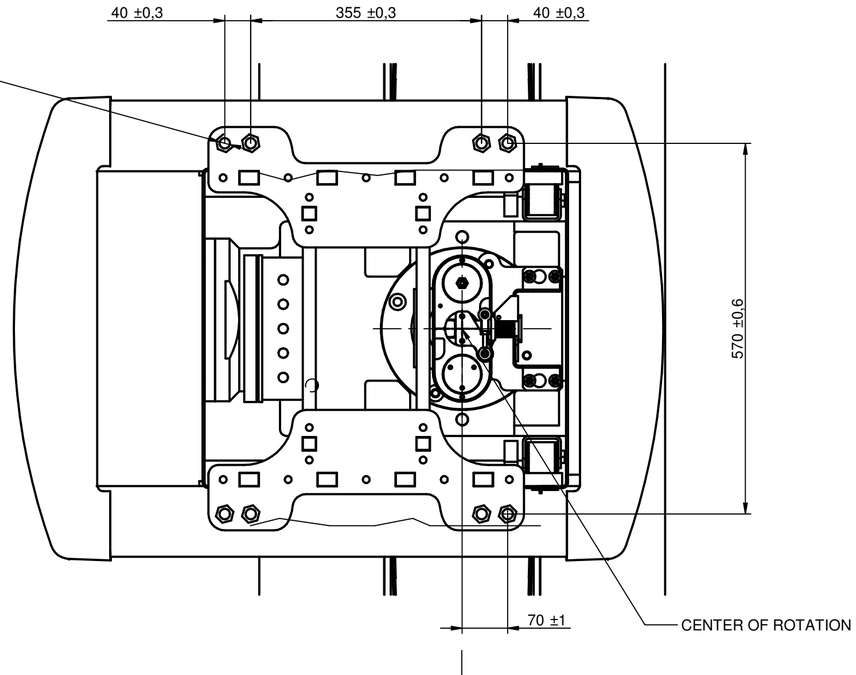
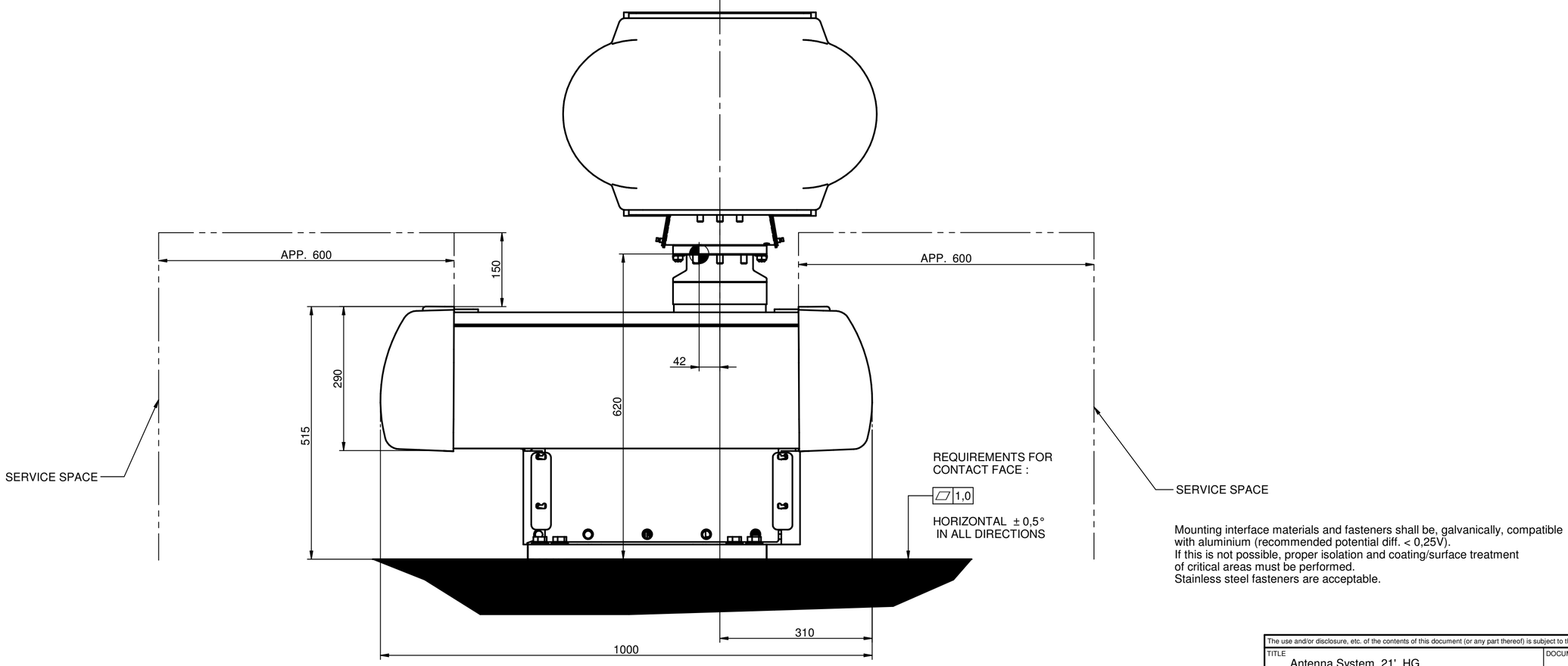
FOR INSTALLATION USE:
8 BOLTS DIN 933 , M16x100, A4, CL. 70
16 WASHERS, FLAT DIN 125A, A4
8 WASHERS, LOCK DIN 127B, A4
8 NUT DIN 934, M16, A4
TIGHTENING TORQUE
LUBRICATED THREAD: 103 Nm
DRY THREAD: 186 Nm

