

	<b>Scope of Work</b>	<b>Technology</b>
---	----------------------	-------------------

Title: Scope of Work for 40 m ET Tower at Enzelberg RS
 Unique Identifier: **474-11023**

Document Unique Identifier: **LES1000**

Project Unique Identifier: **TX2019-061**

Area of Applicability: **Engineering**

Documentation Type: **Report**

Revision: **2**

Total Pages: **19**

Next Review Date: **N/A**

Disclosure Classification: **CONTROLLED DISCLOSURE**

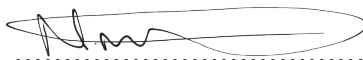
**Compiled by**



**Khulani Gasas**  
 Senior Technician

Date: 21.09.2020

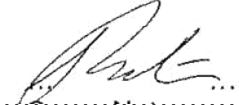
**Reviewed by**



**Ndangi Muthadi**  
 Senior Engineer

Date: 21.09.2020



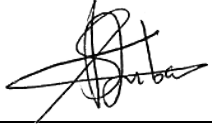
**Authorised by**



**Suren Natesan**  
 LES Middle Manager (Civil and Structural)

Date: 21.09.2020

**Design Team**

Name	Functional Responsibility	Date	Signature
Khulani Gasa	Senior Technician	21/09/2020	
Ndangi Muthadi	Senior Engineer	21/09/2020	
Siyabonga Dubazana	Chief Engineer	21/09/2020	

Revision	Date	Brief details of updates	Approved by
1	June 2020	First issue	S. Natesan
2	September 2020	Removal of decommissioning SOW as per client requirements, included antenna mounting bracket details and details on how to lock the nuts	S. Natesan

**CONFIDENTIAL**

## CONTENTS

	<b>Page</b>
<b>1. INTRODUCTION .....</b>	<b>4</b>
<b>2. SCOPE OF WORK.....</b>	<b>4</b>
2.1 PHASE 1: PRODUCTION OF MANUFACTURING DRAWINGS .....	4
2.1.1 General Arrangement Information.....	4
2.1.2 Design Information .....	4
2.1.3 Workshop Drawings .....	4
2.1.4 Tower Erection Drawings .....	5
2.2 PHASE 2: DESIGN OF TOWER FOUNDATION .....	6
2.3 PHASE 3: MANUFACTURING AND TOWER CONSTRUCTION .....	6
2.3.1 Material Quality.....	6
2.3.2 Tower fabrication .....	6
2.3.3 Quality inspection of the supplied steel .....	6
2.3.4 Prototype Assembly .....	7
2.3.5 Corrosion levels.....	8
2.3.6 Other pre-construction activities .....	9
2.3.7 Construction activities .....	9
2.3.8 Geo-Technical information .....	9
2.3.9 Total tower mass .....	9
2.4 TOWER DRAWINGS .....	10
2.5 TOWER EARTHING AND BONDING .....	14
2.6 OTHER USER DEFINED REQUIREMENTS .....	14
2.7 SITE INFORMATION .....	16
2.8 BILL OF MATERIALS (BOM) .....	17
2.9 APPLICABLE STANDARDS .....	18
2.10 DEFINITIONS.....	19
2.10.1 Disclosure Classification .....	19

**CONFIDENTIAL**

## 1. INTRODUCTION

This document is to give detailed scope of work for construction of 40 m tower at Enzelberg radio site (RS) [coordinate 25 25 10.5S, 26 13 20.9E]. The tower is to be used to provide telecommunication network for purpose of SCADA RTU and Telephone lines.

## 2. SCOPE OF WORK

The document covers the general Scope of work needed to be done at Enzelberg radio site. It gives the guideline of the scope of work to be covered by appointed contractor for construction of 40 m Tower i.e. to produce manufacturing drawings (tower detailed drawings), supply, delivery and erection of 40 m Tower at Enzelberg RS in the North west operating unit (OU). The scope is split into 4 distinct phases as defined below.

### 2.1 PHASE 1: PRODUCTION OF MANUFACTURING DRAWINGS

**Once the contract is awarded to the supplier, the member schedule together with the tower outline will be made available for the supplier to commence with the tower detailing process of the tower in strict accordance to general tower specification, 240-59967638.**

This involves tower detailing in order to provide workshop drawings that will be used to source the tower steel from the supplier. All the tower manufacturing drawings done on AutoCAD must be submitted to Eskom for approval before proceeding to the next phase of the project. The Project manager for the project will be responsible for arranging with Eskom to ensure that enough time is allowed for the review process.

