

## **PROCEDURE FOR STATION TCAS TOWER**

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**Abstract**

This document describes the standard operating procedure for Station TCAS at Tower location, Installation and Commissioning

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**1. Purpose:**

- 1.1.** To identify the location of RF tower in station, in order to ensure the tower is within the Railway premises and avoid infringement to track as much as possible.
- 1.2.** It should be as close to Relay room as possible and ensure location clearance from the customer.

**2. Scope:**

Scope of this document provides the survey of TCAS Tower location, Location approval from customer, Soil testing, foundation and installation & commissioning of Tower and sub-components of the Station TCAS Tower. Interface connections with peripheral units like STCAS, RTU, Antenna and Earthing within Station yard / IB Hut / LC Gate.

**3. Reference Document:**

#	Document Name	Document Number	Verson	Source
1.	TCAS Product Specification	RDSO/SPN/196 /2012	3.2 May - 2017	RDSO
2.	Safety Instructions	5 16 76 0014	1.0	HBL
3.	Tower SOP			HBL
4.	Tower Design Drawing	-		Tower Designer
5.	Tower Design Drawings Approval	-	-	Third Party
6.	TCAS Tower Proposed Location Approval	EG-IC-FT-23	0.0	Railway
7.	Station TCAS Connectivity Drawing			HBL
8.	TCAS Tower Inspection Certificate	-	-	Rites
9.	Tower Foundation & Installation	-	-	Railway

#### 4. Do's & Don't:

##### Do's

1	Foundation will execute as per design under supervision of Railway officials.
2	Demarcating / barricading the foundation area to stop trespassers
3	Labours working in foundation area should wear safety apparels.
4	Experienced Riggers for Tower installation, Antenna & RTU unit installations
5	Riggers should wear safety apparels and drinking water during installations.
6	Site in-charge or rigger supervisor should be available at site, when riggers climb for installation.
7	Tx & Rx antenna placement as per design
8	All equipment and cable installation shall be as per SOP.
9	Record the stage wise work progress & completion, to capture in site folder.
10	Tower earth has to be done as per Station Connectivity drawing.

##### Don'ts

1	No un-authorised person is allowed in the proximity of foundation
2	Work on the towers when the weather conditions are bad and can also be life-threatening. Water or snow, even in a small amount can induce fatal accident.
3	Expose the copper bus bar, which is connected as ring earth. This is to avoid theft of copper.
4	Do the painting, till the RTU, Antenna and interface cabling work is completed.
5	Miss the verification of Tower materials received at site, as per supplier dispatch documents.

## 5. Survey:

### 2.1 Collect the following data from the customer.

- a. Cable route Plan

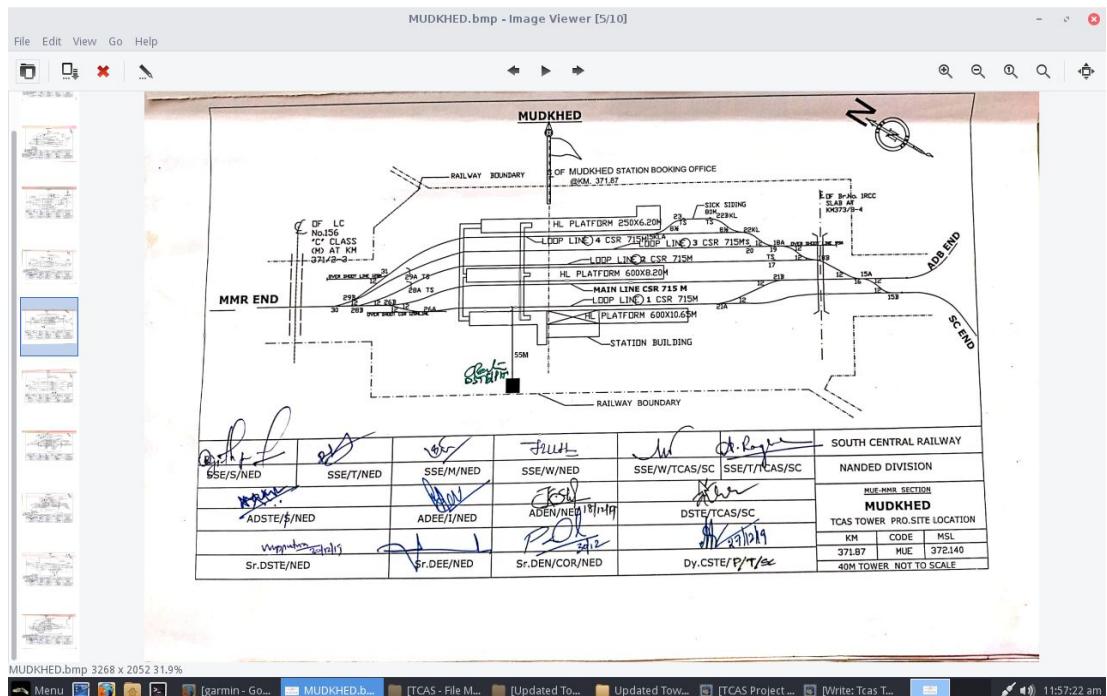
### 2.2 Location Identification:

