Market Outreach Session

Supply, Installation and Civil Works of Fixed Weather Surveillance Radars with Power Backup System

Procurement Category	Procurement Process	Procurement Method and Document Type	Market Approach	Award Criteria
Works	Single Stage - Two Envelope	Request for Bids	Open | International	Rated (40% + 60%) Most Advantageous Bid*

The Most Advantageous Bid is the Bid of the Bidder that meets the Qualification Criteria and whose Bid has been determined to be substantially responsive to the Bidding document and is the Bid with the highest combined technical and financial score.

Dated: Tuesday March 25, 2025

Section II – Bid Data Sheet (BDS)

	A. General
No. and Details of Lots	Five (05) as follows: ***Lot-1 (Gwadar)*** ***Lot-2 (Lahore)*** ***Lot-3 (D. I. Khan)*** ***Lot-4 (Cherat)*** ***Lot-5 (Quetta)***
	C. Preparation of Bids
Language	The language of the Bid is: ***English*** All correspondence exchange shall be in ***English*** language. Language for translation of supporting documents and printed literature is ***English.***
Lot-wise Pricing	Bidders shall quote for the following components or services on a single responsibility basis: ***each lot/ contract 100% (fully) complete in all aspects***
Price Adjustment	The prices quoted by the Bidder ***shall*** be subject to adjustment during performance of the Contract.
Bid Security	A Bid-Securing Declaration ***shall be*** required.
Bid Validity	The Bid shall be valid until: ***180 Days form the bid(s) submission date.***

Dated: Tuesday March 25, 2025

Section II – Bid Data Sheet (BDS)

	D. Submission of Bids
Bid Copies	In addition to the original of the Bid, the number of copies is: ***Two (2) hard copies and one (1) separate soft copy of Technical and Financial Bids.*** ***In case of any discrepancy between the soft and hard copies, the hard copy shall prevail.***
	E. Public Opening of Technical Parts of Bids
Bids Opening	The Bid opening shall take place at: Street Address: *Pakistan Meteorological Department, Pitras Bukhari Road, Sector H-8/2* City: *Islamabad* Country: *Pakistan*
	G. Evaluation of Technical Parts of Bids
Technical Weightage/ Evaluation and Scoring Criteria	The technical factors and sub factors as applicable and the corresponding scores out of 100% are: ***Technical Part Scoring Methodology given at Section III - Evaluation and Qualification Criteria*** Weight in percentage: ***40% (.4X of 1.0)*** **The minimum qualifying score in technical evaluation (Technical Part Scoring Methodology) is 70%. Only those bidders, who score at least 70% in technical evaluation would be qualified for financial part opening/ evaluation.** ***Features evaluation will contribute 100% to/ of the technical factor(s).***

Dated: Tuesday March 25, 2025

Section II – Bid Data Sheet (BDS)

	I. Evaluation of Financial Part of Bids
Price Adjustment (Bid)	The adjustments shall be determined using the following criteria, from amongst those set out in Section III, Evaluation and Qualification Criteria: Deviation in Time for Completion: ***No*** Life cycle costs: the projected operating and maintenance costs during the life of the Facilities ***No*** Functional Guarantees of the Facilities ***No*** Work, services, facilities, etc., to be provided by the Employer ***No***
Bid Evaluation Currency	The currency that shall be used for Bid evaluation and comparison purposes to convert (at the selling exchange rate) all Bid prices expressed in various currencies into a single currency is ***Pak Rupees*** The source of exchange rate shall be: ***State Bank of Pakistan*** The date for the exchange rate shall be*:* ***Selling Rate prevailing 14 days prior to the last date for submission of bids***
	J. Evaluation of Combined Technical and Financial Parts and Most Advantageous Bid
Financial Weightage and Combined Evaluation	The weight to be given for cost is: ***0.6X of 1.0***

Dated: Tuesday March 25, 2025

Maintenance and Support

	Post Installation Support
Maintenance and Support Plan	The bidder shall provide a maintenance and support plan, including on-site training, remote troubleshooting, and software updates, for critical issues for a period of three (03) years.
Spare Parts	The supplier shall supply spare parts for a period of three (03) years. Radar Spare Parts availability guaranteed for period of not less than 15 years.

Dated: Tuesday March 25, 2025

Section III - Evaluation and Qualification Criteria

Technical Part

Technical Evaluation

Mandatory Requirements:

Subject to meeting/ qualifying the following mandatory criteria only, the Purchaser's evaluation of responsive bids ***will consider*** scored technical factors.

A. **General Technical Requirements:** All weather radar(s) proposed by the bidder must strictly meet with the Technical Specifications of the Project.

B. **Maintenance and Reliability:** i) The radar should be designed to have a high Mean Time Between Failures (MTBF) and be easy to maintain. Regular maintenance should be possible with minimal downtime to ensure continuous weather monitoring; ii) The radar should be supported by an efficient maintenance plan, with easily available spare parts, technical support, and a low meantime to repair (MTTR).

Dated: Tuesday March 25, 2025

Section III - Evaluation and Qualification Criteria

C. **Data Processing and Integration:** i) The radar should have advanced data processing capabilities, including filtering and analyzing radar data in real-time. The radar system should be equipped with intuitive and user-friendly visualization software that allows meteorologists to easily interpret and analyze the data. Real-time processing and display of radar images, with color-coded displays for easy identification of weather patterns should be as per WMO standards; ii) The radar's data output should be adjustable to meet with the central meteorological data processing system for seamless integration and decision-making; iii) Data observed by the radar should be capable of integrating with other meteorological data, such as satellite data, weather stations data, and numerical weather prediction models existing radars to improve the overall quality of forecasts and understanding of complex weather system.

D. **Dual-Polarization Features:** i) The dual-polarization radar should have the ability to classify various types of precipitation (rain, snow, hail) to improve the accuracy of precipitation observation.

E. **Environmental Adaptability:** i) The radar system must be designed to operate under sever environmental conditions (e.g., extreme temperatures, strong winds, high humidity). It should be able to function in harsh weather conditions such as storms or heavy rain without degradation in performance, except for technical limitations imposed by the radio characteristics in each frequency band; ii) The radar should comply with international electromagnetic radiation standards and other local regulations, including frequency spectrum allocation. Compliance with the recommendations of the International Telecommunication Union (ITU) and other national and international standards is necessary to ensure safe and legal operation.

Dated: Tuesday March 25, 2025

Section III - Evaluation and Qualification Criteria

F. **Safety and Scalability:** i) The radar should meet safety standards for operators and the surrounding environment, including electromagnetic radiation safety, especially for personnel working near the radar; ii) The radar should be scalable to accommodate future expansions, such as enhancing data processing capabilities.

G. **Upgradability and Customization:** i) The radar should be capable of software and hardware upgrades to keep pace with technological advancements, such as improved signal processing, data analytics, or integration with other sensors and systems; ii) Customizing options of radar product display should be available to address the specific needs of the region, whether in terms of weather phenomena to monitor, operational environments, or regional forecast priorities.

H. **Signal Quality and Accuracy:** The bidder shall ensure that the radar is designed and optimized to minimize the effects of parallax error such as range accuracy, bearing accuracy, data processing (interpolation and extrapolation), senor fusion and user interface.

I. **Documentation and Past Performance:** i) Comprehensive technical documentation such as system manuals, installation guides, operational procedures and maintenance manuals with its summary for routine maintenance work must be provided by the bidder to ensure the system is easily deployed, operated and maintained; ii) The bidder must have at least two successful completions of past projects with customer references/recommendations which must be attached with the bidding documents.

Dated: Tuesday March 25, 2025

Section III - Evaluation and Qualification Criteria

J. **Data Integrity and Security:** Data Integrity and Quality: full support/compliance with Encryption (Data encryption in transit and at rest), Role-based Access Controls, Vulnerability Scanning/ Assessment and Firewall Protection (Network Security).

K. **Alerts and User-Friendliness: i)** System/Application Alerts: ability to customize thresholds for critical parameters and the system shall deliver alerts via email, SMS, and Push Notification on regular or need basis; ii) User-friendliness: Intuitive Interface (Easy-to-navigate menus and controls) and Clear Data Presentation (Visualizations and reports).

L. **Remote Access and Monitoring:** Remote Access and Control: Web-based remote access and mobile app for monitoring and control with Web Services (APIs for data access) and Data Visualization.

M. **Data Visualization and Anomaly Detection:** Anomaly Detection: should be capable for identification and flagging of unusual or erroneous data.

Dated: Tuesday March 25, 2025

Common Mistakes in Bids Submission and How To Avoid Those

Common Mistakes and their Avoidance
Careful reading and understanding of Bidding Documents especially ‘Section I - Instruction to Bidders’ and ‘Section II – Bid Data Sheet’ before the preparation of Bids.
Compliance of ‘Documents Comprising the Bid’ as per ITB 11 of Section-I.
Compliance of ‘Evaluation and Qualification Criteria’ as per Section-III.
Preparation/ submission of ‘Bidding Forms’ as given in Section-IV.
Compliance of the Product/ Solution as per Employer’s Requirement in Section-VII.
Careful study and understanding of ‘Section VIII – General Conditions of Contract’ and ‘Section IX – Particular Conditions of Contract’ for Contract terms and Condition.
For payment terms and conditions, ‘Section X – Contract Forms’ may be referred.

