**Tеchnical Specifications - Medical Imaging Equipment**

1. **Multislice CT Scanner for cardiovascular procedures for Institute for cardiovascular diseases “Dedinje”**

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| **Line Number**  | **Specifications Required** | **Specification offered** | **Location in technical specification (datasheet) or original producer statement** |
| **1.** | **GANTRY** |
| 1.1. | Aperture, minimum 70 cm |  |  |
| 1.2. | Full rotation shortest time (3600), no longer than 0.28 sec |  |  |
| **2.** | **PATIENT TABLE**  |
| 2.1. | Minimum scannable range - 175cm or more |  |  |
| 2.2. | Maximum load capacity - 204 kg or more |  |  |
| 2.3. | Table length - 240 cm or more |  |  |
| **3.** | **GENERATOR** |
| 3.1. | Maximum power - 100 kW or more |  |  |
| 3.2. | Maximum intensity of current - 740 mA or more |  |  |
| 3.3. | Maximum voltage - 135 kV or more  |  |  |
| **4.** | **X-RAY TUBE** |
| 4.1. | Anode effective heat capacity - 5,5 MHU and more, with anode cooling rate of 1370 kHU/min or more, or equivalent that allows continuous work without waiting for tube cooling  |  |  |
| 4.2. | Number of focal spots, two or more |  |  |
| 4.3. | Helical (spiral) scanning (exposure) time - 60s or more |  |  |
| **5.** | **DETECTOR SYSTEM** |
| 5.1. | Total number of detector rows - 128 or more |  |  |
| 5.2. | State of the art Detector technology (Gemstone Clarity, Stellar, Matrix array, Nanopanel Prism or equivalent) |  |  |
| **6.** | **ACQUISITION PARAMETERS** |
| 6.1. | Number of acquired slices - 256 or more |  |  |
| 6.2. | Scan field of view - 50 cm |  |  |
| 6.3. | Ability of choosing different range diameters of scanning  |  |  |
| 6.4. | Full rotation time, (360 degrees), 0,28 second or faster |  |  |
| 6.5. | Retrospective and prospective ECG triggered scan acquisition  |  |  |
| 6.6. | Adaptive ”pitch” with ECG triggering combination during arteriography and coronography |  |  |
| 6.7. | System must be with state of the art iterative reconstruction software for dose reduction ( at least 50%), maintaining picture quality and clarity (Safire, Iris, Aidr 3D, iDose, ASIR- V, ADMIRE, VEO or equivalent) |  |  |
| **7.** | **OPERATING CONSOLE**  |
| 7.1. | Flat screen color monitor with minimum 1,3 MP or more ; minimum 19” (48 cm) or more; resolution 1,280 x 1,024 or more |  |  |
| 7.2. | „DICOM“ state of the art protocols: DICOM Print, DICOM Storage, DICOM Modality Worklist |  |  |
| 7.3. | Automatic „Filming mode“ |  |  |
| 7.4. | CT angiography with analyzes  |  |  |
| 7.5. | Dynamic bolus tracking program, with precise scanning time assessment and manual activation according automatic bolus detection  |  |  |
| 7.6. | Cardiological acquisition program with algorithm for temporal resolution improvement  |  |  |
| 7.7. | RAM capacity on operator console - 8 GB or more |  |  |
| 7.8. | Total system storage capacity – 520000 lossless image compressed or non-compressed, 512 X512 matrix |  |  |
| 7.9. | High or ultra-high resolution scanning for lung examination |  |  |
| 7.10. | Reconstruction speed 40 images/ second, or more, and 20 images/ second, or more, in reduction dose options  |  |  |
| 7.11. | Artifacts reduction Software (technology) due to cardiac motions or coronary arteries motions during cardiac acquisitions or advanced superfast scanning technology or equivalent  |  |  |
| 7.12. | Real time VRT, MPR, 3D imaging, cardiac view, volume rendering or equivalent  |  |  |
| 7.13. | Ultra High Spatial resolution - min. 24 lp/cm or more |  |  |
| 7.14. | Artifact reduction technology due to orthopedic implants, iodine or bones… Metal Artifacts Reduction or equivalent |  |  |
| 7.15. | Dynamic brain perfusion studies software with low-dose CTA  |  |  |
| 7.16. | Myocardial perfusion and stress perfusion, Quantitative dynamique acquisition mode  |  |  |
| **8.** | **DIGNOSTIC TOOLS ON SERVER** |
| 8.1. | CT scanner advanced visualization system with integrated data base server (compatible with different CT manufacturer) with:* at least 4 (four) workstations
* with contemporary users that can simultaneously access to different applications (described under point 8.)
