

CHAPTER XI

RADIO COMMUNICATION (Analog/Digital VHF)

11.1 RADIO COMMUNICATION

11.1.1 “Communication by Radio” means the transfer of intelligence from one point to another through space using radiated electromagnetic energy (Radio Waves) (in the FREQ spectrum of from about 10KHz to about 30,000 KHz.)

Radio Frequency Spectrum

Class	Freq. Range	Wave length
VLF	10-30 kHz	30,000-10,000 m
LF	30-300 kHz	10,000 - 1,000 m
MF	300-3000 kHz	1,000-100m
HF	3-30 MHz	100-10m
VHF	30-300 MHz	10-1m
UHF	300-3000MHz	100-10cm
MW	3 to 30 GHZ	10-1 cm

11.1.2 The objective of any communication is to pass information from one place to another. Radio Communication consists of generation, propagation and reception of electromagnetic waves. Modes used in Indian Railways are-

- VHF Communication
- UHF Communication
- M/W Communication

11.1.3 VERY HIGH FREQUENCY (VHF) COMMUNICATION

The frequency band of VHF Communication is 30 MHz to 300 MHz. The frequency allotted by WPC (Wireless Planning and Coordination wing of ministry of communication) in VHF for Indian Railways are in the band 146.2 MHz to 167.95 MHz. Communication in this range of frequencies is mainly due to line of sight, reflection and scattering of waves.

11.1.4 Uses of VHF

VHF Communication is used (now a days) for many applications such as:-

- Traffic Control
- Police Duties.
- Mobile Communication
- Point to Point Communication
- Point to MultiPoint (Group) Communication

- Disaster Management

Possible uses of VHF Communication on IR are

- Communication during Maintenance and Construction Blocks
- Yard communication
- Communication in the train between Guard & Driver.
- Mobile Communication in between moving train/vehicle with fixed location (Station) or another moving train/ vehicle.
- Emergency Communication:
 - ART equipped with hand held and base station VHF sets.
- Duplex VHF Sets are utilised for
 - Extension of exchange number to distant place.
 - Control working.(Train Traffic Control)/Patching.

11.2 SPECIFICATION & PERFORMANCE PARAMETERS

11.2.1 VHF PARAMETERS

1. Frequency Range
 - 30 MHz to 300 MHz
 - Frequency Band used in Railways is 146.2 MHz to 167.95 MHz.
 - One spot frequency is used for each channel
2. Mode of Propagation:
 - Line of sight waves
 - Reflection & scattering of waves
3. Type of operation: Simplex
Duplex
4. Channel capacity:- 1/16/128/256 channel
 - Voice or Low speed Data or both.
5. Type of Equipment:
 - i) Walkie-Talkie (Hand Held) Set-
1W/2W to 5W switchable output power operated on in-built NiMH / Li-ion batteries. (For communication in the train in between Guard & Driver , in between moving train/vehicle with fixed location (Station) or another moving train/ vehicle, 5W sets are to be used)
 - ii) Portable 25W VHF Sets –
Portable 25W VHF Sets are normally used in Loco and vehicles operated on 12V battery set.
 - iii) Fixed 25W VHF sets (Base Stations) – Installed at desired locations , mainly at ASM rooms.
 - Operating on AC Mains or by 12V battery.

- External antenna with feeder cable connector mounted on a mast by itself or on Roof top as needed.

6. Antennas used

- Whip Antenna
- Ground Plane (GP) Antenna
- Dipole
- Low Profile
- Yagi Antenna

7. Feeder cable:

- 50 Ohms Unbalanced Coaxial cable

8. Expected Communication Range in open area:

- Walkie -Talkie to Walkie - Talkie - 1 to 2 Km.
- Portable Set can transmit - 12 Km to 15 Km.
- Fixed 25W VHF Set to Fixed 25W VHF Set - upto 25 Kms when antenna used are directional & fixed at the height of 15 to 20 metres.

The range may get reduced due to the number of parameters like terrain, ghat section, tunnels and obstructions etc.

9. License:

- Mandatory

As per the latest guidelines WPC license is required to be taken for each VHF set.

10. Frequencies allotment:

Following frequencies has been decided by the Railway Board for different use.

Standardisation of VHF- Frequencies on Indian Railway

Chl#	Frequency in MHz	SM at All Stations	Station to LC Gate	Driver & Guard	Shunting/Operating	Engineering Deptt.	Electrical Deptt.	S&T Deptt.	Commercial Deptt.	RPF	Mechanical Deptt.	To be Used for	
1	146.400									X		Security department	
2	147.975	ART Frequency										Accident site communication	
3	148.100										X	Mechanical Department	
4	149.750					X						Engg. Department	
5	150.100	XC										F1 for PLC, 1st Section of Straight sec.	
6	150.150	XC										F2 for PLC, 2nd Section of Straight sec.	
7	159.600	XC										F3 for PLC, 3rd Section of Straight sec.	
8	159.650							X				S&T department	
9	159.700		XC									Communication with LC Gate	
10	160.400	X			X	X	X	X	X	X	X	Common Frequency	
11	160.550								XE	XE		Train Escorting purpose	
12	161.150	X		X								Driver & Guard Communication	
13	161.425						X					Electrical Department	
14	162.100	X			X							Shunting & Yard Communication	
15	146.200	XC										F4 for PLC, 1st Section	For Junction Station (Direction 1)
16	148.050	XC										F5 for PLC, 2nd Section	
17	149.800	XC										F6 for PLC, 3rd Section	
18	149.850	XC										F7 for PLC, 1st Section	For Junction Station (Direction 2)
19	151.400	XC										F8 for PLC, 2nd Section	
20	151.450	XC										F9 for PLC, 3rd Section	
	160.450	VHF based Approaching Train Warning System for Track Maintainers											

Note:

- X Channel Programmed
 - XC Channel Programmed with CTSS/MF Coding.
 - XE For Train Escorting only
 - # Frequencies allocated against channels can be interchanged if railways are using some other frequencies except Driver Guard.
- Use of un-allocated frequency is prohibited.