Corrosion protective measures shall be taken to the two grounding spots





Mounting interface materials and fasteners shall be, galvanically, compatible with aluminium (recommended potential diff. < 0,25V).
If this is not possible, proper isolation and coating/surface treatment of critical areas must be performed.
Stainless steel fasteners are acceptable.

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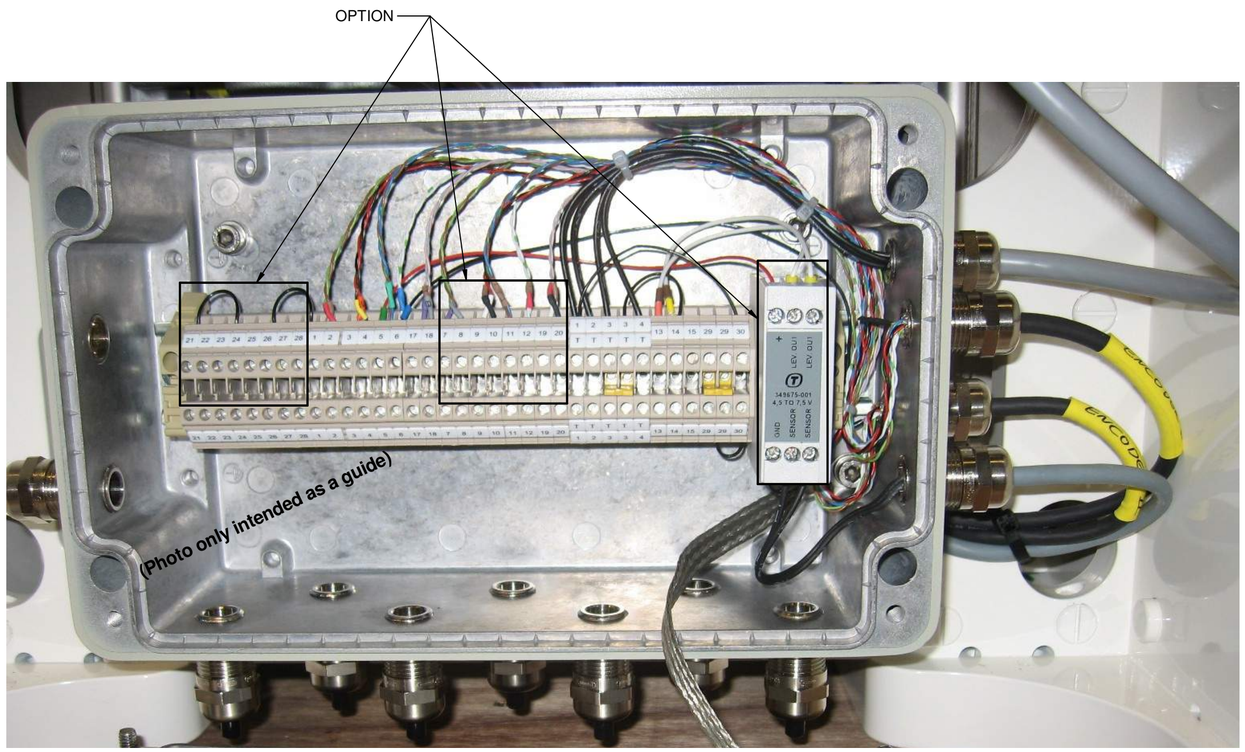
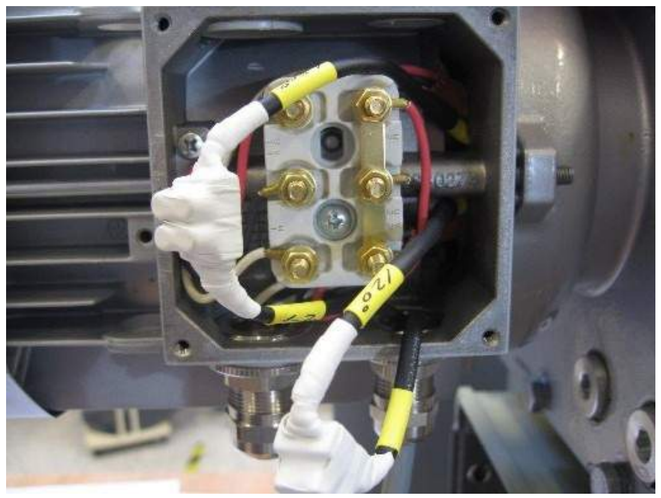
Antenna System, 21', HG	259460-ZD	J1	4 OF 7