* with flow of processing of at least 15000 images/sec, or more
* in client - server architecture
* with minimum 4 license, or more, for web access
 |  |  |
| 8.2. | Server storage hardware of 4Tb, or more |  |  |
| 8.3. | Hardware configuration for 4 (four) diagnostic workstations: - brand name PC Windows base, - 1 Tb memory , - Intel Core i5 (or more) processor, - 8Gb RAM, or more - 2 (two) diagnostic DICOM compatible monitors, minimum 2 Mp resolution, or more and screen diagonal minimum 21,3 inch, or more |  |  |
| 8.4. | Advanced Cardiological Software; state of the art technology  |  |  |
| 8.5. | Advanced Vascular Analyzis Software; state of the art technology  |  |  |
| 8.6. | Aorta Analyzes Software Package; TAVI, TEVAR, EVAR … preparing for intervention; state of the art technology  |  |  |
| 8.7. | 4D CTA of brain with DSA and perfusion ; state of the art technology  |  |  |
| 8.8. | Advanced Myocardial Perfusion Software ; state of the art technology  |  |  |
| 8.9. | Advanced Abdominal Parenchymal Organs Perfusion Software ; state of the art technology  |  |  |
| 8.10 | Willis hexagon analyzes, state of the art technology; on operating console or workstation  |  |  |
| 8.11. | CT virtual endoscopy of larynx or bronchi; on operating console or workstation  |  |  |
| 8.12. | - DICOM functions: SEND, Query/Retrieve, PRINT, storage. Image reception in DICOM format. DICOM Get work list (HIS/RIS)- Disc burning of study with viewer on CD or - DICOM adapter for integration with other modalities |  |  |
| **9.** | **ADDITIONAL EQUIPMENT** |
| 9.1. | Double Syringe Contrast Injector:* opportunity for mixture of contrast and
* workstation
* two pistons

RIS/ PACS compatible. |  |  |
| 9.2. | DICOM color printer on photo paper or X-ray gray scale film  |  |  |
| **10.** | **OTHER REQUIREMENTS FOR BIDDER** |
| 10.1 | Warranty period on complete system 12 Months |  |  |
| 10.2 | Free of charge software upgrading during warranty period  |  |  |
| 10.3 | To make location project based on space and room project where system will be installed |  |  |
| 10.4 | Installation of the offered system- “Turnkey” project (preparation of existing CT facilities- technical room, examination room and control room. HV cable from HV substation to technical room has to be provided by Beneficiaries).  |  |  |
| 10.5 | 10 days on site training for staff (doctors and technicians) who will work on the system. Training has to be done by certified Application specialist |  |  |
| 10.6 | Education in Institution with high volume workflow of cardiovascular patients that undergo MDCT cardiovascular diagnostic on similar CT that as offered ; three weeks (or more) duration for 2 radiologists and two technicians |  |  |
| 10.7 | Operator manual (in Serbian and English) and Service manual (in English) |  |  |
| 10.8 | Service personel response time in warranty period: max 24 hours |  |  |
| 10.9 | System “Up-time” during warranty period has to be minimum 95% of working days |  |  |
| 10.10 | Spare parts available min. 7 years from the moment of system delivery |  |  |

1. **Digital angiography system for cardio-vascular diagnostic and interventional procedures Institute for cardiovascular diseases “Dedinje”**

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| --- | --- | --- | --- |
| **Line Number**  | **Specifications Required** | **Specification offered** | **Location in technical specification (datasheet) or original producer statement** |
| **1.** | **C-ARM** |
| 1.1. | Floor or ceiling mounted C-arm; easily handling; providing all kind of interventional procedures with cranial-caudal and lateral angulations and projections |  |  |
| 1.2. | Must to provide movement of detector panel with SID in range of 95-115 or more  |  |  |
| 1.3. | Must provide easy operator access to the patient by both side of patient and using femoral, radial or brachial approach in the same procedures (palm to palm) without movement or rotation of patient off table. Must provide longitudinal head to toe coverage just by motorized C-arm or table movement without table or patient rotation |  |  |
| 1.4. | All controls C-arm, table or acquisition must be tableside. All handling stick must be above panel of control unit |  |  |
| 1.5. | C-arm position memorizing controlled by tableside control unit.  |  |  |
| 1.6. | Memorizing of parameters of C-arm like cranial-caudal or lateral angulations, SID… |  |  |
| 1.7. | Automatic C-arm positioning based on reference image |  |  |
| 1.8. | Software protection of C-arm to patient collision |  |  |
| **2.** | **PATIENT TABLE** |
| 2.1. | Floor mounted |  |  |
| 2.2. | Motorized up and down movement with lowest position on 80 cm or less |  |  |
| 2.3. | Floating tabletop of radio transparent material, length of table 260 cm or more, width of table 50 cm or more but not to wide in order to avoid collision with C- arm lateral angulations. To provide stepping DSA table movement. „Metal free“ area of table to be 200 cm or more, in length There must be cranial-caudal tilt |  |  |
| 2.4. | Table rotation +/- 90 degrees around vertical axis |  |  |
| 2.5. | Maximal loading of table 240 kg or more |  |  |
| 2.6. | Tableside control unit must have: 1. Table blockage and releasing;
2. Motorized C-arm movement
3. Motorized vertical table movement
 |  |  |
| 2.7. | Regarding function tableside control unit must have: * Image adjustment
* Roadmapping adjustment (superimposition)
* Collimation adjustment
* Changing field of view, image magnifying
* Level of fluoroscopy choice
* Acquisition choice
* Stenosis analyzes (QCA,QVA)
* LV analyzes (LVA,)
* Stent visualization improvement
* Management of functions from diagnostic workstation
 |  |  |
| 2.8. | Necessary additional equipment for table: 1. Removable hand support
2. Radiolucent table top for comfortable patient
3. Both table side metal rails for additional stands and protection montage for comfortable patient lying on the table
4. Acquisition foot pedal,