Identify at least two possible locations for installation of Radio Frequency tower. In consultation with respective Railway zonal / divisional S&T, **Engineering (Civil), Electrical (Gen) and TCAS Project** Departments, RF tower placement location is to be finalized. Latitude and Longitude co-ordinates of Tower location is measured using by using GPS Navigator and data should indicate with an accuracy of 3m with 2decimals. This data is recorded in "TCAS Tower Lat - Long Survey" format (EG-IC-FT-22 Rev0).

Lattitude and longitude Co-ordinates data of a station: Example

Station Name	Latitude	Longitude
Shankarpalli	17°27'03.15"	078°07'49.75"

Lattitude and longitude Co-ordinates of all stations has to recorded in survey format (EG-IC-FT-22 Rev0) and this document has to be given to Project Engineering team for analysing RSSI survey for that particular Tower location (Railway station). If the Lattitude and longitude Co-ordinates suggested by site and Railway staff comply to the RSSI requirements, then, Project Engineering will issue necessary drawing (EG-IC-FT-23, Rev-0) for approval from concern Railway departments. Placed below is a Tower Location approved document is for reference.



*Figure 1: TCAS Tower site Location Approved.*

Based on Latitude & Longitude data, Project Engineering department issues Tower location drawing / document (EG-IC-FT-23, Rev-0) to I&C for getting approval from below from the concerned Railway departments.

- 1) TCAS Project Engineering
- 2) Signal & Telecommunication
- 3) Engineering Dept
- 4) Electrical Dept

New Tower location has to be identified, Latitude and Longitude co-ordinates reading to be taken again and same has to be recorded in the TCAS Tower Lat Long survey format (EG-IC-FT-22 Rev0) and submitted to project engineering team for RSSI survey and approval. Railway departments approves the recommended Latitude /Longitude co-ordinates of Tower location. For initiating foundation work, before excavation, the site is thoroughly checked for presence of any underground cables (using cable locators) to avoid any damages during excavation. While checking the presence of cables under the proposed Tower location site, confirmation from following departments is to be obtained.

1. S&T
2. Rail-Tel.
3. Electrical

Representatives from above mentioned department visit Tower location with cable locator, check if any cables are present under the ground and eventually give clearance for excavation..In case if any cables are detected in the path, excavation is done manually with utmost care, the cables route is diverted from the excavated Pit.Excavation work is carried out in presence of above mentioned departmental officials to avoid any damage to cables and for immediate rectification in case of any accidental damages. Complete tower foundation exaction is to be carried out in the presence of the above mentioned Railway staff. The cost and damage is to the contractor and penalty is also imposed on the contractor in case of any damages. Hence utmost care is to be taken during excavation. Excavations is done as per the approved foundation for the respective site.

## 6. Criteria for evaluating the best Location:

Ensure the tower is within the Railway premises, avoid infringement to track as much as possible and it should be as close to Relay room as possible.

Location Reference	Reasons for choosing this location
Identify at least 2 locations in the station area, preferably surrounding to RRI / EIS building and avoid crossing railway tracks in the station yard.	Vacant space of <b>8x8 m</b> , 40 mtrs away from the nearest track, with accessibility for truck movement

Table 1: Rationale for location selection

## 7. Tower

1. Tower is designed under the guidelines issued by RDSO specification and considering sites specified requirements from the Special conditions of Tender contract.
2. As per RDSO specification clause no 5.4.1.4 the following points are to be considered.
3. Railway shall decide type of Tower - Whether Lattice type or Concrete type or any other type.
4. Railway shall decide height of tower. Minimum height of self-supported tower shall be of 30m (for future installations tower height shall be 40m) height above ground level.
5. In case of tower on top of building, the typical height shall be on 4 m on top of building has to be considered and approval has to be taken from Railway.
6. Railway to ensure that basis of design of tower and foundation shall include wind velocity, soil bearing capacity, tower site, Ladder, Platform, Staging, Aviation Lamp and Earthing arrangement.
7. Design of mechanical structure and foundation is done as per guidelines given by a design consultant / Tower Manufacturer and approved by Third Party.
8. Tower design drawing are to be validated and approved through a Third party certifying body viz : IITs or CPRI. Third party approved Tower drawing are further validated and approved by Railways.
9. Tower manufacturing will start after receipt of approvals from Railways.

