GOVERNMENT OF INDIA, MINISTRY OF RAILWAYS
RESEARCH DESIGNS & STANDARDS ORGANISATION

MANAK NAGAR, LUCKNOW-226011

सत्यमेव जयते

SPECIFICATION FOR VHF BASED APPROACHING TRAIN WARNING SYSTEM FOR TRACK MAINTAINERS

Specification No. RDSO/SPN/TC/105 /2015 Rev. 0.0

Telecom Directorate
Research Designs & Standards Organisation
LUCKNOW-226011

Document Data Sheet **SPECIFICATION No. RDSO/SPN/TC/105 /2015**		Revision **Rev. 0.0**
Title of Document Draft specification For VHF based Approaching Train Warning System		
Prepared By **Shri P.Lal** **Joint Director / Tele -1**		
Approved By **Shri D.N.Tewari** **Executive Director / Telecom**		
Abstract: This document specifies technical specifications for VHF based Approaching train warning system		

DOCUMENT CONTROL SHEET

NAME	ORGANISATION	FUNCTION	LEVEL
ShriP.Lal	RDSO	Member	Prepare
ShriD.N.Tewari	RDSO	Approving Authority	Approve

AMENDMENTS

Specification No.	Version	Amendment	Amendment Details	Effective date
RDSO/SPN/TC-105/2014	0	-	First issue	30-10-2015

SN	TABLE OF CONTENTS	Page No.

1.0 FOREWORD:

1.1 Patrolling on Railway Track is performed throughout the year to ensure safe running of trains during all-weather conditions. There have been cases of ***loss of life*** due to train hitting maintenance staff while performing duties. This equipment will give an advance Warning to maintenance staff about an approaching train in mid-section through hand held VHF receiver unit so that maintenance staff are alert about approaching train. This equipment will be helpful to protect precious life of the railway staff-working along the railway tracks.

1.2 For this purpose, coded signals are transmitted to indicate information of an approaching train. These RF signal are received and decoded by Hand held VHF Receiver to generate necessary audio visual alarms with vibration alert to maintenance staff. Signal strength should be strong enough for proper reception.

1.3 VHF receiver shall give an audio, visual alarm with vibration alert for an approaching train to user when Receiver is in "ON condition. This equipment can be used by any field maintenance staff.

1.4 In the absence of IRS specification, the procurement may be made as per draft specification.

1.5 This specification requires references to the following standards specifications:

SN	Specification No.	Description
1.	IS-9000 (Series)	Basic Environment Testing Procedure for Electronic and Electrical items.

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.

2.0 General Requirements:

2.1. VHF Transmitter s*hal*l be capable of working in an ambient temperature range of –10˚C to +55˚C and relative humidity up to 95% at ambient temperature of 40˚C without any degradation in performance

2.2. Suitable Class C protection device against surge/transient voltages shall be provided at input of the mains power supply source of transmitter . The parameters of Class C protection shall be as per clause no. 5.9 of specification no. RDSO/SPN/TC/98/2011, Rev. 0 or latest.

2.3. The System shall work satisfactory in AC/DC Electrified and Non-Electrified sections.

2.4. System shall be suitable for working in all areas including where locomotives having thyristor controlled Single Phase or 3-Phase Induction Motors haul Passenger or Freight Trains and where Chopper Controlled EMU Stocks are operated.

2.5. VHF based Approaching Train Warning System shall be capable of working in non-air conditioned environment in the field.

2.6. Mast, required for installation of Antenna of 15 Watt VHF Set is not included in the scope of this specification. Mast can be procured separately by Railways depending upon site requirement.