5. Table extension up to 300 cm length if there is no default table length of 300 cm
 |  |  |
| **3.** | **HV GENERATOR** |
| 3.1. | High frequency microprocessor inverter controlled generator  |  |  |
| 3.2. | Generator power of 100 kW or more  |  |  |
| 3.3. | Tube heating protection  |  |  |
| 3.4. | Continues imaging of tube rest capacity  |  |  |
| **4.** |  **X-RAY TUBE AND COLLIMATION** |
| 4.1. | Number of focus, two or more  |  |  |
| 4.2. | The smallest focus size to be 0,4 mm or less  |  |  |
| 4.3. | Minimal Heat capacity to be 2,4 MHU or more  |  |  |
| 4.4. | To be equipped with manual rectangle blends |  |  |
| 4.5. | To be equipped with semitransparent blends movable independently of rectangle blends |  |  |
| 4.6. | To be equipped with Cu filters  |  |  |
| 4.7. | To be equipped with virtual collimation on last hold image.To be equipped with grid-switch or flat emitter technology or equivalent dose reduction technology for pulse fluoroscopy |  |  |
| **5.** | **FLAT PANEL DETECTOR** |
| 5.1. | Detector size 295 mm (or more up to 305 mm) x 395 mm or more , rotatable  |  |  |
| 5.2. | Pixel size to be 200 µm or less |  |  |
| 5.3. | DQE, 70% or less on 0 Lp/mm  |  |  |
| 5.4. | Number of field of views – 5 or more  |  |  |
| 5.5. | Digitalization depth ( gray scale level) 12 bits or more |  |  |
| 5.6. | Removable greed against scattered radiation |  |  |
| 5.7. | Acquisition matrix 2000x1500 (approximately), with highest acquisition speed of 30 fps |  |  |
| 5.8. | Synchronized rotation of detector and collimation regardless C-arm position  |  |  |
| **6.** | **DIGITAL SYSTEM** |
| 6.1. | Digital pulsed fluoroscopy; three speed (or more) choice opportunity: 7.5 (or less), 15 (or 10) and 30 fps  |  |  |
| 6.2. | LIH (Last Image Hold) |  |  |
| 6.3. | Fluoroscopy sequence archiving in DICOM format and system (Fluoro Loop or equivalent); prospective and retrospective |  |  |
| 6.4. | Digital acquisition; three speed (or more) choice opportunity: 7.5(or less), 15 (or 10) and 30 fps  |  |  |
| 6.5. | Vessel analyze (QCA, QVA)  |  |  |
| 6.6. | LV analyze (LVA)  |  |  |
| 6.7. | Coronary stent advanced visualization  |  |  |
| 6.8. | Digital subtraction visualization (DSA) with highest speed of 6 fps (or more) in matrix of 2000x1500 (approximately) for vascular studies |  |  |
| 6.9. | Road mapping (RM) with automatic ‘’pixel shift’’ correction and superimposition of live fluoroscopic image and reference image in real time. LIH RM and DSA RM with changeable superimposition and tableside command |  |  |
| 6.10. | Bolus chase or stepping technique for DSA single injection acquisition |  |  |
| 6.11. | 3D rotational angiography for high contrast studies of peripheral vessels with immediate overview in operating room |  |  |
| 6.12. | State of the art Low dose protocol |  |  |
| 6.13. | Acquisition console with two diagnostic monitors of 19 inch (or more) ; number of pixels 1,3 MP ( or more), in control room, for demographic data entry and real time image |  |  |
| 6.14. | System capacity to be 50 000 (or more) images in 2000x1500 (approximately) matrix; 12 bits; with antivirus integrated system protection and data protection |  |  |
| 6.15. | CD and DVD image archiving device in DICOM system with automatic burning of DICOM viewer |  |  |
| 6.16. | Networking, connecting, archiving according DICOM 3.0 protocol:DICOM Storage DICOM Storage CommitmentDICOM Query/RetrieveDICOM Modality WorklistDICOM Radiation Dose Structured Report |  |  |
| 6.17. | Ceil mounted carrier of monitor and monitor of 56 inch (or more) diagonal in operating room; available for imaging of different formats and modalities from different sources (angio-suite, hemodynamic system , ultrasound, IVUS, CT, MR etc.) such as: 1. real time image, 2. reference image,3. different diagnostic sources images: CT, MR etc) , real time available imaging (US, TTE , TEE, IVUS, FFR, OCT, OFDI…) by adequate technique4. Additional reserve 19 inch monitor; integrated or free mounted, according to manufacturer; in case of malfunction of primary monitor. 5. Number of entry ports: 8 or more.6. Monitor must have opportunity to be positioned symmetrically at both side of patient table. |  |  |
| 6.18. | Bidirectional interphone communication system between angio-suite and control room |  |  |
| 6.19. | Cone beam CT or equivalent  |  |  |
| **7.** | **DIAGNOSTIC WORKSTATION WITH ADVANCED 3D VISUALISATION** |
| 7.1. | Independent or integrated workstation with advanced tools for interventional procedures analyzes with imaging ability on big monitor in angio-suite |  |  |
| 7.2. | One or more diagnostic monitors in control room of 19 inch (or more) and with 1,3 MP (or more) |  |  |
| 7.3. | Different diagnostic sources imaging studies showing |  |  |
| 7.4. | 3D visualization of coronary and vascular structures, high contrast by rotational angiography acquisition with ability to be shown in control room |  |  |
| 7.5. | Advanced stent visualization; on acquisition console or on workstation |  |  |
| 7.6. | 3D roadmaping and MR/CT roadmap: Overlapping of live fluoroscopic image with 3D model of vessel acquired by 3D rotational angiography or by CT or MRI angiography with immediate show on big display in angio-suite (6.18).  |  |  |
| 7.7. | CD and DVD device for image archiving in DICOM format and with automatic burning of DICOM viewer |  |  |
| 7.8. | Networking, connecting, archiving according DICOM 3.0 protocol:DICOM Storage DICOM Storage CommitmentDICOM Query/RetrieveDICOM Modality WorklistDICOM Radiation Dose Structured Report  |  |  |
| **8.** | **ADDITIONAL EQUIPMENT** |
| 8.1. | Radiation protection: ceiling mounted protection glass; lead ribbons table mounted: below and above table flat |  |  |
| 8.2. | Ceiling mounted LED light, intensity of 50.000 Lux or more |  |  |
| 8.3. | Electric power distribution box |  |  |
| 8.4. | Contrast injector with changeable flow real time control; volume of syringe 150 ml or more, with air detection and transducer compatible; mounted on patient table |  |  |
