

**GOVERNMENT OF INDIA, MINISTRY OF RAILWAYS****सत्यमेव जयते****SPECIFICATION****FOR****VHF BASED****SECURED STATION COMMUNICATION EQUIPMENT  
(SSCE)****SPECIFICATION No. RDSO/SPN/TC/73/2008****Version- 1.0****Issued by****TELECOM DIRECTORATE  
RESEARCH DESIGNS & STANDARDS ORGANISATION  
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VHF Based Secured Station Communication Equipment (SSCE)			

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<b>Approved by:</b>	D. K. Singh Executive Director/Telecom
<b>Abstract:</b>	This document specifies technical specification of VHF Based Secured Station Communication Equipment (SSCE).

<b>DOCUMENT CONTROL SHEET</b>			
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## 1.0 FOREWORD:

- 1.1 Railway Board vide its letter No. 2004/Tele/WL/2/Misc. dated 22.05.2007 have issued "Guidelines for Utilization of Walkie-Talkie/VHF Sets on Indian Railway". The equipment as per this specification will facilitate implementation of following features required for fully implementing Railway Board Guidelines.
- DTMF Signaling with Selective Calling
  - CTCSS/DCS Signaling alongwith Inverse Scrambling to ensure one to one secured and Secret Communication
  - Displaying of Called and Calling Party ID on each other Set
  - Automatic Switchover of VHF Set to Driver/Guard Communication Channel.
- 1.2 The equipment deployed as per this specification will ensure voice recording of conversation taking place on Driver/Guard Communication Channel within the radio coverage area of Station VHF Sets.
- 1.3 The equipment deployed as per this specification can also be used for voice recording of telephonic conversation taking place between Station and Cabins.
- 1.4 In the absence of IRS specification, the procurement may be made as per this specification.
- 1.5 This specification requires references to the following standards specifications:

SN	Specification No.	Description
1.	QM-333	Specification for Environmental testing of Electronic Equipments for Transmission and switching use.

Wherever reference to any of the above specification appears in this document, it shall be taken as a reference to the latest version of the specification unless the year of issue of the specification is specifically stated.

- 1.6 Antenna Mast, which is required for installation of Antenna of 25 Watt VHF Set is not included in the scope of this specification. This Mast shall be procured separately by Railways depending upon requirement of site.

## 2.0 SYSTEM FUNCTIONAL REQUIREMENTS

- 2.1 Secured Station Communication Equipment (SSCE) shall normally remain tuned in Driver/Guard Communication Channel with speaker in ON Condition. This shall also allow Station Master to communicate in Driver/Guard Communication Channel through PTT enabled Handset of Special Type Telephone Set.
- 2.2 Through SSCE, SM shall be able to selectively call adjacent Station Masters by lifting the hand

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set and Pressing Designated Push Button on his Special Type Telephone Set. This action shall take place in DTMF Signaling in Driver/Guard Communication Channel and will activate a ring in the called station.

Subsequent to ringing at called station, both the SSCE at Calling Station as well as Called Station will automatically change to designed frequency out of frequencies F1 to F9 reserved for PLC Working as per Railway Board's letter No. 2004/Tele/WL/2/Misc. dated: 22.05.2007. Subsequently Simplex Communication can take place between two stations.

The Frequency Allocation Scheme of SSCE at Straight Line Section, Single Junction Station and Double Junction Station shall be as per Railway Board's letter No. 2004/Tele/WL/2/Misc. dated: 22.05.2007 and Shown in ANNEXURE-I.

- 2.3 SSCE shall use "Split Band Frequency Inverse Scrambling" for VHF Voice Communication between adjacent stations on "Designed PLC Working Channels".
- 2.4 SM shall be able to tune his SSCE to "Accident Site Communication Channel" or "Common Frequency Channel" or "Shunting & Yard Communication Channel" by lifting the hand set and Pressing Designated Push Button on his Special Type Telephone Set. This will facilitate Simplex Communication for SM on these channels through PTT enabled Handset of Special Type Telephone Set.
- 2.5 When the Handset of Special Type Telephone Set is replaced to cradle, the SSCE will automatically switch to Driver/Guard Communication Channel with Speaker ON.
- 2.6 SSCE shall voice record all the conversation within its radio coverage area in "Driver/ Guard Communication Channel", "Designed PLC Working Channels", "Accident Site Communication Channel", "Common Frequency Channel" and "Shunting & Yard Communication Channel" when tuned to these channels. All the Voice Recording shall be Date and Time Stamped alongwith Stamping of Station Identity, and VHF Channel Identity. This entire VHF Conversation shall be recorded through Single Channel of Voice Logger.
- 2.7 SSCE shall also have provision to voice record all the wireline telephonic conversation taking place between Station & Cabins and also between Station & Adjacent Stations. This Voice Recording shall be Date and Time Stamped alongwith stamping of Station Identity & Channel Identity. The SSCE shall have provision of 3 such channels for wireline telephonic conversation recording.