10. Manufactured Tower will be inspected by RITES at manufacturer premises.

## 8. Soil Investigation Report:

The object of soil investigation is to ascertain the nature and characteristics of sub – soil below the ground level of the tower proposed location this is to establish relevant properties for determination of safe bearing capacity of soil. The study includes estimation of safe bearing capacity of soil for design of foundations structures.



Figure1: Soil Investigation testing

5.1 The soil investigation scope of work includes the following:

- a. Excavation of one Pit of size 2 X 2 X 3.0 mtr or one bore hole of size 150mm dia has to be done.
- b. Soil samples are collected at the depths of 1mtr, 2mtr and 3.0mtr with a precaution that collected samples should not be exposed to atmosphere and not mixed with any material, till samples are handed over to testing lab.
- c. Soil samples collected from the bore hole has to be given to relevant laboratory for tests as per SBC as Per SHEAR CRITERIA IS: 6403-1981.
- d. The soil test report shall include the details of the tests carried out, their analysis and recommendations regarding the foundation system to be adopted based on SBC (soil bearing capacity) values.

- e. Once the Soil test complete, that particular contractor will submit the soil investigation report as per IS standards and certification by third party specialist.

## 9. Tower Foundation:

Based on Soil Bearing Capacity test report, suitable foundation from approved foundation design parameters like 50 / 75 / 100 /150 / 200Kpa from NWT / WT table are to be selected for foundation work.

Before initiating the foundation work, visual inspection by customer for below mentioned materials is required.

1. Fine sand aggregate (River Sand)
2. Stone aggregate (As mentioned in foundation design)



3. Cement 53 Grade of Coromandal / Ultratech brand or similar make.



4. Steel Fe 500 Grade or Higher of SAIL / TATA / Vizag / Jindal brand.



After getting clearance for material usage, below mention steps have to be followed for executing the foundation work

- a) Marking is done at approved tower location as specified in approved drawing.



- b) Excavation of pit has to be done as per foundation drawing.



- c) Safety barricading has to be done on four sides of the excavated pit.



- d) Pre-stressed cement concrete (PCC) work has is done for steel reinforcement provided within it to carry tensile load as well as compression. Concrete ratio is as per design.



- e) Bending and placement of steel reinforcement on PCC as per design. Concrete ratio is as per design.



- f) Reinforced cement concrete (RCC) has is done in 3 stages.

1. Steel reinforcement of horizontal basement has to be done in first stage.
2. Steel reinforcement of vertical columns has to be done in second stage.
3. CIP (Cast in Part) concreting

- g) Make concrete cubes of size 150 x 150 x 150 mm – 3nos are to be made, cured, and after curing these concrete cubes are sent to lab for testing purpose.
- h) These concrete cubes are to be collected for all 3 stages and submitted to third party lab (Govt approved lab) for testing, reports will be submitted to customer.
- i) The parameters of these cubes should be within the limits.
- j) Placement of cast in part (CIP) and concrete has to done in final stage.



**Note:**

- i. Customer inspects each state of foundation work and acknowledges the work details in site folder.
- ii. After completion of every stage of concrete work, water curing has to be done.
- iii. Vendor should submit test reports for cement, sand, aggregate, steel from supplier and Lab concrete cube test reports of each Tower foundation from third party to HBL.

## 10. Erection of Tower:

1. Towers are inspected by inspecting Authority (RITES) and transported to site
2. Tower material received at site are verified as per the BOQs and mentioned in dispatch document.



3. Arranging of security for tower materials till tower erection is completed.
4. Inspection of tower material is done by customer at site.



Customer will inspect the Tower material and record the details in site folder.

5. After customer inspection of Tower material, erection work is initiated as per tower design documents.



6. One coat of yellow primer coating and two coats of orange and white color bands on each segment of tower is done.



7. Lightning protection rods and Aviation Lamp are to be fixed on the top of Tower.
8. Aviation lamp shall operate on 110V DC power supply.
9. Copper cable of suitable size is used for connecting the 110V DC supply from IPS room to tower.
10. Aviation lamp installed, should glow during night time, not during the day time, this need to be ensured.
11. Vendor should submit the test reports for material used for each Tower manufacturing like MS Pipes, MS Flat, Bolts and also process activities done like Welding and Galvanizing to HBL.
12. Low intensity Aviation lamp lighted with red light should be used for structure with  $H \leq 45$  m during Sun set and Sun rise.