TB1

ENSURE THAT UNUSED CABLE INLETS ARE CLOSED WITH BLIND PLATES



TB2



TB2

SCHEMATIC

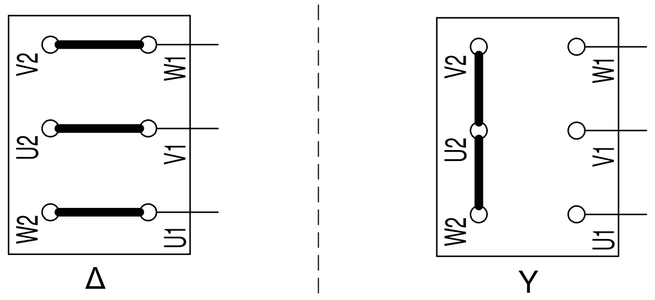


TABLE 3 : TERMINATION

CABLE INLET	FUNCTION	REF DES	TERMINAL	WIRE FUNCTION	SPECIFICATION
M16 x 1,5 E2	Encoder azimuth	TB1	1	ACP2+	BAL 8192 PULSES/REV, RS422, PHASE 2
		TB1	2	ACP2-	
		TB1	3	ARP+	BAL 1 PULS/REV, RS422
		TB1	4	ARP-	
		TB1	5	+5V/+15V	+5V ± 10%, max.120mA, approx. 35mA, 10-30V, max. 100mA, approx. 20mA at 15 V
		TB1	6	GND	
		TB1	17	ACP1+	BAL 8192 PULSES/REV, RS422, PHASE 1
		TB1	18	ACP1-	
M16 x 1,5 E4	2nd Encoder Azimuth (259222-001 OPTION)	TB1	7	ACP2+	BAL 8192 PULSES/REV, RS422, PHASE 2
		TB1	8	ACP2-	
		TB1	9	ARP+	BAL 1 PULS/REV, RS422
		TB1	10	ARP-	
		TB1	11	+5V	+5V ± 10%, max.120mA, approx. 35mA 10-30V, max. 100mA, approx. 20mA at 15 V
		TB1	12	GND	
		TB1	19	ACP1+	BAL 8192 PULSES/REV, RS422, PHASE 1
		TB1	20	ACP1-	
M16 x 1,5 E3		TB1	T1	Normally	MOTOR PROTECTION 155 ± 10°C AUTOMATIC RESET. MAX. 2,5A - 250VAC
		TB1	T2	Closed	
		TB1	T3	Normally	MOTOR OVERHEAT ALARM 120 ± 10°C AUTOMATIC RESET. MAX 2,5A - 250VAC
		TB1	T4	Closed	
M20 x 1,5		TB2	U1	MOTOR SUPPLY	PHASE 1
		TB2	V1		PHASE 2
		TB2	W1		PHASE 3
		TB2	GND	SHIELD	
M16 x 1,5 E5	Oil Sensor (304139-001 Option)	TB1	13	Normally closed	Current max.0,5A - 300VAC/DC (breakdown min. 600VDC) Switching Power 50VA
		TB1	T3		