The contractor to produce manufacturing and erection drawings for the tower as per general tower specification, 240-59967638

**The copyright for all the produced manufacturing drawings will belong to Eskom as this is an Eskom design.**

The design drawings shall show the following data and information for each tower type, including all tower extensions.

#### 2.1.1 General Arrangement Information

Eskom will provide

#### 2.1.2 Design Information

Eskom will provide

#### 2.1.3 Workshop Drawings

Workshop drawings shall have all their details necessary to fabricate tower members. Drawings shall show tower members and plates in their assembled positions with design reference dimensions indicated. The orientation of members shall be clearly indicated.

Dimensional tolerances of hot rolled sections and plates as well as fabrication tolerances shall be considered when workshop drawings are prepared.

All bent angles and plates shall be detailed to finished dimensions. Hot and cold bending shall be clearly indicated.

### CONTROLLED DISCLOSURE

Suitable bolt grip tables shall be prepared based on the available bolt lengths and one washer thickness.

Member identification

Bill of materials – each workshop drawing shall include the complete bill of materials for the tower article indicated on the drawing. The bill of material shall include the following information:

Tower Members	Mark, Quantity, Section, Length, Unit Mass and Total Mass
Bolts	Diameter, Length and Quantity
Nuts	Diameter, Quantity
Washers	Diameter, Thickness, Quantity
Packers	Diameter, Thickness, Quantity
Total Mass	Members, Fasteners, Galvanizing, Grand Total

- **General Information**

The following information shall be included on each drawing:

- Quality and specification of all materials
- Legend for matching bolts and bolt holes
- Legend describing cutting and clipping codes
- Range of members described on the drawing
- Small tower outline with applicable tower article highlighted.

- **Mass of Tower Articles:**

The calculations of mass for angles and other rolled shapes shall be in accordance with the mass per metre listed in the latest edition of the South African Steel Construction Handbook, published by the South African Institute of Steel Construction. All plate material shall be based on a mass density of 7 850kg/m<sup>3</sup>. Lengths used to determine mass of members shall be based on the detailed lengths shown on the finals, accepted shop drawings and not on the “ordered overall lengths”. Material lost from clips, back cuts, blocks, holes etc, shall not be deducted from the mass of a member or plate.

Of the above calculated mass, 3.5% of the uncoated material shall be used for the mass of the zinc coating (galvanising).

#### 2.1.4 Tower Erection Drawings

The erection drawing shall show the identification mark and orientation of each member, the number and type of bolts, nuts, washers and packers required at connections. Lifting points and component masses and installation of torque fasteners shall also be indicated.

Note: Fabrication drawings and erection drawings may be combined

**CONTROLLED DISCLOSURE**

## 2.2 PHASE 2: DESIGN OF TOWER FOUNDATION

The construction of the foundation shall be in accordance with the following drawing:

*"0.53/Enzel: Enzelberg 40m\_Microwave\_Tower\_Raft\_Foundation\_Layout\_and\_Details"*

Should the soil conditions be unfavourable for the installation of this design, the contractor shall inform Eskom.

## 2.3 PHASE 3: MANUFACTURING AND TOWER CONSTRUCTION

### 2.3.1 Material Quality

The following material grades shall be utilized:

Steel Sections	S355JR
Plates (less than 19mm thick)	S355JR
Plates (greater than 19mm thick)	S355J0 (for better workability)
Bolts	Grade 8.8 to ISO 898
Nuts	Grade 8
Washers and Packers	S275JR

Impact properties in the longitudinal direction of all structural materials shall be determined for grade S355JR material greater than 19mm in thickness in accordance with the Charpy V-notch test. Charpy V-notch requirements at a minimum, shall meet the requirements of 27 J absorbed energy at room temperature (21° Celsius)

Silicon and Phosphorous content of steel is limited as follows:

"Aluminium Killed Steel": Silicon (Si) = 0.01 to 0.04%, Phosphorous (P) < 0.015% max

"Silicon Killed Steel" : Silicon (Si) = 0.15 to 0.25%, Phosphorous (P) < 0.02% max

### 2.3.2 Tower fabrication

Tower fabrication must be done as per general tower specification, 240-59967638

The supplier and his manufacturing facility shall employ a production process that has an integrated Quality Management System (QMS). The Quality Management System employed shall be based on the framework of SABS /ISO 9001 standards for Quality Management Systems or be an equivalent recognised system approved by Eskom Quality Assurance Division. Details of the QMS shall be provided.