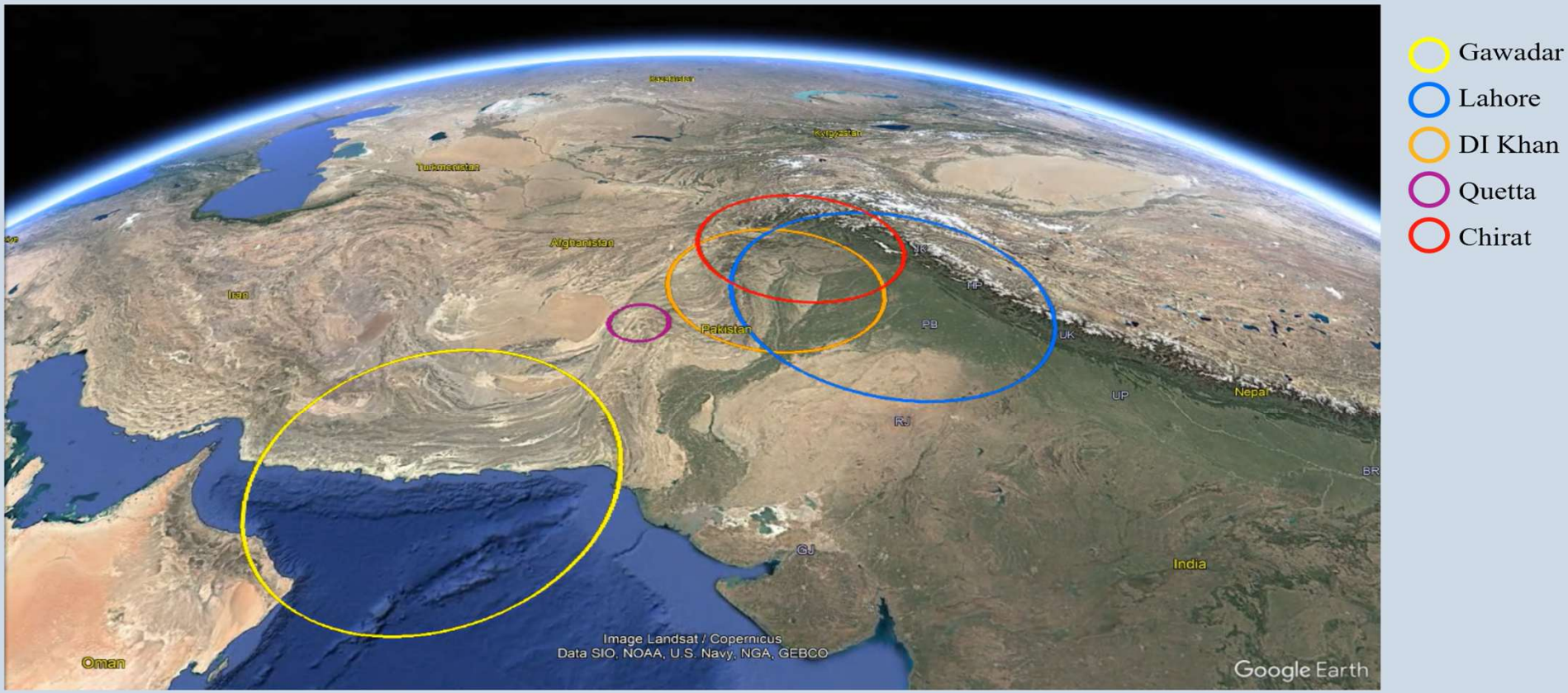
Dated: Tuesday March 25, 2025

Proposed Location of New Radars

S#	Bands	Location	Grid Refercne
1.	2 S-Band	Punjab Lahore	Lat 31°32'33.00"N Long 74°19'30.84"E
2.		Balochistan Gawader	Lat 25°16'58.50"N Long 62°30'20.26"E
3.	2 C-Band	Cherat	Lat 33°48'56.73"N Long 71°52'24.87"E
4.		DI Khan	Lat 31°50'10.24"N Long 70°55'1.50"E
5.	1-X-Band	Quetta (Fixed)	Lat 30º 14’ 33.73”N Long 66º 59’ 14.62”E

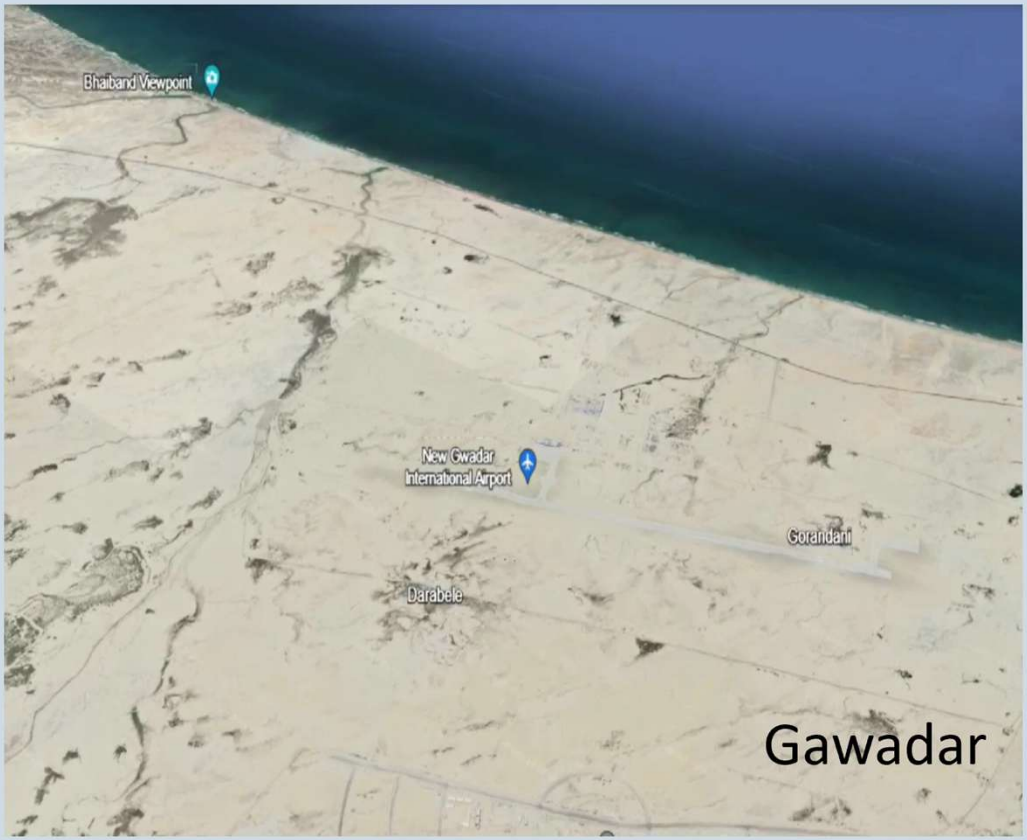
Dated: Tuesday March 25, 2025

Total Radar Coverage



Dated: Tuesday March 25, 2025

S Band



Dated: Tuesday March 25, 2025

C Band

Dated: Tuesday March 25, 2025

X Band

Dated: Tuesday March 25, 2025

Key Technical Specifications

Radar	Oscillator Type	Range	Polarization	Tx	Genset	Power Backup Unit
S Band	Magnetron	450 km	Dual	850 kW or more	30 kVA	>5 mins Lith-ion battery
C Band	Solid State	300 km		>2 kW		
X Band		130 km		>500 W	10 kVA	> 15 mins Lith-ion battery

Dated: Tuesday March 25, 2025

Key Technical Specifications

Radar	Tuned Frequency GHz	BW MHz	Beam Angle (Deg)	Hybrid Solar System	Diagnostic System
S Band	2.700 to 2.900	20	1	20 kVA	BITE TDME
C Band	5.300 to 5.700	5	1		
X Band	9.300 to 9.500	5	1.5 or less	10 kVA	

Dated: Tuesday March 25, 2025

Radar Structure and Height (Tentative)

Name of Radar Station	Construction of Radar Tower	Structure Type	Height from Ground Level (GL) to Radar Antenna Centre
Gwadar	Required	Reinforced Concrete Structure	40m
Cherat			30m
Quetta			20m
Lahore PMD RMC	Already Available	Renovation work required for Reinforced Concrete Structure	20m (Height of the existing building)
Dera Ismail Khan	Already Available	Renovation work required for Reinforced Concrete Structure	20m (Height of the existing building)

Dated: Tuesday March 25, 2025

Environment & Social Management Requirements for Suppliers

- **Supplier's Environment and Social Management Plan (S-ESMP):**
  - Must be submitted for approval.
  - Should include agreed Management Strategies and Implementation Plans.
  - Implementation is required as per WB E&S standards.

- **Environment and Social Safeguard Management Unit:**
  - The Supplier must establish and maintain this unit with qualified Experts throughout the project duration.

- **Grievance Redress Mechanism (GRM):**
  - The Supplier must establish a GRM and report the status of complaints to the Purchaser.

- **Independent Monitoring:**
  - The Purchaser reserves the right to conduct independent environmental and social monitoring throughout project execution.

Dated: Tuesday March 25, 2025

i) Rated Criteria;

ii) Eligibility & Qualification Criteria; and

iii) Technical Specifications For S-Band, C-Band And X-Band Dual Polarization Doppler Weather Radar

Attached

Dated: Tuesday March 25, 2025

Technical Part Scoring Methodology

1. Weighted Table for Project Implementation Schedule

Factor	Sub-Factor	Description	Maximum Number	Respective Number	Condition
Project Implementation Schedule	Implementation Timeline	Estimated project duration	10	10	less than or equal to 18 months
				7	>18 months and ≤21 months
				3	>21months and ≤24 months
				0	≥24 months

2. Weighted Table for Environmental Hardiness with Certification of Radar Transmitter

Factor	Sub-Factor	Description	Maximum Number	Respective Number	Condition
Environmental Hardiness with Certification	Environmental Hardiness	Ability to withstand harsh environmental conditions	10	10	Harsh environmental conditions (-15 C to 55 C)
				5	Moderate environmental conditions (-5 C to 40 C)
				0	Inadequate environmental hardiness (0 C to 25 C)

3. Weighted Table for Maintenance and Support

Factor	Sub-Factor	Description	Maximum Number	Respective Number	Condition
Maintenance and Support	Maintenance and Support Services	Level of support provided	10	10	*Comprehensive maintenance and support services
				5	*Adequate/limited maintenance and support services
				0	*Insufficient maintenance and support services

*Note: For details, please refer to "*Comparison Table: RADAR Support Plans" given below.*

***Comparison Table: RADAR Paid Support Plans (including free support for three years after the completion)**

Feature	Comprehensive	Adequate/Limited	Insufficient
Availability	24/7/365	Business hours	Minimal or no availability
Scope	Covers all aspects of RADAR services	Limited to specific issues or components	Minimal or no coverage
Response Time	Priority response, often within minutes	Standard response times	Delayed or no response
Level of Assistance	Proactive monitoring, troubleshooting, and optimization	Self-service options, basic troubleshooting	Minimal or no assistance

Access to Technical Account Managers (TAMs)	Dedicated TAMs for personalized guidance	Limited access to TAMs	No access to TAMs

4. Weighted Table for Radar Transmitter Design

Factor	Sub-Factor	Description	Maximum Number	Respective Number	Condition
Radar Transmitter Design	Designed Mean Time between Failure (MTBF)	Predicted elapsed time between inherent failure	5	5	Over 25,000 hours
				3	Between 15,000 and 25,000 hours
				0	Less than 15,000 hours
	Designed Meantime to Repair (MTTR)	Average time taken to diagnose and rectify faulty equipment	5	5	Less than 1 hour
				3	Between 1- 6 hours
				0	More than 6 hours

5. Weighted Table for Free Software Update after the successful SAT without Hardware Binding

Factor	Sub-Factor	Description	Maximum Number	Respective Number	Condition
Radar Software	Radar Operation Software	Updates of Software for configuration and control of radar	5	5	Over 5 years
				3	Between 3 - 5 years
				0	Less than 3 years
	Radar Display Software	Updates of Software for generation and visualization of Radar products	5	5	Over 5 years
				3	Between 3 - 5 years
				0	Less than 3 years

6. Weighted Table for Radar Spare Parts Availability Guarantee (excluding PC and other computing peripherals)

Factor	Sub-Factor	Description	Maximum Number	Respective Number	Condition
Radar Spare Parts	Transmitter, Receiver and Signal Processor	Availability of Spare	10	10	Over 15 years
				5	Between 8 to 15 years
				0	Less than 8 years
	Antenna Controller and Assembly	Availability of Spare	10	10	Over 15 years
				5	Between 8 to 15 years
				0	Less than 8 years

7. Experience in large-scale, multi-sectoral projects (consistent with 4.2(a) Specific Experience) with significant E&S risks and mitigation measures.

