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PROVISIONAL
TEST SCHEDULE AND TEST PROCEDURE
FOR
DOWNLINK INTERFACILITY FEEDER CABLE
FOR C, Ext C & Ku BAND
(No.TEC/TSTP/GR/TX/SFC-001/03.FEB 2009)

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1.0 Scope:

The objective of the test schedule is to carry out design and performance evaluation of the downlink Interfacility feeder cable for C, ext C & Ku band operating with all types of earth stations. Test schedule for inspection and testing and field acceptance will be largely based on this document. The design evaluation would consist of examining (a) the individual unit/module specification and test results recorded by factory for their adequacy (b) the maintenance philosophy built in the equipment construction practice (i.e. equipment layout, unit/ module layout, facilities provided and their locations etc) (c) examination of the types of components/modules (local/foreign) used from the point of view of the quality assurance. These aspects would be checked by subjecting the Combiner/Divider for Intermediate Frequency for ambient and climatic test. The design evaluation may be carried out separately or along with the performance evaluation.

2.0 Test Equipment Required:

The instruments listed below or their equivalent is used in normal test setups.

No.	Name of Instrument
1.	Frequency Counter
2.	Power Meter
3.	Sensor
4.	Synthesizer
5.	Spectrum Analyser
6.	Scalar Network Analyser (SNA)
7.	Precision Attenuator (75 ohm & 50 ohm)
8.	X-Y Plotter
9.	50 ohm load.