2.7. Industry standards Material for the printed circuit board (PCB) shall be used.

2.8. Assembled and tested printed boards should have conformal coating to enable them for functioning under adverse environmental conditions. The coating material should be properly chosen to protect the assembly from Humidity, Dust and dirt, Airborne contaminants like smoke and chemical vapors, Conducting particles like metal clips and filings, Accidental short circuit by dropped tools, fasteners etc. Abrasion damage

3.0 DETAILS OF EQUIPMENT:

3.1 The system will consist of mainly two parts:

i. Fixed VHF Transmitter

ii. Hand held VHF Receiver-HHR

3.2 Fixed VHF **Transmitter:** This unit will be normally installed in a Relay Room or Station Master's Room. The output of transmitter shall be connected through suitable RF cable to the Antenna mounted on roof top or mast at a suitable height to get adequate coverage in the block section. The Transmitter Unit shall consist of:

1. Base station complete with Modulator with Power amplifier
2. Power supply unit with built- in 12V/7AH Battery& Suitable charger.
3. Antenna with RF cable

3.3 **VHF Based Hand held Receiver (HHR):** This is a small VHF Receiver unit, which will be kept by the field staff working along the railway track. This unit will have the following features:

3.4 Respective Signal depending upon approaching train on UP/DN track a Trigger shall be transmitted by Transmitter once every 20 seconds (Nominal). This transmitted signal will be received and decoded by HHR present in the block section under the coverage area of the transmitter.

3.5 Then HHR will process the received signal to decode and generate an audio visual alarm by glowing ("UP" LED and/or "DN"), LED Audible Alarm with vibration to alert maintenance staff about the presence of approaching train on UP/DN train .

3.6 This system will work at frequency 160.450 MHz

3.7 Typical sketch/3D diagram of hand held terminal is shown in figure-2

4.0 FUNCTIONAL REQUIREMENTS OF THE SYSTEM:

4.1 Fixed VHF TRANSMITTER:

4.1.1 The transmitter shall have a suitable modulator to superimpose information of advance starter signal.

4.1.2 **VHF Transmitter** shall be provided with a power supply of 12 V DC.

4.1.3 Power supply of Transmitter shall have built-in 12V/7AH Maintenance Free Battery to provide sufficient power backup with charger working on 230V AC. The charger shall be of 13.8 V/2 amp capacity.

4.1.4 Power supply should have protection against overcharging with suitable indication.

4.1.5 Power supply should have protection against short circuit.

4.1.6 Each **VHF Transmitter** will have a unique ID Code.

4.1.7 **VHF Transmitter** will transmit the signals at 160.450MHz Carrier Frequency

4.1.8 RF power output of the transmitter shall be of minimum 15 watts.

4.1.9 N.O. & NC - contact of "Advance Starter Signal - Relay" should be used for automatic working of the Transmitter.

4.1.10 Trigger to **VHF Transmitter** for data transmission about an approaching train shall be applied automatically using potential free contact of Advance Starter Signal available in signaling relay room.

4.1.11 It should be also possible to manually trigger the **VHF Transmitter** by applying information of departing train in the section by a push button switch provided on the transmitter panel for "UP and/or DN" trains.

4.1.12 **VHF Transmitter** shall transmit this signal once every 20 sec.

4.1.13 An indication shall be provided on front panel to indicate health of the transmitter by a Blinking LED.

4.1.14 Transmitter out-put shall be connected to an Omni directional antenna provided at roof top/mast depending upon requirement of the site to insure availability of the signal throughout the block section.

4.1.15 ON/OFF Switch shall be provided to start and stop Transmitter.

4.1.16 Power supply cord of minimum 3 meter length with 5A plug top shall be provided to connect 230 V AC .

4.1.17 External terminal strip shall be provided on transmitter back/side panel to connect contacts of advance starter signal of the UP/DN trains coming from Relay Room.

4.1.18 Typical RF signal coverage diagram is shown in Annexure-A. There should be coverage of RF signal for a minimum distance of 10 KM.

4.1.19 Typical 3D diagram of VHF transmitter is shown in figure-1

4.2 VHF Based Hand held Receiver (HHR):

4.2.1 HHR shall only respond to the transmitted signal received from the VHF Transmitter for which it has been programmed.

4.2.2 **Hand held Receiver** will give visual indication with Buzzer & Vibration (Sound enough to draw the attention of the user) of the approaching train for UP/DN directions through blinking LEDs provided for UP/DOWN directions trains.

