18.5.45 TOILET VENTILATION

Toilet ventilation shall be supplied through ventilation system connected to the system for extraction of air from the toilet. All cabins and anterooms shall have aero-valves for extraction of waste air. Ducts shall be made with spiral tubes, the diameter of which shall be as per design. Extraction fan shall be the existing one on the roof of the facility. Air shall be recovered through grille on the door. Cabin doors shall be lifted above the floor so as to enable free flow of air between premises and towards parts of the room with over pressure.

18.5.46 OVER PRESSURE VENTILATION ON STAIRCASE AND IN ELEVATOR WELL

Staircase and elevator space shall have over pressure intended to prevent inflow of contaminated air while laboratories are working, and in case of fire or unforeseen situations due to spillage of chemicals. Emergency ventilation shall be provided by axial fans which are placed at the attic and shall supply staircase and elevator space directly with air.

18.5.47 TECHNICAL GASES

Technical gases which are kept in specially built facility next to the building shall be applied for devices used for analysis such as gas chromatograph mass and infrared spectrometer. For the needs of laboratory, gases such as hydrogen, nitrogen, argon, synthetic air and helium shall be applied according to the valid RS standards, norms and approved Main Design. The scope of works and quantities will be presented in the BoQ.
Upon completion of the works, the Contractor shall be liable to carry out all specified tests and measurements and submit written certificates in the form of attest to the Supervisor.

19 INSTALLATION OF ELECTROMOTOR DRIVE AND AUTOMATIC CONTROL

With respect to all the foreseen works, the Contractor shall be fully familiar with all Final Design details, as well as with all local regulations, international and local standards (SRPS), common practice of trade and circumstances for their execution.
Electrical installation of electromotive drive and automatic control for the air-conditioning and heating system between seasons as well as cooling the building has to be installed in accordance with the mechanical design of thermal-technical installations and according to SRPS IEC 60364-5-51. The building is labelled as BD-2 regarding evacuation in case of fire.

HEATING, COOLING AND AIR CONDITIONING SYSTEM

Heating, cooling and air conditioning system comprises the following sections:

- The existing EL fuel oil boiler room
- Newly designed networks for radiator heating system of laboratories and upper floor
- Newly designed networks for hot water supply of the air conditioning compartment
- Air conditioning VRV system as well as heating system between seasons until the main boiler room is put into operation as well as for summer procession of air to be transferred to the laboratories
- Air conditioning compartments for primary air conditioning of 4 laboratories including the office premises

- Secondary air conditioning systems
- Air conditioning of hoods, extract system and safety boxes
- Break down air conditioning

System management is obtained via automatic control by selecting the SUMMER or WINTER mode over SUMMER/WINTER position switch.

19.1 HEATING AND COOLING SYSTEM

VRV system air conditioners are wall mounted and management in a room is obtained by remote controls for each air conditioner separately.VRV system is connected to the compartment air conditioning (four in total), as well as the electric boiler and when specified temperature in the referent room is reached the temperature sensor in the waste air channel emits signal to the three-way valve regulator of the compartment air conditioning for closing and pumping within compartment air conditioning to be turned off, whereas the electric boiler pump circulates water through distributor and collector with no differential pressure. VRV system maintains temperature inside the room. If there is a temperature drop in the referent room by 2° C, the pump within compartment air conditioning turns on and the three-way valve opens. Such mode is on until the specified temperature in the referent room is reached.

Compartment air conditioning and VRV system operating management is obtained over temperature sensor located in the referent room (system KK-1 room No. 8, system KK-2 room No. 41, system KK-3 room No. 16, system KK-4 room No. 32) in the extract channel set to the room temperature of 22° C. Compartment air conditioning inserts constant quantity of air. In rooms where heat loss cannot be covered with air conditioning, local air conditioners set to projected temperature of 22° C are turned on. EMV 1 valve separates electric boiler heating cycle from the existing central boiler room heating cycle and EMV 2 valve separates the existing central boiler room heating cycle from the electric boiler heating cycle. Three-way valve regulates water temperature according to the compartment air conditioning hot water heater.

The described system operates during the main boiler room breakdowns with compartment air condition simultaneous operation factor of 0.5 – that is 50% (two out of four operating simultaneously) Heat loss is covered by the main boiler room supplying the heating elements with necessary water temperature. Heating elements are also provided with thermal heads. Water temperature management is obtained over the main external temperature sensor of the main existing boiler room.

19.2 AIR CONDITIONING

Secondary air conditioning inserts fresh processed air (heated or cooled) into the laboratory. The fresh air quantity to be inserted is constant. Waste air fan with frequency regulator discharges the waste air to the roof of the building. 10-20 Pa gage pressure, regulated over variation between injecting the fresh air and discharging the waste air, is maintained in the room over the pressure transmitter. In the premises where gage pressure is regulated with hoods and extract systems incorporated, flow rate regulators are mounted on channels and managed via transmitter set at Δp=10-20Pa. Hoods and extract systems take air from the laboratory premises. Flow rate regulator in the extract channel reduces the air quantity being extracted by the hoods and extract systems from the room. Once the air conditioning system is off, the secondary air conditioning is on.

19.3 BREAK DOWN AIR CONDITIONING

Breakdown air conditioning turns on in case of an accident only: fire or chemical contamination of the area. At the moment, all systems but breakdown fan lose power supply. Signal for turning on the break down air conditioning is provided by the fire protection command station and gas detection command

station. There are signal emitters in the room and are connected to the fire protection command station. There are signal emitters in each group of premises. Once the accident occurs, fixed motor drive FKS (motor drive smoke valve) open in the accident affected section only while the rest remain closed. Frequency regulation fan turns on and air conditioning begins. Air extraction for the air conditioning is obtained through overpressure shutters and through wall mounted Ø100 mm relief grilles indoors.

19.4 ELECTROMOTOR DRIVE ELECTRICAL INSTALLATIONS

According to the mechanical design, thermal-technical installations, apart from the network supply, will have emergency power supply source. All the electromotor drive electrical installations are connected to the main distribution box of the generator supply, which is specially provided for the first floor and installed next to the existing diesel-generator.

Since the laboratories are divided into two separate sections, the entire air conditioning system is also divided into two systems concentrated in two cabinets – RO-KS1 (left part of the corridor) and RO-KS2 (right part of the corridor). All electrical installations of the electromotor drive and automatic control with compartment air conditioning KK-3 and KK-4 are connected to RO-KS1 system, whereas all electrical installations of the electromotive drive and automatic control with compartment air conditioning KK-1 and KK-2 are connected to RO-KS2 cabinet. The breakdown installation cabinet is connected to RO-KS1.

Apart from the air conditioning system, redundant heating and cooling system is also envisaged over three VRV devices mounted on the roof and connected to RO-KS2 cabinet. Controlling these systems is envisaged to be via remote controllers for each internal unit. Turning the air conditioning off in case of fire is envisaged to be via fire signalling command station.

For cooling the racks in server room there are two split units envisaged, backing each other up. The internal units are located in the server room while the external ones are on the roof. The design envisages their supply whereas the Contractor is responsible for interconnecting them to operate simultaneously.

For cooling the upper floor and heating between seasons, there are two VRV devices envisaged and marked as VRV-1, where compartment air conditioning KK3 and KK-4 are connected while compartments KK-1 and KK-2 are connected to VRV-2 device. These devices are mounted on the roof. VRV-2 device is connected with NHXHX-J 4 X 4 mm2 cable to RO-KS2 cabinet, whereas VRV-1 device is connected with NHXHX-J 4 X 4 mm2 cable to RO-KS1 cabinet, as shown in the graphics.

For all electrical consumers, automatic control is envisaged over time programs as well as manual control from the electric cabinet door. Signalling of operating and breakdown conditions of all consumers regarding air conditioning, heating and cooling is obtained over LEDs on the electric cabinet door.

19.5 ELECTROMOTOR DRIVE DISTRIBUTION BOXES

Cabinets for electromotor drive and automatic control are stand-alone or wall-mounted cabinets. The cabinets are made of twice pickled sheet with door, lock and a key, with minimum protection of IP 54; they are protected from corrosion and painted with finishing colour RAL 7035.

It is envisaged that cable enter on top of the cabinets, where sufficient number of PVC boots is to be envisaged for all planned electric lines and 20% backup. The cabinets are to be equipped with copper buses N – zero and Pe – protective, of appropriate section and with line connecting clamp terminals.

Wiring of all the planned equipment in the cabinets is to be completed with P/F cables and all flexible connections are to be completed with stranded conductors. All the equipment to be incorporated into cabinets must be thoroughly marked according to the graphics with marks provided in the graphics.

Cabinet doors are bound to be bypassed with P/F type stranded conductors with 6 mm2 section on the cabinet structure. Complete optimal and synoptic arrangement of the planned equipment in the cabinets, paying attention to 20% backup for the possible additional extensions.
Mushroom push buttons are planned on all electric cabinet doors for break down turning off of the electromotive drive electric cabinet supply.
Mechanical design envisages incorporation of fire protection and smoke valves with electromotive activators, fusible elements and end contacts. In case of breaking of any fire valve within the system, the appropriate system turns off. On the cabinet door there is position signalization of all PPK and DK, as well as push buttons for testing the valves in the systems.
At the temperature lower than +8° C the system behind the heater in compartment air conditioning is turned off, the heater pump is turned on and the regulation valve opens to maximum position.

19.6 AUTOMATIC OPERATION OF THE SYSTEM

Free programmable controllers are applied, used with some of standard buses and appropriate interface modules, as well as standard protocols applied in such installations. As VRV systems VRV1-1 and VRV-2 serve as heating pumps and own their controllers, their connection with controllers of compartment air conditioning is reached over BUSNET/IR protocols.
Each compartment is provided with its own controller. Turning on each compartment air conditioning is controlled from certain rooms, according to the Main Design. Turning on may be manual or automatic over a switch 1-0-2 (manual-0-automatic). After the compartment air conditioning is off, the secondary ventilation is bound to be operating, as indicated in the Main Design.
Fans that insert air from all compartments are envisaged to have frequent regulation mounted on the fan itself and delivered along with the fan.
Fans for waste air discharge, as well as break down air conditioning fan, are envisaged to have separate frequent regulators in cabinets RO-KS1 and RO-KS2. ,
In rooms with hoods or movable extract console devices, it is possible to turn them on only when the compartment air conditioning is on for air conditioning of the hoods, or movable extract console, as presented in the Main Design.
Turning on the safety box device must be constant, meaning after the compartment air conditioning is off.
For all the systems there is local – service control from the electric cabinet and the remote – automatic control over automatic command controller, located in automatic control cabinets. The basic control mode is automatic.
On the extract element for the pump and fan electric motors there are protective motor switches.
On the cabinet door there are signalling synoptic modules with LEDs for operating and breakdown condition signalling.

19.7 MANUAL OPERATION OF THE SYSTEM

All electromotor drives also have the possibility of manual operation. This mode is mainly for maintenance systems, various adjustments or potential breakdown turn off.
Turning on the movable extract console (movable elements) is manual, over rugged switches 0-1 located immediately next to the console. Switches are mounted in the parapet (if there is one) or in the wall next to the console.
In the room No.3 (storage), air heating electric heater turns on over thermostat in the heater itself.

