

# **VOLUME 3**

## **TECHNICAL SPECIFICATIONS**

**Works on hydro-technical complex at Srpski Itebej and Klek**

**Ref.: VI-84/25**

# **VOLUME 3.0**

## **TECHNICAL SPECIFICATIONS - GENERAL**

# VOLUME 3.0

## TECHNICAL SPECIFICATIONS - GENERAL

### CONSTRUCTION SITE

#### FENCING AND SIGNBOARDS AT THE CONSTRUCTION SITE

The Contractor must maintain the security of its activities, including fencing of the construction site according to the regulatory requirements;

- 1) The Contractor shall fence the construction site. The fence shall be installed in line with the regulations on occupational health and safety and a sketch of the construction site approved by the Supervisor. The cost for fencing will be as specified in BoQ.
- 2) A Signboard, prepared according to the "Visibility Guidelines of the European Union", shall be fixed on the temporary fence adjacent to the entrance gate to the site;
- 3) The Contractor shall obtain instructions from the Supervisor regarding information to be displayed on the signboard. The dimensions and text on the board shall be as per the requirements in the latest version of the EU "Visibility Guidelines" which can be found at [http://ec.europa.eu/europeaid/work/visibility/index\\_en.htm](http://ec.europa.eu/europeaid/work/visibility/index_en.htm). The Contractor shall not undertake or allow billposting or advertising of any kind upon the Works without the written consent of the Supervisor. At finalization of works (Provisional Acceptance), all temporary fences, gates and signs erected by the Contractor must be removed;
- 4) The Contractor shall install commemorative plaques at the main site in line with the above manual and in agreement with the Contracting Authority after Provisional Acceptance.
- 5) Construction site board prepared in accordance with the Law on Planning and Construction shall be placed on the temporary fence adjacent to the entrance gate to the site;
- 6) The Contractor shall provide the whole information concerning the regulations and procedures governing the use of local facilities for access, transport, storage facilities and in compliance with them to take measures for providing the necessary documents;
- 7) The Contractor shall be aware of existing restrictions and shall be responsible for their observance during construction;
- 8) The Contractor shall be liable for all damages on the existing infrastructure caused by him - they shall be repaired at its expense;
- 9) The Contractor will be responsible for ensuring the control of any access or the right to leave the boundaries of the construction site, so that it does not lead to interference with the locals or damage to public or private property as a result of the entry or exit of its employees and subcontractors;
- 10) The Contractor shall indemnify and hold harmless the Contracting Authority against any accusations arising from its failure to comply with the above point, including legal fees and costs.

#### TEMPORARY SITE FACILITIES

- 1) The Contractor, prior to the start of construction works, shall submit a draft *Design for the organisation and execution of construction*. The Design must be submitted no later than 15 days before the planned start of construction works. The design must indicate the work zones, as well as areas for temporary storage of necessary construction materials and goods, and areas for temporary settlements for the personnel of the Contractor and Supervisor.
- 2) The Contractor shall provide and install all necessary facilities/installations for accommodation of its staff, including dressing and rest containers, toilets, drinking and washing water, electricity, etc. All costs for temporary facilities shall be included in the Bid.

## **FACILITIES FOR THE CONTRACTOR AND SUPERVISOR**

- 1) The Contractor shall hand over the fully equipped office to the Supervisors within 2 weeks of being ordered to do so.
- 2) The cost of office and accommodation shall be paid by the Contractor and shall be included in the unit prices in the Bill of Quantities.
- 3) The Contractor shall procure, at its own risk and expense, all additional facilities outside the site that may be necessary for its work.

## **OFFICES FOR THE SUPERVISOR**

All offices for the Supervisor shall have at least two grounded electrical sockets, rooms exceeding 10 m<sup>2</sup> floor area, having at least one additional socket per 5 m<sup>2</sup> of floor area or part thereof.

The Contractor shall supply, install and maintain in the offices, equipment and furniture which shall be new, undamaged and complete with all necessary keys.

The Contractor shall supply, install and maintain furniture such as desks, cupboards, drawing tables and plan chests, chairs and shelves, etc. in the numbers, trademarks and quality as approved by the Beneficiary and the Supervisor.

The Contractor shall arrange internet connection.

## **PROTECTIVE EQUIPMENT FOR THE SUPERVISOR**

The Contractor shall initially provide the Supervisor with protective clothing and equipment, as follows, and, as the Supervisor considers necessary, provide replacement items under the provisions for maintenance of the Supervisor's facilities. Prior to making this provision, the Contractor shall obtain a list of appropriate sizes from the Supervisor. As and where the Contractor's methodology, activities or planned testing programme may require additional protective equipment (such as gloves, earplugs, goggles, torches etc.) the Contractor shall make these available to the Supervisor and when the need arises.

## **FACILITIES FOR THE CONTRACTOR**

The Contractor shall provide and maintain on site suitable site offices for its own use. It shall also provide and maintain on approved sites, sufficient stores, tanks and workshops for the proper storage of materials, fuel plant and equipment.

The stores shall be of such size and construction to provide adequate storage and protection of stocks of material, fuel, spares, etc. in quantities ensuring uninterrupted progress of the work. Workshops shall be suitably equipped to ensure carrying out of major repairs, overhaul or modification by the Contractor of all plant and equipment in or on the Works. The Contractor shall allow in its rates for all costs related to provision of the offices and workshops for its own use.

## **SITE CLEANING**

The Contractor shall make every effort to keep the site tidy and in orderly manner and to take at any time every possible precaution against the contamination of subsoil and groundwater.

The Contractor shall be responsible for making all arrangements for the disposal of solid and liquid wastes from the site. Furthermore, it shall give strict instructions to all its employees to use the sanitary accommodation provided at the site.

## **STORAGE OF EQUIPMENT AND MATERIALS IN PUBLIC SPACE**

Construction materials and equipment shall not be stored outside the site borders.

Where Works are to be completed in public spaces, all plant and excess material shall be removed immediately from the site upon completion of the relevant task so as to limit public objections and complaints.

## **TRAFFIC ARRANGEMENTS**

The Contractor shall as far as required, comply with all requirements and recommendations of the Police and Authorities regarding traffic arrangements and road safety measures on public roads outside the construction sites. The Contractor shall, where necessary, provide all barriers and traffic signs agreed by the Supervisor.

Traffic diversions, if necessary, shall be planned and arranged with the responsible Authorities by the Contractor and harmonized with the Supervisor. No diversion shall be implemented without a written consent of the responsible Authority and after given information to the Supervisor. Access to the site shall be available to vehicles of emergency services and residents in the areas.

All traffic signs and traffic control signals, as necessary and/or may be required by the Police Authority for the safe direction and control of the traffic shall be provided, placed and maintained by the Contractor on the appropriate sites and locations on the access to the sites. The location and size of all such signs and the lettering thereon shall be agreed by the Supervisor before placement of the signs.

The Contractor shall reposition, cover or remove signs as required during the progress of the works.

## **CONTRACTOR'S GENERAL RESPONSIBILITIES**

### **MANAGEMENT OF THE PROJECT BY THE CONTRACTOR**

- 1) The Contractor shall provide the Quality Assurance Plan (QAP) for the management and execution of construction works;
- 2) The QAP should reflect the management structure and clearly describe the duties, responsibilities and powers of each member of the Contractors' staff;
- 3) The representative of the Contractor and its staff must possess experience and qualifications according to the contract, RS Law and type and scope of works;
- 4) This QAP will be updated and provided again whenever there is a change in personnel.

### **APPROVAL AND INSTRUCTION BY THE SUPERVISOR**

Where reference is made in this Specification, the Bills of Quantities or in the drawings for approval, instruction or direction, they shall be given by the Supervisor.

Approvals, instructions or directions by the Supervisor shall not relieve the Contractor from its liabilities and responsibilities under the Contract.

### **QUALITY ASSURANCE PLAN**

- 1) The Contractor shall be responsible for assuring such quality of materials, works and processes that shall comply with the requirements of the Specifications.
- 2) In order to meet the specified requirements, the Contractor shall implement Quality Assurance System presented in Quality Assurance Plan containing the following details:
  - Quality control procedures;
  - Personnel responsibilities;
  - Procurement procedures;
  - Testing procedures;
  - Equipment and measurement devices;
  - Frequency of testing, measurements etc.;
  - Holding points in production for inspection;
  - Rejection and corrective procedures;
  - Documentation and communication
  - H&S and Environmental Plan.
- 3) The Contractor shall be liable to keep a register of all materials delivered on site or implemented in the construction to be accessed for review upon request by the Supervisor or Contracting Authority. Also, the Contractor shall maintain archive of the whole correspondence and instructions.

The Contractor shall within 28 days of the date of the Letter of Acceptance provide the Supervisor with the Organisation chart containing names, CVs and duties of all key personnel whether or not they are related to quality assurance directly.

## **WORK PROGRAMME**

## **FORM OF SUBMISSIONS**

The Work Programme presented by the Contractor shall consist of a detailed schedule of all construction works and phases. Once approved, the Work Programme shall be binding for the construction works on site.

## **REQUIREMENTS**

The Contractor shall present a Work Schedule for execution of the works with distribution of resources and manpower, including volume of works, number of workers for the stage, coordination of activities, interaction with different participants in the process, time limit for execution and sequence of the works all in accordance with Contract.

## **WORK PROGRAMME**

Pursuant to the requirements, the Work Programme to be submitted by the Contractor shall show the planned monthly rates of progress between the programme dates for commencement and completion of each major item or work for the various stages of construction, in accordance with the Conditions of Contract.

The Work Programme shall take into account climatic conditions, groundwater, geo-technical data, completion of critical components by the Contractor or other contractors, water supply service conditions and other conditions, to ensure the completion of the works in accordance with the Contract.

The Contractor shall not be permitted to commence any construction work on that part of the works until the Supervisor has no objection to the method statements, drawings and calculations. Sufficient time for approval of drawings materials and method statements must be allowed for in the Work Programme for each component.

The Contractor shall allow in its Programme a reasonable period for work to be carried out by Public Utility Services, Authorities and the Beneficiary where necessary. The Beneficiary will provide all necessary assistance in liaising with such Authorities.

The Contractor shall also allow in its Programme sufficient time required for provisional acceptance and for the maintenance periods (Defects Notification Period) as stipulated in the Contract.

## **MONTHLY PROGRESS REPORTS**

During of the execution of the Contract, the Contractor shall follow the progress of activities relative to the time schedule and shall submit to the Supervisor Monthly reports for the results of its activities, conforming to the following requirements:

- 1) The Report to be provided to the Supervisor in 1 hardcopy in Serbian and English languages as well as digitally (on CD enclosed to the Report);
- 2) Diagrams with detailed progress description, Contractor's documents, delivery, construction works, assembly and tests;
- 3) Digital photos (on CD enclosed to the Report);
- 4) Linear chart (schedules) for the current Stage, showing the actual and the planned progress;
- 5) Provision of resources - actual and planned;
- 6) Diagram for labour flow - actual and planned;
- 7) Report, reflecting all considerable differences from the construction programme, and if necessary, explanation for the proposed steps to be undertaken for the completion of the approved programme;
- 8) Statistics on safety and environment protection;
- 9) Financial Statement.

When actual work progress differs from that shown in the Construction Programme, the Contractor shall submit an updated schedule to the Supervisor. The updated time schedule shall be current to the last day of a calendar month and shall show the detailed "work-as-executed" programme in respect of work carried out. They shall be submitted within ten working days of the following month at the latest.

## **PROGRESS PHOTOGRAPHS**

Digital colour photographs showing the progress of the Works in detail shall be taken by the Contractor every week, from positions to be selected by the Supervisor.

The Contractor shall hand over the corresponding electronic files to the Supervisor on a CD, as well as an electronic list numbering and labelling each photograph (location, date when taken and a brief description or title).

## **CONTRACTOR'S DOCUMENTATION GENERAL**

- 1) For design, works and supply use of metric units is compulsory.

- 2) All documents will be issued in English. Official documents, which are to be presented to state or municipality authorities, will be also issued in Serbian.
- 3) Works documentation (see Chapter 3.1.4.) will be in English and in Serbian, except Construction Log, which will be in Serbian.
- 4) Reports and correspondence documentation will be in English and in Serbian.
- 5) When submitted as computer files the documents shall be under Windows, compatible with following formats: texts in MS Word, Tables in MS Excel, drawings in ACAD, time schedules in MS Project.

## **DESIGN FOR EXECUTION**

The Contractor shall prepare, in accordance with RS legislation, design for execution developing the drawings included in this Tender Dossier and taking into account the Contracting Authority's Requirements, written in the present Technical Specifications. Contractor's drawings will be checked and can be applied after a written consent is issued by the Supervisor and the Beneficiary.

## **WORKS DOCUMENTATION**

The Contractor shall be liable to provide the Supervisor with due documentation as per local Regulations. The Contractor shall keep/maintain the following Works documentation:

- 1) Inspection Book (forms laid down by the Law of the Republic of Serbia),
- 2) Construction Log (forms laid down by the Law of the Republic of Serbia),
- 3) Measurement Book (forms laid down by the Law of the Republic of Serbia),
- 4) All necessary certificates (for material, equipment and other) during the works execution.

The Works Site Manager shall keep the Construction Log and submit the Measurement Book sheets of the executed works along with each invoice. The Measurement Book has to be verified by the Supervisor.

The Construction Manager has to enter the following data into the Construction Log:

- Number and qualification of workers executing the works,
- Number and type of construction machinery used for works execution,
- Weather conditions under which the works are executed,
- How the works are executed and if there is any deviation from the design, contract and regulations in doing so.

## **AS-BUILT DESIGN**

- 1) Based on a survey of executed works, as-built technical documentation will be prepared by the Contractor and delivered to the Supervisor (in accordance with Law on Construction and Planning).
- 2) As-built drawings for all executed works must be delivered in digital form and 3 (three) printed and bind hard copies, signed by the Responsible Designer and the Supervisor.
- 3) Contractor is obliged to support the Beneficiary during technical acceptance and make necessary corrections in the submitted documentation and designs upon the request of Authorities in order to obtain a use permit.

## **OPERATION AND MAINTENANCE MANUALS**

- 1) The Contractor shall provide comprehensive operation and maintenance manuals for the delivered equipment including a full technical description and operational characteristics thereof. The Contractor shall provide 2 copies in both English and Serbian of each of the manuals bound loose leaf in ring binder folders.
- 2) Manuals shall be prepared in accordance with the approved standard. Manuals shall also be subject to the approval of the Supervisor.

## **HEALTH & SAFETY AND ENVIRONMENT PROTECTION**

### **HEALTH & SAFETY**

#### **GENERAL REQUIREMENTS**

Without limiting the Contractor's obligations under the Conditions of Contract, the Contractor shall take all measures and precautions necessary to ensure the health, safety and welfare of staff, labour, and other persons authorised to be on the Site, as well as visitors and third parties. The Contractor shall prepare H&S Plan and develop detailed sequence and safety measures in the Organisational plan for the management and execution of the works.

The Contractor shall:

- 1) Fully comply with the *Law on Safety and Health at Work*.
- 2) Appoint a member of staff responsible for all matters related to health and safety for the duration of the Contract according to RS regulations.
- 3) Provide and maintain equipment in a safe working condition and adopt safe methods of work.
- 4) Adopt methods for the use, handling, storage, transport, and disposal of materials, and substances which are not injurious to health and safety.
- 5) Provide and maintain adequate lighting, signing, and fencing of the Works.
- 6) Provide adequate protective clothing and safety equipment, including such information, instruction, training and supervision as are necessary to ensure the health and safety of all persons employed on or entering on the Site in connection with the Works.

Safety equipment shall include but not be limited to:

- safety helmets,
  - protective footwear with integral steel toe-caps,
  - safety glasses, welding goggles and other eye protectors,
  - ear defenders,
  - safety harnesses,
  - high visibility reflective vests,
  - Fire extinguishers.
- 7) Provide and maintain access to all places on the Site in a condition that is safe and without risk of injury.
  - 8) Provide and maintain adequate water, waste water and waste collection, for all offices, workshops, and laboratories erected on the Site.
  - 9) Provide and maintain adequate sanitary units at locations where works are in progress.
  - 10) Appoint a member of its staff to be responsible for the safety of the Works throughout any shutdown period and notify the Supervisor of the name and contact telephone number of the responsible person.
  - 11) Report all accidents to the Supervisor and appropriate authorities at the time of occurrence or as soon as possible thereafter.

#### **TESTING AND CERTIFICATION OF MECHANIZATION AND EQUIPMENT**

- 1) The Contractor shall provide and maintain equipment for lifting, embedding and transporting materials and must comply with all relevant requirements of the standards in Serbia;
- 2) All equipment must be regularly maintained in accordance with the recommendations and standards of the manufacturer, according to local laws and recommendations of the relevant authority;
- 3) The Contractor shall prepare and update a register of certificates of testing of the equipment used on construction sites according to RS Law;
- 4) The Contractor must appoint competent personnel responsible for the operation of all kinds of equipment. They must provide evidence that they have passed training and have respective license for operating the specific equipment;
- 5) All the technological equipment (with test certificates) used on or around the site must be equipped with the necessary protective devices that will be in continuous readiness;
- 6) Should the Supervisor consider the Contractor's method of working unsafe or that there are insufficient or inadequate safety barriers or other devices or that there is insufficient safety or rescue equipment, the Contractor shall change its method of working or install or strengthen safety and rescue equipment if so instructed. Such instructions shall not relieve the Contractor of any of its responsibilities under the Contract.
- 7) The Contractor shall immediately notify the Supervisor about any accident that occurs, whether on site or off site, in which the Contractor is directly involved, and which resulted in any injury to any person whether directly concerned with the site or a third party. Such initial notification may be verbal and shall be followed by a written comprehensive report within 24 hours of the accident.
- 8) Transportation of any material by the Contractor shall be in suitable vehicles, which do not cause spillage when loaded, and all loads shall be suitably secured. Any vehicle shall be removed from the site, which does not comply with this requirement or any of the local traffic regulations and laws.
- 9) The Contractor shall ensure access to sites at all times to any authorised external institutes or experts carrying out safety inspections.



## **FIRE PROTECTION**

During the performance of the Contract the Contractor shall make arrangements to the agreement of the Supervisor for the protection of the permanent works and any temporary works and any adjacent property from fire and, if required, it shall give the Fire Authority access to all facilities periodically to inspect the fire prevention arrangements.

Particular care must be exercised in connection with the operation of electric arc welding equipment, oxyacetylene cutting equipment and other processes involving the use of naked lights. Special arrangements will be necessary for the storage of highly flammable liquids on the site.

The Contractor shall remove all waste and material of a flammable nature and take other steps as the Supervisor may require but this shall not relieve the Contractor of any of its obligations under the Contract.

## **ENVIRONMENT PROTECTION**

### **GENERAL**

- 1) The Contractor shall take all necessary measures and precautions and otherwise ensure that the execution of the Works and all associated operations on or off site are carried out in conformity with statutory and regulatory environmental requirements.
- 2) The Contractor shall take all measures and precautions to avoid any nuisance or disturbance arising from the execution of the Works. This shall be achieved wherever possible by suppression of the nuisance at source rather than abatement of the nuisance once generated.
- 3) The provisions of these Sub-Clauses shall only be disregarded in respect of emergency work required for the saving of life or property or the safety of the Works.
- 4) In the event of any spoil or debris or silt from the Sites being deposited on any adjacent land, the Contractor shall immediately remove all such spoil debris or silt and restore the affected area to its original state to the agreement of the Supervisor.
- 5) The Contractor should comply with the guidelines of the Banks in this regards as well as those for resettlement and rehabilitation of the affected population.

The offer should include appropriate cost-effective mitigation measures, which should form part of the project cost. *Environmental Management Plan (EMP)* shall be prepared by the Contractor incorporating proposals concerning the implementation, management and monitoring of the environmental components of the project.

Within two (2) weeks from the commencement of the works, the Contractor shall submit an EMP with operational details of its proposals to the Supervisor for approval.

### **ENVIRONMENTAL PROTECTION DURING CONSTRUCTION PERIOD**

The Contractor shall use such construction methods and shall maintain all borrow/stockpile/spoil disposal area so as to assure the stability and safety of the Works and any adjacent feature, to assure free and efficient natural and artificial drainage and to prevent erosion.

The Supervisor has the power to disallow the methods of construction and/or the use of any borrow/stockpile/spoil disposal area if in their opinion the stability and safety of the Works or any adjacent features are in danger, or if they disturb natural or artificial drainage, or if the method or use of the area will promote undue erosion.

Following excavation for the works, the Contractor shall take all steps necessary to complete drainage and slope protection works in advance of each rainy season. Erosion or instability or sediment deposition arising from operations not in accordance with the Specifications shall be repaired immediately by the Contractor at its expense.

The Contractor shall also take all steps necessary to complete drainage in advance of each winter rainy season in the areas excavated for borrowing materials.

Notwithstanding approval of the intended method of working, the Contractor shall at all times be responsible for constructing the earth works in accordance with the Specifications, the Design and drawings.

### **PREVENTION OF POLLUTION**

The Contractor shall ensure that its activities do not result in any contamination of land or water by polluting substances.

The Contractor shall implement physical and operational measures such as: oil and grease traps in drainage systems from workshops, and service and fuel ingress and kitchens, the establishment of sanitary solid and liquid waste disposal systems, the maintenance in effective condition of the same assures, the establishment of

emergency response procedures for pollution events, and dust suppression, all in accordance with normal good practice and to the agreement of the Supervisor.

## ENVIRONMENTAL CONSIDERATIONS

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

- **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 environmentally safe disposal of any material resulting from the demolition and other site materials with approval from the relevant local Authorities at a designated licensed disposal facility.
- **Excavated soil** - Reuse of excavated natural soil, which is free of cohesive components, salt, sulphate and/or clay materials, may be used as backfill for trenches and excavations. The Contractor will be responsible for environmentally safe disposal of surplus materials with approval from the relevant local Authorities at a designated licensed disposal facility.
- **Ground water** - Temporary and/or permanent groundwater lowering may be required. The Contractor shall apply appropriate dewatering measures as required and shall also ensure that adequate measures are implemented to control surface water discharge.
- **Air pollution** - Construction may give rise to dust and construction equipment exhaust emissions. Due note shall be taken of the proximity of residential housing to the works. The normal health and safety controls will be required to safeguard the residential and passing population.
- **Noise pollution** - Construction works may cause annoyance caused by noise. The normal health and safety controls will be required to safeguard the residential and passing population.
- **Maximum noise levels** - During construction works the Contractor shall comply with the local and national requirements. The Contractor shall be legally responsible and financially liable to observe Serbian environmental legislation.  
The noise levels shall be in accordance with the relevant Serbian noise environmental legislative.  
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 residential areas. 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 its workmen carry out their duties in a quiet manner particularly when working at night.
- **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.

## AIR QUALITY

- 1) The Contractor shall devise and arrange methods of working to minimize dust, gaseous or other air-borne emissions and carry out the Works in such a manner as to minimize adverse impacts on air quality.
- 2) The Contractor shall utilize effective water sprays during the delivery and handling of materials when dust is likely to be created, and to dampen stored materials during dry and windy weather.
- 3) Stockpiles of materials shall be sited in sheltered areas. Stockpiles of friable material shall be covered with clean tarpaulins, and sprayed with water during dry and windy weather. Stockpiles of material or debris shall be dampened prior to their movement, except where this is contrary to the Specification.
- 4) Any vehicle transporting no coherent material shall not be loaded to a level higher than the side and tail boards, and shall be covered with a clean tarpaulin in good condition. The tarpaulin shall be properly secured and extend at least 300 mm over the edges of the side and tail boards.
- 5) In periods of high wind, dust generating operations shall not be permitted within 200 m of residential areas having regard to the prevailing direction of the wind.
- 6) Construction vehicles and machinery shall be kept in good working order and engines turned off when not in use. Appropriate measures shall be taken to limit exhaust emissions from construction vehicles, machinery and plant.
- 7) An advance warning shall be given to potentially affected persons, so that some measures can be taken by them before commencement of works, especially before dismantling/demolition.

## **NOISE**

- 1) The Contractor shall consider noise as an environmental constraint in its planning and execution of the Works.
- 2) The Contractor shall take all necessary measures to ensure that the operation of all mechanical equipment and construction processes on and off the Site shall not cause any unnecessary or excessive noise, taking into account applicable environment requirements. The Contractor shall use all necessary measures and shall maintain all plant and silencing equipment in good condition so as to minimize the noise emission during construction works.

## **MEASURES FOR DECREASING THE NEGATIVE ENVIRONMENTAL IMPACT**

In order to mitigate negative environmental impact, the Contractor should propose necessary actions in its Environmental Management Plan (EMP), such as:

- 1) to create adequate organisation for execution of construction works which shall comply with local construction regulations;
- 2) to provide water sprinkling of the construction site
- 3) to create organisation for control on the facilities storing fuel and lubricants and on the technical condition of the machines in order to avoid accidental oil spills;
- 4) along the construction site, waste water should be treated and sedimentation tanks and oil separators should be placed if needed;
- 5) to foresee the necessary maintaining and drainage measures for the construction site, access roads and service roads, in order limiting the erosion processes;
- 6) to specify the quantity and type of waste and how its disposal is intended to be transported and removed from the site area;
- 7) Measures for fast conservation of unfinished works at unfavourable conditions.

## **MATERIALS**

### **GENERAL**

- 1) All materials used shall be of the best quality as specified and described in the Specification, Design, Drawings and the Bills of Quantities. Where in the Design Drawings and/or BoQ the products are brand named, this should be understood as supplemented by 'or equivalent'. These materials shall be procured from approved manufacturers or suppliers.
- 2) The Contractor must secure the compliance with the Specification of materials or plant to be provided under this Contract before the supplier or manufacturer is proposed for approval to the Supervisor.
- 3) The Contractor shall take into consideration the local climatic and other environmental conditions when selecting and proposing the materials. The quality of the material has to be confirmed by the attestations and suppliers certificates, all according to TS and RS regulations.
- 4) Whenever possible, the Contractor shall provide equipment of a similar nature from the same manufacturer, e.g. electric motors;

The Contractor shall note that particular attention will be paid to these requirements. In cases where the proposed equipment is not standardized with regard to manufacturer and type, the Contractor shall be required to provide conclusive technical justification; considerations of price alone will not be accepted. Equipment and components that have not been standardized will not be accepted.

### **ORIGIN**

Certificates of origin have to accompany the products proving that supplies originate from an eligible country as stated in GC of the Contract.

### **CONFORMITY OF MATERIALS**

All materials implemented during construction shall be in compliance with the requirements of:

- Requirements of the local legislation;
- REGULATION (EU) No 305/2011 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 9 March 2011 laying down harmonized conditions for the marketing of construction products;
- The present Technical Specifications;

- Requirements of the design documentation.

All materials applied shall be accompanied with quality certificates to prove their concordance with the requirements set out in the design, the Specification and the Code for Civil Construction Works.

The Contractor shall make diligent efforts to procure the specified materials. Where, due to different reasons, the materials required by the Contract are not available, substitute materials may be used but with the prior approval by the Supervisor and the Designer.

## **TECHNICAL REQUIREMENTS FOR EXECUTION OF WORKS**

### **TECHNICAL REQUIREMENTS**

#### **PURPOSE OF THE TECHNICAL REQUIREMENTS**

The purpose of the technical requirements is to provide quality performance of works to comply with technical regulations and standards. Therefore, the Contractor is obliged to adhere strictly to them and to perform all the works that are the subject of this project, in accordance with technical requirements, design documentation, accompanying drawings and Bill of Quantities.

In addition, technical requirements define the method of measurement. Therefore, bidders are required to include all costs for not separately analysed and measured items in the unit prices of the existing ones.

### **GENERAL TERMS**

#### **NOTICE OF COMMENCEMENT**

The Contractor shall give a written notice to the Supervisor of its intention to commence works (Notice of Commencement).

Also, according RS law, Notice of Commencement must be submitted to competent Local and National Authority. The works shall not be commenced until written approval has been received from the Supervisor.

#### **TECHNICAL SPECIFICATION FOR WORKS**

Technical Specifications are an integral part of the Tender Documentation, and are annexed to the Works Contract. The Contractor is fully familiar with all details of the provided design documentation, 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), as well as 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.

Communication between the Contractor and the Beneficiary (also Designer), during the works will be carried out exclusively through the Supervisor.

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 and final products ready for use.

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.

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 specifications. The Contractor will be responsible to keep records on the progress of works in the measurement book and have it controlled and verified by the Supervisor.

Upon the completion of the works the Contractor will remove from the building site and other used areas all its 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.

All construction works must be carried out under the conditions and in the manner prescribed by RS Law on Construction and Planning.

For all works, applicable Serbian regulations and standards shall prevail.

## **TECHNICAL STANDARDS AND REGULATIONS**

In accordance to these Technical Requirements the Contractor shall ensure that its performance incorporates the following key principles

- For all required works and services specified in this Tender Dossier, the relevant Serbian standards and codes of practice shall apply. In any case, if Serbian standards are more strict or dominant, they shall apply to replace other standards given or not in other parts of this document.
- For works and services where no relevant Serbian standards or codes of practice exist the latest European Standards and code of practice shall be applied.
- The proposed application of other standards and code of practice for certain works and/or services shall be such as to ensure equal or higher than specified quality and safety of works, and to facilitate operation, inspection, maintenance, repairs, lubrication and similar operations.
- In any case, National standards and code of practice have to be used for each service and work, accompanied with explanations, to demonstrate to the agreement of the Supervisor that application of these standards and code of practice shall give required quality, safety, functionality and durability of the completed works.
- The applicable version of any standard shall be that valid 28 days prior to the latest date for submission of tenders.

## **MATTERS NOT COVERED BY THE STANDARDS**

Any materials and workmanship not fully specified herein or covered by the Standards, Codes or Manuals shall be of such type and quality so as to produce a required quality of work. In such circumstance the Supervisor shall determine whether all or any of the materials offered or delivered to the site are suitable for use in the Works and the Supervisor's decision in this respect shall be final and conclusive.

## **CIVIL WORKS**

The term "Civil Works" means the obligations of the Contractor to perform all manufacturing, excavation, building, structures and other construction Works.

All other works from the Contractor's Offer whether specified or not in the BoQ or any other Contract Document (including the Contractor's proposal), as necessary for the completion of the Works and the operation thereof, and as required under the terms of the Contract;

## **MECHANICAL AND ELECTRICAL INSTALLATIONS**

The term "Mechanical and Electrical Installations" shall mean the obligations of the Contractor under the Contract to cover all manufacturing, delivery, assembling and installation, testing and commissioning of the required mechanical and electrical equipment and machinery for the proper completion of Works, which shall be performed by the Contractor.

The following shall be included, but not limited to, within the limits of the Works:

- Mechanical and electrical equipment and machinery, including motors and pumps and spare parts;
- Complete piping system, incl. armatures and fittings;
- All other auxiliary materials of any description and all materials.
- Spare parts for fixed and mobile mechanical equipment.

## **CONTRACTOR'S EQUIPMENT**

Details of all Contractors' Equipment to be used in the execution of the Works shall be submitted to the Supervisor prior to its use.

The Supervisor's consent to use such Equipment will not be unreasonably withheld, but if, in the Supervisor's opinion, circumstances arise which make it desirable that the use of the said Equipment should be suspended either temporarily or permanently, the Contractor shall change the method of performing the work affected and it shall be deemed to have no cause for claims against the Supervisor on account of having to carry out the work by another method, nor it shall be deemed to have cause for claim if any order issued by the Supervisor results in the Contractor's Equipment having to stand idle for a period of any duration whatsoever or having to be removed.

