TECHNICAL SPECIFICATION FOR

Design and Fabrication
33.5m MF Tower
Hopedale Hill, Hopedale,
Labrador 55º 27' 52" N
60º 13' 13" W
Project # F6839-155503

DFO Contract #FP802-150060

Fisheries & Oceans Canada / Pêches et Océans Canada
P.O.Box 5667 St. John's, Nfld. and Labrador /
Saint Jean, Terre Neuve et Labrador
A1C 5X1

PROJECT NO. F6839-155503
DATE: May 2015

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Section 01010

Summary of Work

1.0 General

The work covered under this project consists of a new MF Broad Band MF Tower for the CCG at the **Hopedale Hill, Hopedale, Labrador** site. The work to be done under this Specification shall include all labour, materials and equipment necessary to complete the design and fabrication as described in the Specification and Drawings. The specification is for a 30-year intended performance life. Work shall include but not be limited to the following:

- Engineering design and supply of a **33.50 m MF Tower,** guys (structural and curtain), guy insulators, guy hardware, required antenna matching unit, foundations and anchors, base insulator, and lighting system. Refer to general arrangement drawings in Appendix B.

- Contractor is required to deliver all items to CCG base in St. John's, NL.
- All materials used on this project are to be of specification grade, meaning complete dimensional, manufacturing, technical/engineering specifications and standards information must be available for all materials to ensure "fit for use" compliance.
- Supply of auxiliary all facilities as indicated such as ladders, safety rails, ice guards, ATU Enclosure, and platforms.
- Supply of connectors for all lines as specified by owner.
- Supply of line hangers, ground kits and necessary hardware as required. All hangers shall be heavy duty and constructed of stainless Steel material.
- Design and supply of all required obstruction markings.

2.0 Definitions

"Owner" means: Fisheries and Oceans Canada, Canadian Coast Guard (CCG)

"Engineering Consultant" means: for this project, to be determined at a later date.

3.0 Existing Site

3.1 Site is located at 55º 27' 52" N (latitude) and 60º 13' 13" W (Longitude), at the existing NavCan site at **Hopedale Hill, Hopedale, Labrador**. This site is 106m above sea level. Refer to Appendix A for site location.

3.2 Any dimensions given in this Specification or appended drawings are approximate and are for guidance only. Exact dimensions and layouts to be determined by the Contractor in the field.

4.0 Completion Schedule

4.1 All work on the project shall be completed within the time indicated in the tender document.

4.2 Tender submission shall include a schedule of all Contractors activities including design, fabrication, and transportation. Design to be completed by July 15th, 2015 and fabrication and delivery to be completed by August 31, 2015.

5.0 Existing Soil Conditions

5.1 Geotechnical reports are attached in the Appendix D of this Specification.

5.2 Contractor is to advise the owner if any discrepancies exist between the Geotechnical report and actual excavations.

6.0 Work Commencement

6.1 Contractor is to **provide an updated detailed schedule and** commence work immediately upon award of contract and after review and approval of all submittals.

6.2 The weather conditions, short construction season and site remoteness may require the use of longer work days and additional work force to complete the project within the scheduled completion date.

6.3 The Contractor is to make every effort to ensure sufficient material and equipment is delivered to site at the earliest time possible upon award of the contract.

END OF SECTION

Section 01300

Submittals

1.0 General

1.1 The Contractor shall submit for review three (3) complete sets of design and detail drawings in binders to the Engineering Consultant/Owner. The review period by the Engineering Consultant/Owner shall be two (2) weeks. After successful review, one copy of each submitted drawing will be returned to the Contractor either "Reviewed" or "Reviewed as Noted". There after no change shall be made to the drawing without the permission of the Owner. The Professional Engineer, responsible for the design, shall seal all drawings submitted to the Owner and must be registered to practice by the Association of Professional Engineers and Geoscientists of Newfoundland. **The Design Engineer shall have a minimum of five years experience designing towers of a similar nature.**

1.2 The Contractor, at no additional cost to the Owner, shall make any changes in the drawings which may be required, consistent with this Specification and shall submit revised copies for review in the manner herein set out. The review does not relieve the Contractor from responsibility for ensuring that his complete work meets all the requirements for the drawings and Specifications contained herein. Items submitted are to be complete, in final form and ready "for construction". Incomplete submissions will be returned. The Contractor shall ensure that the tower design, including guy location, does not interfere with the operation of the antenna systems.

1.3 Any work done prior to the return of the reviewed drawings shall be at the Contractor's own risk. The Owner or his representative may issue a stop work order if any site work is started prior to approval of engineering drawings. Any costs associated with this shall be the Contractor's responsibility.

1.4 Drawings of the work produced by the Contractor and all rights and privileges associated therewith shall become the exclusive property of the Owner who will be free to make any use or reuse of said drawings which in the opinion of the Owner is reasonable and/or required in the Owner's interest.

2.0 Tender Submission

2.1 The Tenderer shall include the following documentation with the tender submission:

a) List and description of previous projects completed which are of a similar nature.

b) Resume (CV) and tower related experience of the Project Manager and Tower Engineer of Record. Tower Engineer to have a minimum of five years experience designing similar structures. Confirm registration or eligibility for registration with the Association of Professional Engineers and Geoscientists of Newfoundland. Resume

(CV), qualifications, and tower experience of the potential site foreman. Site foreman to have a minimum of five years experience as foreman working on towers of similar size.

c) Preliminary design drawing complete with leg, diagonal and horizontal sizes, anticipated tower base and anchor loads, guy sizes and anchor radius.

2.2 Questions pertaining to any of the above or other items in the specification documents MUST be addressed to the Contracting Officer for this project as indicated in the Tender documents

3.0 Drawings

3.1 All drawings shall be a minimum of 280 mm x 430 mm (11”x17”) and include a graphic scale bar. Larger sizes will be permitted only if the Owner gives prior written approval. The Contractor shall make every effort to provide consistent sized drawings, which optimize the amount of information shown. The Contractor shall provide a Table of Contents listing all drawing titles with a sequential numbering system. All drawings shall be bound in bindered sets. Drawings shall conform to CCG standards. Contractor shall be responsible for verifying and making themselves familiar with the latest CCG drawing standards. All drawings to be provided in AutoCAD format (latest version).

3.2 All drawings shall have a title block, which clearly shows the Project Name and Location, Owners Name (Canadian Coast Guard), design engineer, date, revision number, and a description of the drawing content. All drawings must be approved and stamped by a Professional Engineer licensed to practise in the Province of Newfoundland and Labrador, prior to submission. The drawings are also to be stamped with the design firms Permit to Practice Engineering Seal. **Unsealed drawings will not be reviewed.**

4.0 Contract Technical Submission

4.1 On acceptance of Tender, the Contractor shall submit for review:

4.1.1 Copies of all Quality Control and Quality Assurance programs in place relating to, governing and demonstrating the ability to complete the work in question, including but limited to, the tower painting process, steel fabrication process and the tower steel galvanizing process. Details of all material handling procedures are to be included.

4.1.2 Details with regard to the steel supplier and fabrication company and their CWB certification number.

4.1.3 Sealed drawings, which include:

- Structural profile drawing showing the sizes of legs, web members and bolts. The elevations at which the member sizes changes shall be clearly shown. The location, spacing and design arrangement of all insulators**.** The drawing shall include all pertinent design information including design standard, ice loading, wind loading, bearing pressure, soil conditions, elevation difference from base and any special design factors. A copy of this drawing shall be submitted on a CD in AutoCAD format (unless other wise discussed with owner).
- A detailed plan of the tower clearly showing the attachment position and size of all attachments including (but not limited to), TX lines, ladders, safety rails, obstruction lighting and tech cables, safety devices and anti-climbs in relation to the leg and web members and broadband antenna system and insulators.
- Detailed drawings showing the following:
  a) Details of tower sections.
  b) Details of each different leg and web member and their connections.
  c) Details of lighting and ground fault interrupters.
  d) Details of TX Line placement
  e) Details of all required ice guards
  f) Details of anti-climb devices.
  g) Details of grounding bars
  h) Details of all torque triangle members and their connections and splice details.
  i) Details of curtain guy system, insulator type and location.
  j) Details of base insulator system.
  k) Description of materials, i.e. grades of steel, bolts, steel capacity, etc.

- Details of guy assemblies, including:

  a) Make, type, diameter, breaking strength, cross sectional area, weight, etc.
  b) Make, supplier, size and description of all guy assembly hardware, including ultimate capacity.
  c) Preformed guy grips: Make, type, length, diameter, number and size of wires and a note indicating that grip lay shall be the same as the guy lay.
  d) Mechanical or pressed sleeves: physical dimensions such as length and diameter.
  e) Turnbuckles: Make, ultimate capacity, diameter, take up.
  f) Bridge sockets: Make, size and take up.
  g) Initial design tensions and pulse charts over a range from –30º C to +30º C in 5ºC increments.

h) Details of antenna, curtain guys, anchors, insulators and connections. These shall include plan view drawings showing the position, **azimuth and elevation** of the antenna system in relation to tower legs and web members. These details shall be to scale and accurately reflect position of the antenna relative to the tower face and mounts.
i) Details of supports for all TX lines and conduit, present and future, including material details.
j) Details of any special members.
k) Details of the climbing ladder, safety fall arrest rail and trolley system.
l) Tower profile, anchor radius, anchor drop off, etc.
m) Details of the tower base foundation, base insulator and guy anchors, showing all dimensions and steel reinforcement or rock anchor details. Drawings shall show concrete strength. Where rock bolts are used, installation and testing procedures shall be clearly indicated on the drawings. Generic copies of typical foundations are not adequate.
n) Manufactures detailed Bill of Materials showing quantities, part number, drawing reference number, weight, mark number, etc.
o) Design details related to wind and ice loading, design standard, etc.
p) Details with regard to any special design assumptions.
q) Any other drawings or diagrams required in order to make clear the work intended or show its relation to adjacent work of others.
r) Details of grounding screen layout including wire type, size, # radials, length, spacing, connections and typical installation detail (buried or surface mounted).
s) All vendor data sheets for antennas, tx lines, ground kits, lighting systems, and all other third party products proposed for use.

4.2 On acceptance of the Tender, the Contractor shall submit for review, a professionally sealed design calculation report, which includes:

- Reference design standard.
- All design loadings.
- All foundation analysis and calculations.
- All tower computer analysis input and output.
- All tower member capacity calculations.
- Any other information requested by Engineering Consultant.

4.3 Contractor shall submit a detailed work schedule including all project milestones for design, fabrication and transport. This schedule shall be maintained and updated. Each revision shall be submitted to the Owner/Engineering Consultant for review.

5.0 Inspection Reports

5.1 The Contractor is to submit two (2) copies of all quality control test reports required by this specification immediately upon completion of testing.

END OF SECTION

Section 01400

Quality Control

1.0 Shop Inspection

1.1 Contractor's and subcontractor's facilities and quality control and quality assurance procedures are subject to inspection/review at any time by the Owner or the Owners representative.

1.2 Inspection shall not relieve the Contractor of his responsibility but is a precaution against oversight or error. Defective material and workmanship wherever found at any time prior to final acceptance of the work will be rejected regardless of previous inspection

1.3 Inspection shall not relieve the Contractor of his responsibility but is a precaution against oversight or error. Defective material and workmanship wherever found at any time prior to final acceptance of the work will be rejected regardless of previous inspection.

1.4 As part of shop inspection, be prepared to assemble part (or complete) tower section(s).

2.0 Conformance Letter

Upon completion of the installation stage of the project the Contractor is to provide the Owner with a Conformance Certification Letter stating that the tower has been designed, fabricated and installed as per the Project Specifications.

END OF SECTION

Section 01545

Safety Requirements

1.0 Summary of Safety Requirements

1.1 This section describes specific safety requirements to be observed and enforced during the scope of this work.

1.2 Inclusion of these safety requirements shall not constitute a relief of the Contractors responsibility but is a precaution against oversight and errors.

1.3 The Contractor is solely responsible for safety procedures necessary to, meet the requirements of these specifications and to ensure the safety of workers and the general public.

1.4 Provide all workers, including sub-trades, with adequate and appropriate safety procedures prior to commencement of their duties. Ensure all workers comply with all safety regulations required by National and Provincial Building Codes, Workmen's Compensation Board, Canada Labour Code Part II and any applicable Provincial acts and municipal statutes and bylaws.

1.5 In the event of conflict between any provisions of above authorities the most stringent provision governs.

2.0 Environmental Requirements

2.1 Contractor is solely responsible for all environmental protection procedures deemed necessary to comply with all applicable Federal, Provincial and Municipal regulatory requirements.

Section 01600

Materials and Equipment

1.0 Submittals

1.1 Within five working days of written request by the Owner, submit following information for any and all materials and products proposed for use:

- name and address of all manufacturers and suppliers
- trade name, model and catalogue number
- performance, descriptive and test data
- manufacturer's installation or application instructions
- evidence of arrangements to procure
- conformance to applicable standards

2.0 Supply and Use

2.1 Use new material and equipment unless otherwise specified.

2.2 Provide material and equipment of specified design and quality, performing to published ratings and for which replacement parts are readily available.

2.3 Use products of one manufacturer for equipment or material of same type or classification unless otherwise specified.

3.0 Manufacturer's Instructions

3.1 Unless otherwise specified, comply with manufacturer's latest printed instructions for materials and installation methods.