19.8 SECONDARY AIR CONDITIONING

According to the design, there is also secondary air conditioning for some rooms. Secondary ventilation is always on, until the main air conditioning is turned on over compartment air conditioning. Secondary air conditioning switches, mounted on cabinets, are mainly service switches for each fan. In case of fire, the secondary air conditioning turns off.

19.9 LABORATORY AIR CONDITIONING

In certain rooms defined by mechanical installations, air insertion and extraction are envisaged depending on the fact whether and when the devices (hood, safety box or movable console) are turned on. Regulation of air insertion and extraction is planned to be over movable shutters (CAV and VAV devices) equipped with automatic regulators of air flow, with standard cable, mounted on the shutters.
In the rooms with automatic flow rate regulators, flow is regulated by switches of differential pressure for sub-pressure and overpressure measurement, and differential air pressure sensors are planned for the regulation of frequency regulators, all according to the design.
Installation of all VRV systems and its components, the wiring, adjusting and putting into operation is to be executed by the authorized Contractor. The cables from the cabinets RO-KS1 and RO-KS2 to VRV have to be placed too.
Temperature is controlled over temperature sensor, mounted on the exhaust channel of the referent room. Temperature regulation during compartment air conditioning operation is obtained by three-way valves on the delivery line, and is regulated according to the specified curve based on the exhaust air temperature and outside temperature.
The design also envisages overpressure in the area of elevator shaft and staircase. Operating time of the timer is in the period between 6-22 h, and is turned off in the period between 22-6 h. In case of fire, the over-compressive air conditioning is turned on regardless of the position of the timer.
For waste air exhaust from the hood, safety box and movable extract consoles; filtered fans on the roof should be placed according to the design. Filter filthiness is regulated over differential pressure switch, indicated by optical signalization on the cabinets and they thus turn off once the filter becomes filthy.

19.10 PERFORATED CABLE SUPPORTS (PCS) CHANNELS

All incorporated PCS channels in the upper floor area must be of 90 min fire resistance, whereas PCS channels mounted vertically on façade sides and over the roof are standard perforated PCS channels with a cover. PCS channels are to be mounted in suspend ceiling areas in corridor and room and are to be mounted on wall or floor structure, with all the necessary fixing or hanging equipment, as well as the grounding. PCS channel routes are previously to be adjusted with routes of the mechanical, electrical installations of high and low voltage as well as the water supply.
Route of a PCS channel with a cover, planned to be on the building façade, is to follow the routes of the façade mechanical installations. Route of PCS channel on the façade is to be adjusted with mechanical installations in such way that there is a possibility of additional potential access to PCS channel for maintenance or similar.
24 V cables must be led over separate PCS channel and it is possible to use telecommunication PCS channel if there is sufficient space in it, in agreement with the Supervisor.

19.11 HEATING SUBSTATION

For hot water supply between seasons for the need of compartment air conditioning mounted on the roof, there is a separate electric 100 kW boiler. Electric boiler is connected to the network supply. The boiler is located in the existing boiler room according to the design. Boiler supply is envisaged to be

over distribution box located in the boiler room and it is to be supplied via cable NHXHX 3x150 +70 mm2 envisaged by the electrical installations design. The cabinet is made of twice pickled sheet, with door, lock and a key, with minimum protection of IP 54; it is protected from corrosion and painted with finishing colour RAL 7035.
The cabinet is stand-alone or wall-mounted, which is to be determined on site. The cabinet is planned to contain automatic regulation according to the design. Main switch is envisaged to be on the cabinet, and it is also the 'Winter-Summer' switch. In addition, there is also 0-1 switch on the door for boiler operation 'between seasons-winter'.
The substation is envisaged to be provided with automatic control for controlling the unit operation and connected with the bus to the AC in cabinets RO-KS1 and RO-KS2.
Upon completion of the works, the Contractor shall be liable to carry out all specified tests and measurements and submit written certificates in the form of attest to the Supervisor.

20 GAS INSTALLATIONS

The designed installation provides the supply of special gases to the equipment for lab analysis in the scope of activities of the Toxicology laboratory. Appropriate technology and equipment, which meets the requirements of high-purity gases, quality and reliability of supply has TO BE INSTALLED.

20.1 DESCRIPTION OF THE TECHNOLOGICAL PROCEDURE

Required gases intended for the supply of equipment in the laboratory are located in appropriate bottles in which they are supplied by the gas supplier.
A free-standing construction building has been designed for the substation of technical gases to accommodate bottles and technological equipment.
Equipment for the following gases shall be retained in the substation:
Hydrogen - Quality 5.0
Nitrogen - Quality 5.0
Helium - Quality 5.0
Compressed synthetic air

Equipment for methane is removed, and the existing equipment for nitrogen 3.5 will be used for the new gas - argon.
All the bottles are located in one room in the substation, connected to the corresponding primary control panels. There are two bottles (active and spare) provided for each gas.
Primary control panels are fully equipped with all necessary reinforcement to reduce pressure and smooth and safe charge of the consumers. There is a distribution network pipeline starting from each panel to customers in laboratory facilities. The panels are sound, and their arrangement is in line with the arrangement of the pipeline in the distribution system, all according to the Main Design. The existing pipelines made of copper need to be removed, and then install the newly designed pipelines made of stainless steel.
To maintain the required purity of gases, specialized equipment for collectors and consumer spots has been provided. Material of the piping, pipe connections and the method of assembly, testing and maintenance must be according to the design and must meet the appropriate high standards.
When installing a new bottle to the collector, it is necessary to first blow the connecting pipes with the gas from the bottle, in order to remove any air.
In the process of exploitation, all users must be thoroughly familiar with the operating procedures and safety measures.

Installation mode is determined by its purpose of the supply of lab equipment, which represents small consumers with high purity gas requirement.
Basic procedures:

1. Supplying bottles from the gas supplier.
   - Transport of full technical gas bottles with the supplier's vehicle,
   - Reception and unloading of bottles to the plateau, in front of the door of the room for certain type of gas,
   - Transportation of individual full - empty bottles in the appropriate rooms, loading empty bottles in the supplier's vehicle.
   - Shipping the supplier's vehicle.
2) Connecting bottles with an elastic spiral connector according to the specific procedure for blowing and commissioning
3) Occasional supervision of the installation operation.
4) Securing access to the fire brigade vehicles in case of accident.

The facility of the substation is located on the free area of the pavement, up to the internal road in the immediate vicinity of the building where the lab is located.
Ground where the substation is to be places shall be levelled, and must be free of overhead and underground installations.
The purpose of the building is storing of the gas bottles:
Hydrogen - quality 5.0 - one active and one sparc bottle
Nitrogen - 5.0 Quality - one active and one spare bottle
Argon - 5.0 Quality - one active and one spare bottle
Helium - 5.0 Quality - one active and one spare bottle
Compressed synthetic air - one active and one spare bottle

Bottles (two of each gas) are connected to the first instance control panels for each gas. One distribution network pipeline starts from each control panel of the substation to a consumer in the lab facility.
Substation equipment is placed in the construction building with dimensions in the base 2.5 x1.6 m.
Safety distance around the open parts of the substation of technical gases is a zone width of 3 m measured from the edge of the object. There are protection walls installed on the sides with fire resistance min 2 h, and minimum height 2 m. In the area within the safety distance and close to the walls of the substation, storage of flammable and aggressive substances, smoking and access with open flames, vehicle parking are prohibited. Protective panels on the sides are set for security reasons, replacing the safety distance according to relevant regulations, and there are openings in the building walls (windows) and electrical appliances near the substation. The building construction, equipment and pipelines are made of non-combustible materials.
The substation is a semi-open type with fireproof walls on three sides and a fence in a frame made of wire twists on the front side. The side walls are made of material that is fire-resistant for min. 2 hours. Over one side wall up to the roof structure (the side where there are flammable gases, left, seen from the entrance) there is a triangular opening designed with a wire fabric filling for room ventilation. Wire mesh door for intake and exit of bottles is planned on the front side of the substation. The existing area under and around the substation will be levelled and built of concrete, and the concrete area in front of the substation shall be done in the form of an inclined plane for the transport of bottles with handcart to and from the substation.
The roof is constructed of non-combustible materials, of light building structure. The floor is made of steel profiles with a mesh, and due to the presence of flammable gases, it must be covered with aluminium sheeting to provide antistatic floor, wear resistance and prevention of arcing. The floor is raised above the surrounding terrain min. 10cm.

From the front, towards the road, there is a door installed for intake and exit of bottles. The door opens towards the field and must be locked. All contact surfaces must be made of non-sparking materials preferably aluminium.
Electrical equipment in danger zones of combustible gases must be under anti-explosive protection.
Storage and intake of combustible materials, as well as smoking and use of open flames, use of sparking tools are prohibited in the safety zone of the substation.
As the building is semi-open type, it is possible to naturally ventilate the space through a wire fence on the front and a triangular hole with wire mesh on the side of the substation.

20.2 SUBSTATION EQUIPMENT

In the substation for bottle storage, control panels are placed for pressure control, inlet pressure up to 200 bar, discharge pressure 10 bars.

The substation equipment includes the mechanical equipment consisting of the following parts:

1. Two standard bottles of each specified type of gas under pressure (one active and one spare), except for methane, for which only one bottle is intended.
2. Reduction panels for pressure reduction connected to gas bottles with a flexible connection.

One distribution network pipeline starts from each reduction panel of the substation to a consumer in the lab facility.
The equipment provided is specially designed and manufactured for the safe operation and top cleanliness of gas, which is necessary for laboratory use; fully in compliance with the EUstandards.
Gas is bottled under pressure. Each bottle is connected to one branch of the panel regulator through a flexible hose. Pressure is reduced in the pressure reduction valve from the pressure in the bottle to the proper working pressure in the distribution pipeline.
The following equipment is located in the substations:

1. Automatic control panel for all gases except methane for pressure regulation for two bottles type BM 65 - 2UK, made of chrome messing for gasses of clearness 6.0, pressure regulator and valve made with stainless steel membrane Pul = 300 bar Pizl 1.5-10 bar with automatic regulation panel for high pressure, dimensions 450 x 172 x 160 mm, input jack for connection of a flexible hose DN6 NP200. The control panel consists of the following elements:
    - pressure regulators with automatic switching from one branch to another and activation lever, with contact manometers ϕ 50 mm at each inlet side and pressure control manometer ϕ 50 mm and safety valve on the exit side 1/8-27 NPT f; outlet jack of the regulator ¼-18 NPT f;
    - 2 process gas shut-off valves, one for each branch,
    - 2 relief shut-off valves (one for each branch – outlet jack ¼ -18 NPT f);
    - 2 filters made of sinter stainless steel, one for each branch.
    - 2 flexible pipes for connection of each bottle to the control panel, DN6 NP200;
    - fire cartridge at the output jack (hydrogen only).
    - Bottles for appropriate gas,
    - Bottle holders (delivery together with the regulator),

Reducing panels are fitted with contact pressure gauges on the inlet side of the reducing valves, with the function to signal the emptiness of bottles with pressure drop below the set value (10-12 bar.m). Signal panels are placed in the appropriate room designated by the Beneficiary (recommended with constant presence of staff) or in the substation. When the pressure drops below the set value (empty active bottle), the signal from the pressure gauge activates a sound and light signalling to notifying the

operator that the active bottle is almost empty. After the pressure drop below the value set on the reduction valves, the backup branch is automatically put into operation. The operator should put the handle the control panel in the position corresponding to the active branch (indicated by an arrow) and replace the empty bottle with a full one, which then becomes a spare bottle in the substation system.
In the control panels, the pressure from the bottles is reduced from max. 200 bar (N2, H2, SV, He, Ar) to 0-10 bar.
At the output pipelines of the hydrogen substation, as an additional security measure, there is a solenoid valve, normally closed, which closes the gas supply to the flow point if a large amount of gas is detected in the room with consumer spots.
All vent lines of security and vent valves are performed in a safe place directed so as to enable good dispersion of gas and its dilution. Line ends are routed so as to prevent the penetration of atmospheric water that can freeze and threaten the operation of the safety devices. Exists of safety valves and vent valves for combustion gases lighter than air are performed in the highest place where they cannot endanger people and objects, mandatory out of the eaves of the object so that gases that are lighter than air would not accumulate in that area.