4.2.3 Following indications shall be provided for UP/DN direction approaching trains.

SNo.	Indication	Description of warning signals
1.	Train on 'UP'track	UP LED should blink with Buzzer (beep) & Receiver will vibrate thrice for 1 second duration. Visual indications shall continue for next 2 minutes.
2.	Train on 'Down' track	DN "LED" should blink with Buzzer (beep) & Receiver will vibrate once for 3 seconds duration. Visual indications shall continue for next 2 minutes.

4.2.4 Audio indications shall be repeated thrice every minute till next 2 minutes as a reminder to the maintenance staff.

4.2.5 When HHR is receiving a healthy RF Signal, both UP and DN LED will blink twice without any buzzer or vibrator after every minute. (to indicate that the equipment is in signal range)

4.2.6 When RF signal is weak in the block section, HHR will sound only two beeps buzzer without any LED or Vibrator.

4.2.7 Power ON/OFF switch shall be provided on HHR to conserve battery power when not in use.

4.2.8 The device shall be housed in a small pocket model enclosure (It should be small enough so that it should be kept in the pocket of the user) with built-in antenna and rechargeable battery.

4.2.9 Battery of HHR should last for about 8 hours (when fully charged) with "UP" & "DN" indications.

4.2.10 A Battery monitoring circuitry with over charge protection shall be provided in HHR unit.

4.2.11 Receiver unit shall have facility of charging from 230 VAC through an external charger.

4.2.12 Receive Function of HHR shall not work when unit is plugged in for charging.

4.2.13 Low Battery Status of shall be shown HHR & Charging/Charged may be provided on Charger or HHR unit.

4.2.14 To switch ON/OFF the HHR, a Switch shall be provided in HHR unit and switch on indication shall be defined in manual.

4.2.15 To switch OFF the HHR, procedure shall be defined in manual.

4.2.16 VHF Receiver should give respective LED indication along with Buzzer to indicate UP/DN direction approaching Train.

4.2.17 HHR shall have fasting arrangement (spring loaded clamp) for fixing it on trouser belt/pocket.

5 TECHNICAL REQUIREMENTS OF THE SYSTEM:

5.1 VHF TRANSMITTER:

5.1.1 Specification of the 15 Watt VHF Transmitter:

SN	Parameters	Characteristics
A.	GENERAL	
1.	Carrier Frequency	160.450 or as agreed by the Railway (150 – 174 MHZ)

2.	Emission	8K50F3E / 16KOF3E/11KOF3E (depending upon channel spacing)
3.	Frequency Stability	±5 PPM
4.	Operating Temperature Range	-10^0 C to 55^0 C
5.	RF Power Output	Min. 15 Watt
6.	Frequency Deviation	+/- 5 kHz
7.	Modulation distortion	Better than 5%
8.	Modulation fidelity	Within +1, -3 dB of 6 dB / otave
9.	Spurious and Harmonics	Better than 70 db
10.	Output Impedance	50 Ω
11.	Connector	Connector - UHF - type Female

5.1.2 Transmitter circuitry and Power supply arrangement should be housed in Mild Steel body having size less than 200 x 275 x 200 mm. The body should be powder coated.

5.1.3 Suitable 'Earthing' terminal shall be provided for earthing the body of Transmitter. Earthing terminal shall be marked as: ⏚ .

5.1.4 Following Indication shall be provided on front panel of the VHF Transmitter :

SN	Description	LED Colour
i.	Transmitter ON	White
ii.	UP Trigger ON	Blue
iii.	Down Trigger ON	Yellow
iv.	Bi-colour LED For Transmitted Signal	Carrier Transmitted TxC-(Red) Train Signal Transmitted TxD- (Green)
v.	Battery Low	Red
vi.	Charging (CHG-RED) Battery Full Charge (Green)	Bi-colour LED

5.2 Specification of Ground Plane (G.P.) Antenna

SN	Parameters	Characteristics
A	ELECTRICAL SPECIFICATIONS	
i.	Frequency Range –	150 - 175 MHz
ii.	Bandwidth –	25 MHz
iii.	Impedance –	50 Ohms unbalanced
iv.	VSWR – less than	1.5
v.	RF Power handling capacity –	50 Watt
vi.	Connector type	Connector type - UHF – Female
vii.	Lightening Protection	Direct Ground

B MECHANICAL SPECIFICATIONS:

Support Pipe with minimum Wall Thickness of 2.5mm and outer dia of 50 mm and height as per site requirement shall be provided for mounting antenna.