### **3.0 SYSTEM TECHNICAL REQUIREMENT**

- 3.1 SSCE shall be designed using Microcontroller.
- 3.2 SSCE shall have provision to operate from any of the two available sources of power supply i.e. Electricity and Battery. Provision of Battery along-with Charger is under Scope of Supply for SSCE.
- 3.3 The SCCE should be designed in such a way that it should have built in arrangement to process,

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- record and store any ongoing voice communication from ASM Unit.
- 3.4 The recording and storage of voice communication should start as soon as call is commenced from/to SSCE and the same is terminated with the replacement of PTT enabled Handset of Special Type Telephone Set.
  - 3.5 Storage of Voice Communication should follow the FIFO (First In First Out) methodology. Once Voice Communication is stored in, no way it should get corrupted.
  - 3.6 There shall not be any compression of the Voice Signals. The capacity of Voice Storage shall be at least 1400 Hours.
  - 3.7 In case of any problem in Voice Recording, there shall be Audio Visual alarm to draw the attention of SM/ASM on duty. Audio Alarm will continue till such time it is acknowledged by SM/ASM. Visual alarm will continue till such time problem is rectified.
  - 3.8 There should be an Ethernet Interface Port through which Recorded Voice can be transferred from SSCE to Laptop for replay or taking backup on CD/DVD.
  - 3.9 SSCE shall also have provision to record all the wireline telephonic conversation taking place between Station & Cabins and also between Station & Adjacent Stations. This Voice Recording shall be Date and Time Stamped alongwith stamping of Station Identity & Channel Identity. The SSCE shall initiate recording as soon as it detects voice on wireline (VOX Based) and shall stop when voice communication on line stops. The SSCE shall have provision of 3 such channels for wireline telephonic conversation recording.
  - 3.10 It shall be possible to replay the Voice Recordings by simple operation from SSCE unit without use of Laptop.
  - 3.11 SSCE shall record all the events related to its operation alongwith Date & Time. For VHF Voice Communication these events includes Dialed/Received Station ID, VHF channel etc. Provision of a Data Port to download these events through a password protected software shall be provided.
  - 3.12 SSCE shall have capacity to store at least 10,000 such events. These events shall be recorded in the Flash EPROM Memory so that the stored events cannot be erased in case of power supply interruption. When the Flash EPROM Memory is be full with recorded events then events shall be overwritten by following FIFO (First In First Out) methodology.
  - 3.13 For Retrieval of Voice Recording and Data Records a Windows OS based GUI (Graphical User Interface) shall be provided alongwith SSCE. This shall facilitate the function of search of Voice Recording and Events Data Records from SSCE using option like Date, Time, Message Type, VHF Channel ID, Wireline Channel No. etc. This shall also facilitate tagging of Voice/Data Records by remarks and archival of Voice/Data Records to CD/DVD. The Laptop or PC required to run this GUI is not included in the scope of supply of this specification and shall be arranged separately by Railways.
  - 3.14 Provision of RF Surge/Lightening Protection Device as part of SSCE at the RF Port of 25 W VHF shall be made. The connection to Stacked Dipole Omni-Directional Antenna shall be made from the other end of this RF Surge/Lightening Protection.

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3.15 All the components used in the equipment shall be of high grade quality from reputed manufacturer.

#### **4.0 TECHNICAL SPECIFICATIONS**

4.1 SSCE shall comprise of

- (i) Microcontroller based equipment with built in Voice/Data Storage facility.
- (ii) MIL Standard 810 G Compliant, 25 Watt VHF Radio Set.
- (iii) Special Type Telephone Set with LCD Display, Feature/Function Keys and Built-in-Speaker.
- (iv) 12 Volt 15 Amp DC SMPS Based Power Supply from reputed manufacturer.
- (iv) 12 Volt 120 AH Maintenance Free Battery from reputed manufacturer.