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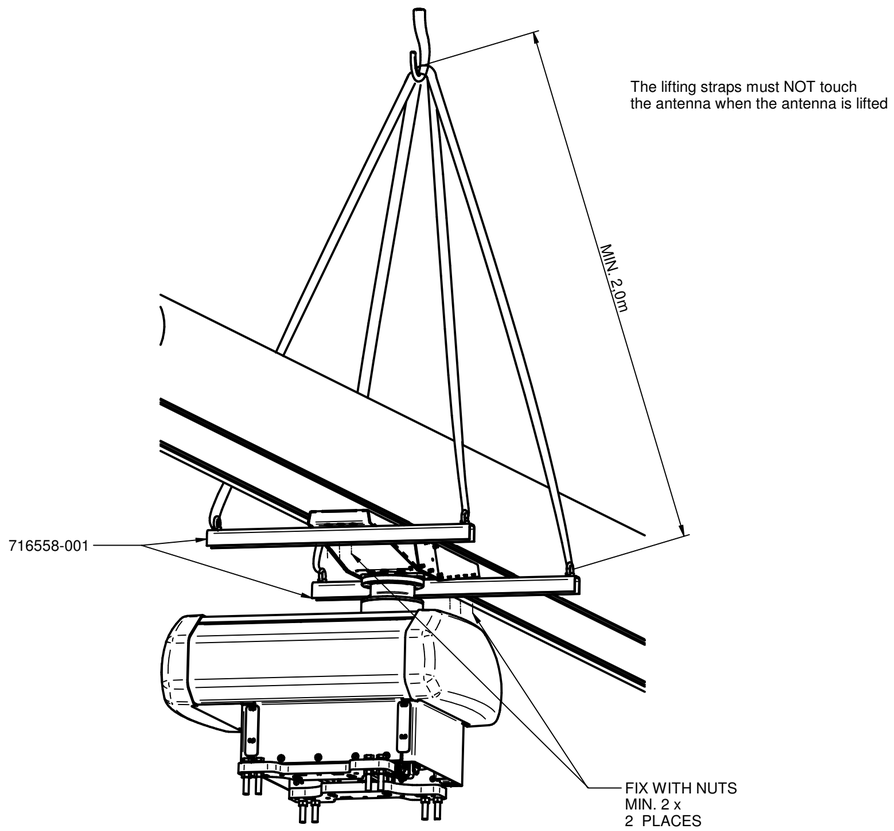
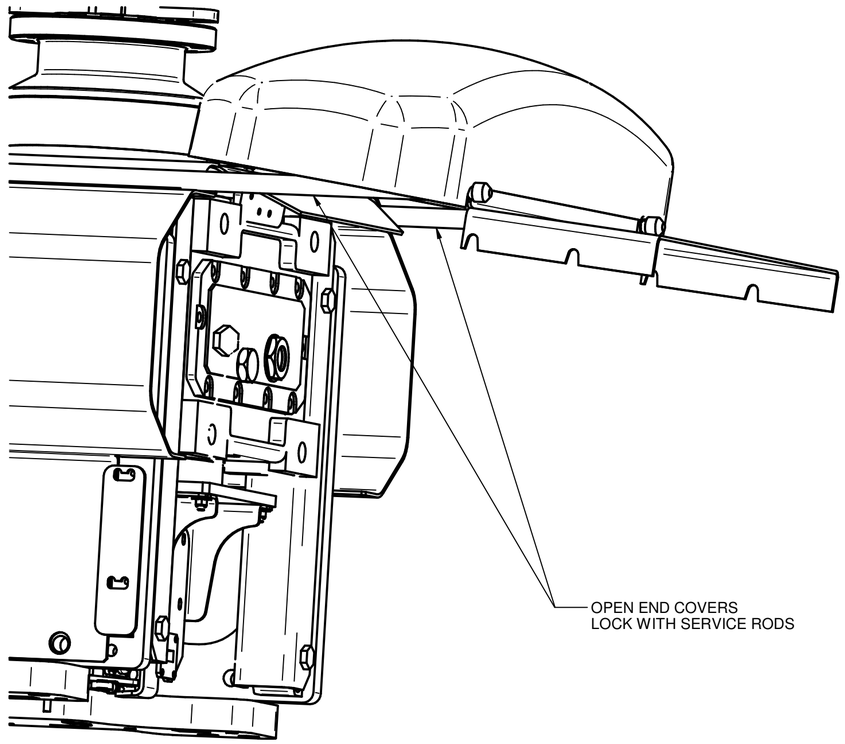
Lifting Instruction for
variant -931 see page 6