## **SUBCONTRACTED WORKS**

The Contractor shall appoint subcontractors for the work for which the Contractor is not experienced, recognized or approved.

The Contractor shall submit for consent, the names of all proposed subcontractors and suppliers of special manufactured items with full details of the company, reference list and all other documentation needed for approval of the subcontractors and shall indicate the precise sections of the work for which each will be responsible.

The Contractor shall be solely responsible for the overall co-ordination of the Contract. Direct formal communication between its sub-contractors and the Supervisor will not be allowed.

## **METHOD STATEMENTS**

The Contractor shall provide, in writing, a description of the arrangements and methods it intends to apply for the execution of the Works.

Method Statements (MS) shall show in detail the methods proposed by the Contractor for carrying out the principal activities of construction in full safety. In particular, the Contractor shall indicate the resources (plant, personnel, materials) to be allocated, timing and sequencing, emergency/contingency measures, and any other information required to clearly detail the proposed methods. All necessary health and safety and environmental measures required shall be clearly indicated.

This will be supported by calculations for temporary works for supporting excavated faces and shuttering of concrete. Flowcharts, sketches and drawings shall be included if necessary.

Proposed MS will be submitted to the Supervisor (also to the Beneficiary) for approval. The Supervisor (in cooperation with the Beneficiary's representative) will review and provide its comments within 10 days. The Contractor shall make final corrections (if any) and submit them to the Supervisor for final approval, 15 days before the commencement of relevant work. Written agreement shall be obtained before any work is commenced.

## **PROVISIONAL TIME SCHEDULE**

The Defects Notification Period (DNP) shall be twelve (12) months under the Contract and shall commence after completion of the Works.

The duration and sequence of the various activities constituting the Works may be varied by the Contractor to suit its own proposals for carrying out the works, subject to the approval of the Supervisor, but no consideration will be given to any request by the Contractor to extend the Contract completion dates.

## **STANDARDS ON THE SITE**

The Contractor shall purchase and keep on Site at least one copy of each of the relevant Standards, Codes and Manuals or approved National Standards which are referred to in the Specification. In addition, the Contractor shall keep on Site a copy of any other Standard, Code, Manual, or National Standard, which applies to materials supplied. Copies of the standards shall be made available for reference at all times at the office of the Supervisor.

Should the Supervisor require an English or Serbian translation of any of the Standards or Manuals, the Contractor shall provide a translation within 7 days of receiving a written request from the Supervisor.

## **TECHNICAL SPECIFICATIONS OF THE MOBILE FIRE EXTINGUISHING EQUIPMENT**

### **Hand-held portable fire extinguishing apparatuses using powder - Technical requirements**

The apparatuses shall have cylindrical shape. The range of the jet must be minimum 3 m, and the quantity and pressure of the propellant gas must ensure equal powder ejection. The remaining powder in the tank must not exceed 10% of the original quantity. The apparatuses shall be operational at temperatures from – 20 to + 45oC. The free play of the units for activation of the apparatuses (button, handle, lever ...) must be  $3 \pm 1$  mm, and the hand wheel on the valve of the propellant gas bottle shall have free play at the angle of 30°. The direction of opening of the hand wheel shall be counter-clockwise. The apparatuses shall always be used in the upright position. The apparatuses having fillings over 3 kg (S-6, S-9, S-12) must have the discharge nozzle (with a mechanism for release and interruption of the powder jet) connected to the tank, by means of a flexible hose 800 mm long, and the discharge nozzle and the hose must be of materials that do not conduct electricity. The apparatuses type S shall be delivered filled (the powder and the propellant gas under pressure).

The apparatuses shall be filled with the powder up to 3/4. In smaller apparatuses, carbon dioxide shall be used as the propellant gas and, for bigger apparatuses, nitrogen. The allowable deviation in the filling of apparatuses with powder shall be:

- For apparatuses up to 3 kg:  $\pm$  up to 3% ;
- For apparatuses over 3 kg:  $\pm$  0.2 kg.

The allowable deviation in the quantity of gas under pressure in a steel bottle shall be  $\pm$  2%, and the allowable deviation in the pressure of gas in the tank, which is to be under constant pressure, shall be  $\pm$  10% of the indicated operating pressure at the temperature of 20°C.

Technical data for hand-held portable fire extinguishing apparatuses using powder:

Apparatus	Powder content [kg]	Gas content [g]	Gross weight [kg]	Action time [s]	Jet range [m]	Operating pressure [bar]	Test pressure [bar]	Safety valve [bar]
S-0,5	0.5	10	1.6	4-5	3-4	10-12	20-25	16
S-1	1	20	2.5-3.2	7-8	4-5	12	20-25	16
S-2	2	36-40	4.2-5.3	8-12	4-5	12	20-25	16
S-3	3	50-60	5.5-7	12-17	4-5	12-15	20-25	16
S-6	6	120-130	11-12	12-15	4-6	12-14	22-25	16-19
S-9	9	160-200	15.7	20-22	4-6	12-14	22-25	16-19
S-12	12	200-250	18-19	25-28	4-6	12-15	22-25	16-19

There are various workmanships (versions) of the apparatus type S, but all of them function in the same way in principle.

# **VOLUME 3.1**

## **TECHNICAL SPECIFICATIONS –**

### **ARCHITECTURAL WORKS ON TECHNICAL BUILDING**

#### **WITHIN HYDRO-COMPLEXES KLEK**

Upon the developer's request the Main design for reparation of facilities has been developed within the hydro-complexes of Klek, cadastral lots no 643/2 c.m. Klek.

The developer has obtained the Decision on the approval of the execution of works No 143-351-13/2018, ROP-PSUGZ-32319-ISAWHA-3/2018 of 31 January 2018 and Preliminary designs related to repairing, developed by the company Hidroprojekt Zrenjanin doo in February 2016.

#### **TECHNICAL BUILDING**

The facility comprises only a ground floor. Under a part of the ground floor there is a basement. Its shape is rectangular and the dimensions are 14.47m x 11.22m. The structure of the basement is vaulted. Above the ground floor there is a ceiling construction made of roof trusses, planks, cane and plaster. It is a gable roof with the double hangers system with ties above the joist hangers above the roof trusses. The roof cover consists of interlocking roof tiles.

#### **Functions**

The spot elevation of the ground floor is distanced 125cm from the surrounding terrain so that the ground floor is accessible through the external staircase. The clear height of the rooms is around 370cm. There is a side entrance to the facility to the east and a front entrance to the north.

The structure contains one larger premise, an office, a male and female sanitary block and accompanying rooms. The conference room is organized around the big spot of the monitor screen placed on the southern wall of the conference hall where there are also two chairs for the lecturers. The space for the participants is arranged in the rows. For the purpose of organizing a different kind of lectures, additional folding tables are also planned that will be stored in the basement. Wardrobe on the north wall of the conference hall is planned for the placement of the clothes. The darkening of the hall is provided by the inner wooden folding curtains.

The free walls between the windows and doors are designed for the installation of exhibiting of the museum pieces so that special lighting is provided for these walls.

The gathering and preparation of a lecturer is in the office, where the space for an interpreter who has direct contact through the window with a conference room is allocated. In addition to visual contact, a computer network with headphones and speakers are also provided. Office space also serves for the door keeper's stay at the regular use of the building as well as for the usual administration.

The kitchen is provided as a kitchenette for the preparation of the usual beverages and as a distribution kitchen in case of serving meals when the food is brought by the catering.

Sanitary blocks are retained in the existing positions, but completely redesigned. REC is placed in a separate premise - a storage room.

Roof repairing covers the disassembly of the roof cover which consists of interlocking roof tiles and roof laths along all elements of the roof edge and gutters. All the damaged and rotten parts of the roof construction are disassembled. This refers to the principal rafters as well as to tie beams which were shortened before and which should be replaced. The chimneys are to be demolished and reconstructed on the same brick position.

All damaged and disassembled parts of the roof construction are to be made of the coniferous timber of II quality class. Undamaged rafters which are disassembled due to the tie beams replacement technology are reused. New visible wooden elements are profiled according to the existing profiling. Overall roof structure and wooden deck frame are to be coated with an insect and fungus protection agent



according to the manufacturer's instructions 2-3 times. The rafters are levelled and covered by 2.5 cm thick plunks, over which steam-permeable and water-permeable foil is placed and fastened with 5x5 cm sticks in the direction of rafters. Depending on the choice of interlocking roof tiles the lathes are nailed down of 5x3cm upon the instruction. There are unbalanced snow loadings integrated in the roof construction. Tin roof edges and gutters are constructed of steel galvanized sheet metal.

Complete construction of the floor is planned, with the creation of space for the construction of a new, thick structure with hydro and thermal insulation. An internal excavation of the outer walls of the conference hall up to a level of the field in the width of min 60 cm and the creation of a workbench for walls cutting is a part of this operational item. Cutting these walls from capillary moisture should be done at a level of about 20 cm from the ground so that there remain 14 rows of facade brick on the building socle. Below the water insulation the dilapidated wall of min 50cm height is to be demolished and replaced by reinforced concrete, which will in this case enter min 30cm below the ground. Reinforced concrete is to be drawn in from the outer side of the wall 5cm for adaptation of the socle. XPS plates with the thickness of 4cm, with final processing of mass called kulirplast will be applied on the plinth by glueing.

The entire cutting operation is to be performed in sections at max. 1.00m in order to avoid collapsing of the wall. The continuity of reinforced concrete is to be achieved by leaving the appropriate anchor plate nuts. Water insulation of water repellent glass wool strips of 4mm thickness, with adequate coatings. Welded overlaps are of 10 cm at least. This also refers to welded overlap and joint with vertical insulation of the wall so that the width of the water repellent strip increases 10 cm into the inner space in relation to the thickness of the upper part of the wall. The grout area above the water insulation on the facade side must be injected with cement emulsion under pressure, due to the establishment of static stability and taking care of the aesthetics of facade brick. All the dilapidate bricks must be replaced with adequate and similar. There are no aesthetic requirements in the inside area and more attention is to be paid to the wall's firmness at wall underpinning.

Vertical water insulation of the plinth wall is to be done by glueing repellent glass wool strips of 4mm thickness onto the firm and flat surface of the inside area of the wall. Before applying the water insulation onto the wall, the wall must be cleaned and levelled by partial concrete removal, by building an extension or by plastering, depending on the humps on the wall. Protect the vertical water insulation with the shiner brick leaning on the new reinforced concrete.

Horizontal water insulation of the inner walls is done cutting at the level of 20cm below the level of the constructed floor. This is also performed in sections. Below the water insulation a concrete padstone should be constructed about 10 cm above the reinforced concrete for making available a flat surface for water insulation. The width of the water repellent strip is to be increased 10 cm due to the overlap with the water insulation of the floor.

The floor structure is made of a layer of gravel, reinforced concrete slabs and water insulation over a plate which is at -20cm level. The continuity of water insulation with the 10 cm overlap and welding with vertical water insulation of the plinth wall and inner walls.

Cutting or any water insulation of these walls above the basement will not be performed at this situation stage except for water insulation of the floors and inner walls at -20 cm level.

Thermal insulation is to be installed in the floor from EPS plates 10cm thick, of 30kg / m<sup>3</sup> min density, PVC foil is to be set and cement screeds 6cm thick, Shults steel reinforcement frames with overlaps or synthetic fibres. In the contact between the screed and the wall, a section from EPS plates 1cm thick (floating floor) is to be installed.

The final floor is made of ceramic and granite tiles in glue. The plinth of 10cm height is performed on the wall.

Water insulation of the basement will be performed on the well cleaned and prepared walls on the inner side of walls with mass that penetrates into walls from the manufacturers Bauplus, Texal or similar ones upon the manufacturer's instructions.

Crumbly mortar on interior and exterior walls cracks, and grouts are to be cleaned to the depth of 2cm. Mortar should be stripped off and at mere chase cutting for electrical wiring and the installation of water supply and sewerage. By plastering the straight transition between the old and new mortar is to be achieved. There is a partial drifting of these surfaces.

The treatment of interior walls and partially of the ceiling is done in semi-dispersible colours of light shades.

In the sanitary blocks there are beautiful ceramic tiles high up to 210 cm and in the kitchenette, behind the kitchen elements there are tiles up to 150 cm high.

The ceiling of plaster performed by casting plaster of cane is to be disassembled on the whole facility. All the layers between the ceiling joist are demolished. The new ceiling of two layers of 12.5mm thick plasterboard plates is performed on the substructure of CD / UD profile. Thermal insulation made of mineral wool, 20cm thick with steam protection from below and water vapor permeable waterproof foil is placed between the ceiling joists.

In the conference room, the ceiling of 60x60cm in height made of mineral panels of "armstrong" type or similar one is to be lowered. Lighting fixtures are installed in the ceiling. The necessary electrical installations are performed in the cavity of the ceiling. In the other rooms, a new suspended ceiling composed of 12.5mm thick plasterboard on the metal sub-structure of the CD / UD profile is lowered. The necessary electrical installations are performed in the cavity of the ceiling. The ceiling profiles are secured to the ceiling at the places of the existing ceiling joists. Lighting bodies in these rooms are superstructural.

The windows are double, wooden, alike the existing ones, with all the leaves opening inside and the windows are installed for half of a brick towards the inside from the outer surface of the facade. Glazing of the outer window leaves performed by double thermal insulation with glass of  $U_g \leq 1.30 \text{ W / m}^2\text{K}$ , and internal single glass of 4mm thickness. Alike the existing ones on the inside there are foldable solid wood shutters constructed and assembled. Installation should be carried out with stainless steel joints and sealed with polyurethane foam.

The interior doors are solid wooden, profiled. The detailed reparation and bringing into a functional state is necessary to perform. The old paint is to be stripped of by shingles and burning with hot air. Surface treatment is to be performed by drilling and sanding to the smooth fine surface. Nonfunctional fittings are to be replaced by adequate or similar ones, which in particular refers to the door handles. Broken glass is to be replaced with adequate one, also possibly rotten parts of wood are to be replaced too.

#### Electrical Installations

Elimination of all the shortcomings in the existing internal electrical and strong power supply is planned, so that the new electrical installation is to be practically performed in Notes 4 and 5.

#### Plumbing and drainage

The complete replacement of the existing installation is planned along with monitoring of the architectural solution of the layout of sanitary facilities. For installations routing the old route is to be used at the greatest extent.

Procurement and installation of water pipes made of crosslinked polyethylene with all required fittings within the piping network. The sewage installation is made of polypropylene sewage pipes.

All new sanitary equipment is specified in the Bill of Quantities.

#### Heating

The structure is not heated because it is not used in the winter period, so pursuant to Article 7, paragraph 1, point 8 of the Rulebook on the conditions, content and method of issuing Certificate of energy properties (Official Gazette of RS No. 69/2012) for this structure it is not necessary to obtain an energy passport and, therefore, the developing of the Energy Efficiency Study, according to the Energy Efficiency of Buildings (Official Gazette of RS No. 61/2011).

For an occasional use of the facility in the transitional period late autumn and early spring, the electric panel radiators are installed on the parapets. For heating the door keeper's office in winter time would be heated with a tiled stove.

#### Ventilation

All rooms have windows and, therefore, natural ventilation apart from sanitary blocks. Ventilation of these rooms is artificial, designed so that PVC pipes Ø110mm and with built-in fans perform the function of ventilation.

#### Facility equipment

The structure is fully equipped with furniture provided by the domestic furniture manufacturer, specified in Bill of Quantities of equipment and furniture.

# **VOLUME 3.2**

## **TECHNICAL SPECIFICATIONS AND TECHNICAL REQUIREMENTS—**

### **CONSTRUCTION WORKS TO REPAIR THE SHIP LOCK IN KLEK**

#### **3.2.1. TECHNICAL DESCRIPTION**

##### **3.2.1.1. CURRENT STATE**

The hydrotechnical complex of the ship lock in Klek was constructed between 1910 and 1912, consisting of the upper chamber of the ship lock and the structures of the technical building, workshop and auxiliary facilities.

In the 1960s, the lower (downstream) chamber of the ship lock was added, which made this ship lock the only two-stage lock in the canals within the DTD hydraulic engineering system.

In late 1960s, navigation through the canal was suspended, which reduced the maintenance activities on the canal and the associated hydrotechnical structures, resulting in the current poor state of the structures.

Klek ship lock and floodgate are located on the Navigable Begej canal near the village of Klek, at chainage km 0+740, immediately upstream from the point where the Navigable Begej discharges into the Banatska Palanka-Novi Bečej canal.

The upper chamber of the ship lock is 10 m wide and 99 m long in total (including gates and lock pounds), with 5.8 m high walls. The crown of the wall is at the elevation of 78.70 m.a.s.l., while the bottom of the chamber is at the elevation of 72.90 m.a.s.l. The walls are made of stone, subsequently lined with a layer of concrete with reinforcing mesh. The layer of concrete has mostly degraded or has completely fallen off.

The lower chamber of the ship lock is 10 m wide and 79 m long in total, with 6.50 m high walls. The crown of the wall is at the elevation of 78.00 m.a.s.l., while the bottom of the chamber is at the elevation of 71.50 m.a.s.l. The bottom slab, walls and cantilevered pathways at the top of the chamber walls are made of reinforced concrete. There is minor local damage to the concrete on the visible parts of the chamber walls, and also concrete surface degradation of a lower level.

The difference of elevations between the walls of the upper and lower chamber, amounting to 70 cm, is bridged with concrete stairs, which are in quite good condition. Concrete pathways on the walls of both chambers have partly cracked, while the concrete pathway on the pier has degraded to a considerable extent. Concrete cloth - pillars of the pier have suffered surface damage, without degraded concrete sections.

Abutments of the bridge crossing the Navigable Begej canal are made of brick, which is damaged in some segments, especially under the bridge structure. The intermediate pier is located on the right wall of the ship lock and it is made of brick and stone, subsequently lined with concrete, which has fallen off at some places, while at others, it has detached from the original pier structure.

Linings of the canal slopes upstream from the floodgate are made of stone, while in their downstream segment, they are made of concrete.

#### **PHOTOGRAPHS OF THE CURRENT STATE**



Damaged wall of the upper chamber of the ship lock



Damaged wall of the lower chamber of the ship lock



Damaged intermediate pier





Damaged intermediate pier



Damaged abutment



Damaged pathway on the wall of the ship lock



Damaged last two spans of the pier



Appearance of the pier



Pier pathway



Floodgate threshold model



Damaged concrete lining of the canal

### **3.2.1.2. SCOPE OF WORKS**

Repair of the ship lock includes the following groups of works:

1. PREPARATORY WORKS
2. DISASSEMBLY AND DEMOLITION WORKS
3. EARTHWORKS INCLUDING CONSTRUCTION OF ACCESS ROADS AND HANDLING PLATFORMS
4. CONCRETE WORKS
5. MASONRY WORKS
6. REINFORCING STEEL WORKS
7. CARPENTRY
8. METALWORK
9. OTHER WORKS
10. PREPARATION OF THE AS-BUILT DESIGN

The following are the functional parts of the ship lock where repair works are planned to be carried out:

- UPPER CHAMBER OF THE ship lock
- LOWER CHAMBER OF THE ship lock
- PATHWAYS ON THE ship lock WALLS
- PIER (upstream access dock for conducting ships into the ship lock chamber)
- PIERS OF THE BRIDGE ACROSS THE BEGEJ
- BANK REVETMENTS
- FLOODGATE THRESHOLD MODEL
- FENCE AND GATES AT THE ENTRANCE TO THE COMPLEX

### **3.2.1.3. DESCRIPTION OF WORKS**

#### **1. PREPARATORY WORKS**

In order to carry out ship lock chamber repair works, it is necessary to undertake onshore works including:

- Cofferdam construction of jumbo bags filled with sand in front and behind the inlet and outlet lock head with previous cleaning of the bottom from deposits and sludge in the cofferdam zone.
- Water pumping from the ship lock chambers
- Cleaning the chamber bottom of deposits and sludge
- construction of the first order niches and thresholds next to the inlet and outlet lock head in order to install new stop logs
- Installation of stop logs (5 pcs) in front of the upstream ship lock gate

In order to execute the pier and bank revetment repair works, a lower water level of the Begej is recommended (min. elevation 74.40 m.a.s.l.). At this water level and in case there is no water in the ship lock chambers, the sliding safety factor amounts to 0.95, which means that the facility is not safe against sliding. In order to meet the sliding safety requirement, the groundwater level in the soil behind the bank wall of the chambers should be at the elevation of 73.40 m.a.s.l. (or lower).

Accordingly, the design for repair works includes construction of drainage wells along the bank wall of the upper and lower chambers. It is planned to construct 8 wells, with a 225 mm diameter and 20 m long. The wells should be spaced 25 m apart, and positioned 5 m from the

bank wall of the chambers. It is assumed that water will be pumped over a period of 90 days, i.e. the period assumed to be required to execute the repair works on both chambers.

For the purpose of monitoring the groundwater level, it is planned to install 2 piezometers along the bank (left) wall of the ship lock.

NOTE: Stability calculations have been made for the lower reinforced concrete chamber, which was built in the 1960s and which is provided with the design documentation. The upper chamber of the lock is made of stone; it was constructed between 1910 and 1912 and it is not provided with the design documentation.

It is planned to use scaffolding to repair the walls of the ship lock chambers and the piers of the bridge across the Begej. Depending on the water level of the Begej, the works to repair the pier are to be carried out either from a vessel and/or from scaffolding.

## 2. DISASSEMBLY AND DEMOLITION WORKS

The design for repair works includes disassembly of the following elements:

- Wooden fender beams in the ship lock chambers and on the pier pillars
- The fence and gates of the entire complex

Demolition works include the following:

- Stripping off of reinforced concrete wall lining of the upper chamber (reinforced with a mesh)
- Demolition of damaged concrete pathway sections on the walls of both ship lock chambers
- Stripping off of reinforced concrete lining of the intermediate pier of the bridge across the Begej (the pier is located on the right wall of the ship lock)
- Demolition of upper brick layers on the walls of the abutments of the bridge across the Begej
- Demolition, i.e. removal of the last two spans of the pier, which have been displaced from the design position and separated from the pier structure
- Demolition, i.e. stripping off of the cement screed on the stairs on the right bank slope

## 3. EARTHWORKS INCLUDING CONSTRUCTION OF ACCESS ROADS AND HANDLING PLATFORMS

Planned earthworks include manual excavation of soil during the repair of access pavements.

In terms of access roads, the design includes the construction of three transverse access roads, 80 m long and 3 m wide. The access roads are to connect the existing route leading to the complex of the hydrotechnical node of Klek with the left bank of the ship lock, at three locations: at the upstream, intermediate and downstream gates of the ship lock. At these three locations, it is also planned to construct handling platforms (two end platforms measuring 20x12 m, and an intermediate platform measuring 15x14 m).

The access road structure consists of the following: 30 cm of sand, 20 cm of crushed stone aggregate 0-63 mm and 10 cm of crushed stone aggregate 0-31.5 mm; total thickness 60 cm.

The handling platform structure consists of the following: 40 cm of sand, 25 cm of crushed stone aggregate 0-63 mm and 10 cm of crushed stone aggregate 0-31.5 mm; total thickness 75 cm.



The site where access roads and handling platforms are to be constructed is occupied by green space. Therefore, the design includes tree cutting and stump removal. While doing the site layout survey, ensure that the routes of access roads and handling platform locations are positioned so as to require minimum tree cutting.

#### 4. CONCRETE WORKS

The design for repair works includes the following concrete works:

- Concreting of pathways on the ship lock walls
- Concreting of access pavements
- Concreting of reinforced concrete lining of the intermediate pier of the bridge across the Begej (the pier is located on the right wall of the ship lock)
- Concreting of stairs on the right bank slope
- Concreting of the floodgate threshold model on the right bank (in front of the workshop, next to the spare floodgate frames)

#### 5. MASONRY WORKS

Before carrying out masonry works to repair the chambers and bridge piers, as well as the pathway and pier pillars, it is necessary to pressure wash the surfaces, using an HD device.

After the cleaning, the following works are to be carried out:

- Replacement of damaged stone sections of the upper chamber
- Jointing of stone walls of the upper chamber
- Repair of concrete walls and the bottom slab of the lower chamber using restoration mortar
- Application of a penetrating sealer to concrete walls and the bottom slab of the lower chamber
- Laying of face brick layers on the piers of the bridge across the Begej
- Jointing of face brick layers on the piers of the bridge across the Begej
- Repair of minor damage to concrete pathways on the ship lock chamber walls using restoration mortar
- Sealing of cracks on concrete pathways on the ship lock chamber walls
- Repair of the pathway, pillars and longitudinal wall of the pier using restoration mortar
- Grouting of joints on the concrete revetment of the Begej bank
- Construction of a cement screed on the stairs on the bank revetment slopes
- Construction and installation of the fence and gates made of galvanized steel pipes and plasticized mesh, 2 m high, at the entrance to the complex

#### 6. REINFORCING STEEL WORKS

The design includes construction of a reinforced concrete lining on the intermediate pier of the bridge across the Begej (the pier is located on the right wall of the ship lock). The lining is to be reinforced using steel reinforcing mesh Q-503, while the steel reinforcing mesh at the corners is to be connected using reinforcing steel Ø10, B500B.

#### 7. CARPENTRY

The design includes installation of new wooden fenders on the walls of the ship lock chambers and the pillars of the pier. The fenders should be made of dry pine timber 30x30/400 cm in the ship lock chambers and 20x20/350 cm on the pillars of the pier.

## 8. METALWORK

Metalwork includes:

- Construction and installation of threshold lining on the bottom of the chamber, at the upper and intermediate lock gates (lining to be made of 10 mm thick stainless steel sheets)
- Construction of a recess for the upper bearing of the lock gate for the upper and intermediate lock gates
- Construction of recesses and abutments for the lateral supports of the upper and intermediate lock gates
- Construction of the lining of vertical edges at the upper and intermediate gate recesses
- Construction of the lining and recess with a face guide for installing stop logs, upstream of the upper lock gate and downstream of the lower lock gate
- Construction and installation of threshold lining for stop log support, upstream of the upper lock gate and downstream of the lower lock gate
- Repair of the steel fence on the wall of the ship lock and the pier
- Repair of step irons (fixed ladders) in the ship lock chambers
- Repair of manhole covers, metal edge protection and other metal elements

Note: Before construction and preparation of installation points for metal elements and mechanical equipment, all measures are to be checked on-site.

## 9. OTHER WORKS

Other works include the previously mentioned installation of 2 piezometers for monitoring the groundwater level, and also repair of the stone cladding of the bank revetment.

## 10. PREPARATION OF THE DESIGN OF THE CONSTRUCTED FACILITY

Having completed the works, the Contractor is to prepare the Design of the constructed facility in case that there were changes during the execution of works compared to the design solution provided in the Detailed Design.

### NOTES:

- The use of most of the repair materials is specified by the Manufacturer and limited by the base and ambient temperature requirements, ranging from +5°C to +30°C. Accordingly, the Designer recommends that the repair works be carried out in the period when the expected temperature corresponds with the specified one so as to avoid low-quality works.
- The works to repair the ship lock gates, mechanical equipment and floodgate are included in the mechanical engineering section of the Detailed Design (Book 6).

The works to repair the facilities within the hydrotechnical node of Klek (technical building, workshop and shed) are included in the architectural engineering section of the Detailed Design (Book 1).

## **3.2.1. TECHNICAL REQUIREMENTS**

### **INFORMATION ABOUT THE WATER REGIME OF THE NAVIGABLE BEGEJ RIVER IN KLEK HYDROTECHNICAL NODE**

According to the data provided by the Investor - PWMC Vode Vojvodine:

- in the period from 15 September to 1 May (natural flow regime), the water level in the Begej canal is 74.40 m.a.s.l.
- in the period from 1 May to 15 September (backwater flow regime), the water level in the navigable Begej canal ranges between 77.50 to 77.70 m.a.s.l. upstream of the floodgate i.e. at the inlet heat of the ship lock upper chamber and between 74.20 to 74.40 m.a.s.l. downstream of the floodgate.

According to the data provided by the Investor, the planned start of the repair works of KLEK Hydrotechnical Node is November 1, 2019 and the works will be performed 18 months (until 1 May 2021).

### **LIST OF FACILITIES AND DESIGN REPAIR WORKS**

The repair works of Klek hydrotechnical complex include the works on the following facilities:

- upper and lower ship lock chamber
- pier (ship dock)
- bank revetment
- road bridge pillars over the canal
- floodgate threshold model
- fence and gates at the entrance to the complex
- technical building
- access roads, handling platforms and sidewalks
- power cables and outdoor lighting

Volume 1 – Architectural Design provides a Technical Description of the technical building, workshop and shed building repair works.

Volume 2 – Structural Design provides a Technical Description of construction and repair works of the lock chamber, pier, bank revetment, road bridge pillars, floodgate threshold model, fence and gate of the complex, construction of access roads and handling platforms.

Volume 4 – Power Installations Design provides a Technical Description of power cable and outdoor lightning installation works and repair works of the power installations of the technical building, workshop and shed building.

Volume 6 – Mechanical Installation Design provides a Technical Description of floodgate, gates and ship lock mechanical equipment repair works and stop log construction works.

### **TECHNICAL DESCRIPTION OF CONSTRUCTION WORKS**

Prior to the commencement of works, it is necessary to construct access roads and handling platforms for the transport and storage of construction materials and equipment and construction machinery operation (cranes, excavators, loaders, trucks, etc.)

## SHIP LOCK UPPER AND LOWE CHAMBER REPAIR WORKS

To repair the ship lock chambers, it is necessary to ensure dry working conditions, which require some preparatory works. In addition, the use of most of the repair materials is specified by the Manufacturer and limited by the base and ambient temperature requirements, ranging from +5°C to +30°C. Accordingly, the Designer recommends that the repair works be carried out in the period from early April to the end of October (except in the period of high summer temperatures) when the expected temperature corresponds with the specified one so as to avoid low-quality works.

Please note that the ship lock chamber extends almost over its entire length (except the inlet part of the upper chamber head) downstream of the floodgate, which means that at the time of repair works, the water level of the Begej will be 74.20 to 74.40 m.a.s.l.

Preparatory works include the following works:

- cleaning of the bottom in front of the inlet and outlet lock head in the zone intended for the installation of the cofferdam of jumbo bags.
- construction of the jumbo bag cofferdam filled with sand upstream and downstream of the lock head.
- Water pumping from the ship lock chambers
- Cleaning the chamber bottom of deposits and sludge
- construction of the first order niches and thresholds next to the inlet and outlet lock head in order to install new stop logs
- installation of stop logs (5 pcs) at the upstream end of the ship lock upper chamber.

The design defines that these preparatory works are to be performed in the lowest water level, i.e. from 15 September to 1 May (natural flow regime) when the water level in the Begej canal is 74.40 m.a.s.l. At this water level of the Begej, the required cofferdam height in the upstream area is 2.0 m ( $H=74.40-72.90+0.50=2.00$  m), while in the downstream area it is 3.0 m ( $H=74.40-71.50+0.10=3.00$  m).

Should the water level of the Begej river increase, it will be needed to increase the height and width of the Begej river.

The Designer's recommendation is to execute the preparatory works in the period of natural flow regime in order to perform the repair works in the period from May to October, i.e. in the period when the substrate temperature and ambient temperature are in line with the temperature prescribed by the manufacturer of the repair materials.

