**Annex No. 2**

**To the Regulation with ID No. RTU-2018/8**

**Technical Specification and Technical Offer (Form)**

# **“Acquisition of Scientific Equipment and Facilities for the Faculty of Materials Science and Applied Chemistry,** **RTU: 500 MHz Nuclear Magnetic Resonance Spectrometer”**

Location name>, <Year>, <Date>, <Month>

Bidder < Name> is familiar with the regulation of the open tender “Acquisition of Scientific Equipment and Facilities for the Faculty of Materials Science and Applied Chemistry, RTU: 500 MHz Nuclear Magnetic Resonance Spectrometer” organized by Riga Technical University, identification No. RTU-2018/8, and submit the following technical offer:

Riga Technical University (hereinafter referred to as the Customer) is willing to acquire a 500 MHz nuclear magnetic resonance (hereinafter referred to as NMR) spectrometer for scientific research purposes. For the equipment to be suitable for modern applications within the next 10-15 years, it must be supplied with the possibility of acquiring, processing and analysing 1D, 2D and 3D NMR spectra and conducting parallel detection experiments for chemical samples in liquid and in a solid phase with suitable liquid and solid-state probes. The spectrometer in the package with the appropriate software is intended for the NMR spectra registration of soluble organic compounds and inorganic compounds with a purpose to determine their chemical structure and purity, substance interaction studies, reactions kinetics and reaction mechanism studies, dynamic process studies, tautomeric balance studies, inorganic and organic materials, composite and geopolymeric materials studies in a solid phase to identifytheir structure at atomic and molecular levels. The NMR spectrometer will be placed in the laboratory on the 4th floor of the Faculty of Materials Science and Applied Chemistry, resulting in special requirements for the protection of the equipment against electromagnetic field disturbances, vibration and requirements for the resulting loads on the floor.

If the technical specification of the Customer contains a specific type of goods or standard, or any other indication of the specific origin of the goods, a particular process, brand or type, the bidder may offer equivalent goods or compliance with equivalent standards meeting the requirements and parameters of the technical specification and ensuring the operation and functionality required in the technical specification.

When offering an equivalent product in the technical offer, the Supplier must prove its equivalence. Within the framework of the Tender, the equivalent of the goods to be delivered will be considered an item equivalent to the requested technical parameters. The goods must also be economically equivalent to the costs which may arise during the introduction and use of the product.

