

VOLUME 3

TECHNICAL SPECIFICATIONS

TENDER REF.: EuropeAid/138746/ID/WKS/RS

**The Construction of the Building for emergency Services in Novi Pazar Health Centre and
the Finishing the Construction of a New Block within Vranje Hospital**

Lot 2: Finishing the Construction of a New Block within Vranje Hospital

Location: Vranje, Republic of Serbia

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GENERAL ITEMS

0.1 General

This Technical Specification for works execution will be an integral part of the Tender Documentation, which being an Annex to the Contract on Works Execution, therefore will be considered as the integral part of the said Contract on Works Execution.

The Contractor is fully familiar with all details of the Main Design, as well as with all local regulations, local standards (SRPS), common practice of trade and circumstances for their execution, nevertheless, it is understood that, whenever local regulations, local standards (SRPS), or any common practice of trade, are subject to any interpretation, clarification, ambiguity, or dispute, a ruling by the Supervisor will prevail, always provided that such ruling will be fully in compliance with and will be based on the subject local regulations, local standards (SRPS), including, but not limited to:

ICS Number	Standard Number	Year	TITLE
91.200	SRPS ISO 3443-1	2003	Tolerances for building - Part 1: Recommendations for basic principles for evaluation and specification
	SRPS ISO 3443-8	2005	Tolerances for building - Part 8: Dimensional inspection and control of construction work
	SRPS ISO 7077	1994	Measuring methods for building - General principles and procedures for the verification of dimensional compliance
	SRPS ISO 12491	2002	Statistical methods for quality control of building materials and components

and in accordance with common practice of trade and any such ruling by the Supervisors and subsequent instruction in that respect, will not constitute any ground for variation order and/or any additional payment.

All works must be carried out precisely and professionally. Prior to application, the Supervisor must examine all material and all his comments referring to material and quality of work will be obligatory for the Contractor. The agreed prices include all fully completed works, the final product, and ready for use.

Any reference to specific brand names of the equipment and/or materials found in the design documentation (including but not limited to technical specifications, bill of quantities or drawings) is to be interpreted as only guidance for definition of performance and not as obligatory to be supplied by the Contractor. The Contractor is free to provide equipment and/or materials from any source, which are compliant with Technical Specifications and in accordance with Rules of Origin.

ICS Number	Standard Number	Year	TITLE
03.120.10	SRPS ISO 9001	2008	Quality management systems-Requirements
	SRPS ISO 10001	2008	Quality agreement-Customer satisfaction-Guidelines for codes of conduct for organization

The Contractor will be responsible for any and all damages caused by the Contractor during any works, to any third party, structure, main building or adjacent buildings, and any and all repair works and compensations of any kind will be at the Contractor's expense

The Contracting Authority will provide to the Contractor the area necessary for organization of the building site. The Contractor is obliged to respect safety and protection regulations set up by the Beneficiary when organizing the building site. All other matters in this regard will be the competence of the Contractor.

Supply of water, electricity and all other raw materials to the building site, all the time during the execution of the works, will be the sole liability of the Contractor, including all costs and necessary administrative procedures.

Prior to the commencement of the works, and also in the course of the execution of every work item, the Contractor will ask the Supervisor for any explanations and clarifications required, therefore, the Contractor will solely bear full material responsibility for all works not completed in accordance with the concept and details of this Main Design.

It is also considered that the Contractor will be responsible for safeguarding of the building site and maintenance of existing structure and/or building all the time during the progress of the works until the final completion and acceptance of the building by the Contracting Authority. Upon the completion of the works the Contractor will remove from the building site and other used areas all his tools, machinery, surplus material, etc. so as to have the site neatly arranged as defined in the investment-technical documentation and all other areas restored in same condition as before the construction.

0.2 Standards to be used

Coding of each specific technical specification for any type of works given in this Technical Specification, and subsequently in the Bills of Quantities, is based on the International Classification for Standards – ICS, providing comprehensive correlation between the international and local standards. The Institute for Standardization of the Republic Serbia (Institut za Standardizaciju Srbije, Stevana Brakusa 2, 11030 Beograd, <http://www.iss.rs/kataloge.htm> within its Catalogue provides numerous updated tables enabling connection between international and local standards, as well as, updated review of old SRPS standards which have been either withdrawn, or replaced, or simply renamed.

Any reference to SRPS standards are to be understood as minimum requirement. The Contractor is free to execute any of the works in accordance with other local or international standards providing equal or better characteristics of the material, products or workmanship.

For all construction and construction-craft works it is mandatory to use appropriate labour and good quality materials which must comply with existing technical regulations as well as descriptions in respective items of the Bill of Quantities.

0.3 Obligation to execute works in accordance with Design for Building Permit

Prior to commencement of the works, the Contractor is required to study the design and to timely prepare comments and request all the necessary explanations from the Supervisor. The Design for Building Permit is already prepared and the Contractor has obligation to prepare corresponding Design for Execution of the works. See more details in Article 1.8.2.

The Contractor is obliged to execute works according to the design, TS-s and signed contract. For any changes according to the design and deviations of any kind, both in terms of technical solutions and in terms of material selection, the Contractor must obtain the consent of the Supervisor.

All designs prepared by the Contractor have to be submitted to the Supervisor for approval. After completion of the works, the Contractor has to prepare documentation, designs and any other document needed and requested for Technical acceptance.

0.4 Certificates

For each material or equipment that is installed, the Contractor shall submit the manufacturers "type" test certificates, or recent test results carried out on similar items, i.e. CE-certification, certificate of origin, etc. Certificates are to be submitted to the Supervisor in advance.

Any Equipment and Materials which will be incorporated in the Works, or Services used for the execution of the Works, shall comply with the rules of origin published in the PRAG current at the Base Date and shall have their origin in an Eligible Country including the areas.

- The origin of Goods is distinct from nationality of the Supplier.
- The origin is to be determined according to the Community Customs Code.

A product can not originate in a country in which no production process has taken place. On the other hand, the country of production is not necessarily the country of origin but only when the relevant provisions of Council Regulation (EEC) 2913/92 and its implementing regulation are fulfilled. Furthermore, the country of origin is not necessarily the country from which the goods have been shipped and supplied. Where there is only one country of production, the origin of the finished product is easily established. However, in cases where more than one country is involved in the production of Goods it is necessary to determine which of those countries confers origin on the finished goods. The country of origin is deemed to be the country in which the Goods have undergone their last, economically justified, substantial transformation and the provisions of Article 24 of the Community Customs Code must therefore be applied on a case by case basis to those goods.

The Contractor must certify that the Goods tendered comply with the origin requirement specifying the country or countries of origin. To this end, the Contractor shall provide "Certificate of Origin", which must be made out by the competent authorities of the supplies' or supplier's country of origin and comply with the international agreements to which that country is a signatory.

All the materials for which a Supervisor determines that they do not comply with the agreed Bill of Quantities and the required quality, the Contractor shall immediately remove from the construction site, and the Employer may order suspension of the works if the Contractor tries to use it.

0.5 Health and Safety

The Contractor is obliged to prepare a study on occupational health and safety on the construction site, according to the "Occupational Health and Safety Regulations in the Construction Industry". The Contractor shall take all necessary and prescribed occupational health and safety measures during the execution of works (supports, protective fences on slab and staircases, covering the openings on slabs, disposal of wood and other material to the area designated for storage, construction of protective canopies at the height of the first floor slab, scaffolds). All these works are calculated within the item for which the price is calculated, and are not calculated separately.

0.6 Site documentation

The Contractor shall keep a measurement book and a construction log book according to existing legislation, and enter the necessary information on a daily basis, and these books shall be reviewed and each page certified and signed by the Supervisor.

0.7 Environmental considerations

0.7.1 General

The following environmental protection measures shall be observed during the execution of the works.

0.7.2 Demolition material

Reuse of demolition materials as backfill for trenches and excavations or/and hard fill for construction foundations and roadways is possible, unless contaminated or hazardous materials such as asbestos are identified. The Contractor will be responsible for environmental sound disposal of any material resulting from the demolition and other site materials under permission from the relevant local Authorities and shall be disposed of in a licensed deposit areas.

0.7.3 Excavated soil

Reuse of excavated natural soil, which is free of cohesive components, salt, sulphate and/or clay materials as backfill for trenches and excavations. The Contractor will be responsible for environmental sound disposal of surplus materials under permission from the relevant local Authorities.

0.7.4 Ground water

It is estimated that the ground water table is below top of the ground level. Temporary and/or permanent groundwater lowering may be required for deep foundations and trenches during construction to proceed. The Contractor will be responsible for ensuring of these measures, as well as day- and surface water discharge.

0.7.5 Air pollution

Construction may give rise to dust and vehicle exhausts. Due note is to be taken of the proximity of residential housing to the works. The normal health and safety controls will be required to safeguard construction and the residential and passing population.

0.7.6 Noise pollution

Construction may cause annoyance caused by noise. The normal health and safety controls will be required to safeguard construction and the residential and passing population.

0.7.7 Maximum Noise Levels

The Contractor shall comply with the local and National requirements and the issued permission for construction. The Contractor shall be legally responsible and financially liable to observe environmental legislation.

The noise levels shall be in accordance with the relevant noise environmental legislative.

The noise level at a distance of 1.0 m from each sound-producing item of mechanical or electrical plant or equipment shall not exceed 72 dB(A). The Contractor shall estimate and substantiate by calculation to be submitted at design submission stage the equivalent noise levels.

Noise and disturbance shall be kept to the reasonable minimum as far as required for this project. The Contractor's attention is drawn to the close proximity of some working sites to buildings in continuous use. All plant and tools used at such sites above or near ground level shall be silenced or of a silent type.

The Contractor shall take all necessary steps to ensure that his workmen carry out their duties in a quiet manner particularly when working at night.

Where compressors or generators are to be used for less than one-month suitable baffles or other provisions to reduce noise emission shall be provided with suitable acoustic baffles to reduce the emission of noise. Acoustic screening shall be provided for outside plant equipment to the satisfaction of the Supervisor.

The Contractor shall perform take noise intensity readings as required by the Supervisor and shall submit the results to the Supervisor. The Contractor shall comply with any additional measures required by the Supervisor to keep noise and disturbance, e.g. odours to the minimum.

0.7.8 Pollution Prevention

The Contractor shall not pollute or unnecessarily disturb lands, roads and other places on and around the Site. No trees or other vegetation shall be removed except to the extent necessary for the Works.

The Contractor shall take all reasonable precautions to prevent:

- Silting, erosion of beds and banks and pollution of rivers and watercourses;
- Interference with the supply to or abstraction from underground water sources;

The Contractor shall provide, maintain and remove on completion of the works, settling lagoons and other facilities to avoid pollution caused by the Contractor's operations such as but not limited to quarrying, aggregate washing, concrete mixing and grouting.

0.8 Quality Assurance System

0.8.1 Quality Assurance Plan

The QAP shall, as a minimum, cover the following issues:

- Staff and management organization (organisation chart, staff qualifications & experience etc)
- Management plan (procedures, information system etc)
- Quality control plans (procurement, design, construction etc)
- Document Control (information system, storage, dissemination, archive etc)

The person responsible for the Contractor's QAP shall be authorized and qualified to take decisions on quality assurance issues, and his reference and communication lines to the Company's overall quality assurance organization and its responsible management shall be clearly shown. His duties shall as a minimum be as follows:

- Management of documents.
- Management of procurement.
- Management of Sub-Contractors and suppliers, and requirements to their QAP's.
- Control of materials and workmanship, defects and material reconciliation, procedures for corrective actions, etc.
- Handling of the deviations, additions or variations to the Contract Documents.

Persons performing quality control and testing shall be independent of those executing or supervising the Works.

The Contractor's system of management of documents for the execution of the Works shall include his Sub-Contractors and suppliers, and shall be designed to ensure the following:

- Only valid and approved documents are used for the execution of the Works;
- A complete record of changes and amendments to documents is maintained

The Contractor's shall present with his Tender a preliminary Control Plan describing important and critical control activities which shall be based on the Tender Document and the Contractor's own consideration in respect of execution.

0.8.2 Design Control

The Contractor is obliged only to prepare corresponding Design for Execution of the works if it differs from the Design for Building Permit. Design for Building Permit is already prepared and Building Permit issued. See Article 1.9 below.

The Contractor's designer shall institute a quality assurance system to ensure that his design is completed with due care and attention as per the technical requirements.

The designer must maintain a documented Quality Control Plan (QCP) which is compatible with the Contractor's QCP plan. Sub-providers shall either agree to comply with the providers QCP or have their own documented QCP in place.

The QCP for design shall cover the following activities:

- Selection and assignments of appropriate qualified professionals to perform the project tasks
- Appointment of qualified specialists to oversee and review all elements of the work and carry out a consistent, deliberate program of quality control
- Creation of a design team with a management structure conducive towards quality and continually improving the quality process
- Procedures to ensure that all personnel involved in performing the work have a clear understanding of the scope, intent of the overall project as well as their own responsibilities
- Procedures to prepare appropriately design criteria and environmental assessment
- Procedures for preparation and dissemination of the project schedule to ensure that all personnel involved in performing the work are aware, and understand the importance of meeting intermediate deadlines as well as final completion dates
- Procedures for peer reviews to be conducted by qualified personnel outside of the design team
- Procedures for maintaining documents recording the quality control process properly, to the degree appropriate to each project

The Contractor must present for the approval of the Supervisor his quality assurance plan and quality control plans.

0.8.3 Construction Control

The responsibility rests with the Contractor to produce work which conforms in quality and accuracy of detail, to the Contract Requirements.

The Contractor must, at his own expense, institute a quality control system and provide experienced Engineers, foreman, surveyors, material technicians, other technicians and other technical staff, together with all transport, instruments and equipment to ensure adequate supervision and positive control of the Works at all times. All quality controls shall be recorded by documents which format and content shall be approved by the Supervisor.

A comprehensive Quality Assurance System (QAS), covering all aspects of the Contract and the Works must be implemented, documented and maintained by the Contractor during the period of the Contract.

The QAS shall as a minimum consist of:

- Quality Assurance Plan(QAP)
- Control Plan(CP)

The QAS system shall be presented to the Supervisor for approval within one month from the commencement of the works.

0.8.4 Quality Control Plan for Construction (QCP)

Within one month of the commencement of the works, the Contractor shall present for the Supervisor approval his detailed CP for all quality assurance efforts or measures for the works or sections thereof. However, such CP shall be presented to the Supervisor not later than one week before any actual construction activity.

The QCP shall include controls as specified in the Contract as well as any other normal and special controls that the Contractor finds necessary in order to ensure the quality of his work.

The QCP shall for each control activity describe type, method, range, time/frequency, criteria for approval and documentation and who is responsible for performing the activity.

If the Employer does not approve the QCP as submitted, then the QCP shall be amended for further approval. Subsequent changes in the range and contents of the quality assurance work will not be allowed as a reason to extend agreed deadlines or to increase contract sums.

0.8.5 Documents Control

During the Contract period, the Contractor shall, to the satisfaction of the Supervisor, document that the Works comply with the quality assurance requirements stipulated in the Contract or approved during the Contract period.

Consequently, based on the approved QAS and the QCPs, the Contractor shall during the execution of the works carry out and document the quality control and its compliance with the stipulated requirements.

The Contractor's quality control does not limit his responsibility for completing the Works according to the Contract.

At any time during the period of the Contract, if the Supervisor can substantiate that the Contractor's control and/or documentation is not functioning as planned or is not being adhered

to, the Contractor must propose improvements to remedy the situation at his own cost and within the agreed time for completion.

All control activities specified in the Control Plan shall be documented.

The QCPs and all other issues related to the QAS shall be kept and maintained by the Contractor in the Quality Manual.

On the basis of the QAP and QCPs the Contractor shall produce the necessary form for registration, log books, and check lists, etc. before the Works are commenced.

All documentation shall be provided with identification, the date and signature of the person responsible for the documentation. The identification shall as a minimum comprise: name of project; activity number as defined in the CP; time and place of control activity.

All original documentation shall be inserted in Control File in the Quality Manual, which shall be kept and maintained by the Contractor at the project site throughout the period of the project. In addition to the control documentation the Control File shall also include all other relevant quality documentation. The Supervisor shall have full access to the Control File at all the times.

0.9 Design for Execution of the works

The Design for Building Permit is prepared by the Employer and presented in Volume 5. Based on this Design, the Contractor shall submit prior to any commencement of work to the Supervisor for his approval Design for Execution of the works.

The Supervisor approval of the Drawings, Contract Records etc. and of the Workshop test records etc, shall not relieve the Contractor of the obligation to meet the terms of the Specification and any of the plant which upon delivery to site is found to be incorrect or unsatisfactory, or which fails to perform its duty satisfactorily during commissioning or during the Defects Notice Period shall be replaced to the Supervisor's satisfaction.

The Design for Execution of the works, which have to be produced by the Contractor shall be made and submitted in accordance with the following requirements.

- All dimensions shall be in metric units and each drawing shall be properly identified by a drawing head and a numbering code in the form prescribed by the Supervisor upon commencement of the Works. ISO or DIN standard size sheets shall be used. Drawings shall not be larger than DIN A1;
- The Drawings of all parts of the construction shall be clear and complete. The scales indicated on the Contract Drawings can generally be used. A further choice of recommended metric scales are 1:100, 1:50, 1:20, 1:10, 1:5 and 1:1 depending on the kind of drawing and or details to be presented;
- The Contractor shall submit a softcopy and six hardcopies of all Drawings and calculations to the Supervisor when seeking his approval and the Engineer will return one copy of the Drawings and calculations to the Contractor with his comments;

- Any changes or modifications to the Working Drawings that the Supervisor considers necessary shall be made by the Contractor promptly and the drawings resubmitted for approval in three copies until final approval is obtained;
- 6 copies of each set of the approved Drawings including a softcopy and calculations shall be submitted to the Supervisor ;

Approval of Design for Execution of the works will be given by the Supervisor in the form of a stamp "RELEASED FOR CONSTRUCTION" together with the date and the authorized signature of the Supervisor. Only those Drawings carrying the signature of the Supervisor and dated stamp shall be used for execution. Drawings carrying other signature than those of the Supervisor shall not be used for execution. Commencement of work on any part of the Works construction will only be permitted after the approval of the Design for Execution of the works by the Supervisor.

All cost related to the above mentioned Design for Execution of the works submitted to the Supervisor shall be covered by the lump sum amounts.

All modifications requested by the Supervisor in accordance with the Technical Specification shall be carried out without any additional charge. If the Contractor disagrees with the alterations requested by the Supervisor, the Contractor shall send written notice to the Supervisor within seven days of receiving the altered drawing(s). In such a case the Contractor shall resubmit the particular drawing(s) and calculations if needed, in five copies to the Supervisor subsequent to the Contractor's consideration of the Supervisor's comments.

Should it be found at any time after approval has been given by the Supervisor to a Design for Execution of the works submitted by the Contractor that the said Design for Execution of the works does not comply with the terms and conditions of the Contract or that the details do not agree with the Design for Execution of the works previously approved, such alterations and additions as may be deemed necessary by the Supervisor shall be made therein by the Contractor and the work carried out accordingly without entitling the Contractor to extra payment on account thereof, except where such alternations and additions are to be made in direct consequence of written order by the Supervisor to vary the Works.

No examination by the Supervisor of any document submitted by the Contractor or of the Design for Execution of the works, nor the approval expressed by the Supervisor in regard thereto, either with or without modification, shall absolve the Contractor from any liability imposed upon him by any provision of the Contract. Notwithstanding the Supervisor's approval of the Design for Execution of the works the Contractor shall be responsible for any dimensional or other errors.

0.10 As-Built Drawings

Concurrently with the progress of work on Site the Contractor shall prepare all necessary drawings and diagrams of the "As-Fitted" / "As-Built" Works. Such approved Working Drawings as have been selected by the Supervisor shall be correctly modified for inclusion in

the As-Built Drawings incorporating such variations to the Works as have been ordered and executed. During the course of the Works, the Contractor shall maintain a fully detailed record of all changes from the approval to facilitate easy and accurate preparation of the As-Built Drawing.

The As-Built documentation shall be prepared according to what has actually been built and it shall include all electrical, mechanical and building requirements and in sufficient detail to fully define the location, size, line, level purpose and nature of all elements.

The As-Built drawings shall incorporate full topographical surveys of all alignments, including roads, pavements, existing services, project pipes and service connections, inspection chambers, street names, property limits, etc.

The Supervisor shall approve the title block and numbering system to be used.

The Contractor shall submit 1 (one) reproducible copy and 3 (three) prints of all As-Built Drawings clearly named as such to the Supervisor for approval before applying for the Taking-Over Certificate for the respective Section of the Works. After approval of the As Built Drawing the Contractor shall supply an electronic copy of the drawing that shall become the property of the Employer.

Drawings shall be prepared on computer-assisted design and drafting software of a form and version compatible with the systems which will be operated by the Final Beneficiary (ACAD or similar compatible format). Each copy shall be durably bound in a volume or volumes depending on bulk. All material except Drawings shall be A4 size. Drawings shall be on international A size sheets and shall be bound into volumes. Volume titles shall be clearly inscribed on the front cover and on the spine of the cover. Drawings shall be marked "AS-BUILT". All design, structural, electrical and mechanical Drawings shall be filed on CD as AutoCAD Drawings in DWG format and shall be handed over to the Employer 2-fold. The operating manual shall be filed on CD as Word or Excel files.

As-Built Drawings shall be submitted before the issue of Taking-Over Certificate. Irrespective of the other contractual prerequisites no Section of the Works will be considered substantially completed until the respective As-Built Drawings have been approved by the Supervisor.

0.11 Sampling and Testing

Sampling and testing of materials includes the provision of samples of materials and workmanship as well as the testing and quality control for pipes, manholes, fittings, soils, concrete, asphalt, and other building materials as well of mechanical and electrical installations.

The Contractor shall provide for the approval of the Supervisor, samples of all construction materials and manufactured items required for the Permanent Works. All samples rejected by the Supervisor shall be removed from Site. All approved samples shall be stored by the Contractor in a sample room, at a location approved by the Engineer, for the duration of the Contract, and any materials or manufactured items subsequently delivered to Site for

incorporation in the Permanent Works shall be of a quality at least equal to the approved sample. The approved samples may only be disposed of with the Supervisor approval.

Samples shall be submitted and tests carried out sufficiently early to enable further samples to be submitted and tested if required by the Supervisor. Samples for testing will generally be selected by the Supervisor from materials to be utilized in the project and all tests will be under the supervision of the Supervisor.

Material and installations requiring testing shall be furnished in sufficient time before intended use so as to allow for testing. No materials represented by tests may be used prior to receipt of written approval of said materials.

The Contractor shall give the Supervisor at least 14 days notice in writing of the date on which any of the materials and/or installations will be ready for testing or inspection at a certified laboratory.

The Contractor shall in any case submit to the Supervisor within 7 (seven) days after every test such number of certified copies of the test readings as the Supervisor may require.

Approval by the Supervisor as to the placing of orders for materials or as to samples or tests shall not prejudice any of the Supervisor powers under the Contract.

After all construction is completed and before applying for taking-over, the Contractor shall perform field tests as called for in the Specifications. The Contractor shall demonstrate to the Supervisor the proper operation of the facilities and the satisfactory performance of the individual components. Any improper operation of the system or any improper or faulty construction shall be repaired or corrected to the satisfaction of the Supervisor. The Contractor shall make such changes, adjustments or replacement of equipment as may be required to make the same comply with the Specifications, or replace any defective parts or materials.

In addition to any special provision made herein as to sampling and testing materials by particular methods, samples of materials and workmanship proposed to be employed in the execution of the Works may be called for at any time by the Supervisor and these shall be furnished without delay by the Contractor at his own cost. Approved samples will be retained. The Supervisor will be at liberty to reject all materials and workmanship that are not equal or better in quality and character than such approved samples. The tests required for quality control shall include but not be limited to:

- a) tests conducted at the premises of the Contractor, Subcontractor, manufacturer or supplier which are normally or customarily carried out at such premises for the items or materials being supplied for the Works;
- b) tests which are normally or customarily conducted on the items or materials being supplied for the Works by the Contractor, Subcontractor, supplier or manufacturer but which have to be conducted at an approved laboratory because the necessary testing facilities are not available on the premises of the Contractor, Sub-Contractor, supplier and manufacturer;

- c) tests on locally obtained materials or items either on the Site or at an approved laboratory for the purpose of obtaining the approval of the Supervisor to the classification, use and compliance with the Specifications of such items or materials;
- d) routine quality control tests conducted by the Contractor to ensure compliance with the Specifications;
- e) regular testing of concrete and other materials as specified in the relevant Chapters of the Technical Specifications;

standard shop and Site acceptance tests, including trial assemblies, of mechanical and electrical installations.

0.12 TECHNICAL PROFESSIONAL CAPACITY OF THE TENDERER

Key personnel – at a minimum, the following key personnel should be committed from the tenderer to the successful achievement of this contract:

Site Engineer:

- University degree in civil engineering;
- Working knowledge of the English language;
- At least 8 (eight) years of post-graduated experience as site engineer in building projects and water and sewerage installation,
- Site Engineer or equivalent position on at least 2 projects of similar nature and complexity;

Electrical Engineer:

- University degree in electrical engineering;
- Working knowledge of the English language;
- At least 5 (five) years of post-graduated experience as electrical engineer;
- Electrical Engineer or equivalent position on at least 2 projects of similar nature and complexity;

Mechanical Engineer:

- University degree in mechanical engineering;
- Working knowledge of the English language;
- At least 5 (five) years of post-graduated experience as mechanical engineer;
- Mechanical Engineer or equivalent position on at least 2 projects of similar nature and complexity;

H&S officer

- University degree
- Working knowledge of the English language;
- At least 3 (five) years of experience as H&S officer on site
- Licensed according to RS regulations

Site Engineer, Electrical Engineer and Mechanical Engineer positions must possess, the

relevant professional licenses as required by law on Planning and Construction of the Republic of Serbia and other relevant legal provisions.

The tenderer must submit in the tender the list, CV's and copies of diploma/degrees and employers certificates of all the staff listed above.

Please note that before the contract commencement date, the tenderer must demonstrate that it possesses proper form, issued by the Agency of Business Registry, proving that it is authorized for that type of work, according to the Serbian Law for planning and construction.

0.13 PRELIMINARY WORKS

0.13.1 Site preparatory works

Prior to commence earth works, or any other works, the Contractor shall be under obligation to undertake all necessary preparations to provide the placement, maintenance and removal of required installations and devices, electric power distribution (for operation of machines and lighting) and other installations. The Contractor shall provide the safety of structures and property, prevent any trespassing, taking care that all works are performed in full compliance with the design documentation, safety regulations set up by the Beneficiary for the operation of the prison and time schedule of the Contracting Authority.

The work must be executed during normal working hours on normal working days. Deviation from these rules will be allowed only under extraordinary circumstances like a previously written request or special permission of the Supervisor and Contracting Authority.

The Contractor must set up his own temporary buildings, sheds and barracks to operate as changing rooms and lunch rooms for the working members and as storing for materials and equipment. The size, lay-out and place for them will be approved by the Supervisor. The installation, maintenance and dismantling of the changing rooms, canteens, offices and tool sheds and materials, etc, shall be done on the account of the Contractor and before the work is accepted provisionally.

The Contractor shall be fully-responsible for the stored materials and equipment. He must lock his-sheds and secure the stored items and make arrangements for protecting them against extreme heat, cold and moisture. Only approved materials may be stored and rejected materials must be removed immediately from the site.

All ancillary works (excavation, backfilling, etc.), shall be considered as preliminary works that must be performed by the Contractor fully in compliance with the instruction of the Supervisor. Such work shall involve engagement of the work force and equipment, for excavation, transport and disposal of excavated material, fully observing provisions prescribed for transportation of surplus materials as defined in this document.

0.13.2 Visibility

The Contractor shall provide erect and maintain for the duration of the contract a water resistant signboard at the entrance to the Sites or other location approved by the Supervisor. The design of the signboard and information given is to be approved by the Supervisor prior to manufacture and erection. Further requirements regarding the signboard can be found in the "Communication and Visibility Manual for EU External Actions" on the following address:

http://ec.europa.eu/europeaid/work/visibility/index_en.htm

The signboard and in particular its construction design and location should be approved also by the Employer.

After completion of all the works, the signboard shall be replaced by commemorative plaque. The commemorative plaque shall be installed as stationary on the approved location by the

Beneficiary. The Contractor will be responsible for the maintenance of the commemorative plaque during the Defects Notification period. No other advertisements may be placed on the site unless the prior approval of the Employer is given

0.13.3 Facilities and equipment for the Supervisor

Office accommodation, equipment and facilities for the Supervisor will be provided by the Contractor, prior to the Commencement of works.

During construction stages, the Supervisor will be based at the construction site. The Works Contractor will provide and maintain the following site office facilities for the Supervisor for the duration of the construction works:

The Contractor shall provide prefab (container type) offices at site for Supervisor's team.

The office for Supervisor shall have the minimum surface of 30 m², consisting two rooms, one toilet and small kitchen, equipped with fire extinguisher, first aid kit, and window type AC unit (cooling & heating) in each room. The Contractor shall within 2 weeks of being ordered to do so hand over to the Supervisor fully equipped all the office accommodation as specified.

The cost of office and accommodation shall be borne by the Contractor and shall be included in the unit prices in the Bill of Quantities.

All the offices, furniture and equipment, provided to the Supervision and Beneficiary for perusal during the implementation of the works remain property of the Works Contractor. The assets will be returned back to the Contractor in one month time after the date of issue of the Provisional Acceptance for the works.

The Contractor will provide communication facilities of a telephone set, e-mail and fax for the use of the Supervisor and his staff at the Supervisor's Site office. The Contractor will install telephone line to the Supervisor's offices to supply the telephone, fax machine, Internet and e-mail. The cost of connection, rental and telephone bills for the communication facilities will be borne by the Contractor.

The Contractor will equip the offices with 2 computers containing Microsoft Windows 7 and Microsoft Office 2007 or similar and compatible with stated operating system and software. The computers will be interconnected in a network. The software MS Project or similar and compatible with, will be installed on at least on one computer. One A4 laser printers, 600dpi minimum, and one A4/A3 photocopier will be provided for the offices.

The Contractor will provide safety equipment: 5 sets of personal equipment (helmet, reflective jacket and boots).

Any charges for the above mentioned facilities to the Supervisor shall be provide by the Contractor and the costs thereof shall be included in the rate set forth in the Bills of Quantities.

0.13.4 Personal protective equipment (PPE)

The wearing of protective equipment and/or clothing will be in conformance with applicable regulations. Only equipment complying with regulations or other applicable regulations/standards will be used. Equipment that has been altered in any way will not be worn on the work. Welders are required to wear head protection (hard hats) during welding operations. Soft cap welding or cutting may be authorized only at the direction of the Supervisor.

All personnel are required to have the company logo and name displayed prominently on their hard hat. The name will be applied above the brim of the hat using block letters.

Hard hats are required to be worn at all times with the following exceptions:

- Administration building (offices work)
- Lunch and break periods providing no work is in progress in immediate break area
- Other buildings

Hard hats will not be altered in any way and must be worn with brim to the front, but not during welding. Hard hats will be homologated to conform with the European OSHA Standards.

All personnel on the project will wear approved protective eyewear during working hours. Eyewear must have vendor/manufacture trademark on lenses and homologated stamp on frames.

Tinted lenses are prohibited inside buildings or other structures with limited illumination. This includes prescription glasses.

Safety glasses will have side shields.

In cases where employees perform work in tight or enclosed spaces on the project, goggles, face shield, and other protective equipment are required to be worn to prevent any eye injury.

All grinding operations will be performed with a full-face shield and safety glasses or goggles.

People who wear prescription or corrective eyeglasses will wear goggles (or covered safety glasses) over the eyewear or have prescription glasses with frames, lenses, and side shields that meet the OSHA standards.

Welders will wear dual eye protection while welding.

Safety glasses are required to be worn at all times with the following exceptions:

- In administration buildings (office work)
- During lunch and break periods (providing no work is in progress in immediate break area)
- In project offices
- When goggles are worn

Respiratory equipment will be selected on the basis of the hazards to which the worker will be exposed. Respiratory equipment will be used, stored and maintained in accordance with the manufacturer's requirements. Only approved respiratory protection equipment will be worn.

Approved hearing protection will be worn by all personnel in designated areas.

The Contractor's HSE Manager is responsible for establishing areas under control of the construction group where hearing protection may be required to be worn. This includes the use of required protective equipment when operating equipment produces sound level above the 90 dB (A) level.

Dress requirements

All personnel are required to wear appropriate clothing for the work being performed.

Shirts worn by personnel must have sleeves at least 10 cm in length. Knit shirts, sleeveless shirts, sleeves rolled up onto the ball of the shoulder and other such apparel or practices are prohibited.

People working near moving machinery must prevent clothing and body parts from being caught by the moving components.

Clothing soaked with grease, paint, thinners, solvents, or similar materials will not be worn.

Sturdy leatherwork safety shoes or boots are required.

0.13.5 First aid and medical services

It will be the Contractor's policy to provide and maintain adequate first aid, medical services in the corresponding premises at the work site. External medical facilities will be used in the case of extreme emergencies.

First aid facilities: The Contractor shall provide and maintain an adequate size of first-aid facilities complete with standard equipment and supplies. Such facilities shall be easily accessible to all employees.

Emergency transportation: A job site emergency car will be available as immediate means of transportation to the nearest hospital.

Contractor will also prepare for the approval of the Supervisor, a list of external facilities to notify and request assistance in case of emergency.

TECHNICAL REQUIREMENTS - ARCHITECTURAL DESIGN

Health Center is located in Vranje, 1, Jovana Jankovića, Lunge st.

Cadastral municipality Vranje lot no 6573

Subject of construction: Surgery block, Phase I - B

The terms of reference were prepared for the implementation of Phase I of construction, i.e. the annex of the Centre, where services of patho-anatomy, emergency center, central sterilization, maternity (in the strict sense of the word), the central operational block, central services and intensive care patient care shall be located, as well as the management of the Centre and cabinets of management team on the last floor.

In the second and third phases of construction and reconstruction, under the same program, it is planned to modernize and supplement the facilities that form the core of "hot" medicine, since they were constructed in different periods of time during the last fifty years. These are following facilities:

- Facility A - floors: P+2, area of each floor is 567,18 m², i.e. in total 1.701,54 m². It was envisaged to locate a central laboratory on ground floor (within the central diagnostics service), X-ray diagnostics service on I floor, and modern hospital units on II and III floors (which are to be extended). With the extended floor, total area of the A facility will be around 2.268,72 m².
- General surgery infirmary will be located on the II floor, and gastroenterology, pulmonology, and oncology infirmaries will be located on the III floor.
- Facility B, floors P+3, the area of each floor is 566,82 m², i.e. 2.267,28 m² in total. It is foreseen to locate a part of diagnostic clinic on the ground floor, and orthopedics patient unit on the I floor.
- On the II floor it will be located a sick unit of urology and on the III floor ORL unit and ophthalmology.

Extension of reception office and hospital street that will extent the facility C on the north side, as well as communication connection, also on the ground floor, between the annex and the pediatrics facility, and along the facility C on the south side, with total area of 357,60 m² is included too.

The design envisages the establishment of a central entrance hall for external patients who are coming to the examinations for diagnostic service. It will be place for registration of patients, as well as scheduling of inspections, and performance of all administrative actions.

From here, patients would be directed left and right to the diagnostic department, which is extended now for seven rooms, toilets and waiting premises.

The entrance to the hospital for healthy people (staff and visitors of the patients) is designed next to the main entrance hall. In this entering, transition hall, registration of the presence of personnel shall be done, as well as control of visitors passes.

Finally, between the entrance hall to the diagnostics and hospital street, there was designed a service for reception of patients to the hospital.

Central wardrobe of the staff is designed on the ground floor C, in addition to the existing boiler room, as well as entrance for technical needs.

Area of newly designed annex is 1,012.45 m².

-Facility C, floors ground floor + 3 floors (P + 3), area of each floor is 600,84 m², i.e. in total 2.403,36 m². On the ground floor there is located a central boiler room on heating oil, and in the rest part of the floor it was foreseen a personnel wardrobe and technical entrance to the Center, on the I floor there is gynecology unit for patients, and on the II floor postoperative intensive treatment and care department, and finally on the III floor - endocrinology, rheumatology and nephrology units.

– Facility D was designed and built for the needs of gynecological obstetric department.

As the respective program adopted a concept to have all internal medicine unites located on the same floor, i.e. III floor, and all surgical sick units on the II floor, where a central operational block is located, relocation of certain departments of particular treatment units is foreseen.

On the ground floor of the lamella D there is located a reception department for parturient women and pregnancy pathology department, on the II floor, where the maternity hospital is also located, there is maternity infirmary, and on III floor infirmary of cardiology and on attic there are premises of Administration Center.

TOTAL CALCULATING AREA OF CONSTRUCTION ON THE COMPLEX

Facilities A+B+C+D + attic 12.936,87 m²

Annex + attic (surgery block) 5.016,00 m²

Pediatrics Facility^{1/2} P + P + 3 1.975,00 m²

Psychiatric Facility P + 1 1.409,00 m²

Facility of infectious department P+1 1.202,50 m²

Blood transfusion facility P+0 392, 00 m² -

Facility for kitchen and restaurant for staff P+0 654,00 m² -

The old surgery facility P + 1 1.102,00 m² -

Substations and generators of Diesel P+0 288, 00 m² -

Administrative facility and sometime ORL P+1 1.176, 00 m² -

Facility OZZZ P+3 2.352,00 m² -

Facility of technical services P+0 201,00 m² -

Garbage depony facility P+0 103, 75 m² -

Total 28.808,12 m ²

TOTAL AREA OF TERRAIN UNDER FACILITIES

Lamella A 657,18 m²

Lamella B 566,82 m²

Lamella C 600,84

1.082,00 m²

Lamella D 975,90 m²

Annex (surgery block) 836,00 m²

Pediatrics 432,00 m²

Psychiatry 704,50 m²

Infective department 629,00 m²

Blood transfusion 392,00 m2

The kitchen and restaurant for staff 654,00 m2

Administrative building and old ORL 588,00 m2

Old surgical block 551,00 m2

Substation and generators 288,00 m2

Regional bureau for health protection 492,00 m2

Technical service 291,00 m2

Waste depony 103,00 m2

Total 9.004.24 m2

1.1 New building of surgical block

Design of reinforced concrete structure of the facility and the main design which included a basement (morgue and patho-anatomical laboratory), second floor (surgical block with 6 operating rooms) and the attic where there are technical and administrative premises of the Health Center is prepared. Technical control of the design was performed, construction permit was obtained and reinforced concrete structure of the facility was constructed, and also, insulation works and the facade with windows in order to close the facility.

The design includes ground floor (emergency room), I floor (maternity and central sterilization) and III floor (Central Office intensive treatment and care of patients). Elaboration involves main architectural design with the Bill of Quantities, schematics of joinery and locksmith with relevant details, as well as the main designs of installations of low and high voltage, of HVAC installations and sewage and water supply.

1.2 SURGICAL BLOCK PHASE I – B

SURGICAL BLOCK, CALCULATING AREA PHASE I - B

FLOOR NEW BUILDING BEING ADAPTED TOTAL

Ground floor 881,80 143,75 1.025,55 m2

I floor 881,80 143,75 1.025,55 m2

III floor 881,80 143,75 1.025,55 m2

Total 2.645,40 m2 431,25 m2 3.076,65 m2

NET FLOOR AREA

Ground floor 914,00 m2

I floor 895,91 m2

III floor 927,16 m2

Total 2.737,07 m2

1.3 TREATMENT OF THE AREA

Includes

- performing of heat-acoustic insulation and a layer of concrete screed for equalization of surface of floor coverings;
- Execution of substructure walls of extruded profiles of galvanized steel;
- Execution of both side lining walls of pairwise waterproof plates each with a thickness of 11 mm;
- Execution of lining of masonry walls or walls and columns, doubled with waterproofing plaster boards;
- installation of all installation and necessary equipment;
- execution of suspended ceilings;
- execution of wearproof, fire-resistant and moisture resistant floor coverings.

List of works is presented according to the schedule of execution.

The quality of materials and quality of execution must be of the first class and as required by the design. Attention needs to be paid to the substructure of separating walls which must be made on towed profiles of galvanized steel and not on painted ones; that on the steel folds there is no zinc protection which had burst and crumbled, that those profiles are made of Aluminium sheets, that plaster of the concrete slab must be waterproof and 11 mm tick. Slabs must be factory thinned along its perimeter in order to allow calibration of the composition.

All material and each product must have a certificate from the authorized institution from the aspect of quality, durability, environmental protection and fire protection. It is being required, because it was happening that offered granite had excessive radioactive radiation; the proposed wallpaper emitted toxic fumes when burning; as well as proposed PVC floor coverings, while putting out fire with water emitted toxic vinyl chloride and so on.

Within the design of I-A phase of this facility, there was mentioned a floor covering on self-leveling epoxy, while the technological design envisaged epoxy with the addition of elastomer.

The first is a solid floor which is used in industrial buildings, while the other is special elastic floor, which is being applied in medical institutions.

According to the works schedule, over performed concrete plaster above insulation and concrete intermediate ceiling, it shall be performed a substructure of partition walls on architectural sections on galvanized steel tin.

One side of partition walls is coated. The coating is performed at first, on the side of premise, not on the communication side.

The second side of the partition walls coating is performed only upon implantation of all installations through the substructure.

Connecting of the coatings towards the corridor side is performed by jointing of aluminium profiles.

This allows possible intervention and insight into the condition of installation in partition wall without hindering the work in workrooms.

1.4 THE QUALITY OF WORK

All materials which are used in construction should have a positive opinion of the competent institution. Only finished and semi-finished products are brought to the facility.

The quality of all products, as well as the approval of the product with the required descriptions of the design, must be approved by the Supervisor.

The product generally may be accepted, rejected, because it does not correspond to the quality of manufacture or description of the work, or it can be returned to the manufacturer for finishing. If the products do not correspond in terms of quality or description, the Employer may reject the respective product and entrust the production to another manufacturer, without any compensation to the first one.

If the Contractor notices some mistakes in the design, he is obliged to address to the Supervisor for clarification and correction. But also, if the Supervisor observes mistakes in the executed works, the contractor is obliged to correct the mistake, and to carry works out according to the design documentation, without any fees.

Levels of the ground floor, first and second floors are designed on the same level as existing facility of gynecology, and connected to it too. The level of the third floor has been raised for ten centimeters in order to gain more space above the suspended ceiling on the second floor for accommodation of numerous and bulky channels for air conditioning of operation rooms, and also kept a clean room height of 3.00m.

Installations are placed in the space of suspended ceiling, and the height of premises is reduced for 3.00 to 2.90 meters.

1.5 TREATMENT OF THE AREA OF SURGICAL BLOCK OF HEALTH CENTER IN VRANJE

All installations and connections of particular medical devices are being designed based on adequate technology.

- Within the preliminary design, calculations of the economic capacity of the facility are being elaborated, as well as basic measures of certain services, the size of dressing room, halls and others. As part of this phase there is also: the title list of medical and nonmedical equipment, in the basics of 1: 200 it is being drawn and marked by a certain code of equipment, and finally it is being given a summary of specifications and equipment.
- Within the detailed main design, drawings of fixed medical equipment were given, as well as a position of connections of various installations; also, position of specific connectors (energy needs, distance from the characteristic points and height).
- Synchronous plan of installation provides the basic elements of the way and place of installation of all types of installations, the details of the positions for each of the many installations, details of important installation hubs.
- Premises book (Raum buch)

Important elements of construction

a) The window is of special significance for the facility. It has a role of thermal and hydro insulator of building, barriers against the penetration of noise from the street, and finally element of ventilation and shading the premises.

It must be of good structural properties of the architectural aluminum sections or aluminum and wood or rarely only of wood, with opening around vertical bottom or horizontal axis. Some wings can be fixed, but it is necessary to allow the washing outside parts of the window from inside the facility.

It is necessary that the window has a ventilation opening in the upper horizontal window jambs for natural ventilation of premises during the cold winter months. This hole needs to be closable.

The window should be glassed with thermal glass, as follows: external float glass of thickness of 4 mm, 6 mm interspace filled with argon gas, the inner glass of thickness 6 mm. Clear glasses without bubbles and warping. It is not good if glass is stained in terms of glare, because visually it changes the color of the patients' skin, so it is hard to discern the state of jaundice on patients. It is possible to apply stop - glass ray provided that it does not change the natural color brightness.

Door jambs and wings of window must be constructed in a way to avoid "thermal bridge". The window as a unity, must be in the group 2.1 DIN4108, where $2k = 2.8$ (thermal conductivity). Soundproofing of window as a unit mustn't exceed $R_w = 34$ dB.

Sealing of windows opening wings is performed with rubber strips highly resistant to weather and temperature that prevails in certain areas. The quality of sealing is to be according to the nomenclature H.A.D.M.

Sealing between locksmithery and building elements, as well as the composition of the window - the window, perform high - resistant silicone putty, permanently elastic or expandable foam materials.

Shackle must ensure the function and safety of windows in exploitation. Do not be guided with some regulations that require three-layer glass. It is necessary that the window meets certain design values in the field of thermal conductivity. Three-layer glass to that extent burden the window wing that no hinge can stay for a long time buried in the window frame. It is recommended a protection of aluminum locksmithing with pulver colors, because the same is permanent and refines aluminum elements. Since this is a relatively new procedure, so the description of works on laminating of metal surfaces is described below.

The pulverization can be carried out on all metal surfaces.

Laminating, as surface protection of metallic elements, is done in two phases:

- stage of surface preparation and
- Phase of protection.

Surface preparation before laminating

Preparation of metal surfaces is one of the most important operations in the process of protection. Surface protection is performed by chemical procedure (yellow or gold chrome plating). Chromate layer on the metal has a dual role: it is a good protection against corrosion and provides excellent adhesion of the coating. The process of preparation is being conducted in

the following sequence: degreasing, washing, leaching, washing, neutralization (pickling), rinsing, chromating, washing, rinsing and drying. After this pretreatment the metal is ready for further proceedings of plastic coating.

Laminating (pulverisation)

It is carried out by using of a fine powder, which is electrified with negatively charge of direct voltage from 20 to 100 V. Particles supplied with electric power come close to a grounded object (which is being processed). The same are being attracted and fitted tightly. The procedure is performed automatically, with two robots with three guns, in a particular flow cabin. The thickness of application is 70-80 microns and it is very uniform. Subject, to which surface the color powder is being applied, is transferred by a hanging transporter to the tunnel furnace. The temperature is between 180 and 200°C, and the baking time is 10 to 25 minutes, depending on the type of powder, material to be treated and its massiveness. During the process of baking, the powder melts and flows over the entire surface of the object, so as to give a homogeneous layer which is being compacted at the end, by the following crosslinking reaction or polymerization.

The main features of protection are: high water resistance, resistance at temperatures up to 120°C, high compatibility with pigments, excellent adherence to the substrate, abrasion resistance, resistance to weathering, good coverage and high mechanical properties. Powder coatings are available in all shades and colors according to RAL. Laminating is done on all metal surfaces.

Window parapets

Regardless of kind of facade, from fire protection reasons, within the thermal protection facade coating, it must be carried out a wall on reinforced concrete of minimum tickness of 10cm (MB20).

1.6 WINDOW BLIND

Equally important are blinds by which a people who live or works in house, defends against excessive sunlight, bad weather or unwanted visitors. Simply, shutter on the window is an integral part of it.

1.7 PRECAST DRYWALL

A number of installations that are installed in such objects is so large that the classical brick wall becomes quite unsuitable for construction. Partition brick wall is 10cm thick, 12cm in some cases. Therefore, it is advisable to apply brick-on-edge or half brick wall. Installation of numerous installations in these walls, requires numerous cuttings of grips on freshly built brick, as well as drilling and bridging.

The advantages of these walls are:

- Easy to assemble.
- They are constructed in types of firewalls and insulation in terms of moisture, radioactive and X-ray radiation.
- It is easy to revise installations that were incorporated in them. It is easy to carry out repairs, modifications and the addition of new installations without the visible damaging of walls surface.

- Finishing treatment of such walls is very different and depends on the choice of the Supervisor and employer.
- Soundproofing of these walls is good.
- They are sufficient constructive that can carry pieces of furniture, such as hanging cabinets, shelves and so on.
- They can easily be washed and disinfected without damage.
- Inner and outer corners are protected from wear and fracture. - Etc.

The partition walls are built in a specific model. As a rule, any lining is produced with a width of 110 to 124 cm and a height of 3 to 6 meters.

These walls consist of a substructure and both sides cladding.

The substructure of the partition wall is made of galvanized steel sheet, 0.75 mm thick, molded in the shape of the letter "U" by pulling through special tools. Steel sheet is perforated by holes 40x20mm at the axial distance of 300mm. Profile "U" is of the dimension 50x50 mm or in larger sections in the case of larger interfloor height.

The vertical division of the bearing part of substructure is placed at the axial distance of 1.00 to 1.15 m, depending on the production dimensions of panel cladding which are at the manufacturer's disposal. The horizontal division is shown in the enclosed drawing and includes five horizontal profiles at altitudes of 0.75, 0.90, 2.11, 2.62 and 3.02.

Interconnection of the profiles at the intersection is done by "pop-rivets". For the installation of the door it is necessary to construct a prefabricated frame of the same profiles, at the distance which is 11.5 cm wider than the designed doors opening.

The entire substructure must be solidly built. The profiles which are installed in the floor and in the ceiling construction must be placed one above another, straight with no wriggle, and must be fixed every min. 60 cm of the wall length. On the site only galvanized steel sheet can be accepted, as well as all connecting stainless material.

1.8 Detail of plinth for precast partition wall

The manner of execution of plinth is presented. This is a very important detail because it provides an effective maintenance of hygiene of wall after placing the floor.

Profile "11" is placed as the basis for lining and not dismantled during dismantling of lining. Over it, floor covering is placed, either self-leveling, either one in the form of metric material to be bonded. This manner of execution of plinths is very convenient, technically more correct and excellent for hygiene maintenance.

Material for the construction of plinth is extruded aluminium profile of 10cm height with "tooth" that adheres to the external panel covering.

To ensure sound insulation of wall base in particularly demanding premises, the gap between two plinths, at its height, is filled with sifted dry sand.

Free walls fronts are treated by using of special extruded aluminum profiles and in the way as presented by enclosed detail.

All extruded aluminum profiles (except plinth) were stained by pulver colors and color is chosen by the Supervisor.

The interior angles are performed by adding the rounded external parts of extruded aluminum, which are easily fastened to the substructure with self-tapping screws.

Facing of the wall and ceiling is performed in similar way, by using the same rounded, typical extruded aluminum profiles, painted by pulver colors.

It is also necessary to fix respective rounded profile to the substructure, with self-tapping screws.

External corner of partition wall is executed in the same manner as free wall front, with the implementation of a single "ing" profile, given that it is about one protected corner.

However, in certain places, where architecture and interior design require, angular solution will be implemented by application of external parts which are performed of aluminum sheet with thickness of 1.2 mm, the outer radius of 200 mm and inner diameter of 90 mm and filled with comb and expanded phenol.

Here it is shown a manner of protection and performance of the corners of prefabricated partition walls.

From all stated above it can be concluded that it is a developed system with number of the associated and ancillary products that meet all technical requirements during the construction of assembly - fabricated walls. A partition wall is just one part of the whole treatment area. In the same manner a door in the partition wall, ceiling, floor, holes in the wall and fenders along the corridor are constructed. To avoid mismatches of joints of wall and suspended ceiling it is placed a corner profile of ceiling, which gives the softness of the design, as well as treatment of external and internal wall corners.

The door in the partition wall is the part of this system. For the installation of the door it is necessary appropriately to treat the substructure of the wall. The conditions under which it is necessary to place a frame in the substructure, as well as measures necessary to be met, are shown in the technical drawing given here.

Door frame is made of profiled steel sheet 1mm thick, which is protected by pulver color against corrosion and impact. The corner frame parts can be done with some curves, and by application of "abs" synthetic material.

Doors in healthcare facilities of any space, do not need over-light, because it interferes with broaching of numerous installation and actually has no use.

At the patient rooms there are locks. The door must be self-closing, and the door wing must be from both sides supplied with aslant handle for opening the wings, which must be in the range of design handles.

The doors on the patients' bathrooms are made as unit doors, with door wing supplied with internal door wing as well. As for spatial organization of patient rooms, the doors are being opened towards the bathroom, it is necessary in case of accident, that a nurse can enter the bathroom if the patient has fallen unconscious on the door. Therefore, the wing must be supplied

with an internal wing size 00:40 x 1.45 m, which is opened to the outside, and which is supplied with lock BSS art. 304 + 754W chromed continuous hinges.

Fire doors must satisfy the characteristic F 90. By appearance it must be like any other, with a clear indication that it is fireproofing.

The door on the premises of the X-ray department or area for the application of radioisotopes for diagnostic purposes shall be composed of one layer of lead sheet of thickness 1 or 2 mm, and according to the calculations.

Doors wing itself must be designed in a manner that it looks like covering regardless the wall it is placed in, it should not skew and it has to have characteristic of 32 dB of sound isolation in laboratory conditions. Drawing which is given below has only an informative character.

Hardware is according to the Supervisor's or Employer's choice. Wing door is supplied with two control hinges (half of "boomer"), i.e. three hinges when it is about the door wing which is protecting the premise against radiation or fire. Each door are equipped with a patent lock in the pyramid system. Doorknobs, handles, rosettes and others of hard juvidur are made according to the design approved by the Supervisor. Quality of locks must be of first-class, with reinforced spring for returning of the doorknobs to its original position. Details of handrails and guards are given enclosed.

c) Offset fenders – are predicted along all corridors, as well as in some specific areas where frequent transports of equipment and patients may damage the surface of the walls.

Fenders are made of extruded aluminum profiles of dimensions 180 x 30 mm which are slightly profiled. They are mounted on the walls by the metal spacers. The top edge of the fender (the handle) is at 900 mm from the finished floor. Fixing method must be such that the holders of fenders are fixed with kniping screws to the substructure either to horizontal to 90 or 75 from the floor, either to the vertical at a distance of 1.00 m.

All metal parts and components made of aluminum shall be pulverized. The color is chosen by the Supervisor.

At each door along the corridor, from the handle, left or right, at the length of 1.0 m fender is built as a shelf, by application of mechanism that is given by enclosed detail. This means that the fender can be risen and serve as a shelf to the nurse who enters the room for some reason and there is no need to entere an object that she will use elsewhere.

Lead sheet metal of thickness of 1 mm has a bulk density of 11 kg/m².

Upon completion of the lining by lead sheet it is placed a mounting lining.

It is necessary to take care that compounds of lead sheets are overlapped and secured from "leaking" of radiation.

Suficient height of the coating of the partition wall with lead is 2.20 m.

Care has to be taken about superposition of radiation between two spaces for accommodation of x-ray. According to some experiences, due to intensity of radiation it is not advisable that the neighborhood units are devices of x-ray angiography and computer tomography. In all cases it is necessary to consult with equipment manufacturers and physicists.

Doubling of substructure of partition walls is necessary when implanting of vertical installation of larger dimensions. It is primarily the installation of sewerage. This is because the hospital

does not have a visible verticals of various installations in which dust and dirt could be accumulated. Toilet console pan, which is elevated from the floor for its easier maintenance.

1.9 Preparation of the partition wall and the installation of urinal

Urinal with a detector of ammonium into the trap of outflows. The door in the partition wall. Details of the interior are designed at the same principles.

When choosing a partition wall it is necessary to take care of:

- Its constructiveness;
- Possibility of hooking of equipment;
- Good sound isolation;
- Washability and disinfection solutions;
- Minimal fire characteristics F 30th;
- Minimal noise protection 36 dB under laboratory conditions.
- Do not use a final coating of vinyl wallpaper because no fire inspection will accept it.
- Lining shall be appropriate for wet rooms.
- Options for protection against insects.
- The possibility of easy access to built-in installations.
- A compound of the floor and the wall must be designed to allow easy maintenance of hygiene.

1.10 Treatment of wall and ceiling surfaces

New walls are executed according to the system of prefabricated walls in the system of dry wall boards, by using of double-sided double-layer coating of plaster pasteboard plates, each $d=11\text{ mm}$. The first layer is horizontal, the second vertical, that broaching the cables and pipes do not need to be entered into the walls by chase cutting, but should be laid on the surface of the walls, and over them, at a distance of 2 to 3 cm, to stick a gypsum boards of thickness 11 mm with specialized adhesive on the surface of existing walls. Panel joints should be bandaged and treated with special putty offered by the manufacturer. The lining plates of cardboard-plaster must be waterproof. Two possibilities of surface treatment of walls are being suggested: fasadex or water varnish.

For coloring of the walls, it is necessary at first to bandage and level joints of walls plasterboards with the material supplied by manufacturer of walls. Then wall surfaces shall be skimmed with primer, delivered by the company which is delivering also colors for finishing treatment. Skimmed surfaces shall be sanded and cleaned of dust. Only then it is applied a water lacquer, optionally: with roller, brush, trowel or spray. For application with a roller or brush the aqueous varnish is mixed with 5 to 10% of water. For trowel application the water is not needed. For spray application it is necessary to mix varnish with 10% of water sprinkler nozzle 2 mm, pressure of 2 Atm. Tool is to be immediately washed with water and soap, because for some time it becomes useless if it is not washed.

One liter of aqueous varnish is spent for painting of $\text{cca}12\text{ m}^2$ of the wall.

Colored surface may be bright (metallic) or matt (satinato), according to RAL card.

Color is fireproof, does not reveal smells at high temperatures, it is resistant to impact and abrasion. Between two applications of the paint it has to pass 8 hours. Surfaces do not have to be painted if it is high humidity, when the temperature is below + 10 ° C and if the surfaces are exposed to sunlight.

Lining walls in all required areas, where it has to be maintained a high level of hygiene and sterility shall be made of inert material, waterproof, resistant to fire.

The material, on which the coating is made, must not contain any radioactivity. It can be a gypsum board, specially made, 10 mm thick with standard tapered thickness of one generating. They are laid in two layers on both sides, the compositions are bandaged, and the entire surface is coated with leveling compound twice and three times is sanded. On such executed surface a curable mass is placed, which is also sanded and everything is colored with special colors that have anti bactericidal effect. Of course, the coating is carried out only after placing of all the installations in cavities of walls, and coloring and ironing only after execution of necessary connections.

The compositions of the first layer of plasterboards may not coincide with the composition of the second layer. Therefore, it is most effective that the first layer is placed in plates in horizontal direction and the second in the vertical direction. If in empty space between two linings, panel of hard mineral wool is placed, then such partition wall has a fire resistance greater than F 90.

A color that is applied to the walls and ceiling in operating rooms and intensive care units is generally green-gray, RAL 6011.

Execution of lining of partition walls can be made only on the basis of detailed drawings and surface design. Each hole in the wall must be drawn in, dimensioned and determined by elevations in the area.

Lead sheet of thickness of 1 mm is placed to the constructed substructure in operating rooms and halls for intervention, as protection against radiation. In this case, adhesive paper tape ("fuk paper") is placed to the substructure in order to prevent electrolysis on the composition of these two different metals.

The connection of the vertical wall and floor surfaces, should be performed by molded plinth, rounded, of 10 cm height for easy and efficient washing the floor and inner corners. Plinth is made of extruded aluminum profiles. Over plinth it can be easily applied a mass of the floor covering, whether it is of the self-leveling mass of the epoxide with the addition of elastomers, whether some of the floor coating in the form of a synthetic rubber or other. It is important for floor to be of an electrically conductive material and grounded.

Along the corridor it is necessary to set fenders at a height of 0.74 cm. This will be good protection from the frequent transport of pallets and materials.

1.11 Treating the ceiling

The ceiling must be suspended at least for some 0.70m from the interfloor structure in order to place numerous of installations and girders of medical equipment. Height of operating rooms and hall for intervention should be 3.00m. The ceiling in operating rooms, rooms for awakening,

postoperative care and intervention halls must be sealed. It does not have to be assembly, but in some places it must be equipped with the revision shafts for access of installation branching nodes and for modification of absolute filters in the air conditioning system.

Finishing treatment of the sterile areas is very important. Therefore, manner of work and precautionary of one of the leading companies in the production and application of the substrate and the final layer of paint will be indicated.

Description

Universal base is basically a hydro-soluble paint, for interiors and exteriors, based on acrylic resins and aqueous dispersions. This base can be applied whenever it is desired to increase the coverage and uniformity of the final product works and guarantee the fullness of color. In order better to respond to the request of application, an extraordinary power of filling of prominences, good extensibility and easy applicability was added to the product. When dry scum is formed on the surface of the applied color, the second layer of the substrate can be easily applied, in order to improve its appearance. Due to its nature, surface acrylic semigloss lacquer can be applied to various bases, even as a system for external protection.

Recommendation for application

The base can be applied in the interior and the exterior, such as:

- To the surfaces of new and old wood, already painted wood (doors, beams, panels, etc.)
- To all other works on wood to be coated with professional color 21.
- To the surfaces of aluminum which are not decorated (anodized) and to galvanized steel surfaces.
- To the plastered or unplastered walls in the interiors of apartments, commercial premises, hospitals, public areas.
- To the plastic and PVC materials.
- Technical characteristics
- Binder: Acrylic copolymer, as an aqueous dispersion
- solvent: water
- Bulk density UNI8910: 1.33 +/- 0.05 kg / l.
- Viscosity UNI 8902: about 9000 +/- 10% cps at 25 ° C (viscosity at Brookfield rotation)
- Drying (at 25 ° C and 65% humidity): 2 hours at the touch; wait 6 hours before applying the second layer of color.

Notes for use

- This product can be applied as:
- Coating over rough mortar or similar surfaces
- Coating on the surface of deaerated lime and sand, as a new coat of paint or a coating over the already painted surfaces.
- For painting on plaster or cardboard-plaster, such as boards or partition walls.
- Coating for the base of cement mortar and, in principle, all surfaces made on the basis of concrete surfaces' coating

Wall cobalt glass is ideal for finishing works of satin structure and on plastics in the interior spaces.

It is suitable for food contact, but not suitable as a color for casks or vessels that should contain liquid foods, such as water, beer, wine etc.

Technical characteristics:

- Binder nature: acrylic copolymer as an aqueous dispersion
- Volume weight UNI 8910: 1.24 +/- 0,05 kg / l.
- Viscosity UNI 8902: 1650 cps +/- 10% at 25°C
- Drying (at 25 ° C and 65% RH) 30 minutes at the touch; wait 3 hours before applying the second layer
- Gloss ISO 2813: 20 +/- 5
- Resistance to washing UNI 10560: 10.000 strong brush strokes (superwashing)
- Certificate of stability in contact with different foodstuff, referring to:
- All bulk and wet substances, with a pH > 5;
- All bulk substances, oiled and greased;
- All bulk substances, with the alcohol at a pH of > 5;
- Cereals and variations thereof, bakery products (bread, cakes), fruits and vegetables;
- This product should not be used in contact with the following products:
- Foods in bulk, wet, oily or mixed with alcohol, with a pH <5
- Vinegar, pickled sauces, mayonnaise and oil / fruit emulsions

1.12 Floors

This is a very important construction element at hospitals.

The following requirements need to be met:

- To be resistant to wear
- Not to seem stiff when walked upon
- To be easily washed with detergents and disinfectants
- In wet condition, after washing, not to be slippery
- Not to have a composition which would "rattle" rolling transport means
- Not to be soluble by chemicals
- Not to be flammable
- To be self-extinguishing
- Not to emit toxic gases during combustion
- Not to create resistance when walked upon, otherwise it would tear women stockings
- After washing it must not be lubricated with various "creams", because it just rubs bacteria in the floor area
- Not to emit any strong odors
- Not to change color on parts exposed to the sun, but also in general
- The dirt should be easily seen on it (meaning that it is not colored, "marbled")
- There should be no trace on floor coverings' surface even after a burning cigarette butt is extinguished on it by a shoe.

It is necessary to pay attention to all these circumstances and ask from the manufacturers of floor coverings to submit laboratory certificates issued by a referential laboratory.

Today, the floors are made on a concrete base, either in the form of bonded coatings, or from self-leveling materials, which harden after the bonding. Therefore, the base must be exquisitely prepared because the quality of the floor depends a lot on it.

Concrete leveling layer must be placed because it is impossible to execute an ideally level structurally reinforced concrete slab, without sagging, even up to 5 cm. This leveling layer is executed in plates. Between it and reinforced concrete structure thermal insulation and low rolling transport means are placed, all in accordance with the calculations. So, one should count on additional layers of total thickness of six to seven centimeters, to be added to the structure.

Leveling layer concrete grade must not be less than MB 30 and it must be reinforced with Q reinforcement. Surface is smooth, matt. The work is executed in the fields of about 6 m².

The durability of the floor coverings largely depends on the quality of the executed foundation.

Prefabricated partition wall is placed on the prepared, dry surface, and after that the floor coverings itself.

Nowadays there are two kinds of flooring for hospitals, and those are the coverings made of synthetic rubber and self-leveling floors made of epoxy resin with the addition of elastomers. Synthetic rubber floor can be bought as fabricated goods or in plates 500 x 500 mm or 625 x 625 mm, 2 mm thick. It is glued to the surface by special adhesives. It is found in a variety of colors and finishes: flat, with larger or smaller pastilles, polychrome and others. There are also antistatic floors made for the needs of the operating block, intensive care, X-ray department and others. Antistatic floor is executed over the grid made of copper strips at every 500 mm cross, which are peripherally connected with the grounding straps. The dimensions of copper strips are 50 x 0.3 mm. The floor is very comfortable for walking and resistant to wearing.

Epoxy resin floor with the addition of elastomers is obtained in separate components, and the emulsion is made on the spot. This is a self-leveling floor that is easy to pour even to smaller vertical surfaces. This part refers to the oval aluminum skirting. It can be done in any color. It can be placed anywhere in the hospital: patient rooms, doctors' offices, operating rooms, laundries, kitchen, shower and toilet. It is executed in antistatic performance, on the described base for electricity discharge. It is cast 2 to 2.5 mm thick and requires a strong base, because the binding of epoxy and elastomer creates large shrinking forces, so the base protects the covering if the same does not have the requested concrete grade.

The floor is very good, pleasant for walking. It can be repaired with the same material. If a hard object is pressed into this foundation, upon the termination of the force floor covering receives its original geometry.

Floors of technical rooms may also be executed, for economic reasons, only from epoxy resins. It is a tough and resilient floor, but when walking upon it, it "rattles".

Hospitals should not have doorsteps in any of the premises. That would be a huge hindrance when transporting patients, materials, food and everything else. For the same reason there are no staircases with one or two steps. Level differences can be overcome only by ramps, shorter up to 12% decline, longer ones – up to 8%.

Entrance halls, stairs, entrances and others may be coated with marble or granite, as stated in the design.

1.13 HEALTH AND SAFETY MEASURES

This part is related to the applied prescribed measures and norms concerning safety and health at work, during the designing, and in accordance with the Law on Safety and Health at Work of the Republic of Serbia (Official Gazette No.101 of 2005)

The occupational safety part includes:

- a) Occupational safety during the construction of investment facility;
- b) Occupational safety during the exploitation of the object

a) Occupational safety during the construction of investment facility

It is primarily an investment facility which was built through phase of reinforced-concrete works and finishing off operations on the basement floor, second floor and attic (mostly a technical floor). This study takes into account only the ground floor, first and third floor levels. Nevertheless, the measures that will be listed here can be applied to all other floors.

Many safety measures have already been listed in the detailed technical description, but here they will be mentioned taxatively.

The construction of assembling-dismantling dry walls is planned, making it easier to perform construction works, the construction site is by the nature of things clean during the construction, while the walls themselves have a big advantage over the construction by using bricks. There is no chiselling of walls, the lining is first executed on one side, and after all the designed installations are placed into the construction of partition walls the other side of the lining is laid.

It is forbidden to bring food into construction site, as well as to dine. This prevents the reproduction of mice, rats, cockroaches and ants, which then remain in the hospital.

It is necessary to establish a temporary facility in the immediate vicinity of the facility to be constructed, for offices, dressing rooms, showers, toilets and dining rooms for workers and staff on construction site

It is necessary to undertake all security measures against the theft of materials and finished products. The police in this case is not required to implement the order. The Employer (or Main Contractor, according to contractual obligations) are required to implement rigorous measures of protection against theft and the destruction of material and equipment.

During construction, the Contractor shall provide temporary railings on the stairs, terraces and all exterior openings on the facility.

In the preliminary phase of construction (Phase I-A) the works on the closure of the facility by the designed facade, as well as by the insulation of roof surfaces, are in progress.

Safety measures during the exploitation of this facility provided by this design are the following:

Monolithic self-leveling epoxy floor with the addition of elastomers which give a clean and smooth surface is designed. There are no doorsteps in hospitals. The choice of flooring is described in detail in the Technical specifications. The application of vinyl-asbestos flooring, tiles, wood and marble or granite is unacceptable. This is because some are dangerous to the

lives of people in the facility in case of fire, while the other make excellent nests for the bacteria, thus creating ideal conditions for the spreading of intra-hospital infections.

In all important areas epoxide floors with the addition of elastomers in antistatic execution are predicted, as a measure of protection against ignitions and explosions. All metal parts of the partition walls, ceilings, fences, blinds on the windows and facade are grounded.

The choice of color quality on the linings of partition walls and suspended ceilings is imposed by the need for all these surfaces to be anti bactericidal. Suggested colors are created in Europe on the basis of a programme for innovation of materials for hospitals, sterile rooms, laboratories, slaughterhouse industries, dairies and institutions which require highly sterile work conditions.

Assembling-dismantling suspended ceilings allow easier access to built-in installations, their revision and extension of installation systems.

External blinds (curtains) are envisaged on the windows of all the floors, because it is unacceptable to have a pretty facade with no blinds on the windows. Inner blinds are unacceptable because they are secondary sources of heat and also places of the deposition of dust and dirt.

Handrails are predicted along the corridors as a means of help for the patients who have difficulties in moving, but also as bumper protections from transport means.

A number of doors are opened and closed automatically, as a help to the medical staff during the transportation of patients. Automation can be turned off in case of power failure and the doors can be operated manually.

A pyramid of keys to all the doors in the surgical block is predicted. This means that each door has its own particular key that on each floor there is one key that opens all the doors on that floor and that for all the doors in the facility there is one central key. Central keys for each floor are kept by the head nurse on that floor; central key for the entire facility is kept by the responsible manager of that facility, but also at the police and the fire department. That creates a modern facility protection system.

The weakness of the system is that some irresponsible local manager can change door lock cylinder on his office door and thus destroy the whole system and endanger the safety of the facility.

TV surveillance of the facility and its approaches is predicted in the interest of safety.

Many measures have been taken for the purpose of the protection against the spreading of intra-hospital infection: washing and disinfection of floors, central system for the production and distribution of disinfecting solutions, a non-recycling of air in the system of air conditioning in important areas, the choice of places for cooling towers outside the zone of influence on the object, using the materials for partition walls which are washable even with disinfection means, etc.

Ambulances enter the enclosed space where the patient is carried into the emergency department. This is a humane treatment of the patients, because they are not carried out of the vehicle into the open during rain, snow or frost, and they are also protected from prying eyes.