5.3 Specification of RF Cable

SN	Parameters	Characteristics
i.	Length	As per site requirement
ii.	Type	Low Loss RF cableCable
iii.	Voltage	Shall withstand 2500V DC
iv.	Jacket	Polyethylene Black
v.	Outer Diameter	>10 mm
vi.	Characteristic Impedance	50 + / - 1 ohm
vii.	Average Power Rating	1.00 kW at 150 MHz
viii.	Attenuation	0.05 dB / Meter at 150 MHz

5.4 **VHF Based Hand held Receiver (HHR):**

5.4.1 HHR shall be manufactured preferably from non-metallic material. If metallic cases are used, suitable treatment for resistance against corrosion and rust shall be provided.

5.4.2 HHR should be portable (pocket model) and should be less than 25 x 50 x 150 mm in size (without clamp).

5.4.3 The typical shape of **Hand held Receiver (HHR) shall be as per figure-2.**

5.4.4 HHR should have an inbuilt Li-ion Battery of 3.6V DC and not less than 700mAH capacity. It should give at least 8 Hrs backup during working.

5.4.5 HHR should have built in Antenna.

5.4.6 **Hand held Receiver** should not be more than 200 gm in weight.

5.4.7 HHR should be provided with 230V AC external Battery Charger.

5.4.8 Following LED indication shall be provided on **Hand held Receiver.**

SNo.	Description	LED Indication
i.	Up direction train	Blue LED
ii.	Down direction train	Yellow
iii.	Battery status	Battery Low -Red LED Battery charging - Blinking Green LED Battery fully charge-steady Green LED

5.4.9 Receiver hand set should be water resistance should meet following technical parameters.

SN	Receiver Parameter	Specification
i.	Sensitivity	0.25µV / -110dbm at 12 dB SINAD
ii.	Frequency stability	±5 PPM
iii.	Selectivity	Better than 65 dB
iv.	Harmonic and Spurious rejection	Better than 70 dB
v.	Squelch Sensitivity	Better than –119 dbm
vi.	Operating conditions	-5˚C to 55˚C

6.0 CLIMATIC AND ENVIRONMENTAL REQUIREMENT:

6.1 VHF based Approaching Train Warning System shall meet the following climatic and environmental requirements:

SN	TEST		REFERENCE
1	Change of Temp Test		IS 9000 Part XIV Sect. II
	Low temp	-10^{o} C ± 3^{o} C	
	High temp	$+55^{o}$ C ± 2^{o} C	
	Rate of change in temperature	1^{o} C± 0.2^{o}C / min	
	Duration	3 Hrs at each temp. -10^{o} C & $+55^{o}$ C	
	Cycle	1	
	Condition	Fully functional during Test	
2	Dry Heat Test		IEC-571; IS:9000 Part-III Sect 3
	Temp	$+55^{o}$C ±2^{o}C	
	Duration	16 hrs	
	Condition	Fully functional during Test	
3	Cold Test		IS 9000 Part II Sect. III
	Temp	-10^{o} C ± 3^{o} C	
	Duration	2 hours	
	Condition	Fully functional during Test.	
4	Damp Heat Test(Cyclic)		IS 9000 Part V Sect. 2, 12+12 Hours Cycle, Variant 1
	Upper temp	40^{o} C ± 2^{o} C	
	Humidity	95% (+1%, -5%)	
	Cycles	6	
	Condition	Fully functional during one hour period towards end of each cycle. Stabilization shall be done at 25^{o} ± 3^{o} C	
5	Damp Heat Test (Steady State Storage)		IS 9000 Part IV
	Temp	40^{o} ± 2^{o} C	
	Humidity	93% (+2% , -3%)	
	Severity	4 days	
	Condition	Fully functional during Test.	
6	Salt Mist Test Duration48 Hours		IS 9000 Part XI Procedure I