Simultaneously with the preparatory works, it is necessary to construct new stop logs (5 pieces), which should be placed in the prepared niches at the upstream gate no later than 1 May. The design dimensions of a stop log are  $b/h/L=810/1100/10400$  mm. One stop log weighs around 4000 kg (4 tons).

As the lock chamber repair works will be performed in the period from 1 May to 15 September (backwater flow regime), when the water level in the Begej canal upstream of the lock ranges between 77.50 and 77.70 m.a.s.l., and downstream of the ship lock 74.20 to 74.40 m.a.s.l. the required number of stop logs is as follows:

on the upstream chamber side  $n=(77.70-72.90)/1.10=4.36$  5 pcs of stop logs adopted (upper chamber bottom level: 72.90 m.a.s.l.)

Once the stop logs are installed in front of the upstream gate, the jumbo bag cofferdam may be removed.

Water flow to the downstream lock chamber, where water level of the navigable Begej river ranges between 74.20 to 74.40 m.a.s.l. throughout the year is to be provided by a cofferdam of jumbo bags filled with sand, which will be installed downstream of the outlet lock head. This cofferdam is to be removed upon completion of the lock chamber repair works.

In order to meet the chamber stability requirements in the lock chamber repair stage (dry chamber without water), it is necessary to monitor and maintain the groundwater level behind the chamber wall at 73.40 m.a.s.l. (1 m under the Begej water level) as shown in the Lock Chamber Stability Calculation, which constitutes an integral part of this volume of the design, no. 2.6.1.

In this regard, the preliminary works include the installation of 2 piezometer for monitoring the lowest water level and construction of 8 drainage wells for lowering the water level to 73.40 m.a.s.l., as defined by the technical description and priced bill of quantities for the ship lock repair, taking into account the fact that in the design development stage, the required hydrogeological data were not available to the designer and consequently, the number, layout, diameter and the depth of the drainage wells are determined without a detailed calculation.

The designer defined that the construction and removal of the upstream and downstream cofferdam of jumbo bags be performed by a crane on the left bank of the Begej. The size of one jumbo bag filled with sand is 1.0x1.0x1.0 m. The weight of one this bag is 2 tons.

After the cofferdam is constructed, water shall be pumped by sludge pumps into the Begej River. In order to clean the chamber bottom from deposits and sludge, it is necessary to “break” the deposits by water pressure and then to pump them with the sludge pump. The deposits and sludge are to be transported to the existing sludge removal container, which is, according to the information provided by the Investor, located on the bank at a distance of 700m.

Once the dry working conditions are provided, prepare the first-order niches in the walls of the inlet and outlet ship lock head and prepare the threshold lining in order to provide support for stop logs on the bottom slab. To prepare the niches, it is necessary to set up a 4.50 m high scaffolding, given that the niche height is 6 m from the bottom to the top. The preparation of niches implies increasing of the size of the existing niches and their lining with stainless steel sheets, all with the aim of providing conditions for undisturbed installation and sealing of new steel stop logs.

In order to ensure dry working conditions, the thresholds are to be constructed using stainless steel sheets on upstream and downstream end of the bottom chamber slab. The steel cofferdam beams are elaborated under the Mechanical Installations Design (Volume 6), and the niche and threshold lining details are provided in the Structural Design (Volume 2, drawing no. 2/1.7.10.).

New steel stop logs are to be installed by a crane on the left bank of the Begej river. According to the design, one stop logs weighs 4 tones.

To execute the ship lock chamber wall repair works, it is necessary to set up of around 4.50 m high scaffolding given that the wall height is 6m.

The upper chamber is constructed with stone and involves the following repair works:

- removal of the mesh reinforced concrete wall lining, thickness of around 4 cm
- cleaning with high water pressure (using HD devices)
- replacement of damaged stone parts
- joint filling

The upper chamber is reinforced concrete structure and involves the following repair works:

- cleaning with high water pressure (using HD devices)
- repair of the damaged concrete parts using the repair cement mortar
- penetrate application

#### PIER REPAIR WORKS

The recommended period for the execution of pier repair works is from 15 September to 1 May (natural flow regime) when the water level in the navigable Begej canal ranges is 74.40 m.a.s.l. This would allow to execute the pillar concrete lining repair works in dry conditions given that the level of stone prism crown under the pier is 75.60 m.a.s.l.

As the pier pillars reach a height of around 3 m, a working platform needs to be installed on the stone prism and its slope on the lock side in order to repair the pillars and bottom surface of the pier pathway.

As the pier is surrounded by water on three sides, and given that it is connected to the land on one (transverse) side by the pedestrian bridge and lock wall, people, material and equipment may be transported either from land or from water (by vessel).

To access the pier from land, it is necessary to install prefabricated stairs on the ship lock wall crown (level 78.70) at the beginning of the pier, which will be used to descend to the stone prism crown level under the pier pathway (75.60). The stairs would overcome the height difference of 3.10m.

The top surface of the pathway and the pier gate may be repaired from the land using the pedestrian access bridge and ship lock wall.

Removal of the last two pier field, which are displaced from the design position and separated from the other part of the structure is to be performed from water by a backhoe dredger, which will transport the demolished material to the left bank, where it will be loaded to a truck and transported to the 15 km distant landfill determined by the Investor.

#### BANK REVETMENT REPAIR WORK

The recommended period for the execution of the bank revetment slope repair works is the period of the lowest water level, i.e. in the period from 15 September to 1 May (natural flow regime) when the water level in the navigable Begej canal is 74.40 m.a.s.l.

The works include repair of the stone cladding with rolled crushed stone in the bottom part and manually stacked crushed stone in the upper part.

#### REPAIR OF THE ROAD BRIDGE PILLARS OVER THE CANAL

The road bridge pillar repair works are not dependent on the Begej water level and can be performed independently of the water regime conditions. It is important that during the execution of works, due to the use of repair materials, the substrate temperature and the ambient temperature range between +5°C to +30°C. Accordingly, the Designer recommends that the repair works be carried out in the period from early April to the end of October (except in the period of high summer temperatures) when the expected temperature corresponds with the specified one so as to avoid low-quality works.

In order to execute the repair works, it is necessary to set up a 1.30 m high scaffolding given that the pillar height ranges from 2.80 to 3.10m. The height from the bottom edge of the bridge structure to the pillar bottom is:

$$H = 82.00 - 78.70 = 3.30 \text{ m.}$$

## REPAIR OF OTHER FACILITIES

The repair works of the floodgate threshold model, fence and gates at the entrance to the complex, technical building, power cables and outdoor lightning) are not dependent on the Begej water level and may be executed independently of the water regime conditions. It is important that during the execution of works, due to the use of repair materials, the substrate temperature and the ambient temperature range between +5°C to +30°C.

Accordingly, the Designer recommends that the repair works be carried out in the period from early April to the end of October (except in the period of high summer temperatures) when the expected temperature corresponds with the specified one so as to avoid low-quality works.

# VOLUME 3.3

## TECHNICAL SPECIFICATIONS - ELECTRICAL WORKS ON REHABILITATION OF HYDRO COMPLEXES KLEK

### GENERAL PROVISIONS

Pursuant to the ToR, and based on the bases and data from the construction and mechanical designs, the following parts of the complex are developed under this design of electrical installations for the **Rehabilitation of Klek hydroengineering complex**:

Ancillary facilities:

- Technical building;
- Lighting of hydraulic power system;
- Marking of waterways;
- STS power facility.

The following electrical installations are described:

- Measuring point cabinets (MPC), main distribution cabinets (MDC) and distribution cabinets (DC) of sub-distribution for the supply of consumers;
- Interior installations of general electrical lightning;
- Exterior installations of electrical lightning and light signals of hydraulic power system;
- Installations of "panic" lighting on main communications and exits;
- Installation of mono-phase and three-phase Schuko sockets;
- Installation of earthing, potential equalization and lightning protection of buildings.

The technical solutions envisaged by this design are in compliance with the valid SRPS, IEC and ISO standards, other applicable technical regulations for this area and good engineering practice.

### DESCRIPTION OF CURRENT CONDITION OF POWER INSTALLATIONS OF THE HYDRO-TECHNICAL COMPLEX

#### Technical building

The building was built at the beginning of the twentieth century. It remained unchanged until present, except that electrification of the building was carried out in the mid-1970s. The power supply of the consumers in the facility is provided through two metering-distribution cabinets, MDCs, equipped with fuses, faulty current protection switches and measuring groups for metering of power consumption, situated on the facade of the facility. The metering-distribution cabinets MDC-1 and MDC-2 are supplied through self-supporting cable harnesses from the pole-mounted substation STS 10/0.4 kV/kV, 50kVA, from the low voltage distribution cabinet, through the three-phase roof carrier on the residential building. The electrical installation of the building was maintained only in the part of the building that was used as an office, and only within the scope of regular maintenance. It is necessary to replace the complete cable distribution and adjust the installation to the actual needs of the users in the building. Electrical installation equipment is partly broken, worn out, and its complete replacement is necessary. Existing lights in the building are of poor lighting characteristics, defective, unsafe and need to be completely replaced. There is a classical lightning installation on the facility in the form of a Faraday cage, with two down lead conductors and metering points, that is out of function.

#### Lighting of hydraulic power system

The hydraulic power system lighting is carried out on the right side of the river Begej bank, with one lighting pole between the facilities on the hydraulic power system and the ship lock, with twelve light poles equipped with lamps with sodium high pressure lightbulbs. The supply cables of light poles, downstream from STS – 9 pieces, were replaced in 2015 with PP00 4x4mm<sup>2</sup> cables.



### **Marking of waterways**

Marking of waterways has not been installed.

## **NEWLY DESIGNED INSTALLATIONS**

### **Technical building**

#### **Building power supply**

The basic power supply of the building will be provided from the public electric distribution network of medium voltage (20/10kV/kV), from the pole-mounted substation 20/10/0.4 kV/kV/kV, with the power of 50kVA.

Main distribution cabinet MDC is supplied through the cabinet of the metering point, situated on the facade of the residential facility. The metering point cabinet is supplied from LV cabinet with STS power cable of PP00 4x16mm<sup>2</sup> type.

The measurement of the power consumption is provided by existing, three-phase active electronic metering device that shall be located in a new standard metering-distribution cabinet.

#### **Distribution cabinets**

The main distribution cabinet MDC (power supply from MPC) is located in the building and it supplies all consumers in the building.

The cabinet housings are made of polyester, in IP54 protection.

#### **Electrical installations of interior lighting**

The present design of the administrative building reconstruction of the hydroengineering complex in Klek foresees the dismantling and replacement of existing worn-out lamps and installation switches with new ones.

The lighting of individual rooms is envisaged by means of adequate installation of lighting points with above-fitted fluorescent lamps. In the ancillary rooms, lamps with bulbs with wire filaments and fluo compact are envisaged.

Lighting installation is performed by cables of type N2XH 2,3,4 x1.5mm<sup>2</sup>, in the wall and ceiling, under mortar.

Activation of the lighting is by means of a single-pole installation switch of "in wall" type.

For panic lighting of escape routes and exits, the lamps with their own source of power supply (Ni-Cd batteries), automatic charging and automatic switch-on in the event of a power outage shall be foreseen. These lamps are above fitted with a 1x8W bulb, autonomy 3h, similar to the type BPN P 108, IP40, Buck. The installation of panic lighting provides passage of communications to the exit from the building, in case of a need for evacuation and voltage failure, and they should be provided with stickers with direction markings to the nearest exit and exit signs.

#### **Electrical installations of sockets and plugs**

The present design of the administrative building reconstruction of the hydroengineering complex in Klek foresees the dismantling and replacement of existing worn-out lamps installation sockets with new ones. The sockets have been selected and fitted according to the conditions of the site where they are being mounted.

Electrical distribution for the purpose of installation of mono-phase sockets is foreseen by means of cables of type N2XH 3x2.5mm<sup>2</sup>, placed in the wall, under the mortar.

Electrical distribution for the purpose of installation of three-phase five-pole sockets is foreseen by means of cables of type N2XH 5x2.5mm<sup>2</sup>, placed in the wall, under the mortar.

The sockets are installed at a height of 0.5m from the floor level.

#### **Lightning protection of facilities**

The existing lightning installation of the administrative building will be disassembled during the reconstruction of the roof covering, roof structure and facade, and the design foresees its complete replacement.

The new lightning installation has been implemented in accordance with PTN 11/96 and valid SRPS standards for this type of works. In order to protect the buildings from lightning, a protection levels has been selected in advance according to SRPS IEC 1024-1-1, and for the adopted level of protection, a lightning protection installation consisting of an earthing system, a system of down lead conductors and a reception system has been designed.

#### Earthing system:

A standard lightning installation has been designed for the building with the following characteristics: for accepting the lightning electricity discharge, a ground ring made of galvanized steel strip Fe-Zn 25x4mm steel strip, which is laid in a trench, at a distance of 1.5 m from the building and at a depth of 0.8 m is foreseen. This type of earth electrode is of type "B" according to IEC SRPS 1024-1, point 2.3.3.2 .. The manufacturing of ground wires from the earth electrode to the test joint and metallic components is envisaged by the Fe-Zn 25x4mm band, and the joints of the earth tape and ground wire are fitted by standard cross-run clamps in the ground, which are filled with bitumen.

#### The system of down lead conductors:

Four down lead conductors have been provided for the routing of the lightning discharge. The down lead conductors are fitted with galvanized Fe-Zn 20x3mm band, on adequate supports, across the facade of the building. At the very end of a vertical lightning conductor, down lead, and at a height of 1.75m from the ground level, a measuring joint is fitted according to standards and norms, overlapping, and this point is to be secured by a cross-run plate of type P SRPS N.B4.936. At the bottom, towards the earth electrode, an earth leakage is used, a steel galvanized strip Fe-Zn 25x4mm, length 4.5m. A ground wire strip (P 25x4 SRPS N.B4.901 Č) to the level of the measuring joint on the facade of the building shall be mechanically protected by a galvanized section A 40x40x 51500 SRPS N.B4.913 P.

#### Reception system:

For the reception system lightning protection installations, the natural components of the steel galvanized sheet with more than 0.5mm thickness are partially used, and partially galvanized Fe-Zn 20x3mm strip for the hills and slopes of the roof on the adequate supports at a distance of 1m between each other. The joints of the reception system strip are fitted with standard cross-run clamps. The width of the reception system installation mesh sieve is in accordance with the general requirements of SRPS IEC 1024-1.

### **Protection against electric shock**

Power supply system in terms of earthing (JUS N. B2.730) is TN-C-S. The functions of neutral and protective conductors is only integrated in the part of the system to the main power supply points, and further down it is separated throughout the installation. All built-in equipment shall comply with the standard SRPS N.B2.741 in regards to the protection against direct contact and with other standards that apply to that type of equipment.

Protection against electric shock is provided by automatic power outage in case of failure, by means of the prescribed protection devices of the differential current ZUDS according to SRPS N.B2.741. The zinc-coated strip Fe-Zn 25x4mm is supplied to the main GPU earthing terminal, in a standard box, with the SIP bus mounted at the MPC.

The main potential equalization is provided by connecting all metal components of non-electrical installations at the entrance to the building, by P-Y 1x16 mm<sup>2</sup> conductor and adequate bonding material.

After the completion of the works, the contractor shall perform measurement of grounding resistance, loop resistance and check the continuity of the protective conductor on all protected circuits and shall perform the equipotential check.

### **Selection and placing of electric equipment**

All electric equipment was selected in accordance with the requirements of SRPS N.B2.751 standard, depending on the external impacts defined in preceding items and according to SRPS N.B2.730 standard, in line with the architectural-construction design.

The selection of the type of power distribution was made in accordance with SRPS N.B2.752 standard, and, in this case, it is BD2 in halogen-free version for electrical installation, i.e. the installation that does not release poisonous fumes in case of fire.

The areas in which water bursts are expected to occur according to AD3 impact class possess the equipment of at least IP X3 protection degree for premises where water jets according to AD5 class are expected, with the protection of IP X5 class at least, according to standard SRPS N.A5.070.

### **Type of distribution system**

TN-C/S power supply system with earthing is envisaged as the type of distribution system, so that the protection from indirect contact is provided with the automatic switching off of power supply with the application of a special protective line, i.e. protective earthing.

In addition, a measure of additional potential equalisation is envisaged also for all metal masses in the facility and in the sanitary blocks, with the central rail for potential equalisation, connected to the earthing of the facility.

Envisaged as an additional protection of the socket and lighting installations from indirect contact is the faulty current protection switch SZS x/0.3A.

### **Selection of cables**

Cables selected according to permanently permitted currents in accordance with the provisions of SRPS N.B2.752. for the type of distribution according to the place of installation are A1,D1,J, namely, tables of correction factors for certain type of distribution.

### **Maintenance**

Regular maintenance, including periodical inspections, examinations and repairs of all installations and equipment according to the instructions of the manufacturer is required within the given endurance period. It is necessary to periodically check the efficiency of protection measures for safety within the established endurance and to check the reliability of the equipment through which the proper operation of the installation is provided, determined by endurance.

Maintenance works shall be carried out by persons competent in the works in question.

## **DISTRIBUTION OF ELECTRICAL INSTALLATIONS**

The high voltage installations in the facility are distributed in the wall and dropped ceiling through installation pipes.

The distribution cabinet and concentration of all installations are placed at the entry area of the facility.

### **POWER SUPPLY**

The power supply of the facility from the existent metering point is regulated through a project prepared by Hidroprojekt Zrenjanin doo.

The connection of the power supply cable with MPC on the facade of the facility and further to the MDC location should be carried out with the cable of N2XH 5x10mm<sup>2</sup> type.

### **Overall network supply of the facility**

Total installed power  $P_i = 22.2 \text{ kW}$ ,  $k_j = 0.5$   $P_{jm} = 11.1 \text{ kW}$

Power supply characteristics are: three-phase alternating current, frequency 50 Hz, rated voltage 3x400/230 V. Distribution system, as regards protection and earthing is TN-C/S system.

## **DISTRIBUTION CABINETS - Main distribution cabinet MDC**

Main distribution cabinet is a built-in distribution panel with IP 40 protection with door. It should be mounted in the entry hallway, at the place shown in the graphical documentation. The cabinet is envisaged for the installation of 36+6 modules.

Automatic switches, whose characteristics are given in the graphical documentation and the Bill of Quantities and price calculation, should be mounted in the cabinet for the protection of certain terminals from overload and short-circuit currents. 4-pole differential circuit-breaker 40/0.3 A should be installed in MDC for protection from accidental contact with parts under voltage.

MDC should be equipped with buses for neutral and protective line.

## **LIGHTING INSTALLATION**

General indoor and anti-panic lightings are envisaged. General lighting shall have built-in and surface-mounted LED lamps.

Indoor general lighting is turned on with installation surface-mounted switches and dimmers mounted at the height of 1.5 m from the finished floor.

Anti-panic lights are planned to be installed at all exits from the facility. Safe movement and abandonment of premises in the event of power interruption are thus secured. Anti-panic lights feature autonomous reserve battery supply and 2h autonomy in operation.

The general and anti-panic lights should be installed with cables of N2XH 2 i 3x1.5 mm<sup>2</sup> type.

## **INSTALLATION OF SOCKETS AND PLUGS**

Envisaged for the facility is the installation of single-phase sockets of general purpose and single-phase, specific purpose outlets. All single-phase sockets are of module, built-in type.

Single-phase sockets should be mounted at the height of 0.4m except on locations with the heights indicated in the graphical document.

Operating, single-phase sockets in the kitchen should be mounted at the height of 1.1 m.

Power supply of single-phase sockets and single-phase specific-purpose outlets should be done with cables of N2 XH 3x2,5 mm<sup>2</sup> type.

## **PROTECTION**

The protection of cables from overload and short circuits is secured with fuses and automatic circuit breakers, with dimensions in accordance with the cross section, type and manner of cable laying, in accordance with SRPS N.B2.752 standard.

The protection from indirect contact is provided in accordance with the Rulebook on technical norms for low voltage electrical installations (Official Gazette of SFRY, number 53, dated 02.09.1988), by protective device turning off within the prescribed interval (TN - C - S system).

An additional protection from indirect contact is provided by the automatic power switching off by application of the differential protective current 40/0.3A.

The internal electric network shall be built in TN-C-S system, so that the protection from indirect contact is provided with the automatic switching off of power supply with the application of a special protective line, i.e. protective earthing.

In addition to this, the measure of additional potential equalisation is applied also, for all metal masses, through the connection with the protective earthing of the facility.

## **FINAL REMARKS**

The Contractor shall carry out all works according to the effective technical regulations engaging competent workforce. They are obliged to inform the Supervisor, i.e. the Investor on all potential faults and mistakes in the project. At the very location, the works on electrical installations have to be carried out so that they are harmonised with other installations and construction works, as regards the functioning, space and time (according to the dynamics of works).

All used materials must be in accordance with SRPS, EN and IEC standards and have to be inspected before installation and only whole new elements can be installed.

The Contractor is obliged to inspect the whole installation, carry out the required measurements, providing relevant certificates, and perform all tests of correct functioning with the required setting and regulation.

## **INSTALLATIONS IN TECHNICAL BUILDING**

### **TECHNICAL DESCRIPTION**

Upon the Investor's request the Main design for the rehabilitation of the technical building in Klek has been developed, cadastral lot no. 643/2 C.M. Klek. According to the Investor's ToR, the rehabilitation includes the internal ground part of the facility.

The facility is registered at the Real estate as a building for water management purposes cadastre, with the surface of 158m<sup>2</sup>. There are also other facilities intended for water management purposes at the lot. The lot size is 9,258.00m<sup>2</sup>, while the total size of the facility is 361.00m<sup>2</sup>, so that the floor area of the lot is 3.90%.

The facility comprises only a ground floor. There is a basement under a part of the ground floor. It is of rectangular shape, dimensions 14.47m x 11.22m. The roof is gable, with interlocking tiles.

The structure contains one larger premise, an office, a male and female sanitary block and accompanying rooms. The conference room is organized with two chairs for the lecturers. The space for the participants is arranged in the rows. For the purpose of organizing a different kind of lectures, additional folding tables are also planned that will be stored in the basement. Wardrobe on the north wall of the conference hall is planned for the placement of clothes. The darkening of the hall is provided by the inner wooden folding curtains.

The free walls between the windows and doors are designed for the installation of exhibiting of the museum pieces so that special lighting is provided for these walls.

Office space also serves for the door keeper's stay at the regular use of the building as well as for the usual administration.

The kitchen is provided as a kitchenette for the preparation of the usual beverages and as a distribution kitchen in case of serving meals when the food is brought by the catering.

Sanitary blocks are retained in the existing positions, but completely redesigned.

The project includes the rehabilitation of all electrical installations of the facility. Works on repair of remaining parts of the roof, basement and facade are envisaged within the Main Design for repair of the hydro-technical complex Klek, made by Hidroprojekt Zrenjanin doo, in February 2016.

### **ANTI-BURGLARY SYSTEM**

The role of the envisaged anti-burglary system is to secure all premises of the facility and automatically inform competent persons in case of unallowed access. The base of the system comprises the central unit and peripheral elements. The central unit is placed in the technical premise. 8 IR movement detectors, placed in the facility, are connected to the central unit. Placed in the main entry hallway is the keypad with LCD display through which the system is directly activated and deactivated. The system condition control, activation and deactivation can be done remotely, as well, through phone line (GSM) or through TCP/IP protocols (local computer network or internet). In the case of alarm, the executive functions of the system are the activation of the sound and light signalisation, as well as the automatic notifications to competent persons through GSM network and/or internet.

### **FINAL REMARKS**

The Contractor shall carry out all works according to the effective technical regulations engaging competent workforce. They are obliged to inform the Supervisor, i.e. the Investor on all potential faults and mistakes in the project. At the very location, the works on electrical installations have to be carried out so that they are harmonised with other installations and construction works, as regards the functioning, space and time (according to the dynamics of works).

All used materials must be in accordance with SRPS, EN and IEC standards and have to be inspected before installation and only whole new elements can be installed.

The Contractor is obliged to inspect and test the whole installation, to conduct the required measurements, providing certificates and perform all tests of proper functioning, along with the required adjustments and regulation.

## **Lighting of hydraulic power system**

### **Lights**

The lights intended to replace the existing ones and for the lighting of the hydraulic power system are light for urban surroundings with aluminium alloy housing under pressure, protector and polycarbonate cover, mirror electropolished and anode protected aluminium high-purity and control gear, of the type K-LUX/1640/100 MINEL SCHREDER, with high pressure sodium lamp 100W, 230V, 50Hz, under protection IP66 and IK09.

The passage under the bridge is lit with the surface-mounted lamps of TITAN BS103, BUCK, 1xT26 36W, G13, IP65, 230V type, two of which are placed on both sides of the bridge.

### **Light poles**

Replacement and installation of conic light poles, 4m high, Ø60mm on pole top with the base of min. 400x400x10mm, with Ø90mm opening, protected by warm internal and external zinc plating and additional anti-corrosion protection up to 40cm above the foundation base is foreseen. The pole shall be equipped with:

- carrier and connection panel RPO-4;
- fuse FRA 16/6A or automatic switch B 6A, 1 piece;
- power supply cable for lamp PP00-Y 3x1.5mm<sup>2</sup>, 4m;
- zinc bolt for earthing and inside the pole and on the pole;
- cover with a red arrow (lighting symbol);
- protection of connection area from rain and
- ordinal number of the pole.

### **Power supply cables**

The installation of the lighting on the hydraulic power system will be supplied by power provided from the public electric distribution network of medium voltage (20/10 kV/kV), from the pole-mounted substation 20/10/0.4kV/kV/kV, with the power of 50kVA.

The controls for lighting the hydraulic power system are present and are situated in the low voltage distribution cabinet of the pole-mounted substation.

The power supply cables of the light poles which have not been repaired, i.e. replaced in 2015 (poles with S10.L; S11.L and S12.L marks) are of PP00-Y 4x4mm<sup>2</sup> type, per input/output principle.

The cables for outdoor lighting are laid in a cable trench measuring 0.4 x 0.8 m. At crossing points with other installations, it is envisaged to lay protective PVC pipes in advance. The pipes are of nominal diameter Ø50mm.

Protection against direct contact voltage is carried out in such a way that all live parts are in the pole, on an insulated panel or in a lamp that is positioned at such a height that it can not be reached by unauthorized persons.

On the pole there is an aperture for the connection to the connection board, which is closed by a sealed cover. The cover is fixed with a cap screw.

Protection against indirect contact voltage is foreseen by the same system as for the entire complex.

Additional lightning protection is foreseen. The Fe/Zn 25x4mm strip shall be laid in the same trench, parallel to the cables of the exterior lighting.

## **Marking of waterways**

### **Traffic lights**

Traffic lights signalization is foreseen in accordance with applicable regulations on inland waterways navigation. It consists of optical signals formed by red and green lights. It is implemented with input and output traffic lights, one per each unit. The traffic lights consist of a single two-part driver lantern. A two-part lantern consists of one red and one green light.

### **Traffic lights pole**

Traffic lights are fitted on the pole, 3.2m high, Ø60mm on pole top with the base of min. 400x400x10mm, with Ø90mm opening, protected by warm internal and external zinc plating and additional anti-corrosion protection up to 40cm above the foundation base.

### **Power supply cables**

The basic power supply will be provided from the public electric distribution network of medium voltage (20/10kV/kV), from the pole-mounted substation 20/10/0.4kV/kV/kV, with the power of 50kVA. The traffic light distribution cabinet is powered from the low voltage distribution cabinet of the pole-mounted transformer substation, through PP00-Y 3x2,5mm<sup>2</sup> cable. The housing of the distribution cabinet is made of steel sheet metal protected with anti-corrosion paint. The housing has a door, lock and a key. Envisaged in the cabinet is the construction for carrying equipment made of perforated profiles. Placed above the equipment is a protective plate.

According to the design, the traffic lights at the upstream and downstream entrance into the ship lock shall be manually operated, with a switch, from the distribution cabinet DC-Semafor.

The cables for the power supply of traffic lights are laid in a cable trench measuring 0.4x0.8 m. At crossing points with other installations, it is envisaged to lay protective PVC pipes in advance. The pipes are of nominal diameter Ø50mm.

Protection against direct contact voltage is carried out in such a way that all live parts are in the pole, on an insulated panel or in a the traffic light that is positioned at such a height that it cannot be reached by unauthorised persons.

On the pole there is an aperture for the connection to the connection board, which is closed by a sealed cover. The cover is fixed with a cap screw.

Protection against indirect contact voltage is foreseen by the same system as for the entire complex.

Additional lightning protection is foreseen. The Fe/Zn 25x4mm strip shall be laid in the same trench, parallel to the cables of the traffic lights.

### **Pole-mounted substation STS 10/0.4 kV/kV/kv, 50kVA**

The hydro-technical complex will be supplied by power from the public electric distribution network of medium voltage (10 kV), from the pole-mounted substation 10/0.4 kV/kV, with the power of 50kVA.

Judging by its condition, no investments have been made in the energy facility for a long period of time. Revision of the transformer station should be carried out for the purpose of the regular operation of the pole-mounted substation and regular and continuous supply of electric power. Based on the revision a complete report will be prepared with expert findings and with the measures required for rehabilitation of equipment.

Works on the revision of the energy facility would include the following:

#### **1. Inspection obligation**

Rulebook on technical norms for operation and maintenance of electric power facilities and lines (Official Gazette of SRY 41/93).

#### **2. Manner of inspection**

- 1) Rulebook on technical norms for electric power facilities with nominal voltage over 1000V (Official Gazette of SFRY 4/74);
- 2) Rulebook on technical norms for fire protection of electric power facilities and devices (Official Gazette of SFRY 74/90) and
- 3) Rulebook on technical norms for electric power facilities with nominal voltage over 1000V (Official Gazette of SFRY 61/95) and
- 4) Rulebook on technical norms for protection of low voltage networks and accompanying transformer stations (Official Gazette of SFRY no. 13/78 and Official Gazette of SRY 37/95)

# VOLUME 3.4

## TECHNICAL SPECIFICATIONS AND TECHNICAL REQUIREMENTS – MECHANICAL WORKS KLEK SHIP LOCK AND FLOODGATE

### 3.4.1. TECHNICAL DESCRIPTION

#### SHIP LOCK

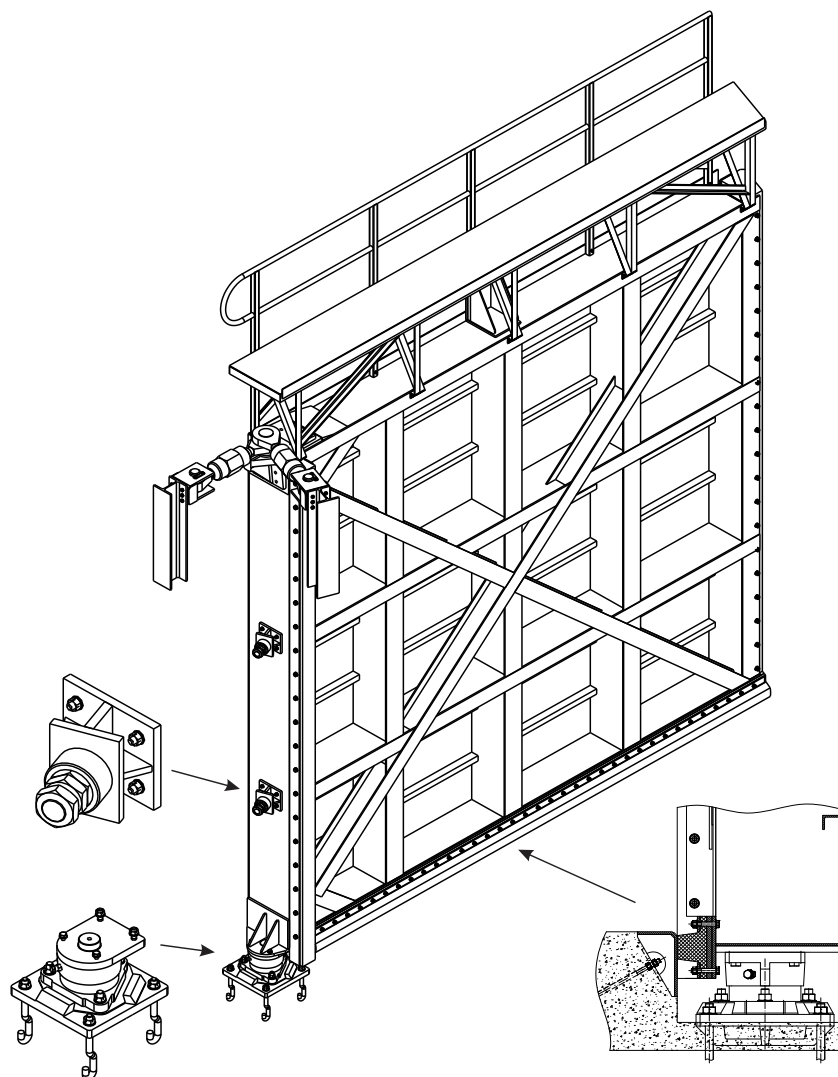
##### Upper door

Based on the inspection of the doors, detailed visual inspection and measurements on the part of the equipment and the structure that is located above the water level, it can be concluded that the steel stop logs plates (formwork) and the supporting structure have corroded only partially and, based on the assessment of the condition of the part of the structure, that the doors could be repaired without the necessity to manufacture new ones, though the final decision is to be made after the equipment underwater has been inspected.