3.2 Prior to use of product or material, notify Owner in writing of any conflict between these specifications and manufacturer's instructions. Owner will designate which document is to be followed.

4.0 Conformance

4.1 When material or equipment is specified by standard or performance specification, upon request of Owner, obtain from manufacturer and independent testing laboratory report stating that materials or equipment meets or exceeds specified requirements. Trace-ability of all materials is to be performed.

5.0 Substitution

5.1 Owner is not obligated to consider any substitutes or changes after contract award. Contractor is responsible for all costs associated with reviewing requested changes.

5.2 Proposals for substitution after Contract Award must include, all documentation and information required as part of this contract and statements of respective cost differences of items originally specified and proposed substitutions.

5.3 Should proposed substitution be accepted either in part or in whole, contractor will assume full responsibility and costs when substitution affects other work on project and pay for design or drawing changes required as result of substitution.

5.4 Amount of credits arising from approval of substitutions will be determined by the Owner and the Contract Sum will be reduced accordingly. No substitutions will be permitted without prior written approval from Owner.

END OF SECTION

Section 02350

Rock Anchors

1.0 Design

1.1 For rock conditions, anchors into rock shall be designed for the transfer of shear and foundation loads to suit parameters indicated in the geotechnical report.

1.2 The minimum number of rock bolts to be installed at one anchor shall not be less that two. Alternatively, single rock bolts in certain applications may be approved by the Owner/Engineering Consultant provided there is a comprehensive testing program implemented by the Contractor in accordance with the requirements of this section.

1.3 Standard of acceptance for anchors to rock are Williams Rock Bolts.

1.4 Two nuts shall be supplied and installed to secure the anchor weldment. The second nut shall act as a locking nut and be of adequate quality for that purpose.

1.5 Grout supply recommended by Rock Bolt Manufacturer and to suit geotechnical conditions. Grout shall be high early strength expanding type, with expansion of 3% to 4% prior of the gel stage. Grout shall have a minimum compressive strength of 40 MPa.

1.6 Design and supply appropriate cathodic protection for anchor shafts. Anodes to be zinc or magnesium and to last the performance of tower.

END OF SECTION

Section 05020

Tower Structure

1.0 General

1.1 The design and supply of the tower shall be in accordance with the latest version of but not limited to the codes and standards identified in Section 01010 Summary of Work.

2.0 Tower Design

2.1 Tower shall be designed in accordance with CSA S37-13 with a maximum of two (2) guy levels. The tower should have a maximum serviceability response (tilt and/or twist) of less than 2.0 degrees under working loads. Torsion resistors are not preferred.

2.2 Design Ice Load: The tower shall be designed with loading consideration of 50 mm of radial ice on all exposed surfaces, including members, guys and all attachments, and antenna components. The density of the ice shall be taken as 900 kg/m 3. (Rime ice loading not considered)

2.3 Design Wind Load: Use Site Specific Wind Data contained in Appendix C.

2.4 The tower shall be a guyed “all-welded” tower, sections composed of welded round leg members.

2.5 The Design Engineer accepting responsibility for the tower structure shall:

- Have a minimum of five (5) years design experience as it relates to guyed and self-support towers.
- Be registered or eligible for registration with the Association of Professional Engineers and Geoscientists of Newfoundland.
- Seal all drawings issued that relate to the tower.

3.0 Materials

3.1 All steel CSA G40.21M – 350W u/n. Preference shall be given to the use of structural steels with improved resistance to brittle fracture. A36 modified steel is not acceptable. All materials to be used in the tower shall be new and in accordance with the requirements of CSA Standard S37-13.

3.2 Use of material sections less than 5mm in thickness will not be permitted on primary or secondary structural members. Sections used for attachment or support of auxiliary facilities may be permitted subject to review by the Engineering Consultant.

3.3 Hollow sections will not be permitted on primary or secondary structural members which include tower legs, horizontals and diagonals.

3.4 Two copies of mill test certificates for each lot of steel received from the mill by the Contractor shall be forwarded to the Owner. These certificates shall record results of tests indicting the following:

- Yield Strength
- Ultimate Tensile Strength
- Percent Elongation
- Chemical Composition

3.5 All guys shall be one continuous length Bridge Strand or Guy Strand (Grade 180) and guy attachment assemblies unless otherwise approved by the Engineering Consultant. Cut ends of strand shall be capped with a stainless steel hose clamp or ear clips.

3.6 All primary, tension-loaded steel tower member (These include but are not limited to anchor assemblies, guy lugs, horizontals at guy levels, torsion resistors and leg sections that experience tension loading) shall provide Charpy V-Notch Impact Resistance of not less than 20 joules at -20 degrees Celsius or 15 ft-lbs at 0 degrees Fahrenheit. Data verifying the above requirement shall be provided to the Owner by the Contractor.

4.0 Connections

4.1 Connections in the shop may bolted or welded. All site connections shall be bolted.

4.2 Make all welded connections in conformance with CSA Standard W59.1. Use only low hydrogen electrodes or processes of equivalent rating. All weld designs shall be clearly indicated on the design drawings.

4.3 Make all bolted connections with high strength bolts clearly marked A325 conforming to A.S.T.M. Standard Specification A325. Place a hardened washer in under the bolt element (nut or bolt head) turned in tightening the bolt. Tighten all bolts by the turn of the nut method as specified in CSA Standard S16.

5.0 Workmanship

5.1 Workmanship and finish throughout shall be equal to the best modern practice for this class construction. All members shall be in accordance with the drawings and shall be straight and true as per CSA S37-13. All like parts shall be interchangeable. All punched holes must be accurately

located so that the structure can be erected with a minimum of "drifting". The ends of members shall be clipped as required to facilitate assembly. In any bending or reworking of any material, methods employed shall ensure that the physical properties of the material are not impaired.

5.2 Each separate member shall be distinctly identified by a number assigned to that member. Each member shall be clearly marked with its member number to facilitate erection and traceability. All like parts shall have the same number.

5.3 Punching shall be done by methods designed to ensure accuracy. The centre of any hole shall, in no case, be displayed more than1.5mm from its position shown on the drawings. Plugging or welding mis-punched holes will not be allowed. Punches and dyes shall be sharp and true and all punch holes shall be round, true to size, and free from ragged edges and burrs. Where applicable, punching performed on bent members, shall be done after bending to avoid distortion of holes.

5.4 All welding shall be performed in accordance with CSA Standard W59 latest revision and shall be undertaken by a fabricator fully approved by the Canadian Welding Bureau to the requirements to CSA Standard W47, latest revision. Provide copy of CWB Certification to Owner.

5.5 Materials shall be handled and stored in the plant and on the job site in such a manner that no damage shall be done to the materials of any existing building or structure. Special care shall be taken to ensure that galvanizing, priming, or painting is not damaged during handling and erection of materials. Storage of materials on the site will be the responsibility of the Contractor.

6.0 Galvanizing

6.1 All materials, structural steel, pipe and fittings, including bolts, nuts and washers shall be hot dip galvanized to the requirement of CSA S37-13 and the standards specified therein.

6.2 Galvanizing applied to structural members is to have a minimum mass of Zinc coating of 610 g/m² (2 oz/ft²) equivalent to a thickness of 87 µm (3.40 mils). Galvanizing applied to bolts, nuts and threaded fasteners is to have a minimum mass of Zinc coating of 460 g/m² (1.5 oz/ft²) equivalent to a thickness of 65 µm (2.54 mils).

6.3 All materials shall be completely fabricated before galvanizing. No galvanizing shall be permitted on assemblies after being bolted. No machine or shop work shall be allowed after galvanizing (except the tapping of nuts).

6.4 Before galvanizing, the steel shall be thoroughly cleaned of all paint, grease, rust, scale or other materials that will interfere with proper binding of the zinc with the steel as per the requirement of CSA S37-13and the standards specified therein.

6.5 Test for thickness and uniformity of coating shall be made, on at least 10 members, throughout the galvanization process and from time to time on as many samples as may be considered necessary by the Owner. Such tests shall be conducted in full accordance with the requirements of CSA S37-13and the standard recording results of the foregoing tests shall be forwarded to the Owner by the Contractor. The Contractor shall engage an independent testing firm to complete this work. All costs are to be included in the tender price.

6.6 The Contractor shall field paint all steel members of the tower where the galvanized finish has been scrapped or chipped during erection in the field. This shall be done using Zinc-rich paint, as supplied by Galvcon or an approved equal. Steel members that have a slightly damaged finish shall be given three coats of Zinc-rich Paint applied according to the manufacturer’s printed instructions.

6.7 Contractor shall warranty all galvanizing work for a period of not less than three (3) years.

7.0 Painting

7.1 The tower shall be painted by a qualified painting facility subject to audit and approval by the Owner in 7 equal and alternating bands of International Orange (#12197) and White (# 17875) in accordance with latest edition of

Transport Canada, Canadian Aviation Regulations, TP 382/621.9 – Standards Obstruction Marking.

7.2 All surfaces of the tower are to be painted with exception of an area of the leg splice plates connection mating surfaces, thus to ensure a good electrical connection.

7.3 All paints must meet ASTM performance requirements for abrasion resistance, hardness, fading, flexibility and salt-spray resistance. Paint products must not contain Lead (pb) in their composition.

7.4 Surface Preparation – Galvanized steel must be cleaned prior to blasting in accordance with SSPC-SP-1 – "Solvent Cleaning"

7.4.1 Light Sweep blast all surfaces in accordance with SSPC-SP-7 to remove any chromate treatment, or poorly adhered zinc salts that may be present to increase mechanical bonding through increased roughness. Care should be taken to remove as little zinc as possible while maintaining desired roughness. After sweep blasting, the coating system should be applied ideally the same day with a maximum delay of one day.

7.4.2 SPECIFICATION FOR ABRASIVE SWEEP-BLASTING

- Blast pressure - 300kPa maximum.
- Media grade 0.2 to 0.8 mm
- Media type(<5 mhos hardness) – clean silica and slags, alumina.
- Angle of blasting to surface 30-60°
- Distance from surface 300-600mm
- Nozzle type minimum – 10mm venturi type.
- Grit should not be recycled.

7.5 Application

7.5.1 Coating System to be water based Acrylic (no Alkyds are acceptable)

- Primer: Aqualux 523-613 @ 2.5 – 3.5 mils dft (or approved equivalent)

- Finish: Aqualux 522-121white & 522-126 Orange @ 2.5 – 3.5 mils dft (or approved equivalent)

7.5.2 All paint shall be applied in shop conditions as per manufacturers instructions, evenly spread and free from all marks, stains, defects and flaws.

7.5.3 Painting shall not be done under the following conditions:

- ambient temperature is lower than 10º C and humidity above 50%.
- damp/wet weather.
- tower metal is hot enough to cause paint blister and produce a porous coating.
- the previous coat is not thoroughly dry as per manufacturers recommendations.

7.5.4 The Contractor shall be responsible for damage done by paint spraying or dripping on the Owner's or other's property.

7.5.5 Contractor shall warrant all painted items for three (3) years for 90 % coverage. Any damage to the paint from normal environmental conditions prevalent at the site shall be repaired by the Contractor at no cost to the Owner in a manner approved by the Owner.

7.6 Coating Protection

7.6.1 The tower shall be erected in a manner that will not bend, scrape, distort, or injure the component parts of the galvanizing.

7.6.2 Where painting or priming is done in the shop, any areas damaged during transit or erection shall be cleaned and touched up with new Zinc rich primers and/or paint as required.

END OF SECTION

Section 05121

Auxiliary Facilities

1.0 Tower Components

The following facilities shall be considered to be an integral part of the tower contract and shall be supplied as such. In mounting any of these auxiliary facilities, care shall be taken that the structural members of the tower are not weakened by the drilling of holes or any other means.

1.1 **Ladder** – The tower shall be equipped with a climbing ladder (outside climb required) complete with a CSA approved fall arrest rail centered in the ladder. The ladder shall be a separate assembly bolted to the tower and shall conform to the latest version of CSA S37-13. Provide an unobstructed climbing path and maintain the required climbing radius as per CSA S37-13.

1.2 Ice Protection

1.2.1 Bonding strap from tower to tuning unit housing, the tuning unit housing and all horizontal runs of transmission lines shall be protected from falling ice in a manner approved by the Owner.

1.2.2 Three U-Bolt clips are to be spaced 300 mm apart, directly above the grounding connection and guy markers on each guy.

1.3 Turnbuckles and Shackles

1.3.1 Turnbuckles and shackles shall be manufactured from AISI 1035 steel, heat treated, and shall be hot dip galvanized in accordance with the requirements of the latest version of CSA S37-13. The minimum turnbuckle length shall be 457 mm. Provide full articulation at anchor ends of each turnbuckle by means of shackles.

1.3.2 Install all turnbuckles so as to provide a minimum of 250 mm of take-up for future adjustment. Provide a locking device for each turnbuckle including turnbuckles used on broadband array (if applicable). The locking device shall consist of vinyl coated cable or an approved equivalent.

1.3.3 All guy hardware including turnbuckles and shackles to be Crosby Brand (Heavy Duty Grade) or approved equivalent.

1.4 Guy (100%) Terminations

1.4.1 Bridge sockets shall be sized to provide a minimum of 1220 mm of adjustment. The sockets shall be installed so as to provide a minimum of 760 mm of take-up for future adjustment. The bridge sockets shall be made of heat treated steel. Contractor is to provide details of other 100% terminations.