3.0 Figure:

BLOCK DIAGRAM FOR VSWR/RETURN LOSS MESUREMENTS

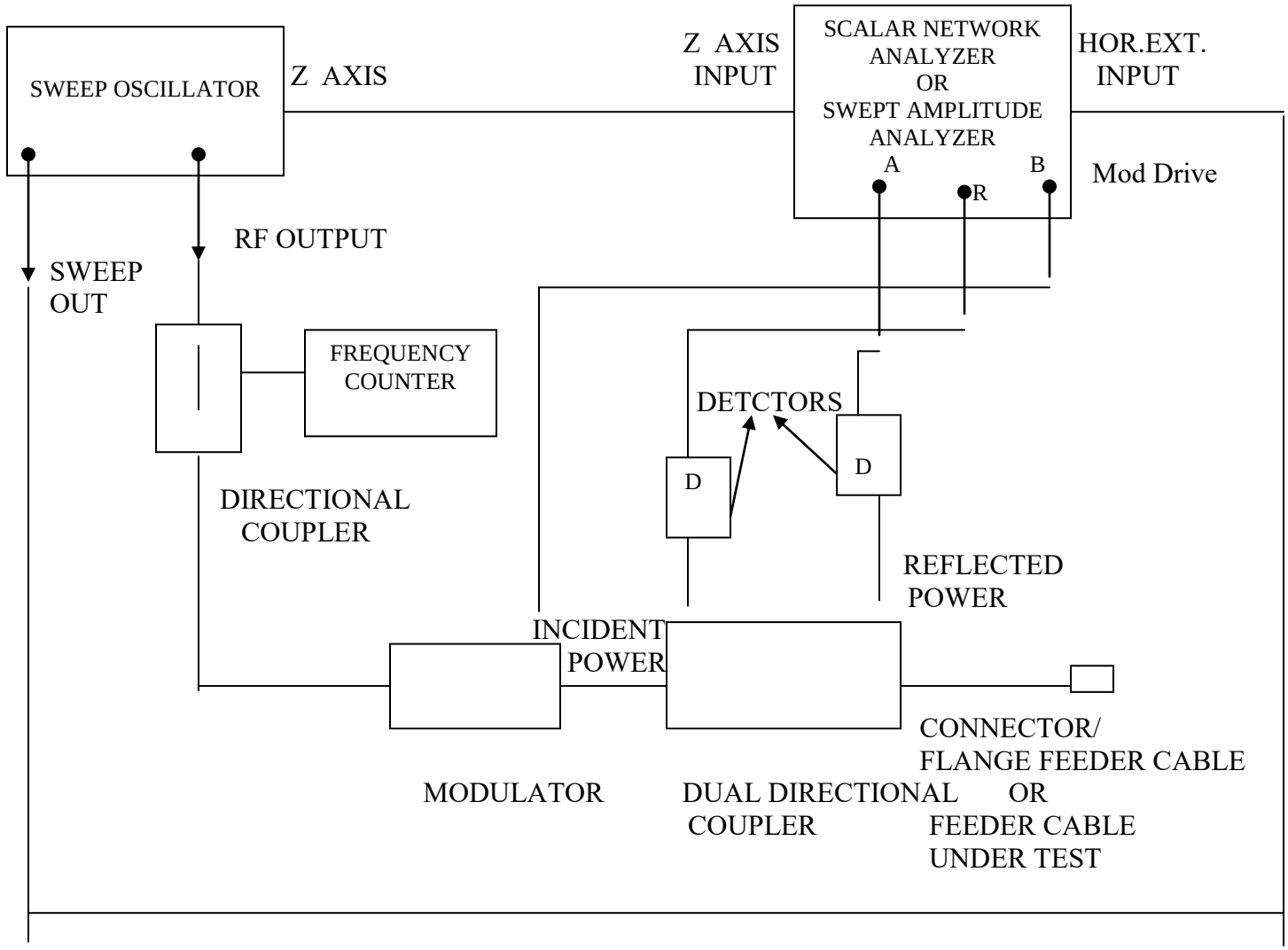

FIG.1

ATTENUATION MEASUREMENTS
OF FEEDER CABLE/WAVEGUIDE

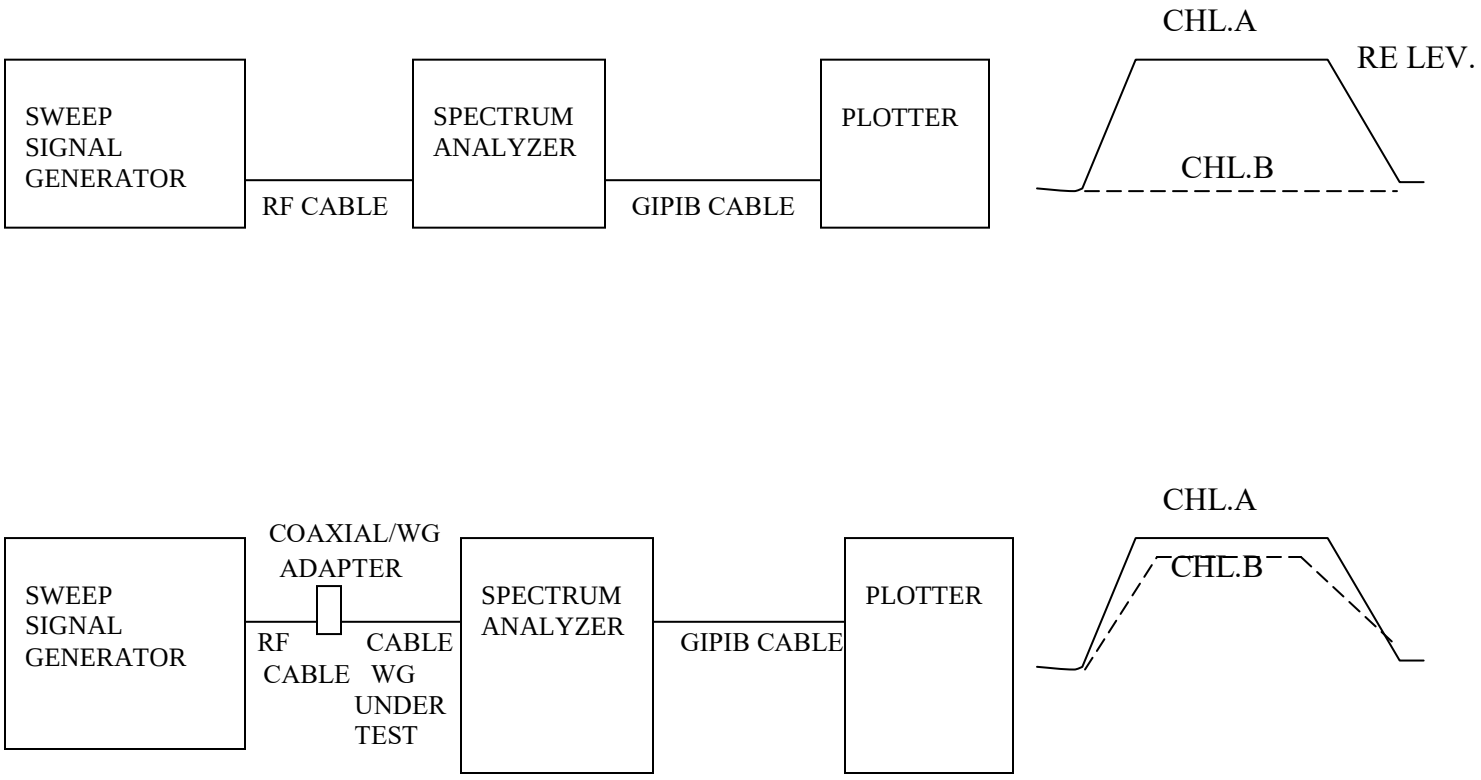

FIG.2

4.0 Test Procedures for measuring various parameters:

Clause No.	Clause	
1.0	This document contains generic requirements for Downlink Interfacility Feeder Cable for 'C', Ext 'C' band having1/2" and 'Ku' band having 3/8" diameter to be used in conjunction with Low Noise Amplifier subsystem at one end, and power divider at other end. It shall consist of flexible coaxial cable with rugged polyethylene jacket. The cable shall be provided in lengths to be indicated by customer. The cable would be supplied either pre-connectorised, or the connectorisation of the cable would be done by the customer on site, which shall be possible with standard hand-tools.	To be verified for the functions mentioned in this GR.
2.0	**Functional and Technical Requirements**	
2.1	**MATERIAL**	
2.1.1	Inner conductor: Copper*	Obtain a certificate from manufacturer of certified lab
2.1.2	Outer conductor: Copper* *Copper used shall conform to BIS standard IS-1897 (1983) "Specification for copper strip for electrical purposes" (second revision)	Obtain a certificate from manufacturer of certified lab
2.1.3	Dielectric: Foamed Polyethylene	Obtain a certificate from manufacturer of certified lab
2.1.4	Jacket: Polyethylene jacket with any light colour, and UV stabilized to protect it from degradation in sunlight.	Obtain a certificate from manufacturer of certified lab

2.2	**CHARACTERISTICS**	
2.2.1	Nominal diameter: 1/2" for C**,** Ext C-band & 3/8" for Ku-band	**Visual, Mechanical and Dimensional Tests:** The cable shall be examined to verify that the design, construction, physical characteristics and workmanship are in accordance with the application requirements. **Diameter Measurements:** The diameter measurement of inner and outer conductors and jacket shall be made