The loadbearing structure consists of standard sections lined on one side with steel stop logs. The sections of the loadbearing structure and steel stop logs are to be connected by welding. This is the way to keep the same visual appearance of the doors. The upper door is defined in Drawing No. PUK-1.01.01.00.00

Vital changes to the existing solution refer to the changes of the upper and lower bearings, the method of door support in the niches, the niches themselves which have been adapted to the new support and sealing, the threshold structure, horizontal sealing (rubber instead of oak beams). All these changes have either no or negligible effect on the visual appearance of the new doors, compared to the existing doors, Figure 1 **Error! Reference source not found.** All these changes have either no or negligible effect on the visual appearance of the new doors, compared to the existing doors.





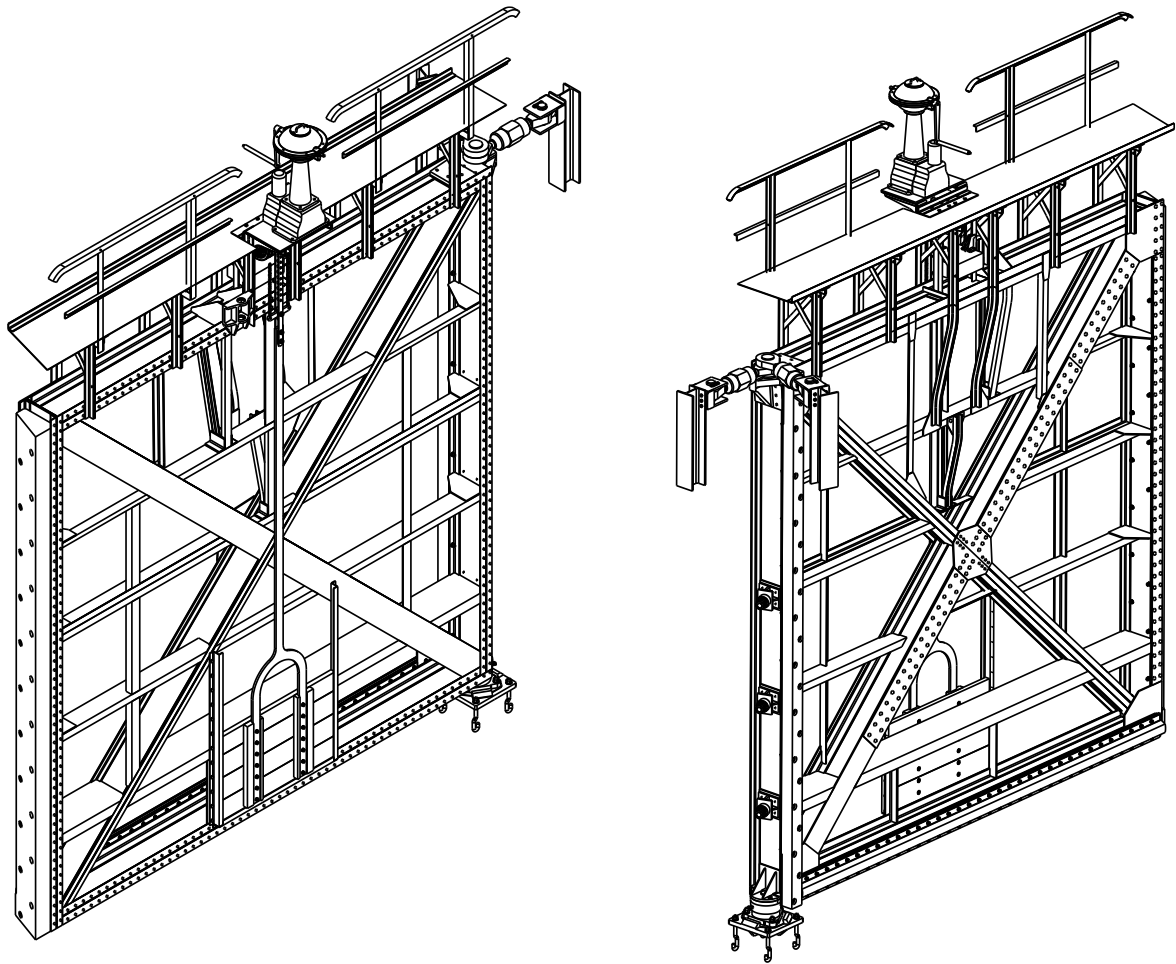
*Figure 1: Review of the basic upper door elements*

### **Middle door**

Based on the inspection of the doors by detailed visual inspection and measurements on the part of the equipment and the structure that is located above the water level, it can be concluded that the sheets (formwork) and the supporting structure have visibly corroded and based on the assessment of the part of the gates under the water it is necessary to manufacture a new door.

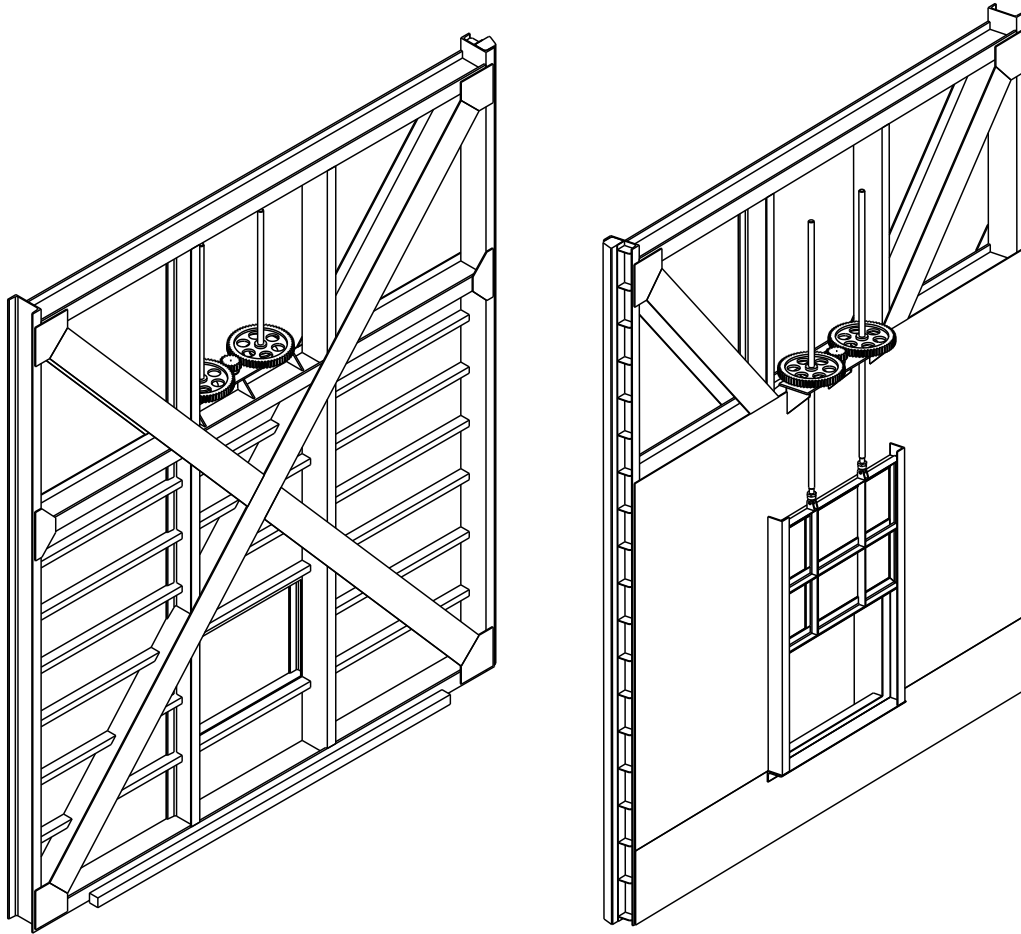
The new door is to have the identical geometric shape as the existing door. The loadbearing structure consists of standard sections lined on one side with steel stop logs. The sections of the loadbearing structure and steel stop logs are to be connected by welding. Where the existing solution has rivets in the visible part of the structure (above water), the connection is to be made by welding with high-quality setting (welding) of strips with rivets as a mask. This is the way to keep the same visual appearance of the doors. The upper door is defined in drawing no. PUK-1.01.02.00.00.

Vital changes to the existing solution include changes in the upper and lower bearings, the method of door support in the niches, the niches themselves, which have been adapted to the new support and sealing, the threshold structure, horizontal sealing (rubber instead of oak beams) and flashboards where sealing is done using rubber on a stainless steel strip, L-section supports, with oak board infilling, Figure 2. All these changes have either no or negligible effect on the visual appearance of the new doors, compared to the existing doors.



*Figure 1. Overview of the middle door leaf*

## **Lower door**



*Figure 3. Overview of the lower door leaf*

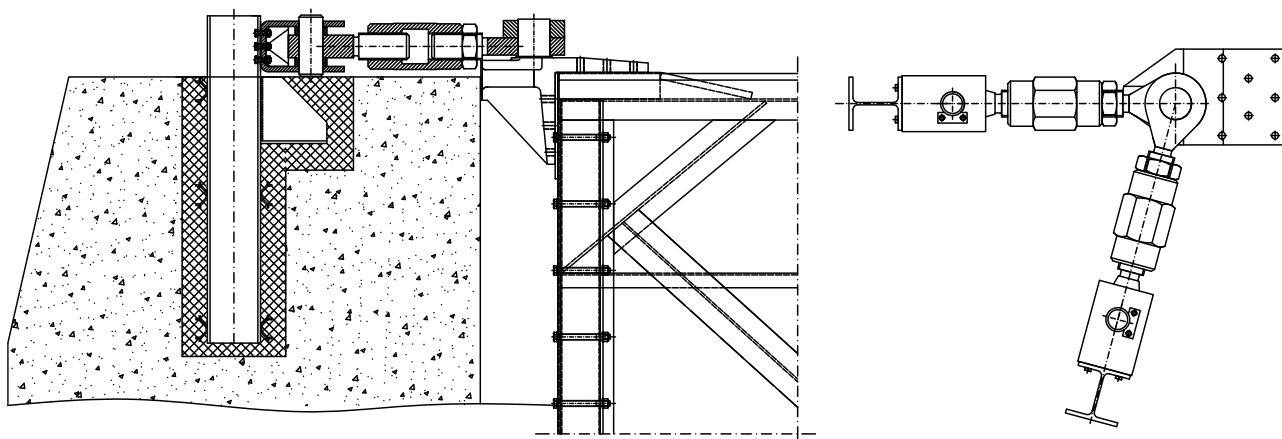
At the meeting held in Voda Vojvodine premises on 23 November 2018, it was concluded that in the future (forthcoming period), there will be no need for two-stage locks. Therefore, the lower chamber, and consequently the lower doors with the entire equipment, will stop being operational.

Therefore, both gate leafs and the associated equipment need to be dismantled and disposed at a suitable location in the ship lock area.

## **Upper bearing**

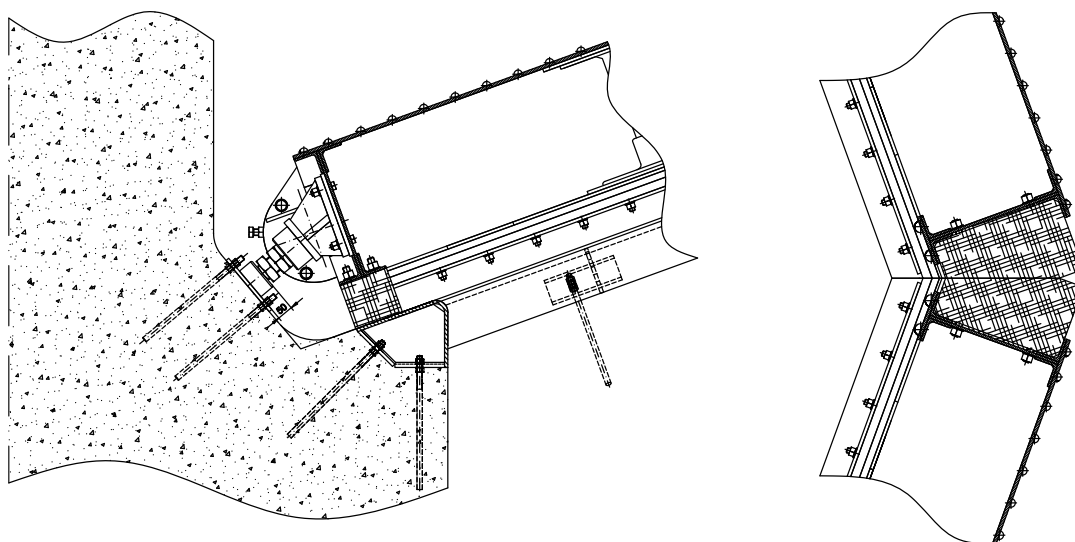
Due to the unification of the bearings on the hydromechanical equipment of the entire hydraulic engineering system, it is necessary to replace the upper and lower bearings on the upper and middle doors.

Figure 4 shows the solution ensuring adjustment of the position of the upper bearing shaft, and thus of the doors. The drawings showing the solution for the upper bearing of the upper and middle doors are presented in drawing no. PUK-1.01.01.02.00. The rotating axis of the door is to be adjusted by two braces placed at an angle. Turning of a nut with the left and right thread increases or decreases the space between the joint axis and tie shaft axis allowing the top point of the door shaft to move to the brace level.



*Figure 2: Upper bearing elements*

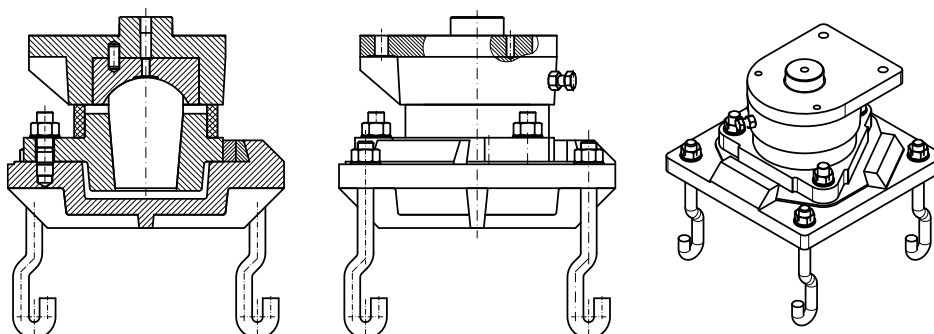
It should be noted that the application of this solution requires careful adjustment of the upper and lower bearings so as to ensure correct fitting of the support elements, arranged at the height of the side section of the doors in the niche, to receive lateral force when the doors are closed together with correct fitting of the vertical oak beams in the niche and between the doors that used for sealing. The solution for lateral supports in this design enables certain adjustment, which is much better than the previous method of door support in niches when the doors are closed. Figure 5 shows characteristic door alignment points.



*Figure 5: Characteristic door support and sealing points*

### **Lower bearing**

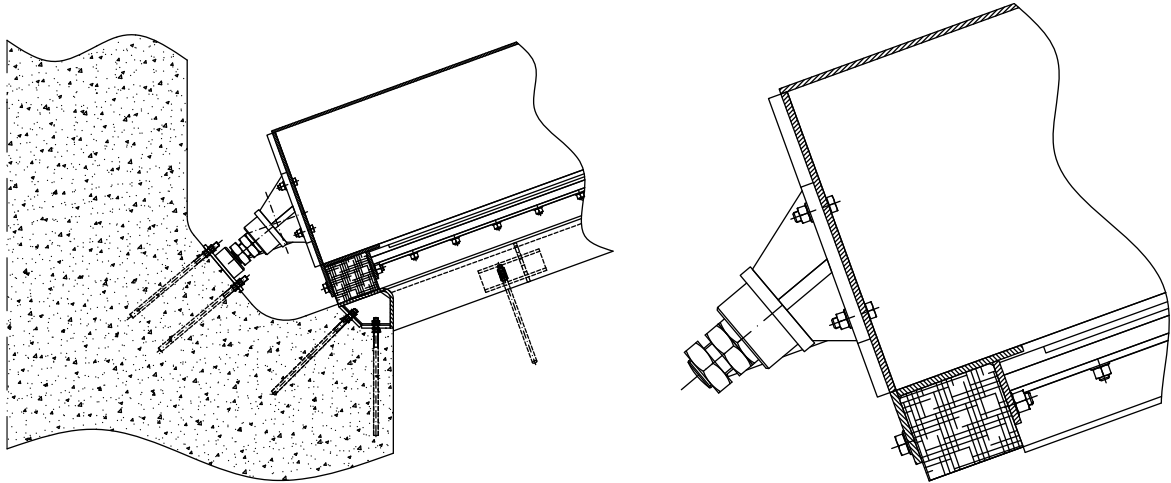
The existing lower bearings are to be replaced by the new solution (Figure 6), drawing no. PUK-1.01.01.03.00, applied at several ship locks with double-leaf doors within the competence of the PWMC Vode Vojvodine. The lower bearing may move partially in the horizontal plane and thus contribute to the adjustment of the support and sealing of the doors via the upper bearing. The use of new bearings with a modern structure does not interfere with the appearance of the double-leaf door, as they are always under water.



*Figure 6: Lower bearing*

### **Support and sealing elements in the door niche**

The existing doors receive horizontal forces (when the doors are closed) via oak beams onto the concrete. The leaning of adjustable lateral supports is applied instead of wood, as shown in Drawing No. PUK-1.01.01.00.00 and PUK-1.01.02.00.00. The solution does not affect the appearance of the gates, given that the supports are hidden in the door niche, both when the door leaves are open and closed. In addition, instead of sealing by having oak beams lean against the concrete, modern lateral sealing solutions involve leaning against stainless steel.

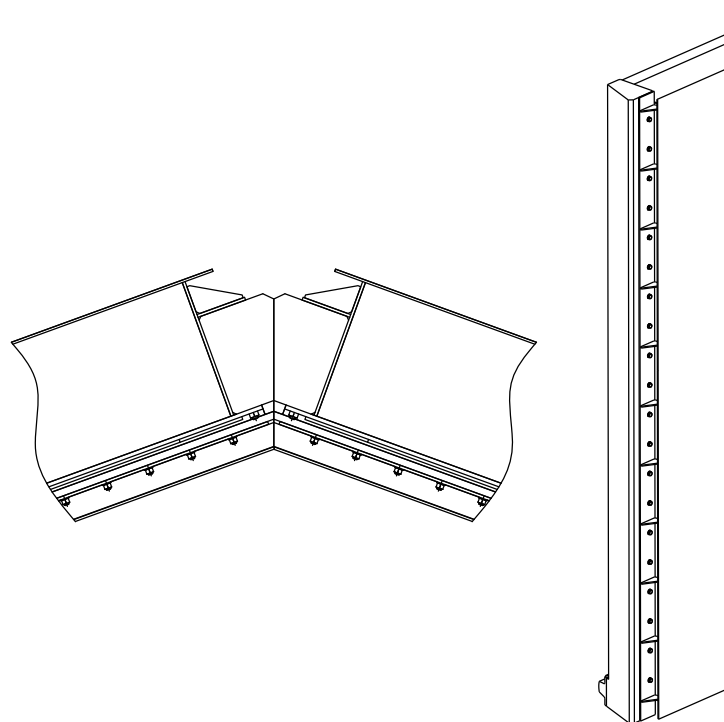


*Figure 7: Support and sealing in the door niche*

The existing lateral sealing in the door niche via an oak beam leaning against steel lining is to be kept.

### **Support and sealing between door leaves**

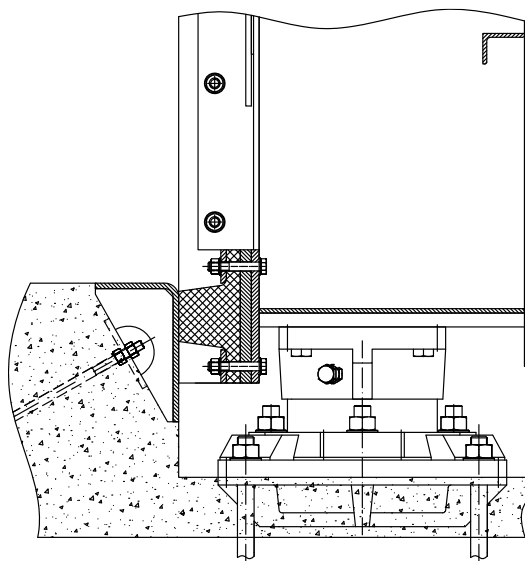
When closed, the door leaves are mutually supported via oak beams, Drawing No. PUK-1.01.01.00.00 and PUK-1.01.01.01.00. The existing solution for the mutual support and sealing of door leaves via oak beams is to be kept.



*Figure 8. Support and sealing between door leaves*

### **Support and sealing at the door threshold**

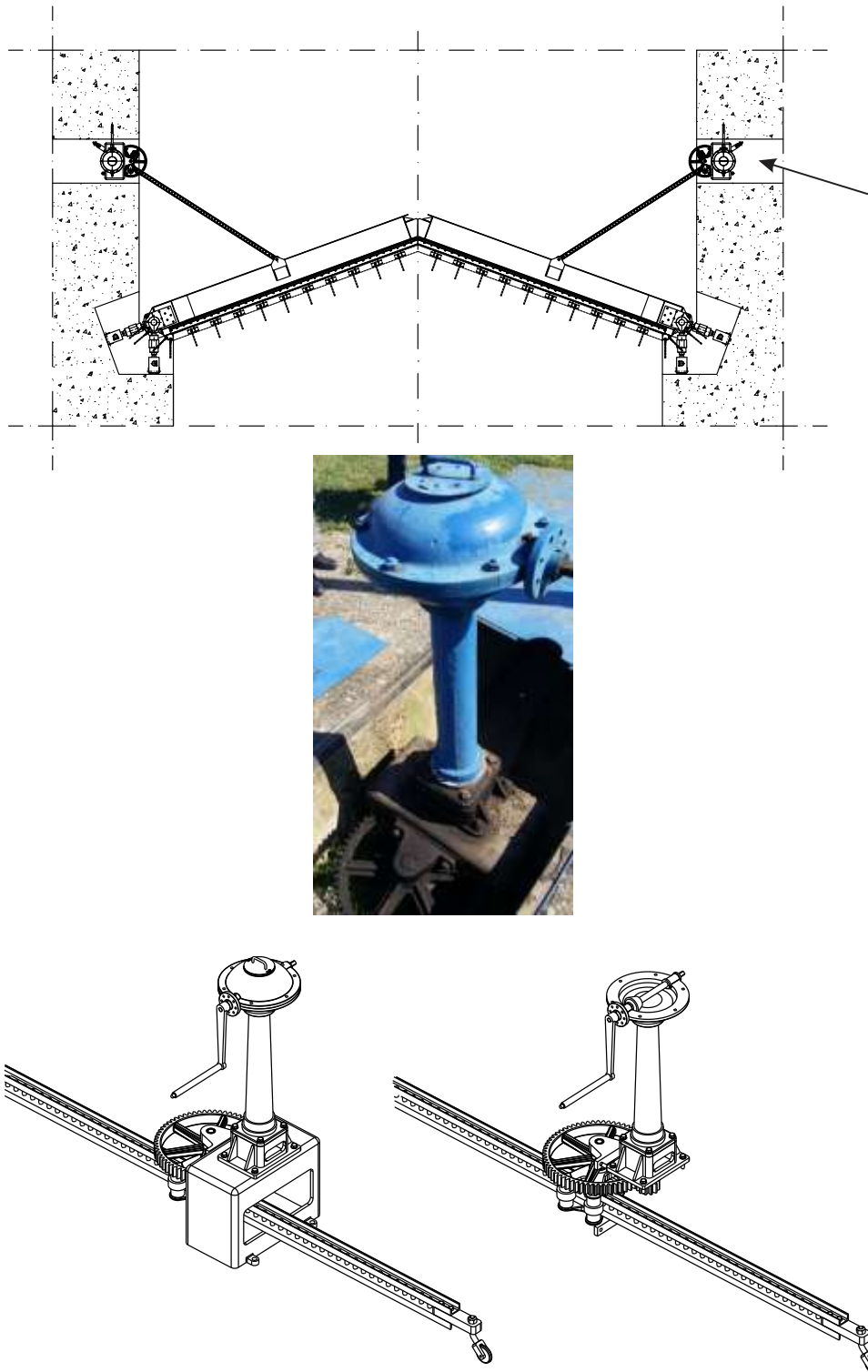
With the existing solution the forces are transmitted to the stop log threshold by leaning the beams against the threshold. These beams also have the role of gaskets. Given that this part of the door is always under water, sealing is possible by using structural rubber that can make high-quality connection with vertical oak beam seals on both lateral sides. The support and sealing solution for double-leaf doors is presented in Drawing No. PUK-1.01.01.01.00.



*Figure 9. Sealing elements at the door threshold*

### **Door opening and closing mechanism**

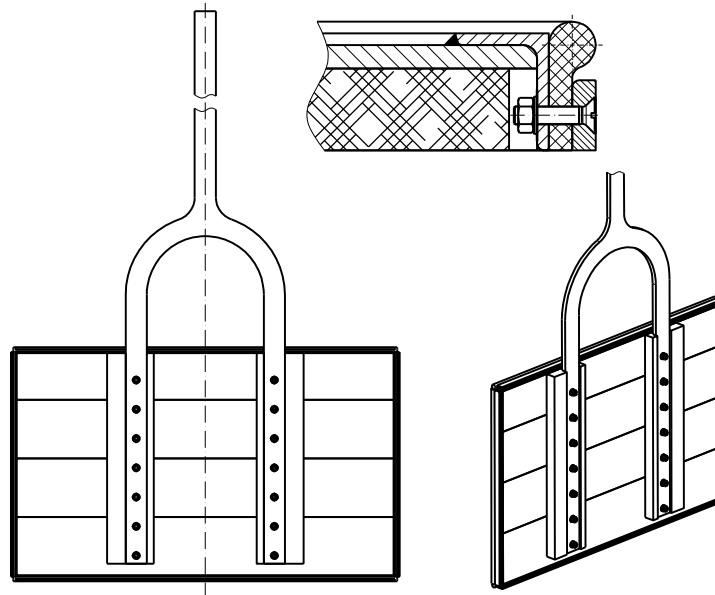
On the basis of detailed visual inspection and measurements it is concluded that the condition of the elements of the mechanism is satisfactory, so their repair is necessary (anti-corrosion protection of the supporting structures of devices and inspection, cleaning and greasing of the transmission mechanism). Since there is no technical documentation for the closing and opening mechanism of the doors, the existing mechanism has been measured and surveyed within this project and documentation has been made based on assembly drawings, No. PUK-1.01.01.04.00.



*Figure 10. Position of the door closing/opening mechanism*

### **Flashboards**

Dimensions of the flashboards will be the same as those of the existing ones. Instead of originally wooden flashboards, these will be a combination of an L-section frame with the filling made of oak boards, while the sealing is done using rubber onto stainless steel. The steel frame is filled with oak boards fastened by screws to the steel frame sheets on one side, and on the other, to the arms of the vertical bar for flashboard lifting, in the same way as in the case of the original solution. This is the way to ensure the same visual appearance and a considerably stronger and durable structure since oak boards are protected upon opening and closing of the flashboard. What may be the greatest advantage of the solution is the sealing made via the rubber note sliding along the segments of stainless steel. The figure shows details of the new flashboard.

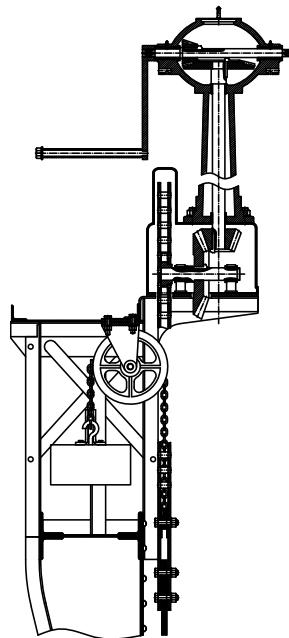


*Figure 11. The flashboard with guiding and sealing elements*

### **Lifting and lowering mechanism of the middle door flashboard**

As in the case of the mechanism for closing and opening the doors, due to the visual appearance, manual operation of the mechanism for lifting and lowering the door flashboards is to be kept.

As the new door leafs will be installed, it is planned to construct a new supporting structure for devices, counterbalance, toothed rack and gear levers. The inspection established that the condition of elements is satisfactory. Therefore, the transmission mechanism needs to be cleaned and greased and the bolts, nuts and washers need to be procured.

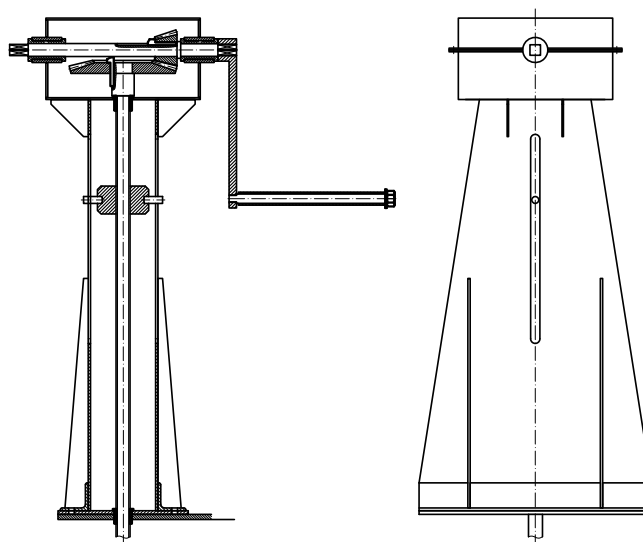


*Figure 12. Overview of the condition of the existing middle door flashboard lifting/lowering mechanism*

### **Lifting and lowering mechanism of the middle door flashboard**

As this door is not planned to be used in the future, the door should be dismantled and disposed next to the gate leaf.