1.5 Anti-climb Devices

1.5.1 The tower is to be provided with a lockable, anti-climb device approved by the Owner. The Anti-climb should incorporate a framed, heavy gauge expanded wire mesh cage bolted flush to the tower face using round headed hardware that cannot be used as a step or hand hold. The panel should be 2.5 m high (minimum) with the lower edge positioned approximately 3 m above grade. Access should be prevented from both outside and inside the tower. Contractor is to submit drawings of the anti-climb system including specification sheets on the wire mesh and gauge thickness for approval by the Owner.

1.5.2 The anti-climb shall be hinged on the climbing face. Operable panels shall been framed, hinged on one vertical side, with a combined latching mechanism with a lock on the opposite vertical edge. A locking mechanism requiring removable hardware such as long steel rods to open access panels is not acceptable.

1.5.3 For an inside climb, the anti-climb shall be accessible through a hatch door inside the structure.

1.5.4 The trap door in the horizontal anti-climb should easily open up to allow safe access to the tower.

1.5.5 Barbed wire will not be permitted as part of the anti-climb.

1.6 Guy Markers

1.6.1 Each guy shall be equipped with yellow vinyl guy markers located at the anchor end of each guy. Install such that markers extend to mark at a point 4 m above the ground.

1.6.2 Guy markers shall be approximately 2 m in length and vandal resistant. Field drill 25 mm holes as 200 mm spacing to render these useless for other purposes.

1.6.3 Contractor shall submit shop drawings for Owner approval.

1.7 Fall Arrest

1.7.1 The Contractor shall design, supply and install a CSA approved Fall Arrest Rail to meet CSA S37-13 and the latest version of CSA Z259.1-1976 and CSA Z259.2-M1979. Rail system is to be Trylon type trolley compliant or approved equivalent.

1.7.2 The fall arrest rail shall be free from obstructions for the complete height of the tower.

1.7.3 The fall arrest rail shall be supported at spans not more than 1 m. Any extension beyond the top of the tower must be structurally supported for the entire height.

1.7.4 Proper manufactured stop hardware is to be installed at the top of the fall arrest rail to prevent accidental dislodging of the trolley from the rail.

1.7.5 The fall arrest system shall be supplied complete with two new CSA approved trolleys that will be turned over directly to the owner. Trolleys shall be supplied with permanently attached lock safe swivel clips for attachment to front D ring of CSA Approved full body harness.

1.7.6 Cable fall arrest systems are not acceptable.

2.0 Security Fence

2.1 Contractor is supply a galvanized chain link security fence around the base of the tower that is minimally 14 m X 14m, 2.5 m high with three levels of barb wire and a 1.2m wide single gate split horizontally into two independently operable sections. Fence material is to be commercial heavy duty schedule 80 pipe. All fence posts, rails etc. are to be grounded.

END OF SECTION

Section 16450

Grounding

1.0 General

1.1 The Contractor shall be responsible for the design and supply of a complete permanent continuous grounding system for the MF tower system (except as noted). The design shall consider existing site topography and soil/rock conditions and is subject to approval by the Owner.

1.2 Refer to Appendix B for details of grounding required for this tower system.

1.3 Refer to Appendix H for CCG supplied materials.

1.4 In rock conditions, the Contractor shall propose products and systems which shall attain the desired protection. This must be clearly shown on design drawings. All above ground runs of conductor must be securely attached to the rock at spaces not more than 3 m.

1.5 The tower contractor will connect tower guys to the grounding systems as follows:

1) to the tower-using Burndy Versatail or exothermic welding (Cadweld)
2) to the guy wires – using Burndy KVSU or approved equal connectors, such that adverse reactions of different materials will not occur.
3) to the ground ring – by means of exothermic welding (Cadweld).
4) wire to wire connections underground – using exothermic welding (Cadweld).
5) all connections shall be made according to manufacturer's directions. Provide Burndy Pentrox E compound on all connections.
6) Before making a ground system connection, remove all paint, foreign matter or dirt.

2.0 Ground Rods

2.1 Ground rods shall be copper-coated steel rods measuring 19 mm in diameter and 3 m in length. All ground rods shall be buried vertically at an angle of not more than 30^{o} from vertical such that the top of the rod is installed at 400 mm below finished grade. All ground rods shall be directly connected to the basic ground grid using thermit connectors.

A compression connection shall be installed as per the manufacturer's instructions and shall not be used to connect to more than one conductor per compression operation unless specified by the manufacturer.

2.2 Ground rods which cannot be driven vertically shall be placed in a 76 mm diameter drilled hole, filled with a Bentonite and water mixture. The procedure for placing the ground rod in Bentonite is as follows:

1. Drill 76 m diameter hole in rock, 3 m deep.
2. Pour water 1/3 height of the hole.
3. Insert ground rod.
4. Add Bentonite powder in hole, alternating with water.

3.0 Earth Enhancing Compounds

Earth enhancing compounds shall be considered for use at sites where the main external buried ground grid impedance to true earth cannot be reduced to the value specified in section 5.2 using metallic conductors and ground rods.

4.0 Standards of Acceptance

1) Ground Rods and Lightning Rods:
   - C.L.M. DN6CC10
   - L.C.A. 7510
   - Slater 9450

2) Thermit Connectors:
   - Cadwell connectors manufactured by ERICO Products Inc.
   - Compression Connectors: Burndy Hyground Compression System

END OF SECTION

Section 16500

Lighting and Power supply

1.0 General

1.1 Contractor is responsible to verify requirements for obstruction lighting as per 621.19/TP382. Obstruction lights for the tower shall conform to the latest edition of Canadian Aviation Regulations 621.19/TP382 and the Nationals Electrical Manufactures Association (NEMA). The tower height shall be based on the highest intended projection of the structure.

1.2 All required equipment is be supplied, as specified, by Contractor.

1.3 The complete wiring system and lighting fixtures shall be of a waterproof type using COREFLEX CABLE or an approved equal, rigid fittings, and cast-iron or aluminum, type junction boxes.

1.4 All wiring shall be in accordance with CSA requirements, and type RA-90-40C wire shall be used throughout the installation. Wires shall be routed in to a junction box or fixture, and shall be routed down the tower from the top of the junction box or fixture.

1.5 Tower obstruction lighting shall be wired so that lamps in each double obstruction fixture will be on opposite side of a three-wire circuit. Circuits are to be wired in a flip-flop fashion and controlled by a photocell as the base of the tower.

1.6 The obstruction lamps shall be 130 volts long life, type 116 A21-TS or equivalent.

1.7 As required for Medium Frequency (hot) towers, contractor is to supply base Austin (or equivalent transformer for lighting power.

1.8 Lighting system to have a control system that is capable of remote monitoring and signalling operation.

1.9 Lighting system to operate automatically using a photovoltaic cell protected from falling ice.

2.0 Auxiliary Power Outlet

2.1 A weatherproof power receptacle shall be located at the base of the tower. The AC outlets will be complete with GFI protection and will be on separate circuits. 120V, 20 amps.

3.0 Permits and Temporary Lighting

3.1 The Contractor shall obtain an electrical installation permit from the appropriate agency and submit to the Owner evidence that the lighting installation has been inspected and approved by the said agency.

3.2 When required by Transport Canada, the tower Contractor shall make arrangements to provide temporary tower lighting until the tower is accepted, and the permanent power supply is available. These arrangements will be subject to the final approval of the Owner.

4.0 Ice Protection

4.1 The Contractor shall install ice protection for all lights and lighting systems.

5.0 Cable Attachment

5.1 The Contractor shall adequately secure the cables at distances not exceeding 750mm. Use of wrap-lock/tie wrap device to secure cables is unacceptable.

6.0 Shop Drawings

6.1 The Contractor shall submit shop drawings clearly indicating all elements of the lighting system.

7.0 Termination of Wire and Hook Up

7.1 The Contractor shall terminate all wiring inside the building, in the existing electrical panel. The Contractor shall attach conduit to ceilings and walls so as to avoid conflict with existing equipment. All conduits shall be installed in a neat manner.

END OF SECTION

Section 16875

Electrical Antenna

1.0 General

1.0.1 Work under this section relates to the Design, Fabrication, Installation, Testing, Optimization and Commissioning of a Medium Frequency Receive antenna tower system.

1.0.2 Contractor is responsible for the complete design of the antenna tower arrangement including structure, broadband elements, base insulator, guy insulators, tuning unit, ground plane and all other items required for the system to operate on the parameters identified below.

1.1 Antenna Specifications

1.1.1 The Medium Frequency Antenna Tower is required to perform as follows:

1.1.2 Receive MF Tower:
Frequency range: 2- 4.6 Mhz
Bandwidth: 2.6 Mhz
Antenna System VSWR: Not to exceed 2.5 over the specified frequency range.
Radiation pattern: Omni-directional
Polarization: Vertical
Characteristic Impedance: Nominal 50 ohms unbalanced.
Impedance matching: The ATU will consist of a “T“matching network which must consist of an input coil, shunt capacitor and an output capacitor. The “T” matching network must use variable components for optimum tuning. The ATU will also have a static drain coil going from the RF output to ground. The ATU shall not incur an insertion loss greater than 1.5 dB over the specified frequency range. Design, supply and installation of this unit is the complete responsibility of the contractor.

2.0 Products

2.1 Materials for MF Tower

2.2 The base insulator and guy insulators shall be designed to safely withstand the radio frequency potentials and mechanical stresses associated with the service conditions and operation conditions specified. A rain shield shall be provided over the base insulator.

2.3 A lighting transformer shall be incorporated into the base insulator, or supported from tower.

2.4 The radio frequency connection will be by means of Andrews' LDF-5-50, foam dielectric Heliax cable or approved equivalent from the new MF tower ATU Enclosure to the receiver multicoupler in the existing equipment building.

2.5 Ground rods to be 19 mm by 3000 mm, copper clad.
Grounding equipment to: CSA C22.2 No. 41 1950 (R1967)
Copper grounding cables to: ASA G7.1 1964
Radial Ground screen: 90 radials spaced evenly 4 degrees apart consisting of #8 soft drawn solid copper wires extending a distance of 50 m from the center of the tower, including ground rods, straps, and ring as per Appendix B.
(See Appendix H for CCG supplied materials).