The bringing out of the deceased from the hospital is done in the covered area, protected from the view from hospital windows or from within its grounds.

Visit to the severely ill patients in intensive treatment and care service is made possible in a manner that it does not disturb the work and hygiene in this service.

1.14 Technical descriptions Phase I-B for the construction of surgery ward

1.14.1 Concrete and reinforced-concrete works

1.14.1.1 General

All concrete work shall be carried out fully in accordance with the Main Design, Static Analysis and applicable regulations and standards.

"Rulebook on technical measures and conditions for concrete and reinforced concrete" (PBAB) Serbian standards (SRPS) or international standards.

The Main Design defines concrete quality, separately for each Static Analysis item, including crushing strength after 28 days (C) and class of concrete, as well as number of test samples for each Static Analysis item, provided that the Contractor shall be obliged to observe the above stated fully.

Natural aggregate mixture shall be used for concrete C12/15 at the maximum; all other concrete quality shall be made from separated aggregate, which shall be comprised under the unit price.

The concrete shall be mixed mechanically from aggregate, cement and water, subject to the Supervisor approval, following the prevailing regulations:

MATERIAL	ICS Number	Standard Number	Year	TITLE
Cement	91.100.10	SRPS EN 197-1	2010	Cement - Portland cement, Portland composite cement, blast furnace cement, pozzolanic cement, composite cement - Definition, classification and technical conditions
		SRPS B.C1.012	1996	Cement - Delivery, packing and storage density
		SRPS ENV 196-4	1995	Methods of testing cement - Quantitative determination of constituents
		SRPS ENV 197-1	1997	Cement - Composition, specifications and conformity criteria - Part 1: Common cements
Natural and crushed aggregate	91.100.15	SRPS B.B2.009	1986	Raw materials for production of aggregates for concrete – Technical requirements
		SRPS B.B2.010	1986	Aggregate for concrete – Technical requirements
		SRPS B.B3.100	1983	Crushed aggregates for concrete and asphalt

		SRPS B.B8.040	1982	Crushed aggregate for concrete and mortar - Examination of aggregate with organic impurities
		SRPS B.B8.042	1984	Natural and crushed aggregate - Chemical analysis of aggregates for concretes and mortars
	91.100.30	SRPS U.M1.057	1984	Concrete - Grading of aggregate for concrete
Water	91.100.30	SRPS U.M1.058	1985	Concrete - Water for making concrete - Technical requirements and testing methods
Admixtures for concrete	91.100.30	SRPS U.M1.034	1996	Concrete - Admixtures for concrete - Definitions and classification
		SRPS U.M1.035	1996	Concrete - Admixtures for concrete - Quality requirements and testing
		SRPS U.M1.037	1981	Concrete - Admixtures for concrete - Previous testing

The aggregate has to be clean, without organic impurities, or earth (acceptable up to 2% by weigh), otherwise the aggregate has to be washed.

The Contractor shall be under obligation to present evidence on quality of material used for concrete manufacturing (cement, aggregate, water).

The concrete quality and executed works have to be in accordance with prevailing regulations:

ICS Number	Standard Number	Year	TITLE
91.100.30	SRPS ISO 2736-1	1997	Concrete tests - Test specimens - Part 1: Sampling of fresh concrete
	SRPS ISO 2736-2	1997	Concrete tests - Test specimens - Part 2: Making and curing of test specimens for strength tests
	SRPS ISO 4012	2000	Concrete - Determination of compressive strength of test specimens
	SRPS ISO 4013	2000	Concrete - Determination of flexural strength of test specimens
	SRPS ISO 4109	1997	Fresh concrete - Determination of the consistency - Slump test
	SRPS ISO 4848	1999	Concrete - Determination of air content of freshly mixed concrete - Pressure method
	SRPS U.M1.051	1987	Concrete - Production control in the concrete plants
	SRPS U.M1.021	1997	Concrete - Classification by compressive strength
	SRPS U.M1.055	1984	Concrete - Method of test for resistance of concrete against freezing
	SRPS U.M1.015	1998	Concrete - Concrete, hardened - Determination of the depth of penetration of water under pressure

	SRPS U.M1.016	1992	Concrete - Method of test for resistance of concrete against freezing and thawing
	SRPS U.M1.045	1987	Transport and delivery of ready-mixed concrete
	SRPS U.E3.050	1981	Prefabricated concrete units - Technical requirements for manufacture and installation

The Contractor will be under the obligation to prepare design documentation for concrete fully in accordance with the article 232 of the Rules on concrete and reinforced concrete (PBAB 87) and to deliver for the Supervisor's approval.

The concrete works shall be executed by qualified work force only, respecting technical specifications and prevailing regulations, national and international standards for such type of works.

Concrete consistency is selected in such a way the with available installation equipment high quality compaction can be achieved, which means that installation should be as easy as possible without occurrence of segregation and with satisfactory finishing touches.

Prior to concreting formworks should be checked, as well as the struts regarding the stability and shape, while during the concreting constant control of concrete should be done. Concrete should not start before the Supervisor inspects the reinforcement and gives written approval for concreting.

Particular attention during concreting should be paid to reinforcement; it should not be dislocated, and it should remain in the position as installed, and it should be all covered with concrete.

Joints should be determined prior to concreting. Their position depends on the procedure, concrete mixer capacity, type of load in that part of structure, and if concreting of visible surfaces is done their position depends on requirements set for their layout.

Lean concrete bedding MB 20 (C16/20) will be placed under the concrete constructions in thickness according to the design

Concreting should be continued in the following way: If work process allow it, 6-12 hours after final concreting the Contractor will wash the contact surface of the joint with water under pressure of 3 - 4 bars or with jet of quartz sand with grain size of 0.5-5 mm under the pressure of 7 bars because concrete can reach 5 kg/cm² of strength under pressure. If there are no conditions for this type of procedure, it is necessary for contact surfaces to be hollow punched. Excess material and place of work should be cleaned and washed with water.

Prescribed number of samples shall be tested by the licensed (accredited) laboratory on the Contractors expense. The Supervisor shall be entitled to request additional sample testing, up to the maximal number of samples foreseen under the regulation, fee of any additional expense on his side, if the Supervisor should request additional sample testing, exceeding the maximal number of samples foreseen under the regulation, then in case of unsatisfactory test results expenses shall be on the Contractor, otherwise, in case of positive test results, the Contractor shall bear expenses of such additional testing.

Concreting shall not commence prior to the inspection and acceptance of the reinforcement by the Supervisor.

Only plain concrete casting shall be done manually in 5-15 cm layers, the reinforced concrete casting shall be done mechanically with vibration, provided that a vibration equipment shall be in accordance with the type of structure, subject to the Supervisor approval. Concrete should be compacted during the installation and immediately after it. Compaction should be done by mechanical vibrations and the Contractor should provide sufficient number of vibrators for internal vibration as well as the conditions for their dislocation. Vibrators should be applied to all concrete around the reinforcement, in the corners and angles of formwork, and they should be used long enough and be of such capacity to compact the concrete completely, but vibrations should not be extended in order to avoid segregation. Separated mortar should not occur on the

surface. Vibrators should be inserted and taken out from the concrete carefully. They should not lean on reinforcement directly or they should not be directed towards the parts and layers of concrete which have hardened to the degree which does not make concrete plastic any more. Before placement of new concrete onto the hardened concrete, formwork should be tightened again, the surface of hardened concrete should be made rough, thoroughly cleaned up of undesired material and cement paint and wetted with water.

Immediately after concreting, concrete should be protected against:

- very quick drying,
- precipitation and running waters,
- high and low temperatures,
- vibrations that might disturb inner structure and
- mechanical damages.

Concrete classification following SRPS norm (SRPS U.M1.021)

ICS Number	Standard Number	Year	TITLE
91.100.30	SRPS U.M1.021	1997	Concrete - Classification by compressive strength (neq ISO 3893:1977)

The common regulation for concrete in the Republic of Serbia is “the Regulation for Concrete and Reinforced Concrete” (always referred to as: “BAB87”), meanwhile, applying newly introduced 1997 standard SRPS U.M1.021 (**Concrete - Classification by compressive strength - neq ISO 3893:1977**) and “BAB87”, certain discrepancies appear. The newly introduced standard SRPS U.M1.021 refers to EUROCODE 2 and EN 206 and subsequently defines 28 days **compressive strength** [N/mm²] using, either a cylinder Ø 15 cm/30 cm test sample, or a 15 cm cube test sample, compared to the 20 cm cube test sample usual and prescribed for “BAB87”.

Please find below a table presenting and emphasizing such discrepancies:

“MB” following “BAB 87”	Concrete Classes following EUROCODE 2 & EN 206	28 days Compressive Strength [N/mm ²]	
<i>Cube 20 cm</i>	<i>C</i> <i>[Cylinder Ø15cm/30cm]</i> <i>[Cube 15 cm]</i>	<i>Cylinder Ø15 cm/30 cm</i>	<i>Cube 15 cm</i>
MB 10	C 8/10	8	10
MB 15	C 12/15	12	15
MB 20	C 16/20	16	20
MB 25	C 20/25	20	25
MB 30	C 25/30	25	30
MB 35	C 30/37	30	37
MB 40	C 30/37	30	37
MB 45	C 35/45	35	45

Executing concrete screed

The reinforced-concrete structure of the building was built according to the main design Phase I-A. Mezzanine ceiling is a reinforced concrete mushroom-like structure MB 50, 22 cm thick, with capitals on the columns. Since this is a slab 22 cm thick, it is certain that due to "concrete flowing" there has occurred a certain deflection in the middle of the ceiling field. These deflections may often be 6 to 8 cm deep. Via the execution of concrete screed a perfect horizontal base must be achieved for the finishing floor covering. Concrete screed predicted in such manner will not be 6 cm thick, as is envisaged by this design. In some places it will be enlarged by the amplitude of ceiling deflection.

Over the executed reinforced-concrete ceiling thermal-acoustic insulation 2cm thick is placed. This insulation is not so necessary for the purpose of thermal insulation, because the building is heated throughout its entire area, but because such a hard and thick ceiling is a good conductor of sound in terms of impact or movement of rolling objects.

After the placing of this insulating layer it is necessary to set up its protection from moisture and laitance from concrete screed. This protection consists of thick polyethylene canvas, with 10 cm overlaps.

Concrete screed must be made from aggregates without organic ingredients and earth; the aggregate that passes through the sieves Ø 20mm, concrete grade 30. It is important to achieve this grade because the predicted self-leveling finishing floor cover during the bonding creates a prying force which has to be annulled by concrete screed.

Concrete screed must be executed in the form of chess fields, size 10 to 12m², for example 3,5 x 3,5m. Reinforcement of each field should be performed with Q reinforcement Ø 8 mm on the grid 10/10 cm.

"Black" fields should be concreted first, and after 48 hours "white" fields should be reinforced. Each field must be perfectly flat, horizontal, and final layer must be smoothed by the spreading of cement powder.

Depending on the time of year in which the related works are executed, moisture in concrete should be maintained by the spraying of concrete surfaces with hose which at its end has a "rose" for water jets' spraying. Within 48 hours from the moment of the concreting of the executed base one must not step on it, or transport any materials.

In rooms where fixed medical equipment will be installed concrete screed should not be executed until the investor contracts medical equipment. This includes x-ray room, the rooms for sterilizers and devices for automatic washing and disinfecting of instruments in central sterilization and others.

1.14.2 Placing of granite slabs

Granite slabs for floor will be selected by the Supervisor and Employer. They must be of proper dimensions, undistorted, ground and highly polished. For the treatment of floor surfaces (entrance hall of the emergency center) granite slabs 3 cm thick, sheet size cca 50 x 80 cm, in strong cement mortar, should be applied. There is no thermal and sound insulation underneath this floor. Slab joints are invisible, the slabs are well levelled, so they create a monolithic impression.

Lining of the walls and pillars of the Emergency Center truck passage

Granite slabs 2 cm thick, dimensions 50x80 cm, will be placed dry by the application of high-strength stainless steel seals, which, on one side, are implanted into concrete wall surfaces, and on the other – into slab edges. The external junctions of slabs at the corners of columns and walls should be executed with slabs whose visible sides (the edge of the slab) are ground and polished (not "mitred"). Undistorted granite slabs should be of a regular size, ground and highly polished.

Supply and lining of the parapet sills with granite slabs

Granite slabs 2 cm thick, polished on one side and one edge, with a drip cap on the unpolished side next to the polished edge, dimensions: width 35 cm, length 60 cm and more. The slabs should be placed into strong cement mortar. The joints between metal window frame and granite slabs should be filled with special universal waterproof adhesive paste. The slabs should be placed horizontally, without any inclinations.

1.14.3 Works on the construction of partition walls

A detailed description of these works is given in the technical report of the Method Statement for the Medical Center Surgery. All construction phases will be presented here chronologically.

1. Construction of partition walls substructure: The substructure is made of galvanized steel drawn sections 50 x 50 mm, perforated for installations' flow. It is laid on the finished, dry base of concrete screed over the hard rubber band 3 mm thick, 50mm wide. The substructure is placed from the floor to the upper mezzanine concrete ceiling. Calculation is done without the deduction of the openings for doors and glass surfaces on the partition wall. Technical report.
2. Procurement, transport, delivery and placing of partition wall plinth made of aluminum drawn sections. In all according to the given detail. Technical report.
3. Execution of the partition wall lining 3.10 m high, waterproof plasterboard twin panels, 11mm thick each, from floor plinth up to 10 cm above the anticipated suspended ceiling. Wall surfaces, on which the lining is performed in two-layer boards, with a total height of 3.10 m, are marked in the Design. They are connected to each other with omega profiles or they are bandaged together, according to the purpose of the room. The calculation includes only the actually executed surfaces. Technical report.
4. Execution of the partition wall lining 2.60 m high, waterproof plasterboard twin panels, 11mm thick each, from floor plinth up to 10 cm above the anticipated suspended ceiling. Wall surfaces, on which the lining is performed in two-layer boards, with a total height of 2.70 m, are marked in the Design. They are connected to each other with omega profiles or they are bandaged together, according to the purpose of the room. The calculation includes only the actually executed surfaces. Technical report.
5. Creating a single double-sided partition wall lining Waterproof plasterboard panels, at the height of the partition wall, from the suspended ceiling to the plate floor. This lining is of a greater height above the suspended ceiling of 2.60m from the floor to the ceiling (for example, in corridors and smaller rooms) and of a smaller height in the premises whose ceiling is at a height of 3.0m from the floor. These linings are placed before the placing of the suspended ceiling, and after the completion of the assembly of installation channels and conductors. The position requires precise tailoring of plates around the conductors and sealing of the joints of various materials (plaster boards, metal conductors of air conditioning and ventilation, copper pipes for medical gases, plastic conductors of hot and cold water, etc.) with universal adhesive fixing paste. The

calculation is done according to the actually executed square measure of the lining. This partitioning, along all partition walls, and in the area above the suspended ceiling, is essential for the prevention of the transmission of sound, pleasant or unpleasant odors from one room to another.

6. A window in the partition wall is executed in all according to the details given in the technical report. It implies double vitrification, with the glass 4 mm thick, curtain and metal frame painted with powder color. Calculation is done according to actually executed square measure.
7. Purchase and installation of pressed mineral wool in boards 0,50 x 1,00 m, 4 cm thick, hermetically packed in thicker polyethylene foil. Mineral wool tables should be inserted into the cavity of partition walls' substructure, after the execution of the substructure, plinth, and one side of the lining and the conduction of all installations through the partition walls.
8. Coating of concrete pillars and wall surfaces made of concrete or bricks with two-layer boards of plasterboard waterproof sheets 11 mm thick. First the substructure made of metal galvanized drawn sections of a cross-section 2,5 x 2,5 cm should be placed, and then the coating should be performed via joint bandaging or through the execution of joints via omega profiles, depending on the design. -Outer corners of the walls and pillars should be protected with drawn Al sections, according to the details given in Technical report.
9. Execution of partition walls with protection against X-ray radiation. Protection against X-ray radiation can be successfully implemented in precast prefabricated walls by inserting a lead sheet of certain thickness. The places where it is necessary to perform this insulation are determined according to the request of the supplier of X-ray equipment, the design on the protection and the consent of the Institute for the Protection from X-rays and radioactive radiation. In principle, lead sheet 1 mm thick and weighing 11 kilos/me is applied. Lead sheet is placed on the substructure of the partition wall from the floor to a height of 2.20 m, in the room. First a so-called »fuk paper« should be pasted to lead sheet substructure in order to avoid the occurrence of electrolysis at the junction of two different metals. Overlaps at the board joints should be 5 cm wide. Over the placed lead sheet a selected lining with joints which are bandaged is laid. A detailed description is given in the technical report of the Method Statement. The item in the BoQ includes only procurement, delivery, base preparation, tailoring and fixing of sheet lead lining. Leaded glass in the wall between the X-ray room and the command devices' room should be delivered by a company that supplied the appliance itself. The cost is calculated according to actually built surface per 1 m2.

1.14.4 Joinery works

If not stated otherwise erection method shall be dry, anchoring by bolts through pre-drilled holes in frames. Connection between wall and frames shall be filled in with polyurethane foam.

Colour of wooden doors shall be according to the design or chosen by the Supervisor (Beneficiary).

ICS Number	Standard Number	Year	TITLE
91.060.50	SRPS EN 1026	2008	Windows and doors - Air permeability - Test method
	SRPS EN 1027	2008	Windows and doors - Water tightness - Test method

	SRPS EN 1121	2008	Doors - Behaviour between two different climates - Test method
	SRPS EN 12365-1 (en)	2009	Building hardware - Gasket and weather stripping for doors, windows, shutters and curtain walling - Part 1: Performance
	SRPS ENV 1627 (en)	2008	Windows, doors, shutters - Burglar resistance - Requirements and classification
	SRPS EN ISO 10077-1 en)	2008	Thermal performance of windows, doors and shutters - Calculation of thermal transmittance - Part 1: General
91.180	SRPS U.F4.020	1990	Finishing works in building - Building-in of building joinery - Technical requirements
	SRPS U.F2.025	1992	Finishing work in building - Glazier works - Technical requirements

All workshop drawings and material samples shall be subject of the Supervisors approval.

All measures given under any item of Technical Specification are related to opening dimension (i.e. masonry dimensions). All provided dimension shall be subject of verification before commencing production.

All exterior doors and windows as well as interior doors are made of multi-chamber aluminium profiles, power coated, and all according to the sample selected by the Beneficiary.

The price of joinery works include fabrication, corrosion protection, installation, final processing, fittings and glazing as well as all the necessary scaffolding, unless not otherwise specified in the respective item of the BoQ.

These works should begin during the phase of the execution of the partition walls' other side. Finished products are brought into the building, colored and varnished, vitrified or ready for installation (in the case of larger closets and nurse posts).

The Supervisor does not interfere with the production technology, but he can only accept a very high quality product that was manufactured according to the required measures and descriptions, from first class timber, permanently undistorted and without any crackings. All door frames must be made of drawn metal sections which will be degreased and painted with powder colors. In the technical report of the Method Statement design a detailed description of how to perform the preparation of metal products for plasticizing and application of powder color is given. This technology is the only guarantee of the stability of color on metal products. Painting and preparation for it should be executed with water-based varnish. In the technical report of the design technical descriptions for this type of work are given. Every door which is locked must have locks and keys in the pyramidal system. In each of these items the specificity of production will be highlighted.

1.14.5 Windows and glass facade surfaces

The window is of a particular importance for the facility. It has a role of thermal and hydro insulator of the building, a barrier against the penetration of noise from the street, and finally a role of the element of ventilation and shading of the rooms.

It should have good structural properties, made of drawn sections of aluminum or aluminum and wood or, rarely, only of wood, with the opening around vertical lateral or lower horizontal axis. Some wings can be fixed, but it is necessary to allow the washing of outer parts of the window from inside the building.

It is necessary for the window to have a vent shaft in the upper horizontal window frame for natural ventilation of rooms during cold winter months. This shaft has to be closed easily.

The window should be vitrified with thermoinsulative glass as follows: outer float glass 4 mm thick, interspace 6 mm wide filled with argon gas, inner glass 6 mm thick. The glass must be clear, without bubbles and distortion. It is not good for the glass to be stained in terms of shading, because it visually changes the color of the skin of patients, so it is hard to discern possible case of jaundice on the skin of patients. It is possible to apply stop-ray glass provided that it does not change the natural lighting color. Frame and window sashes must be designed so as to avoid "thermal bridge". The window as a whole must be in group 2.1 DIN4108, where $2k = 2.8$ (thermal conductivity). Soundproofing of windows as a whole must not exceed $R_w = 34$ dB. Draught stripping of opening window sashes must be executed with rubber bands highly resistant to weather and temperature that prevails in certain areas. The quality of the stripping should be according to nomenclature H.A.D.M.

Stripping between metalworks and construction elements, as well as the window – window joints, should be performed with highly resistant silicone putty, permanently elastic, or with foamy expanding materials.

Window furniture must ensure the function and safety of windows during exploitation. Do not succumb to some regulations that require three-layer glass. The provision that there must be three glasses is nothing. It is necessary that the window meets certain calculated values in the field of thermal conductivity. Three glasses burden the sash to that extent that no hinge can stay stuck in the window frame for a long time.

It is recommended to use protection of aluminium metalworks with powder color, because the same is permanent and refines the aluminium metalworks.

Since this is a relatively new procedure, description of works on the plasticizing of metal surfaces is provided.

Pulverizing can be carried out on all metal surfaces.

Plasticizing is one of the newer methods of surface protection of metallic elements. It is performed in two phases:

- the phase of surface preparation and
- the protection phase.

Surface preparation prior to plasticizing

Preparation of metal surfaces is one of the most important operations in the process of protection. Surface protection is performed by chemical procedure (yellow or gold chromating). Chromate layer has a dual role on the metal: it is a good corrosion protection and it provides excellent adhesion of the coating.

The process of preparation goes as follows: degreasing, rinsing, leaching, rinsing, neutralization (pickling), rinsing, chromating, washing, rinsing and drying.

After this pretreatment the metal is ready for further plasticizing.

Plasticizing (pulverisation).

It is executed by using a fine powder, which is electrified with negative charged DC voltage from 20 to 100 V. Electrically charged particles come close to a grounded object (which is processed). They become attracted and fit tightly. The method is performed automatically, with two robots, with three guns each, in a special flow booth. The coating thickness is 70-80 microns and it is very uniform. The object to whose surface the color powder is applied, is transported via hanging conveyor into tunnel furnace. The temperature is between 180 and 200 ° C, and the baking time is 10 to 25 minutes, depending on the type of powder, the material which is treated and its massiveness. During the baking the powder melts and flows over the entire surface of the object, thus creating a homogeneous layer which, through the following crosslinking reaction, i.e. polymerization, hardens in the end.

The types of powdered varnishes which are used are based on polyester resins, epoxy resins or epoxy - polyester resins. Polyester resins are applied to the outer surfaces.

The main features of protection are: high water resistance, resistance even at the temperatures up to 120 ° C, high compatibility with pigments, excellent adhesion to the base, resistance to abrasion, resistance to weather conditions, good coverage and high mechanical properties. Powder varnishes are available in all shades and colors according to RAL. Plasticizing is executed on all metal surfaces.

Window parapet

No matter what the facade looks like, for the reasons of fire protection, inner thermal protection and facade cladding, a wall must be executed from reinforced concrete of a minimum thickness of 10 cm MB20.

1. Production, transportation and installation of facade partitions (curtain wall), with doors and windows.

The construction is executed according to the above description, from drawn aluminum sections, via interrupted thermal bridge, painted with powder colors in the shade chosen by the Supervisor.

The structure should be anchored at the mezzanine ceiling level to reinforced concrete ring beam and concrete walls.

Glazing is done according to the description with argon gas between the panes, under pressure. The openings are executed according to the given scheme. Window furniture is of a special quality, certified. Calculation per 1 m² of executed and assembled structure received by the Institute for Material Testing of Serbia.

1.14.6 WINDOW CURTAINS

The curtain must have a certain strength both in terms of the materials from which it was made and in terms of its assembly and resistance to all types of weather, it should be painted with colors that reflect sun rays, the paint should be easily washable and durable, the curtain should be silent during the stormy wind and the manipulation with the same, it must be easily modified according to one's desires to allow as much light as one wants, to allow air flow between the windows and the curtains and to be easily gathered and spread, thus enabling a wide view through the window.

Painting works are executed after completion of the construction of partition walls, and before the installing of prefabricated-disassembling ceilings. It is possible to start these works in the rooms where the plasterboard ceiling has already been envisaged and executed (operation rooms, rooms for preparation of patients and others).

Before the commencement of these works it is necessary to execute the protection of the omega profiles at the joints of the boards using self-adhesive tapes, protection of glass surfaces from paint spraying etc. This is necessary because the water varnish, which is predicted as the wall finishing and it is very difficult to remove after drying.

This design envisages wall finishing to be executed by skimming (according to the prescribed recipe) and by painting the walls and non-demountable ceilings with water-based varnish. The number of coatings is lower in all ordinary rooms and corridors (three successive applications by roller, after the drying of the previous layer) and is five in the premises of high sterility.

In the Technical technology report there are detailed descriptions of these works. The color will be determined by the Supervisor, and the color of the walls and ceilings in sterile rooms is according to RAL 6011. The calculation is done on the basis of applicable standards, according to 1m² of wall or ceiling surface.

1.14.7 Lowered ceilings

They are already described in the technology design report. They are laid after the installation of partition walls, the placing of all installations above suspended ceilings and completion of all painting works.

1.15 TEnergy block

1.15.1 Location:

Electrical energy block is located at the south-west part of the Health Centre Vranje complex, on the cadastral lot no. 6573. The facility contains entrances on the eastern and western side, whereas one of the emergency exits is placed on the southern side. Entrance to the O₂ and nitrous oxide substation, as well as entrance to the power substations, is situated on the western side of the facility. Entrance to the air compressor and vacuum station, to the LV and HV block and to the diesel generators room are situated on the western side. Oil sump is located at the south-western part of the facility, whereas the south-eastern part of the facility houses the electrical installation manhole.

The surface is at a gradient in the direction north-south. The facility is accessed via power line which powers the newly constructed surgery block.

1.15.2 Function and structure:

The facility – the electrical energy block contains only the ground floor.

The facility includes the following rooms:

1. Power substation 7.55 m2
2. Power substation7.55 m2
3. Power substation7.55 m2
4. LV and HV block 46.24 m2
5. Diesel generators.....	51.59 m2

6. Substation for O2 and Nitrous oxide	38.09 m2
7. Air compressor and vacuum stations	29.40 m2
Total		187.97 m2

In every room, the floor is made up of a cement screed, except for a portion of the air compressor and vacuum station room, where the floor is made of ceramic tiles and concrete. Along the section with the installation conduits, these are delivered with segmented covers made of knitted wire mesh sheets.

In the majority of the rooms, the ceiling is made up of roof decking, whereas in the LV and HV room, the ceiling is delivered as a dropped ceiling, made of drywall panels on a metal substructure.

The facility is mainly naturally ventilated, through windows and doors in the external wall. The diesel generator room is ventilated automatically through fixed and moveable blinds. The LV and HV room has a separate emergency exit. Walls that divide certain rooms into separate fire emergency section are made of aerated concrete blocks coated with plaster on both sides, 20cm thick, which supersedes the roof as an anti-fire wall 50cm high (above the rooftop decking).

The facility has a gable roof, with canopies on the eastern and western side above the entrances.

The pavement around the facility is lowered to 15cm bellow the floor level, and the land around the facility is surfaced and levelled wherever it necessary.

1.15.3 Construction:

The primary structural system of the facility is a constructed system with horizontal and vertical armoured concrete beams. The rooftop construction is made of steel rooftop bars with steel rafters to which roof decking is attached to.

In the section of the three power substations, the construction of facility is rather specific. At the level + 0.00, a reinforced concrete decking with steel U and I profiles (which are to support the transformer cabinets) is to be delivered completely according to the details. Bellow this decking, a decking with manholes and PVC pipes drainage is to be constructed.

The foundations are to be constructed with a slab and footing.

The facade walls are made of 20cm, i.e. 25cm, thick aerated concrete blocks, coated with plaster on both sides.

The partition walls are to be constructed with 20cm thick aerated concrete blocks, coated with plaster on both sides.

1.15.4 External coating:

The plinth is to be coated with marble plaster in the shade selected by the Supervisor.

Walls and pillars on the facade are coated with “bavalit” decorative render finish whose shade and type will be selected by the Supervisor, and entirely according to the manufacturer's instructions.

Window sills, horizontal and vertical gutters, boarding of the PP skewback are made of steel galvanized plasticized sheets, 0.7mm thick.

1.15.5 Internal coating:

The walls are to be plastered on both sides and covered with a final layer of paint with facade, whose shade will be selected by the Supervisor, completely in accordance with the manufacturer's instructions.

1.15.6 Carpentry and metalwork:

The entrance doors, as well as the windows, are made of aluminium anodised profiles (S 22). All external doors have panels that are opened outward. What is specific about all the double-panelled external doors is the fact that the lower sections of panels contain moveable blinds. Moveable blinds or fanlight with suitable flaps is situated above the door.

Electrical installations, heating and ventilation are included in separate designs.

Water supply and sewage installations for the surgery ward facility—ground, first and third floors

One part of the design of the surgery ward facility within the complex of the Health Center Vranje has been completed. The facility was connected to the external network within the complex, works have been completed in the basement, as well as on the second floor and the attic. The concept of the installation is defined by the previous design documentation, and this design provides solutions for the ground, first and third floors. This design fully complies with existing design documentation and the already provided technical solutions regarding water supply and sewage.

The following solutions have been adopted from the previous design documentation and the following installation have been completed:

- sanitary water supply, cold water
- sanitary water supply, hot water and circulation
- water supply for firefighting purposes
- pipe network for disinfectants
- sanitary sewer system

within the overall dimensions of the floors which are the subject of this design. General items provided by „Energoprojekt-Industrija“ have been retained and adopted as final solutions (drainage of rain water, central heating of hot water, disinfectants technology, pressure boosting in the technological water supply network). Specifically, this design has continued the provided capacities which are defined by the existing design and they were not considered separately. The previous design has only been modified for the second floor and the attic, since there were technical requirements to execute the sanitary sewer network in a different way due to the new layout of the sanitary fixtures, and to supplement the water supply network with the new deionized water network. Deionization units have been installed in the attic and the network is installed throughout the facility to the consumers that require this type of water. Those were the sole and exclusive modifications of the previous documentation. Everything else complies with it, and the technical solution provided in this design has been incorporated into the existing design.

2.1 DESCRIPTION OF THE EXISTING DESIGN

The surgery ward facility which is the subject of this design abuts the existing facility at the location of the Health Center Vranje, with whom it is connected in technological terms. The existing facility does not have a basement, thus this is the only floor that has no communication with the old facility. Other floors are connected with hallway areas of the adjacent facility.

The water supply installations are connected to the external network dn 100, from where the systems of sanitary cold water and firefighting water branch, directly from the location network, the high pressure process water, which has a pressure boosting system at the entrance to the

facility, and hot water and circulation network, which also, upon entering the facility is directed to the central hot water preparation system. The concept of solving the upper floors is such that each of them is supplied with water independently, thus the solution was adopted to install stack of water supply risers in the duct in axis 7. In the stack are one riser of each type of the water supply installation, which have outputs on each floor individually. Thus, the water supply is centralized on one hand, and at the same time each floor is autonomous and can be individually switched off if required.

The sanitary sewage system has been solved by installing risers with consumers on each floor individually. Architectural and technical solution of the space on each floor is based on a relatively large number of risers, as well as their frequent subdivision from one floor to another. The numbering and marking of risers is retained in the design. Drainage is solved through multiple outlets to the network within the complex. Riser group which is located along the very border of the existing facility and in the areas which are joined with the new facility, and are located in the existing one, has been directed to the existing network, which is located below the ground floor of the existing facility (these risers are marked with a V). Other risers (marked with FV) descend to the basement ceiling, where they are collected by the means of horizontal distribution and routed to several outputs. These outputs have been retained in this design, and horizontal distribution in the basement has been retained to the extent that the new technical solutions have permitted.

In the existing design documentation, the following pipe materials have been selected for individual installation. For the firefighting water, galvanized pipes with the necessary threaded fittings have been selected. For the cold water, hot water and circulating water networks, as well as for the disinfectants installations, polypropylene pipes with heat fusing have been selected. Cast iron socketless pipes with external and internal anti-corrosion coatings are designed for the sewage network inside facility (not for installation in the ground). The same materials are used in this design.

2.2 WATER SUPPLY INSTALLATIONS

The location of water supply risers is within the installation duct in axis 7. Risers for the firefighting water, sanitary water, cold, hot and circulating water are installed, as well as the riser of the high pressure process water. The disinfectants riser is placed near the axis H-34, while the subsequently placed deionized water riser is placed in axes B-2 and B-5. These are the starting points for installations in all floors which are being discussed here.

From the risers, the water supply network branches in the suspended ceiling into two parts which go longitudinally through the facility, mostly in the hallway areas, supplying all the consumers. The firefighting water network is made of galvanized pipes without valves on the entire distribution. Hydrants are placed at 1.50 m from the finished floor, inside communication areas and near the staircase areas. Sanitary, cold, hot and circulating water networks are placed parallel to the firefighting network route, however they are extended to all consumers. Polypropylene pipes with thermal insulation, thickness 15 mm have been designed (insulation must be self-extinguishing). Sectoral valves are designed for sanitary water networks, so that parts of the floor network can be shut down for interventions. Also, central valves for the entire floor are installed at the riser branching point itself. These valves are installed in the suspended ceiling, while within individual consumer groups, central valves are installed for each group. These valves shut down several sanitary consumers and are placed on the wall in order to be accessible. Disinfectant network descends through the riser from the attic through the room for soiled, where disinfectant consumer is located on each floor. Other consumers on each floor are supplied from the horizontal distribution which is parallel with other installations.

The only new system compared to the existing documentation is the deionized water network. The need for this type of water is demonstrated by solving the floors that are discussed in this design. Water demineralizers were selected, which have three columns with a capacity of 3,000

to 4,000 liters between two regenerations. The design foresees deionizers type and they are placed in the attic. Deionizers are supplied from the high pressure process water riser. Therefore, it was necessary first to extend the process water riser, which only ran to the third floor. At the top of the riser, an air valve is installed, and from there a route is separated which supplies deionizers. Two deionizers with valves in front and behind are installed for the purpose of safe operation. Capacities are chosen so that one is operational and the other one is a backup at full capacity, so that when one regenerates, the other is activated and starts to operate. Connecting and exploiting of deionizers must be performed according to the instructions of the equipment supplier. A network to the two deionized water risers runs from the deionizer, one descends only to the third floor and supplies the water distillation device, beside the sink. The second riser descends to the first and ground floors. On the first floor it supplies equipment for washing, disinfection and drying of instruments, as well as the steam autoclave with its own steam generator. On the ground floor another device for water distillation is installed. Deionized water network is also designed with polypropylene pipes with insulation thickness of 15 mm.

2.3 SEWAGE INSTALLATION

There are five exits from the building in different parts of the facility. One part of the risers is evacuated according to the existing network in the floor of the ground level of the facility. Sewage network distribution on the basement ceiling, which routes the risers considered in this design is almost completely retained, with minimal changes due to addition of new sanitary fixtures and consumers. Cascades on outlets through the outer wall are fully retained. Also, the horizontal distribution under the floor of the existing facility remains of the same capacity with existing inspection chambers as given in the existing design documentation. Risers marked with a V are connected to those inspection chambers.

Pipes are made of cast iron with external coating for the purpose of anti-corrosion protection, and the internal coating is made of cement mortar. Pipes are socketless with rubber rings as sealants and clamps which thighten the rubber seal. The network is laid out in such a way that it drains all consumers listed in the technology and architecture.

For pipes up to dn 70, slopes of 2% have been designed, and with increasing the diameter to dn 100, the slopes are reduced to 1.5%. Relocation of all risers is determined according to these rules. Certain risers have been retained from the previous design, such as the basement ventilation or installations which drain the attic and the second floor, so that they have been included here only for compliance purposes. In the horizontal distribution, as well as at the bottom of each riser, inspections are placed for the purpose of network interventions.

All sewage outlets are properly siphoned. Also, the installed drainage gullies have traps inside the drainage gully bodies. In front of the technological consumers and washers („trocadero“), PVC drainage gullies are installed, dn 100, while in shower cabins and regular sanitary blocks for staff and visitors, they are dn 70.

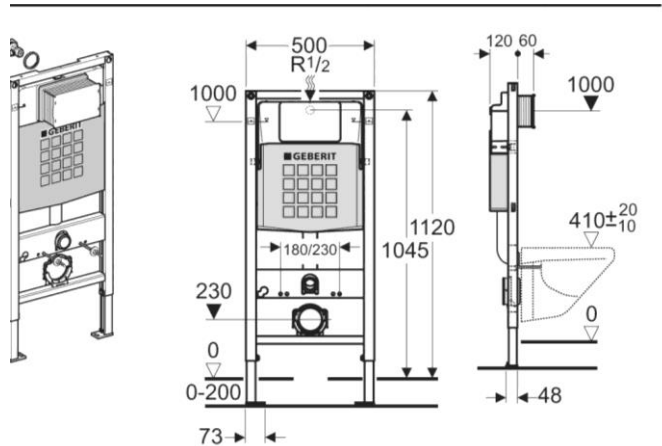
Complete sewage network is ventilated via ventilation heads on the roof of the facility. Some risers are grouped in order to be routed to a common ventilation system. Ventilation heads are made of sheet metal and their appearance needs to be matched with the entire appearance of the roof and material used.

2.4 SANITARY FIXTURES

Sanitary fixtures have been designed according to the intended use of the facility and the primary concern during the selection was the appropriate maintenance of the sanitary fixtures as well as the area they are located in. There are also connections to the water supply and sewage networks of technological equipment, which needs to be connected according to the instructions

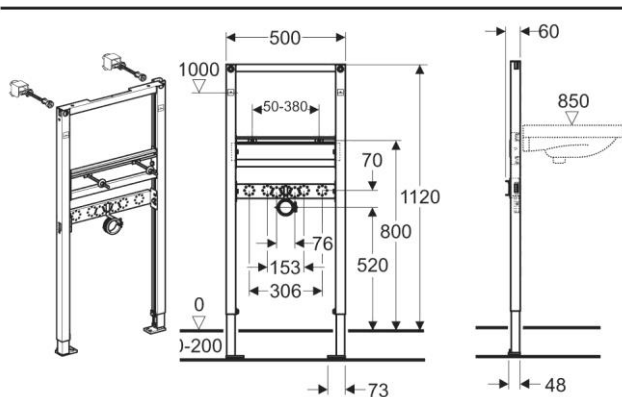
of the supplier. In this design, networks are routed to such consumers and connection of each of them is possible, specifically sufficient capacities have been provided for these consumers. For toilet suits, console toilets are designed with flushing cisterns which are mounted as shown below. The design allows the dimensions for this type of flushing cisterns and toilets, and the pipes are designed for them as well. If another type of sanitary fixture or the flushing cistern is used, connection of toilets with installations have to be arranged on-site.

Duofix WC frame 1.12m with UP300

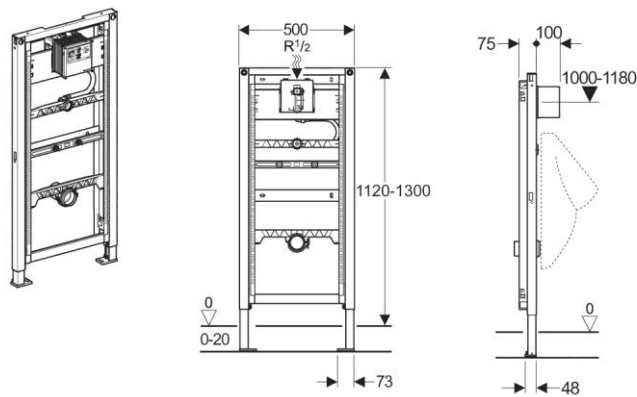


The wash-basins are mouted adequate to the solution for the toilet installation, which is shown in the drawing below.

Duofix basin frame 1.12 m - PreWall



Urinals are designed in an identical manner and their installation is also provided in the attached drawing.



In the part of the facility which is covered in this design, showers are also included, which are equipped with mobile shower mixer units and connected to the sewage network through the drainage gully. Next to each shower cabin, a drainage gully is designed dn 70. Design also includes drainage gullies dn 100 in rooms next to certain technological consumers or in rooms with washers („trocadero“).

Technological consumers are connected according to information provided in manufacturer's catalogues. As the equipment is purchased separately, it is always necessary to check the capacity of the connectors i.e. if they meet the needs of the equipment. Generally, it is necessary to carry out the connecting of the equipment according to the instructions of the equipment supplier, and capacities for each individual location where it is being installed are provided in this design.

Connectors for washing and disinfection units are installed, at the height of 15 cm above the finished floor water connectors dn 15 are installed, as well as siphoned drain in the floor dn 100.

Surgeons scrub troughs are connected in a row of two or three troughs with water supply network at a height of 56 cm above the floor and built-in thermostatic valve which controls the water temperature at the drain. Thermostatic valves are part of the equipment that accompanies surgeons scrub troughs. Troughs are connected with the sewage network through the wall siphon dn 32 to the sewage pipe dn 50.

Portable bathroom for disabled with portable bath has also been foreseen in the design. It consists of a wall mounted fixed part with connectors to the water supply and sewage network and the mobile part where the patient is placed. The bath is attached to the fixed part when used for bathing, and is detached when used for transport.

In certain areas, where it is required by technological needs, in addition to classical faucets, the third faucet is installed. Depending on the requirements, the third faucet is connected to the disinfectants network or to the demineralized water network.

In the maternity ward, troughs for bathing babies are installed, which, adequately to the surgeons scrub troughs, have thermostatic valves which regulate temperature of the water that comes out of the faucet (mounting and connecting is the same as for the surgeons scrub trough). Certain baby troughs have a built-in shower with flexible hose, installed on the surface of the sink.

Washers, dryers and units for glove powdering are also connected to the water supply and sewage installations. These units are also connected to hot and cold water at a height of 56 cm above the finished floor (pipe diameter dn 15), while they are connected to the sewage system via a siphon dn 100.

The machine for washing, disinfection and drying of instruments on the first floor has connections in the floor. Water supply pipes are led through the cement screed and penetrate the floor in the places shown in the catalogue. Hot and cold water pipes are dn 15, while deionized water pipe is dn 20. All pipes have valves on the wall next to the machine, so that each machine

can be switched off individually if needed. For connection with the sewage system, connectors dn 70 are provided, as well as a drainage gully dn 100 in front of the area where instruments are put in.

Steam autoclave with its own steam generator on the first floor has the same water supply connectors as the previous device. For the purpose of this device, a drainage gully dn 100 is installed at the point where the quipment enters into the autoclave.

Above the sinks, which are determined by technological requirements, individual water distillers are allowed, to which deionized water is led, thus in addition to hot and cold water faucet, there is also another faucet and the distiller on the wall.

In rooms for patients who need dialysis, a reverse osmosis unit is foreseen. Connection to this unit is from the sanitary cold water, and it is placed in the utility room, where a drainage gully is foreseen due to other equipment, so that it is not necessary to foresee an additional drainage gully for this unit.

2.5 OCCUPATIONAL HEALTH AND SAFETY MEASURES

according to the Occupational Health and Safety Act (Official Gazette RS 101/05)

Appendix on the occupational health and safety contains:

- a) Occupational health and safety during the construction of the investment facility;
- b) Occupational health and safety during the exploitation of the facility.
- c) Occupational health and safety during the construction of the facility

Since the works are executed partly inside the facility, and partly outdoors, the following types of works are foreseen according to the design:

- 1. Earthworks, concrete and installation works outside the facility;
- 2. Installation works inside the facility.

2.5.1 EARTHWORKS

For manual excavation at a depth greater than 1 m, digging must be carried out under supervision of the designated person.

At a depth of more than 1 m, start the supporting from the ground surface. Any undercutting is prohibited.

If any installations are found during excavation, works must be stopped until supervision of an authorized person of the organization which maintains these installations is provided.

Sturdy ladder must be provided for workers to enter and exit the excavation. The length of the ladder must be at least 75 cm above the edge of the excavation.

Before starting the excavation works, and always after rain, frost or melting of snow and ice, the head of excavation works must examine the status of works and, if necessary, take appropriate protective measures against the risk of collapse of the sides of the excavation.

For excavations deeper than 2 m, a solid fence of a minimum length of 90 cm above the ground should be provided.

For removing the soil from the excavation from a depth of over 2 m, inter-floors must be used with edge protection height of at least 20 cm. Inter-floors are placed on special props.

2.5.2 CARPENTRY WORKS

For supporting use a system of vertical planks without distance between them.

Formwork for supporting the sides of the excavation must be at least 20 cm higher than the ground surface to prevent falling of material from the ground into the excavation.

Removal of formwork must be carried out under the supervision of a qualified person. If the removal would risk the safety of workers, formwork must be left in the excavation. Elements for bonding and fixing of prop parts, such as needles, frames, screws, nails, wires, etc. must comply with applicable Serbian standards.

2.5.3 CONCRETE AND INSTALLATION WORKS

Comply with the existing regulations and orders of the supervisory authority during execution of concrete and installation works.

b) Occupational health and safety during the exploitation of the object.

b.1.) WATER SUPPLY NETWORK

During any interventions on the pipeline, especially in the water meter chamber, the neighbouring valves must be closed first, in order to avoid any work on the pipeline under pressure. If, however, damage on the fittings in the chamber occurs, and water starts to come in, it is necessary to leave the chamber as soon as possible, and then turn off the water at the adjacent valve.

If it is suspected that the water pipe is electrically charged, all known measures of protection against electrical shock must be used.

While handling chlorine, during the disinfection of the new pipeline or repair of the old one in the existing network, personal protective equipment for working with chlorine must be used.

b.1.1) Personal safety equipment

For performing works on the water supply network, depending on the nature of work, danger, harmful effects of various conditions and other elements, the following personal safety equipment should be provided:

1. for head protection:
 - helm (construction)
2. for eye and face protection
 - eye and face shield
 - safety glasses with clear lenses and side protection
3. for hearing protection
 - ear plugs for hearing protection against the noise of volume up to 85 dB
 - ear plugs for hearing protection against the noise of volume up to 105 dB
4. for respiratory protection
 - respirator for respiratory protection against rough, non-aggressive and non-toxic environment
 - respirator for respiratory protection against harmful fumes in smaller amounts
 - hose mask (with hood and helmet)
 - devices with oxygen or compressed air
5. for hand protection
 - leather gloves
 - leather gloves with steel rivets and plates
 - padded leather gloves for work at temperature of 5C
 - gloves made of natural or synthetic rubber in various lengths
6. for leg protection
 - leather knee pads

- shin protectors made of leather or sturdy fabric, lined with felt
- 7. for protection of wrists and shoulders
 - leather wrist protector
 - leather shoulder protector
- 8. for protection against humidity and cold
 - mat made of leather or other insulation material
- 9. for protection against fall in galleries
 - ropes made of jute or coats with safety closures at the ends
- 10. for protection against electrical shock
 - electrical insulating safety shoes
 - gloves made of electrical insulating material
 - electrical insulating mat
 - electrical insulating stand
 - electrical insulating pliers
 - ropes for earthing and short-circuiting

b.2.) SEWAGE

Upon entering the sanitary or storm sewer manholes, canal and manhole ventilation is mandatory. Natural ventilation is achieved by opening the adjacent sewer lids. At least 15 minutes should pass from opening at least two adjacent sewer covers. Forced ventilation is used if the natural ventilation cannot be achieved, or if it is insufficient. Forced ventilation is achieved by using ventilation aggregates.

After the performed ventilation, the possibility of toxicity, combustibility and flammability (this applies only for large collectors) must be checked.

Toxicity is tested by using a toximeter with indicator tubes. Each of these tubes reacts to one or at the most two gases, and therefore, to ensure more safety, it is better to perform testing on a number of tubes.

Combustibility is measured by using a explosimeter, i.e. the concentration of flammable and combustible gases is being measured.

During a longer stay in manholes or test canals, it is necessary to permanently control the toxicity, flammability and gas combustibility. A well trained person must be designated for this task.

Total protection of lungs and other respiratory organs is applied in cases when all the above stated methods are not able to establish with certainty the existence of toxic substances. The same applies when the toxicity is established, but for certain reasons it is not possible to remove it, and the intervention in the canal is urgent. Total protection of lungs and other respiratory organs is a special protective measure, which is implemented by using special clothing and device which operates based on the principle of the compressed air bottle. Instead of the compressed air bottle, the air can be transported through special pipes from the ground surface. When it can be established with certainty that only one specific gas is present in the sewer, a gas mask with a special filter can be used (this applies only for large collectors, and not for home installations).

b.2.1) Personal protective equipment

For performing works in the sewer, depending on the nature of work, danger, harmful effects of various conditions and other elements, the following personal safety equipment should be provided:

1. for head protection:
 - helm (construction)

2. for eye and face protection
 - eye and face shield
 - safety glasses with clear lenses and side protection
3. for hearing protection
 - ear plugs for hearing protection against the noise of volume up to 85 dB
 - ear plugs for hearing protection against the noise of volume up to 105 dB
4. for respiratory protection
 - respirator for respiratory protection against rough, non-aggressive and non-toxic environment
 - respirator for respiratory protection against harmful fumes in smaller amounts
 - hose mask (with hood and helmet)
 - devices with oxygen or compressed air
5. for hand protection
 - leather gloves
 - leather gloves with steel rivets and plates
 - padded leather gloves for work at temperature of 5C
 - gloves made of natural or synthetic rubber in various lengths
6. for leg protection
 - leather knee pads
 - shin protectors made of leather or sturdy fabric, lined with felt
7. for protection of wrists and shoulders
 - leather wrist protector
 - leather shoulder protector
8. for protection against humidity and cold
 - mat made of leather or other insulation material
9. for protection against fall in galleries
 - ropes made of jute or coats with safety closures at the ends
10. for protection against electrical shock
 - electrical insulating safety shoes
 - gloves made of electrical insulating material
 - electrical insulating mat
 - electrical insulating stand
 - electrical insulating pliers
 - ropes for earthing and short-circuiting

2.6 INTERNAL WATER SUPPLY AND SEWAGE INSTALLATIONS

2.6.1 General

The entire work on the water supply and sewage networks must be executed according to the applicable technical regulations and approved design.

The Investor is obliged to ensure the license and all necessary solutions for the execution of works from authorities, within the designated time frame.

The Investor is obliged to notify authorities in written form regarding the commencement of works, as well as to timely invite the competent authorities to perform an inspection and acceptance of the installations.

Changes to the design may be performed upon the approval of the Investor or the Supervisor – representative of the Investor (if the amendments do not affect the design as a whole) and the Investor guarantees for their use.

In the event of unforeseen additional works, the Contractor shall, before the start of such works, perform price analysis and submit it to the Supervisor of the Investor for review. Only after the approval by the Investor, the Contractor may start the execution of additional works.

Otherwise, completed additional works will be treated as contracted work and paid per prices established in the Bill of Quantities for the respective items, or as determined by the Supervisor.

The calculation shall be made according to the actually executed quantities, measured on site, regardless of the quantities in the Bill of Quantities.

All water supply and sewage pipes are measured per m' per axle.

All sewage system fittings (bends, branches, reducers, revisions, etc.) as well as water supply system fittings (elbows, bends, reducers, tees, etc.) are not calculated or paid separately, but are measured as straight pipes. In case of reducers, the larger diameter is calculated.

Also, all the necessary penetration of walls, floor structures, grooving for the purpose of pipe installation, scrimming, walling up, patching and plastering upon the completion of pipe installation are not paid separately, but must be included in the price of the respective item. The price of each item also includes all duties.

2.6.2 Water supply

All construction works shall be executed professionally according to designs, technical regulations and standards, using skilled labor.

Construction material must be of good quality and meet the technical regulations and standards for specific types of material and works.

All installation works shall be executed professionally and shall be of good quality, fully according to designs and technical regulations and standards.

Plumbing sealants as well as the auxiliary material must be of good quality, without any defects, in accordance with existing standards and fully fit for their purpose.

The entire plumbing material is domestic production.

The purchased, transported plumbing material shall be installed with the necessary fittings, with the entire joining (varnish, hemp) and installation (hooks, clips) material. Inspection and testing of the pipes (to sound and pressure), couplings and fittings (to sound), the necessary pipe cutting, threading of valves, wrapping with hemp dipped in varnish or red lead, twisting of pipes or joints, straightening and providing pipe gradient, coating pipes with bitumen as well as securing pipes with hooks or clamps shall be performed in accordance with high quality standards and applicable technical regulations and standards.

Pipes outside the wall, which are free standing, must be at a distance of 2-3 cm from the wall and secured with clips at every 2 m.

Pipes which are installed in the ground shall be coated with "bitulit" coating, then with bitumen and wrapped with bituminous jute.

Works include measuring and marking of the water supply network.

Before commissioning, it is mandatory to perform inspection of the entire installation.

2.6.3 Sewage

All construction works shall be executed professionally according to designs, technical regulations and standards, using skilled labor.

Construction material must be of good quality and meet the technical regulations and standards for specific types of materials and works.

All installation works shall be executed professionally and shall be of good quality, fully according to designs and technical regulations and standards. Sewage sealants as well as the installation and auxiliary material must be of good quality, without any defects, in accordance with existing standards and fully fit for their purpose.

The entire plumbing material is domestic production.

The purchased and transported sewage system material must be of good quality and without any deviation from existing technical standards, and fully fit for its purpose.

Pipeline joints must be well sealed, specifically: for ceramic pipes with tow and asphalt putty, and for cast iron, by using tow and lead.

All sanitary facilities must be supplied, transported and installed professionally and they must be of good quality.

All sanitary fixtures must be from domestic manufacturers.

After installing the sewer network it is necessary to perform the necessary testing of the same and only after the testing has been completed, it should be proceeded with backfilling and scrimming.

Venting of the sewer network is performed via ventilation pipes DN 100 mm and 70 mm, which have ventilation heads on their ends DN 150 mm and DN 120 mm above the roofs.

2.6.4 List of applied technical regulations and standards

1. Manhole covers
SRPS.M.J.6.210 Manhole covers;
SRPS.M.J.6.220.227 Technical regulations for manufacturing, testing and application
2. Ceramic pipes
SRPS.B.D1.200 Ceramic sewer pipes, fittings, plates and clinker bricks
SRPS.B.D1.210 Quality requirements
SRPS.B.D1.220 Straight pipes
SRPS.B.D1.230 Reductions
SRPS.B.D1.225 Simple bends
SRPS.B.D1.226 Offset bends
SRPS.B.D1.240 Straight junctions, one way and two way
SRPS.B.D1.241 Bent junctions, dimensions
SRPS.B.D1.245 Fork junctions, one way and two way
SRPS.B.D1.270 Revision straight pipes
3. Cast iron sewer pipes
SRPS.C.J1.421 Sewer pipes fittings made of cast iron
Technical requirements for manufacturing and delivery
SRPS.C.J1.430 Pipe, shape and dimensions
SRPS.C.J1.431 Inspection pipe
SRPS.C.J1.440 Bends. Shape and dimensions
SRPS.C.J1.441 Offset bend
SRPS.C.J1.474 Branches 87°. Shape and dimensions
SRPS.C.J1.471 Branches double 45°
SRPS.C.J1.475 Branches double 87°
SRPS.C.J1.470 Branches 45°. Shape and dimensions
4. Asbestos cement sewer pipes and fittings
SRPS.B.C4.020
5. Sewer pipes and fittings made of rigid PVC
SRPS.G.C6.511 ...521
SRPS.C.J1.480 Pipeline shutters DN 50 mm
SRPS.C.J1.481 Pipeline shutters DN 70 mm
SRPS.C.J1.482 Pipeline shutters DN 100 mm
6. Galvanized pipes
SRPS.C.B5.225 and for fittings SRPS.C.B6.500 ... 595
7. Shutters:
M.C5.021 (71) General purpose valves
M.C5.031 (69) Flanged valves
M.C5.051 (69) Angle flanged valves
M.C5.111 (69) Relief valves, flanged

- | | | | |
|-----|----------------------------|------|---|
| | M.C5.121 | (69) | Relief valves, angle form, flanged |
| | M.C5.181 | (69) | Relief valves, flanged |
| | M.C5.201 | (69) | Relief valves, angle form, flanged |
| | M.C5.260 | (66) | Stop valves |
| | M.C5.261 | (66) | Outlet valves |
| | M.C5.262 | (67) | Valves with cap built in wall |
| | M.C5.270 | (66) | Angle valves |
| | M.C5.271 | (66) | Angle outlet valves |
| | M.C5.280 | (66) | Discharge valves |
| | M.C5.281 | (66) | Angle valves |
| | M.C5.282 | (66) | Angle control valves |
| | M.C5.600 | (63) | Shut off devices for general purposes |
| | M.C5.325 | (70) | Shut off cocks |
| | M.C5.400 | (61) | Cocks for general purposes |
| | M.C5.431 | (61) | Bronze cocks |
| | M.C5.451 | (61) | Bronze cocks, angle form |
| | M.C5.481 | (61) | Bronze three-way cocks |
| 8. | <u>Faucets</u> | | |
| | M.C5.250 | (66) | Wall mount faucet |
| | M.C5.251 | (66) | Wall mount faucet with coupler |
| | M.C5.820 | (67) | Valve with swimmer |
| | M.C5.290 | (66) | Free standing washbasin mixer |
| | M.C5.300 | (66) | Wall mounted outlet valves with swiveling outlet pipe |
| | M.C5.301 | (66) | Wall mounted angular outlet valves with swiveling outlet pipe |
| 9. | <u>Mixers</u> | | |
| | M.C5.804 | (67) | Pillar mixer unit with swiveling outlet pipe |
| | M.C5.803 | (66) | Wall mixer unit with swiveling outlet pipe |
| | M.C5.805 | (67) | Pillar mixer with one outlet pipe |
| | M.C5.806 | (67) | Mixer unit for bath water tank |
| | M.C5.807 | (67) | Mixer units for water heater |
| | M.C5.800 | (66) | Bath wall mixer unit |
| | M.C5.801 | (66) | Bath wall mixer unit with swiveling outlet pipe |
| | M.C5.802 | (66) | Shower mixer unit |
| | M.C5.816 | (70) | Bidet mixer unit |
| 10. | <u>Miscellaneous parts</u> | | |
| | M.C5.310 | (67) | Safety valves DN 1/2" and DN 3/4" |
| | M.C5.311 | (67) | Safety valves DN 1" |
| | M.C5.821 | (71) | Water closet flush valves |
| | M.C5.810 | (67) | Water seal for the sink |
| | M.C5.811 | (66) | Water seal for urinal |
| | M.C5.812 | (67) | Discharge knee with stopper (for the bath tub) |
| | M.C5.813 | (67) | Over flow knee (for the bath tub) |
| 11. | <u>Sanitary fixtures</u> | | |
| | U.N5.100 | (73) | Vitreous china sanitary ware, definition and types |
| | U.N5.110 | (73) | Vitreous china wash-basins |
| | U.N5.112 | (72) | Wash-basin of cast iron |
| | U.N5.120 | (73) | Wash-out WC pans |
| | U.N5.121 | (73) | Wash down WC pans |
| | U.N5.125 | (62) | Water closet flushing ledge |
| | U.N5.210 | (71) | Bath tubs of cast iron or steel sheet |
| | U.N5.220 | (71) | Semi bath tub of cast iron or steel sheet |
| | U.N5.230 | (71) | Shower baths of cast iron or steel sheet |

U.N5.300	(72)	Kitchen sinks, built on table top units
U.N5.305	(72)	Enameled sink basins of iron casting
U.N5.306	(72)	Enameled double sink basins of iron casting
U.N5.310	(72)	Double kitchen sink basins

DISINFECTION AND FLUSHING OF WATER SUPPLY PIPELINES

2.6.5 General

Causes of pipeline contamination may be soiling of pipes and installed material, or penetration of dirt (sand, soil, mud, contaminated water) during the execution of works.

In order to ensure bacteriological safety of water, it is necessary to perform disinfection of the network before commissioning, as well as in certain time intervals during operation.

In order for the washing and disinfection procedure to be as simple and efficient as possible, it is necessary to install as clean as possible pipes and fittings, and to take measures to prevent the penetration of various materials in the pipeline during installation.

If there is water in the trench, it must be pumped out before laying the pipeline.

During each interruption of works, it is necessary to close the pipe ends with wooden plugs, in order to prevent penetration of material and entry of animals.

In order to achieve good disinfection results, it is necessary to previously clean and flush the network.

Water supply network disinfection and flushing is carried out according to applicable regulations, with mandatory presence of the representative of the water supply company's sanitary service.

2.6.6 Washing of pipeline

Washing of pipeline is carried out after the trial pressure test.

Only use potable water is allowed for washing.

For the purpose of efficient washing of the pipeline, it is necessary to achieve a minimum water flow velocity of 1.5 m/s.

Method of flushing depends on the number and position of the network outlets (performed from top to bottom).

Flushing lasts until clear water appears on the outlet, at least 20 minutes, i.e. until the amount of the water used for flashing reaches approximately three times the volume of the section which is being washed.

Minimum quantities for washing of the pipeline:

- For diameters < 150mm, $3 \div 5 V$,
- For diameters > 150mm, $2 \div 3 V$ (where V is the volume of the section which is being washed).

If the water is being discharged into open space, it must be ensured that this does not cause any damage.

Washing of pipeline shall be planned by sections and performed every six months.

2.6.7 Disinfection of the pipeline

The disinfection process is performed by injecting chlorine into the part of the pipeline which is bounded by flanges.

Inserting chlorine into the pipeline is performed through hydrants, through specially provided branches, or by using a special device with chlorinator.

The following agents are commonly used for disinfection:

- Sodium hypochlorite,
- Calcium hypochlorite
- Chlorinated lime.

Disinfectants are prescribed by the competent water supply company, in compliance with the relevant sanitary inspection.

Parts of the network that are being disinfected must be completely isolated from the other parts. Since chlorine represents a health hazard, the responsible person from the health authority must provide adequate protection for workers who perform disinfection.

Workers must be trained and equipped with prescribed protective equipment (gas masks, rubber boots, rubber aprons, rubber gloves, etc.).

The responsible manager must inform the public (users of the water supply network), by means of public notice, on the performance of disinfection, in order to avoid the use of water with high content of chlorine.

2.6.8 Flushing of the pipeline

Upon expiry of the time scheduled for disinfection, the flushing of the pipeline with potable water is performed. Flushing continues until the chlorine content drops below 1mg/l.

After completing the flushing, a bacteriological analysis is performed of the required number of samples. If the results of this analysis do not show satisfactory results, it is necessary to repeat the disinfection and flushing. The exploitation of the water supply network can start only after obtaining an approval for the use of water.

2.6.9 Calculation and payment

Calculation and payment shall be done per m' of disinfected and flushed pipeline.

GENERAL TECHNICAL REQUIREMENTS FOR STEEL PIPES

2.6.10 General

Supplied and installed steel pipes must comply fully with the following standards and regulations:

Welded steel pipes

1) For pipes for operating pressures of up to 25 kp/cm², provided that the product of the inner pipe diameter (mm) and operating pressure (kp/cm²) does not exceed:

- 7 200 for steel Č.0000 i.e.
- 10 000 for steel Č.0370
- (all of the above applies to liquid of up to 120°C) the following standards apply:
- SRPS Č.B5.025 – Technical conditions for manufacture and delivery.
- SRPS Č.B5.027 – General instructions.
- SRPS Č.B5.240 – Shapes and dimensions

2) For pipes for operating pressures of up to 64 kp/cm², if the pipes are delivered with the factory certificate, they are usually made of steel: Č.0261; Č. 0361 and Č.0461.

The following standards apply:

- SRPS Č.B5.026 – Technical conditions for manufacture and delivery.
- SRPS Č.B5.027 - General instructions
- SRPS Č.B5.240 - Shapes and dimensions

Seamless steel pipes

1) For pipes for operating pressures of up to 25 kp/cm², provided that the product of the inner pipe diameter (mm) and operating pressure (kp/cm²) does not exceed 7.200 for steel Č.0000, the following standards apply:

- SRPS. Č.B5.020 - Technical conditions for manufacture and delivery
- SRPS. Č.B5.023 - General instructions
- SRPS. Č.B5.221 - Shapes and dimensions
- SRPS. Č.B5.226 – Selection of dimensions for nominal pressures from 1 to 25 at.

2) For pipes for operating pressures of up 64 kp/cm², if the pipes are delivered with the factory certificate, they are usually made of steel: Č.1212; Č.1213; Č.1402; Č.1502 and Č. 3100, the following standards apply:

- SRPS. Č.B5.021 - Technical conditions for manufacture and delivery
- SRPS. Č.B0.023 - General instructions
- SRPS Č.B5.221 - Shapes and dimensions

When ordering welded and seamless pipes, it is mandatory to indicate:

- External pipe diameter
- Wall thickness
- Type of steel
- Operating pressure
- Applicable standards for pipes

The Contractor shall obtain all the necessary certificates from the pipe manufacturer, which proves that the supplied pipes will fully satisfy the design requirements.

2.6.11 Pipelaying

Excavation and preparation of the trench

In addition to the conditions provided in the design and safety regulations, the following conditions also must be met:

- Rocks and rough stones shall be removed from the trench,
- Before pipelaying, the trench must be dry (pumping, drainage pipes).

Trench width is determined by the pipelaying conditions, i.e. by the pipe installation regulations.

The minimum width of the trench should be $D + 2 \times (20 - 35 \text{ cm})$ (where D is the outer pipe diameter), but not less than 0.8 m. Otherwise the width of the trench depends on the foundation method, plunking and strutting, and installation.

Determining levels for pipelaying shall be performed by accurate leveling and this is not paid extra, but is included in the unit price of the completely installed pipeline. Method of execution, composition and content of aggregates, cement and water of concrete pipes should be such, that all components have uniform properties, water impervious, with required strength and accurate dimensions.

The inner surfaces of the pipes must be smooth. The pipe ends must be executed without damage, with sharp edges, and front surfaces must be perpendicular to the axis of the pipes.

Non-reinforced pipes must withstand the internal pressure of $0,5 \text{ kg/cm}^2$.

It must be ensured to chemically test the soil where this network is installed, and, if the results show that the soil contains acid, or any substances that might be harmful to the concrete material of the sewer network pipeline, it is necessary to perform appropriate external protective insulation, so that the concrete is completely protected from the harmful external influences. These works that might occur, as well as the material used for such works, are not included in the unit price as per this item of the Bill of Quantities, but the Contractor shall reach a special agreement with the Investor regarding this, depending on the nature (chemical aggressiveness) of the soil pollution with which the pipeline comes into contact, as well as depending on the volume and value of this work.

Foundation of pipes

Shaping of the bedding is crucial for the pipeline capacity. The pipeline bedding namely, determines the uniform pressure distribution in the area of fitting of the pipes. The fitting angle shall not be less than 60° , both for concrete and reinforced concrete pipes. The angle is determined based on the structural analysis. Pipelaying, which represents point bedding (e.g. direct to the aligned bottom of the excavation, to the sand or concrete base without forming a semicircular bedding) is not allowed. The pipe must lie evenly in the bedding along the entire length. It is necessary to avoid the point supporting. Therefore, the excavation for the coupling must be executed so that it has the sufficient width and depth, so that the coupling does not appear as the point support. This also applies to the jointing phase. Coupling (place of joint) is backfilled after the water impermeability test.

Due to different types of substrates for foundation of the pipeline, there is no single rule, but the foundation method is determined for each individual case.

Original soil bedding

It is suitable in sandy or sandy-gravel soil (exceptionally in loose mixed soil). After leveling and stabilization of the trench bottom, a semicircular bedding is formed, which corresponds to the outer side of the pipes. Depth of the bedding depends on the fitting angle, which is determined by structural analysis. Shaping is done by means of profile and model laths.

The bedding is executed easily, by forming a semicircular bedding with a fitting angle of 60° , followed by the lateral filling and compacting of material to the height of the fitting level (according to structural analysis). By compacting the filled material, at least the density of the original soil composition must be reached.

Lying on the flat trench ground, without the previous forming of the bedding, is not allowed.

Sandy and gravel-sandy bedding

In cohesive and solid soil (hard clay, marl, loam), in rock or in the soil which contains coarse gravel or stone, laying directly on the original soil is not possible, because such soil cannot be processed

properly. In that case it is necessary to execute sandy or gravel-sandy bedding. The thickness of the made sand or gravel-sandy material under the pipe footing must be at least $100 \text{ mm} + 1/10 \text{ DN}$ (where DN is the inner diameter of the pipe). If the rock is at the bottom, the minimum thickness under the pipe footing is $100 \text{ mm} + 1/5 \text{ DN}$.

Forming of bedding is carried out by using the same method as in the case of laying on natural base. Pipelaying without formed bedding, directly on the rolled bottom part of the sandy bedding is improper.

If sandy gravel is used for creating the bedding, it has to be well compressible, and its maximum grain size may be $1/5$ the height of the bedding at the pipe footing.

Concrete bedding

If the soil at the bottom of the trench is not suitable for making the sandy bedding (poorly supporting and highly variable soil), the concrete bedding is executed.

The concrete bedding is also executed in case of big incline of the pipeline, in case when there is a risk of material eluviations. When conditions for pipelaying are very unfavorable, a reinforced concrete foundation slab is executed.

Minimum thickness of the concrete bedding at the pipe footing and on the side is $100 \text{ mm} + 1/10 \text{ DN} + 50 \text{ mm}$. For the construction of the concrete bedding, concrete with minimum strength is used, which corresponds to MB 10. Pipelaying is executed in two ways:

- Direct laying into the shaped bedding, or
- Subsequent bedding concreting.

In the first case, on the shaped bedding, which corresponds to the outer shape of the pipe, a 10 cm thick coating of fresh concrete is applied, and then the pipe is laid.

In the second case, first a flat concrete slab is made. Then, the pipe is laid onto the bedding, which must be so high to allow concreting of the pipe bedding.

At the same time, by this type of pipeline foundation, it must not be allowed for the pipe to fit only at the footing (linear bedding) or that the coupling represents the point support.

2.6.12 Storing, handling and transport

Storing, handling and transport must be carried out fully according to manufacturer's instructions.

Pipes or parts of the pipeline that are not imbeded, pressure pipelines in pumping stations, storm water downpipes passing through facilities above the floor level, etc. shall be insulated as follows: Prior to applying the insulation, the pipes must be cleaned in the same manner as in the previous case.

Insulation consists of two coats of red lead primer and three coats of oil paint.

Pipes are deposited on supports. They must lie on a flat and hard surface. The distance between the brackets must be such, that each bracket has a distance from the pipe end that is equal to $1/5$ of the pipe length. On both ends of the bracket, pipes must be supported by wooden pegs, which are securely fastened to the bracket.

The pipes that follow are deposited in such a way as to form a pyramid or symmetrical rows, over the newly placed supports.

Pipes with profiles exceeding 800 mm are deposited in a single row on supports with wedges.

If the pipes are stacked too densely, damage occurs. Therefore, when stacking and handling, instructions should be strictly followed. Pipe shrouds and edges must not be damaged during handling. Therefore, various impacts, uneven lifting, hard laying and lowering of pipes must be avoided. Uncontrolled rolling is also not allowed.

