Technical Specification Conceptual Drawing of

X-Band Dual Polarization Doppler Weather Surveillance Radar

Technical Specifications

Specifications of Solid-State X-Band Dual Polarization Doppler Weather Radar

Radome	Quantity	: 1 set
	Type	: Sandwich panel (spherical surface)
	Dimension	:Determined to accommodate the specific antenna dimensions and maintenance requirements, with adequate clearance for antenna rotation and service access
	Surface	: White color, gel coat finish suitable for all weathers (high solar reflectance for thermal management)
	Survival wind speed/ hailstorm	: 60m/sec. or more
	Transmission loss	: 0.3dB or less on one way path in dry
	Relative humidity	: 0% - 100%
	Lightning protection	: Lightning rods
	Obstruction light	: LED (red color), automatic switch control (on/off), waterproof Steel base ring including necessary installation materials
Antenna	Quantity	: 1 set
	Type	: Parabolic antenna
	Reflector size	: As per the design requirements
	Beam width	: 1 degrees or less at -3dB point without Radome
	Antenna gain	: 42 dB or more without Radome (for 1.3° beamwidth) OR 45 dB or more without Radome (for 1° beamwidth)
	Polarization	: Simultaneous dual polarization (horizontal and vertical)
	1st Side lobe level	: -25dB or less without Radome
	Angular positioning accuracy	: 0.05° degrees or less
	Pedestal structure	: Pedestal including the motor and rotary joint for azimuth and elevation
	Driving range	: Azimuth 360 degrees, elevation -2 degrees – +90 degrees
	Rotation speed	
	Azimuth	: 0 to 6rpm or higher, selectable

	Elevation : 0 to 2 rpm or higher, selectable VSWR : 1.5 or less without Radome Dehydrator : Yes BITE :YeS
Transmitter	Quantity : 1 set
	Transmitter type : Solid-state power amplifier Polarization : Simultaneous Dual Polarization Transmitting frequency : Selectable between 9,300 MHz and 9,500 MHz (± 2.5 MHz) Observation Range : 130 km or more Occupied frequency bandwidth : 10 MHz or less Transmitting power : At least 500W per channel (each for horizontal and vertical at Tx output) Power amplifier protection : High VSWR protection, High Temperature protection Radiation blanking : It shall be able to set both azimuth and elevation Pulse width : from 0.5μs to 100μs Pulse repetition frequency (PRF): from 900Hz to 3,000Hz, selectable Duty : 50% Maximum BITE :Yes (Web-Browser based BITE with trend graphics)
Digital Receiver & Signal Processor	Quantity : 1 set
	Receiver type : Coherent IF digitizer Receiver Noise figure : 3.5dB or less at the input terminal of low noise amplifier (LNA) Clutter rejection capability :Yes Pulse compression type : Chirp modulation Pulse compression ratio : 100 or less Sensitivity : -115dBm or better Range bin : 8000 bins or more Processing area : (Intensity mode) throughout 0 km to 150km or more in range and 0 to 360 degrees in azimuth (Doppler mode) throughout 0 km to 150km or more in range and 0 to 360 degrees in azimuth Intensity signal process: Dynamic range : At least 94 dB or better -Range correction: depending on radar equation -Air-attenuation correction: 0.01dB/km in Observation Range Velocity signal process: -Processing type: Pulse pair or FFT -Trigger control: Dual-PRF ratio (4:5) -De-aliasing of doppler velocity: Real-time processing by Dual-PRF -Maximum de-aliasing Doppler velocity: ±64m/s or more