| 8.5. | Hemodynamic measurement system  |  |  |
| 8.5.1. | Full hemodynamic monitoring with recording and data base with color laser printer, integrated with big display in angio-suite  |  |  |
| 8.5.2. | CD and DVD archiving device. |  |  |
| 8.5.3. | System must have:* 12 channels ECG
* Invasive Blood pressure (IBP) measurement, 4 ports
* SpO2
* CO (Cardiac Output)
* Non invasive blood pressure (NBP) measurement
 |  |  |
| 8.5.4. | Automatic measurement of valve area, pull-back pressure, shunt measurement,  |  |  |
| 8.5.5. | One monitor or more, in control room, diagonal 19 inch or more, enabled showing on big display in angio-suite  |  |  |
| 8.5.6. | Networking, connecting, archiving according DICOM 3.0 protocol:DICOM Modality Worklist DICOM MPPS |  |  |
| 8.5.7. | FFR, iFR (or equivalent) enabled image on control room monitor, compatible with FFR catheters of all producers (St.Jude, VOLCANO,ACIST…) |  |  |
| 8.6. | Integrated FFR, iFR (or equivalent), integrated OCT (or equivalent) on system in angio-suite.Real time angio-optical coregistration.Integrated in patient table. |  |  |
| 8.7. | IVUS integrated system in angio-suite. |  |  |
| **9.** | **OTHER REQUIREMENTS FOR BIDDER** |
| 9.1. | Warranty period on complete system 12 Months |  |  |
| 9.2. | To make location project based on space and room project where system will be installed |  |  |
| 9.3. | Installation of the offered system- “Turnkey” project (preparation of existing angio facilities- technical room, examination room and control room. HV cable from HV substation to technical room has to be provided by Beneficiaries).  |  |  |
| 9.4. | 10 days on site training for staff (doctors and technicians) who will work on the system. Training has to be done by certified Application specialist |  |  |
| 9.5. | Operator manual (in Serbian and English) and Service manual (in English) |  |  |
| 9.6. | Service personel response time in warranty period: max 24 hours |  |  |
| 9.7. | System “Up-time” during warranty period has to be minimum 95% of working days |  |  |
| 9.8. | Spare parts available min. 7 years from the moment of system delivery. |  |  |

1. **Magnetic resonance system 1.5T equipped and suitable for whole body examinations for Clinical Hospital Center „Zemun“**

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| **Line Number**  | **Specifications Required** | **Specification offered** | **Location in technical specification (datasheet) or original producer statement** |
| **1.** | MAGNET |
| 1.1. | Magnet field strength 1,5T |  |  |
| 1.2. | Superconductive magnet with active shielding |  |  |
| 1.3. | Tunnel bore in isocenter at least 70 cm ± 2% |  |  |
| 1.4. | Guaranteed magnetic field homogeneity in accordance with V.R.M.S. method :DSV, for spherical volume diameter of 10cm: 0,04 ppm or lessDSV, for spherical volume diameter of 30cm: 0,4 ppm or less |  |  |
| 1.5. | Magnet length from cover to cover 150 cm ± 10% |  |  |
| 1.6. | Field of view - not less than 55x55x50 cm (XxYxZ) |  |  |
| 1.7. | „Zero boil off" technology- no helium consumption |  |  |
| **2.** | GRADIENT SYSTEM |
| 2.1. | The greatest amplitude in each orthogonal projection at maximum Field of View- not less than 33 mT/m |  |  |
| 2.2. | The highest value of slew rate amplitude in each orthogonal projection- not less than 145 T/m/s |  |  |
| 2.3. | Gradient power at least 20 kW |  |  |
| **3.** | RF SYSTEM |
| 3.1. | RF system with 16 channels for simultaneous A/D conversion |  |  |
| **4.** | RF COILS |
| 4.1. | Integrated whole body coil |  |  |
| 4.2. | Separate, dedicated Multichannel coil for thorax, abdominal and pelvic exams with coverage of minimum 50cm and with minimum of 16 coil elements |  |  |
| 4.3. | Separate, dedicated, head-neck coil with minimum of 16 coil elements |  |  |
| 4.4. | Spine coil with minimum of 32 coil elements, with coverage of minimum 100cm and with possibility of axial movements inside the patient table |  |  |
| 4.5. | Extremity coils: Two flexible coils of different sizes with minimum of 16 coil elements in a row each, for examination of joints |  |  |
| 4.6. | Breast coil with at least 8 elements |  |  |
| 4.7. | Integrated coil technology (GEM, Tim, Atlas, dStream or equivalent) |  |  |
| **5.** | PATIENT TABLE |
| 5.1. | Minimal height position of patient table- 45 cm or less |  |  |
| 5.2. | Maximum load of patient table- minimum 200 kg |  |  |
| 5.3. | In bore ventilation and lightening |  |  |
| 5.4. | Bidirectional voice communication |  |  |
| 5.5. | Patient video monitoring system |  |  |
| 5.6. | Coil storage cart or shelves for coils |  |  |
| **6.** | PHYSIOLOGICAL MEASURMENT UNIT |
| 6.1. | Wireless signal transfer |  |  |
| 6.2. | ECG with trigger |  |  |
| 6.3. | Puls |  |  |
| 6.4. | Respiration |  |  |
| **7.** | DIGITAL SYSTEM |
| 7.1. | Two (2) workplaces- one for acquisition and another one for post processing |  |  |
| 7.2. | DICOM functionalities on acquisition workplace: Storage SCU, Print SCU, DICOM Media, MWM SCU |  |  |
| 7.3. | DICOM functionalities on post processing workplace: Storage SCU, Print SCU |  |  |
| 7.4. | LCD color monitor, at least one for each workplace, monitor size not less than 24" |  |  |
| 7.5. | DVD-RW or CD-RW on acquisition workplace |  |  |
| 7.6. | Diffusion and perfusion quantification on both workplaces (acquisition workplace and post processing workplace) |  |  |
| 7.7. | Image composing (composing of few spine segments, upper and lower abdomen or peripheral blood vessels) on both workplaces (acquisition workplace and post processing workplace) |  |  |
| 7.8. | 3D post processing - MIP, 3D rendering, 3D visualization in all planes on both workplaces (acquisition workplace and post processing workplace) |  |  |
| 7.9. | Diffusion Tensor Imaging Evaluation and tractography, as well as fusion with anatomical images on both workplaces (acquisition workplace and post processing workplace) |  |  |
