fasteners with specified hardness classes — Coarse thread and fine pitch thread

xvi. ISO 2320:2015 – Fasteners — Prevailing torque steel nuts — Functional properties

xvii. ISO 16047:2005/AMD 1:2012 – Fasteners — Torque/clamp force testing — Amendment 1

xviii. ISO 10684:2004/COR 1:2008 – Fasteners — Hot dip galvanized coatings — Technical Corrigendum 1

xix. BS EN 10269:2013 – Steels and nickel alloys for fasteners with specified elevated and/or low temperature properties

xx. ISO 5817:2014 – Welding — Fusion-welded joints in steel, nickel, titanium and their alloys (beam welding excluded) — Quality levels for imperfections

xxi. ISO 6520-1:2007 – Welding and allied processes — Classification of geometric imperfections in metallic materials — Part 1: Fusion welding

xxii. ISO 6520-2:2013 – Welding and allied processes — Classification of geometric imperfections in metallic materials — Part 2: Welding with pressure

22.6.2. The mast structure protective treatment technology shall assure that the complete structures can withstand installation in proximity of the sea.

### 22.7 Protective paint

22.7.1. The steel structure of the mast as well as access ladder or stairs, cable ladder, floor of platforms shall be painted in accordance with the RAL colour coding schema which will be provided to the Contractor at the PDR.

22.7.2. The time between the galvanisation and the painting shall be as short as possible.

22.7.3. After cleaning of the steel galvanised structure, one coat of primary and two coats of polyurethane paint shall be applied as a minimum. A minimum thickness of 80µm shall be obtained.

22.7.4. The protective paint shall meet requirements as stipulated in following standards:

a. ISO 12944-2:2017 Paints and varnishes — Corrosion protection of steel structures by protective paint systems — Part 2: Classification of environments

b. ISO 12944-3:2017 Paints and varnishes — Corrosion protection of steel structures by protective paint systems — Part 3: Design considerations

c. ISO 12944-4:2017 Paints and varnishes — Corrosion protection of steel structures by protective paint systems — Part 4: Types of surface and surface preparation

d. ISO 12944-5:2019 Paints and varnishes — Corrosion protection of steel structures by protective paint systems — Part 5: Protective paint systems

### 22.8 Grounding and lightning protection

22.8.1. The mast structures shall be equipped with suitable lightning protection and grounding kit, which shall ensure lightning protection of installed equipment.

22.8.2. It shall consist of adequate lightning rods, surge arresters, grounding rings, connection, special anticorrosive protection for buried sections and such forth.

22.8.3. The design, production and installation of the grounding and lightning shall be compliant with requirements stipulated herein in this Annex and in site specific Appendixes.

### 22.9 Air Obstacle Lights

22.9.1. The installations of air obstacle lights shall be implemented in accordance to ICAO Annex 14, Volume 1, Chapter 6, “Visual aids for denoting obstacles”, latest edition.

22.9.2. Each light kit shall include a double toroid transformer to be connected to light power supply at the base of the related antenna.

22.9.3. The air obstacle lights shall be of following characteristics:

a. Based on LED technology

b. Equipped with alarm/remote status control device(s)

c. Equipped with galvanized steel wire protection guard

d. Low wind load factor

e. No RF-radiations

f. The level of protection against dust and water shall be minimum IP 66 according to IEC 60529:1989/AMD2:2013/COR1:2019 - Corrigendum 1 - Amendment 2 - Degrees of protection provided by enclosures (IP Code)

g. High-temperature resistant borosylicate glass

h. Body made of marine grade copper free aluminium

### 22.10 Cabling and cable support structures

22.10.1. The design, production and installation of cabling and cable support structures shall be compliant with requirements stipulated herein in this Annex and in site specific Appendixes.

## SECTION 23 FIRE PROTECTION AND FIRE FIGHTING

**23.1** The Contractor shall pay special attention to the coordination between this section and all the other sections in order to provide a coherent overall solution without contradiction.

**23.2** Administrative & design activities, equipment and installation characteristics, as well as execution of the works, including works supervision, quality assurance, quality control, testing & commissioning and health & safety measures shall be planned, organized and executed in compliance with following standards and reference documents (the list is neither exhaustive nor limitative):

23.2.1. Commission Decision of 3 May 2000 implementing Council Directive 89/106/EEC as regards the classification of the resistance to fire performance of construction products, construction works and parts thereof or THN equivalent.

23.2.2. BS EN 13501-1:2018 Fire classification of construction products and building elements. Classification using data from reaction to fire tests or THN equivalent.

23.2.3. BS EN 15725:2010 Extended application reports on the fire performance of construction products and building elements or THN equivalent.

# SECTION 24 ELECTRICAL WORKS

## 24.1 General

24.1.1. The Electrical Works shall include:

a. The integration with Low Voltage Main Power Distribution Board

b. The Electrical Distribution Panels

c. The Distribution Cables and Wiring

d. The Electrical Equipment

e. The Uninterruptible Power Supply

f. The Lightning Protection and Grounding Connection

g. The Electrical Works Legal Inspection

## 24.2 Applicable documents

24.2.1. The below list is nor exhaustive neither limitative.

24.2.2. The electrical installations and the equipment used shall comply with the documents listed below:

a. IEC 60038: IEC standard voltages or THN equivalent.

b. IEC 60364: Electrical installations of buildings or THN equivalent.

c. IEC 60309: Plugs, socket-outlets and couplers for industrial purposes or THN equivalent.

d. IEC 61009: Residual current operated circuit-breakers with integral overcurrent protection for household and similar uses or THN equivalent.

e. IEC 61537: Cable management - Cable tray systems and cable ladder systems or THN equivalent.

f. IEC 61643: Low-voltage surge protective devices or THN equivalent.

g. IEC TR 60083: Plugs and socket-outlets for domestic and similar general use standardized in member countries of IEC or THN equivalent.

h. IEC 60529: Degrees of protection provided by enclosures (IP Code) or THN equivalent.

i. Directive 2014/30/EU of The European Parliament and of The Council of 26 February 2014 – electromagnetic compatibility or THN equivalent.

j. MIL-STD 461G (or THN equivalent) – Requirements for the control of electromagnetic interference characteristics of subsystems and equipment, December 2015

k. Directive 2014/35/Eu of The European Parliament and of The Council of 26 February 2014 – ‘low voltage directive’ or THN equivalent.

l. Particular rules imposed by the electrical power supply company

### 24.3 Quality criteria

24.3.1. All equipment used shall be ambient physicochemical and fluids resistant.

24.3.2. All equipment and material delivered shall be new, of high quality, of standard manufacturing, known brand and manufacturer with good logistic support.

24.3.3. All equipment shall fulfil the THN legislation requirements for electrical equipment.

24.3.4. Hybrid and self-made equipment are not allowed.

24.3.5. Equipment, materials and accessories as well as installation techniques non explicitly described in this SOW shall be conceived by the Contractor such that they satisfy the following conditions:

a. Good operation of installation they belong to

b. Perfect integration in the environment (for instance in false ceiling)

c. Easy operation by the users

d. Long MTBF

e. Simplified operation and maintenance

f. Quick repair

g. Possibility to upgrade or modify without important re-engineering.

### 24.4 Integration with the Main Power Distribution Board (MPDB)

24.4.1. The integration shall include installation of adequate circuit breakers, and modification of existing power distribution system and the power boards/ panels as required to connect power cables for SSSB electrical installation.

### 24.5 Capacitor Bank

24.5.1. When required, a capacitor bank shall be provided and integrated with the MPDB to maintain a power factor equal to 0.95.

24.5.2. The capacitor bank shall be compliant with (the list is nor exhaustive neither limitative) IEC 60871, IEC 60831, IEC 61921, IEC 60099, IEC 60076, IEC 61869 or THN equivalent.

24.5.3. The capacitor bank shall be controlled by an electronic regulator with selector of power factors, auto-manual selector, and step indicators.

### 24.6 Site Monitoring System (SMS)

24.6.1. Site Monitoring System is a COMMS site sub system (not PFE) in order to supervise the correct operations of infrastructure and equipment. On the other hand, the major function of the system is to reveal the status of operation of a site. It shall adapt, to an already installed SMS, taking over the Alarm/States of the monitored components.

24.6.2. Site Monitoring System is distributed over all SSSB COMMS sites.

24.6.3. The system consists of an alarm panel per site allowing visualizing (via LEDs) and audible (via buzzer) alarms, managed by the SMS. Furthermore, it shall have an Alarm Acknowledge button, LED Test functionality and a Power LED.

24.6.4. The Alarm Panel shall be installed in the equipment room (SSSB COMMS room) into the front of a rack.

24.6.5. One desk mountable Alarm Panel, if requested by the THN, shall be installed at remote/local location chosen by the THN. It shall have the identical functionality as the Alarm panels, installed at the SSSB COMMS sites – but here representing Alerts/States for all SSSB COMMS sites dedicated to a SSSB Buffer Centre.

24.6.6. The SMS shall communicate all alerts/states to the SSSB Opens System Communication Control System (OSCC), which shall present the states of the different SSSB COMMS sites and COMMS devices at all OSCC components (e.g. to the SSSB Operator at the SSSB Buffer Centre).

24.6.7. The bi-directional exchange of information between the SMS and the SSSB OSCC shall be performed preferably by SNMP v.3x or by Dry-Contacts (I/O device). The Contractor is invited to recommend other techniques for the information exchange between SMS and OSCC, where a final decision shall be performed by the Purchaser.

24.6.8. All SSSB COMMS devices, including Purchaser Furnished Equipment (PFE) shall be monitored by the SMS. This shall be valid for all devices providing an alarm or status by any means (IP, Serial, Dry-Contact, or any other).

**REMARK:**

The OSCC will perform control of SSSB COMMS key equipment. For COMMS devices, where ”concurrent” access of SMS and OSCC is not possible – OSCC will take precedence to intercept alarms/states and will provide them to the SMS for further processing.

The THN shall have the final decision on the device alarms/states to be indicated at the Alarm Panels. The THN shall also have the final decision on multiple sub-alerts causing an active alarm indication at the Alarm Panel LED.

24.6.9. The Contractor shall provide an ICD to the Purchaser latest at the Critical Design Review Meeting (CDR), representing the SW interface between the SMS and the OSCC.

### 24.7 Electrical Distribution Panels

24.7.1. Equipment shall be designed for rated voltage of 500 VAC. It shall be capable of withstanding, for one second, the dynamic and thermal effects produced by the short-circuit current to be determined by the Contractor but in any case not less than:

a. 15 kA effective

b. 37.5 kA asymmetrical amplitude

24.7.2. The Contractor shall indicate on his drawings the rating and characteristics of the equipment offered.

24.7.3. All electrical equipment fitted in electrical panels or used to control power supply circuits shall be designed to withstand the stress resulting from maximum short-circuit current that might occur at the point where the equipment in question is located.

24.7.4. The equipment layout in the panels shall be clear, logical and rational, enabling all the items to be easily mounted, connected and maintained and the relationship between the various components to be easily understood.

24.7.5. The compartment within the cabinets and the boxes shall be of a size to permit rapid and safe access to the equipment housed in them. The overall size of each panel shall be such that new lead-outs can be added.

24.7.6. The degree of protection shall be at least IP 30.

24.7.7. The cabinets shall include a framework to hold the equipment, enclosed with panels of fire-proof insulating material.

24.7.8. The frame works shall be equipped with DIN rails to which equipment shall be mounted.

24.7.9. The covering panels shall have openings through which the cut-off controls can be reached while all live parts remain protected. Protection of the complete unit with cabinet door open shall be at least IP 20.

24.7.10. The front doors shall be of hinged type and have locking devices with single handle and be lockable with a key.

24.7.11. All doors shall be connected to the cabinet or box framework by two tinned copper stranded conductors.

24.7.12. Meters, switches, alarm lights/led, indicator lights/led shall be mounted on the front doors or behind an outer doors when required due to H&S regulations. Adjustable devices shall be lockable.

24.7.13. Each board/panel shall include 30% spare, non-equipped space.

24.7.14. Each board/panel shall be clearly marked on the outer side of the door by means of thermoplastic plate engraved with following information:

a. Voltage (for instance 3 x 400 V + N – 50 Hz)

b. Destination (for instance EPDB – No-Break)

c. Type of distribution (for instance TN-S)

24.7.15. Each board shall be equipped with internal lighting.

**24.8 Distribution Boards/Panels Equipment**

**24.8.1. Switches**

a. Switches shall conform to IEC 60669, IEC 60947, IEC 62626 or THN equivalent.

b. Each pole shall provide a double break, with breaking and making speed independent of the operator.

c. The switches shall be of rotary, bar or knife type.

d. If switches have associated fuses, the switch-fuse assembly shall be fitted in the same compartment box.

e. Each switch shall be operated by means of rugged handle at the front which, by its position and markings, clearly shows whether the switch is open or closed.

f. If the control handles are located on the doors, they shall be equipped with a coupling system enabling the doors to be opened without handles being dismantled. In no circumstances shall this system permit the position of the handle to be inverted in relation to the position of the switch it controls.

**24.8.2. Circuit-breakers**

a. The circuit-breakers shall conform to IEC 60947, IEC 60898, EN 61008, EN 61009 or THN equivalent.

b. The circuit-breakers shall have a breaking capacity at least equivalent to the short-circuit current assumed possible where they are located.

c. When circuit-breakers do not have the required breaking capacity, they must be linked with high breaking-capacity fuses.

d. The breaking capacity of the circuit-breakers shall not be lower than 10 kA with a 400 V power supply.

e. The circuit-breakers shall be of the air, dry-breaking type with a manual reset system. In the event that the assumed established current is over 15 kA, control must be effected by energy storage devices operated by hand or by electric motors.

f. The control device shall always be situated on the front of the circuit-breaker.

g. Each pole shall be equipped with an adjustable thermo-magnetic release.

**24.8.3. Small Automatic Switches**

a. Single pole automatic switches will be accepted. The Contractor shall determine the type and rated current of the equipment on the basis of the circuits to be protected. They shall be of the fixed type. Manually controlled and fitted with a thermos-magnetic trip device.

b. In the case of equipment not protected by upstream fuses, the effective breaking capacity shall be at least 15 kA. The electrodynamics resistance and closing capacity shall be at least 37.5 kA asymmetrical amplitude.

### 24.8.4. Earth Leakage Circuit Breaker

a. Earth Leakage Circuit Breakers shall be provided as required by the IEC 60364.

### 24.8.5. Tele breakers

a. Tele breakers are accepted. These devices shall have solid silver contacts or a mercury-contact relay system.

b. The connecting screws shall be made of nickel-plated brass, with oscillating clams, for connecting conductors with a cross-section of up to 2.5 mm².

c. They shall be fitted with a built-in or separate indicator or light showing the position of the contacts and with an operating lever or push-button.

d. The rated voltage shall be at least 250 V and the rated current 10 A.

e. The heating, in continuous operation, shall not exceed 80°C.

### 24.8.6. Fuses

a. The fuses shall be of the blade cartridge type with handle, have a high breaking capacity and have enclosed quick-melting system. In motor supply circuits, fuses of time-lag type shall be installed if motor starting current makes it necessary.

b. The fuses shall conform to IEC 60269-2, (or THN equivalent standard) Low-voltage fuses – fuses mainly for industrial application.

c. As far as possible thermomagnetic circuit-breakers shall be used and fuse cut-outs only be accepted for capacities of 2 amps or less or in any cases where the best thermomagnetic circuit-breaker on the market have less breaking capacity than the estimated short-circuit current at the point where they are installed.

d. When fuse cut-outs are used they shall always be mounted on a fuse-holder disconnector.

e. The disconnectors shall be of the load-break type.

### 24.8.7. Contactors

a. The contactors shall conform to IEC 60947-4-2, IEC 60947-4-1, and IEC 61095 or THN equivalent.

b. The contactors shall have a double-break system on each pole. Motor – controlling contactors shall be linked to adjustable thermal relays in the absence of a circuit-breaker.

c. The relays shall be adjusted such that the extremes temperature permissible for which the motors are protected cannot be exceeded, i.e. maximum 1.5 x in for less than two minutes.

d. The associated relays shall act on all phases.

e. Upstream protection by means of fuses or circuit-breakers shall be suitably rated and shall have a breaking capacity at least equivalent to the short-circuit current which might occur where they are located. This protection shall be grouped in the same compartment as the corresponding contactor.

f. Each contactor shall be equipped with at least two auxiliary “NO” contacts and two auxiliary reverse contacts.

g. The thermal relays shall also have auxiliary contacts, either one “NO” plus one “NC”, or a reverser.

**24.8.8. Instrument transformer**

a. When required, the Contractor shall provide and install the instrument transformer that shall be of a dry type, insulated with Araldite.

**24.8.9. Equipment Power Distribution Board (EPDB)**

a. One EPDB shall be provided in the SSSB Equipment room. It shall be of steel sheet construction and shall incorporate easy access to all components for maintenance.

b. The EPDB shall be divided in two sections:

   i. One No-Break section supplied from the UPS

   ii. One Short-Break section supplied from the MPDB

c. The compartment within the cabinet shall be of a size to permit rapid and safe access to the equipment housed in them. The overall size of each panel shall be such that new lead-outs can be added.

d. The degree of protection shall be at least IP 30.

e. The two front doors shall be of hinged type and have locking devices with single handle and be lockable with a key.

f. The two doors shall be connected to the cabinet or box framework by two tinned copper stranded conductors.

g. The No-Break section and the Short-Break section shall each be equipped with:

   i. One four-pole bus bar

   ii. One four-pole input circuit-breaker with thermomagnetic protection. However, if there are any upstream panels with overcurrent protection devices, the EPDB shall have instead input switches (contactors) as this is not a good engineering practice to have two overcurrent protection devices directly in series.

   iii. One voltmeter with selector switch (phase-phase and phase-neutral)

   iv. Three ammeters

   v. A copper grounding bus bar

vi. Output power feeders;

h. Meters, switches, alarm lights/led, indicator lights/led shall be mounted on the front doors or behind an outer doors when required due to H&S regulations.

i. An Emergency OFF push button shall be mounted on the panel. It shall be protected to prevent inadvertent operation.

j. The No-Break section shall provide power supply distribution to all SSSB equipment that cannot suffer any power supply interruption.

k. The Short-Break section shall provide power supply to all SSSB equipment that can accept short power interruption and to all auxiliary and utility loads.

l. Note: The power interruption is dictated by the time required for the change over from mains to stand-by power supply.

### 24.9 Cables and wiring

24.9.1. The following cables and wiring are required:

a. The LV cables to connect the Mains Power Distribution Board to the Equipment Power Distribution Board and Power Panels;

b. The LV cable to the UPS power input;

c. The LV cable from the UPS to the Equipment Power Distribution Board

d. All wiring for distribution of power from the Equipment Power Distribution Boards and Panels to electronic equipment

e. All required power cables from the buildings to various antenna locations

f. All required remote control and signaling cables

g. All other cabling and wiring required for proper and intended functioning of all equipment provided under this statement of work

h. All earthing cables

24.9.2. Technical requirements.

a. All cables and wires shall be rated for current carrying capacity in accordance with the applicable industry standards.

b. Free movement of cables shall be assured when equipment is pulled out for maintenance/repair.

c. Wires and cables shall be placed and protected as to prevent contact with rough irregular surfaces and sharp edges. Cables connecting to components mounted onto doors or panels shall be protected so that no possibility of damage arises during opening and closing of doors or panels.

d. Cable harnesses shall be routed away from heat generating equipment and no wire or cable connection shall be in tension.

e. For the dimensioning of the bending radius of cables the regulations of DIN VDE 0298, part 3 or equivalent shall be followed.

f. All soldered connections shall be clean and smooth in appearance and shall provide excellent electrical conductivity. The insulation of soldered wires shall not show damage from the heat of the soldering operation.

g. All electrical cables shall conform to IEC 60228, IEC 60287-3-2 (Economic optimization of power cable size) or THN equivalent.

### 24.9.3. Redundant cables

a. Redundant cables shall be removed or stop-ended and clearly marked:

b. The term “STOP END” means the provision of a permanent seal in which all cores are insulated and protected so that the cable can be energized safely.

c. Removed cables shall be disposed of in accordance with THN local standards and regulations in force.

### 24.9.4. Jointing and terminating of cables

a. All joint and termination equipment shall be used to the Manufacturer’s recommendations.

b. The Contractor shall provide evidence that the joint or termination Manufacturer has stated that the materials to be employed are suitable for the type of cable to be jointed or terminated.

c. A cable shall not be cut until the jointing or terminating commences and the work shall proceed continuously until it is completed. All necessary precautions shall be taken to prevent damage and ingress of moisture and impurities. Cable ends shall be free from moisture before jointing commences. Where circumstances prevent completion the cable ends shall be sealed.

d. Core identification shall be matched at each joint without twisting or crossing of the cores. Where numbered cores are jointed to coloured cores, the system adopted shall be consistent throughout all cable runs and, on sites with existing installations, consistent with the system already in use. The location of the joint shall be recorded and included in the handover documentation.

e. Joints selected for use with armoured cables shall not reduce the fault current withstand capacity nor increase the impedance of the circuit protective conductor.

f. Armouring and metal sheaths shall be connected by a bonding conductor directly to the external earthing terminal of the equipment at all terminations. Metal sheaths of single core cables shall be bonded and earthed at one point only, unless indicated otherwise, and insulated glands shall be used at the open-circuit end or ends.

g. Cable tails at terminations shall be formed by separating and bringing out the cores. Each tail shall be long enough to connect to the terminals of the equipment.

h. For three phase circuits the phase conductors shall be arranged, where practical, in trefoil formation where they pass through enclosures of equipment.

i. For HV and LV terminations coloured or numbered discs shall be provided on the outside of sealing boxes to indicate the disposition of the phases and neutral conductors inside. Insulating tape shall not be used for marking cables inside joints or terminations.

j. Continuity of spare cores shall be maintained at joints, and at terminations the cores shall be connected to earth at the supply end and in a spare terminal at the load end.

k. For screened cable, continuity of screening shall be maintained across the joint.

l. Armour Termination shall be by means of mechanical cable glands. For armoured cables the glands shall have an earth bond attachment.

### 24.9.5. Marking and notices

a. A marking system, including all information fields of the labels, shall be presented to the Purchaser for acceptance.

b. Identification labels shall be fixed to the outside of equipment enclosures. Label format and materials shall be appropriate to the installation and shall be fixed by non-corrosive materials appropriate to the intended application and location.

c. Characters for labels fixed on the means of isolation at the origin of each installation shall be at least 10mm high and 1.5mm thick. On all other labels characters shall be at least 4mm high and 0.5mm thick.

d. Where there are two or more incoming supplies this shall be clearly indicated at each point of isolation. Labels on single-phase equipment supplied from a three-phase supply shall indicate the phase to which it is connected.

e. A label indicating the system concerned shall identify all joint boxes.

f. A diagram showing the allocation of terminals for each incoming cable shall be permanently fixed inside each joint box cover. The diagram shall be afforded protection suitable for the environment in which it is located.

### 24.9.6. Marking of cables

a. Marker slabs, with cast iron marker plates secured to a concrete base, shall permanently identify the location of buried cables. The wording on the markers shall be “HV CABLE” or “LV CABLE” as appropriate; in addition the word “JOINT” shall be added where appropriate.

Alternatively, marker posts shall only be used where they do not cause obstruction or danger.

b. Cable marker slabs shall be installed, as required, flush with the finished ground level, on the precise line of the cable.

c. Cable markers shall be located at every point where a cable enters a building, sub-station, plinth or distribution pillar, at each joint, change of direction, road and pathway crossing, and along the route of the cable at intervals not exceeding 45m.

d. Trunking and ducting shall be permanently and conspicuously identified.

e. Cables shall be permanently and conspicuously identified.

f. Cable identification shall be located within 500mm of terminations and joints, at least once within each separate compartment through which the cables pass, at intervals not exceeding 24m, and shall coincide with the colour bands, where used. Consideration shall also be given to identifying cables at entry or exit points and where buried cables emerge from the ground.

g. Every cable end shall be provided with a means of identification showing the designation, number and cross-sectional area of cores and rated voltage of the cable.

h. All cables, conductors and wires shall be easily, clearly, permanently identified, and each cable, conductor or wire used for interconnection in any power board and equipment or outside connection between any power equipment and power boards, shall be labelled at both ends with the same number or letter. Permanent cable tags, labels, marking clips, heat shrinkable sleeves, etc. shall be used for that purpose. The identification number or letter shall be given on the installation drawings.

i. The colour identification of cores shall comply with EN 60445:2017 Basic and safety principles for man-machine interface, marking and identification. Identification of equipment terminals, conductor terminations and conductors or THN equivalent.

j. For live conductors the identification shall extend throughout the length of the cables.

k. Cables forming part of alarm, control, communication or monitoring circuits shall have identification sleeves at their terminations with specific circuit identification. Identification shall be consistent with the relevant wiring diagrams.

### 24.9.7. Cable separation

a. Metallic information technology cabling and mains power cabling shall be separated as specified in EN 50174-2:2018 - Information technology. Cabling installation. Installation planning and practices inside buildings or THN equivalent.

b. However, whenever there is RED and BLACK equipment installed, separation requirements for cabling and the actual equipment shall meet requirements stipulated in SECAN Doctrine and Information Publication (SDIP) - Selection and Installation of Equipment for the Processing of Classified Information: SDIP-29/2.

c. 30% of additional space shall be allowed along cable routes for future additions and cable supports shall be of adequate size for the ultimate load.

d. Adequate space shall be left between cable runs and the building fabric and other services to allow for the future removal or installation of cables.

**24.9.8. External cabling**

a. All electrical connection between buildings, antenna locations shall be made with underground cables which run in ducts/trenches to facilitate cable replacement. Each cable shall be run in one piece without splices or junctions.

b. The cables shall be provided as armoured (a steel or aluminium armour in the form of tape(s), wires or braids) and compliant with IEC 60502, EN 50267, EN 60332-1-2 (for single core cables) or THN equivalent.

c. The cables shall be covered by sheaths and insulation protecting against local climatic condition and assuring sufficient UV resistance in accordance with EN 50289-4-17:2015 or THN equivalent.

d. The size and insulation shall be in accordance with national and local standards/regulations, taking into account the maximum load and ambient temperature.

**24.9.9. Laying cable in trenches:**

a. The cables runs must be protected against damages by earth settlement, contact with hard objects and the impact of hand tools in the event of excavation work and also against chemical action due to soil ingredients.

b. In ground subject to long or frequent flooding, when the cable lies in ground water for two months per year or when the trench acts as a drain, the cables shall be considered as permanently immersed and shall be laterally (water shall not penetrate into the cores of the cable) and longitudinally (with a barrier that shall prevent the spread of moisture along the cable length) watertight.

c. The cables must be buried at a minimum depth of:

   i. 0.6 m for low voltage cables, signal cables and telephone cables;

   ii. 0.8 m for high voltage cables

d. 1 m below ground accessible to vehicles.

e. The trenches shall be as narrow as possible: ± 50 cm for one cable.

f. The depth of the trench shall be 10 cm more than the depth at which the cables are to be buried. The bottom of the trench must be free of any rough objects that may damage the external sheath of the cables.

g. The cables shall be laid on a 10 cm layer of sand or fine earth. They shall then be covered with another 10 cm layer of sand or fine earth. A marker shall be placed 20 cm above the upper part of the cables. The trench shall then be filled in with a layer of maximum thickness 15 cm, carefully tamped to give the sub-soil the same consistency as it had before the trench was dug.

h. In principle the radius of the curve shall be 20 times the diameter of the cable with the biggest external diameter.

i. Cables installed on the surface shall be parallel with the lines of the building construction and properly aligned.

j. Cables buried below ground shall, as far as practicable follow the features of the site such as roadways and building lines. Ducts at road and crossings shall normally be at right angles to the line of the road.

### 24.9.10. Internal cabling

a. All cables between the MPDB and Power Boards or Power Panels shall be shielded. Electrical continuity of cable shielding shall be provided to assure correct grounding. All cabling shall run in cable ducts or on cable racks/trails.

b. All cables shall have non-toxic, non-flammable coating.

c. All cables shall be halogen-free, low smoke, thermoplastic insulated and sheathed cables in compliance with IEC 62821 or THN equivalent.

### 24.9.11. Signaling and data cables

a. Following standards apply (the below list is not exhaustive neither limitative):

i. ISO/IEC 11801 – Information technology - Generic cabling for customer premises

ii. ISO/IEC TR 14763-2-1:2011 Information technology - Implementation and operation of customer premises cabling - Part 2-1: Planning and installation - Identifiers within administration systems

iii. EN 50174-1:2018+A1:2020 Information technology. Cabling installation. Installation specification and quality assurance or THN equivalent.

iv. EN 50174-2:2018 - Information technology. Cabling installation. Installation planning and practices inside buildings or THN equivalent.

v. EN 50174-3:2013+A1:2017 Information technology. Cabling installation. Installation planning and practices outside buildings or THN equivalent.

vi. EN 50346:2002+A2:2009 Information technology. Cabling installation. Testing of installed cabling or THN equivalent.

vii. EN 50173 series - Information technology. Generic cabling systems

viii. EN 50310:2016+A1:2020 Telecommunications bonding networks for buildings and other structures or THN equivalent.

ix. IEC 61754 series - Fibre optic interconnecting devices and passive components - Fibre optic connector interfaces or THN equivalent.

x. IEC 61935-1:2019 Specification for the testing of balanced and coaxial information technology cabling - Part 1: Installed balanced cabling as specified in ISO/IEC 11801-1 and related standards or THN equivalent.

xi. ISO/IEC 14763-3:2014+AMD1:2018 CSV - Information technology - Implementation and operation of customer premises cabling - Part 3: Testing of optical fibre cabling or THN equivalent.

b. All conductors not in used in a cable shall be grounded at both ends.

### 24.9.12. List of cables

a. The list of cables shall include:

i. Cable number

ii. Cable standardised cross-section

iii. Cable diameter

iv. Operating voltage

v. Insulating voltage of the cable guaranteed by the manufacturer

vi. Length laid in meters

vii. Type of cable (according to Standards)

viii. Colour of external covering

ix. Wiring diagram

x. Cable course from the beginning to the end of the cable

### 24.9.13. Cable supports

a. Cable support management shall be compliant to EN 61537:2007 Cable management. Cable tray systems and cable ladder systems or THN equivalent.

b. The type and sizes of cable support systems shall be selected by the Contractor to suit the circumstances of the installation, unless otherwise indicated. Following preferences shall be taken into account:

i. For horizontal runs - cable tray or cable rack

ii. For vertical runs - cable cleats or cable tray or cable rack

iii. Where marshalling of cables occurs (eg. at switchboards) - cable racks.

### 24.9.14. Protective finishes for ferrous materials

a. All ferrous metal for cable tray, cable racks, cable ladder, cable hangers and their fixings and suspensions shall have a galvanised finish.

b. Galvanised finishes shall be hot dipped to EN ISO 1461 or THN equivalent, except that support steelwork in dry indoor unpolluted areas shall be galvanised to EN 10346 or THN equivalent.

c. In coastal and polluted areas where ferrous materials are used, consideration shall be given to the use of stainless steel or silicon steel with l2OO g/m2 coating ISO 1461.

### 24.9.15. Cable trays

a. Cable of different categories (HV cable, LV cables, Signalling cable etc.) shall be laid in different cable trays.

b. The cable trays shall be made of hot-galvanised (450 gr/m²) mild steel with minimum zinc thickness of 30 µ. The cable trays may take various forms as follows:

i. Type A: A unit consisting of angle-iron uprights and bars in bent sheet metal forming a closed U. This type shall mainly be reserved for cables with a large cross-section.

ii. Type B: In perforated sheet metal. This type shall mainly be used for cables with small cross section such as remote signaling, remote control and telephone cables, etc.

iii. Type C: In wide-gauge metal mesh (± 5 x 5 cm). This type is suitable for all kinds of cable.

c. When made from metal plate they shall comply with EN 10130:2006, EN 10131:2006 or EN 10149-3:2013 as appropriate or THN equivalent.

d. The cable tray units shall be self-supporting, their strength and the spacing of the bearing elements shall be such that the maximum sag in the horizontal run shall be 1/220 of the span.

e. Bends, tees, risers, reducers and four-way crosspieces shall be factory made wherever possible, and shall be of the same construction, material, thickness and finish as the cable tray. All tees and crosspieces shall have a 45°gusset on each side from the point of intersection.

f. Cable trays shall be cut along a line of unperforated material. Holes cut in cable trays for the passage of cables shall be fitted with grommets, bushes or other lining. Cutting of cable trays shall be kept to a minimum.

g. Each length of a cable tray shall be securely bolted to an adjacent length with factory made couplings of adequate dimensions to prevent sagging or twisting in accordance with the Manufacturer’s recommendations.

Where required, bolts and nuts shall be appropriately dimensioned mushroom-head steel roofing type. Ends of coupling bolts shall not come into contact with the cables. No welding shall be used in the joining of cable trays.

h. Where cables are laid on the cable tray they shall be secured by ties, each tie securing the cables of only one circuit. The ties shall be of a proprietary type low in halogen, self-extinguishing and ultra-violet resistant. The use of wire or similar material is not permitted. Ties shall be used at less than 600mm intervals along each cable, and within 100mm of each bend or set.

i. Cables shall be supported by cable cleats where cable trays are vertical.

j. Cable trays shall be fixed at regular intervals in accordance with Manufacturer's recommendations but not exceeding 1200mm and at 225mm from bends and intersections. A minimum clear space of 25mm shall be left behind all cable trays.

k. Cable trays shall be installed with a 20mm gap at building or structural expansion joints.

l. Cable tray supports shall be installed within 150mm on either side of the joint.

### 24.9.16. Cable cleats

a. Cable cleats shall be made from materials that are resistant to corrosion without the need for treatment or special finish. Plastic materials shall be non-brittle down to minimum - 20°C. Non-metallic cleats used for low smoke fume (LSF) cables shall be of LSF material.

b. Cable cleats shall be of a size such that they can be tightened down to grip the cables without exerting undue pressure or strain on them. For vertical cables two-bolt cable cleats shall be used which shall grip the cables firmly enough to prevent them slipping.

c. The cable cleats shall comply with IEC 61914:2015 Cable cleats for electrical installations or THN equivalent.

d. The spacing of cable cleats shall:

   i. Assure the ability of the cleat to withstand axial slippage forces

   ii. Assure resistance to electro-mechanical forces – i.e. the ability of the cleat to withstand the forces between the cables in the event of a short-circuit

   iii. Assure the cleats shall be located immediately on each side of bends in the cable.

e. Single core cables shall be cleated with trefoil cleats where appropriate.

### 24.9.17. Cable racks and cable ladders

a. Cable racks shall comply with relevant standards referenced herein in this Annex and shall be constructed from proprietary systems using channel sections with return lips and compatible fixing accessories.

b. Ladder rack shall be factory made from steel complying with relevant standards referenced herein in this Annex.

c. Racks and supports shall be selected to provide adequate support without racks sagging more than 1/360 of the support span.

d. Cable racks and ladders shall be installed with a 20mm gap at building or structural expansion joints. Supports shall be installed within 150mm on either side of the joint.

e. Cables shall be fixed to racks and ladders by cable cleats.