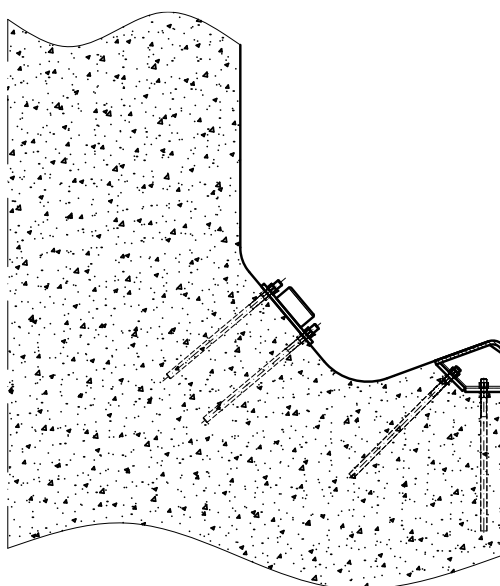


*Figure 13. Manually driven flashboards of the lower door lifting/lowering mechanism*

### **Door niches**

The existing niches should be adjusted to the new solution for the door support and sealing.

**NOTE:** The part relating to the concreting and connection elements (stalks, anchor bolts, concrete composition and method of installation) is to be defined by construction experts.

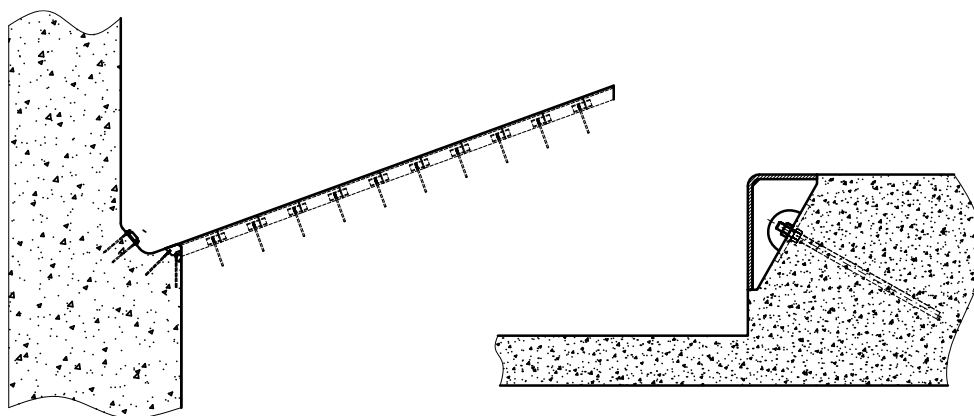


*Figure 14. Door niche details*

### **The door threshold**

The existing thresholds are flashed with steel sheet and are adjusted, with the new concreting, to the new method of horizontal door sealing.

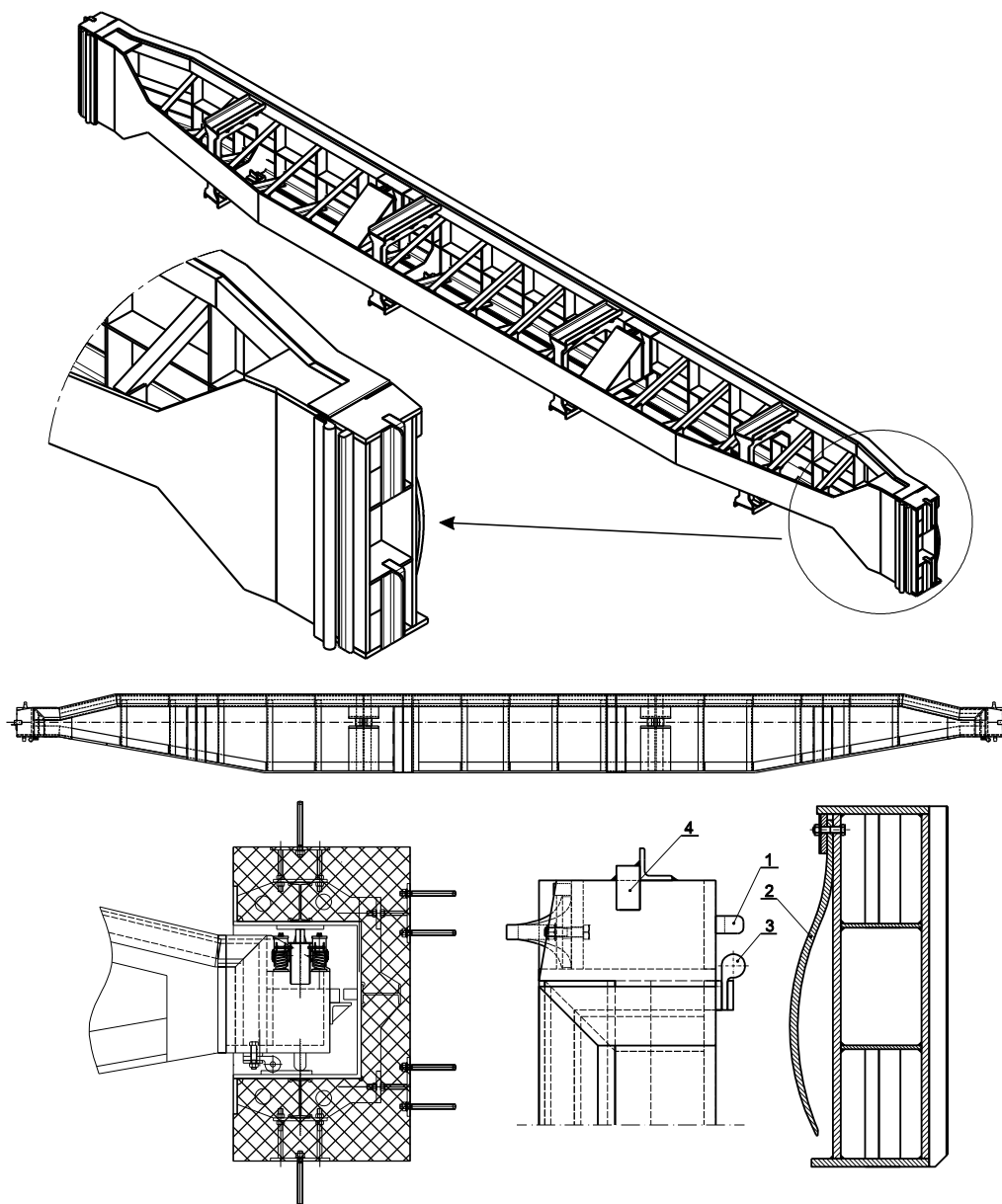
**NOTE:** As in the previous case, it should be noted that the part relating to the concreting and connection elements (stalks, anchor bolts, concrete composition and method of installation) is to be defined by construction experts.



*Figure 15. Door threshold details*

### **Stop logs**

The structure of the stop log is the same for all stop logs. Since the measurements upon the inspection were carried out at the level of the lock crown, the specified lengths are only approximate and need to be precisely determined upon equipment assembly, identifying possible deviations from the values specified here. Furthermore, it is necessary to determine the verticality of the stop log niches, i.e. their being parallel on the lateral ends of the lock.

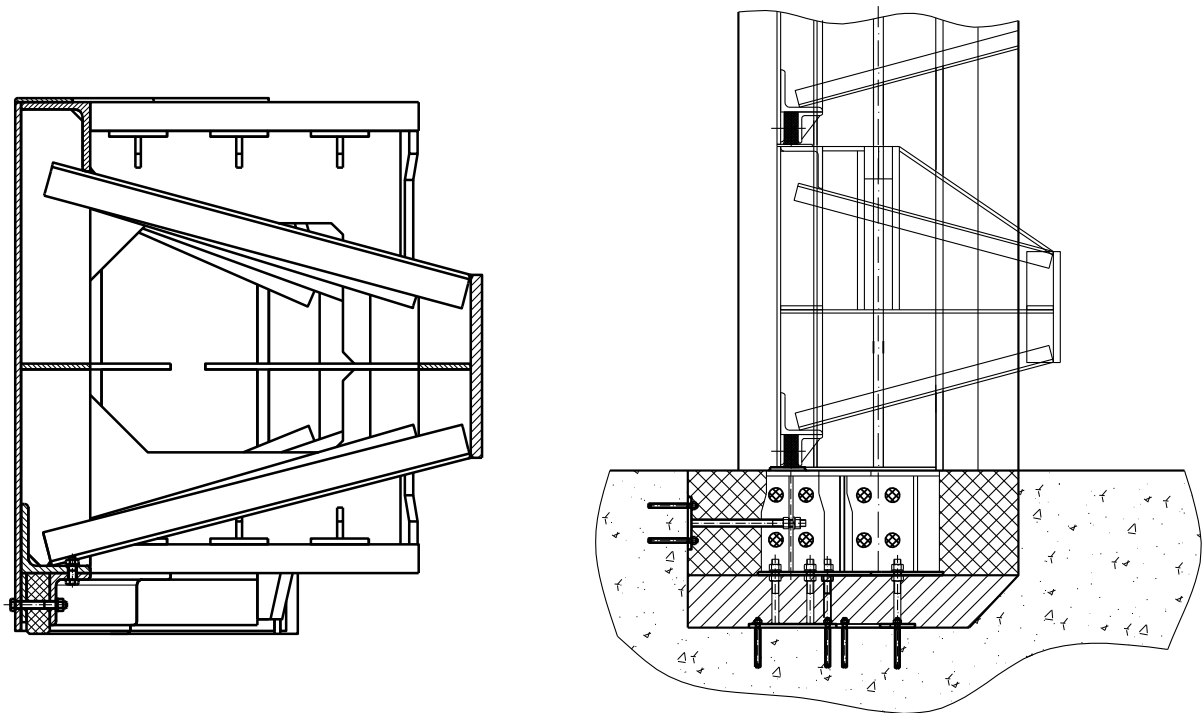


*Figure 16. Overview of the structure of the stop log boxes and the end of the seals with the elements for supporting and sealing in the niche.*

In order to ensure a proper support and guiding of the stop logs in the niche, the design includes, on one side, the support in the shape of a tongue made of thick sheet metal (item 1, Figure 16) welded onto the stop log box. Installation of new vertical rubber seals in the shape of a musical note, and also the elements to attach them to the steel structure are shown in Drawing No. PUK-1.01.04.01.00.

The new solution should ensure deformation of the seals under the impact of the hydrostatic pressure of water. To achieve this, it is necessary to have the support pressed against the stainless steel strip, which is possible to accomplish by the operation of a spring. The lateral pressure is possible to achieve in several ways. The leaf spring is selected as the solution (item 2, Figure 16 and drawing no. PUK-1.01.04.01.01).

In order to ensure good sealing on the threshold, i.e. the upper surface of the stop log in the area where the two support each other, the stainless steel strip is welded along the whole length of the stop log, with the strip providing good fitting of the lower structural rubber of the next stop log. This reconstruction should prevent beams to be directly supported by rubber gasket. Since stop logs support each other along a relatively thin edge, great precision is required to guide stop logs in the niche, which is achieved by means of the supporting tongue and spring, ensuring guiding in the direction of the lock, while lateral guiding is carried out by means of special stops on the stop log and the niche.



*Figure 17. Stop log cross section and position of one against the other*

This solution for a stop log requires a larger niche. It is, therefore, proposed that the reconstruction be undertaken as shown in Figure 18. As already noted, the reconstructed threshold and stop log niches in the support and sealing area should have stainless steel strips welded onto them.

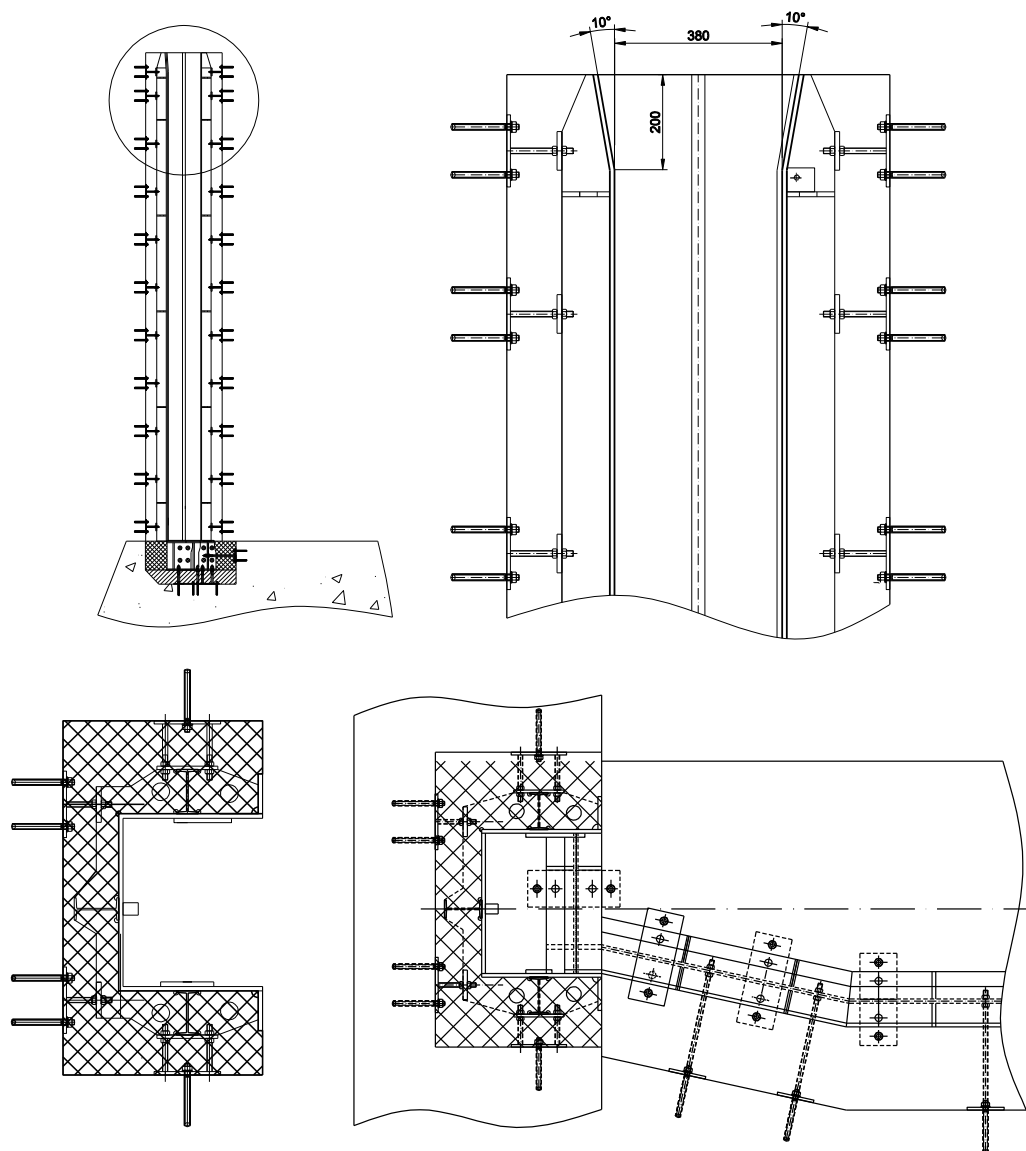
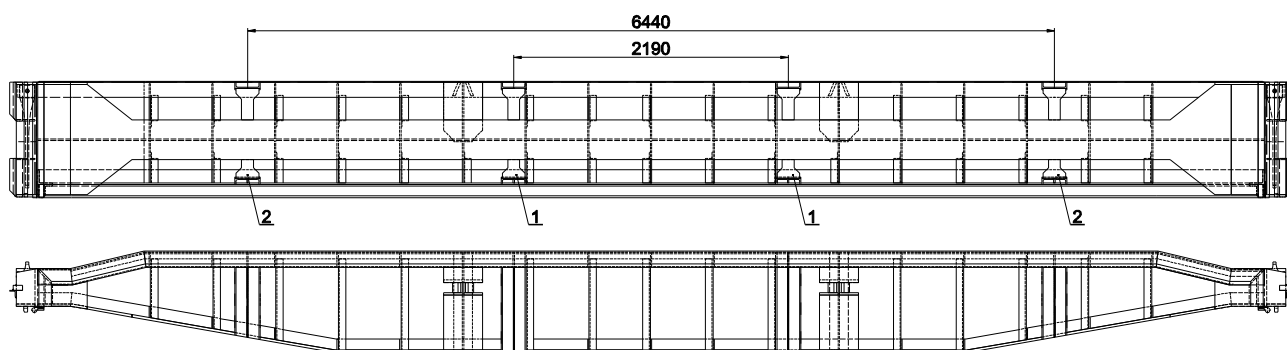
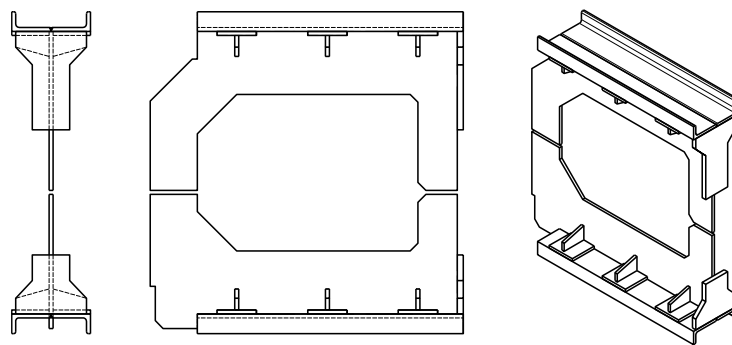


Figure 18. Stop log niches and threshold in the lock

For the purpose of ensuring proper storage of stop logs and protection of the structural rubber, U-sections with ribs are to be welded at four points of the structure, Figure 19, Drawing No. PUK-1.01.04.03.00 and PUK-1.01.04.04.00.



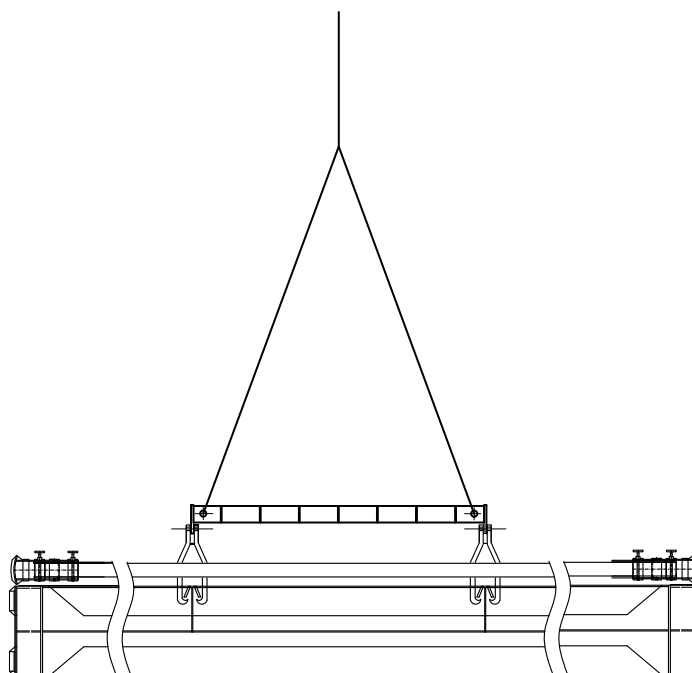


*Figure 20. Cross-section of the stop log in the area of semi-automatic tongs engagement and points of stop log support.*

**IMPORTANT NOTE:** Due to the conditions in which the measurements were carried out, upon disassembly of hydromechanical equipment, conduct accurate measurements of the light size, height of the niches, possible deviations in the lateral spacing at the level of the floor and the crown of the lock in the area of the stop log niches.

**Stop logs are to be handled** using mobile cranes. It is necessary to designate the appropriate space (platform) for positioning the mobile crane for the upper and lower cofferdam. Based on the particular distances to the centre of the cofferdam, it is necessary to select a mobile crane with a load-bearing capacity of minimum 5 t at an appropriate distance. When stop logs are not used, it is necessary to designate the appropriate space for their storage where it would be possible to protect them against weather impacts during longer periods.

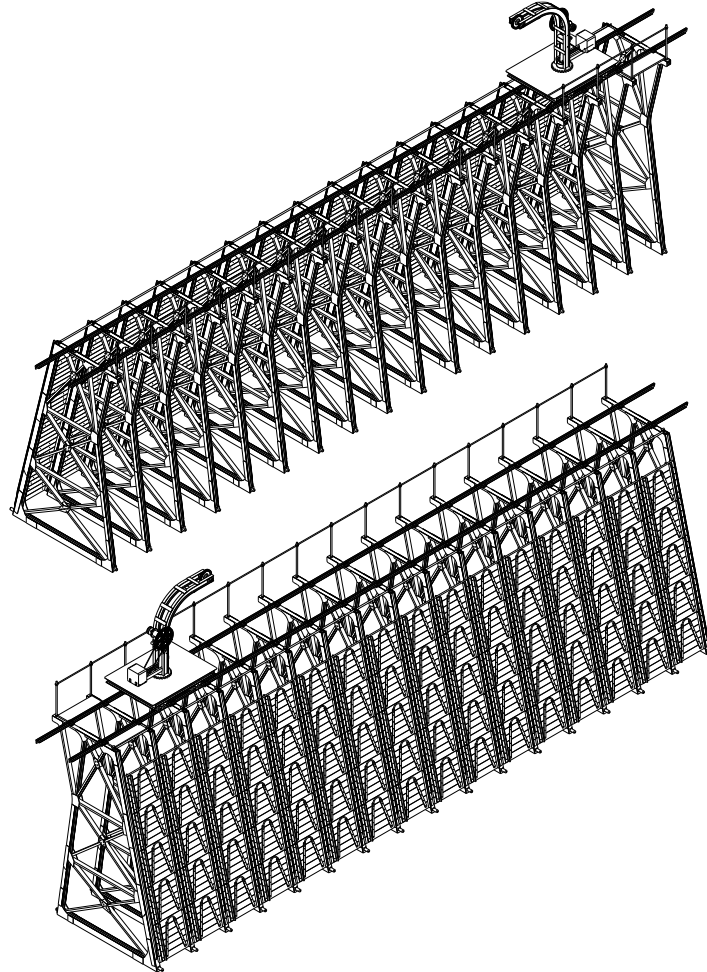
The Bezdan portal crane traverse should be used for handling stop logs. It is not necessary to make a new traverse but only to have traverse connections on-site which would suit the specific lock niches. Figure 21 shows the solution for the devices for handling stop logs.



*Figure 21. Traverse for handling stop logs*

## FLOODGATE

The frames have a lattice structure. Placement and alignment of the frames at a certain angle in the bearings on the bottom of the floodgate (Poire system) allow to have a stop log supporting structure whose top surface, by placing the treads, forms the bridge along which the people and cranes for stop log handling to move. No frame-related works are planned.



### Frames

The inspection established that the frame structure is in good condition. Figure 22a shows a part of the space frame whose major part is concreted, while the other non-concreted part allows one side of the stop logs to be supported, so called stop logs of the first order in the floodgate system. The space frame is defined in Drawing No. PUK-1.02.03A.00.00 and PUK-1.02.03B.00.00. Anti-corrosion protection of space (lateral) frame supporting structure is to be provided .

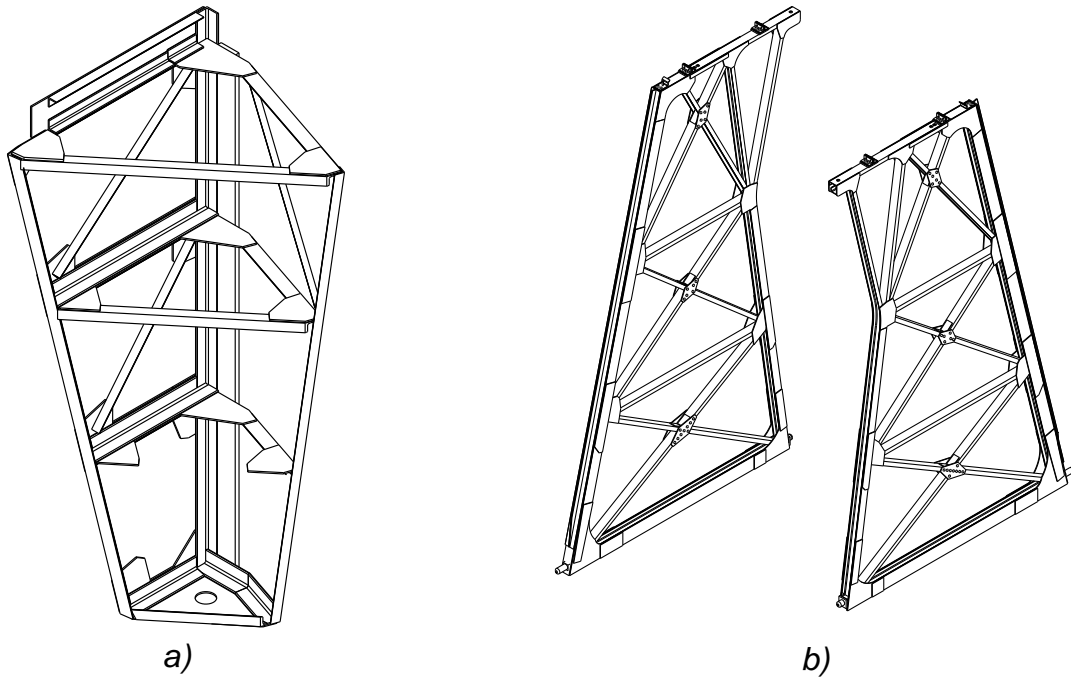
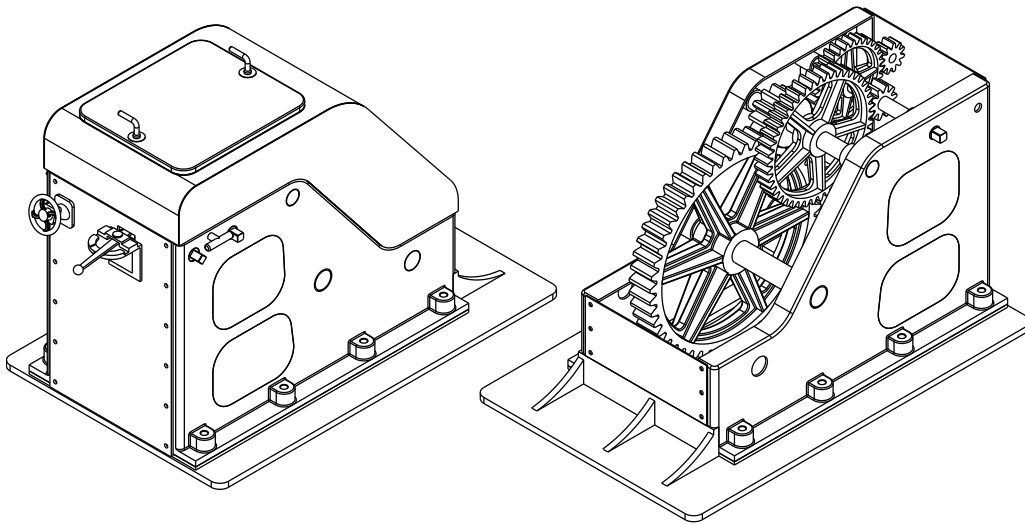


Figure 22. Space lattice frame (a) and main floodgate frames (b)

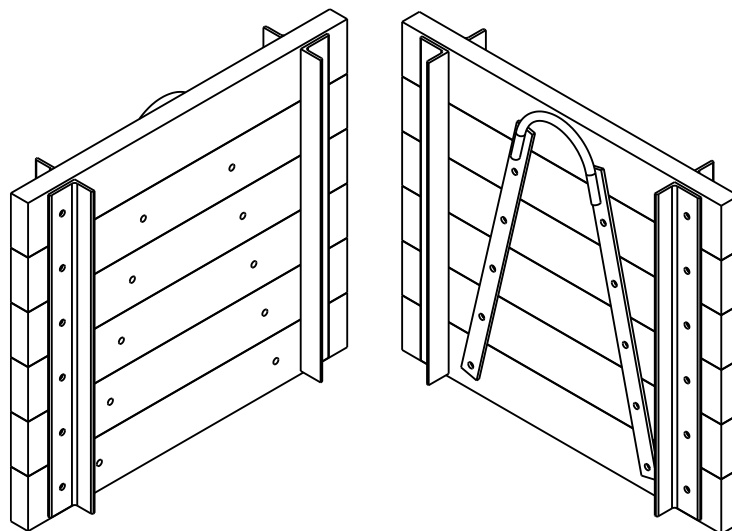
### **Frame lifting/lowering device**

To lower (lay down) and lift (put upright) the frames, a mechanism consisting of the gears and wheel chain is used. It is defined in Drawing No. PUK-1.02.11.00.00. It is planned to protect the metal casing against corrosion.



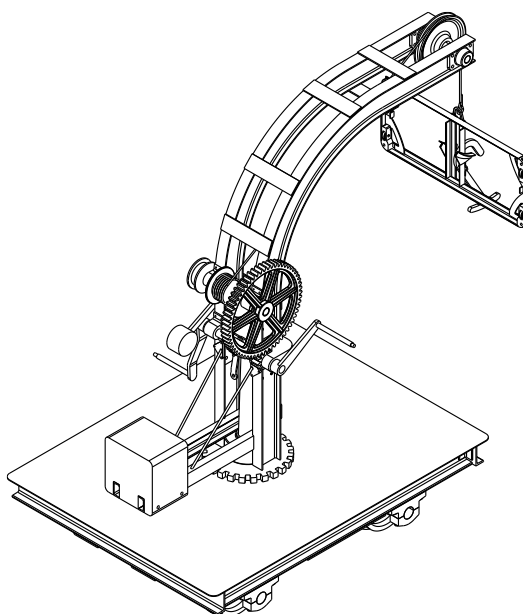
### **Stop logs**

Stop logs ensure regulation of the flow on the floodgate by being lowered by means of a console crane, supported by the sliding surfaces of frames, in the case of the first line from the bottom of the floodgate, while the other lines are supported by already lowered frames to the required level. There are 18 stop logs in the first line and there are 5 lines in total. The inspection established a good condition of a number of stop logs. 10 pcs of stop logs are to be constructed according to drawing no. PUK-1.02.02.00.00.

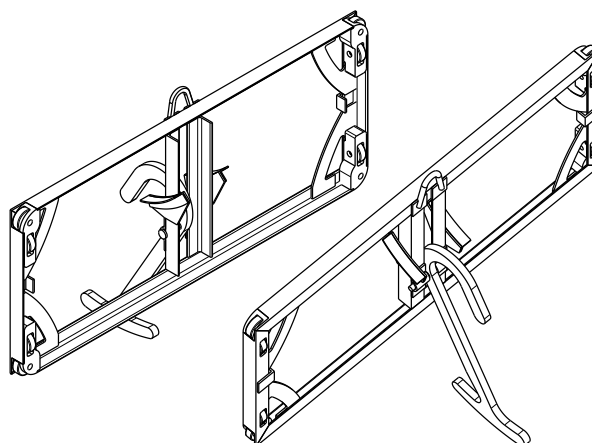


### **Cantilever crane for stop logs**

Stop logs are handled by a cantilever crane that, in addition to manual hoisting, may rotate around the vertical axis and move along the floodgate on rails at the tread level. The detailed inspection established that the crane elements are in good condition, so the anti-corrosion protection needs to be provided for the supporting structure, trolleys, treads, drawing no. PUK-1.02.05.00.00.