20.3 SPECIAL REQUIREMENTS

a) Requirements for the construction part of the building:

- Floor level above the surrounding terrain (concrete slab min 10 cm thick),
- Floor surface made of material that will not wear off or spark,
- Light roof of non-combustible materials,
- Metal doors, non-sparking (aluminium)

b) Requirements for electrical installations:

- Explosion protection for electrical devices in the substation and in danger zones,
- Adequate lightning protection,
- Electrical grounding of technology equipment and the facility,
- Electrical signalization of empty bottles.

c) Requirements applying to fire protection means:

- Fire extinguisher S9 for fire extinguishing with powder according to SRPS Z.C2.035,
- warning signboards of the type of danger and info plates on the type of gas, full and empty bottles, labels with conditional colours for gases,
- Natural ventilation of rooms.

d) Requirements applying to staff training:

- All employees must be trained to operate this type of installation as well as to implement of all measures and means of protection against explosions and fires

Installation operation mode is determined by its purpose of supplying the lab equipment, representing small consumers with high purity gas requirements.

Basic procedures in the sub-station:

1. Supplying bottles from the gas supplier.
2. Occasional supervision of the installation operation.
3. Securing access to the fire brigade vehicles in case of accident.

20.4 DISTRIBUTION PIPELINE AND EQUIPMENT ON CONSUMERS SPOTS

Main pipelines from the substation to the lab are built of seamless stainless steel pipes quality 1.4435 (316/316L), dimensions Ø12x1 mm, according to SRPS EN 10216-5.
Distribution network includes special pipe lines for each of the gases, connecting the equipment in the substations with consumer spots. Distribution pipelines and branches to the consumer spots are built of the same quality pipes, size Ø12x1 and Ø8x1 mm.
Secondary panel regulators regulate pressure from the network to the required working pressure for device operation. Exit jack of the secondary panel controller connects to a hose or capillary tube towards the consumers - devices for analysis.
Main pipelines are placed overhead from the substation, first through a tubing bridge in the horizontal distributor, and then on the external facade of the lab building on the existing route of the pipelines to be replaced, in the vertical plane, according to the provided schedule (lighter gases above the heavier gases, provided that the pipeline for synthetic air is set to the lowest point). Then, at the level of the L' – 7' column, pipes are rising vertically along the façade in aluminium ducts to the place above the windows on the first floor, at the height of room 39. From here, the piping is placed in the ducts on the facade of the building in two directions: a group with 5 pipes leading to consumers on in rooms 39,38,37,14,18,21,27, and another branch with two pipes going to the room 41.
Between the substation and the lab building, the main pipelines are lined along the tube bridge in the existing ducts, where the existing copper pipes will be replaced with new stainless steel pipes. The other end of the tube bridge relies on a steel plate that is fixed to the lab building.
The tube bridge consists of box profiles 50x50x3mm approximately 1200mm in length, standing in a vertical plane with the axial distance 120 mm. 50x50mm profiles are mutually linked with profiles 20x20x2mm, which are also holders of main pipelines.
The main distribution pipelines are placed on the building facade in aluminium ducts that will be attached to the aluminium frame that will carry the shutters. This steel profile is attached to the steel structure. The ducts will be fixed at the positions between the windows at the distance of 1.25 m. Pipes in the ducts lean via plastic clamps.
Upon entering the building on the first floor, the pipes are placed on the interior walls in the vertical plane (lighter gases above the heavier gases), and at the consumption places, verticals are put down towards the consumption spots. Support is provided by plastic clamps with sliding rails plugged into the walls or fixed with screws for steel construction.
In the room 41, the pipelines for nitrogen and synthetic air are laid in a suspended ceiling. Installation place and method of fixing the consumer spots (EM65-1) will be determined during the installation based on the recommendations of the equipment user.
Distances of the support is up to 1250 mm for Ø 8 pipes and up to 1500 mm for Ø 12x1mm pipes, and the girders are especially made with clips. At the point of entry into the lab room, it is required to drill the wall and place protection pipes to pass through the wall (filling the inter-space with adequate insulator).
In the room 41, the pipelines for nitrogen and synthetic air rely on the supports of perforated galvanized steel straps with clips. The tape is plugged in the ceiling. Consumer spots for gases are placed on the wall close to the consumer. Secondary panel regulator type EM65-1, equipped with a secondary pressure regulator with final pressure manometer and the shut-off valve are installed at the consumer spots.
Secondary panel regulators type EM65-1 for all five gases, according to the design, are installed for all the consumers in all rooms (except 41 where the only two with each digester gas). Height at which they are installed is generally 1200 mm, but due to the specificity of the labs and the planned furniture, the installation spot will be precisely defined during installation.
Distribution pipeline routes and arrangement of the consumer spots are given in the design.

Forced ventilation, with fans in explosion protection, as well as a system for the detection of explosive gases (ventilation system and gas detection) is provided in the room with consumers.
Switchboard for the detection of explosive gas is placed in a room with a constant presence of staff. In the event of high concentrations of flammable/explosive gas (hydrogen) in the room, the alarm signal is activated and solenoid valves on hydrogen and methane pipelines in the substation are automatically closed.
As a security measure in case of power failure, the solenoid valve on the pipeline on the hydrogen pipeline in the substation closes automatically (normally closed), thus closing the gas supply from the substation to the consumer spots.

21 TELECOMUNICATION

Telecommunication systems consist of:

- Automatic fire detection
- Automatic detection of gases (attached as separate to the mechanical part of the project)
- Common TV system
- Structured cabling system
- Video surveillance system
- Access control system and video interphone

21.1 AUTOMATIC FIRE DETECTION SYSTEM

In respect of the all foreseen works, the Contractor shall be fully familiar with all Final Design details, as well as with all local regulations, international and local standards (SRPS), common practice of trade and circumstances for their execution
For the needs of reconstruction and adaptation it is necessary to implement a fire detection system that would provide the supervision and control of all the premises, a timely detection of occurrence and location of fire, as well as the warning to the staff and persons on duty about the occurrence of fire.
In the building there is a system with a Central and elements of an outdated production. The existing system will be adapted and linked to new systems (for detection of gases, access control, and video surveillance) and establish an integrated system of technical protection for the entire building.

The intended addressable fire detection system consists of:

- central unit of fire detection
- management console
- parallel console
- automatic and manual fire detectors
- parallel indicators
- elements for alarming (alarm sirens)
- cable installations

The Central will be placed in the room next to the reception desk with 24 hour attendance.

21.1.1 THE ALARM PLAN

The Alarm Plan defines the organization and procedures in case of fire.
Two ways of alarming are planned:

- alarm from the automatic detectors
- alarm from the manual detectors (call points)

The detection Central operates in two modes: in the "DAY" mode and the "NIGHT" mode. During the "DAY" mode which operates during working hours (employees are present in the building) the alarms are treated in two ways as: automatic fire detectors and manual call points.
The switching from day to night mode needs to be done semi-automatically, i.e. automatically (by means of the switching clock) passing from day to night work, and manually when switching from night to day work (in cases when public holidays or non-working days occur at irregular intervals). The indicator for night alert serves to avoid forgetting to manually switch to day work when employees are present.

21.1.2 CENTRAL FOR FIRE DETECTION

It is planned to have a fire microprocessor based addressable central. It is used for signalization of fire in order to establish an interactive, totally redundant Fire detection system with the capacity of 4 addressable loops, with 127 addressable interactive Secure Line detectors in each loop and with the possibility of extension. The Central should contain a power supply unit with batteries 2x12V, 18Ah for an auxiliary power supply, minimum of 72 hours in quiet mode and 30 minutes in alarm mode in case of failure of power supply and to have the possibility that its software selects the sensitivity and the criterion of work of fire detectors (of smoke, temperature or combined). The Central should contain relay modules with programmable outputs for the needs of shutdown of dampers, electric power, fire protection (FP) doors or similar in case of fire. The Central has to network with other panels, control panels, parallel tableaux and similar. It should have VdS attest and has to meet the standard SRPS EN54-2.
Two loops are needed for the connection of existing elements and one loop is needed for the newly designed ones. The other loop remains in reserve.
The Central should provide power supply and continuous supervision of signal-alarming lines, signalling activation of signal lines or occurrence of a failure on them, send alarm signals to acoustic sources as well as the management and certain interventions by the two-stage plan of alarm. Also, it should provide signals necessary for connecting the fire signalization system with other systems (effect on ventilation systems, air conditioning etc.).
The Central is supplied with voltage of 220V, 50Hz from the energy distribution box, with a separate electrical circuit, and in case of power failure disposes with spare power supply.
For the handling of the system envisaged, an operational management console, with TFT display of 5.7" and SecuriWheel to navigate through the menus is required. All states of the system have to be displayed in text format on the display. It should be possible to choose printing in four languages, including Serbian. It should be possible to change the language during the operation of the Central. On the console there are 3 function keys and 7 LEDs for displaying conditions of priority.
The works have to be executed according to RS standards, approved Main Design and applicable fire protection regulations.

21.1.3 FIRE DETECTORS (CALL POINTS)

AUTOMATIC FIRE DETECTORS

Based on the use of the building, and on the basis of possible causes of fire breaking, speed of development of fire and the conditions prevailing in the premises, for the automatic detection of fire is foreseen the use of optical smoke fire detector because it performs fire detection at an earlier stage of its development.
Addressable optical smoke detectors are provided for the fire detection system in all rooms except the toilets.

The density of detectors is determined on the basis of the analysis and taking into account the following parameters:

- principle of supervision over the premises
- geometry of the rooms
- contributing conditions
- Manufacturer's equipment data and other.

The works have to be executed according to RS standards, approved Main Design and applicable fire protection regulations.

21.1.4 MANUAL CALL POINTS

Manual call point serves as a handheld remote detection of fire alarm signal to the Central for signalization of fire without verification time and thus has a role in fire protection for direct alarming.
In all communication parts of the building the addressable manual call points will be set equivalent to the type that was used for calculations in the Main Design.

21.1.5 PARALLEL INDICATORS

For all call points that are placed in suspended ceilings and in premises that are locked is foreseen the connection of parallel indicators working through detectors. The indicators will be clearly marked and placed in a visible place above the door to the premises.
The predicted indicators have to be equivalent to the type that was used for calculations in the Main Design.