3.0 Execution

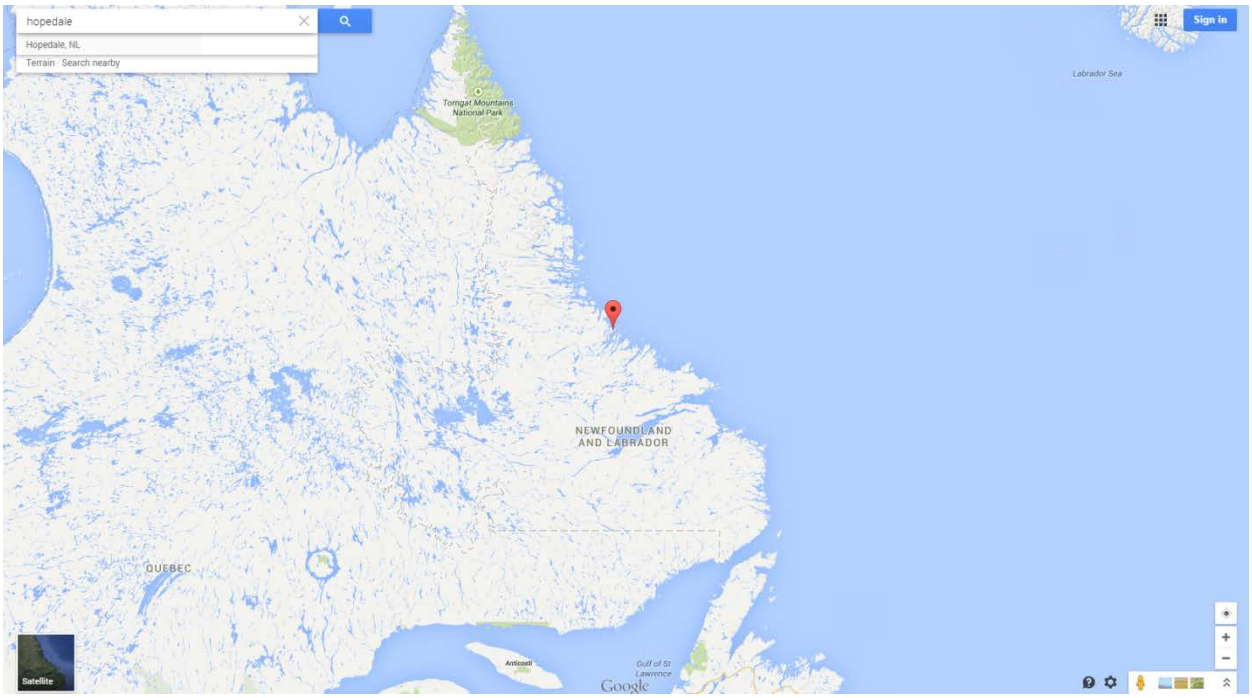
3.1 Electrical Bonding

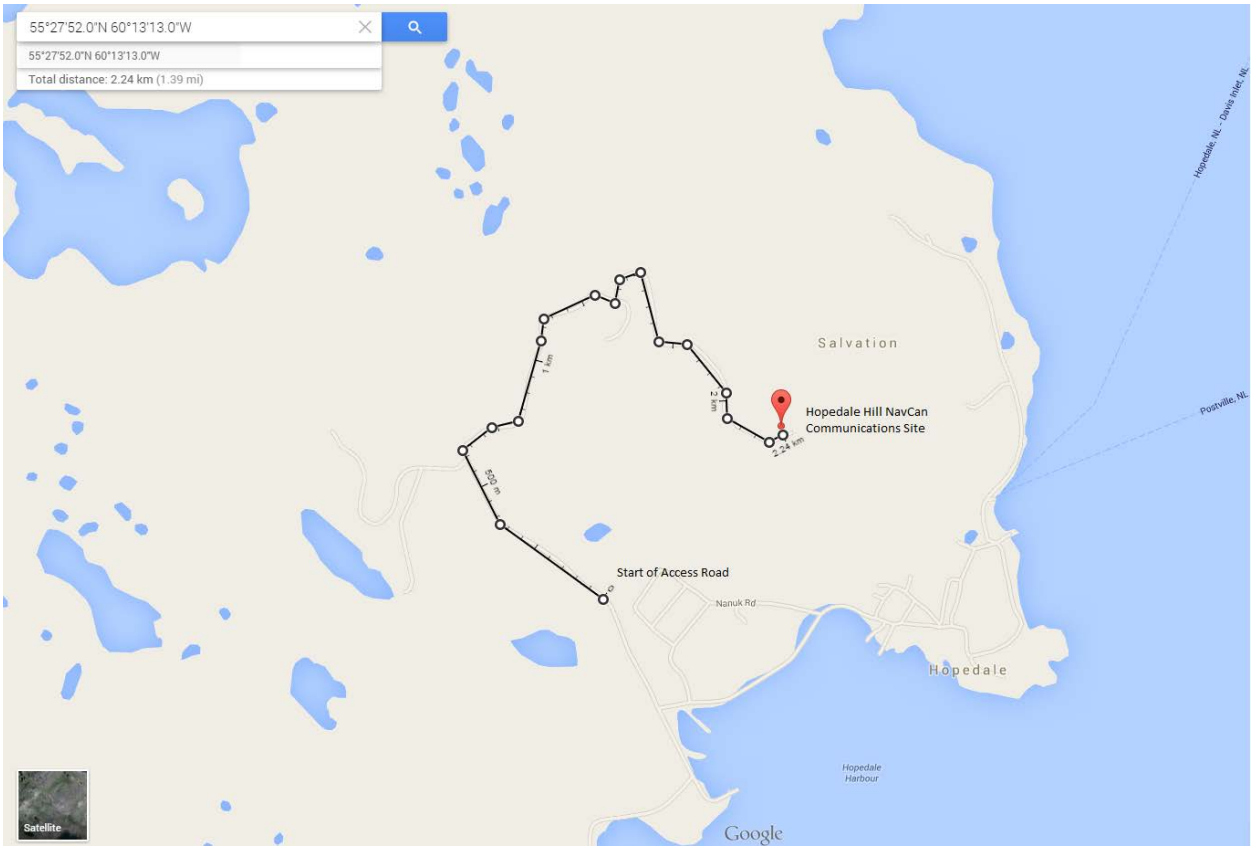
3.2 Special care shall be taken to ensure continuity of required electrical connections and proper bonding of electrical conduits, etc., upon initial assembly and throughout antenna structure life when subjected to salt spray conditions in coastal installation.

END OF SECTION

Appendix A

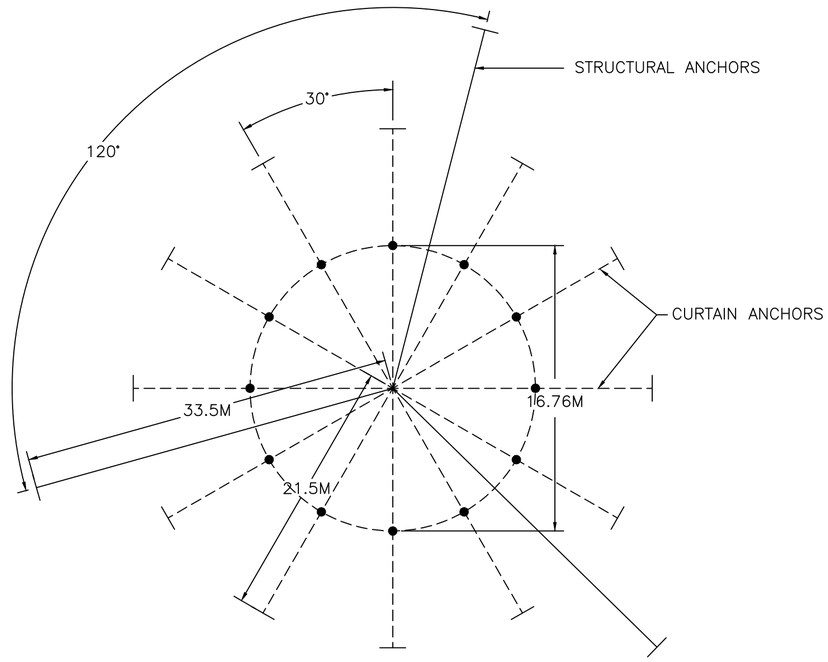
Site Location Map


hopedale
Hopedale, NL
Terrain · Search nearby
Sign in
Tomgat Mountains National Park
Labrador Sea
NEWFOUNDLAND AND LABRADOR
QUEBEC
Satellite
Anticosti
Gulf of St Lawrence
Google

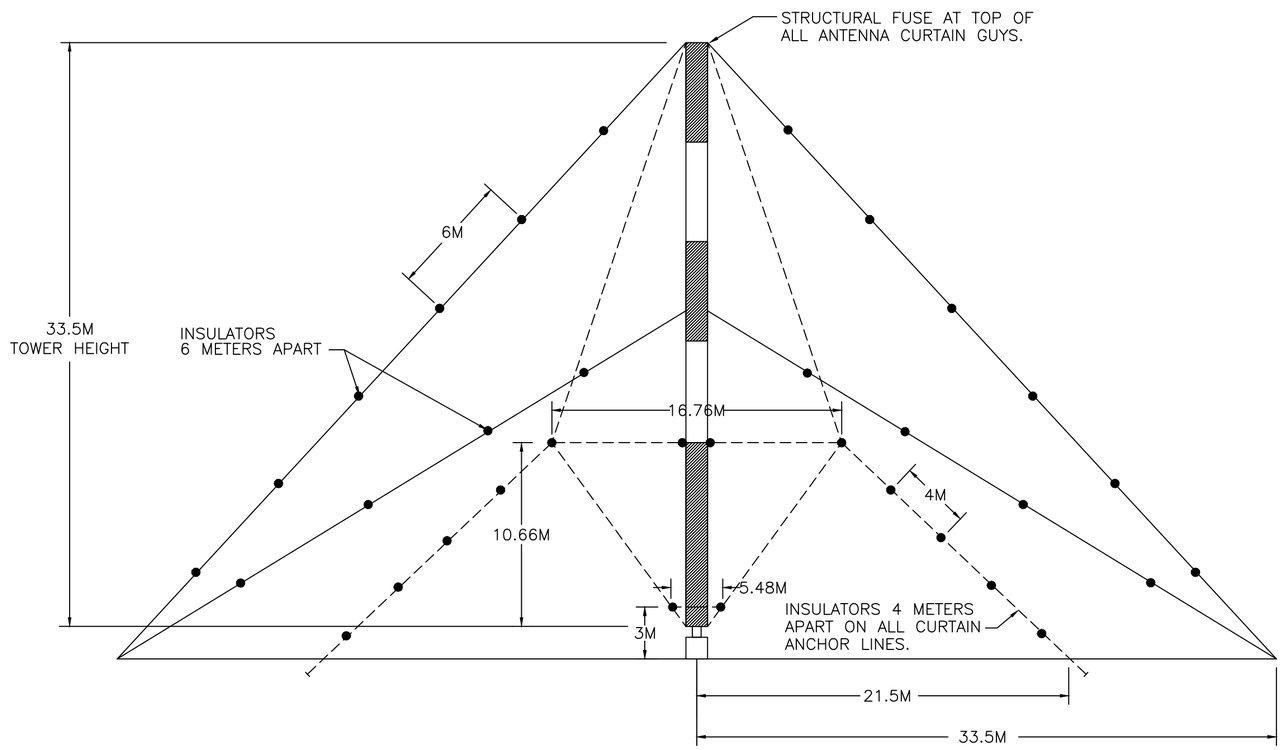

55°27'52.0"N 60°13'13.0"W
55°27'52.0"N 60°13'13.0"W
Total distance: 2.24 km (1.39 mi)
Salvation
Hopedale Hill NavCan
Communications Site
Start of Access Road
Nanuk Rd
Hopedale
Hopedale
Harbour
Satellite
Google
Hopedale, NL - Davis Inlet, NL
Postville, NL

Appendix B

New MF Tower Profile and General Arrangement Grounding



PLAN VIEW



PROFILE VIEW

Fisheries and Oceans Coast Guard
Pêches et Océans Garde côtière

NOTE:

1. INSULATORS TO BE DESIGNED FOR STRUCTURAL LOADING CONDITIONS.
2. GUY RADIUS OF 33.5m IS FOR LEVEL GROUND. TOWER DESIGNER IS RESPONSIBLE TO DESIGN APPROPRIATE GUY RADIUS BASED ON INFORMATION PROVIDED.

no. no	revision revision	date date	by par	approved approuve

Project – projet

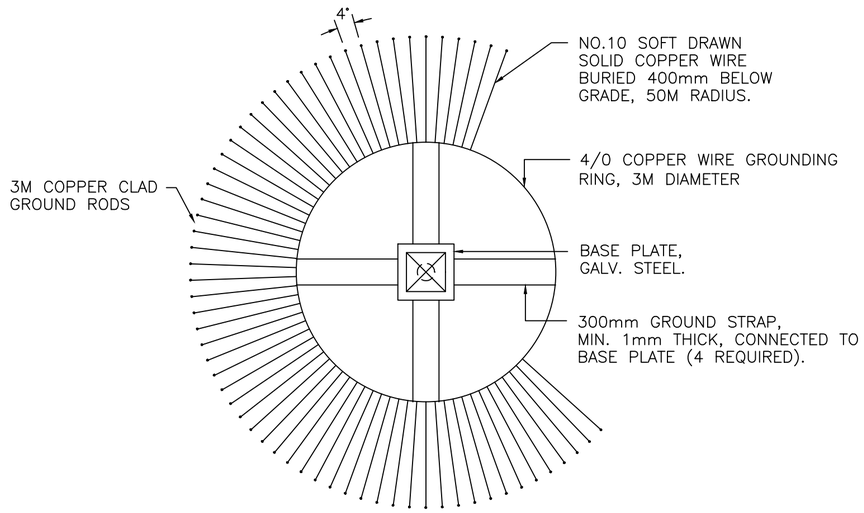
HOPEDALE HILL MF–RX SITE

Drawing – dessin

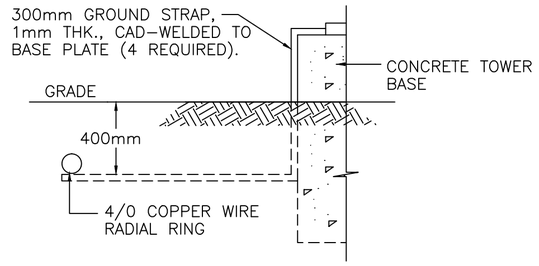
MF RECEIEVER TOWER
GENERAL ARRANGEMENT

drawn – dessine: G.F.S.	designed – dessine par:
date – date: NOV. 2014	checked – verifie: J. LAMBE
scale – echelle: N.T.S.	approved for tender– approuve pour l'offre:

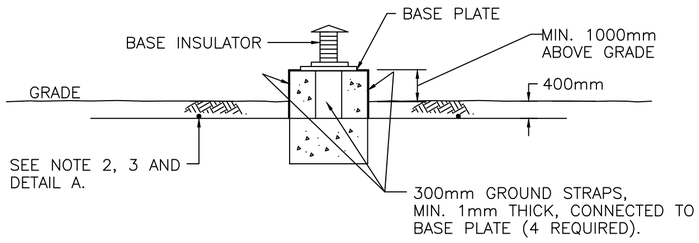
project no. – projet no.	drawing no. – no du dessin	sheet – feuille
F6839–145549	13N0801C02201	1/2



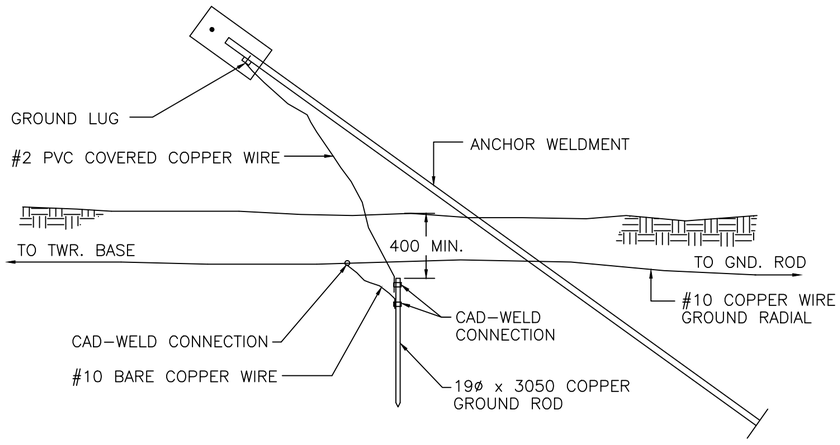
GROUND SCREEN



DETAIL 'A'



ELEVATION



TYPICAL GUY ANCHOR GROUNDING DETAIL

N.T.S.