*Figure 23. Cantilever Crane*

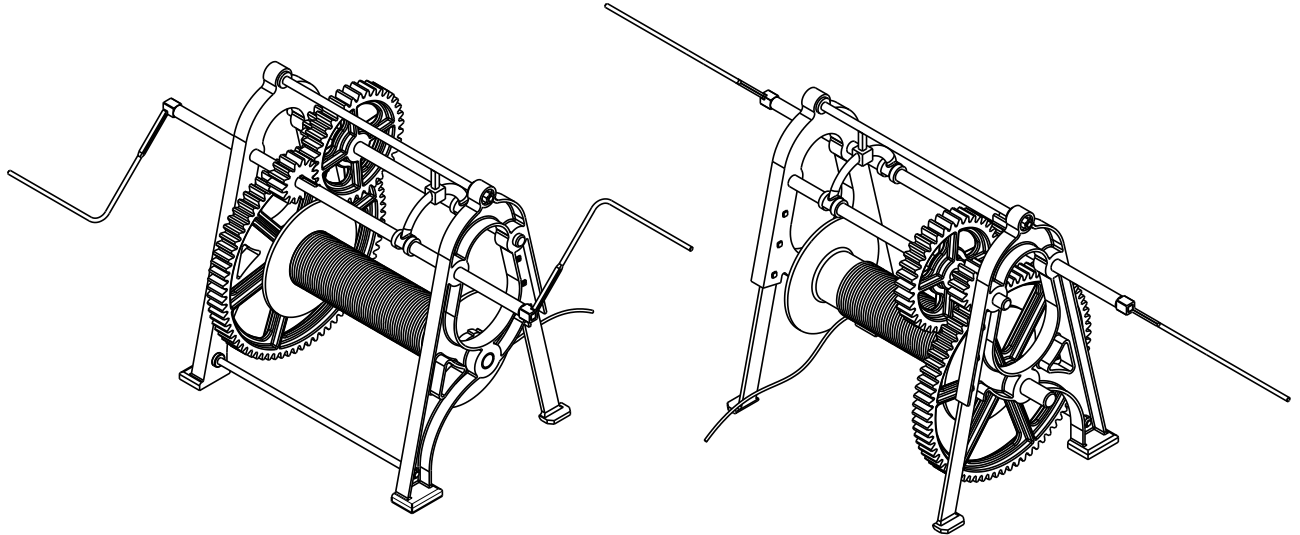




*Figure 24. Traverse for handling stop logs*

### **Device for moving the cantilever crane**

Previously, this device was used to move the crane and trolleys, but is not used any more. In order to preserve the authenticity of the equipment at Klek hydro node, this device will be kept and needs to be cleaned well and protected against corrosion.



*Figure 25. Ancillary device for moving the cantilever crane*

## **3.4.2. TECHNICAL REQUIREMENTS**

### **SPECIAL TECHNICAL REQUIREMENTS**

As one of the basic requirements for the development of this Project was to preserve the authenticity of the appearance and performance of hydrotechnical equipment, an on-site surveying of the existing equipment was carried out as a basis. As discharging of the chambers for the submersible equipment parts was not planned, the design was performed taking into account certain assumptions and estimates. After discharging the ship lock chambers, the Contractor shall perform accurate measurements of all parameters of hydrotechnical equipment and compare them with the parameters defined under the technical documentation. Should considerable deviations be established, the Contractor shall inform the Investor and the main Designer in order to align and finalise the technical documentation. The Contractor shall prepare as-built documentation and submit it to the Client.

The Contractor shall take into account the restrictions that apply in the road network of Serbia when planning the transport of its equipment. In addition, the Contractor will make a plan and take into account all relevant factors related to loading, unloading and transport of all equipment and materials. The Contractor shall collect all necessary data related to the maximum allowable cargo weights that can be transported by road, rail or river and will comply with all regulations that apply to them.

## Double leaf gates

The ship lock gates will be repaired and replaced. The steel structure of new gates is to be made of structural steel with welded steel profiles. Gate plates are joined by welded to steel straps with rivet heads.

The gate opening mechanisms will be cleaned, degreased and inspected for defects. Based on the inspection results, the parts of the mechanisms will be replaced if necessary, while the screws, nuts and washers will be replaced regardless of the inspection results. The anti-corrosion protection will be applied.

The drive mechanisms of flashboards will be cleaned, degreased and inspected for defects. Based on the inspection results, the parts will be replaced if necessary. All screws, nuts and washers will be replaced regardless of the inspection results. Adequate anti-corrosion protection will be applied. New gates will be fitted with new supports for drive mechanisms.

Once repaired and protected against corrosion, all gate drive mechanism and flashboard drive mechanisms will be assembled in order to check their functionality before the final installation of the double leaf gates. Any correction will be made if necessary. The double leaf gates will be installed only after demonstrating the functionality of the driver mechanisms. Certificates of testing or test reports will be prepared and delivered to the Client.

Each door leaf has two bearings that will be replaced by new ones. For the upper radial bearing, the existing niche on the side concrete wall is to be reworked so as not to undermine the current appearance of the ship lock. The bottom bearing, the so-called mushroom bearing, is placed below the threshold. The same structural solutions are applied to each gate leaf and/or bottom bearing.

The gates are to be vertically sealed by oak beams supported by side niches (side sealing) coated with steel along the entire seal height. Vertical sealing between the leaves is to be achieved by a direct support of oak beams. Wooden seals should be of oak without knots.

Horizontal sealing in the bottom part is to be provided by profiled rubber supported by the bottom threshold, which is also coated with steel sheets. At the support points of these seals, a stainless steel strip is to be provided and welded to the sheet metal flashings. The profiled rubber seals should have the following properties:

- Tensile strength                      min. 20.6 MPa
- Elongation at break                      min. 450%
- Shore hardness                      60

A new flashboard with a metal frame made of L-shaped profiles of inserted oak boards will be provided instead of the current flashboard solution of oak boards, which will not undermine the current gate appearance. Rubber seals in the shape of musical note supported by stainless steel strips welded to the gate plates around the water openings shall ensure water tightness.

Seal quality inspection requirements. At the maximum water pressure and without the use of other sealing materials, gate leakage must not exceed the value of:

- for horizontal rubber seals - 0.1 l/s per running meter of the active seal,
- for vertical wooden seals - 0.2 l/s per running meter of the active seal,
- for rubber seals of flashboards- 0.1 l/s per running meter of the active seal.

The Contractor will guarantee the functionality and safe and reliable operation of the gate ~~and revitalised drive mechanisms~~ of gate leafs and flashboards that allow water to pass through the gate.

The scope of works involves surveying, disassembly of the existing double-leaf gate, fabrication, testing, delivery and installation of the one.

The Contractor will delivery all special tools and equipment required for the installation and maintenance of the double-leaf gate equipment.

**IMPORTANT NOTES FOR CONCRETED PARTS (niches and thresholds):**

- The parts of niches and thresholds that require concreting and connection elements (stalks, anchor bolts, concrete composition and method of installation) are to be defined by construction experts. It is important to provide a construction permit for these parts of the structure. The Calculation for hydro-mechanical equipment (Detail Design - Rehabilitation of Klek and S. Itebej Hydro Nodes - Volume 6 Mechanical Installations Design, AD "VOJVODINA PROJEKT" Novi Sad, 17 Bulevar Kralja Petra 1, 2018) defines loads as a basis for the execution of construction works.
- To ensure high quality operation of the hydromechanical equipment, execute all the planned construction works on the ship lock prior to constructing the ship lock. If this is not possible, prior to constructing the gates, the niches and thresholds are to be concreted and coated, after which the relevant dimensions will be determined as a precondition for their proper operation.

All main parts, components and sub-assemblies will be inspected for sizes. Should the size inspection establish deviations that may affect assembly and disassembly of equipment, they will be corrected.

Anti-corrosion protection will be inspected by the Client. The inspection will include:

- surface cleanliness
- thickness and adhesion of coats. The coat thickness will be inspected at 2 control points per m<sup>2</sup>.
- quality of used materials

The elements of the double-leaf gates will be assembled in the Contractor's factory and visually inspected by the Client prior to their delivery to the construction site. The inspection will include a review of sizes, anti-corrosion protection and finishes.

Prior to the delivery to the construction site, the threshold will be pre-assembled in the factory and visually inspected by the Client, particularly in terms of its size, finishes and anti-corrosion protection.

Prior to the delivery to the construction site, the steel coats of side niches will be pre-assembled in the factory and visually inspected by the Client, particularly in terms of its size, finishes and anti-corrosion protection.

Seals will be placed on the supports during the factory assembly. The parts will be clearly marked before they are disassembled for transport. All sizes will be inspected and any identified error in sizes or contact points will be corrected. Before attaching them, the Client will inspect the sealing elements for their hardness, porosity or any damages.

The final on-site tests will start after successful completion of the installation. The tests will include three stages as follows:

- Pre-tests (dry run) are to be carried out after the installation and prior to putting the double-leaf gate into operation in order to determine the level of completion and functionality of the installed equipment.
- The operation of the double-leaf gate will be tested in order to ensure operational and safety requirements during the test-run period.

- Guaranteed performance test (drive and performances) is to be carried out in order to verify the guaranteed performance and ensure safe operation during the test-run period.

The test-run period will start after successful completion of the tests. Details related to the final on-site tests will be prepared by the Contractor as a part of the separate programme defining the sequence of tests, equipment preparation and test procedures. This programme will be pre-verified by the Client.

A successful guaranteed performance test (drive and performance) during the test-run period will be accepted without the need to repeat it during the acceptance period.

Pre-tests (dry run) will include the following:

- visual inspection of seals,
- radiographic or ultrasonic testing of welds on supporting elements,
- control of the accuracy of the assembly of all components, in particular, functionality of seals, gate and flashboard drive mechanisms.
- control of the accuracy of side supports
- control of thresholds and niches

The Contractor will record all results in the test reports and deliver them to the Client for approval. Should the inspection and tests fail to provide satisfactory results, the equipment must be repaired and adjusted until the requirements defined under the Contract have been met.

The inspections and tests will be performed in order to inspect the gate for leaks. Any correction will be made if necessary. The guaranteed performance tests are necessary to demonstrate the efficiency of seals and related equipment in real conditions.

After the successful completion of all tests, the test-run period will start.

## **Stop logs**

The Contractor will guarantee the functionality and safe and reliable operation of the stop logs under the worst case load conditions. At the maximum water pressure and without the use of other sealing materials, stop log leakage must not exceed the value of 0.1 l/s per running meter of the active seal,

Fabrication of lateral stop logs involves:

- Fabrication of stop logs according to the design documentation.
- Installation of a spring on each side of the stop log.
- Reconstruction of the stop log niches as shown in the drawings. Installation of new vertical seals in the shape of a musical note, and also the elements to attach them to the steel structure. The new solution should provide water tightness due to the deformation of seals under the hydrostatic pressure of water and partially due to their own deformation (bending).
- Reconstruction of a downstream steel support through which the stop logs lean against the niche, which will protect the seal in the shape of musical note against damages on the one hand and allow rubber sealing under the water pressure on the other hand.
- Reconstruction of the stop log niches on the top head. Delivery and installation of the stop log niches, which in the support and sealing area should have stainless steel strips welded onto them.

- Welding of the stainless steel strips to the upper stop log surface onto which the “knife” and the seal of the next/top stop log is to be leaned against.
- Delivery and installation of the stop log thresholds, which in the support and sealing area should have stainless steel strips welded onto them.

#### IMPORTANT NOTES FOR CONCRETED PARTS (niches and thresholds):

- The parts of niches and thresholds that require concreting and connection elements (stalks, anchor bolts, concrete composition and method of installation) are to be defined by construction experts. It is important to provide a construction permit for these parts of the structure. The Calculation for hydromechanical equipment-defines the loads as the basis for the execution of construction works.
- To ensure high quality operation of the hydromechanical equipment, execute all the planned construction works on the ship lock prior to constructing the ship lock. If this is not possible, prior to constructing the gates, the niches and thresholds are to be concreted and coated, after which the relevant dimensions will be determined as a precondition for their proper operation.

The profiled rubber seals should have the following properties:

- Tensile strength                      min. 20.6 MPa
- Elongation at break min. 450%
- Shore hardness                      60

Certificates of testing or test reports will be prepared and delivered to the Client for all performed tests.

Factory works and factory tests:

- All main parts, components and sub-assemblies will be inspected for sizes.
- Anti-corrosion protected will be inspected by the Client. The inspection will include:
  - cleanliness of cleaned surfaces
  - thickness and adhesion of coats. The coat thickness will be inspected at about 2 control points per m2.
  - quality of used materials
- Prior to the delivery to the construction site, the threshold will be visually inspected by the Client, particularly in terms of its size, finishes and anti-corrosion protection.
- Prior to the delivery to the construction site, the steel coats of the side niches of stop logs will be visually inspected by the Client, particularly in terms of its size, finishes and anti-corrosion protection.
- Seals will be placed on the supports during the factory assembly. The parts will be clearly marked before they are disassembled for transport. In addition, the sealing elements will be inspected by the Client for the quality of materials, hardness, porosity and any damages prior to attaching them to the stop log board.

The final on-site tests will start after successful completion of the installation of side niches and thresholds. The tests will include two stages as follows:

- Pre-tests (dry run) are to be carried out after the installation and prior to the guaranteed performance test in order to determine the level of completion and functionality of the installed equipment. These tests will include radiographic or

ultrasonic testing of welds on supporting elements and control of the accuracy of the installation of elements, particularly, the seals.

- Guaranteed performance tests (drive and performances) are to be carried out in order to verify the guaranteed performance and ensure safe operation during the test-run period.

Details related to the final on-site tests will be prepared by the Contractor as a part of the separate programme defining the sequence of tests, equipment preparation and test procedures. This programme will be pre-verified by the Client.

A successful guaranteed performance test during the test-run period will be accepted without the need to repeat it during the acceptance period.

After the successful completion of all tests, the test-run period will start.

## **OTHER GENERAL TECHNICAL REQUIREMENTS**

The obligations and the works to be performed by the Contractor include:

- Dismantling of the hydrotechnical equipment covered by this project,
- Testing and inspection of the existing condition and repair of the equipment to be retained,
- Procurement of materials and equipment fabrication.
- Factory tests of all materials and equipment in Contractor's premises.
- Packing of materials and equipment for transport and storage at the Construction Site.
- Transport and transport insurance to the Construction Site.
- Equipment installation, execution of works and their securing at the Construction site.
- Final tests at the construction site and provision of all necessary materials and equipment.

### **Fabrication requirements**

The materials used to manufacture the equipment must be of such type, composition and physical properties to fit their intended use and to comply with the best engineering practice. All equipment will meet the standards that apply to materials, fabrication and tests.

A source of origin must be known for each used material. The Client shall be entitled to request evidence of the quality of materials used by the Contractor and of the references of the material manufacturer. The Contractor will submit the list of manufacturers it proposes to order steel profiles, forgings, castings and other materials to the Client for approval. The rolled materials must be free of any defects such as cracks, splits, layers, surface swells, etc. It is not permitted to repair the defects by welding without a written approval of the Client. All the attests, certificates and certificates of materials and parts that will be procured must be provided. Three (3) copies of these documents must be delivered to the Client.

All works must be thoroughly and professionally performed in line with the best practice for equipment fabrication. If during the fabrication, there is a deviation in the characteristics defined under this Project, the Contractor shall obtain the approval of the Client. The written report and technical documentation on the nature of deviation and proposed repair method must be provided to the Client by the Contractor and the Client will decide whether the part of Works is acceptable after the repair.

All welds must be continuous and airtight. When welding sheets, the calculated weld thickness should be equal to the thickness of the thinner sheet or 0.8 of the sheet thickness, but not less than 6 mm. All but-welded seams must be fully penetrated and welded on both sides. The parts of the elements to be welded must be mechanically treated. The sheet surfaces to be welded must be cleaned. The welded parts must be free of any damages and must meet the requirements of the relevant standards. All welds are to be performed by certified welders. The certificates of welders' qualifications shall be provided to the Client for review.

All niches, thresholds, concrete fillers and canals with floor slabs for cables shall be made by the Contractor. The Contractor shall deliver of anchors, fasteners, stalks and plates to be installed in the concrete. The drawings defining the parts and elements to be installed in the concrete must be approved or if needed, redefined by the construction designers. All adjustments of the levels of foundations, subgrade and injection of the structure on the foundations and cementing to the walls and floors will be performed by the Contractor.

The Contractor shall deliver the tools, instruments and equipment required for the transport, handling, installation, testing and maintenance. The list of this equipment will be prepared by the Contractor and submitted to the Client for approval. It will be considered that the offered price includes all costs of the above mentioned equipment. The contractor will bring all the material necessary for the complete installation of hydromechanical equipment to the Construction Site.

### **Installation requirements**

The Contractor shall install the delivered equipment and connect all auxiliary devices in line with the verified drawings and written installation instructions. After the installation, all the equipment or equipment parts will be inspected by the Contractor and Client who will then sign a Certificate of Installation Completion and Equipment Readiness for Final Tests. The Contractor will install the delivered equipment in line with the Work Programme. All the equipment and materials will be installed in line with the Technical Requirements. The Contractor will be responsible and will replace or repair any identified damage or defect of the equipment or materials caused by improper installation at its own cost.

The warehouse (open and closed storage areas) for temporary storage of equipment will be provided by the Contractor in the space provided by the Client. Equipment storage is an obligation of the Contractor who shall provide a storage plan with clearly indicated sizes of open and closed warehouse space, all in accordance with the Work Plan. The Contractor shall organise an on-site recording of materials and equipment.

The material should be disposed at the Construction Site in a way that provides an undisturbed access to the materials and their maintenance in order to facilitate the inspection and review of warehouse materials and operations. The Contractor is obliged to keep the warehouse organised and clean.

In order to load and unload equipment at the Construction Site and warehouse, as well as to install the equipment, the Contractor will provide the means of transportation and installation equipment. If the additional handling equipment is required, the Contractor will provide it at its own expense. The Client does not guarantee the efficiency and safety of these devices and the Contractor will use them at its own risk and will protect the Client against any compensation claims that may arise in relation to human injuries, property damage, etc.

The Contractor shall employ and keep on site a sufficient number of experienced staff to organise, manage, execute and finalise the works. The Contractor shall provide

the tools, equipment, materials, temporary fasteners and scaffolding to execute the works. The accommodation costs shall be borne by the Contractor. The local transport of the Contractor's staff to and from the Construction Site is the Contractor's obligation. The Contractor is obliged to provide a sufficient number of containers at the Construction Site for office and other needs. The Contractor will provide and keep the first aid equipment for its own needs at the Construction Site.

The contractor will be provided with electricity at the terminal point, the location of which will be determined in agreement with the Client. The Contractor shall timely notify the Client of its requests for electricity supply. The Contractor will provide all the materials and equipment necessary for the distribution of electricity from the above mentioned terminal point to the consumers.

The Client will provide adequate supply of industrial water to the connection point, the location of which will be determined in agreement with the Client. The Client will provide drinking water at the Construction Site, which will be free of charge, provided that it is economically spent.

The Contractor will provide pressurised air and consumables at the Construction Site.

The Contractor shall provide telephone, fax, e-mail and other means of communication for the purpose of carrying out works at the Construction Site. The telephone lines for the Contractor's offices at the Construction Site will be provided by the Client.

Equipment installation and other works will be performed so as not to obstruct the works of other Contractors. The Contractor will submit the installation plan to Client for review. After the installation of each part of the Works, they will be the subject of verification by the Client. The Contractor will make the records of all main inspections and measurements.

The Contractor will keep the site clean during the execution of works. All material that is not used and is no longer required for the execution of works, as well as all discarded materials will be removed from the Construction Site in the manner and at the order of the Client. Upon the completion of works, the Contractor will remove all temporary works it performed in order to protect the facility. It will remove all equipment or excess material and any residual waste accumulated during the execution of works and will leave the installation site clean and organised.

The Contractor is obliged to deliver welding electrodes. All the welding electrodes will be supplied in watertight boxes and kept in heated warehouses for at least 4 hours before their use. Welding electrodes that absorbed the moisture will be discarded. The basic requirements are the same as for welding in the Contractor's factory.

No later than two months before the start of installation, the Contractor shall notify the Client in writing of the manager of installation works and the deputy manager authorised to represent the Contractor before the Client. The manager selection is subject to approval by the Client. The Client or its representative has the right to supervise each stage of installation, as well as to perform certain measurements and internal tests of partly or fully installed equipment. The Contractor is obliged to deliver to the Client the certificates and protocols of factory tests for all equipment prior to its installation in accordance with the Special Technical Requirements. The Contractor is obliged to ensure all the conditions necessary for inspection and quality control.

### **Anti-corrosion Protection**

All equipment will be protected against corrosion depending on the working conditions. The protection will be mainly provided in the manufacturer's factory, while



the repair of damaged segments, welding protection and decorative painting will be carried out at ship lock.

As a rule, the first layer of protection should be applied immediately after the surface preparation. No surface preparation or final coating, i.e. first or final coat, will be permitted prior to the mechanical treatment, inspection, workshop assembly and workshop testing equipment. An exception to this rule may be approved by the Client at a special request, if justified.

It is necessary to fulfil two essential requirements in order to provide the first class anti-corrosion protection. The first requirement is the diligently and well prepared surfaces, i.e. cleaned surfaces prior to the application of primers in order to ensure good adhesion of non-porous steel primers. The second requirement is the application of the top quality primers and coats which ensure good adhesion to the steel surfaces and/or primers. All the primers and coatings should be of adequate uniform thickness and provide non-porous and elastic coating films.

In order to ensure the durability of anticorrosion protection, it is necessary to immediately remedy any observed mechanical damage of the coating caused during the installation and operation of the equipment.

The level of the corrosion damage of steel surfaces and the level of treatment before applying the anti-corrosion protection should be controlled according to the Swedish standards SIS 05 5900-1967. The painting works should be mainly aligned with BS CP 231. All the painting works are to be executed in accordance with the best practice and under the constant supervision by the qualified and experienced Client's representative.

Factory and pre-fabricated anti-corrosion protection. Unless otherwise requested, the sandblasting shall be performed in the manufacturer's factory, and then the basic protective primer and the first cover (final) coating shall be applied. This anti-corrosion protection will be provided during the equipment transport and installation.

All sandblasting and painting works will be performed only when the relative humidity is less than 80% and the ambient temperature is above 5°C. During the application of anti-corrosion protection, a control log book will be kept in which all the data relevant for high quality protection will be entered.

The basic requirement for ensuring the quality and durability of anti-corrosion protection is well-prepared steel surface prior to the application of the primer. The surfaces of the structure that are greased during the fabrication or transports should be degreased. The surfaces are to be degreased by trichlorethylene ( $C_2HCl_3$ ), which is applied by brushes or cloths and rubbed well. The surfaces are to be rubbed until the grease has been dissolved and removed. Then, the degreased surfaces should be wiped with dry cotton cloths.

The next operation for the protection of anti-corrosion protected surfaces is cleaning by sandblasting to the metal gloss. Sandblasting should be performed until all impurities, iron oxides, slag and other mechanical impurities have been removed. If the slag remains in the thicker layers after rolling or welding, it is recommended to remove the slag by hammer. All dents on the sandblasted surface must be free of any traces of iron oxides and impurities. Sandblasting is to be performed with special compressor air machines. The sandblasted surfaces must be blown by filtered dry air before applying the coats.

The well sandblasted surface must have SA 2.5 cleanliness level according to the Swedish norms SIS 05 99 00 - 1967, A-C, Sa 2 ½ (or other relevant standards). The quality of materials used to sandblast the surfaces must be such that it efficiently removes impurities. The sand grain size shall range between 0.5 to 1.3 mm. The grain size of granulated furnace slag shall range between 0.5 to 2 mm and must not contain

sulphur, sulphur compounds and other active ingredients. Prior to applying the primer, the quality of cleanliness of sandblasted surfaces should be immediately and carefully inspected. If the impurities and iron oxides are not removed from all pores, sandblasting must be repeated. In this way, fine, evenly rough and very clean surfaces should be obtained to which the coats adhere very well.

#### Surface protection by painting

- Epoxy primer with high content of Zn in d.s.f. of 70 µm.
- tar epoxy coating in d.s.f. 3x120 µm.
- total thickness of the protective film is 430 µm.

After sandblasting, metal surfaces are very active in terms of oxidation and for this reason it is necessary to apply primers to these surfaces as soon as possible. This should be done within a maximum of 8 hours. If the ambient is saturated with moisture, the coating should be applied within a maximum of 4 hours. The tar epoxy coating should be applied by a brush to inaccessible places such as angular joints, welds, in order to achieve a full, uniform thickness of the paint. The interval between applying two coatings for tar epoxy paint is 24 hours, a the maximum interval is 5 days. If more than 5 days pass until the next layer is applied, the previous layer should be grinded off.

### **Packing and dispatch**

The Contractor shall prepare, pack and load all the materials and equipment for transport in such a way that they are protected against damage during transport. The Contractor will be liable for any damage caused by inadequate packaging. Parts that need to be stored at the Construction Site in the open space for several months must be adequately protected against weather. Where necessary, heavy parts will be placed on pads or will be in placed a box, and any part that may be lost will be placed in a box or attached to a steel strip and visibly marked for identification. The outer surfaces of all packages will be clearly marked indicating the total weight, position of the largest weight and the hook and rope attachment points and will have an identification number related to the corresponding transport documents. Spare parts will be packed separately according to the specification and will be shipped and properly packed for storage for a period of at least 10 (ten) years. The packaging material shall remain the property of the Client.

During the transport, the Contractor will be responsible for:

- packaging, loading, transport from the place of manufacture, either by its own means or any other means, to the place of loading;
- securing the load and its transport from the place of loading to the place of unloading;
- insurance of the overall value of equipment, cargo, for securing and forwarding the shipping documents and for paying of all transport and transhipment documents and costs.

A least 30 (thirty) days before the planned delivery date, the Contractor will send a written notice to the Client with the identification, or description, weight and dimensions of the material and equipment to be delivered. When sending each consignment, the Client will be notified in writing. In order to enable the possible customs procedures, all packages and shipping documents will be clearly marked for this purpose.

## **Safety and security measures**

The application of safety measures will be inspected and supervised in all areas of works. The adequate number of lights will be installed and maintained for sufficient illumination of all areas where the works are carried out, and wherever the lighting is necessary for safety reasons. Where safety lighting is required, it will be provided with separate a power supply.

The contractor will install and maintain the canopies at the warehouses of fuel, oil and other hazardous materials. These canopies will be set up in remote areas, outside the populated areas and outside the warehouses and parking lots. The Contractor will take all necessary measures to prevent fuel, oil or other hazardous materials or toxic substances from entering watercourses. The contractor will mount and maintain fences in all areas where the fence is required.

All the Contractor's personnel will use safety helmets, gloves, safety boots, life jackets and other protective clothing and shoes, as required by the works. The Contractor's personnel will be trained in the use of safety equipment and the Contractor will ensure that such equipment can be used in all conditions.

The Contractor shall provide warning signs for all Works requested by the Client in accordance with the applicable safety standards for the performance of Works. The Contractor will provide all necessary temporary signs written in Serbian during the installation and acceptance of works .

## **Fire protection**

The Contractor shall be responsible to protect its equipment against fire and will provide assistance to ensure fire protection of other structures and equipment that belong to the Client and third parties. Furthermore, the Contractor will provide fire protection equipment for its personnel.

The Contractor will take all necessary measure to prevent the fire. The following precautions should be provided:

- No open flames are allowed at the Construction Site. Incineration of waste materials will be performed in the designated areas outside the Construction Site as indicated by the Client.
- Flammable materials will be stored in places where the spread of fire is limited to a minimum, if possible. Non-flammable plastic films will be used to protect the materials.
- If the nature of works requires the use of open flame, for example, all welding procedures, all flammable materials will be removed from the working area. If such removal is impossible, the working area will be specifically protected by fire extinguishing equipment.
- The position of the fixed fire extinguishing equipment will be determined by the Client. Portable equipment shall be available to the Contractor at any time when its personnel is present at the construction site and must be readily accessible by the personnel as requested by the Client.
- The Contractor will maintain the fire extinguishing equipment in good condition and will regularly refill the fire extinguishers regardless of who and when they were emptied. An adequate amount of fresh chemical filling for fire extinguishers will be kept ready at the construction site.
- All equipment provided under this item shall be the property of the Contractor and will be removed when requested by the Client.

- The firefighting equipment will be available at the construction site from the beginning to the end of the works. If the equipment is to be installed in several time intervals and if the time period between the two intervals is more than one month, every time when the Contractor leaves the construction site it will provide the Client with the sufficient amounts of chemical substances for equipment refilling given the fact that the Contractor's personnel will not be present in this period. When the Contractor's personnel is present at the construction site, it shall inspect the fire extinguishing equipment on a weekly basis.

## **Standards**

Materials, fabrication and testing of all works will be in accordance with Serbian standards and official regulations and with other standards, unless they are in contradiction with the previous one. If there is no appropriate or equivalent standard among Serbian standards or regulations, EN standards will be applied. The contractor may offer another standard and such a standard will be accepted after the Client approves it.

Prior to the fabrication of the equipment, the Contractor is obliged to make a comparative list of Serbian standards, indicated standards and standards it intends to use for the activities in question and submit it to the Client for review.

## **Technical data and reports**

The Contractor must submit to the Client for approval a detailed Program of Work outlining the proposed sequence of works including the dismantling of existing equipment, procurement of materials, construction, delivery to the Construction Site, installation of new equipment, acceptance tests and the test run. The program of work must be aligned with the Contractor's Construction Program.

The Contractor must submit to the Client for approval all necessary information that ensures satisfactory installation and final testing of the Equipment. The instructions will include information on the methods of handling the parts of the equipment and special precautions to be taken during the installation.

The Contractor must prepare complete and detailed instructions for the operation and maintenance of the equipment. Such instructions must include descriptions, drawings, schemes and catalogues of standard equipment.

The Contractor will submit to the Client drawings that define all changes in relation to the Remediation Project.

The Contractor shall provide the monthly progress reports. The status and trends of the progress of works will be illustrated by means of plans, diagrams, charts, drawings, photographs, tables.

The Contractor shall submit to the Client for review and approval a program of works that includes the dismantling of existing equipment, recording of the existing condition, repair of the existing equipment, fabrication of the new equipment, delivery, installation, acceptance and test run period;

## **Equipment testing**

The Contractor will prepare and submit to the Client for approval a detailed Final Testing Program.

Immediately after one technological unit is completed and installed and all excess material is removed after the installation, this unit may be tested. The Contractor shall notify the Client in writing that such technological unit is completed and ready for final testing. The Client will, together with the Contractor's representative, inspect the

mentioned part of the equipment in order to verify that this part is completed and ready for final testing.

A certificate of completed installation and readiness for final testing will be issued by the Client after the inspection of works and verification of its readiness for final testing.

The certificate of completed installation and readiness for final testing will be issued for each section (technological unit). The technological units will be defined and agreed jointly between the Client and the Contractor in the form of the final testing program.