6.2 **Vibration Test** : VHF based Approaching Train Warning System shall be subjected to vibration test as per IS:9000 (Part VIII)

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.
vi.	Magnitude of "g"		: 1

7.0 TESTS AND PERFORMANCE REQUIREMENT

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

7.2 **Type Test :T**he following shall constitute Type Test:

A minimum of two samples of fixed VHF Transmitter along with antenna and four hand held Receiver sets along with necessary license shall be required for type test. Necessary license shall be arranged by the firm and these samples shall not form part of supply.

a) Visual Inspection
b) Applied high voltage test (At fixed **VHF transmitter unit Only)**
c) Insulation resistance test (At fixed **VHF transmitter unit Only)**
d) Functional Test
e) Performance Test
f) Climatic Test
g) Field Trial (Minimum one month in actual field conditions).

7.2.1 **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 2.

7.2.2 **Applied High Voltage Test:** The equipment shall withstand 1KV AC for a period of one minute without any damage, applied between the body and all the current carrying terminals looped together after removing from Electronic Circuits. (At fixed VHF Transmitter unit only).

7.2.3 **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. Electronic circuitry should be bypassed during test. (At fixed VHF Transmitter unit only).

7.2.4 **Functional Test:** It shall be carried out to test the compliance to specification for Functional Requirement as per Clause 3.0.

7.2.5 **Performance Test:** 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.

7.2.6 **Climatic and Environmental Test**: VHF based Approaching Train Warning System shall meet the climatic and environmental requirements mentioned in clause 6.0.

7.2.7 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 7.2.5.

7.2.8 **Field Trial:** On completion of Type Test, Field Trial for minimum one month period shall be conducted by installing complete equipment in actual field conditions on a selected section to judge the performance of the system for which necessary license will be arranged by firm.

7.3 ACCEPTANCE TEST:

7.3.1 The following shall constitute the acceptance test on VHF based Approaching Train Warning System and shall be carried out on complete offered lot.

a) Visual Inspection
b) Applied high voltage test
c) Insulation resistance test
d) Functional test
e) Performance test

7.3.2 Any other tests as required necessary by the inspecting authority to ensure conformity with the requirement of the specification for equipment shall also be carried out.

7.4 ROUTINE TEST

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

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

8.0 GUIDLIENCES FOR MANUFACTURE:

8.1 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.

8.2 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.

8.3 The manufacturer shall have suitable inspection facilities and testing equipment at their works.

8.4 The manufacturer shall arrange training to Rly. Staff free of cost on uses & maintenance.

9.0 MANUFACTURER'S IDENTIFICATION

9.1 following information shall be printed on Sticker /engraved on VHF Transmitter and HHR equipment:

a) Manufacturer's Name
b) Year of manufacture and serial number.
c) RDSO Specification No.
d) Indian Railways.

10.0 PACKING :

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) Address of consignee.

11.0 INFORMATION/ DOCUMENTS TO BE FURNISHED BY THE MANUFACTURER

11.1 Manufacturer shall prepare and submit following Document during the Type Test for approval of RDSO/Lucknow.

a) Operating Instruction Manual
b) Approved QAP
c) Preventive Maintenance Manual with Maintenance Schedule
d) Technical Instruction Manual giving details of circuit and connection diagrams, values of rating of all components, PCBs wiring etc.

11.2 Manufacturer shall ensure necessary spares for a period of 5(five) years for proper working of the equipment.

11.3 Unless otherwise agreed between purchaser and manufacturer, the equipment shall have warranty for a period of one year after installation or two years from the date of supply, whichever is earlier.