For lifting multiple pipes at once, lifting by using strips or levers placed through the pipe is not allowed.

During transport pipes must be protected in such a way so that horizontal or vertical movements do not occur.

Pipes that are treated with protective coatings must be protected from weather conditions. Sealing rings also must be stored indoors (warehouse), so that they are not exposed to atmospheric influences, sun, etc.

2.6.13 Welding

Steel pipes are joined by welding outside the trench or successively inside the trench. Providing the required position of the pipes is the responsibility of the installer.

Upon completion of the welding, the installer submits the geodetic survey of the installed pipeline to the Investor. Afterwards the hydraulic pressure pipeline testing can be performed.

Welding must be carried out according to specific type of the pipes and manufacturer's instructions, in order to obtain a continuous pipeline that will fully meet the design requirements.

In this regard, the Contractor must determine the proper welding methods, provide all the necessary materials, ensure full safety of workers, and all welders must have certificates according to applicable regulations.

Quality control of welds must be complete and in accordance with applicable regulations, and checked by using recognized methods.

The Contractor and the Investor should provide professional and continuous supervision during the works.

Welding of one weld should be performed by several workers, and each of them has a specific task. For better control, the welds are numbered, and section numbers and welders details are also marked.

The supervisory authority must strictly control all operations, and upon completion of welding, a visual inspection is performed.

During execution of welding works, the supervisory authority of the Contractor and Investor must keep the welding log, where their remarks, inspection results and survey are recorded, and instructions are given for the necessary corrections of welds.

It is very important to repair any damage to the pipe corrosion protection on the welds, so that, together with the existing one, it represents the continuous and reliable corrosion protection on the entire stretch of the designed pipeline. Corrosion protection on the welds shall be performed after the completed hydraulic pressure and water permeability test.

2.6.14 Corrosion protection

External protection

Welded steel pipes that are laid in the ground, should be protected with external insulation coating based on bitumen, by using plastic strips, etc. Pipes may be factory insulated or they can be insulated on site.

If the pipes are factory insulated, it is necessary to obtain appropriate certificates, and if they are insulated on site (on the construction site), then the following conditions must be fulfilled, i.e. the quality of performed protection must match the quality of the factory protection.

Prior to application of the insulation, pipes must be cleaned of soil, scale, rust, etc. until metallic sheen is achieved. Application of insulation can begin only after the pipe inspection by the supervisory authority has been completed.

Insulation consists of:

- Inner protective base
- Basic layer of bituminous varnish "T1"
- Layer of bituminous mass 11.0

- Glass fiber fleece
- Layer of bituminous mass 11.0
- Glass fiber fleece
- Layer of bituminous mass 11.0
- Glass fiber fleece
- Layer of bituminous mass 11.0
- Lime paste coating

Characteristics of protective materials and testing methods:

1. Bituminous varnish “T1”, which is used for bituminous mass 11.0 and as the inner pipe protection, has the following characteristics:

- 1.1. Viscosity according to VK 4 mm at +20°C – testing method up to 20 seconds SRPS U.M3.100
- 1.2. Content of dissolvent – evaporation process approx. 60% (+5%) SRPS U.M3.240
- 1.3. Characteristics of the remainder after evaporation SRPS U.M3.085
- 1.3.1. Softening point P.K. in °C 105-120 SRPS U.M3.010
- 1.3.2. Penetration 100 p/5 se, at 25°C in tenths of a millimeter, 10-35 SRPS U.M3.10
- 1.3.3. Ash, maximum 0,5wt. % SRPS U.M3.10
- 1.3.4. Water absorption at +40°C, for 5h -maximum 1,5g/m² – Dutch regulations - section 3.9
- 1.3.5. Suitability of application, after drying, coating must provide homogeneous continuous film with uniform thickness without visual defects (bubbles, grains, cracks, peeling, etc.) and good adhesion.
- 1.3.6. Physiological suitability, appropriate – Regulation on hygienic technical measures for the protection of potable water Official Gazette of the SFRY 44/1960

2. Bituminous mass 11.0 is used for external protection, as well as for internal protection “U2” and has the following characteristics:

- | | |
|---|-----------------|
| | Testing methods |
| 2.1. Softening point P.K in °C minimum 90°C | SRPS U.M3.010 |
| 2.2. Penetration 100 p/5 se at 25°C in tenths of a millimeter, at least 15 | SRPS U.M3.010 |
| 2.3. Breaking point according to FRASS °C, minimum - 10°C | SRPS U.M3.010 |
| 2.4. Ductility at 25°C in centimeters, at least 2 cm | SRPS U.M3.0110 |
| 2.5. Flow at an angle of 45°C for a 5 mm layer on steel sheet, at + 70°C for 20 h, maximum 6 mm Dutch regulations - section 3.4. | |
| 2.6. Resistance to indentation of seal under load of 2,5 kg/cm ² at 25°C maximum 17 mm - Dutch regulations - section 3.5. | |
| 2.7. Resistance to ball impact of 66.8 g. at 0°C in free fall from 2m, shows no change – Dutch regulations - section 3.6a. | |
| 2.8. Ash content, maximum 35 % | SRPS U.M3.010 |
| 2.9. Tilting of the filler to the deposition at 200°C, for 5h maximum 2 (i.e. between the content of ash in the upper and lower half of the barrel) - Dutch regulations - section 3.8 | |
| 2.10. Water absorption, for 4 maximum 1,0 g/m ² - Dutch regulations - section 3.9 | |
| 2.11. Adhesion: adequate to the testing conditions - Dutch regulations - section 3.11 | |
| 2.12. Paraffin content in wt. % maximum 2.5% | SRPS U.M3.010 |
| 2.13. Fillers: finely ground quality mineral material, which does not give the taste and smell to water | |
| 2.14. Physiological suitability, appropriate – Regulation on hygienic and technical measures for the protection of potable water (Official Gazette of the 44/1960) | |
3. As reinforcement for anti-corrosion bituminous coatings, glass fiber fabric is used, which in fact a strip is made of glass fibers glued together. Its characteristics are:

- 3.1. Breaking force – Longitudinal

min 8 kp/50 mm

– Transversal	min 6 kp/50 mm
3.2. Combustible substances	15 - 17 %
3.3. Thickness of the fibers	18 - 22 microns
3.4. Thickness of the fleece	0,5 - 0,7 mm
3.5. Weight of the fleece	60 - 70 g/m ²
3.6. Porosity	0,8 - 1,2 mm VS
3.7. Hydrolytic class	4

The executed insulation must have a thickness of 6.5 mm with a tolerance of +1.0 mm and must withstand the tested voltage of 20 kV.

Testing the validity of the insulation is performed by using an electrical device for insulation testing. The device moves along the pipes at low speed and, at defect spots, the sparks appear. All defective spots should be repaired and re-tested.

If the pipes are factory insulated, damage may occur during transport. Insulation should be checked in the same way if the insulation is performed at the construction site.

In addition to the above mentioned insulation, other types of corrosion protection can also be used (such as e.g. the above mentioned plastic strips protection, etc.), however, after application, it must provide the same corrosion protection as the one foreseen herein, using the bituminous protective coating.

Internal protection

Internal protection consists of one layer of the cold bituminous primer and one layer of cold bituminous coat. The coating is applied on completely dry surface and cleaned to black gloss (includes removal of scale, dirt, rust, dust and grease). Cold bituminous coat must be free of substances which are harmful to human health (in particular phenol). Also, the chosen protective material shall not affect the taste and smell of the water and must be stable in water.

Internal protection may be regular and intensified.

The regular protection consists of a protective layer that is formed by coating or dipping. This process is suitable for all non-aggressive water types. It is not mandatory that the formed layer is smooth and pore-free. Before applying the protective layer, the inner surface of the pipe must be cleaned of scale and rust.

The intensified insulation is applied for aggressive water types. On a regular layer of insulation, one layer of heated bituminous mass is applied by pouring. The process is carried out with simultaneous rotation of pipes. In this case, the total insulation thickness is 2.5 mm.

Other insulation methods may be applied.

Insulation surface must be smooth and pore-free. When storing the pipes, the insulation layer must be resistant to the temperature of -20°C. At a temperature of -5°C the insulation layer must be sufficiently flexible to follow the elastic deformation of pipes and must maintain its anti-corrosion properties. At an outside temperature of +40°C significant changes of the internal insulation material should not occur.

2.6.15 Hydraulic testing

Before testing the pipeline to internal water pressure, air pressure testing is recommended (by sections in length of 700 ± 200 m). The test pressure must not exceed 6 atm due to the risk of air explosion. The pipeline is kept under pressure for 12 hours. The pressure variations are allowed only due to changes in the ambient temperature.

The emergence of air bubbles under the insulation is not allowed.

Testing of pipeline and fittings for water pressure must be carried out fully in compliance with applicable regulations.

Upon successful completion of hydraulic testing, the corrosion protection of joints is performed.

The process is carried out as follows:

- the existing insulation is tilted at 15 cm from the installed weld at an angle of 15°;
- the weld is thoroughly cleaned;
- a protective layer of bituminous mass is applied to completely dry surface (with the approval of the Investor, insulating strips may be used alternatively).

2.6.16 Calculation and payment

Calculation and payment shall be made per m' of completely procured, installed and tested pipeline (according to all previously described), together with all taxes and duties.

GENERAL TECHNICAL REQUIREMENTS FOR PVC SEWER PIPES

2.6.17 General

Procured and installed PVC pipes must be made of polyvinyl chloride, without softeners and fillers (hard PVC), quality according to SRPS G. C6 502. Stability is according to SRPS.G.C6.503, and dimensions according to SRPS.G.C6.501 and DIN 19531.

2.6.18 Pipelaying

Excavation and preparation of the trench

In addition to the conditions provided in the sewer design and safety regulations, the following conditions also must be met:

- Rocks and rough stones shall be removed from the trench,
- Before pipelaying, the trench must be dry (pumping, drainage pipes).

Trench width is determined by the pipelaying conditions, i.e. by the pipe installation regulations. The minimum width of the trench should be $D + 2 \times (20 - 35 \text{ cm})$ (where D is the outer pipe diameter), but not less than 0.8 m. Otherwise the width of the trench depends on the foundation method, plunking and strutting, and installation.

Determining levels for pipelaying shall be performed by accurate leveling and this is not paid extra, but is included in the unit price of the completely installed pipeline.

The inner surface of the pipes must be smooth. The pipe ends must be executed without damage, with sharp edges, and front surfaces must be perpendicular to the axis of the pipes.

Foundation of pipes

Shaping of the bedding is crucial for the pipeline capacity. The pipeline bedding namely, determines the uniform pressure distribution in the area of fitting of the pipes. The fitting angle shall not be less than 60°, both for concrete and reinforced concrete pipes. The angle is determined based on the structural analysis. Pipelaying, which represents point bedding (e.g. direct to the aligned bottom of the excavation, to the sand or concrete base without forming a semicircular bedding) is not allowed. The pipe must lie evenly in the bedding along the entire length. It is necessary to avoid the point supporting. Therefore, the excavation for the coupling must be executed so that it has the sufficient width and depth, so that the coupling does not appear as the point support. This also applies to the jointing phase. Coupling (place of joint) is backfilled after the water impermeability testing.

Due to different types of substrates for foundation of the pipeline, there is no single rule, but the foundation method is determined for each individual case.

Original soil bedding

It is suitable in sandy or sandy-gravel soil (exceptionally in loose mixed soil). After leveling and stabilization of the trench bottom, a semicircular bedding is formed, which corresponds to the outer side of the pipes. Depth of the bedding depends on the fitting angle, which is determined by structural analysis. Shaping is done by means of profile and model laths.

The bedding is executed by forming a semicircular bedding with a fitting angle of 60° , followed by the lateral filling and compacting of material to the height of the fitting level (according to structural analysis). By compacting the backfilled material, at least the density of the original soil composition must be reached.

Laying on the flat trench ground, without the previous forming of the bedding, is not allowed.

Sandy and gravel-sandy bedding

In cohesive and solid soil (hard clay, marl, loam), in rock or in the soil which contains coarse gravel or stone, laying directly on the original soil is not possible, because such soil cannot be processed properly. In that case it is necessary to execute sandy or gravel-sandy bedding (with dominant content of sand). The maximum size of the gravel grains, which are installed into the substrate is 20mm.

Forming of bedding is carried out by using the same method as in the case of laying on natural base. Pipelaying without formed bedding, directly on the rolled bottom part of the sandy bedding is improper.

Pipes are laid in a layer of sand - 10cm below and 30 above the top of the pipe. Material is compacted manually. If mechanical compactors are used, it is necessary to comply with the instructions of the equipment manufacturer.

Concrete bedding

If the soil at the bottom of the trench is not suitable for executing the sandy bedding (poorly supporting and highly variable soil), the concrete bedding is executed.

The concrete bedding is also executed in case of big incline of the pipeline, in case when there is a risk of material eluviations. When conditions for pipelaying are very unfavorable, a reinforced concrete foundation slab is executed.

Minimum thickness of the concrete bedding at the pipe footing and on the side is 100 mm +1/10 DN + 50mm. For the construction of the concrete bedding, concrete with minimum strength is used, which corresponds to MB 10.

Pipelaying is performed in two ways:

- Direct laying into the shaped bedding, or
- Subsequent bedding concreting.

In the first case, on the shaped bedding, which corresponds to the outer shape of the pipe, a 10cm thick coating of fresh concrete is applied, and then the pipe is laid.

In the second case, first a flat concrete slab is made. Then, the pipe is laid onto the bedding, which must be so high to allow concreting of the pipe bedding.

At the same time, by this type of pipeline foundation, it must not be allowed for the pipe to fit only at the footing (linear bedding) or that the coupling represents the point support.

2.6.19 Storing, handling and transport

Pipes should not be dragged or thrown to the ground. It is recommended to protect them appropriately (cover), however they may be stored in the open air for a short period of time.

When storing the pipes, it must be ensured that their entire length fits on the surface in order to prevent possible deformation. Stacking height is determined in such a way that the pipes from the bottom row keep their circular cross section. The recommended stacking height should not exceed 2 meters.

2.6.20 Joining and installation of pipes

Joining of pipes

Pipes and fittings are joined by using sleeves with rubber rings, completely according to the manufacturer's instructions. Before joining the pipes, it is necessary to clean the inner surface of the sleeve and the ring, as well as the end of the pipe that is being inserted. Before joining, it is necessary to smear the end of the pipe with potassium soap, regular soap or other similar substances, as recommended by the pipe manufacturer. Inserting pipes into the sleeve is performed up to the indentation depth mark, i.e. 5÷10 mm of free space is left (for possible dilatations). Shortening of pipes is carried out by using saws with fine teeth, at right angle. Skewing of the cut parts of the pipe is performed at an angle of cca 15° by using a file or other suitable tool.

All installed pipes must have appropriate certificates. Before the installation, pipes must be visually inspected and all damaged parts must be removed.

Particular attention must be paid to the ambient temperature when working with PVC pipes, because at low temperatures (below 0°C) pipes become very brittle, and at high temperatures (over 20°C) pipes soften.

All fittings are made of rigid PVC, same material as the pipes.

With the pipes, it is mandatory to procure special pieces for installation of PVC pipes in the walls of manholes and other walls.

Installation of the pipeline

The Contractor is required to obtain and lay by the trench only the pipes listed in the design, which is controlled by the supervisory authority.

Pipes are installed manually, using appropriate tools. Exceptionally, laying of larger profiles may be done using the installation machine.

Works on the installation may begin only after the completion of all preparatory work, namely:

1. The trench is excavated according to the design and aligned in direction and finished grade.
2. Altitude points are marked with stakes at the finished grade level.
3. Pipe and jointing material (with all its parts) has been prepared and distributed along the trench.
4. Before lowering the pipes into the trench, it is necessary to examine the pipes and cut off all damaged parts and perform repairs by using cutting tools and by manually scraping the pipe ends.
5. Pipes must be laid in such a way, that the entire length rests on the bottom of the trench, i.e. on the surface of the concrete cushion.
6. The fitter controls the accuracy of the finished grade of the installed pipeline using crosses and ensures the proper tamping of pipes (checking is done by loading of pipes). Complete installation of all pipes and parts must be performed fully in accordance with all situational plans, longitudinal profiles and other detailed drawings. All pipes must be laid in such a way that their axes fully comply with the existing positions in the horizontal and vertical direction (within permitted

tolerances).

Each specified level in the longitudinal profiles must be achieved in order to achieve the proper hydraulic flow of water and to avoid “collisions” with other underground installations.

Before checking the test pressure, pipes must be covered with a layer of selected material, thickness of 30cm, above the top of the pipe, and then with a layer of finer material (about 15cm). It is necessary that all joints remain free in order to perform their control during the test pressure. Covering of pipes is performed to prevent their displacement during testing (especially lighter pipes with smaller diameters).

After completion of the test pressure and acceptance of the pipeline, joints are being backfilled (first with sand, then with finer material). In order to avoid damaging the uncovered places, backfilling should be carried out upon the completion of the pressure test.

2.6.21 Hydraulic testing

For the purpose of quality control of executed works and installed material, it is necessary to perform testing of the installed pipeline.

Water infiltration is not allowed (entry of external water into pipes), or exfiltration (loss of waste water from pipes). Both occurrences cause damage to the building stability, and penetration of waste water into the soil may produce sanitary consequences.

In order to ensure the required water permeability, it is necessary to ensure that the pipes and canals are waterproof, and joints must be sealed.

The quality of the joints and the entire network is checked as follows:

Filling the pipeline

The pipeline is slowly filled from the lowest end and is kept filled for 1 hour before the beginning of testing, which ensures elimination of air.

Pipeline is kept under a pressure of 0.4 bar (4 m of water column) relative to the lowest point.

Test duration and validity criteria

It is necessary to provide the appropriate equipment for the testing procedure.

The network is considered to be working properly if during the test (which lasts 15 minutes) it is not necessary to compensate more than 0.02 l/m² of the inner surface of the pipeline.

If during the testing, abnormalities in installation (leakage) occur, it is necessary to observe the critical areas and interrupt the control procedure.

Network repairs may only be done by replacing the defective material (gluing, etc. is not allowed).

Upon completion of the repairs, it is necessary to repeat the entire test procedure.

Testing the water impermeability is carried out before the final backfilling of the pipeline.

Test procedure

The ends of the canal are closed with the appropriate type of closures with fast connection. There are openings on them to which two hoses are connected (one for filling of the canal with water, and the other for the discharge of air).

Filling the canal with water is performed from a mobile tank (volume up to 55 l), which is placed at a height of 4 m above the top of the pipe.

Then the canal is filled with water and the required level is achieved in the tank. During the test, this level is maintained by adding water, whose quantity needs to be measured (based on the amount of added water, the validity of the executed network is evaluated).

Depending on the conditions, the supervisory authority prescribes the testing procedure for the

specific sewage network.

2.6.22 Calculation and payment

Calculation and payment shall be made per m' of completely procured, installed and tested pipeline (according to all previously described), together with all taxes and duties.

GENERAL TECHNICAL REQUIREMENTS FOR CAST IRON SEWER PIPES (without sleeve)

2.6.23 General

Procured and installed cast iron sewer pipes must be made in accordance with SRPS C.J 1-485-493 (DIN 19522) standard.

All pipes and fittings must comply with SRPS, DIN and ISO standards.

All installed pipes must have appropriate certificates. Before installing the pipes, it is mandatory to visually inspect the pipes, and remove all damaged pipes.

2.6.24 Storing, handling and transport

As the cast iron pipes may easily break or burst, it is necessary to handle them carefully, both during transport and at the warehouse and in the trench.

Joining of pipes, transport and storing must be performed fully according to manufacturer's instructions.

2.6.25 Joining and installation of pipes

Joining of pipes

Pipes and fittings are joined by a rubber sealing ring and steel tension ring.

The rubber sealing ring must be resistant to impurities contained in the waste water and to hot water.

Installation of pipeline

The Contractor is required to obtain and lay by the trench only the pipes specified in the design, which is controlled by the supervisory authority.

If the pipes are intended for evacuation of hot waste water, the joints must be capable of accepting loads which arise due to temperature elongation, without reducing the functionality of sealing.

The joints must ensure the stability of the lines attached to the walls and ceilings.

During the installation of the pipeline, the Contractor is obliged to fully comply with the design documentation and instructions of the supervisory authority.

If during the installation, shortening of pipes is performed, all ends must be straight.

Connections of sanitary fixtures are executed by combining with sleeved elements.

2.6.26 Network testing

For the purpose of quality control of executed works and installed material, it is necessary to perform testing of the installed pipeline.

Water infiltration is not allowed (entry of external water into pipes), or exfiltration (loss of waste

water from pipes). Both occurrences cause damage to the building stability, and penetration of waste water into the soil may produce sanitary consequences.

In order to ensure the required water permeability, it is necessary to ensure that the pipes and canals are waterproof, and joints must be sealed.

The quality of the joints and the entire network is checked as follows:

Filling the pipeline

The pipeline is slowly filled from the lowest end and is kept filled for 1 hour before the beginning of testing, which ensures elimination of air.

Pipeline is kept under a pressure of 0.4 bar (4 m of water column) relative to the lowest point.

Test duration and validity criteria

It is necessary to provide the appropriate equipment for the testing procedure.

The network is considered to be working properly if during the test (which lasts 15 minutes) it is not necessary to compensate more than 0.02 l/m^2 of the inner surface of the pipeline.

If during the testing, abnormalities in installation (leakage) occur, it is necessary to observe the critical areas and interrupt the control procedure.

Network repairs may only be done by replacing the defective material (gluing, etc. is not allowed).

Upon completion of the repairs, it is necessary to repeat the entire test procedure.

Testing the water impermeability is carried out before the final backfilling of the pipeline.

Depending on the conditions, the supervisory authority prescribes the testing procedure for the specific sewage network.

2.6.27 Calculation and payment

Calculation and payment shall be made per m' of completely procured, installed and tested pipeline (according to all previously described), together with all taxes and duties.

GENERAL TECHNICAL REQUIREMENTS FOR STAINLESS STEEL PIPES

2.6.28 General

The attached table shows comparative labeling standards for stainless steel pipes.

Fittings and flanges for the pipes must be made of stainless steel of appropriate quality.

As the differences in materials may cause difficulties during welding or errors in welds at jointing places, all pipes and pipe elements must belong to the same "batch".

2.6.29 Storage

Storing of pipes and pipe elements is done in closed room, and only the Contractor has the access to it. The room must be dry and protected from dust.

Pipes and pipe elements are made of steel 316 L, they are cleaned and pipe ends are closed with protective caps and then individually packed in PVC foil.

2.6.30 Welding

The most common way of joining pipes is direct abutting welding in protective argon atmosphere using the machine for extensive welding of the previously straight prepared ends.

Manual welding is allowed only exceptionally, in places that are inaccessible for extensive welding, such as fitting joints or joints of fittings and elements of soluble connections, i.e. fittings.

Manual welds are potential weak spots of the pipeline and must therefore be entrusted to the specially certified welder or proved by the prescribed test procedure.

1) Testing of welds is performed by Roentgen recording of welds as follows:

- a) In case of extensive automatic welding
 - for all pipelines except for the DIW (demineralized water) and WFI (distilled water) water and clean steam 10 %
 - for DIW water and clean steam 20 ÷ 50 %
 - for WFI water 50 ÷ 100 %
- b) In case of manual welding
 - for all pipelines 100 %

If during this recording, errors are revealed, it is mandatory to perform recording of all welds in both directions. If an error shows then, it is considered that the connecting pipelines are inadequate and must be replaced. Replacement costs are borne by the Contractor.

2) Testing of complete connecting pipelines (its components and welded joints) is performed by filling with helium at 10 bar and maintaining the pressure for 24 hours.

The Contractor and Investor should provide professional and continuous supervision during the works.

During execution of welding works, the supervisory authority of the Contractor and Investor must keep the welding log, where their remarks, inspection results and recordings are recorded, and instructions are given for the necessary corrections of welds.

2.6.31 Pipelaying

If stainless steel pipelines are laid on supports, it must be ensured that supports or clips have rubber or silicone lining, in order to prevent contact of the stainless steel pipes with other metals.

Generally, the distance between supports, types of supports, pipeline protection measures, etc., are carried out according to the rules, standards and experiences for execution of pipelines for specific types of fluids.

Laying the stainless steel pipeline in the soil is performed in the same manner as the laying of pipes made of conventional steels.

2.6.32 Corrosion protection

As a rule, pipelines made of stainless steel do not require special external anti-corrosion insulation if they are in contact with non-aggressive environments, such as non-aggressive gases, soils, fluids, etc.

If the protection is necessary, the pipe manufacturer should be consulted.

2.6.33 Fittings

All fittings which are installed on the stainless steel pipeline must be of the same material as the pipeline on which they are installed.

2.6.34 Calculation and payment

Calculation and payment shall be made per m' of completely procured, installed and tested pipeline (according to all previously described), together with all taxes and duties.

GENERAL TECHNICAL CONDITIONS FOR PP WATER SUPPLY PIPES

2.6.35 General

Procured and installed PP (polypropylene) pipes must be in accordance with the following standards:

- DIN 8078 - standard for quality,
 - DIN 8077 - standard for dimensions and
 - DIN 16962 – standard for jointing parts (fittings).
- All installed pipes must have appropriate certificates.

2.6.36 Storing and handling

Pipes may be stored at any outside temperatures. When storing the pipes, it must be ensured that their entire length fits on the surface in order to prevent possible deformation. Avoid bending of pipes during transport and storage.

At temperatures below 0° C, pipes may be damaged by impact, and therefore must be handled with care.

PP pipes which contain UV-stabilizers may also be stored in the open air (up to 6 months).

2.6.37 Joining and installation of pipes

Joining of pipes

Pipes and fittings are connected by semi-fusion welding or welding with electric socket.

Semi-fusion welding

Pipes and fittings must be clean and smooth. Pipe ends must be cut at right angle. Before the start of the welding, it is necessary to check the functionality of the welding machine and reaching the welding temperature.

Welding is performed with welding machine, by simultaneous heating of parts that are being joined. When the welding temperature is reached, elements are pushed into one another. This provides for an absolutely sealed joint.

Without delay and axially (without rotation), pipes and fittings are pushed into appropriate heating elements (sleeve and mandrel) to the stop. After the heating time has elapsed, the heated elements are removed from the machine and immediately pressed into each other (without rotation).

It is important to comply with the prescribed depth of penetration, in order not to exceed the stop in the fitting.

Electric socket welding

This procedure is used primarily for repair and welding on existing installations. The parts to be joined must be directed axially. Upon insertion of parts in the E-socket, this socket is connected to the welding machine.

The finished joint should not be loaded until it cools down. The use of coolants is not permitted.

Installation of pipelines

The Contractor is obliged to procure only the pipes foreseen in the design, which is controlled by the supervisory authority.

For connection of fittings to pipelines, it is not necessary to perform grounding.

Pipe clips must be made according to the diameter of the PP pipes.

Ensure that the fastening material does not damage the outer surface of the pipe.

The most convenient fastening elements are clips with rubber lining. At the same time, the rubber insert represents a sound insulator.

Two types of supports may be executed – fixed (solid) and sliding (leading).

Fixed (solid) support

By proper arrangement of fixed points, uncontrolled movements of the pipeline are avoided and safe installation of the pipeline is ensured.

Fixed supports should be sized and executed in such a way to accept and compensate for the elongation force and any additional load.

As clip holders, threaded rods should be used (pivoting clips are not recommended). It is necessary to pay attention to short distances to the wall, i.e. ceiling in which the anchoring is performed. The clip and bracket must be stable and tightly fastened.

Vertical distributions must be securely installed. If the fixed support is placed immediately before or after branching, compensation bends or lyre are not needed in the risers to compensate for elongation.

Sliding (leading) support

When positioning the sliding supports, it must be ensured that axial displacements are not prevented by the too close installed elements, such as fittings, valves, etc.

Pipeline elongation

When installing pipelines in walls and floors, casting pipeline in concrete or mortar prevents temperature elongation.

When installing pipeline in distribution canals, it is necessary to ensure that pipe branches have enough space to adjust to riser movements which occur due to their elongation. Positioning of risers in canals, dimensions of openings for branches and execution of nodes for torsion compensations must be carried out in accordance with design documentation and instructions of the supervisory authority.

When laying pipes in open space, attention must be paid to the exterior and the stability of the pipeline. Elongation compensation is achieved by changing the pipeline direction or by using a flexible bend (lyre loops).

In order to ensure the elongation compensation by change of direction, during installation the Contractor is obliged to comply with prescribed distance between fixed supports and elbows, which are designed on the network.

Elastic bends (lyre loops) are installed when elongation compensation cannot be achieved by changing direction. The Contractor is obliged to execute lyre loops according to the project documentation and instructions of the supervisory authority.

2.6.38 Hydraulic testing

All lines must be tested (while still visible) by test pressure, which is 1.5 times higher than the operating pressure.

During the test, constant temperature of fluids must be ensured, in order to prevent changes in the

test pressure.

Testing is performed in three stages:

- Pre-testing,
- Main testing,
- Final testing.

Tested pressure gauges must be used to measure the test pressure, whose scale allows reading of pressure change of 0.1 bar. Place the pressure gauge preferably on the lowest point of the pipeline.

Pre-testing

The test pressure during pre-testing is 1.5 times higher than the operating pressure.

This pressure must be repeated 2 times in 30 minutes, with a 10 minute break. Over the next 30 minutes, the pressure in the network must not drop by more than 0.6 bar.

There shall be no unsealed places.

Main testing

Successful preliminary testing is the necessary requirement for performing the main testing.

The test pressure is 1.5 times higher than the operating pressure.

The main testing lasts for 2 hours and upon the completion, the pressure drop should not be greater than 0.2 compared to the pressure measured after the pre-testing.

Final testing

Successful main testing is the necessary requirement for performing the final testing.

The network is put under pressure of 1 bar in intervals of at least 5 minutes. The cycle is repeated 4 times, and between the cycles, the network is brought to the state without pressure.

It is considered that the testing is satisfactory if all the joints are sealed well.

The occurrence of leaks

If there is leakage at the joints (drops, jets, etc.), it is necessary to stop the testing, discharge the pipeline, perform necessary repairs, and then repeat the test.

Report

Reports are made on completed tests and they are submitted to the buyer and the pipe manufacturer. The report is signed by the Investor (or Supervisor) and the Contractor.

2.6.39 Flushing and disinfection

Flushing and disinfection of the network are performed in the same manner as all water supply installations, in accordance with the description attached in the section “Disinfection and flushing of the water supply system”.

2.6.40 Calculation and payment

Calculation and payment shall be made per m' of completely procured, installed and tested pipeline (according to all previously described), together with all taxes and duties.

2.7 THE EXTERNAL FIRE PROTECTION HYDRANT NETWORK

The external fire protection hydrant network has been designed to be of high density polyethylene pipes NDPE-PE-100 for pressure of PN 16 bars.

The pipes are connected by welding and the fittings with bushing.

The network has been designed to cover the circle of MHC Vranje. Hydrants are overhead Ø80. With external hydrants a cabinet for external hydrants has been designed.

Under the terms of Vranje Public Water Supply Company the connection to the existing pipeline Ø250, made of asbestos-cement pipes is provided at Bora Stankovic Street. The connection itself has been provided in the manhole. Available pressure is 4,5bars.

After entering the circle of MHC Vranje water measuring manhole has been designed. In the water meter manhole air valve has been designed as well.

All fittings are made of cast iron.

On the network discharge is envisaged in the lowest part of the network.

Water from the manhole for discharging is to be pumped using mobile pump.

In the area of the surgical block the connection has been provided to the building of the Stage I (surgical block).

The site around the connecting manhole is to be filled up and levelled in the height of road shoulder. In the manhole V₁₁ connection for overhead tank has been provided. Overhead tank is provided in the second and third stage of the Preliminary Design for sanitary purposes. When the main design will be elaborated, then a solution will be given for automatically closing of the supply tank of sanitary drinking water in case of fire. When performing works, special attention is to be paid to the existing installation. The Employer submitted us surveying of the existing installations and according to that, design was made, however care should be taken of the depth of electricity, water and heating pipes since not in all the locations have been surveyed installation depths. The Contractor is obliged to execute works in the presence of Supervising Engineer and representatives of Employer.

When performing the connection to the existing network, consult the representatives of Public Water Supply Company Vranje.

Quantity of water needed for fire extinguishing has been calculated for the final stage of reconstruction of the hospital based on technical standards for hydrant firefighting network - Article 13 and Article 14. This means that the following data have been used when calculating the balance of required water for extinguishing fire:

- The facility includes 500 beds (i.e. patients)
Supporting medical staff – around 600 workers
Total of 1.100 users
this means that on the basis of the said Regulations (30/91), the building belongs to category K-3 of fire risk.
Building area is 18.000 m², height 3,40m, i.e. volume of about 61.000 m³ located in the column of 50.001-200.000 m³.
- These two data provide the necessary quantity of water for extinguishing fire by internal and external hydrants of: $Q = 30 \text{ lit/s}$
The division of this quantity was carried out as follows:
 - internal installations $4 \times 2,5 \text{ l/s} = 10 \text{ l/s}$
 - external installations $4 \times 5,0 \text{ l/s} = 20 \text{ l/s}$

Hydraulic calculation is attached and shows that the available pressure of 4.5 bar may be sufficient for the proper operation of the network.

Sub Station (SS) 10/0.4kV; 2(3) x 1.000kVA

3.1 MAIN CHARACTERISTICS OF SS FACILITY

GENERAL DESCRIPTION

This master plan includes construction of its own substation SS10/0.4kV, 2(3)x1.000kVA for supply on the entire consumption in the context of the facilities of the new surgery building and related facilities and plants which are in the function of the new surgery. From the basic conditions that require a certain number and size of the LV feeder according to the project documentation for the construction of this building, the equipment and the size of the substation was adopted and designed. The project also defines and divides ducts (consumers) which are powered directly from the NN block of SS and ducts that are powered by the generator station. The capacity of the substation in the first alternative is 2x1.000kVA, but as an alternative there is a possibility to expand the capacity to SS 3x1.000kVA. This extension is very likely, knowing the power state of neighboring buildings on the hospital grounds. The equipment at this stage is completely ready in terms of construction for installation of LV block and power transformer with the development of HV and LV connections. The part of consumption which is powered by a generator (two power units at 275kVA) is linked to a specific block distribution substation which is located in the area of HV and LV block substation. These cabinets are supplied with power via cubicle generators with automatic switch of their connection SS - Aggregate.

Analysis of newly designed SS load

According to the analysis of the existing requirement for energy from the SS, the powered facility is the new surgery with a part of the Gynecology facilities (a loft, which was upgraded and connected with the new surgery loft) all in accordance with the General electrical projects carried out by the project company "Energoprojekt" and "Rebal". The building has electrical works carried out fully in accordance with these projects. The highest consumption is by the heating and cooling plant. The cooling equipment (chiller) is located outside the building and consists of two separate switchboards conferred on electric power so that one board can be powered from a single LV SS duct with two parallel connected cables. Also, the ventilation and heating plants located on the premises of the new surgery on the top floor and the third floor are powered with twin cables. Complete consumption of ventilation and heating (more consumers) goes only through SS. Other consumption is divided into standard mains and generator power. Priority consumers are marked in the facility and they receive power through the generator station. Consumers in operating rooms and intensive care, in addition to power from the generator station, have power over AR plants placed in the attic of the building. Power supply to all consumers in the building of the new surgery is divided so as to have a whole when it comes to rooms and purpose. Communication between the SS, generator station and control room (department no. 14 on the top floor) is provided with a signal cable type PP00 21x1.5mm², with parallel communication cable JY (St) Y 20x2x0.8mm. After the defined requirements during the plant operation, the equipment and SS command department are further to be defined and installed.

10KV SWITCHYARD

It is composed of 7 (seven) typical fabricated cells, nominal voltage 12kV, made of pickled sheet 2mm thicknes. The block has the depth and width of 700mm, with high-voltage equipment, depending on the cell type and the following arrangement:

- 3 pcs.: transformer cell 12kV, 10kV equipped with power disconnectors; 630A, power interruptions 7MVA, power short circuit PX> 250mV, with high performance 10 kV fuses for rated current of about twice the nominal current of the transformer with the lowest power

interruption of 250mV. The dimension of a single cell is 700x700x2000mm set frontally in order to the wall. The access to the cell is from the front.

- 3 pcs. cable (conductive) cell 12kV, the same size as the previous one, each equipped with power disconnecter knives for shorting (grounding). Short circuit blades and grounding must be mechanically locked with the key blade disconnectors. While handling a knife others must be switched off - open. Disconnectors have rated voltage 12kV; 630A current, short-circuit power $P_X > 250\text{mV}$, power disconnection $P_i > 7\text{MVA}$, with rapid expulsion.

- 1 pc. load cell 12kV, the same size as the previous one, equipped with additional disconnector fuses for the protection of voltage measuring transformers. Voltage and current transformers are mounted in each phase. Current transformers in the upper part of the cell are fixed to the top plate and effectively grounded. All previous cells form a unit.

Supply cell no. 2 is connected to the intake pipe from TS35/10kV, "Vranje 2" via cable 3XHE49 - A 1x240mm²/10kV. This route is the main supply for the SS. From cell 3 via the same type of cable and the substation supply cable is connected to spare duct via TS 10/0.4 kV "Hospital". Through this duct the substation remains in the system of 10kV network of the city and the necessary manipulations can temporarily switch to another primary power source. This should be taken into account in all the operations in the substation.

CONNECTION OF THE POWER TRANSFORMER AND 10KV BLOCK

Connection of power transformers with appropriate power disconnectors on high voltage cable block is made via cable with similar characteristics as the type PHP48-3x50mm²/ 10kV, flat in the cable channel of the facility and then through PVC pipes F125 to the transformer department where the console built on the transformer is fixed with appropriate clamps of non-magnetic material (mesin, bronze or similar). The console and cable end of 10kV cable are effectively grounded.

TRANSFORMATION

Three-phase power transformers are used for transformation in oil self-cooling, transmission ratio $10.000\text{V} \pm 2 \times 2.5\%/400\text{V}$; 1000kVA forces, coupling DY5, frequency 50Hz, with integrated buhól relay and contact thermometer. The first stage involves the installation of two such transformers of such characteristics that they can permanently work in the parallel connection. In the second stage the third 1000 kVA transformer is added, which must have such characteristics that it is entitled to work in pair with the previous two transformers. During the installation it is necessary to revise the transformer and is necessary to take into account that:

- The transformer must have enough oil that can be controlled on oil gauge. Oil level in oil gauge changes with temperature oil. The oil must be dry with no moisture, ie. must have certain electrical strength and other properties. For possible testing the oil sample is taken from the lower oil discharge so that 10-15l oil is dropped and then filled with clean and dry 1 liter dose.

- Insulators on the transformer, cooling plates must be clean. Terminals must be tight and must not be overheated.

- Silicagel in air dryer must be livid. If it becomes red it should be dried or possibly replaced. The primary voltage must not be higher than 5 % of the rated voltage of the switch position. It is necessary to measure the primary voltage and to adjust the position of the switch.

- It is necessary to measure the load and oil temperature. It is measured with a thermometer in pocket on the lid, which is filled with oil. Oil temperature must not be higher than 100°C , except for short periods in phase overload.

- Access to the transformer after opening the door of substation department once again is protected by placing colored wooden protective strips, placed in the door frame tray at the 80cm distance.

CONNECTION OF THE TRANSFORMERS AND LV SWITCHGEAR

The connection between power transformers and low voltage switchgear is established by copper rails 3ECu - 80x10mm for phase conductor and ECU 50x10mm for the prime line. The rails are placed at the distance so that they have width so as to preferably directly go to the ports of LV block and on the side of LV power transformer port. If the distance is estimated the connection copper rails should be fixed to the bulkhead at the console of box or "L" profiles with insulators type IPC - 1 screwed onto the console.

LOW VOLTAGE DISTRIBUTION LINES

Switchboard low voltage contains ten (10) fields in one unit (transport and the introduction done in at least three parts). Each field in its exterior shape has a dimension 600x790x2000mm (transformer bays and coupler) and 800x790x2000mm (discharge and compensation fields, up the wall type. When it comes to purpose these are:

- 2 pcs. connection (transformer) box to connect power transformers with LV block. The field is equipped with a three-button power $I_n = 2000A$, 500V, $I_{cc} \geq 75kA$, with electronic relays, voltage trigger, current transformers transmission ratio of 1500 / 5A, ammeters 0-1500 / 5A for connection to measuring transformers, voltmeter 0-500V with switch, pushbutton for emergency switch off. The terminal from the power transformers to block is colored with copper rails with cross section 3ECu - 80x10mm + ECU 50x10mm.

- 1 pc. coupler equipped switch power, the same characteristics as the transformer box.

- 5 pcs. drain fields with drains fitted switches with electromagnetic and thermal- relay rated current $I_n = 250A$; 400A; 630A; 800A, with measuring current in each copy in the middle stages. All switches are equipped with thermal-magnetic relays. All drains with drain to the bottom (cable lines). The profile on which cables are fixed has openings f11 at the distance of 30 and 40mm. Along with these rails, clamps are to be done for the cables provided from single-line diagrams with steel sheet $d = 2mm$ width 50mm.

- 2 pcs. compensation field in which relays are placed for control and switch on/off command of capacitor batteries, switches, fuses, batteries and other necessary midfield supplied. Field of compensation has dimensions 800x790x2000mm.

The main copper rails for stages are 100x10mm and 60x10mm for zero. In excerpts dimensions copper rails are different and their minimum load must be 25 % higher than the rated current of the switch. Rails are colored and dimensioned to surge current SC at least 65kA. The main rails are installed in the middle of the block upright on insulators IPC - 1 at the distance of 600 and 800 mm and axial distance of 175mm and abstract rails on insulators IPB -1. All copper bars for drains are colored. The board is free-standing fixed to the floor channel and the wall on the back. Made of double pickled sheet, 2mm thickness, box profiles welded to the frame with screw connection. The design must be well degreased and plasticized. All the connecting material must be of stainless quality. The board is made of four parts which contain:

- First part of the field F1 and F2 length 1400mm
- Second part of the field F3; F4 and F5 length 2200mm
- Third part of the field F6; F7 and F8 length 2200mm
- Fourth part of the field F9 and F10 length 1400mm

This arrangement is planned for the space that dictates their entry into the wiring department.

TRANSFORMER COOLING

Due to losses in voltage that occur during operation of transformers, it is necessary to provide a safe space in which cooling is located. The project provides natural ventilation of the transformer box. Transformers are on the platform, which is in relation to the surrounding terrain raised to 0.9m. Due to the adopted orientation of transformer departments and relatively low height entrance door to achieve satisfactory cooling, the development of input-output blinds is planned on the door transformer box. Attached to the budget calculation there are the dimensions and layout of the designed blinds.

OIL PIT

Designed pit for the reception of transformer oil in general average must meet the following requirements:

- Watertight to groundwater and rainwater,
- Cover for heavy traffic passage,
- Resistant to aggressive liquids,
- Capacity to the inlet pipe for the two oil capacities of a transformer unit,
- At the bottom it has a pocket for oil extraction, it is satisfactory and it may fulfill its purpose and increase capacity of SS to 3x1000kVA.

MEASUREMENTS IN SS

The measurement of electrical energy on the 10 kV indirect measuring group (three system) all in accordance with the request of the responsible power company. Measuring cabinet is set on a free wall directly at the entrance to the installation of HV and LV equipment. In addition to the closet, a cabinet or a rack should be installed in which there is a numbered book, which is stamped by SS users. It is obligatory to enter the date and time of entry of persons by name, last name, number of powers of electricity distribution, as well as the responsible official (Hospitals) in whose presence an unknown person was there. All persons are signed after notes on their reasons for entering the plant. If reading the measuring group is in process, the state read is entered into the book.

To control the load on LV side the following measurements are provided:

- The inlet of the transformer by 3 pieces of current transformer with an ammeter for current and maximum load,
- In the middle stages of transform field one current transformer for connection relay for compensation,
- For each cable duct a current transformer in the middle stage, rated current switch and ammeter with appropriate measurement range.
- To measure the voltage on 0.4kV side a voltmeter is provided for each transformer with scale 0-500V with a voltage meter switch which can measure all the line and phase voltages. All measuring instruments are located on the front of LV switchboards.

SUBSTATION LIGHTING

Work lighting inside the substation is designed with fluorescent lamps mounted directly on the ceiling. Lamp arrangement is given on the basis of SS. They are turned on by the installation switch right next to the entry to the room.

In the room of high voltage and low voltage two lamps are to be set with their own power supply (batteries) that, when power fails, have at least 2 hours autonomy. The lamps have automatics for protection from excessive charging or discharging.

In each transformer box one lamp is provided, above each door (three above the transformer box and two on entrances to the HV and LV plant). The low-voltage transformer block on the field will have one single-phase and one three-phase aluminum dry port for possible connection devices which are used to maintain or repair the equipment.

GROUNDING

SS grounding consists of operative and protective grounding unified in a single unit. When the construction works on the reconstruction of the premises of the energy block and landscaping around the building a galvanized strip is to be laid freely in a trench and in part in the newly formed AB fundamental strips. At 2m from the facility ground facility in trench in at least 1m depth to lay galvanized strip FeZn 25x4mm with driving probe in the corners of the building. The probes are 2.5", 3m length and are driven through top edge at the level of the tape drives. Thus formed contour serves as a lightning protective earthing of the building.

Note: careful when driving probes on other existing underground installations.

In the building itself, as well as other construction works to be performed in the reconstruction of the object (based on partition walls, retaining walls, concrete channels and a shaft) a basic grounding is to be created. In the lower parts of these concrete structures to pass galvanized strip and connected so as to form a single galvanic unit. Thus placed tape is durable and is substantially affected by aggressive environment.

The tape is laid in the foundation and freely in the trench at all places where they are getting closer a link is formed in a quality way and the blend is properly founded. Thus performed grounding guarantees a small enough value of ground resistance that can also meet the requirements of working in a joint grounding.

When laying LV cables from SS to the facility, set up a lasting connection between basic grounding of the new surgery facility and the newly formed grounding energy block.

According to the regulations the protective grounding installations above 1 kV should always be connected to protective 10 kV ground installations. Thus connected protective grounding can be connected to the drive grounding installations up to 1 kV if all plants are intended only for the use and consumption of SS and substations fed by it, that is, one user which this case is fulfilled. The plants for its own need include the electrical equipment for power supply to the auxiliary devices, light sockets and operating electrical equipment, office and residential installations. Thus in the system of "zeroing", "TN-C", it is necessary to galvanically connect the protective grounding of all types and levels with the operative grounding of the substation.

Since the resistance of the joint ground is below the prescribed value $R_{ZD}=4\Omega$ and in ground current the grounding voltage is less than specified permissible value for step and touch voltage $V_s = V_t = 65V$, the conditions are fulfilled for the safe operation of SS. Also in electrical installations which are supplied from the substation TN-C / S secure system can be applied.

Regardless of the value of the resulting transition resistance grounding it is necessary to apply the following additional protective measures:

- All metal masses, structural parts, control levers, housings with which there is a possibility of contact through serving, must be clearly grounded on the network of the protective ground and galvanically connected to each other so as to form a conductive unit.
- Place for serving is to be covered by attested rubber insulation carpet that needs to be isolated for full level of operating voltage. The width of the carpet must be equal to the width of 1.25m or manipulative hall in the place where it is narrower or wider than 1.25m.

- Secondary current circuits of transformer.
- Metal cloaks and power cable screens.

- HV ground coils with unipolar insulated voltage transformers.
- Valve arresters for surge;
- Neutral (zero) conductor voltage network if the protective grounding is used as united
- Other grounding electrodes, which may affect the reduction in the total resistance of the protective grounding (Off. Gazette of SFRY 13/78, item 50).

Practically the protective grounding in SS is achieved with the following parts:

- All the supporting structures of electrical appliances in HV and LV plant are connected to metal frames and cabinet cell via zinc-plated screw connections and gear pads. The same applies for the interconnection of individual cells, so it is practical enough to tie a switchyard quality and safe only in one place (planned for at least two binding sites). Metal construction cell may in items 81 and 82 (Off. Gazette of SFRY 4/74) serve as the ground of protective grounding, because the individual elements are welded or connected to the above mentioned screw connections and the cross-section of these elements is equivalent to the minimum allowed cross-section of the grounding.
- A power transformed boiler is connected to the protective ground, as well as mount transformer, voltage distribution rack, HV installation, all steel plates to cover the channel, all blinds on the walls and door stations. Nut M12 connects LV and HV installation with external potential ring FeZn - galvanized strip 25x4mm, through parting compound in the cable channel below the LV block. This circuit should be clearly marked and easily accessible for the verification and measurement.
- Protective ground (Potential ring) with a galvanized strip FeZn - 25x4mm, in the form of a ring around the building at a distance of 1-2m from the foundations of the building and at 0.8m depth with the addition of pipe grounding at the contour corners.
- Combined operative and protective grounding is normally performed in the substation. In extreme circumstances the operative and protective grounding are performed as separate groundings (Regulation on technical norms for the protection of LV networks and associated substations - Official Gazette of the SFRY no. 13/78). If the legislation requires to perform operative and protective grounding these must be effectively separated. In this case as well as in terms of spatial possibilities where separate groundings that can be effectively separated could not be done, a combined grounding is provided.

PROTECTION AGAINST DANGEROUS TOUCH AND STEP VOLTAGE

Protection against dangerous touch and step voltage is achieved by protective grounding, which is connected to the joint ground of SS. In the SS grounding everything will be connected the way it is stated above.

Manipulative space in front of the 10kV switchgear and LV switchboard is covered by rubber carpet 1.25m (1.5m) width, with a minimum thickness of 5mm, dielectric strength higher than 2KV, attested to 10kV.

It is stipulated that when serving the appliance one must use: insulating base, with 10kV insulator legs, 10kV insulation pole and 10KV protective gloves.

A ground zero rail is provided directly on low voltage in the switchboard on joint SS ground, as a safeguard against switching high voltage on the low voltage and as security that voltages at low voltage can not be higher than 250 V towards the ground.

FIRE PROTECTION

In the 10kV and LV 0.4kV substation room for fire protection are provided:

- 3 pcs. portable fire extinguisher filled with CO₂ - 5kg
- 1 pc. transport fire extinguisher filled with CO₂ - 10kg
- 1 pc. chest with dry sand and shovel

Under each transformer there is drain leakage or oil from the damaged transformers. Above the sink on the iron grate there is a 20cm layer of washed gravel size 3-5 cm. All drains below the transformer with cast sewer pipes in the slope are connected with the collection oil pit, which is common for all three transformer fields.

LIGHTNING CONDUCTOR INSTALLATION

According to the regulations of SS whose transformer unit does not exceed 1000kVA it is not needed to perform lightning conductor installation, this substation is part of the object for which it is necessary to draft the classic lightning conductor (aggregate cells and medical gases). Also, the size of the facility requires installing a lightning conductor defined by the reconstruction project.

NOISE PROTECTION

The substation is a part of the building, which is partly built of brick and partly of reinforced concrete elements, plastered on both sides of the wall, the noise emitted by the transformer is less than 35dB outside the station at a distance of 3.5 m and 2m height.

HANDLING THE APPLIANCES

All handling and manipulation in the substation must be performed only by a person who is professionally trained and tested. The manipulations are performed manually in the transformer plant. Each manipulation has to be approved by the appropriate dispatcher or service manager and clear and conspicuous warning signs should be put.

TECHNICAL EQUIPMENT

All the characteristics of the equipment, calculation of the short circuit and equipment check, cooling, grounding and connection diagrams are given in the chapter "Calculation" and the graphic attachments.

FIRE PROTECTION

Fire protection should be in accordance with the "Technical regulations for special fire protection in power plants" Off. Gazette SFRY 24/75). Since the power transformer has power less than 1.500kVA and is placed in a special building, the grate with a layer of gravel is not set, but only a collection funnel to drain oil to the pit. Crushed stone is to be placed on the collection

hopper. In the transformer boxes and switchgear department fire extinguishers should be placed, filled with CO₂. A study on fire protection is given as a separate attachment.

GENERAL TECHNICAL CONDITIONS

Construction of a substation and installation of equipment is to be done according to the regulations in force, the Regulations on technical standards for electric power plants over 1000V. Regulations and recommendations for electric power facilities in the field of the relevant electrical distribution or an appropriate community. Regulations on technical measures for the operation and maintenance of electric power plants, and other currently valid Serbian standards, regulations and rules relating to the objects of this type.

3.2 TECHNICAL DESCRIPTION

3.2.1 INTRODUCTION

Reconstruction of the ELECTRICAL ENERGY BLOCK OF THE HEALTH CENTRE VRANJE shall be conducted in two phases, those being:

- Phase I: Construction and rehabilitation of the existing electrical energy block facility which is supposed to be adapted to suit the specific purposes of certain sections of the facility, to put into service three separate functions:
 1. Power substation 10/0,4kV, 2(3)x1.000kVA
 2. Diesel generator 2x250kVA
 3. Station for medical and technical gases
- Phase II: Equipping a certain space with devices and installations suitable for such a space.

This part of the electrical-energetic design covers the new diesel generator station to be used for the purpose of the NEW SURGERY BLOCK OF THE HEALTH CENTRE VRANJE in Vranje. Based on the above mentioned, a power generating station is to be equipped. It will meet the electrical-energetic needs of high-priority consumers in the new surgery block and in the extension of the top floor of the gynaecology ward.

Inside the Institute of Hygiene building, there is a diesel generator station (250 kVA). It is used to supply power to the consumer inside the hospital complex (the Surgery building and the Institute of Hygiene), the burden placed on it is small, and with the relocation of the existing surgery block, the need for this station has been removed, and therefore, the terms of reference define that it is to be relocated to the new electrical energy block.

To supply power to high-priority consumers in the new surgery block, both the existing relocated diesel generator 250 kVA and a new diesel generator 250 kVA are to be used. The power generators shall be situated in a separate room adjacent to the power substation of the new electrical energy block.

The scope of this notebook is the relocation of the existing diesel fueled power generator, whose alternator power is 250 kVA, into the new space of the energy block.

The subject of this book is the relocation of the existing diesel power generator, with alternator power output of 250 kVA, to the new premises of the electrical energy block.

3.2.2 ELECTRICAL ENERGY FACILITY

The construction facility consists solely of the ground floor, with premises separated according to their purposes which are elaborated in the previous chapter. Each of these sections is separated with anti-fire walls whose required fireproof quality is defined in a separate survey. Each section is covered in specific parts of the design.

This part covers the description of the grounding system, general lighting, electrical installations for the lighting and connection ports and equipotential bonding.

Facility's grounding system.

At the existing facility, prior to its reconstruction, no earthing terminal or lightning rod system had been installed. For this reason, the design for the reconstruction of the facility envisages that an earthing terminal, lightning rod system and equipotential bonding are to be installed in the very facility, as well as general installation of high-voltage current.

The earthing device is delivered by combining the base earthing electrode inside the facility, earthing strip around the facility and outdoor lighting earthing arrangements and by connecting all the nearby earthing terminals (the new surgery building, the perimeter wall, the protective contact grounding arrangements of the 10 kV grid and all other earthing terminals which are in the immediate vicinity).

The base earthing electrode is to be installed with FeZn 25 x 4 mm stripe in all the new base stripes, according to the detailed design for it, with the necessary number of outlets inside and on the outside of the facility. The stripe in the base is to be welded to the main reinforcement so that the two make an integral and permanent galvanised whole. This grounding device is to be used for both operating and protective grounding device. The base earthing electrode is to function as functional and protective grounding arrangement. The base earthing electrode is connected to the earthing strip which is to be delivered around the facility at 1.5 to 2 m from the base, at a depth of 1 m. At the corners of the facility, 4 probes have been placed, 2.5 to 3 meters long, and 1 m deep (upper end of the probe). All of the above mentioned is to be interconnected to make the grounding arrangement for this facility.

During the construction of the abutment, in the lower section of its base, the FeZn 25 x 4 mm stripe is to be placed onto the main reinforcement, it is to be welded onto the reinforcement by making outlets for the grounding of the metal fence, with maximum distance between the outlets being 10 m. This earthing terminal is to be connected to the earthing terminal of the electrical energy block, the new surgery building and to the outdoor lighting grounding arrangement.

The earthing terminals which are delivered in the described manner and interconnected to be permanent and of high quality are the basic prerequisite for their proper and long-term functioning. The ground resistance should be measured at every point which allows it without the prior need of additional construction works. These measurements are to be included in a written expert report in at least two copies.

Lightning protection system

It is delivered by means of standard air terminal made of FeZn 20 x 3 mm stripe placed on the rooftop of the facility in the form of a mesh (Faraday cage), by connecting to it all the metal objects on the rooftop and other parts of the roof which exceed the level of the placed lightning protection mesh. Metal ventilation ducts from the power generating station are delivered to the

rooftop, and these need to be grounded at at least two points. It is also necessary to ground the exhaust tubes that are delivered to the rooftop. TR sheets are to be connected to each of the down conductors at several points.

Equipotential bonding

In each section of the facility, it is necessary to form permanent and high-quality connections between all the metal objects which are not exposed to voltage during regular operating cycle. In addition to the equipment installed in the electrical energy block premises, it is also necessary to ground all the metal elements which are integral parts of the construction facility and which during regular operating cycle may be within a hand's reach (cabinets, doors, windows, bars, tubes, conduits, etc.).

Inside the gas and power generating station, each perforated cable tray, valve, bend, coupling and engine are to be bypassed permanently and with the highest quality, with a special marking on the point of bypassing.

Equipotential bonding rail (each in every separate section) is to be placed closer to the outlet of the base earthing terminal on a convenient spot where it would not be exposed to mechanical and chemical effects. On the walls of all the rooms, an enclosed grounding arrangement device structure made of the FeZn 20 x 3 mm stripe is to be placed at 0.4 m from the floor onto the stripe supporting brackets ("bells") which are screwed onto the wall at 0.8 to 1 m distance. From this equipotential bonding rail, the elements are to be grounded by means of a strand conductor with a suitable cross section and a lug at the connection termination. The conductor is to be a yellow-green stripe painted with black and white lines.

3.2.3 OVERVIEW OF HIGH-PRIORITY CONSUMERS

In the block diagramme of the electrical current supply for the newly designed facility, a distribution line for supplying power from emergency sources (diesel generators) is presented.

In accordance with the applicable regulations and the Investor's requests, the following systems in the Facility have been defined as systems which require an emergency power supply source:

- the facility's safety systems;
- portion of the consumers;
- parts of the surveillance and operation system;
- auxiliary power supply system for the diesel generator station (electrical devices necessary for safe functioning of the diesel generator);
- parts of the lighting system;
- central devices of the TT installations in the facility.

Information on the above mentioned consumers are provided in the corresponding electrical and mechanical designs.

3.2.4 OPERATION

Given the operation method and the consequential period of interrupted supply of electrical energy, the power generator is operated automatically.

During the voltage outage in the distribution grid, the power generator is turned on automatically and takes over the supply of power to the electrical devices. Duration of the interruption of voltage supply is cca 15-20 seconds.

After restoring normal functioning of the distribution grid, the power generator shall be tuned off automatically and the devices shall be switched to the mains voltage.

As a back-up solution, it is possible to manually turn the power generator on and off by accessing the distribution – operation cabinet of the diesel generator.

The diesel generator station does not require an operator to monitor and operate the machine, and selfprotecting devices have been installed which will, in the event of failure, automatically turn off the power generator and set off the light and sound alarm.

For remote signalling of operation and errors, non-voltaged contacts for the following signals have been installed:

- diesel during operation;
- low voltage of rechargeable batteries;
- outage of the mains voltage;
- diesel generator prepared to take over the supply;
- network parameters outside of permitted values;
- failure to start the power generator (after three unsuccessful starts);
- low level of fuel in the daily reservoir;
- activated safeguard of the generator's output relay;
- low level of oil.

All the signals are designed to be forwarded to the automatic control cabinet.

3.2.5 TECHNICAL SPECIFICATIONS

Diesel generator which is to be relocated has an alternator power output of 250 kVA.

Diesel generator which is purchased as new has an alternator power output of 250 kVA.

3.2.6 OPERATION OF THE VENTILATION SYSTEM

Since the air flow necessary to cool the engine and combustion exceeds the necessary air flow calculated according to the dissipation from the generator and engine, the ventilation system is designed in the following manner:

1. Power generator is in operation mode:
electromotive regulation blinds for fresh and waste air are open.
2. Power generator is not in operation mode:

The electromotive regulation blinds for waste air are closed. Room temperature is regulated by a thermostat and electromotive regulation blinds for fresh air: at a temperature higher than the one set on the thermostat (regulation at 25-40°C) the electromotive regulation blinds for fresh air are open, whereas at temperatures lower than the one set on the thermostat, the electromotive regulation blinds for fresh air are closed.

In addition to automated operation, it is also possible to manually turn the system on and off, whereby the electromotive regulation blinds for fresh air are opened and closed.

The premises are naturally ventilated through the blinds installed in the door, walls and on the rooftop of the facility. On the interior side of the outer fixed blinds, electromotive closing flaps are placed and these are opened during the ignition of the diesel generator.

The exhaust tubes are delivered to the rooftop and directed opposite to the surgery building. Before remounting it, the liquid fuel reservoir (0.4 m³) needs to be washed clean, coated with an anticorrosive layer and painted. The supplying pipes and frame need to be replaced. Under the reservoir, a discharge sump (0.5 m³) needs to be placed. Inside the diesel generator room, it is necessary to place a metal crate with sand (0.25 m³) and shovel, as well as a fire extinguisher.

For the purpose of maintaining minimum temperature required to start the diesel generator, the design envisages the installation of a 3 kW electrical heater, controlled by the room's thermostat.

3.2.7 LIGHTING, CONNECTING PORTS AND GROUNDING ARRANGEMENT INSTALLATION

Supply of power to the lighting and connecting ports system is to be delivered from the auxiliary power supply systems (=HDSP), situated in the diesel generator station. The auxiliary power supply systems (=HDSP) supplies power also the engine used to start (open – close) the regulation blinds and the ventilator.

For the purpose of lighting the premises, the design proposes lamps with fluorescent tubes, placed on the ceiling of the facility, and wall lights above the door.

The level of electrical – mechanical protection is adopted on the basis of the purpose of the premises and the conditions prevalent inside the premises.

Level of lighting in the premises is aligned with the JKO's recommendations.

The lights are to be turned on by means of a switch which is installed in the room.

A single-phase and three-phased socket of general purpose is to be installed in the facility.

Installation should be delivered by using PP00-Y cables laid along the wall in collars.

The lightning protection system is to be delivered by standard laying of striped conductors over the rooftop (Faraday cage), with grounding of all metal objects on the roof and the facade with and air terminals.

The grounding arrangement is entirely new, and it is planned to be delivered by laying the FeZn 25 x 4 mm stripe in the new AB base earthing stripes, by laying it in the trench around the facility and by connecting it to the earthing terminal of the New surgery facility. The earthing terminal shall be complemented by an extension of the stripe that is laid in the trench of the public outer grounding arrangement.

The grounding arrangement (equipotential binding) of metal objects is to be delivered by placing galvanised stripe along the perimeter of the room. All metal objects of the very power generator, electrical cabinet, metal door and blinds are connected to the earthing terminal installed in the described manner.

Upon completing the installation of the grounding arrangement, it is necessary to perform measurements of the contact resistance, soil electric potential, contact voltage and step voltage. Based on the results obtained, a measurement report is to be drafted.

3.3 TECHNICAL DESCRIPTION

INTRODUCTION

Reconstruction of the health center in Vranje will take place in three phases
Stage I involves the construction of Annex to the existing hospital building with sections A, B, C and D. In the annex:

- ♦ on the second floor surgical block will be formed
- ♦ in the laboratory basement other facilities as well
- ♦ in the loft technical rooms, offices, etc. (see architectural drawings and design).

Based on the above, Stage I involves the surgical block and extension of gynecology loft.

Other floors in the annex will be equipped in Stage II (not subject to this Contract).

The subject of this volume are the electric power systems (interior installations) for Stage I of the

Annex building extending next to the existing hospital building and technical block (medical gases). Annex will have a basement, ground floor, three floors and loft. However, only the basement, second floor and attic will be completed for the intended purpose.

- Annex electricity power supply

Block diagram of the annex electricity power is given in Figure gp III-4-EEN-1.02.

Annex shall be supplied from the following sources:

- from the power grid (primary, network supply), or from the substation to be reconstructed (discussed in Book III, Volume 1)
- from diesel-electric generator (backup source - processed in Book III, Volume 3).

External cable network from the substation and diesel generating plant to the Annex was treated in Book III, Volume 2. All external cable connections from the power station and diesel generating station will end in the cable terminal boxes (KPK). They will be placed at the lateral facade of the Annex.

KPK cables shall be conducted and connected to distribution boards.

1. Installation for power supply of technological consumers

The primary supply of consumers will be the electricity distribution network, and the power station. However, certain processes (eg, surgery) and consumers require power for some time after the failure of primary, network, power supply. In accordance with current regulations and the requirements of the Employer, in the facility, as systems that require backup power, the following are planned:

- facility safety systems
- existing boiler room with fuel oil (boilers)
- part of monitoring - control system
- part of the installation of lighting
- central devices of telecommunication systems
- technological consumers

The safety systems imply the electrical equipment and installations which must function at the outbreak of the fire. For supplying of these systems basic (network 0.4 kV) and backup (diesel) power sources are provided.

As safety system in the facility the following is planned:

- plant for raising pressure of fire water (hydrocil)

The basic requirement for supplying safety systems in surgery rooms and intensive care is that the first failure (contact of phase to zero or protective line) may not cause the reaction of the protective device or disconnection of consumers. This requirement can be met by using IT systems i.e. systems with isolated neutral point. Therefore, between the reserve source and consumers will be placed the insulating transformer, transmission ratio 0.23/0.23 kV. On the primary side (as viewed in the direction of energy) of the insulating transformer neutral point will be directly earthed, and on the secondary-insulated. On the secondary side of the transformer insulation controller is envisaged. The function of the same would be to warn that on the secondary side weakening of the insulation occurred, but not to perform disconnecting of

the entire installation or the relevant part

Power supply of safety system will be with "halogen free" cables that are fire-resistant (retain dielectric strength 120/180 minutes).

Time to set up the power supply from the diesel-electric generator is about 30 seconds. Such deenergization is too long for some processes and consumers. In such cases, the use of devices for uninterrupted power supply (UPS) is provided. These devices will be connected to the backup power source. Therefore it is not necessary that the capacity of the battery is high, because they assume supply just during time required for backup source to take power.

"Technical equipment" includes devices and consumers which are essential for the functioning of the hospital complex and processes.

Additional safety measure is the introduction of IT systems for supply of consumers in surgery rooms. The system of protection of IT will be applied for:

- ♦ supply of standby power (diesel-electric aggregate)
- ♦ Uninterrupted Power Supply System.

Each operating room will have special switchboards for power from the backup source or from the UPS. Boards will be installed in a niche in front of the hall. Each board will be installed:

- Isolation Transformer 4 kVA transmission ratio of 230/230 V
- Associated switch gear and protective equipment (switches, circuit breakers, contactors)
- Insulation controller
- Temperature of the insulation transformer controller
- Load of the insulating transformer controller (on the secondary)

For each type of power supply in surgery rooms (backup source, uninterrupted power supply) IT system will be formed by applying a single-phase insulating transformer with transmission ratio of 230/230 V. On the secondary side of each transformer, insulation controller is predicted. From each insulation controller signal will be conducted on the occurrence of the earth fault in the control and monitoring system (see Book III, Volume 5).

Power supply of part of the equipment in surgery rooms will be via UPS. The design includes two UPS devices. Rated power of each UPS is chosen to withstand the total load. UPS will operate in parallel. In this way there will be no interruption in power at the inner defect in one UPS or external fault.

In front of each surgery room there will be cabinets (marked with TH1D + TH1 to TH6D + TH6U) powered by generator, and inverter (UPS) voltage 230 V, 50 Hz. These voltages are formed in a special distribution board out of the cabinets. The cabinets will supply:

- ♦ General lighting and lighting by rheostat
- ♦ Surgical and anesthetic Ampel and rail systems
- ♦ Bactericidal lamps
- ♦ Negatoscope
- ♦ The operating lamp (with three and seven boxes)
- ♦ Opening-closing of doors
- ♦ Electrical power supply of medical equipment (over ampel, rail systems and sets)

Power schemes of surgery rooms are given in figures gp III-4-EEN.201 to 2.28.

In each operating room by one command signal cabinet has been predicted (marked as KO-TH1 to KO-TH6). From them the following will be controlled and managed:

- general lighting
- operating lamps (with three or seven boxes)
- Monitoring the degree of isolation
- Winding temperature insulating transformer
- Load of insulation transformer
- Control of degree of filters contamination
- Room temperature
- Room humidity

Consumers in the room of the intensive care (Fig. 03.38) will be supplied from a separate cabinet, marked with TH7D + TH7U to the same principle as consumers in the surgery room. With on-duty nurses command signal cabinet is predicted, designated as KO-TH7, which will have the same function as the cabinet in surgery rooms. Schemes of the above cabinets are given in the drawings gp-III-4-EEN-2.25 to -2.28.

In the operating room is installed antistatic floor.

Power supply for installation of technological consumers with electricity in the basement is planned from:

- Distribution boards =HOPTHSM (network), =HOPTHSD (diesel) and =HOPTHSU (UPS). Boards will be located in the basement.
- Distribution boards =HOPTH2M (network), =HOPTH2D (diesel) and HOPTH2U (UPS), stored in the attic of the building from which second floor consumers are supplied.

For supply of the consumers in the attic of the building (connectors in medical and rooms for nurses) switchboards are anticipated: HOPP2M, HOPP1M, HOPP1D, HOPP1U, HOPTPM, HOPTD, and HTPU.

All boards in the attic are supplied from the distribution boards HPM, HPD and HUPS1, except table HOPT2M which is directly powered from KPK – 2M.

In addition to the aforementioned consumers, according to the technological design, which except the Terms of Reference was the basis for elaboration of the design, supply of the following technological consumers is envisaged:

- In laboratories (jacks in the parapet branching).
- In surgery rooms sets with 6 mono-phase sockets (4 diesel and 2 UPS).

A number of consumers will be connected to voltage supply via the individual single-phase and three-phase sockets and direct connections. These will be carried out in the system of TN-C (S) and at the beginning of each outlet circuit breaker is foreseen. These terminals will be supplied from the board HOPT2M.

In the energy channel, which inlets gases (above the tables), a certain number of sockets that will be powered by diesel and UPS is envisaged. For each energy channel two kinds of power are envisaged: diesel-generators and UPS. Within the energy channel there is also space and connections for telecommunications and mechanical-technical installations.

At the right place (next to the tables) are foreseen parapet distributions with single-phase connectors powered from the network, diesel and UPS.

In addition to these types of connections, in the Annex are provided individual single-phase and

three-phase sockets and direct connections for various consumers power supply (washer, refrigerator, hand dryers and other general consumers).

To prevent icing vertical down-pipes, (6 pieces) in collection points on the roof are provided heaters and power supply thereof. Also heaters and two standpipe lines for fire protection water in the installation channel are envisioned.

Supply of medical gases facility (board =HMED) has been envisaged from the annex, from board =HGVKSD.