Fisheries and Oceans Coast Guard
Pêches et Océans Garde côtière

NOTES:

1. 90 GROUND RADIALS SPACED 4° APART, CONSISTING OF NO.10 SOFT DRAWN COPPER WIRES TO EXTEND A DISTANCE OF 50 METERS FROM CENTER OF TOWER. ALL ABOVE GROUND RUNS OF CONDUCTOR MUST BE SECURELY ATTACHED TO THE ROCK AT NOT MORE THAN 3M.
2. RADIAL RING MADE OF 4/0 COPPER WIRE AND BURIED 400mm BELOW GRADE.
3. CAD–WELD GROUND RADIALS TO RADIAL RING AND RODS.
4. GROUND RODS (3M) AT END OF EACH RADIAL.
5. CAD–WELD GROUND STRAPS TO BASE PLATE BEFORE PLATE IS INSTALLED UNDER INSULATOR.

no. no	revision revision	date date	by par	approved approuve

Project – projet

HOPEDALE HILL MF–RX SITE

Drawing – dessin

MF RECEIVER TOWER
GROUNDING SYSTEM DETAILS

drawn – dessine: G.F.S.	designed – dessine par
date – date: NOV. 2014	checked – verifie: J. LAMBE
scale – echelle: N.T.S.	approved for tender– approuve pour l'offre

project no. – projet no.	drawing no. – no du dessin	sheet – feuille
F6839–145549	13N0801C02202	2/2

Appendix C

Site Specific Wind Pressure

T5441 Hopedale Hill, NL 30.5m Tower

Site Specific 10-yr. Hourly Wind Pressure Documentation Sheet

Site Information:

Name: T5441 Hopedale Hill, NL
Latitude: 55° 27' 52.7" N
Longitude: 60° 13' 13" W
Tower Height (m): 30.5
Elevation MSL (m): 107

UTM Coordinates:

Zone: 20
Easting (m): 675729
Northing (m): 6150011

Results:

Q_e (Pa): 690
Uncertainty of Q_e: [20%, -25%]
Q_{nbc} (Pa): 500
Icing: ****Rime Icing May Occur****
Return Period: **10**

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

$$Q_h = 0.12919 \{[1 + 0.1962\, e^{(-0.0073\, z)}]\, 62.27\}^2 \quad (z/10)^{0.2}$$

Profile Formula General Form:

$$Q_h = 0.12919 \{[a_1\, e^{(-a2\, z)} + a_3\, \ln(z/z_h) / \ln(z/z_{01})]\, v_{01}\}^2 \quad (z/10)^{0.2}$$

Site Values of Coefficients:

$a_1 = 0.1962,\ a_2 = 0.0073,\ a_3 = 1.0000,\ z_h = 0.0500,\ z_{01} = 0.0500,\ v_{01} = 62.27$ mph

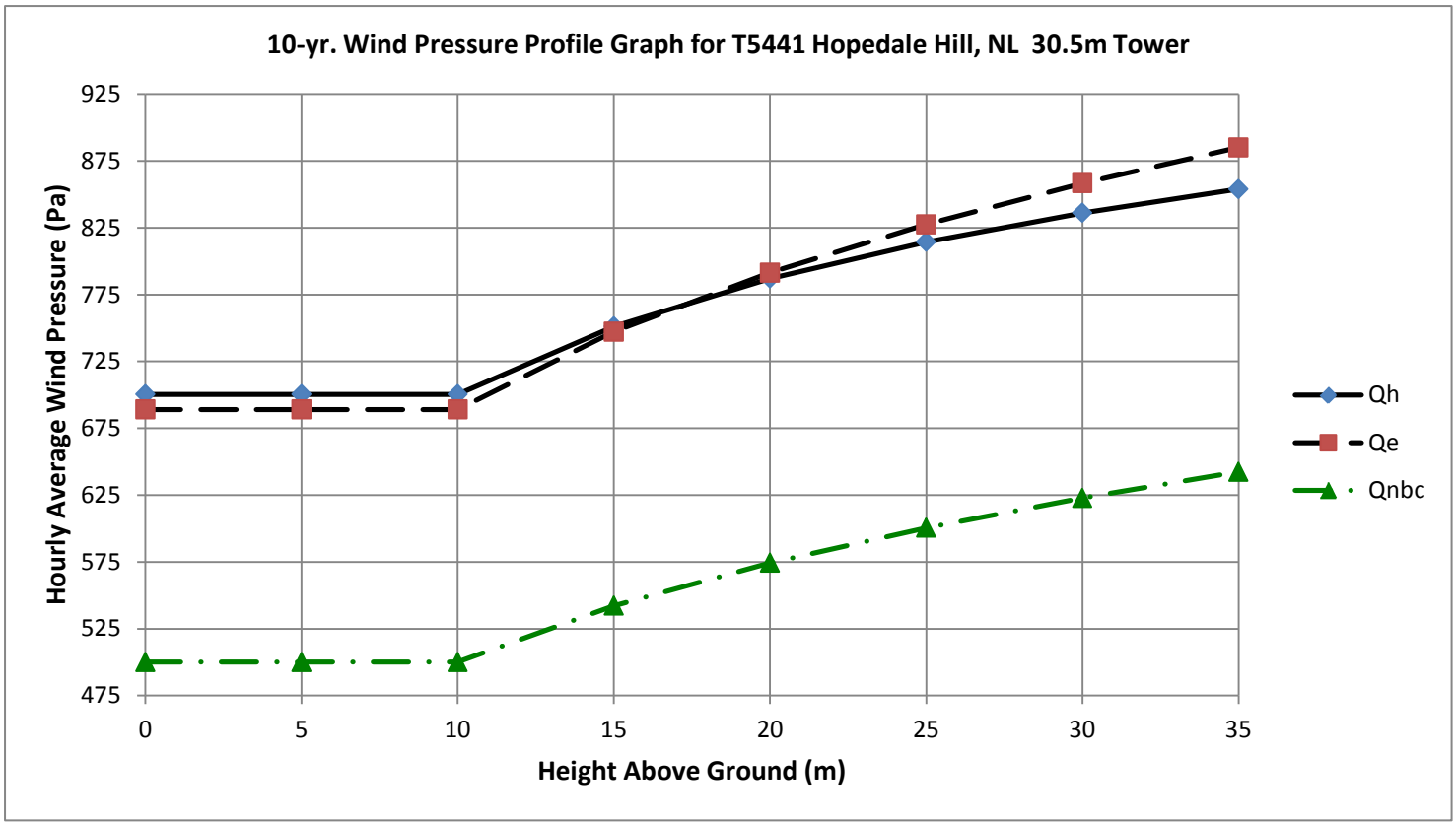
Definitions

Tower Height: Height of the tower from ground level at the base of the tower to the top of the structure.
Q_e: "Site Specific Equivalent Wind Pressure at 10 m" => the wind pressure which, when using the 2/10 power law yields the same average wind pressure over the height of the tower as the Wind Pressure Profile Formula.
Q_{nbc}: Regionally representative reference wind pressure at 10 m in the format of the National Building Code of Canada. As per the November 17, 1988 meeting of the CSA Antenna Tower Technical Committee, the Q_{nbc} value profiled with the 2/10 power law should comprise the minimum hourly average wind pressure at all heights above ground.
Wind Pressure Profile Formula: Formula for the design wind pressure as a function of height.
Height: the vertical distance (m) above ground level at the base of the tower.

Notes:

n.b. 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.
This site will experience rime (in-cloud) icing during the cold season. We recommend that you consult with the tower owner and service personnel regarding icing severity and duration for design purposes.

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%].



Qe profile = Qe (the site-specific equivalent reference wind pressure) with the 2/10 power law profile.

Qh = site specific wind pressure directly from Taylor and Lee (1984) simple guidelines.

Qnbc profile = regionally representative wind pressure in the National Building Code format with the 2/10 power law profile

T5441 Hopedale Hill, NL 30.5m Tower

Site Specific 30-yr. Hourly Wind Pressure Documentation Sheet

Site Information:

Name: T5441 Hopedale Hill, NL
Latitude: 55° 27' 52.7" N
Longitude: 60° 13' 13" W
Tower Height (m): 30.5
Elevation MSL (m): 107

UTM Coordinates:

Zone: 20
Easting (m): 675729
Northing (m): 6150011

Results:

Q_e (Pa): 830
Uncertainty of Q_e: [20%, -25%]
Q_{nbc} (Pa): 600
Icing: ****Rime Icing May Occur****
Return Period: **30**

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

$$Q_h = 0.12919 \{[1 + 0.1962\, e^{(-0.0073\, z)}]\, 68.14\}^2 \quad (z/10)^{0.2}$$

Profile Formula General Form:

$$Q_h = 0.12919 \{[a_1\, e^{(-a2\, z)} + a_3\, \ln(z/z_h) / \ln(z/z_{01})]\, v_{01}\}^2 \quad (z/10)^{0.2}$$

Site Values of Coefficients:

$a_1 = 0.1962,\ a_2 = 0.0073,\ a_3 = 1.0000,\ z_h = 0.0500,\ z_{01} = 0.0500,\ v_{01} = 68.14$ mph

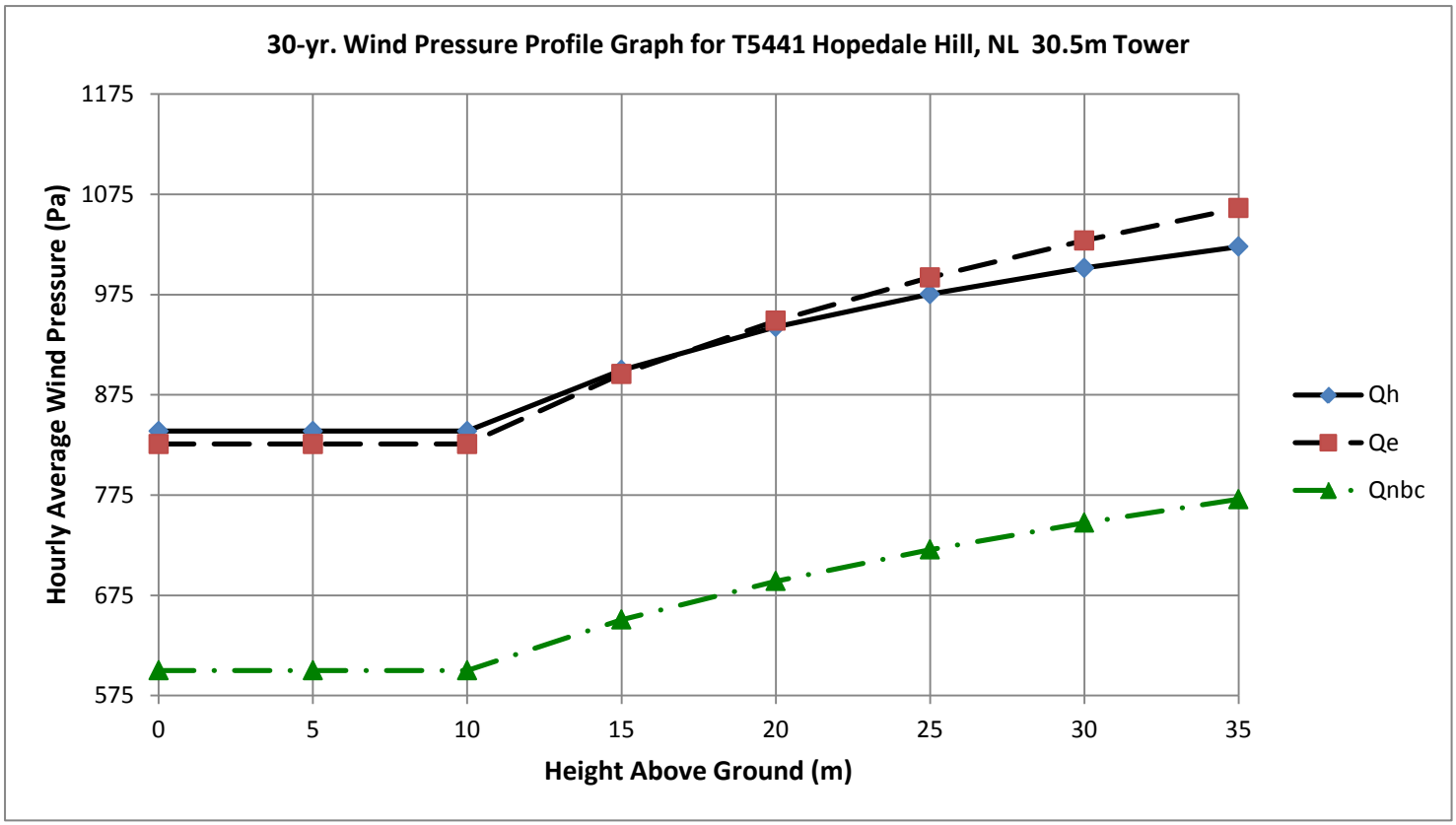
Definitions

Tower Height: Height of the tower from ground level at the base of the tower to the top of the structure.
Q_e: "Site Specific Equivalent Wind Pressure at 10 m" => the wind pressure which, when using the 2/10 power law yields the same average wind pressure over the height of the tower as the Wind Pressure Profile Formula.
Q_{nbc}: Regionally representative reference wind pressure at 10 m in the format of the National Building Code of Canada. As per the November 17, 1988 meeting of the CSA Antenna Tower Technical Committee, the Q_{nbc} value profiled with the 2/10 power law should comprise the minimum hourly average wind pressure at all heights above ground.
Wind Pressure Profile Formula: Formula for the design wind pressure as a function of height.
Height: the vertical distance (m) above ground level at the base of the tower.