11.4 All the components used in the equipment shall be of industrial grade from reputed manufacturer.

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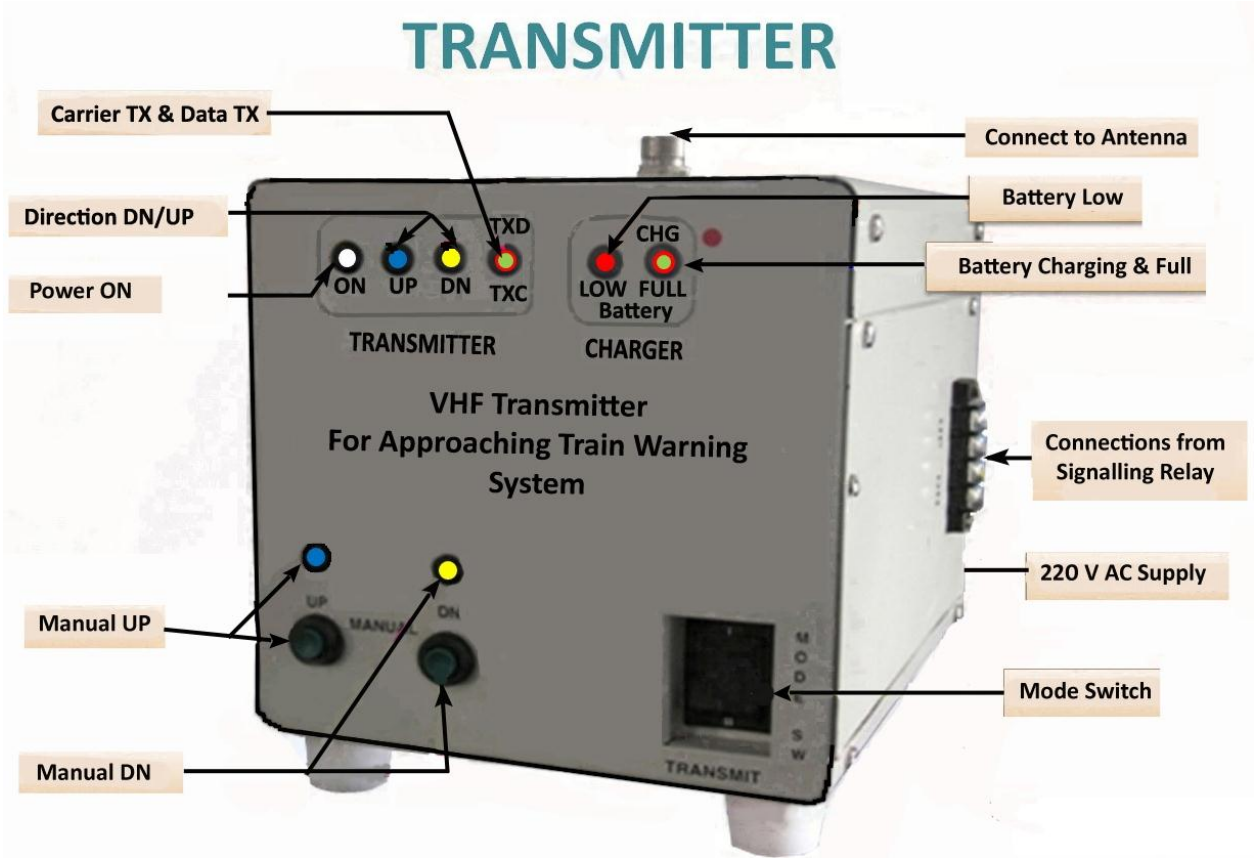
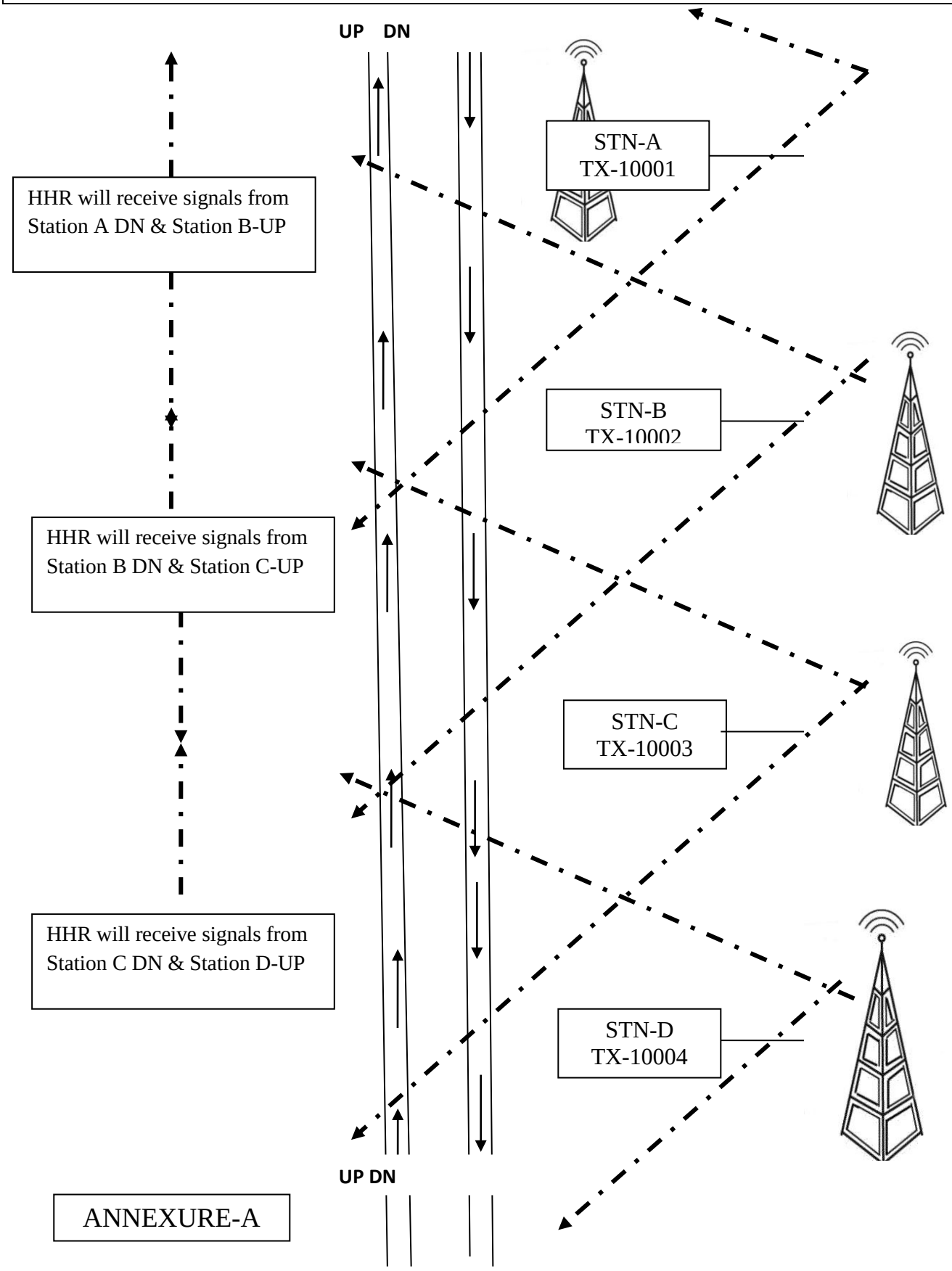


Figure-1

HAND HELD RECEIVER(typical view)

Figure-2


UP DN
STN-A
TX-10001
HHR will receive signals from
Station A DN & Station B-UP
STN-B
TX-10002
HHR will receive signals from
Station B DN & Station C-UP
STN-C
TX-10003
HHR will receive signals from
Station C DN & Station D-UP
STN-D
TX-10004
UP DN

ANNEXURE-A