Installation for the power of technology consumers is envisaged as "halogen-free" cables type NHXHX-J, resting on shelves in lowered ceiling in the hallways. Extending cables shall be in terminal installation boxes of halogen free materials, deposited into cabinets.

All power cables are induced in the building, as already mentioned, over nine KPK, situated on the lateral wall of the energy channel.

In the energy channel cables will be laid in two vertical racks to building loft. In the same tracks are laid also cables from distribution HUPS1 (for board HOPTSU), HGVK and HPPV as shown in the drawing gp III-4-EEN- (1.03 to 1.06).

All cables for power supply of consumers on the second floor (surgery block), which depart from the boards HOPT2M, HOPT2D and HOPT2U (room 14-loft) are passing through the third floor and are brought through the shelves to three vertical descents, which will be installed in the partition wall of corridor of the III floor in the form of niche, as shown in the drawing gp III-4-EEN-2.47.

Cables for consumers in the attic, II floor or basement are placed on the shelves as shown in the drawing gp III-4-EEN (2.45 to 2.48).

3.3.1 Installation of interior lighting and sockets for general purpose

Installation of lighting

The design foresees the following types of lighting installations in the facility:

- Working (general) lighting
- Security (anti-panic) lighting
- Safety lighting
- Signalling (elaborated in design of telecommunication systems)

General lighting is planned to be supplied from 0.4kV network across the storey distribution boards.

Security (anti-panic) lighting is provided with lamps with its own AKU (rechargeable) batteries and will be powered from a reserve power source (diesel generator).

Safety lighting will be supplied from the reserve power source. On duty lighting will also be supplied from the reserve power source.

For power supply of lighting installations and general-purpose sockets the following are anticipated:

- in the basement distribution boards =HOPTSM (network supply) and =HOPTSD (backup supply from diesel generator).
- on the second floor are designed switchboards =HOP2M and =HOPT2M for network supply, boards =HOP2D and =HOPT2D for supply from diesel generators and board =HOPT2U for supply from UPS. Boards =HOPT2M, =HOPT2D and =HOPT2U will be placed in the loft, in room no. 14.
- for power supply of lighting installations in the facility loft are envisaged distribution boards =HOPP1M, =HOPP2M, =HOPTPM (network supply), boards =HOPP1D and =HOPTD (reserve supply from diesel generators) and boards =HOPP1U and =HTPU

for supply from UPS.

In the surgery rooms lighting will be carried out with fluorescent light sources 2x36W and spot reflectors, which will be incorporated in the plenum of air condition, with the possibility of adjusting spot reflector through rheostat, which together with the setup switches are placed in the technical cabinets for each operating room.

In the attic, the lamp will be with LED light source to be mounted on the ceiling using a prop for hanging (on suspenders). In the technical area lamps will be built in with fluorescent light source in the corresponding protection and will be set after the installation of mechanical and hydro installations in such a way as conditions may allow (directly on the ceiling or on suspenders).

Outlets for power supply of lighting circuits will be equipped with low-voltage installation switches.

The installation will be performed using "halogen free" cable type NHXH-J, deposited into cabinets, under mortar, in the partition panels or lowered ceiling. Power supply of lamps from standby power supply (diesel) which do not have their own power source is envisaged using "halogen free" cables type NHXH-Fe120/E90-J. Extending cables shall be done in terminal installation boxes built into the wall or junction boxes mounted in the ceiling area, made of halogen free materials.

General lighting is provided in offices, non-intervention rooms, nurses' rooms, medical rooms, Chief rooms, corridors, stairway, washrooms, other auxiliary rooms of the building, as well as in patients' rooms, using the lamps that are part of the hospital sets (energy channel) placed on the wall.

Within the general (working) lighting of facility, it is planned for the part of the same to be supplied from the reserve energy sources (diesel generators), thereby enabling so-called safety-lighting. Security-lighting will consist of approximately (25-30)% of working lighting in the corridors and rooms of particular importance. These areas are: the surgery rooms, interventions, nursing rooms, medical rooms, as well as all the laboratories, preparation, recovery (sick room). The lighting will be carried out via the lights that are an integral part of patient sets.

Security (anti panic) lighting is provided using lamps with its own AKU (rechargeable) batteries and will be powered from a reserve power source (diesel generator). Security lighting is planned in the stairwell, corridors, all communications, intensive care unit ("recovery"), preparation, and will serve to highlight the shortest path to the exit from the building. Lamps of this lighting can be supplied via AKU battery that provides them with work to 1h after termination of the network or reserve power source.

Lamps of on duty lighting will be installed in the room for the "recovery" at a height of 0.3m from the floor and their switching on will be made by installation switch located in the nursing desk within the room. The role of these lamps is facilitating a night tour of the patients by the medical staff. Lamps of on duty lighting are planned to be connected to the diesel-generator power supply. In this manner, the unrestricted visiting patient without disturbing them is enabled.

Height of brightness, the degree of mechanical protection and types of lamps has been adopted, depending on the purpose of the premises and the processes that will take place in them.

The lighting inside the building is planned using lamps with fluorescent tubes, compact fluorescent tubes and lamps with halogen light source, all depending on the ceiling type and purpose of a room. In the basement and the second floor lowered ceiling is built in, made of gypsum board and lamps are designed for installation in the same. In the toilets, which are also with lowered ceiling, are planned lamps with compact fluorescent tubes for installation in the same. Lamps with halogen light sources are intended to be set in rooms 3.38 on the second floor, mounted on the wall and provide indirect lighting. Also in the basement in 06.18, they are installed in lowered ceiling, and the magnitude of brightness is regulated by a so-called

"dimmer" or regulators of brightness.

Switching lighting on in the premises is provided for using the switch in the room itself, and in the case of sanitary facilities switching on is provided in the hall at the entrance of the same.

In the »recovery« room (03.38) installation of lamps is provided within patients sets (energy channels) providing any type of lighting, such as:

- Indirect lighting will serve as general lighting and consists of two fluorescent tubes with a lens hood (for each of the beds). The turning on of indirect lighting within the patient's sets is provided using the switch in the premise itself directly at the door.
- Direct lighting will be used as a reading light, consisting of one fluorescent tube of 18W (for each of the beds) with a lens hood and electronic switch on / off the lights, to be placed above the bed.

By simultaneous switch on of indirect and direct lighting the necessary and sufficient lighting will be provided which will allow checking of patients in bed. Patients sets are made of aluminum, contain all the necessary connections, as well as a place of passage and telecommunication connections and mechanical-technological installations for one, two or three beds.

Extension of cables shall be in terminal installation boxes built into the wall or junction boxes mounted in the space of a suspended ceiling (made of halogen free material).

All connectors that are powered from any UPS power system should carry a special mark and be coloured red.

It is anticipated to conduct cable installation in PVC cable ducts and cable trays to the proper width, and in points of separation of one cable in the clamps. For cable ducting through the floor PVC pipes are provided, and for power supply of individual outlets, parapet distribution and trunking.

Heights of brightness, the degree of mechanical protection and types of new lamps have been adopted, depending on the purpose of the premises and the processes that take place in them.

Installation of sockets for general purpose

In the facility are provided connectors for general purpose, which will be powered from the network, the backup source (diesel generator) and from UPS.

Disposition and the number of general-purpose sockets is defined in accordance with operating conditions and requirements for connection of the consumer at the premises.

In every room, as well as in corridors, is provided a number of general-purpose sockets, which are powered from the network. Depending on the needs, there is also a certain number of sockets that are supplied from UPS.

According to customer requirements in the facility is designed also an appropriate number of single-phase and three-phase sockets, as well as connectors for terminals and telecommunications equipment. Connectors are mounted on a wall, panel or trunking on the wall.

Jacks that are installed in a panel, wall or trunking are placed at 30 cm and 110 cm from the floor, as indicated on the drawings. Laying cables is provided as one of the following manners:

- at group laying cables are laid to cable racks of appropriate width
- at individual laying cables are laid on clamping
- for cable conducting inside the offices and laboratories to general-purpose sockets and the installation switches partition panels are used through which cables are induced in the PVC pipes Ø16 and 23mm.

For power supply of sockets installations are provided cables type NHXHX-J, section and number of tendons defined in the single-pole diagrams which form an integral part of this design. The degree of electrical-mechanical protection is adopted depending on the purpose of premises and conditions in them.

- Lightning conductor and grounding

Lightning conductor consists of internal and external lightning protection installations (UGI and SGI), which are galvanically connected and form effective protection against lightning.

Outdoor lighting installations (SGI)

The system of external lightning protection installation for the building is formed using:

- rods with device for early start, mounted on top of the building (the function of the receiving system)
- two down-conductors from rod clamp to the grounding ring of the building (one of which is existing)
- ring grounding around the building.

Grounding element of the Annex is designed as a ring, i.e. by depositing zinc FeZn 25x4mm in the trench around the building (at 2m from the facility), connected to the existing grounding of building with sections A, B, C and D, synchronized with other installations in the infrastructure. On the wall of the Annex, on the outside of the energy channel, horizontal, setting of galvanized steel tape FeZn 25x4mm is provided, on the appropriate supports, at a height of 0.5 m from ground level. Through this tape grounding of each KPK will be carried out.

Grounding of elevator guide-ways at the top is envisaged, by the shortest route, to the engine stand and stand to the roof lightning protection system. Grounding guide-ways of the elevator is also envisaged in the bottom of the shaft.

When locating rod clamps the configuration of the roof of the existing building was taken into account and the possibilities of fixing clamps, so the same will be placed on the roof of section "C", along the wall of the section "D". The rod clamps need to be welded to a steel plate, which is supported by the roof of section "C" and fixed with the corresponding terminals on the wall of section "D", taking into account that the rod with device for early start should be 5m above the roof of section "D" and of the annex building. For the connection of terminals and down-conductors adequate clips have been provided.

As down-conducting line galvanized strip FeZn 25x4mm is planned, placed on the facade.

At a height of 1.5 m from the ground level are provided test joints and a box for the test joint. The test joint is executed from crossing element that must be placed in the box for testing joint. The tape is protected from the test joint to ground entry by a suitable mechanical protection. All points of connecting strip which is connecting the test joint with the grounding of the facility were achieved using appropriate crossed pieces and the ring grounding.

On one of the down-conducting lines execution of lightning counter is provided (above test joint).

Internal lightning conductor (UGI)

UGI is carried out by equalizing the potential of all metal masses inside the building. In the facility area placing of the following is provided for:

- the required number of major rail for potential equalization (GŠIP)
- the required number of rails for potential equalization (ŠIP).

In the facility, in addition to equalizing the potentials in toilets, on the system for potential equalization is also provided connection of metal structure of partition panels, anti-static flooring, chandeliers and Ampels in operating rooms and patients sets (a set of sockets and connectors for Hospital appliances). For grounding will be used the cable PP00-Y 1x50 mm² (from GSIP to the first SIP) i.e. PP00-Y 1x25 mm² as the bus line, which will be conducted placed on shelves in a suspended ceiling. Secondary distribution will be carried out via cables type PP00-Y 1x25 mm². Grounding of anti-static floor is performed using Cu lugs and screws, with connecting to a partition panel and anti-static floor. Connecting cable 1x4 mm² to collective grounding line (cable PP00-Y 1x25 mm²) must be carried out without interrupting the assembly cable. Connection of SIP to some of GSIP is carried out by cable PP00-Y 1x50 mm². Each GSIP is connected to grounding of the facility using galvanized strip Fe / Zn 20x3 mm via the corresponding crossing element.

From the GSP, within the technical-mechanical rooms, laying of Fe / Zn strip 20x3 mm is envisaged fixed to the supports on the walls of the rooms. The height of the tape placing is 0.6m to 1.0m from the floor. From the strip placed on the wall of the room to the technological, thermal and hydro-technical equipment, mechanical channels, pipes, cable racks, switch-boards and metal structures laying galvanized strip 20x3 mm is envisaged. Connecting galvanized strip is realized via the grounding screw or welding. It is anticipated for the pipes, channels, racks and frames in the energy channel to be connected via steel galvanized strip to the installation of grounding. At the beginning and at the end of the treated floors of the I stage of annex facility it is required to connect pipes, ducts and racks to the installation of the grounding via cable to the nearest SIP.

Copper braid is connecting all metal moving parts (windows, doors) to a metal frame, and frames to potential equalization system. Cable trays and pipes outside their connecting point are to be bridged with the star washers and conductor 1x10mm.

Any metal part of toilets is grounded via clamps and protective conductor PP-Y, 1x4mm² (connecting to SIP in toilets).

3.4 TELECOMMUNICATIONS

INTRODUCTION

A Surgical Ward with six operating rooms with accompanying rooms is planned to be built on the second floor of the Extension.

Pathology Ward with Mortuary is planned to be built in the basement.

Offices and technical areas are planned to be situated at the top floor (attic), in such a way that they will form a unique whole with the top floors of the atrium and the gynaecology ward.

The following telecommunications systems are planned to be installed at the Clinical Centre:

- telephone line system;
- local computer network;
- interphone line system;
- fire alarm system.

During the design of this solution, necessary capacities of central devices for phase I of implementation of CC Vranje project have been taken into consideration, and each of these devices has the option of extension to cover the total needs of CC Vranje.

Systems of telephone lines, interphone lines and local computer network shall be delivered as an integrated structured cable network and they shall processes in this notebook.

Fire alarm system is processed in Notebook 7.

Applicable legal regulations, rules, standards and recommendations of the Republic of Serbia have been applied in the design:

- Law on Planning and Construction (Official Gazette of the Republic of Serbia, May 2003)
- Law on Occupational Health and Safety of the Republic of Serbia (Official Gazette of the Republic of Serbia, No. 101/2005)
- Law on Occupational Safety of the Republic of Serbia (Official Gazette of the Republic of Serbia, No. 42/98)
- Law on Fire Protection (Official Gazette of the Republic of Serbia, No. 37/88 and 48/94)
- Rulebook on Technical Standards of stationary fire alarm installations (Official Gazette of SRJ No. 87/93).
- Rulebook on technical standards for drafting technical documents which needs to accompany systems, equipment and devices for fire detection and alarms (Official Gazette of SRY", June 23rd 1995).
- Main design of the connections for ZJ PTT;
- Instructions for construction of telephone lines and delivery of ZJ PTT.
- Rulebook on technical standards for low-voltage electrical installations (Official Gazette of SRJ, No. 87/93).

3.4.1 INTEGRATED TELEPHONE-INTERPHONE-COMPUTER NETWORK

To deliver telephone lines, digital PBX with capacity of 60/180 connection ports is planned. Connection to Telekom telephone network is to be delivered by means of two ISDN primary connection ports. Cable installation of the telephone will be delivered through an integrated – structured cable network with Category 6 FTP cables.

Inside the areas of the operation block and intensive care, interphone devices are planned for voice communication. Table devices are planned inside the offices, and wall devices for the operation blocks. Wall devices are to be designed for medical purposes, suitable for sterile rooms. Interphone exchange shall be inside the PBX room and it will hold capacity for connection of 64 devices. Cable installation is to be delivered in the form of structural cable network with Category 6 halogen free FTP cables.

Local computer network should provide interconnection between the working stations, forming of groups within the CC, connection to the external networks (the Internet), connection of the technical systems (surveillance, video conference). The network should be structured with FTP cables, minimum Category 6, halogen free. IT centre should be located at the top floor of the Extension. The network will consist of an active and passive section – horizontal cable distribution. Apart from the servers, active equipment will include communication devices (switch, router), working stations with network cards, UPSs for uninterrupted power supply and necessary interfaces – modems for interconnection and for the connection to the external networks (media converters, HDSL modems, 2Mbit transfer systems).

Passive equipment will include termination cabinets (main and floor ones), connective patch panels and voice patch panels, RJ-45 receptacles and telecommunication cables (optical 6 fibre cables and [FTP 4 x 2 x 0.5](#) CAT 6).

3.4.1.1 TELEPHONE LINE SYSTEM

Telephone line system should enable delivery of local telephone lines within the complex of the Health Centre and external telephone lines of Telekom, by connecting it to the public telephone

traffic by means of PBX Vranje. Telephone line system should also enable connection of the Health Centre Vranje with other centres (Niš, Belgrade) and to the Internet network.

Digital PBX with capacity of 60/180 connecting ports is to be installed. Connection to the Telekom telephone network should be delivered by means of two ISDN primary connecting ports and the existing cable with capacity of 20 x 4 x 0.4. Connection to the existing telephone installation of the Health Centre, which enables connection with the city's cable network of Telekom, shall be delivered inside the existing telephone cabinet on the ground floor of the Internal Medicine department. Trunks have been planned for the connection to the local computer network. Automatic PBX shall be installed in a room on the top floor of the Extension. Automatic PBX will have a source of uninterrupted power supply.

Along with the telephone exchange, a telephone splitter with capacity of 300 pairs is to be installed. Telephone cable installation shall be delivered by means of integrated – structured cable network with halogen free Category 6 FTP cables.

For every working post in the facility, one receptacle (RJ-45) is to be installed. Receptacles shall be connected by means of cables with terminal switches – patch panels, which are located inside the termination cabinets with high density of telephone installations.

The telephone system shall consist of:

- automatic private branch exchange (PBX);
- automatic telephone devices; and
- cable installations.

DIGITAL PRIVATE BRANCH EXCHANGE

Modern digital branch exchange, with modular concept and flexibility, is to be installed, so that it can be configured to satisfy the various communication needs, enabling simple subsequent expansion and addition of new features.

This modern digital branch exchange can be configured by different combinations of hardware and software modules, such as:

- telephone apparatus without a central operator;
- private branch exchange (PBX) with operator,
- multi PBX used by several special divisions or companies;
- Cordless system (wireless communication)
- ACD (automated call distribution) system;
- combination of the above mentioned configurations.

PBX cabinet shall be equipped with a microscopic panel with a set of addresses and a set for data. The exchange will enable monitoring, time calculation, control (status), recording of errors and logics for managing the bus and bus time options.

The architecture of the entire system is package oriented with IP protocol.

The cabinet shall be supplied with a rectifying unit, with the possibility of back-up power source from rechargeable (“*accu*”) batteries, as well as with the possibility of external powering from 48V DC or 36V AC.

System maintenance can be remote or local. The modem installed on the panel shall be used for remote maintenance. It is directly connected to the commutative field and it does not require a free line circuit inside the system.

Digital PBX system shall be equipped with the following panels:

- PRI/E1 Telekom transmitter

2x30 channels

• Digital extensions	24 per panel x 8
• Tone generator panel	1
• Processor board	1
• Announcement/Message recording panel	1
• Power supply system	1

The system is highly reliable. The system's availability is in the range from 0.99 to 0.99999.

Digital system allows the option of VOICE ANNOUNCEMENT, which removes the load from operator's function. This function is possible with the application of ISDN standards (BRI or PRI transmitters).

Central system management is located on the processor panel, whereas several different panels, with corresponding interfaces, provide connection of the peripheral units (telephones, other telephone branch exchanges, computers, printers etc.) to the system. Regional processors report (upon system start-up) to the central processor on the panels installed inside the system, of their positions and the number of individual lines on every panel which have been equipped.

System tact is generated by the oscillator (frequency 16.384 MHz) which may be synchronised by the main telephone branch exchange (defined as MASTER) by means of a digital telephone transmitter.

During the operation of the branch exchange, continuous control of the synchronisation source is provided, and in case of tact disruption, the system will switch onto a different source.

Standard telephone line occupies two time channels, one for participant A and the other for participant B.

Basic functions of the panel are:

- PCM tact with the option of external adjustment;
- system commutation field with a conference bridge;
- clock with real-time, with battery safety;
- modem for remote maintenance;
- PCM tone generator for signalisation and for 12 – 16 DTMF tones;
- processor surveillance (watchdog) and restarting of the system in case of crash of CP or RP;
- audio-port for on-hold music;
- temperature sensor;
- system crash indicator alarm;
- voltage measurement and control;
- communication bus;
- MPU (Multi Party Unit) - conference bridge;
- TSU (Tone Sender Unit) -tone panel, provides systemic (call control tone, occupied tone) and DTMF tones towards the public network and other equipment.

For the purposes of local system control and maintenance, PC is used which shall be located at the PBX and which has an installed programme for control and maintenance, attached to any port of the system.

Control and maintenance programme enables the following possibilities:

- system programming;
- system configuration in off-line mode;
- erasing and uploading all systemic data;
- reading of alarm reports;

- reading of the hardware and software version of the system.

For the purposes of safety, any intervention, whether it is from a systemic telephone or by means of control and maintenance programme, in the form of systemic programming which requires the highest level of authorisation, must be authorised because it enables alteration of all programmable parameters in the system.

Every irregularity in the system, detected by the central and regional programmes, are transmitted to the central operating system, by means of the warning mechanism, for any type of mistakes: hardware defect, improper device behaviour, blockage of joint system resources, as well as pure programming errors.

Reception of tariff impulses from the public telephone branch exchange, in the event that the exchange is connected digitally (ISDN), is to be delivered directly. Reading of the tariff data is possible both on displays of systemic telephones and on the local printer or on a PC with installed software application.

This PBX has a Direct Inward Dialling – DID function, which enables the user of the public telephone line to dial the desired number and reach the desired local line in the branch exchange, without the need for an intermediary involvement.

Direct dialling is possible to deliver both with analogue and digital line towards the public telephone exchange.

ISDN function (Integrated Services Digital Network) enables transmissions of voice, image and data via the same line.

Music On-Hold – this feature provides the option of playing music or some pre-recorded message to the callers while they wait for an answer.

Abbreviated Number Dialling

This feature provides the possibility of defining numbers of common interest for the majority of local lines as common and to programme their abbreviated dialling.

Call redirecting – group, individual, common

This feature enables a local line in a certain group for call redirecting to answer the call which is directed to another local line within the same group (group redirecting) by means of an access code.

Individual call redirecting is realised from any local line, by dialling the customer number whose call is being redirected and by means of a corresponding code for individual redirecting, after hearing the ‘occupied’ tone.

Common call redirecting is possible from systemic telephones with programmed keys for this purpose. It shall be defined as a fictional number, and all calls directed to it will be signalled to every telephone with a programmed key. The call is answered by simply pressing the programmed key.

Conference

This feature enables the telephone extension to establish conference line by dialling a special code.

The telephone extension which initiates the conference shall be marked as conference initiator and its disconnection will end the conference call.

Intercom

Intercom line represents the possibility of having a two-way “hotline” between two telephone extensions in the system. The call from these extensions shall be realised by pressing the same

key, without answering the telephone.

Message System

This feature allows a telephone extension to leave a message to the other extension (or to a group of extensions), if the other extension is not answering.

There are three kinds of messages that can be left: “Call back” (after reading, the telephone extension which left the message shall be automatically dialled), voice or textual message.

AUTOMATIC TELEPHONE DEVICES

Telephone traffic inside the facility shall be realised by using digital automatic telephone devices.

At the offices of the director, chief, head nurses, heads of services and secretaries, it is planned to install digital automatic telephone devices with multiple lines. These telephones shall allow for the following features:

- to connect several lines;
- interphone functions (hands-free);
- conference call;
- on-hold function;
- dialled numbers memory;
- LCD display for showing the dialled number, time and duration of the conversation;
- function of redialling the last dialled number, microphone switch-off;
- Adjustment of volume of the sound.

In other rooms, single-line devices are to be installed, which are to be plugged to the PBX with a single-pair installation cable.

TELEPHONE CABLE INSTALLATION

Point of main concentration of the integrated cable network shall be inside the IT centre room at the top floor of the Extension. On the II floor and in the basement, termination cabinets at points of high-density of the installation of the integrated cable network are designed. Receptacles are connected to the patch panels of the termination cabinets with FTP cables. Receptacles, which are meant to be telephone-type, shall be connected to the Telco type voice panels by means of patch cables. From the voice panels to the PBX distribution cabinets, multicore TK cables are to be delivered, those being: from the termination cabinets in the basement – installation halogen free cable JH (St) H 80 x 2 x 0.6, from the termination cabinets at the II floor – installation halogen free cable JH (St) H 80 x 2 x 0.6, and from the main termination cabinet in the IT centre to the distribution cabinet - installation halogen free cable JH (St) H 80 x 2 x 0.6.

To connect the PBX and the new telephone installation to the city's telephone grid of Telekom Vranje, it is necessary to deliver an installation halogen free cable JH (St) H 40 x 2 x 0.6 from the telephone distribution cabinet to the existing telephone cabinet on the ground floor of the Internal Medicine Ward.

The vertical ascension of the cables from the basement to the attic shall be delivered by means of two 40 x 40 mm PVC conduits.

Telephone distribution cabinet (TP-Y.01) shall be equipped with 30 disconnecting modules 10 x 2. Because of the integrated telephone network, RJ-45 type receptacles are to be installed. All receptacles shall be connected to the termination cabinets by means of Category 6 [FTP 4 x 2 x 0.5](#) cables.

Installation FTP cables, from the receptacles of the termination cabinet, shall be delivered through PVC conduits and through cable trays. Dimensions of the cable trays are to be 200 x 50 mm and 100 x 50 mm.

Telephone cable installation is to be delivered according to the paths shown in the designs of the floor plans, pursuant to technical conditions and defined standards and rules.

3.4.1.2 INTERPHONE LINE SYSTEM

Inside the operation block and intensive care area, interphone devices are to be installed for voice communication. Table devices are to be used in the offices, and wall devices inside the operation area. Interphone exchanges shall be inside the PBX room and it is to have capacity to connect 48 devices. Cable installations are to be delivered as structured cable network with Category 6 halogen free FTP cables.

INTERPHONE EXCHANGE

Interphone exchange is to be inside the same room as the new PBX, at the top floor of the extended section. Interphone exchange is to be connected to the new digital private branch exchange, in order to exploit the option of integrating the interphone traffic into the telephone traffic.

Interphone exchange should allow for 64 interphone devices to be connected to it, with the possibility of expansion. Apart from voice connectivity, the interphone exchange must provide the following features, as well:

- hands-free conversation;
- loud conversation;
- quiet confidential conversation;
- private call;
- microphone disconnection;
- conference call;
- speed dialling;
- connection to the PBX; and
- connection to the sound system station.

The power shall be supplied to the exchange by means of line voltage of 230 V, AC, but it will also be equipped with its own source of uninterrupted power supply, which is supposed to provide the operation of the interphone system for 8 hours without supply from the line voltage.

INTERPHONE DEVICES

For the majority of the sterile rooms (Class C), apart from voice connectivity, the interphone devices should also enable transmission of alarm signals and alarm warnings.

Interphone devices in the offices are to be table-type, and in the sterile rooms built in wall panels, at the height of 1.5 m from the floor.

In the area of operation blocks and intensive care, interphone devices are to be placed inside the wall panels, which are supposed to provide voice connectivity and notification of dangers.

Wall devices are to be of medical-type, purposefully made for sterile rooms and suitable for maintenance of cleanliness in the room.

Interphone lines provide voice communication between participants of the interphone traffic, but also enable voice communication to be realised between a user of interphone device and a user of the telephone system.

Interphone devices are to be placed inside the operation rooms, at the doctors' office, at the anaesthesiologist's office, inside the intensive care room, inside the autopsy room, with the head nurse and on-duty nurses.

Interphone devices enable the voice communication to be realised even from the distance of up to 5 meters.

Interphone devices shall be connected to the exchange by means of RJ-45 receptacles and integrated cable network.

INTERPHONE CABLE INSTALLATIONS

Interphone installation is to consist of installation receptacles and installation cables.

The interphone devices shall be connected to the exchange by means of integrated cable network.

The point of main concentration of the integrated cable network shall be located in the IT centre room at the top floor of the Extension. Termination cabinets for installation of the integrated cable network are to be installed on the II floor and in the basement. Receptacles shall be connected to the termination cabinets, onto the patch panels, by means of FTP cables. Receptacles, which are supposed to be telephone-type receptacles, shall be connected to Telco-type voice panels by means of patch cables. From the voice panels to the PBX distribution cabinets, multicore TK cables are to be delivered, which shall connect the telephone and interphone installation with the interphone exchange and PBX. Installation halogen free cables are to be delivered from the termination cabinets to the telephone distribution cabinet, those being: from the termination cabinets in the basement – installation halogen free cable JH (St) H 80 x 2 x 0.6, from the termination cabinets on the II floor – installation halogen free cable JH (St) H 80 x 2 x 0.6, and from the main termination cabinets in the IT centre to the telephone distribution cabinet - installation halogen free cable JH (St) H 80 x 2 x 0.6.

Because of the integrated telephone network, RJ-45 type receptacles are to be installed. All receptacles shall be connected to the termination cabinets by means of Category 6 [FTP 4 x 2 x 0.5](#) cables.

Installation halogen free FTP cables, from the receptacles of the termination cabinet, shall be delivered through PVC conduits and through cable trays. Dimensions of the cable trays are to be 200 x 50 mm and 100 x 50 mm.

Telephone cable installation is to be delivered according to the paths shown in the designs of the floor plans, pursuant to technical conditions and defined standards and rules.

Interphone cable installation is to be delivered according to the paths shown in the designs of the floor plans and pursuant to technical conditions and defined standards and rules.

Cable installation shall be delivered by means of Category 6 halogen free FTP cables and telephone receptacles which are to be type RJ-45.

All cables shall be laid in the facility across cable trays or through f 16 mm PVC installation conduits, the same as with the telephone installation.

3.4.1.3 COMPUTER NETWORK

Local computer network should be equipped with a server, communications equipment, necessary number of points of concentration of installation (main and secondary termination cabinets) and cable installation by means of halogen free FTP cables of minimum Category 6. All cables should end in terminal connectors – patch panels. The main termination cabinet shall be placed in the administrative section of the facility. The network will be able to connect to the networks in other facilities.

Local computer network should provide interconnection between the working stations (PCs), connection to the networks in other centres (Niš and Belgrade) and with the internet network. For every working station in the facility, one receptacle is planned (RJ-45).

Local computer network shall consist of two parts: the active devices and passive network.

The active part of the computer network will consist of: servers, switches (of suitable capacity) 10/100 autosense, media converters, 100 TX to 100 FX (SC), optical terminal boxes, optical cable distribution line and optical patch distribution cable line.

The main design for the computer network is made in accordance with the domestic and global standards in the area of telecommunication and computer communications.

Two server devices are planned: one web server, which is to be used for internet connections, and one file server, which shall be used for the business network.

Connection to the internet communication server shall be delivered by means of a ROUTER device. This way, access to the business network from the internet shall be protected.

Communication devices shall be installed inside the termination cabinet. Managed switch is the main switch for this group of communication devices. Server configuration, as well as configurations of the working stations, primarily depend on the selected network operating system, as well as on requirements which the applicative part of the information system may bring about. In any case, the servers must be computers with outstanding performances: processor with substantial processing power, disk (or disks) with large capacity, with short access time and RAM of large capacity.

The main concentration box shall be equipped with patch panels and communication devices (switchers). Server and the main concentration box shall be located inside the IT centre room at the top floor of the Extension. UPS power supply is provided for the server, and it can supply the server with power for one hour without power from the network.

The passive part of the network (horizontal distribution line) includes computer receptacles, cable distribution line and the main termination – distribution cabinet. The distribution box is planned to be installed inside a self-standing cabinet which will also have space for the active equipment part (switches).

Integrated telephone-computer network will enable flexible changes in the type of connectors depending on future changes of the purpose of the rooms or changes to the number of connectors. This solution provides a possibility to make these changes through interventions on the distribution box, by means of patch cables, without any intervention inside the rooms or along cable lines.

COMPUTER NETWORK DEVICES

The equipment necessary for delivery of the local computer network consists of:

- Network servers and working stations;
- 24 port 10/100 *switch*, managed, and
- 24 port 10/100 switches, and
- Network adapters (cards).

Powering of the communication equipment shall be delivered by means of corresponding switches inside the rack cabinet. Since the functioning of the network equipment is necessary in case of electricity outage, the design includes continues power supply to the communication devices by means of uninterruptible power supply (UPS) devices.

IT centre of the Health Centre Vranje shall decide on the configuration of the local computer network, the servers and communication devices, user programmes and manufacturers of these devices. For that reason, this design shall deal with the solution for the passive portion of the computer network.

In this design, a possible solution for this network is offered.

The network shall have a File server, Mail server and a Firewall.

File server: Storage Server/ 3.0 GHz, 800MHz, 2Mb L2/ 512Mb RAM/ 4x250GB 7.2k S-ATA, S/RAID 7t, CD-ROM 48x/20x, 530W p/s, Tower, 3.0Ghz/800Mhz/2Mb L2 cache, processor,

512Mb PC2-3200 ECC DDR2 non chip kill SDRAM RDIMM and Express 1Gb (2x512Mb) PC2-3200 CL3 ECC DDR2 non chip kill SDRAM.

Mail server: Storage Server/ 3.0 GHz, 800MHz, 2Mb L2/ 512Mb RAM/ 4x250GB 7.2k S-ATA, S/RAID 7t, CD-ROM 48x/20x, 530W p/s, Tower and Express 1Gb (2x512Mb) PC2-3200 CL3 ECC DDR2 non chip kill SDRAM.

Firewall: PIX 515E.

This solution offers a possibility of creating a standard DMZ zone and of defining complex Access lists and filtration rules. Special convenience is the possibility of creating VPN tunnels by means of contemporary algorithms.

PASSIVE PART OF THE COMPUTER NETWORK

Passive part of the computer network (horizontal distribution line) includes computer receptacles, cable line and concentration – distribution boxes.

MAIN DISTRIBUTION BOX

Main distribution cabinet - distribution box is an enclosure which will also house space for the active equipment part.

All cables of the integrated telephone - computer network in the facilities of the complex shall end at terminal connectors of the corresponding distribution boxes – patch panels.

The box shall be equipped with:

- patch panels;
- communication device (switch);
- media converter;
- optical termination box;
- powering unit;
- cooling unit;
- rack cabinet.

Rack cabinets should be of standard width 19'', suitable height and depth of at least 600 mm, and on the front side they need to have two perforated vertical rails for mounting of devices and equipment. Distance between the rails' axes should be 466 mm, whereas the distance between the closer edges should be 450 mm, and the distance between the further vertical edges should be 482 mm or more. The front side of the enclosures should be sealed with glass door with a lock. The lateral sides should be removable, to enable access to the installed elements. The cabinet must have ventilation openings on the upper or bottom side (air suction and discharge).

All the enclosures must be grounded, by connecting them to the safety grounding system of the corresponding facility. All metal parts of the installed equipment inside the enclosure must be connected to a chassis, for the purpose of equipotential bonding. This connection is to be done by means of P/F-Y 1 x 2.5 mm² cable.

Connecting cables and patch cables inside the cabinet need to be delivered through panels with cable guides. Patching of devices and equipment inside the box shall be done by means of patch and transfer cables FTP – PATCH cables.

Bendable FTP cables for patching sockets inside the rack cabinet (Patch Cord Cable) shall be approximately 1 m long. Bendable (patch) FTP cables, which are to be used for connecting working stations – computers at the working space, shall be delivered in lengths of 3 m to 5 m.

Termination of Category 6 FTP cables must be made by means of special tools and according to the procedure defined by the EIA 568 standard. Both ends of the cable must terminate at moulded RJ-45

connectors.

RJ-45 RECEPTACLES

Fixed FTP cables of the horizontal installation are to end at RJ-45 receptacles. These receptacles must meet the standard requirements relating to Category 6. Inside the rack cabinets, modular receptacles RJ-45, which are used for mounting onto the cable guide, are to be installed. All eight conductors of the FTP cable must be at both ends connected to IDC connectors, which are located in RJ-45 receptacles. The connection is to be performed by means of special tools and by applying the procedure of impressing – crimping. The procedure of joining and the sequence of pins are defined by EIA / TIA 568 standard.

While connecting the RJ-45 receptacle, ends of the cable are allowed to be laid at maximum length of 13 mm. Upon mounting and connecting all the receptacles, it is necessary to perform a testing of every line per sequence of pins and per Category 6 criteria. Should it be established that there is at least one element that does not meet the set requirements, it must be recalibrated to fit the required values, and the entire testing procedure needs to be repeated.

FIXED FTP CABLES

Halogen free Category 6 FTP cables are to be used for the cable distribution line.

If the FTP cables need to be laid parallel with the electricity power cables with voltage range of 220 V / 380 V, then the EIA / TIA – 569 standard should be abided by. This standard, among other requirements, predicts minimum permitted distance between telecommunication cables and power cables, which do not come with screen – shield, with voltage range of up to 480 V, and power of up to 5 kVA, permitted distance to the TK cable is 6 inches (152 mm), if the power cables are inside metal tubes. According to this standard, the distance between TK cables and fluorescent tubes must be 12 inches (305 mm), and the distance from the electrical motors is at least 1020 mm.

If there is a need to crossover the TK cable and the power cable, it needs to be done at a 90° degrees angle, or by placing an insulation pellet of at least 3 mm of thickness.

If at any portion of the cable line, the TK cable is required to be delivered parallel with the heating and water pipes, then the minimum distance between them must be at least 50 mm. If the TK cable is required to be crossed over with the heating and water pipes, then it needs to be done with the minimum distance of 30 mm. If such distance is impossible to provide, then a heating insulator with minimum thickness of 10 mm needs to be placed.

Upon parallel delivery and crossover of the TK cables and the heating and water pipelines, TK cables need to be placed above/on top.

Upon delivery of TK cables (FTP type), it is necessary to meet the requirement that stipulates that the cables must not be exposed to stress that exceeds 110 N, and that the cables are not permitted to be twisted, rolled or squeezed – pressed. Minimum bending diameter for FTP cables may be 4 (four) times greater than the cable's external diameter.

All elements included in the computer network need to meet the requirements of Category 6 standard, i.e. all the works, starting from the design to the finishing works, need to be in accordance with the following standards: ISO/IEC IS 11801; ANSI/TIA/EIA-568; IEC-603-7; EN-50173; EN-55022; IEC 332-1/UL 1581 VW-1; TIA/EIA TSB-67; DIN 44312-X.

EQUIPMENT, MATERIALS AND DELIVERY OF WORKS ON TELECOMMUNICATIONS INSTALLATIONS

GENERAL CONDITIONS

All the works need to be performed in absolute accordance with the design and these conditions which form an integral part of the design, as well as in accordance with the regulations which may be applicable to this type of installation.

The facility needs to be constructed according to the approved design. If a justifiable need for smaller deviations from the design should arise during the construction, for any such deviation the Contractor shall acquire written approval from the supervisor of the Investor, who will, if necessary, present the deviation to the designer and seek his/her consent.

The approval of major deviations from the approved design which disrupt the essence of the technical solution, the designer who created this design shall be deemed competent.

To approve major deviations from the approved design which significantly change the plan or proforma invoice or significantly disrupt the contractual obligations of the Contractor, the Investor shall be deemed competent.

Works on the project may commence only after obtaining a construction permit from the competent body, after providing equipment, transport, protection and after registering the construction site to the competent body that authorised the construction.

Before the possession of site, the work manager and the Investor's supervisor shall verify the alignment of the design with the on-site situation.

The materials installed must be completely in accordance with the valid regulations, technical conditions and standards. Upon delivery of materials to the construction site, the work manager shall revise the material and record its condition in the construction logbook. If the Contractor used material which is subsequently determined as unsuitable, upon the request of the supervisor such material must be removed and replaced by another which meets the requirements.

Apart from the materials, the work also needs to be properly done. The Contractor shall compensate, at its own expense, anything that might prove to be done improperly during and after the delivery of works.

While delivering the works, attention must be paid to coordinate the works with other contractors, as well as to cause minimum damage to the already delivered, i.e. existing installations.

Any waste or litter that might result from the delivery of works, the Contractor shall remove from the construction site. The place for waste disposal shall be determined by the investor

Integration with the existing devices and installations, as well as drilling and chiselling of reinforced concrete constructions, are to be performed solely with written consent from the supervisory body.

The work manager shall keep a construction logbook and measurement book, and to introduce a construction inspection book.

Upon completing all the works, the Contractor shall perform a test of the installation pursuant to existing rules. The results obtained by this evaluation must meet the requirements.

Should the installation prove to be faulty during inspection, the Contractor shall correct the malfunctions at its own expense.

The installation may be repossessed from the Contractor only after all the works have been completed and the technical validity of the installation inspected.

After completing the works, the Contractor's organisation shall draft test logs and technical documents of the as-built facility, and it shall submit the first copies of these documents to the Investor.

In agreement with the Contractor, the Investor shall define a warranty period for this installation.

The warranty period must not be shorter than one year, starting from the day of technical acceptance of all the installation by the user. During this period, the Contractor shall remove any malfunction and flaws on the installation which arise from improperly done work or poor quality of materials, with no right to any compensation or delay.

TELECOMMUNICATIONS DEVICES

All devices are to be placed according to the layout drawings in this design. Any potential change must be made only after obtaining written consent from the supervisory body. Before the

commencement of works, the Contractor shall mark the locations for placement of devices, distribution cabinets, distribution boxes and lines.

Details for attaching the devices to the wall or onto the corresponding carriers shall be defined in the documents of the equipment provider.

After attachment, levelling and wiring of the cabinets for housing of devices, the equipment is to be installed, which, for the purpose of transport, was specially packed in absolute accordance with the manufacturer's documents.

Installation of fire alarm devices, break-in alarm, access control and gas detection system is to be delivered by means of telephone cables with PVC insulation, aluminium foil inside the sheath and copper conductors with 0.8 mm diameter.

All cables and conductors are to be delivered as projected in this design, it being:

- along the wall or ceiling on plastic cable spacer clips inside a lowered ceiling;
- inside the wall in plastic installation tubes;
- through cable trays (on parts of the line where there are more than three cables);
- along the wall inside PVC conduits – trunkings.

If the installation cables are placed in tubes, no more than two cables may be placed inside a tube of $f = 16$ mm.

While placing cables, it is necessary to keep in mind the following technical conditions:

1. the necessary cable is to be cut only when the actual length of the segment is defined on the spot;
2. before installation, inspect every piece of cable;
3. cables are to be attached according to the schematics provided in the attachments;
4. avoid placing the cables immediately next to the power lines;
5. pay attention to specific connections of cables and connectors at the terminals of the segment parts;
6. if the walls need to be drilled to introduce the cables, bendable plastic hose is mandatory during cable placement;
7. during installation, avoid major bending of the cable (minimum diameter of the curve 3 cm);
8. mark the cables properly; and
9. Upon completing the placement of cables, inspect the placed cables and draft an as-built design with exact paths and lengths of the used cable.

All the tubes and distribution boxes used at sections of the installation which are delivered inside the tubes must be made of insulation material. The interior diameter of the tube must match the diameter and number of cables which are inserted into the tubes, and according to Serbian regulations. The pipes which are placed along the walls and ceiling must be laid under the final layer of the coating on the walls.

Tubes need to be laid so that there is not a single spot between two distribution boxes where condensed water might accumulate.

With horizontal lines, the tubes between two distribution boxes need to be softly arched, with the top of the arch facing upwards and the ends facing downwards, towards the distribution boxes.

TK and EE cables are to be laid parallel with minimum distance of 20 cm. When it comes to horizontal lines, EE cables are to be laid at 30 cm from the ceiling, cables for signalisation and other installations are to be laid at 10 cm above them, and 10 cm above these cables, telephone cables are to be delivered.

Distribution boxes at such cables are to be placed, as a rule, one facing the other under the angle of 45°. upon parallel delivery of hard pipes, the spacing between certain types of installation must be at

least 5 cm.

Crossover of cables of TK installations with EE cables is to be avoided. At crossover spots, which are to be laid under the angle of 90°, the distance between the two types of cables must be 10 mm, and if this is not possible, a 3 mm thick insulation pellet is to be placed.

Guidance of cables through the pipes is to be performed after final works on the walls.

Upon laying down the cables, it is necessary to make sure the cables do not get damaged. At spots where the cables change direction, soft curves are required whose radius must be at least 15 times wider than the cable diameter.

Installation cables for signalisation are to be laid continuously from one detector to another. The detectors must be in a single line – no branching is allowed. At spots where the bases of the detectors are, cables with minimum length of 30 cm are to be delivered.

All metal parts of the telecommunication devices, distribution cabinets, distributors and cable trays must be grounded with stranded copper conductor and connected to the grounding system of the facility.

At the outlets for connection of the devices, sufficient lengths are to be provided so that the devices may be placed at the defined positions.

Outlets for manual fire alarms are at 1.5 m from the floor.

Outlets for alarm sirens are placed at 2.5 m from the floor.

All distribution cabinets are placed on the wall, at 1.5 m from the floor.

In the rooms where there is moisture or dust, a TK device and apparatus are to be installed with proper IP protection.

Upon placement of fire detectors, it is necessary to pay attention to the following:

Distance between the detector and the walls and the stored goods must be at least 0.5 m, except in the hallways, passages or similar parts of the facility whose width is less than 1 m.

If there are beams or air flow ducts below the ceiling at a distance which is smaller than 0.15 m, then the lateral distance between the detectors must be at least 0.5 m. The stored goods or shelves whose distance from the ceiling is less than 30 cm prevent the spread of smoke, so these must be treated as compartments (walls).

Part of the roof which is connected to the room, and whose surface exceeds 10% of the total surface of the given room's ceiling, must be treated as a separate room.

Perforated ceiling which provides ventilation must be closed off around the detectors at a minimum surface of 1 m².

Fire alarm system must be functional even when the ventilation is on. With respect to the system for supplying rooms with air, the following shall apply:

- (smoke and heat) detectors must not be placed in the way of the fresh air current from the system for air-conditioning and ventilation;
- if the air current is supplied from a lateral wall through bars, the detector must be at least 1.5 m apart from such a ventilation duct;
- if the air ducts are on the ceiling, the detectors are to be placed symmetrically between the ducts.

With respect to the system for suction of air from a room, the following rules shall apply:

- if the air ducts are on the ceiling, detectors should not be placed in front of the duct, but in the turbulence zone;
- if the air duct is on the wall immediately below the ceiling, detectors are to be placed in front of the ducts.

At least one detector on the stairway is to be placed on the ceiling of the top floor. Of some of the floors are separated from the top floor with doors, the detector is to be placed on the ceiling in front of the door. At a stairway which is higher than 12 m and does not have vertical compartments, additional detectors must be placed at least of every third floor or at every sixth landing.

Inside the hallways whose width is less than 3 m, maximum permitted distance between the smoke detectors is 15 m, and between heat detectors is 10 m. On the cross-sections of the hallways, at least one detector is mandatory.

Upon completing the mounting of the cables, it is necessary to mark the cables by means of metal rings and inspect the pairing of cords. It is also necessary to verify if the insulation resistance meets the following requirements:

- insulation resistance a/b must not be lower than the minimum value of 10 M ohm/km,
- insulation resistance a/z must not be lower than the minimum value of 10 M ohm/km.
- All results of the inspection must be in accordance with PTT regulations for these types of cables.

MOUNTING AND COMMISSIONING OF THE DEVICES

Before commissioning of the devices, all distribution cabinets must be grounded. Ground resistance value must be measured and delivered along with the documents for technical acceptance.

Cables are to be connected in absolute accordance with this design and documents from the equipment manufacturer – without switching on the devices.

Before commissioning the devices, the device users must be trained. All device providers must deliver to the Investor the documents for proper operation and maintenance.

Equipment is to be commissioned solely in the presence of the supervisory body. After inspection of the installed equipment and delivered connections, the power supply shall be delivered and the devices shall be switched on.

Programme for final calibration and testing of the devices and equipment shall be defined by the supervisory body, and those need to be in accordance with PTT regulations for the given devices.

TECHNICAL REQUIREMENTS FOR EXECUTION OF ELECTRIC POWER DRIVE STATION INSTALLATION

All electrical installations are to be carried out using cables type and cross-section of which are indicated in the drawings in the BoQ.

Before installing the cables the Contractor is obliged to carry out all the necessary preliminary works.

The cables must be laid horizontally and vertically. Slanting laying is not allowed.

Cables are to be cut and laid only when at the site the exact points of connections to electrical devices, as well as their routes and lengths are determined.

The cable must not be laid at temperatures below -50C. In the event that laying must be done without delay, the cable must be pre-heated for at least 24 hours in a room where the temperature is +5⁰C.

Intersection of telecommunication and signal cables with power cables must be carried out at a right angle, at a distance of at least 0.5m (for cable above 250V) and in the parallel conducting they must be distanced at least 10cm.

If it is possible to achieve a distance of 0.5m then the cables at the intersecting point must be fed into the protective tube length of 2 to 3m. In this case, the distance must not be less than 0,3m.

Coupling and uncoupling of the conductors may only be carried out in a distribution box "veko" using terminals or by soldering connections and wrapping with insulating tape.
Spacer clips for fastening electrical lines are to be set at each 30-40cm length.
Sealing points (feedthroughs) should be carefully carried out taking into account the bending radius of the cable and mechanical stress on the inlet.
Protective pipes for laying cables must be protected against rust, burns, and roughness and painted with certain anti-corrosive coating.

Bending radius of protective pipes must not be less than 15 pipe diameters. It is recommended that fixing pipes is done using clamps with screws.

The protective pipe must be placed so as to prevent the formation of points where water could collect.

Final joints of protective pipes with devices in operation are to be performed using flexible pipes so as to form a continuous mechanical unit and not to leave even one unprotected portion of the cable. All cables which are laid vertically on the wall or structure are to be protected using floor metal pipe up to height of 2,5m.

Passage of all cables through walls is to be carried out through pipes (with feedthroughs), or if the pipes are made of steel, they should be rounded at the ends, and after feeding the cables glue or putty is to be used for closing the cables.

Installing the equipment and protective measures

The Contractor is obliged to ensure that no device or piece of equipment is installed so that it interferes with the subsequent installation of other equipment.

All prefabricated elements that are not protected against corrosion must be cleaned of rust and coated with protective coating that meets the requirements of the environment.

When performing electrical installations the contractor is required to conduct protection against indirect contact with power supply system type TN-S fully in accordance with SRPS standards and applicable regulations.

All exposed conductive parts of the installation must be connected to a grounded point of system using the protective conductor.

Protective conductors must be grounded close to matching transformers and generators.

Metal structure of each cabinet or panel should be connected with proper joint with the protective bus and with the corresponding point of common grounding installations.

Panel or cabinet which is structurally composed of several parts (fields) must have proper galvanic compounds between those parts, so that it represents one galvanic unit.

Galvanic connection for movable parts (doors) must be made of flexible copper braids.

Upon completion of works, touch voltage measurements must be performed on the facility as well as the verification of the effectiveness of measures of the equalizing and protection against indirect contact. The measurement results must be in accordance with applicable standards and IEC regulations.

Performing measurements and formation of certificates may be entrusted only to such company, which is registered for this kind of works, which will be proven by enclosing the Act on registration in the attest composition.

Performing measurements and formation of certificates is to be performed in full compliance with the laws, regulations and recommendations in the domain of Electrical distribution system.

In the event that for any reason the expected values are not obtained, consult the Supervising Engineer, who is required to attend the measurements.

The designer is obliged to offer solution proposal, if this happens.

3.5 TECHNICAL SPECIFICATION

Installation for the power supply of HVAC and hydrotechnical consumers

Introduction

The subject of the design documentation is reconstruction of the Health Centre complex in Vranje. A 3 phase reconstruction is foreseen, while this main design includes only phase 1. Phase 1 includes:

- basement, second and fourth floor of the new building (annex) – surgical ward
- interventions in the existing boiler room in the internal medicine ward facility and the existing heating substation in the gynecology ward facility
- medical gases central facility,

while phases 2 and 3 shall include other floors of the new building, as well as some of the other facilities (systems) within the HC Vranje (for the scope of the reconstruction of the HC Vranje in phases 2 and 3, see the preliminary design).

The following volumes are foreseen in the electrical engineering design:

VOLUME 1	Transformer station
VOLUME 2	External electrical installations
VOLUME 3	Diesel-generator station 250kVA
VOLUME 4	Electric power systems
VOLUME 5	Installation for the power supply of the HVAC system consumers and Building Management System
VOLUME 6	Telecommunication connections
VOLUME 7	Technical security systems

This part of the electrical engineering design (volume mp III 5) includes installation for power supply of consumers of the heating, ventilation and air conditioning systems and installation of automatics of their operation for phase 1. The building management system has modular character, so that it can be easily expanded according to the needs of phases 2 and 3.

As a basis for this design, the following has been used:

- Terms of Reference
- Architectural-construction design
- Mechanical installations design
- Hydro-technical installations design
- FF study.

Electrical installations in this design comply with other volumes (parts) of the electrical engineering design. During the design, the phase character of the complex reconstruction has been considered.

Installation for the power supply of the HVAC system consumers

Distribution cabinets for power supply of the HVAC system consumer shall have the following characteristics:

- type-tested, according to standard IEC 60947

- assembled from prefabricated elements
- free standing or hanging, wall mounted, with door with a key
- 3-separation form (separate compartments for incoming units, busbar and outgoing units)
- protection level min. IP54
- painted in the appropriate RAL, according to the request of the Investor
- minimum 10% of spare space inside the outgoing units compartment.

For power supply of the HVAC system consumers, the following is foreseen:

- in the technical area in the basement of the new building (annex), distribution boards =HGVKTPM and =HGVKTPD
- in the existing boiler room on the ground floor of the internal medicine ward facility, distribution board =HGVKKD
- in the existing heating substation on the ground floor of the gynecology ward facility, distribution board =HGVKTPGD
- in the technical area on the fourth floor of the new building (annex), distribution boards =HGVKM1, =HGVKD1, =HGVKO1

Distribution boards with the suffix D shall be supplied through diesel generator, while those with the suffix M shall be supplied exclusively through the network.

Block diagram of the power supply of these boards is shown in Figure 5 mp III 5-EEN-01.2.

On the incoming unit to distribution boards =HGVKD1 and =HGVKTPD surge arresters shall be installed as overvoltage protection, which meets the requirements of protection level B and C. They will protect against overvoltage both the mentioned distribution boards and automation cabinets OAD1 and OATP, which are powered from them. All lines to distribution boards are equipped with circuit-breaker switchgear, while distribution boards =HGVKD1, =HGVKTPD, =HGVKTPM, =HGVKTPGD and =HGVKKD also have a relay for detecting the presence and phase sequence, as well as signalization of the presence of voltage on buses.

Equipping of outgoing units in distribution boards is designed according to the type of the chosen HVAC, i.e. hydrotechnical consumer, so that:

- outgoing units for direct power supply of all fans are equipped with motor powered protection switch (with shortcircuit and overcurrent member) and contactor
- outgoing units for power supply of local extractor fans for digesters which will be switched on/off via motor powered protection switch, located next to the digester (so called DEN switches), equipped with MCB (Miniature Circuit Breaker), i.e. installation switch and contactor on the outgoing unit; each switch shall have 1 NO auxiliary contact for signalization of protection response and 1 NO auxiliary contact for signalization of the switch status (open/closed)
- outgoing units for power supply of all fans controlled by frequency converters, equipped with a motor powered protective switch (with shortcircuit member) and contactor; frequency converters are designed with a filter to prevent network soiling with higher harmonics upstream from them and they shall have a built-in EMC protection
- outgoing units for power supply of circulation pumps, equipped with appropriate protective motor powered circuit-breaker (with short-circuit and overload member) and contactor; TP pumps, strength 7.5kW and 11kW shall be supplied with standard module with incorporated overload protection of the pump motor
- outgoing units for power supply of electric steam humidifiers and electric chamber reheaters, equipped with a MCB (Miniature Circuit Breaker), i.e. installation switch and contactor on the outgoing unit; each switch shall have 1 NO auxiliary contact for

signalization of protection response and 1 NO auxiliary contact for signalization of the switch status (open/closed)

- outgoing units for power supply of the split system, equipped with a MCB (Miniature Circuit Breaker), i.e. installation switch
- outgoing units for power supply of the fan-coil, equipped with a MCB (Miniature Circuit Breaker), i.e. Installation switch and contactor. Power supply of the fan-coil is provided from the lighting distribution boards and general purpose sockets, and it is included in the volume mp III 4.

Equipment in the distribution boards has been selected in accordance with requirements for coordination type 2.

In the distribution board =HGVKD1, which will include frequency converters, system of forced ventilation of the same is foreseen. 2. All the responsibility for the adequacy of the ventilation choice is borne by the supplier. The ventilation system must be installed in such a way that the temperature in the distribution board is within the permitted limits required by the equipment, and the required level of the distribution board IP 54 should not be disturbed.

Installation for power supply of HVAC and hydrotechnical consumers, which are not regulated by frequency converters, is designed with power copper cables, type NHXHX-J with appropriate cross-section.

Due to occurrence of higher harmonics in the cables that connect frequency controllers and engines of certain fans, according to the manufacturer's recommendations, cables type N2XCH-J are foreseen with halogen free insulation (netting of galvanized round steel wires which make an electromagnetic shield and prevent the impact of higher harmonics and radio disturbances of the surrounding electrical and electronic equipment). Given that the frequency converters are designed with a filter which eliminates the higher harmonics, generated by the controller to the network, it is not necessary to foresee such cables from the frequency controller further to the transformer station.

In the existing boiler room, in addition to interventions on two pump systems (for the primary hot water and electric boiler), the reconnection of the boiler burner power supply is foreseen, so that they are supplied through the diesel-electric generator (via distribution board =HKD, which is not the subject of this design). With this measure, by the means of power supply of other consumers responsible for heating of the new facility (surgical ward) from the reserve source of electric power, the requirement in the mechanical part of the design has been met – that heating of the facility remains in operation in case of failure of the supply from the network. This applies especially to the parts of the facility that do not have radiator heating (operating rooms on the second floor and the pathology ward in the basement).

Note: during the switch to the power supply mode through diesel-generators, air chambers will retain all functions except air humidification in winter and cooling in summer.

Most of the hydrotechnical consumers are supplied as set units with their own automatics. These consumer are:

- 2 sanitary water heaters for hot water
- Substation for increasing the hydrant water pressure
- Substation for increasing the process water pressure
- Substation for increasing the demi water pressure

They will be power supplied directly from the main distribution boards or from the transformer station. Since some of them are part of the facility security systems, all conditions for their smooth operation in emergency mode shall be met (fire, failure of mains voltage, etc.). Power supply of all the above mentioned consumers and providing the above mentioned working

conditions are subject of volume mp III 4. This volume includes only recirculation pumps for sanitary hot water, which are independent of the water heater operation.

Drains heating system in the new facility and pipe heating system for the firefighting water are included in the volume mp III 4.

In the central medical gases facility, there will be 4 stations for the production of medical gases. Those are:

- oxygen station
- compressed air station
- vacuum station
- nitrous oxide station.

These stations are supplied together with their distribution boards which are used for power supply and management thereof. Power supply from the mentioned distribution boards shall be provided from the newly designed distribution board =HMED, which is subject of the volume mp III 4. On each floor in which medical gases are used, that are produced in the medical gases central facility, there will be devices for signalization of their status and alarm signaling in the event of reduced/increased pressure. Their power supply is processed in the power supply design of technological consumers (volume mp III 4). This design specifies the control-signal cable connections between the said medical gases distribution boards and BMS and these distribution boards and local alarm-status panels.

For a detailed specification of HVAC and hydrotechnical systems in the new facility and the scope of the reconstruction of the existing ones in the gynecology ward and internal medicine ward (within phase 1 of reconstruction of the HC Vranje) see volumes mp II and mp IV.

Building Management System

This main electrical engineering design foresees the Building Management System for the new building (annex) of the HC Vranje and the central facility for medical gases.

Design solutions have been made based on the following:

- Terms of Reference
- Mechanical design and documentation
- Hydro-technical design and documentation
- Telecommunication installations design
- Architectural-construction design
- Firefighting study.

Supervisory and management system includes the supervision and management, and measuring and controlling functions for the following systems and units:

- HVAC systems (heating, ventilation and air conditioning systems, hot water preparation, cold water preparation)
- hydro-technical systems
- system for producing medical gases (supervision only)
- fire protection (supervision only)
- elevators, UPS units, IT system, diesel generator (supervision only).

The design envisages the following:

- text documents
- graphics and drawings, except for operation diagrams for PLCs.

After contracting and delivery of complete HVAC, hydro-technical and electrical equipment and machinery, it is necessary to make adjustments and if needed, adjust the design solutions to the delivered equipment.

Note: Terms microprocessor substation, controller and PLC are used in the text, which represent the same item.

PURPOSE AND FUNCTION OF THE BMS

The design solution shall represent the future Building Management System of the facility.

Organization of the future BMS will be based on the principle of a distributed system of microprocessor substations. The envisaged concept enables flexible expansion of the BMS in future reconstruction phases of the HC Vranje (phases 2 and 3).

Each microprocessor substation (MPS) will supervise and manage the operation of a specific set of technical facilities and systems via corresponding input-output modules, managed by microprocessor unit and corresponding software on the substation level. This way, the substations execute the functions of the programmable logic control and direct digital control (PLC and DDC).

On the fourth floor (the attic) of the surgical ward (new facility – annex), in room no. 13, a control (dispatching) center (OWS – Operator Working Station) will be located, in which the systematization and processing of all the data collected on individual systems treated by the BMS will be performed. In the future centre, the following will be provided:

- systematization and processing of this information,
- display of desired values,
- based on the processed data, issuing of appropriate management instructions which are sent to individual installations/systems.

Software in the central computer will provide a variety of man-machine communication possibilities, which are realized by using the keyboard/mouse, monitor and printer.

Introduction of the automation and dispatching systems will enable monitoring and management from one central place.

The functioning of the central system can be globally divided into several types of operations and procedures:

BASIC FUNCTIONS:

- Monitoring and control of operating signals and failure signals (status and alarms)
- Categorization of signals in the event of failures and alarms
- Issuance of digital and analog commands in the function of time and event
- Delays and deletion of individual alarms
- Programmable management of appropriate points (analog measurements of temperature, pressure, etc.) and their regulation
- Consumption optimization of all types of energy

OPERATOR FUNCTIONS:

- Address selection via functional keyboard

- Entering and modification of user parameters by using appropriate communication dialogue
- System connection with user programs
- Entering and modification of parameters and displaying them in relation to system safety
- Issuing commands for connection and disconnection
- All manipulations of program records or database
- Issuing periodic reports on performance of individual systems based on historical data in the central computer

INDICATOR FUNCTIONS:

- Occurrence of failures, alarms, depending on the nature and location
- Accompanying text on a printer or monitor with complete diagrams of parts of installations in which an alarm has occurred

RECORDING FUNCTIONS:

- Events or changes of conditions, received from the peripheral devices (transmitters/sensors)
- Interventions such as time, priority changes or corrections

SYSTEM OPERATION MONITORING FUNCTION:

- Monitoring the working condition of the control center and substations hardware
- Monitoring of data transfer (transmission line)
- Provision of information in the event of mains voltage failure.

CONFIGURATION OF THE BUILDING MANAGEMENT SYSTEM

In order to fulfill all the requirements and functions of monitoring, management, measurement and control, the building management system is designed, based on programmable logic controllers – intelligent microprocessor substations which perform independently the functions of the programmable logic control (PLC) and direct digital control (DDC).

A modular type system is envisaged, and it allows easy expansion and communication with other systems, while retaining all the features of the existing system.

The central supervisory and management system can generally be divided into three technical parts:

- The first part consists of a central processing computer with accompanying peripheral equipment and system controller, which together form the command-control center or the operator working station.
- The second part consists of microprocessor substation or PLCs (Programmable Logical Controller) for managing the respective installations, with the necessary wiring of sensors, converters and engine starters.
- The third part consists of the primary transmission network (BUS) for the realization of communication of the central computer with substations and between the substations, and the secondary transmission network for communication between the equipment in the field and PLCs.

In the respective facility, all three parts of the building management system have been

provided.

Block diagram of the BMS is shown in Figure mp III 5-EAU-03.1.

Depending on the requirements of the centralized supervision and management system, each of the described parts requires an appropriate hardware and software.

The Building Management System shall consist of the following functional parts:

- primary equipment in the field - facility
- microprocessor substations, in automation cabinets
- elements for manual control, in automation cabinets, and if necessary, dislocated from the same to the location of the equipment, which is controlled
- cables and cable accessories for interconnection and communication of all elements of the building management system
- operator working station (OWS).

MANAGEMENT LEVELS

The building management system shall be hierarchically organized in three levels, each with a different level of automation:

- **FIRST**, the lowest level of management allows the manual control of the respective systems, individually for each consumer (fan and pump engines, ON/OFF and continuous louver and valve drives, etc.). This level of management is designed only for the test - repair operation mode. Manual management functions are achieved by using levers on the I/O microprocessor substation modules. The lever status is transferred to the microprocessor substations, based on which the operation mode of the entire HVAC system is changed.
- **SECOND**, the middle level of management performs the functions of monitoring, management, measurement and control via programmable microprocessor substations, located in the automation cabinets. In order to achieve this, the selection switches must be set to "AUTO". In the "AUTO" mode, microprocessor substations perform programmable logic control (PLC) and direct digital control (DDC) in accordance with the implemented management algorithm and appropriate application. The PLC function is executed based on the program in the substation, entered during the commissioning. All primary blockages, time programs, selection switches status, all input signals which determine the operation of the system are entered into the program. This level of management allows independent operation of each individual subsystem, i.e. execution of all supervisory and management functions of the subsystems even in the case that there was no communication with the operator working station, i.e. the third level of management.
- **THIRD**, the highest level of management enables the realization of the control monitoring, registration and management functions. This level allows the processing of certain data from microprocessor substations, their chronological registration, visualization and recording, i.e. the Man-machine interface (MMI). This fulfills the requirement for registration of all required parameters that are crucial for securing the necessary environmental conditions in the rooms.

For the realization of the above mentioned third level functions, the following is designed:

- operator working station – central computer for supervision and management with peripheral equipment (monitor, printer, etc.).
- system controller

- appropriate software application packages.

Operator working station is connected via adequate communication with the system controller (router) that is connected to the substations, which ensures the coordination of management and synchronization of operation between individual subsystems, as well as the central supervisory and management function.

It is envisaged that the operator working station is supplied from the appropriate UPS source.

The basic functions of the central supervisory and management system will be:

- Cyclical scanning of all substations by sending messages that contain the substation address and all other instructions and requests
- Sorting of data obtained from the substation for individual operator terminals
- Time synchronization of substations
- Continuous supervision over the operation of the whole system (control of the internal and external components operation, transmission routes and firmware)
- Management by means of “time” and “event” and other programs, i.e. issuing commands for turning on and positioning, as well as alarm in time and event function; this enables management of individual systems in the facility by intervention of the operator via mouse or keyboard or starting the special subroutine in the software of the central computer, which has the override function, since it is on a higher hierarchical level than the substations software.
- Supervision of the operating time of the individual units in order to issue commands of connection and disconnection (optimization of energy consumption and the use of equipment)
- System protection against access of unauthorized persons (proof of authorizations and entry expectancy control at the subsystem level)
- Collecting and summarizing data to generate historical data banks and function trends that are used for statistics, inspections and periodic reports.

PRIMARY EQUIPMENT IN THE FIELD - FACILITY

For indication, measurement and control of parameters of the heating, ventilation and air conditioning and hydro-technical systems, appropriate measuring and control equipment in the field-facility is envisaged:

- measuring equipment: sensors for temperature, humidity and differential pressure and flow
- indicator equipment: thermostats, differential pressure gauges
- control equipment: control valves and motorized louvers.

The primary equipment in the field for the HVAC and hydro-technical systems is discussed in detail and specified in the mechanical and hydro-technical design.

AUTOMATION CABINETS

Automation cabinets are designed for collection and processing of all signals from the facility and enabling the first and second levels of management. Their layout is shown in the block diagram. For the management of HVAC and hydro-technical consumers, the following is provided:

- in the technical area in the basement of the new facility (annex), automation cabinet OATP
- in the technical area on the fourth floor (attic) of the new facility (annex), automation cabinet OAD1
- in the central facility for medical gases, automation cabinets for the control of operation of the respective installations, which are the subject of the supplier; status and alarms of these installations are entered into the automation cabinet OATP.

Automation cabinets are designed to be made of sheet metal, with free standing doors on the front, with a glass window with required dimensions, in order to have a view at the MPS and modules for local management and control.

The following equipment is foreseen for the automation cabinets:

Sources and distribution of control voltages: voltage transformers, installation switches, switchgears for turn-on and turn-off of the control voltage, etc. Power supply of the automation cabinets is planned so that:

- automation cabinet OAD1 is supplied from the distribution board HGVKD1
- automation cabinet OATP is supplied from the distribution board HGVKTPD.

In microprocessor substations, the battery supply and formation of the required supply voltage is envisaged.

Micro processor substation (MPS): programmable logic controller – microprocessor substation shall perform the following functions independently and autonomously:

- direct digital control (DDC)
- programmable logic control (PLC)
- time programs
- historical data bank
- optimization

These functions will be realized through the implemented software package.

The structure of the substation in terms of hardware and software will be such that it is completely modular (card principle), which results in its high flexibility (expandability) and applicability in a variety of applications.

Each of the MPSs can process the following analog and digital input signals:

- digital inputs (DI) – dry contact, optocoupler, transistor (open collector)
- counting (pulse) inputs (CI) - dry contact, optocoupler, transistor (open collector)
- analog inputs (AI) - Ni1000, Pt1000, Pt 100, 0/2...10V, 0/0.2...1V, 0/4-20mA, 500Ω...2000Ω
- digital outputs (DO) – dry contacts 42V/2A in the form of commands 0-1, 0-1-2, "OPN-O-CLS", 0-1-2-3, 0-1-2-3-4-5-6, or pulse commands 0-1
- analog outputs (AO) - 0/2...10V, 0...20mA.

Number and layout of substations within a single automation cabinet will be determined after the supplier has made a choice, based on the total number of signals that are functionally connected to the respective automation cabinet, given in this design.

Equipment for the local management and control: equipment for the local management and control for all consumers will be placed in the automation cabinets.

For the operation mode selection (manual – automatic) and blockage of operation of all consumers of a HVAC system (chamber) on DO and AO substation modules, a three-position switch “M-0-A” is designed. In switch position “0” a direct (hardware) blockage of the HVAC system is performed.

Safety of people during testing and repairs is achieved by putting the selector switch in position “0” and locking the automation cabinet door.

In addition to the managing and controlling elements, the automation cabinet will include the appropriate number of auxiliary relays for reproduction of individual digital signals from the facility – dry contacts and for direct – hardware blockage of the air chamber fan operation. Auxiliary relays are provided also for signals from the frost thermostat, the collective blockage and for separation of voltage 24 VAC/230 VAC. Light signaling of the status of fire dampers for each damper separately, is planned on the automation cabinet door, as well as the status of the frost thermostat and auxiliary voltages. The required number of terminal strips with serial terminals is provided. Sets of terminals are sorted according to the type of signal, voltage level and HVAC system.

Since consumers which are supplied from the distribution boards HGVKTPGD and HGVKKD are dislocated in relation to the microprocessor processing that is performed via MPS in the automatic cabinet OATP (technical area, room 35 in the surgical ward), the design foresees that in the distribution boards HGVKTPGD and HGVKKD, AO and DO modules are installed (which would otherwise be located in the MPS in the OATP). Data transfer between the module and corresponding tabs will be conducted via bus communication (cables WOATP-TPG-AO and WOATP-TPG-DO). This allows the service manual operation mode of those consumers directly from their location, which facilitates servicing and commissioning of the same.