## 11. Antenna.

1. With reference “**station RSSI survey report**” done by project engineering, document are issued to I&C and supplier for installing Tx and Rx antenna placement on top of tower.
2. Necessary clamps required for installing Tx and Rx antenna on the Tower are also provided by the tower manufacturer.
3. Tx antenna – 2nos has to be placed as per tower design drawing.
4. Rx antenna – 2nos has to be placed below Tx antenna as per design drawing.
5. I&C to check and ensure the Tx and Rx antenna are fixed / clamped properly with supporting clamps as per SOP document.
6. Antenna - elements fixing shall be as per details given in “**station RSSI survey report**” .
7. LMR 600 cable having suitable connectors to be fixed to Tx and Rx antenna.
8. LMR600 cable has to be routed in suitable feeder clamps and fixed tower frame as per SOP.
9. Aviation cable has to be run through cable feeder clamp as per SOP.
10. Other end of LMR600 cables are to be connected to SPD devices provided on rear side of RTU (Radio Tower Unit) unit and they are tightened properly.

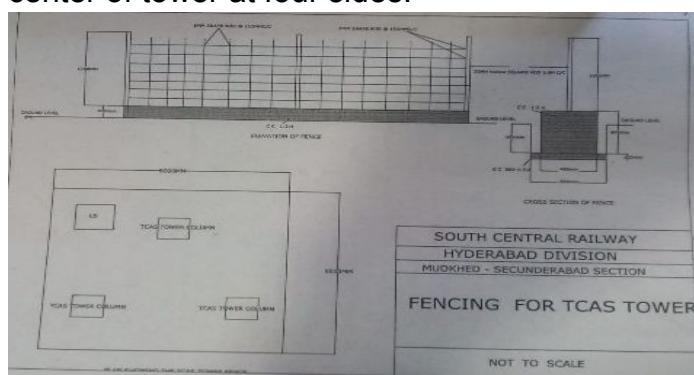
## 12. Earthing & Lightning Protection.

1. For lightning protection GI rods of 1mtr length and 16mm dia of 3nos will be fixed at top of the tower.

2. 3nos maintenance free earth at tower bottom has to be done and 1no maintenance free earth for RTU (Radio Tower Unit) box as per RDSO specification no. RDSO/SPN/197.
3. Connecting of lightning protection rods to tower legs by means of GI strip 25x3mm or 35sq.mm Green colour PVC insulated Multistrand copper cable and from legs to maintenance free earth by 35sqmm cable or Copper strip 25x2mm
4. All three earth pit electrodes of Tower are connected in ring using Copper strip 25x2mm.

### 13. Tower Fencing

1. Fencing arrangements has to done four sides of the tower as per drawing given in SCR tender document.
2. Tower fencing shall be as per drawing given below.
3. 24Mtr length fencing has to be provided having 6mtr length on each side.
4. From ground level, 400mm height x 400mm width cement concreting has to be done.
5. Height of fencing shall be 1.2mtr, placed above concrete.
6. Provision of gate is not shown in this drawing, separate approval must be taken.
7. Fencing work with one side gate must be provided at 3metres from center of tower at four sides.



### 14. Testing & Inspection.

1. Testing the verticality of the tower will be done by customer after completion of erection of Tower. The center of the top of the tower and the center of the base of the tower shall be within the limit ( $\pm 25\text{mm}$ ). This may be checked in the field after completion of erection of tower at site.
2. Collection of Tower Installation completion certificate form customer.

## 15. Documentation.

### 12.1. TCAS Specification

The TCAS subsystems comply with **RDSO specifications RDSO/SPN/196/2012 dated 17/05/17** for functional and safety requirements.

### 12.2. Tower Specification

The TCAS tower height, number of limbs, frame lengths, colour shades, design and approval shall be as per details specified in special conditions of contract and as per RDSO specification.

### 12.3. TCAS Tower location Lat, Long survey data in the format (EG-IC-FT-22, Rev-0)

### 12.4. Station RSSI Survey Report issued by Project Engineering.

### 12.5. Tower design approval from CPRI.

### 12.6. Tower Location drawing (EG-IC-FT-23, Rev-0) approval from Railways

### 12.7. Soil Inspection Report from third party.

### 12.8. Tower Design drawing.

### 12.9. Tower commissioning certificate.

# TCAS TOWER LOCATION LAT LONG SURVEY REPORT

## **Proposed TCAS Tower Location at** **Station.**

Latitude  
Longitude