with a micrometer caliper or any other instrument of equal accuracy. The inner conductor should be made accessible by stripping and removing the outer components. Measurement should be made on a sample unit. Four points of measurements may be taken. At each point, measurement may be made in two mutually perpendicular planes. They should meet the values mentioned in the detailed specifications of the manufacturer.
2.2.2	Frequency : 3.700 GHz to 4.200 GHz for C-band : 4.500GHz to 4.800 GHz for Ext. C-band : 10.700 GHz to 12.750 GHz for Ku-band	To be noted with frequency counter& The attenuation and return loss is to be checked over the concerned band
2.2.3	Nominal characteristic impedance : 50 Ohms	Obtain a certificate from manufacturer of certified lab
2.2.4	Return loss with connectors at both ends of the cable.: 23 db minimum for C, Ext C- band and 16 db minimum Ku-band	**Return Loss Measurement:** Return loss measurement of the cable may be made on the complete cable with suitable connectors at both ends. Set up may be arranged as in Fig 1. (a) Adjust the sweep signal generator to sweep over the desired band of frequencies with the frequency counter. Sweep should be 'off' when checking the end frequencies. Disconnect the frequency counter. Set the analyzer scale calibration at 5 or 10 dB per division. (b) Calibrate the set up by putting a short at the test port of the directional coupler. The trace of the analyzer should be positioned at a convenient place. This trace will be for 0 dB return loss i.e. 100% reflection. c) Remove the short and connect the feeder cable at the test port with the distant end terminated with the connector. The trace will move down. (d) For return loss at frequency, read the number of divisions the trace has moved down. Number of divisions* 5/10 will give the return loss at that point. (e) Return loss may be plotted over the prescribed frequency band. (f) Worst value of the return loss may be entered in the data