LIFTING INSTRUCTIONS

- USE LIFTINGYOKES
  TERMA PART NO.:716558-001
- MOUNT LIFTING YOKES AS
  SHOWN, AND FASTEN WITH NUTS
- MINIMUM SLING LENGTH: 2,0m
- REMOVE LIFTING YOKES
  AFTER MOUNTING ANTENNA
- HANDBOOK DOC. 716558-HC



SERVICE

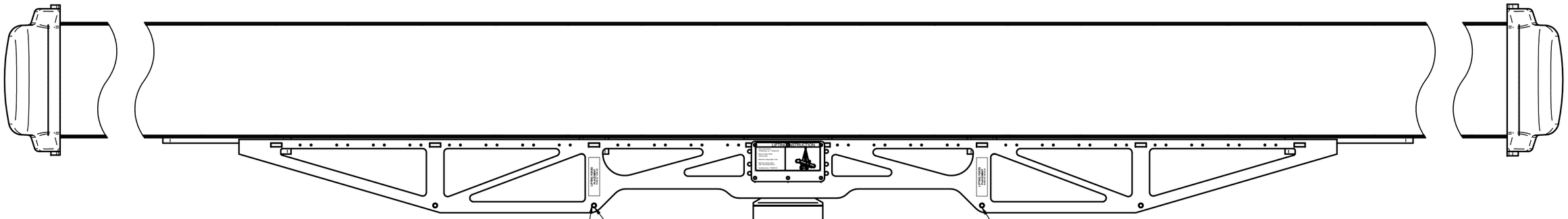


TITLE	DOCUMENT NO.	REV	PAGE
Antenna System, 21', HG	259460-ZD	J1	6 OF 7

-931

Specific dimensions are shown is this view
(Otherwise, see sheet 1 - 2)