OPERATOR WORKING STATION (CONTROL CENTER)

Operator working station is envisaged at the dispatch center (monitoring room) of the surgical ward (fourth floor, i.e. attic). It will consist of the following elements:

- central PC with complete peripheral equipment
- flat monitor
- laser printer
- communication interface
- device or card for the required communication interface and protocol
- portable handheld terminal

Through the central computer and monitor, an active dialog is enabled between the operator and the central supervisory and management system and in particular:

- Display of all databases with stored data
- Display of instructions and texts that are intended to help the operator
- Display of listings by installations with real parameter values, real condition feedback and possible inputs that the operator can enter via keyboard
- Graphics display
- Protocols display
- Dynamic image of the installations.

The printer is designed for registering of alarm messages, as well as for the ability to print a

large number of protocols with a date, time, place and address of the point in the installation on which the information is printed.

Only authorized persons have access to the system due to an alphanumeric identification code (password).

A handheld portable control panel is designed for direct access to all analog and digital signals at the substation level, i.e. for direct manual control of the primary equipment, programming of the substations and emergency response.

SOFTWARE PACKAGES

In order for the supervisory and management system to fulfill all the required functions of measurement, control, signaling and management, adequate programs, i.e. software packages have been provided:

- at the operator working station level
- at the substations level.

Software packages at the operator working station level

This package supports all the basic system functions and, among other, allows the following:

- Database generation and management
- Access to the microprocessor substations
- Collection and transfer of information
- Mathematical signal processing
- Program for the graphics presentation on the screen
- Issuing texts
- Programs for generating protocols and reports
- Automatic printing of alarms and events
- Identification code
- Patrol tour
- Time and event programs
- "MASTER - SLAVE" functions
- "MULTI - USER" function
- Historical data bank
- Optimum start/stop program
- Program for monitoring of peak load
- Program for optimization of energy consumed
- Program for regulation of fresh air
- Program for residual heat usage
- The "zero-energy zone" program
- Program for device "cyclical start/stop"
- Maintenance programs.

Basic software functions that are performed at the substation level are as follows:

- DDC – direct digital control:

This package contains a large range of software modules necessary to perform control and regulation functions. These are predefined blocks that can be used, if necessary, so as to enter

only the operating data. By connecting these modules together, even the most complex applications can be solved. All information is processed in digital form.

The substation constantly scans all the actual measured values, as well as the set values that are related to it and determines which regulating actions need to be executed. This concept avoids the use of a large number of compact controllers. Also, such reference values can be measured only once and then distributed to a large number of regulatory circuits through communication cards.

All parameters, characteristic gradients, threshold values, regulatory functions can be easily modified in digital form.

- PLC – programmable logic control:

Instruction set and time programs allow completely free programming of PLC operations and thus provide the necessary flexibility in application. Modifications, as in the DDC, can be easily performed by online programming and from the control center or via mobile devices. PLC modules allow easy and efficient solution of all applications.

- Time program:

Through this package, a very large number of connections / disconnections in the time function can be performed, such as every day, every seven days, over the holidays, etc. Capabilities of this program are similar to the central computer time program of the operator working station.

- Optimization programs:

The substation can operate with several optimization programs, which refer to the part of the installation that is connected to the same.

- Historical databank (HDB) and trend functions:

The data bank in the substation can automatically store analog and binary information in a certain period of time. These values can be read via the operator working station or a handheld portable service terminal. Also, the aforementioned functions may be displayed in graphic form. Using this function, data are added at the substation level and processed at the central computer level, i.e. issued in form of various statistical protocols, maintenance lists, graphics, etc.

CONNECTING OF THE BUILDING MANAGEMENT SYSTEM EQUIPMENT

Connecting of the building management system equipment and signal transmission is performed by using appropriate command-signal and communication cables.

Connecting the primary equipment in the field with automation cabinets

Measuring and control equipment in the field and supervisory and monitoring facilities are connected with automation cabinets via command-signal cables of the appropriate type and with appropriate number of conductors, defined on the basis of the type and number of signals that are transmitted by them:

- digital signals will be transmitted with cables type NHXHX and NHXHX-J
- analog signals will be transmitted with cables type J-H (St) H.

For the connection between controllers, also shield cables J-H(St)H have been provided. The

communication protocol between the microprocessor substations will be determined after the selection of the controller.

Connecting automation cabinets with operator working station

Connecting the controller in the automation cabinet OAD1 is envisaged to the appropriate router, through which the controller network in the building will be connected to the operator working station. Through the aforementioned router, local communication protocol (local area network between the controllers) is being transferred to the communication protocol and operator working station. Local data and messages are limited to the local area network, while the global data and messages have no restrictions. The connection between controllers, router and automation cabinet OAD1 is provided with cables FTP, CAT6.

Monitoring of accuracy and reliability of data exchange between the central computer and substations is performed during communication. If a substation does not respond to the message, an alarm is being printed that reads »no reply«, followed by the substation code, time and date.

At the building level, one local control panel with large set of options is foreseen. This local control station allows the processing of data of all network controllers regardless of their location, easy access to all system data, reading of measured values, acoustic and visual alarm signaling, display of all current values, issuing of analog and digital commands, calendar, ability to change the time and time programs, ability to test cable connections, graphical display of all parameters in real time, monitoring of trends and access protection by means of user password.

In rooms with suspended ceilings, cables are laid above them, on racks or clamps.

In places exposed to mechanical damage, as well as on connectors to the primary equipment in the field, cables are routed through steel rigid and flexible pipes.

EFFECTS OF EMERGENCY SITUATION IN THE BUILDING ON OPERATION OF THE HVAC AND HYDRO-TECHNICAL CONSUMERS

Fire

In case of fire in the building, it is necessary to automatically shut down all air conditioning and ventilation systems and close all fire dampers.

The FF switchboard provides fire alarm signal in form of dry contact. Acceptance of the signal is performed in the automation cabinet OAD1, where relay storing of the fire signal is provided, with the obligation of its hand activation by pressing the button after the cessation of fire (cancellation of signal by the FF switchboard).

The signal from the FF switchboard via the auxiliary relay has the following effect:

- shut down of all fans, electric humidifiers and fan-coils and closing of louvers
- closing of the appropriate fire dampers (motorized dampers with spring return).

The fire dampers have the limit switch for position signaling. The signal of closed position of the fire damper of the appropriate air conditioning system is entered into the automation cabinet to the auxiliary relay which provides direct shutdown of fans and protective pumps of that air conditioning system. This ensures that in case only the fire damper reacts (either accidentally or deliberately), only the air conditioning system is turned off where that damper is located. Light signaling of the flap closure status is provided on the automation cabinets.

Entering fire alarm signals and closure status of the fire dampers is also provided in the controller. Based on these signals, the substation should, via software, shut down the aforementioned HVAC consumers (software system lock). This way, a higher level of safety of the HVAC systems shutdown is ensured in case of fire, as well as activation of the security

systems.

HVAC system for increasing water pressure in the fire network will be directly powered via diesel generator, based on the information on the pressure drop in the respective network.

Frost

In case of the frost thermostat reaction, an automatic hardware activation of the circulation pumps of the chamber heaters is provided, as well as shutdown of the recuperation pump and the chambers fans. Also, light signaling of the frost thermostat status is provided on the automation cabinets. The signal on the occurrence of frost is entered into controllers, which enables the software activation of the circulation pumps of the chambers heaters, shutdown of the recuperation pump and the chambers fans.

Emergency shutdown of HVAC systems

Emergency stop push buttons for shutdown of the HVAC consumers in case of emergency will be placed on automation cabinets and appropriate places in technical areas.

Incorrect phase sequence

In case of incorrect phase sequence on the ingoing unit of distribution boards of the electric motor drive, direct (hardware) shutdown of the motor powered consumers is provided. The same signal is entered into the controller, which enables software shutdown of the engine. The incorrect phase sequence signal is obtained from the relevant device, provided for this purpose.

Short interruption in the power supply of the automation cabinets

In the event of a local failure on outgoing units for the automation cabinets power supply, the building management system will continue to operate thanks to specially designed UPS units for automation cabinets OAD1 and OATP (which will maintain all control voltages), while the batteries within the microprocessor substations will enable their operation without interruption.

Failure of the mains voltage

In the event of the mains voltage failure, all air chambers that are responsible for air conditioning of the second floor (operating rooms) and pathology ward (basement) are designed to continue their operation, however without the possibility of air humidification in winter and cooling function in summer. This operation mode will be enabled by using diesel generators. In the period between the mains voltage failure and the moment when the diesel generator starts to accelerate, through the special UPS units, in the automation cabinets OAD1 and OATP all control voltages will be maintained, while the batteries within the microprocessor substations will enable their operation without interruption. This way, the air conditioning system will be able to start immediately after the diesels generators start, while software can enable its time delay, if necessary. In order for software to »recognize« the operation mode in which the time delay of the chambers start is necessary, signals from the distribution board of the diesel generator are taken regarding the mains voltage failure and the end of the diesel generator acceleration.

Operator working station and associated communication equipment will be powered through the sockets which are powered by the UPS units and diesel generators.

Emergency situation signaling in the operating rooms

In case that the ambient parameters (temperature, humidity and filter soiling) in operating rooms and post-operative care units are exceeding permissible values, light signaling is provided in the control cabinet, which will be located in each of the respective rooms. Control cabinets are subject of volume mp III 4, and this design envisages establishment of adequate signals within the BMS and sending them to the aforementioned cabinets.

Medical gases status signalig (including the alarm signaling in the event of significant deviation from the allowed values) is planned through special local alarm-status control panels. These panels are the subject of the medical gases design, while this volume envisages the necessary control-signal cable connections, and in the volume mp III 4, the power supply thereof is provided.

IT systems (isolating transformers) status for each of the operating rooms and post-operative care units are provided in the control cabinet of the each of these rooms, which is the subject of volume mp III 4.

Note: For the description of the functioning and regulation of individual elements of the HVAC systems, see the mechanical part of the project. For the description of the functioning and regulation of individual elements of the hydro-technical systems, see the hydro-technical part of the project.

3.6 TECHNICAL DESCRIPTION

FACILITY: 10 kV cable line for the connection to PS10/0.4 kV;
2(3) x 1,000 kVA, "New Surgery"

LOCATION: within the complex HC Vranje, CL No. 6573/1 CM Vranje 1

SUBJECT AREA OF THE DESIGN

The area included in the linear facility design of the 10 kV cable line in the city of Vranje is the sector delineated by the following:

- PS35/10 kV "Vranje 2"
- Jovana Jankovića-Lunge Street
- to PS 10/0.4 kV New Surgery in the electrical energy block HC Vranje (CL No.6573/1 CM Vranje 1)
- In the complex of the hospital in Vranje, up to
- PS10/0.4kV "Infective" in the hospital complex.

According to the technical terms issued by the "Elektro distribucija-Vranje", the newly designed electrical-energetic facility PS 10/0.4 kV, 2x1,000kVA "New Surgery", is to be connected to the existing power source, i.e. to the PS 35/10 kV "Vranje 2", with a 10 kV cable line, and then to use the same cable to establish a connection to the PS 10/0.4 kV "Infective".

Based on the delivered TECHNICAL TERMS issued by the Electricity Distribution Company "Jugoistok" d.o.o. Niš, a branch of "Elektro distribucija Vranje", registered under the number 137771/2 as of September 23rd 2015, the connection to the 10 kV cable network is to be delivered from the PS 35/10 kV "Vranje 2" with a 3 XHE 49 A 1x240 mm²/10kV cable, laid inside the pavement of J. Jovanovića - Lunge Street, to the entrance to the hospital complex.

For the area covered in these design documents, there is a detailed spatial plan for the entire pathway for laying down the cable.

The requirements for the design of 10 kV cable lines in this section are:

- Designed cable type 3 XHE 49A 1x240 mm²/10 kV.
- Embedding depth at least 1.00 m on a non-regulated surface

- Embedding depth at least 0,80 m on a regulated surface
- The grid must be open, offering the possibility of two-sided powering
- The maximum output current must be in accordance with the specifications of the existing cable
- At the end-consumer point, the voltage drop must not exceed 5%

Disposition of the newly designed PS 10/0.4 kV and 10 kV cable lines is provided in the designs for this sector, in a 1:500 ratio.

The calculation for load bearing capacity, voltage drop and other necessary information is provided in a separate attachment which attests that the said cable has been properly selected.

Technical specifications of the designed cable are provided further in the text.

XHE 49 (-A) 6/10 kV

With Al-copolymer foil









Conductor nominal cross section	Conductor cross section	Electrical safety nominal cross section	Insulation thickness	Laminated sheath thickness	External diameter approx.	Weight of the cable with a Cu conductor	Weight of the cable with an Al conductor
240	18.2	25	3.4	2.2	35	3075	1155

Without Al - copolymer foil

Conductor nominal cross section	Conductor cross section	Electrical safety nominal cross section	Insulation thickness	Laminated sheath thickness	External diameter approx.	Weight of the cable with a Cu conductor	Weight of the cable with an Al conductor
mm ²	mm	mm ²	mm	mm	mm	kg/km	kg/km
240	18.2	25	3.4	2.0	35	3035	1515

Conductor nominal cross section	Electrical resistivity of the conductor 20°C (DC)		Electrical resistivity of the conductor at 90°C (AC)		Capacitance	Charging current (per phase)	Impedance triangle	flush	
	Cu	Al	Cu	Al				ground	air
mm ²	Ohm/km	Ohm/km	Ohm/km	Ohm/km	μF/km	A/km	mH/km	mH/km	mH/km
240	0.0754	0.1250	0.0988	0.1620	0.417	0.79	0.325	0.545	0.464

A M P A C I T Y (A)

Conductor nominal cross section	COPPER CONDUCTOR				ALUMINUM CONDUCTOR			
								

mm ²	in the ground	in the ground	in the air	in the air	in the ground	in the air	in the air	in the air
240	556	560	635	723	437	452	499	573

ROUTE DESCRIPTION

LOCATION of the PS 10/0.4 KV; 2x1,000 kVA "New Surgery" is inside the hospital complex, in the newly reconstructed electrical energy block, CL No. 6573/1 CM Vranje 1, and it is constructed with reinforced concrete shear walls (exterior walls), whereas the interior of the facility is constructed with a unobstructed access from the frontal side, both to the transformer cabinet and to the HV and LV room.

From *PTS35/10 kV "Vranje 2" to PS10/0.4 kV "New Surgery"*

The cables are delivered from PS35/10 kV "Vranje 2" through the existing cable conduits of $\phi 100$ pipes which penetrate the AB wall of the PS to the greenery, then through the lot of this PS to the crossing point to the other side of the local street. Along this side of the street, the cable is laid along the pavement in J. Jankovića-Lunge Street. The excavation and precise excavation points shall be defined by the lot owner (Elektrodistribucija – Vranje) who will be permanently present throughout the works on the site. The excavation shall be done manually by workers who are trained for this type of work. The crossing point of the internal street shall be marked by markings in the concrete pavement.

Along the pavement of J. Jovanovića-Lunge Street, the cable pathway is to be laid at the depth between 1.00 and 0.80 m (upper rim of the cable), depending on the depth of the existing connections of other installations which are being intersected by the cable line. The cable pathway encounters obstacles in the form of automotive service pits and perimeter walls, as well as by the presence of underground installations. This is the case along the entire section of the pathway in J. Jovanovića-Lunge Street. After the cable pathway enters the hospital complex, it will remain in an area which, up until this moment, has only one hot water intersection. The details of this intersection are provided in the attachment. The pathway continues unobstructed down to the trench until it approaches the electrical energy block, where there is one intersection with an underwater canal where pipes for medical gases are laid.

After the cable is delivered from the PS10/0.4 kV "New Surgery" towards PS10/0.4 kV "Infective", the cable is partially laid in the cable duct together with the LV powering cables which power the surgery consumers, enters through the manhole and in that section it is laid along the wall in a mechanically protected conduit until it leaves the facility. From there, it continues along the joint pathway with the LV powering cables which power the air-conditioning system of the "Chiller" facility. After separation in front of the chiller's base, the cable shall be laid inside the future pavement of the street all the way to the PS10/0.4 kV "Infective".

The excavation and top-soiling of the trench shall be done manually after the existing underground installations have been mapped by their respective owner. Before laying the cable, the trench is to be cleared of any objects that might in any way damage the cable. The trench's daylight width is 40 cm, and depth 90 cm. After the excavation, the trench is to be filled with selected fine-grain soil or sand which is to serve as bedding for laying the cable. After laying the cable, the pathway is to be surveyed and all specific cross sections mapped. The survey is to be submitted to the municipal cadastral register of underground installations, and a certificate of surveying and submitting the survey is to be requested. After this, the cable is to be buried in a 10 cm layer of fine-grain soil or sand, plastic safeguards are to be placed (each cable must have a separate safeguard), covered with a 10 cm layer of fine-grain soil or sand, compressed

manually, a warning tape is to be placed, another 20 cm layer of fine-grain soil is to be poured and compacted, this layer of the trench is to be compacted manually, a second layer of warning tape is to be laid and the trench surfaced with the remaining soil. This layer may be compacted mechanically. The surplus of soil is to be transported to the disposal site, and if this is not possible, it must be spread out over the site. At every bend, intersection with other underground installations and straight lines exceeding 25 cm, a concrete marking with a brass plate on the top is to be placed. Details of this marking are provided in the design.

Distance between the cables which are laid parallel inside the trench must not be less than 7 cm. Depth of the excavation is in average 1.00 m, and in no place must it be less than 0.80 m. After the laying has been completed, and before the topsoiling, the Contractor shall perform geodetic surveying of the laid cable and to obtain a certificate of this from the municipal cadastral authority.

All details related to the laying of cables, manner, place, time, marking, connecting, gripping, and other details are provided in the attachment with the description of positions in the bill of quantities for the works, technical terms, recommendations which define this type of work, and these must be abided by during the delivery of works.

The Investor ***SHALL request presence of the competent service and their responsible persons*** from all the owners of the underground installations along the cable pathway before starting the excavation, as well as the official possession of the site from the competent service. During the excavation of the trench and laying of the cables, the Contractor must be completely familiar with the pathway and the existing obstacles in it. Section of the pathway contains obstacles and existing underground installations, which means that the trench ***MUST be excavated manually*** along this section.

The design projects the pathway based on the issued consent by the City of Vranje Construction and development Directorate.

The cadastral-geodesic design contains lengths of cable from the connecting port at the PS35/10 kV "Vranje 2" to the PS10/0.4kV "New Surgery" and then also to the PS10/0.4kV "Infective".

4. MECHANICAL INSTALLATIONS

4.1. Mechanical installation of heating, ventilation and air conditioning

The main design of mechanical installation has been prepared on the basis of architectural and construction background, the Terms of Reference, the technological basis and the data obtained from the Employer, visual inspection of the existing mechanical installations, and applicable regulations for this type of facilities and installations.

GENERAL NOTES

The facility consists of an existing part with several sections, different number of floors and the new extension to the annex facility (basement, ground floor, three floors and attic).

Architectural-construction design envisages construction of the loft on the existing section of new gynecology that is connected to the attic of new extended annex building. This design envisages the heating, ventilation and air conditioning of basement, second floor and attic of the new annex, as well as the extension of the loft on the section of new gynecology. As the installation is carried out in several phases, technical areas in which air conditioning equipment is stored, as well as thermal-cooling substation, are sized for the final phase. All equipment, piping and air ducts are also sized (and their performance is planned in the first stage) so that equipment from the second stage may be smoothly connected to them.

AIR CONDITIONING AND VENTILATION OF NEW OVERBUILT ANNEX BUILDING

For air conditioning of rooms in new extension to of the annex facility in the final stage was adopted 15 air conditioning systems. System selection is made on the basis of criteria on purposes of certain rooms, concurrency, requirements for humidity, temperature and the criterion of covering the thermal load.

Calculations of heat losses made according to standard DIN 4701, from 1959 and calculations of heat gains according to standard ASHRAE CLTD/CLF from 1985.

Internal temperature and relative humidity of the rooms have been adopted in accordance with their purpose and applicable regulations.

	Number of air alterations (i/h)	Temperature of the room (°C)	Relative humidity (%)
- surgery room	20÷24	22/24	50 ± 5
- intensive care - patient preparation	20	22/24	50 ± 5
- hand wash	10÷15	22/24	50 ± 5
- passing	10÷15	20/26	50 ± 10
- other rooms	5÷10	18/26	50 ± 10
- primary air (offices)	50 m ³ /h per person	20/26	50 ± 10

In line with the increasing demands of quality and hygiene, all air chambers that supply air to the premises of operating rooms, intensive care units, maternity wards are hygienic performance and are designed to work with 100% fresh air.

According to the terms of reference in order to achieve requirements for the purity of the air pursuant to DIN 1946/4 a three-stage air filtration is provided using filter class EU4, EU9 and absolute "HEPA" filters, class H13. Filter class EU4 and EU9 are housed in air handling units while the filter class H13 are located in the lowered ceiling.

In determining the volume of air per premises, it was taken into account that the low pressure and excess pressure system solves the problem of air flow.

Taking fresh air is conducted through the southern facade and ejection of exhaust air is conducted through the roof.

Channels for air supply are isolated by the thermal insulation of appropriate thickness with a vapor barrier.

In all chambers the waste air heat usage is provided.

The first phase includes the installation of air chambers K-1; K-7; K-8; K-9; K-10; K-11; K-12. The second phase includes the installation of air chambers K-2; K-3; K-3A; K-4; K-5; K-6; K-13; K-14; K-15.

AIR CHAMBERS I-PHASE

Basement – Pathology

System K-1

System K-1 is designed for air conditioning of rooms in the basement of the new extension to Annex, where located the department of pathology. The supply air is prepared in an air chamber, which is located in the technical area on the top floor of the new annex and consisting of the following elements:

- ♦ Section of input jack
- ♦ Basic filter of class EU4
- ♦ Section of ventilators of input air
- ♦ Section of heat recuperation
- ♦ Sections of hot-water air heaters
- ♦ Section of air humidifier
- ♦ Section of air cooler
- ♦ Silencer
- ♦ Final filter of class EU9
- ♦ Section of output jack

The air for air conditioning is prepared by first filtering fresh air in filter class EU4, then heated in winter, in warm-water heaters, and in the summer cooled in the air cooler, then such treated air is filtered through silencer and a final filter class EU9 and distributed through channels of galvanized sheet in the lowered ceiling to diffusers through which is let into the premises. In winter the air is wet using humidifier steam. For preparation of steam are provided electric humidifiers placed in the technical area of the attic, near the chamber.

The air is sucked from the room through captor aluminum grids and channels of galvanized sheet through false ceiling, and conducted to the exhaust ventilation section KO-1, which is also located in technical space in the attic; then conducted out into the surrounding atmosphere. Ventilation section consists of a silencer, section of heat recovery and exhaust ventilator.

In addition to the general suction of the rooms are provided also local suctions (OV 1 ÷ OV 8) for the following rooms: autopsy, identification, fume hoods, toilets, photographing, elevators and compressor plant. The air is sucked through captor aluminum grid, channels made of galvanized sheet and channel fan, and then discharged into the atmosphere through the roof. All the fans are located in the technical area of the attic.

II floor – Surgical block

Systems K-7; K-8; K-9; K-10; K-11

Systems K-7; K-8; K-9; K-10; K-11 are envisaged for air conditioning of surgery rooms. System K-7 for rooms SL03.21 and SL03.22, system K-8 for room SL03.23, system K-9 for rooms SL03.24 and SL03.25, system K-10 for room SL03.23 and system K-11 for intensive care area. The supply air is prepared in air handling units, which are located in the technical area on the top floor of the new extension to the annex, which consist of the following elements:

- ♦ Section of input jack
- ♦ Basic filter of class EU4
- ♦ Section of ventilators of input air
- ♦ Section of heat recuperation
- ♦ Sections of hot-water air heaters
- ♦ Section of air humidifier
- ♦ Section of air cooler
- ♦ Silencer
- ♦ Final filter of class EU9
- ♦ Section of output jack

The air for air conditioning is prepared by first filtering fresh air in filter class EU4, then heated in winter, in warm-water heaters, and in the summer cooled in the air cooler, then such treated air is filtered through silencer and a final filter class EU9 and distributed through channels of galvanized sheet in the lowered ceiling to diffusers with absolute HEPA filters of class H13 through which is let into the premises. In winter the air is wet using humidifier steam. For preparation of steam are provided electric humidifiers placed in the technical area of the attic, near the chamber.

The air is sucked from the room through captor aluminum grids and channels of galvanized sheet through false ceiling, and conducted to the exhaust ventilation section KO-7÷KO-11, and then conducted out into the surrounding atmosphere. Ventilation section consists of a silencer, section of heat recovery and exhaust ventilator, and is placed in technical area of the loft.

System K-12

It covers the preparation of primary (fresh) air for rooms that are air conditioned using fan convectors on the second floor of the new annex. The system operates with 100% fresh air. The supply air is prepared in a climate chamber, which is located in the technical area on the top floor of the new annex and consisting of the following elements:

- ♦ Section of input jack
- ♦ Basic filter of class EU4
- ♦ Section of ventilators of input air
- ♦ Section of heat recuperation
- ♦ Sections of hot-water air heaters
- ♦ Section of air humidifier
- ♦ Section of air cooler
- ♦ Silencer
- ♦ Final filter of class EU9
- ♦ Section of output jack

The air for air conditioning is prepared by first filtering fresh air in filter class EU4, then heated in winter, in warm-water heaters, and in the summer cooled in the air cooler, then such treated air is filtered through silencer and a final filter class EU9 and distributed through channels of galvanized sheet in the lowered ceiling to diffusers through which is let into the premises. In winter the air is wet using humidifier steam. For preparation of steam are provided electric humidifiers placed in the technical area of the attic, near the chamber.

The air is sucked from the room through captor aluminum grids and channels of galvanized sheet through false ceiling, and conducted to the exhaust ventilation section KO-12 and then conducted out into the surrounding atmosphere. Ventilation section consists of a silencer, section of heat recovery and exhaust ventilator, and is placed in technical area of the loft.

In addition to the general suction of the rooms are provided also local suctions (OV-9 and OV-10) for the following rooms: showers and digesters. The air is sucked through captor aluminum grid, channels made of galvanized sheet and channel fans, and then discharged into the atmosphere through the roof. All the fans are located in the technical area of the attic.

AIR CHAMBERS II-PHASE

Ground floor – Emergency Room

System K-2

It is designed for air conditioning of operating rooms and intensive care.

System K-3

It is designed for air conditioning of other premises on the ground floor.

System K-3A

It is designed for air conditioning of other premises on the ground floor.

I sprat – Maternity hospital

System K-4

It is designed for the delivery rooms.

System K-5

It is designed for the aseptic maternity hospital.

System K-6

It is designed for the aseptic maternity hospital and sterilization.

III sprat – Intensive care

System K-13

It is designed for the operating room.

System K-14

It is designed for the intensive care.

System K-15

It is designed for other rooms of the third floor.

FAN CONVECTORS

By system of fan convector facilities air conditioning is realized in the summer and heating in winter. The fan convectors are connected to two-pipe system and in summer they operate with water 7/12°C and in winter with water 60/50°C.

The fan convectors are placed in the parapet below the window.

Pipe network of fan convectors is kept in a suspended ceiling of the floor below. Regulation of fan convector operation is performed from the air side. Temperature control in the premises is carried out by individual controller with thermostat with adjustable fan speed and room temperature.

CONNECTION TO THE INSTALLATION OF HOT AND COLD WATER

MHC Vranje is supplied with hot water 110/70°C from the existing boiling room, with three hot-water boilers (3x2.326.000W) operating using liquid fuel and three electrical boilers (3x340kW) placed in the atrium of the existing building.

In the new architectural and construction solution for reconstruction and extension of the facility of annex it is necessary to perform partial modifications to existing installations.

Existing electric boilers with equipment, fittings and pipes are completely dismantled and brought out.

The current pipeline from the boiling plant to substation (ground floor - new gynecology) due to the increased capacity, (will be connected the installation of the extension to the facility of annex) must be dismantled and replaced by a new larger pipeline. This increase in capacity causes replacement of existing pumps (operating and reserve), as well as part of pipeline in the boiler room. Increasing the capacity in the substation has caused its complete reconstruction and replacement of existing circulation pumps and fittings. One of the disassembled electric boilers will be installed in the existing boiler room and will serve for heating hot water in summer. Boilers are placed in the boiler room (3x3,5m³).

From this substation are conducted also pipelines (110/70°C) to the substation in the basement of the extension to the annex facility. All pipelines are sized for the final phase of the installation assembly. Pipeline routes are planned so that the subsequent connection can be carried out without disturbing the work of already mounted installation. Pipelines are insulated with mineral wool in the lining of aluminum sheet. Connections are planned for heaters of air chamber (110/70°C), for heaters of boilers (2x2,5m³ - 110/70°C) and connection to the ventilator convectors (60/50°C). This design also envisages connection for existing radiator heating of the building in which are situated premises of technical services and technical gas stations.

Cold water 7/12°C is intended to cool the air in summer. For the preparation of cold water is provided a cooling unit (5/10°C) with air cooled by condenser, which is located on the green area in the courtyard of the hospital. The cooling unit is designed to operate at 35% mixture of glycol and water. System of cold water 5/10°C is designed to operate at 35% solution of glycol, in order for the installation not to be emptied in winter.

For the circulation of cold water 7/12°C is planned circulation pump, and for the expansion of water in the system closed expansion tank with membrane and heat exchange 5/10°C - 7/12°C. Connections for cold water are designed 7/12°C coolers of chambers and fan convectors. From cooling generator to substation cold water pipelines 5/10°C are conducted in concrete channel. Piping of cold water must be isolated by insulation with a vapor barrier.

STATIONS OF MEDICAL GASES

This facility is an existing one and in the the first phase is partially reconstructed, i.e. only a part for placement of cells with oxygen, nitrogenous oxide, vacuum and compressed air.

Gas stations and distribution of medical gases have been treated by a separate design.

In gas stations radiator heating is planned from a sub-station in basement of the surgical block. In the premises of gas stations natural ventilation is provided through the blinds built into the door and the facade.

4.2. TECHNICAL DESCRIPTION of mechanical installation of heating, ventilation and air conditioning

The main design of mechanical installation has been prepared on the basis of architectural and construction background, the Terms of Reference, the technological basis and the data obtained from the Employer, visual inspection of the existing mechanical installations, and applicable regulations for this type of facilities and installations.

GENERAL NOTES

The facility consists of an existing part with several sections, different number of floors and the new extension to the annex facility (basement, ground floor, three floors and attic).

Architectural-construction design envisages construction of the loft on the existing section of new gynaecology, which is connected to the attic of new extended annex building. This design envisages heating, air conditioning and ventilation of the ground floor, first and third floor of new annex, as well as ventilation and heating and cooling of substation in the attic.

Design of the II stage is mostly synchronized with the design of the I stage, i.e. Complied with disposition of equipment, channels and pipelines.

Discrepancy points that may occur will be emphasized in the drawings.

AIR CONDITIONING AND VENTILATION OF NEW OVERBUILT ANNEX BUILDING

For air conditioning of rooms in new extension to of the annex facility in the final stage was adopted 15 air conditioning systems. System selection is made on the basis of criteria on purposes of certain rooms, concurrency, requirements for humidity, temperature and the criterion of covering the thermal load.

Calculations of heat losses and heat load are made according to standard ASHRAE CLTD from 1989.

Internal temperature and relative humidity of the rooms, purity class, air flow velocities, and minimum quantities of fresh air have been adopted in accordance with their purpose and following European and Russian recommendations and regulations:

VDI 2167 - Building services in hospitals – Heating, ventilation and air-conditioning
Swiss Guideline - 'Heating, ventilation and air-conditioning systems in hospitals
(Planning, construction, operation)'

SanPiN 2.1.3.1375-03 - Hygienic conditions for the placement of the appliances, equipment and operation of hospitals, maternity wards and other medical facilities

ГОСТ Р 52539-2006- Air cleanliness in hospitals. General requirements

Internal temperature and relative humidity of the rooms have been adopted in accordance with their purpose and applicable regulations.

	Number of air alterations (i/h)	Temperature of the room (°C)	Relative humidity (%)
- surgery room	20÷24	22/24	50 ± 5
- intensive care - patient preparation	20	22/24	50 ± 5
- hand wash	10÷15	22/24	50 ± 5
- passing	10÷15	20/26	50 ± 10
- other rooms	5÷10	18/26	50 ± 10
- primary air (offices)	50 m ³ /h per person	20/26	50 ± 10

In determining the volume of air per premises, it was taken into account that the low pressure and excess pressure system solves the problem of air flow.

Taking fresh air is conducted through the southern facade and ejection of exhaust air is conducted through the roof.

Channels for air supply are isolated by the thermal insulation of appropriate thickness with a vapor barrier.

In all chambers the waste air heat usage is provided.

The second phase includes installation of air chambers K-2; K-.3; K-3; K-4; K-5; K-5a; K-6; K-13; K-14; K-15.

SYSTEMS II-PHASE

Ground floor - Centre for care of emergencies (except operation hall with accompanying premises)

System K-2

System K-2 (4200m³/h) is scheduled for air conditioning of OP room and supporting facilities on the ground floor of the new extension to the annex facility, where the Centre for Medical Emergencies is located.

Air conditioning chamber is hygienic (washable), multi-level performance and is located in the technical area in the attic of the new annex.

The supply air is prepared in a fresh air section, which consists of the following elements:

Section of input jack with motor ON/OFF dumper and flex. connection.

Filter class EU4

Filter class EU7

Section of heat recuperate unit

Section of hot water air heater

Section of air cooler

Section of air humidifier

Section of electrical re-heaters of air

Section of propelled fan

Silencer

Filter class EU 9

Silencer

Section of output jack with flex. connection.

The air for air conditioning is prepared in a manner that fresh air is first filtered in filter class EU4 and EU7, heated / cooled in a recuperate unit, then heated in winter with hot-water heaters, and in the summer and in transitional period it is cooled and dehumidified in the air fridge. In the winter period the air is moisturized via steam humidifier, and in the summer and transitional period it is reheated via the electrical re-heaters. Then thus-treated air through is filtered by silencer and a final filter class EU9 and distributed through the channels of galvanized sheet.

Duct is for pressures up to 2000 Pa and air velocity up to 10 m/s.

In order to meet the tightness at all seams and joints is applied hermetic type SDS.

In order to prevent condensation and reduce noise in the system, the entire duct system (insertion) is isolated with adhesive thermal insulation with a vapour barrier. The insulation thickness is 10 mm.

Distribution elements have plenums and are connected to duct system of galvanized sheet metal through flexible hoses that absorb sound.

Distributive elements for air supply consist of high efficiency filters; class H13, connections for measuring pressure drop and the DOP test.

Replacing the filter is carried out from the room.

The air from the room is sucked through captor aluminium grid and by channels of galvanized sheet metal through false ceilings is conducted to the exhaust ventilation section KO-2 (3000 m³/h) and thrown further into the surrounding atmosphere. Ventilation section consists of the following elements:

- Section of input jack with flex. connection.
- Section of heat recuperate unit
- Section of exhaust fan

- Section of output jack with flex. connection.

Automatic operation of the system

Insertion system is designed to operate with a constant flow rate.

On inserting, in front of each distribution element are mounted controllers for maintaining constant flow. Regulators are with weight, without auxiliary power, circular and square section. The fan engine of section of fresh air for air chambers is with variable speed. The difference between the static and dynamic pressure is measured at the measuring cross, on the first section behind the chamber and this value is held constant.

This achieves constant design flow, not depending on the contamination of the filter.

Over-pressure of +20 Pa in the OP room compared to the corridor is held by changing rotation number of exhaust fan in air condition chamber.

Air temperature and humidity are measured in the channel for the draw out.

In control panel located in the OP room it is possible to read the following sizes:

temperature and humidity of the air, over-pressure in the room and degree of contamination of HEPA filter. When the values go out the limits light signal turns on or the like.

In control box there is also the option for the surgeon and staff to change air temperature in the range of 22-26 degC.

At a time when OP rooms are not used, in order to save energy and extend work of HEPA filters in the plenum, a switch in the control box is designed for turning off the device for re-circulation.

Exhaust chamber works with variable flow.

By changing rotation number of exhaust fan, the pressure in the OP room is maintained.

System K-3

System K-3 (9900 m³/h) is designed for air conditioning of all rooms on the ground floor, except OP room with supporting rooms.

Air conditioning chamber is standard multi-floor performance and is located in the technical area in the attic of the new annex.

The supply air is prepared in a fresh air section, which consists of the following elements:

Section of input jack with motor ON/OFF dumper and flex. connection.

Filter class EU4

Filter class EU7

Section of heat recuperate unit

Section of hot water air heater

Section of air cooler

Section of air humidifier

Section of electrical re-heaters of air

Section of propelled fan

Silencer

Filter class EU 9

Silencer

Section of output jack with flex. connection.

The air for air conditioning is prepared in a manner that fresh air is first filtered in filter class EU4 and EU7, heated / cooled in a recuperate unit, then heated in winter with hot-water heaters and in the summer and in transitional period it is cooled and dehumidified in the air fridge. In

the winter period the air is moisturized via steam humidifier, and in the summer and transitional period it is reheated via the electrical re-heaters. Then thus-treated air through is filtered by silencer and a final filter class EU9 and distributed through the channels of galvanized sheet. Duct is for pressures up to 2000Pa and air velocity up to 10m/s.

In order to meet the tightness at all seams and joints is applied hermetic type SDS.

In order to prevent condensation and reduce noise in the system, the entire duct system (insertion) is isolated with adhesive thermal insulation with a vapour barrier. The insulation thickness is 10mm.

Distribution elements have plenums and are connected to duct system of galvanized sheet metal through flexible hoses that absorb sound.

Distribution elements for air supply are composed of manual controls of the air flow.

The air from the room is sucked through captor aluminium grid and by channels of galvanized sheet metal through false ceilings is conducted to the exhaust ventilation section KO-3 (10350 m³/h) and thrown further into the surrounding atmosphere. Ventilation section consists of the following elements:

- Section of input jack with flex. connection.
- Section of heat recuperate unit
- Section of exhaust fan
- Section of output jack with flex. connection.

Automatic operation of the system

Insertion system is designed to operate with a constant flow rate.

The fan engine of section of fresh air for air chamber is with variable speed. Static pressure is measured on the first section behind the chamber and this value is held constant.

This achieves constant design flow, not depending on the contamination of the filter in air condition chamber.

Air temperature and humidity are measured on the first section behind the chamber.

The system of extraction is designed to operate with a constant flow rate.

At the entrance to the chamber is measured static pressure, and this value is kept constant.

System OV-10

System OV-10 is designed for extraction of polluted air from toilets and dressing rooms. The air is sucked through Pv valve and through the roof discharged into the atmosphere. The fan is located in the technical area of the attic.

Duct electric heaters

Envisaged for X-ray rooms (loss in winter period) and dressing rooms, where the designed temperatures are higher than in the other rooms of the system K -3.

Electric heaters are single phase and are managed by the controller pulser. Temperature sensor is placed in a channel for the extraction. To prevent overheating, pressure switch is placed before heater, and after the heater - limit thermostat.

Duct water heater / cooler

Envisaged for air conditioning of rooms no.27, 28, 24, 19 at the western side of facility and have a significant heat load.

System is connected to network piping of F/C apparatus.

Regulator is a room one and placed in room 27. Triple-arm valve is 3/4" also Carrier.

Radiator heating

For ancillary facilities that have external windows are provided electric convectors, type TPA and VPS (IP24 protection from moisture and splash). Convectors are supplied with thermostat and overheat protection.

Air curtains

At the main entrance are placed two hot water air curtains length of 1500mm. Air curtains are connected to network piping of F/C apparatus.

Operation of curtains is controlled by central system. Maintained temperature in the room. Regulation opens / closes the valve on the water side, it is also possible the choice of first or second fan speed as well as curtains switching off.

I floor– Maternity rooms and central sterilization

I floor – Delivery room

System K-4

System K-4 (3950 m³/h) is envisaged for air conditioning of delivery rooms, sterile corridor and incoming communication.

Air conditioning chamber is hygienic (washable), multi-level performance and is located in the technical area in the attic of the new annex.

The supply air is prepared in a fresh air section, which consists of the following elements:

- Section of input jack with motor ON/OFF dumper and flex. connection.

- Filter class EU4

- Filter class EU7

- Section of heat recuperator

- Section of hot water air heater

- Section of air cooler

- Section of air humidifier

- Section of electrical re-heaters of air

- Section of propelled fan

- Silencer

- Filter class EU 9

- Silencer

- Section of output jack with flex. Connection

The air for air conditioning is prepared in a manner that fresh air is first filtered in filter class EU4 and EU7, heated / cooled in a recuperate unit, then heated in winter with hot-water heaters, and in the summer and in transitional period it is cooled and dehumidified in the air fridge. In the winter period the air is moisturized via steam humidifier, and in the summer and transitional period it is reheated via the electrical re-heaters. Then thus-treated air through is filtered by silencer and a final filter class EU9 and distributed through the channels of galvanized sheet.

Duct is for pressures up to 2000Pa and air velocity up to 10m/s.

In order to meet the tightness at all seams and joints is applied hermetic type SDS.

In order to prevent condensation and reduce noise in the system, the entire duct system (insertion) is isolated with adhesive thermal insulation with a vapour barrier. The insulation thickness is 10 mm.

Distribution elements have plenums and are connected to duct system of galvanized sheet metal through flexible hoses that absorb sound.

Distributive elements for air supply consist of high efficiency filters; class H13, connections for measuring pressure drop and the DOP test.

Replacing the filter is carried out from the room.

The air from the room is sucked through captor aluminium grid and by channels of galvanized sheet metal through false ceilings is conducted to the exhaust ventilation section KO-4 (3550m³/h) and thrown further into the surrounding atmosphere.

Ventilation section consists of the following elements:

- Section of input jack with flex. connection.
- Section of heat recuperate unit
- Section of exhaust fan
- Section of output jack with flex. connection.

Automatic operation of the system

Insertion system is designed to operate with a constant flow rate.

On inserting, in front of each distribution element are mounted controllers for maintaining constant flow. Regulators are with weight, without auxiliary power, circular and square section. The fan engine of section of fresh air for air chambers is with variable speed. The difference between the static and dynamic pressure is measured at the measuring cross, on the first section behind the chamber and this value is held constant.

This achieves constant design flow, not depending on the contamination of the filter.

Air temperature and humidity are measured in the channel for air supply.

The system of extraction is designed to operate with a constant flow rate.

At the entrance to the chamber is measured static pressure, and this value is kept constant.

System K-5

System K-5 (4500 m³/h) is designed for conditioning of maternity hospital OP room.

Air conditioning chamber is hygienic (washable), multi-level performance and is located in the technical area in the attic of the new annex.

The supply air is prepared in a fresh air section, which consists of the following elements:

- Section of input jack with motor ON/OFF dumper and flex. connection.
- Filter class EU4
- Filter class EU7
- Section of heat recuperate unit
- Section of hot water air heater
- Section of air cooler
- Section of air humidifier
- Section of electrical re-heaters of air
- Section of propelled fan
- Silencer
- Filter class EU 9
- Silencer
- Section of output jack with flex. connection.

The air for air conditioning is prepared in a manner that fresh air is first filtered in filter class EU4 and EU7, heated / cooled in a recuperate unit, then heated in winter with hot-water heaters, and in the summer and in transitional period it is cooled and dehumidified in the air fridge. In the winter period the air is moisturized via steam humidifier, and in the summer and transitional period it is reheated via the electrical re-heaters. Then thus-treated air through is filtered by silencer and a final filter class EU9 and distributed through the channels of galvanized sheet.

Duct is for pressures up to 2000Pa and air velocity up to 10m/s.

In order to meet the tightness at all seams and joints is applied hermetic type SDS.

In order to prevent condensation and reduce noise in the system, the entire duct system (insertion) is isolated with adhesive thermal insulation with a vapour barrier. The insulation thickness is 10 mm.

Distribution elements have plenums and are connected to duct system of galvanized sheet metal through flexible hoses that absorb sound.

Distributive elements for air supply consist of high efficiency filters; class H13, connections for measuring pressure drop and the DOP test.

Replacing the filter is carried out from the room.

The air from the room is sucked through captor aluminium grid and by channels of galvanized sheet metal through false ceilings is conducted to the exhaust ventilation section KO-5 (4600m³/h) and thrown further into the surrounding atmosphere. Ventilation section consists of the following elements:

- Section of input jack with flex. connection
- Section of heat recuperate unit
- Section of exhaust fan
- Section of output jack with flex. connection

Automatic operation of the system

Insertion system is designed to operate with a constant flow rate.

On inserting, in front of each distribution element are mounted controllers for maintaining constant flow. Regulators are with weight, without auxiliary power, circular and square section.

The fan engine of section of fresh air for air chambers is with variable speed. The difference between the static and dynamic pressure is measured at the measuring cross, on the first section behind the chamber and this value is held constant.

This achieves constant design flow, not depending on the contamination of the filter.

Over-pressure of +20Pa in OP room compared to the corridor is maintained using engine flow regulator.

Air temperature and humidity are measured in the channel for extracting.

In control panel located in the OP room it is possible to read the following sizes:

temperature and humidity of the air, over-pressure in the room and degree of contamination of HEPA filter. When the values go out the limits light signal turns on or the like.

In control box there is also the option for the surgeon and staff to change air temperature in the range of 22-26 degC.

Exhaust chamber works with variable flow.

The fan engine of exhaust air section for air chamber is with variable speed. Static pressure is measured on the first section in front of the chamber and this value is held constant.

System K-5a

System K-5a (2500m³/h) is designed for conditioning rooms that are designed to accommodate the babies.

Air conditioning chamber is hygienic (washable), multi-level performance and is located in the technical area in the attic of the new annex.

The supply air is prepared in a fresh air section, which consists of the following elements:

- Section of input jack with motor ON/OFF dumper and flex. connection
- Filter class EU4
- Filter class EU7
- Section of heat recuperate unit
- Section of hot water air heater
- Section of air cooler
- Section of air humidifier
- Section of electrical re-heaters of air
- Section of propelled fan
- Silencer
- Filter class EU 9
- Silencer
- Section of output jack with flex. connection

The air for air conditioning is prepared in a manner that fresh air is first filtered in filter class EU4 and EU7, heated / cooled in a recuperate unit, then heated in winter with hot-water heaters, and in the summer and in transitional period it is cooled and dehumidified in the air fridge. In the winter period the air is moisturized via steam humidifier, and in the summer and transitional period it is reheated via the electrical re-heaters. Then thus-treated air through is filtered by silencer and a final filter class EU9 and distributed through the channels of galvanized sheet.

Duct is for pressures up to 2000Pa and air velocity up to 10m/s.

In order to meet the tightness at all seams and joints is applied hermetic type: SDS.

In order to prevent condensation and reduce noise in the system, the entire duct system (insertion) is isolated with adhesive thermal insulation with a vapour barrier. The insulation thickness is 10mm.

Distribution elements have plenums and are connected to duct system of galvanized sheet metal through flexible hoses that absorb sound.

Distributive elements for air supply consist of high efficiency filters; class H13, connections for measuring pressure drop and the DOP test.

Replacing the filter is carried out from the room.

The air from the room is sucked through captor aluminium grid and by channels of galvanized sheet metal through false ceilings is conducted to the exhaust ventilation section KO-5a (2150m³/h) and thrown further into the surrounding atmosphere. Ventilation section consists of the following elements:

- Section of input jack with flex. connection
- Section of heat recuperate unit
- Section of exhaust fan
- Section of output jack with flex. connection

Automatic operation of the system

Insertion system is designed to operate with a constant flow rate.

On inserting, in front of each distribution element are mounted controllers for maintaining constant flow. Regulators are with weight, without auxiliary power, circular and square section.

The fan engine of section of fresh air for air chambers is with variable speed. The difference between the static and dynamic pressure is measured at the measuring cross, on the first section behind the chamber and this value is held constant.

This achieves constant design flow, not depending on the contamination of the filter.
Air temperature and humidity are measured in the channel for air supply.
The system of extraction is designed to operate with a constant flow rate.
At the entrance to the chamber is measured static pressure, and this value is kept constant.

System K-6

System K-6 (4500m³/h) is designed for air conditioning of room for central sterilization, which is located on the first floor.

Air conditioning chamber is hygienic (washable), multi-level performance and is located in the technical area in the attic of the new annex.

The supply air is prepared in a fresh air section, which consists of the following elements:

- Section of input jack with motor ON/OFF dumper and flex. connection
- Filter class EU4
- Filter class EU7
- Section of heat recuperate unit
- Section of hot water air heater
- Section of air cooler
- Section of air humidifier
- Section of electrical re-heaters of air
- Section of propelled fan
- Silencer
- Filter class EU 9
- Silencer
- Section of output jack with flex. connection

The air for air conditioning is prepared in a manner that fresh air is first filtered in filter class EU4 and EU7, heated / cooled in a recuperate unit, then heated in winter with hot-water heaters, and in the summer and in transitional period it is cooled and dehumidified in the air fridge. In the winter period the air is moisturized via steam humidifier, and in the summer and transitional period it is reheated via the electrical re-heaters. Then thus-treated air through is filtered by silencer and a final filter class EU9 and distributed through the channels of galvanized sheet.

Duct is for pressures up to 2000Pa and air velocity up to 10m/s.

In order to meet the tightness at all seams and joints is applied hermetic type SDS.

In order to prevent condensation and reduce noise in the system, the entire duct system (insertion) is isolated with adhesive thermal insulation with a vapour barrier. The insulation thickness is 10mm.

Distribution elements have plenums and are connected to duct system of galvanized sheet metal through flexible hoses that absorb sound.

Distribution elements for air supply are composed of hand controls the air flow.

The air from the room is sucked through captor aluminium grid and by channels of galvanized sheet metal through false ceilings is conducted to the exhaust ventilation section KO-6 (2100m³/h) and thrown further into the surrounding atmosphere. Ventilation section consists of the following elements:

- Section of input jack with flex. connection
- Section of heat recuperate unit
- Section of exhaust fan
- Section of output jack with flex. connection

Automatic operation of the system

Insertion system is designed to operate with a constant flow rate.

The fan engine of section of fresh air for air chamber is with variable speed. Static pressure is measured on the first section behind the chamber and this value is held constant.

Air temperature and humidity are measured on the first section behind the chamber.

The system of extraction is designed to operate with a constant flow rate.

At the entrance to the chamber is measured static pressure, and this value is kept constant.

The system of maintaining relative humidity in the room where placed pass-through autoclaves

The system consists of a duct fan with variable speed and relative humidity sensors which are filtered and motor flow regulator on inserting.

When relative humidity is $\leq 55\%$, fan operates at 400m³/h and the flap is in a minimum open position.

When relative humidity is $\geq 70\%$, fan operates at 1000m³/h and the flap is in a maximum open position (flow rate 1000m³/h).

For values between 55 i 70%, flow is altered linearly 400 to 1000m³/h.

Duct electric heater

It is designed for the dressing room, where the design temperature is higher compared to other rooms of the system K-6.

Electric heaters are single phase and are managed by controller pulser. Operating temperature sensor is placed in a channel for the extraction. To avoid overheating, pressure switch is placed before heater, and limit thermostat after the heater.

System OV-11

System OV-11 is designed for extraction of polluted air from toilets and dressing room. The air is sucked through Pv valve and through the roof discharged into the atmosphere. The fan is located in the technical area of the attic.

System OV-15

System OV-15 is designed for extraction of polluted air from room envisaged for chemical substances. The air is sucked through Pv valve and through the roof discharged into the atmosphere. The fan is located in the technical area of the attic. The fan is of made of plastic, resistant to chemicals, the channels are of stainless steel.

System OV-16

System OV-16 is designed for extraction of polluted air from control laboratory. The air is sucked through Pv valve and through the roof discharged into the atmosphere. The fan is located in the technical area of the attic. The fan is of made of plastic, resistant to chemicals, the channels are of stainless steel.

III floor – Intensive care

System K-13

System K-13 (3100m³/h) is designed for air conditioning of OP room of intensive care and auxiliary rooms.

Air conditioning chamber is hygienic (washable), multi-level performance and is located in the technical area in the attic of the new annex.

The supply air is prepared in a fresh air section, which consists of the following elements:

- Section of input jack with motor ON/OFF dumper and flex. connection
- Filter class EU4
- Filter class EU7
- Section of heat recuperate unit
- Section of hot water air heater
- Section of air cooler
- Section of air humidifier
- Section of electrical re-heaters of air
- Section of propelled fan
- Silencer
- Filter class EU 9
- Silencer
- Section of output jack with flex. connection

The air for air conditioning is prepared in a manner that fresh air is first filtered in filter class EU4 and EU7, heated / cooled in a recuperate unit, then heated in winter with hot-water heaters, and in the summer and in transitional period it is cooled and dehumidified in the air fridge. In the winter period the air is moisturized via steam humidifier, and in the summer and transitional period it is reheated via the electrical re-heaters. Then thus-treated air through is filtered by silencer and a final filter class EU9 and distributed through the channels of galvanized sheet.

Duct is for pressures up to 2000Pa and air velocity up to 10m/s.

In order to meet the tightness at all seams and joints is applied hermetic type SDS.

In order to prevent condensation and reduce noise in the system, the entire duct system (insertion) is isolated with adhesive thermal insulation with a vapour barrier. The insulation thickness is 10mm.

Distribution elements have plenums and are connected to duct system of galvanized sheet metal through flexible hoses that absorb sound.

Distributive elements for air supply consist of high efficiency filters; class H13, connections for measuring pressure drop and the DOP test.

Replacing the filter is carried out from the room.

The air from the room is sucked through captor aluminium grid and by channels of galvanized sheet metal through false ceilings is conducted to the exhaust ventilation section KO-13 (3100m³/h) and thrown further into the surrounding atmosphere.

Ventilation section consists of the following elements:

- Section of input jack with flex. connection
- Section of heat recuperate unit
- Section of exhaust fan

Section of output jack with flex. connection

Automatic operation of the system

Insertion system is designed to operate with a constant flow rate.

On inserting, in front of each distribution element are mounted controllers for maintaining constant flow. Regulators are with weight, without auxiliary power, circular and square section.

The fan engine of section of fresh air for air chambers is with variable speed. The difference between the static and dynamic pressure is measured at the measuring cross, on the first section behind the chamber and this value is held constant.

This achieves constant design flow, not depending on the contamination of the filter.

Over-pressure of +20Pa in the OP room compared to the corridor is held by changing rotation number of exhaust fan in air condition chamber.

Air temperature and humidity are measured in the channel for the draw out.

In control panel located in the OP room it is possible to read the following sizes:

temperature and humidity of the air, over-pressure in the room and degree of contamination of HEPA filter. When the values go out the limits light signal turns on or the like.

In control box there is also the option for the surgeon and staff to change air temperature in the range of 22-26degC.

Exhaust chamber works with variable flow.

By changing rotation number of exhaust fan the pressure in the OP room is maintained.

System K-14

System K-14 (7550m³/h) is designed for air conditioning of room of intensive care.

Air conditioning chamber is hygienic (washable), multi-level performance and is located in the technical area in the attic of the new annex.

The supply air is prepared in a fresh air section, which consists of the following elements:

Section of input jack with motor ON/OFF dumper and flex. connection

Filter class EU4

Filter class EU7

Section of heat recuperate unit

Section of hot water air heater

Section of air cooler

Section of air humidifier

Section of electrical re-heaters of air

Section of propelled fan

Silencer

Filter class EU 9

Silencer

Section of output jack with flex. connection

The air for air conditioning is prepared in a manner that fresh air is first filtered in filter class EU4 and EU7, heated / cooled in a recuperate unit, then heated in winter with hot-water heaters, and in the summer and in transitional period it is cooled and dehumidified in the air fridge. In the winter period the air is moisturized via steam humidifier, and in the summer and transitional period it is reheated via the electrical re-heaters. Then thus-treated air through is filtered by silencer and a final filter class EU9 and distributed through the channels of galvanized sheet.

Duct is for pressures up to 2000Pa and air velocity up to 10m/s.

In order to meet the tightness at all seams and joints is applied hermetic type SDS.

In order to prevent condensation and reduce noise in the system, the entire duct system (insertion) is isolated with adhesive thermal insulation with a vapour barrier. The insulation thickness is 10mm.

Distribution elements have plenums and are connected to duct system of galvanized sheet metal through flexible hoses that absorb sound.

Distributive elements for air supply consist of high efficiency filters; class H13, connections for measuring pressure drop and the DOP test.

Replacing the filter is carried out from the room.

The air from the room is sucked through captor aluminium grid and by channels of galvanized sheet metal through false ceilings is conducted to the exhaust ventilation section KO-14 (8400m³/h) and thrown further into the surrounding atmosphere.

Ventilation section consists of the following elements:

- Section of input jack with flex. connection
- Section of heat recuperate unit
- Section of exhaust fan
- Section of output jack with flex. connection

Automatic operation of the system

Insertion system is designed to operate with a constant flow rate.

On inserting, in front of each distribution element are mounted controllers for maintaining constant flow. Regulators are with weight, without auxiliary power, circular and square section. The fan engine of section of fresh air for air chambers is with variable speed. The difference between the static and dynamic pressure is measured at the measuring cross, on the first section behind the chamber and this value is held constant.

This achieves constant design flow, not depending on the contamination of the filter.

Air temperature and humidity are measured in the channel for air supply.

Exhaust chamber works with constant flow.

At the entrance to the chamber is measured static pressure, and this value is kept constant.

System K-15

System K-15 (6150m³/h) is designed for air-conditioning of auxiliary rooms of the third floor.

Air conditioning chamber is hygienic (washable), multi-level performance and is located in the technical area in the attic of the new annex.

The supply air is prepared in a fresh air section, which consists of the following elements:

- Section of input jack with motor ON/OFF dumper and flex. connection
- Filter class EU4
- Filter class EU7
- Section of heat recuperate unit
- Section of hot water air heater
- Section of air cooler
- Section of air humidifier
- Section of electrical re-heaters of air
- Section of propelled fan
- Silencer
- Filter class EU 9
- Silencer
- Section of output jack with flex. connection

The air for air conditioning is prepared in a manner that fresh air is first filtered in filter class EU4 and EU7, heated / cooled in a recuperate unit, then heated in winter with hot-water heaters, and in the summer and in transitional period it is cooled and dehumidified in the air fridge. In the winter period the air is moisturized via steam humidifier, and in the summer and transitional period it is reheated via the electrical re-heaters. Then thus-treated air through is filtered by silencer and a final filter class EU9 and distributed through the channels of galvanized sheet.

Duct is for pressures up to 2000Pa and air velocity up to 10m/s.

In order to meet the tightness at all seams and joints is applied hermetic type SDS.

In order to prevent condensation and reduce noise in the system, the entire duct system (insertion) is isolated with adhesive thermal insulation with a vapour barrier. The insulation thickness is 10mm.

Distribution elements have plenums and are connected to duct system of galvanized sheet metal through flexible hoses that absorb sound.

Distributive elements for air supply consist of manual controls of airflow.

The air from the room is sucked through captor aluminium grid and by channels of galvanized sheet metal through false ceilings is conducted to the exhaust ventilation section KO-15 (2750m³/h) and thrown further into the surrounding atmosphere. Ventilation section consists of the following elements:

Section of input jack with flex. connection

Section of heat recuperate unit

Section of exhaust fan

Section of output jack with flex. connection

Automatic operation of the system

Insertion system is designed to operate with a constant flow rate.

The fan engine of exhaust air section for air chamber is with variable speed. Static pressure is measured on the first section in front of the chamber and this value is held constant

Air temperature and humidity are measured on the first section behind the chamber.

The system of extraction is designed to operate with a constant flow rate.

At the entrance to the chamber is measured static pressure, and this value is kept constant.

System OV-13

System OV-13 is designed for extraction of polluted air from toilets and dressing rooms. The air is sucked through Pv valve and through the roof discharged into the atmosphere. The fan is located in the technical area of the attic.

System OV-17

System OV-17 is designed for extraction of polluted air from laboratory. The air is sucked through Pv valve and through the roof discharged into the atmosphere. The fan is located in the technical area of the attic. The fan is of made of plastic, resistant to chemicals, the channels are of stainless steel.

System V-1

It is designed for ventilation, heating and cooling technical rooms on the third floor.

The system consists of filters EU4, the water heater/cooler, fan for insertion and irreversible flaps.

After the heater / cooler is set frost thermostat.

The system is connected to pipe network of F/C appliances.

Fans are coupled and are turned on over the wall thermostat TSO 672, the product Sauter or similar, which has the option of setting: heating, cooling, off, and adjustment range of temperatures from +5 to +30°C.

Loft - a technical room

System V-2

It is designed for ventilation, heating and cooling technical room in the loft.

The system consists of filters EU4, the water heater/cooler, fan for insertion and irreversible flaps.

The system is connected to pipe network of F/C appliances.

Fans are coupled and are turned on over the central system. Maintained temperature in the room from +5 to +30°C.

FAN CONVECTORS

By system of fan convector cooling rooms is realized in the summer and heating in winter. The fan convectors are connected to two-pipe system and in summer they work with water 7/12°C and in winter with water 60/50°C.

The fan convectors are placed in the parapet below the window.

Pipe network of fan convectors is kept in a suspended ceiling of the floor below.

Pipes are PPR PN20, the insulation is made of expanded rubber thickness 13mm.

For each F/C is provided by one ball, balancing (terminal) and the vent valve.

For each floor are designed two branches (eastern and western), and in each branch on transition of the metal to plastic piping is set filter with two ball valves in distribution, and balancing valve in return.

Carrier fan convectors are designed, type: 42N for floor installation.

In areas with high efficiency filters, instead of the standard G2 filters are designed F / C appliances with 'plasma' 'antibacterial filters.

Individual regulation of operation is provided. For each room where the F/C apparatus is situated, one wall controller type "A" is placed.

Room temperature is adjusted on the controller, fan mode, summer or winter regime and it allows the possibility of reducing the cooling/heating by $\pm 4^{\circ}\text{C}$ to save energy.

To prevent excessive condensation and to increase comfort on the "water side" are set 3-arm valves.

Condensate drain is from FC appliance from PP PN10 flexible pipes Ø20, which are further connected via a siphon to the horizontal of PP pipes for home sewage, dimensions Ø32.

Horizontal is conducted with a decline of 2% and is connected to a drain of a sewage system.

CONNECTIONS TO INSTALLATION OF HOT AND COLD WATER

Air conditioning chambers

Chambers are supplied with hot water 110/70°C from existing boiler room and cold water 7/12°C from cooling plant.

Substation and pipeline distribution are treated by design of I phase.

Design of I phase envisages reserves in capacity of air chambers for I-b stage, as following:

- for III floor: 110/70°C – 255.000W
7/12°C – 100.000W
- for IV floor: 110/70°C – 800.000W
7/12°C – 380.000W

In Design of the I-b phase the required capacities of air chambers of I-b stage are:

- for III floor: 110/70°C – 150.000W
7/12°C – 82.000W
- for IV floor: 110/70°C – 493.000W
7/12°C – 275.000W

Based on the above it can be concluded that the alleged capacity is not exceeded.

The exact feed points of chambers and nominal size of connections (ball and balancing valve) of Phase I-b are given in the graphic documentation of Mechanical Design on Phase Ib.

F/C appliances

F/C appliances are supplied with hot water 7/12°C and 60/50°C from the newly designed substation.

The substation and piping are processed in the Phase I design.

Design of I phase envisages reserves in capacity of F/C appliances, as following:

- $Q_{gr} = 15.000W$
- $Q_{hl} = 15.000W$

In Design of the I-b phase the required capacities of F/C appliances of I-b phase are:

- $Q_{gr} = 55.794W$
- $Q_{hl} = 69.358W$

Total capacity of I and I-b phase of system 7/12°C and 60/50°C are:

- $Q_{gr} = 130.494W$
- $Q_{hl} = 174.258W$
- $q(7/12°C) = 32274 \text{ kg/h}$
- $q(110/70°C) = 3000 \text{ kg/h}$

By checking it has been found that the nominal size of piping and fittings meet the new, higher capacity, and that replacement of pumps and 3-arm reg. valve designed in the first phase should be done:

Mechanical design of I phase, drawing: gp-II.1-MGV-009 – Scheme of connecting newly designed substation with the existing boiler room:

- item.10 – circulation pump, 3m³/h, 35kPa, replaces pump UPS 32-60 180
- item.13 – circulation pump, 33m³/h, 95kPa, replaces pump TP 65-110/4

item.19 – 3-arm reg. valve, kvs=10m³/h, 3m³/h, 9kPa, replaces 3-arm reg. valve kvs=6.3m³/h

To facilitate operation of the installation in the first phase, it is necessary to perform the entire network 7/12°C (60/50°C), and install F/C appliances and other equipment in phase Ib.

Pipeline distribution

Horizontal pipeline (distribution and return) of hot water 110/70°C, dimensions Ø133x4 by design of the first phase has been foreseen under the ceiling of the ground floor.

Due to the small height of the ceiling and a large number of installations, pipeline shall be moved in suspended ceiling of the basement, where there is enough space.

4.3. MECHANICAL PART

TECHNICAL DESCRIPTION

Based on the terms of reference the relocation of the existing diesel generator of 250 KVA in the newly designed space has been provided. The design envisages dismantling, safety control and transmission of all equipment in the new space.

Ventilation of space is provided in a natural way through the blinds built into the door and facade wall. On the inside of the external fixed blinds power drive closing flaps are set, being open when starting diesel generator.

Exhaust pipes are carried out on the facade. Before reassembling, the tank of liquid fuels (0.4 m³) should be rinsed, corrosion protected and painted. Supply pipes and reinforcement should be replaced. Below the tank it is necessary to set the tub for discharging (0.5 m³). In the space of diesel generator, metal case with sand (0.25 m³) and a shovel as well as fire extinguisher should be installed.

To maintain a minimum temperature to start diesel generator, installation of electric fan heater power of 3 kW guided by ambient thermostat is planned.

TECHNICAL DESCRIPTION

Distribution line

Due to the specific character of the installation and the known antibacterial effect of copper, the distribution line for the medical gasses shall be delivered from special, attested, grease-free and deoxidised high-phosphorous copper tubes SF-Cu DIN EN 1057 and DIN EN 12168.

The tubes are seamless, smooth drawn, annealed in vacuum and delivered as soft in rolls 25 m long or as hard in straight 5 m long tubes. They are connected with copper fittings and welded joints by brazing with silver in a protective atmosphere of acetylene flame, without the use of oxygen. For the fittings, non-organic materials, primarily Teflon tapes, are used for sealing.

Pipelines of the medical gasses and vacuum between the facility of the medical gasses station and facility of the Surgical Ward are to be placed under ground, inside a concrete conduit whose dimensions are 400 x 500 mm.

Main pipelines shall have the following dimensions:

- | | |
|-----------------------------------|-------------|
| ❑ Oxygen (O ₂) | Ø 22 x 1 mm |
| ❑ Compressed air 5 bar (KV5) | Ø 22 x 1 mm |
| ❑ Compressed air 8 ± 2 bar (KV10) | Ø 22 x 1 mm |

- | | |
|---|-------------|
| <input type="checkbox"/> Nitrous oxide (N ₂ O) | Ø 15 x 1 mm |
| <input type="checkbox"/> Vacuum (VAK) | Ø 54 x 2 mm |

Immediately after introduction of the main pipeline for vacuum Ø 54 x 2 mm to the Energy conduit, two parallel secretion separators are placed, which have the function of preventing deposit of secretion in the underground section of the pipeline and its clogging. The underground section of the pipeline for vacuum is also its lowest section.

In the distribution network along the hallways and rooms, the pipes are to be delivered horizontally above the lowered ceiling and tightened with collars. Vertical lowering of the pipes towards the connecting ports shall be done by means of inter-constructing of mounting compartment walls or under the plaster, if the compartment walls are made of solid material.

Pipeline marking

Direction of the flow of medical gasses and exhaust pipelines for vacuum should be marked with an arrow. Pipelines are to be marked also with rings of different colour for each type of gas, placed at every 5 metres and at every branching or turning point of the pipeline:

- | | |
|--|--------|
| <input type="checkbox"/> Oxygen | blue |
| <input type="checkbox"/> Nitrous oxide | grey |
| <input type="checkbox"/> Compressed air 5 bar | yellow |
| <input type="checkbox"/> Compressed air 10 bar | yellow |
| <input type="checkbox"/> Vacuum | white |

Additionally, according to DIN 13260, markings of the following mediums have also been established:

- ☐ For compressed air, - pressure in bar,
- ☐ For compressed air engine- "Exhaust gas of the compressed air engine ", black letters on yellow background;
- ☐ Exhaust of anaesthesia gas - "Outlet of anaesthesia gas", black or white letters on purple background in accordance with ISO/DP 7281:1988.

Control valve box

To control pressure in the distribution network and to enable the possibility of separating certain segments, standard control boxes (KVK) are to be installed, equipped with grab valves, contact manometers and vacuum metres for signalisation, so that, in event of works being carried out on the installation or in case of fire, they could interrupt the supply of one portion of the consumers, without interrupting the operation of the entire installation. They are to be installed inside the mounting construction of the compartment walls or by digging inside the wall made of solid material.

Medical and technical staff on-call shall have immediate information on the current state of the medical gas and vacuum supply system and they may take necessary actions. In case of emergency, these control boxes may be opened without a key, for the purpose of closing the valves, by hitting the lock with a fist, and it will fall out of place without any damage.

Connecting ports

For points of consumption of medical gases and vacuum, i.e. connecting ports, automatic, quick-release standard receptacles are to be installed. These receptacles vary, depending on the type of

gas, i.e. they have different profiles, so that it prevents mistakes in connecting devices and consumption of the wrong gas.

Capacity of the medical gases 5 bar receptacle is 40 ± 3 litres per minute, upon working pressure of 5 ± 0.5 bar, and maximum working pressure is 10 bar. Capacity of the vacuum receptacle is 25 ± 2 litres per minute, upon vacuum of -0.7 ± 0.2 bar.

Receptacles may be installed in different ways, depending on the type and purpose of the room where they are placed. They are placed inside installation conduits and in stationary and moveable supplying units, such as anaesthesiology and surgical stands in operation rooms, stands in post-operational recovery and intensive care rooms. Connecting ports for medical gases and vacuum inside the wall and ceiling installation conduits are presented in the technical design for the equipment.

WALL INSTALLATION CONDUITS - PREPARATION

Purpose: Connection and operation of all kinds of devices to the installation of high and low electricity, medical gases and vacuum by means of installed receptacles.

Composition: Receptacle 220 V/16 A;
Low electricity receptacle;
Equipotential receptacle;
Medical gasses receptacles (O₂, KV5, N₂O);
Vacuum receptacle (VAK);
Box rails for tools.

Supply of gases: Outlet in the wall

SURGICAL CEILING STAND

Purpose: Supply of electrical energy, medical gases and vacuum, support of electrosurgical handpiece and other devices for the needs of surgeons.

Composition: Receptacles 220 V/16 A;
Low electricity receptacles;
Equipotential receptacles;
Compressed air receptacles 8 ± 2 bar (Air-Motor/KV10);
Compressed air receptacles 5 bar (KV5);
Vacuum receptacles (VAK).

Supply of gases: Outlet in the ceiling

Note: Parallel kit of receptacles on the operation room wall in the immediate vicinity of the surgical stand.