	Output data : Reflectivity (Z), Doppler velocity (V), Spectrum width (W), Differential reflectivity (ZDR), Differential phase shift (φDP), Specific differential phase shift (KDP), Polarimetric correlation coefficient (ρHV) Output data grid Azimuth : 1 degree or less Range : 30 m or finer Output data resolution : Up to 32 bits BITE :Yes (Web-Browser based BITE with trend graphics)
Duplexer	Quantity : 1 set
	Type : Dual backup type TR limiter or circulator with diode limiter
Radar Controller	Quantity : 1 set
	Hardware CPU : Intel® Xeon or equivalent latest generation & Series or higher Main memory (RAM) : 64GB or more Hard disk : 1TB (SSD) × two (2) drives or more (RAID-5) Optical media drive : Solid State LAN interface: : 10Base-T, 100Base-TX and 1000Base-T, two (2) port or more Monitor display : Color LCD type, 19 inches or more Input power : AC 230V, single phase, 50Hz Accessories : English keyboard, mouse, LAN arrester (RJ45) Software Operation system: as per OEM with support till 10 years from time of delivery Application software: • Operating System platform independent [Radar control and monitoring] -Antenna scanning and radiation to control by pointing device -Monitoring of the result of the radar control -Fault monitoring including temperature alarm inside of the equipment -True north confirmation by sun tracking feature [Observation scheduling]

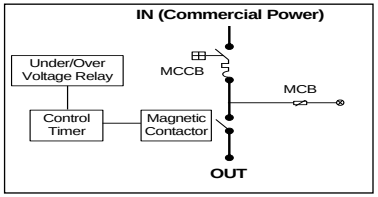
	-Antenna scanning mode (PPI, RHI, Volume Scan) -Elevation angle setting -Selection of Pulse width or set -Data elements (Reflectivity (Z), Doppler velocity (V), Spectrum width (W), Differential reflectivity (ZDR), Differential phase shift (φDP), Specific differential phase shift (KDP), Polarimetric correlation coefficient (ρhv)) -Selection of PRF [Radar echo display] -X-Y coordinates image in the form of PPI indication (Reflectivity (Z), Doppler velocity (V), Spectrum width (W), Differential reflectivity (ZDR), Differential phase shift (φDP), Specific differential phase shift (KDP), Polarimetric correlation coefficient (ρhv)) [Automatic shutdown] -Automatic graceful shutdown upon signal from the Power Backup Unit
Data & Protocol Converter	Quantity : 1 set
	Hardware CPU : Intel® Xeon or equivalent latest generation & Series or higher Main memory (RAM) : 64GB or more Hard disk : 1TB (SSD) × two (2) drives or more (RAID-5) Optical media drive : Solid State LAN interface: : 10Base-T, 100Base-TX and 1000Base-T, two (2) port or more Monitor display : Color LCD type, 19 inches or more Input power : AC 230V, single phase, 50Hz Accessories : English keyboard, mouse, LAN arrester (RJ45) Software Operation system: as per OEM with support till 10 years from time of delivery Application software: • Operating System platform independent [Data receiving, converting and transfer] -Collection of Ingested data -Compression processing of raw data

	-Dissemination of raw data over the network -FTP data transfer through live IP -GRIB-2, ASCII, NETCDF,GEOTIFF,PNG format etc. -The software shall include an interface for administrators and operators to create and schedule automatic export of products in various formats (e.g., GRIB2, ASCII, NetCDF, GeoTIFF, PNG) to external sources via FTP/SFTP or other compatible protocols. [Parameter setting] -Setting of dissemination schedule [Display processing] -Latest data display by the PPI style (selectable of Reflectivity (Z), Doppler velocity (V), Spectrum width (W), Differential reflectivity (ZDR), Differential phase shift (φDP), Specific differential phase shift (KDP), Polarimetric correlation coefficient (ρhv)) -Display of receiving status [Time adjustment] -Automatic adjustment by GPS NTP server (including GPS antenna) [Automatic shutdown] -Automatic graceful shutdown upon signal from the Power Backup Unit
Radar Data Display Unit	Quantity : 2 sets
	Hardware CPU : Intel® Xeon or equivalent latest generation & Series or higher Main memory (RAM) : 64GB or more Hard disk : 1TB (SSD) × two (2) drives or more (RAID-5) Optical media drive : Solid State LAN interface: : 10Base-T, 100Base-TX and 1000Base-T, two (2) port or more Monitor display : 65 inches or more LED or video wall Input power : AC 230V, single phase, 50Hz Accessories : English keyboard, mouse, LAN arrester (RJ45) Software Operation system: as per OEM with support till 10 years from time of delivery