After issuing the Certificate of Completion and Readiness for Final Testing for any part of the equipment, the Contractor shall proceed with final testing of such part of the equipment.

The Contractor shall carry out the Final Tests under its full responsibility and shall provide a sufficient number of qualified staff of all categories for this purpose.

The Client will designate its staff to assist in the course of the final tests and such staff will receive work instructions by the Contractor.

The Final tests can also be organized for individual technological units if the operation of such part of the Equipment is independent from the operation of other technological units and / or operation of the Equipment as a whole.

The Client has the right to require the Contractor to make changes in the procedure, or to request additional tests or data necessary for the appropriate verification of the guaranteed performance. Such changes and / or additional tests will be carried out at no extra cost to the Client.

The Contractor shall provide all technical instructions and shall bear full responsibility for the commissioning and safe operation of the Equipment during the Final Testing period.

The Contractor will be responsible and will perform all maintenance work during the period of the Final Testing of the Equipment until the date of issuance of the Acceptance Certificate.

The Final testing period will last as stipulated by the Work Program. During this period, the Contractor will put into operation the plant, or parts thereof, to determine whether each part of the installation is in good working condition and ready for normal operation.

After the successful completion of all planned tests, the test run period will commence.

The test run will be performed under the supervision and responsibility of the Contractor. At the same time, the test run period will be considered the training period for the Client's staff.

Two months before the date planned for the commencement of the Final Testing, the Contractor shall provide the Client with details of the conditions and methods of the test run (including detailed procedures for evaluating the results and other data related to the test run), together with the tables for keeping the log books into which the data collected during the test run will be entered. The Client shall have the right to require the Contractor to make changes in the mode of operation or to request additional tests or data, in order to ensure a valid verification of safe and reliable operation. Such changes and / or additional test runs will be performed by the Contractor at no additional cost.

The test run shall demonstrate the ability of the equipment to operate continuously in real conditions. Therefore, the test run will be interrupted only in exceptional cases and with the approval of the Client.

Working conditions during test-run period shall correspond to the values specified in the contract documents and the manner of performing the test-run.

The test run will last at least 3 (three) months. The Client will determine the time period (atmospheric conditions, water level, ...) when the test run will be carried out. If there is a prolonged unreasonable interruption of the test-run by the Contractor, in order to perform repairs or modifications, its duration will be extended, at no extra cost to the Client.

At the end of the test-run, the Contractor will prepare Final Test Run Reports for the Acceptance Tests, supplemented with additional results obtained during test run, and deliver them to the Client for review.

If it is demonstrated that all the results are satisfactory, the Client will issue a Certificate of Acceptance.

If some of the test runs stipulated in the Technical Requirements are not completed by the date of handing over of the equipment, then the Certificate of Acceptance will contain the comments about the non-completed tests, as well as the provisions regarding the deadline for their completion. Additional costs of the delayed tests will be borne by the Contractor, except in cases where the suspension of the execution of such tests was based on the Client's special requests.

If the equipment or part of it shows deficiencies during Test Run, the Contractor will make corrections and any necessary changes immediately after the Test Run Period and the Test-Run will be repeated under the same conditions and deadlines, and all reasonable costs incurred by the Client due to repetition of the tests will be deducted from the Contract Price.

If the test run shows unsatisfactory results, then after the expiration of the test run period, the penalties for delay will be applied.

## **WARRANTIES**

Guaranteed values of the equipment will be inspected during the Final Test, and before the test run period of the equipment. Exceptionally, with the consent of the Client, some tests of the guaranteed values of the equipment may also be made during the test run period. The guaranteed values of the equipment must correspond to the values stipulated in the Technical Requirements.

If the guaranteed values of the equipment are not demonstrated, the Contractor will make appropriate changes or improvements, and if afterwards the equipment does not meet the requirements, the Contractor will pay the prescribed penalties or the Client will refuse to accept such equipment.

The Contractor will provide the Client with a warranty for the functionality of hydraulic equipment for a period of 5 (five) years while the warranty for anti-corrosion protection shall be valid for a period of 10 years.

# VOLUME 3.5

## TECHNICAL SPECIFICATIONS - ARCHITECTURAL WORKS ON TECHNICAL BUILDING WITHIN HYDRO- COMPLEXES SRPSKI ITEBEJ

Upon the developer's request the Main design for reparation of facilities has been developed within the hydro-complexes Srpski Itebej, cadastral lots no 10827/1, 10825, 10827/2, 10828/1, 10828/2 and 10826 c.m. Srpski Itebej.

The developer has obtained the Decision on the approval of the execution of works No 143-351-585/2017, ROP-PSUGZ-32314-ISAWHA-1/2017 of 22 November 2017 and Preliminary designs related to repairing, developed by the company Hidroprojekt Zrenjanin doo in February 2016.

### TECHNICAL BUILDING

The facility comprises only a ground floor. Under a part of the ground floor there is a basement. Its shape is rectangular and the dimensions are 14.47m x 11.22m. The structure of the basement is vaulted. Above the ground floor there is a ceiling construction made of roof trusses, planks, cane and plaster. It is a gable roof with the double hangers system with ties above the joist hangers above the roof trusses. The roof cover consists of interlocking roof tiles.

#### Functions

The spot elevation of the ground floor is distanced 125cm from the surrounding terrain so that the ground floor is accessible through the external staircase. The clear height of the rooms is around 370cm. There is a side entrance of the facility to the west and a front entrance to the south.

The facility consists of several offices, a sanitary block and other facilities along with a kitchenette.

Roof repairing covers the disassembly of the roof cover which consists of interlocking roof tiles and roof laths along all elements of the roof edge and gutters. All the damaged and rotten parts of the roof construction are disassembled. This refers to the principal rafters as well as to tie beams which were shortened before and which should be replaced. The chimneys are to be demolished and reconstructed on the same brick position.

All damaged and disassembled parts of the roof construction are to be made of the coniferous timber of II quality class. Undamaged rafters which are disassembled due to the tie beams replacement technology are reused. New visible wooden elements are profiled according to the existing profiling. Overall roof structure and wooden deck frame are to be coated with an insect and fungus protection agent according to the manufacturer's instructions 2-3 times. The rafters are levelled and covered by 2.5 cm thick plunks, over which steam-permeable and water-permeable foil is placed and fastened with 5x5 cm sticks in the direction of rafters. Depending on the choice of interlocking roof tiles the lathes are nailed down of 5x3cm upon the instruction. There are unbalanced snow loadings integrated in the roof construction. Tin roof edges and gutters are constructed of steel galvanized sheet metal.

Complete construction of the floor is planned, with the creation of space for the construction of a new, thick structure with hydro and thermal insulation. An internal excavation of the outer walls of the conference hall up to a level of the field in the width of min 60 cm and the creation of a workbench for walls cutting is a part of this operational item. Cutting these walls from capillary moisture should be done at a level of about 20 cm from the ground so that there remain 14 rows of facade brick on the building socle. Below the water insulation the dilapidated wall of min 50cm height is to be demolished and replaced by reinforced concrete, which will in this case enter min 30cm below the ground. Reinforced concrete is to be drawn in from the outer side of the wall 5cm for adaptation of the socle. XPS plates with the thickness of 4cm, with final processing of mass called kulirplast will be applied on the plinth by glueing.

The entire cutting operation is to be performed in sections at max. 1.00m in order to avoid collapsing of the wall. The continuity of reinforced concrete is to be achieved by leaving the appropriate

anchor plate nuts. Water insulation of water repellent glass wool strips of 4mm thickness, with adequate coatings. Welded overlaps are of 10 cm at least. This also refers to welded overlap and joint with vertical insulation of the wall so that the width of the water repellent strip increases 10 cm into the inner space in relation to the thickness of the upper part of the wall. The grout area above the water insulation on the facade side must be injected with cement emulsion under pressure, due to the establishment of static stability and taking care of the aesthetics of facade brick. All the dilapidate bricks must be replaced with adequate and similar. There are no aesthetic requirements in the inside area and more attention is to be paid to the wall's firmness at wall underpinning.

Vertical water insulation of the plinth wall is to be done by glueing repellent glass wool strips of 4mm thickness onto the firm and flat surface of the inside area of the wall. Before applying the water insulation onto the wall, the wall must be cleaned and levelled by partial concrete removal, by building an extension or by plastering, depending on the humps on the wall. Protect the vertical water insulation with the shiner brick leaning on the new reinforced concrete.

Horizontal water insulation of the inner walls is done cutting at the level of 20cm below the level of the constructed floor. This is also performed in sections. Below the water insulation a concrete padstone should be constructed about 10 cm above the reinforced concrete for making available a flat surface for water insulation. The width of the water repellent strip is to be increased 10 cm due to the overlap with the water insulation of the floor.

The floor structure is made of a layer of gravel, reinforced concrete slabs and water insulation over a plate which is at -20cm level. The continuity of water insulation with the 10 cm overlap and welding with vertical water insulation of the plinth wall and inner walls.

Cutting or any water insulation of these walls above the basement will not be performed at this situation stage except for water insulation of the floors and inner walls at -20 cm level.

Thermal insulation is to be installed in the floor from EPS plates 10cm thick, of 30kg / m<sup>3</sup> min density, PVC foil is to be set and cement screeds 6cm thick, Shults steel reinforcement frames with overlaps or synthetic fibres. In the contact between the screed and the wall, a section from EPS plates 1cm thick (floating floor) is to be installed.

The final floor is made of ceramic and granite tiles in glue. The plinth of 10cm height is performed on the wall.

Water insulation of the basement will be performed on the well cleaned and prepared walls on the inner side of walls with mass that penetrates into walls from the manufacturers Bauplus, Texal or similar ones upon the manufacturer's instructions.

Crumbly mortar on interior and exterior walls cracks, and grouts are to be cleaned to the depth of 2cm. Mortar should be stripped off and at mere chase cutting for electrical wiring and the installation of water supply and sewerage. By plastering the straight transition between the old and new mortar is to be achieved. There is a partial drifting of these surfaces.

The treatment of interior walls and partially of the ceiling is done in semi-dispersible colours of light shades.

In the sanitary blocks there are beautiful ceramic tiles high up to 210 cm and in the kitchenette, behind the kitchen elements there are tiles up to 150 cm high.

The ceiling of plaster performed by casting plaster of cane is to be disassembled on the whole facility. All the layers between the ceiling joist are demolished. The new ceiling of two layers of 12.5mm thick plasterboard plates is performed on the substructure of CD / UD profile. Thermal insulation made of mineral wool, 20cm thick with steam protection from below and water vapor permeable waterproof foil is placed between the ceiling joists.

In the conference room, the ceiling of 60x60cm in height made of mineral panels of "armstrong" type or similar one is to be lowered. Lighting fixtures are installed in the ceiling. The necessary electrical installations are performed in the cavity of the ceiling. In the other rooms, a new suspended ceiling composed of 12.5mm thick plasterboard on the metal sub-structure of the CD / UD profile is lowered. The necessary electrical installations are performed in the cavity of the ceiling. The ceiling profiles are secured to the ceiling at the places of the existing ceiling joists. Lighting bodies in these rooms are superstructural.

The windows are double, wooden, alike the existing ones, with all the leaves opening inside and the windows are installed for half of a brick towards the inside from the outer surface of the facade. Glazing



of the outer window leaves performed by double thermal insulation with glass of  $U_g \leq 1.30 \text{ W / m}^2\text{K}$ , and internal single glass of 4mm thickness. Alike the existing ones on the inside there are foldable solid wood shutters constructed and assembled. Installation should be carried out with stainless steel joints and sealed with polyurethane foam.

The interior doors are solid wooden, profiled. The detailed reparation and bringing into a functional state is necessary to perform. The old paint is to be stripped of by shingles and burning with hot air. Surface treatment is to be performed by drilling and sanding to the smooth fine surface. Nonfunctional fittings are to be replaced by adequate or similar ones, which in particular refers to the door handles. Broken glass is to be replaced with adequate one, also possibly rotten parts of wood are to be replaced too.

#### Electrical Installations

Elimination of all the shortcomings in the existing internal electrical and strong power supply is planned, so that the new electrical installation is to be practically performed in Notes 4 and 5.

#### Plumbing and drainage

The complete replacement of the existing installation is planned along with monitoring of the architectural solution of the layout of sanitary facilities. For installations routing the old route is to be used at the greatest extent.

Procurement and installation of water pipes made of crosslinked polyethylene with all required fittings within the piping network. The sewage installation is made of polypropylene sewage pipes.

All new sanitary equipment is specified in the Bill of Quantities.

#### Heating

The structure is not heated because it is not used in the winter period, so pursuant to Article 7, paragraph 1, point 8 of the Rulebook on the conditions, content and method of issuing Certificate of energy properties (Official Gazette of RS No. 69/2012) for this structure it is not necessary to obtain an energy passport and, therefore, the developing of the Energy Efficiency Study, according to the Energy Efficiency of Buildings (Official Gazette of RS No. 61/2011).

For an occasional use of the facility in the transitional period late autumn and early spring, the electric panel radiators are installed on the parapets.

#### Ventilation

All rooms have windows and, therefore, natural ventilation apart from sanitary blocks. Ventilation of these rooms is artificial, designed so that PVC pipes Ø110mm and with built-in fans perform the function of ventilation.

#### Facility equipment

The structure is fully equipped with furniture provided by the domestic furniture manufacturer, specified in Bill of Quantities of equipment and furniture.

# **VOLUME 3.6**

## **TECHNICAL SPECIFICATIONS AND TECHNICAL REQUIREMENTS–**

### **CONSTRUCTION WORKS TO REPAIR THE SHIP LOCK IN SRPSKI ITEBEJ**

#### **3.6.1. TECHNICAL DESCRIPTION**

##### **CURRENT STATE**

The hydrotechnical complex of the ship lock in Srpski Itebej was constructed between 1910 and 1912, consisting of the ship lock chamber and the structures of the technical building, workshop, residential building and auxiliary facilities.

In late 1960s, navigation through the canal was suspended, which reduced the maintenance activities on the canal and the associated hydrotechnical structures, resulting in the current poor state of the structures.

Srpski Itebej ship lock and floodgate is located on the Navigable Begej canal, near the village of Srpski Itebej, at chainage km 28+970, near the border between Serbia and Romania.

The ship lock chamber is 10 m wide and 90 m long in total (including gates and lock pounds), with 5.8 m high walls. The crown of the wall is at the elevation of 81.20 m.a.s.l., while the bottom of the chamber is at the elevation of 75.40 m.a.s.l. The walls are made of watertight yellow clinker brick, which is in rather poor condition. Visible parts of the chamber walls have suffered brick damage and also surface brick degradation. In addition, the wall lining made of solid brick in the upper segment of the right wall has been displaced from the design position in several places.

The most severe damage to the ship lock walls has been found in the upstream segment, between the pier and the floodgate. The damage is of such an extent that it requires repairing the entire wall, whose lower part is under water even at a minimum water level.

Concrete pathways on the ship lock walls have cracked in several places, especially in the wall area within the upstream segment, between the pier and the floodgate. The manhole located in the area has cracked in its upper segment, while the support frame for the manhole cover is broken.

The steel pedestrian bridge across the Navigable Begej canal is located upstream from the floodgate, in its immediate vicinity. The bridge has a box section; it is 1 m wide, spanning 25 m. There is no design documentation for this bridge. The bridge bearing and supports are made of steel sections. The left support is on the right wall of the ship lock chamber, while the right one is on the bank wall on the right bank of the canal. Due to the extensive damage to the ship lock wall, between the pier and the floodgate, the left support of the bridge has suffered subsidence.

The pier is made of steel frames, constructed of steel sections. Frame posts are driven into the channel of the canal. Three steel U-sections are installed over the frames to support the pathway made of wooden planks. The pathway is completely dilapidated and it is very dangerous to walk along it. Longitudinal sections - pathway supports are corroded and bent. Steel frames have suffered considerable damage due to corrosion.

The linings of the canal slopes are constructed of stone.

Wooden fender beams in the ship lock and on the pier have rotted away significantly.

## PHOTOGRAPHS OF THE CURRENT STATE



Damaged right wall of the ship lock chamber



Damaged left wall of the ship lock chamber



Damaged wall from the pier to the floodgate (August 2018)





Damaged wall from the pier to the floodgate at a lower water level (April 2018)



Damaged wall from the pier to the floodgate at a lower water level - close-up (December 2017)



Damaged bank wall at the right bridge support (December 2017)



Damaged pathway on the right wall of the ship lock



Damaged pathway on the right wall of the ship lock, in the area of the damaged wall from the pier to the floodgate





Subsidence of the left support of the pedestrian bridge on the ship lock wall - upstream view



Subsidence of the left support of the pedestrian bridge on the ship lock wall - downstream view



Damaged pier (May 2017)



Damaged pier - close-up (August 2018)



Damaged bank revetment

## **SCOPE OF WORKS**

Repair of the ship lock includes the following groups of works:

1. PREPARATORY WORKS
2. DISASSEMBLY AND DEMOLITION WORKS
3. EARTHWORKS INCLUDING CONSTRUCTION OF ACCESS ROADS AND HANDLING PLATFORMS
4. CONCRETE WORKS
5. MASONRY WORKS
6. REINFORCING STEEL WORKS
7. CARPENTRY
8. METALWORK
9. OTHER WORKS
10. PREPARATION OF THE AS-BUILT DESIGN

The following are the functional parts of the ship lock where repair works are planned to be carried out:

- ship lock CHAMBER
- THE WALL ON THE UPSTREAM SECTION OF THE BEGEJ, BETWEEN THE PIER AND THE FLOODGATE
- WALL IN RIGHT BANK OF THE BEGEJ RIVER IN THE ZONE OF THE BANK BRIDGE SUPPORT
- PATHWAYS ON THE ship lock WALLS
- PIER (upstream access dock for conducting ships into the ship lock chamber)
- SUPPORTS OF THE PEDESTRIAN BRIDGE ACROSS THE BEGEJ
- BANK REVETMENTS
- FLOODGATE THRESHOLD MODEL
- FENCE WITH GATES IN FRONT OF THE COMPLEX FACILITIES (BUILDINGS)
- FENCES AND GATES AT THE ENTRANCE TO THE COMPLEX

## **DESCRIPTION OF WORKS**

### **1. PREPARATORY WORKS**

In order to carry out ship lock chamber repair works, it is necessary to undertake onshore works including:

- Cofferdam construction of jumbo bags filled with sand in front and behind the inlet and outlet lock head with previous cleaning of the bottom from deposits and sludge in the cofferdam zone.
- Water pumping from the ship lock chamber
- Cleaning the chamber bottom of deposits and sludge
- construction of the first order niches and thresholds next to the inlet and outlet lock head in order to install new stop logs
- Installation of stop logs (5 pcs) in front of the upstream ship lock gate

In order to repair the pier, wall between the pier and floodgate and the bank revetment, a lower water level of the Begej is recommended (natural flow regime in the period from 15 September to 1 May, when the minimum elevation is 77.80 m.a.s.l.).

In the case there is no water in the ship lock chamber, and if the lower water level is higher than 76.80 m.a.s.l., the structure may not be safe against sliding. Since there is no design documentation required for the calculation of the chamber stability against sliding, it is necessary to monitor the facility and the groundwater level. Accordingly, the design includes installation of 2 piezometers along the bank (left) wall of the ship lock to monitor the groundwater level, and it also includes construction of drainage wells along the bank wall of the ship lock chamber. It is planned to construct 4 wells, with a 225 mm diameter and 20 m long. The wells should be spaced 25 m apart, and positioned 5 m from the bank wall of the chamber. It is assumed that water will be pumped over a period of 90 days, i.e. the period assumed to be required to execute the repair works on the chamber.

NOTE: Stability calculations for the ship lock chamber have not been made since the structure was built between 1910 and 1912 and it is not provided with the design documentation.

It is planned to use scaffolding to repair the walls of the ship lock chamber.

For the purpose of repairing the wall from the upstream side of the Begej, in the section between the pier and the floodgate, the design includes cleaning of the Begej bottom in the wall area (50 m in length and 10 m in width of the Begej, assuming that the sludge thickness is



0.50m( and construction of the cofferdam using jumbo bags filled with sand. It is planned to place PVC film between the bags. The cofferdam in the damaged wall area is to be constructed in two parts (upstream and downstream of the floodgate), given that in the natural flow regime, the floodgate frames are laid on the bottom of the Begej.

After the cofferdam is built, the water is planned to be pumped using a mud pump to ensure dry repair works on the wall, in its full height.

Depending on the water level of the Begej, the works to repair the pier are to be carried out either from a vessel or from scaffolding.

## 2.DISASSEMBLY AND DEMOLITION WORKS

The design for repair works includes disassembly of the following elements:

- Wooden fender beams in the ship lock chamber and on the pillars of the pier
- Wooden planks on the pathway of the pier
- Steel elements of the pier (frames and longitudinal sections of the pathway)
- Damaged steel supports of manhole covers
- wire part of the fence with metal pillars on the brick gate in front of the building
- fences and gates at the entrance to the complex

Demolition works include the following:

- Demolition of damaged and displaced sections of the chamber walls made of watertight solid brick
- Demolition of damaged sections of the wall between the pier and the floodgate
- Demolition of the concrete pathway on the ship lock walls
- removal of the damaged brick wall parts in the zone of the right bank bridge support of the Begej river
- Demolition of a section of the reinforced concrete manhole on the right upstream pound of the ship lock

## 3.EARTHWORKS INCLUDING CONSTRUCTION OF AN ACCESS ROAD AND HANDLING PLATFORMS

Planned earthworks include manual excavation of soil during the repair of access pavements.

An access road is planned to be constructed, 134 m long and 3 m wide. The access road is to connect the existing route on the left bank of the complex of the hydrotechnical node of Srpski Itebej with the left bank of the ship lock, including construction of two handling platforms measuring 20x12 m each. Next to each of the handling platforms, the plan is to additionally construct a smaller platform, measuring 11.40x6.40 m, to store stop logs.

The access road structure consists of the following: 30 cm of sand, 20 cm of crushed stone aggregate 0-63 mm and 10 cm of crushed stone aggregate 0-31.5 mm; total thickness 60 cm.

The handling platform structure consists of the following: 40 cm of sand, 25 cm of crushed stone aggregate 0-63 mm and 10 cm of crushed stone aggregate 0-31.5 mm; total thickness 75 cm.

The site where access roads and handling platforms are to be constructed is occupied by green space. Therefore, the design includes tree cutting and stump removal. While doing the site layout survey, ensure that the routes of access roads and handling platform locations are positioned so as to require minimum tree cutting.

#### 4.CONCRETE WORKS

The design for repair works includes the following concrete works:

- Concreting of pathways on the ship lock walls
- Concreting of access pavements
- Concreting of the reinforced concrete manhole on the right upstream pound of the ship lock
- Concreting the reinforced concrete footing of the bridge support on the ship lock wall
- Concreting of the floodgate threshold model on the right bank (in front of the workshop, next to the spare floodgate frames)

#### 5.MASONRY WORKS

Before carrying out masonry works to repair the chamber, the wall between the pier and the floodgate and also the wall of the right abutment, it is necessary to pressure wash the surfaces, using an HD device.

After the cleaning, the following works are to be carried out:

- Building of removed segments of chamber walls using watertight solid brick
- Building of the removed wall between the pier and the floodgate using solid brick, watertight solid brick and dressed stone
- construction of the removed wall parts using the solid brick in the zone of the right bank support of the Begej river bridge.
- Jointing of the ship lock chamber walls, the wall between the pier and the floodgate and the walls of the right abutment

The masonry works also include:

- Repair of the stone elements under the pier
- Plastering of the fence walls made of brick (the fence in front of the facilities within the complex of the hydrotechnical node)
- Construction and installation of the wire part of the fence with metal pillars on the brick fence (in front of the buildings of the hydro node complex)
- construction and installation of the wire fence and gates at the entrance to the complex

#### 6.REINFORCING STEEL WORKS

The design includes reinforcing upon repairing of the manhole on the upstream pound of the ship lock. The manhole is to be reinforced using reinforcing mesh, which should be connected at the corners with reinforcing steel Ø10, B500B.

#### 7.CARPENTRY

The design includes installation of new wooden fenders on the walls of the ship lock chamber and the pillars of the pier. The fenders should be made of dry pine timber measuring 30x30/400 cm in the ship lock chamber and 20x20/350 cm on the pillars of the pier.

#### 8.METALWORK

Metalwork includes:

- Construction and installation of threshold lining on the bottom of the chamber, at the upper and lower lock gates

- Construction of a recess for the upper bearing of the lock gate for the upper and lower lock gates
- Construction of recesses and abutments for the lateral supports of the upper and lower lock gates
- Construction of the lining of vertical edges at the upper and lower gate recesses
- Construction of the lining and niche with a face guide for installing stop logs, upstream of the upper lock gate and downstream of the lower lock gate
- Construction and installation of threshold lining for stop log support, upstream of the upper lock gate and downstream of the lower lock gate
- Construction and installation of steel frames (pillars) of the pier
- Construction and installation of pathway supports on the pier, made of steel sections U100
- Construction and installation of pathway treads on the pier, made of hot-dip galvanized grid treads (grids)
- Repair of the steel fence on the wall of the ship lock and the pier
- Repair of manhole covers, cover supports and other metal elements
- Repair of step irons (fixed ladders) in the ship lock chambers
- Lifting of the structure of the bridge across the Begej using hydraulic presses (estimated bridge weight is 9350 kg), using temporary supports
- Construction and installation of new supports for the bridge across the Begej
- Painting of the box structure of the bridge across the Begej, bridge fence and pathway, including base preparation, application of primer and two layers of paint for metal surfaces
- Construction of threshold lining at the gates of the ship lock chamber (lining is made of 10 mm thick stainless steel)

Note: Before construction and preparation of installation points for metal elements and mechanical equipment, all measures are to be checked on-site.

## 9. OTHER WORKS

Other works include the previously mentioned installation of 2 piezometers for monitoring the groundwater level, and also repair of the stone cladding of the bank revetment.

## 10. PREPARATION OF THE DESIGN OF THE CONSTRUCTED FACILITY

Having completed the works, the Contractor is to prepare THE Design of the constructed facility in case that there were changes during the execution of works compared to the design solution provided in the Detailed Design.

### NOTES:

- The use of most of the repair materials is specified by the Manufacturer and limited by the base and ambient temperature requirements, ranging from +5°C to +30°C. Accordingly, the Designer recommends that the repair works be carried out in the period when the expected temperature corresponds with the specified one so as to avoid low-quality works.
- The works to repair the ship lock gates, mechanical equipment and floodgate are included in the mechanical engineering section of the Detailed Design (Book 6).

The works to repair the facilities within the hydrotechnical node of Srpski Itebej (technical buildings) are included in the architectural engineering section of the Detailed Design (Volume 1).

## **3.6.2. TECHNICAL REQUIREMENTS**

### **INFORMATION ABOUT THE WATER REGIME OF THE NAVIGABLE BEGEJ RIVER IN SRPSKI ITEBEJ HYDROTECHNICAL NODE**

According to the data provided by the Investor - PWMC Vode Vojvodine:

- in the period from 15 September to 1 May (natural flow regime), water level in the Begej canal ranges between 77.80 to 78.60 m.a.s.l.

- in the period from 1 May to 15 September (backwater flow regime), water level in the Begej canal ranges between 80.00 to 80.20 m.a.s.l.

According to the data provided by the Investor, the planned start of the repair works of SRPSKI ITEBEJ Hydrotechnical Node is November 1, 2019 and the works will be performed 18 months (until 1 May 2021).

### **LIST OF FACILITIES AND DESIGN REPAIR WORKS**

The repair works of Srpski Itebej hydrotechnical complex include the works on the following facilities:

- ship lock chamber
- ship lock wall on the Begej side between the pier and floodgate
- ship lock wall on the Begej side in the zone of the bridge bank support
- pier (ship dock)
- bank revetment
- pedestrian bridge over the canal
- floodgate threshold model
- brick fence in front of the complex of buildings
- fence and gates at the entrance to the complex
- technical building
- access roads, handling platforms and sidewalks
- power cables and outdoor lighting

Volume 1 – Architectural Design provides a Technical Description of the technical building, workshop, residential building and shed building repair works.

Volume 2 – Structural Design provides a Technical Description of construction and repair works of the lock chamber, pier, bank revetment, pedestrian bridge, floodgate threshold model, fence and gate of the complex, construction of access roads and handling platforms.

Volume 4 – Power Installations Design provides a Technical Description of power cable and outdoor lightning installation works and repair works of the power installations of the technical building, workshop, residential building and shed building.

Volume 6 – Mechanical Installation Design provides a Technical Description of floodgate, gates and ship lock mechanical equipment repair works and stop log construction works.

### **TECHNICAL DESCRIPTION OF CONSTRUCTION WORKS**

Prior to the commencement of works, it is necessary to construct access roads and handling platforms for the transport and storage of construction materials and equipment and construction machinery operation (cranes, excavators, loaders, trucks, etc.)

## LOCK CHAMBER REPAIR WORKS

To repair the ship lock chamber, it is necessary to ensure dry working conditions, which require some preparatory works. In addition, the use of most of the repair materials is specified by the Manufacturer and limited by the base and ambient temperature requirements, ranging from +5°C to +30°C. Accordingly, the Designer recommends that the repair works be carried out in the period from early April to the end of October (except in the period of high summer temperatures) when the expected temperature corresponds with the specified one so as to avoid low-quality works.

Please note that the ship lock chamber extends almost over its entire length (except the inlet part of the chamber head) downstream of the floodgate, which means that at the time of repair works, the water level of the Begej will be 77.80 to 78.60 m.a.s.l.

Preparatory works include the following works:

- cleaning of the bottom in front of the inlet and outlet lock head in the zone intended for the installation of the cofferdam of jumbo bags.
- construction of the jumbo bag cofferdam filled with sand upstream and downstream of the lock head.
- Water pumping from the ship lock chamber
- Cleaning the chamber bottom of deposits and sludge
- construction of the first order niches and thresholds next to the inlet and outlet lock head in order to install new stop logs
- installation of stop logs (5 pcs) at the upstream end of the lock chamber.

The design defines that these preparatory works are to be performed in the lowest water level, i.e. from 15 September to 1 May (natural flow regime) when the water level in the Begej canal ranges from 77.80 to 78.60 m.a.s.l. At the maximum water level of Begej, the cofferdam height is 3.75 m ( $H=78.60-75.05+0.20=3.75$  m). Should the water level of the Begej river increase, it will be needed to increase the height and width of the Begej river.

The Designer's recommendation is to execute the preparatory works in the period of natural flow regime in order to perform the repair works in the period from May to October, i.e. in the period when the substrate temperature and ambient temperature are in line with the temperature prescribed by the manufacturer of the repair materials.

Simultaneously with the preparatory works, it is necessary to construct new stop logs (5 pieces), which should be placed in the prepared niches at the upstream gate no later than 1 May. The design dimensions of a stop log are  $b/h/L=810/1100/10400$  mm. One stop log weighs around 4000 kg (4 tons).

As the lock chamber repair works will be performed in the period from 1 May to 15 September (backwater flow regime), when the water level in the Begej canal upstream of the lock ranges between 80.00 and 80.20 m.a.s.l., the required number of stop logs is as follows:

on the upstream chamber side  $n=(80.20-75.05)/1.10=4.68$  5 pcs of stop logs adopted

(bottom level upstream and downstream of the chamber gate: 75.05 m.a.s.l.)

(chamber bottom level: 75.40 m.a.s.l.; threshold height under the gate  $h=75.40-75.05=0.35$  m)

Once the stop logs are installed in front of the upstream gate, the jumbo bag cofferdam may be removed.