Notes:

n.b. 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.
This site will experience rime (in-cloud) icing during the cold season. We recommend that you consult with the tower owner and service personnel regarding icing severity and duration for design purposes.

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%].



Qe profile = Qe (the site-specific equivalent reference wind pressure) with the 2/10 power law profile.

Qh = site specific wind pressure directly from Taylor and Lee (1984) simple guidelines.

Qnbc profile = regionally representative wind pressure in the National Building Code format with the 2/10 power law profile

T5441 Hopedale Hill, NL 30.5m Tower

Site Specific 50-yr. Hourly Wind Pressure Documentation Sheet

Site Information:

Name: T5441 Hopedale Hill, NL
Latitude: 55° 27' 52.7" N
Longitude: 60° 13' 13" W
Tower Height (m): 30.5
Elevation MSL (m): 107

UTM Coordinates:

Zone: 20
Easting (m): 675729
Northing (m): 6150011

Results:

Q_e (Pa): 890
Uncertainty of Q_e: [20%, -25%]
Q_{nbc} (Pa): 650
Icing: ****Rime Icing May Occur****
Return Period: **50**

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

$$Q_h = 0.12919 \{[1 + 0.1962\, e^{(-0.0073\, z)}]\, 70.84\}^2 \quad (z/10)^{0.2}$$

Profile Formula General Form:

$$Q_h = 0.12919 \{[a_1\, e^{(-a2\, z)} + a_3\, \ln(z/z_h) / \ln(z/z_{01})]\, v_{01}\}^2 \quad (z/10)^{0.2}$$

Site Values of Coefficients:

$a_1 = 0.1962,\ a_2 = 0.0073,\ a_3 = 1.0000,\ z_h = 0.0500,\ z_{01} = 0.0500,\ v_{01} = 70.84$ mph

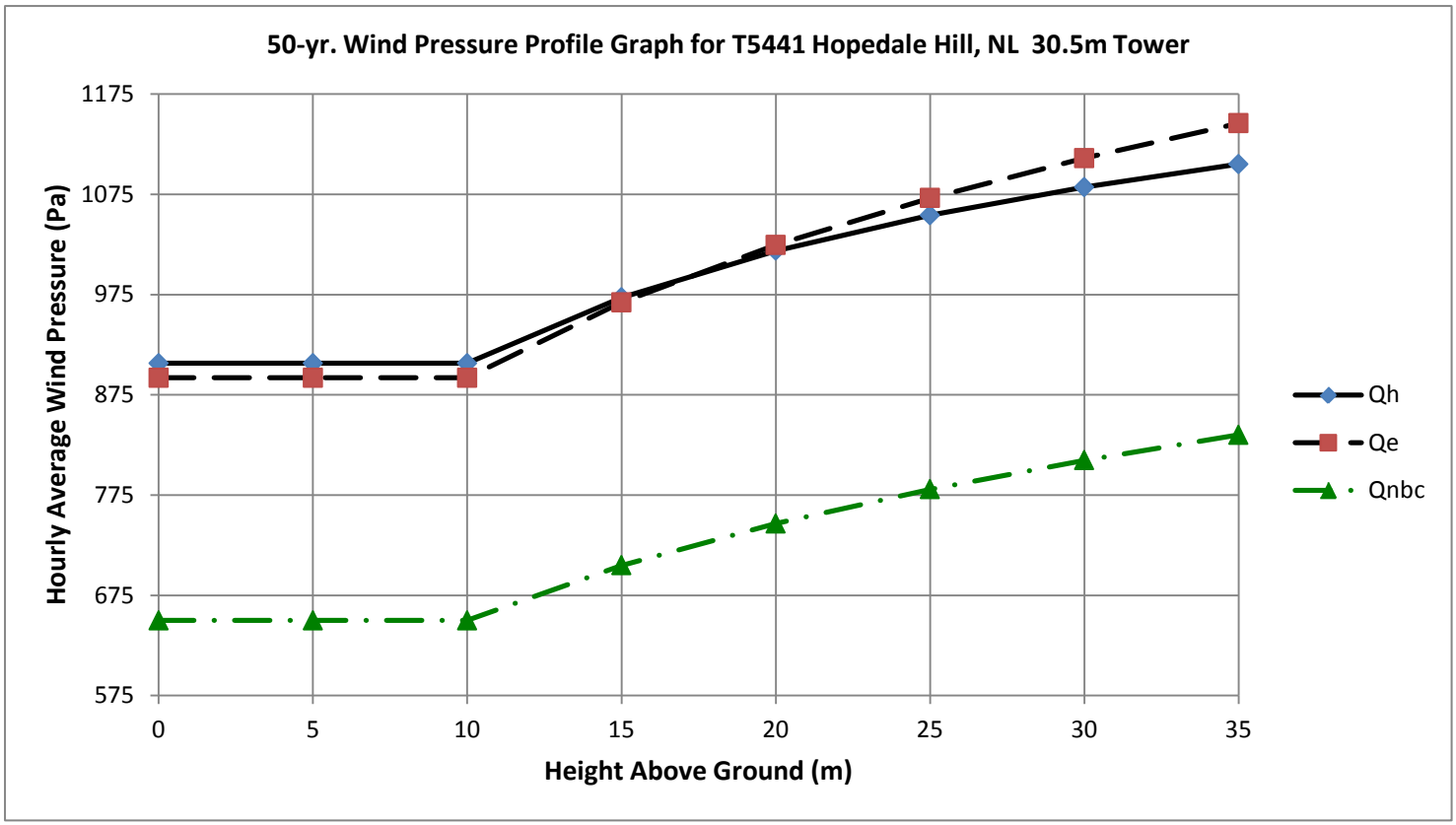
Definitions

Tower Height: Height of the tower from ground level at the base of the tower to the top of the structure.
Q_e: "Site Specific Equivalent Wind Pressure at 10 m" => the wind pressure which, when using the 2/10 power law yields the same average wind pressure over the height of the tower as the Wind Pressure Profile Formula.
Q_{nbc}: Regionally representative reference wind pressure at 10 m in the format of the National Building Code of Canada. As per the November 17, 1988 meeting of the CSA Antenna Tower Technical Committee, the Q_{nbc} value profiled with the 2/10 power law should comprise the minimum hourly average wind pressure at all heights above ground.
Wind Pressure Profile Formula: Formula for the design wind pressure as a function of height.
Height: the vertical distance (m) above ground level at the base of the tower.

Notes:

n.b. 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.
This site will experience rime (in-cloud) icing during the cold season. We recommend that you consult with the tower owner and service personnel regarding icing severity and duration for design purposes.

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%].



Qe profile = Qe (the site-specific equivalent reference wind pressure) with the 2/10 power law profile.

Qh = site specific wind pressure directly from Taylor and Lee (1984) simple guidelines.

Qnbc profile = regionally representative wind pressure in the National Building Code format with the 2/10 power law profile

Appendix D

Geotechnical Report

Geotechnical Services
Replacement of MF Tower
Hopedale, NL
DFO-CCG Project No: F6839-145551

Prepared for:
Canadian Coast Guard, Department of Fisheries and Oceans
P.O. Box 5667, St. John's, NL
A1C 5X1

Prepared by:
Stantec Consulting Ltd.
141 Kelsey Drive
St. John's, NL A1B 0L2

November 25, 2014

Table of Contents

GEOTECHNICAL SERVICES
REPLACEMENT OF MF TOWER
HOPEDALE, NL
DFO-CCG PROJECT NO: F6839-145551

November 25, 2014

1.0 INTRODUCTION

Acting at the authorization of the Department of Fisheries and Oceans, Canadian Coast Guard (DFO-CCG), Stantec Consulting Ltd. (Stantec) has carried out a geotechnical site assessment on November 14, 2014 for the proposed installation of a replacement tower at Hopedale, Newfoundland and Labrador.

The scope of services for this project was in accordance with DFO-CCG's request for quotation (RFQ) document No. F6839-145551 dated November 2014. The scope of work for this project is accordance with Section 4.0 of the RFQ document. This phase of the work was limited to completing a site visit, collect relevant information during the site visit limited to visual surficial observations and measurements, and provide a geotechnical report based on our findings.

This report has been prepared specifically and solely for the project described above. It contains all of the findings of this assessment provides recommendations for the foundation design in accordance with CSA Standard S37-01, Appendix L (Site Soil Investigations) of Antennas, Towers, and Antenna Supporting Structures.

2.0 FIELD PROCEDURES

The site assessment was completed on November 14, 2014 Stantec with representation from DFO-CCG and NE Parrott Surveys. The assessment consisted of a visual geotechnical investigation of the site. The extent of the investigation was limited to visual assessment with hand tools and included: a walk over survey; observation of the bedrock exposure in the area; mapping of the geological features; and collection of rock samples for classification and testing. Access to the site was via helicopter provided by Universal Helicopters Newfoundland Limited under charter with DFO-CCG.

3.0 SITE CONDITIONS

General Site Conditions

In general, the site is described as consisting of exposed barren rock. Overburden is not present with the immediate vicinity of the proposed tower. Bare rock outcrop comprises the majority of the site, however, in many low lying areas of the site mosses and low shrubs have developed and occasional small boulders may also be found. In other low lying area water appeared to accumulate and caused minor weathering of the bedrock. Old concrete ruins and cut down telephone poles are located southeast of the proposed tower site. The proposed tower site is located on top of an exposed bedrock ridgeline with trenches trending at approximately 310º

and 290º and pinching out towards the east. The trenched topography was approximately 3 m in height and 2 m in width. This area has been glaciated. The bedrock observed has well-rounded rock outcrops and glacial striae.

Representative site photographs taken during the site visit illustrating the various features and observations are attached to this report.

Bedrock Conditions

- Description

The bedrock is described as pinkish grey coarse grained **granodiorite gneiss**. The attached photos show the nature of the bedrock.

- Structure

The bedrock is very sound to sound with occasional jointing. Foliations were observed throughout the bedrock with a general trend of 190º and dip ranging from 35º to 70º.

- Strength

Based on Point Load Index Strength Testing (PLIS) of hand samples collected during the site visit, the average $PLIS_{50}$ of the rock was 5.4 MPa. Using an empirical correction factor of 24, the estimated Unconfined Compressive Strength (UCS) of the rock is approximately **130 MPa**.

- Density

The measured average density of the rock was **2,660 kg/m³**.

- Weathering

The rock is estimated to be **slightly weathered** (W2) at the ground surface.

- Rock Quality Designation (RQD)

RQD values are estimated based on recommendations by the International Association of Engineering Geologist procedure in the absence of rock core. Based on our assessment of the volumetric joint count (Jv) of the rock mass the RQD of the rock is estimated to be **>75%**.

- Geological Strength Index (GSI)

Based on Hoek et al (1992) classification scheme, the estimated **GSI is 65**.

- Depth to Sound Rock

Sound bedrock implies an RQD greater than 75%. Based on our visual observations of the surficial exposure, sound bedrock appears to be at the surface (**0 m depth**). In low lying areas

located southeast of the proposed tower the depth to sound bedrock has not been determined due to overburden above the rock. It is prudent to note that the geological conditions of bedrock can vary with depth and therefore in order to confirm the depth and extent of sound bedrock, borehole drilling is recommended.

Groundwater Levels

Since a borehole investigation was not completed, static groundwater level was not determined, however, water was pooled at the surface at several locations. The bedrock at this site is considered to be impermeable.

4.0 DESIGN AND CONSTRUCTION CRITERIA

The comments and recommendations presented herein are in accordance with CSA Standard S37-01, Appendix L (Site Soils Investigations) for Antennas, Towers, and Antenna Supporting Structures.

It is understood that the height of the new tower at Hopedale is yet to be determined, but will replace the 33.5 m tower installed in 1986. It is also understood that the base of the structure will consist of a reinforced concrete pad anchored to bedrock. No details on the exact location of the tower at the Hopedale site have been provided. Design loads and a preliminary foundation drawing for the tower were not provided to Stantec by DFO-CCG in the Statement of Work document dated November 2014. For the purpose of this assessment, no detailed design parameters will be provided.

Shear Strength

In accordance with the strength criteria for intact and jointed rock masses as provided by Hoek and Brown, 1980, the following empirical ultimate shear strength estimates are provided.

Intact Rock; τ **= 16 MPa**

Rock Mass; τ **= 1 MPa**

Allowable Bearing Pressure

For the tower base, a maximum allowable bearing pressure of **1,000 kPa** may be used for footings supported on a prepared intact bedrock surface as follows: where footings bear on bedrock, the areas should be free of loose bedrock fragments, soil, mud, bedrock irregularities, bedrock pinnacles and unfavorable sloping surfaces. Hand cleanup of the bedrock footing bearing areas to remove any loose materials will be required to achieve the recommended allowable bearing pressure. Settlements of footings on the suitably prepared bedrock surface as described below will be negligible.