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| **N.p.k.** | **Iekārta** | **Minimum requirements** | **Bidder's technical offer \***  *Link to the document issued by the manufacturer (technical description), page and position* |
| **1.** | **Superconducting magnet** (*ASCEND™ 500 MHz/54 mm Long Hold Time Magnet* or equivalent) | - Magnetic field at least 11.74 Tesla  - Bore diameter not more than 54 mm  - Actively shielded against outer magnetic field disturbances, such as trams, trains or elevators; Shielding effectiveness at least 97%  - Strayfield outside the magnet: radial 0.6m / axial 1.2m from magnetic center  - Helium hold time >180 days  - Automatic helium level measurements with alarm function for helium level below the set limit  - Nitrogen level sensor  - At least 36 orthogonal shimming gradients  - Support for automatic shimming, tuning and matching  - Magnet stand for reduction of vibrations in both the vertical and horizontal directions <3.8 Hz  - Liquid nitrogen transfer line  - Liquid Helium transfer line  - Total height with helium transfer line during helium refill must not exceed 2.9 m  - Total mass of the magnet (with full cryogens, stand, sample changer, and probe) must not exceed 550 kg/m2 |  |
| **2.** | **Console (Control electronics cabinet)** | - stainless steel one bay cabinet with 19-inch rack mounts and full RF shielding (shielded against DVB-T, ATSC, ISDB-T and DTMB), optimized for high resolution and solid state nuclear magnetic resonance (further - NMR) experiments  - Ethernet router with at least 8 TCP/IP ports for connection of peripheral devices  - Integrated processing unit with at least 1 TB hard drive  - At least 36 shim current sources with at least 20 Bit resolution and up to 1 A current range for room temperature shim system  - Digital deuterium lock system (*2H Lock*), (*2G DigiLock™* or equivalent)  - Compatible with pulsed field gradients, able to decouple and pulse at the 2H frequency  - Spectra acquisition unit with:  -At least 80 MHz system clock  - Simultaneous syncing of the parameters on all channels in not more than 12.5 ns  - At least 3 RF transmitters (channels) and at least 3 receivers (*TRX1200* or equivalent) with:  - Real time digital filters with practically rectangular filter characteristics  - Integrated pulse program engine (sequencer, wave form memory)  Providing:  - A dedicated receiver for every transmitter that support for all current and possible future parallel receiver experiments with compatible probes (e.g., parallel 1H-13C- and 31P-13C-correlation spectra with triple resonance probes)  - Simultaneous modulation of RF amplitude, frequency and phase in less than 12,5 ns that is suitable for all current and possible future experimental methods such as optimal control theory sequences  - Oversampling possibility for elimination of folding artefacts  - Receiver spectral width up to 7.5 MHz  - Frequency increment step size not more than 0.005 Hz  - Digitizer effective dynamic range >17 Bit (5 MHz spectral width) / >19 Bit (1 MHz spectral width) / >23 Bit (6 kHz spectral width)  - RF range at least 5-1200 MHz (for both, transmit and receive)  - ADC, 240 MSPS @16 Bit  - DAC, 960 MSPS  - Intermediate frequency at least 1.8 GHz for both, transmit and receive  - Sequencer waveform memory at least 1GB (for pulse shaping, optimal control applications, composite pulse decoupling)  - Timing and gradient unit for all gradient amplifiers  - Gradient control unit with resolution not more than 12.5 ns for Z-gradient  **Gradient amplifier** (GAB/2 or equivalent)  - Fast single channel gradient amplifier unit for pulsed field gradient shimming and single axis gradient enhanced spectroscopy (*gradient spectroscopy,* GRASP)  - On-axis (Z) and off-axis (magic angle) gradient shimming using real-time shim current control for single axis gradient probes together with TopSpin or equivalent software.  **Variable temperature unit** (BSVT or equivalent)  - Digital temperature sensor resolution better than 5mK  - Temperature stability at least 10mK/K for room temperature probes  - Temperature control step size not more than 0.01 °C  - Support of different temperature sensor types (e.g. thermocouple T or E, PT100)  - Variable temperature gas flow control up to 3000 L/h with mass flow regulation  - Built-in anti-freeze mode for cryogenic probes  - Support for up to 4 heaters  - Working temperature range at least -150 °C to +600 °C with compatible probes  - Gas flow control system for different sample holders (spinners, rotors) insertion  - Support of various cooling (BCU or equivalent) and low temperature (nitrogen evaporator/heat exchanger) units  - Internal NMR thermometer for measuring and control of sample temperature using differences in chemical shifts of two NMR signals  **Sample insertion system**  - Supports spinning of 3-10 mm sample tubes, shim system cooling and automatic sample detection  **Single channel high frequency amplifier**  - Linear single channel RF amplifier for observe and decoupling with:  - At least 500W RF peak power over 180 – 600 MHz (max. 50W CW)  - At least 100W RF peak power over 180 – 600 MHz (max. 20W CW) or  - High / Low power RF mode switchable by software  Provides:  - Pulse program controlled blanking, power rise/fall times less than 100 ns  - Built-in computer controlled amplifier safety with transmitted/reflected RF power control  - Ethernet interface for integration in the NMR system  **Double channel broadband RF amplifier**  - Linear 2 channel RF amplifier for observe and decoupling with:  - At least 500 W RF peak power for both channels in 15-600 MHz range (max. 50W CW)  