### 24.9.18. Suspension and fixing

a. Proprietary suspension systems comprising channel sections with return lips and compatible fixing accessories or slotted angles complying with BS 6946 shall be used. Fixings may be fabricated from mild steel flat bar where necessary. Metal arc welding shall comply with EN 1011 or THN equivalent.

b. Suspensions and fixings shall comply with respective paragraphs stipulated herein in this Annex.

c. Bolts, nuts, washers and screws shall be non-corrosive and compatible with the environment in which they are installed.

### 24.9.19. Bonding

a. Metallic cable trays, racks and ladders shall be electrically and mechanically continuous throughout and bonded to the earth system.

b. Supplementary bonding shall be installed wherever necessary, between component parts of cable trays, racks or ladders where the method of mechanical connection does not provide permanent and reliable metal-to-metal joints of negligible impedance.

c. After the cables are laid all the openings pierced through obstacles/walls shall be properly sealed, so that they remain watertight and dust proof and have the same fire resistance as the walls. After assembly, damage to galvanisation shall be made good by the application of a zinc-rich paint or by a cold galvanisation substance.

d. The bearing elements shall be made of galvanised steel (450 gr/m²) at least 30 µ thick. All precautions shall be taken to obviate corrosion resulting from the Fe-Zn galvanic couple.

e. One the side of the cable tray shall be left with free access along its entire length so that operations (laying or removing of cables) are not hampered by the bearing elements.

f. Bearing elements shall be fixed to partitions, walls, ceiling or the framework of the building. In no circumstances bearing elements may be fixed to parts liable to be subsequently removed.

g. For the purpose of assembling the units and making cross-points, accessories produced by the manufacturer shall be used as far as possible.

## 24.10 Electrical equipment

### 24.10.1. Standard power sockets

a. Standard power sockets shall conform to Directive 2001/95/EC of the European Parliament and of the Council of 3 December 2001 on general product safety or THN equivalent.

b. There is no harmonised household plug system throughout Europe. Therefore, the standard power sockets shall fall under national legislation.

c. They shall be designed for a rated current of 16A.

d. The sockets shall be compliant with:

i. IEC 60884-1:2002+AMD1:2006+AMD2:2013 CSV Plugs and socket-outlets for household and similar purposes - Part1: General requirements or THN equivalent.

ii. IEC 60906-1:2009 IEC system of plugs and socket-outlets for household and similar purposes - Part 1: Plugs and socket-outlets 16 A 250 V ac. or THN equivalent.

### 24.10.2. Industrial type sockets

a. These sockets shall conform to:

i. IEC 60309-1:1999+AMD1:2005+AMD2:2012 CSV Plugs, socket-outlets and couplers for industrial purposes - Part 1: General requirements or THN equivalent.

ii. IEC 60309-4:2006+AMD1:2012 CSV Plugs, socket-outlets and couplers for industrial purposes - Part 4: Switched socket-outlets and connectors with or without interlock or THN equivalent.

b. They shall be used amongst other for outdoor sockets.

c. These sockets shall be provided with protective caps when not in used. The caps shall be solidly fixed to the sockets. Their degree of protection shall be IP 65.

### 24.10.3. Emergency stop push-button

a. The Emergency stop push-buttons shall be provide on each equipment and machinery provided under this contract unless:

i. The emergency stop device would not lessen the risk, either because it would not reduce the stopping time or because it would not enable the special measures required to deal with the risk to be taken

ii. The equipment/ machinery is portable hand-held and/or hand-guided

b. The Emergency stop push-button shall meet the following requirements:

i. Tamper Resistant - an emergency stop actuator shall be constructed so that it can only be removed from the inside of a panel. Removal from the outside of the panel is acceptable if it requires a tool.

ii. Shall not be a replacement for proper safeguarding or automatic safety devices.

iii. The activation of the emergency stop shall not impair the effectiveness of other safety devices.

iv. A mushroom type push button, red colour.

v. It shall be protected to prevent inadvertent operation.

vi. Its activation shall be possible without opening any panels, flaps, doors or any other type of covers with easy access and no obstructions.

c. It shall be in conformity with the requirements of the following directives and standards. The below list is neither exhaustive nor limitative:

i. Directive 2006/42/EC of the European Parliament and of the Council of 17 May 2006 on machinery or THN equivalent.

ii. ISO 13850:2015 Safety of machinery. Emergency stop function — Principles for design or THN equivalent.

iii. IEC 60204-1:2016 Safety of machinery – Electrical equipment of machines or THN equivalent.

iv. IEC 60947-5-5:1997+AMD1:2005+AMD2:2016 CSV - Low-voltage switchgear and control gear - Control circuit devices and switching elements - Electrical emergency stop device with mechanical latching function or THN equivalent.

v. IEC 60947-5-1:2016 Low-voltage switchgear and control gear - Control circuit devices and switching elements - Electromechanical control circuit devices or THN equivalent.

vi. Local codes and installation requirements

### 24.10.4. Legal inspections for electrical works

a. The Contractor shall request an independent company duly accredited in the Territorial Host Nation to execute all inspections legally required in this Territorial Host Nation.

b. Those inspections shall be identified in the schedule of supply and services.

c. No electrical work shall be accepted as long as the Purchaser is not in possession of the inspection report stating the compliance of the installation.

### 24.11 UPS

24.11.1. The Contractor shall provide UPS system in order to protect sensitive units from having logical and physical damages in the case of the Prime Power failures. Additionally, the UPS shall have 30% of spare capacity.

24.11.2. The UPS system shall provide protection against data loss and system damage due to power failures, voltage dips, voltage spikes, under voltage, overvoltage, switching spikes, interference voltages, frequency changes and harmonic distortion.

24.11.3. Although a main central UPS unit is preferred, the Contractor may choose, when justified by best engineering practice and improving efficiency of the system, to also provide local UPS equipment where UPS power is required away from the Equipment room/ Control Console room.

24.11.4. The UPS system shall be compliant with:

a. IEC 62040-1:2017/COR1:2019 Corrigendum 1 - Uninterruptible power systems (UPS) - Part 1: Safety requirements or THN equivalent.

b. IEC 62040-2:2016 Uninterruptible power systems (UPS) - Part 2: Electromagnetic compatibility (EMC) requirements or THN equivalent.

c. IEC 62040-3:2011 Uninterruptible power systems (UPS) - Part 3: Method of specifying the performance and test requirements or THN equivalent.

d. IEC 62040-4:2013 Uninterruptible power systems (UPS) - Part 4: Environmental aspects - Requirements and reporting or THN equivalent.

24.11.5. The UPS system shall protect all SSSB equipment except for 5Kw HF Power amplifiers.

24.11.6. The UPS shall be on line, double conversion type.

**24.11.7. Input Characteristics:**

a. Voltage: 400 V 3-phases ± 10%

b. Frequency: 50 Hz ± 5%

c. Input power factor: > 0.9 lagging

d. THD: < 5% in accordance with IEC TS 61000-3-4 or THN equivalent.

e. Two inputs are required: one to supply the rectifier and one to supply the by-pass.

**24.11.8. Output Characteristics:**

a. Rated out power: to be determined by the Contractor

b. Power factor: from 0.8 to 1

c. Nominal voltage: 3-phases 400/230 V ± 1%

d. Nominal frequency: 50 Hz ± 0.5%

e. Voltage transients: ±3% for load change from 0 to 100% or from 100 to 0%

f. System efficiency: > 90% at full load

g. Operating time on batteries : minimum 30 minutes under maximum designed load (including 30% of spare capacity)

h. The UPS shall meet following the requirements:

   i. Soft start

   ii. Zero transfer time

   iii. Surge suppressor

   iv. Static bypass for overload

   v. Manual bypass for maintenance

   vi. Battery monitoring

   vii. Protection against deep discharge of batteries

   viii. Redundant backup management system with minimum N+2 modules

   ix. Hot-swappable modules, which means it shall be possible to replace /insert another module even when UPS is fully energized and working without interruption for the operation

   x. The sound pressure level shall not exceed 65 dB(A) in accordance with ISO 3746:2010

   xi. Operating temperature/ Humidity: 0 to 40 (°C) / 0 - 95% (Non-Condensing)

   xii. Thermal protection

i. Batteries shall meet following requirements:

   i. Replacement of the batteries shall be possible without powering down the UPS

   ii. The batteries shall be valve regulated LEAD-ACID (the type and model which does not require dedicated ventilation)

   iii. The batteries shall be compliant with:

      IEC 60896-21:2004 Stationary lead-acid batteries - Part 21: Valve regulated types - Methods of test or THN equivalent.

      IEC 60896-22:2004 Stationary lead-acid batteries - Part 22: Valve regulated types - Requirements or THN equivalent.

j. Shall be located in one cabinet adjacent to the UPS cabinet

k. Autonomy: not less than 30 minutes at full load (including 30% of spare capacity)

l. Minimum operating life time: 10 (ten) years

**24.11.9. Command**

a. As a minimum, the following commands shall be provided locally and remotely:

i. System OFF

ii. System on UPS

iii. System on Static By-pass

iv. System on Manual By-pass

v. Alarm silence switch

**24.11.10. Control**

a. As a minimum, the following possibilities shall be provided:

b. Measurement of:

i. Input current

ii. Input voltage

iii. Input power

iv. DC voltage

v. DC current

vi. Output voltage

vii. Output current

viii. Output frequency

ix. Output power

c. A mimic display indicating different operation mode showing the status of main circuit breakers and switches

d. As a minimum, visual and audible alarms:

i. Battery at low level and low voltage

ii. System on by-pass

iii. Input supply failure

iv. Overload

v. High temperature

vi. USP not answering – communication lost

vii. Logging of previous minimum 200 alarms shall be possible

viii. The UPS shall be provided with two contacts for remote alarms, one for urgent (red) alarm and one for non-urgent (yellow) alarm

e. Automatic battery check-up

### 24.11.11. Communication and remote control

a. In addition, the UPS shall be provided with:

i. Communication interface RS232/C, or Ethernet RJ45

ii. SNMP V. 3.x compliant

b. The UPS shall be equipped with appropriate output protection. A short-circuit in the UPS distribution panel shall not damage the UPS.

## 24.12 Lightning protection and grounding connection

### 24.12.1. Lightning protection

a. The Contractor shall design and provide the most suitable solution to ensure lightning protection of all provided equipment, installations and infrastructure in accordance with applicable legislations and standards in given Territorial Host Nation.

b. The earth electrode (respective wires and penetration rods) system shall be able to handle the lightning current for dispersal into the ground.

c. The lightning protection system shall be compliant with:

i. IEC 62305-1:2010 Protection against lightning - Part 1: General principles or THN equivalent.

ii. IEC 62305-2:2010 Protection against lightning - Part 2: Risk management or THN equivalent.

iii. IEC 62305-3:2010 Protection against lightning - Part 3: Physical damage to structures and life hazard or THN equivalent.

iv. IEC 62305-4:2010 Protection against lightning - Part 4: Electrical and electronic systems within structures or THN equivalent.

d. The equipment shall not be damaged and the Communications and Information Systems (CIS) equipment shall continue to operate without degradation when subjected to the lightning waveforms conforming to STANAG 4370 edition 7, AECTP 250 - leaflet 254 atmospheric electricity and lightning.

e. Appropriate Surge Protection Devices (SPD) and other lightning protection measures shall be used to provide sufficient protection for the equipment. They shall be compliant with (non-exhaustive list):

i. IEC 61643-11:2011 Low-voltage surge protective devices - Part 11: Surge protective devices connected to low-voltage power systems - Requirements and test methods or THN equivalent.

ii. IEC 61643-12:2020 Low-voltage surge protective devices - Part 12: Surge protective devices connected to low-voltage power systems - Selection and application principles or THN equivalent.

iii. IEC 61643-21:2000+AMD1:2008+AMD2:2012 CSV Consolidated version

iv. Low voltage surge protective devices - Part 21: Surge protective devices connected to telecommunications and signalling networks - Performance requirements and testing methods or THN equivalent.

v. IEC 61643-22:2015 Low-voltage surge protective devices - Part 22: Surge protective devices connected to telecommunications and signalling networks - Selection and application principles or THN equivalent.

### 24.12.2. Grounding

a. Grounding study / ground resistance measurements at various locations (indoor premises for SSSB system, antenna locationsetc.) shall be performed by the Contractor in order to ensure good operation including lightning protection.

b. The main grounding network shall consists of grounding rings buried under the antenna foundations.

c. All metallic parts of the SSSB system in the buildings shall also be connected to this grounding system.

d. The Contractor shall integrate the SSSB grounding system with existing grounding system of the site according to respective THN laws and regulations.

e. The grounding installation shall be compliant with IEC 60364-5-54:2011 Low-voltage electrical installations - Part 5-54: Selection and erection of electrical equipment - Earthing arrangements and protective conductors or THN equivalent.

# SECTION 25 ROADS AND LANDSCAPING

## 25.1 General

25.1.1. This scope shall include:

a. Temporary roads

b. Landscaping (sodding, planting and gardening).

25.1.2. Administrative activities, geodetic & design activities, as well as execution of the construction works, including works supervision, quality assurance, quality control and health & safety measures shall be planned, organized and executed in compliance with:

a. THN national legislation

b. National standards or international standards that are applicable in THN (when THN equivalent standards do not exist or are superseded by international standards applicable in THN)

c. Best industry practices that are most relevant to the scope of work

## 25.2 Temporary roads

25.2.1. During constructing phase the Contractor may need a temporary road network to access all required areas, and a temporary parking/ storage area to execute works under this contract.

25.2.2. It is the Contractor’s responsibility to build this temporary road network and temporary parking /storage as well as to demolish them and to restore the site to the required condition as before the Contractor’s works commence.

## 25.3 Landscaping

25.3.1. In addition to the measures that the Contractor shall implement during the execution of the site works, at the end of the site civil works the Contractor shall complete finishing and landscaping in order to stabilize the soil and prevent erosion.

25.3.2. These works shall include sowing and planting.

25.3.3. Any works, although having an aesthetic aspect, shall in no way interfere with the existing physical security measures. Therefore, the Contractor shall take particular care during the design and execution of landscaping works to assure that the effectiveness of any of the site security measures stays intact (i.e. planting of shrubs shall not limit monitoring of any sensitive points and areas and shall not reduce the required lighting level).

# Appendix 1: IFB-CO-15577-SSSB-BookII-PartIV-SOW-ANNEX F-SRS-CW-NLD

# Civil Works at the Site Noordwijk, NL

1. **General**

1.1. The detailed description and technical specifications of below listed works are formulated in the SOW - ANNEX F - System Requirements Specifications (Civil Works) – the Netherlands.

1.2. The site, including antenna fields, is located within NATURA 2000 area that is designated under following directives respectively:

1.2.1. Directive 2009/147/EC of the European Parliament and of the Council of 30 November 2009 on the conservation of wild birds, amended by:

1.2.1.1. Regulation (EU) 2019/1010 of the European Parliament and of the Council of 5 June 2019

1.2.2. Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora, amended by:

1.2.2.1. Council Directive 97/62/EC of 27 October 1997

1.2.2.2. Regulation (EC) No 1882/2003 of the European Parliament and of the Council of 29 September 2003

1.3. The Contractor shall plan, organize and execute all works, as well as obtain all required permissions and authorizations, taking into account requirements introduced by the directives related to NATURA 2000 and their implementations as directed in respective THN regulations and standards.

**2. Responsibilities of the Contractor**

2.1. If the Contractor identifies that existing not used/ not operational infrastructure, installations and equipment shall be removed to enable installation and correct O&M of SSSB system and its supporting infrastructure, it is the Contractor’s responsibility to remove and dispose of the above mentioned infrastructure, installations and equipment. This activity can only be exercised after THN approval of each item scoped for removal and disposal.

2.2. Provision and installation of new steel RF cabling manhole covers at the entry points to the COMMS building (executed only if the Contractor provides new sections of outdoor RF cabling for antennas):

2.2.1. Locking mechanisms, such as a sliding locking bar that can be secured with a padlock to enable it to be secured when not in use.

2.2.2. The padlock, as the minimum shall meet following requirements:

2.2.2.1. Body made from hardened steel

2.2.2.2. Inner components made from non-corrosive materials

2.2.2.3. Hardened boron steel shackle minimum 10 mm diameter

2.2.2.4. Precision, minimum 3-pin cylinder lock mechanism

2.2.2.5. Minimum 3 keys

2.2.2.6. Suitable for outdoor use, weatherproof

2.3. Provision and installation of SSSB electrical installation with associated cabling, ducting, cable trays and ancillaries as stipulated in the SOW - ANNEX F:

2.3.1. Complete SSSB electrical installation, both indoor and outdoor, with dedicated EPDBs (Equipment Power Distribution Boards), including surge protection devices and residual current devices (RCD), required to power all equipment provided by the Contractor for SSSB project (including power distributed to antenna fields etc.)

2.3.2. Integration of the SSSB electrical installation with existing MPDB (Main Power Distribution Board) and other power panels as required:

2.3.2.1. The integration shall include installation of adequate circuit breakers, and modification of existing power distribution system and the power boards/ panels as required to connect power cables for SSSB electrical installation

2.4. Provision and installation of UPS system as stipulated in the SOW – ANNEX F.

2.5. Provision and installation of SSSB lightning protection and grounding system with associated cabling, ducting, cable trays and ancillaries as stipulated in the SOW - ANNEX F:

2.5.1. Complete SSSB lightning protection and grounding system, both indoor and outdoor (including surge protection devices, grounding rings (including buried, roof and mast mounted elements), grounding rods, lightning rods, trays, ducts and other ancillaries) required to protect all equipment provided by the Contractor for SSSB project (including antennas)

2.5.2. Integration of the SSSB lightning protection and grounding system with existing lightning protection and grounding system of the site according to respective THN laws and regulations:

2.5.2.1. The integration shall include execution of necessary earth works, welding, anticorrosive protection, and necessary modification of existing lightning protection and grounding system.

2.6. Removal and disposal of:

2.6.1. 1(one) antenna – main structure – wooden pole of (TBD) m

2.6.2. all ducting, cabling, grounding, guyed lines, foundation, anchoring and other ancillaries related to the antenna and the antenna mast that is scoped for disposal.

2.7. Provision and installation of required number of new antenna masts capable of supporting the SSSB system and with all associated works (antenna field preparation, foundation, trenches etc.), air obstacle lights, lightning protection, grounding and other ancillaries as stipulated in the SOW - ANNEX F.

2.7.1. The antenna masts and shall be designed for minimum service life of 30 years without the need for substantial maintenance

2.7.2. The antenna masts and shall be provided with cathodic protection system (including protection of the guy anchors) designed for minimum service life of 30 years without the need for substantial maintenance

2.8. Provision and installation of indoor sections of RF and power cabling with associated cable trays, ducts etc.:

2.8.1. Indoor, the Contractor shall install the RF cabling and connect it to new SSSB equipment at one end, and at the other end – connect it to existing RF cabling terminations at the inside of EMP shield

2.9. Provision and installation of outdoor RF cabling and power cabling for antennas:

2.9.1. THN NL offers for reuse existing RF cabling.

2.9.2. The Contractor shall modify the existing outdoor RF cabling terminations (for example by providing and installing outdoor RF cabling extensions with all required ancillaries and related civil works such as earthworks, ducting, piping, backfilling etc.) required for new SSSB antennas

2.9.3. The power distribution, grounding connections and the location for new indoor SSSB equipment (that shall be provided by the Contractor) is

within Electromagnetic Pulse (EMP) protected enclosure. Therefore, any works conducted by the Contractor shall not degrade integrity/ effectiveness of the existing EMP protected enclosure.

2.9.4. In case it is not possible to reuse existing outdoor RF cabling, following activities shall be included in the scope executed by the Contractor:

2.9.4.1. Dismantling and hand-over to THN NL of redundant RF cabling

2.9.4.2. Installation of new RF cabling with associated earthwork, backfilling, ducting, trays, and marking of the cable runs in the terrain.

2.9.4.3. Provision and installation of required manholes including the manhole to accommodate cable entry into the building via EMP shield

2.9.4.4. All cables leaving or entering the EMP protected area shall be routed through the existing EMP cable entry panel.

2.9.4.5. Provision and installation of new steel RF cabling manhole cover(s) at the entry points to the COMMS building

2.10. Provision and installation of safety marking and labelling, both indoor and outdoor, for all structures, machinery and installations provided by the Contractor, as stipulated in the SOW Main Body and in the SOW – ANNEX F.

2.11. All concrete works exposed to outdoor environment (regardless if buried or not) shall be executed with the utilization of concrete that meets, as the minimum, following requirements according to EN 206:2013+A2:2021 (or THN equivalent standard):

2.11.1. exposure class of XS1 and strength of C 32/40 for structures exposed to airborne salt but not in direct contact with sea water;

2.11.2. exposure class of XS3 and strength of C 33/45 for structures located at tidal and spray zones.

2.12. All metal works exposed to outdoor environment such as antenna masts with their ancillaries, cable trays and ladders, bolts, nuts, washers, fasteners etc. (regardless if buried or not) shall be protected against corrosion category C5M Maritime, defined according to ISO 12944-5:2019 (or THN equivalent standard).

2.13. When designing and erecting masts with all associated ancillaries, the Contractor shall take into account wind load imposed by winds of min 190 km/h speed, without ice formation.

2.14. Supporting Civil Works:

2.14.1. Rebuilding of pavements after pipe, cabling, ducting and other installation works.

2.14.2. Associated earthworks and backfilling, drilling for the pipes, cabling, ducting and other installation works.

2.14.3. Closing of the penetrations (with mortar, plastering, finishing/painting of affected sections in partitions) in walls, floors, roofs and ceiling after pipe, cabling, ducting and other installation works.

2.14.4. Water, sound and fire insulation as required in all areas affected by the Contractor works.

# Appendix 2: IFB-CO-15577-SSSB-BookII-PartIV-SOW-ANNEX F-SRS-CW-NLD

# Civil Works at the Site Zeewolde, NL

## 1. General

1.1. The detailed description and technical specifications of below listed works are formulated in the SOW - ANNEX F - System Requirements Specifications (Civil Works) – the Netherlands.

## 2. Responsibilities of the Contractor

2.1. Provision and installation of Health and Safety (H&S) fence around each of the antennas, that shall be provided and installed by the Contractor:

2.1.1. The fence shall form continues line around each antenna.

2.1.2. The fence shall be built in such a distance from antennas to assure that:

2.1.2.1. the radiation right outside the fence line is within the limits established in: ICNIRP Occupational standard. Richtlijn: Health Physics, Volume 74, Number 4 Guidelines for limiting exposure to time-varying electric, magnetic and electromagnetic fields up to 300 GHz

2.1.2.2. and the fence does not interfere with SSSB system operation

2.1.3. The timber elements of the fence shall be made of impregnated wood that is robustly protected against local weather and soil conditions:

2.1.3.1. pressure treated timber

2.1.3.2. protected against rot, fungal, bacterial and insect damage

2.1.3.3. all-weather wood sealer shall be applied on all elements that are to be buried before burying them, and on their sections protruding from the ground level for min 30 cm

2.1.3.4. pressure treated wood shall dry for a few weeks after purchasing it before applying a wood sealer (for details the manufacturer recommendations shall be followed)

2.1.3.5. the wood impregnation agents shall be compliant with Regulation (EU) No 528/2012 of the European Parliament and of the Council of 22 May 2012 concerning the making available on the market and use of biocidal products

2.1.3.6. the Contractor shall apply the level of treatment for the timber to be used for the Use Class 4 (External use which has direct soil or water contact. For example, fence posts or decking which is sunk into the ground.) according to ISO 21887:2007 Durability of wood and wood-based products — Use classes (or respective THN equivalent)

2.1.3.7. the timber shall be characterized by its inherent durability of minimum Class 3: life span of 10-15 years.

2.1.4. The fence shall extend to a height of at least 1.2 m above ground level throughout.

2.1.5. Fence posts shall be of minimum cross-section 15cm x 15cm and installed at centers not exceeding 1.5 m.

2.1.6. Fence post shall be installed in concrete foundations of the size adequate to the soil type and wind load at each site.

2.1.7. Fence posts shall be mounted straight/vertical.

2.1.8. Fences around each antenna shall have at least one double leaf gate constructed to the same standard as the fence and shall open outwards.

2.1.9. The gates shall be of minimum 3.0m width, manually operated, equipped with closing mechanism and a padlock.

2.1.10. Each gate leaf shall be mounted on minimum 3(three) hinges.

2.1.11. The closing mechanism at the gates, as the minimum shall meet following requirements:

2.1.11.1. locking mechanisms, such as a sliding locking bar that can be secured with a padlock.

2.1.12. The padlock at the gates, as the minimum shall meet following requirements:

2.1.12.1. Body made from hardened steel

2.1.12.2. Inner components made from non-corrosive materials

2.1.12.3. Hardened boron steel shackle minimum 10 mm diameter

2.1.12.4. Precision minimum 3-pin cylinder lock mechanism

2.1.12.5. Minimum 3 keys

2.1.12.6. Suitable for outdoor use, weatherproof

2.1.13. The fence shall have at least three horizontal timber elements, perpendicularly connected at both ends to the fence posts.

2.1.14. The horizontal timber elements shall be of minimum cross-section 15cm x 2.5cm and installed as follows:

2.1.14.1. The top surface of the top horizontal timber element aligned with the top surface of the posts

2.1.14.2. The rest of horizontal timber elements evenly spaced in such a way that the bottom surface of the bottom horizontal element shall be around 25-30cm above ground level

2.1.15. The fence structure shall be erected using galvanized steel fixings such as nuts, bolts, washers and other carpentry fittings

2.1.16. Use of nails is forbidden

2.2. If the Contractor identifies that existing not used/ not operational infrastructure, installations and equipment shall be removed to enable installation and correct O&M of SSSB system and its supporting infrastructure, it is the Contractor's responsibility to remove and dispose of the above mentioned infrastructure, installations and equipment. This activity can only be exercised after THN approval of each item scoped for removal and disposal.

2.3. Provision and installation of new steel RF cabling manhole covers at the entry points to the COMMS building (executed only if the existing cable entry panel is not suitable for reuse by the Contractor)

2.3.1. Locking mechanisms, such as a sliding locking bar that can be secured with a padlock to enable it to be secured when not in use.

2.3.2. The padlock, as the minimum shall meet following requirements:

2.3.2.1. Body made from hardened steel

2.3.2.2. Inner components made from non-corrosive materials

2.3.2.3. Hardened boron steel shackle minimum 10 mm diameter

2.3.2.4. Precision, minimum 3-pin cylinder lock mechanism

2.3.2.5. Minimum 3 keys

2.3.2.6. Suitable for outdoor use, weatherproof

2.4. Provision and installation of SSSB electrical installation with associated cabling, ducting, cable trays and ancillaries as stipulated in the SOW - ANNEX F:

2.4.1. THN NL offers for reuse existing power distribution system with existing 2(two) power sockets to connect 2(two) 5 kW transmitters. Should that existing installation be not suitable, require any modification and installation of additional items it shall be the Contractor's responsibility as stipulated hereafter below.

2.4.2. Complete SSSB electrical installation, both indoor and outdoor, with dedicated EPDBs (Equipment Power Distribution Boards), including surge protection devices and residual current devices (RCD), required to power all equipment provided by the Contractor for SSSB project (including power distributed to antenna fields etc.)

2.4.3. Integration of the SSSB electrical installation with existing MPDB (Main Power Distribution Board) and other power panels as required:

2.4.3.1. The integration shall include installation of adequate circuit breakers, and modification of existing power distribution system and the power boards/ panels as required to connect power cables for SSSB electrical installation

2.5. Provision and installation of UPS system as stipulated in the SOW – ANNEX F.

2.6. Provision and installation of SSSB lightning protection and grounding system with associated cabling, ducting, cable trays and ancillaries as stipulated in the SOW - ANNEX F:

2.6.1. Complete SSSB lightning protection and grounding system, both indoor and outdoor (including surge protection devices, grounding rings (including buried, roof and mast mounted elements), grounding rods, lightning rods, trays, ducts and other ancillaries) required to protect all equipment provided by the Contractor for SSSB project (including antennas)

2.6.2. Integration of the SSSB lightning protection and grounding system with existing lightning protection and grounding system of the site according to respective THN laws and regulations:

2.6.2.1. The integration shall include execution of necessary earth works, welding, anticorrosive protection, and necessary modification of existing lightning protection and grounding system.

2.7. Removal and disposal of:

2.7.1. Existing outdoor RF cable terminations if they become redundant as a result of the Contractor's works.

2.7.2. Existing reinforced concrete antenna foundations all ducting, cabling, grounding, anchoring and other ancillaries related to the antenna foundations that are scoped if they become redundant as a result of the Contractor's works.

2.7.3. These activities can only be exercised after THN approval of each item scoped for removal and disposal.

2.8. Provision and installation of required number of new antenna masts capable of supporting the SSSB system and with all associated works (antenna field preparation, foundation, trenches etc.), air obstacle lights, lightning protection, grounding and other ancillaries as stipulated in the SOW - ANNEX F.

2.8.1. The antenna masts and shall be designed for minimum service life of 30 years without the need for substantial maintenance

2.8.2. The antenna masts and shall be provided with cathodic protection system (including protection of the guy anchors) designed for minimum service life of 30 years without the need for substantial maintenance

2.9. Provision and installation of indoor sections of RF and power cabling with associated cable trays, ducts etc.:

2.9.1. Indoor, the Contractor shall install the RF cabling and connect it to new SSSB equipment at one end, and at the other end – connect it to existing RF cabling terminations at the indoor part of the cable entry panel

2.10. Provision and installation of outdoor RF cabling and power cabling for antennas:

2.10.1. THN NL offers for reuse existing outdoor sections of RF cabling.

2.10.2. The Contractor shall modify the existing outdoor RF cabling terminations (for example by providing and installing outdoor RF cabling extensions with all required ancillaries and related civil works such as earthworks, ducting, piping, backfilling etc.) required for new SSSB antennas

2.10.3. In case it is not possible to reuse existing outdoor RF cabling, following activities shall be included in the scope executed by the Contractor:

2.10.3.1. Dismantling and hand-over to THN NL of redundant RF cabling.

2.10.3.2. Installation of new RF cabling with associated earthwork, backfilling, ducting, trays, and marking of the cable runs in the terrain.

2.10.3.3. Provision and installation of required manholes including the manhole to accommodate cable entry into the building if the existing cable entry panel is not suitable for reuse by the Contractor

2.10.3.4. Modification of existing or provision and installation of a new cable entry panel for the cabling provided and installed by the Contractor.

2.10.3.5. Provision and installation of new steel RF cabling manhole cover(s) at the entry points to the COMMS building should the manhole be provide and installed by the Contractor.

2.11. Provision and installation of safety marking and labelling, both indoor and outdoor, for all structures, machinery and installations provided by the Contractor, as stipulated in the SOW Main Body and in the SOW – ANNEX F.

2.12. All concrete works exposed to outdoor environment (regardless if buried or not) shall be executed with the utilization of concrete that meets, as the minimum, following requirements according to EN 206:2013+A2:2021 (or THN equivalent standard):

2.12.1. exposure class of XS1 and strength of C 32/40 for structures exposed to airborne salt but not in direct contact with sea water;

2.12.2. exposure class of XS3 and strength of C 33/45 for structures located at tidal and spray zones.

2.13. All metal works exposed to outdoor environment such as antenna masts with their ancillaries, cable trays and ladders, bolts, nuts, washers, fasteners etc. (regardless if buried or not) shall be protected against corrosion category C5M Maritime, defined according to ISO 12944-5:2019 (or THN equivalent standard).

2.14. When designing and erecting fences and masts with all associated ancillaries, the Contractor shall take into account wind load imposed by winds of min 190 km/h speed, without ice formation.

2.15. Supporting Civil Works:

2.15.1. THN NL offers for reuse existing penetrations in walls, floors, and ceilings as presented in ‘Transmit site Zeewolde - Site information’ (Version number 1.0, Date: 19-08-2020) and supporting photographic documentation. Should these existing penetrations be not suitable or require any modification it shall be the Contractor’s responsibility to execute required works for installation of SSSB equipment.

2.15.2. Rebuilding of pavements after pipe, cabling, ducting and other installation works.

2.15.3. Associated earthworks and backfilling, drilling for the pipes, cabling, ducting and other installation works.

2.15.4. Closing of the penetrations (with mortar, plastering, finishing/painting of affected sections in partitions) in walls, floors, roofs and ceiling after pipe, cabling, ducting and other installation works.

2.15.5. Water, sound and fire insulation as required in all areas affected by the Contractor works.

# Appendix 3: IFB-CO-15577-SSSB-BookII-PartIV-SOW-ANNEX F-SRS-CW-NLD

# Civil Works at the Site Albatros, NL

## 1. General

1.1. The detailed description and technical specifications of below listed works are formulated in the SOW - ANNEX F - System Requirements Specifications (Civil Works) – the Netherlands.

## 2. Responsibilities of the Contractor

2.1. If the Contractor identifies that existing not used/ not operational infrastructure, installations and equipment shall be removed to enable installation and correct O&M of SSSB system and its supporting infrastructure, it is the Contractor's responsibility to remove and dispose of the above mentioned infrastructure, installations and equipment. This activity can only be exercised after THN approval of each item scoped for removal and disposal.

2.2. Provision and installation of SSSB electrical installation with associated cabling, ducting, cable trays and ancillaries as stipulated in the SOW - ANNEX F:

2.2.1. THN NL offers for reuse existing power distribution system including:

2.2.1.1. existing 2(two) circuit breakers (2 x B16) at the power panel located in the room for new SSSB system installation

2.2.1.2. the 2 x B16 circuit breakers are connected to two power outlets installed in the vicinity of planed location for new SSSB system so power cables (to be provided and installed by the Contractor), between those outlets and new SSSB equipment, will be approximately 5m long for each SSSB rack

2.2.1.3. indoor cable trays

2.2.1.4. should that existing installation be not suitable, require any modification and installation of additional items it shall be the Contractor's responsibility as stipulated hereafter below

2.2.2. Complete SSSB electrical installation, both indoor and outdoor, with dedicated EPDB(s) (Equipment Power Distribution Board(s)), including surge protection devices and residual current devices (RCD), required to power all equipment provided by the Contractor for SSSB project

(including power distributed to antennas located right above the SSSB room, on the building roof)

2.2.3. Integration of the SSSB electrical installation with existing MPDB (Main Power Distribution Board) and other power panels as required:

2.2.4. The integration shall include installation of adequate circuit breakers, and modification of existing power distribution system and the power boards/ panels as required to connect power cables for SSSB electrical installation

2.3. Provision and installation of UPS system as stipulated in the SOW – ANNEX F.

2.4. Provision and installation of SSSB lightning protection and grounding system with associated cabling, ducting, cable trays and ancillaries as stipulated in the SOW - ANNEX F:

2.4.1. Complete SSSB lightning protection and grounding system, both indoor and outdoor (including surge protection devices, grounding rings (including roof and mast mounted elements), lightning rods, trays, ducts and other ancillaries) required to protect all equipment provided by the Contractor for SSSB project (including antennas)

2.4.2. Integration of the SSSB lightning protection and grounding system with existing lightning protection and grounding system of the site according to respective THN laws and regulations:

2.4.2.1. The integration shall include execution of necessary welding, anticorrosive protection, and necessary modification of existing lightning protection and grounding system.