November 25, 2014

Recommended Anchoring Procedure

- Anchor Type: Non-shrink cement or resign set anchors
- Allowable working bond stress at the rock-grout interface should not exceed 1000 kPa.
- The upper 500 mm of bedrock from the surface should be ignored in determining the anchor bond capacity.
- A maximum apex angle of 60° has been assigned for determining the cone of rock mobilized by the anchor.
- We recommend performance testing of anchors on test anchors to verify the design capacities of the materials used before the actual anchors for the towers are installed. All anchors installed for the towers should be tested to include a selection of performance and proof testing in general accordance with ASTM 2235 – Rock Bolt anchor pull test, and guidelines set forth in the Post Tensioning Institute documents to ensure the anchors have meet the project requirements.
- Anchor design should also take into consideration the loading direction where loads may not be normal to the rock surface or parallel to the anchor alignment.

November 25, 2014

5.0 CLOSING REMARKS

This report has been prepared for the sole benefit of the Canadian Coast Guard, Marine, and Civil Infrastructure – Facilities Engineering and their agents, and may not be used by any third party without the express written consent of Stantec and the client. Any use which a third party makes of this report is the responsibility of such third party.

Use of this report is subject to the Statement of General Conditions provided in the Appendix. It is the responsibility of the Department of Fisheries and Oceans, Canadian Coast Guard, who is identified as "the Client" within the Statement of General Conditions, and its agents to review the conditions and to notify Stantec Consulting Ltd. should any of these not be satisfied. The Statement of General Conditions addresses the following: use of the report; basis of the report; standard of care; interpretation of site conditions; varying or unexpected site conditions; and planning, design or construction.

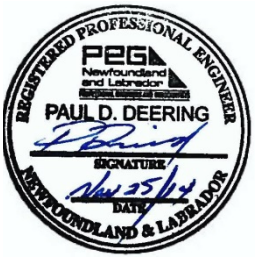
We trust this information meets your present requirements. Should any additional information be required, please do not hesitate to contact our office at your convenience.

Yours truly,

STANTEC CONSULTING LIMITED

Paul D. Deering, P.Eng., P.Geo.

Attachments: Statement of General Conditions
Site Photographs



STATEMENT OF GENERAL CONDITIONS

USE OF THIS REPORT: This report has been prepared for the sole benefit of the Client or its agent and may not be used by any third party without the express written consent of Stantec Consulting Ltd. and the Client. Any use which a third party makes of this report is the responsibility of such third party.

BASIS OF THE REPORT: The information, opinions, and/or recommendations made in this report are in accordance with Stantec Consulting Ltd.'s present understanding of the site specific project as described by the Client. The applicability of these is restricted to the site conditions encountered at the time of the investigation or study. If the proposed site specific project differs or is modified from what is described in this report or if the site conditions are altered, this report is no longer valid unless Stantec Consulting Ltd. is requested by the Client to review and revise the report to reflect the differing or modified project specifics and/or the altered site conditions.

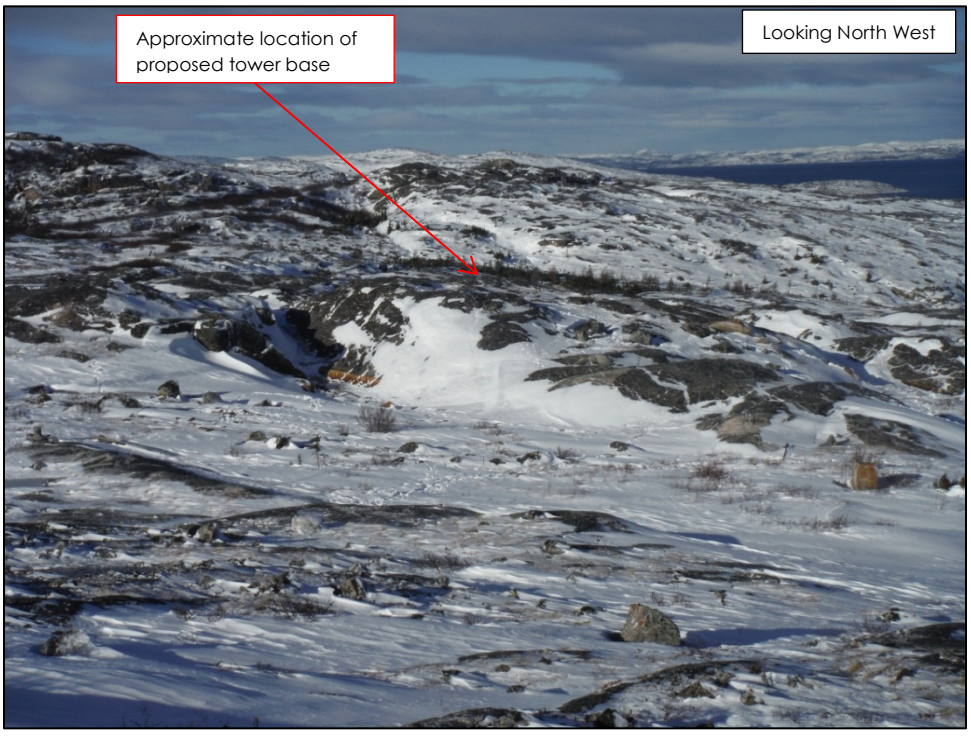
STANDARD OF CARE: Preparation of this report, and all associated work, was carried out in accordance with the normally accepted standard of care in the state or province of execution for the specific professional service provided to the Client. No other warranty is made.

INTERPRETATION OF SITE CONDITIONS: Soil, rock, or other material descriptions, and statements regarding their condition, made in this report are based on site conditions encountered by Stantec Consulting Ltd. at the time of the work and at the specific testing and/or sampling locations. Classifications and statements of condition have been made in accordance with normally accepted practices which are judgmental in nature; no specific description should be considered exact, but rather reflective of the anticipated material behavior. Extrapolation of in situ conditions can only be made to some limited extent beyond the sampling or test points. The extent depends on variability of the soil, rock and groundwater conditions as influenced by geological processes, construction activity, and site use.

VARYING OR UNEXPECTED CONDITIONS: Should any site or subsurface conditions be encountered that are different from those described in this report or encountered at the test locations, Stantec Consulting Ltd. must be notified immediately to assess if the varying or unexpected conditions are substantial and if reassessments of the report conclusions or recommendations are required. Stantec Consulting Ltd. will not be responsible to any party for damages incurred as a result of failing to notify Stantec Consulting Ltd. that differing site or sub-surface conditions are present upon becoming aware of such conditions.

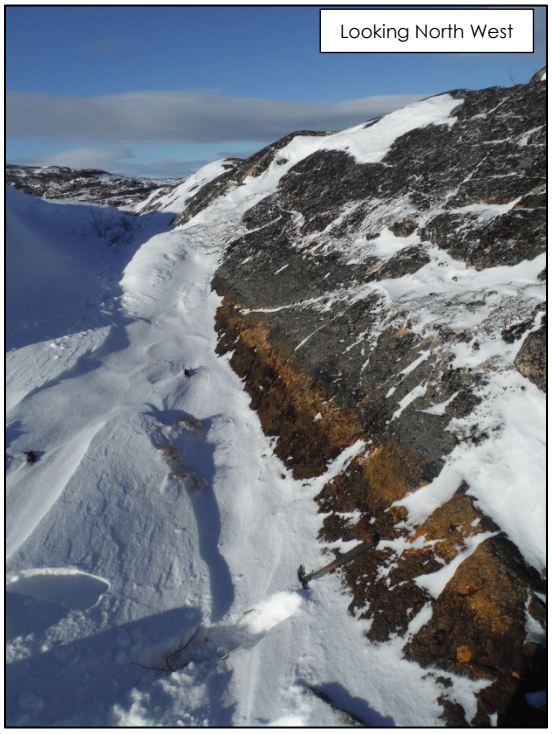
PLANNING, DESIGN, OR CONSTRUCTION: Development or design plans and specifications should be reviewed by Stantec Consulting Ltd., sufficiently ahead of initiating the next project stage (property acquisition, tender, construction, etc), to confirm that this report completely addresses the elaborated project specifics and that the contents of this report have been properly interpreted. Specialty quality assurance services (field observations and testing) during construction are a necessary part of the evaluation of sub-subsurface conditions and site preparation works. Site work relating to the recommendations included in this report should only be carried out in the presence of a qualified geotechnical engineer; Stantec Consulting Ltd. cannot be responsible for site work carried out without being present.

Photograph 1 – Aerial view of proposed tower site



Photograph 2 – View of proposed tower site

Photograph 3 – Trench trending 310°

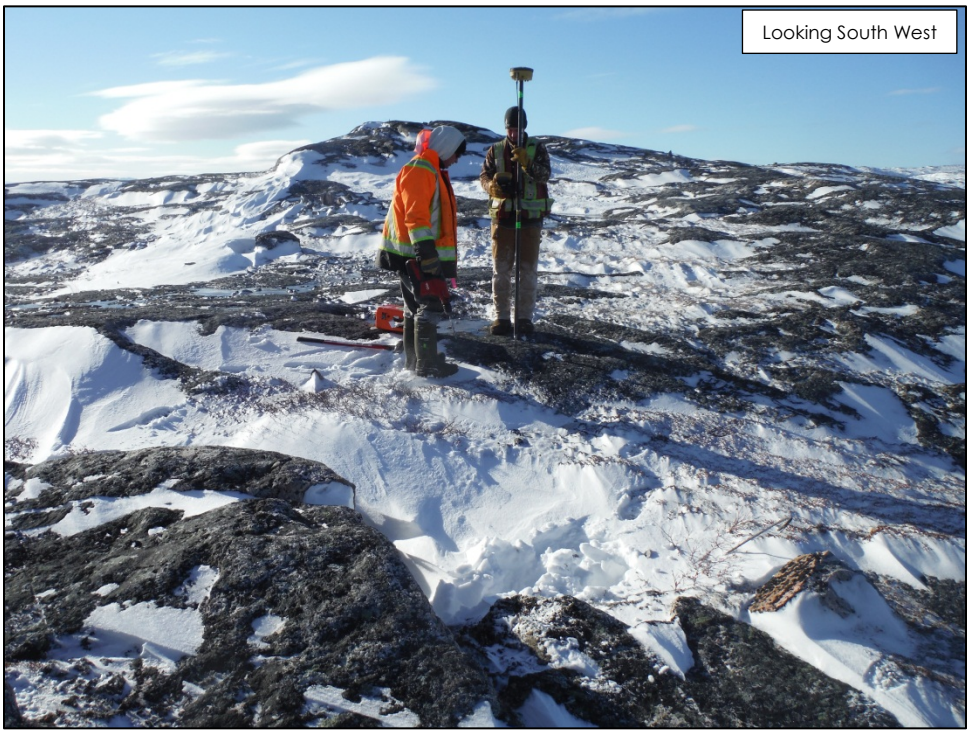


Photograph 4 – Surface weathering in trench

Photograph 5 – Trench trenching 290°.

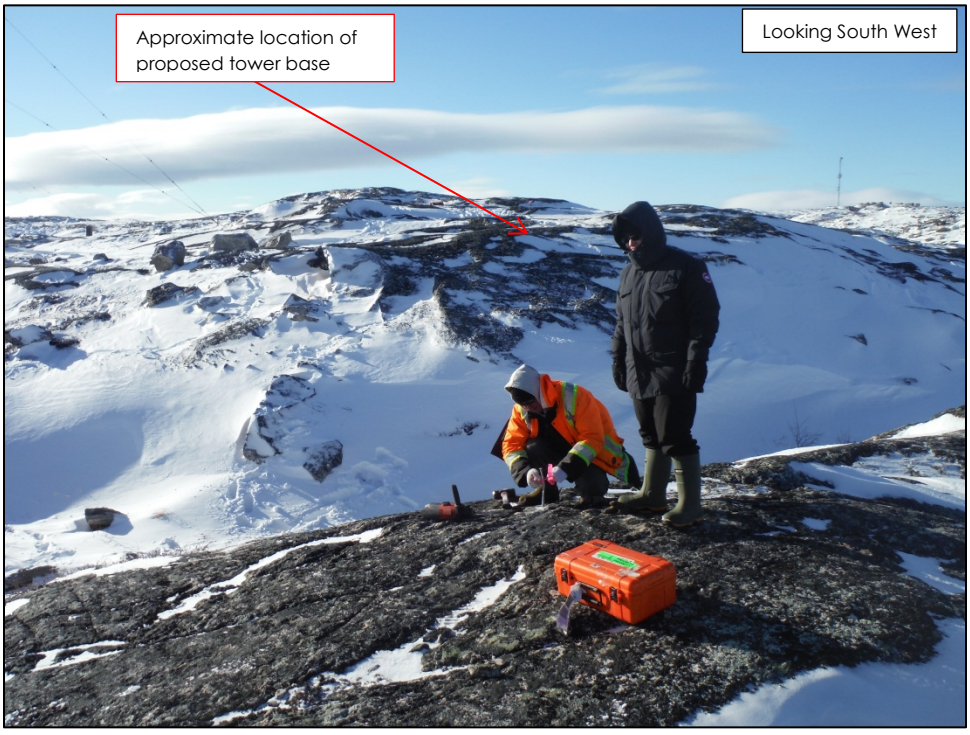
Photograph 6 – Surface weathering in trench