#### **4.2 Electrical Parameters for SSCE**

4.2.1 Power Supply: 12 Volt DC SMPS Based Power Supply with Input of 165 V to 260 V AC, 50Hz and Output of 12 V DC +/- 10 %, 15 Amp.

4.2.2 Current Consumption: 6 Amp max. on wireless

#### **4.3 Microcontroller based Equipment with Voice/Data Storage facility**

4.3.1 The system must be designed using 25 MHz, 16-bit or higher data bus micro-controller of reputed make. Internal ROM of Microcontroller shall be minimum 256 kbytes and Internal RAM of Microcontroller shall be minimum 8 kbytes.

4.3.2 The equipment shall have Real Time Clock with an accuracy of  $\pm 3.5$  ppm within Operating Temperature Range of  $-10^{\circ}\text{C}$  to  $+55^{\circ}\text{C}$ .

4.3.3 The equipment shall have Flash Memory of minimum 8 Mbytes to store the events as per Clause 3.11 and 3.12.

4.3.4 The System shall have minimum Voice Recording of 1400 Hrs with 64 kbps G.711 A/ $\mu$  law PCM Coding on minimum 40 GB storage device.

4.3.5 S/N Ratio of Voice Recording shall be better than -40 dB. Recording Sensitivity shall be better than -20 dBm. Frequency Response for 300-3400 Mhz shall be +/- 3 dB. The distortion of the recorded Voice Signal when replayed shall not be more than 5% with respect to original signal.

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#### 4.4 25 Watt VHF Set:

4.4.1 VHF radio set of 25 watt for wireless communication shall be MIL Grade, 810G compliant.

4.4.2 Specification of the 25 Watt VHF Set

SN	Parameters	Characteristics
<b>A.</b>	<b>GENERAL</b>	
A1.	Frequency Range	146 to 174 MHz
A2.	Channel Spacing	12.5 kHz or 25 kHz
A3.	Emission	8K50F3E or 16K0F3E
A4.	Frequency Spread	28 MHz
A5.	Frequency Stability	5 PPM
A6.	Type of Operation	Simplex / Semi - duplex, Press to talk
A7.	Operating Temperature Range	-30 <sup>o</sup> C to 55 <sup>o</sup> C
A8.	Speaker Impedance	8 $\Omega$
<b>B.</b>	<b>TRANSMITTER</b>	
B1.	RF Power Output	10 to 25 Watt
B2.	Frequency Deviation	+/- 5 kHz (W type), +/- 2.5 kHz (N type)
B3.	Modulation Sensitivity	80mV for 60% max. deviation at 1000Hz.
B4.	Modulation distortion	Better than 5%
B5.	Modulation fidelity	Within +1, -3 dB of 6 dB / Octave
B6.	Spurious and Harmonics	-36 dBm (.25uW)
B7.	Output Impedance	50 $\Omega$
<b>C.</b>	<b>RECEIVER</b>	
C1.	Sensitivity	0.3uv / -118 dbm at 12 dB SINAD
C2.	Selectivity	Better than 60 dB
C3.	Image and Spurious rejection	Better than 65 dB
C4.	AF distortion	Better than 5%
C5.	Audio output	Better than 250 mW with less than 5% distortion at 1 kHz ref. measured at specified AF output.
C6.	Squelch Sensitivity	Better than -119 dbm
C7.	AF Response	Within +1, -3 dB of 6 dB / Octave

4.4.3 Specification of Stacked Dipole Omni Directional Antenna

SN	Parameters	Characteristics
<b>A</b>	<b>ELECTRICAL SPECIFICATIONS</b>	
A01	Frequency Range – MHz	146 - 174
A02	Bandwidth – MHz	10
A03	Impedance – Ohms	50 unbalanced
A04	VSWR – less than	1.5
A05	RF Power handling capacity – Watt	100
A06	Termination	N – female
A07	Lightening Protection	Direct Ground
<b>B</b>	<b>MECHANICAL SPECIFICATIONS</b>	
B01	Support Pipe Material	Aluminum
B02	Support Pipe Length – feet	12