2.5. Removal and disposal of:

2.5.1. one antenna mast (approximately 6m height) mounted on the building roof;

2.5.2. 2 x 19 inch rack with various communication and electronic equipment

2.5.3. all ducting, cabling, grounding, guyed lines, foundation, anchoring and other ancillaries related to the antenna and the antenna mast that are scoped for disposal.

2.6. Provision and installation of required number of new antenna masts capable of supporting the SSSB system with all associated works (foundation/ interface plate to the building roof etc.), air obstacle lights, lightning protection, grounding and other ancillaries as stipulated in the SOW - ANNEX F.

2.6.1. The antenna mast(s) shall be designed for minimum service life of 30 years without the need for substantial maintenance

2.6.2. The antenna mast(s) shall be installed on the roof of an existing multistory building

2.7. Provision and installation of indoor and outdoor RF cabling of the length approximately 25m for each SSSB antenna:

2.7.1. THN NL offers for reuse indoor RF cabling trays

2.7.2. Should the offered trays are not suitable for new SSSB installation it is the Contractor's responsibility to provide and install new cable trays

2.8. Removal and disposal of existing support structure and fixings of the existing RF cable conduit leading to the building roof from the floor right below.

2.9. Provision and installation of a new support structure and fixings for the existing RF cable conduit leading to the building roof from the floor right below:

2.9.1. All elements shall be made from galvanized steel

2.9.2. All elements shall be protected against corrosion as specified hereafter and in the SOW – ANNEX F.

2.10. Refurbishment of existing or removal and disposal, and then provision of a new galvanized steel conduit for RF cable leading to the building roof from the floor right below:

2.10.1. Regardless of which option is chosen by the Contractor, the conduit shall be protected against corrosion as specified hereafter and in the SOW – ANNEX F

2.10.2. Regardless of which option is chosen by the Contractor, the conduit shall be watertight sealed

2.11. Provision and installation of safety marking and labelling, both indoor and outdoor, for all structures, machinery and installations provided by the Contractor, as stipulated in the SOW Main Body and in the SOW – ANNEX F.

2.12. All concrete works exposed to outdoor environment (regardless if buried or not) shall be executed with the utilization of concrete that meets, as the minimum, following requirements according to EN 206:2013+A2:2021 (or THN equivalent standard):

2.12.1. exposure class of XS1 and strength of C 32/40 for structures exposed to airborne salt but not in direct contact with sea water;

2.12.2. exposure class of XS3 and strength of C 33/45 for structures located at tidal and spray zones.

2.13. All metal works exposed to outdoor environment such as antenna masts with their ancillaries, cable trays and ladders, bolts, nuts, washers, fasteners etc. (regardless if buried/concealed or not) shall be protected against corrosion category C5M Maritime, defined according to ISO 12944-5:2019 (or THN equivalent standard).

2.14. When designing and erecting the mast(s) with all associated ancillaries, the Contractor shall take into account wind load imposed by winds of min 190 km/h speed, without ice formation.

2.15. Supporting Civil Works:

2.15.1. Associated drilling for the pipes, cabling, ducting and other installation works.

2.15.2. Closing of the penetrations (with mortar, plastering, finishing/painting of affected sections in partitions) in walls, floors, roofs and ceiling after pipe, cabling, ducting and other installation works.

2.15.3. Water, sound and fire insulation as required in all areas affected by the Contractor works.

# Appendix 4: IFB-CO-15577-SSSB-BookII-PartIV-SOW-ANNEX F-SRS-CW-NLD

# Civil Works at the Site Julianadorp, NL

## 1. General

1.1. The detailed description and technical specifications of below listed works are formulated in the SOW - ANNEX F - System Requirements Specifications (Civil Works) – the Netherlands.

## 2. Responsibilities of the Contractor

2.1. Provision and installation of Health and Safety (H&S) fence around each of the antennas, that shall be provided and installed by the Contractor:

2.1.1. The fence shall form continues line around each antenna.

2.1.2. The fence shall be built in such a distance from antennas to assure that:

2.1.2.1. the radiation right outside the fence line is within the limits established in: ICNIRP Occupational standard. Richtlijn: Health Physics, Volume 74, Number 4 Guidelines for limiting exposure to time-varying electric, magnetic and electromagnetic fields up to 300 GHz

2.1.2.2. and the fence does not interfere with SSSB system operation

2.1.3. The timber elements of the fence shall be made of impregnated wood that is robustly protected against local weather and soil conditions:

2.1.3.1. pressure treated timber

2.1.3.2. protected against rot, fungal, bacterial and insect damage

2.1.3.3. all-weather wood sealer shall be applied on all elements that are to be buried before burying them, and on their sections protruding from the ground level for min 30 cm

2.1.3.4. pressure treated wood shall dry for a few weeks after purchasing it before applying a wood sealer (for details the manufacturer recommendations shall be followed)

2.1.3.5. the wood impregnation agents shall be compliant with Regulation (EU) No 528/2012 of the European Parliament and of the Council of 22 May 2012 concerning the making available on the market and use of biocidal products

2.1.3.6. the Contractor shall apply the level of treatment for the timber to be used for the Use Class 4 (External use which has direct soil or water contact. For example, fence posts or decking which is sunk into the ground.) according to ISO 21887:2007 Durability of wood and wood-based products — Use classes (or respective THN equivalent)

2.1.3.7. the timber shall be characterized by its inherent durability of minimum Class 3: life span of 10-15 years.

2.1.4. The fence shall extend to a height of at least 1.2 m above ground level throughout.

2.1.5. Fence posts shall be of minimum cross-section 15cm x 15cm and installed at centers not exceeding 1.5 m.

2.1.6. Fence post shall be installed in concrete foundations of the size adequate to the soil type and wind load at each site.

2.1.7. Fence posts shall be mounted straight/vertical.

2.1.8. Fences around each antenna shall have at least one double leaf gate constructed to the same standard as the fence and shall open outwards.

2.1.9. The gates shall be of minimum 3.0m width, manually operated, equipped with closing mechanism and a padlock.

2.1.10. Each gate leaf shall be mounted on minimum 3(three) hinges.

2.1.11. The closing mechanism at the gates, as the minimum shall meet following requirements:

2.1.11.1. locking mechanisms, such as a sliding locking bar that can be secured with a padlock.

2.1.12. The padlock at the gates, as the minimum shall meet following requirements:

2.1.12.1. Body made from hardened steel

2.1.12.2. Inner components made from non-corrosive materials

2.1.12.3. Hardened boron steel shackle minimum 10 mm diameter

2.1.12.4. Precision minimum 3-pin cylinder lock mechanism

2.1.12.5. Minimum 3 keys

2.1.12.6. Suitable for outdoor use, weatherproof

2.1.13. The fence shall have at least three horizontal timber elements, perpendicularly connected at both ends to the fence posts.

2.1.14. The horizontal timber elements shall be of minimum cross-section 15cm x 2.5cm and installed as follows:

2.1.14.1. The top surface of the top horizontal timber element aligned with the top surface of the posts

2.1.14.2. The rest of horizontal timber elements evenly spaced in such a way that the bottom surface of the bottom horizontal element shall be around 25-30cm above ground level

2.1.15. The fence structure shall be erected using galvanized steel fixings such as nuts, bolts, washers and other carpentry fittings

2.1.16. Use of nails is forbidden.

2.2. If the Contractor identifies that existing not used/ not operational infrastructure, installations and equipment shall be removed to enable installation and correct O&M of SSSB system and its supporting infrastructure, it is the Contractor's responsibility to remove and dispose of the above mentioned infrastructure, installations and equipment. This activity can only be exercised after THN approval of each item scoped for removal and disposal.

2.3. Provision and installation of new steel RF cabling manhole covers at the entry points to the COMMS building (executed only if the Contractor provides new sections of outdoor RF cabling for antennas and current EMP cable entry plate is not suitable for use for new SSSB system):

2.3.1. Locking mechanisms, such as a sliding locking bar that can be secured with a padlock to enable it to be secured when not in use.

2.3.2. The padlock, as the minimum shall meet following requirements:

2.3.2.1. Body made from hardened steel

2.3.2.2. Inner components made from non-corrosive materials

2.3.2.3. Hardened boron steel shackle minimum 10 mm diameter

2.3.2.4. Precision, minimum 3-pin cylinder lock mechanism

2.3.2.5. Minimum 3 keys

2.3.2.6. Suitable for outdoor use, weatherproof

2.4. Provision and installation of SSSB electrical installation with associated cabling, ducting, cable trays and ancillaries as stipulated in the SOW - ANNEX F:

2.4.1. THN NL offers for reuse existing power distribution system including:

2.4.1.1. existing 2(two) power sockets of 63 A each (installed in the vicinity of planed location for new SSSB system so power cables (to be provided and installed by the Contractor) will be approximately 5m long for each SSSB rack)

2.4.1.2. indoor cable trays

2.4.1.3. should that existing installation be not suitable, require any modification and installation of additional items it shall be the Contractor's responsibility as stipulated hereafter below

2.4.2. Complete SSSB electrical installation, both indoor and outdoor, with dedicated EPDBs (Equipment Power Distribution Boards), including surge protection devices and residual current devices (RCD), required to power all equipment provided by the Contractor for SSSB project (including power distributed to antenna fields etc.)

2.4.3. Integration of the SSSB electrical installation with existing MPDB (Main Power Distribution Board) and other power panels as required:

2.4.3.1. The integration shall include installation of adequate circuit breakers, and modification of existing power distribution system and the power boards/ panels as required to connect power cables for SSSB electrical installation

2.5. Provision and installation of UPS system as stipulated in the SOW – ANNEX F.

2.6. Provision and installation of SSSB lightning protection and grounding system with associated cabling, ducting, cable trays and ancillaries as stipulated in the SOW - ANNEX F:

2.6.1. Complete SSSB lightning protection and grounding system, both indoor and outdoor (including surge protection devices, grounding rings (including buried, roof and mast mounted elements), grounding rods, lightning rods, trays, ducts and other ancillaries) required to protect all equipment provided by the Contractor for SSSB project (including antennas)

2.6.2. Integration of the SSSB lightning protection and grounding system with existing lightning protection and grounding system of the site according to respective THN laws and regulations:

2.6.2.1. The integration shall include execution of necessary earth works, welding, anticorrosive protection, and necessary modification of existing lightning protection and grounding system.

2.7. Removal and disposal of:

2.7.1. CODAN HF antennas will removed by THN NL. However, the Contractor is required to remove and dispose the foldable antenna masts, each 12 m height;

2.7.2. Any legacy / old racks are to be disassembled and stored indoors on site in a premises provided by THN NL;

2.7.3. all ducting, cabling, grounding, guyed lines, foundation, anchoring and other ancillaries related to the antennas and the antenna masts that are scoped for disposal.

2.8. Provision and installation of required number of new antenna masts capable of supporting the SSSB system and with all associated works (antenna field preparation, foundation, trenches etc.), air obstacle lights, lightning protection, grounding and other ancillaries as stipulated in the SOW - ANNEX F.

2.8.1. The antenna masts and shall be designed for minimum service life of 30 years without the need for substantial maintenance

2.8.2. The antenna masts and shall be provided with cathodic protection system (including protection of the guy anchors) designed for minimum service life of 30 years without the need for substantial maintenance

2.8.3. The air obstacle lights will only be required when any of the new antennas is higher than existing 45m height antenna

2.9. Provision and installation of indoor sections of RF cabling of the length approximately 12 m for each SSSB rack, with associated cable trays, ducts etc:

2.9.1. Indoor, the Contractor shall install the RF cabling and connect it to new SSSB equipment at one end, and at the other end – connect it to existing RF cabling terminations at the inside of EMP shield

2.9.2. The new RF cables shall be installed in the existing cable trays to the maximum possible extent

2.9.3. Where necessary, the Contractor shall provide and install new sections of cable trays for RF cabling

2.10. Removal and disposal of the existing indoor coaxial cables.

2.11. Provision and installation of outdoor RF cabling and power cabling for antennas:

2.11.1. THN NL offers for reuse existing RF cabling.

2.11.2. The Contractor shall modify the existing outdoor RF cabling terminations (for example by providing and installing outdoor RF cabling extensions (approximate length of the required extensions: 70m for each antenna) with all required ancillaries and related civil works such as earthworks, ducting, piping, backfilling etc.) required for new SSSB antennas

2.11.3. The power distribution, grounding connections and the location for new indoor SSSB equipment (that shall be provided by the Contractor) is within Electromagnetic Pulse (EMP) protected enclosure. Therefore, any works conducted by the Contractor shall not degrade integrity/ effectiveness of the existing EMP protected enclosure.

2.11.4. In case it is not possible to reuse existing outdoor RF cabling following activities shall be included in the scope executed by the Contractor:

2.11.4.1. Dismantling and hand-over to THN NL of redundant RF cabling

2.11.4.2. Installation of new RF cabling with associated earthwork, backfilling, ducting, trays, and marking of the cable runs in the terrain.

2.11.4.3. Provision and installation of required manholes including the manhole to accommodate cable entry into the building via EMP shield

2.11.4.4. All cables leaving or entering the EMP protected area shall be routed through the existing EMP cable entry panel.

2.11.4.5. Provision and installation of new steel RF cabling manhole cover(s) at the entry points to the COMMS building

2.12. Provision and installation of safety marking and labelling, both indoor and outdoor, for all structures, machinery and installations provided by the Contractor, as stipulated in the SOW Main Body and in the SOW – ANNEX F.

2.13. All concrete works exposed to outdoor environment (regardless if buried or not) shall be executed with the utilization of concrete that meets, as the minimum, following requirements according to EN 206:2013+A2:2021 (or THN equivalent standard):

2.13.1. exposure class of XS1 and strength of C 32/40 for structures exposed to airborne salt but not in direct contact with sea water;

2.13.2. exposure class of XS3 and strength of C 33/45 for structures located at tidal and spray zones.

2.14. All metal works exposed to outdoor environment such as antenna masts with their ancillaries, cable trays and ladders, fences, gates, bolts, nuts, washers, fasteners etc. (regardless if buried or not) shall be protected against corrosion category C5M Maritime, defined according to ISO 12944-5:2019 (or THN equivalent standard).

2.15. When designing and erecting fences and masts with all associated ancillaries, the Contractor shall take into account wind load imposed by winds of min 190 km/h speed, without ice formation.

2.16. Supporting Civil Works:

2.16.1. Rebuilding of pavements after pipe, cabling, ducting and other installation works.

2.16.2. Associated earthworks and backfilling, drilling for the pipes, cabling, ducting and other installation works.

2.16.3. Closing of the penetrations (with mortar, plastering, finishing/painting of affected sections in partitions) in walls, floors, roofs and ceiling after pipe, cabling, ducting and other installation works.

2.16.4. Water, sound and fire insulation as required in all areas affected by the Contractor works.

# IFB-CO-15577-SSSB

NATO Communications and Information Agency
Agence OTAN d'information et de communication

# BOOK II

# PART IV – STATEMENT OF WORK

# SOW - ANNEX G

# SYSTEM REQUIREMENT SPECIFICATIONS (SRS) - TECHNICAL (GREECE)

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# Introduction

## 1.1 Overview

The Ship-Shore-Ship-Buffer (SSSB) system is a real-time digital link buffer system supporting the exchange of tactical information between the NATO Air Defence Ground Environment (NADGE) system, Airborne Early Warning (AEW) systems and Naval Forces through the use of NATO data Link-1, Link 11, Link 11B and Link 22. This is illustrated in Figure 1:

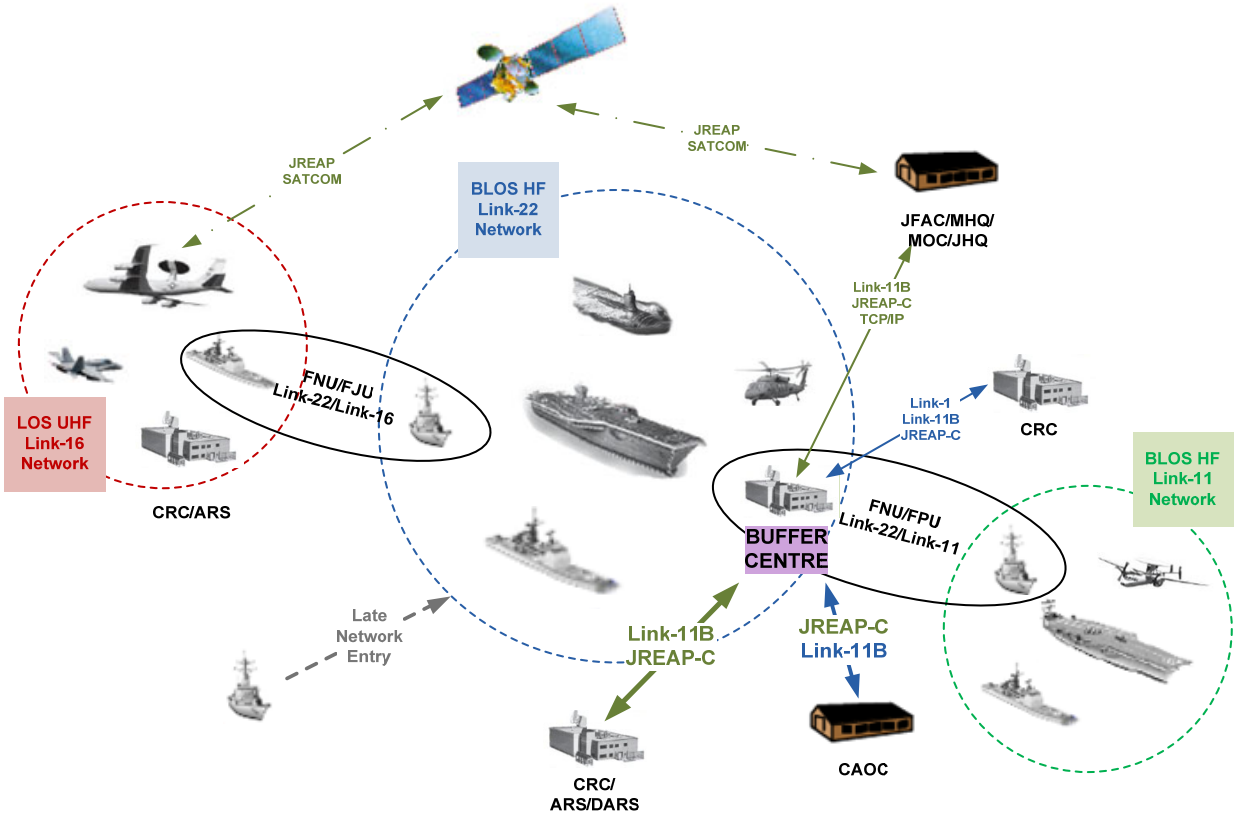


Figure 1: Tactical data exchange layout.

The SSSB system is organised in three sub-systems, see **Error! Reference source not found.**:

Radio Network Communication: Provided by several radio sites.

Command and Control:

a. Tactical Data Link Processing and Presentation, provided at the main and remote SSSB Control Centre.

b. Distributed Radio Control and Management of the communication equipment, provided at all sites.

Signals Transport: Transport of digital and analogue signals:

c. Co-located Radio Sites, where HF-TX, HF-RX and UHF components are located within the same compound.

d. Non-Colocated Radio Sites, where HF-TX, HF-RX and UHF components are partly or fully separated, but located in the same area. The distances between the components can vary.

## 1.2 Purpose

1.2.1 The purpose of the SSSB system is to provide communication between Maritime and Airborne Early Warning (AEW) units and their Command and Control Centre, located at the Buffer Centres.

1.2.2 The SSSB-UK-GR-NL project aims at providing the Territorial Host Nation of Greece (THN) with a SSSB system that is planned to upgrade the existing SSSB system within Greece.

1.2.3 The purpose of this document is to specify the system requirements for the SSSB-UK-GR-NL System as depicted by **Error! Reference source not found.** below, and consisting of:

a. Six SSSB Radio Sites, HF-TX/RX/UHF Sites at Kartsinoudi, Limnonari and 7th Air Force Radar sites on the island of Skyros, Mavros and Sideros sites on the island of Crete and a new site on the island Kythira connected to Buffer Centres at ARS Larissa, CRC Panis and CRC Ziros (Crete), shall be implemented by the Contractor (see

b. Figure 2 to Figure 9). The distances between the SSSB sites are shown in Figure 10.

c. The GRC National Defence Network (NDN) for the transport of the signals between the Buffer Centres at ARS Larissa, CRC Panis and CRC Ziros (Crete) and the six Radios Sites at Sites at Kartsinoudi, Limnonari and 7th Air Force Radar sites on the island of Skyros, Mavros and Sideros sites on the island of Crete and a new site at Naval Entity (NE) 47 on the island Kythira.

d. The National Defense Network (NDN) will be provided by the Host Nation.

1.2.4 Radio Sites

a. The Radio Sites at Kartsinoudi, Limnonari, Mavros and Sideros are already existing SSSB COMMS Sites, which have to be upgraded/renewed.

b. The existing operational functionality has to be kept till the SSSB Final System Acceptance to assure operational continuity.

c. The Radio Sites at 7th Air Force Radar Station and Naval Entity 47 are military sites without any existing SSSB functionality. This site will become new SSSB COMMS sites.

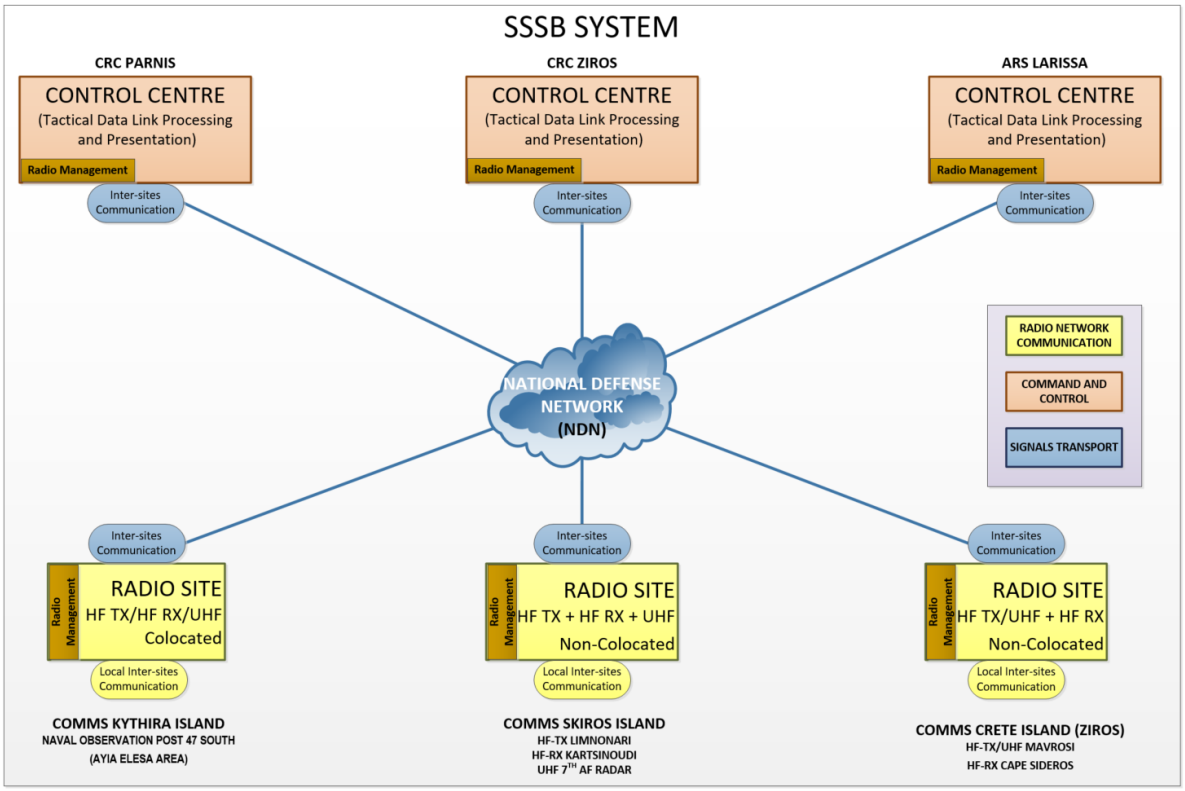


Figure 2: GRC Buffer Centres and TX/RX/UHF COMMS locations.


Figure 2: GRC Buffer Centres and TX/RX/UHF COMMS locations (less Crete)

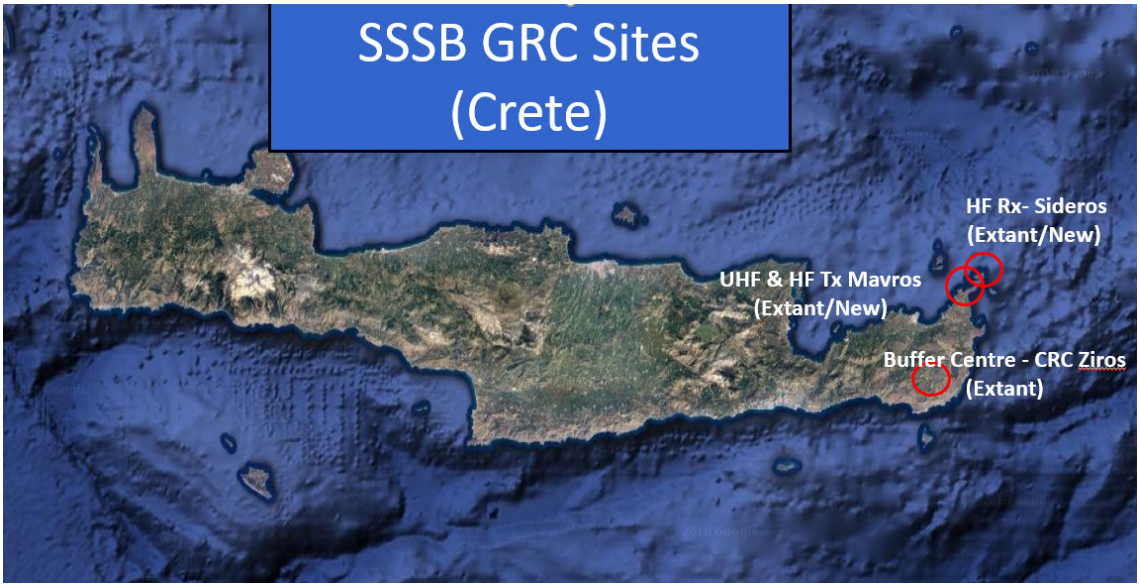


Figure 3: GRC Buffer Centres and TX/RX/UHF COMMS locations (Crete)

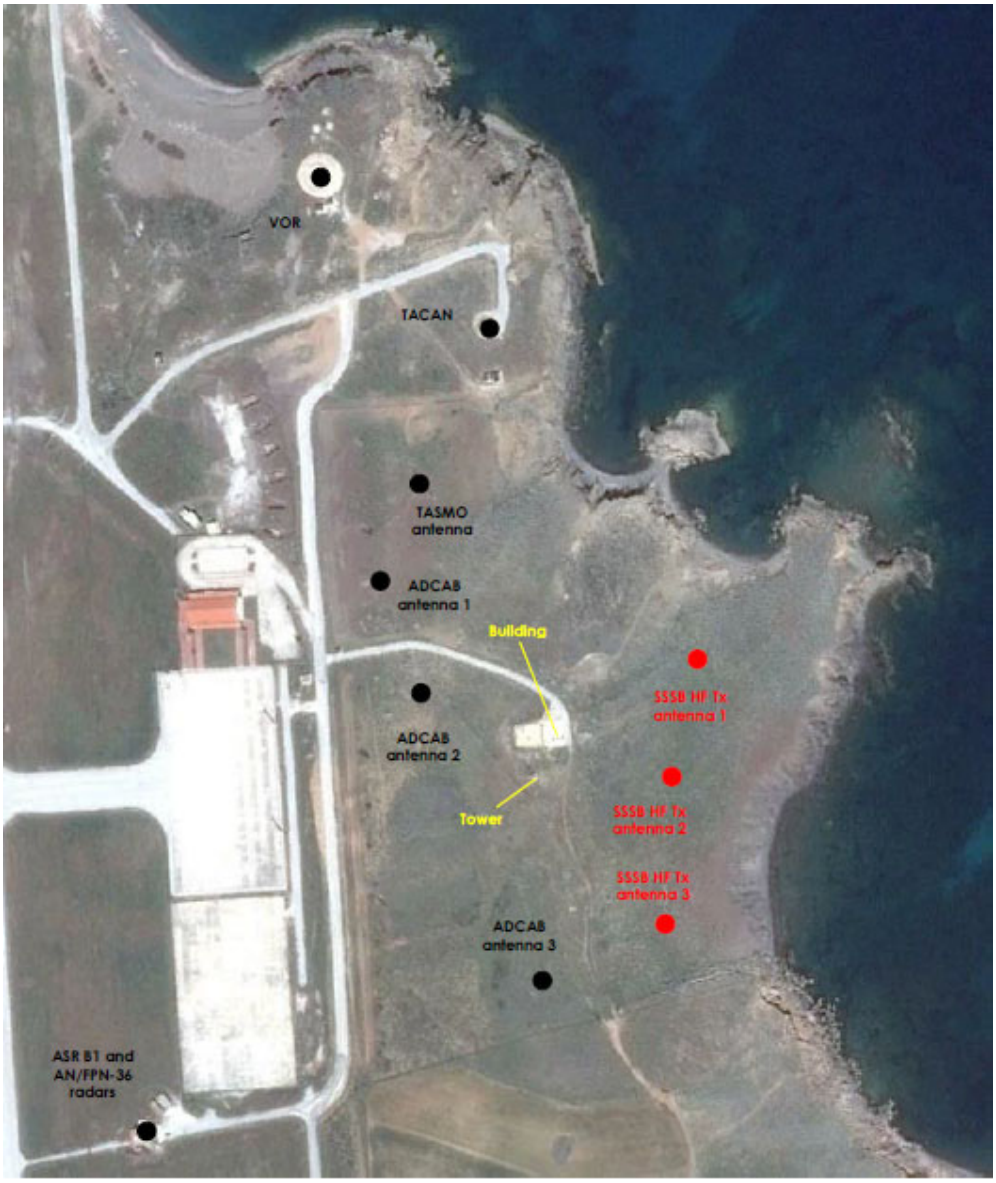


Figure 4: HF-TX Site Kartisinoudi (Skyros Island) – Current Site Configuration


Figure 5: HF-RX Site Limnonari (Skyros Island) – Current Site Configuration


Figure 6: New UHF Site 7th Air Force Radar Station (Skyros Island)

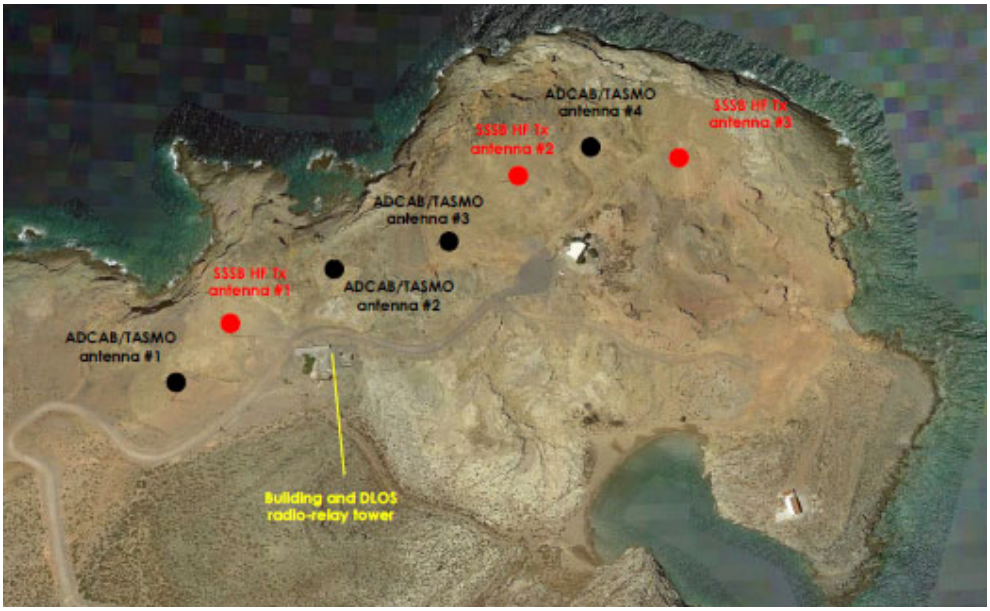


Figure 7: HF-RX site Cape Sideros (Crete Island) Current Site Configuration


Figure 8: HF-TX/UHF site Cape Mavros (Crete Island) Current Site Configuration

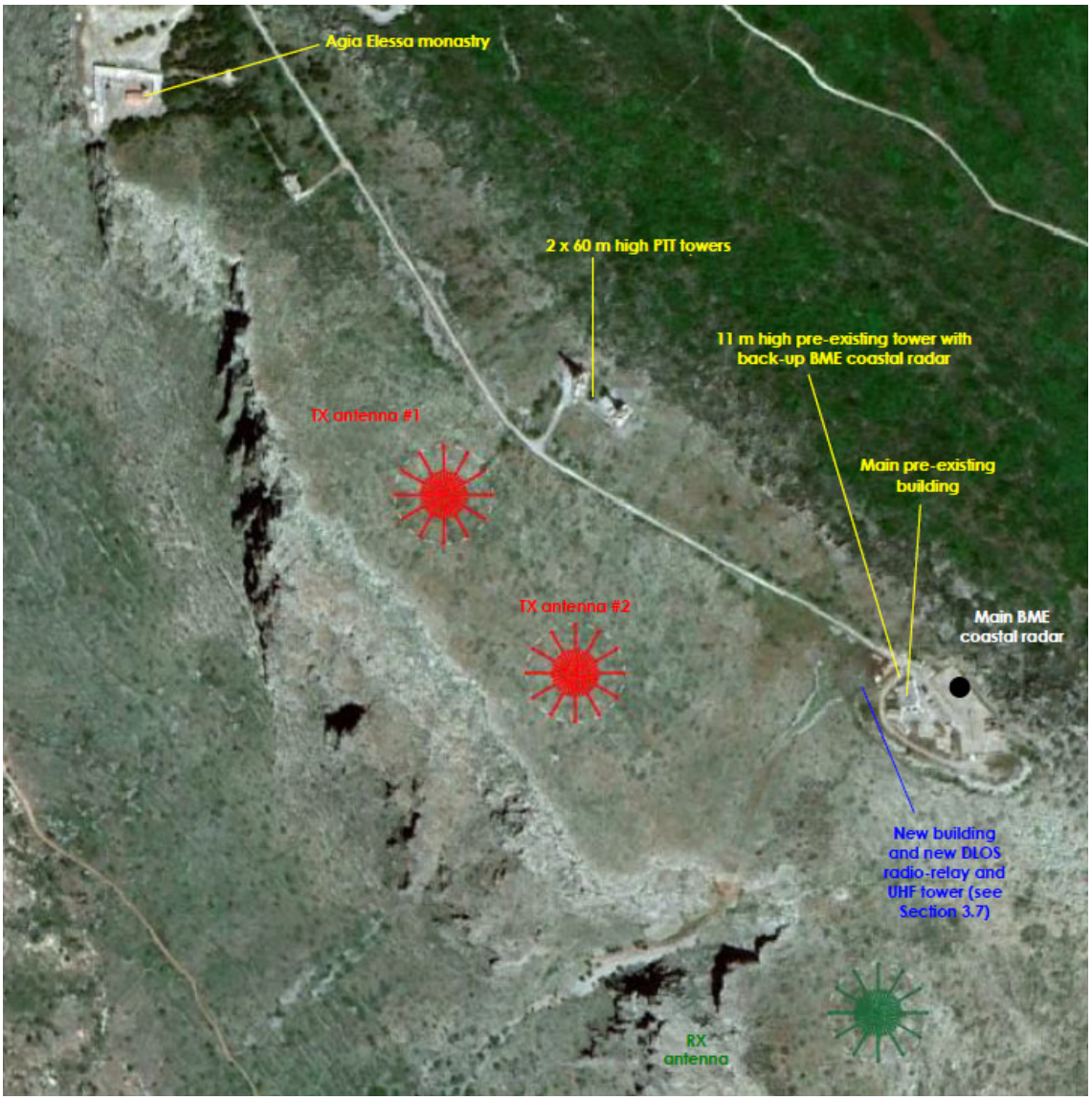


Figure 9: New HF TRX/UHF site Naval Entity (NE) 47 (Kythira Island)

| LOS Distances Km Elev (m) | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Kartsinoudi (Skyros) | Limnonari (Skyros) | 7th AF Radar (Skyros) | Sideros (Crete) | Mavros (Crete) | NE 47 (Kythera) | ARS Larissa | CRC Ziros (Crete) |
| 1 | 15 | Kartsinoudi (Skyros) | X | 25 | 7 | 437 | 440 | 340 | 208 | 459 |
| 2 | 28 | Limnonari (Skyros) | 25 | X | 18 | 414 | 416 | 330 | 230 | 437 |
| 3 | 187 | 7th AF Radar (Skyros) | 7 | 18 | X | 432 | 433 | 316 | 215 | 453 |
| 4 | 22 | Sideros (Crete) | 437 | 414 | 432 | X | 8 | 316 | 600 | 32 |
| 5 | 139 | Mavros (Crete) | 440 | 416 | 433 | 8 | X | 311 | 600 | 25 |
| 6 | 104 | NE 47 (Kythera) | 340 | 330 | 316 | 316 | 311 | X | 391 | 313 |
| 7 | 131 | ARS Larissa | 208 | 230 | 215 | 600 | 600 | 391 | X | 615 |
| 8 | 809 | CRC Ziros (Crete) | 459 | 437 | 453 | 32 | 25 | 313 | 615 | X |

Figure 10: Distances between SSSB Site locations (*Km*), Site elevations (*m*).