### 2.3.3 Quality inspection of the supplied steel

The contractor to send an inspection notification to Eskom 7 days in advance for the inspection of the steel to be used in order for Eskom to verify the quality of the steel provided.

## CONTROLLED DISCLOSURE

#### **2.3.4 Prototype Assembly**

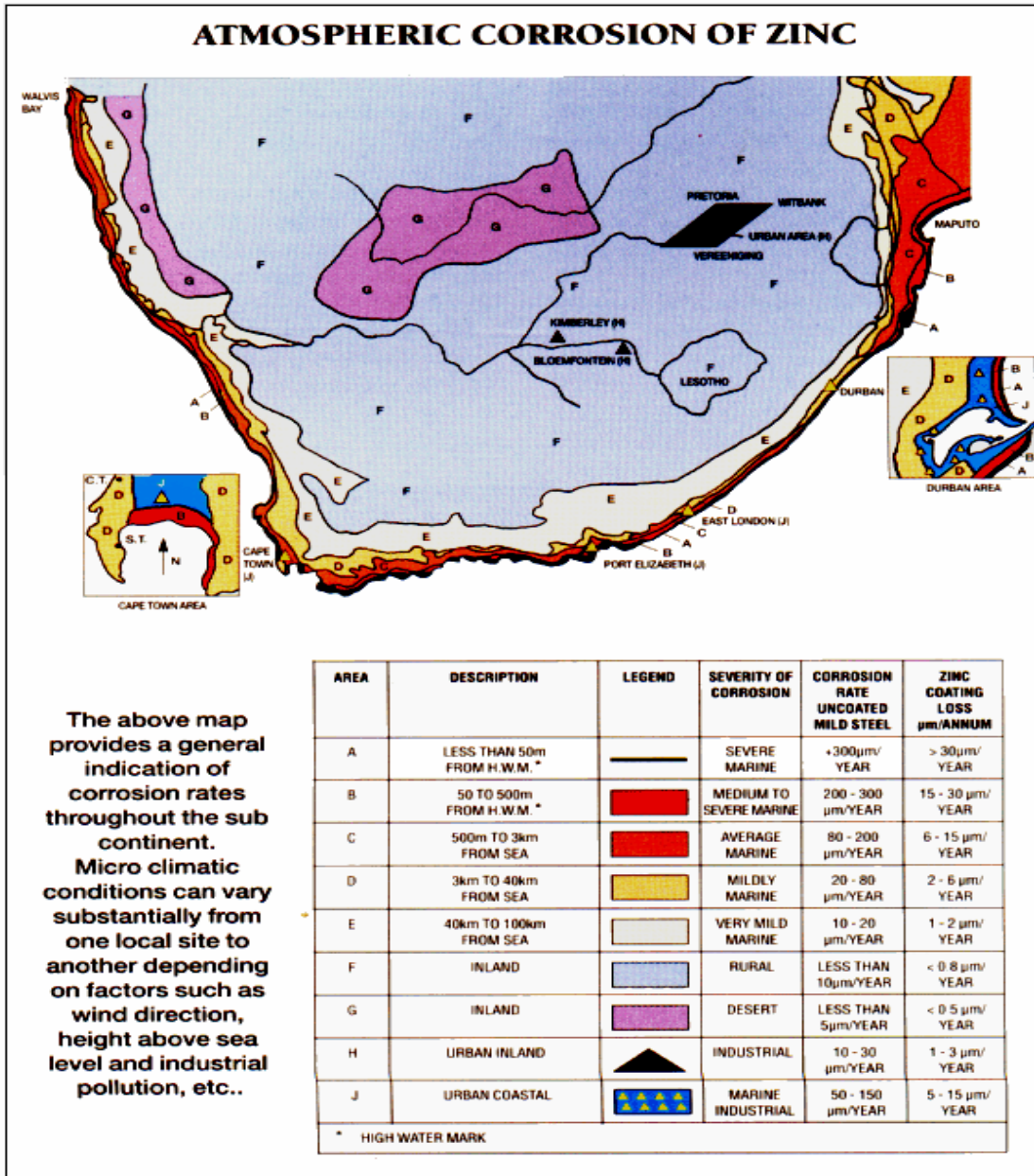
- a) All structures shall be test assembled in the shop to the extent necessary to ensure accurate fit in the field. Prototype assembly shall include all structure components and accessories. Assembly procedure shall demonstrate that each section fits the adjacent section.
- b) A Prototype Assembly Report shall summarize the findings of the prototype assembly and all necessary modifications to the members.
- c) The prototype structure shall be assembled with the correct fasteners and bolts tightened to the correct torque.