ANAESTHESIOLOGY CEILING STAND

Note: Supply of electricity, medical gases and vacuum, support of screens and other devices for the needs of the anaesthesiologists.

Composition: Receptacles 220 V/16 A;
Low electricity receptacles;
Equipotential bondage receptacles;
Oxygen receptacles (O₂);
Compressed air 5 bar receptacle (KV5)
Nitrous oxide receptacles (N₂O);
Vacuum receptacles (VAK);
Exhaust of expiratory gases receptacle.

Supply
of gases: Outlet in the ceiling

Note: Parallel kit of receptacles on the operation room wall immediately next to the anaesthesiology stand.

CEILING STAND – RECOVERY/ INTENSIVE CARE

Note: Connection and operation of all kinds of devices to the installation of high and low electricity; medical gases and vacuum by means of installed receptacles.

Composition: Receptacles 220 V/16 A;
Equipotential receptacles;
Oxygen (O₂) receptacles;
Compressed air 5 bar receptacles (KV5);
Receptacles for devices;
Box rails for tools.

Supply of gasses: Outlet in the ceiling,

Outlets for gas supply are the following:

1. ANAESTHESIOLOGY STANDS

O₂ - Ø 8 x 1 mm
KV5 - Ø 12 x 1 mm
N₂O - Ø 8 x 1 mm
VAK - Ø 12 x 1 mm
Narcotics discharge Ø 15 x 1 mm

2. SURGICAL STANDS (CARDIOLOGY, ORTHOPAEDICS)

KV5 - Ø 8 x 1 mm
KV10 - Ø 12 x 1 mm
VAK - Ø 12 x 1 mm
Air-Motor discharge Ø 15 x 1 mm

3. SURGICAL STANDS (GYNAECOLOGY, UROLOGY, GENERAL SURGERY, ORL + OFT)

KV5 - Ø 8 x 1 mm
VAK - Ø 12 x 1 mm

4. RECOVERY

O2 - Ø 8 x 1 mm
KV5 - Ø 8 x 1 mm
VAK - Ø 12 x 1 mm

5. ANAESTHESIOLOGY SPARE WALL KIT

O2 - Ø 8 x 1 mm
KV5 - Ø 12 x 1 mm
N2O - Ø 8 x 1 mm
VAK - Ø 12 x 1 mm
Narcotics discharge Ø 15 x 1 mm

6. SURGICAL SPARE WALL SET (CARDIOLOGY, ORTHOPAEDICS)

KV5 - Ø 8 x 1 mm
KV10 - Ø 12 x 1 mm
VAK - Ø 12 x 1 mm
Air-Motor discharge Ø 15 x 1 mm

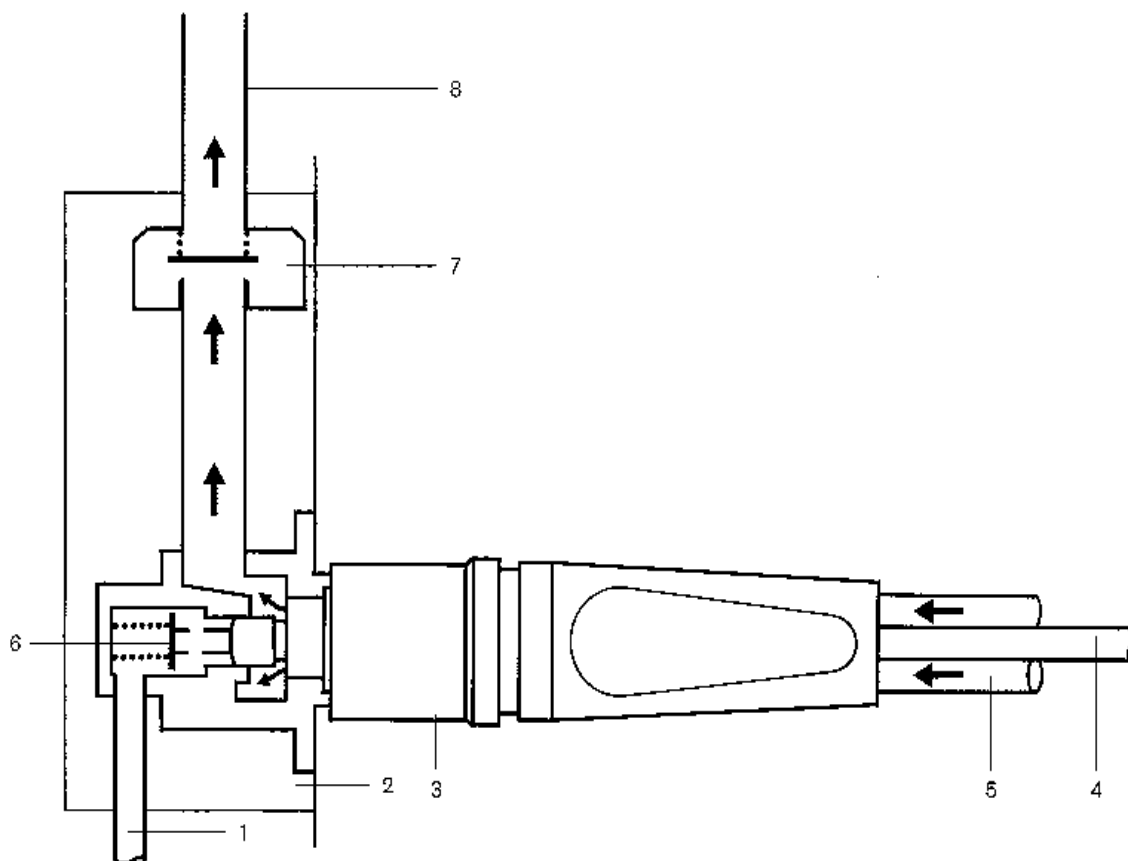
7. SURGICAL SPARE WALL SET (GYNAECOLOGY, UROLOGY, GENERAL SURGERY, ORL + OFT)

KV5 - Ø 8 x 1 mm
VAK - Ø 12 x 1 mm

8. PREPARATION

O2 - Ø 8 x 1 mm
KV5 - Ø 8 x 1 mm
N2O - Ø 8 x 1 mm
VAK - Ø 12 x 1 mm

Connecting port – mounting elements



- | | |
|---|--|
| 1 Service valve | 6 Plug-in coupling (Steckkupplung) |
| 2 Valve | 7 Inner profile for every type of gas |
| 3 Flush mounting box
with a branch pipe Ø 8 x 1 mm | 8 Profiled opening for every type of gas (EN
737-3) |
| 4 Gasket/Seal | 9 Wire end sleeve |
| 5 Gasket/Seal ring ("O"-ring) | 10 Protective plastics |

Connecting ports (receptacles) for compressed air 8 ± 2 bar (KV 10) are different from the connecting ports for other medical gases.

Principle and functional difference is in the fact that the compressed air is supplied to the device via connecting port and at the same time exhausted to the atmosphere.

This is necessary to avoid pollution with exhaust air from the device of the sterile environment in the rooms in which compressed air 10 bar is used.

Connecting port KV 10 / Air-Motor

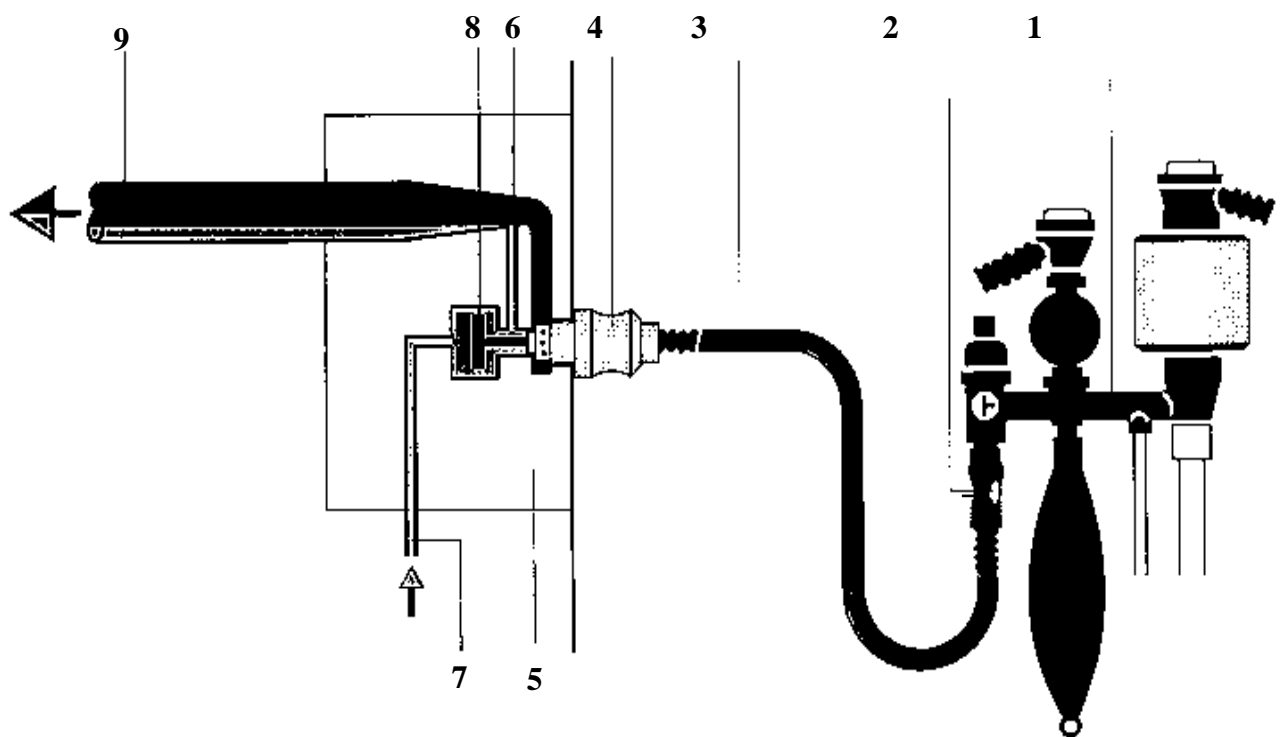
- | | |
|---|---|
| 1 Supply of compressed air 8 ± 2 bar, $\varnothing 8 \times 1$ mm | 5 Exhaust air |
| 2 Flush mounting box | 6 Valve |
| 3 Socket | 7 Check valve |
| 4 Powering air 8 ± 2 bar to the pneumatic tools | 8 Exhaust tube of the Air-Motor, $\varnothing 15 \times 1$ mm |

Receptacle for the connecting port of the exhaust of anaesthesia gas in the operation rooms, during long operations, is also specific. For shorter interventions which require anaesthesia, it is not necessary to exhaust the anaesthesia gas, given the low concentration.

Via tubes $\varnothing 8 \times 1$ mm compressed air 5 bar is supplied to this receptacle, and the air is used for powering the ejector which sucks out the anaesthesia gas and discharges it into the atmosphere.

Discharge of anaesthesia gas must be installed, because otherwise the anaesthesia gas which the patient exhales would accumulate inside the operation room and endanger the present medical staff.

Connecting port for discharge of anaesthesia gas (discharge of expiratory gases)



- | | |
|---|--|
| 1 Circular anaesthesia system | 6 Ejector |
| 2 Suction duct for the surrounding air | 7 Compressed air 5 bar, $\varnothing 8 \times 1$ mm |
| 3 Hose for extracting anaesthesia gas | 8 Valve |
| 4 Socket for discharge of anaesthesia gases | 9 Exhaust tube for discharge into the atmosphere, $\varnothing 15 \times 1$ mm |
| 5 Flush mounting box | |

In every operation room on the II floor, one connecting port on the surgical stand and one spare port on the wall are to be installed for discharge of gases from the pneumatic (Air-Motor), with an exhaust tube Ø 15 x 1 mm for discharge into the atmosphere, and one connecting port for discharge of anaesthesia gas (discharge of expiratory gases) on the anaesthesiology stand and one spare port on the wall, also with an exhaust tube Ø 15 x 1 mm for discharge into the atmosphere, are to be installed.

Signalisation

To avoid grave consequences of possible interruption of supply of medical gases, alarming in event of non-permitted, extremely high and low pressures inside the installations for the medical gases is to be applied, and it is to operate on both audio and visual level – with a signal lamp. The sound signal may be turned off, whereas the lamp will continue blink until the cause of alarm has been removed.

N – Safety alarm panels (*Notfallsignale*)

In every operation room:

N2	pressure O2 lower than 4 bar,
	pressure KV5 lower than 4 bar,
N2	pressure N2O lower than 4 bar,
	vacuum (VAK) lower than – 0.55 bar,

TECHNICAL DESCRIPTION

Introduction

The subject of this project with accompanying installations for ground floor (emergency room), first floor (maternity and central sterilization) and third floor (central intensive care hospitals) of the annex (phase I-B).

System description:

AIR CONDITIONING AND VENTILATION OF NEW OVERBUILT ANNEX FACILITY

SYSTEMS II-PHASE

Ground floor - Centre for care of emergencies (except operation hall with accompanying premises)

Ground floor – OP room

System K-2

System K-2 is scheduled for air conditioning of OP room and supporting facilities on the ground floor of the new extension to the annex facility, where the Centre for Medical Emergencies is located.

Air conditioning chamber is hygienic (washable), multi-level performance and is located in the technical area in the attic of the new annex.

The supply air is prepared in a fresh air section, which consists of the following elements:

- Section of input jack with motor ON/OFF dumper and flex. connection
- Filter class EU4
- Filter class EU7
- Section of heat recuperate unit
- Section of hot water air heater
- Section of air cooler
- Section of air humidifier
- Section of electrical re-heaters of air
- Section of propelled fan
- Silencer
- Filter class EU 9
- Silencer
- Section of output jack with flex. connection

The air for air conditioning is prepared in a manner that fresh air is first filtered in filter class EU4 and EU7, heated / cooled in a recuperate unit, then heated in winter with hot-water heaters, and in the summer and in transitional period it is cooled and dehumidified in the air fridge. In the winter period the air is moisturized via steam humidifier, and in the summer and transitional period it is reheated via the electrical re-heaters. Then thus-treated air through is filtered by silencer and a final filter class EU9 and distributed through the channels of galvanized sheet.

Duct is for pressures up to 2000Pa and air velocity up to 10m/s.

In order to meet the tightness at all seams and joints is applied hermetic type SDS.

In order to prevent condensation and reduce noise in the system, the entire duct system (insertion) is isolated with adhesive thermal insulation with a vapour barrier. The insulation thickness is 10mm.

Distribution elements have plenums and are connected to duct system of galvanized sheet metal through flexible hoses that absorb sound.

Distributive elements for air supply consist of high efficiency filters; class H13, connections for measuring pressure drop and the DOP test.

Replacing the filter is carried out from the room.

The air from the room is sucked through captor aluminium grid and by channels of galvanized sheet metal through false ceilings is conducted to the exhaust ventilation section KO-2 and thrown further into the surrounding atmosphere. Ventilation section consists of the following elements:

- Section of input jack with flex. connection
- Section of heat recuperate unit
- Section of exhaust fan
- Section of output jack with flex. connection

Automatic operation of the system

Insertion system is designed to operate with a constant flow rate.

On inserting, in front of each distribution element are mounted controllers for maintaining constant flow. Regulators are with weight, without auxiliary power, circular and square section.

The fan engine of section of fresh air for air chambers is with variable speed. The difference between the static and dynamic pressure is measured at the measuring cross, on the first section behind the chamber and this value is held constant.

This achieves constant design flow, not depending on the contamination of the filter.

Over-pressure of +20Pa in the OP room compared to the corridor is held by changing rotation number of exhaust fan in air condition chamber.

Air temperature and humidity are measured in the channel for the draw out.

In control panel located in the OP room it is possible to read the following sizes:

temperature and humidity of the air, over-pressure in the room and degree of contamination of HEPA filter. When the values go out the limits light signal turns on or the like.

In control box there is also the option for the surgeon and staff to change air temperature in the range of 22-26degC.

At a time when OP rooms are not used, in order to save energy and extend work of HEPA filters in the plenum, a switch in the control box is designed for turning off the device for re-circulation.

Exhaust chamber works with variable flow.

By changing rotation number of exhaust fan, the pressure in the OP room is maintained.

System K-3

System K-3 (9900m³/h) is designed for air conditioning of all rooms on the ground floor, except OP room with supporting rooms.

Air conditioning chamber is standard multi-floor performance and is located in the technical area in the attic of the new annex.

The supply air is prepared in a fresh air section, which consists of the following elements:

- Section of input jack with motor ON/OFF dumper and flex. connection
- Filter class EU4
- Filter class EU7
- Section of heat recuperate unit
- Section of hot water air heater
- Section of air cooler
- Section of air humidifier
- Section of electrical re-heaters of air
- Section of propelled fan
- Silencer
- Filter class EU 9
- Silencer
- Section of output jack with flex. connection

The air for air conditioning is prepared in a manner that fresh air is first filtered in filter class EU4 and EU7, heated / cooled in a recuperate unit, then heated in winter with hot-water heaters, and in the summer and in transitional period it is cooled and dehumidified in the air fridge. In the winter period the air is moisturized via steam humidifier, and in the summer and transitional period it is reheated via the electrical re-heaters. Then thus-treated air through is filtered by silencer and a final filter class EU9 and distributed through the channels of galvanized sheet.

Duct is for pressures up to 2000Pa and air velocity up to 10m/s.

In order to meet the tightness at all seams and joints is applied hermetic type SDS.

In order to prevent condensation and reduce noise in the system, the entire duct system (insertion) is isolated with adhesive thermal insulation with a vapour barrier. The insulation thickness is 10mm.

Distribution elements have plenums and are connected to duct system of galvanized sheet metal through flexible hoses that absorb sound.

Distribution elements for air supply are composed of manual controls of the air flow.

The air from the room is sucked through captor aluminium grid and by channels of galvanized sheet metal through false ceilings is conducted to the exhaust ventilation section KO-3 and thrown further into the surrounding atmosphere. Ventilation section consists of the following elements:

- Section of input jack with flex. connection
- Section of heat recuperate unit
- Section of exhaust fan
- Section of output jack with flex. connection

Automatic operation of the system

Insertion system is designed to operate with a constant flow rate.

The fan engine of section of fresh air for air chamber is with variable speed. Static pressure is measured on the first section behind the chamber and this value is held constant.

This achieves constant design flow, not depending on the contamination of the filter in air condition chamber.

Air temperature and humidity are measured on the first section behind the chamber.

The system of extraction is designed to operate with a constant flow rate.

At the entrance to the chamber is measured static pressure, and this value is kept constant.

System OV-10

System OV-10 is designed for extraction of polluted air from toilets and dressing rooms. The air is sucked through Pv valve and through the roof discharged into the atmosphere. The fan is located in the technical area of the attic.

Duct electric heaters

Envisaged for X-ray rooms (loss in winter period) and dressing rooms, where the designed temperatures are higher than in the other rooms of the system K -3.

Electric heaters are single phase and are managed by the controller pulser. Temperature sensor is placed in a channel for the extraction. To prevent overheating, pressure switch is placed before heater, and after the heater - limit thermostat.

Duct water heater / cooler

Envisaged for air conditioning of rooms no.27, 28, 24 and 19 at the western side of facility and have a significant heat load.

System is connected to network piping of F/C apparatus.

Regulator is a room one, Carrier type A and placed in room 27. Triple-arm valve is 3/4" also carrier.

Radiator heating

For ancillary facilities that have external windows are provided electric convectors (IP24 protection from moisture and splash). Convectors are supplied with thermostat and overheat protection.

Air curtains

At the main entrance are placed two hot water air curtains length of 1500mm. Air curtains are connected to network piping of F/C apparatus.

Operation of curtains is controlled by central system. Maintained temperature in the room. Regulation opens / closes the valve on the water side, it is also possible the choice of first or second fan speed as well as curtains switching off.

I floor– Maternity rooms and central sterilization

I floor – Delivery room

System K-4

System K-4 is envisaged for air conditioning of delivery rooms, sterile corridor and incoming communication.

Air conditioning chamber is hygienic (washable), multi-level performance and is located in the technical area in the attic of the new annex.

The supply air is prepared in a fresh air section, which consists of the following elements:

- ♦ Section of input jack with motor ON/OFF dumper and flex. connection
- ♦ Filter class EU4
- ♦ Filter class EU7
- ♦ Section of heat recuperator
- ♦ Section of hot water air heater
- ♦ Section of air cooler
- ♦ Section of air humidifier
- ♦ Section of electrical re-heaters of air
- ♦ Section of propelled fan
- ♦ Silencer
- ♦ Filter class EU 9
- ♦ Silencer
- ♦ Section of output jack with flex. Connection

The air for air conditioning is prepared in a manner that fresh air is first filtered in filter class EU4 and EU7, heated / cooled in a recuperate unit, then heated in winter with hot-water heaters, and in the summer and in transitional period it is cooled and dehumidified in the air fridge. In the winter period the air is moisturized via steam humidifier, and in the summer and transitional period it is reheated via the electrical re-heaters. Then thus-treated air through is filtered by silencer and a final filter class EU9 and distributed through the channels of galvanized sheet.

Duct is for pressures up to 2000Pa and air velocity up to 10m/s.

In order to meet the tightness at all seams and joints is applied hermetic type SDS.

In order to prevent condensation and reduce noise in the system, the entire duct system (insertion) is isolated with adhesive thermal insulation with a vapour barrier. The insulation thickness is 10mm.

Distribution elements have plenums and are connected to duct system of galvanized sheet metal through flexible hoses that absorb sound.

Distributive elements for air supply consist of high efficiency filters; class H13, connections for measuring pressure drop and the DOP test.

Replacing the filter is carried out from the room.

The air from the room is sucked through captor aluminium grid and by channels of galvanized sheet metal through false ceilings is conducted to the exhaust ventilation section KO-4 and thrown further into the surrounding atmosphere. Ventilation section consists of the following elements:

- ♦ Section of input jack with flex. connection
- ♦ Section of heat recuperate unit
- ♦ Section of exhaust fan
- ♦ Section of output jack with flex. connection

Automatic operation of the system

Insertion system is designed to operate with a constant flow rate.

On inserting, in front of each distribution element are mounted controllers for maintaining constant flow. Regulators are with weight, without auxiliary power, circular and square section. The fan engine of section of fresh air for air chambers is with variable speed. The difference between the static and dynamic pressure is measured at the measuring cross, on the first section behind the chamber and this value is held constant.

This achieves constant design flow, not depending on the contamination of the filter.

Air temperature and humidity are measured in the channel for air supply.

The system of extraction is designed to operate with a constant flow rate.

At the entrance to the chamber is measured static pressure, and this value is kept constant.

System K-5

System K-5 is designed for conditioning of maternity hospital OP room.

Air conditioning chamber is hygienic (washable), multi-level performance and is located in the technical area in the attic of the new annex.

The supply air is prepared in a fresh air section, which consists of the following elements:

- Section of input jack with motor ON/OFF dumper and flex. connection
- Filter class EU4
- Filter class EU7
- Section of heat recuperate unit
- Section of hot water air heater
- Section of air cooler
- Section of air humidifier
- Section of electrical re-heaters of air
- Section of propelled fan
- Silencer
- Filter class EU 9
- Silencer
- Section of output jack with flex. connection

The air for air conditioning is prepared in a manner that fresh air is first filtered in filter class EU4 and EU7, heated / cooled in a recuperate unit, then heated in winter with hot-water heaters, and in the summer and in transitional period it is cooled and dehumidified in the air fridge. In the winter period the air is moisturized via steam humidifier, and in the summer and transitional period it is reheated via the electrical re-heaters. Then thus-treated air through is filtered by silencer and a final filter class EU9 and distributed through the channels of galvanized sheet.

Duct is for pressures up to 2000Pa and air velocity up to 10m/s.

In order to meet the tightness at all seams and joints is applied hermetic type SDS.

In order to prevent condensation and reduce noise in the system, the entire duct system (insertion) is isolated with adhesive thermal insulation with a vapour barrier. The insulation thickness is 10mm.

Distribution elements have plenums and are connected to duct system of galvanized sheet metal through flexible hoses that absorb sound.

Distributive elements for air supply consist of high efficiency filters; class H13, connections for measuring pressure drop and the DOP test.

Replacing the filter is carried out from the room.

The air from the room is sucked through captor aluminium grid and by channels of galvanized sheet metal through false ceilings is conducted to the exhaust ventilation section KO-2 and thrown further into the surrounding atmosphere. Ventilation section consists of the following elements:

- Section of input jack with flex. connection
- Section of heat recuperate unit
- Section of exhaust fan
- Section of output jack with flex. connection

Automatic operation of the system

Insertion system is designed to operate with a constant flow rate.

On inserting, in front of each distribution element are mounted controllers for maintaining constant flow. Regulators are with weight, without auxiliary power, circular and square section.

The fan engine of section of fresh air for air chambers is with variable speed. The difference between the static and dynamic pressure is measured at the measuring cross, on the first section behind the chamber and this value is held constant.

This achieves constant design flow, not depending on the contamination of the filter.

Over-pressure of +20Pa in OP room compared to the corridor is maintained using engine flow regulator.

Air temperature and humidity are measured in the channel for extracting.

In control panel located in the OP room it is possible to read the following sizes: temperature and humidity of the air, over-pressure in the room and degree of contamination of HEPA filter.

When the values go out the limits light signal turns on or the like.

In control box there is also the option for the surgeon and staff to change air temperature in the range of 22-26degC.

Exhaust chamber works with variable flow.

The fan engine of exhaust air section for air chamber is with variable speed. Static pressure is measured on the first section in front of the chamber and this value is held constant.

System K-5a

System K-5a is designed for conditioning rooms that are designed to accommodate the babies.

Air conditioning chamber is hygienic (washable), multi-level performance and is located in the technical area in the attic of the new annex.

The supply air is prepared in a fresh air section, which consists of the following elements:

- Section of input jack with motor ON/OFF dumper and flex. connection
- Filter class EU4
- Filter class EU7
- Section of heat recuperate unit
- Section of hot water air heater
- Section of air cooler
- Section of air humidifier
- Section of electrical re-heaters of air
- Section of propelled fan
- Silencer
- Filter class EU 9
- Silencer
- Section of output jack with flex. connection

The air for air conditioning is prepared in a manner that fresh air is first filtered in filter class EU4 and EU7, heated / cooled in a recuperate unit, then heated in winter with hot-water heaters, and in the summer and in transitional period it is cooled and dehumidified in the air fridge. In the winter period the air is moisturized via steam humidifier, and in the summer and transitional period it is reheated via the electrical re-heaters. Then thus-treated air through is filtered by silencer and a final filter class EU9 and distributed through the channels of galvanized sheet.

Duct is for pressures up to 2000Pa and air velocity up to 10m/s.

In order to meet the tightness at all seams and joints is applied hermetic type SDS.

In order to prevent condensation and reduce noise in the system, the entire duct system (insertion) is isolated with adhesive thermal insulation with a vapour barrier. The insulation thickness is 10mm.

Distribution elements have plenums and are connected to duct system of galvanized sheet metal through flexible hoses that absorb sound.

Distributive elements for air supply consist of high efficiency filters; class H13, connections for measuring pressure drop and the DOP test.

Replacing the filter is carried out from the room.

The air from the room is sucked through captor aluminium grid and by channels of galvanized sheet metal through false ceilings is conducted to the exhaust ventilation section KO-4 and thrown further into the surrounding atmosphere. Ventilation section consists of the following elements:

- Section of input jack with flex. connection
- Section of heat recuperate unit
- Section of exhaust fan
- Section of output jack with flex. connection

Automatic operation of the system

Insertion system is designed to operate with a constant flow rate.

On inserting, in front of each distribution element are mounted controllers for maintaining constant flow. Regulators are with weight, without auxiliary power, circular and square section. The fan engine of section of fresh air for air chambers is with variable speed. The difference between the static and dynamic pressure is measured at the measuring cross, on the first section behind the chamber and this value is held constant.

This achieves constant design flow, not depending on the contamination of the filter.

Air temperature and humidity are measured in the channel for air supply.

The system of extraction is designed to operate with a constant flow rate.

At the entrance to the chamber is measured static pressure, and this value is kept constant.

System K-6

System K-6 is designed for air conditioning of room for central sterilization, which is located on the first floor.

Air conditioning chamber is hygienic (washable), multi-level performance and is located in the technical area in the attic of the new annex.

The supply air is prepared in a fresh air section, which consists of the following elements:

- Section of input jack with motor ON/OFF dumper and flex. connection
- Filter class EU4
- Filter class EU7
- Section of heat recuperate unit
- Section of hot water air heater
- Section of air cooler
- Section of air humidifier
- Section of electrical re-heaters of air
- Section of propelled fan
- Silencer
- Filter class EU 9
- Silencer
- Section of output jack with flex. connection

The air for air conditioning is prepared in a manner that fresh air is first filtered in filter class EU4 and EU7, heated / cooled in a recuperate unit, then heated in winter with hot-water heaters, and in the summer and in transitional period it is cooled and dehumidified in the air fridge. In the winter period the air is moisturized via steam humidifier, and in the summer and transitional period it is reheated via the electrical re-heaters. Then thus-treated air through is filtered by silencer and a final filter class EU9 and distributed through the channels of galvanized sheet.

Duct is for pressures up to 2000Pa and air velocity up to 10m/s.

In order to meet the tightness at all seams and joints is applied hermetic type SDS.

In order to prevent condensation and reduce noise in the system, the entire duct system (insertion) is isolated with adhesive thermal insulation with a vapour barrier. The insulation thickness is 10mm.

Distribution elements have plenums and are connected to duct system of galvanized sheet metal through flexible hoses that absorb sound.

Distribution elements for air supply are composed of hand controls the air flow.

The air from the room is sucked through captor PV Valves and aluminium grid and by channels of galvanized sheet metal through false ceilings is conducted to the exhaust ventilation section KO-3 and thrown further into the surrounding atmosphere. Ventilation section consists of the following elements:

- Section of input jack with flex. connection
- Section of heat recuperate unit
- Section of exhaust fan
- Section of output jack with flex. connection

Automatic operation of the system

Insertion system is designed to operate with a variable flow rate.

The fan engine of section of fresh air for air chamber is with variable speed. Static pressure is measured on the first section in front of engine flow regulator and this value is held constant.

Air temperature and humidity are measured on the first section behind the chamber.

The system of extraction is designed to operate with a constant flow rate.

At the entrance to the chamber is measured static pressure, and this value is kept constant.

The system of maintaining relative humidity in the room where placed pass-through autoclaves

The system consists of a duct fan with variable speed and relative humidity sensors which are filtered and motor flow regulator on inserting.

When relative humidity is $\leq 55\%$, fan operates at $400\text{m}^3/\text{h}$ and the flap is in a minimum open position.

When relative humidity is $\geq 70\%$, fan operates at $1000\text{m}^3/\text{h}$ and the flap is in a maximum open position (flow rate $1000\text{m}^3/\text{h}$).

For values between 55 i 70%, flow is altered linearly 400 to $1000\text{m}^3/\text{h}$.

Duct electric heater

It is designed for the dressing room, where the design temperature is higher compared to other rooms of the system K-6.

Electric heaters are single phase and are managed by controller pulser. Operating temperature sensor is placed in a channel for the extraction. To avoid overheating, pressure switch is placed before heater, and limit thermostat after the heater.

System OV-11

System OV-11 is designed for extraction of polluted air from toilets and dressing room. The air is sucked through Pv valve and through the roof discharged into the atmosphere. The fan is located in the technical area of the attic.

System OV-15

System OV-15 is designed for extraction of polluted air from room envisaged for chemical substances. The air is sucked through Pv valve and through the roof discharged into the atmosphere. The fan is located in the technical area of the attic. The fan is of made of plastic, resistant to chemicals, the channels are of stainless steel.

System OV-16

System OV-16 is designed for extraction of polluted air from control laboratory. The air is sucked through Pv valve and through the roof discharged into the atmosphere. The fan is located in the technical area of the attic. The fan is of made of plastic, resistant to chemicals, the channels are of stainless steel.

III floor – Intensive care

System K-13

System K-13 is designed for air conditioning of OP room of intensive care and auxiliary rooms.

Air conditioning chamber is hygienic (washable), multi-level performance and is located in the technical area in the attic of the new annex.

The supply air is prepared in a fresh air section, which consists of the following elements:

- Section of input jack with motor ON/OFF dumper and flex. connection
- Filter class EU4
- Filter class EU7
- Section of heat recuperate unit
- Section of hot water air heater
- Section of air cooler
- Section of air humidifier
- Section of electrical re-heaters of air
- Section of propelled fan
- Silencer
- Filter class EU 9
- Silencer
- Section of output jack with flex. connection

The air for air conditioning is prepared in a manner that fresh air is first filtered in filter class EU4 and EU7, heated / cooled in a recuperate unit, then heated in winter with hot-water heaters, and in the summer and in transitional period it is cooled and dehumidified in the air fridge. In the winter period the air is moisturized via steam humidifier, and in the summer and transitional period it is reheated via the electrical re-heaters. Then thus-treated air through is filtered by silencer and a final filter class EU9 and distributed through the channels of galvanized sheet.

Duct is for pressures up to 2000Pa and air velocity up to 10m/s.

In order to meet the tightness at all seams and joints is applied hermetic type SDS.

In order to prevent condensation and reduce noise in the system, the entire duct system (insertion) is isolated with adhesive thermal insulation with a vapour barrier. The insulation thickness is 10mm.

Distribution elements have plenums and are connected to duct system of galvanized sheet metal through flexible hoses that absorb sound.

Distributive elements for air supply consist of high efficiency filters; class H13, connections for measuring pressure drop and the DOP test.

Replacing the filter is carried out from the room.

The air from the room is sucked through captor aluminium grid and by channels of galvanized sheet metal through false ceilings is conducted to the exhaust ventilation section KO-13 and thrown further into the surrounding atmosphere. Ventilation section consists of the following elements:

- Section of input jack with flex. connection
- Section of heat recuperate unit
- Section of exhaust fan
- Section of output jack with flex. connection

Automatic operation of the system

Insertion system is designed to operate with a constant flow rate.

On inserting, in front of each distribution element are mounted controllers for maintaining constant flow. Regulators are with weight, without auxiliary power, circular and square section. The fan engine of section of fresh air for air chambers is with variable speed. The difference between the static and dynamic pressure is measured at the measuring cross, on the first section behind the chamber and this value is held constant.

This achieves constant design flow, not depending on the contamination of the filter.

Over-pressure of +20Pa in the OP room compared to the corridor is held by changing rotation number of exhaust fan in air condition chamber.

Air temperature and humidity are measured in the channel for the draw out.

In control panel located in the OP room it is possible to read the following sizes:

temperature and humidity of the air, over-pressure in the room and degree of contamination of HEPA filter. When the values go out the limits light signal turns on or the like.

In control box there is also the option for the surgeon and staff to change air temperature in the range of 22-26degC.

Exhaust chamber works with variable flow.

By changing rotation number of exhaust fan the pressure in the OP room is maintained.

System K-14

System K-14 is designed for air conditioning of room of intensive care.

Air conditioning chamber is hygienic (washable), multi-level performance and is located in the technical area in the attic of the new annex.

The supply air is prepared in a fresh air section, which consists of the following elements:

- Section of input jack with motor ON/OFF dumper and flex. connection
- Filter class EU4
- Filter class EU7
- Section of heat recuperate unit
- Section of hot water air heater
- Section of air cooler
- Section of air humidifier
- Section of electrical re-heaters of air
- Section of propelled fan
- Silencer
- Filter class EU 9
- Silencer
- Section of output jack with flex. connection

The air for air conditioning is prepared in a manner that fresh air is first filtered in filter class EU4 and EU7, heated / cooled in a recuperate unit, then heated in winter with hot-water heaters, and in the summer and in transitional period it is cooled and dehumidified in the air fridge. In the winter period the air is moisturized via steam humidifier, and in the summer and transitional

period it is reheated via the electrical re-heaters. Then thus-treated air through is filtered by silencer and a final filter class EU9 and distributed through the channels of galvanized sheet.

Duct is for pressures up to 2000Pa and air velocity up to 10m/s.

In order to meet the tightness at all seams and joints is applied hermetic type SDS.

In order to prevent condensation and reduce noise in the system, the entire duct system (insertion) is isolated with adhesive thermal insulation with a vapour barrier. The insulation thickness is 10mm.

Distribution elements have plenums and are connected to duct system of galvanized sheet metal through flexible hoses that absorb sound.

Distributive elements for air supply consist of high efficiency filters; class H13, connections for measuring pressure drop and the DOP test.

Replacing the filter is carried out from the room.

The air from the room is sucked through captor aluminium grid and by channels of galvanized sheet metal through false ceilings is conducted to the exhaust ventilation section KO-13 and thrown further into the surrounding atmosphere. Ventilation section consists of the following elements:

- Section of input jack with flex. connection
- Section of heat recuperate unit
- Section of exhaust fan
- Section of output jack with flex. connection

Automatic operation of the system

Insertion system is designed to operate with a constant flow rate.

On inserting, in front of each distribution element are mounted controllers for maintaining constant flow. Regulators are with weight, without auxiliary power, circular and square section.

The fan engine of section of fresh air for air chambers is with variable speed. The difference between the static and dynamic pressure is measured at the measuring cross, on the first section behind the chamber and this value is held constant.

This achieves constant design flow, not depending on the contamination of the filter.

Air temperature and humidity are measured in the channel for air supply.

Exhaust chamber works with constant flow.

At the entrance to the chamber is measured static pressure, and this value is kept constant.

System K-15

System K-15 is designed for air-conditioning of auxiliary rooms of the third floor.

Air conditioning chamber is hygienic (washable), multi-level performance and is located in the technical area in the attic of the new annex.

The supply air is prepared in a fresh air section, which consists of the following elements:

- Section of input jack with motor ON/OFF dumper and flex. connection
- Filter class EU4
- Filter class EU7
- Section of heat recuperate unit
- Section of hot water air heater
- Section of air cooler
- Section of air humidifier
- Section of electrical re-heaters of air
- Section of propelled fan

Silencer
Filter class EU 9
Silencer
Section of output jack with flex. connection

The air for air conditioning is prepared in a manner that fresh air is first filtered in filter class EU4 and EU7, heated / cooled in a recuperate unit, then heated in winter with hot-water heaters, and in the summer and in transitional period it is cooled and dehumidified in the air fridge. In the winter period the air is moisturized via steam humidifier, and in the summer and transitional period it is reheated via the electrical re-heaters. Then thus-treated air through is filtered by silencer and a final filter class EU9 and distributed through the channels of galvanized sheet.

Duct is for pressures up to 2000Pa and air velocity up to 10m/s.

In order to meet the tightness at all seams and joints is applied hermetic type SDS.

In order to prevent condensation and reduce noise in the system, the entire duct system (insertion) is isolated with adhesive thermal insulation with a vapour barrier. The insulation thickness is 10mm.

Distribution elements have plenums and are connected to duct system of galvanized sheet metal through flexible hoses that absorb sound.

Distributive elements for air supply consist of manual controls of airflow.

The air from the room is sucked through captor aluminium grid and by channels of galvanized sheet metal through false ceilings is conducted to the exhaust ventilation section KO-15 and thrown further into the surrounding atmosphere. Ventilation section consists of the following elements:

- Section of input jack with flex. connection
- Section of heat recuperate unit
- Section of exhaust fan
- Section of output jack with flex. connection

Automatic operation of the system

Insertion system is designed to operate with a constant flow rate.

The fan engine of exhaust air section for air chamber is with variable speed. Static pressure is measured on the first section in front of the chamber and this value is held constant

Air temperature and humidity are measured on the first section behind the chamber.

The system of extraction is designed to operate with a constant flow rate.

At the entrance to the chamber is measured static pressure, and this value is kept constant.

System OV-13

System OV-13 is designed for extraction of polluted air from toilets and dressing rooms. The air is sucked through Pv valve and through the roof discharged into the atmosphere. The fan is located in the technical area of the attic.

System OV-17

System OV-17 is designed for extraction of polluted air from laboratory. The air is sucked through Pv valve and through the roof discharged into the atmosphere. The fan is located in the technical area of the attic. The fan is of made of plastic, resistant to chemicals, the channels are of stainless steel.

System V-1

It is designed for ventilation, heating and cooling technical rooms on the third floor.
The system consists of filters EU4, the water heater/cooler, fan for insertion and irreversible flaps

After the heater / cooler is set frost thermostat.

The system is connected to pipe network of F/C appliances.

Fans are coupled and are turned on over the wall thermostat TSO 672, which has the option of setting: heating, cooling, off, and adjustment range of temperatures from +5 to +30°C.

Loft - a technical room

System V-2

It is designed for ventilation, heating and cooling technical room in the loft.

The system consists of filters EU4, the water heater/cooler, fan for insertion and irreversible flaps.

The system is connected to pipe network of F/C appliances.

Fans are coupled and are turned on over the central system. Maintained temperature in the room from +5 to +30°C.

FAN CONVECTORS

By system of fan convector cooling rooms is realized in the summer and heating in winter. The fan convectors are connected to two-pipe system and in summer they work with water 7/12°C and in winter with water 60/50°C.

The fan convectors are placed in the parapet below the window.

Pipe network of fan convectors is kept in a suspended ceiling of the floor below.

Pipes are PPR PN20, the insulation is made of expanded rubber thickness 13mm.

For each F/C is provided by one ball, balancing (terminal) and the vent valve.

For each floor are designed two branches (eastern and western), and in each branch on transition of the metal to plastic piping is set filter with two ball valves in distribution, and balancing valve in return.

Carrier fan convectors are designed, type: 42N for floor installation.

In areas with high efficiency filters, instead of the standard G2 filters are designed F / C appliances with 'plasma' antibacterial filters.

Individual regulation of operation is provided. For each room where the F/C apparatus is situated, one wall controller type "A" is placed.

Room temperature is adjusted on the controller, fan mode, summer or winter regime and it allows the possibility of reducing the cooling/heating by $\pm 4^{\circ}\text{C}$ to save energy.

To prevent excessive condensation and to increase comfort on the "water side" are set 3-arm valves.

Condensate drain is from FC appliance from PP PN10 flexible pipes Ø20, which are further connected via a siphon to the horizontal of PP pipes for home sewage, dimensions Ø32.

Horizontal is conducted with a decline of 2% and is connected to a drain of a sewage system.

CONNECTIONS TO INSTALLATION OF HOT AND COLD WATER

Chambers are supplied with hot water 110/70°C from existing boiler room and cold water 7/12°C from cooling plant.

Substation and pipeline distribution are treated by design of I phase.

Signaling the status of medical gases

(including an alarm in the event of significant deviation from the permissible values) is planned through separate local alarm -status control panels. These panels are the subject of the design on medical gases, while in this volume the necessary command-signal cable connections are provided.

INSTALLATIONS OF ELECTRICAL MOTORS

The design envisages technical solutions required for execution and installation of electrical-energetic installations of el. motor drives, required for the power supply and control of systems:

- system of the air conditioning, ventilation and heating
- medical gases
- system of hydro-technical consumers

The basis for the elaboration of this design is the data (technological requirements) for the development of these systems, defined by mechanical design and terms of reference.

ELECTRICAL POWER SUPPLY AND DISTRIBUTION CABINETS

The electricity supply to all consumers of el.mot.drive installation is provided in a reliable and high quality method from the distribution cabinets:

- RTK-3S placed on III floor in mechanical room (48 Technical rooms)
- RTK-PO/1 placed in the loft (IV floor) in mechanical room (17 Technical rooms)
- RTK-PO/2 placed in the loft (IV sprat) in mechanical room (17 Technical rooms)

Power supply of cabinets RTK-3S, RTK-PO/1 and RTK-PO/2 is executed from distribution plant 0,4kV traffo, located in substation RT-TS outside the medical facility.

In these distribution boards in outlets for electric pumps and fans are provided circuit-breakers. Cabinets are intended as free-standing, in **IP43** protection, with built-in equipment to protect el. consumer.

MANAGEMENT SYSTEMS OF AIR CONDITIONING, VENTILATION AND HEATING

An automatic control system in the building was realized by programmable DDC controllers arranged in three cabinets of automation (sub-central system) RTK-3S/PS-3S , RTK-PO/1/PS-PO/1 and RTK-PO/2/PS-PO/2.

Controllers in all substations are connected with each other and with management station by communication BUS cable.

Operating the motor consumers is realized with automatic switchboards, using electronic managing module with selector switch 1-0-A, for each system one switch for the pump and one switch for the fans.

Position **1** is for local service test of engine. Position **A** is provided for managing one engine on the basis of application software in the microprocessor substations of central system.

In automatic cabinets signaling of operating and emergency conditions is provided using light modules with LEDs.

In the central monitoring and control system CSNU signals of all operating and emergency conditions are introduced.

OPERATION OF SYSTEM IN CASE OF FROST

At the occurrence of temperature lower than 5°C behind the heater in ventilation chambers, the appropriate system is shut down the pump of the heater is switched on and control valve is maximally open.

OPERATION OF SYSTEM IN CASE OF FIRE

In case of fire in the facility, by the signal from PPC, all air conditioning and ventilation systems are shut, as well as all electrical motor fire dampers with final contacts. In case of drop of FP flaps in one of the air conditioning and ventilation system only the corresponding system switches off.

INTERVENTION EXCLUSION OF SYSTEM

For urgent emergency shutdown of air conditioning and ventilation systems mushroom stop buttons are designed.

INSTALLATION

To perform energy installations use cables with thermoplastic insulation and copper conductors. Section and number of cores is determined to meet all the prescribed requirements in respect of:

- voltage drop
- termical conditions at normal operation and short circuit
- conditions of neutralization

Distribution of cables perform partly on cable tray / racks, partly on clamps, and all inlets into the engines perform in metal flexible pipes.

PROTECTION AND GROUNDING

Protection is anticipated against:

- short-circuit and overload with automatic motor protection circuit-breaker
- unallowed contact voltage by system TN-S

In mechanical substation one rail for potential equalization is envisaged. On rail for potential equalization are connected protective rails in control cabinets, as well as all the metal masses, which normally are not powered (pipes, ducts, etc.).

3.7 CENTRAL SYSTEM OF MONITORING AND CONTROL -CSNU

The main function of the anticipated system is management, monitoring the work and failures of the system represented in the facility.

Information about the state of the system is collected via a microprocessor substation, which in addition to the acquisition of these data, control and monitors the operation of all systems in the facility.

By common communications link all the information are brought to Data Unit-PC (color-graphic terminals) located in the dispatch center, room No.13 in the attic.

PC (color-graphics terminal) and printers make up the central monitoring system CSNU.

This information is via volt free contact links conducted to microprocessor substation.

As already mentioned, in dispatching center is the PS computer (color graphic terminal) used for visualizing data from the drive and communicating with operators as well as dot-matrix printer to obtain hard copies of all protocols and alarms in real time, and also laser printer for processing reports and analyzes of operators.

CONTROL CENTER (DISPATCHING CENTER)

In the control center information is received and followed, obtained from substations arranged in the facility. Information are processed and in a suitable form represented to operators. On the basis of data processed, suitable instructions are issued via operator, or activities of software, which are forwarded to substations. On substation level instructions from the central computer are installed in a local application software.

The control center has been processed in design:

Main	Design
MEDICAL HEALTH CENTRE V R A N J E - FAZA I	
SURGERY BLOCK AND EXTENSION OF THE GYNAECOLOGY LOFT	
designer ENERGOPROJEKT INDUSTRIJA AD BEOGRAD	
- CONTRACT 2267-EI/05	
- DESIGN ZIT 205705	
Book III: Electro-technical design	
VOLUME 5: Installation for supply of consumers of system GVK and control	
- monitoring	system

MICROPROCESSOR SUBSTATIONS

They represent the elements of the central system and are located:

- RTK-3S located on III floor in mechanical room (48 Technical rooms)
- RTK-PO/1 located in the loft (IV floor) in mechanical room (17 Technical rooms)
- RTK-PO/2 located in the loft (IV floor) in mechanical room (17 Technical rooms)

Task of substation is to accept information from the plant regarding measured quantities or parameters (analog inputs-measurement), to monitor by counting some values and to limit them to preset values (counting function). All received data are processed in the framework of the substations, where according to predetermined software selection is done of information to be forwarded to the control center, thus significantly freeing superior system from a lot of information, which make difficult distinguishing between the important from the unimportant. Based on the collected and processed data at the substation level are generated adequate control and regulation functions for the implementation of the program of logical control and direct digital regulation.

In generating management and control functions at the substation level superior computer participation is enabled in center.

Each substation is equipped with a CPU module and input-output I / O modules for the implementation of digital-to-analog functions. CPU module controls the operation of I / O modules and contains a complete software, through which the communication with the computer in the center is achieved as well as communication with the I / O modules on the level of substation. CPU module performs the calculation of the output variables depending on the input data and the preset parameters. Programming and re-programming of substations is carried out locally, via mobile devices or remotely from a control center.

The substation is required to meet the following characteristics:

- possibility of connecting different types of encoder (sensor) and executive units
- download and deliver of analog and digital inputs and outputs
- indication of alarm of failures and their own mistakes
- the ability to control all functions P , PI , PID
- the ability to combine regulation and logic functions
- possibility to choose time delay
- the ability of functions of cascade, sequent and differential type
- Software support for standard termotechnical systems
 - program control of peak power load
 - software energy saving
 - continuous self-diagnostics
- autonomy of work according to the status of the central computer
- 72 - hour battery supply for keeping programs and parameters

Power supply of substations is provided with uninterruptible power systems.

SOFTWARE SUPPORT

The software support can be classified in the programs at the level of central processing units and programs at the substation level.

a) PROGRAMS AT THE LEVEL OF THE CENTRAL PROCESSING UNIT

Basic software package (basic program) CPU, which includes:

- operating system
- program for generating and managing databases
- program for alphanumeric addressing
- program of accessing MPP substations (cyclic scanning of substations)
- program for the acquisition and transfer of information (acceptance and processing of digital and analog inputs and outputs)
- program for mathematical signal processing
- program for dialogue with peripherals
- word processor (input, modification, etc.).
- program for automatic printing status and alarms
- program for generating protocols / reports
- program to monitor the size limit for analog and digital address - this program allows:
 - defining limit values for all analog measurements
 - defining logical "0" and "1" for all digital measurements
 - defining limit values for all analog executive functions)
- program to review all the addresses in the system
- programs for defining levels of access to data (identification code)

- time programs (“time”)
- event programs (“event”) allow:
- software realization of alarm plan
- defining algorithm and providing the conditions and ways to connect with other telecommunication systems; external time synchronization
- software package for the formation of the historical database (HDB).

This package provides a chronological record and keeping the preset situations and events

- “Master slave” function (silencing of alarm)
- “Multi user ” function (simultaneous work with multiple peripherals)
- software package for color graphic presentation of all technical systems

Through a central computer in the control center by means of the software package the entire process is monitored and managed. It provides the following functions:

- Direct access to the system through the "window" in the same way as in the system of dialogue
- The operator may choose the manner of keeping programs: via the mouse or keyboard
- Dynamic image format
- Display of each part of the process on the screen.
- Monitoring of the measurement values with setting the upper and lower size limit
- Performing digital and analogue commands
- Defining the priorities of various alarms
- Tracking the curve of individual measured values
- Monitoring the trend of process parameters
- Listing of all status, alarm and measured values, in recording the same on-screen and printer
- Storing and archiving data
- Visualization of historical data bank
- Transfer of data from historical data banks in other applications via DDE (Dynamic data exchange)
- Statistical analysis of the data collected
- Program to conduct preventive maintenance includes:
- Programs of system conducting operators by means of menu
- The possibility of issuing work orders according to the calendar, the number of working hours, or as needed
- Monitoring the execution of work orders
- Automatic control of the cost of materials and working hours
- The possibility of a systematic creation of new work orders and modifications of existing
- Functional analysis and periodic planning
- Programs of warehouse operations
- Programs of work schedules and labour
- Issuing periodic reports (historical data)

b) PROGRAMS AT THE SUBSTATION LEVEL

- Operational Programme of substations
- Applications for direct digital control and logic control (DDC / PLC)
- Time programs
- Programs for optimization:

- Optimal on and off
- Optimal cyclic operation
- Historical Database (HDB)

4.4. Stations with medical gases

On the basis of calculated consumption of medical gases and designed consumption in the future, based on current procurement of oxygen and consumption estimates for other gases, the designed oxygen demand exceeds the capacity of the substation with bottled oxygen, which according to the design is 2x12 bottles, designed as a backup oxygen supply system. The primary source is a system with liquid of oxygen.

Calculated consumption for the new building of Surgery by the design amounts to 640 l/min, respectively 38.4 Nm³/h. According to the consumption of bottles for other departments (22 t/yr or 2x40 bottles a week), the total estimated amount of oxygen is:

Two criteria:

- 22000 kg/52 = 423 kg/a week
- 80 x 8,5 kg (bottles of 150 bar) = 680 kg/a week

Average value of 550 kg /week shall be adopted, respectively (calculated for 5 days a week when consumption is max) 110 kg /day = 77 Nm³/day. Adopting a strict requirement that all consumption takes place within 8h daily, the capacity is ~9,6 Nm³/h, and may be adopted 10 Nm³/h, totally amounting to 48,4 Nm³/h.

Consumption requires more storage and evaporating capacity of consumption, so that in the first phase supply from small tanks with liquid oxygen is proposed – by pallet tanks, trucks, and in the future from the storage tank. Both installations can be set up alongside the existing, reconstructed building of technical section, in one part of which building of the medical gases station is planned.

This is the peak consumption on the basis of which equipment and pipelines are dimensioned, but average consumption is much lower, one third of calculated top-level is adopted. The assumption is that with the use of pallet tanks, the same would be changed once a week, which is satisfactory. To supply the building of Surgery substation construction in the first phase is proposed, with the transmission tanks of liquid oxygen with capacity of 1000 kg. Capacity is about 650Nm³ in the average operating pressure (13 bars min). The substation is the primary source of oxygen supply and substations with bottles is the secondary one, as backup source of supply. It is proposed to extend the substation with bottles to 2x20 bottles.

Substation with bottles of nitrogen sub-oxide is the source of supply of nitrogen sub-oxide. Selected substation is enough to supply this gas, since in the stationary part a significant increase in capacity is not expected.

Increasing the capacity of the compressor station is estimated on the basis of capacity increase of oxygen and it is approved 25%, so that the consumption of KV 5 bar (not KV10) is: 930 x 1,25 = 1162,5 lN/min.

For consumption basic compressor unit of 15 kW, capacity 1640 l/min is accepted.

For installation of a vacuum, because of relatively large length of the pipelines to the other facilities of Health Center, it is suggested that the vacuum station covers only consumption of surgery building, while in other buildings it is suggested to use the ejector powered by compressed air or separate smaller vacuum cells in the buildings themselves.

TECHNICAL DESCRIPTION

Supply for the health center in Vranje, Surgical Block, with medical gases (oxygen, nitrous oxide, compressed air) and vacuum will be done from one central point, marked in the documentation as medical gas and vacuum stations.

Location of medical gas and vacuum stations is chosen so that it is close to the consumer, taking into account the available space, length of the distribution network and the conditions for safe and secure supply.

Medical gas and vacuum station object

The object is projected as a sturdy, made of non-flammable building materials, floor standing, with a roof under appropriate slope for the drainage of sediment, which makes the roof structure weight max. 50kg/m², and in case of an explosion in one of the cells it could be easily discarded.

The building consists of two separate rooms - nitric oxide and oxygen station, vacuum and compressed air station. To enter any of the rooms a folding aluminum door is provided, 2m width, with blinds installed at the bottom for ventilation and cooling air intake for cooling compressors and vacuum pumps. At the opposite outer wall, above the window, an entire length of the blinds is installed for ventilation and exhaust hot air from compressors and vacuum pumps.

Station lighting is combined, natural - using windows and artificial - using the appropriate lamps.

Facility heating is provided in winter so that the temperature of the rooms must not be below + 5 ° C and above + 40 ° C, to prevent freezing of moisture from compressed air and vacuum and provide sufficient capacity to exclude gas from the oxygen bottle and nitrous oxide. Heating is provided by radiators fed with hot water 90/70 ° C. The use of radiant heaters with direct action on the bottles with oxygen and nitrous oxide is forbidden.

The building must be provided with grounding and lightning protection in accordance with the applicable regulations.

Firefighting equipment for the facility should include handheld portable S - 9 with 9 kg powder or CO₂-5 with 5 kg of carbon dioxide in each of the cells, as well as boards' warnings.

Oxygen station

The station has two collectors with 12 standard bottles of 40 (50) lit in two rows, one working collector branch, other spare, with automatic reduction station capacity min. 80Nm³ / h of oxygen. On each collector branch there is manual shut-off valve, sintermetal filter, 6 collector connection valves with connecting copper pipes for two bottles Ø 8x1,5 mm and a shut-off valve for collector relief.

Automatic reduction oxygen station

The station is located in a protective housing and consists of a first stage reduction valve with built-in safety valves, a pilot reducing valve with a solenoid valve for providing pressure control, reduction valve with second degree output pressure of 5 ± 0.5 bar., safety valve, pressure encoder, ball valve, as well as a microprocessor which controls the operation of the station. Work parameters are shown on LCD display.

Technical characteristics:

❑ Capacity	min. 80 Nm ³ /h
❑ Maximum input pressure	200 bar
❑ Output pressure	5 bar
❑ Pressure encoder voltage	max. 48 V/2,5 A

The station has the ability of oxygen supply from the liquid oxygen cold reservoir and the evaporator, the pressure of which does not exceed 15bar, and via connection set consisting of sintered filters, non-return valves and ball valves.

Microprocessor control is achieved through 4 sensors (pressure encoders) to provide information about the pressures of the left and right branches of the collector, the pressure of oxygen in the tank with liquid oxygen and pressure in the network after the second degree of reduction. Irregularities are signaled by several alarms, for example blinking LCD display and notification on the irregularities that occurred:

- ❑ Low oxygen pressure in liquid oxygen station
- ❑ Left branch bottles empty
- ❑ Right branch bottles empty
- ❑ 50 % reserve
- ❑ Network pressure change ± 20 %

From the second level of reduction the oxygen goes to the distribution network Ø 22x1mm. Oxygen concentrator has 3 output terminals Ø 22x1mm, one of which is used for building the Surgical block, the other for future expansion and the third for relief trunk pipeline during interventions and tests.

Each port of the hub is equipped with a ball valve DN 20 and pressure gauge Ø 50 mm, measuring range 0-16bar, which shows the pressure in the oxygen network.

Nitrous oxide station

The station has two collectors with 6 standard bottles of 40 (50) lit in two rows, one working collector branch, other spare, with automatic reduction station capacity min. 20 Nm³ / h of nitrogen oxide. On each collector branch there is manual shut-off valve, sintermetal filter, 2 collector connection valves with connecting copper pipes for two bottles Ø 8x1,5 mm and a shut-off valve for collector relief.

Automatic reduction nitrous oxide station

Automatic reduction station consists of a reduction first degree valve with a built-in safety valve and pressure gauge on the high pressure side, automatic change-over valve which switches from one to another branch at a 10 bar pressure in the bottles and the second degree reduction valve with 5 ± 0.5 bar discharge pressure.

The station is located in a protective housing and on the outside only 3 manometer can be seen, one for high pressure collector of each branch and one for the output pressure from the station after second degree reduction.

Technical characteristics:

❑ Capacity	min. 20 Nm ³ /h
------------	----------------------------

❑ Maximum input pressure	200 bar
❑ Output pressure	5 bar
❑ Pressure encoder voltage	max. 48 V/2,5 A

From the reduction station nitrogen oxide is brought into the distribution network Ø 15x1mm. Nitrous oxide concentrator has 3 output terminals Ø 22x1mm, one of which is used for building the Surgical block, the other for future expansion and the third for the relief of trunk pipeline during interventions and tests.

Control unit

A control unit is connected to the concentrator consisting of a low pressure gauge with low contact (4 bar) and high contact pressure (6 bar), the relief valve capacity 80Nm³ / h, the preset opening pressure 6.6bar, and the spare connection with a high speed connector for connecting the bottle with reducing valve in case of emergency.

The pressure is to be controlled in the network of nitric oxide to signal low (4 bar) and high pressure (6 bar) in the network, protect the distribution network of the overpressure safety valve opening pressure 6.6bar and provide necessary supply of nitrogen oxide in the event of maintenance or failure of the reduction station.

Compressed air station

In the room there are 2 compressors, compressed air 1500lit reservoir, air dryer, filter-reducing group to prepare 5 bar and 10 bar air and automatic condensate separator, which along with the provided reinforcement and signaling make the compressed air station.

Air Compressor

The compressor is supplied as a fully equipped unit ready for use - with suction filter, non-return valve on the discharge, safety valves as well as automatic work control, with high and low pressure switch.

Technical characteristics:

❑ Capacity	min. 1,300 lit/min
❑ Maximum output pressure	15 bar
❑ Motor power	11 kW
❑ Operation voltage	400 V/50 Hz AC
❑ Control voltage	230 V/50 Hz AC

Compressed air tank

Compressed air is supplied from the compressor to a tank that serves as a backup air and as a compensator for sudden gusts of consumption, for example 10 bar air which is more rarely used than 5 bar air, but has a much higher consumption.

Technical characteristics:

❑ Volume	1,500 lit
❑ Maximum operating pressure	15 bar
❑ Dimensions	Ø 1,000 x 3,000 mm
❑ Material	C. 0361 (galvanized inside and out)
❑ Input/output air terminal	R 2"

The compressed air tank must be equipped with a pressure gauge and a safety valve set to the opening pressure 16,5bar.

To automatically drain the condensate from the compressed air tank the electronic level controller condensate is provided, which is placed behind the taps to manually drain the condensate. It is a device that detects the formation of condensation in the internal container and if it is full it opens the solenoid valve that releases the resulting condensate, with no loss of air .

Compressed air dryer

From the tank, the air pressure of 15 bar is lead through copper pipes Ø 28 x 1.5 mm to the dryer where on the basis of cooling air to the dew point the separation of the moisture and air drying is done. The dryer is supplied as a compact unit ready for operation.

Characteristics of compressed air dryer:

<input type="checkbox"/> Capacity	min. 216.5 m³/h
<input type="checkbox"/> Air pressure	max. 15 bar
<input type="checkbox"/> Output dew point	+ 5 °C
<input type="checkbox"/> Temperature of ambient air	min. + 2 °C / max. + 50 °C
<input type="checkbox"/> Refrigerant	that doesn't damage ozone layer

On/off switches must be placed on the device as well as work signaling and automatic drain condensate.

For its normal operation, and the flow of cooling air, as well as service and maintenance, the dryer requires a minimum free space on the sides and on the front.

The condensate from the dryer, together with the drain from the tank, is lead into into sewerage. In case of failure of the device or the necessary maintenance a "by-pass" line is provided that enables the delivery of compressed air without passing through the dryer.

Filter-reduction station

From the dryer the 15 bar air pressure is lead through copper pipe Ø 22x1mm first to the filter, and then to reduction groups, which are integral parts of filter-reduction station for compressed air, in which it is processed and the air pressure is reduced to the necessary 5 and 10 bar.

Technical characteristics:

<input type="checkbox"/> Maximum input pressure	16 bar
<input type="checkbox"/> Output pressure	5 bar/10 bar
<input type="checkbox"/> Capacity	min. 280 m³/h
<input type="checkbox"/> Input terminal	Ø 22 x 1 mm
<input type="checkbox"/> Output terminals	Ø 22 x 1 mm

Filter-reduction group consists of two parallel lines, one for the preparation of 5 bar air (CV5) and the other for preparation of 10bar air (CV10), which are supplied from a 15 bar pressure compressed air tank.

Each line (CV5 and CV10) consists of a filter and the reducing group, wherein the line CV5 has two parallel reductive group and the line of CV10 has only one.

Filter group

<input type="checkbox"/> Prefilter	Smallest particle size 0,01m.
------------------------------------	-------------------------------

- ❑ Activated carbon
- ❑ Bacteriological filter

Residual oil content depends on the filter cartridge, at least 7 bar and 21 °C:
below 0,5 mg/m³.
Connection for condensate drain:
ISO 228/1-G 1/8.
Capacity of oil adsorption:
No oil vapor and odorizers.
Adsorption capacity: 100 g.
Penetration less than 0,03 %
Acc.to DIN 24184 (aerosol test 1)

Reduction group CV5

A reduction valve, safety valve and ball valve are located within the reduction group.

Technical characteristics:

- | | |
|--------------------------|-------------------------------------|
| ❑ Capacity | min. 2 x 100 m ³ /h |
| ❑ Maximum input pressure | 16 bar |
| ❑ Output pressure | 5 bar |
| ❑ Safety valve settings | open at 6,55 bar, close at 5,45 bar |
| ❑ Terminals | input/output Ø 22mm |

Reduction group CV10

A reduction valve, safety valve and ball valve are located within the reduction group.

Technical characteristics:

- | | |
|--------------------------|------------------------------------|
| ❑ Capacity | 80 m ³ /h |
| ❑ Maximum input pressure | 16 bar |
| ❑ Output pressure | 8 ± 2 bar |
| ❑ Safety valve settings | open at 10,46bar, close at 8,74bar |
| ❑ Terminals | input/output Ø 22 mm |

Vacuum station

Two vacuum pumps are located in the room, 2,000 lit vacuum tank and 2 double bacteriological filter which sterilize the air before it is discharged into the atmosphere, which along with the planned reinforcement and signaling make the vacuum station.

Vacuum pump

A high vacuum vacuum pump is provided (98 %), directly connected to the electric drive, oil lubricant, air cooled, low noise level and vibration. When the pump is stopped it is automatically relieved. The internal check valve protects the components under vacuum.

Technical characteristics:

- | | |
|---------------|--------------------|
| ❑ Capacity | min. 1,150 lit/min |
| ❑ Motor power | 5.5 kW |
| ❑ Voltage | 230/400 V/50 Hz |

- ❑ On/off pressure 0.3/0.2 bar aps.

Vacuum reservoir

It serves as a vacuum reserve in the installation. It is separated by a ball valve R 2" from the installation and can be excluded from the system, while it does not interrupt the operation of vacuum pumps and the entire installation.

Technical characteristics:

- ❑ Volume 2,000 lit
- ❑ Calculation pressure 1 bar (external pressure)
- ❑ Dimensions Ø 1.000 x 2.441 mm
- ❑ Material C.0361 (galvanized inside and out)
- ❑ Vacuum pump terminal R 2"

Double bacteriological filter

It protects the surrounding air from pollution when the installation operates. It consists of two containers in parallel operation (an operation container, a spare one) and two three-pointed ball valves DN 40 for shifting from one container to another. In containers there is an interchangeable filter cartridge (element) class S, coated with silver and copper with a bactericidal effect on fungi, spores and bacteria.

Filter characteristics:

- ❑ Flow capacity 90 Nm³/h
- ❑ Absorbtion capacity 99,97 % particle 0,2 - 0,5 µm
aerosol test 1 (DIN 24 184)

Liquid oxygen station

Liquid oxygen station is planned for the final stage of consumption of HC Vranje and is subject to a separate project.

Distribution network

Due to the specific installation and the well-known antibacterial effect of copper, the medical gas distribution network is carried out by specialized, certified, defatted and deoxidised high-phosphorus copper pipes SF - Cu DIN EN 1057 and DIN EN 12168.

The pipes are seamless, smoothly drawn, annealed in a vacuum and are delivered as soft coiled length of 25 m or as hard straight pipe length of 5 m. They are connected to the copper fittings and overlapping connections brazed with silver in the protective atmosphere of acetylene flame, without the use of oxygen. For threaded connections inorganic materials are used as sealing material, primarily Teflon tape.

Pipelines of medical gases and vacuum between the medical gas station and vacuum and Surgical block building facility are placed underground, in concrete channel, dimensions 400 x 500 mm.

The main pipelines have the following dimensions:

<input type="checkbox"/> Oxygen (O ₂)	Ø 22 x 1 mm
<input type="checkbox"/> Compressed air 5 bar (KV5)	Ø 22 x 1 mm
<input type="checkbox"/> Compressed air 8 ± 2 bar (KV10)	Ø 22 x 1 mm
<input type="checkbox"/> Nitrous oxide (N ₂ O)	Ø 15 x 1 mm
<input type="checkbox"/> Vacuum (VAC)	Ø 54 x 2 mm

Immediately upon the main pipeline for vacuum Ø 54 x 2 mm entering the energy channel, two parallel discharge separators are set that have the function to prevent the deposition of discharge in the underground part of the pipeline and its blockage. The underground part of the pipeline for vacuum represents the lowest share.

Discharge separator

It serves to protect vacuum pumps and bacteriological filter of secretions and body fluids. It consists of a plastic container with 8 lit content on which one valve is mounted for pressure equalization with the atmosphere as well as a drain valve. At the entrance and exit of the separator ball valves DN 32 are placed which are closed when the container is empty or the separator for any reason is excluded from use.

In the distribution network in the corridors and rooms the water pipes are horizontally placed above the suspended ceiling and secured by clamps. The vertical descent pipe to the connection points is done through interconstruction of prefabricated walls or under plaster, if the walls are made of solid material.

Pipeline marking

The direction of flow of medical gas and extract pipelines for vacuum should be marked with an arrow. Pipelines are also marked with rings of different colors for each type of gas, set at every 5 meters on each branching or turn of the pipeline:

<input type="checkbox"/> Oxygen	blue
<input type="checkbox"/> Nitrous oxide	grey
<input type="checkbox"/> Compressed air 5 bar	yellow
<input type="checkbox"/> Compressed air 10 bar	yellow
<input type="checkbox"/> Vacuum	white

Additionally, according to DIN 13260, marks are established for the following media:

- ☐ For compressed air - pressure in bar,
- ☐ For pneumatic engine - "The exhaust gas of the pneumatic engine", black letters on a yellow background
- ☐ For gas drain for narcosis - "Gas exit for narcosis" black or white letters on a purple background acc.to ISO/DP 7281: 1988

Control Valve Cartridge

To control the pressure in the distribution network and the possibility of separating individual segments, standard control valve cartridges are provided (CVC), equipped with shut-off valves, pressure gauges and contact vacuum meters for signaling, so that, in case of installation work or fire, they can stop the supply of a part of the consumer, with no interruption in operation of the

entire installation. They are installed in the prefabricated construction of partition walls or dug into the wall of solid material.

Medical and technical personnel on duty have immediate information about the current state of the system supplying medical gases and vacuum and can take the necessary measures. These control cartridges in an emergency, in order to close the valve, can be opened without a key, by striking a fist onto the lock that dislodges with no damage.

Control valve cartridges are installed in second floor corridor, as follows:

- ❑ Control valve cartridges for OP rooms Pict.03.21, Pict.03.22, Pict.03.23
CVC2 (O2, CV5) for oxygen and compressed 5 bar air
CVC3 (CV10, N2O, VAC) for compressed 10 bar air, nitrous oxide and vacuum
- ❑ Control valve cartridges for OP rooms Pict.03.24, Pict.03.25, Pict.03.26
CVC2 (O2, CV5) for oxygen and compressed 5 bar air
CVC3 (CV10, N2O, VAC) for nitrogen oxide and vacuum

5. Technical description of lifts

5.1. Technical description of the lift L1

The purpose of this lift is to transport both cargo and people, between the ground floor and the fourth floor in a hospital facility. It is to be installed inside a reinforced concrete hoistway. The drive machine is to be placed at the top of the hoistway.