21.1.6 ELEMENTS FOR ALARMING

Informing the staff and clients in the building about the occurrence of fire shall be carried out by using audible alarm signals emitted over sirens installed in the building. The sirens are to be equivalent to the type that was used for calculations in the Main Design with the output level of 105dB for indoor installation. The alarm sirens are installed at the height of 2.2m from the top layer of the floor and are powered by the Central (control panel).

21.1.7 INSTALLATION OF FIRE DETECTION

The connection of the detectors (call points) with the Central will be done with cables JH (St) H 2x2x0, 8mm. The connection of alarm sirens to the Central is foreseen with halogen-free fire resistant cables JE-H (St) H 2x2x0, 8mm FE180/E30.
Power supply of centrals and additional power supply units will be taken from the nearest power panel in the building. For this is foreseen the cable NHX-NH 3x1,5mm^2 FE180.
The installation of fire detection shall be set in flexible halogen-free pipe installation in suspended ceiling. The installation cables in places of transition from one to the other fire sector should be protected by fire-retardant compound, on each side by 1m.

21.1.8 CHECK UP OF LOOP RESISTANCE

The allowed loop resistance of the addressable signal line amounts to 100Ω. The installation cable type JH (St) 2x2x0, 8mm has the loop resistance of 73,2Ω at 1000m. Bearing in mind the requirement that the maximum loop resistance can be 100Ω, it implies that the maximum allowed length of the addressable signal line is 100/73, 2=1,36km. The maximum length of the designed loop is less than the allowed 1360m so that it meets the established requirements.

21.1.9 THE EXECUTIVE FUNCTIONS OF THE CENTRAL FOR FIRE DETECTION

In case of fire detection by any automatic or manual call point in the building, the central equivalent to the type that was used for calculations in the Main Design, through the relay outputs provides the following:

- activation of alarm sirens,
- lowering of the elevator to the level of evacuation, opening of the elevator doors and blockade of its function,
- turning off of ventilation and air-conditioning upstairs,
- closing of all fire protection dampers,
- closing the (double wing) fire protection (FP) door in the common corridor,
- activation of overpressure ventilation in the elevator and the staircase,
- activation of emergency ventilation,
- unblocking of all the doors in the system of access control and video interphone,
- closure of solenoid (EM) valve for H_2.

The rechargeable battery for PPC has to be supplied too.

21.2 TV INSTALLATION

An installation of TV is foreseen for distribution of TV signals in all the premises in the part of the area planned to be adapted.
Within this installation, for the concentration of the newly designed TV installations, is foreseen the installation of a new cabinet RO-TV inside the existing cable verticals in the anteroom of the sanitary facilities. In this cabinet should be placed a broadband amplifier to which, a signal coming from the existing concentration cabinet of TV signals, will be brought and intensified to the level so that it could be distributed in all the premises. Considering the small number of sockets, for further distribution of TV signal to the sockets in the premises, there are foreseen three splitters which also need to be installed in the RO-TV.
For the distribution of RTV signals inside the building is foreseen a halogen-free cable T100 LSFH 215101 placed into suitable halogen free PVC pipes in the suspended ceiling and in the wall under the plaster, and for the TV sockets for receiving TV/R and SAT signals within the range 5-862 MHz with maximum 5dB decrease as defined in the Main Design.
The level of reception at the output connectors is in the range from 63,5 to 77dB/μV, provided that at the point "N", at the entrance to the main distribution frame of the building (R-0) the level of 93dB/μV is ensured.

21.3 THE STRUCTURED CABLING SYSTEM

The construction of structural cable infrastructure is the basis for construction of an integrated information system in the building. The system should provide full efficiency and flexibility while supporting generally accepted standards.
The structured telephone and computing cable system is composed of the cable concentrators, of connection points around the premises and the cable for their interconnection. This cable infrastructure in a star like topology connects the connection points from the operating rooms with the concentrators.
For the concentration of cables, the existing storey concentrator (RO) will be used. The concentrator has height of 42HU, width and depth of 80cm and it has small wheels (which are necessary for the manipulation, considering its position). The cabinet interior has widths of 19", and on its front and rear sides there are two rails for the mounting of the equipment. On its front side the cabinet has a darkened

glass door with lock and key, and on the upper side it has openings for exhaust air, while at the bottom there are openings for air intake and integrated thermostats.
For the connection of concentrator with all the sockets in the work area are foreseen the optimal cable routes: in halogen free PVC pipes in suspended ceiling, in the wall and parapet canals placed in the radiator covers under the windows.
The horizontal distribution which follows a "star" pattern is carried out according the standard ISO/IEC 11801 and EN 50173. The elements of the horizontal distribution are: patch panels, sockets and cables. The number of sockets in each room is determined in accordance with the Main Design.
The route to laying cables meets the indicated criteria of international standards, of the general structured cabling, as well as those for placing of telecommunication cables in business buildings EIA/TIA 569. These standards prescribe minimum distances of (TC) telecommunication cables from the source of electromagnetic fields as follows:

- from parallel supply cables up to 480V with consumption to 2kVA the distance of 12,7cm (5") and with the consumption of 2-5kVA the distance of 15,2cm (6"),
- from the fluorescent lamps a minimum distance of 30,5cm (12"),
- from the electric motors the distance of at least .102 cm.

Apart from this, when lying cables one should observe the following:

- minimum bending radius is 8x diameter of the cable
- maximum withdrawal force is 110N

Having in mind the aspect of fire protection to the possibility of evacuation in case of emergency, the building has been classified as BD-2, and to connect the concentrator with fixed telephone and computing sockets are foreseen fixed (rigid, wall) halogen free S/FTP cat.6.cables.
Installation cable FTP (Foiled Twisted Pair) consists of 4 twisted pairs with full cross section, additionally wrapped only in a metallic foil.
Installation cable S/FTP (Shielded Foiled Twisted Pair) unlike the FTP cable is wrapped with a metal foil and sirma.

The characteristics of category 6 FTP cable are:

Frequency	Attenuation	NEXT	PSNEXT	ELFEXT	PSELFEXT	RETURN LOSS
1	2.1	66.0	64.0	66.0	64.0	23
4	3.8	65.3	63.3	58.0	55.0	23
10	6	59.3	57.3	50.0	47.0	23
16	7.6	56.2	54.2	45.9	43.0	23
20	8.5	54.8	52.8	44.0	41.0	23
31.25	10.7	51.9	49.9	40.1	37.1	23
62.5	15.5	47.4	45.4	34.1	31.1	23
100	19.9	44.3	42.3	30.0	27.0	23
155	25.3	41.4	39.4	26.2	23.2	21.1
200	29.1	39.8	37.8	24.0	21.0	20.0
250	33	38.3	36.3	22.0	19.0	19.0

The cables must not be under tension greater than allowed, must not be winded up, twisted or crushed and must be in one piece. The minimum bending radius of the cable is at least 8 cable diameters, unless the manufacturer specifies otherwise.
The parallel laying and crossing of supply cables of 230V, 50Hz and FTP cables should be avoided.
For re-linking in the rack-cabinets there are used patch cord cables with the length of 1m, 2m, 3m. These cables can be factory-produced or made by the Contractor, in which case they must be attested.

All eight conductors at both ends of the flexible FTP patch cord cable should end up into RJ-45 connectors. One should use the tool designed for this purpose, apply the prescribed method and allocate pins according to the standard EIA/TIA 568A.
The patch cord cables must not render impossible the access to other elements in the rack-cabinet, but they are pulled through the panels by patch guides. They must not be stretched, neither twisted nor crushed.
The rack-cabinet, sockets and cables must be clearly marked with labels bearing printed marks in specified nomenclature and according to technical documentation. In the project of in built design and later in the database for the purpose of maintenance, it is necessary to make full marks of the elements.
For the patch cord cables in the rack-cabinet and for the cables connecting computers in the work area it is necessary to use a rubber sleeve in colour for RJ-45 connectors, according to the appropriate logical pattern which should be introduced in consultation with the Supervisor. Additionally, the cables should be visibly marked by the tag line at both ends.
In working premises are scheduled sockets of the type 2xRJ-45, cat 6 enabling the transfer of data in the class E, according to international standard ISO/IEC 11801. They are mounted in metal ducts in the IT rooms, i.e. in the finishing dossers in other rooms, according to international standard ISO/IEC 8877. The back of the socket has an IDS connector, for permanently fixing of FTP cables. For connection of individual wires of FTP cables to sockets is used the pin pattern EIA/TIA5682.
The sockets are scheduled for installation in parapet canals which are placed partly in the radiator covers under the windows and partly as upgrades on the partition walls.
In the rack-cabinet there are RJ-45 cat. 6 connectors (modules) installed in distribution (patch) panels.
The layout of phone and computer (SKS) sockets in the premises, as well as of the accompanying installations is defined in the Main Design.
The look of rack-cabinet as well as its occupation with the passive and active equipment is defined in the Main Design.
For the power supply of the future active equipment in the distribution cabinet, which is distributed through the power distribution panel, is foreseen UPS which is placed in the bottom of the concentration cabinet where the distribution is mounted. Each connector of power supply and all power cables of the active equipment should be marked with the name of device which is connected to that place.
For the need of urgent disconnection of supply, the main switch of the power supply panel should be visibly noticeable and access to it should be easy after the opening of the rack-cabinet.
All the metal housings of the equipment in the rack need to be connected to the chassis of the rack-cabinet through the point for equalization of potential. The connection should be done in the manner described in the manufacturer's technical instructions, or by cable NHXCHX 1x2,5mm^2 of the corresponding length on whose ends are mounted pedals (which is solved by energy project). The rack-cabinet must be earthed to the rail for equalization of potential which should be placed next to each power cabinet in the vertical canal by the cable NHXHX 1x16mm^2, which is a part of the energy project. All the built-in metal canals as well as the metal ducts should be obligatory earthed using the material according to the manufacturer's instructions.

21.4 VIDEO SURVEILLANCE SYSTEM

Video surveillance system (CCTV-closed circuit television) is foreseen for surveillance of space and ensures visual monitoring of the common corridor and the space within certain premises.
In order to exploit resources of structural cabling system which is also designed for the subject area, it is envisaged a video surveillance system based on IP system that meets the following requirements:

- monitoring images from cameras in real time,
- video recording for a period of at least seven days,
- possibility of insight into video recording,

- review of recorded material from the video server, without interrupting the current recording,
- Possibility of transferring of recorded material to other media (CD, DVD, USB...),
- possibility to increase memory capacity for archiving video recording,
- Compression of video signal in H.264 or MPEG4 format.

The foreseen surveillance cameras for the anticipated area are placed in an integrated DOME housing of 1.3 Megapixel resolutions, with BLC and WDR function and a varifocal lens of 3-9mm,. 1/3 inch Fixdome colour IP camera; SXGA 1280x960 (max. 12 ips), VGA 640x480 and QVGA 320x240 (max. 25 ips); integrated lenses 3.0-90mm, F1-2; Mechanical IR filter; integrated Web Server; Two way duplex audio G.726; minimum lightning 0.4 Lux; Automatic electrical shuttle between 1/25 and 1/10,000 sec; Back-light compensation (BLC); 1xBNC, 1xEthernet 10/100Mbps, Audio jack 3,5mm, 1 alarm enter, 1 alarm exit, RS485 connector; Multi-purpose environment; detection of movements and e-mail registration; Rate signal/noise bigger than 50 dB; alarm enter; Supply 12VDC/24VAC or PoE; Supported protocol TCP/IP, UDP/IP, DHCP, DNS, HTTP, RTP (RTCP, RTSP), SMTP, NTP, IGMP v3, UPnP; Supplied together with 2GB SD card as defined in the Main Design. They are mounted in/on the suspended ceiling and oriented so as to cover the maximum of the supervised area.