**CONTROLLED DISCLOSURE**

When downloaded from the EDMS, this document is uncontrolled and the responsibility rests with the user to ensure it is in line with the authorised version on the system.

### 2.3.5 Corrosion levels

The position of the tower is about located in the North West which falls under the rural inland category as per **Figure 2.1**. The expected corrosion level in the region is less than 10 µm/year. Therefore, standard galvanizing is specified with a thickness of 85µm in order to carter for rate of corrosion on the tower steel.



**FIGURE 2.1: CORROSION LEVELS EXPERIENCED IN REGIONS OF SOUTH AFRICA**

**CONTROLLED DISCLOSURE**

### 2.3.6 Other pre-construction activities

The contractor to supply the following documents to Eskom for review and acceptance before construction commences:

- a) All the Safe Work Procedures to be used detailing step by step methodology that will be used by the contractor during construction to ensure that the tower is safely constructed.
- b) The contractor to note that ORVHS authorization is required for all the sites that are located within the substation yard
- c) The contractor to provide Eskom with a quality, inspection and test plan (QITP) for acceptance before any construction can take place. An example of this will be provided to the contractor once the contract has been awarded

### 2.3.7 Construction activities

The construction of the tower must be done in accordance to the Eskom standard 240 – 59967638.

### 2.3.8 Geo-Technical information

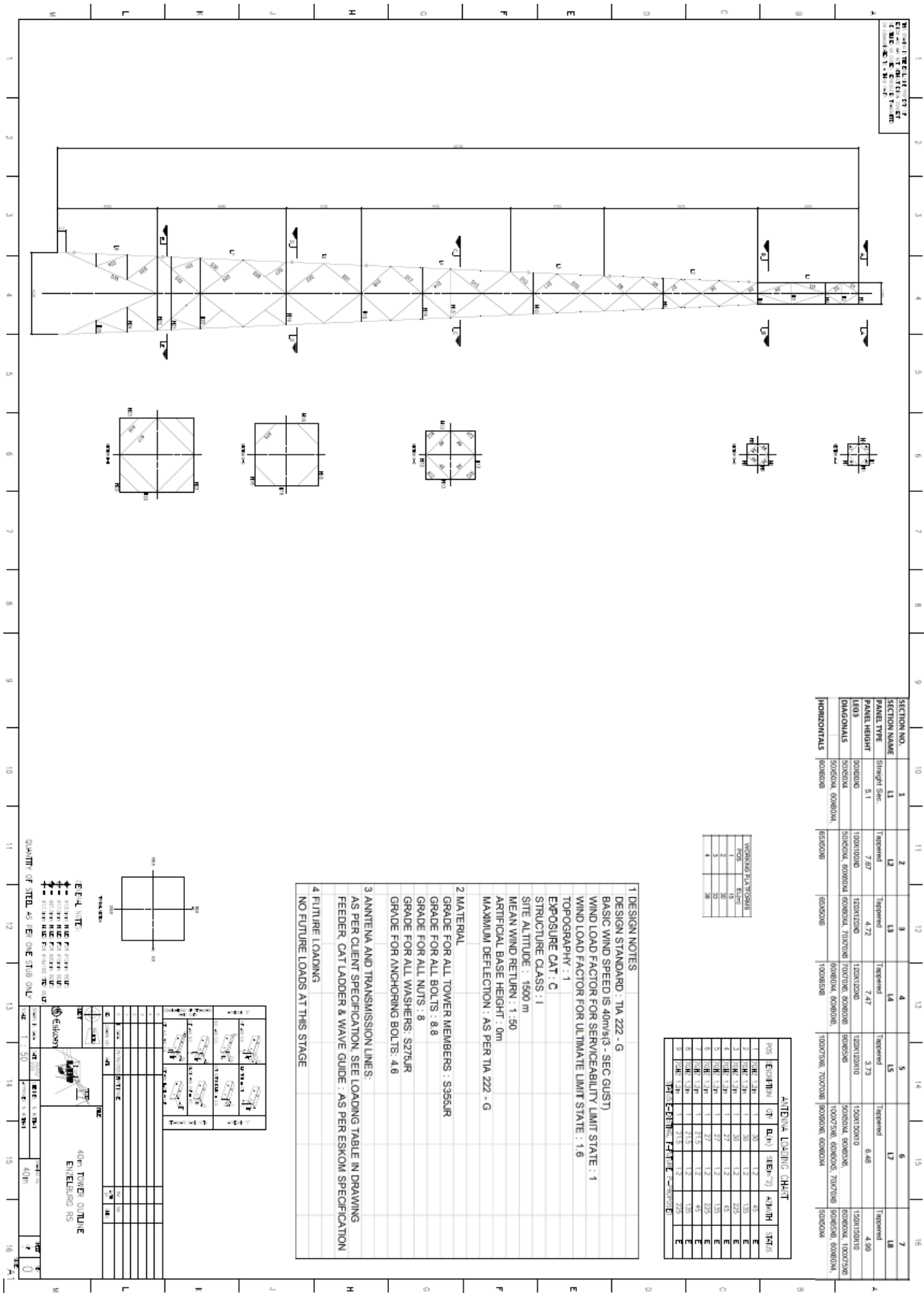
Eskom will provide the report (5027-06-Enzelberg RS *Geotech Report Final*)

