 <b>PETROBRAS</b>	<b>TECHNICAL SPECIFICATION</b>	Nº: <b>I-ET-3010.00-5592-762-PPT-001</b>
	CLIENT: <b>SRGE</b>	SHEET: <b>1</b> of <b>13</b>
	JOB: <b>TELECOM TOWER</b>	
	AREA: <b>-</b>	
TIC	TITLE: <b>TELECOM TOWER</b>	<b>INTERNAL</b>  <b>OI/CS</b>

MICROSOFT WORD / V.2016 / I-ET-3010.00-5592-762-PPT-001\_A.docx

### INDEX OF REVISIONS

REV.	DESCRIPTION AND/OR REVISED SHEETS
0	ORIGINAL ISSUE
A	REVISED WHERE INDICATED

	REV. 0	REV. A	REV. B	REV. C	REV. D	REV. E	REV. F	REV. G	REV. H
DATE	APR/15/2022	OCT/25/2022							
DESIGN	PROJ-US	PROJ-US							
EXECUTION	Y3S7	Y3S7							
CHECK	CY22	CY22							
APPROVAL	X187	X187							


INFORMATION IN THIS DOCUMENT IS PROPERTY OF PETROBRAS, BEING PROHIBITED OUTSIDE OF THEIR PURPOSE  
 FORM OWNED TO PETROBRAS N-0381 REV. L



<b>TECHNICAL SPECIFICATION</b>	Nº: <b>I-ET-3010.00-5592-762-PPT-001</b>	REV. <b>A</b>
AREA: -	SHEET <b>2</b> of <b>13</b>	
TITLE: <b>TELECOM TOWER</b>	<b>INTERNAL</b>	
	<b>OI/CS</b>	

INDEX

1. SUBJECT .....	3
2. ABBREVIATIONS .....	3
3. REFERENCE DOCUMENTS, CODES AND STANDARDS .....	3
4. GENERAL REQUIREMENTS .....	4
5. SYSTEM DEFINITIONS .....	7
6. TECHNICAL REQUIREMENTS .....	7
7. SCOPE OF SUPPLY .....	10
8. COMMISSIONING .....	12
9. TYPICAL DESGIN .....	13

	<b>TECHNICAL SPECIFICATION</b>	Nº: <b>I-ET-3010.00-5592-762-PPT-001</b>	REV. <b>A</b>
	AREA: -	SHEET <b>3</b> of <b>13</b>	
	TITLE: <b>TELECOM TOWER</b>	<b>INTERNAL</b>	
		<b>OI/CS</b>	

## 1. SUBJECT


- 1.1 The subject of this document is to establish the criteria and basic characteristics for the detailed design, supply, installation, manufacturing and shield testing of a self-supported TOWER to support Radio System applications. That TELECOM TOWER shall be installed on the top of the Accommodation Module of the PETROBRAS FPSO Unit.

## 2. ABBREVIATIONS

ASTM	American Society for Testing and Materials,
ABNT	Associação Brasileira de Normas Técnicas (Brazilian Association of Technical Standards)
ESD	Energy Shutdown
FPSO	Floating Production Storage and Offloading
FSO	Floating Production and Offloading
INMETRO	Instituto Nacional de Metrologia (National Institute of Metrology)
NFPA	National Fire Protection Association

## 3. REFERENCE DOCUMENTS, CODES AND STANDARDS

- 3.1 The TOWER shall be designed, manufactured, installed and tested, at least, in accordance with requirements of those International and National Standards listed below:
- a. Comando da Aeronáutica – Portaria Nº 957/GC3, 9 de julho de 2015
  - b. IEC 60092-401 – Electrical Installations in Ships
  - c. IEC 61892-6 – Mobile and fixed offshore units – Electrical installations
  - d. NBR 5884 – Perfis estruturais soldados de aço
  - e. NBR 6123 – Forças devidas ao Vento
  - f. NBR 6323 – Galvanização por imersão a quente de produtos de aço e ferro fundido – Especificação
  - g. NBR 6355 – Perfis estruturais, de aços, formados a frio
  - h. NBR 7398 – Produto de aço ou ferro fundido revestido de zinco por imersão à quente – Verificação da aderência ao revestimento
  - i. NBR 7399 – Produto de aço ou ferro fundido revestido de zinco por imersão à quente – Verificação da espessura do revestimento por processo não destrutivo
  - j. NBR 11003 – Tintas – Determinação da aderência
  - k. ABNT NBR 6123 – Forças Devido ao Vento em Edificações
  - l. AISC – American Institute Steel Construction
    - i. Specifications for the Design Fabrication and Erection of Structural Steel
    - ii. Code of Standard Practice for Steel Building and Bridges