1.2.5 Radio Sites will consist of:

a. Site Monitoring System (SMS), providing the site status/alerts and equipment alerts.

b. Radio Communication Equipment. To be installed at the Radio Site and dedicated to the Ship-Shore-Ship communication in HF (BLOS) and in UHF (LOS) in the Link 11 and Link 22 mode for the Tactical Data exchange and in Voice mode for the operators' coordination; see Figure 11 to Figure 16.

1.2.6 Radio Management (local) Equipment. Equipment consisting of computers and interface concentrators to provide control of communication devices as follows:

a. The Radio Sites include one Low-Level Controller computer (LLC), one serial line concentrator (multi-serial), one network switch and one network router; see Figure 11 to Figure 16.

b. The HF-TX/UHF Site includes also a Radio-Over-IP (RoIP) converter (Narrow-Band/Wide-Band Gateway) for secure and non-secure Voice Coordination functions; see Figure 11, Figure 13, Figure 14 and Figure 16.

1.2.7 Data Link Equipment. Equipment consisting of Data Terminal Set (DTS) / Signal Processing Controller (SPC), Remote Versatile Link Interface (VLI/R) to provide Link 11 signal interface; see Figure 11 to Figure 16.

1.2.8 Automatic Identification System (AIS) receiver and a dedicated antenna for the reception of information. The AIS receivers in general are placed where HF-TX

capability is provided. Final decisions on site placement will follow the best LOS position for the AIS receiver.

1.2.9 Inter-site Communication:

a. Distributed system dedicated to the connection between the Radio sites and between the Radio sites and the Buffer Centres.

1.2.10 The Buffer Centres are dedicated to the six Radio Sites for:

a. Translation of the Link 11 and Link 22 protocols into Link-1, Link 11B and JREAP-C in accordance with STANAG 5511, STANAG 5522, STANAG 5601, STANAG 5616, STANAG 5518 (latest revisions). Presentation of the Air, Surface and Subsurface tactical picture. Processing of the Automatic Identification System (AIS) Receive-Only information.

b. Radio Management (remote).

c. Management of the VOICE Co-ordination of the Link 11/Link 22 data links.

d. Providing secure data encryption of Link 11 (COMSEC).

e. Providing secure data encryption of Link 22 (COMSEC).

f. Providing secure voice encryption for HF (COMSEC).

g. Providing secure voice encryption for UHF (COMSEC).

h. Providing Link 22 ECM-resistant (EPM) capability.

i. Providing ECM-resistant communications for UHF Voice (EPM Functionality - SATURN).

j. Monitoring of the status operations of infrastructure and equipment.

1.2.11 The overall responsibility of the implementation of the SSSB-GRC system lays with the NCI Agency (the Purchaser), whilst the implementation of the three sub-systems is delegated to:

a. The Contractor for the implementation of six Radio Sites, of nine (9) DLOS microwave inter-site communication systems and for one Fibre Optic (F/O) land line.

b. The THN for the provision of the inter-connection land lines between the Buffer Centres and the Radio Sites (via the NDN).

c. The NCI Agency for the implementation of the SSSB Buffer Control Centres (BCC) at ARS Larissa, CRC Panis and CRC Ziros.

## 1.3 Scope

1.3.1 The overall SSSB project consists of the following phases:

1.3.2 Phase 1:

1.3.3 General Civil Works, by the HN Contractor, for the Radio Sites, including buildings (including new build at NE47 on Kythira), electrical power supplies, HVAC, etc.

1.3.4 Phase 2:

a. A - Radio Communications and inter-sites communications, including associated equipment and civil works, by the Contractor, within scope of this Contract

b. B - Land Inter-sites Communications, by the THN

c. C - Command and Control system at the SSSB Buffer Centres by the NCI Agency

1.3.5 Phase 1: The Contractor shall implement the Civil Works portion of the SSSB at the sites at Kartsinoudi, Limnonari and at 7th Air Force Radar on the island of Skyros, Mavros and Sideros sites on the island of Crete and at Naval Entity (NE) 47 on the island of Kythira (this shall be a new build).

1.3.6 Phase's 2.A, 2.B and 2.C: Execution shall be co-ordinated, between the Contractor, the THN and the Purchaser, respectively NCI Agency.

1.3.7 The Contractor shall implement the Radio Communications portion of the SSSB project with the installation of the HF-TX/RX/UHF Sites at Kartsinoudi, Limnonari and 7th Air Force Radar sites on the island of Skyros, Mavros and Sideros sites on the island of Crete and a new site on the island Kythira within Phase 2.A.

1.3.8 In addition, the Contractor shall provide technical support to the THN and the Purchaser for phases 2.B and 2.C.

1.3.9 The technical support, to be provided by the Contractor, is to consist of, but not be limited to the following:

a. Assisting the THN and the Purchaser in the final identification of the number and characteristics of signals to be transported between the Sites;

b. Assisting the THN and the Purchaser in the integration and testing phases by generating the signals to be transported between the Sites;

c. Assisting the THN and the Purchaser in the overall system integration and testing phases. In the operation of the Radio Management System (RMS) from the Buffer Centres, local sites and verification of the correct transport of the signals between the sites and Buffer Centres.

### 1.4 Purchaser Furnished Equipment (PFE)

1.4.1 To allow the Contractor to complete the implementation of the Radio Sites a number of equipment is provided as PFE.

1.4.2 The PFE equipment/system provided for the technical integration of the SSSB is:

a. Radio Management Equipment, (See Para 1.4.5)

b. Versatile Link Interface, (See Para 1.4.6)

c. Narrowband/ Wideband Voice over IP Gateway, (See Para 1.4.7)

d. Advanced Link Analysis Module (ALAM), (See Para 1.4.8)

e. Time of Day (TOD), (See Para, 1.4.9)

1.4.3 PFE Specifications

1.4.4 The PFE specifications and characteristics are described below.

1.4.5 Radio Management:

a. Radio Management Console (RMC) - based on the SSSB Open System Communication Control (OSCC) Low Level Controller (LLC)

1.4.5.1 The RMC is the operator's interface to the Radio Management Sub-System (RMSS) and is part of the RMSS.

a. Provided to the Contractor as PFE

1.4.5.2 Operational requirements:

i. The RMC is implemented at all Radio Sites and the Buffer Centres.

ii. The RMC is mainly operated from the Buffer Centres, but can also be operated locally at the radio sites, to allow COMMS management, maintenance and site monitoring of all modalities, including Link 11/Link 22 Data.

1.4.5.3 Operational functions:

i. Local and remote control of the installed equipment for:

ii. Power up/down

iii. Mode selection

iv. Frequency selection

v. Power level selection, where applicable

vi. BITE

vii. Status monitor

1. Services – Equipment allocation
2. Access to the Local and Long Haul Networks for telephone communication between the Sites and the Buffer Centres.
3. PSTN (Public Switching Telephone Network) access
4. And other functionalities not listed here.

1.4.6 The Versatile Link Interface is a media converted between NTDS/ATDS interfaces to IP interface in accordance with:

a. MIL-STD-1397

b. ISO-8877

1.4.7 Narrowband/ Wideband Voice over IP Gateway provided to the Contractor as PFE is as follows:

a. The NB/WB Gateway provides signaling information transport for unsecured voice via IP between the SSSB Radio sites and the Buffer Centres SSSB

Operator position.

1.4.7.1 The NB/WB Gateway can:

i. Transport analog Unsecure Voice via IP (bi-directional)

ii. Transport radio PTT signal via IP

iii. Handle digital signals

iv. Handle VoIP streams

v. Provide standard serial interface for radios

1.4.8 The Advanced Link Analysis Module (ALAM) analyses Link 11 and Link 22 audio signals and quantifies their quality.

1.4.9 Time of Day (TOD)

c. TOD-HQ, GPS, military grade, SAASM, incusive the. antenna

# SECTION 2 SSSB System Requirements

## 2.1 Operational Dependence

2.1.1 The SSSB System is operationally dependent on the Buffer Centres at ARS Larissa, CRC Panis and CRC Ziros.

## 2.2 Connectivity

2.2.1 The inter-site connections between the Buffer Centres and the six Radio Sites shall be implemented via the GRC National Defence Network (NDN).

2.2.2 There shall be a main connection between the Buffer Centres and the radio sites, via the NDN.

2.2.3 There shall be fallback (backup) connection between all SSSB sites.

## 2.3 Standardisation

2.3.1 In order to allow interoperability of the HF/UHF radio elements the Contractor shall respect the technical prescriptions contained in the following, (but not limited to) NATO and Military Standards:

a. STANAG 5511 TACTICAL DATA EXCHANGE – LINK 11/11B, Ed. 9, January 2016, NATO UNCLASSIFIED

b. STANAG 5501, Tactical Data Exchange – Link 1 (Point-to-Point), Ed. 7, NATO UNCLASSIFIED

c. STANAG 5601, “Standards for Interface of NATO Data – Links 1, 11, 11B and 14 Through a Buffer”, edition 7, January 2014, NATO UNCLASSIFIED

d. STANAG 5501, Tactical Data Exchange – Link 1 (Point-to-Point), Ed. 7

e. MIL-STD-1397C(SH), ”INPUT / OUTPUT INTERFACES, STANDARD DIGITAL DATA,NAW SYSTEMS”, 1 June 1995, UNCLASSIFIED.

f. STANAG 5522 NATO IMPROVED LINK ELEVEN (NILE) - LINK 22, Ed. 5, January 2016, NATO UNCLASSIFIED.

g. NG-278-A011-LLCIRS, Interface Requirements Specification (IRS) for the Link-Level COMSEC (LLC) segment of the Link 22 (NILE) System, NILE PMO, 28 July 2016.

h. NG-278-A011-SPCSS, Segment Specification for the Signal Processor Controller (SPC) of the Link 22 (NILE) System, NILE PMO, 28 July 2016.

i. STANAG 5518, JOINT RANGE EXTENSION APPLICATION PROTOCOL (JREAP. Ed, 4,26-Apr-2019, NATO UNCLASSIFIED.

j. STANAG 4372 Ed 3
SATURN – A fast frequency hopping ECCM mode for UHF radio

k. ITU-R M.1371-4, Technical characteristic for an Automatic identification system using time-division multiple access in the VHF maritime mobile band, 04/2010

l. NMEA 0183, Standard for Interfacing Marine Electronic Devices.

m. RFC 2833 RTP Payload for DTMF Digits, Telephony Tones and Telephony Signals (VoIP)

n. RFC 3261 Session Initialization Protocol (SIP) (VoIP)

o. RFC 3350 Real Time Protocol (RTP) (VoIP)

p. RFC 3351 Real Time Protocol (RTP) (VoIP)

q. EUROCAE ED 137 (RoIP)

r. MIL-STD-188-203A, Interoperability and Performance Standards for Tactical Digital Information Link (TADIL) A, 8 January 1988.

2.3.2 The Contractor shall implement the Radio Communications System (RCS) and associated equipment and Civil Works in compliance with the governing THN electrical standards.

2.3.3 The Contractor shall implement the RCS and associated equipment and Civil Works in compliance with the Low Voltage Directive 2006/95/EC and/or THN equivalent.

## 2.4 Design requirements

2.4.1 In order to remove the impact of long haul lines delay in the Link 11 “DTS Split” configuration, the Contractor shall implement Link 11 using “Local DTS” configuration at the Radio Site (RS) and the NATO Versatile Link Interface (VLI) architecture between the Buffer Centres and the Radio Site (RRS) (see paragraph 5.1).

2.4.2 The Contractor shall dimension the system to allow implementation of the Tactical Data Link 22 service. The Link 22 service will use the existing Link 22 radios via the Link 22 modem (SPC).

2.4.3 The Contractor is to design the system in order to allow remote control of operational commands and manual control of maintenance commands. In the design and implementation of the automation and the remote control systems the following criteria shall be used:

a. The TX Radio Site at Kartsinoudi (Skyros) will not be manned.

b. The RX Radio Site at Limnonari (Skyros) will not be manned.

c. The UHF Radio Site at 7$^{th}$ AF Radar Site (Skyros) will not be manned

d. The TX/UHF Radio Site Mavros (Crete) will not be manned.

e. The RX Radio Site at Sideros (Crete) will not be manned.

f. The TX/RX/UHF Radio Site on Kythira will be manned

2.4.4 For the PFE sub-system for control and management of the communication equipment the Contractor shall provide the technical documentation and

support to the purchaser in the configuration and customisation of the sub-system in relation to the communication equipment delivered by the Contractor.

2.4.5 The Data Link Equipment (DLE) and the RMSS will be provided to the Contractor as PFE six (6) weeks before the Factory Acceptance Test (FAT). The FAT is the last stage before commencing the on-site implementation activities. The handover of the PFE will allow the Contractor to be autonomous and independent in the implementation and the implementation verification of the six Radio Sites.

2.4.6 At the FAT the contractor shall provide fully equipped and fully integrated racks for the six radio sites (including PFE, radio and COMMS equipment and full applied wiring).

2.4.7 The FAT shall cover Voice and Data signal verification, equipment test, wiring test and SSSB functional test of the all RRH sites systems. The interconnection wiring between the racks shall represent a one-to-one wiring replication as integrated at the radio sites.

2.4.8 Local and remote COMMS control capability verification shall be part of the FAT, where the RMSS shall be used to prove the remote control capability. Local control capability shall be proven using the individual device control user interfaces.

2.4.9 A functional test of the Site Monitoring System (SMS) shall be included in the FAT.

2.4.10 It is the Contractor's responsibility to test the integration of the Contractor-provided equipment with relevant equipment, elements and systems provided as PFE and demonstrate that both the Contractor's equipment and PFE are compatible and function correctly as stipulated SOW Section 3 and described in the enclosed document references.

2.4.11 The Contractor is also required to provide all the necessary support to the Purchaser and the THN for system integration and testing.

## 2.5 Operational Requirements

2.5.1 The fundamental requirement of the SSSB system is to implement a data exchange for:

a. Network Link 11 – TADIL A without degradation of the information content, as specified in Para 2.3.1 Ref. a, r.

b. Network Link 22 – NILE without degradation of the information content as specified in Para 2.3.1 Ref. f, g, h.

2.5.2 The integration of the Radio Sites with the SSSB BCC (at the Buffer Centres) shall allow air and naval surveillance of the Aegean Sea: in the HF frequency range with data Link 11/Link 22 mode and VOICE mode, up to 300 NM[1], and in the UHF spectrum up to 28 NM Ground-to-Ground and 150 NM Ground-to-Air.

[1] LINK-22 will also be supporting the Long Range waveform for distances up to 1000 NM.

Monitoring and control of communication resources will be delegated to the Buffer Centres.

## 2.6 Configuration of the SSSB System

2.6.1 The principle SSSB system sites are:

a. The Buffer Centres, located at ARS Larissa, CRC Panis and CRC Ziros which will be implemented by NATO NCI Agency.

b. HF-TX/RX/UHF Sites at Kartsinoudi, Limnonari and new UHF component at 7th Air Force Radar sites on the island of Skyros, Mavros and Sideros sites on the island of Crete and a new site on the island of Kythira, shall be implemented by the Contractor.