### 2.3.9 Total tower mass

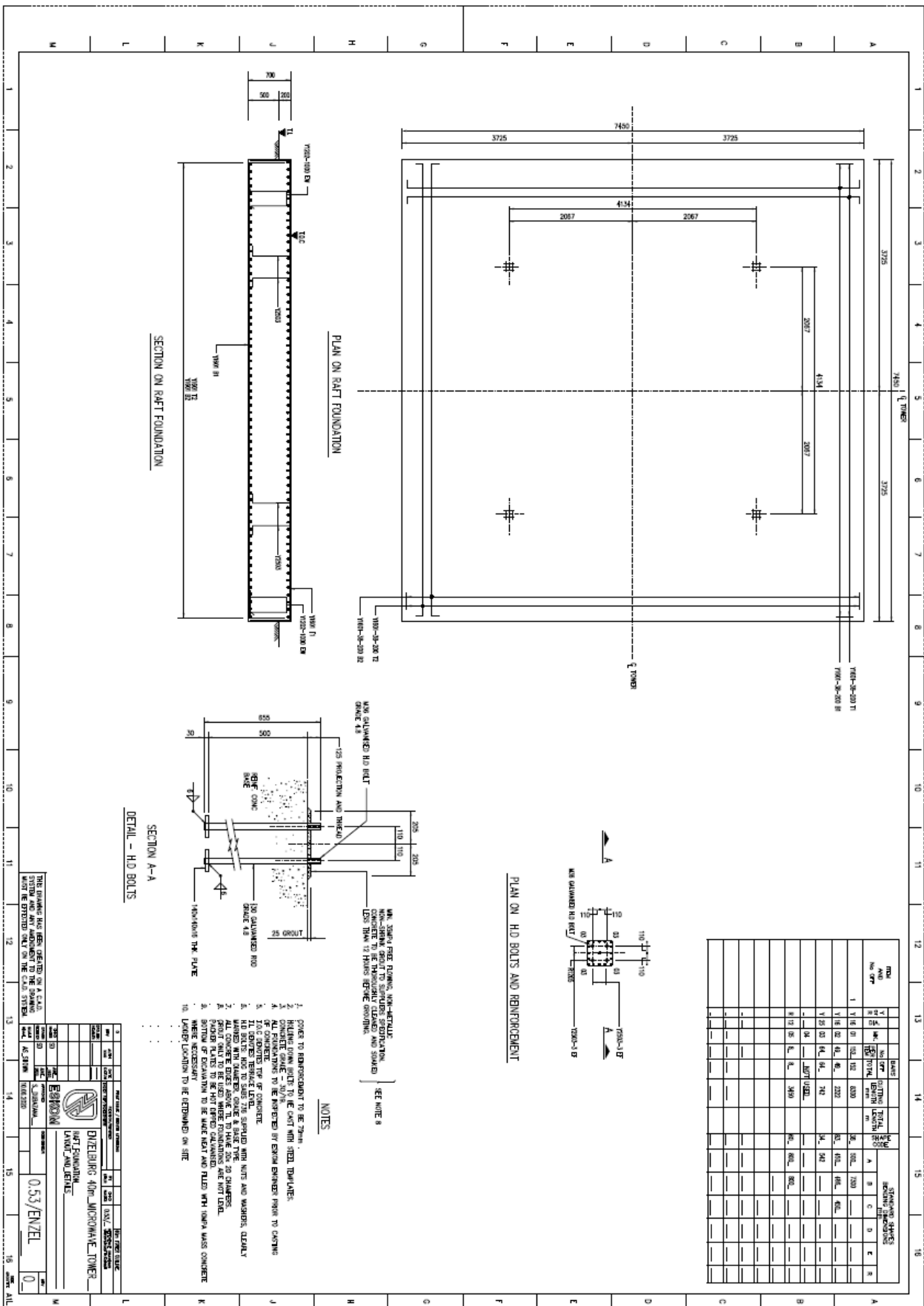
The total tower steel mass including the plates, bolts platforms, and ladders = **6906 kg. This should be used when costing as well.**