Water flow to the downstream lock chamber, where water level of the navigable Begej river ranges between 77.80 to 78.60 m.a.s.l. throughout the year is to be provided by a cofferdam of jumbo bags filled with sand, which will be installed downstream of the outlet lock head. This cofferdam is to be removed upon completion of the lock chamber repair works.

In order to meet the chamber stability requirements in the lock chamber repair stage (dry chamber without water), it is necessary to monitor and maintain the groundwater level behind the chamber wall at 76.80 m.a.s.l. (1 m under the Begej water level) as shown in the Lock Chamber Stability Analysis, which constitutes an integral part of this volume of the design, no. 2.6.1.

In this regard, the preliminary works include the installation of 1 piezometer for monitoring the lowest water level and construction of 4 drainage wells for lowering the water level to 76.80 m.a.s.l., as defined by the technical description and priced bill of quantities for the ship lock repair, taking into account the fact that in the design development stage, the required hydrogeological data were not available to the designer and consequently, the number, layout, diameter and the depth of the drainage wells are determined without a detailed calculation.

The designer defined that the construction and removal of the upstream and downstream cofferdam of jumbo bags be performed by a crane on the left bank of the Begej. The size of one jumbo bag filled with sand is 1.0x1.0x1.0 m. The weight of one this bag is 2 tons.

Water from the ship lock chambers will be pumped by sludge pumps into the Begej river. In order to clean the chamber bottom from deposits and sludge, it is necessary to “break” the deposits by water pressure and then to pump them with the sludge pump. The deposits and sludge are to be transported to the existing sludge removal container, which is, according to the information provided by the Investor, located on the bank at a distance of 500m.

Once the dry working conditions are provided, prepare the first-order niches in the walls of the inlet and then outlet ship lock head and prepare the threshold lining in order to provide support for stop logs on the bottom slab. To prepare the niches, it is necessary to set up a 4.50 m high scaffolding, given that the niche height is 6 m from the bottom to the top. The preparation of niches implies increasing of the size of the existing niches and their lining with stainless steel sheets, all with the aim of providing conditions for undisturbed installation and sealing of new steel stop logs.

In order to ensure dry working conditions, the thresholds are to be constructed using stainless steel sheets on upstream and subsequently on the downstream end of the bottom chamber slab. The steel cofferdam beams are elaborated under the Mechanical Installations Design (Volume 6), and the niche and threshold lining details are provided in the Structural Design (Volume 2, drawing no. 2/1.7.10.).

New steel stop logs (5 pcs) are to be installed by a crane on the left bank of the Begej river. According to the design, one stop logs weighs around 4 tones. The stop logs are to be installed only at the upstream end of the ship lock.

To execute the ship lock chamber wall repair works, it is necessary to set up of 4.30 scaffolding given that the wall height is 5.80.

The ship lock chamber is cladded with water-resistant bricks (yellow clinker brick) and involves the following repair works:

- removal of damaged and displaced parts
- cleaning with high water pressure (using HD devices)

- construction using water-resistant facade bricks in lime cement mortar
- joint filling

## REPAIR OF THE SHIP LOCK WALL ON THE BEGEJ SIDE BETWEEN THE PIER AND FLOODGATE

To repair the ship lock wall on the Begej side, between the pier and floodgate, it is necessary to ensure dry working conditions. Therefore, it is recommended that the works are executed in the period from 15 September to 1 May (natural flow regime) when the water level in the navigable Begej canal range between 77.80 to 78.60 m.a.s.l. In that case, the required cofferdam height and width and consequently the required amount of water pumping are considerably less. The required cofferdam height in that period is 2.95 to 3.75 m, assuming that the Begej bottom level in the floodgate area is 75.05 m.a.s.l.

It is planned that the sand-filled jumbo bag cofferdam installation and removal works be executed by water-based machinery (backhoe dragers) with the previous cleaning of the canal bottom in the damaged wall area.

Please note that in order to provide access to water-based machinery to the site upstream and downstream of the floodgate, the water-based machinery needs to pass under the pedestrian bridge, the bottom edge of which is at 81.30, meaning that the free height for the passage of vessels is 2.60-3.40 m. If this requirement cannot be met, an alternative solution may be a self-propelling backhoe dredger (on tracks) and the road to the upstream side of the pedestrian bridge that crosses the mainland, movement along the bank.

After cleaning the canal bottom and installing the cofferdam, water is to be pumped by sludge pumps into the Begej river and the scaffolding is to be set up along the entire wall height in order to repair the wall. The wall height is  $H=81.20-75.05=6.15$  m and hence, the required scaffolding height is 4.70 m. The scaffolding substrate must be cleaned well from deposits and sludge and must be of adequate strength depending on the scaffolding weight, load capacity (people, material, equipment), number and arrangement of the scaffolding pillars.

Due to the high level of wall damage, it is necessary to carefully perform the wall repair works, in the shortest possible sections and without dynamic loads observing the prescribed and full application of occupational safety and health measures.

The construction works are to be performed in the period when the substrate temperature and ambient temperature range in the interval from +5°C to +30°C, all in accordance with conditions for the use repair material prescribed by the Manufacturer.

The completion of wall repair works is a precondition for the repair of right (canal) ship lock chamber wall in the inlet head area as well as for the repair of the pathway located in this part of the ship lock.

Furthermore, the pedestrian bridge repair works can only be performed after the ship lock wall between the pier and the floodgate on the Begej river side is repaired and only after the mechanical characteristics of the repair material prescribed by the Manufacturer are met.

## REPAIR OF THE WALL ON THE RIGHT BEGEJ BANK IN THE ZONE OF THE BRIDGE BANK SUPPORT

The wall repair works on the right bank of the Begej river in the zone of the bridge support should be performed in the period from 15 September to 1 May (natural flow regime) when the

water level in the navigable Begej canal ranges between 77.80 to 78.60 m.a.s.l. It planned to execute the works from the bank-supported suspended scaffolding (bank elevation 81.20 m.a.s.l.<) observing the prescribed and full application of the occupational safety and health measures.

The construction works are to be performed in the period when the substrate temperature and ambient temperature range in the interval from +5°C to +30°C, all in accordance with conditions for the use repair material prescribed by the Manufacturer.

## PIER REPAIR WORKS

The recommended period for the execution of pier repair works is from 15 September to 1 May (natural flow regime) when the water level in the navigable Begej canal ranges between 77.80 to 78.60 m.a.s.l. In this case, it is possible for the works to take place in dry conditions given that the crown of the stone prism under the pier is at level of 78.10 m.a.s.l.

The pier repair works include the removal of all damaged pier parts and construction of a new pier.

As the pier pillars reach a height of around 3 m, a working platform needs to be installed on the stone prism and its slope on the lock side in order to remove the parts of the pier. The working platform is to be installed at 78.70, i.e. 0.60 m above the stone prism crown in order to ensure dry working conditions at the maximum water level of the natural water regime, which is at the level of 78.60 m.a.s.l.

The removed parts are to be loaded and transported by a dredger, which will transport the demolished material to the left bank where it will be loaded to a truck and transported to the 15 m distant landfill determined by the Investor.

According to the data provided in the Conceptual Design for the repair of Srpski Itebej Hydrotechnical Node, which was prepared by Hidroprojekt Zrenjanin d.o.o. in 2016, the pillars of the pier frame are made of steel sections 240, 8 m long. For the row of pillars on the canal side, the overground part is 3 m high and the pillars are 5 m dug into the ground (2.50 m in the stone prism, 2.5 m in the ground). For the row of pillars on the lock side, the overground part is 5 m high (height from the pier tread to the stone prism crown is 3 m, while the remaining 2 m of the pillar length is in front of the stone prism slope) and 1 m goes through the stone prism toe and 2 m are dug into the ground.

When removing the pier frame pillars, it is not necessary to remove a part of the pillars on the stone prism and ground, but a pillar needs to be cut and only the visible part of the pillar needs to be removed.

The new steel pillars I 240, length 8 m, are to be driven into the ground by steel pile driving drill mounted on the vessel. The pillars are to be driven into the ground directly next to the existing pillars (remaining part of the pillar in the ground may be used as an extension for the pile guide or pillar). In the area of driven piles, a part of the stone prism needs to be temporarily removed by a backhoe dredger and the stone prism is to be re-installed after the pillars are driven into the ground)

As the pier is surrounded by water on three sides, and given that it is connected to the land on one (transverse) side by the pedestrian bridge and lock wall, people, material and equipment may be transported either from land or from water (by vessel).

To access the pier from land, it is necessary to install prefabricated stairs on the ship lock wall crown (level 81.20) at the beginning of the pier, which will be used to descend to the stone



prism crown level under the pier pathway (78.10) or to the working platform level (78.70). The stairs would overcome the height difference of 3.10 or 2.50 m.

The top surface of the pathway and the pier gate may be repaired from the land using the pedestrian access bridge and ship lock wall.

Please note that in order to provide access to water-based machinery to the pier (located upstream of the floodgate) the water-based machinery needs to pass under the pedestrian bridge, the bottom edge of which is at 81.30, meaning that the free height for the passage of vessels is 2.60-3.40 m. If this requirement cannot be met, an alternative solution may be the water-based machinery passage through the ship lock, but this solution requires all chamber repair works to be completed, i.e. the ship lock must be operational..

#### **BANK REVETMENT REPAIR WORK**

The recommended period for the execution of the bank revetment slope repair works is the period of the lowest water level, i.e. in the period from 15 September to 1 May (natural flow regime) when the water level in the navigable Begej canal ranges between 77.80 to 78.60 m.a.s.l.

The works include repair of the stone cladding with rolled crushed stone in the bottom part and manually stacked crushed stone in the upper part.

#### **REPAIR OF THE PEDESTRIAN BRIDGE OVER THE CANAL**

The pedestrian bridge repair works are not dependent on the Begej water level and can be performed independently of the water regime conditions.

It is important to note that these works should not be executed simultaneously with the canal bottom cleaning works next to the floodgate and the precondition for execution of these works is the completion of ship lock wall repair works on the Begej side from the pier to the floodgate only after the mechanical characteristics of the repair materials recommended by the Manufacturer are met.

The canal pedestrian bridge repair works include the repair of the bridge support (in particular, the left support, i.e. support on the ship lock wall) and anti-corrosion protection of the entire bridge. In order to repair the support, it is necessary to lift the bridge by hydraulic presses in order to access the bridge supports.

As this is the steel box structure, it is important that during the execution of works the substrate temperature and the ambient temperature range between +5°C to +30°C. Accordingly, the Designer recommends that the repair works be carried out in the period when the expected temperature corresponds with the specified one.

In order to provide new anti-corrosion protection, which involves substrate preparation, application of the primer and two layers of metal paint, it is necessary to set up a mobile scaffolding along the bridge width with the working platform under the bridge. As this platform will decrease the height of the navigable profile under the bridge, the anti-corrosion protection works need to be aligned with the passage of water-based machinery under the bridge. It is recommended to execute the anti-corrosion protection works prior to the commencement or upon completion of works at the sites upstream of the bridge (canal bottom cleaning next to the floodgate, ship lock wall repair on the Begej side from the pier to the floodgate, pier repair works).

## REPAIR OF OTHER FACILITIES

The repair works of the floodgate threshold model, brick fence in front of the building complex, technical building, fence and gate at the entrance to the complex, power cables and outdoor lightning) are not dependent on the Begej water level and may be executed independently of the water regime conditions. It is important that during the execution of works, due to the use of repair materials, the substrate temperature and the ambient temperature range between +5°C to +30°C.

Accordingly, the Designer recommends that the repair works be carried out in the period from early April to the end of October (except in the period of high summer temperatures) when the expected temperature corresponds with the specified one so as to avoid low-quality works.

# VOLUME 3.7

## TECHNICAL SPECIFICATIONS - ELECTRICAL WORKS ON REHABILITATION OF HYDRO COMPLEXES SRPSKI ITEBEJ

### GENERAL PROVISIONS

Pursuant to the ToR, and based on the bases and data from the construction and mechanical designs, the following parts of the complex are developed under this design of electrical installations for the **Rehabilitation of Srpski Itebej hydroengineering complex**:

Ancillary facilities:

- Technical building;
- Lighting of hydraulic power system;
- Marking of waterways;
- STS power facility.

The following electrical installations are described:

- Cable connection boxes (CCB), measuring point cabinets (MPC), main distribution cabinets (MDC) and distribution cabinets (DC) of sub- distribution for the supply of consumers;
- Interior installations of general electrical lightning;
- Exterior installations of electrical lightning and light signals of hydraulic power system;
- Installations of "panic" lighting on main communications and exits;
- Installation of mono-phase and three-phase Schuko sockets;
- Installation of earthing, potential equalization and lightning protection of buildings.

The technical solutions envisaged by this design are in compliance with the valid SRPS, IEC and ISO standards, other applicable technical regulations for this area and good engineering practice.

### DESCRIPTION OF CURRENT CONDITION OF POWER INSTALLATIONS OF HYDRO-ENGINEERING COMPLEX

#### Technical building

The building was built at the beginning of the twentieth century. It remained unchanged until present, except that electrification of the building was carried out in the mid-1970s. The power supply for the consumers in the building is provided from the MDC located inside the building. MDC is supplied from the cable connection box CCB-2, which is located on the facade of the building. CCB-2 is supplied from the pole-mounted substation STS20/10/0.4 kV/kV/kV, 50 kVA in whose low voltage distribution cabinet there is a measuring group for measurement of electricity consumption. The electrical installation of the building was maintained only in the part of the building that was used as an office, and only within the scope of regular maintenance. It is necessary to replace the complete cable distribution and adjust the installation to the actual needs of the users in the building. Electrical installation equipment is partly broken, worn out, and its complete replacement is necessary. Existing lights in the building are of poor lighting characteristics, defective, unsafe and need to be completely replaced. There is a classical lightning installation on the building, in the form of a Faraday Cage, with four down lead conductors and measuring points, which is out of function.

#### Lighting of hydraulic power system

Exterior lighting is carried out on the right side of the river Begej bank, along the existing road between the facilities on the hydraulic power system and the ship lock, with six lighting poles equipped with lamps with sodium high pressure lightbulbs. On the left side of the river Begej there is no lighting installed on the hydraulic power system.

### **Marking of waterways**

Marking of waterways has not been installed.

## **NEWLY DESIGNED INSTALLATIONS**

### **TECHNICAL BUILDING**

#### **Building power supply**

The basic power supply of the building will be provided from the public electric distribution network of medium voltage (20/10kV/kV), from the pole-mounted substation 20/10/0.4 kV/kV/kV, with the power of 50kVA.

The measurement of the power consumption is provided by existing, three-phase active electronic meter located in the NN box of STS.

#### **Distribution cabinets**

The main distribution cabinet MDC (power supply from CCB-2) is located in the building and it supplies all consumers in the building. The outdoor lighting cabinet DC-SR (power supply from CCB-2) is located in the staircase area and it supplies power to the lighting of the hydraulic power system - the left and right banks of the Begej river and the marking of waterways of the ship lock.

The cabinet housings are made of polyester, in IP54 protection.

#### **Electrical installations of interior lighting**

The present design of the administrative building reconstruction of the hydroengineering complex in Srpski Itebej foresees the dismantling and replacement of existing worn-out lamps and installation switches with new ones.

The lighting of individual rooms is envisaged by means of adequate installation of lighting points with above-fitted fluorescent lamps. In the ancillary rooms, lamps with bulbs with wire filaments and fluo compact are envisaged.

Lighting installation is performed by cables of type N2XH 2,3,4 ×1.5mm<sup>2</sup>, in the wall and ceiling, under mortar.

Activation of the lighting is by means of a single-pole installation switch of "in wall" type.

For panic lighting of escape routes and exits, the lamps with their own source of power supply (Ni-Cd batteries), automatic charging and automatic switch-on in the event of a power outage shall be foreseen. These lamps are above fitted with a 1×8W bulb, autonomy 3h, similar to the type BPN P 108, IP40, Buck. The installation of panic lighting provides passage of communications to the exit from the building, in case of a need for evacuation and voltage failure, and they should be provided with stickers with direction markings to the nearest exit and exit signs.

#### **Electrical installations of sockets and plugs**

The present design of the administrative building reconstruction of the hydroengineering complex in Srpski Itebej foresees the dismantling and replacement of existing worn-out lamps installation sockets with new ones. The sockets have been selected and fitted according to the conditions of the site where they are being mounted.

Electrical distribution for the purpose of installation of mono-phase sockets is foreseen by means of cables of type N2XH 3×2.5mm<sup>2</sup>, placed in the wall, under the mortar.

Electrical distribution for the purpose of installation of three-phase five-pole sockets is foreseen by means of cables of type N2XH 5×2.5mm<sup>2</sup>, placed in the wall, under the mortar.

The sockets are installed at a height of 0.5m from the floor level.

#### **Lightning protection of facilities**

The existing lightning installation of the administrative building will be disassembled during the reconstruction of the roof covering, roof structure and facade, and the design foresees its complete replacement.

The new lightning installation has been implemented in accordance with PTN 11/96 and valid SRPS standards for this type of works. In order to protect the buildings from lightning, a protection levels has been selected in advance according to SRPS IEC 1024-1-1, and for the

adopted level of protection, a lightning protection installation consisting of an earthing system, a system of down lead conductors and a reception system has been designed.

Earthing system:

A standard lightning installation has been designed for the building with the following characteristics: for accepting the lightning electricity discharge, a ground ring made of galvanized steel strip Fe-Zn 25x4mm steel strip, which is laid in a trench, at a distance of 1.5 m from the building and at a depth of 0.8 m is foreseen. This type of earth electrode is of type "B" according to IEC SRPS 1024-1, point 2.3.3.2 .. The manufacturing of ground wires from the earth electrode to the test joint and metallic components is envisaged by the Fe-Zn 25x4mm band, and the joints of the earth tape and ground wire are fitted by standard cross-run clamps in the ground, which are filled with bitumen.

The system of down lead conductors:

Four down lead conductors have been provided for the routing of the lightning discharge. The down lead conductors are fitted with galvanized Fe-Zn 20x3mm band, on adequate supports, across the facade of the building. At the very end of a vertical lightning conductor, down lead, and at a height of 1.75m from the ground level, a measuring joint is fitted according to standards and norms, overlapping, and this point is to be secured by a cross-run plate of type P SRPS N.B4.936. At the bottom, towards the earth electrode, an earth leakage is used, a steel galvanized strip Fe-Zn 25x4mm, length 4.5m. A ground wire strip (P 25x4 SRPS N.B4.901 Č) to the level of the measuring joint on the facade of the building shall be mechanically protected by a galvanized section A 40x40x 51500 SRPS N.B4.913 P.

Reception system:

For the reception system lightning protection installations, the natural components of the steel galvanized sheet with more than 0.5mm thickness are partially used, and partially galvanized Fe-Zn 20x3mm strip for the eaves and slopes of the roof on the adequate supports at a distance of 1m between each other. The joints of the reception system strip are fitted with standard cross-run clamps. The width of the reception system installation mesh sieve is in accordance with the general requirements of SRPS IEC 1024-1.

### **Protection against electric shock**

Power supply system in terms of earthing (JUS N. B2.730) is TN-C-S. The functions of neutral and protective conductors is only integrated in the part of the system to the main power supply points, and further down it is separated throughout the installation. All built-in equipment shall comply with the standard SRPS N.B2.741 in regards to the protection against direct contact and with other standards that apply to that type of equipment.

Protection against electric shock is provided by automatic power outage in case of failure, by means of the prescribed protection devices of the differential current ZUDS according to SRPS N.B2.741. The zinc-coated strip Fe-Zn 25x4mm is supplied to the main GPU earthing terminal, in a standard box, with the SIP bus mounted at the CCB-2.

The main potential equalization is provided by connecting all metal components of non-electrical installations at the entrance to the building, by P-Y 1x16 mm<sup>2</sup> conductor and adequate bonding material.

After the completion of the works, the contractor shall perform measurement of grounding resistance, loop resistance and check the continuity of the protective conductor on all protected circuits and shall perform the equipotential check.

## **LIGHTING OF HYDRAULIC POWER SYSTEM**

### **Lights**

The lights intended to replace the existing ones and for the lighting of the hydraulic power system are light for urban surroundings with aluminium alloy housing under pressure, protector and polycarbonate cover, mirror electropolished and anode protected aluminium high-purity and control gear, of the type K-LUX/1640/100 MINEL SCHREDER, with high pressure sodium lamp 100W, 230V, 50Hz, under protection IP66 and IK09.

### **Light poles**

Replacement and installation of conic light poles, 4m high, Ø60mm on pole top with the base of min. 400x400x10mm, with Ø90mm opening, protected by warm internal and external zinc plating and additional anti-corrosion protection up to 40cm above the foundation base is foreseen. The pole shall be equipped with:

- carrier and connection panel RPO-4;
- fuse FRA 16/6A or automatic switch B 6A, 1 piece;
- power supply cable for lamp PP00-Y 3x1.5mm<sup>2</sup>, 4m;
- zinc bolt for earthing and inside the pole and on the pole;
- cover with a red arrow (lighting symbol);
- protection of connection area from rain and
- ordinal number of the pole.

### **Power supply cables**

The installation of the lighting on the hydraulic power system will be supplied by power provided from the public electric distribution network of medium voltage (20/10 kV/kV), from the pole-mounted substation 20/10/0.4kV/kV/kV, with the power of 50kVA.

According to the design, the lighting is powered from the DC-SR, located in the administrative building, and will be manually activated by a switch from the switchboard and automatically via a time-programmer. Power cables are the type PP00-Y 5x16mm<sup>2</sup>, according to the principle of the input/output, and for the left and right banks of the river Begej.

The cables for outdoor lighting are laid in a cable trench measuring 0.4 x 0.8 m. At crossing points with other installations, it is envisaged to lay protective PVC pipes in advance. The pipes are of nominal diameter Ø50mm.

For the purpose of powering the lighting poles on the left side of the Begej, the power cable goes from the right to the left side of the Begej, the drilling will be carried out under the river bed and adequate protective tubes will be placed.

Protection against direct contact voltage is carried out in such a way that all live parts are in the pole, on an insulated panel or in a lamp that is positioned at such a height that it can not be reached by unauthorized persons.

On the pole there is an aperture for the connection to the connection board, which is closed by a sealed cover. The cover is fixed with a cap screw.

Protection against indirect contact voltage is foreseen by the same system as for the entire complex.

Additional lightning protection is foreseen. The Fe/Zn 25x4mm strip shall be laid in the same trench, parallel to the cables of the exterior lighting.

## **MARKING OF WATERWAYS**

### **Traffic lights**

Traffic lights signalization is foreseen in accordance with applicable regulations on inland waterways navigation. It consists of optical signals formed by red and green lights. It is implemented with input and output traffic lights, one per each unit. The traffic lights consist of a single two-part driver lantern. A two-part lantern consists of one red and one green light.

### **Traffic lights pole**

Traffic lights are fitted on the pole, 3.2m high, Ø60mm on pole top with the base of min. 400x400x10mm, with Ø90mm opening, protected by warm internal and external zinc plating and additional anti-corrosion protection up to 40cm above the foundation base.

### **Power supply cables**

The basic power supply will be provided from the public electric distribution network of medium voltage (20/10kV/kV), from the pole-mounted substation 20/10/0.4kV/kV/kV, with the power of 50kVA. The distribution cabinet of the traffic lights (DC-Semafor) is powered from DC-SR, located in the administrative building, with a cable of type PP00-Y 3x4mm<sup>2</sup>. The housing of the distribution cabinet is made of steel sheet metal protected with anti-corrosion paint. The housing has a door, lock and a key. Envisaged in the cabinet is the construction for carrying equipment made of perforated profiles. Placed above the equipment is a protective plate.

According to the design, the traffic lights at the upstream and downstream entrance into the ship lock shall be manually operated, with a switch, from the distribution cabinet DC-Semafor.

The cables for the power supply of traffic lights are laid in a cable trench measuring 0.4x0.8 m. At crossing points with other installations, it is envisaged to lay protective PVC pipes in advance. The pipes are of nominal diameter Ø50mm.

For the purpose of power supply of the lighting signalization, a power cable goes from the right to the left side of the river Begej, i.e. the cable, along with the power cable of the hydraulic power system lighting on the left side of the Begej is laid under the riverbed, through a protective tube.

Protection against direct contact voltage is carried out in such a way that all live parts are in the pole, on an insulated panel or in a traffic light that is positioned at such a height that it can not be reached by unauthorized persons. On the pole there is an aperture for the connection to the connection board, which is closed by a sealed cover. The cover is fixed with a cap screw.

Protection against indirect contact voltage is foreseen by the same system as for the entire complex.

Additional lightning protection is foreseen. The Fe/Zn 25x4mm strip shall be laid in the same trench, parallel to the cables of the traffic lights.

### **POLE-MOUNTED SUBSTATION STS 20/10/0.4kV/kV/kv, 50kVA**

The hydroengineering complex will be supplied by power from the public electric distribution network of medium voltage (20/10 kV/kV), from the pole-mounted substation 20/10/0.4kV/kV/kV, with the power of 50kVA.

Judging by its condition, no investments have been made in the energy facility for a long period of time. Revision of the transformer station should be carried out for the purpose of the regular operation of the pole-mounted substation and regular and continuous supply of electric power. Based on the revision a complete report will be prepared with expert findings and with the measures required for rehabilitation of equipment.

Works on the revision of the energy facility would include the following:

#### **Inspection obligation**

Rulebook on technical norms for operation and maintenance of electric power facilities and lines (Official Gazette of SRY 41/93).

#### **Manner of inspection**

- 1) Rulebook on technical norms for electric power facilities with nominal voltage over 1000V (Official Gazette of SFRY 4/74);
- 2) Rulebook on technical norms for fire protection of electric power facilities and devices (Official Gazette of SFRY 74/90) and
- 3) Rulebook on technical norms for electric power facilities with nominal voltage over 1000V (Official Gazette of SFRY 61/95) and
- 4) Rulebook on technical norms for protection of low voltage networks and accompanying transformer stations (Official Gazette of SFRY no. 13/78 and Official Gazette of SRY 37/95)

# VOLUME 3.8

## TECHNICAL SPECIFICATIONS AND REQUIREMENTS - MECHANICAL WORKS SRPSKI ITEBEJ SHIP LOCK AND FLOODGATE

### 3.8.1. TECHNICAL DESCRIPTION

#### SHIP LOCK

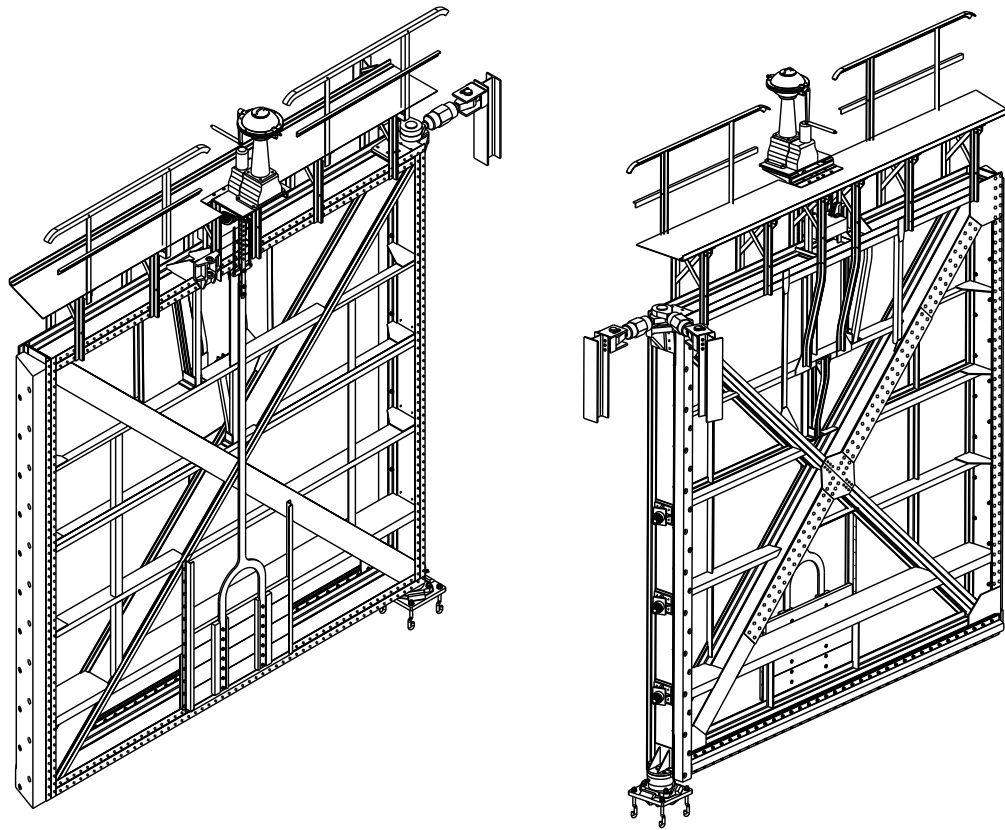
##### Ship lock doors

Based on the inspection of the doors by detailed visual inspection and measurements on the part of the equipment and the structure that is located above the water level, it can be concluded that the sheets (formwork) and the supporting structure have visibly corroded and based on the assessment of the part of the gates under the water it is necessary to manufacture a new door.

The new door is to have the identical geometric shape as the existing door. The loadbearing structure consists of standard sections lined on one side with steel stop logs. The sections of the loadbearing structure and steel stop logs are to be connected by welding. Where the existing solution has rivets in the visible part of the structure (above water), the connection is to be made by welding with high-quality setting (welding) of strips with rivets as a mask. This is the way to keep the same visual appearance of the doors. The upper door is defined in Drawing No. PUI-1.01.01.00.00.

Vital changes to the existing solution include changes in the upper and lower bearings, the method of door support in the niches, the niches themselves, which have been adapted to the new support and sealing, the threshold structure, horizontal sealing (rubber instead of oak beams) and flashboards where sealing is done using rubber on a stainless steel strip, L-section supports, with oak board infilling, Figure 1. All these changes have either no or negligible effect on the visual appearance of the new doors, compared to the existing doors.





*Figure 1 Door leaf*

### **Upper bearing**

The upper bearing completely matches the upper bearing of Klek ship lock, see the technical description of the upper bearing provided in the section for Klek ship lock.

### **Lower bearing**

The lower bearing completely matches the upper bearing of Klek ship lock, see the technical description of the upper bearing in the section for Klek ship lock.

### **Support and sealing elements in the door niche**

See the technical description provided in the section for Klek ship lock.

### **Support and sealing between door leaves**

See the technical description provided in the section for Klek ship lock.

### **Support and sealing at the door threshold**

See the technical description provided in the section for Klek ship lock.

### **Door opening and closing mechanism**

See the technical description provided in the section for Klek ship lock.

### **Flashboards**

See the technical description provided in the section for Klek ship lock.

### **Lifting and lowering mechanism of the lock door flashboards**

See the technical description provided in the section for Klek ship lock (lifting and lowering mechanism of the middle door flashboard).

### **Door niches**

See the technical description provided in the section for Klek ship lock.

**The door threshold**

See the technical description provided in the section for Klek ship lock.

**Stop logs**

See the technical description provided in the section for Klek ship lock.

**FLOODGATE**

See the technical description provided in the section for Klek floodgate.

## **3.8.2. TECHNICAL REQUIREMENTS**

See the technical requirements provided in the section for Klek.