Factor	Sub-Factor	Description	Maximum Number	Respective Number	Condition
Experience in large-scale,	Experience of firm in large-	Ability of the firm to	10	10	Two or more projects

multi-sectoral projects with significant E&S risks and mitigation measures.	scale, multi-sectoral projects with significant E&S risks and mitigation measures.	perform project with E&S risks and mitigation measures		5	One Project
				0	No experience

8. Ability to use local workforce & capacity development

Factor	Sub-Factor	Description	Maximum Number	Respective Number	Condition
Ability to use local workforce and capacity development	% of labor cost from local market	Provision of labor from local market	10	10	(70% to 100%)
				05	(40% to 69%)
				0	(0% to 39%)
	Number of officers who will receive training during the project	Staff (Meteorological & Engineering) trained by the Bidder	10	10	Over 60 Officers
				5	31 to 59 Officers
				0	Less 30 Officers

Qualification (Each Lot)

Factor	1 Eligibility					
Sub-Factor	Criteria					Documentation Required
	Requirement	Bidder				
		Single Entity	Joint Venture (existing or intended)			
			All members combined	Each Partner	At least one Partner	
1.1 Nationality	Nationality in accordance with ITB 4.4.	Must meet requirement	must meet requirement	Must meet requirement	N / A	Form ELI –1.1 and 1.2, with attachments
1.2 Conflict of Interest	No- conflicts of interests as described in ITB 4.2	Must meet requirement	must meet requirement	Must meet requirement	N / A	Letter of Bid
1.3 Bank Ineligibility	Not having been declared ineligible by the Bank as described in 4.5.	Must meet requirement	must meet requirement	Must meet requirement	N / A	Letter of Bid
1.4 State Owned Enterprise or Institution	Compliance with conditions of ITB 4.6	Must meet requirement	Must meet requirement	Must meet requirement	N / A	Form ELI –1.1 and 1.2, with attachments
1.5 Ineligibility based on a United Nations resolution or Borrower's country law	Not having been excluded as a result of the Borrower's country laws or official regulations, or by an act of compliance with UN Security Council resolution, in accordance with ITB 4.8and Section V.	Must meet requirement	must meet requirement	Must meet requirement	N / A	Letter of Bid

Factor	2. Historical Contract Non-Performance					
Sub-Factor	Criteria					Documentation Required
	Requirement	Bidder				
		Single Entity	Joint Venture (existing or intended)			
			All members combined	Each member	At least one member	
2.1 History of non-performing contracts	Non-performance[1] of a contract did not occur within the last five (05) years prior to the deadline for application submission, based on all information on fully settled disputes or litigation. A fully settled dispute or litigation is one that has been resolved in accordance with the Dispute Resolution Mechanism under the respective contract, and where all appeal instances available to the Bidder have been exhausted.	Must meet requirement by itself or as member to past or existing JV	Must meet requirement	Must meet requirement[2]	N/A	Form CON - 2

[1] Nonperformance, as decided by the Employer, shall include all contracts where (a) nonperformance was not challenged by the contractor, including through referral to the dispute resolution mechanism under the respective contract, and (b) contracts that were so challenged but fully settled against the contractor. Nonperformance shall not include contracts where Employers decision was overruled by the dispute resolution mechanism. Nonperformance must be based on all information on fully settled disputes or litigation, i.e., dispute or litigation that has been resolved in accordance with the dispute resolution mechanism under the respective contract and where all appeal instances available to the Bidder have been exhausted.

[2] This requirement also applies to contracts executed by the Bidder as JV member.

2.2 Suspension	Not under suspension based on execution of a Bid Securing Declaration or Proposal Securing Declaration pursuant to ITB 4.7 and ITB 20.9	Must meet requirement	Must meet requirement	Must meet requirement	N/A	Letter of Bid
2.3 Pending Litigation	Bid's financial position and prospective long term profitability still sound according to criteria established in 3.1 below and assuming that all pending litigation will be resolved against the Bidder	Must meet requirement	Must meet requirement	Must meet requirement	N / A	Form CON – 2
2.4 Litigation History	No consistent history of court/ arbitral award decisions against the Bidder[3] since 1st January *2020*	Must meet requirement	Must meet requirement	Must meet requirement	N/A	Form CON – 2
2.5 Declaration: Environmental and Social (ES) past performance	Declare any contract that has been suspended or terminated and/or performance security called by an employer for reasons of breach of environmental, or social (including Sexual Exploitation, and Abuse) contractual obligations in the past five years.[4]	Must make the declaration. Where there are Specialized Subcontractor/ s, the Specialized Subcontractor/ s must also make the declaration.	Must meet requirement	Each must make the declaration. Where there are Specialized Subcontractor/ s, the Specialized Subcontractor/ s must also make the declaration.	N/A	Form CON-3 ES Performance Declaration

[3] The Bidder shall provide accurate information on the related Letter of Bid about any litigation or arbitration resulting from contracts completed or ongoing under its execution over the last five years. A consistent history of awards against the Bidder or any member of a joint venture may result in failure of the Bid.

[4] The Employer may use this information to seek further information or clarifications in carrying out its due diligence.

2.6 Bank's SEA and/or SH Disqualification	At the time of Contract Award, not subject to disqualification by the Bank for non-compliance with SEA/ SH obligations	Must meet requirement (including each subcontractor proposed by the Bidder)	Must meet requirement	Must meet requirement (including each subcontractor proposed by the Bidder)	N/A	Letter of Bid, Form CON-4

Factor	3 Financial Situation					
Sub-Factor	Criteria					Documentation Required
	Requirement	Bidder				
		Single Entity	Joint Venture (existing or intended)			
			All members combined	Each member	At least one member	
3.1 Financial Capabilities	Submission of audited balance sheets or if not required by the law of the Bidder's Country, other financial statements acceptable to the Employer, for the last three (03) years to demonstrate the current soundness of the Bidders financial position and its prospective long term profitability.	Must meet requirement	Must meet requirement	Must meet requirement	N / A	Form FIN – 3.1 with attachments
3.2 Average Annual Turnover	**Lot-1 (Gwadar) and Lot-2 (Lahore) – Either Lot** Minimum average annual turnover of US$ 6.0 Million per year, calculated as total certified payments received for contracts in progress or completed, within the last three (03) years. **Lot-3 (D. I. Khan) and Lot-4 (Cherat) – Either Lot**	Must meet requirement	Must meet requirement	Must meet at least Twenty-five percent (25%) of the requirement	Must meet at least Forty percent (40%) of the requirement – applicable to the lead member/ bidder.	Form FIN –3.2

Factor	3 Financial Situation					
Sub-Factor	Criteria					Documentation Required
	Requirement	Bidder				
		Single Entity	Joint Venture (existing or intended)			
			All members combined	Each member	At least one member	
	Minimum average annual turnover of US$ 8.0 Million per year, calculated as total certified payments received for contracts in progress or completed, within the last three (03) years. **Lot-5 (Quetta)** Minimum average annual turnover of US$ 3.0 Million per year, calculated as total certified payments received for contracts in progress or completed, within the last three (03) years.					
3.3 Financial Resources	The Bidder must demonstrate access to, or availability of, financial resources such as liquid assets, unencumbered real assets, lines of credit, and other financial means, other than any contractual advance payments to meet: (i) the following cash-flow requirement: **a. Lot-1 (Gwadar) and Lot-2 (Lahore) – Either Lot**	Must meet requirement	Must meet requirement	Must meet at least Twenty-five percent (25%) of the requirement	Must meet at least Forty percent (40%) of the requirement – applicable to the lead member/ bidder.	Form FIN –3.3

Factor	3 Financial Situation					
Sub-Factor	Criteria					Documentation Required
	Requirement	Bidder				
		Single Entity	Joint Venture (existing or intended)			
			All members combined	Each member	At least one member	
	US$ 3.0 Million **b. Lot-3 (D. I. Khan) and Lot-4 (Cherat) – Either Lot** US$ 4.0 Million **c. Lot-5 (Quetta)** US$ 1.5 Million and **All Five Lots** (ii) the overall cash flow requirements for this contract and its current commitments.					

Factor	4 Experience					
Sub-Factor	Criteria					Documentation Required
	Requirement	Bidder				
		Single Entity	Joint Venture (existing or intended)			
			All members combined	Each member	At least one member	
4.1 General Experience	Experience in *the Meteorology sector* under contracts in the role of *contractor*, subcontractor, or management contractor for at least the last *fifteen (15)* years starting 1st January *2010.*	Must meet requirement	Must meet requirement	Must meet requirement	N / A	Form EXP-4.1
4.2(a) Specific Experience	**Lot-1 (Gwadar) and Lot-2 (Lahore) – Either Lot** (a) Participation as contractor, joint venture member[5], management contractor, or subcontractor, in at least two (02) contracts within the last fifteen (15) years, each with a value of at least US$ 4.0 Million, that have been successfully and substantially[6]completed	Must meet requirement	Must meet requirements[11]	N / A	N/A	Form EXP 4.2(a)

[5] For contracts under which the Bidder participated as a joint venture member or sub-contractor, only the Bidder's share, by value, shall be considered to meet this requirement

[6] Substantial completion shall be based on 80% or more Plant and installation completed under the contract.