**CONTROLLED DISCLOSURE**

2.4 TOWER DRAWINGS

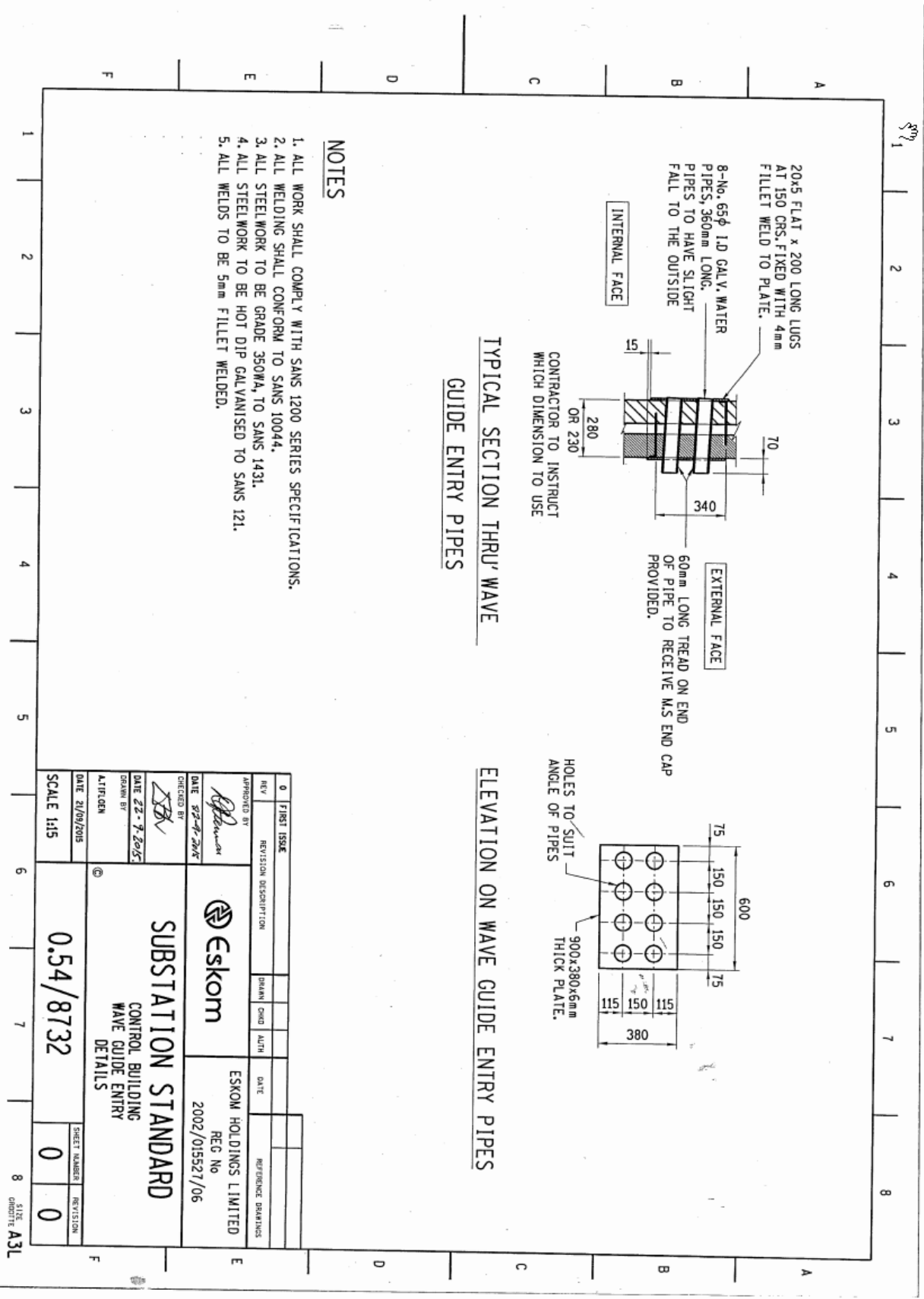


CONTROLLED DISCLOSURE



**CONTROLLED DISCLOSURE**





**CONTROLLED DISCLOSURE**

## 2.5 TOWER EARTHING AND BONDING

The tower earthing and bonding must be done in strict accordance to the radio station earthing and bonding standard - **240-56872313**