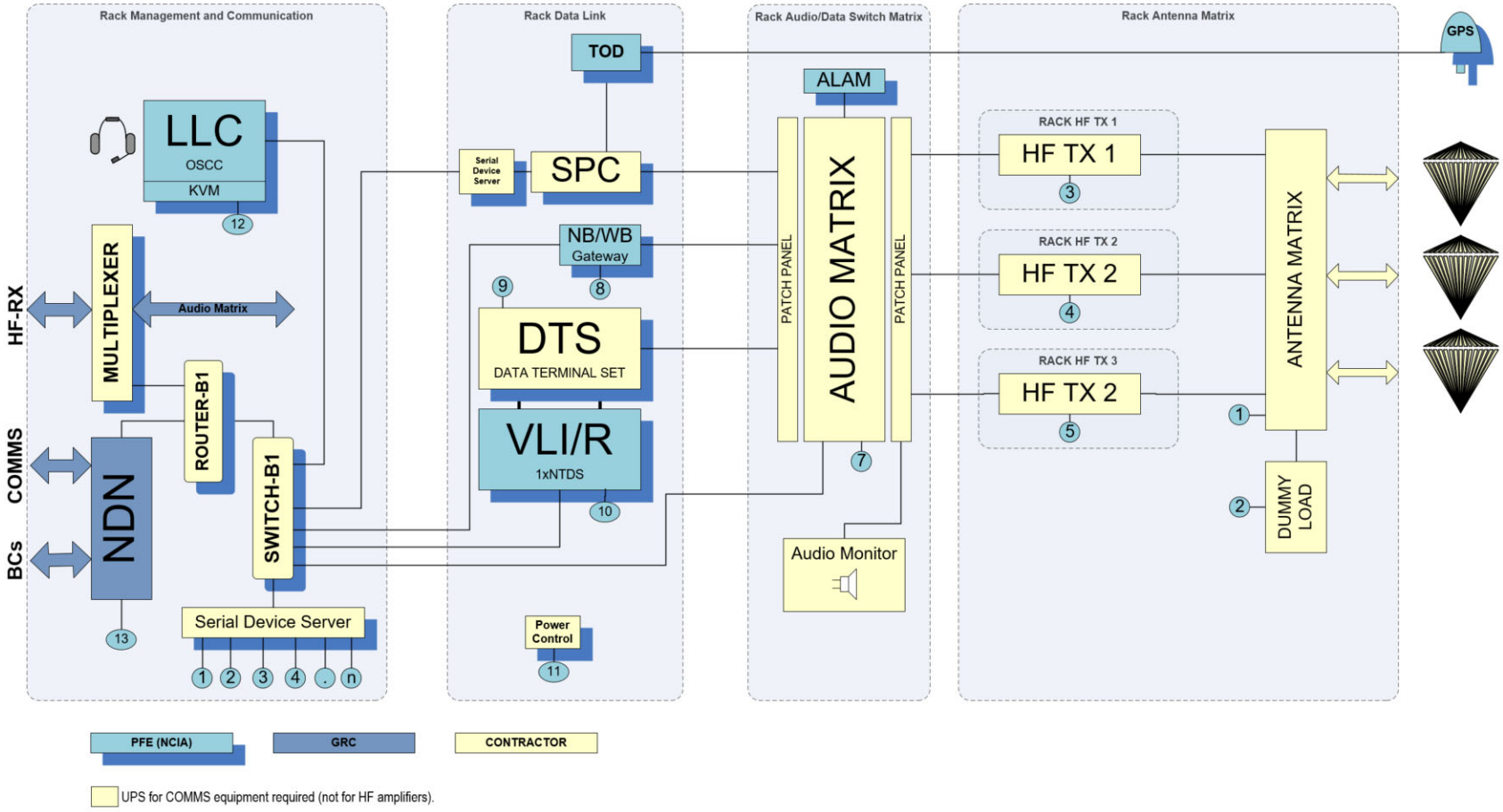


Figure 11: HF-TX Kartsinoudi (Skyros) Radio site block diagram

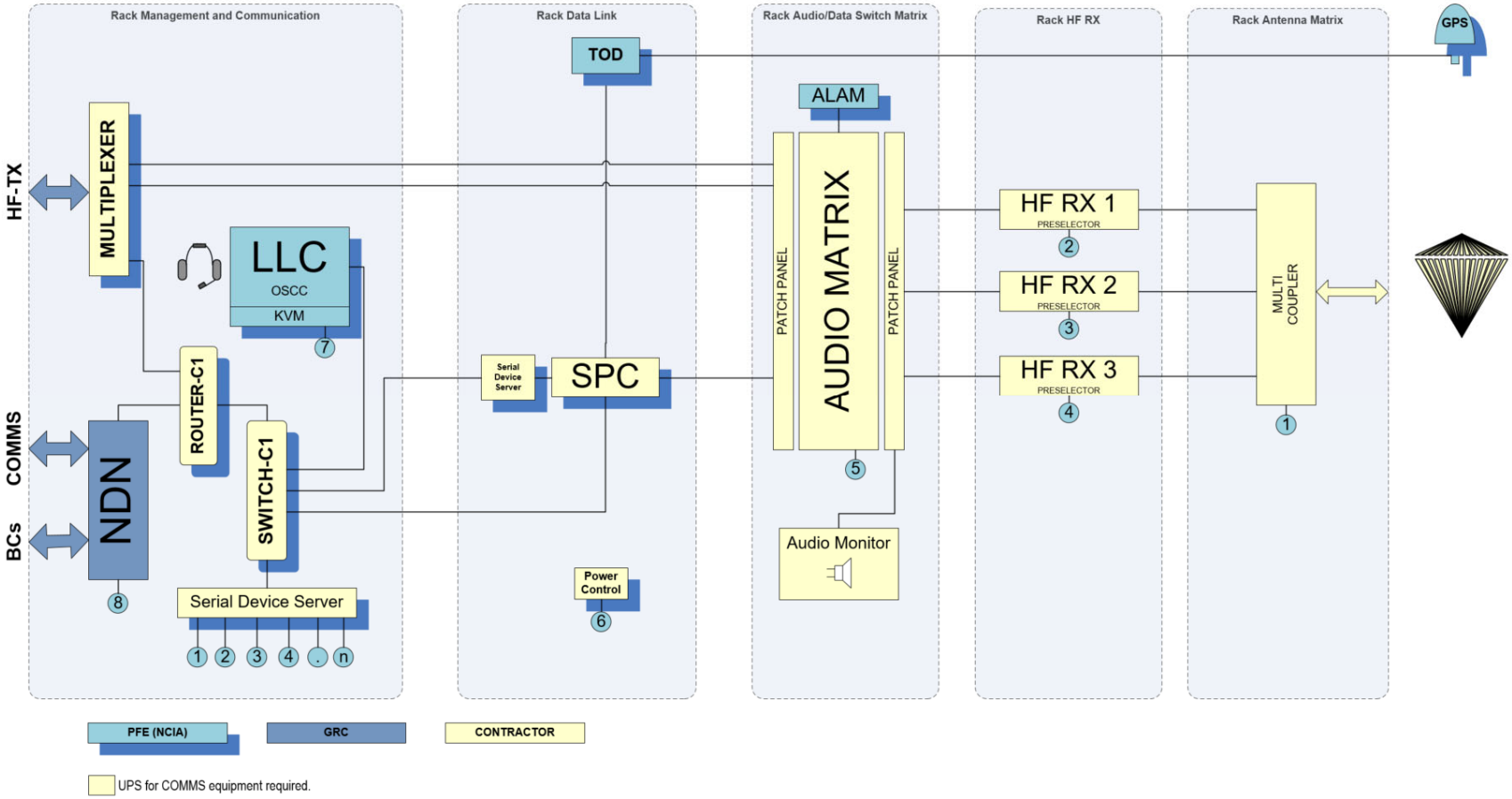


Figure 12: HF-RX Limnonari (Skyros) Radio site block diagram

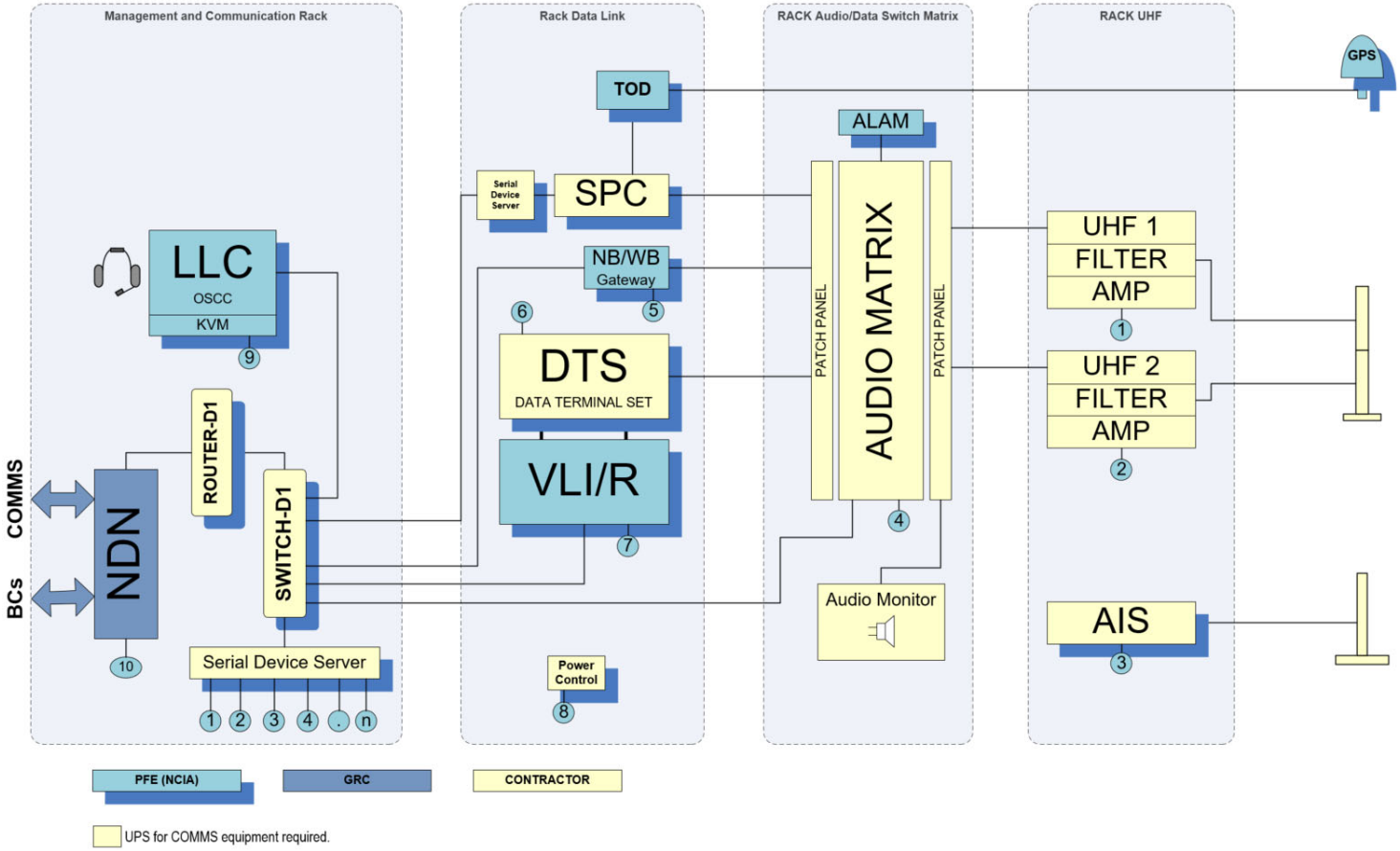


Figure 13: UHF 7th AF Radar Station (Skyros) Radio site block diagram

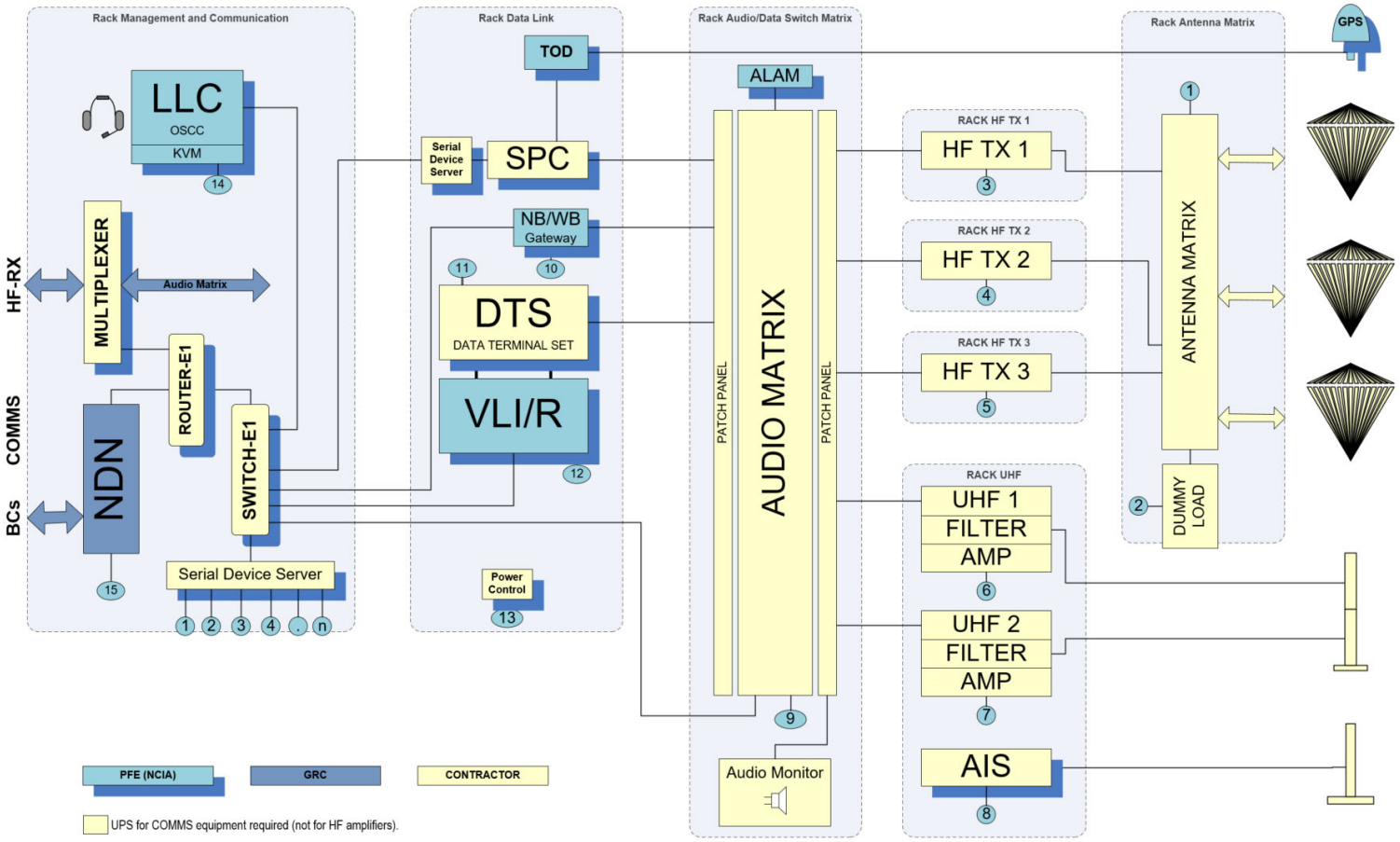


Figure 14: HF-TX/UHF Mavros (Crete) Radio site block diagram

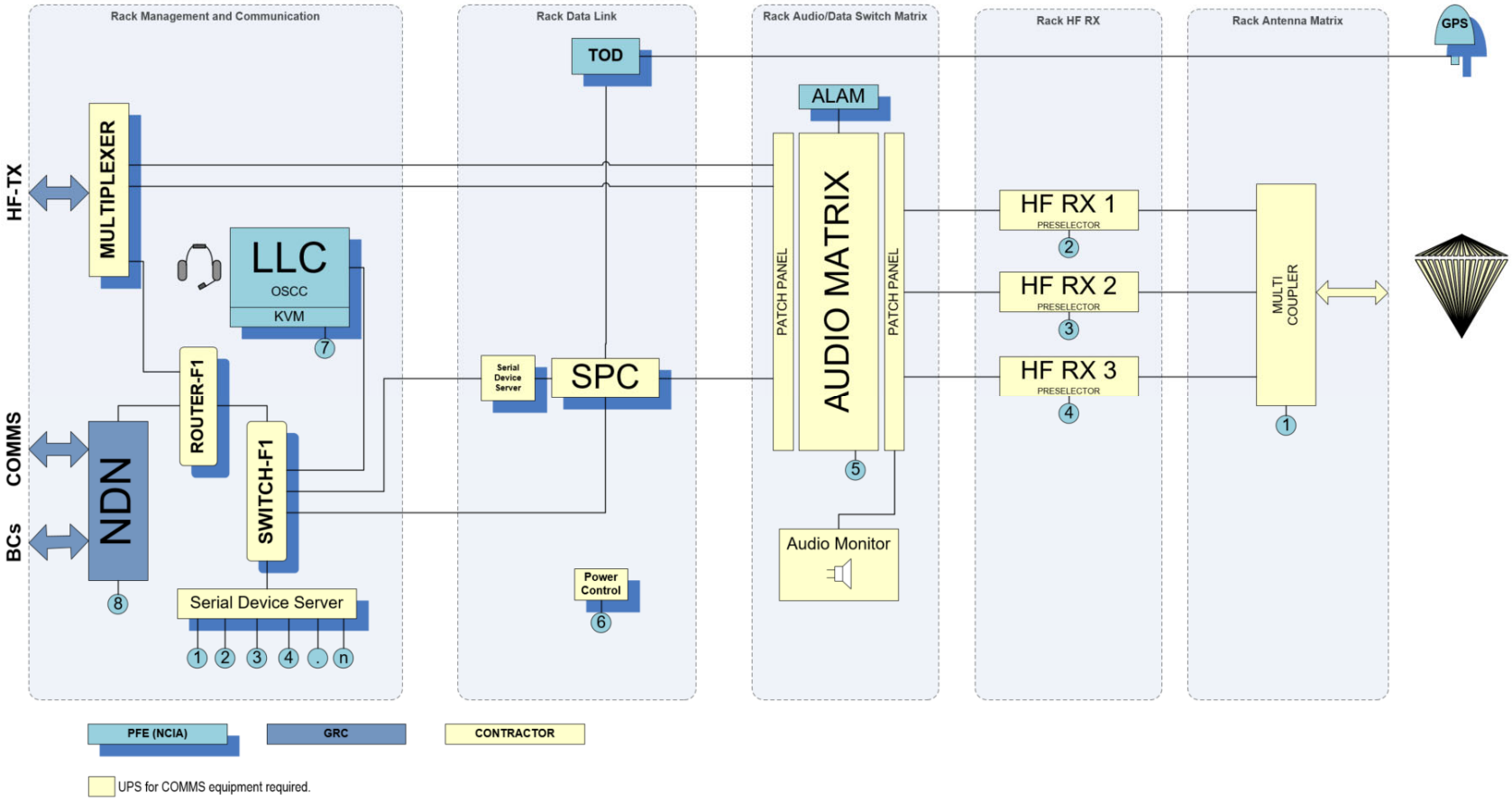


Figure 15: HF-RX Sideros (Crete) Radio site block diagram

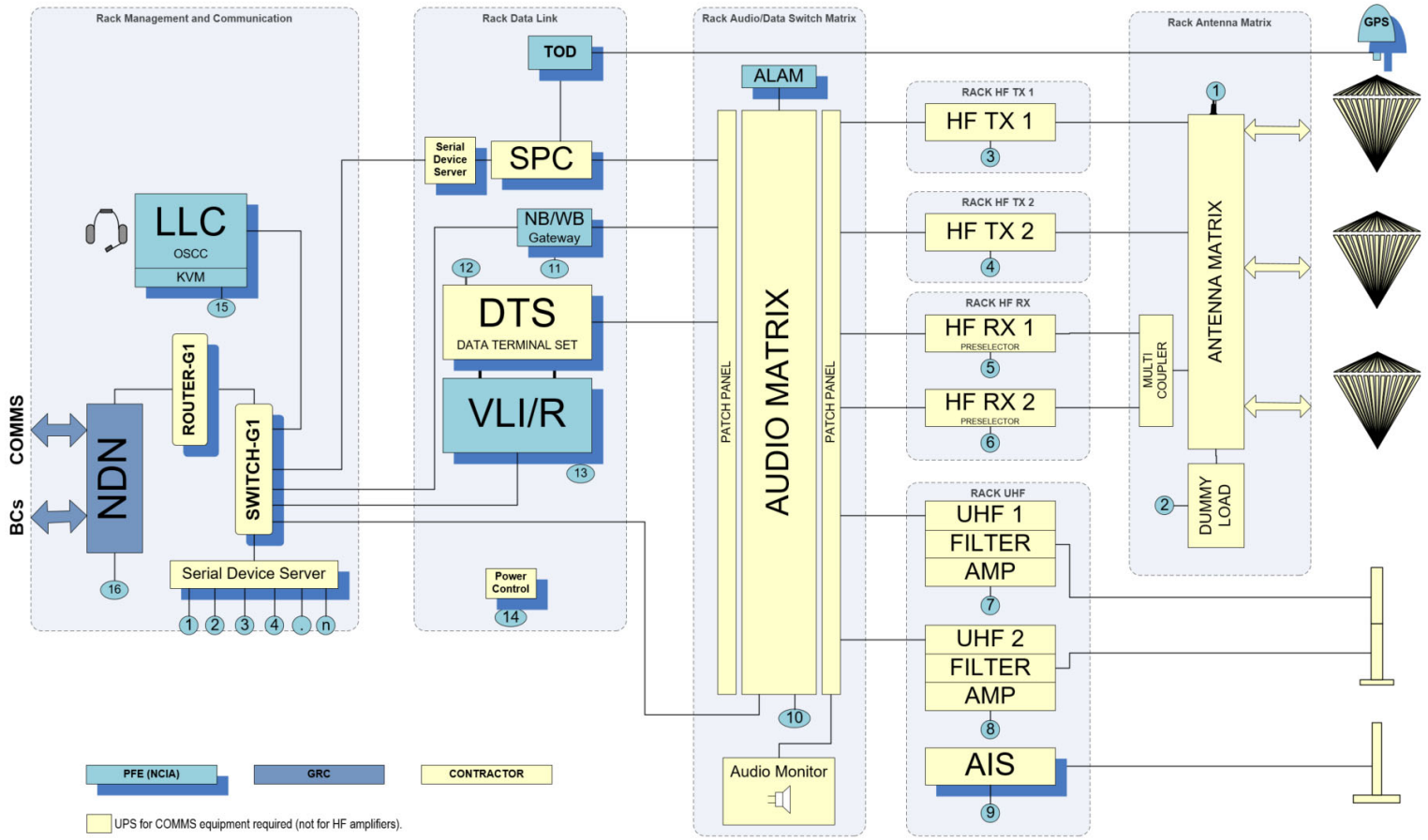


Figure 16: HF-RX/TX/UHF Kythira Radio site block diagram

## 2.7 Multichannel analysis of surface waves (MASW) / Cone Penetration Test (CPT) and Geotechnical Assessment Analysis

2.7.1 For each COMMS site the contractor shall provide a study/analysis covering the following topics, but not limited to, depending on the individual situation of each COMMS site:

a. Fulfilment of project requirements

b. Interference/distortion with other internal or external systems are existing:

i. HF, UHF and DLOS

ii. RX and TX

iii. Selected antennae

iv. Towers

c. Antenna Field and placement of SSSB Antennas

d. Interference with on-site installed Radars

2.7.2 For RX in addition:

a. Radiation from lightning discharges (atmospheric noise due to lightning)

b. Unintended radiation from electrical machinery, electrical and electronic equipment, power transmission lines, or from internal combustion engine ignition (man-made noise)

c. Emissions from atmospheric gases and hydrometeors

d. The ground or other obstructions within the antenna beam

e. Radiation from celestial radio sources

2.7.3 Soil Examination:

a. Multichannel analysis of surface waves (MASW) as conventional seismic approach for near surface investigation including seismic anomaly detection.

b. Cone Penetration Test (CPT) for detection of geotechnical properties of existing soils.

c. Detailed MASW/CPT analysis result and Geotechnical assessment result

d. Type and sizing of the selected foundations

## 2.8 Radio Communication Sub-system Kartsinoudi (Skyros)

2.8.1 The SSSB COMMS system at Skyros is non-collocated composed of three separated sites HF-TX, HF-RX and UHF-TRX locations.

2.8.2 This site is a non-collocated HF-TX location.

2.8.3 The Contractor shall:

a. Install and integrate CIS and the PFE equipment at the radio sites, including supporting sub-systems (e.g. UPS, SMS, etc.)

b. Implement necessary Civil Works related directly to CIS equipment provided by the Contractor and any additional necessary Civil Works outside the main Civil Works, which were already contracted by the HN under a separate Contract.

c. Test, monitor and control the needed equipment including Aerials, Antennae, Radio equipment, etc.

2.8.4 Block diagram showing the components related to the Radio Communication site is provided in Figure 11.

2.8.5 The Contractor shall provide the “yellow” colored components and integrate the others, under the scope of this Contract.

2.8.6 HF-TX Components:

a. HF-TX radio component

b. Radio management, Link 11 DTS, Link 22 SPC, TOD and VLI/R

c. Routers, Multiplexer, Switches and Serial Converters

d. Long distance comms land line to the Buffer Centre at ARS Larissa, CRC Panis and CRC Ziros to the other SSSB COMMS sites.

2.8.7 HF-TX Equipment.

1.5.1.1 The Contractor is to provide, but not limited to, the following equipment for the radio components, less any equipment listed as PFE:

v. HF-TX Antenna field

1. Qty 3 Wide band monocone antennas, vertical polarization for SSSB.

2. RF cabling (incl. trenching)

vi. HF Transmitters

vii. Qty 3 HF Solid State Radio Transmitters 5 kW for SSSB (Link 11, Link 22 and Voice), including cooling/ventilation system

viii. Qty 1 Antenna matrix for HF-TX antennas

ix. Qty 1 Dummy load 5 kW

x. Qty 1 Audio data/voice switch matrix, also capable of switching Link 22 discrete signals, with patch panels

xi. Qty 1 Audio Monitor

xii. Qty 1 ALAM (PFE)

xiii. Qty 1 TOD-HQ, GPS, military grade, SAASM, incl. antenna (PFE)

xiv. Qty 1 DTS

xv. Qty 1 SPC

xvi. Qty 1 VLI/R (PFE)

xvii. Qty 1 Radio Management Equipment Set (PFE)

xviii. Qty 1 Narrow-Band/Wide-Band Gateway (secure and unsecure voice) (PFE)

xix. Qty 1 Multiplexer

xx. Qty 1 Network Router

xxi. Qty 1 Network Switch

xxii. Qty 2 Serial Device Servers, RS-232/RS-422

xxiii. Power switch with remote control capability.

xxiv. All racks with accessories, internal and cabling

xxv. UPS for COMMS equipment, except for HF-TX amplifiers.

2.8.8 DLOS connection in conjunction with the Final GRC National Defense Network (NDN) Design, as appropriate.

2.8.9 The civil works to be implemented by the Contractor shall include but not limited to the implementation of Antenna fields including RF cables and ducting.

2.8.10 Other CW requirements that are the Contractor responsibility are specified in SOW Section 12 and more specifically in the GRC specific System Requirements Specification (Civil Works) Annex (SRS (CW)) I.

## 2.9 Radio Communication Sub-system Limnonari (Skyros)

2.9.1 The SSSB COMMS system at Skyros is non-collocated composed of three separated sites HF-TX, HF-RX and UHF-TRX locations.

2.9.2 This site is a non-collocated HF-RX location.

2.9.3 The Contractor shall:

a. Install and integrate CIS and the PFE equipment at the radio sites, including supporting sub-systems (e.g. UPS, SMS, etc.).

b. Implement necessary Civil Works related directly to CIS equipment provided by the Contractor and any additional necessary Civil Works outside the main Civil Works, which were already contracted by the HN under a separate Contract.

c. Test, monitor and control the needed equipment including Aerials, Antennae, Radio equipment, etc.

2.9.4 Block diagram showing the components related to the Radio Communication site is provided in Figure 12

2.9.5 The Contractor shall provide the “yellow” colored components and integrate the others, under the scope of this Contract.

2.9.6 HF-RX Components:

a. HF-RX radio component

b. Radio management, Link 22 SPC, TOD

c. Routers, Multiplexer, Switches and Serial Converters

d. Long distance comms land line to the Buffer Centre at ARS Larissa, CRC Panis and CRC Ziros to the other SSSB COMMS sites.

**2.9.7 HF- RX Equipment.**

2.9.8 The Contractor is to provide, but not limited to, the following equipment for the radio components, less any equipment listed as PFE:

a. HF-RX Antenna field

i. Qty 1 Wide band monocone antenna, vertical polarization for SSSB, 3 channels

ii. RF cabling

b. HF Receivers component

i. Qty 3 HF Receivers for SSSB with preselectors

ii. Qty 1 HF multi-coupler

iii. Qty 1 Audio data/voice switch matrix, also capable of switching Link 22 discrete signals, with patch panels

iv. Qty 1 Audio Monitor

v. Qty 1 ALAM (PFE)

vi. Qty 1 TOD-HQ, GPS, military grade, SAASM, incl. antenna (PFE)

vii Qty 1 SPC

viii Qty 1 Radio Management Equipment Set (PFE)

ix. Qty 1 Multiplexer

x. Qty 1 Network Router

xi. Qty 1 Network Switch

xii. Qty 2 Serial Device Servers, RS-232/RS-422

xiii. Qty 1 Power switch with remote control capability.

xiv. UPS for COMMS equipment.

2.9.9 The civil works to be implemented by the Contractor shall include but not limited to the implementation of Antenna fields including RF cables and ducting.

2.9.10 Other CW requirements that are Contractor responsibility are specified in SOW Section 14 and the SRS (CW) Annex.

## 2.10 Radio Communication Sub-system 7th Air Force Radar Site (Skyros)

2.10.1 The SSSB COMMS system at Skyros is non-collocated composed of three separated sites HF-TX, HF-RX and UHF-TRX locations.

2.10.2 This site is a non-collocated UHF TRX location.

2.10.3 The Contractor shall:

a. Install and integrate CIS and the PFE equipment at the radio sites, including supporting sub-systems (e.g. UPS, alarm control, monitoring, etc.)

b. Implement necessary Civil Works related directly to CIS equipment provided by the Contractor and any additional necessary Civil Works outside the main Civil Works, which were already contracted by the HN under a separate Contract.

c. Test, monitor and control the needed equipment including Aerials, Antennae, Radio equipment, etc.

2.10.4 Block diagram showing the components related to the Radio Communication site is provided in Figure 13.

2.10.5 The Contractor shall provide the “yellow” colored components and integrate the others, under the scope of this Contract.

2.10.6 UHF TRX Components:

a. UHF radio component

b. Radio management, Link 11 DTS, Link 22 SPC, TOD and VLI/R

c. AIS reception component

d. Routers, Switches and Serial Converters

e. Long distance comms land line to the Buffer Centre at ARS Larissa, CRC Panis and CRC Ziros to the other SSSB COMMS sites.

UHF Equipment.

The Contractor is to provide, but not limited to, the following equipment for the radio components, less any equipment listed as PFE:

a. UHF Antennas

b. Qty 1 Co-linear antenna with two channels

c. RF cabling (incl. trenching)

d. UHF TRX component

e. Qty 2 100 W UHF radio transceivers upgradable to support Link 22 EPM and Voice SATURN and Have Quick II
The UHF radios shall be upgradeable latest at Site Acceptance Test (SAT)

Qty 2 UHF Amplifiers

Qty 1 AIS receiver with antenna (PFE)

f. Qty 1 Audio data/voice switch matrix, also capable of switching Link 22

discrete signals, with patch panels

g. Qty 1 Audio Monitor
h. Qty 1 ALAM (PFE)
i. Qty 1 TOD-HQ, GPS, military grade, SAASM, incl. antenna (PFE)
j. Qty 1 DTS
k. Qty 1 SPC
l. Qty 1 VLI/R (PFE)
m. Qty 1 Radio Management Equipment Set (PFE)
n. Qty 1 Narrow-Band/Wide-Band Gateway (secure and unsecure voice) (PFE)
o. Qty 1 Network Router
p. Qty 1 Network Switches
q. Qty 2 Serial Device Servers, RS-232/RS-422
r. Qty 1 Power switch with remote control capability.
s. All racks with accessories, internal and cabling
t. UPS for COMMS equipment.
u. Power switch with remote control capability.

2.10.7 DLOS connection in conjunction with the Final GRC National Defense Network (NDN) Design, as appropriate.

2.10.8 The civil works to be implemented by the Contractor shall include but not limited to the implementation of Antenna fields including RF cables and ducting.

2.10.9 Other CW requirements that are the Contractor responsibility are specified in SOW Section 14 and more specifically in the System Requirements Specification (Civil Works) Annex (SRS (CW)).

## 2.11 Radio Communication Sub-system Mavros (Crete)

2.11.1 The SSSB COMMS system at Skyros is non-collocated composed of three separated sites HF-TX, HF-RX and UHF-TRX locations.

2.11.2 This site is a non-collocated HF-TX/UHF-TRX location.

2.11.3 The Contractor shall:

a. Install and integrate CIS and the PFE equipment at the radio sites, including supporting sub-systems (e.g. UPS, alarm control, monitoring, etc.)

b. Implement necessary Civil Works related directly to CIS equipment provided by the Contractor and any additional necessary Civil Works outside the main

Civil Works, which were already contracted by the HN under a separate Contract.

c. Test, monitor and control the needed equipment including Aerials, Antennae, Radio equipment, etc.

2.11.4 Block diagram showing the components related to the Radio Communication site is provided in Figure 14.

2.11.5 The Contractor shall provide the “yellow” colored components and integrate the others, under the scope of this Contract.

2.11.6 HF-TX/UHF Components:

i. HF-TX radio component

ii. UHF radio component

iii. Radio management, Link 11 DTS, Link 22 SPC, TOD and VLI/R

iv. AIS reception component

v. Routers, Switches and Serial Converters

vi. Long distance comms land line to the Buffer Centre at ARS Larissa, CRC Panis and CRC Ziros to the other SSSB COMMS sites.

HF-TX/UHF Equipment. The Contractor is to provide, but not limited to, the following equipment for the radio components, less any equipment listed as PFE:

a.HF-TX Antenna field

i. Qty 3 Wide band monocone antennas, vertical polarization for SSSB.

ii. RF cabling (incl. trenching)

b. UHF Antennas

i. Qty 1 Co-linear antenna with two channels

ii. RF cabling (incl. trenching)

c. HF Transmitters, UHF-RX/TX component

i. Qty 3 HF Solid State Radio Transmitters 5 kW for SSSB (Link 11, Link 22 and Voice), including cooling/ventilation system

ii. Qty 1 Antenna matrix for HF-TX antennas

iii. Qty 1 Dummy load 5 kW

iv. Qty 2 100 W UHF radio transceivers upgradable to support Link 22 EPM and Voice SATURN and Have Quick II.
The UHF radios shall be upgradeable latest at Site Acceptance Test (SAT)

v. Qty 1 AIS receiver with antenna (PFE)

vi. Qty 1 Audio data/voice switch matrix, also capable of switching Link 22 discrete signals, with patch panels

vii. Qty 1 Audio Monitor

viii. Qty 1 ALAM (PFE)

ix. Qty 1 TOD-HQ, GPS, military grade, SAASM, incl. antenna (PFE)

x. Qty 1 DTS

xi. Qty 1 SPC

xii. Qty 1 VLI/R (PFE)

xiii. Qty 1 Radio Management Equipment Set (PFE)

xiv. Qty 1 Narrow-Band/Wide-Band Gateway (secure and unsecure voice) (PFE)

xv. Qty 1 Network Router

xvi. Qty 1 Network Switch

xvii. Qty 1 Multiplexer

xviii. Qty 2 Serial Device Servers, RS-232/RS-422

xix. Qty 1 Power switch with remote control capability.

xx. All racks with accessories, internal and cabling

xxi. UPS for COMMS equipment, except for HF-TX amplifiers.

2.11.7 DLOS connection in conjunction with the Final GRC National Defense Network (NDN) Design, as appropriate.

2.11.8 The civil works to be implemented by the Contractor shall include but not limited to the implementation of Antenna fields including RF cables and ducting.

2.11.9 Other CW requirements that are the Contractor responsibility are specified in SOW Section 14 and more specifically in the System Requirements Specification (Civil Works) Annex (SRS (CW)).

## 2.12 Radio Communication Sub-system Sideros (Crete)

2.12.1 The SSSB COMMS system at Skyros is non-collocated composed of three separated sites HF-TX, HF-RX and UHF-TRX locations.

2.12.2 This site is a non-collocated HF RX location.

2.12.3 The Contractor shall:

a. Install and integrate CIS and the PFE equipment at the radio sites, including supporting sub-systems (e.g. UPS, alarm control, monitoring, etc.)

b. Implement necessary Civil Works related directly to CIS equipment provided by the Contractor and any additional necessary Civil Works

outside the main Civil Works, which were already contracted by the HN under a separate Contract.

c. Test, monitor and control the needed equipment including Aerials, Antennae, Radio equipment, etc.

2.12.4 Block diagram showing the components related to the Radio Communication site is provided in Figure 16.

2.12.5 The Contractor shall provide the “yellow” colored components and integrate the others, under the scope of this Contract.

2.12.6 HF-RX Components:

a. HF-RX radio component

b. Radio management, Link 22 SPC, TOD

c. Routers, Switches and Serial Converters

d. Long distance comms land line to the Buffer Centre at ARS Larissa, CRC Panis and CRC Ziros to the other SSSB COMMS sites.

HF-RX Equipment. The Contractor is to provide, but not limited to, the following equipment for the radio components, less any equipment listed as PFE:

a. HF-RX Antenna field

i. Qty 1 Wide band monocone antennas, vertical polarization for SSSB, 3 channels

ii. RF cabling

b. HF Receivers component

i. Qty 3 HF Receivers for SSSB with preselectors

ii. Qty 1 HF multi-coupler

iii. Qty 1 Audio data/voice switch matrix, also capable of switching Link 22 discrete signals, with patch panels

iv. Qty 1 Audio Monitor

v. Qty 1 ALAM (PFE)

vi. Qty 1 TOD-HQ, GPS, military grade, SAASM, incl. antenna (PFE)

vii. Qty 1 SPC

viii. Qty 1 Radio Management Equipment Set (PFE)

ix. Qty 1 Network Router

x. Qty 1 Network Switch

xi. Qty 1 Multiplexer

xii. Qty 2 Serial Device Servers, RS-232/RS-422

xiii. Qty 1 Power switch with remote control capability.

xiv. All racks with accessories, internal and cabling

xv. UPS for COMMS equipment.

2.12.7 DLOS connection in conjunction with the Final GRC National Defense Network (NDN) Design, as appropriate.

2.12.8 The civil works to be implemented by the Contractor shall include but not limited to the implementation of Antenna fields including RF cables and ducting.

2.12.9 Other CW requirements that are the Contractor responsibility are specified in SOW Section 14 and more specifically in the System Requirements Specification (Civil Works) Annex (SRS (CW)).

## 2.13 Radio Communication Sub-system NOP-47S (Kythira)

2.13.1 The SSSB COMMS system at Skyros is non-collocated composed of three separated sites HF-TX, HF-RX and UHF-TRX locations.

2.13.2 This site is a collocated HF-TX, HF-RX and UHF-TRX location.

2.13.3 The Contractor shall:

a. Install and integrate CIS and the PFE equipment at the radio sites, including supporting sub-systems (e.g. UPS, alarm control, monitoring, etc.)

b. Implement necessary Civil Works related directly to CIS equipment provided by the Contractor and any additional necessary Civil Works outside the main Civil Works, which were already contracted by the HN under a separate Contract.

c. Test, monitor and control the needed equipment including Aerials, Antennae, Radio equipment, etc.

2.13.4 Block diagrams showing the components related to the Radio Communication sites are described in Figure 16.

2.13.5 The Contractor shall provide the “yellow” colored components and integrate the others, under the scope of this Contract.

2.13.6 HF-TX/RX/UHF Components:

a. HF-TX radio component

b. HF-RX radio component

c. UHF radio component

d. Radio management, Link 11 DTS, Link 22 SPC, TOD and VLI/R

e. AIS reception component

f. Routers, Switches and Serial Converters

g. Long distance comms land line to the Buffer Centre at ARS Larissa, CRC Panis and CRC Ziros to the other SSSB COMMS sites.

HF-TX/RX/UHF Equipment. The Contractor is to provide, but not limited to, the following equipment for the radio components, less any equipment listed as PFE:

i. HF-TX Antenna field

   i. Qty 2 Wide band monocone antennas, vertical polarization for SSSB.

   ii. RF cabling (incl. trenching)

ii. HF-RX Antenna field

   i. Qty 1 Wide band antenna, vertical polarization for SSSB, 2 channels

   ii. RF cabling

c .HF Antennas

i.Qty 1 Co-linear antenna with two channels

ii.RF cabling (incl. trenching)

d. HF Transmitters, UHF-RX/TX component

i. Qty 2 HF Solid State Radio Transmitters 5 kW for SSSB (Link 11, Link 22 and Voice) including, cooling/ventilation systems

ii. Qty 1 Antenna matrix for HF-TX antennas

iii. Qty 1 Dummy load 5 kW

iv. Qty 2 100 W UHF radio transceivers upgradable to support Link 22 EPM and Voice SATURN and Have Quick II.
The UHF radios shall be upgradeable latest at Site Acceptance Test (SAT)

v. Qty 1 AIS receiver with antenna

vi. Qty 1 Audio data/voice switch matrix, also capable of switching Link 22 discrete signals, with patch panels

vii. Qty 1 Audio Monitor

viii. Qty 1 ALAM (PFE)

ix. Qty 1 TOD-HQ, GPS, military grade, SAASM, incl. antenna (PFE)

x. Qty 1 DTS

xi. Qty 1 SPC

xii. Qty 1 VLI/R (PFE)

xiii. Qty 1 Radio Management Equipment Set (PFE)

xiv. Qty 1 Narrow-Band/Wide-Band Gateway (secure and unsecure voice) (PFE)

xv. Qty 1 Network Router

xvi. Qty 1 Network Switch

xvii. Qty 2 Serial Device Servers, RS-232/RS-422

xviii. Qty 1 Power switch with remote control capability.

xix. All racks with accessories, internal and cabling

xx. UPS for COMMS equipment, except for HF-TX amplifiers.

f. HF Receivers component

i. Qty 2 HF Receivers for SSSB with preselectors

ii. Qty 1 HF multi-coupler

2.13.7 The civil works to be implemented by the Contractor shall include but not limited to the implementation of Antenna fields including RF cables and ducting.

2.13.8 Other CW requirements that are the Contractor responsibility are specified in SOW Section 14 and more specifically in the System Requirements Specification (Civil Works) Annex (SRS (CW)).

## 2.14 Inter/Intra-Sites Communication Sub-system

2.14.1 The inter-sites Communication, provided by the THN via the NDN network, will provide all the necessary channels to allow the exchange of data, voice and control signals between the Buffer Centres and the Radio Sites. THN will also provide a backup communication line between the Radio Sites. The contractor is responsible for the intra-site communication, which will be needed as laid down in Section 4.14. The following list enumerates the type and minimum number of required services/channels:

a. Radio Sites to/from a Buffer Centre

i. Qty 1 IP line with a constant minimum no less than 4 Mbps (better 10 Mbps) for the following:

1. Qty 1 Link 11 monitoring, VoIP, total 64 kb/s
2. Qty 1 Link 22 monitoring, VoIP, total 64 kb/s
3. Qty 1 Link 11 VOICE line, RoIP, total 64 kb/s
4. Qty 1 Link 22 VOICE line, RoIP, total 64 kb/s
5. Qty 2 UHF Voice (NB and WB) lines, RoIP, total 128 kb/s
6. Qty 4 intercom line, RoIP, total 128 kb/s
7. Qty 1 Link 11 Data Line, IP, total 128 kb/s
8. Qty 4 Link 22 Data Lines, IP, total 256 kb/s
9. Qty 4 AIS Data Lines, IP, total 256 kb/s
10. Qty 1 Control & Monitoring, IP, total 2048 kb/s

2.14.2 The Contractor shall provide support to the THN and the Purchaser in the integration and testing of the inter-sites/intra-sites communication sub-systems.

2.14.3 The delay, jitter, throughput of the inter-sites/intra-sites communication sub-systems have to fulfill the requirements for Link 11, Link 22, voice and network specifications.

## 2.15 Radio Management and Command and Control Sub-system

2.15.1 The SSSB Command and Control system is a product consisting of hardware and software elements developed by the NCI Agency SSSB Section. The

Command and Control Centres/Buffer Centres, in combination with the SSSB Radio Sites, will be integrated and tested by the Purchaser, while the contractor will provide engineering support at the Radio Sites.

2.15.2 The radio management system, delivered as PFE, is a product consisting of hardware and software elements developed by the NCI Agency SSSB Section. Before delivery the product has to be configured and customized by the purchaser in order to operate with the communication equipment used at the radio sites. The integration of the SSSB Radio Sites is based on ICDs.

2.15.3 Technical characteristics, documentation and technical support, related to the control of the communication equipment, is to be provided by the Contractor to the purchaser with the system design at PDR and CDR in accordance with SOW **Error! Reference source not found.**

2.15.4 The technical integration documentation is to be provided by the contractor, beside other technical documents, as Interface Control Documents (ICDs) format describing the format of the control messages and the protocol.