	Application software: • Operating System platform independent [Basic data monitoring feature] -Display of X-Y coordinates image in the form of PPI indication (Reflectivity (Z), Doppler velocity (V), Spectrum width (W), Differential reflectivity (ZDR), Differential phase shift (φDP), Specific differential phase shift (KDP), Polarimetric correlation coefficient (ρhv)) [Weather product processing] -PPI (plan position indicator) -RHI (range height indicator) -CAPPI (constant altitude PPI) -RTI (range time indicator) -Maximum value on X-Y axis -Rainfall near surface -VIL (vertically integrated liquid) -Warning output of heavy rainfall -Rainfall and strong wind warning output of specified district -Rain rate and rainfall near surface by DP (dual polarization) (Capable to set the combination of multiple polarization parameters and calculation algorithms) -Arbitrary N-hours rainfall accumulation by DP -Horizontal wind profile (wind direction and speed) -Time series wind profile of the upper layer -Wind shear detection -Multi window feature -Z-R and dual polarization parameter registration -Image file output as JPG file format [Map projection] -Conical projection or Mercator projection -Map data edit function [Product display & retrieval] -Automatic updating of the received product

	-Display of the necessary information Observed date and time Site code Name of product Product range information Legend (color code) -Data display area Map overlay feature Indication of information of a location pointed by pointing device (Location, radar echo value, distance of specified span) -Zooming display 2 or 4 times selectable for the desired area -Animation Animation displays of selected product Selectable items -Type of product -Retrieving period -Retrieving speed -Retrieving direction [Automatic shutdown] -Automatic graceful shutdown upon signal from the Power Backup Unit

Radar Power Maintenance Panel	Quantity	: 1 set
	Circuit breaker	: No-fuse-breaker type
	Main breaker	: No-fuse-breaker type or magnetic-breaker
	Power distribution	: No. of outputs as required including 2 spare
	Input power	: AC 230V, single phase two wire, 50Hz
	Output power	: AC 230V, single phase two wire, 50Hz
Dual Switch	Quantity	: 1 set
	LAN interface	: IEEE 802.3 Ethernet
	Connection port	: 100BASE-TX or more, eight (8) ports or more
	Input power	: AC 230V, single phase, 50Hz
	Each port and power supply shall be duplicated	
Dual Optical	Quantity	: 2 sets

Repeater	LAN interface	: IEEE 802.3 Ethernet
	Connection port	: 100BASE-TX or more: one (1) port or more, optical fiber interface: one (1) set, multi-mode (100Mbps)
	Input power	: AC 230V, single phase, 50Hz
	Each port and power supply shall be duplicated.	
Optical Fiber Cable	Quantity	: 1 set
	Cable type	: Multi mode 2C
	Connector	: ST
	Length	: As per requirements
Dual Router	Quantity	: 1 set
	LAN interface	: IEEE 802.3 Ethernet
	Connection port	: 100BASE-TX or more, three (2) ports or more
	Routing	: IP routing
	Input power	: AC 230V, single phase, 50Hz
	Each port and power supply shall be duplicated	
Phase Change Protector	Quantity	: 1 set
	Component MCCB single pole Magnetic contactor single pole Control breaker, single pole MCB Under and over voltage relay, 250V Control timer 0-30sec Indication lamp	
Power Backup Unit	Quantity	: 1 set
	Input voltage	: AC 230V, single phase two wire, 50Hz
	Output voltage	: AC 230V, single phase two wire, 50Hz
	Back up time	: 15 minutes or longer for all the equipment indicated above
	Energy storage	: Lithium-ion battery
	Others	: Bypass function
Automatic Voltage Regulator (AVR)	Quantity	: 1 set
	Capacity	: as per requirement for the radar equipment, ACs installed in the radar equipment room(s)
	Input power	: AC 230V ±20%, single phase two wire, 50Hz
	Output power	: AC 230V ±5%, single phase two wire, 50Hz