The cameras are powered with PoE switch, class 3 which is foreseen in the RACK, and in accordance with the requirements of the terms of reference, next to every foreseen place for the camera (respecting the height of the camera place) is envisaged a mains connector for the camera power supply of 220Vac which is encompassed by the project of electro energetic installations.

The local server of video surveillance for video recording is foreseen in the existing rack- cabinet of the main concentration of structured cabling system. The server with the appropriate software performs reception, archiving and forwarding of multiple streams to customers, i.e. provides capturing images from all the cameras in maximum resolution with 25 frames per second and has the appropriate network connector as well as supports simultaneous work of multiple users (work stations).

The work stations (for monitoring images from video surveillance system) are foreseen, in accordance with the terms of reference, to be placed in the rooms n° 5 and 37 (which are offices of heads of services of chemistry and toxicology). The computers (work stations) are composed of components from renowned manufacturers, with sufficient strength to ensure reliable and undisturbed work to clients of video surveillance system. For each work station is provided a graphics card with 2 video outputs and 2 monitors of 22" so that the images from cameras can be monitored in real time.

For monitoring the images from the video surveillance system is foreseen the software (Image Recording (standard and alarm, user defined period, alarm and event list), Recording on standard IT hardware, Access to recordings from sureillance or archive mode, Support of all current video standards (MJPEG, MJPEG4, H.264), PTZ Control, Remote Access (worldwide access to SeeTec server via LAN, WAN, VPN, NAT), Motion Detection (integrated server-based motion detection, support of camera-based video analysis and motion detection, automatic alarm via audio, email..), Image export (automatically/manually, encrypted/uncoded, as video stream or as single images), Storage media DAS, NAS, SAN, DVR, IDE, SATA, SCSI Raid, Cascadable servers, floor plans, Support network cameras of different manufacturers, Interfaces to the third-party systems (Fire, access control, intrusions, alarms, all detectors with potential-free contacts) which is installed on the server, work stations and cameras. The server possesses client-server architecture; and it can be expanded with an unlimited number of servers, cameras and clients through the use of additional licenses.

The installation for video surveillance is foreseen with halogen free FTP cat.6 cables, laid in halogen free PVC pipes of corresponding diameter, and partly in halogen free PNK in the corridor. The cables in the rack-cabinet should end up on the patch panel of 24xRJ-45 cat.6 connectors, and those on the side of the camera should end up to RJ-45 connector, and connect the camera with a patch cable of the shortest possible length.

The routes of installations and positions of cameras are the block scheme of video surveillance that is defined in the Main Design. All installations, equipment and works have to fulfil valid RS standards and norms or other applicable standards with same or higher requirements.

21.5 ACCESS CONTROL SUSTEM AND VDIEO INTERPHONE

21.5.1 ACCESS CONTROL SYSTEM

For the needs of control and records of entries/exits in the premises of the NCTC laboratories on the first floor of the building in the lamella "C" it is foreseen a modern access control system, consisting of the following elements: - central device, - controllers for the connection of readers, - contactless card readers, - electric locks, - magnetic contacts, - proximity smartcards.
The system is network-oriented with the ability to remotely supervise and manage and can be fully integrated into foreseen video surveillance system. The management of system is carried out from the server of access control installed with the appropriate software which supports the contactless card reader, having the option to adjust the reader and the controller as well as to configure cards. The software also has the capability to create reports by different criteria (listing for a particular card, time of check-in, time of check-out, listing for several days...) and is dimensioned to satisfy the need for storing the database for a period of at least 6 months of continuous work of the system. The access control software supports the displaying alive video signals from the cameras of video surveillance system. It is that required system integration. The foreseen system is upgradable, i.e. it allows subsequent expansion from the basic level by adding the necessary subsystems at any point. That means when the need arises it is compatible with existing access control system in the building.
The server and the central device of the access control (labelled in the drawing with CKP) which is connected through the Ethernet connections to the server are foreseen in the room 45.
The central device provides power and continuous supervision of communication and detection lines.
The central device is powered by 230V/50Hz from distribution cabinet of high voltage with separate circuit. In case of failure of this power it disposes of reserve power source - which are built-in rechargeable batteries that provide the autonomy of the system.
For the reading of ID cards technology 13,56MHZ are foreseen the contactless card readers which are capable of reading at a distance of 5-12cm. The card readers are mounted on the wall at a height of 1.3m from the floor. Each reader is connected to the door controller i.e. to the dual interface for 2 readers predicted for every door that should be linked to the system. The card readers and the registration reader support the writing and reading from the sector and blocks of the card. In addition to card reader the door is provided with an electromagnetic lock, which unlocks without power, as well as magnetic contact for information on the status of the door – open/closed, which is also connected to the door controller.
Since, from the point of evacuation, the building is categorized as BD2, for connection of elements are prescribed *halogen free* cables and installation pipes.
The readers are connected to the controller with cables, type JH (St) H 5x2x0.8mm. Magnetic locks and electric contacts are connected to the controller with cables; type JH (St) H 5x2x0.8mm.It is anticipated that the central device is connected to the central of fire detection with the cable, type JH-H (St) H FE180/E30 2x2x0.8mm, in order to transfer the signal to unlock the door in the event of fire.
The cables are prescribed to be placed in flexible halogen free PVC pipes laid in the walls under a layer of plaster or gypsum. Where there are suspended ceilings, installation will be done in the low voltage cable racks.

21.5.2 VIDEO INTERPHONE

2 video interphone sets are foreseen for the communication between the entrance into chemistry corridor (premise 2) and toxicology corridor (premise 35) and the corresponding reception facilities (premises 30 and 45). The set consists of a video interphone input module with camera and with one call to be mounted in a suitable place next to the door into the corridors of the mentioned services and a video interphone with monitor and keys to open the entrance door which is mounted close to the work place in the premises of receipt.
The interphone input modules should be connected to the controllers of access control system with cables, type JH (St) H 5x2x0.8mm.

21.6 TECHNICAL REQUIREMENTS

21.6.1 GENERAL CONDITIONS

All works must be carried out according to these Technical Specifications and Main Design. The Contractor has to execute works and fully respect requirements defined in the Construction and Planning Low of RS.
The installed material must comply in all, with applicable regulations, technical specifications and valid RS standards. Before delivering materials to the site, the Contractor is obliged get approval from the Supervisor.
Connecting into existing devices and installations, as well as the drilling and chiselling of reinforced concrete structure, shall be performed only with the written consent of the Supervisor.
The Contractor is not liable for damages arising from improper handling of equipment and installations.
In case of any issues not covered by the present technical requirements, the Contractor shall comply with the applicable RS regulations.

21.6.2 TELECOMMUNICATION INSTALLATIONS

The installation must be carried out fully in accordance with the Technical specification and Main Design.
Each type of installation must have a special distribution box.
The pipe laying begins after the rough plastering and when the mortar is dry enough.
The pipes are placed in hollowed canals on the wall. The canal for the pipe should be wider than the outside diameter of the pipe. The approximate dimensions of the canals are:

- for pipe F29mm – 60x60mm
- for pipe F23mm – 40x40mm
- for pipe F16mm – 30x30mm

In the case of placing more pipes in one direction, the pipe is always laid next to one another, not one above the other.
The front side of the pipe should lie in the plane of brick (i.e.in the plane of wall mass), so that the pipe is entirely covered with a layer of mortar.
In reinforced concrete walls and pillars the mortising of canals is not allowed. The canals inside them are formed during the process of making the walls and pillars.
The pipes should always be laid in a straight line both horizontally and vertically. The horizontally laid pipe is allowed to have a small drop in the boxes so not to hold the condensed water.

If the horizontal pipe-laying requires exiting the pipe route temporarily, due to some modifications, it is allowed to do it by gently curving arc up.
In the corners of the rooms or in wall outfalls, changing the direction of the pipe-laying is done by bending the pipe into the arc. One well done arc when placed in the wall must be covered by at least one entire layer of the mortar.
Changing the direction of pipe in free spaces and surfaces of the wall is done in the boxes.
In the places of direction change of the cables (conductors), mild curves must be made whose radius is not allowed to be less than 15*D (D is the outer diameter of the cable).
Before the pipes are plastered in, one should check whether the passage through the pipes is free for the cable passing without obstacles.
When there is a big distance between the distribution boxes or if in the space between distribution boxes, the pipe has more curves, before the plastering is finished, it is necessary to tuck a steel wire into a pipe for later pulling the cables without a problem.
Distribution boxes are installed in the following cases:

- in place of pipe ramifications,
- when the pipe has an arc and distribution boxes are spaced too far apart,
- when the pipe has two successive arcs,
- if a straight line pipe is longer than 6m.

Before plastering the pipes all distribution boxes should be sealed with paper to avoid the moistening of insulation while plastering and painting the walls.
The continuation of pipes is performed with couplings without paper insulation.
The pipe must not have a coupling while passing through the wall, floor or ceiling.
Distribution boxes and distribution cabinets have to be dug into the wall, so that its upper surface levels with the wall. Setting distribution boxes inside the floor or ceiling is not allowed.
All pipes and distribution boxes used in parts of installations which are done inside the pipes must be made of insulating material. The inside diameter of the pipe must match the cross section and the number of cables which are tucked into them according to RS regulations. Pipes on the walls and ceilings must be laid under the final layer of the wall.
Insulated conductors are tucked into the pipe when the pipe is dry.

21.6.3 TC INSTALLATIONS

All devices should be placed according to drawings from the Main Design. Possible changes may be done on the basis of written approval of the Supervisor. Prior to the commencement of works the Contractor shall mark locations for devices, distribution cabinets, distribution boxes and cables.
Details for fastening devices to the wall or to the appropriate carriers are defined by the supplier. After fixation, levelling and wiring of the cabinet, the equipment should be installed, which is, for transport, especially packed according to the documentation of the manufacturer of the equipment.
Installation of the integrated telephone and computer network should be carried out by using FTP cables of categories in accordance with the design.
Installation of fire detection, burglary signalling, access control and working time evidence should be carried out with telephone cables with PVC insulation, aluminium foil layer and copper conductors with a diameter of 0,8mm.
Installation of video system control and for receiving RTV signals (KDS) should be implemented with coaxial cables of 75Ω.
All cables and conductors should be conducted as foreseen by this project, as follows:

- on the wall and ceiling (in the lowered ceiling) on plastic clamps,
- in the wall in plastic pipes installation,
- on cable shelves (in parts of the route where there are more than three cables), or

- in the wall in PVC canals/rankings.