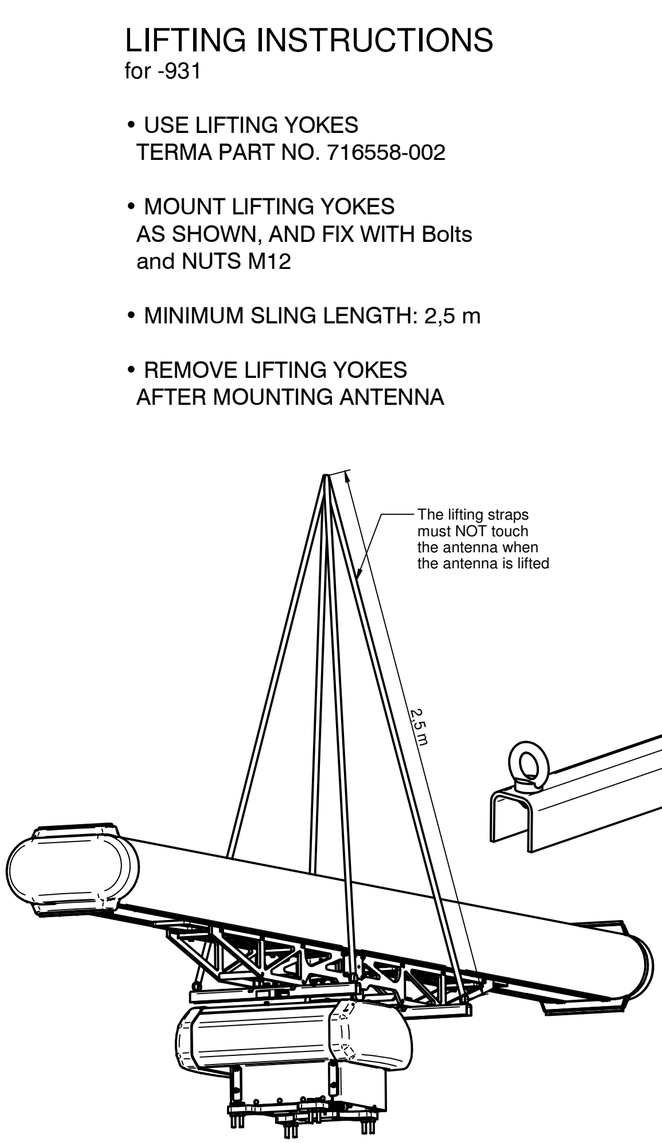
Only The lifting yoke 716558-002 is CE approved for this variant