Isolation Transformer	Quantity	: 1 set
	Capacity	: as per requirement for the radar equipment, ACs installed in the radar equipment room(s)
	Input power	: AC 230V selectable, single phase two wire, 50Hz
	Output power	: AC 230V, selectable, single phase two wire, 50Hz
	Insulation	: Class B
	Surge voltage	: 20kV or more
Grounding System	Quantity	: 2 set
	The installation of complete grounding system for the protection of radar equipment and its peripherals, grounding procedures must comply with national and international regulations	
	Grounding test terminals	: 3 or more
	Grounding terminal box	: Number of terminals as required, with a connection cable to the grounding cable
	Grounding resistance value	: 5Ω or less

Diesel Engine Generator for supporting all the Radar Equipment	Quantity	: 1 set
	Output	: 10kVA or more
	Voltage	: AC 230V, single phase two wire
	Frequency	: 50Hz
	Control unit	: Automatic transfer switch
	Fuel tank	: 200L
	Accessories	: Starting battery, fuel supply & lubricating systems, lubricating oil supply system, anchor bolts for generator and auxiliaries, spare parts for 3,000 hours and tools for maintenance.
Hybrid Solar with Green Meter	10KVA	
Air Conditioner required for the proposed Radar Equipment and Observational Room		
	Type	: Air cooled wall/floor mounted type
	Capacity	: Inverter ACs as per the cooling requirement of the equipment
	Automatic operation	: Thermostatic control
	Controller	: Body/Remote type

Spare Parts	Radar Signal processor	1 unit
	Receiver	1 unit
	Motor assembly for antenna (for azimuth drive)	2 sets
	Motor assembly for antenna (for elevation drive)	2 sets
	Solid-state power amplifier	5 sets
	Power supply unit(s) for radar equipment	1 set
	Fan unit(s) for radar equipment	2 sets
	LAN arrester	1 set
	USB Back up of all Softwares for radar operation	2 set
External Storage	Shall provide sufficient storage capacity (at least 100 TB) for saving the last 10 years of Radar data.	

Circuit Breaker to be installed at a power distribution point	Capacity : As per load requirement of radar equipment room(s) Voltage : AC 230V, single phase two wire
TEST EQUIPMENT	Quantity: 1 set
	The following equipment should be provided as per radar testing requirement: -Spectrum Analyzer -Test Signal Generator -Power Meter -Power Sensor -Frequency Counter -Detector -Attenuator Set -Terminator for Detector -Digital Oscilloscope -Digital Multimeter -Clump Multi Meter -CW Converter -Portable Power Supply Unit Tool Kit :All necessary tools for radar maintenance for electrical/mechanical

	Step Ladder Type : Extension type 11m or more
Consumables	Grease with pump and oil with jug for antenna Slip ring carbon Brush
Calibration and Validation	Calibration: The radar system shall be calibrated in accordance with recognized meteorological standards (e.g., WMO or equivalent) to ensure accurate and consistent measurements of reflectivity, Doppler velocity, and other meteorological parameters. The calibration process shall include: • Internal calibration using built-in test equipment and reference signals. • External calibration using calibrated targets or reference radars. • Regular verification of system performance through routine maintenance and quality control procedures. Validation: The radar data shall be validated against independent measurements (e.g., rain gauges, disdrometers, radiosondes) to assess the accuracy and reliability of the radar-derived products. The validation process shall include: • Comparison of radar-estimated rainfall with ground-based rain gauge measurements. • Evaluation of radar-derived wind profiles against radiosonde observations. Assessment of the radar's ability to detect and characterize severe weather phenomena.
Maintenance and Support	The vendor shall provide a comprehensive maintenance and support plan, including on-site training, remote troubleshooting, and software updates, with a guaranteed maximum response time of 2 days for critical issues.