When placing the cables it is necessary to observe the following:

- to cut the required cable only after determining on the site the real length of that segment,
- before incorporating it to examine every piece of the cable,
- to connect the cables according to the attached scheme,
- to avoid placing the cables in the immediate vicinity of power lines,
- to take care about the particular connections of cables and connectors at the ends of the segment parts,
- if it is necessary to drill the walls for placing the cables, when laying them it is obligatory to use plastic flexible hose,
- while installing, avoid large cable bending (minim. Diameter of curvature 3cm),
- to make appropriate labelling of cables and when the cabling is finished, examine the installed cables and make a project of in-built design with mapped, exact paths and lengths of the installed cables.

TC and EE cables are laid on the parallel distance not less than 20 cm. In case of horizontal spans EE cables are laid at 30cm from the ceiling, at 10cm above them come the signalization cables and other installations, and at 10cm above these the telephone cables. Distribution boxes on these cables are placed as a rule to each other obliquely at an angle of 45°. In the parallel laying of hard pipes, the space between certain types of installations must be at least 5cm.

The crossing of TC installations cables with EE cables should be avoided. At the intersections, that need to be done under the right angle, spacing between these cables must be 10mm and where it is not possible than it is necessary to set the insulating insert 3mm thick.

Cables for sound lines are allowed to run concurrently with other telecommunication cables on the wall or rack, with respect to the selected type of cable with screened mantle.

The cable placing in the pipes should be done after finishing the treatment of the walls.

When placing cables one must take into consideration not to damage the cables. In places where cables change its direction one should make gentle curves whose radius must not be less than fifteen times the cable diameter.

All metal parts of the telecommunication devices, distribution cabinets, splitters and cable racks must be earthed with copper stranded wire, by connecting it to the grounding of the building.

On the connection outputs of the device should be left enough length so that the devices can be set according to the given disposition:

Computer connectors (RJ-45) are placed at 0,3m from the floor.

Outputs for manual call points are placed at 1,5m from the floor.

Outputs for alarm sirens are placed at 2,5m from the floor.

In the premises in which it appears to have moisture and dust it is necessary to ensure installation of TC devices and appliances in the appropriate IP protection.

UTP cables which are used here have to be of the category prescribed in the design and in accordance with ISO/IEC 11801 standard.

- in the wall (by digging) where it is recommended to tuck the cable into the plastic flexible hose, and
- in the wall by using PVC canal

It is recommended to use PVC canals because in case of problems the cables can be directly accessible and it is also much easier to extend the network.

At the ends of the segments are mounted RJ-45 connectors.

If the end of the cable segment is leading to the workstation, this connector is installed in a special connection box. If the end of the cable segment is leading to network equipment (switches), these connectors are mounted on special connection panels (patch panels). Every cable, connection box or connector on the patch panel must be properly marked in accordance with the markings given in the

attached scheme. In order to realize the complete network equipment connections (switches, connection boxes) it is necessary to make a number of short (patch) cables ("Fly" FTP cables of the category according to the project with four pairs of stranded profile) with two male RJ-45 connectors on the network equipment.
All computers in the network have incorporated 32-bit RCI Ethernet FTP adapters (cards) and FTP connector. The connection of the connection box with computer network adapter is done by using UTP cable (or FTP depending on the category) of the required length. It is foreseen the use of FTP "Fly" cable (category 7) with 4 pairs with stranded profile. At the ends of the cable are mounted RJ-45 connectors (by crimping), one of which is connected to the power adapter of the workstation and the other one to the connection box in the room. This way of connecting workstations ensures reliable operation of the network. A mechanical failure on a local segment, the separation of RJ-45 connector from the connection box or from the workstation power adapter will only affect the inability of that workstation while the rest of the network will be functioning normally. In addition to these advantages, this method allows the implementation of network, that in case of change of use of premises (the transition from one frames to another service and alike) by easily bridging the workstations so that they could be joined to any other available network connector.
RJ-45 connectors are mounted on cables in accordance with applicable standard ISO/IEC 8877.
Upon completion of the installation of cables it is compulsory to mark the cables with metal rings and check the count of the vessels.
Also, it is necessary to check whether the insulation resistance meets the following requirements:

- insulation resistance of a/b must not be below the minimum value of 10 MΩ/km,
- insulation resistance of a/z must not be below the minimum value of 10 MΩ/km,
  All results must meet Telekom's regulations for this type of cables.

21.6.4 ELECTRICAL INSTALLATIONS

For devices that are used and require special electrical supply of 230V/50Hz, it is necessary to provide electrical sockets at a distance not exceeding the length of their connecting cable (which is 2,1m).
The electrical installation has to be carried out correctly. Special attention must be paid to correct grounding of the installation. Problems with electrical installations poorly performed grounding, large variations in the power supply voltages or frequency may lead to unstable operation of the network, and it can cause frequent relegation of certain devices, as well as more severe damages to them. Particular danger comes from the fact that all networking components become electrically connected so that in the event of an electrical incident significantly increases the risk for all devices in the network which could produce large damages.

21.6.5 TECHNICAL REQUIREMENTS FOR STRUCTURAL CABLE NETWORK

Before the works start, the Contractor shall accurately determine and mark the positions of all elements of the designed system (sockets, distribution cabinets, active equipment, cable ducts etc).
In this phase the Contractor is also obliged to mark the routes to setting new cables as well as to adapt them to eventually existing cable canalization.
The Contractor shall specify places where the projected installations are going to be included in the existing installation, as well as to determine and carry out the connections of electrical installations which already exist or will be derived from other projects.
In the cabling for computer networks should be used cables in the category foreseen by this project according to ISO/IEC standard, and certified for the work above 100MHz.
For the rack cabinets of 12HU and 18HU it is foreseen the mounting on the wall which needs certain strengthening and holes for wall mounting. Fixing to the wall should be performed with appropriate anchors and screws given the dimensions and weight of cabinets and equipment to be installed.

FTP cables end up in patch panel or in the plug.
FTP cable must not be interrupted nor continued by additions.
FTP cable runs through the ducts (canals) or is attached with OG clamps to the wall at the distance of 30-50cm, or is tucked through the ribbed hose into the wall by digging.
After laying the cable the canals should be covered with suitable cover over its entire length and double ceiling, floors and decorations must be completely restored.
The laying of FTP cables must be introduced so not to interfere with communication through the facilities and not to be in the zones with frequent passage of people.
The FTP cable when pushed through and fastened must not be longitudinally bent, tied in a knot, pinched, or be damaged in any other way.
While pushing FTP cable through it must not be stretched.
FTP cable can be laid vertically or horizontally, but it is not allowed to set it obliquely.
When laying the cables their possible damage should be taken into serious consideration. In places where cable routes change direction, mild curves should be made to bend the cables, whose radius must not be less than eight times the outer diameter of the cable.
FTP cable should not be placed and routed near heat sources (pipelines, radiators, stoves, heaters), and if this is not possible, then it is necessary to make thermal insulation.
FTP cable should not be placed outside the building but inside the one piece PE hose whose ends are in the interior of the building and it must be protected from the weather.
FTP cable should not be placed near the device, object or source that may damage the cable.
The place where the cables end up (patch panels and sockets) is determined uniformly for the entire installation or for every room in particular in order to violate as less as possible the aesthetics of the room and to allow for maximum the functionality of the planned equipment.
Under the rules of carrying out the installation, sockets should be placed at a height of 20-40cm above the floor and patch panels inside the cabinets.
The spare cable which is necessary to leave at the end of the cable where the socket is mounted is 10cm, and at the end where the patch panel is mounted it is 30-100cm, depending on where the patch panel is installed – either inside the wall cabinet or rack cabinet.
Immediately after pulling it through, each cable should be marked by the same number on both ends (with labels). The number of cables should be taken according to the number of sockets, so that the numbers are growing in a clockwise direction when viewed from the entrance door into the room.
After pulling through of FTP cables, cables should be tested for rupture and short circuit. If there is a rupture or a short circuit, pull the cable out and replace it with a new one.
All cables which are correct after being laid should end up into the socket, i.e. on the patch panel, according to the project documentation.
Placing of RJ-45 connectors, sockets and patch panels should be performed only with professional tools and by trained installers.
When installing sockets and patch panels each line should be tested according to the requested performance.
To connect the wall sockets and terminal equipment (computers) i.e. to reconnect patch panel and active equipment, the appropriate patch cables of prescribed length should be used.
In some locations where the computer cables are installed close to the power cables, the minimum distance between the cables should be taken into account as prescribed by standards such as COMMERCIAL STANDARD for Telecommunications Pathways and Spaces. Since none of the standards specifies the power, one must always take into account a less favourable option, i.e. the total capacity of all the power cables.

Table of minimum distance (mm) between energetic and FTP copper cables

strength of power cables	< 2kVA	2-5 kVA	> 5 kVA
power cables or devices without a grounded separation from the communication cable	50	130	600
not shielded power cables or electric devices mounted in a grounded metal canal	30	65	300
power cable installed in grounded metal canal where each is in the same such canal		40	150

Taking into account the proposed cable selection and minimum distances between these cables and power cables to the individual sections, it is recommended to set copper cables in a fully closed metal grounded canals.
Permissible cable attenuation of the structured cable system, at 100MHz, are given in the following table, according to standard EN 50173:

impendence(Ω)	100	120	150
attenuation(dB/100m)	22	19	12,3

21.6.6 CONDITIONS FOR THE INSTALLATION OF ACTIVE COMMUNICATION EQUIPMENT

For the correct installation and functioning of active equipment it is necessary to ensure the right conditions, as:

- Space – Active equipment is foreseen for installation in a standard 19" width cabinet,
- Power supply – To provide conditions for the supply of active equipment within the distribution cabinet and foresee the space for devices for an uninterruptible power supply – UPS,
- Temperature and Humidity – For the proper operation of the equipment it is necessary to provide the appropriate temperature conditions. Typical range of temperatures and maximum air humidity are specified in the documentation of active equipment.
  Distribution cabinets must be properly grounded. Protective cabinets are equipped with a rail for grounding which connects to the grounding hub within the distribution electro-energetic cabinet.
  During the installation of active equipment it is necessary to consult the documentation of active equipment for possible additional requirements specific for a certain manufacturer or type of equipment

21.6.7 POWER SUPPLY OF EQUIPMENT WITH ELETRIC ENERGY

Power supply of equipment within the protective cabinet is performed through the panel of connectors which is usually mounted on the bottom of the protective cabinet. The panel must have a main switch for the possible need for disconnecting power supply of active network devices.
The panel for power supply of equipment is connected to the distribution power network of alternating current of 220V, 50Hz. The power supply should be derived from the power distribution cabinet, from a separate fuse.

To ensure the work of active devices and in case of power failure, an uninterruptible power supply (UPS) is installed in protective cabinets.

21.6.8 FINAL PROVISIONS

The Contractor is obligated, upon completion of all works, to inspect, test and try out the complete cable system.
The Contractor is obligated to carry out all repairs before the handover of the works to the Contracting Authority and Beneficiary for further use and handling.
Everything that is not covered by these technical specifications the Contractor shall make according to valid RS standards and norms.

21.6.9 FINAL TESTING AND MEASUREMENTS OF http CABLES

The last phase of installation deals with final testing performed by the Contractor in the presence of the Supervisor. After installation of the cabling system it is necessary to determine whether the cable system in its whole meets the standardized quality norms and manufacturer's declared characteristics for the designed cabling system. The results of these measurements shall be submitted to the Supervisor prior to the Technical Acceptance and Provisional Acceptance.