[11] In the case of JV, the value of contracts completed by its members shall not be aggregated to determine whether the requirement of the minimum value of a single contract has been met. Instead, each contract performed by each member shall satisfy the minimum value of a single contract as required for single entity. In determining whether the JV meets the requirement of total number of contracts, only the number of contracts completed by all members each of value equal or more than the minimum value required shall be aggregated.

Factor	4 Experience					
Sub-Factor	Criteria					Documentation Required
	Requirement	Bidder				
		Single Entity	Joint Venture (existing or intended)			
			All members combined	Each member	At least one member	
	and that are similar to the proposed Plant and Installation Services. **Lot-3 (D. I. Khan) and Lot-4 (Cherat) – Either Lot** (a) Participation as contractor, joint venture member[7], management contractor, or subcontractor, in at least two (02) contracts within the last fifteen (15) years, each with a value of at least US$ 5.5 Million, that have been successfully and substantially[8]completed and that are similar to the proposed Plant and Installation Services. **Lot-5 (Quetta)**					

[7] For contracts under which the Bidder participated as a joint venture member or sub-contractor, only the Bidder's share, by value, shall be considered to meet this requirement

[8] Substantial completion shall be based on 80% or more Plant and installation completed under the contract.

Factor	4 Experience					
Sub-Factor	Criteria					Documentation Required
	Requirement	Bidder				
		Single Entity	Joint Venture (existing or intended)			
			All members combined	Each member	At least one member	
	(a) Participation as contractor, joint venture member[9], management contractor, or subcontractor, in at least two (02) contracts within the last fifteen (15) years, each with a value of at least US$ 2.0 Million, that have been successfully and substantially[10]completed and that are similar to the proposed Plant and Installation Services. **Common Requirement/ Compliance for All Five Lots** A similar contract shall mean that the Bidder/ Supplier has successfully deployed the relevant Weather Surveillance Radars as listed in the Technical Specifications/ Employer's					

[9] For contracts under which the Bidder participated as a joint venture member or sub-contractor, only the Bidder's share, by value, shall be considered to meet this requirement

[10] Substantial completion shall be based on 80% or more Plant and installation completed under the contract.

Factor	4 Experience					
Sub-Factor	Criteria					Documentation Required
	Requirement	Bidder				
		Single Entity	Joint Venture (existing or intended)			
			All members combined	Each member	At least one member	
	Requirements or other similar solutions. The successfully completed similar contracts shall be documented by a copy of an Agreement/ Operational Acceptance Certificate (or equivalent documentation substantiating the Specific Experience as claimed by the Bidder satisfactory to the Employer).					
4.2(b) Specific Experience	**Lot-1 (Gwadar) and Lot-2 (Lahore)** For the above or other contracts executed during the period stipulated in 4.2(a) above, a minimum experience in the following key activities: a) 1.Peak Power of RADAR i. S band Magneton 850 KW or higher. b) Antenna Pedestal erection. c) Antenna Transmitter i. S band with Magneton	Must meet requirements	Must meet requirements[12]	N / A	N/A	Form EXP-4.2(b)

[12] In the case of JV, the value of contracts completed by its members shall not be aggregated to determine whether the requirement of the minimum value of a single contract has been met. Instead, each contract performed by each member shall satisfy the minimum value of a single contract as required for single entity. In determining whether the JV meets the requirement of total number of contracts, only the number of contracts completed by all members each of value equal or more than the minimum value required shall be aggregated.

Factor	4 Experience					
Sub-Factor	Criteria					Documentation Required
	Requirement	Bidder				
		Single Entity	Joint Venture (existing or intended)			
			All members combined	Each member	At least one member	
	Lot-3 (D. I. Khan) and Lot-4 (Cherat) For the above or other contracts executed during the period stipulated in 4.2(a) above, a minimum experience in the following key activities: a) 1.Peak Power of RADAR i. C band Solid state 2KW or higher. b) Antenna Pedestal erection. c) Antenna Transmitter i. C Band with Solid State. **Lot-5 (Quetta)** For the above or other contracts executed during the period stipulated in 4.2(a) above, a minimum experience in the following key activities: a) 1.Peak Power of RADAR i. X band Solid state 100 Watt or higher. b) Antenna Pedestal erection. c) Antenna Transmitter i. X Band with Solid State.					

TECHNICAL SPECIFICATIONS

Technical Specifications of S-band Dual Polarization Doppler Weather Radar (Magnetron)

Technical Specifications of S-band Dual Polarization Doppler Weather Radar:

Radome	Quantity	: 1 set
	Type	: Sandwich panel (spherical surface)
	Dimension	: Approx. 12m – 13m diameter
	Surface	: White colour, suitable non-observant and non-water sticking finish
	Survival wind speed	: 90m/sec.
	Suitable frequency	: Transmitting frequency
	Transmission loss	: 0.3dB or less on one way path in dry
	Relative humidity	: 0% – 100%
	Lightning protection	: Lightning rod (protecting angles: 60 degrees)
	Obstruction light	: LED (red colour), automatic switch control (on/off), waterproof
	Steel base ring including necessary installation materials	
Antenna	Quantity	: 1 set
	Type	: Parabolic antenna
	Reflector size	: Approx. 8m – 9m diameter
	Suitable frequency	: Transmitting frequency
	Beam width	: 1.0 degrees or less at -3dB point without Radome
	Antenna gain	: 45dB without Radome
	Polarization	: Simultaneous, dual polarization (horizontal and vertical)
	1st Side lobe level	: -26dB or less without Radome
	Angular positioning accuracy	: 0.1 degrees or less
	Driving range	: Azimuth 360 degrees, elevation -2 degrees – +90 degrees or wider
	Rotation speed	
	Azimuth	: 0rpm to 6rpm , selectable
	Elevation	: 0 to 3.6 degrees per second
	VSWR	: 1.4 or less without Radome
Transmitter	Quantity	: 1 set
	Transmitter type	: Magnetron tube
	Transmitting frequency	: 2.7GHz – 2.9 GHz (within ± 10MHz) [The specific available band/Tuneable frequency from FAB(Frequency Allocation Board Pakistan) will be communicated by Project Manager]
	Occupied frequency bandwidth : 20MHz or less	
	Short pulse width operation: Yes	
	Long pulse width operation: Yes	
	Transmitting power	: 850kW peak (each for horizontal and vertical at Tx output)
	Power amplifier protection	: to inhibit operation individually in case of abnormal high temperature in chassis
	Radiation blanking	: It shall be able to set both azimuth and elevation
	Pulse width	: from 0.2μs to 4.0μs
	*Short pulse and long pulse are combined for the observation period	
	Pulse repetition frequency (PRF) : from 200Hz to 2,400Hz, selectable	
Digital Receiver & Signal	Quantity	: 1 set
	Receiver type	: Coherent IF digitizer
	Noise figure of the high frequency circuit	

Processor		: 3dB or less at the input terminal of low noise amplifier (LNA)
	Sensitivity	: -114dBm
	Range bin	: 3,000
	Processing area	: (Intensity mode) throughout 0 km to 450km in range and 0 to 360 degrees in azimuth (Doppler mode) throughout 0 km to 200km in range and 0 to 360 degrees in azimuth
	Intensity signal process:	-Dynamic range : 105dB -Logarithmic linearity: within ±1dB throughout 70dB -Range correction: depending on radar equation
	Velocity signal process:	-Processing type: Pulse pair or FFT (Selectable) -Trigger control: Dual-PRF ratio selectable (2:3, 3:4 and 4:5) -De-aliasing of doppler velocity: Real-time processing by Dual-PRF -Maximum de-aliasing Doppler velocity: ±70m/s (in case of 4:5 dual PRF ratio)
	2nd-trip echo suppression	: Real-time processing by random phase control
	Output data	: Reflectivity (Z), Doppler velocity (V), Spectrum width (W), Differential reflectivity (ZDR), Differential phase shift (φDP), Polarimetric correlation coefficient (ρHV)
	Output data grid	
	Azimuth	: 1 degree or less
	Range	: 150m or finer at 450km observation range
	Output data resolution	: 2 bytes (16 bits)
	Output data indicating interval	: within 1 minute after automatic scan

Dehydrator			Quantity	: 1 set
			Capability of ventilation pressure : 3 ±1liter/min, Upper limit : 300 ±30hPa Lower limit : 70 ±30hPa	

Duplexer	Quantity	: 1 set
	Type	: TR limiter or isolator with diode limiter
Radar Controller	Quantity	: 1 set
	Hardware CPU : Intel® Xeon or equivalent latest generation & Series Main memory (RAM) : 64GB Hard disk : 1TB (SSD) x (RAID-5) LAN interface: : 10Base-T, 100Base-TX and 1000Base-T, two (2) port Monitor display : Color LCD type, 19 inches Input power : AC 230V, single phase, 50Hz Accessories : English keyboard, mouse, LAN arrester (RJ45) Software • Operating System platform independent • Up to 10 years Upgradable Software on Latest Operating System Version • Software without hardware binding Application software: [Radar control and monitoring]	

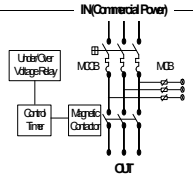
	-Antenna scanning and radiation to control by pointing device -Monitoring of the result of the radar control -Fault monitoring including temperature alarm inside of the equipment -True north confirmation [Observation scheduling] -Antenna scanning mode (PPI, RHI, Volume Scan) -Elevation angle setting -Selection of pulse width (Long range observation mode / Short range observation mode) -Resolution of the azimuth and range -Data elements (Reflectivity (Z), Doppler velocity (V), Spectrum width (W), Differential reflectivity (ZDR), Differential phase shift (φDP), Polarimetric correlation coefficient (ρhv)) -Setting for the clutter filter level -Selection of PRF and processing mode [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), 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 Main memory (RAM) : 64GB Hard disk : 1TB (SSD) x (RAID-5) LAN interface: : 10Base-T, 100Base-TX and 1000Base-T, two (2) port Monitor display : Color LCD type, 19 inches Input power : AC 230V, single phase, 50Hz Accessories : English keyboard, mouse, LAN arrester (RJ45) Software • Operating System platform independent • Up to 10 years Upgradable Software on Latest Operating System Version • Software without hardware binding Application software: [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/API or other compatible protocols. [Parameter setting] -Setting of dissemination schedule -Selection of products to be disseminated [Display processing] -Latest data display by the PPI style (selectable of Reflectivity (Z), Doppler velocity