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B03	Support Pipe O D – mm	50
B04	Support Pipe Wall Thickness – mm	2.5
B05	Radiating Elements Material	Aluminum
B06	Radiating Elements Material O D – mm	12
B07	Radiating Elements Mounting Clamp	Cast Iron / Aluminum
B08	Mounting Clamp for Antenna	Cast Iron / Aluminum
B09	Shipping Length - Feet	6.5

#### 4.4.4 Specification of Antenna Cable

SN	Parameters	Characteristics
A1	Length	As per site requirement
A2	Size	RG 217 Low Loss Cable
A3	Jacket	Polyethylene Black
A4	Outer Diameter	14 mm
A5	Characteristic Impedance	50 +/- 1 ohm
A6	Average Power Rating	1.00 kW at 100 MHz
A7	Attenuation	0.05 dB / Mt at 100 MHz

#### 4.5 Special Type Telephone Set.

- 4.5.1 Special Type Telephone Set shall be microphone and speaker with volume control knob. It shall also have handset with cradle and PTT Switch.
- 4.5.2 Special Type Telephone Set shall be Desk or Wall Mount. It shall be connected with the equipment with 6 (six) wire cable.
- 4.5.3 Operating Temperature Range of Special Type Telephone Set shall be -10<sup>o</sup>C to 55<sup>o</sup>C.

#### 4.6 Specification of 12 Volts Battery (SMF battery)

SN	Parameters	Characteristics
A1	Voltage	12 V
A2	Backup Capacity	Min. 120 AH
A3	Type	Maintenance Free

#### 4.7 Terminals / Connectors:

RJ11 & RJ45 connectors shall be used to connect the 2W telephone sets / lines / PC to eliminate any inadvertent disconnection of the input / output lines.

All other connectors like antenna, power etc. shall be lockable so that it cannot get disconnected inadvertently.

- 4.8 The Earthing arrangement shall be provided by the Railways & is not the part of the equipment.

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## 5.0 TESTS AND PERFORMANCE REQUIREMENT

5.1 Unless otherwise specified, all the tests shall be carried out under prevalent ambient atmospheric conditions.

### 5.2 Type Test

5.2.1 The following shall constitute Type Test:

A minimum of three sample of SSCE are required for type test. These samples shall not be part of supply.

a)	Visual Inspection	(Clause 5.4)
b)	Applied high voltage test	(Clause 5.5)
c)	Insulation resistance test	(Clause 5.6)
d)	Operation test	(Clause 5.7)
e)	Performance test	(Clause 5.8)
f)	Climatic severity test	(Clause 5.9)
g)	Vibration test	(Clause 5.10)
h)	Field Trial	(Clause 5.12)

### 5.3 Acceptance Test.

5.3.1 The following shall constitute the acceptance test on SSCE and shall be carried out on complete offered lot

a)	Visual Inspection	(Clause 5.4)
b)	Applied high voltage test	(Clause 5.5)
c)	Insulation resistance test	(Clause 5.6)
d)	Operation test	(Clause 5.7)
e)	Performance test	(Clause 5.8)

5.3.2 Any other tests as required by the inspecting authority to ensure that equipment is in conformity with the requirement of the specification shall also be done.

### ROUTINE TEST

5.3.3 The manufacturer shall certify that all the tests given in para 5.3.1 have been successfully carried out on all the equipments offered for inspection. He shall produce those tests results at the time of inspection.

5.3.4 The manufacturer shall under take auditing of the components/devices for ensuring the reliability. Audit record shall be shown to the inspection authority.

### 5.4 Visual Inspection

The equipment shall be visually inspected to ensure that it is free from any cracks or any other imperfection including marking and painting etc. Further the equipment shall be checked to satisfy general requirement as per Clause 1, 2, 3 & 4.

### 5.5 Applied High Voltage Test

The equipment shall with stand without any damage a test voltage of 1KV, applied for a period

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of one minute, between the body and all the current carrying terminals looped together.

## 5.6 Insulation Resistance Test

The insulation resistance measured with 100V DC between the body and the current carrying terminals looped together shall not be less than 10 mega ohms.

## 5.7 Operation Test

It shall be carried out to test the compliance to System Functional Requirement as per Clause 2.0.

## 5.8 Performance Test

5.8.1 The Performance Test shall be conducted as per Performance Test Procedure proposed by manufacturer duly reviewed and approved by RDSO/Lucknow. The Performance Test shall be conducted at Manufacturer's Premises or in any other mutually agreed Test Laboratory.

