

Annex No. 1

Technical Specifications

The Contracting Authority requires supplying the equipment which complies with the following minimum technical parameters:

Delivery specifications:

The delivery must include a meteorological radar (hereinafter the "**radar**") located at the Observatory Milešovka of the Institute of Atmospheric Physics of the Czech Academy of Sciences, Czech Republic. Radar must be operating in a fully unattended and remotely controlled regime from the workplace of the Institute of Atmospheric Physics of the Czech Academy of Sciences in Prague.

The protection against lightning must be part of the delivery either in passive or active form.

The delivery must include computer server to run applications installed at the Observatory Milešovka; further supply of appropriate computer hardware and software for the radar to monitor and control various components of the radar; and software for signal processing and evaluation of radar measurements; installation and testing work (installation of the radar station, acceptance tests, software configuration, supply of the appropriate documentation for the radar; appropriate training of radar operators).

Further specifications of the public tender are specified lower in the technical parameters and in the proposal of purchase contract, which is annexed to this tender documentation.

The following technical requirements of the equipment are considered as minimum requirements that must be fulfilled. In case, when the bidder will offer an equipment which does not conform to the technical conditions specified below or an equipment which does not contain all the components described below, the bidder will be excluded from the tender on the basis of failure to comply with the terms and conditions specified by Contracting Authority tender.

The Contracting Authority requires that the equipment was brand new, fully functional and complete.

Technical parameters:

A) Radar system - General characteristics:

- A fully Doppler radar system operating in the X-band (8-12 GHz) in pulse mode or FMCW must be delivered;
- Radar must allow dual polarimetric measurements (STAR; Simultaneous Transmission And Reception);
- Radar must perform digital signal processing starting from the intermediate frequency;
- Data output and consumer products must be in digital form;
- Technical parameters of the radar must fulfil the detection of precipitation (rainrate above 3 mm/h) in the range of 50 km;

- Radar must allow to exclude certain areas in horizontal as well as vertical direction from the scanned area;
- The supplied equipment will meet the EMC.

B) Construction of the radar system:

- All components of the device must be brand new and their age should not exceed 12 months at the date of the completion of Site Acceptance Test (SAT). Contract Authority expressly notes that prototypes and remanufactured components of the older equipment are not permitted;
- Maximum input power supply of all equipment ensuring 24-hour operation of the radar cannot exceed 1 kW;
- Equipment must be adapted to the supply network, which comply with DIN EN 50160. The supply voltage is 230 V 50 Hz, single phase connection;
- All electrical equipment must meet the following legislation or regulations:
 - 2014/30 / EU;
 - IEC 61000-4-5: 2014;
 - IEC/EN 62311 Ed1.0:2007;
- Total size of all radar boxes does not exceed 2000 mm in height, 2000 mm in width and 2000 mm in depth;
- Weight of the antenna unit with radome does not exceed 200 kg;
- Radar cabinets and installed technology must meet the operating temperature range of -20°C to +50°C;
- Connectors must be differentiated so that they cannot be connected by mistake;
- The connectors must be capable of withstanding repeated engagement and disengagement (in the framework of service requirements) without damage and degradation;
- All connectors and measuring points must have granted access, which must be described in the technical documentation;
- All components of radar including connectors, cables, circuit boards, etc. must be clearly identified and described - Client requires that all components are documented in English;
- After an interruption of the power supply system shall allow automatic sequential switching (soft start) and start of operational measurement;
- Safety precautions - all the equipment which could be damaged by inappropriate handling or which endanger the health of operators, must include security protection (safety interlock);
- Noise level of radar cabinets should not exceed 70 dBA when measured one meter in front of cabinets. Supplier at SAT performs the necessary measurements and prepares a report of the measurements;
- Radar must be designed for continuous 24-hour operation;
- Manufacturer's recommended maintenance shutdowns must not cause outages of radar measurements exceeding 2% of the total operational time of measurement, i.e. maximum of 168 hours per year;
- The supplier must guarantee availability of spare parts for at least 7 years from the signing of the contract;

- The Contracting Authority requires to deliver service tools that are required to access all measuring points and forced replacement of any components;
- Radar must contain a "network power switch" which enables remote switching on and off of critical blocks of the radar via commands transmitted over a data network.

C) Transmitter:

- Transmitter must be semiconductor or of type RF magnetron (minimum life time of 50,000 hours);
- Transmitting frequency must be in the X-band and at least three frequencies within the X-band must be offered by the Supplier;
- In case of delivery of a FMCW solution, the transmitter power must be at least 4 W and the stability of the transmitted power must be 0.2 dB in the normal operating conditions and time interval of one month;
- Length of the transmitted pulse must be at least in the range of 0.5 to 20 μ s;
- Repetition rate (pulse repetition frequency, PRF) for pulse mode must be user-adjustable within 1-2 kHz. It must be possible to switch the frequency by using software settings within the measurement scenarios without hardware intervention.