		sheet. **Note: -** If the manufacturer is having other instruments, suitable set up may be made and return loss may be measured accordingly.
2.2.5	Minimum bending radius: 125 mm for C & Ext C-Band: 100 mm for Ku-Band	**Minimum Bending Radius:-** Two Specimens each of suitable length shall be cut from the sample unit. The middle section of the specimen shall be formed for two complete turns around a mandrel of the specified diameter (minimum bending radius). Remove the coiled specimen from mandrel and examine the outer surface for cracks, splits, fractures and wrinkles. There shall be no cracks, splits, fracturing and wrinkling or other damage in the solid conductor material.
2.2.6	Minimum tolerable tensile force : 1200 Newton	Obtain a certificate from manufacturer of certified lab
2.2.7	Maximum attenuation over the whole band: 0.158 dB/m for C &Ext C-Band : 0.52 dB/m for Ku-Band at 25°C** ** Variation of ± 0.2% per °C may be taken for temperature other than 25°C.	**Attenuation Measurements:** Attenuation measurements are made on the complete cable with connectors at both ends. Set up may be arranged as shown in fig 2. (i) Connect the signal generator with Auto/manual sweep to the spectrum analyzer by the standard RF cable. Adjust the sweep signal generator to sweep over the prescribed frequency band. Set the spectrum analyzer to read the full frequency and keep it on max hold position. If the dual channel SA is available, read the sweep on channel A and store it when the clear reading is obtained. (ii) Nominal values for connector losses and meter inaccuracy may be taken into consideration while taking attenuation measurement. (iii) Repeat the step (i) with the RF cable replaced by RF cable + wave guide under test using the suitable adopter as shown in Fig 2. Store this trace in channel B. (iv) Take a plot of the above traces on the plotter connected with the spectrum analyzer. (vi) Insertion Loss or attenuation of the waveguide or cable at any frequency can be found out by taking the difference between two traces in dB at any particular frequency. Attenuation in dB/100m may be calculated as follows: Attenuation in dB/100m = Measured dB* 100/Length of the waveguide in meter (v) Worst value may be entered in the data sheet.
2.2.8	End connectors: N Male	Physical check

2.2.9	Clamps spacing at normal, Critical areas and bends: 0.5 m (5% extra clamps for critical areas to be included)	To be checked and noted
2.2.10	Outer dimensions: To be furnished by the supplier	**Test Procedure:** **Dimensions Measurements:** The E & H diameter measurements of waveguide over the jacket as specified by the manufacturer shall be made with a micrometer caliper or any other instrument of equal accuracy. Measurement should be made on a 330 mm length of Feeder Cable taken from the end of a sample unit. Four points of measurements may be taken. It should meet the values mentioned in the detailed specifications of the manufacturer.
2.2.11	Weight: To be furnished by the supplier	**Test Procedure:** **Weight:** A section of the Feeder Cable shall be weighed on a scale that has 0.1% accuracy. The weight of the Feeder Cable should be as specified by the manufacturer.
3.0	**QUALITY REQUIREMENTS**	
	The Feeder Cable shall be manufactured in accordance with International quality management system ISO 9001:2000 for which the manufacturer should be duly accredited. A quality plan describing the quality assurance system followed by the manufacturer would be required to be submitted. And The equipment shall meet the latest operator's quality manual on i) Quality and reliability in product design. ii) Guidelines for standard of workmanship for printed boards. iii) Guidelines for standard of workmanship for printed board assemblies. iv) Guidelines for standard of workmanship for surface mounted devices. v)Transmission equipment	Obtain a certificate from manufacturer