## 5.9 Climatic Test-degree of severity

5.9.1 Dry Heat Test shall be done in two phases-operational and storage. Operation test shall be done at  $55^{\circ}\text{C} \pm 3^{\circ}\text{C}$  for 16 hrs. and the operation of the equipment shall be tested after completion of the test as per clause no. 5.7. The storage test shall be conducted at  $70^{\circ}\text{C} \pm 2^{\circ}\text{C}$  for 16 hrs with a recovery time of 8 hrs. The test shall be conducted as per QM-333. Operation of the equipment shall be tested after completion of the test as per Clause 5.7.

5.9.2 Damp Heat (Steady State): The equipment shall be subjected to  $40^{\circ}\text{C} \pm 2^{\circ}\text{C}$  with RH not less than 93% for 24 hrs. On completion of the duration of the test the equipment shall be taken out and shall be wiped with dry cloth to remove the condensed water if any from the surface. The equipment shall then be kept in a recovery chamber at  $27^{\circ}\text{C} \pm 5\%$  for 6 hrs and the insulation resistance shall be measured as per clause 5.6. The IR value shall not be less than 10M ohms. The operation test of the equipment shall be done as per clause 5.7.

5.9.3 Cold Storage Test shall be done at  $-10^{\circ}\text{C}$  to for 16 Hours with the recovery time of 8 hrs. The test shall be conducted as per QM-333. The operation of the equipment shall be tested as per clause 5.7.

## 5.10 Vibration Test

5.10.1 The equipment shall be subjected to vibration test as per QM-333

- |                                      |   |                                   |
|--------------------------------------|---|-----------------------------------|
| (i) Freq. Range                      | : | 10Hz to 55 Hz.                    |
| (ii) Vibration amplitude             | : | 0.35mm                            |
| iii) Duration of endurance for sweep | : | 20 sweeps cycles( 10Hz-55Hz-10Hz) |
| iv) No. of axes                      | : | 3 coordinate axes.                |
| v) Duration at resonant frequency    | : | 30 minutes+/- 1 minutes.          |

5.11 After completion of climatic and vibration tests the equipment shall be visually inspected to check for any damaged or cracked parts and performance test shall be carried out as per Clause 5.8.

5.12 **Field Trial:** On completion of Type Test, Field Trial for 4 to 6 weeks shall be conducted by

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installing complete equipments in selected stations to judge the performance of the system.

## **6.0 MANUFACTURE**

- 6.1 The manufacturer shall ensure that in addition to all the provisions of this specification the requirements of other specifications referred to in this specification as far as they are applicable and any specification prescribed by purchaser are fully complied with.
- 6.2 Workmanship limits and fits insulating materials, electro-magnetic coils, electrical contacts, terminals, wiring, rejection, marking and identification, packing and warranty shall be in accordance with the requirements in IRS: S-23.
- 6.3 The manufacturer shall have suitable inspection facilities and testing equipment at their works.
- 6.4 The manufacturer shall provide training to Rly. Staff free of cost for one week at his works.

## **7.0 MANUFACTURER'S IDENTIFICATION**

- 7.1 A metal plate containing the following information shall be firmly secured to the equipment:
- a) Manufacturer's Name and Address.
  - b) Year of manufacture and serial number.
  - c) RDSO Specification No.
  - d) Indian Railways.

## **8.0 PACKING**

- 8.1 The equipment shall be so packed as to permit convenient handling and to protect against loss or damage during transit and storage. The following information shall be given on the packing case:
- a) Name of manufacturer
  - b) Year of manufacture
  - c) Arrow indicating top side.
  - d) Fragile
  - e) Address of consignee.

## **9.0 INSTRUCTION BOOKS AND MEASURING INSTRUMENTS**

- 9.1 Manufacturer shall prepare and submit following Document during the Type Test for approval of RDSO/Lucknow.
- a) Operating Instruction Manual
  - b) Preventive Maintenance Manual along-with Preventive Maintenance Schedule
  - c) Corrective Maintenance Manual.
  - d) Comprehensive Training Document.

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e) Technical Instruction Manual giving details of circuit and connection diagrams, values of rating of all components, PCBs wiring etc.

Subsequently documents (a) to (d) above in 2(two) Hard Copy and 1(one) CD shall be supplied along-with each equipment.