11.2.2 LIMITATIONS OF VHF COMMUNICATION

- Range limited to 20 Km to 30 Km maximum due to requirement of line of sight.
- Dark Zones occur due to terrain, high rise buildings & other structures.
- VHF sets consume more power, hence the set may require more than one battery set for long duration usage.
- Interference due to other users operating at the same frequency.
- Effect of prevailing noise in the surrounding.

11.2.3 Digital radio VHF sets

Digital Mobile Radio (DMR) is an open standard which is not proprietary to any single manufacturer. The DMR standard specifies that DMR equipment must be compatible, so a radio will work on any base station or network, which improves availability of options and pricing. These are having several advantages in terms of Voice Quality, Coverage, Battery Life, Channel Capacity and Data Capabilities etc. In view of these additional features/advantages, Digital Walkie-Talkie sets should be preferred over Analog sets and Analog sets to be phased out gradually. Use of Licence exempted Digital VHF set allowed by WPC may be considered for maintenance purpose (non- crew usage).

11.3 INSTALLATION OF VHF

- For point-to-point communication availability of line of sight is essential.
- Antenna height must be decided at both locations by measuring minimum field strength needed for satisfactory communication. This can be measured by putting one trans-receiver at one end and mounting antenna at a suitable height of 15m to 20 m and measuring the field strength by field strength meter at receiving locations. VHF sets of the same power and frequency can also be installed to check the quality of communication. Antenna height and orientation can be adjusted to get a maximum signal strength or voice.
- Antenna can be mounted on a tower/Mast of approved design or on a pipe on the roof of a building. Feeder cable must be of 50 Ohm. impedance unbalanced of approved design. Antenna and its feeder cable must be earthed as per earthing arrangement defined in chapter XXIII.
- Connectors used must also be of good quality and supplied by an approved supplier.
- Power Supply System with provision of monitoring it through data logger/NMS
- 230V AC mains operated power supply of rated voltage & current is supplied by the supplier along with VHF set. A 12V/80-120 AH battery must be connected on float to the set to prevent communication failure during mains failure.

11.4 VHF Walkie/Talkie Sets

- 11.4.1 VHF Walkie/Talkie sets are used in several departments of the Railways. PCSTE with approval of GM and Sr. DSTE with approval of DRM shall distribute these sets among various departments and units under their jurisdiction in view of safety, train operation, security and maintenance.
- 11.4.2 Procurement of VHF sets and their condemnation shall be done by the S&T department.as per RDSO procedures and Railway Board guidelines.

11.4.3 The S&T department of the divisions shall be responsible for obtaining frequency authorization and obtaining license from Wireless Planning Commission. It shall also be responsible for payment of spectrum charges and license renewal of the entire population of the VHF sets being used in the division.

11.4.5 Procurement procedure for VHF Walkie/Talkie sets

- a. Branch officers in the divisions and the controlling officers in other units of the user department shall submit the requirements of VHF sets with detailed justification to the concerned Sr. DSTE/DSTE in-charge.
- b. Once the quantity assessment based on the availability and demand, specification and description are finalized, nominated SSE/Tele of the division shall prepare non-stock (NS) requisition(s) according to the approved description and specification.
- c. Sr. DSTE/DSTE in-charge of the division shall process the requirement given by the user department to obtain finance vetting and sanction of competent authority. Funds for the procurement, initial license fee and its subsequent annual renewals of licence shall be provided by the respective user department.
- d. The vetted and sanctioned NS indent shall be sent to the stores department for procurement.
- e. Nominated consignee of VHF sets shall receive all the VHF sets and enter them in the stores ledgers for proper accountal.
- f. S&T supervisor shall then issue the VHF sets to the concerned department for use. A copy of the license shall also be provided to the user department.
- g. Every user department in the division/units shall nominate a nodal supervisor for transaction of these VHF sets.
- h. Since codal life of battery of VHF Walkie-Talkie set is less than the codal life of VHF set, it may need to be procured multiple time in due interval during the working life of VHF sets

11.4.6 Maintenance of VHF sets

- a. Maintenance of the VHF sets for the entire population of the division is the responsibility of the S&T department.
- b. Nodal supervisors of the user department shall inform or handover defective sets to the concerned SSE/Tele.
- c. SSE/Tele concerned shall then arrange for repair/replacement of these sets for minor defects departmently and for major defects through authorised agencies/OEM.
- d. The unserviceable handsets should be expeditiously condemned and payment of license fee for those sets to be stopped.
- e. VHF set's transmitting power at different frequencies/channels are to be measured once in a year.
- f. Spurious emission squelch operation current drain frequency stability, frequency deviation, sensitivity of receiver & adjacent channel selectivity are to be checked once in a year in the centralised repair centre or during repair through authorised agencies/OEM.
- g. List of Standard Testing Tools for VHF sets in the centralised repair centre include Digital Multimeter, Communication radio test set , Dummy Load,

Variable power supply, 0-30V, 0-30 A, Battery analyzer, Digital load for battery test , Channel programming kit etc.

11.5 INSPECTION

Fixed VHF installation must be inspected every month by JE, by SSE once in six months and by ASTE/DSTE once in a year.

11.6 FAILURE REPORT

- VHF system's failure must be reported to the controlling officer daily in the morning.
- Monthly statements of a failure must be reported in the PCDO to Headquarter.
- Spare sets must be kept at site or at a suitable location to replace the faulty sets.