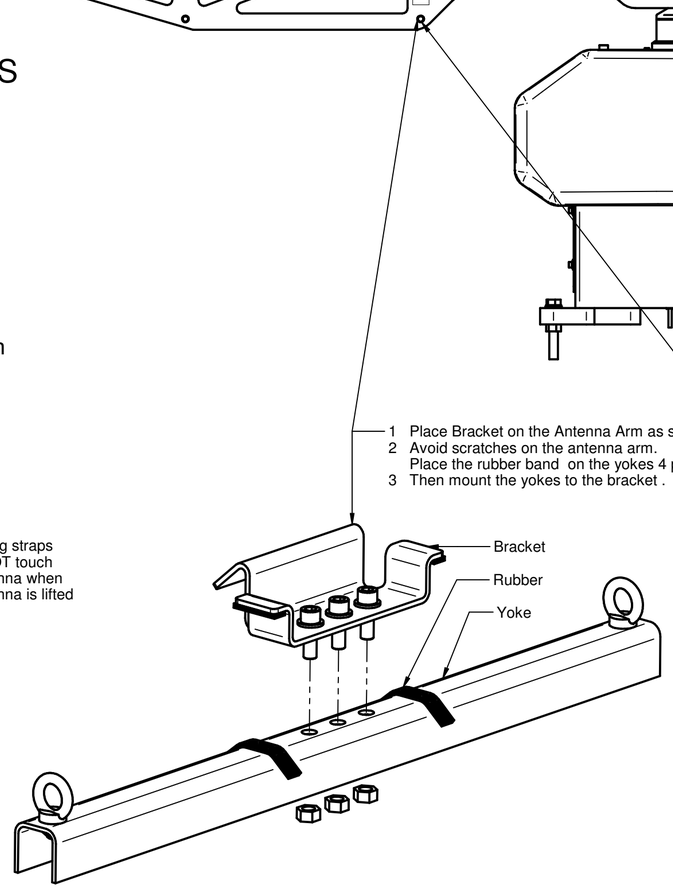
LIFTING INSTRUCTIONS

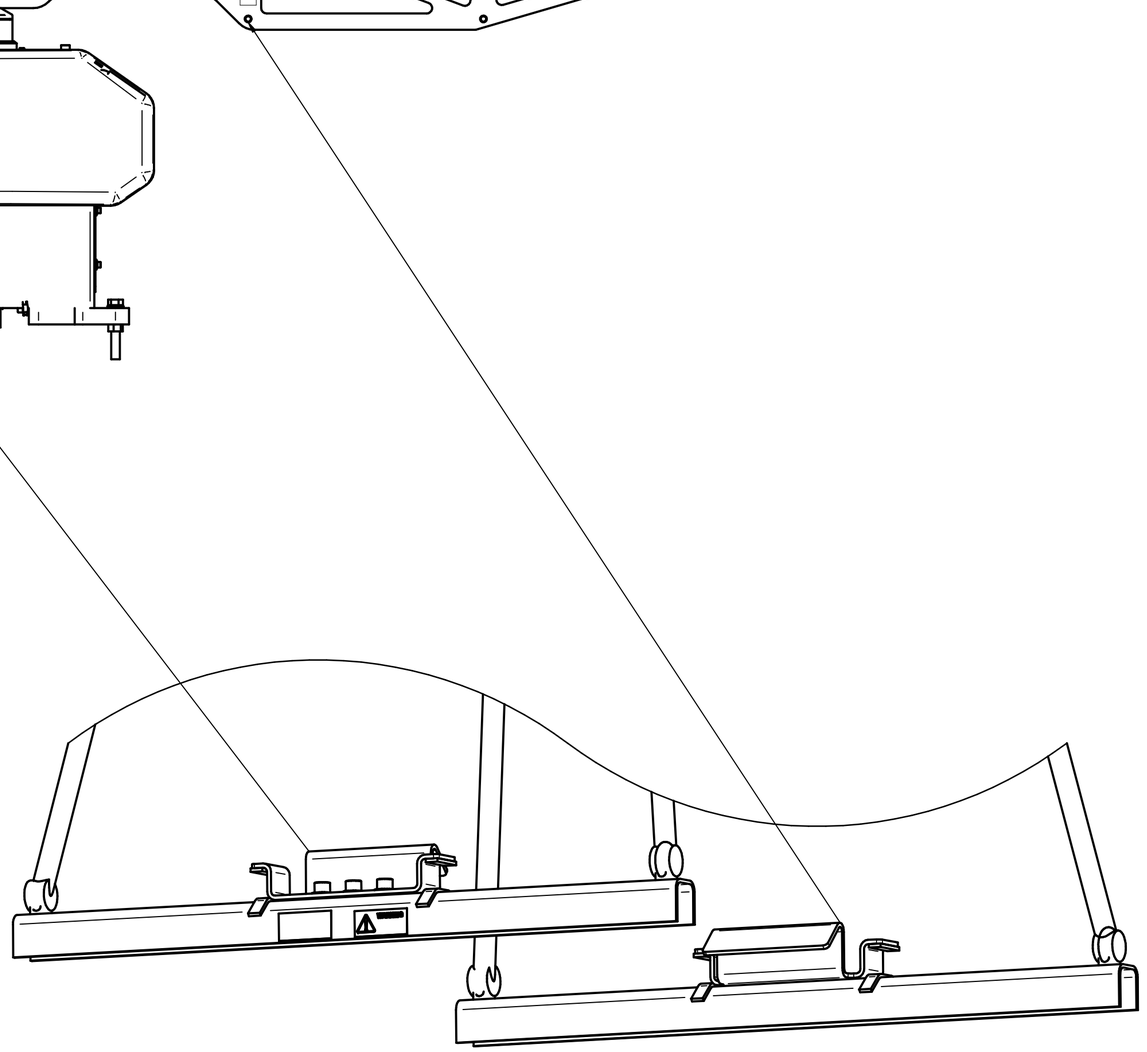
for -931

- USE LIFTING YOKES
  TERMA PART NO. 716558-002
- MOUNT LIFTING YOKES
  AS SHOWN, AND FIX WITH Bolts
  and NUTS M12
- MINIMUM SLING LENGTH: 2,5 m
- REMOVE LIFTING YOKES
  AFTER MOUNTING ANTENNA



1 Place Bracket on the Antenna Arm as shown.
2 Avoid scratches on the antenna arm.
Place the rubber band on the yokes 4 places
3 Then mount the yokes to the bracket .





TITLE	DOCUMENT NO.	REV	PAGE
Antenna System, 21', HG	259460-ZD	J1	7 OF 7