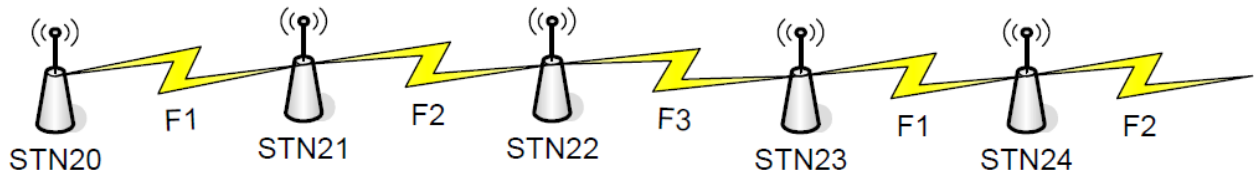
- 9.2 Manufacturer shall submit complete details of the Test & Measuring Equipments required for testing & servicing during Type Test to RDSO/Lucknow.
- 9.3 Manufacturer shall submit, a list of the recommended spares for a period of 5(five) years, during Type Test to RDSO/Lucknow.
- 9.4 All the components used in the equipment shall be of high grade quality from reputed manufacturer.
- 9.5 Data sheet for switches microphone loudspeaker shall be submitted by the manufacturer.

10. **ISO Binding Clause:**

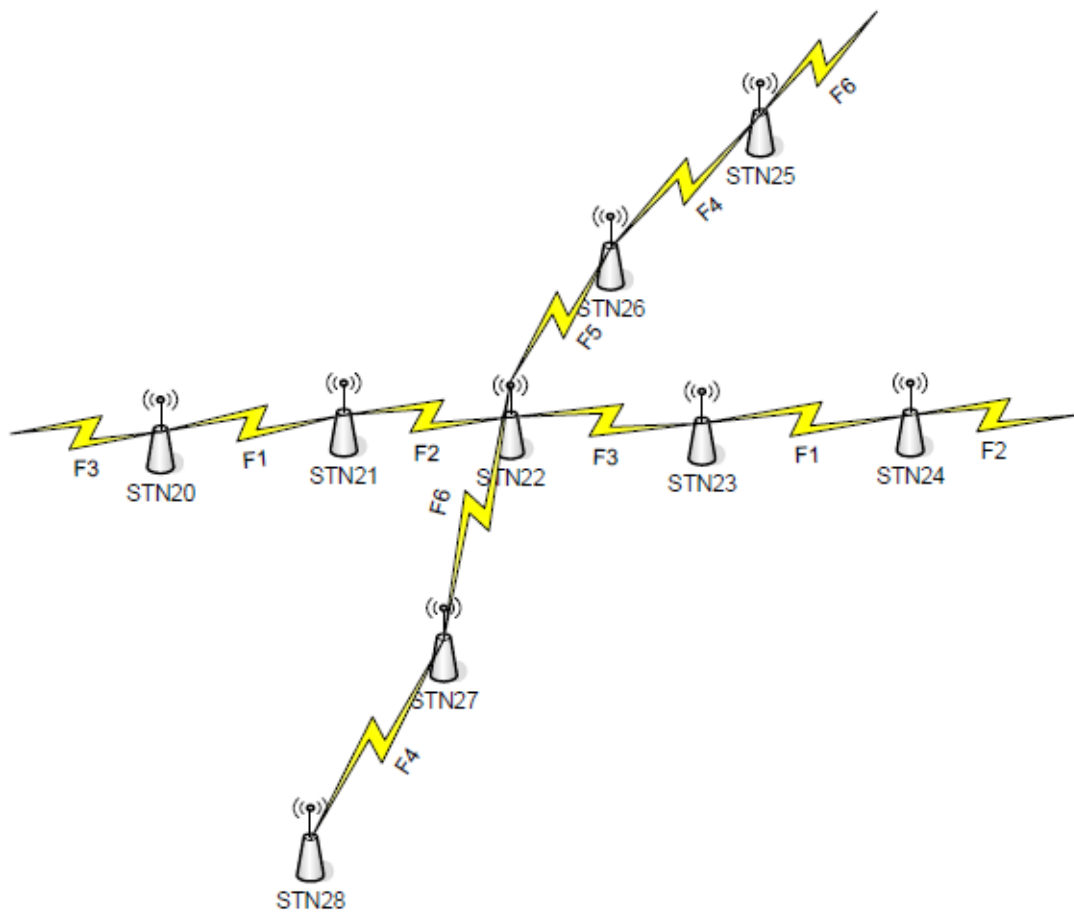
All the provisions contained in RDSO's ISO procedures laid down in Document No. QO-D-8.1-11 (Latest Version) (titled "Vendor-Changes in approved status") and subsequent versions/amendments thereof, shall be binding and applicable on the successful vendor/vendors in the contracts floated by Railways to maintain quality of products supplied to Railways.