| 7.10. | Time intensity curves analysis on both workplaces (acquisition workplace and post processing workplace) |  |  |
| 7.11. | Flow quantification with flow curves display on both workplaces (acquisition workplace and post processing workplace) |  |  |
| 7.12. | Non contrast perfusion quantification (Arterial Spin Labeling) on both workplaces (acquisition workplace and post processing workplace) |  |  |
| 7.13. | Functional myocardial analysis on post processing workplace |  |  |
| 7.14. | Automatic setting of scanning plane and position of slices for head neuro exams |  |  |
| 7.15. | Automatic setting of scanning plane and position of slices for exams of intervertebral spaces |  |  |
| 7.16. | Automatic setting of scanning plane and position of slices for cardiology exams in six (6) typical scanning planes |  |  |
| **8.** | SEQUENCES AND IMAGING TECHNIQUES |
| 8.1. | Standard techniques: spin echo (SE), inversion recovery (IR) or equivalent |  |  |
| 8.2. | Fast techniques: FastSE, FastiR, FastFLAIR, FastFE, FastSTIR or equivalent |  |  |
| 8.3. | Advnced fast scanning techniques: FASE (fast advanced spin echo), hybrid EPI, multi-shot EPI, single-shot EPI, SSFP (steady state free precision), FSE/FASE T2 Plus or equivalent |  |  |
| 8.4. | Steady-State sequence or equivalent |  |  |
| 8.5. | Vascular techniques: 2D-TOF (time of flight), 3D-TOF, 3D- contrast enhanced, SORS-STC (slice-selective off-resonance sync pulse saturation transfer contrast), 2D-PS (phase shift), Cine 2D-PS, flow quantification, 3D-PS (phase shift) or equivalent |  |  |
| 8.6. | Non contrast angiography with following acquisition techniques: FSBB, FBI, Time-SLIP v  |  |  |
| 8.7. | Dynamic (time-resolved) 3D MRA  |  |  |
| 8.8. | Fat Suppresssion: STIR, FastSTIR, WFOP, FatSAT, Water Excitation Technique or equivalent |  |  |
| 8.9. | Patient movement artifact reduction for abdominal, head and MSK exams, using „radial k-space filling" technique in all three planes |  |  |
| 8.10. | Perfusion with contrast |  |  |
| 8.11. | Non contrast perfusion, ASL |  |  |
| 8.12. | Diffusion Tensor Imaging (DTI) with Tractography (Fiber Tracking) |  |  |
| 8.13. | MRCP 2D i 3D |  |  |
| 8.14. | Techiques for cardiac acquisition (cine with and without gating, Black Blood, retrospective acquisition of whole heart cycle, perfusion imaging) |  |  |
| 8.15. | Multislice scanning techniques: from beginning to the end, from end to beginning and from central position to end positions |  |  |
| 8.16. | Scanning of odd and then even slices (in order to reduce interference between slices) |  |  |
| 8.17. | Techiques for 3D post-processing:* Multi Planar Reconstruction (MPR), with double oblique reformatting and slice thickness change
* Maximum Intensity Projection (MIP),
* Minimum Intensity Projection (MinIP),
* Surface rendering
 |  |  |
| 8.18. | Cisternography |  |  |
| 8.19. | Mielography |  |  |
| 8.20. | Urography |  |  |
| 8.21. | Limfangiography |  |  |
| 8.22. | Diffusion techniques: EPI Diffuion, FASE Diffusion  |  |  |
| **9.** | ADDITIONAL EQUIPMENT |
| 9.1. | RF cabin for electromagnetic protection (damping value of min 90dB). RF cabin contains complete cabin with antistatic floor, door, window, antimagnetic lightening, all necessary filters, also with connections for gases supply of the anesthesia system, and all final works, for running requirements of MR scanner for work with the patients |  |  |
| 9.2. | Chiller for MR gradient system cooling |  |  |
| 9.3. | Injector for MR procedures |  |  |
| 9.4. | Antimagnetic stretcher for patient transport |  |  |
| **10.** | OTHER REQUIREMENTS FOR BIDDER |
| 10.1. | Warranty period: min. 12 months from the day of system installation |  |  |
| 10.2. | To make location project based on space and room project where system will be installed. |  |  |
| 10.3. | To make project for civil, electro and thermo­technical works for technical room, examination room and control room. |  |  |
| 10.4. | Installation of the offered system- "Turnkey" project (preparation of facilities- technical room, examination room and control room. HV cable from HV substation to technical room has to be provided by Beneficiaries). |  |  |
| 10.5. | 10 days on site training for staff (doctors and technicians) who will work on the system. Training has to be done by certified Application specialist. |  |  |
| 10.6. | Operator manual (in Serbian and English) and Service manual (in English). |  |  |
| 10.7. | Service personel response time in warranty period: max 24 hours. |  |  |
| 10.8. | System "Up-time" during warranty period has to be minimum 95% of working days |  |  |
| 10.9. | Spare parts available min. 7 years from the moment of system delivery. |  |  |

1. **Digital angiography X-ray system for diagnostic cardiac and interventional procedures for Clinical Hospital Center „Zemun“**

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| --- | --- | --- | --- |
| **Line Number**  | **Specifications Required** | **Specification offered** | **Location in technical specification (datasheet) or original producer statement** |
| **1.** | STAND WITH C-ARM |
| 1.1. | Monoplane ceiling mounted C-arm which enables to the operators free access to the patient from all sides during intervention, without patient moving |  |  |
| 1.2. | Possibility of C-arm rotation around vertical axis |  |  |
| 1.3. | Possibility of continuous C-arm movement in longitudinal direction for peripheral anatomy coverage, without patient moving and coverage of at least 200cm, from left and right patient table side |  |  |
| 1.4. | Possibility of hand examination (for creating shunt, venography, also during PCI with radial/brachial access) with only C-arm positioning, without patient table rotation |  |  |
| 1.5. | SID range at least 90-119 cmCRA angulations at least 50° - CAU angulations at least 45°LAO rotation at least 120° - RAO rotation at least 120° |  |  |
| 1.6. | Possibility of programming the following C-arm parameters: C-arm rotation, C-arm angle, SID, patient table height, field of view |  |  |