Test has to include:

- the connection reliability (wire map),
- lengths of all pairs in the network (length),
- weakening per pair (attenuation),
- level of near-end crosstalk (NEXT),
- level of far-end crosstalk (NEXT@remote),
- PSNEXT,
- PSNEXT@remote,
- ELFEXT – measure of noise in one pair that comes from the other pair. It is measured at the opposite end of the cable from the transmitter (Home/ receiving party),
- Echo (return loss) – measure of the reflected energy caused by impedance along the cable,
- DC resistance,
- Impedance,
- ACR value for all pairs (relationship between attenuation and crosstalk, the quality of the cable is determined on the basis of that relationship)

Tests and checking are done according to the valid RS standards and norms.

With the mentioned device the following can be carried out:

- measure the characteristics of the cable in relation to a particular standard,
- test for open, crossed and split pairs,
- NEXT test for measuring near-end crosstalk
- measuring lengths in meters of twisted pairs,
- measuring propagation delay,
- measuring the impedance of each pair of the cable,
- measuring the cable drain,
- measuring the resistance of each pair,
- measuring the attenuation coefficient for all the combinations of cable pairs,
- measuring the signal loss through the cable and locate the place of the cable drain,
- locate the place of crosstalk on the cable,
- drawing NEXT curve and ACR level of attenuation/crosstalk

21.6.10 TECHNICAL REQUIREMENTS FOR INSTALLATION OF FIRE DETECTION

All elements and devices should be set according to the design. Possible changes could be done on the basis of written approval of the Supervisor. Before starting the works, the Contractor shall mark places of installation of elements and devices, distribution cabinets and cables.
Details of fixing the devices to the wall or onto appropriate carriers will be defined in the documentation of the equipment supplier.
After fixation, levelling and wiring of the cabinet in which the device shall be placed, it is necessary to install the equipment specially packed for transport in everything, according to the documentation of the equipment manufacturer.
All the conductors and cables shall be set according to the design:

- on the wall or ceiling (in the suspended ceiling) on plastic clamps,
- on the wall in plastic insulation PVC pipes.

TC and EE cables are placed parallel at a distance not less than 20cm. In case of horizontal spans, EE cables are laid at 30 cm from the ceiling and10 cm above them are cables for signalization and other installations, and at 10 cm above these, the telephone cables. Distribution boxes on these cables are placed, as a rule, to each other obliquely at an angle of 45^0. In the parallel laying of hard pipes spacing between certain types of installation must be at least 5cm.
The crossing of cables of TC installations with EE cables should be avoided. At the intersections, that need to be done under the right angle, spacing between these cables must be 10mm and where it is not possible, it is necessary to set an insulating insert 3mm thick. The cable placing into the pipes should be done after finishing the treatment of the walls.
When placing cables one must take into consideration not to damage the cables. In places where cables change direction, one should make gentle curves whose radius cannot be less than fifteen times the cable diameter. On connection outputs of the device should be left enough length so that the device can be set according to the given dispositions:
Outputs for manual call points are placed at 1,5m from the floor.
Outputs for alarm sirens are placed at 2,5m from the floor.
Installation for signalization of fire should be carried out with PVC insulated telephone cable installation, with aluminium foil in the wrapping and with copper conductors in diameter of 0,8mm, or "halogen free "cables, all according to the design.
Installation cables for fire signalization should be laid without interruption from one to another detector. Thereby the detectors have to be in a single loop – branching is not permitted. In the foot of the detector it is necessary to leave at least 30 cm of the cable length.
When placing the fire detectors one must take into consideration the following:

- Distance of detectors from the walls and from stored goods must not be less than 0.5m, except in corridors, passageways or similar part of the building with the width less than 1m.
- if there are beams or air vents bellow the ceiling at a distance of less than 0,15m, then the lateral distance of detector must be at least o,5m. Stored goods or shelves whose distance from the ceiling is at least 30cm, prevent the spread of smoke and must be treated as bulkheads (walls).
- the part of the roof which is connected to the room, whose size does not exceed 10% of the total area of the ceiling of the room, must be treated as a separate room.
- the perforated ceiling that provides ventilation around the detector must get closed in an area of $1m^2$.
- in the corridors with the width less than 3m, distance between smoke detectors may be at the most 15m, i.e. 10m between heat detectors.
- at the intersection of corridors must be placed at least one detector.

The fire alarm system must function even when the ventilation is turned on.

In case of the system of air supply into the rooms the following is applied:

- detectors (of smoke and heat) must not be placed in the way of fresh air currents of air conditioning system and ventilation,
- if the air currents are coming out of the side wall through the bars, the detector must be at least 1,5m far from the air holes,
- if the air vents are on the ceiling the detectors should be placed symmetrically between the holes.

In case of the system of sucking the air out of the rooms, one must comply with the following rules:

- if the air vents are on the ceiling, the detectors should not be placed in front of the holes but in the area of turbulence,
- if the air hole is on the wall just below the ceiling, the detectors are being placed in front of the hole.

All metal parts of telecommunication devices, of distribution cabinets, splitters and cable racks must be grounded with copper stranded conductor, by connecting it to the building grounding.
Upon completion of cable installation it is necessary to mark the cables by using metal rings and to check the count of wires. Also, it is necessary to check whether the insulation resistance meets the following requirements:

- insulation resistance of a/b must not be below the minimum value of 10 MΩ/km,
- insulation resistance of a/z must not be below the minimum value of 10 MΩ/km,

All measurement results must meet PTT's regulations for this type of cables.
Upon completion of the works, the Contractor shall be liable to carry out all specified tests and measurements and submit written certificates in the form of attest to the Supervisor.

22 AUTOMATIC GAS DETECTION

With respect to all foreseen works, the Contractor shall be fully familiar with all Final Design details, as well as with all local regulations, international and local standards (SRPS), common practice of trade and circumstances for their execution.
Gas detection system that would provide monitoring and control of the area with H_2 gas, timely detect and locate the occurrence of gas and warn the staff and attendants is designed.
Works have to be done according to approved Main Design, taking into consideration existing condition on the building, technical requirements, applicable RS regulations and standards, as well as the manufacturer's recommendation of the designed equipment.

22.1 GAS DETECTION SYSTEM

Gas detection system consists of:

- Central devices with gas detection modules,
- Gas detector,
- Alarm devices and
- Cable installations.

Central gas detection device is placed in the distribution cabinet on the wall in the joint corridor (room 1), outside the protected area, where it is available to the trained staff on duty around the clock.
Gas detectors will be placed near the places where leakage and occurrence of gas is likely to happen. Location of the detectors has been calculated so that each detector covers the area of approximately $60m^2$.

22.1.1 SWITCHBOARD FOR GAS ALARM AND SYSTEM CONTROL

Switchboard is the main element of the gas alarm system. It provides power and continuous monitoring of the signal lines, signal lines activation signal or the occurrence of a fault thereon, sending of alarm signals to the acoustic sources and operation of executive functions.

Technical requirements for central device for gas detection are:

- Central microprocessor switchboard consisting of a control module for connection of up to 32 gas detectors
- Exit card with total 32 digital outputs (potential-free relay contacts) DIO 32.
- LCD display for alternate display of the measured gas concentrations in detectors.
- LED indicators for alarms, faults and power.
- LCD display has to have backlight, over which programming and display of measured values can be done.
- LEDs should provide indication of the current alarm status at the measuring points.
- The switchboard should have the exit functions that can be programmed.
- The switchboard charged with 230V, 50Hz from the distribution cabinet from a separate circuit. In case of failure of the voltage, it has to be equipped with backup power supply - built in rechargeable batteries that provide the autonomy of the system.

22.1.2 GAS DETECTORS

Gases are detected with detectors (Explosive protection and confirmation: II 3G EEx nA IIC T4 , testing: II 2G EEx d IIC T4 PTB 00 ATEX 1076U , SIL 1 capability, Detection Principe: catalytic burning, Measuring of the gasses: explosive gasses and steam, Range of measuring: 0 – 100% LEL, Outlet signal: 4 – 20 mA, Working temperature: -40 +55°C, Supply: 24V DC, Protection level: IP 54, Construction: Stainless steel, aluminium case, Detector calibration: on H2.) previously calibrated for proper gas - hydrogen $\mathbf{H_2}$. Connection of the detectors was carried out in the detector housing.
The detectors have to fulfil the following technical requirements:

- To be calibrated to detect the following gases for hydrogen, for the measuring scope of 0 – 100 % LEL, in anti-explosive protection II 3G EEx nA IIC T4, tests: II 2G EEx d IIC T4 PTB 00 ATEX 1076U.
- Electrochemical measurement unit, the signal transmission system 4-20mA, supply voltage 10-28Vdc.
- Maximum prescribed cable length is 1000m (depending on the cable used).
- Connected to the switchboard with a cable with minimum 2 wires.

According to the relative density of hydrogen gas (0.069g/l) in relation to air (1g/l), the gas detector is placed at a height of 2.8 m from the ground (at the (suspended) ceiling).

22.1.3 ALARMING ELEMENTS

Alarming is done by the switchboard with audio-visual signals at 10-20%LEL and at 50%LEL.
To alarm the personnel, sirens with yellow flash light mounted on the wall 24V, 46mA, with exit power 106dB to be provided together with illuminated boards with inscriptions "GAS! DO NOT ENTER!" and "GAS! LEAVE THE ROOM!". The boards are provided above the entrance door from the outside and the inside of the protected premises, and sirens are provided within the affected areas and in the corridors.
Alarm sirens with a flash are charged from the switchboard and they are activated from the switchboard via executive relays.

ALARMING DIAGRAM

AUTOMATIC GAS DETECTORS 		SIGNALIZATION FIRST ALARM	SIGNALIZATION SECOND ALARM
10-20% LEL	→		"GAS!"
50% LEL	→		"GAS!"

22.1.4 GAS DETECTION INSTALLATION

Connection of the switchboard with detectors is provided with cables NHXHX 4x1.5mm^2. Signal elements are connected with cables JE-H (St) H 2x2x0.8mm FE180 E30. The cables are laid mainly through halogen free PVC hoses in lowered ceiling through the cable trays.
For signal transmission, i.e. activation of electro-valves for the interruption of gas flow is provided the cable type NHXHX 3x1.5mm^2.
The cables will be laid mainly in halogen free PVC pipes through the provided PNK canal in a lowered ceiling in the corridor.

EXECUTIVE FUNCTIONS OF THE GAS DETECTION SWITCHBOARD

- At alarm 1 - 20%LEL:
- audio-visual alarming at the switchboard
- At alarm 2 - 40-50%LEL
- audio-visual alarming – turning on sirens and "GAS!" boards
- closing the EM valve for H_2 flow
- turning off air conditioning in the affected area
- opening the smoke flap and turning on the emergency ventilation in the affected areas

Upon completion of the works, the Contractor shall be liable to carry out all specified tests and measurements and submit written certificates in the form of attest to the Supervisor.