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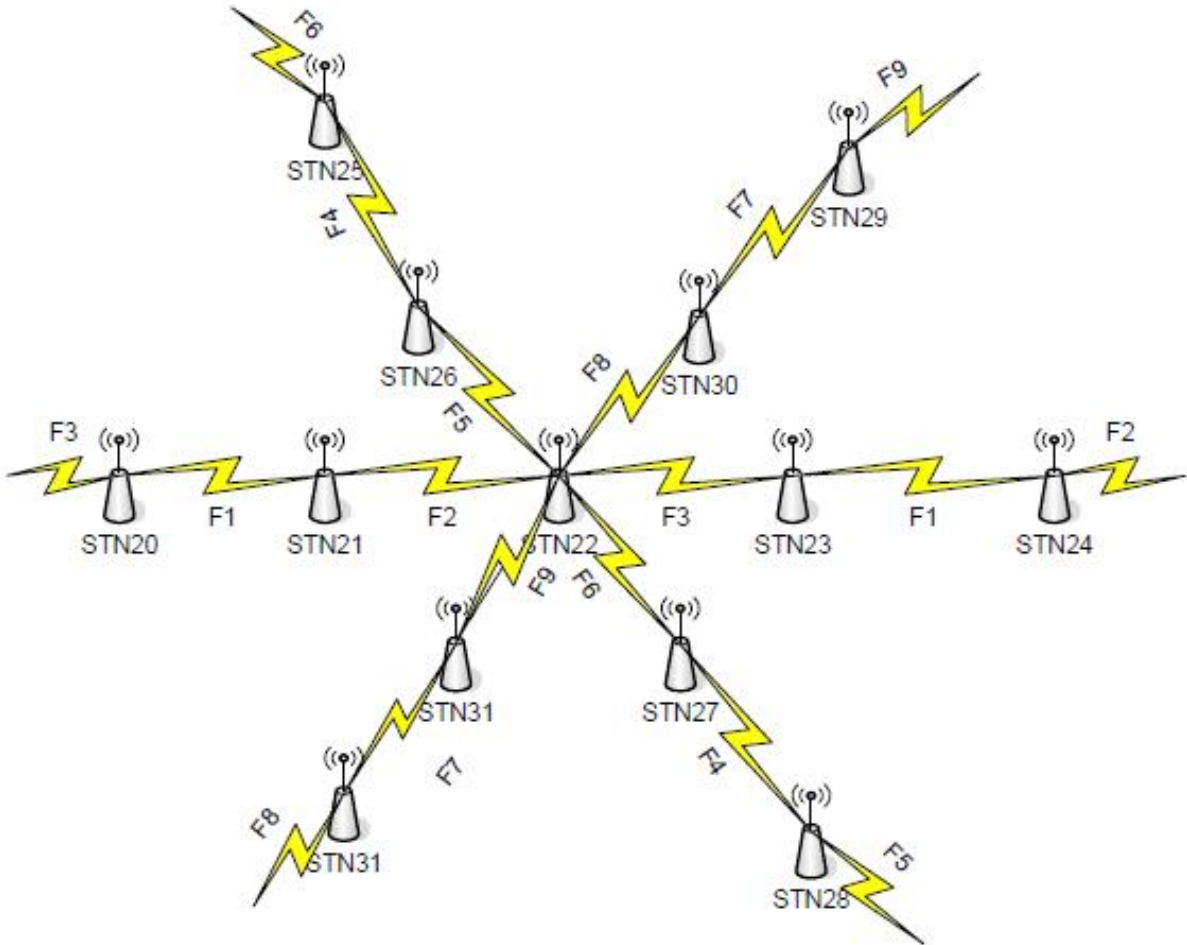
**ANNEXURE -I**



**Diagram 1: Frequency Scheme for Straight Section**



**Diagram 2: Frequency Scheme for 4 Direction Junction Station**



**Diagram 3: Frequency Scheme for 6 Direction Junction station**