TECHNICAL SPECIFICATIONS

Type of lift:	Hospital lift
Number of items:	1
Load:	Q = 1600 kg
Height of elevation:	H = 14380 mm
Speed:	v = 1.0 m/s
Number of landings/entrances:	n = 5/5 all entrances from the same side,
Marking of landings:	(0, 1, 2, 3 and 4)
Main landing:	"0"
Navigation:	"simplex" collective control in both directions with a key for priority travels; microprocessor;
Fire alarm mode:	In the event of a fire alarm, the lift shall automatically guide the car to the main landing "0" and after the passengers have left the lift car, it will shut down.
Electricity outage mode:	The powering of the lift shall be switched to an electrical generating unit.
Type of drive:	electrical motor, gearless, regulated,
No. of starts:	180 starts/h
Navigation positions:	a) during regular use: - from both landings, - from the car, - from the roof of the car (revision travel)

Signalisation:

- on the floors

1) landing operating panels with micro-sensory buttons, car position indicator, direction indicating arrow for further transport, buttons must be suitable for the disabled persons, confirmation of reception of the call;

- inside the car

1) micro-sensory car operating keys with confirmation of reception of the call, Braille symbols and sound signal;

2) car position signal;

3) digital indicator of overload;

5) sound signal for overload;

6) door opening button;

7) door closing button;

8) button for the alarm at the main landing;

9) ventilator switch;

10) STOP button;

Interphone or telephone line: two-way communication between: the car and control centre.

Car:

metal constructions,

- number of car entrances:

1;

- car walls:

final layer of the sides stainless steel, the outer walls coated with anti-sound and anti-vibration material, indirectly in the lowered ceiling.

- lighting:

- car operating panel:

along the entire height of the car inox;

- mirror:

on the back wall;

- handgrip:

on the rims of the car inox;

- floor:

anti-slippery and antibacterial;

- additional equipment:

emergency lighting, ventilator, alarm, interphone.

- car dimensions:

1400x 2400 x 2200 mm

Car door:

automatic two-panel telescopic,

- panels :

final coating inox,

- door safety system:

light door detector and passengers detector,

- dimensions:

1300 x 2000 mm

Landing door:

automatic three-panel telescopic,

- panels and doorposts:

final coating inox,

- dimensions:

1300 x 2000 mm.

- door safety system:

electro-mechanical interlock device,

Hoistway:

- width x length:

2400x 2800 mm,

- hoistway pit:

1400 mm

- hoistway overhead:

4000 mm

Machine room:

Machine-Roomless (MRL)

- drive machine position:

at the top of the hoistway,

- working temperature:

inside the hoistway, it needs to be between +5°C and +40°C,

- working environment:

standard, dry space;

- electrical connection:

3 x 400 / 230 V, 50 Hz

- voltage deviation:

±5%

- power cables:

delivered next to the entrance door at the highest landing.

Counterweight material:

grey iron

Position: on the side next to the car
Car guide rails: 125x82x16 mm
Counterweight guide rails: 70x65x9 mm

Suspension system: 2:1
Driving sheave: $D = 320\text{ mm}$
Folding sheaves: $D = 320\text{ mm}$
Number of sheaves: $z = 6$
Steel rope diameter: $d = 8\text{ mm}$

Power of the electric motor: $P = 10.7\text{ kW}$
Rated output power of the motor: $I = 22\text{ A}$.

HOISTWAY

Hoistway of the lift is to be enclosed with firm and solid walls from all sides and along its entire height, and with a ceiling and a floor. The car of the lift and counterweight are situated in the same hoistway.

At the top of the hoistway there are ventilation openings, whose entire cross-section surface is at least 2% of the surface of the horizontal cross-section of the hoistway. The hoistway must not be used for ventilation of rooms which are not part of the lift system, and equipment and devices which are not integral parts of the lift must not be installed.

The hoistway can hold load pressure caused by the operation of the drive machine, by the action of grip device on the guide rails, and by the pressure of the car or counterweight against the buffers.

The hoistway walls are made of material which is resistant to mechanical damage and fire and which does not cause dust but repels it.

The hoistway walls are made with such mechanical strength that the action of direct force of 300 N must not cause an indentation larger than 10 mm. This force may act from one or the other side of the wall, at any spot, under the condition that it is equally distributed across the surface of 5 mm². Bottom of the hoistway pit is protected from water penetration.

At the level of the lowest landing, an electronic "STOP" switch, with clearly marked positions "ON" and "OFF", double-pole receptacle with protective contact and alternating switch for lighting of the hoistway are installed, purposefully labelled and connected to the alternating switch in the command box.

The interior of the hoistway is equipped with electrical lighting, at 0.5 m from the bottom of the pit and top of the ceiling, and between them at every 7 m. At the bottom of the hoistway, metal climbers are to be installed.

When the car of the lift is standing on completely compressed buffers,

- inside the hoistway pit there is space which allows the placement of a cuboid with minimum size of 0.5 x 0.6 x 1.0 m, so that it lies on one of its surfaces;
- free space between the bottom of the hoistway pit and the lowest position of the car is at least 0.5 m, and between the bottom of the pit and the lowest position of the car guide rails, parts of the grip device, protective tin of the car doorstep more than 0.1 m.

The hoistway contains the following openings:

for the landing doors, hoistway ventilation, connection of the hoistway with the command box and the duct for discharge of gasses and smoke in case of fire.

BUFFERS IN THE HOISTWAY

For the purpose of limiting the movements of the counterweight and car, and their safe stopping, in the event of failure of the limit switch, buffers are to be placed at the bottom of the hoistway. They provide the necessary safety space both at the bottom and top of the hoistway (limited movement of the counterweight). The buffers are without silencers.

HOISTWAY OVERHEAD

This is a machine-roomless lift; the drive machine is placed inside the hoistway, at its top, on a carrier which is fixed onto the side walls of the hoistway and to the car guide rails.

Since this is a machine-roomless lift, the hoistway overhead (where the drive machine is situated) and space in front of the navigation box (at the highest landing) satisfy the requirements for the machine room, which are:

- Walls and ceiling of the hoistway are in bright colours, made of fireproof material which does not cause dust but acts as a repellent. Hoistway overhead is completely sound-isolated from the other rooms.
- The hoistway must be dry and ventilated. The ventilation openings must be installed in a way that they outwardly conduct gasses and smoke in case of fire, and they must be protected with blinds or a net. The temperature must be between + 5°C and +40°C.
- The access to the navigation box must be simple, safe and well-lit.
- Under the ceiling of the hoistway, a carrier (a hook) is attached to the elevator which hoists heavy parts of the lift to their installation location. The position of the hook and its load are shown in the sketch of the lift.
- All revolving parts (sheave, rotating element of the overspeed governor) are coloured in yellow.
- At the overspeed governor, which is inside the hoistway below the drive machine, the direction in which the grip device is activated is shown.

LANDING DOOR

Landing doors are automated and consist of two solid-material folding elements and frame. The landing doors (folding elements and frame) are made of metal, they are deformation-proof and made and installed so that they secure proper functioning of the door interlock device.

Mechanical strength and firmness of the landing doors is such that horizontal force of 300 N (acting normally on a surface of 50 cm²) at any location of the folding elements of the interlocked door, from one or the other side, does not deform them permanently, that it does not deform them elastically for more than 15 mm and that it does not cause disturbances that will affect proper functioning of the door and interlock device. The daylight height of the landing door is 2000 mm ± 50 mm. Daylight width of the landing door is equal to the width of the car door. At every entrance to the hoistway, there is a doorstep that can hold any of pressure upon passengers entering and leaving the lift and loading in and out of cargo. Natural or artificial light, measured on the floor, outside of the landing door, must be at least 50 lx.

The car of the lift will not move or elevate if the landing door is not closed and interlocked. The interlock device of the landing door is activated when the door is closed, before the car leaves the landing. Elements of the interlock device and elements for tightening the interlock device are made of metal or are metal- reinforced and impervious to blows. The interlock device is protected from dust.

The connection between the moveable part of the safety contact which disconnects the safety electrical circuit and the interlock device is direct, without need for adjustment or subsequent adjustment. Subsequent adjustment of the contact may be performed solely by an expert who is in charge of lift maintenance and testing. The interlock device is kept in the interlocked position

by force of strings. If the shaft door is violently unlocked during the movement of the car, the lift will stop.

The landing doors have an electrical safety device that controls whether the door is closed or not. It is permitted that this device is installed on one of the folding door elements, under the condition that it has an immediate mechanical connection with the other folding element, i.e. with the door's control device. The force required to open this door is not greater than 300 N, in the unlocking zone.

If the car stops near the landing door and if the door control device is turned off, it is possible to open the car door through the landing door, i.e. to open both the car door and landing door from the car.

All landing doors are made in a way that they can be unlocked from the outside by using a special key.

The lift system may be set in motion only if all the landing doors are closed and interlocked. Interlocking is performed by means of door contacts and electromagnetic locks with a central locking mechanism.

CAR

Each lift car has four car guiding devices, sliding of the sliders. The car guiding devices are made and placed so that they would not be separated from the guide rails even if they become damaged. While designing the lift's load-bearing elements, the greatest load caused by cargo during its loading in or out from the car has been taken into consideration.

The lift car is framed with solid-material walls, floor, car door and a ceiling. At the lift car there is an entrance for persons with automatic door and ventilation hatches. Walls, floor and ceiling of the car, the car frame and its guiding device as a whole have sufficient mechanical strength to sustain impacts and pressures the car is exposed to during the operation of the lift, when the grip device is activated and when the car leans against the buffers.

The car walls are made in a way so that they would sustain, without permanent deformation, a force of 300 N which acts directly on any point of the wall, provided that it puts equal pressure on the circular and square surface of 5 mm². During this event, the maximum indentation is 15mm. Walls, floor and ceiling of the car are made from materials which are not easily flammable and which do not cause large amounts of smoke and gasses which are life-threatening.

The car floor is designed to bear load of 5 kN/m². At the car doorstep there is a protective tin foil whose minimum width is equal to the daylight width of the landing door. In its lower part, the vertical section of the protective tin foil on the doorstep is slanted under the angle of 60° in relation to the horizontal plane, and the slanted section is 50 mm long, when measured horizontally. The total height of the protective tin foil of the doorstep is 0.75 m. At the entrance to the car there is a doorstep that can sustain all pressures during loading in and out of cargo.

At the entrance to the lift car there is an automatic door. The car door closes the entire entrance to the car. When the car door is closed, the spacing between the folding elements of the door, between the folding elements of the door and the frame and the folding elements of the door and the doorstep are no wider than 10 mm.

Apart from the mechanical firmness of the car walls requirements, the car roof meets the following conditions:

- At every point, the roof must sustain at least two persons or cargo of 2 kN, without permanent deformations, and this surface must be labelled.
- There must be a free flat surface of at least 0.12 m² whose width or length is at least 0.25m.

The surface of the ventilation openings in the upper and lower part of the car is 1% of the usable surface of the car floor. The ventilation openings are made in a way that a round bar with a diameter of 10 mm cannot go through them.

The car frame is equipped with an emergency braking device which is gradually activated by means of the overspeed governor. The car frame is connected with the bearing ropes via specific suspension elements. The frame has security contacts installed which shut down the lift if:

- either of the bearing ropes is loosened;
- the car is overloaded;
- the emergency braking device is activated.

COUNTERWEIGHT

The lift counterweight is made of several firmly connected parts. The elements of the counterweight are made in a way so that they would not fall out, break or get worn out.

Since the counterweight is made of several parts, it is installed in a frame that firmly holds the counterweight's parts so that they would not move or fall out of place. The counterweight moves along rigid guide rails.

LOAD-BEARING ELEMENTS

The car and counterweight hang on steel ropes. Composure, ovality, stretch and flexibility meet the requirements defined by the steel rope standards. The bearing ropes are equally loaded. The load-bearing ropes must not be connected or fixed by interweaving. If one or several ropes in a group are to be replaced, all ropes in the given groups must be replaced.

The ratio between the rated diameter of the drive sheave and auxiliary sheave and the rated diameter of the load-bearing rope is more than $40 \times d$. Safety ratio for the bearing ropes is more than 12. The specific pressure between the load-bearing ropes and the grooves of the drive sheave meets the requirements set by lift standards.

The ends of the bearing ropes are attached to the car and counterweight or to the suspension device with a flat conic casing. With lifts with a drive sheave, when the counterweight is still on the buffers, the hoisting power of the drive sheave is such that it prevents the car from lifting by rotating the drive sheave. The hoisting power is projected in accordance with the regulations on lift standards.

OVERSPEED GOVERNOR

The grip device of the car is activated by the overspeed governor after the car reaches 115% of its rated speed. The minimum force of the overspeed governor which activates the grip device is equal to the doubled force required to activate the grip device, but not less than 300 N.

The direction of rotation of the overspeed governor during which the grip device is activated is clearly marked. The overspeed governor is set in motion by a steel rope with a rated diameter of 6.5mm.

The rope of the overspeed governor is tightened with a device whose sheave, i.e. the counterweight, are guided and supplied by electrical contact. By activating the grip device, neither the rope of the overspeed governor nor its connection will be severed, not even when the braking path is longer than regular. The rope is attached in a way so that it can be easily disconnected from the grip device.

The overspeed governor is placed on the bearing element in the hoistway overhead. The overspeed governor is designed to shut down the lift via electrical safety device before the speed

of a car moving downward reaches a speed required to activate the overspeed governor. Access for the purposes of servicing and inspection should be provided at the highest landing, through the car roof.

If after releasing the grip device, the overspeed governor does not automatically go back to its working position, an electrical safety switch for returning the overspeed governor to its working position is designed to prevent the movement of the lift as long as the overspeed governor is locked. The re-setting of the lift in motion is to be performed solely by a professional who is in charge of lift maintenance.

If the rope of the overspeed governor is loosened or severed, the electrical safety device for control of the overspeed governor rope's rigidity will shut down the lift. The overspeed governor is to be sealed.

GUIDE RAILS

Car guide rails are made of special drawn profiles, with specific gliding surfaces, with project defined dimensions. The guide rails extensions are installed with slats and bolts. The guide rails are attached with console clamps, which are connected to the hoistway walls. The dimensions and distribution of the consoles are defined by the sketches and design for this project. The number of guide rails is even. The length of the guide rails is such that the car and counterweight cannot get off of them.

The guide rails, their consoles and couplings can sustain dynamic load caused by the activity of the grip device, as well as by bending due to uneven load of the car. The bending of the guide rails does not affect proper functioning of the lift.

LIMIT SWITCH

After the car reaches the last landing, the power supply to the lift shuts down by means of a limit switch. The limit switch is activated before the car or counterweight touch the buffers and before the car passes by the final landing by no more than 0.25 m.

The limit switch is not deactivated not even when the car or counterweight press against the buffers.

The limit switch of the lift is not to be used as a switch for stopping the lift at its final landing.

After activating the limit switch, the lift is to be re-set in motion by a professional who is in charge of lift maintenance.

THE SPACE BETWEEN THE ENTRANCE SIDE OF THE CAR AND THE HOISTWAY WALL

The horizontal space between the hoistway wall, the car doorstep, the car door or door frame must not be more than 0.15 m. The horizontal space between the doorstep of the car door and doorstep of the landing door must not be more than 0.035 m.

DRIVE MACHINE

The hoisting power of the car and counterweight is enabled by a friction force between the drive sheave and the bearing ropes. The drive machine is a frequency regulated synchronous motor, with permanent magnets and with gearless traction. The drive machine is equipped with a lift brake which is automatically activated in case there is an electricity outage or outage of control voltage.

The assemblies of the drive machine which transmit the torques are not welded. The connection between the drive motor and the drive sheave is an electrical coupling. The barrel of the brake is connected into a whole with the drive sheave. Electromagnetic brake has a device for manual

unlocking which is made so that after this device is no longer exposed to activity, the brake automatically brakes. The braking force is achieved through pressure guided strings. The braking is done by the action of two coated braking pedals against the braking barrel. The braking coatings are made of inflammable material. The direction of the car movement is clearly indicated on the drive machine. The accuracy of car landing is within maximum limits of ± 50 mm.

Parts of the drive machine which revolve, such as wedges, bolts and loose endings of the axes, are protected so that they cannot harm persons in their vicinity. Parts such as the sheave and flywheel are smooth and yellow.

SAFETY DEVICE WHICH IS ACTIVATED WHEN THE CAR OR COUNTERWEIGHT HIT AN OBSTACLE ON THEIR DOWNWARD PATH

The lift is equipped with a device which shuts down the lift power supply and keeps it motionless when the car or counterweight lowering is prevented by some obstacle in the hoistway.

This electrical device is activated within the time period which does not exceed the smallest of the following values:

- 45 seconds
- travel time required for the entire elevation height, enhanced by no more than 10 seconds;
- travel time required for the entire elevation height, enhanced by no more than 20 seconds, when the travel time for the entire elevation height does not exceed 10 seconds.

ELECTRICAL INSTALLATIONS

INSIDE THE HOISTWAY

Inside the hoistway, plastic conduits for the main vertical distribution line are attached to the wall or to the metal holders placed on the car guide rails. The space between two attachments must not be more than 2 m. The conductors are delivered from the plastic conduits by means of plastic pipes. To connect the moveable car with the rest of the installation, at the middle of the hoistway and in the car there are distribution boxes with clams (marked according to the schematic), between which a bendable multicore cable is laid. The length of the cable is selected in such way that, even when the car is in its final landings, the cable can still have a free arch and not touch the car or the parts of the hoistway. The installations are delivered out from the car also by means of plastic conduits and pipes which are firmly fixed.

At the car roof, a part of the installation which is exposed to stamping by the mounting workers is specially protected. The conductor connections are delivered and laid only with clams or suitable gripping bolts.

The entrances to the hoistway must be lit all the time while the lift is in motion, at least as in the same amount as stairways with low traffic are lit (50 lx).

INSIDE THE COMMAND BOX

This is a machine-roomless lift. The command box is placed inside a slot in the wall right next to the access door at the highest landing.

- The command box is appropriately connected to the foundation grounding electrode, as well as the drive machine inside the hoistway.

- In front of the command box at the highest landing, appropriate fire extinguishing device is placed.
- In front of the control box for navigation, an attested rubber mat is placed, as well as in front of the control box for ventilation of the hoistway at the highest landing of the lift. In front of these boxes there is free space of at least 0.7 m, whose minimum width is 0.5 m.
- Hoistway overhead must be electrically lit with at least 200 lx measured at the spot where the drive machine is placed. The lighting switch is placed inside the control box for navigation.
- Inside the control box for navigation there is an alternating switch for lighting in the hoistway, appropriately labelled, which is connected to the alternating switch in the hoistway pit. One receptacle with safety contact is placed in the control box for navigation. This receptacle is connected to the system's installation by means of a special fuse.

DESIGN BASES FOR ELECTRICAL INSTALLATIONS OF THE FACILITY

Power line for supplying electricity to the lift (specific designs and installation schematics of this line are the subject of the project on electrical installations of the facility) must be laid and guided from the main distribution box of the facility to the command box of the lift, i.e. immediately next to the access to the lift at the highest landing. The power line shall be designed according to the operating current of the electrical generating unit.

To protect the lift system from electrical shock, a connecting port from the facility protection system is to be guided to the control box (the investor's obligation). Inside the control box and to the floor of the hoistway, a connecting port from the lightning rod installation of the facility is also to be guided and installed (the investor's obligation).

The design for the main power line for supplying electricity to the lift shall be done by the designer of the electrical installation of the facility, based on the data supplied by the lift manufacturer. Upon determining the cross-section of the power line, a voltage drop according to the starting current should also be taken into consideration.

The data for design of the main power line are:

- Power of the drive engine is $P = 10.7 \text{ kW}$ with rated current of $I_n = 22 \text{ A}$.
- Design of the vertical riser is performed based on the starting current which is $I_p = 31.0 \text{ A}$.
- Fuse next to the main switch: 35A.

Length of the main power line (in m) is the distance between the command box and the facility's main distribution panel, whose position is determined by the designer of the electrical installation of the facility. The voltage drop must not exceed 5%. Electrical installation is to be delivered between the command panel and all lift elements which have electrical connecting ports according to the attached lift's electrical schematic. Installation is to be laid along the wall, through the floor conduits or through flexible pipes.

The conductors are laid in plastic conduits or flexible plastic pipes. Plastic conduits or pipes must be securely tightened with bolts or collars, and must be always placed under the angle of 90° and in the most suitable way.

LIFT CARS

At the car door, there is an electrical safety device that controls whether the car door is closed and prevents movement of the car if the door or any section of the folding door is not closed.

At the car roof, on the upper bearer of the car frame, a device for service control and a two-pole receptacle with safety contact are placed. The service control device and stop switch are easily

accessible and their distance from the front rim of the car roof is less than 1m, with protection against accidental activation.

The lift car is equipped with electrical lighting, and its reinforcement is mounted in a way that it cannot collapse. The light on the car floor and of the navigation box in the car is 50 lx. Two parallel connected lighting fixtures are used to light the lift car.

If regular power supply to the source of light is disconnected, there is a back-up source of electrical energy in the car to be used for emergency lighting, with permanent charge, which is automatically activated immediately after the outage of voltage. The back-up source of electrical energy is designed so that it will power a source of lighting of 1 W power for at least an hour.

This source of electrical energy is also used to power the alarm device. Its power is projected according to the consumers' needs.

ELECTRICAL INSTALLATIONS AND DEVICES

Electrical installations and devices include the main switch of the electrical circuit and everything connected to it, as well as the switch of the car lighting circuit and everything connected to it.

Insulation resistance between the conductors, as well as between conductors and the ground, must be more than 1000 Ω/W , but no less than:

- 1) 500 k Ω for electrical circuit and safety circuit;
- 2) 250 k Ω for other circuits (for navigation, lighting etc.)

For electrical circuits for navigation and safety circuits, the middle value of direct voltage or effective value of alternating voltage between the conductors and between the conductors and the ground mustn't exceed 250 V.

Zero and safety conductor must be two separate conductors.

Main contactors, as well as contactors that are used for stopping the drive machine, must correspond to their category of use.

- 1) AC 3 - for contactors of alternating circuits;
- 2) DC 2 - for contactors of direct circuits.

Contactors must be designed so that 10% of the total number of connections and disconnections can be performed with the starting current of the motor.

If the back-up contactors are used for controlling the main contactors, they must be in accordance with the category of use.

- 1) AC11 – for back-up contactors in alternating circuits;
- 2) DC11 – for back-up contactors in direct circuits. Main and back-up contactors must meet the following conditions:

- 1) If one of the NC (normally closed) contacts is closed, all NO (normally open) contacts must be open;
- 2) If one of the NO contacts is closed, all NC contacts must be open.

If instead of the back-up contactors, relays are used in the safety circuit for controlling the main contactors, the above mentioned conditions must be met. In that case, incomplete activation of the armature will not be taken into consideration upon error assessment.

The drive electric motors which are powered directly and from the network must be protected from overload and short circuit current. If only one phase of electrical supply is out of function, damages to the motor must be prevented. Protection against overload of the electric motor which is powered directly from the network must be organised by means of devices which automatically shut down all active (phase) conductors of the motor power supply. Reactivation of the safety device must be performed by a professional who is in charge of lift maintenance.

If due to excessive power, there is an excessive spike in temperature on the coils of the motor, as well, the power supply shut down device will also shut down the electricity, and after sufficient cooling of the motor, the electricity supply may be automatically activated.

In the command box, there is a main switch that simultaneously disconnects the power supply to the lift on all poles. This switch is made to sustain the strongest current allowed during normal drive of the lift. It is tightly fixed in either ON or OFF position.

<i>Rated current of the pellet $I_n(A)$</i>	6	10	16	20	25	35	50	63
<i>tisk = 0.4 s</i>	6.47	3.67	2.56	2.04	1.57	0.92	0.65	0.43
<i>tisk = 5 s</i>	11	6.67	4.49	3.49	2.65	1.69	1.22	0.79

Main switch must not disconnect the circuits:for car lighting and ventilation,

Table for the highest permitted impedance of the fault loop $Z_{smax} (\Omega)$

- 1) for receptacles at the car roof,
- 2) for receptacles in the navigation box,
- 3) for lighting in the navigation box,
- 4) for lighting of the hoistway,
- 5) receptacle at the bottom of the hoistway.

The main switch has a label “Main switch” and the positions ON and OFF must be clearly labelled, as well.

The main switch must not be used simultaneously as the lift’s limit switch.

All electrical conductors and cables inside the navigation box and the hoistway, except for the accompanying cable for the car, if exposed to mechanical damage, must be protected with tubes, conduits and similar. The protective layers may be made of metal, plastic and other materials. Cross-section of the conductors of the electrical installation made of copper which form part of the safety circuit or another circuit connected to the safety circuit must be at least 0.75 mm². Cross-section of the conductor for navigation of the lift, for signalisation and telephone, as well as conductors for the connections of the electronics controlling devices, if they are made of copper, must be at least 0.5 mm².

The disconnection of the car light must also shut down the lift navigation system.

Switches for lights in the hoistway and of the navigation box are inside the navigation box.

Metal parts of electrical safety devices are grounded by connections to the safety line connection, regardless of the voltage. Cross-section of the safety conductor, to which metal parts of the drive motor and metal housing of the command box are attached, must not be smaller than the cross-sections of the power lines, but must be at least 6mm², if the line is made of copper, i.e. 25mm² if it is made of galvanised strip.

Lift system must be protected from atmospheric electrical discharge, according to the regulations on standards on lightning rod installations.

**DESIGN OF PROTECTION AGAINST ELECTRICAL SHOCK;
PROTECTION AGAINST INDIRECT TOUCH (SRPS N.B2.741 Art. 5)**

Facility in which the lift system is located is connected to the TN network, and the lift installation is performed in *TN-C-S* system – neutral and protective conductors are partially laid together and partially separately. Protection against indirect touch is provided by means of slow-blow fuses. For the protection to be efficient in case of malfunction of the negligible impedance between the phase and protective conductor or the exposed conductive part, automatic shutdown of power supply in the prescribed time should enter into effect by of the melting of the cut-off pellet of the fuse. This condition shall be met if: $Z_s \times I_a < U_o$

where: Z_s - the impedance of the fault loop which includes the source, conductor under voltage up until the point of fault, and the protective conductor from the point of fault to the source.

I_a – current of cut-off of the meltable pellet of the slow-blow fuse, it being:

- up to 5 seconds for fixed devices of the lift system (electrical distribution box KO-L, electrical motor, controlling group)
- up to 0.4 seconds for circuits of the receptacles with safety contact.

U_o – rated voltage towards the ground ($U_o=220V$).

For the purpose of calculating efficiency of protection against electrical shock, two charts are designed. The first represents registered values of the current of shut down (cut-off) of the meltable pellets of the slow-blow fuse from the shutdown curve for characteristic times of 0.4 and 5 s, and the other is derived from the first by recalculating the highest permitted impedance of the fault loop for registered values according to the formula $Z_s \times I_a < U_o$.

Table for current of cut-off of meltable pellets I_a (A)

Rated current of the pellet $I_n(A)$	6	10	16	20	25	35	50	63
$t_{isk} = 0.4 s$	34	60	86	108	140	240	340	510
$t_{isk} = 5 s$	20	33	49	63	83	130	180	280

Protection against indirect touch is satisfactory if the impedance of the fault loop does not exceed the values:

For fixed devices of the lift system in the main distribution box of the lift, which are powered by a circuit secured with a meltable pellet of:

$$I_n = 35A, Z_s \leq 1.69 \Omega$$

1) For the receptacles with safety contact at the car roof and the hoistway which are powered by circuits circuit secured with a meltable pellet of:

$$Z_s \leq 3.67 \Omega$$

Before commissioning the lift system, impedances of the fault loop must be calculated and determined whether they are within their permitted boundaries.

NAVIGATION

Commands for navigation the car are activated electrically, by means of buttons on the operating panel in the car and on the landing operating box on the outside.

All registered calls shall automatically systemise per direction of travel and car position, and shall be executed in natural sequence of landings. During the travel, both upwards and downwards, the car shall stop at every landing for which a call was registered.

On the car roof, there is a device for **service navigation** of the lift. The activation of the device for service navigation of the lift will shut down external and cabin navigation of the lift. Service travel of the car shall be executed only by constant pressing of the button which is protected so that it cannot be deliberately pressed. The direction of the travel is clearly indicated. Service navigation device has a “**STOP**” switch which is situated at less than 1 m from the landing door. During navigation of the lift by means of the service device, the maximum speed of the car shall be 0.63 m/s, whereby none of the safety devices shall be shut down. During service travel, the car shall not go beyond end landings.

(During service navigation of the lift, one must not override the safety contacts of the landing door or disconnect the end landings and limit switches).

The “**STOP**” switch for emergency shutdown of the lift is an electrical safety device.

Restarting the lift by means of the “**STOP**” switch shall only be done purposefully. By activating the “**STOP**” switch in collective control, external calls shall not be cancelled.

In the lift car, there is a clearly discernible and accessible alarm device. The alarm device is powered from the auxiliary electricity source for lighting of the car and it is designed in the form of a bell. The sound signal of the alarm device is clearly heard both in the car and at the main landing.

At every landing there is a discernible lighting signal for the direction of the travel.

At every access to the hoistway and in the lift car with **collective control**, a signal for confirmation of command reception and execution is placed.

SIGNS, NOTICES AND LABELS

All the signs, notices and labels must be clearly discernible, legible and understandable, made of durable material and permanently fixed. In the lift car and on the shaft doors, there is a sign stating the rated load in kg and maximum permitted number of persons. Part used for setting off the alarm is yellow, with a permanent sign saying “**ALARM**”, the minimum height of letters being 7 mm, or a symbol in the form of a bell.

The following signs and labels are to be placed on the roof:

- 2) on the switch for stopping or next to it - label “**STOP**”
- 3) on the service switch or next to it – label “**NORMAL**” and “**SERVICE**”
- 4) on elements for activating the service travel command or next to them – sign of direction of the travel.

On the outer side of the command box door, the notices “**DANGER OF DEATH**”, “**LIFT DRIVE**” are to be placed.

Inside the command box there is an instruction for setting the car in motion manually and control, and for the application of the key for emergency opening of the landing door.

On the switch for car and hoistway lighting, there are plates with texts “**CAR LIGHTING**”, “**HOISTWAY LIGHTING**”.

On the overspeed governor, there is a plate with the following information:

- 1) company;
- 2) speed of activation (m/s);
- 5) overspeed governor marking;
- 6) technical specifications of the rope.

On the “STOP” switch in the hoistway pit or next to it, there is a label saying “**OFF**”.

On the drive machine, at a clearly discernible spot, there is a metal plate with the following information:

- 1) company;
- 2) technical specifications;
- 3) drive machine mass;
- 4) serial number and year of production.

LIFT TESTING

During the exploitation of the lift, should any of the following parts: load-bearing ropes, drive machine, grip device, overspeed governor, navigation devices, braking devices and hoisting device be replaced, as well as if, during inspection, irregularity which may lead to dangerous drive condition is defined, the lift must not be commissioned until the technical inspection of the lift has verified that all the required conditions for its safe operation are met.

Passengers' lifts are liable to mandatory occasional technical inspection.

Occasional technical inspection of the lift system must be performed no later than the expiration of one year after the previous technical inspection of the given lift.

An examination report is to be formulated on the performed technical inspection.

MAINTENANCE

Every lift is equipped with a manufacturer's manual on operating the lift and its maintenance. Regular lift maintenance must be performed at least once a month. Every lift must keep a maintenance log.

DOCUMENTS ACCOMPANYING LIFT DURING TRANSPORT

During transport, i.e. delivery, a lift must be accompanied by a certificate of guarantee. The guaranteed period for proper functioning of the lift is two years. The lift is equipped with technical manual of the manufacturer.

The period for guaranteed lift servicing is ten years, starting from the day of commissioning the newly installed lift.

GENERAL PROVISIONS

During the guaranteed period, starting from the day when the system was properly commissioned, for every malfunction which occurs which was caused by poor quality of material, poor design or poor mounting, upon receiving a call from the investor, the contractor must remove the failure and restore proper operation of the system.

The contractor shall not be held liable for non-professional and careless operation of the system. Upon finishing the mounting, the lift system must undergo tests based on the Rulebook on Lift Safety ("Official Gazette of the Republic of Serbia", No. 101/2010, dated December 29th 2010). After completing the tests, the investor shall ask for a use permit from the competent authority for issuing use permits.

The contractor shall deliver the following attestations to the investor:

- for the steel rope;
- for the electro-mechanic lock;
- for the emergency braking device;
- for the car overspeed governor;
- for the insulation floor mats.

Simultaneously with commissioning the system, the investor, i.e. the user, shall provide maintenance of the system, it being:

- daily, by means of one person in charge;
- regular maintenance, by means of a professional maintenance organisation;
- regular technical inspection, by means of authorised institution.

5.2. Technical description of the lift – L2

The purpose of this lift is to transport cargo and people between the basement and fourth floor of the hospital building. It will be installed in reinforced concrete hoistway. The drive machine is to be placed in the machine room above the hoistway.

TECHNICAL SPECIFICATIONS:

Type of lift:	Hospital lift for passengers- Sterile
Number of items:	1
Lift mark:	L2
Load:	$Q = 2500 \text{ kg}$
Height of elevation:	$H = 17980 \text{ mm}$
Speed of travel:	$v = 1.0 \text{ m/s}$
Number of landings/entrances:	$n=6/6$, entrances at -1 under 90° in relation to others
Marking of landings:	(-1, 0, 1, 2, 3 and 4),
Main landing:	"0"
Control:	"Simplex" collective control in both directions with a key for priority travels; microprocessor;
Fire alarm mode:	In the event of a fire alarm, the lift shall automatically guide the car to the main landing "0" and after the passengers have left the lift car, it will shut down.
Electricity outage mode:	The powering of the lift shall be switched to an electrical generating unit;
Type of drive:	electrical motor, gearless, regulated,
No. of starts:	180 starts/h
Control positions:	a) during regular use: - from all landings, - from the car

- from the roof of the car (revision travel).

Signalisation:

- on the floors:

1) landing operating panels with micro-sensory buttons, car position indicator, direction indicating arrow for further transport, buttons need to be suitable for the disabled persons, confirmation of reception of the call;

- inside the car:

1) micro-sensory car operating keys with confirmation of reception of the call, Braille symbols and sound signal,
2) car position signal,
3) digital indicator of overload,
5) sound signal for overload,
6) door opening button,
7) door closing button,
8) main landing alarm button,
9) ventilator switch,
10) STOP button;

Interphone or telephone line: two-way communication between: the car and control centre.

Car:

metal constructions, transient under an angle of 90°,

- number of car entrances:

2

- car walls:

final coating antibacterial stainless steel (inox),

- lighting:

indirectly in the lowered ceiling, ceiling made of stainless steel,

- car operating panel:

panel along the entire height of the cabin inox,

- floor:

anti-slippery and antibacterial,

- additional equipment:

two bumper rails and a handgrip on the rims of the car, emergency lights, ventilator, ventilation with air ionisation, alarm, interphone or telephone.

A socket to plug in a germicidal UV lamp is to be placed in the car, and at the entrance to the lift a warning sign that the car is being sterilised, in accordance with the hospital's sterilisation technology.

- car dimensions:

2150x 2400 x 2200 mm.

Car door:

automatic two-panel telescopic,

- panels:

final coating stainless steel (inox),

- door safety system:

safety IR curtain,

- dimensions:

1300x2000mm

Landing door:

automatic two-panel telescopic,

- panels and doorposts:

final coating stainless steel (inox),

- door safety system:

electro-mechanical interlock device,

- dimensions:

1300x2000mm.

Hoistway:

- width x length:

2900 x 3150 mm,

- hoistway overhead:

6300 mm,

- hoistway pit:

1400 mm,

Machine room:

without the hoistway,

- drive machine position:

on the top of the hoistway,

- working temperature:

inside the hoistway must be between +5°C and +40°C,

- working environment: standard, dry space,
- electrical connection: 3 x 400 / 230 V, 50 Hz
- voltage deviation: $\pm 5\%$
- power cable: to be delivered to the top station, next to the entrance doors.

Counterweight material: grey iron,
 Position: on the side next to the car,
 Car guide rails: 125x82x16 mm
 Counterweight guide rails: 70x 70 x9 mm
 Suspension system: 2:1
 Drive sheave: $D = 520 \text{ mm}$
 Folding sheaves: $D = 400 \text{ mm}$
 Number of ropes: $z = 8$
 Steel rope diameter: $d = 10 \text{ mm}$
 Drive machine: gearless, frequency regulated
 Power of the electric motor: $P = 16.6 \text{ kW}$
 Rated output power of the motor: $I = 30 \text{ A}$

HOISTWAY

Hoistway of the lift is to be enclosed with firm and solid walls from all sides and along its entire height, and with a ceiling and a floor. The cars of the lift and of the counterweight are situated in same hoistways.

At the top of the hoistway there are ventilation openings, whose entire cross-section surface is at least 2% of the surface of the horizontal cross-section of the hoistway. The hoistway must not be used for ventilation of rooms which are not part of the lift system, and equipment and devices which are not integral parts of the lift must not be installed.

The hoistway can hold load pressure caused by the operation of the drive machine, by the action of grip device on the guide rails, and by the pressure of the car or counterweight against the buffers.

The hoistway walls are made of material which is resistant to mechanical damage and fire and which does not cause dust but repels it.

The hoistway walls are made with such mechanical strength that the action of direct force of 300 N must not cause an indentation larger than 10 mm. This force may act from one or the other side of the wall, at any spot, under the condition that it is equally distributed across the surface of 5 mm².

Bottom of the hoistway pit is protected from water penetration.

At the level of the lowest landing, an electronic "STOP" switch, with clearly marked positions "ON" and "OFF", double-pole receptacle with protective contact and alternating switch for lighting of the hoistway are installed, purposefully labelled and connected to the alternating switch in the command box.

The interior of the hoistway is equipped with electrical lighting, at 0.5 m from the bottom of the pit and top of the ceiling, and between them at every 7 m. At the bottom of the hoistway, metal climbers are to be installed.

When the car of the lift rests on completely compressed buffers

- inside the hoistway pit there is space which allows the placement of a cuboid with minimum size of 0.5 x 0.6 x 1.0 m, so that it lies on one of its surfaces;
- free space between the bottom of the hoistway pit and the lowest position of the car is at least 0.5 m, and between the bottom of the pit and the lowest position of the car cable guides, parts of the grip device, protective foil of the car doorstep more than 0.1 m.

The hoistway contains the following openings:

the landing doors, hoistway ventilation, connection of the hoistway with the command box and the duct for discharge of gasses and smoke in case of fire.

BUFFERS IN THE HOISTWAY

For the purpose of limiting the movements of the counterweight and car, and their safe stopping, in the event of failure of the limit switch, buffers are to be placed at the bottom of the hoistway. They provide the necessary safety space both at the bottom and top of the hoistway (limited movement of the counterweight). The buffers installed in the lift are without absorbers.

Headroom

This is an elevator without machine room. The machine is fitted inside the hoistway, at the top of the holder that is fixed to the side walls of the hoistway and guides of the car.

Since this lift has no machine room, headroom (where the drive machine is located) and space in front of the car operation (the highest station) meet the requirements for the machine room, as follows:

- The walls and ceiling of the top panes are in light colours, of a material that is resistant to fire, which does not create dust, but prevents its deposition. Top wiper is well sound-isolated from the other rooms.
- An operating shaft must be dry and ventilated. Openings for ventilation shall be so constructed as to carry gases and smoke in case of fire and must be protected by blinds or network. The temperature should be between + 5 ° C to + 40 ° C.
- Access control cabinet must be easily accessible, safe and with lightning available.
- Below ceiling headroom is set bracket (hook) for the crane that lifts the heavy parts of the lift to the site. The position of the hook and the loading are shown in the drawing of the elevator.
- All working parts (pulleys, rotating part of the speed limiter) are colored yellow.
- The speed limiter, which is located inside the hoistway below the driving machine, marked the direction in which comes into effect the capture device.

LANDING DOOR

Landing doors are automated and consist of solid-material folding panels and frame. The landing doors (panels and frame) are made of metal, they are deformation-proof and made and installed so that they secure proper functioning of the door interlock device.

Mechanical sturdiness and firmness of the landing doors is such that horizontal force of 300N (acting directly on a surface of 50 cm²) at any location of the panels of the interlocked door, from one or the other side, does not deform them permanently, that it does not deform them elastically for more than 15 mm and that it does not cause disturbances that will affect proper functioning of the door and interlock device. The daylight height of the landing door is 2,000 mm ± 50 mm. Daylight width of the landing door is equal to the width of the car door.

At every entrance to the hoistway, there is a doorstep that can hold any pressure upon passengers entering and leaving the lift and loading in and out of cargo. Natural or artificial light, measured on the floor, outside of the landing door, must be at least 50 lx.

The car of the lift will not move or elevate if the landing door is not closed and interlocked. The deterring device of the landing door is activated when the door is closed before the car leaves the landing. Elements of the interlock device and elements for tightening the interlock device are made of metal or are metal- reinforced and impervious to blows. The interlock device is protected from dust.

The connection between the moveable part of the safety contact which disconnects the safety electrical circuit and the interlock device is direct, without need for adjustment or subsequent adjustment. Subsequent adjustment of the contact may be performed solely by an expert who is in charge of lift maintenance and testing. The interlock device is kept in the interlocked position by force of springs. If the shaft door is violently unlocked during the movement of the car, the lift will stop.

The landing doors have an electrical safety device that controls whether the door is closed or not. It is permitted that this device is installed on one of the door panels, under the condition that it has an immediate mechanical connection with the other panel, i.e. with the door's control device. The force required to open this door is not greater than 300 N, in the unlocking zone.

If the car stops near the landing door and if the door control device is turned off, it is possible to open the car door through the landing door, i.e. to open both the car door and landing door from the car.

All landing doors are made in a way that they can be unlocked from the outside by using a special key.

The lift system may be set in motion only if all the landing doors are closed and interlocked. Interlocking is performed by means of door contacts and electromagnetic locks with a central locking mechanism.

CAR

Each lift car has four car guiding devices, sliding of the sliders. The car guiding devices are made and placed so that they would not be separated from the guide rails even if they become damaged. While designing the lift's load-bearing elements, the greatest load caused by cargo during its loading in or out from the car has been taken into consideration.

The lift car is framed with solid-material walls, floor, car door and a ceiling. At the lift car there is an entrance for persons with automatic door and ventilation hatches. Walls, floor and ceiling of the car, the car frame and its guiding device as a whole have sufficient mechanical firmness to sustain impacts and pressures the car is exposed to during the operation of the lift, when the grip device is activated and when the car leans against the buffers.

The car walls are made in a way so that they would sustain, without permanent deformation, a force of 300 N which acts directly on any point of the wall, provided that it puts equal pressure on the circular and square surface of 5 mm². During this event, the maximum indentation is 15 mm. Walls, floor and ceiling of the car are made from materials which are not easily flammable and which do not cause large amounts of smoke and gasses which are life-threatening.

The car floor is designed to bear load of 5 kN/m². At the car doorstep there is a protective tin foil whose minimum width is equal to the daylight width of the landing door. In its lower part, the vertical section of the protective tin foil on the doorstep is slanted under the angle of 60° in relation to the horizontal plane, and the slanted section is 50mm long, when measured horizontally. The total height of the protective tin foil of the doorstep is 0.75m. At the entrance to the car there is a doorstep that can sustain all pressures during loading in and out of cargo.

At the entrance to the lift car there is an automatic door. The car door closes the entire entrance to the car. When the car door is closed, the spacing between the panels of the door, between the panels of the door and the frame and the panels of the door and the doorstep are no wider than 10 mm.

Apart from the mechanical strength of the car walls requirements, the car roof also meets the following conditions:

- at every point, the roof must sustain at least two persons or cargo of 2 kN, without permanent deformations, and this surface must be labelled.
- there must be a free flat surface of at least 0.12 m² whose width or length is at least 0.25m.

The surface of the ventilation openings in the upper and lower part of the car is 1% of the usable surface of the car floor. The ventilation openings are made in a way that a round bar with a diameter of 10 mm cannot go through them.

The car frame is equipped with an emergency braking device which is gradually activated by means of the overspeed governor. The car frame is connected with the bearing ropes via specific suspension elements. The frame has security contacts installed which shut down the lift if:

- either of the load-bearing ropes is loosened;
- the car is overloaded;
- the emergency braking device is activated.

COUNTERWEIGHT

The lift counterweight is made of several firmly connected parts. The elements of the counterweight are made in a way so that they would not fall out, break or get worn out.

Since the counterweight is made of several parts, it is installed in a frame that firmly holds the counterweight's parts so that they would not move or fall out of place. The counterweight moves along rigid guide rails.

LOAD-BEARING ELEMENTS

The car and counterweight hang on steel ropes. Composure, ovality, stretch and flexibility meet the requirements defined by the steel rope standards. Load is equally distributed along the load-bearing ropes. The load-bearing ropes must not be connected or fixed by interweaving. If one or several ropes in a group are to be replaced, all ropes in the given groups must be replaced.

The ratio between the rated diameter of the drive sheave and auxiliary sheave and the rated diameter of the load-bearing rope is more than 40xd. Safety ration for the bearing ropes is more than 12. The specific pressure between the load-bearing ropes and the grooves of the drive sheave fulfils the requirements set by lift standards.

The ends of the load-bearing ropes are attached to the car and counterweight or to the suspension device with a flat conic casing.

With lifts with a drive sheave, when the counterweight is resting on the buffers, the hoisting power of the drive sheave is such that it prevents the car from lifting by rotating the drive sheave. The hoisting power is projected in accordance with the regulations on lift standards.

OVERSPEED GOVERNOR

The car grip device is activated by the overspeed governor after the car reaches 115% of its rated speed. The minimum force of the overspeed governor which activates the grip device is equal to the doubled force required to activate the grip device, but not less than 300N.

The direction of rotation of the overspeed governor during which the grip device is activated is clearly marked. The overspeed governor is set in motion by a steel rope with a rated diameter of 6.5mm.

The rope of the overspeed governor is tightened with a device whose sheave, i.e. the counterweight, are guided and supplied by electrical contact. By activating the grip device, neither the rope of the overspeed governor nor its connection will be severed, not even when the braking path is longer than regular. The rope is attached in a way so that it can be easily disconnected from the grip device.

The overspeed governor is placed on the load-bearing element in the hoistway overhead. The overspeed governor is designed to shut down the lift via electrical safety device before the speed of a car moving downward reaches a speed required to activate the overspeed governor.

If after releasing the grip device, the overspeed governor does not automatically go back to its working position, an electrical safety switch for returning the overspeed governor to its working position is designed to prevent the movement of the lift as long as the overspeed governor is locked. The re-setting of the lift in motion is to be performed solely by a professional who is in charge of lift maintenance.

If the rope of the overspeed governor is loosened or severed, the electrical safety device for control of the overspeed governor rope's tightness will shut down the lift. The overspeed governor is to be sealed.

GUIDE RAILS

Car guide rails are made of special drawn profiles, with specific gliding surfaces, with project defined dimensions. The guide rails extensions are installed with slats and bolts. The guide rails are attached with console clams, which are connected to the hoistway walls. The dimensions and distribution of the consoles are defined by the sketches and design for this project. The number of guide rails is even. The length of the guide rails is such that the car and counterweight cannot get off of them.

The guide rails, their consoles and couplings can sustain dynamic load caused by the activity of the grip device, as well as by bending due to uneven load of the car. The bending of the guide rails does not affect proper functioning of the lift.

LIMIT SWITCH

After the car reaches the last landing, the power supply to the lift shuts down by means of a limit switch. The limit switch is activated before the car or counterweight touch the buffers and before the car passes by the final landing by no more than 0.25m.

The limit switch is not deactivated not even when the car or counterweight press against the buffers.

The limit switch of the lift is not to be used as a switch for stopping the lift at its final landing.

After activating the limit switch, the lift is to be re-set in motion by a professional who is in charge of lift maintenance.

THE SPACE BETWEEN THE ENTRANCE SIDE OF THE CAR AND THE HOISTWAY WALL

The horizontal space between the hoistway wall, the car doorstep, the car door or door frame must not be more than 0.15m. The horizontal space between the doorstep of the car door and doorstep of the landing door must not be more than 0.035m.

DRIVE MACHINE

The hoisting power of the car and counterweight is enabled by a friction force between the drive sheave and the bearing ropes. The drive machine is a frequency regulated synchronous motor, with permanent magnets and with gearless traction. The drive machine is equipped with a lift brake which is automatically activated in case there is an electricity outage or outage of control voltage.

The assemblies of the drive machine which transmit the torques are not welded. The connection between the drive engine and the drive sheave is an electrical coupling. The barrel of the brake is connected into a whole with the drive sheave. Electromagnetic brake has a device for manual unlocking which is made so that after this device is no longer exposed to activity, the brake automatically brakes. The braking force is achieved through pressure guided strings. The braking is done by the action of two coated braking pedals against the braking barrel. The braking coatings are made of inflammable material. The direction of the car movement is clearly

indicated on the drive machine. The accuracy of car landing is within maximum limits of $\pm 50\text{mm}$.

Parts of the drive machine which revolve, such as wedges, bolts and loose endings of the axes, are protected so that they cannot harm persons in their vicinity. Parts such as the sheave and flywheel are smooth and yellow.

SAFETY DEVICE WHICH IS ACTIVATED WHEN THE CAR OR COUNTERWEIGHT HIT AN OBSTACLE ON THEIR DOWNWARD PATH

The lift is equipped with a device which shuts down the lift power supply and keeps it motionless when the car or counterweight lowering is prevented by some obstacle in the hoistway.

This electrical device is activated within the time period which does not exceed the smallest of the following values:

- 45 seconds
- travel time required for the entire elevation height, enhanced by no more than 10 seconds;
- travel time required for the entire elevation height, enhanced by no more than 20 seconds, when the travel time for the entire elevation height does not exceed 10 seconds.

ELECTRICAL INSTALLATIONS INSIDE THE HOISTWAY

Inside the hoistway, plastic conduits for the main vertical distribution line are attached to the wall or to the metal holders placed on the car guide rails. The space between two attachments must not be more than 2 m. The conductors are delivered from the plastic conduits by means of plastic pipes. To connect the moveable car with the rest of the installation, at the middle of the hoistway and in the car there are distribution boxes with clams (marked according to the schematic), between which a bendable multicore cable is laid. The length of the cable is selected in such way that, even when the car is in its final landings, the cable can still have a free arch and not touch the car or the parts of the hoistway. The installations are guided out from the car also by means of plastic conduits and pipes which are firmly attached.

At the car roof, a part of the installation which is exposed to stamping by the mounting workers is specially protected.

The conductor connections are delivered and laid only with clams or suitable gripping bolts.

The entrances to the hoistway must be lit all the time while the lift is in motion, at least in the same amount as stairways with low traffic are lit (50 lx).

In the control cabinet

This is a lift without the machine room, the control panel is placed in the hole in the wall right next to the entrance doors at the top station.

- Control cabinet is provided connection to the base earthing facility, as well as driving machines inside the shaft.
- In front of control unit, at the highest station, appropriate fire extinguisher is set.
- In front of control unit management sets are tested rubber mat, as well as in front of the cabinet management ventilation shaft at the highest lift station. In front of the cabinet there is a free space of at least 0.7 m and a width of 0.5 m min.
- Headroom must have electric lighting min 200 lx measured at the point where to set the drive machine. Switch light is placed inside of control unit management.

- The control cabinet is alternating switch for light shaft, a dedicated marked area, which is related to AC switch in the pit shaft. One power socket is placed in the closet management. The connector can be linked to the installation of the building, a separate fuse.

DESIGN BASES FOR ELECTRICAL INSTALLATIONS OF THE FACILITY

Power line for supplying electricity to the lift (specific designs and installation schematics of this line are the subject of the project on electrical installations of the facility) must be delivered and laid from the main distribution box of the facility to the command box of the lift, i.e. immediately next to the access to the lift at the highest landing. The power line shall be designed according to the starting current of the electrical generating unit.

To protect the lift system from electrical shock, a connecting port from the facility protection system is to be delivered to the control box. Inside the control box and to the floor of the hoistway, a connecting port from the lightning rod installation of the facility is also to be delivered and installed.

The design for the main power line for supplying electricity to the lift shall be done by the designer of the electrical installation of the facility, based on the data supplied by the lift manufacturer. Upon determining the cross-section of the power line, a voltage drop according to the starting current should also be taken into consideration.

The data for design of the main power line for this lift are:

- Power of the drive electrical motor and rated current is $P = 16.6 \text{ kW}$, $I_n = 30 \text{ A}$.
- Fuse next to the main switch: 35A.

Length of the main power line (in m) is the distance between the command box and the facility's main distribution panel, whose position is determined by the designer of the electrical installation of the facility. The voltage drop must not exceed 5%. Electrical installation is to be delivered between the command panel and all lift elements which have electrical connecting ports according to the attached lift's electrical schematic. Installation is to be delivered along the wall, through the floor conduits or through flexible pipes.

The conductors are laid in plastic conduits or in flexible plastic pipes. Plastic conduits or pipes must be securely tightened with bolts or collars, and must be always placed under the angle of 90° and in the most suitable way.

LIFT CARS

At the car door, there is an electrical safety device that controls whether the car door is closed and prevents movement of the car if the door or any panel of the folding door is not closed.

At the car roof, on the upper load-bearer of the car frame, a device for service control and a two-pole receptacle with safety contact are placed. The service control device and stop switch are easily accessible and their distance from the front rim of the car roof is less than 1 m, with protection against accidental activation.

The lift car is equipped with electrical lighting, and its reinforcement is mounted in a way that it cannot collapse. The light on the car floor and of the control box in the car is 50 lx. Two parallel connected lighting fixtures are used to light the lift car.

If regular power supply to the source of light is disconnected, there is a back-up source of electrical energy in the car to be used for emergency lighting, with permanent charge, which is automatically activated immediately after the outage of voltage. The back-up source of electrical energy is designed so that it will power a source of lighting of 1W power for at least an hour.

This source of electrical energy is also used to power the alarm device. Its power is projected according to the consumers' needs.

ELECTRICAL INSTALLATIONS AND DEVICES

Electrical installations and devices include the main switch of the electrical circuit and everything connected to it, as well as the switch of the car lighting circuit and everything connected to it.

Insulation resistance between the conductors, as well as between conductors and the ground, must be more than 1000 Ω/W , but no less than:

- 1) 500 k Ω for electrical circuit and safety circuit;
- 2) 250 k Ω for other circuits (for control, lighting etc.)

For electrical circuits for control and safety circuits, the middle value of direct voltage or effective value of alternating voltage between the conductors and between the conductors and the ground mustn't exceed 250 V.

Zero and safety conductor must be two separate conductors.

Main contactors, as well as contactors that are used for stopping the drive machine, must correspond to their category of use.

- 1) AC 3 - for contactors of alternating circuits;
- 2) DC 2 - for contactors of direct circuits.

Contactors must be designed so that 10% of the total number of connections and disconnections can be performed with the starting current of the motor.

If the back-up contactors are used for controlling the main contactors, they must be in accordance with the category of use.

- 3) AC11 – for back-up contactors in alternating circuits;
- 4) DC11 – for back-up contactors in direct circuits.

Main and back-up contactors must meet the following conditions:

- 1) If one of the NC (normally closed) contacts is closed, all NO (normally open) contacts must be open;
- 2) If one of the NO contacts is closed, all NC contacts must be open.

If instead of the back-up contactors, relays are used in the safety circuit for controlling the main contactors, the above mentioned conditions must be met. In that case, incomplete activation of the armature will not be taken into consideration upon error assessment.

The drive electric motors which are powered directly and from the network must be protected from overload and short circuit current. If only one phase of electrical supply is out of function, damages to the motor must be prevented. Protection against overload of the electric motor which is powered directly from the network must be delivered by means of devices which automatically shut down all active (phase) conductors of the motor power supply. Reactivation of the safety device must be performed by a professional who is in charge of lift maintenance.

If due to excessive power, there is an excessive spike in temperature on the coils of the motor, as well, the power supply shut down device will also shut down the electricity, and after sufficient cooling of the motor, the electricity supply may be automatically activated.

In the control box, there must be a main switch that simultaneously disconnects the power supply to the lift on all poles. This switch is made to sustain the strongest current allowed during normal drive of the lift. It must be tightly fixed in either ON or OFF position.

Main switch must not disconnect the circuits:

- 1) for car lighting and ventilation,
- 2) for receptacles at the car roof,
- 3) for receptacles in the control box,
- 4) for lighting in the control box,
- 5) for lighting of the hoistway,
- 6) receptacle at the bottom of the hoistway.

The main switch has a label “*Main switch*” and the positions ON and OFF must be clearly labelled, as well.

The main switch must not be used simultaneously as the lift’s limit switch.

All electrical conductors and cables inside the machine room and the hoistway, except for the accompanying cable for the car, if exposed to mechanical damage, must be protected with tubes, conduits and similar. The protective layers may be made of metal, plastic and other materials.

Cross-section of the conductors of the electrical installation made of copper which form part of the safety circuit or another circuit connected to the safety circuit must be at least 0.75 mm^2 .

Cross-section of the conductor for control of the lift, for signalisation and telephone, as well as conductors for the connections of the electronics controlling devices, if they are made of copper, must be at least 0.5 mm^2 .

The disconnection of the car light must also shut down the lift controlling system.

Switches for lights in the hoistway and of the machine room are in the machine room, near the entrance.

Metal parts of electrical safety devices are grounded by connections to the safety line connection, regardless of the voltage.

Minimum cross-section of the grounded line, to which metal parts of the drive motor and metal housing of the command box are attached, must not be smaller than the cross-sections of the power lines, but must be at least 6 mm^2 , if the line is made of copper, i.e. 25 mm^2 if it is made of galvanised strip.

Lift system must be protected from atmospheric electrical discharge, according to the regulations on standards on lightning rod installations.

DESIGN OF PROTECTION AGAINST ELECTRICAL SHOCK

PROTECTION AGAINST INDIRECT TOUCH (SRPS N.B2.741 Art. 5)

Facility in which the lift system is located is connected to the TN network, and the lift installation is delivered in *TN-C-S* system – neutral and protective conductors are partially laid together and partially separately. Protection against indirect touch is provided by means of slow-blow fuses. For the protection to be efficient in case of malfunction of the negligible impedance between the phase and protective conductor or the exposed conductive part, automatic shutdown of power supply in the prescribed time should enter into effect by of the melting of the cut-off pellet of the fuse. This condition shall be met if: $Z_s \times I_a < U_o$

where: Z_s - the impedance of the fault loop which includes the source, conductor under voltage up until the point of fault, and the protective conductor from the point of fault to the source.

I_a – current of cut-off of the meltable pellet of the slow-blow fuse, it being:

- up to 5 seconds for fixed devices of the lift system (electrical distribution box KO-L, electrical motor, controlling group)
- up to 0.4 seconds for circuits of the receptacles with safety contact.

U_o – rated voltage towards the ground ($U_o=220V$).

For the purpose of calculating efficiency of protection against electrical shock, two charts are designed. The first represents registered values of the current of shut down (cut-off) of the meltable pellets of the slow-blow fuse from the shutdown curve for characteristic times of 0.4 and 5 s, and the other is derived from the first by recalculating the highest permitted impedance of the fault loop for registered values according to the formula $Z_s \times I_a < U_o$

Table for current of cut-off of meltable pellets I_a (A)

Rated current of the pellet I_n (A)	6	10	16	20	25	35	50	63
tisk = 0.4s	34	60	86	108	140	240	340	510
tisk = 5 s	20	33	49	63	83	130	180	280

Table for the highest permitted impedance of the fault loop Z_{smax} (Ω)

Rated current of the pellet I_n (A)	6	10	16	20	25	35	50	63
tisk = 0.4s	6.47	3.67	2.56	2.04	1.57	0.92	0.65	0.43
tisk = 5 s	11	6.67	4.49	3.49	2.65	1.69	1.22	0.79

Protection against indirect touch is satisfactory if the impedance of the fault loop does not exceed the values:

- For fixed devices of the lift system in the main distribution box of the lift, which are powered by a circuit secured with a meltable pellet of: $I_{nI} = 35A$, $Z_s \leq 1.69 \Omega$
- For the receptacles with safety contact at the car roof and in the hoistway which are powered by circuits circuit secured with a meltable pellet of 10A: $Z_s \leq 3.67 \Omega$

Before commissioning the lift system, impedances of the fault loop must be calculated and determined whether they are within their permitted boundaries.

CONTROL

Commands for navigation the car are activated electrically, by means of buttons on the operating panel in the car and on the landing operating box on the outside.

All registered calls shall automatically systemise per direction of travel and car position, and shall be executed in natural sequence of landings. During the travel upwards and downwards, the lift shall stop at every landing for which a call was registered.

On the car roof, there is a device for **service control** of the lift. The activation of the device for service control of the lift will shut down external and cabin control of the lift. Service travel of the car shall be executed only by constant pressing of the button which is protected so that it cannot be deliberately pressed. The direction of the travel is clearly indicated. Service control device has a “**STOP**” switch which is situated at less than 1 m from the landing door. During control of the lift by means of the service device, the maximum speed of the car shall be 0.63

m/s, whereby none of the safety devices shall be shut down. During service travel, the car shall not go beyond end landings.

(During service control of the lift, one must not override the safety contacts of the landing door or disconnect the end landings and limit switches).

The “**STOP**” switch for emergency shutdown of the lift is an electrical safety device.

Restarting the lift by means of the “**STOP**” switch shall only be done purposefully. By activating the “**STOP**” switch in collective control, external calls shall not be cancelled.

In the lift car, there is a clearly discernible and accessible alarm device. The alarm device is powered from the auxiliary electricity source for lighting of the car and it is designed in the form of a bell. The sound signal of the alarm device is clearly heard both in the car and at the main landing.

At every landing there is a discernible lighting signal for the direction of the travel.

At every access to the hoistway and in the lift car with **collective control**, a signal for confirmation of command reception and execution is placed.

SIGNS, NOTICES AND LABELS

All the signs, notices and labels must be clearly discernible, legible and understandable, made of durable material and permanently fixed. In the lift car and on the shaft doors, there is a sign stating the rated load in kg and maximum permitted number of persons.

Part used for setting off the alarm is yellow, with a permanent sign saying “ALARM”, the minimum height of letters being 7 mm, or a symbol in the form of a bell.

The following signs and labels are to be placed on the roof:

- 1) on the switch for stopping or next to it - label “STOP”
- 2) on the service switch or next to it – label “NORMAL” and “SERVICE”
- 3) on elements for activating the service travel command or next to them – sign of direction of the travel.

On the outer side of the command box door, the notices “**DANGER OF DEATH**”, “**LIFT DRIVE**” are to be placed.

Inside the command box there is an instruction for setting the car in motion manually and control, and for the application of the key for emergency opening of the landing door.

On the switch for car and hoistway lighting, there are plates with texts “**CAR LIGHTING**”, “**HOISTWAY LIGHTING**”.

On the overspeed governor, there is a plate with the following information:

- 1) company;
- 2) speed of activation (m/s);
- 4) overspeed governor marking;
- 5) technical specifications of the rope.

On the “**STOP**” switch in the hoistway pit or next to it, there is a label saying “**OFF**”.

On the drive machine, at a clearly discernible spot, there is a metal plate with the following information:

- 1) company;
- 2) technical specifications: type of reduction unit, number of starts of the worm screw, number of teeth of the worm wheel and module, diameter of the output shaft and angle of the wedge of the groove on the drive sheave;
- 3) technical specifications;
- 4) drive machine mass;

5) serial number and year of production.

LIFT TESTING

During the exploitation of the lift, should any of the following parts: load-bearing ropes, drive machine, grip device, overspeed governor, controlling devices, braking devices and hoisting device be replaced, as well as if, during inspection, irregularity which may lead to dangerous drive condition is defined, the lift must not be commissioned until the technical inspection of the lift has verified that all the required conditions for its safe operation are met.

Passengers' lifts are liable to mandatory occasional technical inspection.

Occasional technical inspection of the lift system must be performed no later than the expiration of one year after the previous technical inspection of the given lift.

An examination report is to be formulated on the performed technical inspection.

MAINTENANCE

Every lift is equipped with a manufacturer's manual on operating the lift and its maintenance. Regular lift maintenance must be performed at least once a month. Every lift must keep a maintenance log.

DOCUMENTS ACCOMPANYING COMMISSIONED LIFTS

Commissioned lift, i.e. upon delivery, it must be accompanied by a certificate of guarantee. The guaranteed period for proper functioning of the lift is two years. The lift is equipped with technical manual of the manufacturer.

The period for guaranteed lift servicing is ten years, starting from the day of commissioning the newly installed lift.

GENERAL PROVISIONS

During the guaranteed period, starting from the day when the system was properly commissioned, for every malfunction which occurs which was caused by poor quality of material, poor design or poor mounting, upon receiving a call from the investor, the contractor must remove the failure and restore proper operation of the system.

The contractor shall not be held liable for non-professional and careless operation of the system. Upon finishing the mounting, the lift system must undergo tests based on the Rulebook on lift safety ("Official Gazette of the Republic of Serbia", No. 101/2010, dated December 29th 2010). After completing the tests, the investor shall ask for a use permit from the competent authority for issuing use permits.

The contractor shall deliver the following attestations to the investor:

- for the steel rope;
- for the electro-mechanic lock;
- for the emergency braking device;
- for the car overspeed governor;
- for the insulation floor mats.

Simultaneously with commissioning the system, the investor, i.e. the user, shall provide maintenance of the system, it being:

- daily, by means of one person in charge;
- regular maintenance, by means of a professional maintenance organisation;
- regular technical inspection, by means of authorised institution.

GENERAL AND TECHNICAL TERMS FOR INSTALLATION AND MOUNTING

By entering into an agreement on installation of the lift system, the Contractor and Investor shall agree upon all the clauses of these General and technical terms.

CONTRACTOR'S OBLIGATIONS

The Contractor shall undertake to complete the agreed work in accordance with the project documentations, applicable regulations, standards, technical norms, prescribed actions and occupational health and safety norms, and to:

- provide the safety of persons who are at the construction site and of the environment;
- according to the regulations, keep a construction logbook (to write down information on the progress and manner of delivering the work), a measurement book and a construction inspection book;
- to act upon complaints and requests of the supervisor supervisorand to remove failures in work which the supervisor supervisor made complaints about;
- to secure the construction site, neighbouring objects and the surroundings in case of cease of work;
- to make available decisions on appointing the Responsible contractor and design of the lift at the construction site, i.e. the documents based on which the work is carried out;
- to respect and act upon the Employer's orders, pursuant to which it will decide to engage third parties on the implementation of potential works in a project which have not been included in the Agreement, and which do not disrupt the work and work organisation of the Contractor;
- to undertake that it disposes of trained and professional manpower and all the equipment necessary for the completion of the agreed work, with absolute claim that the working force which is to be hired to do execute this work is qualified for the given work, as well as that all of its employees have been trained and familiarised with prescribed actions and occupational health and safety norms within their profession and performance of work;
- accept that, in the event of its employees cause any kind of damage to the equipment and works of hired third parties, it will bear full liability and costs of damage, with consent that these costs of damage shall be deducted from the amount certified in the interim payments certificates; (this liability also applies to the Employer, if a third party hired by the Employer cause damage to the works and equipment of the Contractor);
- any caused damage or defect of the equipment shall be registered in the construction log book and it shall be certified by the supervisory body;
- immediately after entering into the agreement, and before commencement of the works, indemnify itself and the Employer against losses and damages (works, material, equipment) pursuant to this agreement, in case of damages caused by anything, and it shall provide an insurance policy which covers the liability in case of occupational injuries and liability in case of damages arising from the works, with respect to all persons hired by the Contractor to carry out the work (collective insurance);
- in the event of including a subcontractor in the delivery of work, the Contractor undertakes to make sure its subcontractors possess equivalent insurance policies;

The Contractor shall be solely responsible for and hereby holds the Employer harmless against liabilities in case of all damage claims by third parties for property damages and personal injuries arising from the delivery of works by the Contractor, its employees and its subcontractors with respect to the works.

EMPLOYER'S OBLIGATIONS

The Investor undertakes to deliver a copy of the Main design of the lift with all attachments to the Contractor before the start of works, for the purpose of carrying out the works, as well as confirmations of registry of works on delivery of such designs, and to:

- appoint the Contractor as holder of rights and obligations of the contractor, in accordance with the Law on Planning and Construction, for all the necessary works which are to be carried out pursuant to this Agreement;
- before the date of giving the Contractor possession of the site, appoint a Supervisor and submit the decision on appointing such body to the Contractor. This decision will hold the definitions of obligations and rights of the Supervisor with respect to the Contractor, and the rights provisioned by this decision must not be outside of the law;
- in case of change of the Supervisory body, the Employer shall promptly notify the Contractor in writing; otherwise the Contractor shall not bear responsibility for its actions as if this change had not taken place; Expert supervision of this Supervisor includes:
- control of whether the works are carried out according to the Design of the lift and according to the Proposal;
- control and inspection of the quality of all kinds of works and application of regulations, standards and technical norms;
- giving instructions to the Contractor;
- cooperation with the designer, for the purposes of providing details of technological and organisation solutions for carrying out the works and solving other matters which might appear during the delivery of works.

Objections and suggestions of the Supervisor shall be registered in the construction logbook.

The Investor (the Employer) shall complete all construction and finishing works inside the hoistway and machine room, and works such as:

- construction processing around the installed elements of the lift;
- delivery of the power line to the machine room, i.e. to the control box inside the hoistway wall with machine-roomless lifts, and in accordance with the project data;
- provision of a temporary connecting port inside the machine room, i.e. in the control box inside the hoistway wall with machine-roomless lifts, for three-phase electric current with voltage of 3x230/400V;
- setting up of scaffolding inside the hoistway, according to the design, including its mounting and demounting;
- insurance of equipment and tools with the competent insurance association.

ATTESTS, QUALITY OF INSTALLED MATERIALS, SERVICING

After completing the mounting, an authorised organisation shall attest the lift system in accordance with the Rulebook on Lift Safety ("Official Gazette of the Republic of Serbia, No. 101/2010, December 29th 2015).

After attesting the lift system, the Investor shall ask for a use permit from a competent body.

The material used in the delivery of the agreed works must be in accordance with the description of the works, technical documents. Contractor shall be held responsible for the quality of work.

Upon commissioning the lift systems, the Provider of equipment shall submit valid attestations to the Investor (to the Investor's technical department) for those lift elements as required by the

rules, as well as necessary attestations on quality of material, elements, parts that the Provider supplied and installed.

- The provider of equipment shall enter into an agreement with the Investor, undertaking that it (or an organisation proposed by the Provider) will maintain the system for at least 10 years, starting from the date of commissioning the lift system. However, the Investor may decide otherwise.
- As of the date of commissioning the lift system, the Provider of equipment shall perform finishing works on the system to adapt it as much as possible to the needs of the facility.
- The Provider of equipment shall submit to the Investor a list of spare parts for a certain period of time, based on its own experience.
- Detailed instructions on use, servicing and maintenance of lifts, the Provider of equipment shall submit to the Investor upon commissioning the system.