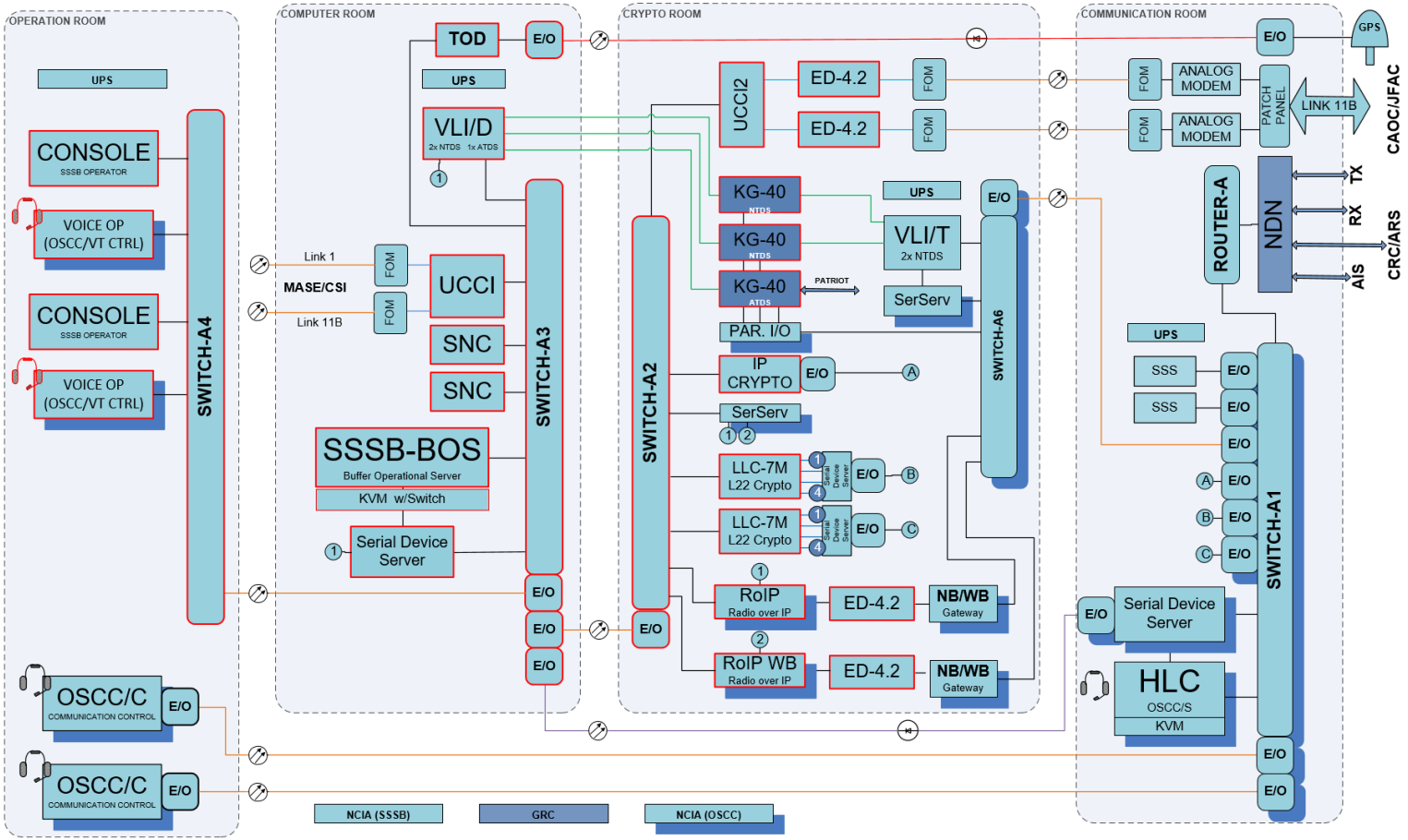


Figure 17: SSSB BC at CRC Parnis block diagram

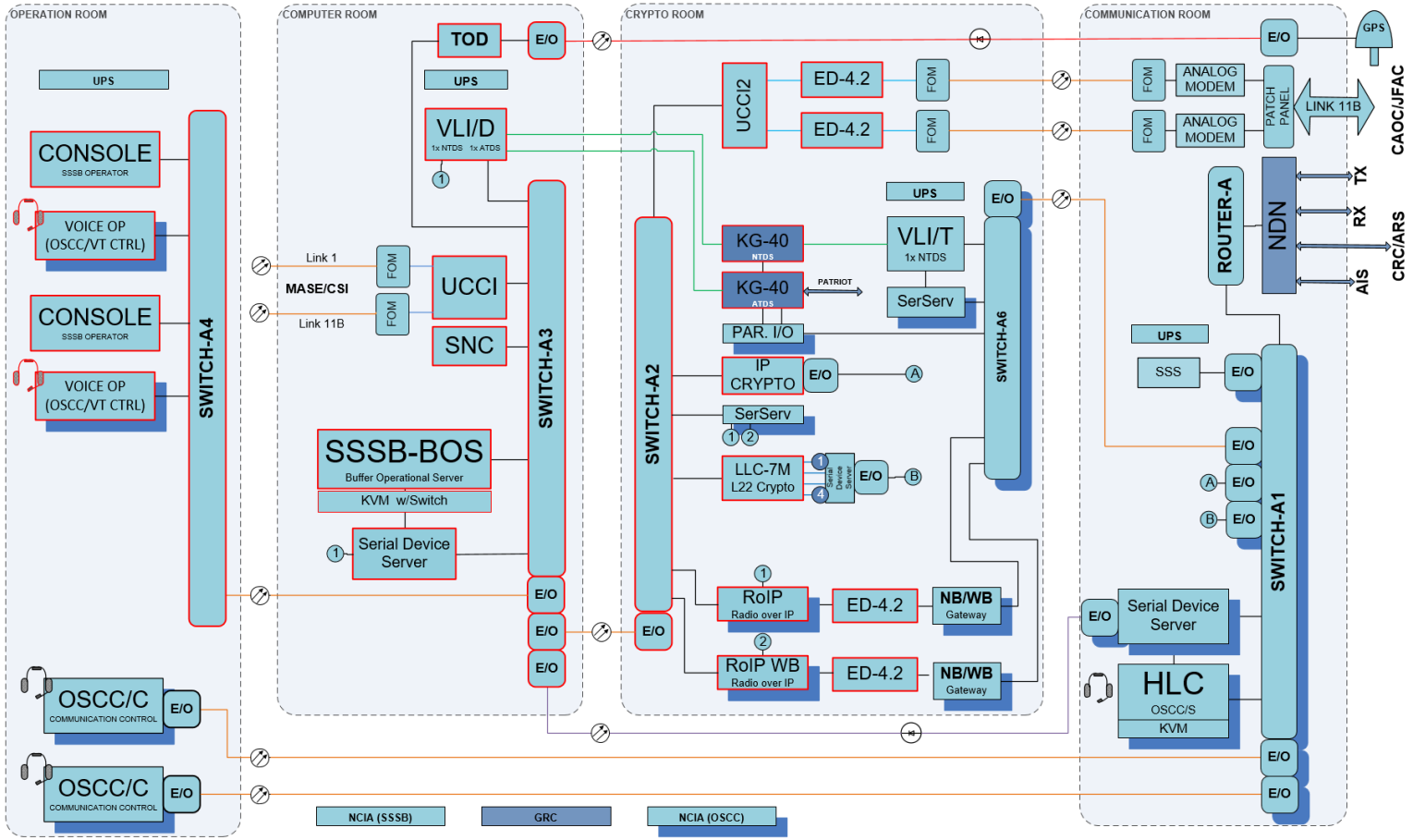


Figure 18: SSSB BC at CRC Ziros block diagram

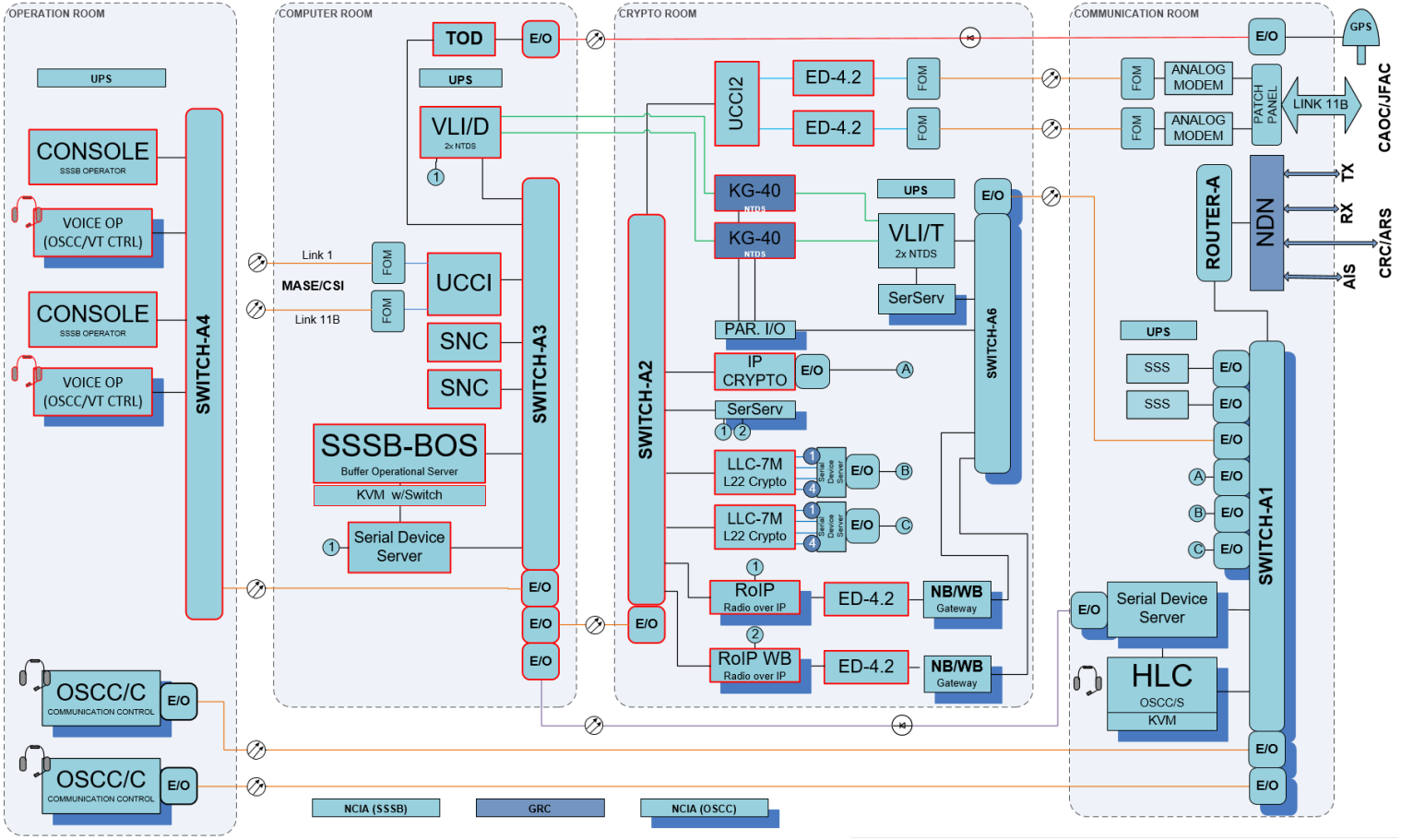


Figure 19: SSSB BC at ARS Larissa block diagram

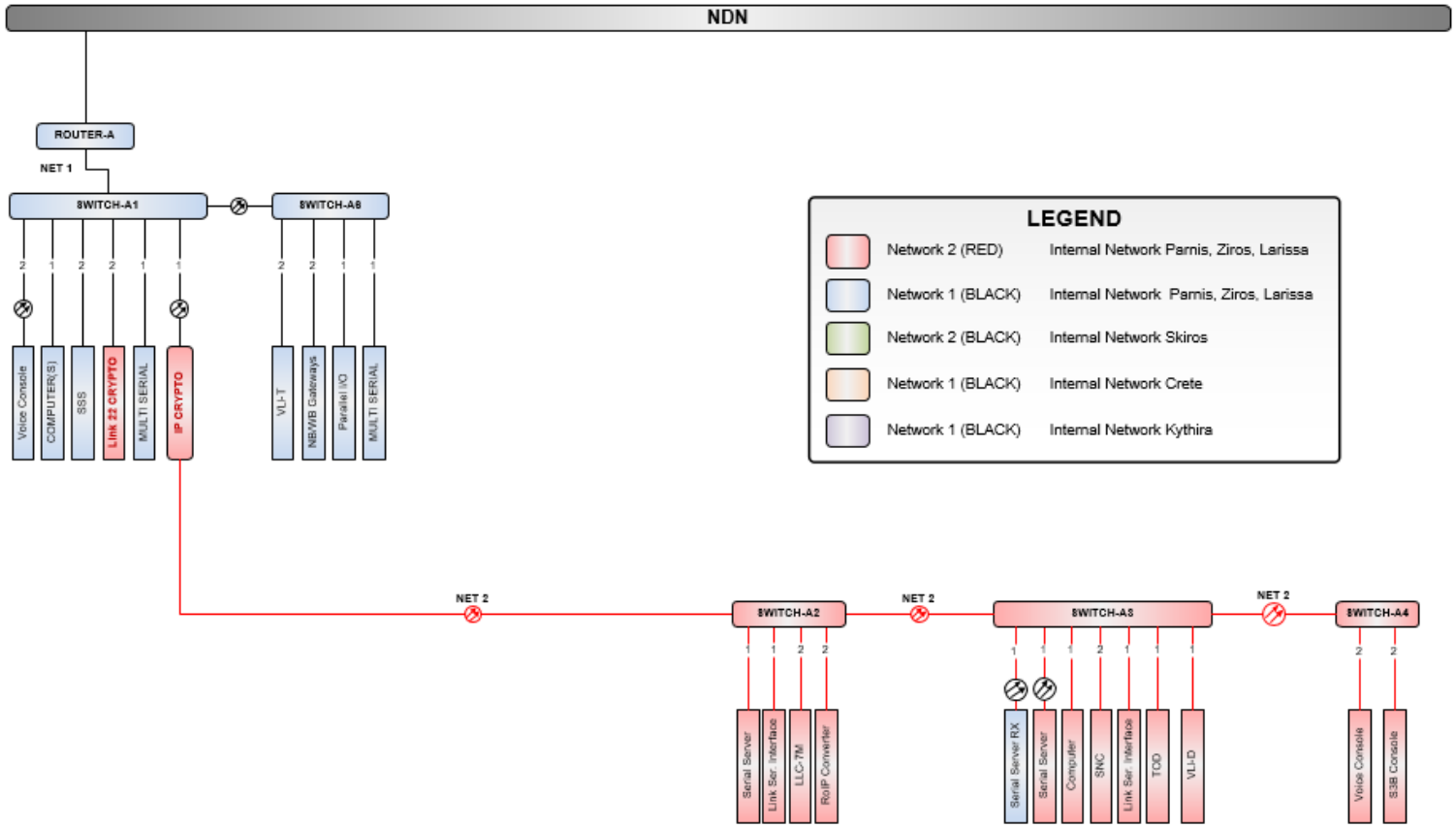


Figure 20: SSSB Brief Network Overview 1/2

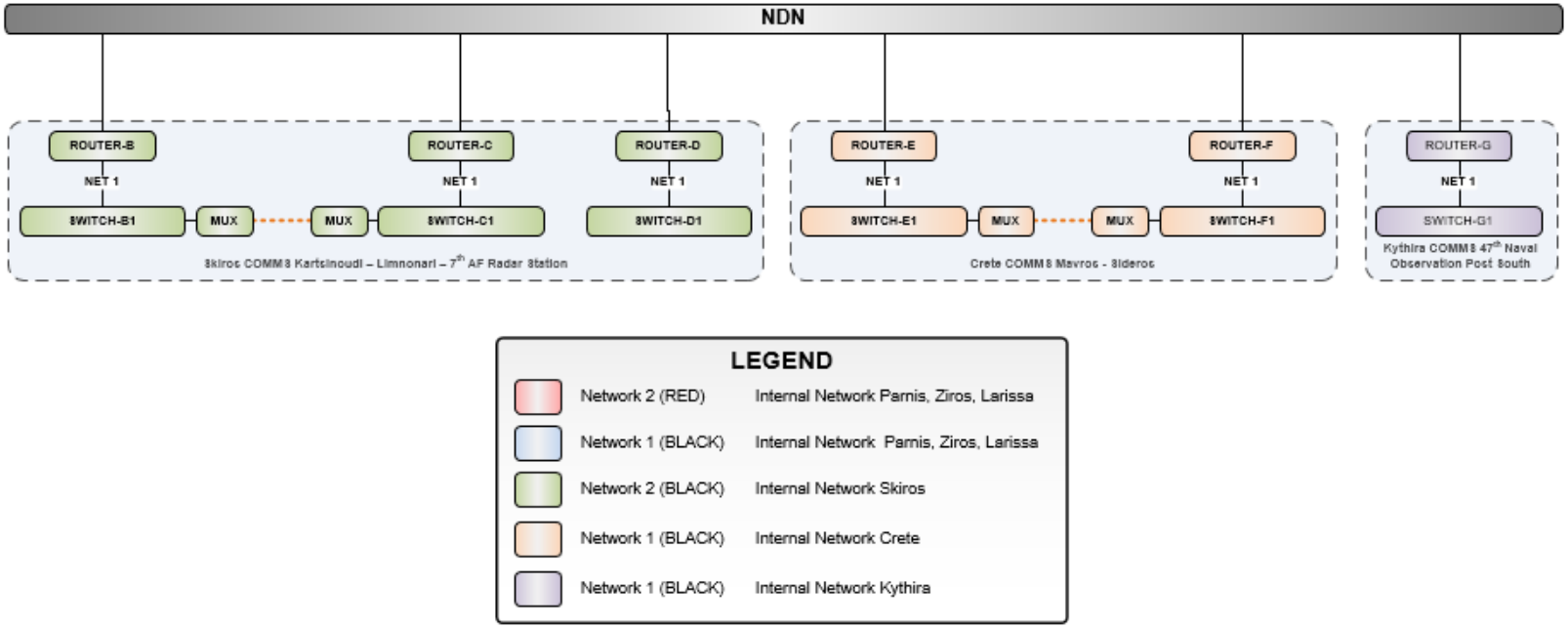


Figure 21: SSSB Brief Network Overview 2/2

## 2.16 System Integration and Testing

2.16.1 The Contractor shall be responsible to perform the testing activities as specified in SOW Section 10.

## 2.17 Summary of Responsibilities

2.17.1 This paragraph provides a summary of the areas of responsibilities of the Contractor, as illustrated in Figure 22.

2.17.2 The Contractor shall be responsible for the:

a. Implementation of the 6 (six) Radio Sites, including integration of the PFE elements.

b. TX Site Kartsinoudi (Skyros) is a non-collocated site.
   - Separate COMMS HF-TX.

c. RX Site Limninari (Skyros) is a non-collocated site.
   - Separate COMMS HF-RX.

d. UHF Site 7th AF Radar (Skyros) is a non-collocated site.
   - Separate COMMS UHF.

e. RX Site Sideros (Crete) is a non-collocated site.
   - Separate COMMS HF-RX.

f. TX/UHF Site Mavros (Crete) is a non-collocated site.
   - Separate COMMS HF-TX/UHF.

g. TX/RX/UHF Site Kythira is a collocated site.
   - COMMS HF-TX.
   - COMMS HF-RX.
   - COMMS UHF.

h. Implementation of nine DLOS connections in conjunction with the Final GRC National Defense Network (NDN) Design, as appropriate.

i. Laying of 1 F/O cables underground, ~20 Km.

j. Delivery of racks for inter-site/intra-site communication equipped with power distribution and accessories including racks for NDN equipment.

k. Support to Purchaser/THN for Radio Sites and Buffer Centres for integration and testing of inter-site communication.

l. Provision of the required information to the Purchaser in the customization and configuration of the radio management PFE elements.

m. Support to Purchaser for overall integration and testing of the complete SSSB system.

2.17.3 The Purchaser (NCI Agency) will be responsible for the:

n. Implementation of the Buffer Centres.

o. Delivery of the PFE elements to the Contractor for radio site installation, integration and testing.

p. Overall authority over the integration and testing of the SSSB system as a whole.

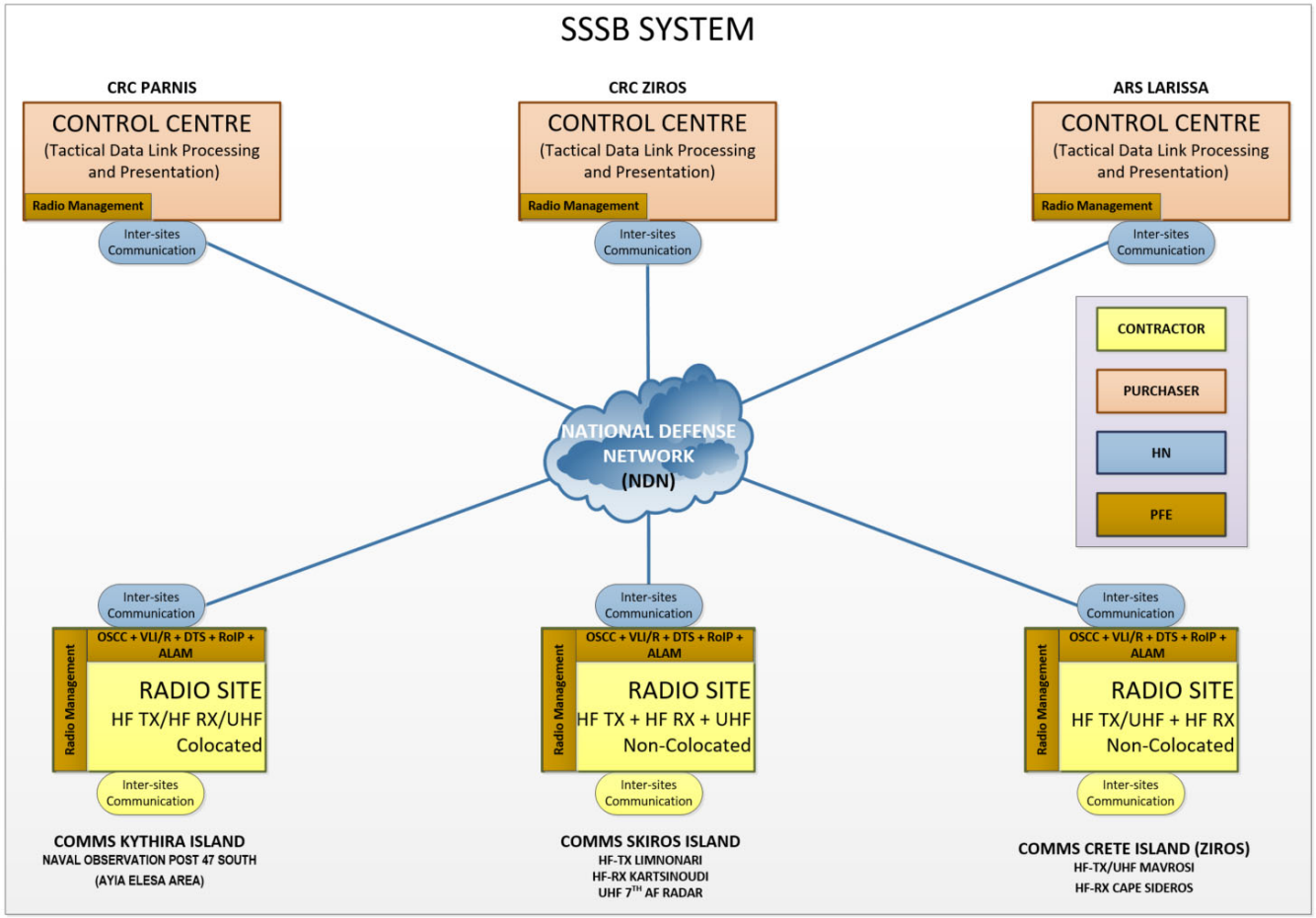


Figure 22: Areas of responsibilities among Contractor, Purchaser and THN

# SECTION 3 Technical Requirements: Equipment and Antennas

## 3.1 Requirements

3.1.1 The following specifications are to be understood as minimal project requirements and NATO MMR criteria for the SSSB HW equipment.

## 3.2 General requirements

3.2.1 In accordance with NATO requirements, the Contractor is to assemble the site equipment with racks of standard dimensions, 19 inch standard, in order to achieve:

a. Uniform implementation in terms of colour, height, depth and accessories.

b. Simplified assembly and acceptance.

c. Simplified installation.

3.2.2 The Contractor shall provide a 20% of growth capacity in terms of space in the racks, power and power socket requirements.

3.2.3 Installation of Equipment:

a. The Contractor shall install equipment racks, miscellaneous devices and antennas, inclusive of materials, cables and all the necessary accessories until finalisation and acceptance by the Purchaser.

b. Any additional minor equipment or communications devices (e.g. modems), not encompassed in the present or following sections, shall be delivered and installed by the Contractor at the sites in case they are required for the proper functioning of the system.

3.2.4 Furniture (Also refer to THN specific SRS (CW) Annexes):

a.The Contractor shall provide the necessary furniture for each site - meaning each working position at each site/sub-site e.g. tables, cabinets, office chairs

(office chairs: highest European Standard/THN required), trolleys, office furniture and workbench).

- A list of the furniture shall be proposed by the Contractor in the bidding offer.

## 3.3 Site Monitor System (SMS)

3.3.1 The Contractor shall supply one Site Monitor System at each site. This shall be compatible with any monitoring system already installed by the THN.

**3.3.2 Function:**

a. The function of the SMS is to reveal the status of operation of the respective SSSB Radio Site.

3.3.3 The SMS shall provide the vital site states and alarms via an interface to the site operator.

3.3.4 The SMS shall convey the monitored data to the SSSB Open System Communication Control (OSCC HLC/LLC) in time using a software interface:

a. States and Alerts triggering sub-alerts shall be changeable/selectable.

b. On request, the SMS logfile contents shall be provided to the OSCC.

c. The contractor shall provide an SMS ICD for OSCC implementation to the purchaser.

**3.3.5 Architecture:**

a. The data to be monitored shall be available at the local and remote SMSs.

b. The SMS system shall have a redundance capability.
c. The data to be monitored shall be conveyed to the other SMS at remote sites.
d. The SMS will relay to the remote monitoring station at the other site and the control centre via Local Area Network (LAN) and Long Haul Network (LHN).
e. The contractor shall implement the software interface to the OSCC using SNMP V. 3.x where also ‘get’ and ‘set’ functionality shall be included
f. The contactor shall install a SMS Alert Panel at one of the COMMS racks at the front side:

- The SMS Alert panel shall represent the status of the local site.

g. The contractor shall install a desk mountable SMS Alert Panel at the location requested by the THN (in general 1 unit, but if needed 2units - e.g. 2nd unit is to be installed at Saxa Vord RRH-O):

- The desk mountable SMS Alert Panel shall represent the status of all logical combined SSSB sites, e.g. for the RRH Saxa Vord COMMS site:
  - COMMS HF TX.
  - COMMS HF RX.

- COMMS UHF.

h. SMS Alert Panels shall:

- Indicate the individual states/alerts by an LED.
- Have an Alert Buzzer.
- Have an ACKNOWLEDGE button to acknowledge any alert and switch off the Alert Buzzer.
- Have a LED/Buzzer Test Button:

i. The contractor shall provide a “SMS ALERT PANEL- RESPONSE PROCEDURE” which describes in detail:

- The error detection and correction measures necessary, to identify the displayed fault.
- To recover the operational state, if possible.
- To secure the related equipment and its surrounding environment - up to the level of human and building safety.
- A list of Alerts and triggering Sub-Alerts as well as the detailed description of each alert - added as an appendix.
- A procedure how to change the triggering sub-alert(s)
- NOTE: This document and its procedures shall be part of the COMMS training to be provided by the contractor.

**3.3.6 Monitored data:**

a. Radio Receivers, HF and UHF.
b. Radio Transmitters, HF and UHF.
c. Low Tension power network.
d. Low Tension UPS.
e. Electric system.
f. Air conditioning system.
g. Equipment air cooling system.
h. Fire Alarms.
i. Anti-intrusion system.

3.3.7 Any other SMS integration recommendation from the contractor in relation to the installed devices shall be detailed in his bidding proposal.

3.3.8 The final SMS Alert Panel Status/Alert list and their triggering sub-states and sub-alerts will be defined and agreed on before the CDR – where the THN holds the final decision.

3.3.9 Any other SMS integration recommendation from the contractor in relation to the installed devices shall be detailed in his bidding proposal.

## 3.4 Rack Transmitter HF/SSB – 5 kW

3.4.1 The Contractor shall supply, integrate and test HF transmitter equipment of

"Solid State" technology.

3.4.2 A typical configuration of the transmitter rack 5 kW, which has the dimension of a standard rack, includes the control circuits, low level RF, power amplifier and power supply.

3.4.3 The Contractor shall supply, integrate and test rack transmitter in accordance with the typical configuration as stated before and shall provide forced air circuit cooling system for the HF-TX or, in case equipment cooling use room ambient air and the available A/C is not adequate then the Contractor shall upgrade or improve the A/C system to the needed level.

3.4.4 The equipment of the rack transmitter component shall meet the following minimum requirements:

a.Frequency range: 2 ÷ 29,9999 MHz.

b. Frequency tuning steps: 10 Hz.

c. Tuning time (max): 10 s.

d. Frequency stability (max):

e. ± 1 part in 107 after 30 minute warm up period.

f. ± 1 part in 108 for any period of 24 hours after a warm up period of 4 hours under any combination of specified service conditions.

g. RF output power: 5 kW nominal PEP and mean, into a 50 ohm impedance unbalanced to ground and with VSWR up to 1.3:12.

h. Power steps: 1/1, 1/2, 1/4 and 1/8 of maximum output power. Other values of power steps are acceptable as long as they will be within 25% range from the required ones.

i. Modes of operation:

j. AM (A3E, R3E, H3E and J3E classes of emission3) including Upper Sideband (USB) and Lower Sideband (LSB) simultaneously or independently[4].

k. CW (A1A class of emission5)

l. Link 11 and Link 22

m. Duty cycle: 100 % under all applicable service conditions.

n. Audio inputs 28: 0 ± 3 dBm and 10.3 dB PEP/avg on balanced ungrounded

[2] Above VWSR 1.3:1 the transmitter should de-rate the output power according to MIL-STD 188-141C.

[3] Respectively: double-sideband, single-sideband reduced (or variable) level carrier, single-sideband full carrier and single-sideband suppressed carrier for single channel analogue telephony (see ITU "Radio regulations – Appendices").

[4] Independent Side Band (ISB).

[5] Double-sideband without the use of a modulating sub-carrier for single channel keyed telegraphy.

lines with 600 ohm terminations.

o. PTT input.

p. Sidetone: to be provided at the HF audio outputs (both USB and LSB).

q. Time delay (max): 3.5 ms (for any single frequency over the range 500 ÷ 3.050 Hz) (design objective 2.5 ms).

r. Group (or differential) delay (max): 500 μs (within the frequency range 815 ÷ 3.050 Hz).

s. Frequency response: 2.5 dB passband fc +415 ÷ fc +3.050 Hz for the USB and fc -415 ÷ fc -3.050 Hz for the LSB (max); 3 dB at 300 Hz (max with respect to the peak response between 450 ÷ 3.050 Hz); 60 dB at fc +5.000 and fc -1.500 Hz for the USB; 60 dB at fc -5.000 and fc +1.500 Hz for the LSB.

t. Phase jitter (max): 2.5 degrees (rms value) and the probability of a shift greater than 30 degrees shall be 0.01 % when measured at the signal output terminals6.

u. Sideband attenuation: 60 dB below PEP.

v. Carrier suppression (where applicable): 50 dB below PEP.

w. Harmonic attenuation: 45 dB below PEP.

x. Spurious attenuation: 45 dBc.

y. In-band intermodulation distortion (IMD): 35 dB below PEP (with reference to IMD products generated by two equal level in-band audio tones spaced 440 Hz).

z. In-band noise: 50 dB below PEP (in each sideband when measured in a 3 kHz bandwidth).

aa. Out-of-band noise (max):

bb. 10 μV (at any frequency between 2 ÷ 24 MHz, with the exception of fc ±15 % and HFoscillator frequency, when measured in a 3 kHz bandwidth using a two-tone test signal input).

cc. 2 μV (at any frequency between 2 ÷ 24 MHz, with the exception of fc ±15 % and HF oscillator frequency, when measured in a 3 kHz bandwidth with the audio signal inputs terminated in 600 ohm dummy loads).

dd. 10 μV (at any frequency between 2 ÷ 24 MHz, within fc ±15 % but with the exception of fc ±3 kHz, when measured in a 3 kHz bandwidth with the audio signal inputs terminated in 600 ohm dummy loads).

ee. 1 μV (with the transmitter in the off keyed condition, at any frequency between

[6] Measurements shall be performed over a sufficient number of adjacent frame pairs to establish the specified probability with a confidence of 95%; measured values shall be the average phase in an averaging time of 9,09 ms or 18.18 ms for frame lengths of 13,3 ms or 22 ms, respectively.

2 ÷ 24 MHz when measured in a 3 kHz bandwidth).

ff. Attack-time delay (max): 7 ms (to reach 90 % of rated power output).

gg. Release-time delay (max): 10 ms.

hh. Built-In Test Equipment (BITE): embedded.

ii. Programmed channels: 99.

jj. Monitor: hours of operation, number of failures, tuning numbers, forward and reflected power.

kk. Remote control: frequency, mode, power level, BITE.

ll. Remote control interfaces: EIA RS 232 (or, equivalently, 422 or 485) and/or 10Base-T IEEE 802.3 (Ethernet).

mm. Power supply: 400 Vac ± 10 % three phases @ 45 ÷ 65 Hz.

nn. Power consumption (max): 20 kW.

oo. Size (max): 1200 x 900 x 2100 mm (W x D x H).

pp. Weight (max): 750 kg.

qq. Operating temperature: 0 ÷ +40 °C.

rr. Relative humidity: 90 % at +40 °C without condensation.

ss. Cooling`/ventilation system: forced air.

tt. In the event of a power outage, the status of the transmitter is to be kept to avoid reconfiguring the exciter portion when the power comes back This shall be obtained by hardware capacity through the transmitter rack itself (e.g. through non-volatile memory) or by the use of a small-size UPS circuit dedicated to the HF transmitter assembly except the amplifier portion.

uu. Transmission exchange time: conforming Link 11 DATA mode

From MIL-STD 188-203 1A:

5.1.7 Switching time. A time period shall be allocated to allow for the switching between the transmit state and receive states. This switching shall be automatic and shall conform to the timing diagram illustrated in FIGURE 5.

a. Receive-to-transmit switching occurs when the picket recognizes its address code, the DNCS recognizes a picket stop code, or the DNCS detects loss of signal presence. When switching from the receive state to transmit state, a silent period of 10 milliseconds shall be required during which the audio output from the DTS to the transmitter shall be inhibited. The audio composite signal shall be applied to the transmitter by the DTS within three frame intervals of the beginning of the silent period. The DTS shall apply the radio keyline a minimum of 7 milliseconds and a maximum of one frame interval prior to the application of the audio composite signal. After application of the audio composite signal and radio set keyline, the transmitter RF output shall reach at least 90 percent of its rated power within 7.0 milliseconds.

b. Transmit-to-receive switching occurs at the end of the transmission, that is, the picket stop code or address code. When switching from the transmit to receive state, the transmitter RF output shall be reduced to the quiescent noise level of 0.1 microvolt (μV) or less in a 6 kHz bandwidth centered on the nominal carrier frequency, and the receiver shall be capable of maximum receive sensitivity within 23 milliseconds or less after reset of the radio set keyline.

## 3.5 UHF Transceivers Assembly

3.5.1 Rack mountable UHF transceiver compliant to Link 11, Link 22 and SSSB Voice standards and equipped with RF filter automatic tuning and amplifier. UHF transceiver have to be upgradeable for Link 22 EPM, voice HAVE QUICK II and SATURN capability. Minimum requirements will be:

a. Frequency range: 225 ÷ 400 MHz.

b. Frequency tuning steps: 25 kHz.

c. Tuning time (max): 7.5 ms.

d. Frequency stability (max):

e. ± 0.0005% of the selected fc after 5 minutes warm up period.

f. ± 5 parts in 106 for any period of 6 months after a warm up period of 30 minutes under any combination of specified service conditions.

g. Modes of operation:

h. FM (F3E class of emission) inclusive of Link 11 data as per STANAG 5511.

i. AM (A3E, classes of emission7).

j. IF selectivity: 6 dB bandwidth of at least 50 kHz (with a peak-to-peak ripple over 90 % of the bandwidth not exceeding 3 dB) and 60 dB bandwidth of maximum 200 kHz.

k. Audio inputs8: nominal 0 ± 3 dBm and 10.3 dB PEP/avg on balanced ungrounded lines with 600 ohm terminations.

l. Audio outputs: nominal 0 ± 3 dBm (adjustable) and 10.3 dB PEP/avg on balanced ungrounded lines with 600 ohm terminations.

m. PTT/Mute input.

n. Phase jitter (max): 2.5 degrees (rms value) and the probability of a shift greater than 30 degrees shall be 0,01 % when measured at the signal output terminals of the transmitter or receiver9.

o. Time delay (max): 3.5 ms (for any single frequency over the range 500 ÷ 3.050 Hz) (design objective 2.5 ms).

p. Group (or differential) delay (max): 500 µs (within the frequency range 815 ÷ 3.050 Hz).

q. BITE: embedded.

r. Programmed channels: 99.

s. Remote control: frequency, mode, power level, BITE.

t. Remote control interfaces: EIA RS 232 (or, equivalently, 422 or 485) and/or 10Base-T IEEE 802.3 (Ethernet).

u. Power supply: 230 Vac ± 10 % single phase @ 45 ÷ 65 Hz.

v. Power consumption (max): 700 W.

w. Rack mountable with size (max): 19” x 580 mm x 3U (W x D x H).

x. Weight (max): 35 kg.

y. Operating temperature: 0 ÷ +40 °C.

z. Relative humidity: 90% at +40 °C without condensation.

aa. Transmitter section.

bb. RF output power: nominal 100 W PEP and 25 W carrier at m = 100% into a 50 ohm impedance unbalanced to ground and with VSWR not

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[7] Respectively: double-sideband, single-sideband reduced (or variable) level carrier, single-sideband full carrier and single-sideband suppressed carrier for single channel analogue telephony

[8] Inclusive of keyline simplex method.

[9] Measurements shall be performed over a sufficient number of adjacent frame pairs to establish the specified probability with a confidence of 95%; measured values shall be the average phase in an averaging time of 9.09 ms and 18.18 ms for frame lengths of 13.3 ms and 22 ms, respectively.

exceeding 3:1 over the defined frequency range.

cc. Power steps: 1/1, 1/2 and 1/4 of maximum output power. Other values of power steps are acceptable as long as they will be within 25% range from the required ones.

dd. Duty cycle: 100% under all applicable service conditions.

ee. Attack-time delay (max): 7 ms (within ±1 dB of its steady state output from the receipt of a keying signal).

ff. Sidetone: to be provided at the UHF receiver audio output.

gg. Frequency modulation deviation: ±20 kHz when produced by a +10 dBm signal at the audio input.

hh. Frequency response (max): 2 dB between 450 ÷ 3.050 Hz and 3 dB at 300 Hz.

iii. Harmonic attenuation: 70 dBc.

jj. Spurious attenuation: 70 dBc at fc ±10 MHz.

kk. In-band IMD: 35 dB below a two-tone test level (935 and 1.045 Hz) for a frequency deviation of ±20 kHz (measurements to be performed on the demodulated transmitter output).

ll. In-band noise: the audio output detected in a nominal 50 Hz audio bandwidth by a test receiver shall be at least 50 dB below the audio output detected when a carrier at the same RF power level deviated ±20 kHz at a 1 kHz rate is applied to the test receiver RF input (with the transmitter at full rated RF power output and with the audio input terminated with a 600-ohm resistor).

3.5.2 Receiver section:

a. RF input: 50 ohm impedance unbalanced to ground.

b. Audio frequency response (max at the receiver output and relative to the peak response between 450 ÷ 3.050 Hz): 2 dB between 450 ÷ 3.050 Hz and 3 dB at 300 Hz for a reference RF input signal level of -73 dBm with peak deviation of 20 kHz applied to the receiver input terminals.

Frequency modulation deviation: an input of ±20 kHz deviation and -67 dBm shall produce a signal output of +10 dBm.

c. Input signal protection:

d. The receiver shall not be damaged by the continuous application of a +35 dBm RF signal

e. The receiver shall be protected when the transmitter is at full power and the electrical isolation between the transmitter and receiver antenna terminals is as low as 26 dB; the protection circuit shall activate within 150 ms time interval used by the transmitter to go from the carrier “on” to the carrier “off” condition; provision shall be made to override the protection circuitry to the

extent required to monitor the transmitter at full power; the override feature shall provide the required receiver output when the electrical isolation between the transmitter antenna terminal and receiver antenna terminals is in the range 26 dB to 36 dB.

f. Image frequency rejection: 80 dB.

g. IF rejection: 80 dB.

h. Spurious frequency rejection: 80 dB.

i. In-band IMD: 30 dB below a two-tone test level (935 and 1.045 Hz) for a frequency deviation of ±20 kHz.