	general documentation. The supplier shall furnish a certification from the manufacturer to this effect, which shall be verified at the time of technical specifications evaluation.	
4.0	**SAFETY REQUIREMENTS**	
4.1	**TEMPERATURE & HUMIDITY**	
4.1.1	The feeder cable systems are for installation and operation under fully exposed weather conditions. The temperatures may range from subzero to extremely hot. The feeder cable system shall be capable of working without relative humidity range from near dry to 95% condensing at 40°C. Optional compliance for temperature lower than -20°C shall be called for specific sites, on need basis.	**Environmental tests** i) Temperature range ii) Corrosion Testing may be done as per latest operator's manual for temperature range and corrosion test for the following parameters: i) Maximum attenuation per meter over the whole band ii) Return loss In case, it is not possible to conduct the tests beyond the temperature range specified in the latest operator's manual, a certificate may be obtained from the manufacturer that there will be no degradation in the performance in this temperature range also. If it is not possible to conduct corrosion test, test report from an accredited laboratory may be obtained from the manufacturer mentioning that the equipment has been tested for salt-mist test and the equipment shall work without any degradation in performance in coastal areas also.
4.2	**CORROSION**	
4.2.1	The feeder cable system shall be capable of withstanding the effects of rains, snowfall, industrial pollution, salinity of atmosphere in coastal areas, etc.	**Environmental tests** i) Temperature range ii) Corrosion **Test procedure:** Testing may be done as per latest operator manual for temperature range and corrosion test for the following parameters: i) Maximum attenuation per meter over the whole band ii) Return loss In case, it is not possible to conduct the tests beyond the temperature range specified in the latest operator's manual, a certificate may be obtained from the manufacturer that there will be no degradation in the performance in this temperature range also. If it is not possible to conduct corrosion test, test report from an accredited laboratory may be obtained from the manufacturer mentioning that the equipment has been tested for salt-mist test and the equipment shall work without any degradation in performance in coastal areas also.

4.3	**ENGINEERING REQUIREMENTS**	
4.3.1	The joints in the Feeder Cable assembly shall have protection as per BIS standard IS 12063 {1987} "Classification of degree of protection provided by enclosures of the electrical equipment" {equivalent to IEC-529} to meet at least the protection level of IP-65	Obtain a certificate from manufacturer of certified lab
4.3.2	The Feeder Cable system shall adopt state-of-the-art technology	Obtain a certificate from manufacturer
4.3.3	All connectors shall be reliable and of standard type to ensure for over 500 failure-free mating operations under the environmental conditions specified	Obtain a certificate from manufacturer of certified lab
4.3.4	The mechanical design and construction of each/units shall be inherently robust and rigid under all conditions of operations, adjustment, replacement, storage and transport and conforming to the latest operator's quality manual on "Specification for environmental testing of electronic equipments for transmission and switching use".	Obtain a certificate from manufacturer of certified lab
5.0	**DESIRABLE REQUIREMENTS**	
5.0.1	The manufacturer shall guarantee the satisfactory performance of the equipment without any degradation in performance up to at an altitude of 3,000 meters.	Obtain a certificate from manufacturer
5.0.2	The equipment shall be able to work without any degradation in performance	To be checked during environmental testing and also obtain certificate from manufacturer