5.3. Technical description of a Small Freights Service electrically driven lift L3

TECHNICAL SPECIFICATIONS:

Type of lift:	Small Freights Service - Sterile
Number of items:	1
Load:	$Q = 100 \text{ kg}$
Height of elevation:	$H = 14460 \text{ mm}$
Speed of travel:	$v = 0.35 \text{ m/s}$
Number of landings/entrances:	5/5 (-1, 0, 1, 2 and 3), all entrances from the same side
Control :	microprocessor; single operation, sent-called;
Control positions:	from all landings by means of buttons on the operating panels and with a STOP button
Electricity outage mode:	the powering of the lift shall be switched to a diesel electrical generating unit;
Signalisation:	
- on the floors:	1) direction indicating arrows for further transport at all landings, 2) lighting signal for confirmation of reception of the call on all floors, 3) sound signal of the car reaching the landing.
Type of car:	metal, with a shelf and lighting – Inox,
car dimensions:	- width: $A = 820 \text{ mm}$, - depth: $B = 720 \text{ mm}$, - height: $H = 800 \text{ mm}$.
number of car entrances:	1 A socket to plug in a UV germicide lamp is to be placed in the car, and at the entrance to the lift a warning sign that the car is being sterilised, in accordance with the hospital's sterilisation technology.
Car door:	roller door final coating inox
- dimensions:	720x 800 mm.
Landing door:	vertically moveable, "guillotine" two-panel door with manual opening,
- panels:	final coating inox,

- dimensions: 720x 800 mm.
- door safety system: electro-mechanic interlock device
Position of the access door: on a parapet which is 850 mm elevated from the floor,

Hoistway: concrete with metal substructure

- width x depth of the hoistway : 1160 x1000 mm

- hoistway overhead: 3220 mm

- hoistway pit: 850 mm, parapet

Machine room position: **up above** the hoistway,

Car guide rails: Double Delta 80,

Counterweight guide rails: Double Delta 80,

Counterweight dimensions: 50 x 320 x 1075 mm

Counterweight material: steel block

Driving sheave: $D = 300$ mm

Number of ropes: $z = 2$

Steel rope diameter: $d = 6.5$ mm

Drive machine type: M200

Power of the electric motor: $P = 0.66$ kW

Rated output power of the motor: $I = 2.15$ A

DESCRIPTION OF THE SYSTEM

Small Freights Service lift is understood as a permanently installed system powered by electricity, aimed at transport of freight, servicing certain landings by making use of the lift car whose dimensions and construction enable safe transport of freight, and which moves along a hoistway between two firmly fixed guide rails.

The drive machine consists of: gear-type reduction unit,
electrical motor,
brake,
drive sheave.

Gear-type reduction unit has massive structure and made of high-quality material. In the housing of the gear-type reduction unit, which is made of casted steel, a high-capacity worm drive is placed. The worm screw is made of high-alloyed steel, and the worm wheel is made of special phosphorous bronze. The entire worm drive has a fine final coating; it is dipped in gear oil, so a silent operation and longevity of the machine are secured. The gear-type reduction unit is connected to an electrical motor of suitable power. The connection between the gear-type reduction unit and the electrical motor is delivered by means of elastic coupling. Electrical motor is an asynchronous machine with short-circuit rotor. Electro-mechanical brake is installed onto the gear-type reduction unit.

The brake is made of an electromagnet with electrical contact and pedal with string, which secure mechanical braking.

The electromagnetic brake itself must provide the braking of the car, if the rated load of the lift is 125%. There is a device for manual braking on the gear-type reduction unit. By means of a flywheel on the axe of the electrical motor, the lift car can be started. The entire system is designed so that one person can perform manual start-up of the car.

The drive sheave is on the main shaft of the gear-type reduction unit. Its dimensions meet the requirements of its working conditions. There is a ring gear on the sheave with necessary number of grooves for hoisting ropes.

HOISTWAY

Hoistway of the lift is framed with firm and solid walls from all sides and along its entire height, and with a ceiling and a floor, with steel construction that bears the load of the equipment and is delivered according to the dimensions provided in the documents.

No installations which are not part of the lift system must be installed inside the hoistway. All access openings to the hoistway are closed with metal doors which are opened from the hoistway. The hoistway overhead, i.e. the floor of the machine room, is to be delivered according to the project documents with suitable hatches for hoisting ropes and electrical installations.

ELECTRICAL INSTALLATIONS INSIDE THE HOISTWAY

Plastic conduits which are used for the main vertical distribution line inside the hoistway are attached to the construction or to the metal holders placed on the car guide rails. The space between two attachments must not be more than 2 m. The conductors are delivered from the plastic conduits by means of plastic pipes. To connect the moveable car with the rest of the installation, at the middle of the hoistway and in the car there is a distribution box with clams, between which a bendable multicore cable is laid. All clams are marked according to the technical documentation. The length of the bendable cable is selected in such way that, even when the car is in its final landings, the cable can still have a free arch and not touch the car or the parts of the hoistway. The installations at the car are also delivered by means of plastic conduits and pipes which are firmly attached. The connection between the conductors is delivered only in the provisioned boxes which are authorised by regulations. Conductors, plastic conduits and pipes are made without halogen elements in accordance with SRPS N. B2. 730, 751 and 752.

The entrances to the hoistway must be lit all the time while the lift is in motion, at least as in the same amount as stairways with low traffic are lit (50 lx).

The hoistway is supplied with electrical lighting at every landing. Inside the hoistway pit, there is a “stop” switch and two-pole receptacle with safety contact and a lighting switch.

CAR

The lift car is made of metal, Sterile, Inox, roller door, with a shelf and permanent lighting of 50lx.

The lift car is installed inside a load-bearing safety frame made of steel profiles of appropriate dimensions, so it provides absolute safety even under the most unfavourable load.

LOAD-BEARING ROPES

The car suspension system is delivered by means of steel ropes. The diameter and number of ropes are defined by calculations provided in the projects. The ropes are made of steel wires for specific lift constructions (SRPS CB6 114G).

GUIDE RAILS OF THE CAR AND COUNTERWEIGHT

Car guide rails are made of special non-standardised steel profiles, with specific gliding surfaces, with project defined dimensions. The guide rails extensions are delivered with slats and bolts. The guide rails are attached with console clams, which are connected to the hoistway walls. The dimensions and distribution of the consoles are defined by the sketches and design for this project.

LIMIT SWITCHES

Limit switches with reinforcements are placed at the top and bottom of the hoistway. When the car passes below or above the end landings for more than 10 cm, the limit switch will shut down the power supply of the lift.

ACCESS DOORS

Access door are made of metal, manually opened, “guillotine” two-panel door with manual opening, made of steel Inox tin, with double walls.

All doors must be supplied with safety mechanical locks with safety contact constructed according to the latest lift regulations. The locks must secure that the door cannot be opened if the car is not at a given station, as well as that the lift cannot be set in motion unless the door is sealed tightly.

SINGLE OPERATION – EXTERNALLY

Lift is operated externally by means of landing operating boxes. At every landing operating boxes are placed with as many calling buttons as the number of landings, with a “stop” button and signal “occupied”. The “occupied” light signal is on when the car is in motion, or when one of the access doors is open. In addition to the optical signalisation, sound signalisation may also be installed.

Mode of operation:

Single operation, relay – externally, is delivered so that upon reception of one call excludes the possibility of receiving others until the received call is executed. Upon arrival at a given landing, the lift will self-stop. A special timer disables the other calls for a few more seconds, to enable the car door to open.

When the lift door opens, the external command will be shut down. Command is activated by pressing the button of the landing to where the lift is supposed to go, and the next command can be assigned only when the first one is executed.

MACHINE ROOM

The drive machine and the command box, main switch are placed inside the machine room which is in the hoistway overhead. The machine room needs to be designed according to the dimensions provided in the project. The walls need to be fire-proof, in bright colours, and made so that the machine room is always dry, heat-isolated and dust-free ($t = +5^{\circ}\text{C}$ do $+40^{\circ}\text{C}$). No installations which do not form part of the lift system must be placed inside the machine room.

Machine room needs to be electrically lit with at least 200 lx, as estimated on the floor. The lighting switch is set from the inside, next to the entrance door.

Machine room needs to be electrically lit with at least 200 lx, as estimated on the floor, and be supplied with a Schucko socket powered from the network.

The machine room needs to be ventilated. Ventilation hatch needs to be protected with a blind and net. The machine room door needs to be made of metal. The door of the machine room must open from the outside and closed with a lock. The entrance to the machine room must be easily accessible and safe and permanently lit.

The power line for powering the lift with electrical energy needs to be delivered from the main distribution box at the facility to the machine room, i.e. to the spot of the lift’s main switch, which is placed immediately next to the machine room door. The power line needs to be designed according to the starting current of the electrical motor.

To ground the lift system, a connection from the grounding system of the facility needs to be delivered to the machine room. A connecting port from the lightning rod installation of the

facility is also to be delivered to the machine room. Inside the machine room of the lift, it is necessary to place a suitable fire extinguisher (completely in accordance with the fire-safety rules).

DRIVE MACHINE BASE

Drive machine base is elastically rested upon the floor of the machine room to absorb the transport of vibration from the machine to the facility.

MAIN SWITCH

Main switch, switches for lighting of the car and hoistway, of the machine room, as well as their fuses, are placed on a special panel immediately next to the entrance to the machine room and are specifically labelled as such.

The main switch must have a label “*MAIN SWITCH*” and the positions ON and OFF must be clearly indicated, as well. The main switch must not be used simultaneously as the lift’s limit switch.

By switching off the main switch and the other switches (for lighting of the car, hoistway, and of the machine room) the entire system will lose power.

COMMAND PANEL

The command panel consists of the housing with load-bearing boards to which command elements (contactors, relays, transformers etc.) are attached and they are mutually connected with electrical conductors. The motor circuit is delivered by means of conductors in accordance with the project. The contact between the command panel and the rest of the lift is delivered by means of suitable clamps which are marked according to the attached technical documentation. On the steel portion of the panel frame there is a collective plate for grounding all the command elements, which are required to be so connected according to the electrical schematic, and at the same time it is connected to the central grounding system of the facility. Electrical schematic of control system is laid inside a special holder next to the command panel.

ELECTRICAL INSTALLATION IN THE MACHINE ROOM

Electrical installation is delivered between the command panel and all the elements of the lift with electrical connecting ports according to the electrical installations schematic (which is laid inside a specific holding device next to the command panel).

DESIGN BASES FOR ELECTRICAL INSTALLATIONS OF THE FACILITY

The design for the main power line for supplying electricity to the lift shall be done by the designer of the electrical installation of the facility, based on the data supplied by the lift manufacturer. Upon determining the cross-section of the power line, a voltage drop according to the starting current should also be taken into consideration $4I_n$.

The data for design of the main power line are:	- for $Q = 100$ kg
- Power of the drive electrical motor:	$P = 0.66$ kW,
- Rated current:	$I_n = 2.15$ A.

The design for the main power line shall be done on the basis of the starting current which is:

$$I_p = k I_n = 4 \cdot 2.15 = 8.6 \text{ A}$$

Length of the main power line lift shall be determined by the designer of the electrical installation of the facility, based on the adopted, i.e. determined path. The voltage drop must not exceed 5%. Based on these pieces of information, the designer of the electrical installation of the facility shall design the main power line.

**DESIGN OF PROTECTION AGAINST ELECTRICAL SHOCK;
PROTECTION AGAINST INDIRECT TOUCH (SRPS N.B2.741 Art. 5)**

Facility in which the lift system is located is connected to the TN network, and the lift installation is delivered in *TN-C-S* system – neutral and protective conductors are partially laid together and partially separately. Protection against indirect touch is provided by means of slow-blow fuses. For the protection to be efficient in case of malfunction of the negligible impedance between the phase and protective conductor or the exposed conductive part, automatic shutdown of power supply in the prescribed time should enter into effect by of the melting of the cut-off pellet of the fuse. This condition shall be met if: $Z_s \times I_a < U_o$

where: Z_s - the impedance of the fault loop which includes the source, conductor under voltage up until the point of fault, and the protective conductor from the point of fault to the source.

I_a – current of cut-off of the meltable pellet of the slow-blow fuse, it being:

- up to 5 seconds for fixed devices of the lift system (electrical distribution box KO-L, electrical motor, controlling group)
- up to 0.4 seconds for circuits of the receptacles with safety contact.

U_o – rated voltage towards the ground ($U_o=220$ V).

For the purpose of calculating efficiency of protection against electrical shock, two charts are designed. The first represents registered values of the current of shut down (cut-off) of the meltable pellets of the slow-blow fuse from the shutdown curve for characteristic times of 0.4 and 5 s, and the other is derived from the first by recalculating the highest permitted impedance of the fault loop for registered values according to the formula $Z_s \times I_a < U_o$

Table for current of cut-off of meltable pellets I_a (A)

Rated current of the pellet I_n (A)	6	10	16	20	25	35	50	63
tisk = 0.4s	34	60	86	108	140	240	340	510
tisk = 5 s	20	33	49	63	83	130	180	280

Table for the highest permitted impedance of the fault loop Z_{smax} (Ω)

Rated current of the pellet I_n (A)	6	10	16	20	25	35	50	63
tisk = 0.4s	6.47	3.67	2.56	2.04	1.57	0.92	0.65	0.43
tisk = 5 s	11	6.67	4.49	3.49	2.65	1.69	1.22	0.79

Protection against indirect touch is satisfactory if the impedance of the fault loop does not exceed the values:

- For fixed devices of the lift system in the main distribution box of the lift, which are powered by a circuit secured with a meltable pellet of: $I_{nI} = 6A, Z_s \leq 11 \Omega$
- For the receptacles with safety contact at the car roof and in the hoistway which are powered by circuits circuit secured with a meltable pellet of 10A: $Z_s \leq 3.67 \Omega$

Before commissioning the lift system, impedances of the fault loop must be calculated and determined whether they are within their permitted boundaries.

SIGNS, NOTICES AND LABELS

All the signs, notices and labels must be clearly discernible, legible and understandable, made of durable material and permanently fixed. In the lift car and on the shaft doors, there is a sign stating the rated load in kg.

On the outer side of the command box door, the notices **“DANGER OF DEATH”**, **“LIFT DRIVE”**, **“AUTHORISED PERSONNEL ONLY”** are to be placed.

Inside the command box there is an instruction for setting the car in motion manually, and for the application of the key for emergency opening of the landing door. On the switch for car, hoistway and machine room lighting, there are plates with texts **“CAR LIGHTING”**, **“HOISTWAY LIGHTING”**, **“MACHINE ROOM LIGHTING”**.

On the **“STOP”** switch in the hoistway pit or next to it, there is a label saying **“OFF”**.

On the drive machine, at a clearly discernible spot, there is a metal plate with the following information:

- 1) company;
- 2) technical specifications: type of reduction unit, number of starts of the worm screw, number of teeth of the worm wheel and module, diameter of the output shaft and angle of the wedge of the groove on the drive sheave;
- 3) technical specifications;
- 4) drive machine mass;
- 5) Serial number and year of production.

LIFT TESTING

Upon completing the installation, the lift system must be subjected to tests in accordance with the applicable rule book on machine safety, SRPS EN81-3. This test should be performed by a competent authority who is responsible for issuance of a report on technical control performed.

During the exploitation of the lift, should any of the following parts: load-bearing ropes, drive machine, grip device, overspeed governor, controlling devices, braking devices and hoisting device be replaced, as well as if, during inspection, irregularity which may lead to dangerous drive condition is defined, the lift must not be commissioned until the technical inspection of the lift has verified that all the required conditions for its safe operation are met.

Lifts are liable to mandatory occasional technical inspection.

Occasional technical inspection of the lift system must be performed no later than the expiration of one year after the previous technical inspection of the given lift.

An examination report is to be formulated on the performed technical inspection.

MAINTENANCE

Every lift is equipped with a manufacturer's manual on operating the lift and its maintenance. Regular lift maintenance must be performed at least once a month. Every lift must keep a maintenance log.

DOCUMENTS ACCOMPANYING COMMISSIONED LIFTS

Commissioned lift, i.e. upon delivery, it must be accompanied by a certificate of guarantee. The guaranteed period for proper functioning of the lift is two years. The lift is equipped with technical manual of the manufacturer.

The period for guaranteed lift servicing is ten years, starting from the day of commissioning the newly installed lift.

GENERAL PROVISIONS

During the guaranteed period, starting from the day when the system was properly commissioned, for every malfunction which occurs which was caused by poor quality of material, poor design or poor mounting, upon receiving a call from the investor, the contractor must remove the failure and restore proper operation of the system.

The contractor shall not be held liable for non-professional and careless operation of the system. Upon finishing the mounting, the lift system must undergo tests based on the Rulebook on Machinery safety ("Official Gazette of the Republic of Serbia", No. 13/2010, dated March 12th 2010).

After completing the tests, the investor shall ask for a use permit from the competent authority for issuing use permits.

The contractor shall deliver the following attestations to the investor:

- for the steel rope;
- for the electro-mechanic lock;
- for the emergency braking device;
- for the car overspeed governor;
- for the insulation floor mats.

Simultaneously with commissioning the system, the investor, i.e. the user, shall provide maintenance of the system, it being:

- daily, by means of one person in charge;
- regular maintenance, by means of a professional maintenance organisation;
- regular technical inspection, by means of authorised institution.

GENERAL AND TECHNICAL TERMS FOR INSTALLATION AND MOUNTING

By entering into an agreement on installation of the lift system, the Contractor and Investor shall agree upon all the clauses of these General and technical terms.

CONTRACTOR'S OBLIGATIONS

The Contractor shall undertake to complete the agreed work in accordance with the project documentations, applicable regulations, standards, technical norms, prescribed actions and occupational health and safety norms, and to:

- provide the safety of persons who are at the construction site and of the environment;
- according to the regulations, keep a construction logbook (to write down information on the progress and manner of delivering the work), a measurement book and a construction inspection book;
- to act upon complaints and requests of the supervisor supervisor and to remove failures in work which the supervisor made complaints about;
- to secure the construction site, neighbouring objects and the surroundings in case of cease of work;
- to make available decisions on appointing the Responsible contactor and design of the lift at the construction site, i.e. the documents based on which the work is carried out;
- to respect and act upon the Employer's orders, pursuant to which it will decide to engage third parties on the implementation of potential works in a project which have not been included in the Agreement, and which do not disrupt the work and work organisation of the Contractor;
- to undertake that it disposes of trained and professional manpower and all the equipment necessary for the completion of the agreed work, with absolute claim that the working force which is to be hired to do execute this work is qualified for the given work, as well as that all of its employees have been trained and familiarised with prescribed actions and occupational health and safety norms within their profession and work performed;
- accept that, in the event of its employees cause any kind of damage to the equipment and works of hired third parties, it will bear full liability and costs of damage, with consent that these costs of damage shall be deducted from the amount certified in the interim payments certificates; (this liability also applies to the Employer, if a third party hired by the Employer cause damage to the works and equipment of the Contractor);
- any caused damage or defect of the equipment shall be registered in the construction log book and it shall be certified by the supervisory body;
- immediately after entering into the agreement, and before commencement of the works, indemnify itself and the Employer against losses and damages (works, material, equipment) pursuant to this agreement, in case of damages caused by anything, and it shall provide an insurance policy which covers the liability in case of occupational injuries and liability in case of damages arising from the works, with respect to all persons hired by the Contractor to carry out the work (collective insurance);
- in the event of including a subcontractor in the delivery of work, the Contractor undertakes to make sure its subcontractors possess equivalent insurance policies;

The Contractor shall be solely responsible for and hereby holds the Employer harmless against liabilities in case of all damage claims by third parties for property damages and personal injuries arising from the delivery of works by the Contractor, its employees and its subcontractors with respect to the works.

EMPLOYER'S OBLIGATIONS

The Investor undertakes to deliver a copy of the Main design of the lift with all attachments to the Contractor before the start of works, for the purpose of carrying out the works, as well as confirmations of registry of works on delivery of such designs, and to:

- appoint the Contractor as holder of rights and obligations of the contractor, in accordance with the Law on Planning and Construction, for all the necessary works which are to be carried out pursuant to this Agreement;
- before the date of giving the Contractor possession of the site, appoint a Supervisor and submit the decision on appointing such body to the Contractor. This decision will hold the

definitions of obligations and rights of the Supervisor with respect to the Contractor, and the rights provisioned by this decision must not be outside of the law;

- in case of change of the Supervisory body, the Employer shall promptly notify the Contractor in writing; otherwise the Contractor shall not bear responsibility for its actions as if this change had not taken place;

Expert supervision of this Supervisor includes:

- control of whether the works are carried out according to the Design of the lift and according to the Proposal;
- control and inspection of the quality of all kinds of works and application of regulations, standards and technical norms;
- giving instructions to the Contractor;
- cooperation with the designer, for the purposes of providing details of technological and organisation solutions for carrying out the works and solving other matters which might appear during the delivery of works. Objections and suggestions of the Supervisor shall be registered in the construction logbook.

The Investor (the Employer) shall complete all construction and finishing works inside the hoistway and machine room, and works such as:

- construction processing around the installed elements of the lift;
- delivery of the power line to the machine room, i.e. to the control box inside the hoistway wall with machine-roomless lifts, and in accordance with the project data;
- provision of a temporary connecting port inside the machine room, i.e. to the control box inside the hoistway wall with machine-roomless lifts, for three-phase electric current with voltage of 3x230/400V;
- setting up of scaffolding inside the hoistway, according to the design, including its mounting and demounting;
- insurance of equipment and tools with the competent insurance association.

ATTESTS, QUALITY OF INSTALLED MATERIALS, SERVICING

After completing the mounting, the lift system shall be attested in accordance with the Rulebook on Machinery Safety ("Official Gazette of the Republic of Serbia, No. 13/2010, March 12th 2010).

After attesting the lift system, the Investor shall ask for a use permit from a competent body.

The material used in the delivery of the agreed works must be in accordance with the description of the works, technical documents. Contractor shall be held responsible for the quality of work.

Upon commissioning the lift systems, the Provider of equipment shall submit valid attestations to the Investor (to the Investor's technical department) for those lift elements as required by the rules, as well as necessary attestations on quality of material, elements, parts that the Provider supplied and installed.

- The provider of equipment shall enter into an agreement with the Investor, undertaking that it (or an organisation proposed by the Provider) will maintain the system for at least 10 years, starting from the date of commissioning the lift system.

However, the Investor may decide otherwise.

- As of the date of commissioning the lift system, the Provider of equipment shall perform finishing works on the system to adapt it as much as possible to the needs of the facility.
- The Provider of equipment shall submit to the Investor a list of spare parts for a certain period of time, based on its own experience.
- Detailed instructions on use, servicing and maintenance of lifts, the Provider of equipment shall submit to the Investor upon commissioning the system.

5.4. Technical description of a passengers' lift with hydraulic drive – L4

The purpose of this lift is to transport people between the basement floor - 2 and the second floor in a business facility. It is to be installed inside a reinforced concrete hoistway. The electricity generating machine is to be placed inside the machine room which is situated at 6 m from the hoistway, at the level of the ground floor.

TECHNICAL SPECIFICATIONS:

TECHNICAL SPECIFICATIONS OF THE LIFT – L4:

Type of lift:	Freight lift with accompanying persons
Number of items:	1
Type of drive:	hydraulic,
Load:	$Q = 1275 \text{ kg}$
Height of elevation:	$H = 3200 \text{ mm}$
Speed of travel:	$v = 0.4 \text{ m/s}$
Number of landings/entrances:	2/2 (-1 and 0), entrances from opposite sides,
Control:	“simplex”; microprocessor;
Car:	metal constructions, standard equipment, directly transient, on the inside, final coating of the walls stainless steel (inox), on the outside, anti-corrosive layer, floor, coated with rubber, car operating panel along the entire height of the cabin inox, lighting – indirect in the lowered ceiling, additional equipment: alarm, emergency lights, ventilator, handgrip.
Dimensions:	1400x2100x2200 mm
Number of car entrances:	2
Car door:	automatic two-panel telescopic, 1200x2000 mm, safety: safety photo curtain
- panels:	final coating stainless steel (inox),
Landing door:	automatic two-panel telescopic, 1200x2000 mm,
- panels and doorposts:	at the other landings - automatic two-panel telescopic, final coating (inox),
Drive system:	hydraulic power generating unit with a cylinder,
Hoistway:	concrete
- width x length:	2130x2640 mm,
- hoistway height:	8200 mm,
- hoistway overhead:	3600 mm,
- hoistway pit:	1400 mm,
Machine room position:	down, next to the hoistway, at the level of the basement.
Drive system:	hydraulic power generating unit with a cylinder,
Hydro-electrical generating unit, consisting of a high-pressure pump, electrical motor, oil reservoir, connecting elements, corresponding steel pipes and rubber hoses, manual pump and oil heater.	
The working cylinder is one-action, with a blocking valve in case of enhanced flow. The blocking valve is there as a safety against the car falling when the pipeline breaks.	

Diameter of the piston: $D = 130 \times 6 \text{ mm}$

Diameter of the cylinder: $D = 159 \times 5 \text{ mm}$

Pump flow: $Q = 160 \text{ l/min}$

Volume of the reservoir: $V = 150 \text{ l}$

Power of the electrical motor: $P = 14.7 \text{ kW}$

Rated output power of the motor: $I = 31 \text{ A}$

Number of ropes: $z = 6$

Steel rope diameter: $d_u = 13 \text{ mm}$

Sheave diameter: $D_{uz} = 520 \text{ mm}$

Hoistway: reinforced concrete,

Car guide rails $125 \times 82 \times 16 \text{ mm}$

Machine room position: down, next to the hoistway, at the level of the basement;

Signalisation:

- on both landings: digital indicator of car position, light indicator of direction of further movement, confirmation of reception of the call,
- inside the car: digital indicator of car position, stop button, door closing button, ventilation activation button, alarm button, emergency light, overload signal, confirmation of reception of the call,

DESCRIPTION OF THE SYSTEM

Lift is understood as a permanently installed system powered by electricity, aimed at transport of persons, i.e. of cargo and accompanying persons, servicing certain landings by making use of the lift car whose dimensions and construction enable safe access for persons or cargo, and which moves along a hoistway between two rigid guide rails.

The lift car is mounted onto a load-bearing frame which is made of steel profiles. The car can move vertically along the hoistway, along fixed rigid guide rails, along which sliders are guiding it, and the drive is realised by the hydraulic power generating machine, by means of a cylinder and system of ropes and pulleys.

The car's load-bearing frame is tightly attached to the load-bearing ropes, which enable the movement of the car. The other end of the ropes is attached to the body of the cylinder, whereby they are wrapped around the body of a pulley installed at the top of the piston. The hydraulic cylinder leans against the bottom of the hoistway, by means of an additional support. By lifting of the piston, i.e. of the pulley installed at its top, the load-bearing frame of the car is also elevated, i.e. the car of the lift with gear ratio of 2:1.

DRIVE DEVICE

The drive device consists of a hydraulic installation and load-bearing steel ropes.

The drive's hydraulic installation consists of the following:

- Hydraulic power generating machine, which includes a high-pressure pump, electrical motor, oil reservoir, connecting elements, corresponding steel pipes and rubber hoses, manual pump and oil heater.
- The cylinder is single-acting, with a blocking valve in case of enhanced flow. The purpose of the blocking valve is to act as safety device against the car falling when the pipeline breaks.
- Group of valves with remote control to operate the lifting or the lowering with two speeds in each direction. The group of valves also includes an attenuator for adjusting the speed of elevation or lowering, pilot electromagnetic directional control valves for transmitting the

remote command, manometer with an attenuator and faucet, safety valve that protects the installation against excessive pressure spike, ball valve at the outlet and pressure switch, whose activation will shut down the electromotor of the pump and control.

INSTALLATION FUNCTION

COMMANDS

Executive commands for start-up are delivered by means of command keys, electromagnetic valves and electrical motor of the pump. Upon executive command, the entire process of start-up, taking off and stopping is done automatically. The command of the elevation is executed by activating the pump and by means of the valve with remote control of elevation. The command of lowering is executed by means of a valve with remote control for lowering, whereby the pump remains off. Lowering command can be executed manually, if necessary.

STATIONARY MODE

When the lift is motionless, the command valve for lowering is in the “CLOSED” position. The acting cylinder is blocked at the pillar of gear oil between its own blocking valve and the command valve for lowering. The load has been removed from the thrust line of the pump.

ELEVATION

Start-up: ELEVATION command is executed by pressing the button of the command key with a mark of the desired landing. Electrical motor of the pump and timer are activated at the same time, and by means of a suitable electromagnetic directional control valve, the timer closes the appropriate piston of the command valve after a delay of 1 to 2 seconds, to enable the pump to start without load. Due to the possibility of adjusting the speed of closing of the control valve, the lift starts in full speed but softly.

Stopping: Stopping at the desired landing is done automatically. When the lift reaches the landing zone, by means of a suitable micro-switch and electromagnetic directional control valve, the lift switches from full speed to landing speed. When the lift is at a desirable landing level, by means of a suitable micro-switch, the pump and control valve shut down, causing a soft stopping of the lift.

LOWERING

Start-up: LOWERING command is executed by pressing the button of the command key with a mark of the desired landing. This activates the electromagnetic directional control valve which brings the control valve for lowering into “OPEN” position. The lift starts in full speed but softly. Soft start is conditioned with the construction of the valve which opens with delay.

Stopping: When the lift reaches the landing zone, by means of a suitable micro-switch and electromagnetic directional control valve, the lift switches from full speed to landing speed. When the lift is lowered to the desirable landing, by means of a suitable micro-switch, the control valve for lowering is in “CLOSED” position. The lift stops softly and remains blocked in such position.

HOISTWAY

Hoistway of the lift is concrete-framed with firm and solid walls from all sides and along its entire height, and with a ceiling and a floor. At the top of the hoistway there are ventilation openings, whose entire cross-section surface is at least **1%** of the surface of the base of the

hoistway. The openings are to be protected with a mosquito net or with blinds. In case that the hoistway is not a part of the facility's facade, the ventilation is delivered by means of conduits to the facility's exterior, if the conduit has a roof-top exit it must have a safety cap. Installations and devices which are not integral parts of the lift must not be installed in the hoistway.

The hoistway contains the following openings: landing doors, ventilation hatches, openings between the hoistway and the machine room. The hoistway must hold load pressure caused by the operation of the lift system, by the action of grip device on the guide rails, and by the pressure of the car against the buffers.

The hoistway walls must be made of material which is resistant to mechanical damage and fire and which does not cause dust but repels it. Bottom of the hoistway pit must be protected from water penetration.

At the level of the lowest landing, an electronic "STOP" switch, with clearly marked positions "ON" and "OFF", double-pole receptacle with protective contact and alternating switch for lighting of the hoistway are installed, purposefully labelled and connected to the alternating switch in the machine room.

The interior of the hoistway is equipped with electrical lighting, at 0.5 m from the bottom of the pit and top of the ceiling, and between them at every 7 m.

Section of the guided path which remains left for the movement of the car upwards, free space above the car roof, and free space between the lowest parts of the hoistway ceiling and the highest elements at the car roof, are within their permitted limits.

When the car of the lift rests on completely compressed buffers

- inside the hoistway pit there is space which allows the placement of a cuboid with minimum size of 0.5 x 0.6 x 1.0 m, so that it lies on one of its surfaces;
- free space between the bottom of the hoistway pit and the lowest position of the car is at least 0.5 m, and between the bottom of the pit and the lowest position of the car cable guides, parts of the grip device, protective foil of the car doorstep more than 0.1 m.

The minimum length of the podium in front of the landing door must be at least 1.5 times longer than the length of the longest car, but not less than 1.5 m.

For loading in heavier pieces of lift equipment, below the hoistway overhead a mounting carrier (hook) needs to be installed, for a crane whose minimum load is 1,000 kg. The carrier must have a label stating its maximum permitted load.

BUFFERS IN THE HOISTWAY

For the purpose of limiting the movements of the counterweight and car, and their safe stopping, in the event of failure of the limit switch, a buffer is to be placed at the bottom of the hoistway. It provides the necessary safety space at the bottom of the hoistway. The buffer installed in the lift is without silencers and aimed at lifts with maximum rated speed of 1.0 m/s.

LANDING DOOR

Landing doors are automatic, telescopic, and consist of solid-material folding panels and frame. The landing doors are made of metal, they are deformation-proof and made and installed so that they secure proper functioning of the door interlock device.

Mechanical sturdiness and firmness of the landing doors is such that horizontal force of 300 N (acting directly on a surface of 50 cm²) at any location of the panels of the interlocked door, from one or the other side, does not deform them permanently, that it does not deform them elastically for more than 15 mm and that it does not cause disturbances that will affect proper functioning of the door and interlock device. At every entrance to the hoistway, there must be a

doorstep that can hold any pressure upon passengers entering and leaving the lift and loading in and out of cargo.

The car of the lift will not move or elevate if the landing door is not closed and interlocked. The deterring device of the landing door is activated when the door is closed before the car leaves the landing. Elements of the interlock device and elements for tightening the deterring device are made of metal or are metal-reinforced and impervious to blows. The interlock device is protected from dust. Unlocked during the movement of the car, the lift will stop.

The landing doors have an electrical safety device that controls whether the door is closed or not. It is permitted that this device is installed on one of the door panels, under the condition that it has an immediate mechanical connection with the other panel, i.e. with the door's control device. The force required to open this door is not greater than 300 N, in the unlocking zone.

All landing doors are made in a way that they can be unlocked from the outside by using a special key.

The lift system may be set in motion only if all the landing doors are closed and interlocked. Interlocking is performed by means of door contacts and electromagnetic locks with a central locking mechanism.

MACHINE ROOM

Machine room is located up down next to the hoistway, and it is framed from all sides with walls, floor and a ceiling. The entrance to the machine room is easily accessible and safe. This entrance is well lit with permanently installed electrical lighting, and the floor mustn't be slippery. The walls and floor of the machine room must be soundproof.

The machine room door is made of metal, fireproof for 90 minutes, it can be locked and it cannot be open towards the inside of the machine room. If the machine room door is locked, it can be open from the inside without using a key. The ventilation of the machine room is defined in the project of mechanical installations of the facility. The ventilation hatches in the machine room are delivered in such a way that they discharge gasses and smoke in case of fire.

Machine room ventilation is not to be used for ventilation of rooms which are not part of the lift system.

Temperature in the machine room needs to be between +5°C and +40°C.

Inside the machine space, it is necessary to place a suitable fire extinguisher (completely in accordance with the fire-safety rules). Expendable materials (cloths for wiping off the lubricants) must be kept inside metal buckets or boxes with lids made of non-flammable material.

CAR

The lift car has four car guiding devices, sliding of the sliders. The car guiding devices are made and placed so that they would not be separated from the guide rails even if they become damaged. While designing the lift's load-bearing elements, the greatest load caused by freight during its loading in or out from the car has been taken into consideration.

The lift car is enclosed with solid-material walls, floor, car door and a ceiling and automatic door.

Walls, floor and ceiling of the car, car door, the car frame and its guiding device as a whole have sufficient mechanical firmness to sustain impacts and pressures the car is exposed to during the operation of the lift, when the grip device is activated and when the car leans against the buffers. The car walls are made in a way so that they would sustain, without permanent deformation, a force of 300 N which acts directly on any point of the wall, provided that it puts equal pressure on the circular and square surface of 5 cm². During this event, the maximum indentation is 15 mm. Walls, floor and ceiling of the car are made from materials which are not easily flammable

and which do not cause large amounts of smoke and gasses which are life-threatening. The car floor is designed to bear load of 5 kN/m².

At the car doorstep there is a protective tin foil whose minimum width is equal to the daylight width of the landing door. In its lower part, the vertical section of the protective tin foil on the doorstep is slanted under the angle of 60° in relation to the horizontal plane, and the slanted section is 50 mm long, when measured horizontally. The total height of the protective tin foil of the doorstep is 0.75 m.

At the entrance to the car there is a doorstep that can sustain all pressures during loading in and out of cargo. Apart from the mechanical firmness of the car walls requirements, the car roof also meets the following conditions:

- at every point, the roof must sustain at least two persons or cargo of 2 kN,
- there must be a free flat surface of at least 0.12 m² whose width or length is at least 0.25m.

The surface of the ventilation openings in the upper and lower part of the car is 1% of the usable surface of the car floor. The ventilation openings are made in a way that a round bar with a diameter of 10mm cannot go through them.

The car frame is equipped with an emergency braking device which is gradually activated by means of a safety rope or suitable device which must not be powered electrically, pneumatically or hydraulically. The car frame is connected with the bearing ropes via specific suspension elements. The frame has security contacts installed which shut down the lift if:

- either of the load-bearing ropes is loosened;
- the car is overloaded;
- the emergency braking device is activated.

LOAD-BEARING ELEMENTS

The car hangs on load-bearing ropes. Load is equally distributed along the load-bearing ropes. The ends of the load-bearing ropes must be attached to the car and to the suspension device with holders whose load capacity must be at least 80% of the ropes load capacity. To equally distribute the load along the ropes, a device for balancing the load must be installed at least on side of the suspension system.

GUIDE RAILS

Car is guided by steel guided rails which are immovable and firmly fixed. The number of guide rails is even. The length of the guide rails is such that the car and counterweight cannot get off of them. The guide rails, their consoles and couplings can sustain dynamic load caused by the activity of the grip device, as well as by bending due to uneven load of the car. The bending of the guide rails does not affect proper functioning of the lift. The gliding surfaces of the guide rails are processed by means of shaving or cold drawing.

LIMIT SWITCH

After the car reaches the final landing, the power supply to the lift shuts down by means of a limit switch. The limit switch is activated before the car touches the buffers and before the car passes by the final landing by no more than 0.15m.

The limit switch is not deactivated not even when the car or counterweight press against the buffers. The limit switch of the lift is not to be used as a switch for stopping the lift at its final

landing. After activating the limit switch, the lift is to be re-set in motion by a professional who is in charge of lift maintenance.

SAFETY DEVICE WHICH IS ACTIVATED WHEN THE CAR HITS AN OBSTACLE ON THEIR DOWNWARD PATH

The lift is equipped with a device which shuts down the lift power supply and keeps it motionless when the car's lowering is prevented by some obstacle in the hoistway. This electrical device is activated within the time period which does not exceed the smallest of the following values:

- 45 seconds
- travel time required for the entire elevation height, enhanced by no more than 10 seconds;
- travel time required for the entire elevation height, enhanced by no more than 20 seconds, when the travel time for the entire elevation height does not exceed 10 seconds.

CONTROL

Commands for navigation of the car are activated electrically, by means of buttons on the operating panel in the car and on the landing operating box on the outside.

On the car roof, there is a device for **service control** of the lift. The activation of the device for service control of the lift will shut down external and cabin control of the lift. Service travel of the car shall be executed only by constant pressing of the button which is protected so that it cannot be deliberately pressed. The direction of the travel is clearly indicated, "up" and "down". Service control device has a "**STOP**" switch which is situated at less than 1 m from the landing door. During control of the lift by means of the service device, the maximum speed of the car shall be 0.63 m/s, whereby none of the safety devices shall be shut down. During service travel, the car shall not go beyond end landings.

(During service control of the lift, one must not override the safety contacts of the landing door or disconnect the end landings and limit switches). The "**STOP**" switch for emergency shutdown of the lift is an electrical safety device. Restarting the lift by means of the "**STOP**" switch shall only be done purposefully. By activating the "**STOP**" switch in collective control, external calls shall not be cancelled. In the lift car, there is a clearly discernible and accessible alarm device. The alarm device is powered from the auxiliary electricity source for lighting of the car and it is designed in the form of a bell. The sound signal of the alarm device is clearly heard both in the car and at the main landing. At every landing there is a discernible lighting signal for the direction of the travel.

ELECTRICAL INSTALLATIONS INSIDE THE HOISTWAY

Inside the hoistway, plastic conduits for the main vertical distribution line are attached to the wall or to the metal holders placed on the car guide rails. The space between two attachments must not be more than 2 m. The conductors are delivered from the plastic conduits by means of plastic pipes. To connect the moveable car with the rest of the installation, at the middle of the hoistway and in the car there are distribution boxes with clamps (marked according to the scheme), between which a bendable multicore cable is laid. The length of the cable is selected in such way that, even when the car is in its final landings, the cable can still have a free arch and not touch the car or the parts of the hoistway. The installations are guided out from the car also by means of plastic conduits and pipes which are firmly attached.

At the car roof, a part of the installation which is exposed to stamping by the mounting workers is specially protected.

The conductor connections are delivered and laid only with clamps or suitable gripping bolts. The entrances to the hoistway must be lit all the time while the lift is in motion, at least in the same amount as stairways with low traffic are lit (50 lx).

SPACE IN THE MACHINE ROOM

The drive machine, the command-control device, main switch and a fire extinguisher for putting out the fire on electrical installations are placed inside the machine room.

Machine room needs to be electrically lit with at least 200 lx, as estimated on the floor. The lighting switch is set from the inside, next to the entrance door.

The circuit for lighting the machine room must be separate from the circuit for powering the lift. The electrical current must be delivered either by means of a separate electrical line or by means of a connection in front of the lift's main switch. One of the receptacles with safety contact is set inside the machine room. The receptacle is connected to the installation of the facility by means of a special fuse.

DESIGN BASES FOR ELECTRICAL INSTALLATIONS OF THE FACILITY

Power line for supplying electricity to the lift (specific designs and installation schemes of this line are the subject of the project on electrical installations of the facility) must be delivered and laid from the main distribution box of the facility to the machine room of the lift, more specifically to where the main switch of the lift is, i.e. immediately next to the access to the entrance to the machine space. The power line shall be designed according to the starting current of the power generating unit.

To ground the lift system, a connecting port from the facility's grounding system is to be delivered to the machine space. Inside the machine space and to the floor of the hoistway, a connecting port from the lightning rod installation of the facility is also to be delivered and installed.

The design for the main power line for supplying electricity to the lift shall be done by the designer of the electrical installation of the facility, based on the data supplied by the lift manufacturer. Upon determining the cross-section of the power line, a voltage drop according to the starting current should also be taken into consideration. The data for design of the main power line for this lift are:

- Power of the power generating unit of the hydraulic lift $Q=1275$ kg is $P=14.7$ kW with rated current $I_n=31$ A.
- The motor starts in the star-delta system. Fuse next to the main switch: 50 A.

Length of the main power line (in m) is the distance between the machine space and the facility's main distribution box, whose position is determined by the designer of the electrical installation of the facility. The voltage drop must not exceed 5%. The main power line is to be designed by the designer of the electrical installation of the facility according to these data.

Electrical installation is to be delivered between the command panel and all lift elements which have electrical connecting ports according to the attached lift's electrical scheme. Installation is to be laid along the wall, through the floor conduits or through flexible pipes, and then sealed. The conductors are laid in plastic conduits whose dimensions are 40x40mm or 40x60mm (depending on the number of conductors) or in flexible plastic pipes. Plastic conduits or pipes must be securely tightened with bolts or collars, and must be always placed under the angle of 90° and in the most suitable way.

LIFT CARS

At the car door, there is an electrical safety device that controls whether the car door is closed and prevents movement of the car if the door or any panel of the folding door is not closed.

At the car roof, on the upper load-bearer of the car frame, a device for service control and a two-pole receptacle with safety contact are placed. The service control device and stop switch are easily accessible and their distance from the front rim of the car roof is less than 1 m. The lift car is equipped with electrical lighting, and its reinforcement is mounted in a way that it cannot collapse. The light on the car floor and of the control box in the car is 50 lx.

If regular power supply to the source of light is disconnected, there is a back-up source of electrical energy in the car to be used for emergency lighting, with permanent charge, which is automatically activated immediately after the outage of voltage. The back-up source of electrical energy is designed so that it will power a source of lighting of 1 W power for at least an hour. This source of electrical energy is also used to power the alarm device. Its power is projected according to the consumers' needs.

Electrical installations and devices include the main switch of the electrical circuit and everything connected to it, as well as the switch of the car lighting circuit and everything connected to it.

Insulation resistance between the conductors, as well as between conductors and the ground, must be more than 1000 Ω/W , but no less than:

- 1) 500 k Ω for electrical circuit and safety circuit;
- 2) 250 k Ω for other circuits (for control, lighting etc.)

For electrical circuits for control and safety circuits, the middle value of direct voltage or effective value of alternating voltage between the conductors and between the conductors and the ground mustn't exceed 250 W.

Zero and safety conductor must be two separate conductors.

Main contactors, as well as contactors that are used for stopping the drive machine, must correspond to their category of use.

- 1) AC 3 - for contactors of alternating circuits;
- 2) DC 2 - for contactors of direct circuits.

Contactors must be designed so that 10% of the total number of connections and disconnections can be performed with the starting current of the motor. If the back-up contactors are used for controlling the main contactors, they must be in accordance with the category of use.

- 3) AC11 – for back-up contactors in alternating circuits;
- 4) DC11 – for back-up contactors in direct circuits.

Main and back-up contactors must meet the following conditions:

- 1) If one of the NC (normally closed) contacts is closed, all NO (normally open) contacts must be open;
- 2) If one of the NO contacts is closed, all NC contacts must be open.

If instead of the back-up contactors, relays are used in the safety circuit for controlling the main contactors, the above mentioned conditions must be met. In that case, incomplete activation of the armature will not be taken into consideration upon error assessment.

The drive electric motors which are powered directly and from the network must be protected from overload and short circuit current.

If only one phase of electrical supply is out of function, damages to the motor must be prevented. Protection against overload of the electric motor which is powered directly from the

network must be delivered by means of devices which automatically shut down all active (phase) conductors of the motor power supply. Reactivation of the safety device must be performed by a professional who is in charge of lift maintenance.

If due to excessive power, there is an excessive spike in temperature on the coils of the motor, as well, the power supply shut down device will also shut down the electricity, and after sufficient cooling of the motor, the electricity supply may be automatically activated.

In the machine room, next to the entrance, there must be a main switch that simultaneously disconnects the power supply to the lift on all poles. This switch is made to sustain the strongest current allowed during normal drive of the lift. It must be tightly fixed in either ON or OFF position.

Main switch must not disconnect the circuits:

- 1) for car lighting and ventilation,
- 2) for receptacles at the car roof,
- 3) for receptacles in the machine room,
- 4) for lighting in the machine room,
- 5) for lighting of the hoistway,
- 6) for ventilation of the machine room,
- 7) receptacle at the bottom of the hoistway.

The main switch has a label “Main switch” and the positions ON and OFF must be clearly labelled, as well.

The main switch must not be used simultaneously as the lift’s limit switch.

All electrical conductors and cables inside the machine room and the hoistway, except for the accompanying cable for the car, if exposed to mechanical damage, must be protected with tubes, conduits and similar. The protective layers may be made of metal, plastic and other materials.

Cross-section of the conductors of the electrical installation made of copper which form part of the safety circuit or another circuit connected to the safety circuit must be at least 0.75mm².

Cross-section of the conductor for control of the lift, for signalisation and telephone, as well as conductors for the connections of the electronics controlling devices, if they are made of copper, must be at least 0.5mm².

The disconnection of the car light must also shut down the lift’s controlling system.

Switches for lights in the hoistway and of the machine room are in the machine room, near the entrance.

Metal parts of electrical safety devices are grounded by connections to the safety line connection, regardless of the voltage.

Minimum cross-section of the grounded line, to which metal parts of the drive motor and metal housing of the command box are attached, must not be smaller than the cross-sections of the power lines, but must be at least 6 mm², if the line is made of copper, i.e. 25 mm² if it is made of galvanised strip.

Lift system must be protected from atmospheric electrical discharge, according to the regulations on standards on lightning rod installations.

DESIGN OF PROTECTION AGAINST ELECTRICAL SHOCK; PROTECTION AGAINST INDIRECT TOUCH (SRPS N.B2.741 Art. 5)

Facility in which the lift system is located is connected to the TN network, and the lift installation is delivered in TN-C-S system – neutral and protective conductors are partially laid together and partially separately. Protection against indirect touch is provided by means of slow-blow fuses. For the protection to be efficient in case of malfunction of the negligible

impedance between the phase and protective conductor or the exposed conductive part, automatic shutdown of power supply in the prescribed time should enter into effect by of the melting of the cut-off pellet of the fuse. This condition shall be met if: $Z_s \times I_a < U_o$

where: Z_s - the impedance of the fault loop which includes the source, conductor under voltage up until the point of fault, and the protective conductor from the point of fault to the source.

I_a – current of cut-off of the meltable pellet of the slow-blow fuse, it being:

- up to 5 seconds for fixed devices of the lift system (electrical distribution box KO-L, electrical motor, controlling group)
- up to 0.4 seconds for circuits of the receptacles with safety contact.

U_o – rated voltage towards the ground ($U_o=220$ V).

For the purpose of calculating efficiency of protection against electrical shock, two charts are designed. The first represents registered values of the current of shut down (cut-off) of the meltable pellets of the slow-blow fuse from the shutdown curve for characteristic times of 0.4 and 5 s, and the other is derived from the first by recalculating the highest permitted impedance of the fault loop for registered values according to the formula $Z_s \times I_a < U_o$

Table for current of cut-off of meltable pellets I_a (A)

Rated current of the pellet I_n (A)	6	10	16	20	25	35	50	63
tisk = 0.4s	34	60	86	108	140	240	340	510
tisk = 5 s	20	33	49	63	83	130	180	280

Table for the highest permitted impedance of the fault loop Z_{smax} (Ω)

Rated current of the pellet I_n (A)	6	10	16	20	25	35	50	63
tisk = 0.4s	6.47	3.67	2.56	2.04	1.57	0.92	0.65	0.43
tisk = 5 s	11	6.67	4.49	3.49	2.65	1.69	1.22	0.79

Protection against indirect touch is satisfactory if the impedance of the fault loop does not exceed the values:

- For fixed devices of the lift system in the main distribution box of the lift, which are powered by a circuit secured with a meltable pellet of: $I_{n1} = 50$ A, $Z_s \leq 1.22 \Omega$
- For the receptacles with safety contact at the car roof and in the hoistway which are powered by circuits circuit secured with a meltable pellet of 10A: $Z_s \leq 3.67 \Omega$

Before commissioning the lift system, impedances of the fault loop must be calculated and determined whether they are within their permitted boundaries.

LIFT TESTING

Upon completing the installation, the lift system must be subjected to tests in accordance with the applicable Rulebook on Lift Safety ("Official Gazette of the Republic of Serbia" No. 101/2010 dated December 12th 2010). This test should be performed by a competent authority that is responsible for issuance of a report on technical control performed.

During the exploitation of the lift, should any of the following parts: load-bearing ropes, drive machine, grip device, overspeed governor, controlling devices, braking devices and hoisting device be replaced, as well as if, during inspection, irregularity which may lead to dangerous drive condition is defined, the lift must not be commissioned until the technical inspection of the lift has verified that all the required conditions for its safe operation are met.

Passengers' lifts are liable to mandatory occasional technical inspection.

Occasional technical inspection of the lift system must be performed no later than the expiration of one year after the previous technical inspection of the given lift. An examination report is to be formulated on the performed technical inspection.

MAINTENANCE

Every lift is equipped with a manufacturer's manual on operating the lift and its maintenance. Regular lift maintenance must be performed at least once a month. Every lift must keep a maintenance log.

DOCUMENTS ACCOMPANYING COMMISSIONED LIFTS

Commissioned lift, i.e. upon delivery, it must be accompanied by a certificate of guarantee. The guaranteed period for proper functioning of the lift is two years. The lift is equipped with technical manual of the manufacturer. The period for guaranteed lift servicing is ten years, starting from the day of commissioning the newly installed lift.

SIGNS, NOTICES AND LABELS

All the signs, notices and labels must be clearly discernible, legible and understandable, made of durable material and permanently fixed. In the lift car and on the shaft doors, there is a sign stating the rated load in kg and maximum permitted number of persons. Part used for setting off the alarm is yellow, with a permanent sign saying "**ALARM**", the minimum height of letters being 7 mm, or a symbol in the form of a bell. The following signs and labels are to be placed on the roof:

- 1) on the switch for stopping or next to it - label "**STOP**"
- 2) on the service switch or next to it – label "**NORMAL**" and "**SERVICE**"
- 3) on elements for activating the service travel command or next to them – sign of direction of the travel.

On the outer side of the command box door, the notices "**DANGER OF DEATH**", "**LIFT DRIVE**", "**AUTHORISED PERSONNEL ONLY**" are to be placed.

Inside the command box there is an instruction for setting the car in motion manually and control, and for the application of the key for emergency opening of the landing door. On the switch for car and hoistway lighting, there are plates with texts "**CAR LIGHTING**", "**HOISTWAY LIGHTING**", "**MACHINE ROOM LIGHTING**".

On the "**STOP**" switch in the hoistway pit or next to it, there is a label saying "**OFF**".

On the power generating unit, at a clearly discernible spot, there is a metal plate with the following information:

company; technical specifications; serial number and year of production.

GENERAL CONDITIONS

During the guaranteed period, starting from the day when the system was properly commissioned, for every malfunction which occurs which was caused by poor quality of material, poor design or poor mounting, upon receiving a call from the investor, the contractor must remove the failure and restore proper operation of the system. The contractor shall not be held liable for non-professional and careless operation of the system.

After completing the tests, the investor shall ask for a use permit from the competent authority for issuing use permits. The contractor shall deliver the following attestations to the investor:

- for the steel rope;
- for the electro-mechanic lock;
- for the emergency braking device;
- for the car overspeed governor;
- for the insulation floor mats.

Simultaneously with commissioning the system, the investor, i.e. the user, shall provide maintenance of the system, it being:

- daily, by means of one person in charge;
- regular maintenance, by means of a professional maintenance organisation;
- regular technical inspection, by means of authorised institution.

GENERAL AND TECHNICAL TERMS FOR INSTALLATION AND MOUNTING

By entering into an agreement on installation of the lift system, the Contractor and Investor shall agree upon all the clauses of these General and Technical Terms.

CONTRACTOR'S OBLIGATIONS

The Contractor shall undertake to complete the agreed work in accordance with the project documentations, applicable regulations, standards, technical norms, prescribed actions and occupational health and safety norms, and to:

- provide the safety of persons who are at the construction site and of the environment;
- according to the regulations, keep a construction logbook (to write down information on the progress and manner of delivering the work), a measurement book and a construction inspection book;
- to act upon complaints and requests of the supervisor and to remove failures in work which the supervisor made complaints about;
- to secure the construction site, neighbouring objects and the surroundings in case of cease of work;
- to make available decisions on appointing the Responsible contractor and design of the lift at the construction site, i.e. the documents based on which the work is carried out;
- to respect and act upon the Employer's orders, pursuant to which it will decide to engage third parties on the implementation of potential works in a project which have not been included in the Agreement, and which do not disrupt the work and work organisation of the Contractor;
- to undertake that it disposes of trained and professional manpower and all the equipment necessary for the completion of the agreed work, with absolute claim that the working force which is to be hired to do execute this work is qualified for the given work, as well as that all its

employees have been trained and familiarised with prescribed actions and occupational health and safety norms within their profession and work they perform;

- accept that, in the event of its employees cause any kind of damage to the equipment and works of hired third parties, it will bear full liability and costs of damage, with consent that these costs of damage shall be deducted from the amount certified in the interim payments certificates; (this liability also applies to the Employer, if a third party hired by the Employer cause damage to the works and equipment of the Contractor);

- any caused damage or defect of the equipment shall be registered in the construction log book and it shall be certified by the supervisory body;

- immediately after entering into the agreement, and before commencement of the works, indemnify itself and the Employer against losses and damages (works, material, equipment) pursuant to this agreement, in case of damages caused by anything, and it shall provide an insurance policy which covers the liability in case of occupational injuries and liability in case of damages arising from the works, with respect to all persons hired by the Contractor to carry out the work (collective insurance);

- in the event of including a subcontractor in the delivery of work, the Contractor undertakes to make sure its subcontractors possess equivalent insurance policies;

The Contractor shall be solely responsible for and hereby holds the Employer harmless against liabilities in case of all damage claims by third parties for property damages and personal injuries arising from the delivery of works by the Contractor, its employees and its subcontractors with respect to the works.

EMPLOYER'S OBLIGATIONS

The Investor undertakes to deliver a copy of the Main design of the lift with all attachments to the Contractor before the start of works, for the purpose of carrying out the works, as well as confirmations of registry of works on delivery of such designs, and to:

- appoint the Contractor as holder of rights and obligations of the contractor, in accordance with the Law on Planning and Construction, for all the necessary works which are to be carried out pursuant to this Agreement;

- before the date of giving the Contractor possession of the site, appoint a Supervisor and submit the decision on appointing such body to the Contractor. This decision will hold the definitions of obligations and rights of the Supervisor with respect to the Contractor, and the rights provisioned by this decision must not be outside of the law;

- in case of change of the Supervisory body, the Employer shall promptly notify the Contractor in writing; otherwise the Contractor shall not bear responsibility for its actions as if this change had not taken place;

Expert supervision of this Supervisor includes:

- control of whether the works are carried out according to the Design of the lift and according to the Proposal;

- control and inspection of the quality of all kinds of works and application of regulations, standards and technical norms;

- giving instructions to the Contractor;

- cooperation with the designer, for the purposes of providing details of technological and organisation solutions for carrying out the works and solving other matters which might appear during the delivery of works.

Objections and suggestions of the Supervisor shall be registered in the construction logbook.

The Investor (the Employer) shall complete all construction and finishing works inside the hoistway and machine room, and works such as:

- construction processing around the installed elements of the lift;

- delivery of the power line to the machine room, i.e. to the control box inside the hoistway wall with machine-roomless lifts, and in accordance with the project data;

- provision of a temporary connecting port inside the machine room, i.e. to the control box inside the hoistway wall with machine-roomless lifts, for three-phase electric current with voltage of 3x230/400V;
- setting up of scaffolding inside the hoistway, according to the design, including its mounting and demounting;
- insurance of equipment and tools with the competent insurance association.

ATTESTS, QUALITY OF INSTALLED MATERIALS, SERVICING

After completing the mounting, an authorised organisation shall attest the lift system in accordance with the Rulebook on Lift Safety ("Official Gazette of the Republic of Serbia, No. 101/2010, December 29th 2015).

After attesting the lift system, the Investor shall ask for a use permit from a competent body.

The material used in the delivery of the agreed works must be in accordance with the description of the works, technical documents. Contractor shall be held responsible for the quality of work.

Upon commissioning the lift systems, the Provider of equipment shall submit valid attestations to the Investor (to the Investor's technical department) for those lift elements as required by the rules, as well as necessary attestations on quality of material, elements, parts that the Provider supplied and installed.

- The provider of equipment shall enter into an agreement with the Investor, undertaking that it (or an organisation proposed by the Provider) will maintain the system for at least 10 years, starting from the date of commissioning the lift system.
However, the Investor may decide otherwise.
- As of the date of commissioning the lift system, the Provider of equipment shall perform finishing works on the system to adapt it as much as possible to the needs of the facility.
- The Provider of equipment shall submit to the Investor a list of spare parts for a certain period of time, based on its own experience.
- Detailed instructions on use, servicing and maintenance of lifts, the Provider of equipment shall submit to the Investor upon commissioning the system.

6. FIRE ALARM SYSTEM

TECHNICAL DESCRIPTION

INTRODUCTION

Fire protection system complies with relevant provisions of law, regulations, rules, standards and recommendations and especially to:

- The Law on Fire Protection ("Off. Gazette RS", no. 111/2009 and no.20/2015)
- The Law on Planning and Construction, Off. Gazette R. Serbia no. 72/2009
- Regulations on technical standards for fixed installations for fire alarm („Off. Gazette SRJ,, no. 87/93)

DESCRIPTION OF STABLE FIRE ALARM INSTALLATIONS

Stable installation of fire alarm must be designed and constructed in such a manner that proper selection, number and arrangement of fire detectors allow for signalling of fire at the earliest possible stage, with a sufficient safety and security to prevent false alert.

Selection of fire detectors depends on the expected size of fire which can occur in case of fire occurrence, the height of space, the impact of surrounding operating conditions and possible sources of interference.

If in the stage of fire emergence smouldering fire expansion with smoke and little heat and radiation of flame can be expected, smoke detectors must be used.

If in the phase of fire breaking rapid expansion of fire with very high heat release and intensive radiation of flame can be expected, smoke and heat detectors and flame detectors or combinations thereof may be implemented.

Smoke detectors are applied in areas likely to cause damage by smoke, regardless of whether it comes to the preservation of human life or of valuable devices sensitive to smoke.

Correlation between different automatic fire detectors and height of the room must conform to the requirements in Fig.1.

Fig.1

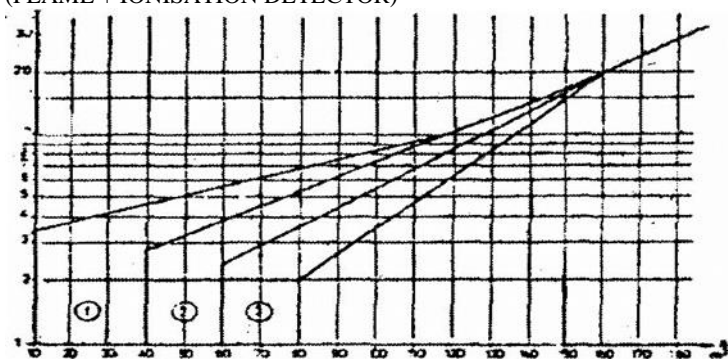
visina prostora, m	dimni javljac	termički javljači			javljac požara
		klasa 1	klasa 2	klasa 3	
20-30					
7,5-20					
6-7,5					
4,5-6					
do 4,5					

LEGENDA prikladan vrlo prikladan neprikladan

The dependence of the smoke detectors in which technical surveillance measures are applied and the height of the area must conform to the requirements in Fig.2.

Fig.2

(FLAME + IONISATION DETECTOR)



A – room area

h – room height

1 – low risk

2 – medium risk

3 – high risk

Smoke detectors and flame detectors can be placed in a location where the temperature does not exceed +50o C.

The temperature of reacting of thermal detectors must be between 10 and 35 ° C above the highest temperature which can occur naturally or by driving operation around detectors.

In rooms with temperatures below 0°C the smoke detectors are not set. For temperatures below 0° C thermal fire sensors are recommended.

Smoke detectors can be placed in the area in which the air velocity is not greater than 5 m/s, unless if allowed use of detectors for higher speeds as well.

Vibrations must not affect the proper operation of fire detectors. Before mounting the detectors vibrations should be measured and determine potential impacts.

Permitted relative air humidity is up to 95%, but creation of fog and dew in smoke detectors must be prevented. In the implementation of technical measures of control in rooms where there is possibility of water spraying, detectors of adequate protection shall be used.

If in the drive stations there are side effects of smoke, dust or similar aerosols, false alarm of smoke detectors should be prevented by applying filters and covers. Use of thermal detectors is more reliable and safer.

If due to the height of space or other reasons use of flame detectors is inevitable, unwanted effects of light should be prevented by using special curtains or blankets placed on detectors.

Taking into account all of the above for this facility we chose optical smoke and thermal smoke detectors.

This project provides the analogue addressable system with one loop for automatic fire alarm, which consists of:

- Addressable switchboard for the fire detection and fire signalling;
- Automatic addressable detectors;
- Addressable manual detectors;
- Alarm sirens;
- Addressable modules;
- Cable installations.

Addressable system means that each detector has its own individual address, so that in case of fire we have accurate information which detector and in which room was activated.

Addressable switchboard

Addressable switchboard is a device for monitoring and control, which is connected to fire alarms and performs light and sound alarm and signalling on fire occurrence to the parallel signaling devices in Fire Services.



Fig. 1 Addressable switchboard

Signalling switchboard represents microprocessor device for fire detection at an early stage.

It monitors the entire detection line, the state of detectors, alarm condition and the correctness of the cable connection.

It consists of a low modulus for automatic and manual detectors, the central processing unit, and control module, a module for connection to a computer, 3 programmable relays, 5 programmable inputs, LCD display, and memory up to 1000 events.

Line module in the switchboard allows connecting a maximum of 128 addresses in the detective line.

Switchboard is powered by 230V AC, 50 Hz from the main switchboards of joint consumption (RTZ).

Signalling switchboard includes:

1. alarm indicator (red);
2. signaling zone indicator (red);
3. ERROR indicator (yellow or white);
4. ON status indicator (green);
5. OFF status indicator of part of fire alarm system (yellow);
6. power indicator from standby power (green);
7. device for execution of functional control.

Signalling switchboard is mounted on the wall in the reception desk on the ground floor at the height of 1.5 meters from the floor where provided the presence of trained staff and thus achieved the maximum control for automatic fire device performance.

It is assumed that the facility will be under 24-hour watch, by trained workers and for these reasons voice alarm apparatus is not anticipated. Near signaling switchboard must be located:

1. plan of alarming;
2. control of books;
3. instructions for use and maintenance of signaling switchboard.

Automatic addressable detectors

Automatic fire detector is part of the stable installation of fire alarm, which continuously or at predetermined intervals follows suitable physical or chemical changes allowing thus fire detection in a controlled area.

Considering the use of the building, possible fire, speed of expansion of fire and the conditions prevailing in the premises, for automatic detection of fire occurrence the optical smoke and heat detectors are provided.



Fig. 2 Appearance of addressable optical detector



Fig. 3 Appearance addressable thermal detector

Optical smoke detector has a very stable optical measuring chamber, through which the scattered infrared light registers and measures the concentration of smoke particles in the air.

Optical and thermal detectors are mounted on the ceiling and are equipped with LED bulb that signals the same is active.

Optical detectors are installed in all rooms except in boiler room and kitchen where thermal detectors are installed, expecting false alarms because of smoke and water vapour.

Optical detectors are activated with the appearance of smoke and heat detectors with an increase of temperature over the permitted one.

Automatic fire alarms cover all rooms except toilets and wardrobes.

When choosing the type of detectors the actual and potential impacts have been taken into account:

- Disrupting effects;
- The size and shape of the room;
- The height and shape of the room;
- The flow of air;
- Fluctuations in temperature.

Addressable manual detectors

Addressable manual detector is a manual signalling detector (alarm), which is switched on by a man after fire detection.



Fig. 4 Appearance of addressable manual detector

Manual detector is used for manual remote alarm of fire signalling to the central device for signalling fire, without controlling time and thus has a role in fire protection for directly alerting. Manual fire alarms are installed in the basement, ground floor, gallery and all floors at a height of 1.5 meters from the floor where it is easily visible to activate.

Activating the manual alarm is made by breaking the glass, which represents safe alarm.

With each manual alarm written plate must be placed, having precisely indicated the purpose and method of switching on.

Alarm sirens

Alarm siren is a device for alerting (alarming) which in case of fire provides sound and light signals.



Fig.5 Appearance of conventional siren with strobe light



Fig.6 Appearance of conventional alarm siren

Informing staff about the appearance of fire is carried out by means of sound and light alarm signals transmitted by alarm sirens set in the building.

Sirens with strobe lamp (sound and light signalling) and without strobe lamps are envisaged, which produce sufficient sound level, and their schedule is given in the drawing.

Alarm siren is mounted at a height of 2.4 meters from the floor.

Cable installations

Installation is carried out under the Regulation on technical norms for low voltage electrical installations (Official Gazette of the FR Y " No.28/1995) and in accordance with SRPS N.B2.751/1986 - Electrical installations in buildings, source and setup electrical equipment, depending on outside influence, according to item 2.4 - Electrical equipment must be performed from a material that blocks spreading of flame and smoke and toxic gases.

The installation of a stable system must meet the following requirements:

- section of cables must be selected to match power consumption of the device used and the requirements with regard to the maximum permissible electric resistance of lines.
- wire thickness in the cable must not be less than 0,6 mm.
- in the use of multi-core cables 10% of reserves is to be left of the number of lines and terminals (joints) in control cabinets.
- not allowed to lay the circuits with power up to 50 V with voltage circuits higher than 50 V together in one tube, cabinet, cable, separate channel or vertical (descending point).
- distribution boxes and cabinets of fixed installations must be marked in red.
- number of connections (connection) should be as small as possible, and each connection is made by soldering or other highly secure mechanical method.
- against electrical effects that interfere with work (electrical interference, lightning, switching on and off of intense consumer, electrical sparks and electromagnetic waves) should be taken appropriate protective measures, such as laying the cables in grounded metal pipes and/or the use of special filters and other protective measures.
- insulation resistance between the line and the line and ground shall be at least 500 kilohms (k Ω).
- for measuring insulation resistance must not be used instruments of voltages higher than 50 V, unless all parts of fixed installations are separated from the line and cable.
- electrical installations and equipment of fixed installations must comply with the area in which are installed (eg. waterproof for tropical conditions, for installation in explosion-endangered areas).
- stable installation of fire alarm systems shall be so designed and constructed that they do not cause radio and/or television interference.

Installation is to be carried out under the mortar and partly in suspended ceilings where the cable is connected with clamps in class E90. Installation for connecting automatic detectors, handheld detectors and addressable modules is provided for the cable type J-H(St)H 2x2x0,8 mm recessed in halogen-free corrugated pipes \varnothing 18 mm, and the siren cable NHXHX 3x1.5 mm² FE180/E90. Power of signaling switchboard is 230VAC/50Hz and is done with a cable N2HX 3x1.5 mm² from RTPR with separate 16 A fuse marked in red.

Backup power is anticipated with two rechargeable batteries of 12 VDC capacity of 16Ah (72 hours operation in steady state and 30 minutes in alarm state).

Housing of signaling switchboard should be connected to the main potential equalization system (in GRO) multi-cord cable P/F-Y 16 mm².

Scheme of installations is given in the drawing in the appendix, as well as the arrangement of individual elements.

The obligatory documentation for stable system for fire alarm

Certificates on conformity of stable elements of fire alarm system must comply with:

- Law on Fire Protection ("Official Gazette RS", no. 111/2009 and no.20/2015)
- Law on Planning and Construction, Official Gazette R Srbije br. 72/2009
- Law on Occupational Safety and Health, Official Gazette R. Serbia no. 101/2005

- The Law on technical requirements for products and conformity assessment (“Official Gazette RS” ,br.36/2009)
- Regulation on technical norms for protection of facilities from atmospheric discharge (Official Gazette FRY no. 11/96)
- Regulation on technical norms for hydrant network for fire extinguishing (Official Gazette SFRY no. 30/91)
- Rulebook on technical standards for fixed installations for fire alarm (Official Gazette SFRY” no. 87/93)
- Regulation on technical norms for low voltage electrical installations (Official Gazette FRY no. 28/95 and Official Gazette SFRY no. 53 and 54/88)
- Regulations on the content of elaboration of technical documentation for building construction (“Official Gazette RS”, no.15/2008)
- Regulations on technical standards for systems of ventilation or air conditioning (Official Gazette SFRY no. 30/89)
- Regulations on technical standards for access roads, turning platforms and plateaus for fire trucks near buildings with increased fire risk (Official Gazette FRY no. 8/95)
- Regulation on technical requirements for protection of garages for passenger cars of fire and explosion (Official Gazette SME no. 31/05)
- Regulation on electrical equipment designed for use within certain voltage limits (Official Gazette RS, no.13/2010)
- Regulations on safety of lifts (Official Gazette RS, no.101/2010)
- Symbols for designs SRPS U.J1.220. SRPSZ.C0.001 - Protection against fire and explosion.
- SRPS N.B2.730/1984 - Electrical installations of buildings, General characteristics and classification
- SRPS N.B2.751/1986 - Electrical installations of buildings, Source and erection of electrical equipment regarding external influences
- Available investment and technical documentation of investors.