Provides:  - 2 identical RF outs for each channel  - Pulse program controlled blanking, power rise/fall times less than 100 ns  Built-in computer controlled amplifier safety with transmitted/reflected RF power control  - Ethernet interface for integration in the NMR system  **Deuterium lock board**  Integrated transmitter and receiver with at least 5 W RF amplifier for locking deuterated solvents  Provides:  - Fast and precise tuning and matching on 2H using TopShim or equivalent software  - Easy and reliable locking on multiple deuterium containing solvents  - Determination of sample temperature using deuterium chemical shifts  **Power control unit** for programmed power on/off  **Device for setting the magic angle** with touch screen interface  Support for up to 8 preamplifiers  Dimension must not exceed 0.7x0.9 m (LxD) and full weight must not exceed load >550 kg/m2 |  |
| **3.** | **Proton signal preamplifier**  (*PHLNA 1H* or equivalent) | - GaAs based factory calibrated preamplifier for 1H and 19F observe and decouple  - At least 4 kW RF max power  - Built-in RF power detection |  |
| **4.** | **Broadband preamplifier 1**  (*HPPR XBB19F 2HP* or equivalent) | - GaAs based factory calibrated preamplifier for nuclei 57Fe to 19F observe and decouple  - At least 500 W RF max power  - Built-in 1H stop filter |  |
| **5.** | **Broadband preamplifier 2** (*HPLNA XBB31P 2HP* or equivalent) | - GaAs based factory calibrated preamplifier for nuclei 57Fe to 31P observe and decouple  - At least 4 kW RF max power  - Built-in RF power detection  - Built-in 1H stop filter |  |
| **6.** | **Deuterium preamplifier**  (HPPR 2H or equivalent) | - GaAs based factory calibrated preamplifier for deuterium observe, decouple and lock  - At least 500 W RF max power  - Built-in 2H lock/observe switch |  |
| **7.** | **2H stop-filter** | **2H stop-filter** |  |
| **8.** | **Double resonance liquids probe**  (*RT-DR-BF/1H-5mm-Z iProbe* or equivalent) | Room temperature double resonance broadband probe for X-nuclei detection with 1H decouple and vice versa  - X-nuclei frequency range: 19F & 31P-109Ag  - High sensitivity for 1H, 19F and 13C nuclei:  - For 1H Signal/Noise at least 800:1 (0.1% EB, noise range 200 Hz)  - 1H spinning line width not more than 0.6/6/12 Hz (@ 50%/0.55%/0.11% height of 1% chloroform)  - For 13C Signal/Noise at least 300:1 (ASTM, noise range 5 ppm) without decoupling and at least 350:1 (0.1% EB, noise range 5 ppm) decoupled  - 13C spinning line width not more than 0.2/3/6 Hz (@ 50%/0.55%/0.11% height of ASTM)  - For 19F Signal/Noise at least 600:1 (TFT)  - Automatic matching and tuning for both channels  -Z-axis gradient at least 5 G/A\*cm  - Working temperature range at least -150°C to +150°C  - 2H lock channel |  |
| **9.** | **T Thermopair adapter for probes** | - Supports at least 2 T termopair channels and heating channel for probes.  - Connects heater safety sensor to protect the probe from overheating when VT gas is off |  |
| **10.** | **Magic angle spinning (MAS) Pneumatic unit**  (MASIII or equivalent) | - Pneumatic unit with spinning rate counter, precision regulating valves, pressure stabilization and sample insert/eject support  - Provides automated spin-up and spin-down of rotors and regulation of the spinning speed to < 0.1%  - Can be controlled directly with the acquisition software  - Includes a buffer tank for precise pressure and flow regulation.  - Touch screen interface for magic angle setup |  |
| **11.** | **Triple resonance liquids and solids state probe**  (*CMPMAS-TR-1H/31P/13C-D-4mm Z* or equivalent) | - Top-loading triple resonance probe for acquisition of high resolution and cross-polarization MAS (HR/CP-MAS) spectra of liquids and solids containing samples without changing the sample  - 1H observe with 13C and 31P decoupling  - 13C (31P) observe with 1H and 31P (13C) decoupling  - 1H decoupling RF field at least 90 kHz  - 2H lock channel  - Single axis gradient at least 55 G/cm @ 10 A  - For 1H Signal/Noise at least 125:1 (0.1% EB, noise range 200 Hz)  - 13C spinning line width not more than 8 Hz (ASTM)  - For 13C Signal/Noise at least 50:1 (ASTM, noise range 40 ppm) in solution and at least 300:1 (natural abundance Ca glycinate, noise range 40 ppm) in solid state  - For 31P Signal/Noise at least 40:1 (TPP, noise range 5 ppm) in solution  - Rotor diameter at least 4 mm  - Rotor active volume 10-80 μL  - Max spinning rate at least 15 kHz (15000 revolutions per second)  - Working temperature range -50°C to 80°C  - At least 3 zirconia rotors, rotor packer, cap removal tool included |  |
| **12.** | **Double resonance solid state probe**  (MASSB-DR-BB/1H-4mm VTN or equivalent) | - Top-loading double resonance probe for acquisition of cross-polarization MAS (CP-MAS) spectra of solid samples  - 31P-67Zn observe with 1H decoupling  - 1H decoupling RF field at least 90 kHz  - Crosspolarization RF field at least 65 kHz  - 13C spinning line width not more than 7 Hz (ASTM)  - For 13C Signal/Noise at least 400:1 (natural abundance glycine, 5 kHz)  - For 15N Signal/Noise at least 65:1 (natural abundance glycine, 5 kHz)  - Rotor diameter at least 4 mm  - Rotor active volume at least 50 μL  - Max spinning rate at least 15 kHz (15000 revolutions per second)  - Working temperature range -50°C to 80°C  - At least 3 zirconia rotors, rotor packer, cap removal tool included |  |
| **13.** | **Triple resonance solid state probe**  (*CP-MAS H/X/Y DVT Trigamma* or equivalent) | - Top-loading triple resonance probe for acquisition of cross-polarization MAS (CP-MAS) spectra of solid samples  -H/X/Y channels for X- and Y-nuclei observe with 1H decoupling  -X channel frequency range: 31P-13C  - Y channel frequency range: 23Na-15N  - 1H decoupling RF field at least 125 kHz  - Crosspolarization RF field at least 70 kHz  - 13C spinning line width not more than 7 Hz (ASTM)  - For 13C Signal/Noise at least 70:1 (natural abundance glycine, 5 kHz)  - For 15N Signal/Noise at least 10:1 (natural abundance glycine, 5 kHz)  - Working temperature range -50°C to 80°C  - Rotor diameter not more than 2.5 mm  - Rotor active volume at least 13 μL  - Max spinning rate at least 35 kHz (35000 revolutions per second)  - At least 3 zirconia rotors, rotor packer, cap removal tool included |  |
| **14.** | **High power filters** | At least 6 high power filters |  |
| **15.** | **Rotor transfer system 1** | Allows insertion of solid state rotors with diameter not more than 4 mm into solid state probes |  |
| **16.** | **Rotor transfer system 2** | Allows insertion of solid state rotors with diameter not more than 2.5 mm into solid state probes |  |
| **17.** | **Zirconia solid state rotors** | At least 10:  - OD not more than 4 mm, ID not more than 3 mm, length at least 18 mm, sample volume at least 92 μL, working temperature range at least -150 °C to 150 °C, compatible with spinning rate at least 15 kHz  At least 5 with:  - OD not more than 2.5 mm with thick walls, working temperature range at least -150°C to 150°C, compatible with spinning rate at least 35 kHz  At least 5 with:  - OD not more than 2.5 mm with thin walls, working temperature range at least -150 °C to 150 °C, compatible with spinning rate at least 35 kHz |  |
| **18.** | **Automatic sample changer**  (SampleCase or equivalent) | Automatic sample changer with at least 24 sample positions  - Suitable for sample tubes with diameter 5 mm and less  - Sample cooling to 6 °C  - Compatible with solid state rotor changer |  |
| **19.** | **Sample tube holders (spinners)** | At least 30 plastic spinners  - Suitable for sample tubes with diameter 5 mm and less and compatible with automatic sample changer  - Working temperature range at least 0 °C to 80 °C  At least 5 ceramic spinners  - Suitable for sample tubes with diameter 5 mm and less and compatible with automatic sample changer  - working temperature range at least 0 °C to 180 °C |  |
| **20.** | **Cooling unit**  (BCU II or equivalent) | Cooling unit for high resolution and MAS experiments at temperatures down to at least -40 oC  Must include:  - Gas dryer with dew point at least -80 oC  - At least 10 L buffer tank |  |
| **21.** | **Low temperature unit** | Cooling unit for high resolution and MAS experiments at temperatures down to at least -100 oC (with compatible probes)  - Suitable for cooling of compressed nitrogen with liquid nitrogen  - Compatible with variable temperature unit and controllable with acquisition software  Must include:   * At least 25 L liquid nitrogen Dewar * At least one HR and at least one MAS heat exchangers * Transfer line |  |
| **22.** | **Compressed nitrogen supply system** | Consists of air compressor, at least one refrigeration dryer, at least one adsorption dryer, and nitrogen generator (separator)  - Purity: at least 95% N2  - Working pressure range: 6-8 Bar  - Nitrogen flow at least 400 l/min (normal conditions)  - Filtration with at least one 0.01 μm, at least one 1 μm, and least one 5 μm filters  - Air compressor must be labeled Oil-less (Oil-free), Purity Class 0 (ISO 8573-1 2010)  - Dew point after dryer at least -70 °C (Class 1, ISO 8573-1 2010)  - Must include installation and connection to the NMR console |  |
| **23.** | **Workstation** | Workstation PC with Windows OS or equivalent and spectra acquisition and processing software in >3 D providing:  - Automatic experiment running with automatic sample changer  - Real time experiment selection  - Pulse sequence programming  - Regular system checkup/validation before experiments  Workstation must include:  - At least 2 TB hard drive  - At least 2 Ethernet interfaces  - At least 24 inch monitor  Software must include:  - 1- and nD NMR spectra library and pulse sequences that allow acquisition with standard, non-uniform sampling (NUS) and parallel receiving experiments  - a module for the calculation of relaxation and diffusion parameters (DOSY);  - a module for multiplet analysis;  - a module for quantification;  - a module for deconvolution and line shape analysis  - a module for structure verification based on library data  - a module for automated experiment planning in real time based on acquired spectra and set verification criteria  - a module for reaction monitoring equipment control  Examples of software:  - TopSpin 4 PROCESSING ACA or equivalent  - Assure SST ACA or equivalent  - CMC-Assist ACA New or equivalent  - CMC-se Structure Elucidation ACA or equivalent  - NUS ACA or equivalent |  |
| **24.** | **Reaction monitoring unit** | Software controlled unit for reaction monitoring in solutions  Includes:  - External reactor  - Reciprocating piston pump with capillaries that are compatible with at least 5 mm sample tubes  - Temperature unit for controlling reaction temperature |  |
| **25.** | **Delivery, installation, checkup and personnel training on site** | Delivery according to contract terms (DDP Incoterms 2010) included  Installation and checkup is included. During the checkup, S/N and signal line shapes according to the specification for room temperature liquids probe must be met.  At least 3 days of training on site included |  |
| **26.** | **Personnel training courses at Vendor’s site** | At least 3 training courses at Vendor’s site included |  |
| **27.** | **Warranty** | At least 36 months after acceptance |  |

**Schedule of deliveries**

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| Nr. | **Requirements** | | **Offer** |
| Product/Service | Deadline for delivery and installation |  |
| 1. | **Compressed nitrogen supply system**  Delivery, installation and training | Not later than 5 months after the signed contract |  |
| 2. | Delivery and installation of:  Superconducting magnet  Console  Proton signal preamplifier  Broadband preamplifier 1  Broadband preamplifier 2  Deuterium preamplifier  2H stop-filter  Double resonance liquids probe  T Thermopair adapter for probes  Automatic sample changer  Sample tube holders  Cooling unit  Low temperature unit  Workstation  Training of personnel for working with the delivered equipment | Not later than 6 months after the signed contract |  |
| 3. | Delivery and installation of:  Magic angle spinning (MAS) Pneumatic unit  Triple resonance liquids and solids state probe  Double resonance solid state probe  Triple resonance solid state probe  High power filters  Rotor transfer system 1  Rotor transfer system 2  Zirconia solid state rotors  Reaction monitoring unit  Training of personnel for working with the delivered equipment | Not later than 9 months after the signed contract |  |
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*\** In the technical tender, the bidder shall provide the following information about the Product and components: < Product manufacturer, model name (if any), exact number of components >, including:

1) technical information certifying the execution of each requirement (parameter). A box filled in by the bidder, where it is written only “corresponding”, will be considered as insufficient information;

2) document (technical description) issued by the manufacturer attached to the offer or on which the link, page and the position are given, according to which the conformity of the parameters of the proposed product with the requirements may be concluded. If such information is not found in the document (technical description) issued by the manufacturer, the offer shall be accompanied by a verification issued by the manufacturer regarding the fulfilment of the requirement.

We hereby confirm and guarantee:

1. veracity and accuracy of the information provided;
2. leading employee who will coordinate delivery \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (name, surname, e-mail, phone);
3. Phone \_\_\_\_\_\_\_\_\_\_ ,e-mail \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and/or web-portal\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ for claiming defects during the execution of the Contract;