## 2.6 OTHER USER DEFINED REQUIREMENTS

1. The contractor shall provide AS-built document such as engineering Certificate signed off by contractor professional engineer to declare that tower is safe, earth test certificate, site drawing and any other documents that deemed applicable by them and Eskom telecommunication and/or Provide documentation related to 40 m tower.
2. The tower shall have platform (full landing zone) with trap doors at the positions listed below. Trap door should be lockable on open and closed position.

15 m

30 m

33 m

38 m

### Notes:

- Trap door should be lockable on open and closed position.
  - Ensure kick plates are minimum 150 mm x 2.5 mm thick.
  - Ensure resting stations or platforms do not interfere with the direct routing paths of the feeder ladder
  - Provide earthing terminal plates at each landing with brass bolts for terminating equipment earthing leads. This must be bonded to main tower down earth or structural steel if a down conductor was nor required.
3. Tower shall have cat ladder to its full length with guard rails as per Eskom standard.
  4. Provide earthing terminal plates with brass bolts as per *Eskom Telecommunications General Tower Specification (240-59967638)* and *Radio station Earthing and Bonding standard (240-56872313)* for terminating equipment earthing leads. This must be bonded to main tower earthing system.

### CONTROLLED DISCLOSURE

5. The contractor must supply and Install universal microwave antenna brackets (*see drawing no 0.53/1020*) per Table 2-1: **Table 2-1**

**Table 2-1: Antenna Mounting Brackets Schedule**

Attachment level	Bracket Type	Quantity
Not required	MB 2/2A	0
3 x @Working platform #3 (33 m level) 3 x @Working platform #2 (30 m level) 3 x @Working platform #1 (15 m level)	MB 1/1A	9
Not required	MB 3	0
Not required	MB 4	0

*The supplier of the antenna mounting brackets is required to verify the tower slopes and the slope of the brackets before manufacturing/ supplying.*

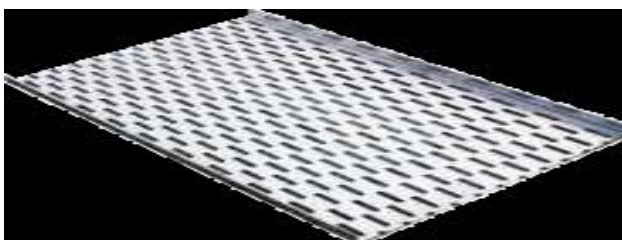
**6. Tower Cable Tray /Feeder entry panel:**

- Contractor to install a 3 m **horizontal cable tray/racking** from the tower to the wall of control room.
- The cable tray must be installed upside down to prevent feeder cable from hail damage.
- The cable tray shall be a **heavy-duty** cable tray pre galvanised standard finish and the splicing method must be overlap with M6 gutter bolts and square nuts. Where bends are required it shall be of horizontal bend (**see example** of horizontal cable tray and horizontal bend below)

**CONTROLLED DISCLOSURE**



Horizontal bend



Straight cable tray heavy duty pre-Galvanised.

- Additional criteria for cable Tray

Width (mm)	304
Height (mm)	19
Finish fasteners	Electro - Galvanised
Number of Gutter bolts and square nuts per joint	3

**7. Wave guide plate details**

Waveguide entry plate shall be installed as per drawing no “0.54/8732 Control building wave guide entry details”

**8. Fence around the Tower**

Fencing requirements are listed as per below

- No fencing is required as the site has existing fencing already.

**2.7 SITE INFORMATION**

The tower is to be constructed at the existing Enzelberg RS, which is located in North West OU.

GPS Coordinate: **25 25 10.5S, 26 13 20.9E**

**CONTROLLED DISCLOSURE**

**2.8 BILL OF MATERIALS (BOM)**

The table below shows high level bill of material required for the tower and not meant to nullify other items that are specified on the Eskom standard 240 – 59967638.