	in saline atmosphere near coastal areas and should be protected against corrosion.	
5.0.3	The equipment shall conform to the requirements for the latest operator's quality manual for Specification for environmental testing of electronic equipments for transmission and switching use-for operation, transportation and storage, including vibration and corrosion (salt mist).	**Environmental tests** i) Temperature range ii) Corrosion Testing may be done as per latest operators manual for temperature range and corrosion test for the following parameters: i) Maximum attenuation per meter over the whole band ii) Return loss In case, it is not possible to conduct the tests beyond the temperature range specified in the latest operator's manual, a certificate may be obtained from the manufacturer that there will be no degradation in the performance in this temperature range also. If it is not possible to conduct corrosion test, test report from an accredited laboratory may be obtained from the manufacturer mentioning that the equipment has been tested for salt-mist test and the equipment shall work without any degradation in performance in coastal areas also.
5.1	**DOCUMENTATION**	
5.1.1	Technical literature in English or Hindi with complete layout, detailed block schematic and circuit diagram of various assemblies with test voltages/waveforms at different test points of the units shall be provided. All aspects of installation, operation, maintenance and repair shall be covered in the manuals. The soft copy as well as hard copy of the manuals shall also be provided. The manuals shall include the following manuals.	To be checked
5.2	**INSTALLATION, OPERATION AND MAINTENANCE MANUAL** a) Safety measures to be	To be checked

	observed in handling the equipment; b) Precautions for installation, operation and maintenance; c) Test jigs and fixtures required, and procedures for routine maintenance preventive maintenance, trouble shooting and subassembly replacement; d) Illustration of internal and external mechanical parts	
5.3	**REPAIR MANUAL** A)List of replaceable parts used, including their sources and the approving authority; B)Detailed ordering information for all the replaceable parts shall be listed in the manual to facilitate reordering of spares as and when required; c) Procedure with flowchart for troubleshooting and subassembly replacement shall be provided. Test fixtures and accessories required for repair shall also be indicated. Systematic troubleshooting charts (fault-tree) shall be given for the probable faults with their remedial actions	To be checked
5.4	**ACCESSORIES**	
5.4.1	COMPULSORY ACCESSORIES Wall gland Hoisting stocking Clamps Flexible cables of 1 meters lengths each (23 dB return loss), along with	To be checked

	prefabricated connectors at both ends For connecting power divider- N-female connector at one end, and SMA-male connector at the other end; For connecting LNA-N-female connector at one end and N-male connector at the other end.	
5.4.2	**OPTIONAL ACCESSORIES** a. Earthing kit b. Cutting tool c. Flanging tool d. Bending tool kit e. Aluminimum foil f. Sealing compound	To be checked
5.5	**MARKING**	
5.5.1	Feeder Cable shall be marked with the following information every 5/10 meters a)Name of manufacturer b)Year of manufacturing c) Frequency of operation	To be checked
6.0	**FIELD TRIAL:** Four week minimum	Field trial should be conducted at the "actual locations", on successful completion of both lab tests and environmental tests. The field trial shall be for a minimum period of one month from the date of commissioning of the amplifier at site. The following tests are to be conducted during field trial. 1. Frequency of operation 2. Attenuation characteristics 3. Return loss

5.0 Observation/Records:

Clause No.	Specification	Parameters	Measured Values/ observations	Compliance Specifications	Remarks
1.0	This document contains generic requirements of Downlink Interfacility Feeder Cable for 'C', Ext 'C' band having1/2" and 'Ku' band having 3/8" diameter to be used in conjunction with Low Noise Amplifier subsystem at one end, and power divider at other end. It shall consist of flexible coaxial cable with rugged polyethylene jacket. The cable shall be provided in lengths to be indicated by customer. The cable would be supplied either pre-connectorised, or the connectorisation of the cable would be done by the customer on site, which shall be possible with standard hand-tools.	To be verified for the function mentioned in the GR			
2.0	**Functional and Technical Requirements**				
2.1	**MATERIAL**				
2.2	**CHARACTERISTICS**				
2.2.1	Nominal diameter	1/2" for C**,** Ext C-band 3/8"& for Ku-band			
2.2.2	Frequency	3.700 GHz to 4.200 GHz for C-band 6.725 GHz to 7.025 GHz for Ext. C-band 10.700 GHz to 12.750 GHz for Ku-band			
2.2.4	Return loss with connectors	23 db minimum for C, Ext C- band and 16 db minimum Ku-band, at both ends of the cable.			
2.2.5	Minimum bending radius	125 mm for C & Ext C-Band: 100 mm for Ku-Band			
2.2.7	Maximum attenuation over	0.158 dB/m for C &Ext C-Band			