	(V), Spectrum width, Differential reflectivity (ZDR), Differential phase shift (φDP), 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 Main memory (RAM) : 64GB Hard disk : 1TB (SSD) x (RAID-5) LAN interface: : 10Base-T, 100Base-TX and 1000Base-T, two (2) port Monitor display : 65 inches -LED or video wall Input power : AC 230V, single phase, 50Hz Accessories : English keyboard, mouse, LAN arrester (RJ45) Software • Operating System platform independent • Up to 10 years Upgradable Software on Latest Operating System Version • Software without hardware binding Application software: [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), 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) -3-dimensional data display -Warning output of heavy rainfall -Rainfall and strong wind warning output of specified district -Calculation of KDP from φDP -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 and microburst 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 (Forward and Reverse) [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 400V, three phase four 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, eight (8) ports
	Input power	: AC 230V, single phase, 50Hz
	Each port and power supply shall be duplicated	
Dual Optical Repeater	Quantity	: 2 sets
	LAN interface	: IEEE 802.3 Ethernet
	Connection port	: 100BASE-TX: one (1) port, 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, three (3) ports
	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 triple pole Magnetic contactor triple pole Control breaker, single pole MCB Under and over voltage relay Control timer 0-30sec. Indication lamp	
Isolation Transformer	Quantity	: 1 set
	Capacity	: 75kVA
	Input power	: AC 360V, 370V, 380V, 400V selectable, three phase four wire, 50Hz
	Output power	: AC 400V, three phase four wire, 50Hz
	Insulation	: Class B
	Surge voltage	: 30kV
Automatic Voltage Regulator (AVR)	Quantity	: 1 set
	Capacity	: 60 KVA
	Input power	: AC 400V ±20%, three phase four wire, 50Hz
	Output power	: AC 400V ±5%, three phase four wire, 50Hz
Power Backup Unit	Quantity	: 1 set
	Capability	: 50kVA
	Input voltage	: AC 400V, three phase four wire, 50Hz
	Output voltage	: AC 400V, three phase four wire, 50Hz
	Back up time	: 20 minutes or longer for all the equipment indicated above
	Energy storage	: Lithium-ion battery
	Others	: Bypass function
Grounding System	Quantity	: 2 set
	The installation of complete grounding system for the protection of radar equipment and its peripherals at the site. The grounding procedures must comply with national and international regulations. Grounding cable : 38mm2 or bigger, length as required (from lightning rod to grounding plate) Copper grounding plate : 3pcs (900mm × 900mm, 1.5mm thick) with grounding resistance reducer Conduit pipe : PVC pipe with fixing metal fitting Groundig test terminals : 3 Grounding terminal box : Number of terminals as required, with a connection cable to the grounding cable Grounding resistance value : 5 ohm	

Diesel Engine Generator for supporting all the Radar Equipment and the Air Conditioner specified below	Quantity	: 1 set
	Output	: 80KVA at continuous
	Output voltage	: AC 400V, three phase four wire
	Frequency	: 50Hz
	Control unit	: Automatic transfer switch
	Exhaust System	: Silencer, expansion joints, vibration isolators and flexible connections
	Fuel tank	: 1000L
	Accessories	: Starting battery, fuel supply & lubricating systems, lubricating oil supply system, steel structural common bed and anchor bolts for generator and auxiliaries, spare parts for 3,000 hours and tools for maintenance.
Hybrid Solar System with Green meter	40 KVA	

Air Conditioners for Radar Equipment and operation room	Type	: Air cooled floor/wall mounted type
	Capacity	: Inverter AC's as per the cooling requirement of the equipment
	Automatic operation	: Thermostatic control
	Controller	: Body/Remote type

Spare Parts	Timing belt for antenna (for azimuth drive)	1 set
	Timing belt for antenna (for elevation drive)	1 set
	Encoder or resolver for antenna (for azimuth angle signal)	1 set
	Encoder or resolver for antenna (for elevation angle signal)	1 set
	Motor for antenna (for azimuth drive)	1 set
	Motor for antenna (for elevation drive)	1 set
	Servo unit for antenna controller (for azimuth drive)	1 set
	Servo unit for antenna controller (for elevation drive)	1 set
	Power supply unit for antenna controller	1 set
	Power supply unit for transmitter	1 set
	Power supply unit for digital receiver and signal processor	1 set
	Magnetron	2 unit
	Signal processor	1 set
	Receiver	1 set
	Fan unit for radar equipment	2 sets
	LAN arrester	3 sets
	Obstruction light	1 set
	Solid State Disk Back up of all Softwares for radar operation	2 sets
External Storage (Network Access Storages(NAS) based)	Shall provide sufficient storage capacity (at least 100 TB) for saving the last 10 years of Radar data	

Step-down Transformer	Capacity	: 200kVA(or as per the requirement of the Office)
	Output power	: AC 400V, three phase four wire, 50Hz
TEST EQUIPMENT	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 -Earth Tester (Measures Earth resistance)	
	Tool Kit	:All necessary tools for radar maintenance for electrical/mechanical
	Step Ladder Type	: Extension type 11m
	Grease with pump and oil with jug for antenna	

Consumables	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 maintenance and support plan, including on-site training, remote troubleshooting, and software updates, for critical issues for a period of three (03) years. Radar Spare Parts Availability Guarantee (excluding PC and other computing peripherals) for period not less than 15 years.

Additional Software/hardware Features:

1) The Radar Control Processor (RCP) system should be having required menu driven software with GUI for Operating the Radar.
2) The antenna tracking sweep should be visible on all the visualization/ application software display systems.
3) The process of setup of various scan parameters should be easily accessible to operators using a workstation GUI.
4) Software should have storm tracking and nowcasting features.
5) Generation of storm vectors (SCITs).
6) Setup of display overlayed on map of Pakistan with political boundaries of international borders, provinces and district boundaries, river catchment etc. using shape files.
7) Provision to incorporate the Bias Values for correction
8) Monitoring the health of the Radar as well as logging of subsystem level information at fixed intervals while Radar in operation.
9) 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.
10) The system should be capable of detecting failures of subsystems and should provide indication remotely.
11) System should have the feature of blanking RF radiation for selective sector.
12) 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.
13) System should have provision for remote access for monitoring and control including equipment power supply.
14) The base data (output of Radar processor) shall be stored and accessible to the user. 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.

15) 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.
16) Display applications for 3D rendering of data in a workstation and a web interface for accessing 2D data via a browser.
17) Should be a fully scalable system architecture and works just as well with a single radar as a network of radars.
18) Integration of Radar system in existing PMD RADARs network to enable central management, data archiving and generation of integrated products.
19) 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.
20) Provision of radar software (Client / Server architecture).
21) Software should be fully licensed and supports installation /operation on any work station specification defined by the client.
22) The final composite view (web based) 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
23) IQ data should be available for archival.
24) Generation of real time Mosaic view with existing radars of PMD.
25) Generation of movie loop and saving it in .mp4/.gif format. Comprehensive combination products such as Severe Weather Indicator (consisting of meso-cyclone detection, divergence and convergence detection and storm structure analysis).

TDME (Test Diagnostic Measurement Equipment)

1) ATE/ STTE : Automatic Test Equipment, Solid State Test Equipment for Simulation
2) Complete consumable / replaceable components list required during repairing / replacement, along with warranty of provision of such components for not less than 15 years.
3) List of single point failure component.
4) Software: packages to run TDME with firmware, O.S and procedure manuals

Inspections and Tests

The following inspections and tests shall be performed:

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

- Factory Acceptance Test (FAT)

A Factory Acceptance Test (FAT) for radars will include inspections, tests, and evaluations conducted at the manufacturer's facility before the radar system is shipped to the customer. The purpose will be to verify that the system meets contractual requirements, specifications, and operational performance criteria.

Key Aspects of Radar FAT:

1. Visual and Mechanical Inspection
Check physical integrity and build quality
Verify dimensions, connectors, and labeling
Inspect materials and components for compliance with standards

2. Power and Electrical Testing
Power-on self-test (POST)
Voltage, current, and grounding checks
EMI/EMC compliance tests (if applicable)

3. Functional Testing
Verify radar start-up and shutdown procedures
Test radar subsystems (transmitter, receiver, signal processor, display)
Check interface with external systems (e.g., networks, power sources)

4. Performance Testing
Measure range, resolution, and accuracy
Doppler and velocity measurement accuracy
Detection and tracking of test targets (if applicable)
Beam pattern and antenna performance tests

5. Software and Algorithm Verification
Verify radar signal processing algorithms
Check firmware and software stability
Test control interfaces and user interface functionality

6. Environmental and Stress Testing (if required)
Temperature and humidity tests
Vibration and shock tests
RF interference and noise immunity tests

7. Safety and Compliance Checks
Ensure compliance with safety standards (e.g., radiation exposure limits)
Confirm adherence to regulatory requirements (e.g., FCC, MIL-STD)

8. Documentation Review
Verify user manuals, schematics, and maintenance guides
Ensure test reports, calibration certificates, and compliance documents are complete

FAT Deliverables:
FAT Report with test results and observations
Compliance certificates
Approval sign-off from customer representatives

Once the radar system passes FAT, it is cleared for shipment and installation, followed by Site Acceptance Tests (SAT) at the deployment location.

- Site Acceptance Test (SAT)

A Site Acceptance Test (SAT) for radars is performed after installation at the operational site to verify that the system functions correctly in its actual environment and meets all contractual and performance requirements. SAT ensures the radar is fully operational before being handed over to the end user.

Key Aspects of Radar SAT:

1. Physical and Installation Verification
Verify correct placement and alignment of radar components (antenna, transmitter, receiver, processor, display units).
Check structural integrity (e.g., mounting, cabling, grounding).

Confirm environmental protections (e.g., waterproofing, ventilation, surge protection).

2. Power and Electrical Checks
Measure power supply voltage, current, and grounding.
Verify backup power functionality (UPS, generator, battery systems).
Check electromagnetic interference (EMI) and electromagnetic compatibility (EMC).

3. Communication and Network Integration
Test data transmission between radar and control centers.
Validate integration with existing networks (e.g., ATC systems, defense networks).
Ensure proper synchronization with GPS or timing systems if applicable.

4. System Boot-up and Functional Testing
Verify correct startup sequence and system initialization.
Test operator control interfaces, displays, and remote monitoring.
Validate system self-tests and diagnostics.

5. Performance Testing in Real-world Conditions
Range and Resolution Testing: Confirm radar detects targets at expected distances and resolutions.
Tracking and Detection Tests: Ensure radar can detect, track, and classify targets correctly.
Clutter Rejection Tests: Verify radar's ability to filter out unwanted signals (e.g., terrain, weather, sea clutter).
Beam Pattern and Coverage Verification: Test radar's azimuth, elevation, and coverage area.
Doppler and Velocity Measurements: Validate moving target detection and speed accuracy.