Item	Description	Unit	Qty.	Labour rate	Total
<b>1</b>	<b>Foundation (all 4 legs)- See drawing no 0.53/Enzelberg: Raft_foundations_layout_and_details</b>				
1.1	Reinforcement steel weight	kg	2112		
1.2	Concrete volume	m <sup>3</sup>	38		
1.3	Excavation volume	m <sup>3</sup>	56		
1.4	Formwork Surface	m <sup>2</sup>	21		
1.5	10mPa mass concrete	m <sup>3</sup>	16.65		
1.6	35Mpa Non-Metallic No shrink grout	m <sup>3</sup>	0.0212		
1.7	M36 GRADE 4.8 GALVANIZED H.D BOLTS WITH 140 x140x16 THK PLATES	n/a	16 x 655 mm LONG		
<b>2</b>	<b>Main tower - See drawing no 40 m Tower outline – Enzelberg RS</b>				
2.1	Supply tower detailed manufacturing drawing package for the tower as per Eskom standard 240 – 59967638	Unit	1		
2.2	Supply steel – <b>including</b> plates, cat ladder, working platforms galvanised at <b>85 µm</b>	kg	6215		
2.3	<b>Supply bolts</b> – After final tightening of all nuts, they shall be fixed in position by punching three indentations at approximately 120-degree intervals around the threads with a round pointed centre punch. The nuts and exposed bolt thread shall be painted with a single pack waterborne anti corrosive paint with a life expectancy of 20 years	kg	691		
2.4	Tower Assembly	hr	24		
2.5	Tower Erection	hr	12		
<b>3</b>	<b>Working/resting platforms - supply and install</b>				
3.1	Already included under 2.2				
<b>4</b>	<b>Antenna Mounting Brackets - Supply and install</b>				
4.1	9x Antenna Mounting brackets <b>MB 1/1A</b>	Unit	9		
<b>5</b>	<b>Miscellaneous - Supply and install</b>				

**CONTROLLED DISCLOSURE**

When downloaded from the EDMS, this document is uncontrolled and the responsibility rests with the user to ensure it is in line with the authorised version on the system.

5.1	Cat ladder and cage – covered under section 2.2				
5.2	Earthing terminating plates	Unit	1		
5.3	Horizontal cable tray/racking-heavy duty including supports and wave guide entry plate	m	3		
5.4	Supply and install waveguide entry plate – 600 x 380 x mm THK plate see drawing no no “0.54/8732 Control building wave guide entry details”	n/a	1		
<b>5.5</b>	<b>Tower lights as per Eskom standard 240-138048594</b>				
5.5.1	Double low intensity lights at tower top – Type B(32cd)	Unit	2		
5.6	Tower painting as per CAA		N/A		
<b>6</b>	<b>Equipment - hire</b>				
6.1	Use of specialized equipment i.e. Crane	hr	12		
<b>7</b>	<b>Fencing –Supply and Install</b>				
7.1	No fencing is required	N/A	N/A		
<b>8</b>	<b>Dismantling work</b>				
8.1	N/A	Rate	N/A		

## 2.9 APPLICABLE STANDARDS

Mast/Tower must comply with Eskom Telecommunication specification as listed.

*240-59967638 General Tower Specification*

*240-56872313 ET Radio Station Earthing and Bonding*

*240-103616544 Aviation requirements Towers rev 1*

*240-138048594 LED Aircraft Warning Light for Eskom Telecommunication Towers*

Informative references

*SANS 10160-3 Basis of structural design and actions for buildings and industrial structures Part 3 Wind actions*

*ETSP 0459 ET Tower Lights Specification\_rev1*

*SCSASACF6 Power lines and telecommunications tower Aviation regulations*

*The civil Aviation Act relating to Obstacles (RSA)*

*ETPN 1490 Environmental Impact Assessment principles*

*Documents available on request or at <http://dt.eskom.co.za/> or Hyperwave*

*Latest revision must always be applied.*

### CONTROLLED DISCLOSURE

When downloaded from the EDMS, this document is uncontrolled and the responsibility rests with the user to ensure it is in line with the authorised version on the system.

## **2.10 DEFINITIONS**

### **2.10.1 Disclosure Classification**

**Controlled Disclosure:** the information is readily available to Eskom employees (internal use). Information may also be accessed by or disclosed to third parties with specific authorisation or consent (either enforced by law or discretionary).

This information includes a wide spectrum of internal business data that can be used by all employees and can be shared with authorised business partners.

Permissions: Read and Modify for the protected content.

### **CONTROLLED DISCLOSURE**

When downloaded from the EDMS, this document is uncontrolled and the responsibility rests with the user to ensure it is in line with the authorised version on the system.