Photograph 7 – Proposed tower base location

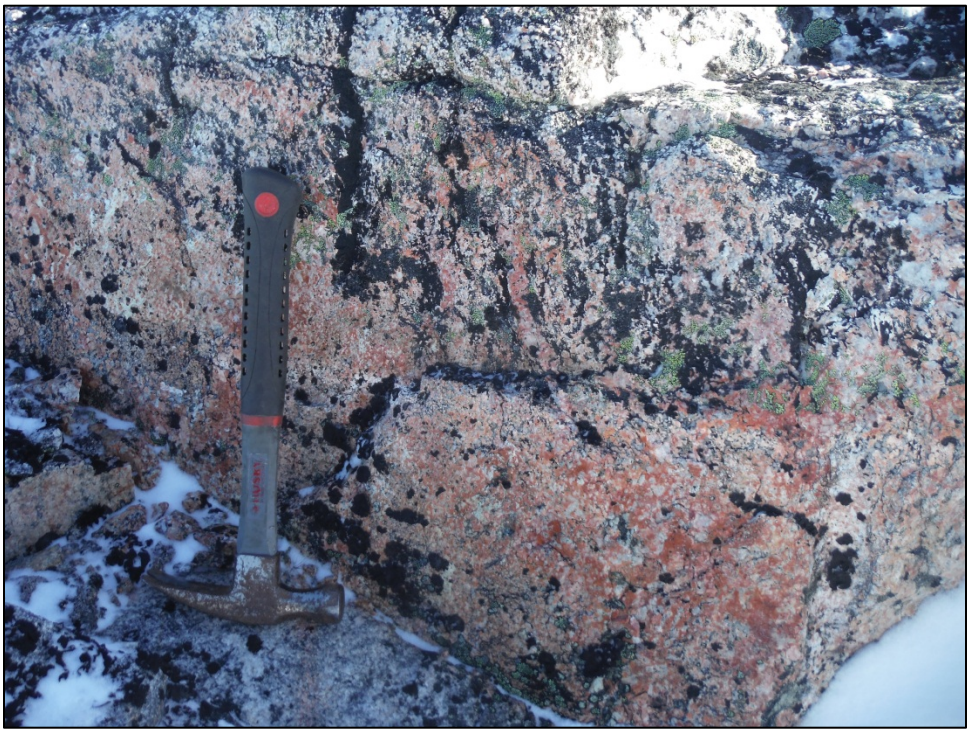


Photograph 8 – Proposed South West Anchor location

Photograph 9 – Proposed South East Anchor location. Low lying area with boulders and shrubs.



Photograph 10 – Proposed North East Anchor location



Photograph 11 – Coarse grained crystals of feldspar and quartz in granitic gneiss

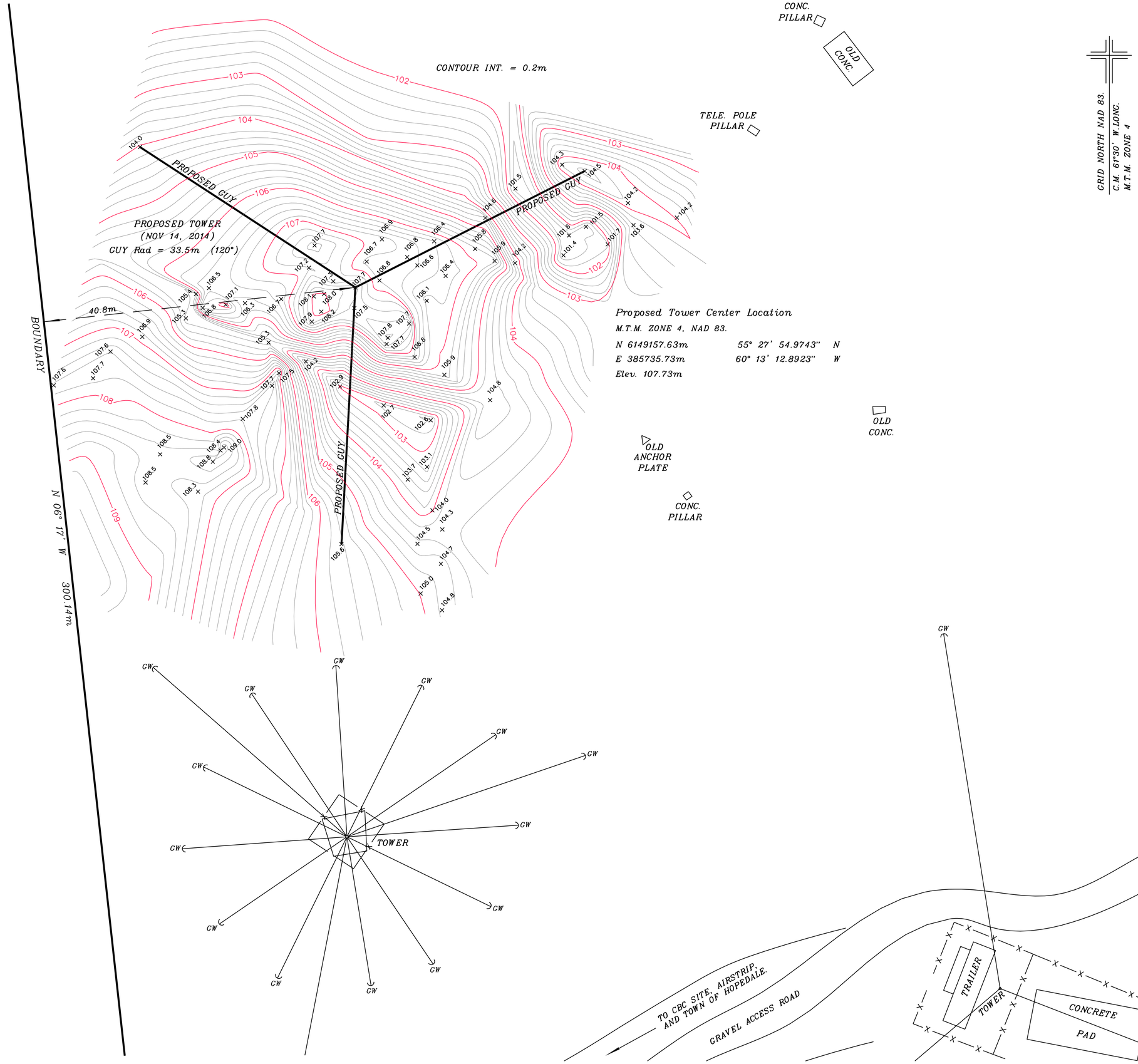
Photograph 12 – Gneiss foliations (from top left to bottom right of photo) in exposed bedrock

Photograph 13 – Exposed grounding stake for existing tower

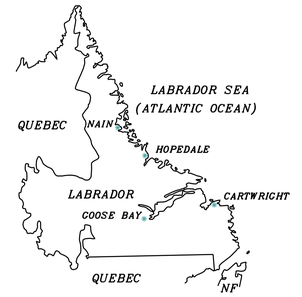
Photograph 14 – Grounding wire encapsulated in cement

Appendix E

Site Survey



Fisheries and Oceans Coast Guard | Pêches et Océans Garde côtière



KEY LOCATION PLAN

N.E. PARROTT SURVEYS LTD.
NEWFOUNDLAND LAND SURVEYORS
GOOSE BAY, NEWFOUDLAND AND LABRADOR
896-5019

NEIL E. PARROTT N.L.S., C.L.S.

LEGEND

Guy Wire —CW→
Chain Link Fence — X — X — X —

NOTE:

ALL COORDINATES AND ELEVATIONS ARE REFERENCED TO PROVINCIAL CONTROL MONUMENT BOYD...No 4109020
M.T.M. ZONE 4, NAD 83.
RTK DATA COLLECTED ON NOVEMBER 14, 2014

PLAN SHOWING TOPOGRAPHIC SURVEY FOR PROPOSED TOWER SITE HOPEDALE HILL (MF - RX) HOPEDALE, NEWFOUNDLAND AND LABRADOR

no. no	eco no. eco no	revision revision	date date	by par	approved approuve

PROPOSED TOWER - SITE SURVEY 2014

CANADIAN COAST GUARD COMMUNICATIONS SITE
HOPEDALE

date - date	drawn - dessine	checked - verifie	designed - dessine par	approved approuve
DEC. 08, 2014	G.C.			

scale - echelle	project no. - projet no.	drawing no. - no du dessin	sheet feuille
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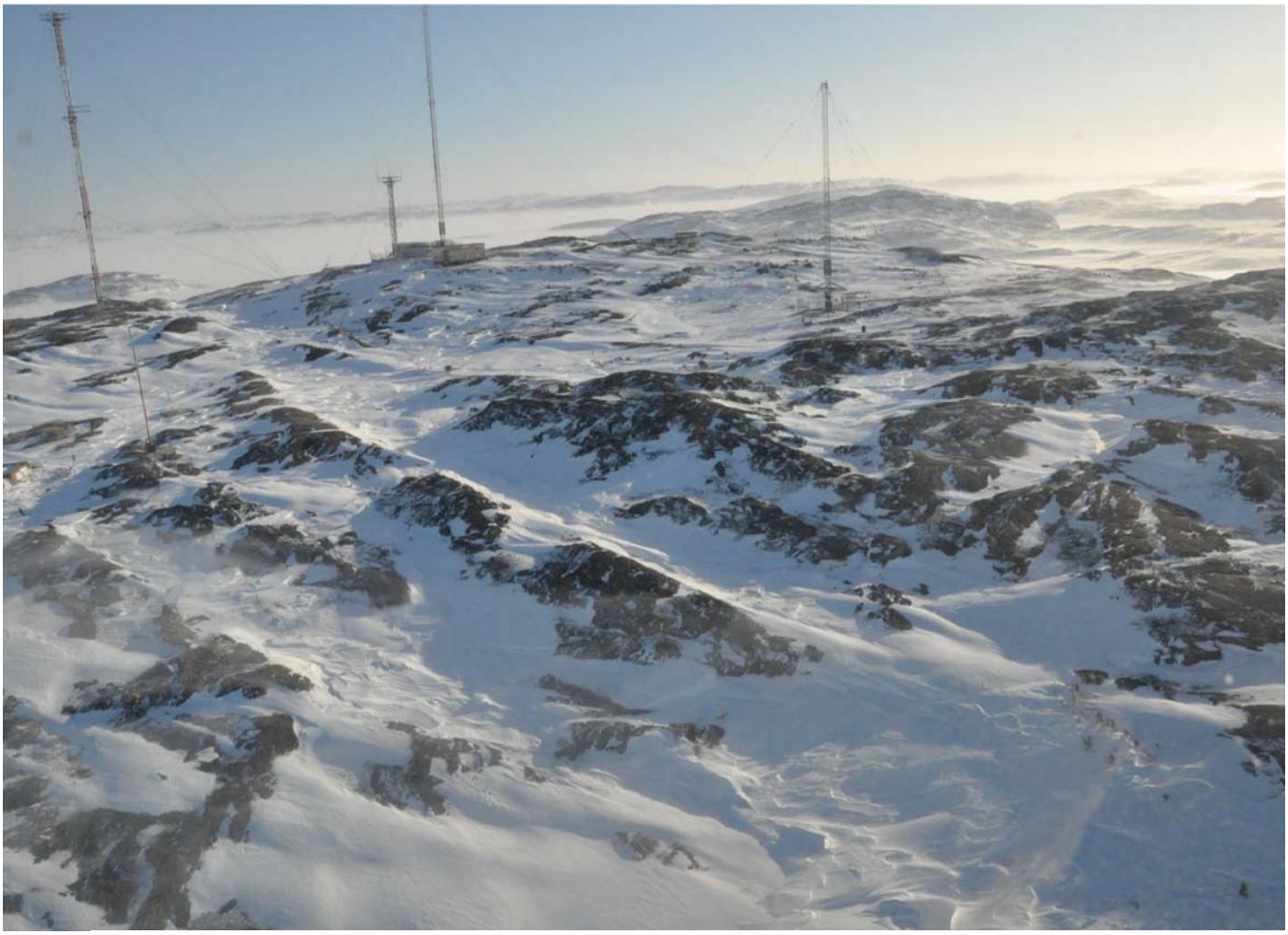
Appendix F

Site Photos




2001/01/10

Appendix G

List of CCG Supplied Materials

Canadian Coast Guard
Martime & Civil Infrastructure

LIST OF MATERIALS SUPPLIED BY CCG

Item #	Quantity	Description
1	4545 meters	#10 Soft Drawn Copper Wire
2	4545 meters	4/0 Bare Stranded Copper Wire
3	45m	#2 Insulated Stranded Copper Wire
4	105	3/4" Ø x 10' Large Copperclad Ground Rods
5	4	Copper Ground Strap (1mm x 300mm x 3500mm)
6	1	Antenna Tuning Unit (for 2-4.6 MHz tower impedance)
7	1	ATU Stainless Steel enclosure

Note: Contractor is responsible to pick up materials at the Canadian Coast Guard base in St. John's, Newfoundland, for delievery to site, and for appropriate installation.