| 1.7. | Display of current C-arm position on “live” display |  |  |
| 1.8. | Possibility of programming the different C-arm projection sequences, in relation to the different acquisition programs |  |  |
| 1.9. | Possibility of automatically positioning of C-arm according to selected reference image |  |  |
| 1.10. | System software for collision protection of C-arm and patient in combination with electro­mechanical sensors |  |  |
| 1.11. | Possibility of C-arm rotation around vertical axis, which pass through detector center and X-ray tube center, at ±135° |  |  |
| 1.12. | Possibility of C-arm continuous movement in lateral direction (left/right) when C-arm is set above patient head with coverage of at least 45 cm to the left and right side without moving of patient table or rotating C-arm |  |  |
| **2.** | PATIENT TABLE |
| 2.1. | Patient table with free floating table top, motorized vertical (up/down) movement and with tabletop suited for cardio-pulmonary reanimation, length at least 260 cm |  |  |
| 2.2. | Tabletop movement in longitudinal direction at least 100 cm and in lateral direction at least ±17,5 cm |  |  |
| 2.3. | The longest length in “metal free” position for examination min. 125 cm |  |  |
| 2.4. | Patient table rotation min. ±90° |  |  |
| 2.5. | Load of the patient table min. 200 kg |  |  |
| 2.6. | Necessary accessories with patient table:- Mobile armrest support- Rails for system mounting from both lateral side of the patient table and also from patient leg side- Radiolucent mattress for patient table |  |  |
| **3.** | GENERATOR |
| 3.1. | High voltage, inverter generator |  |  |
| 3.2. | Nominal output power min. 100 kW |  |  |
| 3.3. | Protection of tube overheating |  |  |
| 3.4. | Continuous display of the tube working capacity |  |  |
| 3.5. | Generator has at least double inverter and in case of malfunction of one inverter, second must insensibly take over operation |  |  |
| **4.** | X-RAY TUBE WITH COLLIMATOR |
| 4.1. | X-ray tube with min. 2 focus |  |  |
| 4.2. | Heat capacity of the tube at least 2,4 MHU |  |  |
| 4.3. | Automatically filter selection depending on patient features |  |  |
| 4.4. | Virtual collimation |  |  |
| 4.5. | Possibility of collimation in square or rectangular shape |  |  |
| 4.6. | Insensibly transition from one to another focus in case of failure of used focus |  |  |
| 4.7. | Automatically synchronized detector and collimator for providing of correct image on the display rotation independent of C-arm position, rotation range min. ±70° |  |  |
| **5.** | FLAT PANEL DETECTOR |
| 5.1. | Total active area min. 195 x 195 mm, but max. 210 x 210 mm |  |  |
| 5.2. | Removable grid against scattered radiation |  |  |
| 5.3. | Possibility of selection at least 4 different field of views |  |  |
| 5.4. | Pixel size max. 200 pm |  |  |
| 5.5. | DQE @ 0 LP/mm and lpGy(RQA 5) at least 70% |  |  |
| 5.6. | MTF @lLP/mm (RQA 5) at least 50% |  |  |
| 5.7. | A/D conversion dept min. 14 bit |  |  |
| 5.8. | Maximum allowed size of the flat panel housing with collision protection is 325 x 300 mm |  |  |
| **6.** | OPERATING MODES |
| 6.1. | FluoroscopyMin. 1.024 x 1.024 pixels on 10 bit Continuous fluoroscopy Pulsed fluoroscopy (“grid pulsed”) at least 7,5; 15; 30 pulses in sec.LIH image can be stored as reference image Function “Last Fluoro Loop” (dynamic fluoro sequences) can be stored in DICOM format. Possibility of selection at least 4 levels x-ray dose |  |  |
| 6.2. | Digital angiographyAt least the following acquisition parameters: 1.024 x 1.024 pixels on 12 bits Max available “Frame rate” at least 30 images/sec in resolution 1.024 x 1.024 pixels Possibility of selection of different “Frame rate” values: 7,5; 15; 30 images/sec Possibility of selection at least 3 X-ray dose levels |  |  |
| 6.3. | Digital subtraction angiography (DSA) |  |  |
| 6.4. | “Single Shot” examination, at least the following acquisition parameters: 1.024 x 1.024 pixels on 12 bits |  |  |
| **7.** | DIGITAL SYSTEM |
| 7.1. | Archiving capacity min 25.000 images, resolution 1.024 x 1.024 pixels on 12 bits |  |  |
| 7.2. | Operator console with functionality suitable for cardiac studies |  |  |
| 7.3. | DICOM functionality:DICOM Storage SCUDICOM Storage Commitment SCUDICOM PrintDICOM Query/Retrieve SCUDICOM Media StorageDICOM Modality Worklist SCUDICOM Radiation Dose Structured Report |  |  |
| 7.4. | Advanced functionality:Advanced stent visualizationTools for coronary artery stenosis analysis(QCA) |  |  |
| 7.5. | Anatomically image zoom without x-ray dose increasing “Digital Acquisition Zoom” which can be applied on all available field of views with possibility of selection at least 4 different zoom factors in acquisition programs in following operating modes: Fluoroscopy, “Roadmap Fluoro”, Digital angiography, Digital Subtraction angiography. |  |  |
| 7.6. | System of data protection with at least 1 redundancy disc (RAID 5) |  |  |
| 7.7. | Possibility of display at least 2 physiological signal which are taking over during appropriate image acquisition. Physiological signals are stored together with appropriate images and sent together with appropriate DICOM data. |  |  |
| **8.** | MONITORS FOR IMAGE DISPLAY |
| 8.1. | MONITOR(S) IN EXAMINATION ROOM |  |  |
| 8.1.1. | Ceiling monitor stand for 6 monitors with at least 2 black and white monitors and4 color monitors, each diagonal size min. 19" |  |  |
| 8.1.2. | Electronic for selection of display one or more external signals |  |  |
| 8.1.3. | Ceiling monitor stand with rotation of ±180° along vertical axis with possibility of longitudinal movements along patient table at least 300 cm and lateral movement at least 280 cm for symmetrical operation from both, left and right side of the patient, femoral radial/brachial access |  |  |
| 8.2. | MONITORS IN CONTROL ROOM |  |  |
| 8.2.1. | System color monitor |  |  |
| 8.2.2. | 2 monitors for live and reference image display |  |  |
| **9.** | ADDITIONAL EQUIPMENT |