Additional Software/hardware Features:

TDME (Test Diagnostic Measurement Equipment)

- ATE/ STTE : automatic test equipment, solid state test equipment for simulation
- complete consumable / replaceable components list required during repairing / replacement, along with warranty of provision of such components for not less than 15 years.
- List of single point failure component.
- software : packages to run TDME with firmware, O.S and procedure manuals

- The Radar system should be having required menu driven software with both GUI and command line controls for Operating the Radar.
- The antenna tracking sweep should be visible on all the visualization/ application software display systems
- The process of setup of various scan parameters should be easily accessible to operators using GUI.
- Software should have storm tracking and nowcasting features.
- Generation of alerts and warning.
- Setup of display overlayed on map of Pakistan with political boundaries of international borders, provinces and district boundaries, river catchment etc. using shape files.
- Provision to incorporate the Bias Values for correction
- Monitoring the health of the Radar as well as logging of subsystem level information at fixed intervals while Radar in operation.
- Interlock, status and analog parameters from sub systems should be available in Radar controller GUI display for monitoring and should be included in the Radar operation for the system and subsystem safety.
- The system should be capable of detecting failures of subsystems and should provide indication locally and remotely.
- System should have the feature of blanking RF radiation for selective sector.
- Real Time display of base products for the selected scan. Base Product display with zooming options, lat-long display, selectable parameter displays and colour coded. Simultaneous display of data having more than one parameter. Base product display with terrain map – GIS. Provision for recording and playback of data.
- System should have provision for remote access for monitoring and control including equipment power supply.
- The base data (output of Radar processor) shall be stored automatically on Product archival workstations in compressed form. At least three-month past data shall be available on the local computer disk at a time. Data converter should be available on the

system for automatic conversion of real-time Radar base data to other common formats such as NetCDF, HDF5, KML, KMZ, gridded binary and NEXRAD-Level II . Base data product images to be archived in different image formats like GIF, JPEG, PNG.

- Output data: Reflectivity (Z), Doppler velocity (V), Spectrum width (W), Differential reflectivity (ZDR), Differential phase shift (φDP), Specific differential phase shift (KDP), Polarimetric correlation coefficient (ρHV) shall be made available for export to external sources via FTP/SFTP or other compatible protocols. The software shall include an interface for administrators and operators to create and schedule automatic export of these products in various formats (e.g., GRIB2, HDF5, NetCDF, GeoTIFF, PNG) to streamline integration into a central forecasting system.
- The system should have concise interactive menus for monitoring and managing the process, which makes it easy to trace data all the way from the radar receiver to the end user.
- Display applications for 3D rendering of data and a web interface for accessing the data via a browser.
- Should be a fully scalable system architecture and works just as well with a single radar as a network of radars.
- Integration of Radar system in existing PMD RADARs network to enable central management, data archiving and generation of integrated products.
- Supplier shall be responsible to provide tool and will perform calibration and optimize R-Z, values for radar rainfall estimation and authentication of all the products. Complete verification report of Radar Rainfall estimation shall be furnished with satisfactory performance scores.
- Provision of web access of radar software(Client / Server architecture).
- Software should be fully licensed and supports installation /operation on other work stations.
- The final composite view should look like a Satellite clouds image as a layer one, AWS data as layer two, Radar data as layer 3, LDN data as layer 4 and weather model products as layer 5.
- Pulse radar transmit code data should also be made temporarily for research and analysis purposes of significant weather events.

- Generation of real time Mosaic view with existing radars of PMD.
- Platform independent: Running on Windows / Linux.
- Radar software must support writing our own python based module of data analysis which can be added by the user.
- Consistent user interface offering easy navigation with MDI (Multi Document Standard).
- Generation of movie loop and saving it in .mp4 format. Comprehensive combination products such as Severe Weather Indicator (consisting of micro-burst detection, meso-cyclone detection, divergence and convergence detection and storm structure analysis).
- Open ended radar software supported with an option of adding additional regional or local features as modules.

Inspections and Tests

The following tests have to be performed before the system as a whole can be approved for operational services.

- **Factory Acceptance Test (FAT)**
- **Provisional Site Acceptance Test (PSAT)**

Transfer of Technology and Capacity Building

The Supplier shall commit to engaging in good-faith negotiations with the Pakistan Meteorological Department (PMD) to establish a comprehensive technology transfer and capacity building program. This program aims to empower PMD with the knowledge, skills, and capabilities necessary to independently assemble, calibrate, install, and maintain X-band weather radars within Pakistan.