D) Antenna:

- Antenna must be parabolic with a gain of at least 30 dBi;
- Beam width should be within 3°;
- The diameter of antenna without radome does not exceed 1500 mm;
- Cross-polarization isolation of the antenna must be greater than 30 dB;
- Rotation unit must allow horizontal scanning in the range of 0 to 360 degrees and vertical scanning in the range of -1 to 90 degrees
- Antenna rotation speed for azimuth must be at least 1 to 10 rpm
- Antenna rotation speed for elevation must be at least 1 to 5 rpm
- The supplier shall define a safe distance for work and the incidence of people from all devices that emit radiation exposure.

E) Receiver:

- Radar delivery must contain a digital receiver (full digitization to an intermediate frequency, at least 14 bit A / D converter);
- The receiver must allow polarimetric measurements;
- Dynamic range must be more than 70 dB including pulse compression gain. The receiver must be low noise - the noise figure must be 3.5 dB at most;

F) Signal Processor:

- Signal processor must ensure evaluating at least the following quantities:
 - reflectivity factor Zh;
 - radial Doppler velocity V;
 - width of the Doppler spectrum W;
 - cross polarization difference;



- differential radar reflectivity factor Zdr;
 - specific differential phase KDP;
 - rainfall intensity (mm/h);
- Range resolution of the radar data must be below or equal to 100 m;
- Number of averaged samples (pulses) for evaluating the radar parameters in the radar beam must be adjustable in the range of at least 20-512;
- Data resolution of output radar data must be at least 8bit (256 levels), reflectivity data in increments of at least 0.5 dBZ, and radial velocity data should linearly cover Nyquist range of velocity.

G) PC software (SW) and hardware (HW):

- PC SW and HW must be delivered at least in the following configuration including:
 - a computing server with installed software for remote interactive control and monitoring of radar equipment as well as software for administration and management of regular radar measurements including radar data processing and measured data sending;
 - Storage capacity for archiving all radar measured data files must cover a period of 6 months at least;
- SW licenses for any software necessary for running the radar measurements and specifically for remote interactive control and monitoring of radar must be delivered.

H) SW for both local and remote interactive control and monitoring of the radar:

- SW for manual control and remote monitoring of the radar must allow the following functions at least:
 - switching off and on of individual parts of the radar;
 - setting of measurement parameters and signal processing;
 - setting of direction in horizontal and vertical plane;
 - displaying actual measured data;
- All errors must be logged in text files. Description of the format of these logged files must be available.

I) SW for creation of advanced products:

- Software for creating advanced products must allow at least the following functions:
 - processing of data from the radar;
 - the possibility of generating products from all evaluated radar measurements.

J) Backup Power Supply UPS:

- Radar system must be able to operate via power supply by the standard UPS.

K) Requirements for spare parts for radar:

- The supplier is obliged to ensure the spare parts supply for a period of 7 years following the successful SAT.

L) Documentation Requirements:

- Contracting Authority declares that all documentation for the device must be in English and delivered in printed and electronic form (including schematics). It must contain at least the following elements:
 - Operator manual - contains instructions and operations necessary for complete control of radar;
 - instructions for basic system settings and data processing and given specific values of important parameters;
 - operation workflow for control of the system and the accuracy of measurements;
 - Technical manual - containing a detailed description of the individual facilities and their maintenance;
 - description of the installation, setup, operation, operational instructions, periodic maintenance and periodic diagnosis;
 - description of the solution of typical problems;
 - Software Guide - containing a description of the programs and data algorithms for signal processing, data collection, product formation and radar control;
 - complete description of the features, structures, control environment, flow and organization of data;
 - description of data processing algorithms for research purposes;
 - detailed description of the file formats for crude, product, control and auxiliary data so that it can be handled by own software;
 - interface description of individual software modules;
 - in case of modification of the software, the documentation must be updated;
- A draft copy of all documentation in both printed and electronic form will be delivered to the Contracting Authority at least one month before the SAT. The final version of the document in three hard copies and electronic form must be received prior to the installation of the radar;
- Approval of the documentation will be part of the approval process;
- Contracting Authority reserves the right to reproduce the entire technical documentation or part thereof in electronic and paper form for internal use;
- Contracting Authority will be entitled to require the update of documentation that occurs:
 - about the same time as any change in hardware or software;
 - in the case of its evident inaccuracy or incompleteness, to which the Contracting Authority notifies the applicant.

M) Requirements for Site Acceptance Test (SAT):

- The supplier will provide the results and official protocol of Factory Acceptance Test (FAT);
- The supplier shall ensure the successful completion of SAT:
 - supplier performs all measurements of transmitter and receiver (transmitted power, frequency, intermediate frequency, receiver, LNA gain, MDS);



- supplier will check the functionality of all software components;
- A 48-hour trouble-free operation of the radar, simulation of normal operating conditions including expected external infrastructure problems (e.g. power interruption or failure data networks) will be part of the SAT;
- The supplier is obliged to provide a list and description of all basic operations and measurements performed during the SAT.

N) Installation Requirements:

- The supplier must ensure the assembly and installation of the radar at the Observatory Milešovka. The survey of the physical space available for radar installation for the smooth transport and installation of individual components is the responsibility of the supplier. Contracting Authority warns that for the transport of the equipment to the Observatory Milešovka a cargo lift with a load capacity of only 250 kg can be used and access by persons performing installation is only possible by hike to the observatory;
- The supplier must provide a detailed description of requirements of the radar site (e.g. power supply, network connection, radar base).