| 9.1. | Injector for angio- procedures |  |  |
| 9.2. | System for hemodynamic measurements |  |  |
| 9.2.1. | System must have 2 monitors in control room, all monitors size min 19” and resolution min 1280x1024 and output for signal display in examination room |  |  |
| 9.2.2. | Surface ECG with min 5 outputs |  |  |
| 9.2.3. | Display of respiration with impedance method |  |  |
| 9.2.4. | Min. 1 channel for saturation measurement (Sp02) |  |  |
| 9.2.5. | Min. 4 channels of invasive blood pressure measurement |  |  |
| 9.2.6. | Min. 1 channel of non-invasive blood pressure measurement |  |  |
| 9.2.7. | Min. 1 channel for temperature measurement |  |  |
| 9.2.8. | Possibility of selection channels, which will be displayed on screen, their allocation and color |  |  |
| 9.2.9. | Complete recording of all signals during intervention |  |  |
| 9.2.10. | Possibility of report creating for spent material |  |  |
| 9.2.11. | Automatically LV-AO “Pullback” analysis |  |  |
| 9.2.12. | Possibility of entering user's defined annotation |  |  |
| 9.2.13. | Possibility of Barcode reader connection for reading of barcodes of all spent equipment during intervention |  |  |
| 9.2.14. | Possibility of upgrade for FFR analysis |  |  |
| 9.2.15. | Laser printer for signal and report printing |  |  |
| 9.2.16. | Start kit - patient cables and electrodes: Surface ECG cable, Sp02 probe for multiple uses, min. two cables sets for IBP, NIBP cuff |  |  |
| **10.** | OTHER REQUIREMENTS FOR BIDDER |
| 10.1. | Warranty period on complete system 12 Months |  |  |
| 10.2. | To make location project based on space and room project where system will be installed |  |  |
| 10.3. | To make project for civil, electro and thermo­technical works for technical room, examination room and control room |  |  |
| 10.4. | Installation of the offered system – “Turnkey” project (preparation of facilities-technical room, examination room and control room. HV cable from HV substation to technical room has to be provided by Beneficiaries). |  |  |
| 10.5. | 10 days on site training for staff (doctors and technicians) who will work on the system. Training has to be done by certified Application specialist. |  |  |
| 10.6. | Operator manual (in Serbian and English) and Service manual (in English) |  |  |
| 10.7. | Service personnel response time in warranty period: max 24 hours. |  |  |
| 10.8. | System “Up-time” during warranty period has to be minimum 95% of working days |  |  |
| 10.9. | Spare parts available min. 7 years from the moment of system delivery |  |  |

1. **Digital radiography system for Clinical Hospital Center „Zemun“**

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| **Line Number**  | **Specifications Required** | **Specification offered** | **Location in technical specification (datasheet) or original producer statement** |
| **1.** | U-ARM STAND WITH X-RAY TUBE ASSEMBLY AND DETECTOR  |
| 1.1. | Floor or wall mounted U-arm stand |  |  |
| 1.2. | Preprogrammed motorized movement of stand with X-ray tube and detector |  |  |
| 1.3. | Patient exposure on patient table- minimum AP/PA and lateral |  |  |
| 1.4. | Patient exposure in standing position- detector isocenter-floor distance in range of minimum 43 cm to 168 cm |  |  |
| 1.5. | Coupled (synchronized) vertical movement of detector and X-ray tube assembly during exposure of standing patient- in range of minimum 125 cm |  |  |
| 1.6. | Oblique projection exposures for standing patient and for exposures on patient table for angle range of ±45 degrees |  |  |
| 1.7. | Variable X ray tube- detector distance for exposures of standing patient in range of minimum 100 cm – 180 cm |  |  |
| 1.8. | Variable X ray tube- detector distance for exposures on patient table in range of minimum 110 cm – 150 cm |  |  |
| 1.9. | Rotation of X-ray tube assembly and collimator in range of minimum ±180 degrees |  |  |
| 1.10. | AEC system with minimum 3 chambers on detector housing |  |  |
| 1.11. | Remote controller for remotely controlled movements of X-ray tube assembly and detector. Controls for movements of X-ray tube assembly and detector on X-ray tube housing |  |  |
| **2.** | PATIENT TABLE |
| 2.1. | Portable (not fixed) patient table with brakes on minimum 2 wheels |  |  |
| 2.2. | Table top length minimum 200 cm |  |  |
| 2.3. | Table top width minimum 65 cm |  |  |
| 2.4. | Patient table load minimum 200 kg |  |  |
| **3.** | GRIDS FOR SCATTERED RADIATION |
| 3.1. | Two different grids for two different SID values for radiographic procedures |  |  |
| **4.** | X-RAY TUBE AND COLLIMATOR |
| 4.1. | X-ray tube with high speed rotating anode with 2 focal spots |  |  |
| 4.2. | Voltage (range): minimum 40-150 kV |  |  |
| 4.3. | Anode heat storage capacity: minimum 300 kHU |  |  |
| 4.4. | Automatic collimator with manual adjustments |  |  |
| 4.5. | Automatic collimator opening depending on selected technique (anatomy examed) |  |  |
| 4.6. | LED lamp lightening |  |  |
| **5.** | GENERATOR |
| 5.1. | Minimum power 50kW |  |  |
| 5.2. | High voltage minimum range of 40-150 kV with increments of 1 kV |  |  |
| 5.3. | Maximum current: minimum 320 mA at 150 kV |  |  |
| 5.4. | Automatic exposure parameters adjustments for selected organ program |  |  |
| **6.** | DIGITAL FLAT PANEL DETECTOR |
| 6.1. | Detector sensitivity, DQE minimum 65% at 0 lp/mm |  |  |
| 6.2. | Nominal image size area minimum 43x43 cm |  |  |
| 6.3. | Pixel size: 150 µm or less |  |  |
| 6.4. | Gray scale acquisition minimum 14 bits |  |  |
| **7.** | CONTROL CONSOLE |
| 7.1. | Fully integrated workstation with controls for operating generator, X-ray tube and detector stand (U-arm), patient management, exposures and image processing; One computer and one monitor for operation of complete system and all system adjustments |  |  |
| 7.2. | TFT touch control display, diagonal size minimum 20“ |  |  |
| 7.3. | DICOM MWL SCU |  |  |
| 7.4. | DICOM protocol for image export to PACS |  |  |
| 7.5. | DICOM Print |  |  |