3.5.3 UHF pre-post selector filter.

3.5.4 Tunable RF filter to improve the selectivity performances of the UHF Link 11 transceiver assembly. The component shall be mounted within the same rack of the UHF transceiver. Minimum requirements:

a. Control from the associated UHF transceiver

b. Frequency range: 225 – 400 MHz

c. RF power rating: 100 W FM modulation

d. Selectivity: 50 dB bandwidth: ±8 MHz

e. Input/output impedance: 50 ohm unbalanced

f. Insertion loss: 2 dB max

## 3.6 Audio/Data Matrix

3.6.1 The Audio/Data Matrix is a switching equipment to commute audio, data (including sidetone) and keyline signals between local consoles, remote consoles, communication equipment and radio transceivers to be provided for all the involved sites.

3.6.2 Audio/Data Switch Matrix to be integrated by the Contractor shall meet the following requirements:

3.6.3 Switching the system from Link 11 to Link 11 HF and UHF, audio and key lines

3.6.4 Switching the system from Link 22 to Link 22 HF and UHF, audio and key lines

3.6.5 Connecting the audio and control signals, VOICE, Link 11 DATA and Link 22 DATA, to the radio equipment HF and/or UHF for all operational modes of SSSB Voice, Link 11 and Link 22.

3.6.6 Extra lines for expansion of two additional services and two additional equipment’s

a. Technology: solid state switching, non-blocking

b. Audio inputs/outputs: 600 ohm balanced

c. Management of input/output PTTs/Mutes/Keylines

d. Audio channels isolation: Providing a maximum decoupling/isolation between signal lines for the Link 22 MSN 1-18 and MWF modulations (MSN), to avoid Crosstalk.

e. The matrix (including the setting of all nodes) shall be reprogrammable/configurable successfully via the remote control interface in less than 5s.

f. Rack mountable: 19”

g. Matrix capacity two times the minimum needed

3.6.7 The Audio/Data Matrix shall be integrated with the “Matrix Bypass” patch panels meeting the following minimum requirements:

a.Passive unit

b. Individual monitor of all the input and output matrix ports

c. Monitoring shall be possible during normal usage and during patching (must be possible at any time)

3.6.8 Individual manual bypass of all matrix ports with disconnection of service and/or equipment from the matrix:

a. Every patch connector named according provided service

b. Provided with a sufficient number of bypass patch cables

The Audio/Data Matrix shall be integrated with the “Audio Monitor” Unit, with the following minimum capabilities:

a. Audio monitor channel 1 for VOICE

b. Audio monitor channel 2 for Link DATA

c. The Audio Monitor Unit (AMU) shall be operated in auto mode when the two channels are connected to the Audio/Data Matrix. The AMU shall be operated in Manual mode using the patch cables from the audio monitor channel port at the patch panel to the patch panel port of the signal to be monitored.

3.6.9 Analog and Discrete signals:

a. Analog Signals Narrow Band (NB)

b. 600 Ohm, 0 +/- 3 dBm for Link 11 and +9 dBm for Link 22, 300 to 3400 Hz

c. Analog Signals Wide Band – NRZ

d. 600 Ohm, +/- 4V TX and +/- 5V RX for Link 22, 16 to 24 kHz

e. PTT/KEYLINE Open Collector

f. Transmit: 0 +/- 0.25V DC (sink 10mA )

g. Receive: Open

h. PTT/KEYLINE +6V

i. Transmit: +6.0 + 1.0, -0.25 V DC (source 2mA)

j. Receive: 0.0 + 0.75, -0.25 V DC (sink 10mA)

k. PPT/KEYLINE V.28

l. Transmit: positive voltage max +12V

m. Reception: negative voltage max -12V

n. **NOTE:** PTT / Keyline - It should be possible to configure any type of input with any type of output

o. Remote control interfaces Serial RS-232 unbalanced / RS-422 balanced and optional 10Base-T IEEE 802.3 (Ethernet).

p. Serial: From 4800 to 11520 b/s

q. Discrete Signals – Used in Secure Voice UHF Wide Band (WB)

r. PT/CT

    i. Vmin -0.3 V

        ii. Vmax +31V,

        iii. Output: Open drain to +28V

        iv. Imax 5mA

        v. Rj ~1kOhm

s. CGC

        i. Vmin -0.3V

        ii. Vmax +5.5V

        iii. Internal pullup (10 kOhm) to +5V

        iv. Input: Schmitt-trigger

        v. Vt- 0.9..1.8V

        vi. Uh >0.25V

t. DPPT

        i. Vmin -0.3 V

        ii. Vmax +31V (7V)

        iii. Output: Open drain with internal pull-up (47 kOhm) to +28V

        iv. Imax 25mA

v. Rj ~230 Ohm

vi. DPPT: contact to GND short circuit proof up to 7V

u. BB/~DP

i. Vmin -32 V

ii. Vmax +0.3V

iii. Output: Open drain

iv. Imax 3.5mA

v. Rj > 2.5 kOhm

vi. Base-Band/Diphase

vii. Contact (open drain) to GND; Open (>100kOhm) when unit is not powered. Controls the base-band/diphase operation.

viii. NOTE: Discrete Signals – Minimal input/output delay, as it can affect the correct functioning of the ciphering.

1. Gain: 0 ±0,5 dB
2. Frequency response (max): NB: ±2 dB between 20 and 3.400 Hz
3. Frequency response (max): WB: ±2 dB between 20 and 26/48 kHz
4. Switching time (max): 10 ms
5. Local control: keyboard and LCD display

## 3.7 Rack HF Antenna Matrix

3.7.1 Coaxial switching systems intended to be used for the connection of every transmitter to each antenna at the HF TX COMMS sites. The minimum requirements are:

a. Automatic/manual and 4 rows by 4 columns type with interlock protection and remote indication matrix status

b. Frequency range: 2 ÷ 29.9999 MHz

c. Input and output impedance: 50 ohm

d. Power rating: 10 kW PEP and mean

e. Insertion loss (max): 0.1 dB

f. VSWR (max): 1.1:1 (into 50 ohm and in all the specified frequency range)

g. RF channels isolation: 70 dB (over the specified frequency range)

h. Remote control interfaces: EIA RS 232 (or, equivalently, 422 or 485) and/or 10Base-T IEEE 802.3 (Ethernet)

ii. Power supply: 230 Vac ± 10% single phase @ 45 ÷ 65 Hz

j. Power consumption (max): 3 kW

k. Size (max): 1.000 mm x 1.000 mm x 42 U (W x D x H)

l. Weight (max): 500 kg (including HF dummy load)

m. Operating temperature: 0 ÷ +40 °C

n. Relative humidity: 90% at +40 °C without condensation

## 3.8 Dummy Load

3.8.1 The minimum requirements are:

a. HF dummy load capable of continuous power dissipation of 5 kW compliant with the following minimum requirements:

b. Frequency range: 2 ÷ 29.9999 MHz

c. Direct connection into 50 ohm coaxial line

d. Power dissipation capability: continuous 5 kW

e. VSWR (max): 1.1:1

f. Optional remote control interfaces: EIA RS 232 (or, equivalently, 422 or 485) and/or 10Base-T IEEE 802.3 (Ethernet)

g. Power supply: 230 Vac ± 10 % single phase @ 45 ÷ 65 Hz

h. Power consumption (max): 2 kW

i. Operating temperature: 0 ÷ +40 °C

J. Relative humidity: 90% at +40 °C without condensation

k. Cooling system: forced air

l. Interlock protection

## 3.9 HF Transmitter Antenna

3.9.1 The design, production and installation of the antenna masts shall comply with the following standards:

a. EN ISO 1461 – Hot dip galvanized coatings on fabricated iron and steel articles;

b. EN 10204 Metallic materials. Types of inspection documents;

c. EN 10025 – Hot rolled products of structural steels. General technical delivery conditions;

d. EN ISO 14 713 (Part 1, 2 and 3) – Zinc coatings - Guidelines and recommendations for the protection against corrosion of iron and steel in structures;

e. EN 10210-1 – Hot finished structural hollow sections of non-alloy and fine grain steels;

f. ISO 898 (part 1, 2 and 5) – Mechanical properties of fasteners made of carbon steel and alloy steel;

g. ISO 5817 – Welding - Fusion-welded joints in steel, nickel, titanium and

their alloys (beam welding excluded) - Quality levels for imperfections;

h. ISO 6520-1 – Welding and allied processes - Classification of geometric imperfections in metallic materials - Part 1: Fusion welding.

3.9.2 The expected lifetime of the antenna mast shall be at least 15 years without the need for substantial maintenance.

3.9.3 Antenna requirements:

a. Due to possible future expansions and limited space at the TX site, a combination of Monocone and Multi-feed antennas with similar performance characteristics should be considered.

HF antenna with vertical polarization, omnidirectional azimuth radiation pattern and high efficiency and high gain at low take-off angle in order to sustain ground wave propagation over all the interested spectrum compliant with the following minimum requirements:

b.Type: monocone (inverted cone)

c. Frequency range: 2 ÷ 30 MHz

d. Polarization: vertical

e. Input impedance: 50 ohm

f. Azimuth plane pattern: omnidirectional (within ± 1 dB)

g. Elevation plane pattern: high gain at low take-off angles (nominal 5 dBi @ 2 MHz)

h. VSWR (max):

i. 2,0:1 into 50 ohm and in all the specified frequency range (transmitting)

j. 2,0:1 into 50 ohm and, at least, in the frequency range 2 ÷ 30 MHz (receiving)

k. Power handling capability (transmission): Based on the HF transmitter power

l. Dimensions (max):
The maximum dimensions of the HF Antenna shall be based on the limited ground available at the TX site, taking into account that in the future an additional antenna for Link 22 (skywave) might be placed at this location.

m. Diameter (maximum dimensions, guy to guy with ground screen included):

- 80 m (transmitting), see also paragraph 3.9.3 (l)
- 80 m (receiving)

n. Height: maximum height in line with THN regulations

o. The antenna sub-systems mounted on the antenna masts, as well as the antenna masts themselves shall be capable of withstanding following environmental conditions without suffering degradation of system

performance (gain, pattern type, sensitivity) and without suffering permanent mechanical damages:

- Local weather conditions pertaining temperature, snow load and ice accumulation (glaze ice – 0.9 g/cm³), as per STANAG 4370. The region is defined as conditions A3 Intermediate and C0 Mild Cold (according to STANAG 4370) for the purpose of this Contract;
- High Temperature: Norm: + 65° C for operation;
- Low Temperature: Norm: - 50° C for operation;
- 44 - 61 m/s ±10% wind at Kartsinoudi (Skyros)
- 44 - 61 m/s ±10% wind at Limnonari (Skyros)
- 44 - 61 m/s ±10% wind at 7th AF Radar Site (Skyros)
- 44 - 61 m/s ±10% wind at Mavros (Crete)
- 44 - 61 m/s ±10% wind at Sideros (Crete)
- 44 - 61 m/s ±10% wind on Kythira
- It will be the Contractors responsibility to retrieve local wind speed data, including exceptional wind speed data, for each local COMMS site from the THN authorities and plan and install appropriate antennas accordingly to meet the local climatic conditions.
- Hailstones of up to 25 mm diameter, 0.9 g/cm3 density and 58 m/s terminal velocity;
- Sand and dust concentrations up to 1 g/m³, with particle size down to 20 μm at an air speed up to 20 m/s;
- The fundamental resonance frequency of the mast with equipment shall be greater than 3 Hz;
- The design of the antenna masts shall take into account seismic conditions of HN.

p. The antenna shall be provided with grounding/earthing and air obstacle light kits; each light kit shall include a double toroid transformer to be connected to light power supply at the base of the related antenna; the installations of air obstacle lights shall be implemented in accordance to ICAO Annex 14, Volume 1, Chapter 6, “Visual aids for denoting obstacles”, latest edition. The antenna and the support structure shall be treated so as to withstand installation in proximity of the sea.

q. Due to the prevailing corrosive climatology conditions (weather conditions with extremely negative impact on the exposed equipment) within the COMMS sites areas, cathodic protection (or equivalent measure) of the antennas shall be provided.

r. Further details on mast specifications and requirements can be found in the Section 25 of SRS (CW) Annex I.

## 3.10 UHF Antenna

3.10.1 Collinear UHF antenna with two dipoles with omnidirectional azimuth radiation pattern compliant with the following minimum requirements:

a. Type: 2-channel collinear dipoles antenna

b. Frequency range: 225 ÷ 400 MHz

c. Polarization: vertical

d. Omnidirectional azimuth radiation pattern

e. Input impedance: 50 ohm

f. Directivity gain: nominal 2 dBi

g. VSWR (max): 2.5:1 (into 50 ohm and in all the specified frequency range)

h. Isolation between channels: 25 dB

i. Power capability: 400 W

j. Dimensions (max):

k. Diameter: 0.35

l. Height: 3 m

m. Weight (max): 35 kg

n. Environmental operation:

o. Minimum 44 - 61 m/s ±10% wind at Kartsinoudi (Skyros)

p. Minimum 44 - 61 m/s ±10% wind at Limnonari (Skyros)

q. Minimum 44 - 61 m/s ±10% wind at 7$^{th}$ AF Radar Site (Skyros)

r. Minimum 44 - 61 m/s ±10% wind at Mavros (Crete)

s. Minimum 44 - 61 m/s ±10% wind at Sideros (Crete)

t. Minimum 44 - 61 m/s ±10% wind on Kythira

u. It will be the Contractors responsibility to retrieve local wind speed data, including exceptional wind speed data, for each local COMMS site from the THN authorities and plan and install appropriate antennas accordingly to meet the local climatic conditions.

v. Omnidirectional

### 3.11 Receiver HF/SSB

3.11.1 Rack mountable HF receiver compliant to Link 11, Link 22 and SSSB Voice standards compliant to the following minimum requirements:

a. Frequency range: 2 ÷ 29.9999 MHz

b. Frequency tuning steps: 10 Hz

c. Tuning time (max): 10 s 10

d. Frequency stability (max):

e. ± 1 part in 107 after 30 minute warm up period

f. ± 1 part in 108 for any period of 24 hours after a warm up period of 4 hours under any combination of specified service conditions

3.11.2 RF input: 50 ohm impedance unbalanced to ground with an input VSWR not exceeding 2,5:1 over the operating frequency range

a. Modes of operation:

- AM including USB, LSB and ISB in compliance with STANAG 5511 and STANAG 5522
- CW

b. Audio outputs: 0 ± 3 dBm (adjustable) and 10,3 dB PEP/avg on balanced ungrounded lines with 600 ohm terminations

c. Mute input

d. Time delay (max): 3.5 ms (for any single frequency over the range 500 ÷ 3.050 Hz) (design objective 2.5 ms).

e. Group (or differential) delay (max): 500 μs (within the frequency range 815 ÷ 3.050 Hz)

f. Audio frequency response (max): 2 dB passband 450 ÷ 3.050 Hz at the receiver output; response down by 2.5 dB between 415 and 450 Hz; response down by 3 dB at 300 Hz; response down by 60 dB at -400 and 4400 Hz; gain for each sideband adjustable to within 1/2 dB of nominal output

g. Phase jitter (max stability): 2.5 degrees (rms value) and the probability of a shift greater than 30 degrees shall be 0.01 % when measured at the signal output terminals11

h. Sensitivity: -110 dBm producing a S+N/N of 10 dB (in both USB and LSB over the specified frequency range)

i. De-sensitisation dynamic range: with the receiver in a SSB mode of operation (with the passband setting providing a nominal 3 kHz bandwidth) and tuning centered on a sinusoidal input test signal which level is adjusted to produce an output SINAD of 10 dB, a single interfering sinusoidal signal equal to or less than 90 dB above the test signal level and offset from this

[10] When the radio is operated with an external automatic antenna multi-coupler, the coupler tuning time should not exceed 60 s.

[11] Measurements shall be performed over a sufficient number of adjacent frame pairs to establish the specified probability with a confidence of 95%; measured values shall be the average phase in an averaging time of 9,09 ms and 18.18 ms for frame lengths of 13,3 ms and 22 ms, respectively.

latter by fc ±5 % shall not degrade the output SINAD by more than 1 dB.j.
Linearity: with the receiver operating at maximum sensitivity and with a reference input signal that produces an output SINAD of 10 dB, the output SINAD shall increase monotonically and linearly within +1.5 dB for a linear increase in input signal level until the output SINAD is equal to 30 dB; when saturation occurs, the output SINAD may vary +3 dB for additional increase in signal level.

j. Input signal protection: the receiver (with primary power on or off) shall not be damaged by the application of any input RF signal up to +53 dBm (open circuit peak value) applied to the receiver input terminals for a duration of 1 minute.

k. Internally generated spurious outputs (max): -112 dBm for 99 % of the available 3 kHz channel; -100 dBm for 0.8 % of the available 3 kHz channel; for 0.2 % of the available 3 kHz channel, spurious signals may exceed these levels.

l. Image frequency rejection: 70 dB

m. IF rejection: 70 dB

n. Other signals spurious: 55 dB for frequencies from fc ±2.5 % to fc ±30 % and 70 dB for frequencies beyond fc ±30 %.

o. Audio frequency Total Harmonic Distortion (THD): with the receiver at rated output level, 35 dB below a reference tone level that is a RF test signal (producing a frequency within 300 ÷ 3050 Hz) 35 dB above the receiver noise threshold.

p. In-band IMD: with reference to two input signals of -53 dBm each spaced 110 Hz apart at frequencies selected to produce audio outputs in the 450 ÷ 3050 Hz range, 35 dB below the output level of either audio tone.

q. Out-of-band IMD: for a two-tone equal-amplitude input signals with each tone at -36 dBm or greater (with the closest signal spaced 30 kHz from the operating frequency), second order (and higher-order) responses shall produce an output SINAD equivalent to a single 110 dBm tone.

r. Automatic Gain Control (AGC):

- Attack time delay (max): 12 ms (from no signal to a two-tone +19 dBm signal).
- Decay (or release delay) time (max): 20 ms (from a 16 tone +19 dBm signal to a two-tone -81 dBm signal, in the data mode).
- Recycle period: capability of repeating the above operations every 100 ms (with a period between data signals higher than 10 ms).

s. Dynamic range: the AGC shall maintain the receiver output level at 0 ± 3 dBm when the input signal level is in the range -87 ÷ +13 dBm.t. t.
BITE: embedded

t. Local and remote (BITE) controls

u. Remote control interfaces: EIA RS 232 (or, equivalently, 422 or 485) and/or 10Base-T IEEE 802.3 (Ethernet)

v. Power supply: 230 Vac ± 10 % single phase @ 45 ÷ 65 Hz

w. Power consumption (max): 350 W

x. Rack mountable with size (max): 19” x 580 mm x 3U (W x D x H)

y. Weight (max): 20 kg

z. Operating temperature: 0 ÷ +40 °C

aa. Relative humidity: 90 % at +40 °C without condensation

bb. Time delay (max): 3.5 ms (for any single frequency over the range 500 ÷ 3.050 Hz) (design objective 2.5 ms).

## 3.12 HF-RX Pre-Selector

3.12.1 Rack mountable HF-RX pre-selector to allow the use of the receiver with strong input signals (improved receiver input selectivity). Each pre-selector shall meet the following minimum requirements:

a. Automatic/manual and fast tuning type (less than 10 ms) with RF input signal protection

b. Frequency range: 2 ÷ 29.9999 MHz

c. Selectivity: 3 dB at 2% off the operating frequency and 50 dB at fc ±10 %

d. Gain: 0 ±3 dB

e. Noise Figure (max): 20 dB

f. IMD: 35 dB

g. Power supply: 230 Vac ± 10 % single phase @ 45 ÷ 65 Hz

h. Power consumption (max): 100 W

i. Rack mountable with size (max): 19” x 580 mm x 2U (W x D x H)

j. Weight (max): 20 kg

k. Operating temperature: 0 ÷ +40 °C

Relative humidity: 90 % at +40 °C without condensation

- Intermodulation distortion: better than 35 dB

## 3.13 HF-RX Multi-coupler

3.13.1 Rack mountable HF-RX multi-coupler in order to allow the use of one HF antenna with two (2) HF receivers. The following minimum characteristics for multi-coupler shall be met:

a.Low noise and high linearity, operative also in presence of strong signals minimizing distortion and intermodulation

b. Frequency range: 2 ÷ 29.9999 MHz

c. Input pass band filter: 2 ÷ 29.9999 MHz, high rejection of out-of-band signals

d. Input and output impedance: 50 ohm

e. Number of inputs (antenna): 1

f. Number of outputs (receivers): 2

g. VSWR input/output (max): 1.5: 1

h. Isolation between RF outputs: 30 dB

i. Rack mountable with size (max): 19” x 480 mm x 4U (W x D x H)

j. Weight (max): 70 kg

k. Operating temperature: 0 ÷ +40 °C

l. Relative humidity: 90 % at +40 °C without condensation

## 3.14 HF Receiver Antenna

The physical and environmental requirements of this antenna and supporting structure are the same as for the HF Transmitter antenna specified in Section 3.9.

## 3.15 RF Cabling

3.15.1 Different type of coaxial cabling to be provided for all the involved sites with the aim to connect transceivers and antennas to be compliant to the following minimum requirements:

a. Standard RG-213/U coaxial cable attenuation (max):

- 10 dB/100m @ 225 MHz;
- 15 dB/100m @ 400 MHz

b. Standard 7/8” coaxial cable attenuation (max):

- 0.2 dB/100m @ 2÷4 MHz
- 0.3 dB/100m @ 6 MHz
- 0.4 dB/100m @ 10 MHz
- 0.7 dB/100m @ 30 MHz
- 1.8 dB/100m @ 225 MHz
- 2.5 dB/100m @ 400 MHz

c. Standard 1-5/8” coaxial cabling attenuation (max):

- 0.1 dB/100m @ 2÷4 MHz
- 0.2 dB/100m @ 6 MHz
- 0.3 dB/100m @ 10 MHz
- 0.4 dB/100m @ 30 MHz

3.15.2 The RF cabling shall be equipped with the proper connectors and cannot be directly connected to the transmitters; they shall pass from a suitable panel to be provided and installed at the entrance of the barrack/building; this latter panel shall be provided and equipped with suitable surge dischargers.

## 3.16 19" Standard Rack Cabinets

3.16.1 19" standard rack cabinets, having the dimensions indicated in this document, in the drawings and, in any case, able to support the installation of the envisaged devices:

a. Ground connection kit for each frame part

b. Two supply ribbons for the active parts, cabled on the back post, composed by at least 12 VDE (C15) type sockets

d. Suitable number of covering blank panels

e. A proportionate magneto-thermal differential breaker and a warning light

f. Front service socket set

g. Proportionate cooling set for equipment heat removal in the worst case

h. Ventilation slits to allow for forced cooling

i. Service drawer, minimum 2U height, placed to be easily accessible by a standing person. One every three racks.

j. Suitable protections against dust for the cables inputs and ventilation slits

k. External label in order to identify the rack in accordance with ANSI/TIA/EIA–606 o ISO/IEC 14763-1 Standards. The label shall be placed either on the front or on the rear of the rack

l. External not removable label in metallic material, reporting the following data:

- Inventory number and contract date (contract nr. Contract number of mm.dd.yyyy Inventory)
- Purchaser
- Contractor (contracting Company name)
- Use destination

3.16.2 The rack/frame protection level shall be at least IP 20 and the supply shall include the supports and those elements required to install cable bundling and blocking.

3.16.3 The rack shall be compliant to IEC 60297 or THN standard and shall be suitable for structured cablings having TIA/EIA 568-C or THN standards or similar. The rack shall be able to contain a 19" Units number equal to how much indicated in the design and in the related estimate. The frame shall allow a correct installation and cablings management (e.g., the cables shall be installed in the observance of minimum bend radius).

## 3.17 Multiplexer

3.17.1 The Multiplexer shall transport Audio signals/services and discreet signals between the HF TX sites and the HF RX site. The selection of Multiplexers shall be performed in close coordination with the purchaser and the THN. The final decision on the selected multiplexer type is with the purchaser.

## 3.18 Network/Router/Switches

3.18.1 Every SSSB COMMS site will constitute a local area network within the boundaries of the SSSB COMMS system.
A COMMS site is connected to the Buffer Centre via the THN National Defense Network (NDN) with the SSSB Buffer Centre.
Between the Buffer Centre and other NATO units, data (SSSB Data, JCHAT, Tactical Data, etc.) will be exchanged via the NATO NGCS network.

3.18.2 The selection of Routers shall be performed in close coordination with the purchaser and the THN. The final decision on the selected Router type is with the THN.

3.18.3 For Network connections between the COMMS racks and to the router, F/O is preferred.

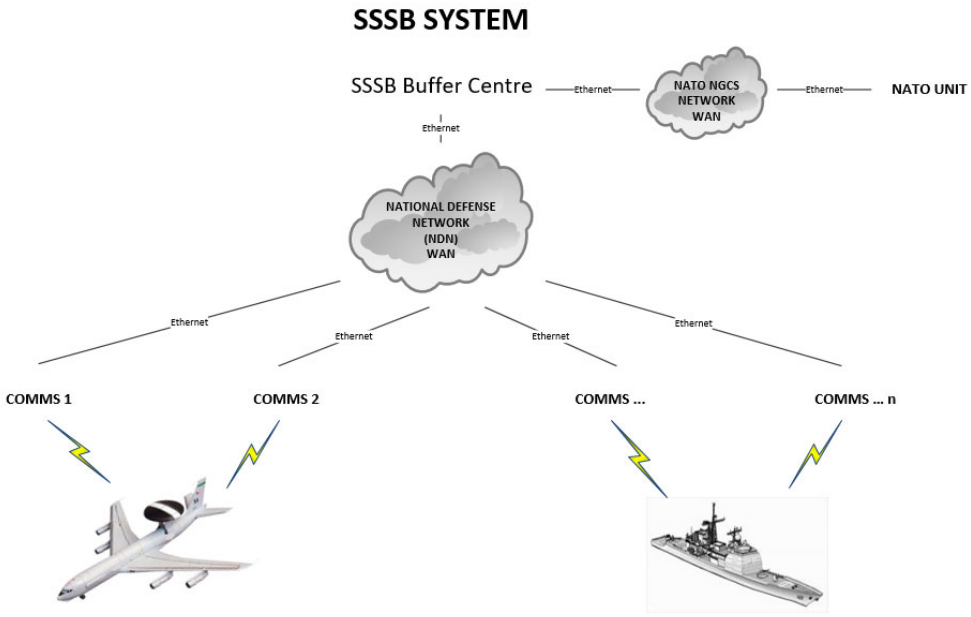


Figure 23: SSSB Network Overview

## 3.19 Time of Day Server (TOD)

3.19.1 A Military Grade Time of Day (TOD) HQ/SATURN GPS server with Selective Availability Anti-spoofing Module (SAASM) shall be used as time reference.

3.19.2 Time Reference for SPC, Frequency Synchronisation for UHF radios and Time Reference for applicable equipment.

3.19.3 The TOD shall fulfil the following requirements:

a. DTS Conforming standards:
   - STANAG 4430 NRS IDD
   - MIL Grade GPS SAASM

b. SPC supports the following control Interface:
   - Serial RS-232 unbalanced (and/or) 10Base-T IEEE 802.3 (Ethernet).

c. GPS Antenna included
d. Have Quick (HQ) Time Code output
e. Low Phase Noise Sine Wave Output 10MHz
f. Provides NTP, PTP
g. Supports the number of devices to be connected.

## 3.20 Link 22 Signal Processing Controller (SPC)

3.20.1 The purpose of the SPC is to provide the modem functions and control of the Link 22 network in radio communication HF-UHF.

3.20.2 SPC Conforming standards:

a. NILE Interface Requirements Specification and NILE Communication Media Segment Specification
   - NG 278-A018-LLCIRS/B4
   - NG 278-A018-SPCSS/B4
   - NG 278-A018-SPCSS/B4, Appendix A, HF FF Media
   - NG 278-A018-SPCSS/B4, Appendix B, UHF FF Media
   - NG 278-A018-SPCSS/B4, Appendix D, UHF FF Media

b. STANAG 4205
c. STANAG 4372
d. STANAG 4539 Annex D

3.20.3 The SPC is intended to support the following configurations:

LOCAL

a. SPC Serial Splitter (SSS)
b. Standard, Long Range, High Throughput Link 22 Waveforms and Maintenance Waveform are implemented in the SPC (MSN 1-18, MFW).

3.20.4 SPC supports the following control Interface:

a. Serial RS-232 unbalanced (and/or) 10Base-T IEEE 802.3 (Ethernet).

## 3.21 Link 11 Data Terminal Set (DTS)

3.21.1 The purpose of the DTS is to provide the modem functions and control of the TADIL-A/Link 11 network in radio communication HF-UHF-SATLINK.

3.21.2 Link-11 modem is defined in MIL-STD-188-203A - Interoperability and Performance Standards for Tactical Digital Information Link (TADIL) A.

3.21.3 The Modem shall fulfil the following requirements:

a.DTS Conforming standards:

- MIL-STD-188-203A,
- SPAWAR-S-850,
- MIL-STD-1397,
- STANAG 5511,
- EIA RS-232-C

b.Single Tone (SLEW) and Multi Tone (CLEW) Link 11 Waveforms are implemented in the DTS

c. DTS supports the following Input/Output data interface:

- Naval Tactical Data System (NTDS).

d. DTS supports the following control Interface:

- Serial RS-232 unbalanced (and/or) 10Base-T IEEE 802.3 (Ethernet).

# SECTION 4 Technical Requirements: Systems and Infrastructure

## 4.1 General

4.1.1 The following paragraphs define the minimal requirements the Contractor shall be compliant with in order to implement auxiliary SSSB systems and to perform infrastructure activities (including cabling).

4.1.2 Civil Works related requirements associated with and in support of the technical requirements can be found in Section 14 of the core SOW as well as in detail in the System Requirements Specifications (Civil Works) (SRS(CW) that can be found at Annex I to the core SOW.

## 4.2 DTS Link 11 Architecture

4.2.1 The encrypted stream of Link 11 data from one TDS computer, such as the SSSB buffer server, to another – or more – TDS computer, such as a naval TDS, responds to the basic architecture of Figure 24, which requests for the use of TDS computers, crypto's, DTSs and RF transceivers for distribution over the air.


Figure 24: SSSB/Link 11 system – Basic architecture

4.2.2 Other solutions were developed throughout the history of deployment of SSSB and Link 11 installations in order to handle situations with radio sites unmanned or remote with respect to the buffer and control centres and efficiently transport multiple audio and control signals between the DTS and the radio equipment. They are known as:

4.2.3 Split-Site DTS, In which the two primary functions of the Link 11 Terminal set (control and conversion into audio signal) are split between two physical locations, a split-local site as the control centre and a split-remote site with both radio transmitters and receivers. A DTS is required at each location

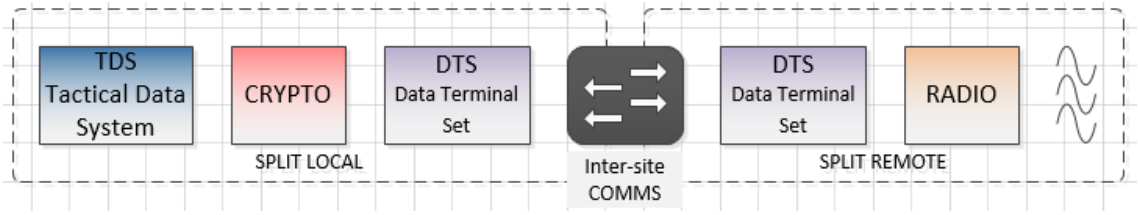


Figure 25: SSSB/Link 11 system – DTS Split-Site architecture

4.2.4 Split-Split Suited for remote independent transmit and receive radio sites, with the radio receiver located at the Intermediate Remote Site (IREM), the transmitter at the Distant Remote Site (DREM) and the TDS computer at the

split local Site. A DTS is required at each location.

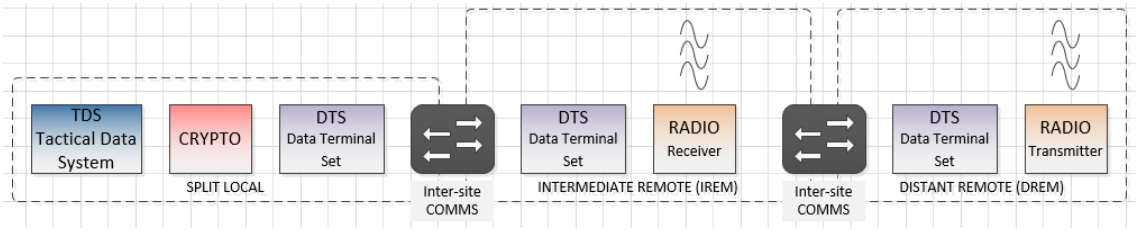


Figure 26: SSSB/Link 11 system – DTS Split-Split site architecture

4.2.5 In both of the configurations above, couples of wireline modems are to be used to connect the DTS devices. According to the technical data from the producer of the DTS model used in most recent NCI SSSB installations, the round-trip delay over the digital links from the local site to a remote site must be less than 65 ms.

4.2.6 For the scope of this project, since the radio sites are remote with respect to the control site(s) and the respective inter-sites communication sub-systems could be implemented, to date, only through the use of the National Digital Network (NDN), such timing requirements could have been achieved only through a very performing NDN.

4.2.7 In order to overcome this limitation and relax the timing requirements for the Inter-site communication sub-system, NCIA developed an alternative design with the use of the VLI (Versatile Link Interface) interfaces. Multiple and differentiated VLI interfaces within the Link 11 architecture provide for the exchange of data and control signal between the TDS computer and the remote DTS:

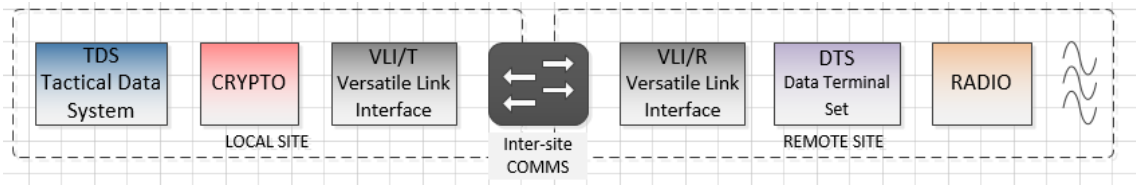


Figure 27: SSSB/Link 11 system – NATO Versatile Link Interface (VLI) architecture

4.2.8 One VLI device in remote configuration (VLI/R) is connected to the DTS of the radio site. It emulates the remote TDS and thus terminates completely the Link 11 interface and all the timing requirements associated to it.

4.2.9 One VLI device in terminal configuration (VLI/T) in the local site. The VLI/T receives Link 11 data from the VLI/R via the NDN network and regenerates the Link 11 signal for the TDS.

4.2.10 One VLI device in data configuration (VLI/D or DLI) in between the TDS computer and the Link11, in order for the computer to interface the crypto NTDS

or ATDS port.

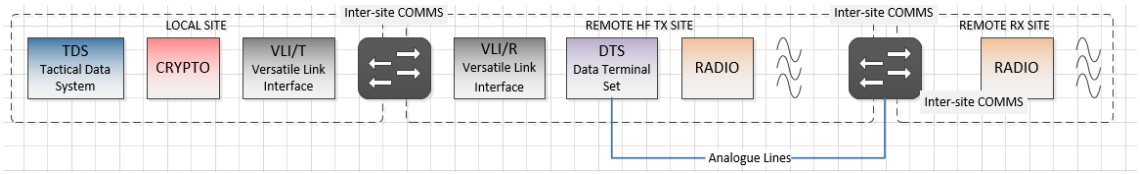


Figure 28: SSSB/Link 11 system – Simplified final architecture

## 4.3 UPS System

4.3.1 If it is subsequently found that additional UPS capacity is required for the correct operations of the CIS equipment in the facility building of the radio sites, then the provision of such additional UPS will be the Contractor's responsibility. In addition, if replacement of battery pack(s) of existing UPS appliances or UPS maintenance is required then the Contractor shall also provide such replacement/services.

4.3.2 In case complementary UPS NB appliances are required, the Contractor shall supply a UPS system with at least the following characteristics:

a. Input voltage 400 Vac three phases with neutral, 45 to 65 Hz, double-online conversation with zero time transfer.

b. Output Power sized in accordance to the applied loads, considering a minimum of 20 minutes of backup power in case of a power failure.

c. Batteries shall be of sealed maintenance-free type, replacement of the batteries shall be possible without powering down the UPS.

d. The expected battery lifetime shall be at least 9 years.

e. UPS shall be rated for a 20% spare capacity.

### 4.4 Rooms Air Conditioning

4.4.1 Additional air conditioning civil works might needed based on the results of the Contrators site survey, to fulfill the cooling requirements of the SSSB System.

### 4.5 HF Transmitters Equipment Cooling

4.5.1 The Contractor shall provide cooling for HF transmitters in accordance with:

a. Close circuit operations

b. Intake air filters from the outside

c. Ventilation or Ventilation/Cooling of the racks with high heat dissipation. Adjustable air flow to keep the mean temperature to the optimal value for the operating equipment. The energy consumption and the air flow shall be kept as low as possible.

4.5.2 The following requirements shall be complied with:

a. The cooling equipment shall be compatible with the installed fire extinguishing system (e.g. providing suitable interfacing, to stop HVAC in case of fire).

b. The cooling equipment shall be duplicated in order to guarantee continuous operations.

c. The cooling system shall be of heat-pump type, air/air reversible, with split unit installed on the walls.

d. The equipment shall be installed outside, preferably on the roof and splinter protected.

e. High quality COTS shall be used.

f. The system shall be automatic and provided with remote control and monitoring interfaces

g. Noise and vibrations shall be kept as low as possible and conforming to working environment specifications

h. Use of fluid is not recommended.

i. The air flow shall be in ducts. Plenum is not recommended. It is recommended the use of suitable diffusers.

j. The recommended cooling gas is R 407 C type or in accordance with the latest regulations.

k. The incoming air flow shall be filtered at least to M Class.

l. The Inside/outside openings shall be shaped (zig-zag) for splinter protection and secured to avoid entrance of animals, objects, etc.

m. The racks shall be provided with automatic air flow control to maintain a constant operating temperature.

n. Whenever possible avoid the use of ON/OFF devices.

o. Special consideration shall be used in considering the heat exchanged of the HF transmitters with the room environment.

p. Minimal energy absorption shall be one of the main design requirements.

q. In addition:

- Outside openings shall be secure.
- Heat distribution using insulated copper pipes.
- Outside Moisture discharge.

### 4.6 RF Cable Laying

4.6.1 The cable shall be of the following types:

a. Flexible cable (wrappable/cable conduit lay)

b. Rigid/semi rigid cable

4.6.2 The Contractor shall follow the below instructions related to the installation environment:

a. Internal, laid

- On metal duct, fixed in ordered manner.
- On metal duct or vertical cable ladder, fixed on the ducts or ladders with cable clamps designed to support the cable weight. The clamps shall be installed at least every linear meter of the cable length.

b. External, laid in cable duct trench at a depth of 60cm with inspection wells every 50m

- If flexible routed through pipes are used then the size of the pipes shall be sufficient to easily proceed with the installation of the cables. The size of the pipes shall also allow the installation of the same quantity of cables again as the initial installation.
- If rigid lay in pipes made of two half concrete or clay pipes, with cable laying on the bottom half covered by the second half and sealed with mortar. Inspection wells shall be provided at junction points.

4.6.3 The Contractor shall perform the installation in accordance with the following general requirements:

a. The curve radius of the laid cables shall conform to the cable manu facturer specifications.

b. In cable routing special care shall be made in order to avoid torsions that can damage the cable and which can prevent pulling out and/or further insertion of additional cables.

c. Cable junctions are allowed only where they correspond to inspection wells.

d. Cable section shall be the same for the whole length of the cable.

e. The cables shall be labelled and identified with cable strips:

- At both ends
- At every inspection well
- Every 10 m along the cable ducts or cable ladders
- Every time the cable change course

## 4.7 HF Antenna Installation

4.7.1 The Contractor shall conduct and/or obtain a proper soil study at the locations of antenna foundations, in order to determine the required design and size of those foundations.

4.7.2 Health and safety measures shall be implemented: including but not limited to safe to climb structures, sharp corners avoidance and proper safety marking.

4.7.3 For antennas that require a ground plane, the Contractor shall:

a. Prepare the installation area in accordance to section 4.9 below.

b. Excavate up to 30 cm the area intended for the laying of the ground plane and verify the flatness.

c. Place pins on the area to allow position identification of antenna and guy line plinths.

d. Put in place a layer of dry rubble on the levelled area.

e. Install the ground plane as per Manufacturer specifications.

f. Put in place a layer of at least 10cm of mixed quarry.

4.7.4 For antennas that do not require ground plane, the Contractor shall:

a. Clean and prepare the area.

b. Place pins on the area to allow position identification of antenna and guy lines plinths.

4.7.5 In addition, the Contractor shall perform the following Civil Works for HF antenna installations:

a. Construction in reinforced concrete of the plinths of such a size to be compatible with the manufacturer specifications and the results of the soil tests.

b. The plinth at the base of the antenna mast shall be large enough to avoid that the grass growing around the area to come in contact with the antenna structure.

c. Connect the metal structures among them to the earth pins.

d. Prepare the base of the antenna for the RF cable joint, and the other devices as service power socket, discharger and air obstacle light power transformer.

e. Build a security/safety fence around the concrete base of at least 1m high. Fence material and size shall be adequate to avoid personnel accidental contact and wild animal access.

f. Antenna installation in accordance with the manufacturer instructions.

## 4.8 UHF Antenna Installation

4.8.1 The Contractor shall install the UHF antennas on a climbing galvanized steel pylon. The length of the pylon shall be identified by the Contractor per each site. UHF antenna as well as AIS antenna shall be not mounted on existing buildings. A combined stand-alone mast/pole construction shall be used instead.

## 4.9 Antennas Field Area Preparation (see also SRS (CW) Annex I)

4.9.1 The site preparation activities are needed to clear all the designated areas inside the sites. In particular the areas dedicated to the HF antennas, the construction/refurbishment of barrack buildings and as well, if needed, the construction of the road. A summary of the preparation activities that may be

required include:

a. Clearing through cutting and stripping to surface level of any type of vegetation (trees, bushes and shrubs, including the remove of roots related to trees of medium size through excavation);

b. Clearing through crushing of main rocks;

c. Removal of any other items that can obstacle the constructions/installations;

d. Digging of topsoil/grass layer, at least 20 cm deep, ground levelling and compacting;

e. Excavation for the construction of the road, the barrack/building and for the external cabling distribution systems for services (power, signal and RF cabling);

f. Preparation of the area designated for the HF antennas.

4.9.2 The zones designated for the HF antennas shall be in different areas at a distance to be analysed and defined. After the clearing of those areas (from trees, bushes, shrubs, main rocks, topsoil, etc.), the related preparation includes (for each area):

a. The flattening with slope close as much as possible to 0%; such flattening shall be performed at least for the expected surface of the ground screen.

b. The excavation of the area intended for the laying of the HF antenna's ground screen. The bottom of the excavation shall be as flat as possible.

c. The placement of pins to allow immediate position identification of the HF antenna tower and guy line plinths.

d. The placement of a first layer of dry rubble (e.g. fine materials passing sieve, crushed rock, mixed quarry or similar) on all the excavated and flattened area for the laying of the HF antenna's ground screen.

4.9.3 All excavated spoil that is not re-used shall be disposed by the Contractor as per HN regulations.

4.9.4 After the preparation of the antenna field, the HF antennas shall be installed.

4.9.5 Such installations include:

a. The construction in reinforced concrete of the antenna plinths. The size and characteristics shall be compatible with the manufacturer specifications, the results of the soil tests, specific seismic and static calculations and the local environmental conditions (wind speed, temperature, a.s.o.);

b. The preparation of the antenna bases for the RF cabling joints, and the other devices (service power sockets, dischargers, power transformers for air obstacle lights, etc.);

c. The installation of the ground screens (provided along with the antennas) as per manufacturer specifications;

d. The installation of air obstacle lights (provided along with the antennas) when

relevant as per manufacturer specifications. No civil, military or private aerodrome or helipad was confirmed within the site boundary or in the proximity to date;

e. The driving into the ground of the earthing/grounding rods (provided along with the antennas). The positions and insertion conditions shall be compatible with the manufacturer specifications and with the results of the soil tests;

f. The electrical connection of the entire antenna metal structures (including the ground screens) to the earthing/grounding rods;

g. The placement of a second layer of dry rubble (e.g. fine materials passing sieve, crushed rock, mixed quarry or similar) in order to fill the all excavated area for the laying of the antenna's ground screens.

4.9.6 Each HF antenna installation shall be capable of acceptable performance when exposed to wind speeds of a minimum 44-61 m/s ±10%. The antennas and the supporting structure shall be designed and treated so as to withstand salt and other effects due to the vicinity of the sea.

4.9.7 As mentioned in other section of the annex it will be the Contractors responsibility to retrieve local wind speed data, including exceptional wind speed data, for each local COMMS site from the THN authorities and plan and install appropriate antennas accordingly to meet the local climatic conditions.

4.9.8 The air obstacle lights infrastructure kits shall include transformers to be connected to the power supply at the base of the antennas, as outlined in para 4.10 below.

4.9.9 Marking and painting shall be provided for the antenna main vertical structures/poles when relevant in compliance with ICAO norms, and valid national THN regulations.

4.9.10 The RF cabling shall be implemented with coaxial cables, minimum section 1-5/8" for the long external runs and 7/8" for cable tails and connections to devices and panels. The cables shall pass from a suitable panel installed at the entrance of the barrack/building and equipped with surge dischargers and earthing kits to be connected with the lightning protection system of the barrack/building.

4.9.11 In order to prevent physical damage to the HF antennas and protect personnel from hazardous RF voltages, the installation shall be completed with the installation of fence(s) around the HF antenna field. The material and size of this security/safety fence(s) shall be adequate to avoid personnel accidental contact and wild animal access.

### 4.10 Antenna Obstruction Lights (Aircraft Warning Lights)

4.10.1 The infrastructure shall be implemented in accordance to ICAO Annex 14, Volume 1, Chapter 6, "Visual aids for denoting obstacles", latest edition, as well as valid national THN regulations.

4.10.2 All the antennas shall be provided with obstruction light kits, based on LED technology for low/no maintenance.

4.10.3 The kit shall include a double toroid transformer to be connected to LT power supply at the base of the antennas.

a. The LT power cable(s), connected to the electric panel of the site, shall be laid into a PVC pipeline laid underground with a sufficient number of inspection wells.

### 4.11 Lightning System

4.11.1 The lightning system, which specific characteristics shall be identified in relation to the structure to be protected, shall be designed in relation to the following regulations:

a. EN 62305-1:2011, “Protection against lightning - Part 1: General principles” or THN equivalent

b. EN 61000 or THN Equivalent

c. Safety regulations

### 4.12 Ground and Earth System

4.12.1 The earth system shall be implemented by means of an underground copper braid laid along the building perimeter reinforced with ground earth stakes accessible and sectioned via inspection wells.

4.12.2 The earth system shall be sized in accordance with the electric system specifications and of the surround soil type and quality. In any case the total earth resistance shall not be in excess of a few tenths of an Ohm.

4.12.3 The ground system shall be implemented by connecting all metal structures existing in the building and of the concerned structures related to the civil infrastructure and the existing systems like electricity, air cooling ventilation heating etc.

### 4.13 Site Monitor System

4.13.1 The Contractor shall supply a Site Monitor System functionality at each HF-TX, HF-RX and UHF sites in support of the SSSB Open System Communication Control (OSCC). It shall be compatible with any monitoring system already installed by the THN.

4.13.2 Function:

a.The function of the site monitor system is to reveal the status of operation of the respective SSSB Radio Site.

b. The monitor system shall provide the vital site states and alarms via an interface to the SSSB Open System Communication Control (OSCC LLC).

c. The monitor system shall provide the vital site states and alarms via an interface to the SSSB Open System Communication Control (OSCC LLC).

d. One rack mountable Alarm/Status panel installed at one of the racks shall

be provided.

e. One desk/wall mountable Alarm/Status panel shall be provided.

4.13.3 Architecture:

a. The data to be monitored are conveyed to the management system that will relay to the remote monitoring station at the other sites and the control centre via Local Area Network (LAN) and Long Haul Network (LHN).

b. Vital Site States.

c. Monitored data.

d. Radio Receivers, HF and UHF.

e. Radio Transmitters, HF and UHF.

f. Low Tension power network.

g. Low Tension UPS.

h. Electric system.

i. Air conditioning system.

j. Equipment air cooling system.

k. Fire Alarms.

l. Anti-intrusion system.

4.13.4 Any other recommendation from the Contractor in relation to the installed devices shall be detailed in his bidding proposal.

4.13.5 The technical integration documentation is to be provided, beside other technical documents, as the Interface Control Documents (ICDs) format describing the format of the control messages and the protocol to be used to exchange the SMS information with the OSCC.

### 4.14 DLOS Microwave Inter-Site Connections

The contractor shall integrate nine (9) DLOS Inter-site connections.

DLOS Inter-site connections shall be integrated at:

4.14.1 Pagia on Skyros Island

a. Integrate DLOS connection between Pagia and Kartsinoudi (DLOS system IDU/ODU including DLOS dishes).

b. Integrate DLOS connection between Pagia and 7th Air Force Radar Station (DLOS system IDU/ODU including DLOS dishes).

c. Integrate DLOS connection between Pagia and Efstratios (DLOS system IDU/ODU including DLOS dishes).

d. Integrate DLOS connection between Pagia and Skopelos (DLOS system IDU/ODU including DLOS dishes).

4.14.2 Skopelos on Skopelos Island

a. Integrate DLOS connection between Skopelos and Pilion (DLOS system IDU/ODU including DLOS dishes).

4.14.3 Limnonari on Skyros Island

a. Integrate DLOS connection between Limnonari and Efstratios (DLOS system IDU/ODU including DLOS dishes).

4.14.4 Cape Mavros on Crete Island

a. Integrate DLOS connection between Cape Mavros and Kyriamadi (DLOS system IDU/ODU including DLOS dishes).

4.14.5 Cape Sideros on Crete Island

a. Integrate DLOS connection between Cape Sideros and Kefalas (DLOS system IDU/ODU including DLOS dishes).

4.14.6 ARS Larissa on Continental Mainland

a. Integrate DLOS connection between ARS Larissa and Pilion (DLOS system IDU/ODU including DLOS dishes).

4.14.7 DLOS Hot-Standby Systems

The integration of eighteen (18) DLOS systems shall be performed as a 1+1 hot standby configured system. Some of the systems shall provide additional space diversity capabilities. The systems shall be integrated at the following locations:

a. Skyros Island
   - 1x at Kartsinoudi COMMS HF-TX.
   - 1x at Limnonari COMMS HF RX.
   - 1x at 7th Air Force Radar Station COMMS UHF-TRX.
   - 4x at Pagia DLOS Relay Station.
     - Two (2) systems shall provide space diversity capabilities.

b. Crete Island
   - 1x at Cape Mavros COMMS HF TX and UHF TRX.
   - 1x at Cape Sideros (Forward Naval Base Kyriamadi area) COMMS HF-RX.
   - 1x at Kefalas (Forward Naval Base Kyriamadi area) DLOS radio-relays station.
   - 1x at Kefalas (Forward Naval Base Kyriamadi area) NDN Access Point.

c. Efstratios Island
   - 2x at Efstratios DLOS Relay Station
     - Systems shall provide space diversity capabilities.

d. Skopelos Island
   - 2x at Skopelos DLOS Relay Station
     - Systems shall provide space diversity capabilities.

e. Pilion (Continental GRC)
   - 2x at Pilion DLOS Relay Station
     - Systems shall provide space diversity capabilities.

f. ARS Larissa (Continental GRC)
   - 1x at ARS Larissa DLOS Relay Station
     - Systems shall provide space diversity capabilities.

### 4.15 F/O underground Lines

Fibre Optic underground lines have to be installed at:

4.15.1 Kyriamadi on Crete Island

a. Lay F/O cable underground from Kyriamadi to Palaikastro ~20 Km F/O line.

### 4.16 Non-Functional Requirements

#### 4.16.1 Reliability, Availability, Maintainability and Testability (RAMT) Program

4.16.2 Basic Reliability shall be expressed as Mean Time Between Failures (MTBF), where ‘failure’ is understood to mean any condition in which an item, assembly, sub-system or the entire system is not operating according to specification. The MTBF of the system shall not be less than 350 hours.

4.16.3 Mission Reliability shall be expressed as Mean Time Between Critical Failures (MTBCF), where ‘critical failure’ is understood to mean any condition in which the entire system is not operating according to specification. The MTBCF of the system shall not be less than 1000 hours.

#### 4.16.4 Maintainability and Testability Requirements (MTR)

4.16.5 Maintainability shall be expressed as Mean Time To Repair (MTTR) and Mean Time to Restore the System (MTTRS):

4.16.6 MTTR shall be calculated for all kind of failures (Critical and non-critical) and shall include fault isolation, access, disassembly, remove and replace, reassembly, configuration, check-out and start-up, and to exclude administrative and logistics delay times.

4.16.7 MTTRS shall be calculated for critical failures only and shall include fault isolation, access, disassembly, remove and replace, reassembly, configuration, check-out and start-up, and to exclude administrative and logistics delay times.

4.16.8 The MTTR at Site Level shall not exceed 30 minutes and the TTRMax (95%) shall not exceed 60 minutes.

4.16.9 The MTTRs at Site Level shall not exceed 45 minutes.

4.16.10 The System shall be designed to include Built-In Test Equipment (BITE) capable of on-line detection of 95% of all failure modes (Fault Detection rate).

4.16.11 The System shall have a Built–In Test Equipment capable to isolate 80% of the detected failures to 1 LRU, 90% to no more than 2 LRUs, 95% to no more than 3 LRUs and 100% to no more than 5 LRUs (Fault Isolation rates).

**4.16.12 Availability Requirements**

4.16.13 Operational readiness is the measure of the degree to which an item is in an operable and ready-for-use state at the start of a mission or operation, when the mission or operation is called for at an unknown time.

4.16.14 The inherent availability of a system is driven by the reliability and maintainability of the Product. It is described as the probability that a system, when used under stated conditions in an ideal support environment (e.g., no lack of support resources) will operate sufficiently at any point in time. It excludes preventive maintenance, delay times.

4.16.15 Inherent availability (Ai) shall be calculated as MTBCF / (MTBCF + MTTRS).

4.16.16 Inherent availability (Ai) shall be greater than 99.9 %.

**4.16.17 Mean Time To Repair (MTTR)**

4.16.18 Mean Time To Repair (MTTR) for hardware faults is the average elapsed time of corrective maintenance. The MTTR elements contributing to the MTTR value shall be those listed in MIL-HDBK-470A, section D2.0, Table D-I.

4.16.19 For HL1/2 tasks, the MTTR shall not exceed 30 minutes.

4.16.20 For HL3 tasks, the MTTR target figure is 120 minutes.

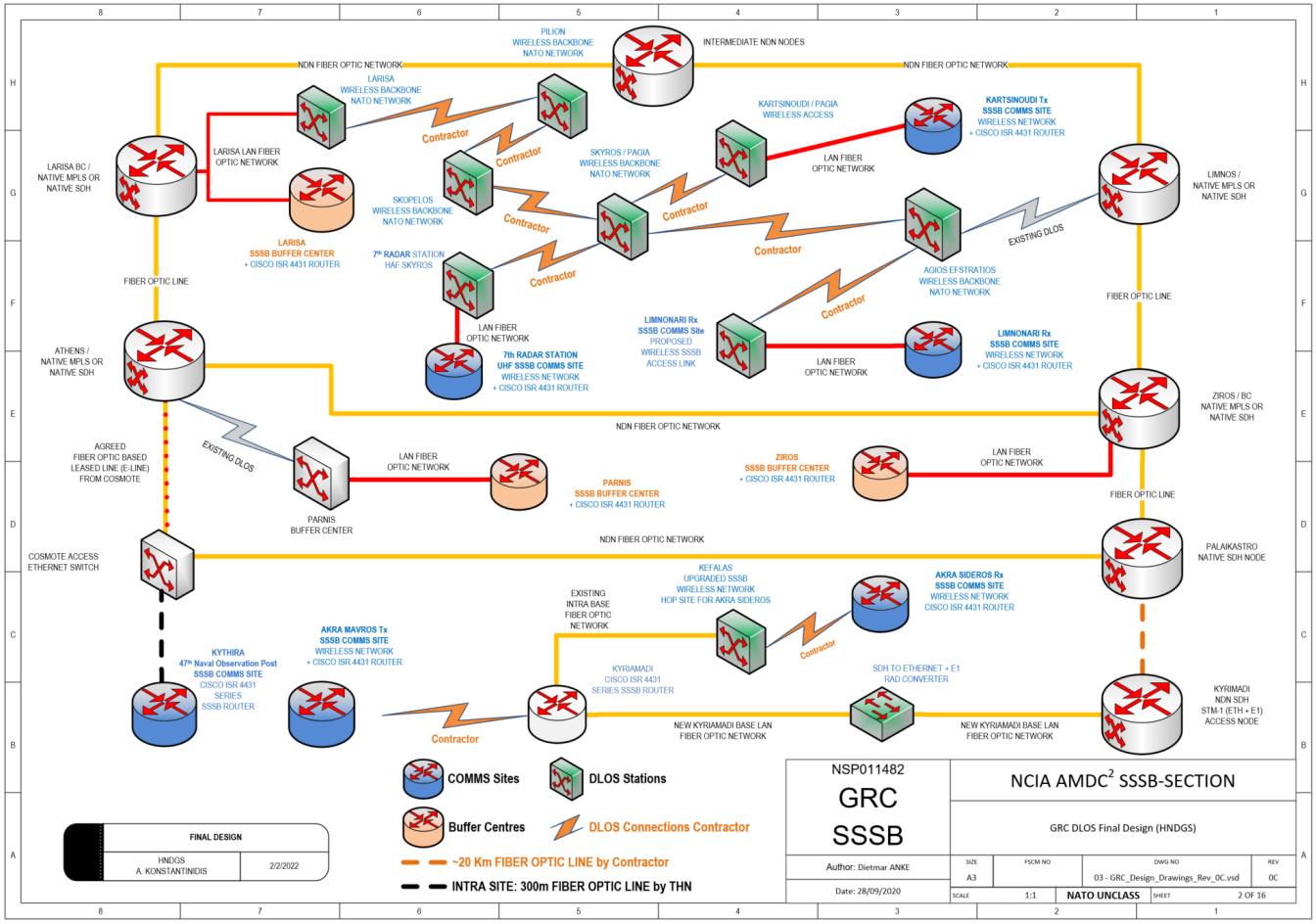


Figure 29: GRC National Defence Network (NDN)

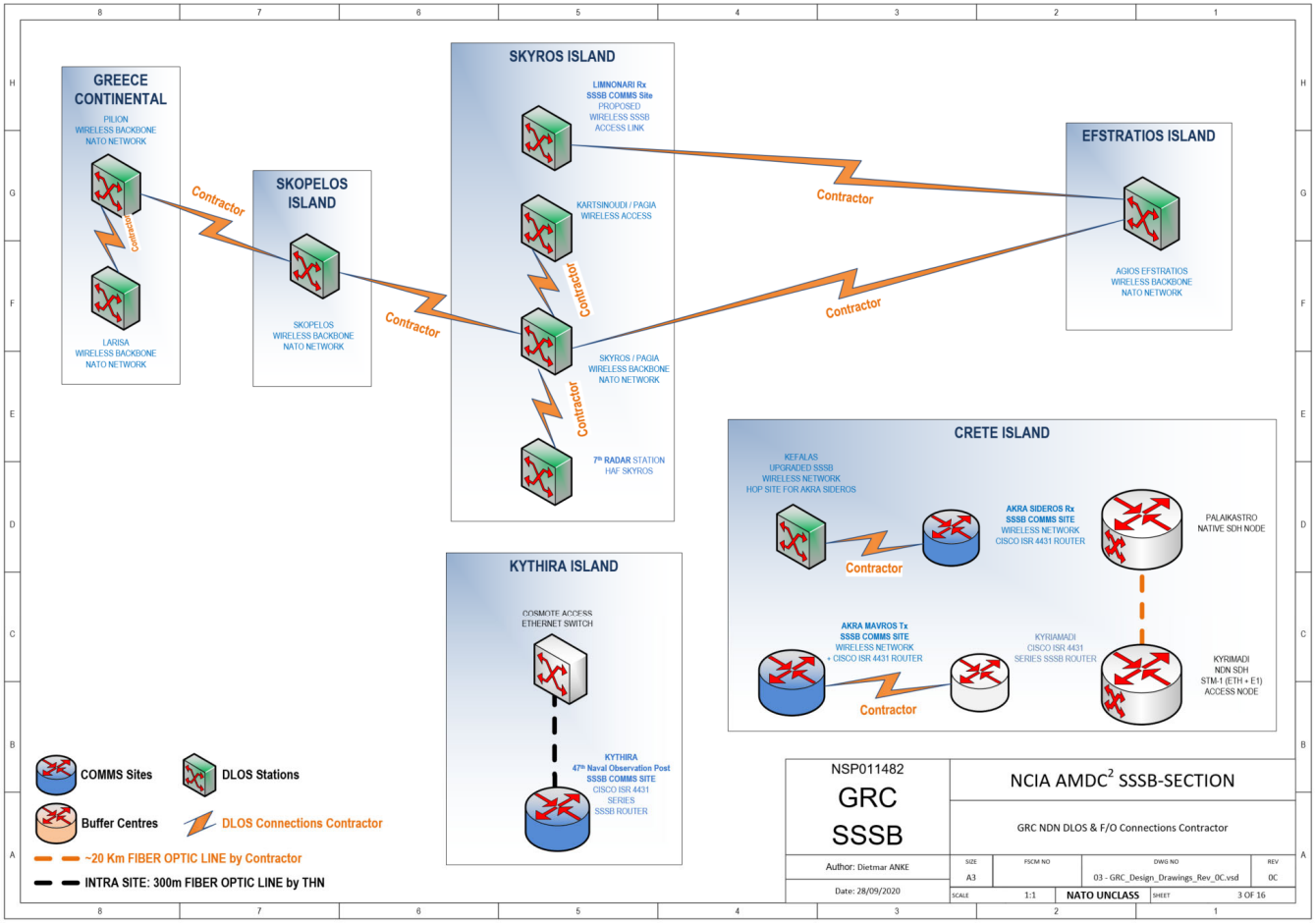


Figure 30: GRC NDN - DLOS & F/O Connections Contractor Responsibilities

# SECTION 5 Technical Verifications

## 5.1 Technical Verifications

5.1.1 These activities are studies dedicated to the verification of the technical and operational.

5.1.2 The Contractor shall prove the EM coverage as per the following:

a. SSSB Operational Requirement

- ‘To provide a real-time automatic exchange of Air Defence (AD) data between Maritime Forces and NATO Air Defence Ground Environment (NADGE)’

b. Radio coverage

c. HF: ‘300 NM gapless coverage’

d. UHF: ‘LOS up to 150 NM’

e. HF Operational Modes

f. Ship-Shore High Speed Data exchange NTDS Link 11 as per MIL-STD-188-203-1A and STANAG 5511

g. Ship-Shore High Speed Data Exchange Link 22 as per STANAG 5522

h. Voice SSB for coordination, Ship-Shore

i. Transmitters

j. HF-TX power 5kW peak and mean, frequency range 2-30 MHz, SSB for Link 11, Link 22 modes and Voice mode

k. Propagation Type

| | | |
|---|---|---|
| l. | Link 11 | Vertical polarization, Ground wave |
| m. | Link 22 | Vertical polarization, Ground wave |
| n. | Link 22 | Sky wave |
| o. | Voice Coordination | Vertical polarization, Ground wave |

p. Minimum S/N in Link 11 mode

q. With reference to MIL-188-203-1A para 5.1.13, in order to identify the coverage area in Link 11 mode, using the simulation program Advanced Stand Alone Prediction System (ASAPS), the following values can be used to guarantee a BER value better than 10-3:

r. Receiver minimum input power value:

s. PIN = -105 dBm (equivalent to 1.27 µV / 50 Ohm)

t. Receiver input Signal Noise Ratio value

u. S/N = 15 dB

v. Minimum S/N in Voice mode

w. In this operational mode for the HF receiver it is possible to assume the following conditions for the input and output (minimum sensitivity) that a good quality of the Voice signal delivered by the receiver:

x. Input signal: -110 dBm (equivalent to 0.7 Volt / 50 Ohm)

y. Output S/N: 10 dB

z. X Antenna Field

aa. The following parameters are the minimum requirement for the TX Antenna Field:

- Coverage Area: 300 NM
- Minimum S/N: 10 dB at the receiver antenna
- TX Power: 5 kW
- Simulations: Month/Day/Hour
- Frequency: 2 to 30 MHz
- BW: 3 kHz
- RX Antenna: Isotropic Vertical
- Man Made Noise: -150 dBW/Hz (shipboard)
- Propagation: Ground Wave
- Polarization: Vertical/Horizontal,
- Elliptic

bb. Results representation

cc. Recommended tabular representation (examples):

| **Area of interest:** | 300 nm | **TX Antenna type** |
|---|---|---|
| **S/N** | 10 dB | |

| **Transmission** | | | | **Reception** | |
|---|---|---|---|---|---|
| TX Power | | 5 kW | | RX Antenna | Isotropic Vertical |
| Mode | | See Table | | BW | 3 kHz |
| Winter | | | | Man Made Noise | -150 dBW/Hz @ 3 MHz |
| Summer | | | | Required Days | 95% |
| Day | D | Hour | | Confidence Level S/N Ration | 95% |
| Night | N | Hour | | | |

| **Freq (MHz)** | **Sky Wave Propagation** | | | | **Ground Wave Propagation** | | | |
|---|---|---|---|---|---|---|---|---|
| | January | | July | | January | | July | |
| 2 | | | | | | | | |
| 3 | | | | | | | | |
| 4 | | | | | | | | |
| 5 | | | | | | | | |
| 6 | | | | | | | | |
| 7 | | | | | | | | |
| 8 | | | | | | | | |
| … | | | | | | | | |
| 29 | | | | | | | | |
| 30 | | | | | | | | |

dd. Legend:

| | |
|---|---|
| O | No Coverage |
| X | Coverage |
| | Not evaluated |

ee. Recommended map representation:

| | | | | | |
|---|---|---|---|---|---|
| **Location** | | **Antenna** | | | |
| **Frequency** | | **Season** | | **Time of Day** | |
| **TX Power** | 5 kW | **Propagation** | | **Man Made Noise** | -150 dBm (ITU R, P372) |
| **Reception confidence** | 95% | **Required Days** | 95% | **Bandwidth** | 3 kHz |

5.1.3 HF Transmitter decoupling: For the radio sites the Contractor shall verify the transmitter decoupling to.

a. Verify if the decoupling between the TX antennas it is sufficient to allow the correct operation of the transmitters in relation to the radiated signal quality.

5.1.4 The Contractor shall verify whether the radio communication system presents side effects related to insufficient decoupling:

a. High coupling

b. Excess of SWR

c. Difficult automatic tuning of the final stage of the amplifier

d. Coupling

e. Spurious emission due to intermodulation between transmitters

f. Spurious emission in the TX bandwidth influence the quality of distant reception

g. Spurious emission outside the TX bandwidth influence the receivers of the RX site

5.1.5 The Contractor shall verify that maximum values recommended for the spurious emission values due to TX intermodulation are not exceeded:

a.The quantity of the spurious emission values are related to:

- Transmitter characteristics
- Power Level
- Antenna decoupling
- Antenna characteristics
- It is assumed that that quantity shall not be bigger than the spurious values generated by the transmitter when used with a dummy load that

is 30/35 dB lower than the value of the two tones generated with full power

5.1.6 Recommended procedure:

a. Reference:

b. Richard C. Jonson, “Antenna engineering Handbook”, Third edition

c. Initial values:

d. Frequency: 2 – 30 MHz

e. Power Level: 5 kW

f. TX Antennas relative distances: (per Final Project)

g. Antenna characteristics: (per Final Project)

h. Equipment characteristics: (per Final Project)

5.1.7 Results representation:

a. The Contractor shall provide drawings, representing the mutual decoupling between the antennas in dB, versus the relative distance, and versus the maximum coupling allowed by the transmitters and of the RF infrastructure

5.1.8 Decoupling between the TX Antenna Field and the RX Antenna Field. For the six radio sites the Contractor shall verify the TX and RX Antenna Fields decoupling.

5.1.9 To verify if the decoupling between the antenna fields it is sufficient to allow the correct operation of the SSSB system in relation to the potential corruption of information due to the amplification and demodulation process provided by the receivers related to string signals radiated by the transmitters.

5.1.10 HF Receiving Antennas efficiency:

a.Contractor shall verify the HF receiving efficiency;

b. Contractor shall implement the RX site with one single receiver antenna;

c. Contractor shall ensure that the antenna shall drive, using a multi-coupler or an antenna matrix, two HF Receivers with the associated division of the received signal from the antenna;

d. Contractor shall verify that, in standard operational conditions, the received signal from a Naval Unit located within the SSSB coverage area is compatible with the receiver Signal Noise figure;

5.1.11 Such verification is deemed necessary even if, due to former experience in similar installation, the S/N ratio provides an external noise higher than the noise generated at the input of the receiver.

5.1.12 In addition, the Contractor shall also verify if the presence of strong received signals produces any distortions at the receiver side. In such case the Contractor shall evaluate if the receiver characteristics are able to cope with such case. In case of adverse results, the Contractor shall propose any specification changes accordingly.