6. Environmental and Stress Testing
Check performance under different weather conditions (rain, fog, high/low temperatures).
Conduct vibration and wind resistance tests if required.
Test lightning and surge protection measures.

7. Safety and Compliance Verification
Confirm compliance with radiation exposure limits and safety protocols.
Verify regulatory compliance (e.g., ICAO, FAA, MIL-STD, ITU regulations).
Ensure safe operational procedures are documented and followed.

8. End-User Training and Documentation Review
Conduct training sessions for operators and maintenance personnel.
Review and hand over operational manuals, maintenance guides, and technical documentation.
Provide SAT test reports and certificates of compliance.

SAT Deliverables:
SAT Report: Summary of tests conducted, results, and observations.
Deficiency List (if any): Issues to be resolved before final acceptance.
Final Approval Sign-Off: Customer acknowledgment that radar meets operational requirements.

Technical Specifications of C-band Dual Polarization Doppler Weather Radar

Technical Specifications of C-band Pulse Compression Solid-state (SSPA) Dual Polarization Doppler Weather Radar

Radome	Quantity	: 1 set
	Type	: Sandwich panel (spherical surface)
	Dimension	: Approx. 8m – 9m diameter
	Surface	: White colour, suitable non-observant and non-water stickling finish
	Survival wind speed	: 90m/sec.
	Suitable frequency	: Transmitting frequency
	Transmission loss	: 0.5dB or less on one way path in dry
	Relative humidity	: 0% - 100%
	Lightning protection	: Lightning rod (protecting angles: 60 degrees)
	Obstruction light	: LED (red colour), automatic switch control (on/off), waterproof
	Steel base ring including necessary installation materials	
Antenna	Quantity	: 1 set
	Type	: Parabolic antenna
	Reflector size	: Approx. 4m – 5m diameter
	Suitable frequency	: Transmitting frequency
	Beam width	: 1.0 degrees or less at -3dB point without Radome
	Antenna gain	: 44.5dB without Radome
	Polarization	: Simultaneous, dual polarization (horizontal and vertical)
	1st Side lobe level	: -26dB or less without Radome
	Angular positioning accuracy	: 0.1 degrees or less
	Driving range	: Azimuth 360 degrees, elevation -2 degrees – +90 degrees
	Rotation speed	
	Azimuth	: 0rpm to 6rpm , selectable
	Elevation	: 0 to 3.6 degrees per second
	VSWR	: 1.4 or less without Radome
	Dehydrator	: Yes
	BITE	: Web-browser based BITE with trend graphics
Transmitter	Quantity	: 1 set
	Transmitter type	: Solid-state power amplifier
	Transmitting frequency	: 5,300MHz – 5,700MHz (± 4MHz) [The specific available band/Tuneable frequency from FAB(Frequency Allocation Board Pakistan) will be communicated by Project Manager]
	Occupied frequency bandwidth: 8MHz	
	Short pulse width operation	: Transmitting frequency +2.00MHz or lower
	Long pulse width operation	: Transmitting frequency -2.00MHz
	Transmitting power	: 2KW peak (each for horizontal and vertical at Tx output)
	Power amplifier protection	: to inhibit operation individually in case of abnormal high temperature in chassis
	Radiation blanking	: It shall be able to set both azimuth and elevation
	Pulse width	: 1μs to 200μs or shorter

	*Short pulse and long pulse are combined for the observation period Pulse repetition frequency (PRF): from 250Hz to 1,500Hz, selectable Duty : 10% Maximum
Digital Receiver & Signal Processor	Quantity : 1 set
	Receiver type : Coherent IF digitizer Noise figure of the high frequency circuit : 3dB or less at the input terminal of low noise amplifier (LNA) Sensitivity : -110dBm Maximum Range bin : 2000 Processing area : (Intensity mode) throughout 0 km to 300km in range and 0 to 360 degrees in azimuth (Doppler mode) throughout 0 km to 150km in range and 0 to 360 degrees in azimuth Intensity signal process: -Dynamic range : 90dB -Logarithmic linearity: within ±1dB throughout 70dB -Range correction: depending on radar equation -Air-attenuation correction: 0.01dB/km in observation range Velocity signal process: -Processing type: pulse pair or FFT (selectable) -Trigger control: Dual-PRF ratio selectable (2:3, 3:4, 4:5) -De-aliasing of doppler velocity: Real-time processing by Dual-PRF 2nd-trip echo suppression: Real-time processing by random phase control Output data : Reflectivity (Z), Doppler velocity (V), Spectrum width (W), Differential reflectivity (ZDR), Differential phase shift (φDP), Polarimetric correlation coefficient (ρHV) Output data grid Azimuth : 1 degree or less Range : 150m or finer at 300km observation range Output data resolution : 2 bytes (16 bits) Output data indicating Interval : within 1 minute after automatic scan Receiver Protector : Yes

Duplexer	Quantity : 1 set
	Type : Dual backup type TR limiter or isolator with diode limiter
Radar Controller	Quantity : 1 set
	Hardware CPU : Intel® Xeon or equivalent latest generation & Series Main memory (RAM) : 64GB Hard disk : 1TB (SSD) x (RAID-5) LAN interface: : 10Base-T, 100Base-TX and 1000Base-T, two (2) port Monitor display : Color LCD type, 19 inches Input power : AC 230V, single phase, 50Hz Accessories : English keyboard, mouse, LAN arrester (RJ45) Software • Operating System platform independent • Up to 10 years Upgradable Software on Latest Operating System Version • Software without hardware binding

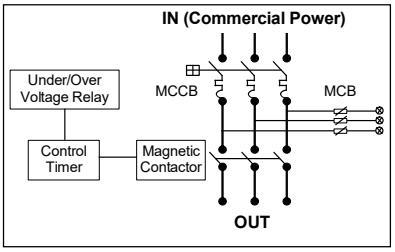
	Application software: [Radar control and monitoring] -Antenna scanning and radiation to control by pointing device -Monitoring of the result of the radar control -Fault monitoring including temperature alarm inside of the equipment -True north confirmation [Observation scheduling] -Antenna scanning mode (PPI, RHI, Volume Scan) -Elevation angle setting -Selection of pulse width (Long range observation mode / Short range observation mode) -Resolution of the azimuth and range -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)) -Setting for the clutter filter level -Selection of PRF and processing mode [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 Main memory (RAM) : 64GB Hard disk : 1TB (SSD) x (RAID-5) LAN interface: : 10Base-T, 100Base-TX and 1000Base-T, two (2) port Monitor display : Color LCD type, 19 inches Input power : AC 230V, single phase, 50Hz Accessories : English keyboard, mouse, LAN arrester (RJ45) Software • Operating System platform independent • Up to 10 years Upgradable Software on Latest Operating System Version • Software without hardware binding Application software: [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/API or other compatible protocols.

	[Parameter setting] -Setting of dissemination schedule -Selection of products to be disseminated [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 Main memory (RAM) : 64GB Hard disk : 1TB (SSD) x (RAID-5) LAN interface: : 10Base-T, 100Base-TX and 1000Base-T, two (2) port Monitor display : 65 inches -LED or video wall Input power : AC 230V, single phase, 50Hz Accessories : English keyboard, mouse, LAN arrester (RJ45) Software • Operating System platform independent • Up to 10 years Upgradable Software on Latest Operating System Version • Software without hardware binding Application software: [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) -3-dimensional data display -Warning output of heavy rainfall -Rainfall and strong wind warning output of specified district -Calculation of KDP from φDP -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 and microburst 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 (Forward and Reverse) [Automatic shutdown] -Automatic graceful shutdown upon signal from the Power Backup Unit

Radar Power Maintenance Panel	Quantity	: 1 set
	Circuit breaker Main breaker Power distribution Input power Output power	: No-fuse-breaker type : No-fuse-breaker type or magnetic-breaker : No. of outputs as required including 2 spare : AC 400V, three phase four wire, 50Hz : AC 230V, single phase two wire, 50Hz
Dual Switch	Quantity	: 1 set
	LAN interface Connection port Input power Each port and power supply shall be duplicated	: IEEE 802.3 Ethernet : 100BASE-TX , eight (8) ports : AC 230V, single phase, 50Hz
Dual Optical Repeater	Quantity	: 2 sets
	LAN interface Connection port	: IEEE 802.3 Ethernet : 100BASE-TX : one (1) port , 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 , three (3) ports 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 triple pole Magnetic contactor triple pole Control breaker, single pole MCB Under and over voltage relay, 500V Control timer 0-30sec. Indication lamp 
Isolation Transformer	Quantity : 1 set
	Capacity : 20kVA Input power : AC 360V, 370V, 380V, 400V selectable, three phase four wire, 50Hz Output power : AC 400V, three phase four wire, 50Hz Insulation : Class B Surge voltage : 30kV
Automatic Voltage Regulator (AVR)	Quantity : 1 set
	Capacity : 25 KVA Input power : AC 400V ±20%, three phase four wire, 50Hz Output power : AC 400V ±5%, three phase four wire, 50Hz
Power Backup Unit	Quantity : 1 set
	Input voltage : AC 400V, three phase four wire, 50Hz Output voltage : AC 400V, three phase four wire, 50Hz Back up time : 20 minutes or longer for all the equipment indicated above Energy storage : Lithium-ion battery Others : Bypass function
Grounding System	Quantity : 2 set
	The installation of complete grounding system for the protection of radar equipment and its peripherals at the site. The grounding procedures must comply with national and international regulations. Groundig test terminals : 3 Grounding terminal box : Number of terminals as required, with a connection cable to the grounding cable Grounding resistance value : 5 or less

Diesel Engine Generator for supporting all the Radar Equipment and the Air Conditioner specified below	Quantity	: 1 set
	Output Output voltage Frequency Control unit Exhaust System Fuel tank Accessories	: 30KVA at continuous : AC 400V, three phase four wire : 50Hz : Automatic transfer switch : Silencer, expansion joints, vibration isolators and flexible connections : 500L : Starting battery, fuel supply & lubricating systems, lubricating oil supply system, steel structural common bed and anchor bolts for generator and auxiliaries, spare parts for 3,000 hours and tools for maintenance.
Hybrid Solar System with Green meter	20KVA	
Air Conditioners for Radar Equipment and operation room		
	Type Capacity Automatic operation Controller	: Air cooled floor/wall mounted type : Inverter AC's as per the cooling requirement of the equipment : Thermostatic control : Body/Remote type