| 7.6. | Postprocessing tools: zoom, contrast and brightness adjustment, flip and image inversion |  |  |
| 7.7. | Algorithms for automatic harmonization of image brightness |  |  |
| 7.8. | Postprocessing tools for enhanced bone and soft tissue visability |  |  |
| 7.9. | Image export on CD in DICOM format with DICOM viewer |  |  |
| 7.10. | Tools for image annotation and patient orientation marks |  |  |
| 7.11. | Exposure level indication (over exposed- under exposed) for each exam |  |  |
| 7.12. | Tools for artifact reduction and imge optimization for better visualisation |  |  |
| 7.13. | Tools for reduction of Scattered grid artifact |  |  |
| 7.14. | Tools for automatic image processing for better visualisation |  |  |
| 7.15. | Adding new organ programs and changing the existing ones |  |  |
| **8.** | **OTHER REQUIREMENTS FOR BIDDER** |
| 8.1. | Warranty period on complete system 12 Months |  |  |
| 8.2. | To make location project based on space and room project where system will be installed |  |  |
| 8.3. | Installation of the offered system- “Turnkey” project (preparation of facilities- technical room, examination room and control room. HV cable from HV substation to technical room has to be provided by Beneficiaries).  |  |  |
| 8.4. | 5 days on site training for staff (doctors and technicians) who will work on the system. Training has to be done by certified Application specialist |  |  |
| 8.5. | Operator manual (in Serbian and English) and Service manual (in English). |  |  |
| 8.6. | Service personel response time in warranty period: max 24 hours. |  |  |
| 8.7. | System “Up-time” during warranty period has to be minimum 95% of working days |  |  |
| 8.8. | Spare parts available min. 7 years from the moment of system delivery.  |  |  |

1. **Premium Cardiovascular ultrasound system for Clinical Hospital Center „Zemun“**

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| **Line Number**  | **Specifications Required** | **Specification offered** | **Location in technical specification (datasheet) or original producer statement** |
| **1.** | **GENERAL FEATURES** |
| 1.1. | Stationary ultrasound system on wheels with central brake, portable concept is not acceptable |  |  |
| 1.2. | LCD monitor size min 23“ Full HD on articulating arm |  |  |
| 1.3. | Height adjustable and rotating control console |  |  |
| 1.4. | Integrated QWERTY keyboard |  |  |
| 1.5. | LCD touch - screen panel size min 12“ |  |  |
| 1.6. | System supports convex, linear, PA sector, matrix, intraoperative, 4D TEE an 4D electronic probes |  |  |
| 1.7. | Minimum 4 active transducer ports |  |  |
| 1.8. | TGC 8 TGC equilizers (on operating console or LCD touch - screen panel) for depth control |  |  |
| 1.9. | TGC equilizers for lateral gain control on LCD touch - screen panel  |  |  |
| 1.10. | Maximum display depth in B mode minimum 50 cm |  |  |
| **2.** | **OPERATING MODES** |
| 2.1. | System supports following operating modes: B-mode, M-mode, ColorDoppler, Powerdoppler, HPRF PWD, Color M-mode, Tissue Doppler Imaging, CW Doppler |  |  |
| 2.2. | Advanced technique for better flow visualisation: B-flow, Advanced Dynamic Flow, Clarify or equivalent. Power doppler is not acceptable |  |  |
| 2.3. | Anatomical M mode |  |  |
| 2.4. | Advanced technique for one button image optimisation in B mode: TEQ, iScan, QuickScan, ATO or equivalent |  |  |
| 2.5. | Automatic one button base line and velocity ranges in PW/CW doppler optimisation |  |  |
| 2.6. | 4D acquisition and heart display in gray scale with color maps |  |  |
| 2.7. | 4D acquisition and heart display in color doppler |  |  |
| 2.8. | Simultaneous visualisation in two planes in real time |  |  |
| 2.9. | Automatic ejection fraction measurement |  |  |
| 2.10. | Quantitative tool for sistolic function assessment, based on speckle-tracking method, with display of segmented miocard movement (left ventricle) as bull-eye graphic in 2D and 3D (automatic measurement in 2D) |  |  |
| 2.11. | 2D analysis functionality requested in point 2.10. is suitable for other ventricle and atriums |  |  |
| 2.12. | Triplex mode with PW or CW doppler |  |  |
| 2.13. | Stressecho package |  |  |
| 2.14. | Simultaneous display of last exam and current exam image. Last exam can be from the same ultrasound machine or other modalities (CT, MR) |  |  |
| 2.15. | Ultrasound system can be upgraded with fusion imaging which enables display of the same anatomical section on ultrasound live image as well as on last exam image performed on CT or MR systems. Image Fusion functionality should be available on 2D transthoracic matrix cardiac probe |  |  |
| **3.** | **OTHER FUNCTIONALITIES** |
| 3.1. | Cine memory minimum 500 MB |  |  |
| 3.2. | Prospective and retrospective clips recording |  |  |
| 3.3. | Image storage in DICOM format on HDD, DVD/CD, USB Flash |  |  |
| 3.4. | Image export in JPEG format and cine clips in AVI (MPEG-4) format |  |  |
| 3.5. | Network connection minimum 1000 Mbps |  |  |
| 3.6. | System has minimum 3 USB ports |  |  |
| 3.7. | System has following DICOM functionalities: Store, Print, Query/Retrieve, Verification, ModalityWorklistManagement, MPPS, Structuredreporting,  |  |  |
|  |  |  |  |
| **4.** | **TRANSDUCERS** |
| 4.1. | 2D transthoracic matrix cardiology probe with field of view of minimum 120⁰ |  |  |
| 4.2. | 4D transthoracic matrix cardiology probe |  |  |
| **5.** | **OTHER REQUIREMENTS FOR BIDDER** |
| 5.1. | Warranty period on complete system 12 Months |  |  |
| 5.2. | 5 days on site training for staff who will work on the system. Training has to be done by certified Application specialist |  |  |
| 5.3. | Operator manual (in Serbian and English) and Service manual (in English). |  |  |
| 5.4. | Service personel response time in warranty period: max 24 hours. |  |  |
| 5.5. | System “Up-time” during warranty period has to be minimum 95% of working days |  |  |
| 5.6. | Spare parts available min. 7 years from the moment of system delivery.  |  |  |