		0.52 dB/m for Ku-Band the whole band at 25°C** ** Variation of ± 0.2% per °C may be taken for temperature other than 25°C.			
2.2.8	End connectors	N Male			
2.2.9	Clamps spacing at normal, Critical areas and bends	0.5 m (5% extra clamps for critical areas to be included)			
2.2.10	Outer dimensions	To be furnished by the supplier			
2.2.11	Weight	: To be furnished by the supplier			
4.0	**SAFETY REQUIREMENTS**				
4.1	**TEMPERATURE & HUMIDITY**				
4.1.1	The feeder cable systems are for installation and operation under fully exposed weather conditions. The temperatures may range from subzero to extremely hot. The feeder cable system shall be capable of working without relative humidity range from near dry to 95% condensing at 40°C. Optional compliance for temperature lower than -20°C shall be called for specific sites, on need basis.	To be checked as per Environmental test			
4.2	**CORROSION**				
4.2.1	The feeder cable system shall be capable of withstanding the effects or rains, snowfall, industrial pollution, salinity of atmosphere in coastal areas, etc.	To be checked as per Environmental test			
5.0.3	The equipment shall conform to the requirements for the latest operator's quality manual for Specification for environmental testing of electronic equipments for transmission and switching use-for operation, transportation and storage,	To be checked as per Environmental test			

	including vibration and corrosion (salt mist).				
5.1	**DOCUMENTATION**				
5.1.1	Technical literature in English or Hindi with complete layout, detailed block schematic and circuit diagram of various assemblies with test voltages/waveforms at different test points of the units shall be provided. All aspects of installation, operation, maintenance and repair shall be covered in the manuals. The soft copy as well as hard copy of the manuals shall also be provided. The manuals shall include the following manuals.	To be checked			
5.2	**INSTALLATION, OPERATION AND MAINTENANCE MANUAL**	a) Safety measures to be observed in handling the equipment; b) Precautions for installation, operation and maintenance; c) Test jigs and fixtures required, and procedures for routine maintenance preventive maintenance, trouble shooting and subassembly replacement; d) Illustration of internal and external mechanical parts			
5.3	**REPAIR MANUAL**	a)List of replaceable parts used, including their sources and the approving authority; b) Detailed ordering information for all the replaceable parts shall be listed in the manual to facilitate reordering of spares as and when required; c) Procedure with			

		flowchart for troubleshooting and subassembly replacement shall be provided. Test fixtures and accessories required for repair shall also be indicated. Systematic troubleshooting charts (fault-tree) shall be given for the probable faults with their remedial actions			
5.4	**ACCESSORIES**				
5.4.1	**COMPULSORY ACCESSORIES**	Wall gland Hoisting stocking Clamps Flexible cables of 1 meters lengths each (23 dB return loss), along with Prefabricated connectors at both ends for connecting power divider- N-female connector at one end, and SMA-male connector at the other end; for connecting LNA-N-female connector at one end and N-male connector at the other end.			
5.4.2	**OPTIONAL ACCESSORIES**	a. Earthing kit b. Cutting tool c. Flanging tool d. Bending tool kit e. Aluminimum foil f. Sealing compound			
5.5	**MARKING**				
5.5.1	Feeder Cable shall be marked with the following information every 5/10 meters	a)Name of manufacturer b)Year of manufacturing c)Frequency of operation			
6.0	**FIELD TRIAL**	Four week minimum			

6.0 Certificate/ Lab Test Report, if any:

7.0 Conclusion: