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| **Nordisk Sikkerhet AS** |
| **Tender title: Supply of control and measurement instruments:**  **X-Ray Diffractometer** |
|  | **Project title: “Control and measurement instruments for State Regulatory Authority of Tajikistan (stage 2)”** |

**Specifications**

Supply of control and measuring instruments:

X-Ray Diffractometer

**Contracting Authority:** Nordisk Sikkerhet AS

**Recipient:** Nuclear and Radiation Safety Agency of Tajikistan

**Tenderer’s name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

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**NOTE**

The Tenderer shall fill in the Annex “Specifications” in the format given below. The Tenderer’s proposed supplies should be manufactured and certified in accordance with the technical regulations and standards of Tajikistan and/or the country of origin. The complete table should be submitted to the Contracting Authority along with the required tender documents. On the front page of the Annex “Specifications”, the Tenderer shall indicate its name. After the completion of this document, it should be signed and dated by the Tenderer-authorized person.

1. **X-RAY DIFFRACTOMETER**

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|  | **Contracting Authority’s Requirements** | **Tenderer’s Offer** |
| Manufacturer | — |  |
| Model | — |  |
| Scope of supply | 1 complex |  |
| TECHNICAL SPECIFICATIONS | | |
| Type | X-ray diffractometer based on high-precision wide-angle 2θ (theta) goniometer with variable radius |  |
| Functions | X-ray diffraction analysis of phase composition, structural state and orientation of a wide range of objects with various shape and size |  |
| Equipment | The X-Ray Diffractometer shall be equipped with the following (or equivalent):  - X-ray Diffractometer including:  (i) Vertical double circular goniometer,  (ii) X-ray tube with program-controlled electromagnetic shutter;  (iii) X-ray tube cooling system,  (iv) Rotating powder sample holder,  (v) X-ray collimation system with a set of changeable slits  (vi) β-filter,  (vii) Protective cabinet;  - Unit for installing two detectors (scintillation and position-sensitive detectors);  - Scintillation detection unit NaI (Tl),  - Linear stripped position-sensitive detector (equipped with a holder, slit system and primary beam trap);  - Unit for measurements on reflection/transparency of various types of samples;  - High-temperature chamber with rotating sample holder (up to 1200 oC or higher);  - Low- temperature and moisture chamber (up to minus 180 oC or lower);  - Reference sample (polycrystalline quartz or equivalent);  - Set of additional holders/cuvettes:  (i) Silicon monocrystalline holder for studying trace amounts of matter,  (ii) Silicon monocrystalline cuvette for calibration against the reference,  (iii) Cuvette for bulk samples (with variable depth),  - Personal computer (with pre-installed software),  - Specialized software for data treatment and analysis  - Spare parts and accessories. |  |
| Type of samples | - Dispersed materials and powders (natural and synthetic ones),  - Monolithic polycrystalline samples (ceramics, details, structures, rocks, etc.) |  |
| **PERFORMANCE** | | |
| **Goniometer** | | |
| Geometry | The X-Ray Diffractometer shall support the following geometries:  - Bragg-Brentano geometry,  - Parallel-beam geometry.  Fast change of the geometries |  |
| Angular range, deg. | - 2θ: From minus 10 to 165  - θD (angle of detector rotation): From minus 5 to 165  - θF (angle of X-ray tube rotation): From minus 5 to 95 |  |
| Automatic alignment of sample plane | Yes |  |
| Programmable scanning modes | Yes, both discreet and continuous |  |
| Available scanning techniques | 1. θ - θ 2. θ 3. Ω 4. 2θ-Ω 5. Ψ |  |
| Minimum scanning step, no more than | 0.0005 deg. |  |
| Scanning speed | From 0.1 to 100 deg./min or better |  |
| **X-RAY TUBE** | | |
| Material of X-ray tube anode | Copper |  |
| Cooling of X-ray tube | Yes, water cooling |  |
| Focus of X-ray tube | 10x1.6 mm2 or better |  |
| **X-RAY TUBE COOLING SYSTEM** | | |
| Cooling of detector | Yes. Autonomous refrigerator-type cooling system.  Cooling of the X-ray tube with water in a closed circuit |  |
| Connection to water supply system | No, not required |  |
| Connection to sewage system | No, not required |  |
| **DETECTORS** | | |
| **1st DETECTOR** | | |
| Type of first detector | Scintillation detector, NaI (Tl) or equivalent |  |
| Maximum count rate, no less than | 1 x 106 imp/sec |  |
| **2nd DETECTOR** | | |
| Type of second detector | Linear stripped (position-sensitive) detector, silicon diode line or equivalent |  |
| Active area dimensions, no less than | 8 x 32 mm2 |  |
| Registration efficiency for line of 8 keV, no less than | 96% |  |
| Energy range | From 4 to 40 keV or better |  |
| Number of channels, no less than | 640 |  |
| Maximum count rate per channel, no less than | 1 x 106 imp/sec |  |
| Cooling | Electrical air cooling (fan) with noise-free performance |  |

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| **HIGH-TEMPERATURE CHAMBER** | | |
| Purpose | Studies of phase transformations, chemical reactions, as well as analysis of thermal deformation of the crystal lattice in the course of heating |  |
| Temperature range | From 25 to 1200 oC or better |  |
| Angular range for 2Θ scanning | From 0 to 164° or better |  |
| Ambiance | - Vacuum,  - Air, inert gas. |  |
| **LOW-TEMPERATURE AND MOISTURE CHAMBER** | | |
| Purpose | Studies of phase transformations, chemical reactions, as well as analysis of measurements of structural state depending on temperature and/or humidity |  |
| Working temperatures | For cooling by compressed air:  - Vacuum: up to minus 5oC,  - Air, inert gas: up to minus 5oC,  - Wet gas: up to plus 10oC  For cooling by liquid nitrogen:  - Vacuum: up to minus 180oC,  - Air, dry nitrogen:  up to minus 120oC  or better |  |
| Humidity range | * From 5 to 95% at ambient temperature of 10 to 60 oC; * From 5 to 70% at ambient temperature of 80 oC   or better |  |
| Angular range for 2Θ scanning | From 0 to 164° or better |  |
| **PERSONAL COMPUTER** | | |
| Personal computer (PC) | On the base of PC having the following or better characteristics:  - Intel Core i5;  - RAM 4096 MB;  - HDD 500 GB;  - LCD monitor 24" or greater;  - External connections: COM-port, Ethernet ≥2;  - Wireless keyboards;  - Wireless mouse. |  |
| Application software functions | - Control and diagnostics of the Diffractometer and its units;  - Automated measurements of the diffraction spectrum in a given angular range with a given exposure (or scanning speed) for θ-θ, θ, Ω, 2θ-Ω, Ψ–scanning in continuous/ stepped scanning mode;  - Measurements with multiple scanning of various angular intervals with subsequent averaging or summing of results;  - Storage of measurement data in the form of data files of various formats;  - Diffraction data treatment and analysis. |  |
| User’s interface | In Russian or Tajik language |  |
| System software | Yes, installed on PC,  including Windows 7/8/10 (32 or 64 bit) |  |
| Application software | Yes, installed on PC |  |
| Software licenses | Both for system and application software,  for 5 years of operation |  |
| Diffraction data treatment and analysis | * Processing the diffraction pattern or its fragment, including:  1. Background approximation (polynomial or custom curve); 2. Separation of Kα doublets; 3. Calculations of the angular positions of maxima; 4. Approximation of reflex profiles by pseudo-Voigt function; 5. Calculation of linear and integrated reflex intensities; 6. Calculation of FWHM reflexes; 7. Calculation of the amorphous phase content (degree of crystallinity); 8. Calculation of mass absorption coefficients for any chemical compounds;  * Quantitative phase analysis of a mixture by seven methods including:  1. Complete analysis of a multiphase mixture; 2. Analysis of an n-component system; 3. Analysis of a sample with a known mass absorption coefficient; 4. Method of internal standard; 5. Method of corundum numbers; 6. Method of additives; 7. Dilution method;  * Calculation of areas of coherent scattering and microstrains; * Calculation of unit cell parameters (UCP) for various components in multiphase systems; * Rietveld method of data processing; * Calculation of theoretical diffraction pattern; * Qualitative analysis using the Powder Diffraction Database PDF-2/PDF-4, made by the International Center for Diffraction Data (ICDD). |  |

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| **OTHER REQUIREMENTS** | | |
| Physical dimensions, no more than | 1500x1500x2400 mm  (length x width x height) |  |
| Weight, no more than | 1000 kg |  |
| Power supply | From mains of AC current, 220 ±10% V, 50±5 Hz |  |
| Mean time between failures, no less than | 10 000 hours |  |
| Service life, no less than | 10 years |  |
| **ENVIRONMENTAL REQUIREMENTS TO OPERATION** | | |
| Ambient temperatures | From +15 to +35 0C |  |
| Relative humidity | Up to 80% at ambient temperature of 250C and lower, without condensation of moisture |  |
| **PRESERVATION AND PACKAGING** | | |
| Packaging | Protection for transportation, handling and reliable storage without re-preservation within 1 year upon delivery. |  |
| Physical dimensions of packaging,  no more than | 900x2000 mm  (the entrance to the place of operation is limited by the door of 900x2000 mm. If required, the doorway may be extended to 1300 x2000 mm) |  |
| **OTHER REQUIREMENTS** | | |
| Certification | Yes, the X-Ray Diffractometer shall be certified for use in Tajikistan or in the country of origin |  |
| Dual-use items (goods, software or technologies) | Not accepted. The X-Ray Diffractometer shall not be subject to export control, shall not contain dual-use goods, software or technologies and must not be under export/import restrictions of a similar nature. |  |
| Visibility of Norwegian financing | Any equipment delivered under the contract should be clearly identified and should have metallic plates or indelible labels containing the flag of Norway and the phrase “Provided with support from the Government of Norway” in Tajik/Russian and in English. |  |

1. **DOCUMENTATION**

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|  | **Contracting Authority’s Requirements** | **Tenderer’s Offer** |
| **DOCUMENTATION** | | |
| Technical specifications/  conditions | Russian |  |
| Passport/logbook | Russian |  |
| User’s manual, including measurement techniques and guidelines on the application of specialized software | Russian |  |
| Documents attesting certification of X-ray Diffractometer in Tajikistan or in the country of origin | Russian or English |  |
| Certificate of primary metrological verification from Tajikistan or the country of origin | Russian or English |  |
| Software licenses | Russian or English |  |
| Training documentation | Russian |  |
| Transportation documentation | Russian and English |  |

1. **DELIVERY TERMS AND CONDITIONS**

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|  | **Contracting Authority’s Requirements** | **Tenderer’s Offer** |
| **DELIVERY TERMS AND CONDITIONS** | | |
| Terms of Delivery | DDP, Incoterms 2010 |  |
| Place of Delivery and Installation | 299/2 Ayni st., 734000, Dushanbe, Tajikistan Technical Support organization of Nuclear and Radiation Safety Agency |  |
| Delivery Time | ≤ 180 calendar days after the date of contract signature |  |

1. **TRAINING COURSE: OPERATION, MAINTENANCE AND REPAIR**

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|  | **Contracting Authority’s Requirements** | **Tenderer’s Offer** |
| **TRAINING** | | |
| **TRAINING COURSE** | | |
| Place of training  (training room to be provided by the Recipient) | 299/2 Ayni st., 734000, Dushanbe, Tajikistan  Technical Support organization of Nuclear and Radiation Safety Agency |  |
| Duration of training course | 2 days |  |
| Language of training course | Tajik/Russian |  |
| Number of trainees, up to | 6 persons |  |
| Themes to be covered | - Operating principles,  - Use and operation,  - Measurement techniques,  - Maintenance and metrological verification,  - Minor repairs. |  |
| Theoretical part duration, no less than | 1/2 day |  |
| Practical part duration, no less than | 1 and 1/2 day |  |
| Instructional video | Optional |  |
| Verification | Test, written form |  |
| **TRAINING COURSE DOCUMENTATION** | | |
| One certificate per trainee | In Tajik /Russian and English |  |
| List of materials to provide per trainee | - Set of training materials;  - User’s documentation;  - Training materials on one CD/DVD. |  |
| Results of test after training should be delivered to the Contracting Authority and Recipient | Yes |  |

1. **WARRANTY AND POST-WARRANTY SERVICES**

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|  | **Contracting Authority’s Requirements** | **Tenderer’s Offer** |
| **WARRANTY AND POST-WARRANTY SERVICES** | | |
| Duration of warranty period |  24 months |  |
| Place of warranty repairs and maintenance | Tajikistan |  |
| Presence of official representative of the manufacturer or authorised service centre in the FSU region | Yes |  |
| Technical support during warranty and post-warranty period | Technical support by email or telephone in Tajik /Russian/English to solve any technical problems (software failure, anomalous behavior, minor improvements concerning process, functional capabilities of data processing, etc.) and rectify any system-disabled state |  |
| After-sales service | Compulsory after-sales service to be provided under a separate agreement with the Recipient shall include the following:  - Maintenance and post warranty repair of the еquipment on the territory of Tajikistan;  - Rapid provision of spare parts and consumables. |  |

1. **TIME SCHEDULE**

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| **No.** | **Action** | **Period of completion** | **Tenderer’s Offer** |
| 1. | Submission of documents:   * Passport/logbook, * User’s manual, including measurement techniques and guidelines on the application of specialized software, * Documents attesting certification of X-ray Diffractometer in Tajikistan or the country of origin, * Certificate of primary metrological verification from Tajikistan or the country of origin, * Software licenses, * Transportation documentation. | 2 weeks before the scheduled shipment and supplied with equipment |  |
| 2. | Submission of documents:   * Training programme, * Training course documentation. | 3 weeks before the scheduled training |  |
| 3. | Submission of documents:   * Programme and procedure of on-site acceptance tests. | 3 weeks before the scheduled on-site acceptance tests |  |
| 4. | Delivery | Within 180 calendar days after the signing of Contract |  |
| 5. | Installation (assembling, mounting, staring-up and adjustment) | Within 200\* calendar days after the signing of Contract |  |
| 6. | Training of personnel | Within 200\* calendar days after the signing of Contract |  |

Note: \*) The personnel training must be carried out not later than 20\* calendar days after the delivery of equipment. The actual dates of training shall be confirmed by the Recipient and Contracting Authority no later than 10 days before the training course.

**Authorized person on behalf of the Tenderer:**

Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Title: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Signature: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Date: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_