Spare Parts	Timing belt for antenna (for azimuth drive)	1 set
	Timing belt for antenna (for elevation drive)	1 set
	Encoder or resolver for antenna (for azimuth angle signal)	1 set
	Encoder or resolver for antenna (for elevation angle signal)	1 set
	Motor for antenna (for azimuth drive)	1 set
	Motor for antenna (for elevation drive)	1 set
	Servo unit for antenna controller (for azimuth drive)	1 set
	Servo unit for antenna controller (for elevation drive)	1 set
	Power supply unit for antenna controller	1 set
	Power supply unit for transmitter	1 set
	Power supply unit for digital receiver and signal processor	1 set
	Solid-state power amplifier	5 sets (if modules are in cascaded) otherwise 1 spare module amplifier
	Signal processor	1 set
	Receiver	1 set
	Fan unit for radar equipment	2 sets
	LAN arrester	3 sets
	Obstruction light	1 set
	Solid State Back up of all Softwares for radar operation	2 sets
External Storage (Network Access Storages(NAS) based)	Shall provide sufficient storage capacity (at least 100 TB) for saving the last 10 years of Radar data	

Step-down Transformer	Capacity : 200kVA (or as per the requirement of the Office) Output power : AC 400V, three phase four wire, 50Hz
TEST EQUIPMENT	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 -Earth Tester (Measures Earth resistance) Tool Kit :All necessary tools for radar maintenance for electrical/mechanical Step Ladder Type : Extension type 11m
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 maintenance and support plan, including on-site training, remote troubleshooting, and software updates, for critical issues for a period of three (03) years. Radar Spare Parts Availability Guarantee (excluding PC and other computing peripherals) for period not less than 15 years.

Additional Software/hardware Features:

1) The Radar Control Processor (RCP) system should be having required menu driven software with GUI for Operating the Radar.

2) The antenna tracking sweep should be visible on all the visualization/ application software display systems.
3) The process of setup of various scan parameters should be easily accessible to operators using a workstation GUI.
4) Software should have storm tracking and nowcasting features.
5) Generation of storm vectors (SCITs).
6) Setup of display overlayed on map of Pakistan with political boundaries of international borders, provinces and district boundaries, river catchment etc. using shape files.
7) Provision to incorporate the Bias Values for correction
8) Monitoring the health of the Radar as well as logging of subsystem level information at fixed intervals while Radar in operation.
9) 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.
10) The system should be capable of detecting failures of subsystems and should provide indication remotely.
11) System should have the feature of blanking RF radiation for selective sector.
12) 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.
13) System should have provision for remote access for monitoring and control including equipment power supply.
14) The base data (output of Radar processor) shall be stored and accessible to the user. 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.
15) 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.
16) Display applications for 3D rendering of data in a workstation and a web interface for accessing 2D data via a browser.
17) Should be a fully scalable system architecture and works just as well with a single radar as a network of radars.
18) Integration of Radar system in existing PMD RADARs network to enable central management, data archiving and generation of integrated products.
19) 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.
20) Provision of radar software (Client / Server architecture).
21) Software should be fully licensed and supports installation /operation on any work station specification defined by the client.
22) The final composite view (web based) 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
23) IQ data should be available for archival.
24) Generation of real time Mosaic view with existing radars of PMD.
25) Generation of movie loop and saving it in .mp4/.gif format. Comprehensive combination products such as Severe Weather Indicator (consisting of meso-cyclone detection, divergence and convergence detection and storm structure analysis).

TDME (Test Diagnostic Measurement Equipment)

1) ATE/ STTE : Automatic Test Equipment, Solid State Test Equipment for Simulation
2) Complete consumable / replaceable components list required during repairing / replacement, along with warranty of provision of such components for not less than 15 years.
3) List of single point failure component.
4) Software: packages to run TDME with firmware, O.S and procedure manuals

Inspections and Tests

The following inspections and tests shall be performed:

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

- Factory Acceptance Test (FAT)

A Factory Acceptance Test (FAT) for radars will include inspections, tests, and evaluations conducted at the manufacturer's facility before the radar system is shipped to the customer. The purpose will be to verify that the system meets contractual requirements, specifications, and operational performance criteria.

Key Aspects of Radar FAT:

1. Visual and Mechanical Inspection
Check physical integrity and build quality
Verify dimensions, connectors, and labeling
Inspect materials and components for compliance with standards

2. Power and Electrical Testing
Power-on self-test (POST)
Voltage, current, and grounding checks
EMI/EMC compliance tests (if applicable)

3. Functional Testing
Verify radar start-up and shutdown procedures
Test radar subsystems (transmitter, receiver, signal processor, display)
Check interface with external systems (e.g., networks, power sources)

4. Performance Testing
Measure range, resolution, and accuracy
Doppler and velocity measurement accuracy
Detection and tracking of test targets (if applicable)
Beam pattern and antenna performance tests

5. Software and Algorithm Verification
Verify radar signal processing algorithms
Check firmware and software stability
Test control interfaces and user interface functionality

6. Environmental and Stress Testing (if required)
Temperature and humidity tests
Vibration and shock tests
RF interference and noise immunity tests

7. Safety and Compliance Checks
Ensure compliance with safety standards (e.g., radiation exposure limits)

Confirm adherence to regulatory requirements (e.g., FCC, MIL-STD)
8. Documentation Review
Verify user manuals, schematics, and maintenance guides
Ensure test reports, calibration certificates, and compliance documents are complete

FAT Deliverables:
FAT Report with test results and observations
Compliance certificates
Approval sign-off from customer representatives

Once the radar system passes FAT, it is cleared for shipment and installation, followed by Site Acceptance Tests (SAT) at the deployment location.

- Site Acceptance Test (SAT)

A Site Acceptance Test (SAT) for radars is performed after installation at the operational site to verify that the system functions correctly in its actual environment and meets all contractual and performance requirements. SAT ensures the radar is fully operational before being handed over to the end user.

Key Aspects of Radar SAT:

1. Physical and Installation Verification
Verify correct placement and alignment of radar components (antenna, transmitter, receiver, processor, display units).
Check structural integrity (e.g., mounting, cabling, grounding).
Confirm environmental protections (e.g., waterproofing, ventilation, surge protection).

2. Power and Electrical Checks
Measure power supply voltage, current, and grounding.
Verify backup power functionality (UPS, generator, battery systems).
Check electromagnetic interference (EMI) and electromagnetic compatibility (EMC).

3. Communication and Network Integration
Test data transmission between radar and control centers.
Validate integration with existing networks (e.g., ATC systems, defense networks).
Ensure proper synchronization with GPS or timing systems if applicable.

4. System Boot-up and Functional Testing
Verify correct startup sequence and system initialization.
Test operator control interfaces, displays, and remote monitoring.
Validate system self-tests and diagnostics.

5. Performance Testing in Real-world Conditions
Range and Resolution Testing: Confirm radar detects targets at expected distances and resolutions.
Tracking and Detection Tests: Ensure radar can detect, track, and classify targets correctly.
Clutter Rejection Tests: Verify radar's ability to filter out unwanted signals (e.g., terrain, weather, sea clutter).
Beam Pattern and Coverage Verification: Test radar's azimuth, elevation, and coverage area.
Doppler and Velocity Measurements: Validate moving target detection and speed accuracy.

6. Environmental and Stress Testing
Check performance under different weather conditions (rain, fog, high/low temperatures).
Conduct vibration and wind resistance tests if required.
Test lightning and surge protection measures.

7. Safety and Compliance Verification
Confirm compliance with radiation exposure limits and safety protocols.
Verify regulatory compliance (e.g., ICAO, FAA, MIL-STD, ITU regulations).
Ensure safe operational procedures are documented and followed.

8. End-User Training and Documentation Review
Conduct training sessions for operators and maintenance personnel.
Review and hand over operational manuals, maintenance guides, and technical documentation.
Provide SAT test reports and certificates of compliance.

SAT Deliverables:
SAT Report: Summary of tests conducted, results, and observations.
Deficiency List (if any): Issues to be resolved before final acceptance.
Final Approval Sign-Off: Customer acknowledgment that radar meets operational requirements.

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

Technical Specifications of X-band Pulse Compression Solid-state (SSPA) Dual Polarization Doppler Weather Radar

Radome	Quantity	: 1 set
	Type	: Sandwich panel
	Dimension	: Approx. 1.5m – 3m diameter
	Surface	: White colour, gel coat finish
	Survival wind speed	: 70m/sec.
	Suitable frequency	: Transmitting frequency
	Transmission loss	: 0.3dB or less on one way path in dry
	Relative humidity	: 0% - 100%
	Lightning protection	: Lightning rod with a pole beside of Radome (Protecting angles: 60 degrees)
Antenna	Quantity	: 1 set
	Type	: Parabolic antenna
	Reflector size	: Approx. 1.5m – 2.5m diameter
	Suitable frequency	: Transmitting frequency
	Beam width	: 1.5 degrees or less at -3dB point without Radome
	Antenna gain	: 37dB without Radome
	Polarization	: Simultaneous, dual polarization (horizontal and vertical)
	1st Side lobe level	: -20dB or less without Radome
	Angular positioning accuracy	: 0.1 degrees or less
	Driving range	: Azimuth 360 degrees, elevation -2 degrees – +90 degrees or wider
	Rotation speed	
	Azimuth	: 0 to 6rpm , selectable
	Elevation	: 0 to 2rpm , selectable
Transmitter	Quantity	: 1 set
	Transmitter type	: Solid-state power amplifier
	Transmitting frequency	: 9,300MHz – 9,700MHZ (±2.5MHz) [The specific available band/Tuneable frequency from FAB(Frequency Allocation Board Pakistan) will be communicated by Project Manager]
	Occupied frequency bandwidth: 5MHz or less	
	Transmitting power	: 100W peak (each for horizontal and vertical at Tx output)
	Radiation blanking	: It shall be able to set both azimuth and elevation
	Pulse width	: from 1µs to 50µs
	*Short pulse and long pulse are combined for the observation period	
	Pulse repetition frequency (PRF): from 900Hz to 2,000Hz, selectable	
	Duty	: 10% Maximum
Digital Receiver & Signal Processor	Quantity	: 1 set
	Receiver type	: Coherent IF digitizer
	Noise figure of the high frequency circuit	: 3.5dB or less at the input terminal of low noise amplifier (LNA)
	Sensitivity	: -110dBm
	Maximum Range bin	: 1000
	Processing area	: (Intensity mode) throughout 0 km to 80km in range and 0 to 360 degrees in azimuth