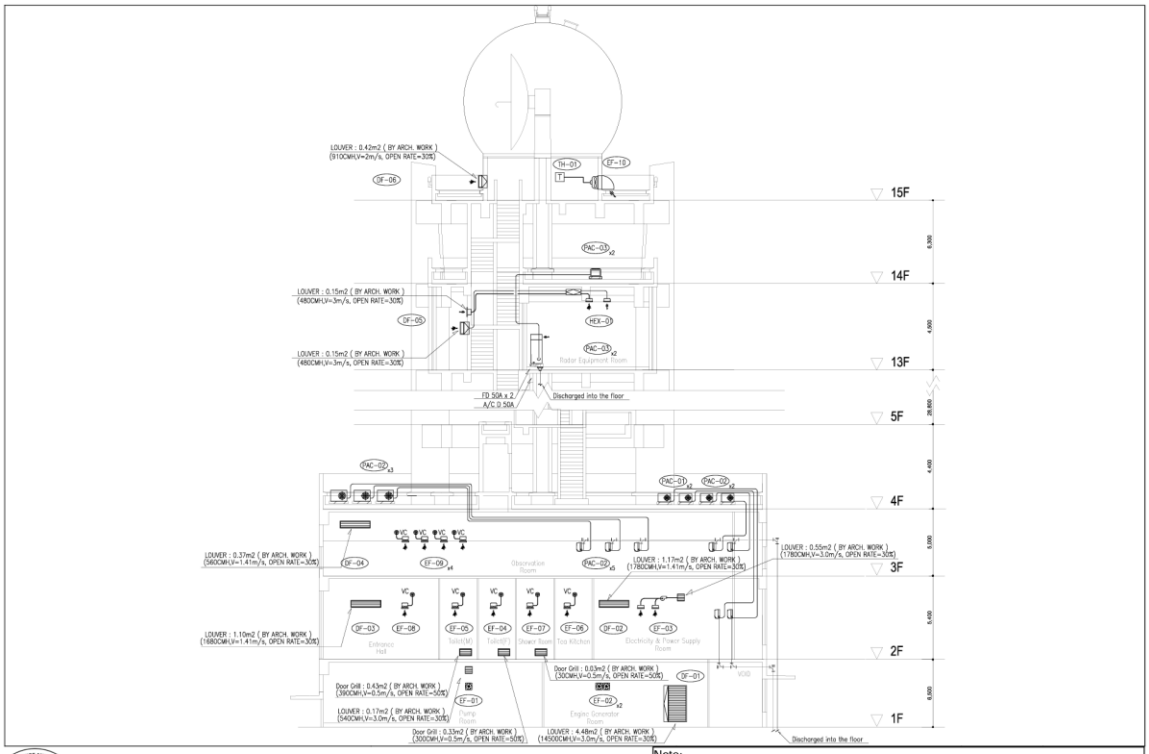
The technology transfer program shall encompass the following key areas:

1. **Assembly and Manufacturing:** Detailed training and documentation on the assembly processes, quality control procedures, and testing protocols for X-band weather radar components and systems.
2. **Calibration and Testing:** Comprehensive training on the calibration and testing procedures for X-band weather radars, including the use of specialized tools and equipment.
3. **Installation and Commissioning:** Guidance and support for the installation and commissioning of X-band weather radars at PMD-designated sites, including site preparation, system integration, and performance verification.
4. **Maintenance and Repair:** Training on preventive and corrective maintenance procedures for X-band weather radars, including troubleshooting techniques, spare parts management, and software updates.

5. **Knowledge Transfer:** Provision of technical documentation, manuals, software, and training materials to PMD personnel, ensuring a sustainable transfer of knowledge and expertise.

The specific terms, conditions, and timelines for the technology transfer and capacity building program shall be mutually agreed upon by the Supplier and PMD through a separate agreement. The program shall be designed to progressively enhance PMD's self-sufficiency in X-band weather radar technology, ultimately enabling the department to independently manage and operate these systems within the country.

Conceptual Drawing



Project Description: Modernization of Hydromet Services of PMD in Pakistan
Integrated Flood Resilience and Adaptation Project (IFRAP)

Note:
These are all conceptual drawings only for the preperation of bids. Designs of all civil structures including foundations will be the responsibility of the bidder and design and drawings will be implemented after due approval of management consultants.