	<b>TECHNICAL SPECIFICATION</b>	Nº: <b>I-ET-3010.00-5592-762-PPT-001</b>	REV. <b>A</b>
	AREA:	-	
	TITLE:	<b>TELECOM TOWER</b>	
		SHEET <b>4</b> of <b>13</b>	<b>INTERNAL</b>
			<b>OI/CS</b>


- m. AISI – American Iron and Steel Institute
  - iii. Specification or the Design of Cold-Formed Steel Structural Members
- n. ANSI /AISC 360-16 – Specification for Structural Steel Buildings
- o. ASTM A123 / A123M – Standard Specification for Zinc (Hot-Dip Galvanized)
- p. ASTM A36 / A36M – Standard Specification for Carbon Structural Steel shapes
- q. ASTM A283 / A283M – Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates steel plates
- r. ASTM A572 / A572M – Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel
- s. ASTM A307 – Standard Specification for Carbon Steel Bolts and Studs
- t. ASTM A325 – Standard Specification for Structural Bolts, Steel, Heat Treated
- u. ASTM A394 – Standard Specification for Steel Transmission Tower Bolts, Zinc-Coated and Bare
- v. ASTM A123 – Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
- w. ASTM A153/A153M – Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
- x. ASTM A385/A385M – Standard Practice for Providing High-Quality Zinc Coatings (Hot-Dip)
- y. EIA/TIA-222 – Structural Standards for Steel Antenna Tower and Antenna Supporting Structures
- z. INMETRO/Portaria nº 179, May 18th 2010 and its annexes
- aa. NFPA 70 – National Electrical Code
- bb. NFPA 72 – National Fire Alarm and Signaling Code
- cc. NFPA 76 – Standard for the Fire Protection of Telecommunications Facilities
- dd. NFPA 780 – Standard for the Installation of Lightning Protection Systems
- ee. OSHA Rules – Occupational Safety and Health Administration

3.2 Electrical installations, equipment and materials shall comply with the requirements of IEC 60079, IEC 61892-7 and Classification Society.

3.3 All equipment, installations and materials shall be type approved and certified by an internationally recognized laboratory and shall be in accordance with INMETRO Portaria nº 115, March 21<sup>st</sup> 2022 and its annexes.

#### 4. GENERAL REQUIREMENTS

4.1 For PETROBRAS detailed design requirements, Installation, Tests and acceptance, CONTRACTOR shall comply with the Memorial Description I-MD-3010.00-5510-760-PPT-001 GENERAL CRITERIA FOR TELECOMMUNICATIONS DESIGN.

	<b>TECHNICAL SPECIFICATION</b>	Nº: <b>I-ET-3010.00-5592-762-PPT-001</b>	REV. <b>A</b>
	AREA:	-	
	TITLE:	<b>TELECOM TOWER</b>	
		SHEET	<b>5</b>

- 4.2 For telecommunications symbols, the Detailed Design shall comply with the Technical Specification: I-ET-3000.00-0000-940-P4X-002 – SYMBOLS FOR PRODUCTION UNITS DESIGN.
- 4.3 For telecommunications TAGs, the Detailed Design shall comply with the Technical Specification: I-ET-3000.00-1200-940-P4X-001 – TAGGING PROCEDURE FOR PRODUCTION UNITS DESIGN.
- 4.4 For telecommunications infrastructure materials, accessories, cable trays cable ladder, the Detailed Design shall comply with the Technical Specification: I-ET-3010.00-5140-700-P4X-002 – SPECIFICATION FOR ELECTRICAL MATERIAL AND EQUIPMENT FOR OFFSHORE UNITS.
- 4.5 Safety Grounding of telecommunication panels enclosure shall be according to I-ET-3010.00-5140-700-P4X-001 – SPECIFICATION FOR ELECTRICAL DESIGN FOR OFFSHORE UNITS." Grounding by simply supporting the casing on the steel structure of the FPSO shall not be deemed adequate.
- 4.6 The equipment, materials and accessories shall attend the ingress protection degree, protection type, classifications zone and groups established by IEC / ABNT.
- 4.7 CONTRACTOR shall supply only equipment, cables and accessories approved and certified by Classifying Society and in technical conformity with the International and National standardization organisms as: ABNT, IEC and INMETRO.
- 4.8 The equipment and materials shall be supplied packed suitably for long periods of storage and be protected against mechanical impact and adverse weather conditions.
- 4.9 CONTRACTOR shall design the tower highlighting the maximum top load admissible and the restrictions to be taken into account and report other parameters that may better characterize the ultimate capacity of the tower.
- 4.10 All operations involving drilling, cutting and bending should always be performed with the concern of the material not losing its quality.
- 4.11 The tower shall be designed, manufactured and mounted to resist all the efforts on the manufacture, transport, vertical line operation and hoisting phases.
- 4.12 All the metallic components of the tower shall be fastened through screws, washers and nuts. The screws, nuts and washers shall obey the norms ASTM A-325 and A-394.
- 4.13 The nuts – it locks (Palnut®) or lock-nuts to be installed obligatorily in all of the screws, after the final squeeze of the main nuts as shown in Figure 1.

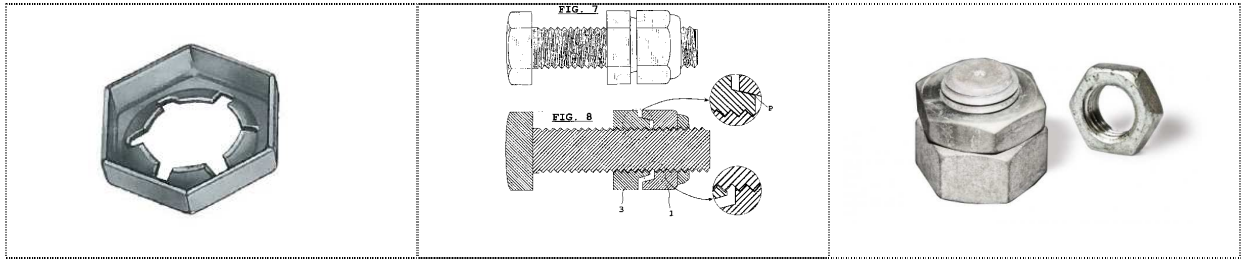


Figure 1: Palnut® and lock-nuts

4.14 The screws shall have at least 3.0 mm (three millimeters) and at most 10.0 mm (Ten millimeters) they haul of the nuts or Palnut®.

4.15 The lower part of the tower structure shall allow free transit it, as described in Figure 2.

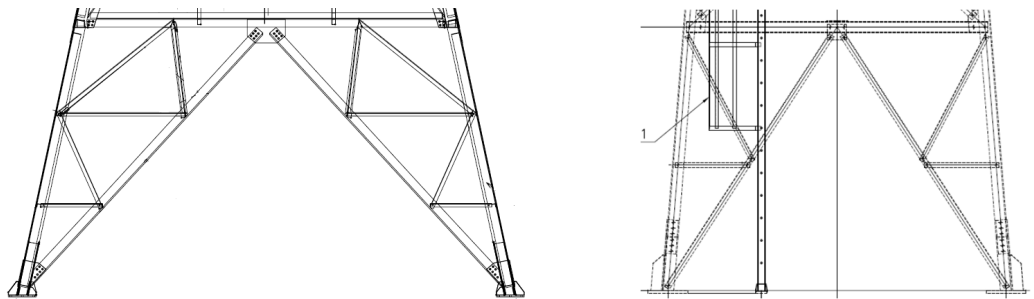


Figure 2: Tower lower part example.

4.16 The tower shall have a sailor-ladder type to access the top of the tower, protected by a guard-rail structure (Figure 3).




Figure 3: Tower Sailor-ladder example.

4.17 The ladders shall have vertical cable ladder system, in order to connect the cable grab to the fall arrest system.

4.18 The tower shall be made by structural beam of steel A-572-G50 in accordance with ABNT standards. These materials shall have certificate of origin in order to guarantee its quality.

4.19 All materials used shall be acquired from reliable manufacturers, with certificate of origin to guarantee the quality of the materials and covered by certificates from testing laboratories, approved by PETROBRAS.

	<b>TECHNICAL SPECIFICATION</b>	Nº: <b>I-ET-3010.00-5592-762-PPT-001</b>	REV. <b>A</b>
	AREA: -	SHEET <b>7</b> of <b>13</b>	
	TITLE: <b>TELECOM TOWER</b>	INTERNAL	
		OI/CS	

4.20 All drilling, cutting, bending and splicing services shall be made before the galvanizing process.

4.21 CONTRACTOR shall consider that after galvanizing or surface coating, the tower shall not be mounted, unless if permanently installed.

4.22 CONTRACTOR shall provide a list of all "SUBCONTRACTORS" that will be contracted for the supply of any accessories and services, if awarded the agreement for supply.

4.23 Tower shall be painted according to I-ET-3010.00-1200-956-P4X-002 - GENERAL PAINTING.

## 5. SYSTEM DEFINITIONS

5.1 Tower shall permit the installation of telecom antennas to properly cover FPSO Unit systems and to allow radio links to other surrounding units without any shadow due to FPSO infrastructure.

5.2 Tower shall have platforms for maintenance and devices installations.

5.3 Tower can also be also used as SPDA system.

## 6. TECHNICAL REQUIREMENTS

6.1 The design shall be presented in such a manner as to indicate the values and formulas used, as well as the algebraic or graphic method adopted for determining the strains arising in the structure and the base.

6.2 In determining the loads supported by the tower and its bases, allowance shall be made for the stresses involved in the antennas to be installed, as well as the accessories, the marking out for night-time operations, the lightning arrestor, the stairways and the platforms.


6.3 The design shall also include a description of all materials and component accessories, with explicit reference to the manufacturers of those items that are not to be produced by the CONTRATOR themselves.

6.4 The height of the tower covered by the present specification is **20 (twenty) meters**.

6.5 Existing designs of a standard type are available, even with different heights but close to the value intended; so suppliers shall present a quotation for alternative supplies, for analysis by PETROBRAS, bearing in mind, however, that the ideal height is that indicated in the previous item.

6.6 Suppliers shall use data for the calculation of the loads derived from:

6.6.1. *Inherent load*: the actual weight of the tower structure, the antennas, stairs, platforms, vertical and horizontal cables ladder, coaxial cables, waveguides and

	<b>TECHNICAL SPECIFICATION</b>	Nº: <b>I-ET-3010.00-5592-762-PPT-001</b>	REV. <b>A</b>
	AREA:	-	
	TITLE:	<b>TELECOM TOWER</b>	
		SHEET	<b>8</b>

<p>the accessories, to handle a load less than 500 kg (five hundred kilograms) for the antennas and an area of exposure to the wind of the order of 15 m<sup>2</sup>.</p> <p>6.6.2. <i>Working loads</i>: weights applied vertically at the top of the tower, corresponding to the weight of two workers (160 kilograms) engaged in eventual activities of assembly and maintenance operations.</p> <p>6.6.3. <i>Temperature</i>: -5 to + 70 °C.</p> <p>6.6.4. <i>Wind</i>: The obstruction pressure shall be calculated in accordance with standard NBR 6123.</p> <p>6.6.5. <i>Vibrations</i>: The tower design shall consider the Petrobras unit vibrations information.</p> <p>6.7 Stresses due to the wind shall be calculated in accordance with standard NBR-6123.</p> <p>6.8 CONTRACTOR shall consider as the most unfavorable condition for the entire structure, including the accessories and the antennas, also taking into account factors of V survival = 180 km/h and V operation = 126 km/h, with a maximum twist angle of 30 minutes for the aforesaid V operation.</p> <p>6.9 Calculations for the structures, accessories, antennas and respective support parts shall be done on a basis of the applied stresses defined above, and in accordance with the principles and standards of constructions.</p> <p>6.10 The antennas and waveguides supports shall be defined in each case and shall be attached using galvanized and bicromatized bolts with suitable nuts and locknuts.</p> <p>6.11 The design shall consider the vertical and horizontal cables, waveguides and ladder to permit interconnection between transmission antennas on the tower and equipment inside the telecom equipment room.</p> <p>6.12 The service decks, shall have the following heights above the floor, based on a 20 (twenty) meters tower: 20 meters, 17,5 meters, 15 meters, 12,5 meters, 10 meters and 7 meters.</p> <p>6.13 All service decks shall be designed and manufactured with passage for cables and waveguides running vertically and horizontally.</p> <p>6.14 The cable tray shall have 500 mm width minimum from the base to the top of the telecommunication tower.</p> <p>6.15 The tower shall be supplied with hangers for tow truck and pulleys, for the lift of antennas and instruments in all faces, with capacity to raise up to 350 kg.</p> <p>6.16 All parts of structure including, screws and nuts, shall be Galvanizing by the hot immersion Process according to - ASTM A-123.</p> <p>6.17 CONTRACTOR shall make an alternated sailor ladder between work platforms. Moreover, all platforms shall be protected by a guardrail structure. The following pictures in Figure 4, as an example, only for illustrate.</p>
--



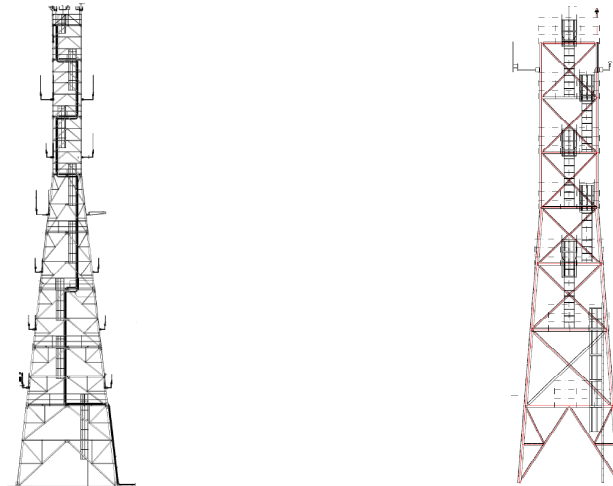


Figure 4: Towers examples

6.18 Electrical equipment installed in external (open) safe areas, foreseen to operating during emergency shutdown ESD-3 shall be certified for installation in hazardous areas Zone 2 Group IIA temperature T3 in accordance with IEC 61892.

#### 6.19 Visual Signaling

6.19.1. The tower design shall be in accordance with Portaria Nº 957/GC3, considering all visual signaling and identifications required by this referenced standard.

6.19.2. The tower and accessories shall be painted and provided with luminous signaling arrangements in accordance with the Brazilian Air Force requirements and standards.

6.19.3. For requirements of the lightning strokes protective system, refer to I-ET-3010.00-5140-700-P4X-001 - SPECIFICATION FOR ELECTRICAL DESIGN FOR OFFSHORE UNITS.


6.19.4. The CONTRATOR shall be responsible to design, manufacture and install the luminous signaling in accordance with updated standard.

#### 6.20 Lightning Protection

6.20.1. The FPSO shall be protected against lightning effects in accordance with the requirements of IEC-61892-6.

6.20.2. For the protection of the unit and prevention of secondary damages to the electric system the recommendations of IEC 61892-6 shall be followed.


6.20.3. For units of the type FPSO and FSO, it also shall be followed the recommendations of IEC 60092-401.

	<b>TECHNICAL SPECIFICATION</b>	Nº: <b>I-ET-3010.00-5592-762-PPT-001</b>	REV. <b>A</b>
	AREA:	-	
	TITLE:	<b>TELECOM TOWER</b>	
		SHEET	10 of 13

- 6.20.4. The grounding of all structural parts of the platform, process vessels and skids shall be assured by bolting it to metallic hull.
- 6.20.5. In the Detailed Design all exposed elements above main deck shall be analyzed against lightning strokes according to Rolling Sphere Method of NFPA 780, with 30 m radius.
- 6.21 Detailed engineering of design shall be render feasible through strategic installation of components, to minimize the number of connections and thus optimize costs of materials and/or work to be done.
- 6.22 Equipment, cables, boxes, materials and accessories for installation in industrial areas (outdoor or indoor) of the unit shall be specified and assembled taking into account the adverse operating conditions on FPSO such as:
- Atmosphere with high content of humidity, salts hydrocarbons and other corrosive factors;
  - Environment subject to the presence of explosive gases shall be in accordance with Hazardous area classification;
  - Exposure to weather conditions (sun and rain) and maritime atmosphere;
  - Air temperature: From -10°C up to +50°C;
  - Air Humidity: 95%.

## 7. SCOPE OF SUPPLY

- 7.1 CONTRACTOR shall supply 01 (one) tower, materials, accessories and services necessities and required to completely mount and commissioning activities.
- 7.2 CONTRACTOR shall submit to PETROBRAS approval the receiving test procedures to be performed, at least.
- Visual inspection
  - Dimensional verification
  - Galvanization verification, as standards applicable
  - Adherence test
- 7.3 After installation of the tower, and its accessories, field tests shall be performed for acceptance of installation accompanied by PETROBRAS.
- 7.4 CONTRACTOR shall submit for PETROBRAS approval, the field acceptance test procedures to be performed, at least.
- Mounting visual inspection
  - Torque check verification test
  - Galvanization verification, as standards applicable

	<b>TECHNICAL SPECIFICATION</b>	Nº: <b>I-ET-3010.00-5592-762-PPT-001</b>	REV. <b>A</b>
	AREA:	-	
	TITLE:	<b>TELECOM TOWER</b>	
		SHEET	11 of 13
			INTERNAL
			OI/CS

- d. Adherence test
- e. Electrical grounding quality verification test

7.5 In case of occurrence of parts or accessories that are defective or undersized, CONTRACTOR shall replace it at their own account.

7.6 CONTRACTOR shall report to PETROBRAS at least 45 (forty five) days in advance the dates on which the tower and their accessories will be available for shipyard delivery, installation and field acceptance.

7.7 The whole task of installation and testing shall be carried out with top quality labor and in line with proper working procedures.

7.8 PETROBRAS reserves the right of, at any moment, reject and ask to substitute such labor as it was offered or applied, if it deems the latter to be inadequate or to be responsible for poor quality of work done or for non-compliance with the established standards and goals.

7.9 CONTRACTOR shall provide the tower Detailed Design:

7.9.1. General layout drawings, illustrating, at least: dimensions, weights, cross-sectional views and construction details.

7.9.2. Catalogues and descriptive bulletins of the tower, accessories and anchoring units, including construction and mechanical aspects.

7.9.3. A preliminary list of packages giving external dimensions and estimated weight for purposes of transportation.

7.9.4. Quality control tests run on the tower and a brief description of the quality control process.


7.9.5. Details of the testing procedures to be used for acceptance of the tower and its accessories, pursuant to the reference standards.

7.9.6. Description of the in-field assembly procedures to be used.

7.9.7. Timetable for the design, purchase of materials and components, manufacture and manufacturing, transportation, assembly, installation, testing and trails for the towers and for the delivery of the respective drawings and documents issued by CONTRACTOR.

7.9.8. A plate with the following information shall be attached to the base of the tower in an easily viewable position:

- a. Manufacturer;
- b. Date of manufacture;
- c. Height;
- d. Weight;

	<b>TECHNICAL SPECIFICATION</b>	Nº: <b>I-ET-3010.00-5592-762-PPT-001</b>	REV. <b>A</b>
	AREA: -	SHEET 12 of 13	
	TITLE: <b>TELECOM TOWER</b>	INTERNAL	
OI/CS			

e. Length of straight section.

## 8. COMMISSIONING

- 8.1 CONTRACTOR shall be responsible to realize a technical commissioning of the infrastructure in order to permit or authorize their use under normal operating conditions.
- 8.2 A professional team certified in Tower assemblages from manufacturer provided shall perform the Installation and Commissioning activities.
- 8.3 The following verifications, at least, shall be verified as scope of commissioning activities in accordance with Contract and this Technical Specification.
- a. Check physical infrastructure;
  - b. Check painting.



TECHNICAL SPECIFICATION	Nº: I-ET-3010.00-5592-762-PPT-001	REV. A
AREA:	-	SHEET 13 of 13
TITLE:	TELECOM TOWER	INTERNAL
		OI/CS

### 9. TYPICAL DESGIN

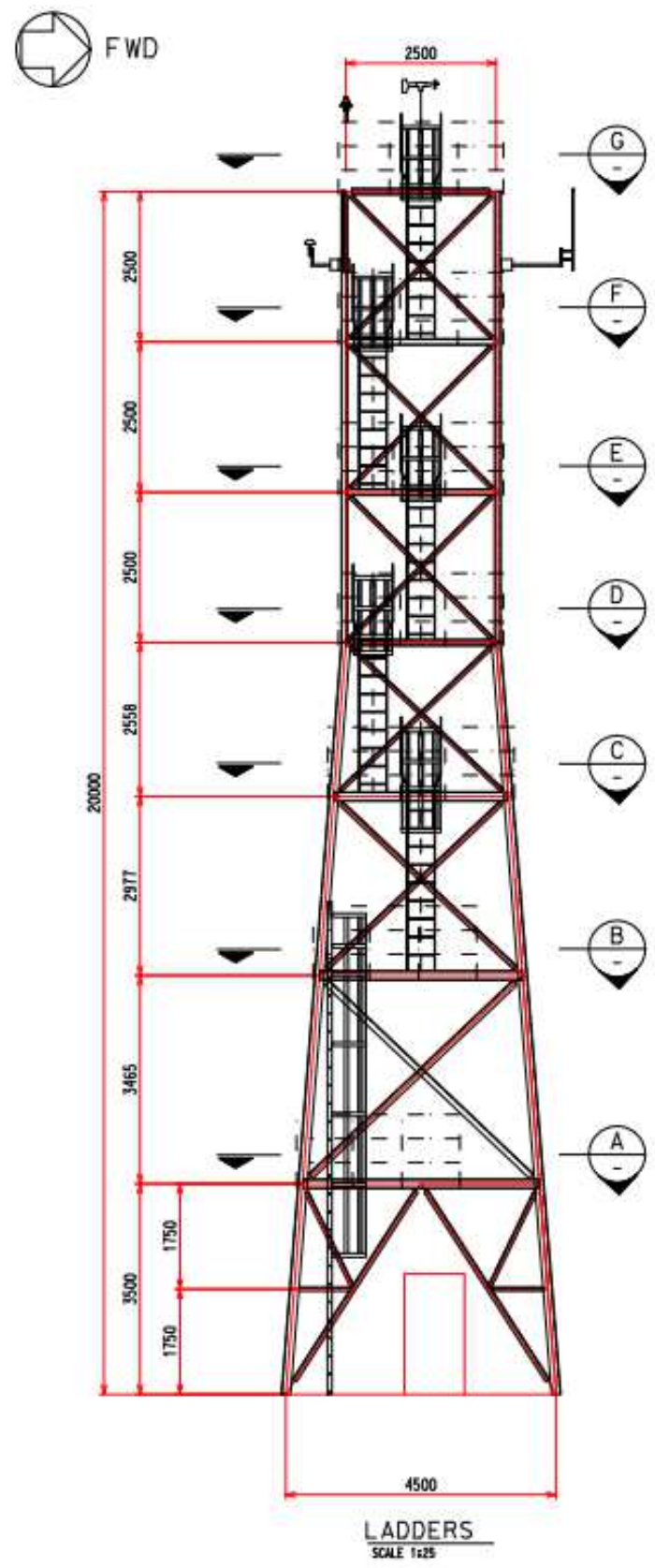


Figure 5: Tower typical design