		(Doppler mode) throughout 0 km to 80km in range and 0 to 360 degrees in azimuth
	Intensity signal process:	
		-Dynamic range : 90dB -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 (Depends on PRF)
	Output data	
		: Reflectivity (Z), Doppler velocity (V), Spectrum width (W), Differential reflectivity (ZDR), Differential phase shift (φDP), Polarimetric correlation coefficient (ρHV)
	Output data grid	
	Azimuth	: 1 degree or less
	Range	: 100m or finer
	Output data resolution	: 2 bytes (16 bits)
	Receiver Protector	: Yes

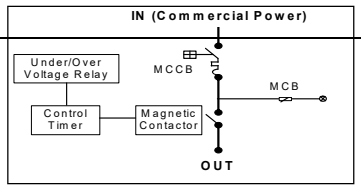
Duplexer	Quantity	: 1 set
	Type	: Dual backup type TR limiter or circulator with diode limiter
Radar Controller	Quantity	: 1 set
	Hardware CPU Main memory (RAM) Hard disk LAN interface: Monitor display Input power Accessories	 : Intel® Xeon or equivalent latest generation & Series : 64GB : 1TB (SSD) x (RAID-5) : 10Base-T, 100Base-TX and 1000Base-T, two (2) port : Color LCD type, 19 inches : AC 230V, single phase, 50Hz : English keyboard, mouse, LAN arrester (RJ45)
	Software • Operating System platform independent • Up to 10 years Upgradable Software on Latest Operating System Version • Software without hardware binding [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 Main memory (RAM) : 64GB Hard disk : 1TB (SSD) x (RAID-5) LAN interface: : 10Base-T, 100Base-TX and 1000Base-T, two (2) port Monitor display : Color LCD type, 19 inches Input power : AC 230V, single phase, 50Hz Accessories : English keyboard, mouse, LAN arrester (RJ45) Software • Operating System platform independent • Up to 10 years Upgradable Software on Latest Operating System Version • Software without hardware binding [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/API 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 Main memory (RAM) : 64GB Hard disk : 1TB (SSD) x (RAID-5) LAN interface: : 10Base-T, 100Base-TX and 1000Base-T, two (2) port Monitor display : 65 inches LED or video wall Input power : AC 230V, single phase, 50Hz Accessories : English keyboard, mouse, LAN arrester (RJ45) Software • Operating System platform independent • Up to 10 years Upgradable Software on Latest Operating System Version • Software without hardware binding [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 Main breaker Power distribution Input power Output power	: No-fuse-breaker type : No-fuse-breaker type or magnetic-breaker : No. of outputs as required including 2 spare : AC 230V, single phase two wire, 50Hz : AC 230V, single phase two wire, 50Hz
Dual Switch	Quantity	: 1 set
	LAN interface Connection port Input power Each port and power supply shall be duplicated	: IEEE 802.3 Ethernet : 100BASE-TX , eight (8) ports : AC 230V, single phase, 50Hz
Dual Optical Repeater	Quantity	: 2 sets
	LAN interface Connection port Input power Each port and power supply shall be duplicated.	: IEEE 802.3 Ethernet : 100BASE-TX : one (1) port , optical fiber interface: one (1) set, multi-mode (100Mbps) : AC 230V, single phase, 50Hz
Optical Fiber Cable	Quantity	: 1 set
	Cable type Connector Length	: Multi mode 2C : ST : As per requirements
Dual Router	Quantity	: 1 set
	LAN interface Connection port Routing Input power Each port and power supply shall be duplicated	: IEEE 802.3 Ethernet : 100BASE-TX , three (2) ports : IP routing : AC 230V, single phase, 50Hz
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	: 20 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
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
	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
	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.
Transformer Hybrid Solar Systen with Green Meter	50 KVA 3 phase commercial 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 (Network Access Storages(NAS) based)	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 -Earth Tester (Measures Earth resistance) Tool Kit :All necessary tools for radar maintenance for electrical/mechanical Step Ladder Type : Extension type 5m
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 maintenance and support plan, including on-site training, remote troubleshooting, and software updates, for critical issues for a period of three (03) years. Radar Spare Parts Availability Guarantee (excluding PC and other computing peripherals) for period not less than 15 years.

Additional Software/hardware Features:

1) The Radar Control Processor (RCP) system should be having required menu driven software with GUI for Operating the Radar.
2) The antenna tracking sweep should be visible on all the visualization/ application software display systems.
3) The process of setup of various scan parameters should be easily accessible to operators using a workstation GUI.
4) Software should have storm tracking and nowcasting features.
5) Generation of storm vectors (SCITs).
6) Setup of display overlayed on map of Pakistan with political boundaries of international borders, provinces and district boundaries, river catchment etc. using shape files.
7) Provision to incorporate the Bias Values for correction
8) Monitoring the health of the Radar as well as logging of subsystem level information at fixed intervals while Radar in operation.
9) 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.
10) The system should be capable of detecting failures of subsystems and should provide indication remotely.
11) System should have the feature of blanking RF radiation for selective sector.
12) 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.
13) System should have provision for remote access for monitoring and control including equipment power supply.
14) The base data (output of Radar processor) shall be stored and accessible to the user. 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.
15) 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.
16) Display applications for 3D rendering of data in a workstation and a web interface for accessing 2D data via a browser.
17) Should be a fully scalable system architecture and works just as well with a single radar as a network of radars.
18) Integration of Radar system in existing PMD RADARs network to enable central management, data archiving and generation of integrated products.

19) 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.
20) Provision of radar software (Client / Server architecture).
21) Software should be fully licensed and supports installation /operation on any work station specification defined by the client.
22) The final composite view (web based) 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
23) IQ data should be available for archival.
24) Generation of real time Mosaic view with existing radars of PMD.
25) Generation of movie loop and saving it in .mp4/.gif format. Comprehensive combination products such as Severe Weather Indicator (consisting of meso-cyclone detection, divergence and convergence detection and storm structure analysis).

TDME (Test Diagnostic Measurement Equipment)

1) ATE/ STTE : Automatic Test Equipment, Solid State Test Equipment for Simulation
2) Complete consumable / replaceable components list required during repairing / replacement, along with warranty of provision of such components for not less than 15 years.
3) List of single point failure component.
4) Software: packages to run TDME with firmware, O.S and procedure manuals

Inspections and Tests

The following inspections and tests shall be performed:

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

- Factory Acceptance Test (FAT)

A Factory Acceptance Test (FAT) for radars will include inspections, tests, and evaluations conducted at the manufacturer's facility before the radar system is shipped to the customer. The purpose will be to verify that the system meets contractual requirements, specifications, and operational performance criteria.

Key Aspects of Radar FAT:

1. Visual and Mechanical Inspection
Check physical integrity and build quality
Verify dimensions, connectors, and labeling
Inspect materials and components for compliance with standards

2. Power and Electrical Testing
Power-on self-test (POST)
Voltage, current, and grounding checks
EMI/EMC compliance tests (if applicable)

3. Functional Testing
Verify radar start-up and shutdown procedures
Test radar subsystems (transmitter, receiver, signal processor, display)
Check interface with external systems (e.g., networks, power sources)

4. Performance Testing
Measure range, resolution, and accuracy
Doppler and velocity measurement accuracy
Detection and tracking of test targets (if applicable)
Beam pattern and antenna performance tests

5. Software and Algorithm Verification
Verify radar signal processing algorithms
Check firmware and software stability
Test control interfaces and user interface functionality

6. Environmental and Stress Testing (if required)
Temperature and humidity tests
Vibration and shock tests
RF interference and noise immunity tests

7. Safety and Compliance Checks
Ensure compliance with safety standards (e.g., radiation exposure limits)
Confirm adherence to regulatory requirements (e.g., FCC, MIL-STD)

8. Documentation Review
Verify user manuals, schematics, and maintenance guides
Ensure test reports, calibration certificates, and compliance documents are complete

FAT Deliverables:
FAT Report with test results and observations
Compliance certificates
Approval sign-off from customer representatives

Once the radar system passes FAT, it is cleared for shipment and installation, followed by Site Acceptance Tests (SAT) at the deployment location.

- Site Acceptance Test (SAT)

A Site Acceptance Test (SAT) for radars is performed after installation at the operational site to verify that the system functions correctly in its actual environment and meets all contractual and performance requirements. SAT ensures the radar is fully operational before being handed over to the end user.

Key Aspects of Radar SAT:

1. Physical and Installation Verification
Verify correct placement and alignment of radar components (antenna, transmitter, receiver, processor, display units).
Check structural integrity (e.g., mounting, cabling, grounding).
Confirm environmental protections (e.g., waterproofing, ventilation, surge protection).

2. Power and Electrical Checks
Measure power supply voltage, current, and grounding.
Verify backup power functionality (UPS, generator, battery systems).
Check electromagnetic interference (EMI) and electromagnetic compatibility (EMC).

3. Communication and Network Integration
Test data transmission between radar and control centers.
Validate integration with existing networks (e.g., ATC systems, defense networks).
Ensure proper synchronization with GPS or timing systems if applicable.

4. System Boot-up and Functional Testing
Verify correct startup sequence and system initialization.
Test operator control interfaces, displays, and remote monitoring.
Validate system self-tests and diagnostics.

5. Performance Testing in Real-world Conditions
Range and Resolution Testing: Confirm radar detects targets at expected distances and resolutions.
Tracking and Detection Tests: Ensure radar can detect, track, and classify targets correctly.
Clutter Rejection Tests: Verify radar's ability to filter out unwanted signals (e.g., terrain, weather, sea clutter).
Beam Pattern and Coverage Verification: Test radar's azimuth, elevation, and coverage area.
Doppler and Velocity Measurements: Validate moving target detection and speed accuracy.

6. Environmental and Stress Testing
Check performance under different weather conditions (rain, fog, high/low temperatures).
Conduct vibration and wind resistance tests if required.
Test lightning and surge protection measures.

7. Safety and Compliance Verification
Confirm compliance with radiation exposure limits and safety protocols.
Verify regulatory compliance (e.g., ICAO, FAA, MIL-STD, ITU regulations).
Ensure safe operational procedures are documented and followed.

8. End-User Training and Documentation Review
Conduct training sessions for operators and maintenance personnel.
Review and hand over operational manuals, maintenance guides, and technical documentation.
Provide SAT test reports and certificates of compliance.

SAT Deliverables:
SAT Report: Summary of tests conducted, results, and observations.
Deficiency List (if any): Issues to be resolved before final acceptance.
Final Approval Sign-Off: Customer acknowledgment that radar meets operational requirements.