23 FIRE PROTECTION

With respect to all foreseen works, the Contractor shall be fully familiar with all Final Design details, as well as with all local regulations, international and local standards (SRPS), common practice of trade and circumstances for their execution.
Main design of fire protection was created based on the obligation prescribed by Article 31 of the Law on Fire Protection ("Official Gazette of the Republic of Serbia" No. 101/09), all in accordance with all technical norms, regulations, bylaws and standards stated in the Main Design. Since fire protection regulations are very strict, specially for these kind of structures, main design of fire protection comprises an integral account of all fire protection measures envisaged by the

documentation – layout plan and fire protection concept.

Following regulations, Technical norms and Standards were used during designing and have to be fully respected during construction, testing and technical acceptance of the building:

- Law on Fire Protection ("Official Gazette of the SRS", No. 111/09'')
- Act on categorisation of objects and land in fire protection ("Official Gazette of the SRS", No. 76/10'')
- Rulebook on technical norms for fire and explosion protection of warehouses ("Official Gazette of SFRY", No. 24/87)
- Regulation on technical norms for the automatic closing of doors or shutters resistant to fire ("Official Gazette of SFRY", No. 35/80)
- Rule on compulsory attesting elements of type construction to fire resistance and conditions to be fulfilled by the joint ventures authorized for attesting of such products ("Official Gazette of SFRY", No. 24/90)
- Ordinance on technical standards for hydrant fire fighting ("Official Gazette of SFRY" No. 30/91)
- Ordinance on technical standards for low-voltage electrical installations ("Official Gazette of SFRY" Nos. 53 and 54/88 and "Official Gazette of FRY", No. 28/95)
- Rules on technical standards for ventilation systems and air conditioning ("Official Gazette of SFRY", No. 38/89)
- Regulation on technical norms for stable installation of fire alarm ("Official Gazette of SFRY", No. 87/93)
- SRPS Z.C0.001 – Protection from fire and explosions. Terms and definitions
- SRPS Z.C0.003 - Protection from fire and explosions. Classification of fires depending on the kind of combustible materials
- SRPS Z.C0.005 – Protection from fire and explosions. Classification of materials and goods depending on their behaviour in a fire
- SRPS Z.C0.012 - Protection from fire and explosions. Categories and grades identification of the fire hazards of materials
- SRPS Z.C1.002 - Protection from fire and explosions. Fire fighting equipment, symbols
- SRPS U.J1.030 – Fire protection. Fire load
- SRPS U.J1. 220 - Fire protection. Symbols for designs
- SRPS U.J1. 240/94 - Fire protection. Types of building structures according to their interior resistance to fire
- Rulebook on construction of plant for inflammable liquids and on inflammable liquid storing and pouring off, published in the "Official Gazette of SFRY", Nos. 20/71 and 23/71
- Rulebook on overhead electric lines jeopardized by explosive mixtures, published in the "Official Gazette of SFRY", No.18/67 from 26 April,1967 /-Official Gazette of SFRY, 28/70-740
- Rulebook on protection against static electricity, published in the "Official Gazette of SFRY", No. 62/73
- Rulebook on technical norms for access roads, turntables and plateaus for fire vehicles in the vicinity of objects with increased risk of fire. Published in the "Official Gazette of FRY", No. 8/95
- Law on Planning and Construction ("Official Gazette of RS", No. 47/2003)
- Law on explosive materials, liquids and gases, ("Official Gazette of SRS", No. 48/1994)
- Serbian electro technical standards – main group N. B. (1988)
- Rulebook on technical norms for lightning protection and Rulebook on Yugoslav standards for lightning protection (SRPS N.B4.803, SRPS N.B4.810, SRPS N.B4.811, SRPS IEC 1024-1, SRPS IEC 1024-1-1) "Official Gazette of FRY", No. 11/96

- Rulebook on technical measures for drive and maintenance of electrical-energetic plants, "Official Gazette of FRY", No. 41/93
- Rulebook on provision of markings for occupational safety and health, („Official Gazette of RS", No. 95/2010)
- Rulebook on equipment and protection systems intended for use in potentially explosive atmospheres, („Official Gazette of RS", No. 001/2013 from 14 January, 2013)

23.1 TECHNICAL DESCRIPTION

Considering the time of the construction of the object and its original purpose, the structure to a large extent fails to meet the today's demands regarding the level of technological equipment, fire protection conditions and requirements related to the quality insulation of the space.
The design of adaptation and reconstruction does not comprise the entire object, but it processes only one of its parts. In accordance with technological requirements and fire protection conditions, the design includes the evacuation route which comprises the stairways space, entrance windshield and the elevator. The design envisages replacement of the entire lining of the stairways and the doors that close the stairways space at each floor, replacement of the elevator and extension comprising one more exit station, as well as a new entrance windshield.
Within the reconstruction and adaptation design of the subject part of the structure, a conceptual plan is given (in the form of a layout) of the entrance windshield.
Replacement and technical improvement will be performed on all the existing installations, and new modern technologies will be introduced, while the existing final linings in the interior will be replaced.
Also, the design will improve the energy efficiency of the first floor by placement of new thermal insulation layers. All the newly designed thermal insulation layers will be placed on the interior side of the facade walls.
Elevator replacement is envisaged as well as extension for one more exit station, so that the elevator pit is formed within the space of the technical floor. The elevator exits on the first, second and third floors will be moved to the stairways space.
Physical-chemical laboratory comprises 255.84 m^2, and toxicology laboratories comprise 168.07 m2 and the shared space comprises 67.68 m^2 of the net executed surface of the floor.
Fire protection zones were defined according to the regulations and are defined in the Main Design.
Fire protection doors have been envisaged for each of the fire protection zones towards the corridor. All the doors have fire resistance of 90 minutes (F90).

23.2 SPECIAL GASES SUB-STATION

For the needs of functioning of laboratories, special gases are required, and those are: nitrogen, hydrogen, helium, argon, and compressed air. The special gases sub-station already exists on the location and it is situated at the corner between the south-west and south-east facade, at about five metres from the structure. The distribution network for the gases from the sub-station along the facade extends up to the second floor. Therefore, the existing duct should be shortened up to the first floor.
From the point of the gas installation supply line, the distribution is then distributed above the window around the object to the corresponding laboratories. Laboratories which use gases are mostly situated along the facades.

23.3 WALLS

The existing reinforced concrete parapets and walls with thickness of d=15.0 cm on the outer side are covered with eloxated aluminium sandwich tin sheets with thickness of 2 cm on the sub-structure over

the durisol with thickness of 4 cm. The piers are lined only with eloxated aluminium sandwich tin sheets with thickness of 2 cm.
The newly designed condition, according to the Energy Efficiency elaborate and in order to improve the thermal conditions, envisages adding of thermal insulation in the interior of the structure. Adding of thermal insulation is performed by lining of parapet walls, piers and full wall facade cloths. The lining is performed with semi-rigid plates of mineral wool (10 cm thick) on parapets and walls and with 5 cm of thickness on piers. Thermal insulation is then lined with gypsum plates on the sub-structure in the parapets and on walls and piers, depending on the finishing, with a single or double gypsum plates on the sub-structure.
The interior existing walls are made of solid bricks d=12 cm and they are situated in the sanitary block, installation canal, elevator shaft and stairways space. In the premises that border with the stairways space and installation canal, the walls are lined with thermal insulation that is 5 cm thick. Over the thermal insulation, the gypsum carton boards are placed on the sub-structure.
The finishing of these walls varies depending on the function of the premises where they are located.
Newly designed reinforced concrete walls of the repository space (pos. 3) are 14 cm thick towards the adjoining premises and are lined with thermal insulation of 5 cm of thickness according to the same principle as the brick walls. The wall finishing towards the chemical laboratory is tiling.
Other newly designed partition walls are prefabricated walls with gypsum carton linings. The walls' structure consists of double gypsum carton boards (d=1.25 cm) placed on the sub-structure on both sides ("CW" profile) with insulation filling.

23.4 FLOORS

The existing floors on the entire surface area of the first floor are to be removed up to the construction reinforced concrete slab. The new floors will be of the same size in order to avoid the difference in the height of floor at the stairways.
The newly designed layers of the floor construction are:
- The existing AB plate – 15 cm
- Thermal insulation (elastic expanded polystyrene) – 3 cm
- PE foil
- Cement screed - 4-4.5 cm (depending on the floor finishing)
- hydro-insulation – acid-resistant epoxy coating; finishing is glued over it.

Finishing of the new floors are:
PVC floor - 0.5 cm (premises 4, 5, 6, 7, 16, 23, 24, 25, 28, 30, 31, 32, 33, 36, 37, 44, 46) with the surface area of 144.43 m^2
Antistatic PVC floor (Bfl, S1/ Cfl, S1) - 0.5 cm (premises 8, 9, 10, 11, 14, 15, 16, 21, 22, 24, 25, 27, 38, 39, 42, 45, 46a) with the surface area of 100.57 m^2
Antistatic PVC floor (Bfl, S1) - 0.5 cm (premise 18) with the surface area of 10.59 m^2
Acid-resistant tiles on glue – 1 cm (premises 3, 12, 12a, 13, 17, 20, 26, 40, 41, 43, 45) with the surface area of 137.53 m^2
Tiles on glue – 1 cm (premises 19, 34, 34A, 34B, 34B′, 34C, 34C′, 34D, 47) with the surface area of 26.38 m^2
Granite ceramics on glue – 1 cm (premises 1, 2, 35, 35a) with the surface area of 62.10 m^2

At the connections of different floor finishing, floor battens of inox are placed.
The new design envisages the removal of the existing stairways lining and finishing of the stairways space through all the floors with granite ceramic tiles on glue.

23.5 CEILINGS

Suspended ceilings have been envisaged in all premises of the first floor.
The height is achieved by lowering of the ceilings in the working premises to 280 cm, and in auxiliary premises and corridors to 240 cm. The ceilings are made of monolithic gypsum carton boards. Ceilings in offices are made of monolithic gypsum carton boards on hangers.
In all premises, except from the space of the corridor, insulation of 3 cm is placed on the concrete floor ceiling, as acoustic insulation towards the premises on the upper floor.
At places where ventilation canals exit the premises into the corridor and where they need to pass under the beams, skewed cascades in the ceilings will appear by which the installations will be hidden. The same principle is applied at the exit of the canals onto the facade in the space of the kitchenette in the physical-chemical department and in the premises for washing of vessels at the toxicology department.
A monolithic gypsum ceiling is designed along the corridor on the sub-structure in order to enable the passage of installations.
At the part of the corridor which belongs to the evacuation route and is placed between the fire protection doors, suspended ceiling is entirely lined from within with promat fire protection panels (5 cm thick), as an installation canal.
All lights in all ceilings are light fittings. Apart from the lights, fire alarms will also be installed in the ceilings as well as ventilation grids and manholes.

23.6 EVACUATION ROUTE

23.6.1 Doors

Fire protection doors are introduced in the parts of the corridor that belong to the evacuation route. In those premises, replacement was performed of the flooring and ceiling linings and also, parts of the walls which belong to that space were brought to their purpose of walls on the evacuation route – wherever it was possible, new PP gypsum prefabricated wall was placed, while the existing brick walls were extended and additionally grouted. All the walls on the evacuation route are fire-resistant F 120 mm.
In the stairways space the existing glazed partitions are replaced by aluminium anti-smoke glazed partitions with folded doors. The doors are made of aluminium profiles without thermal breaks, they are glazed with pamplex glass with thickness of 2x5 mm. Glazing of the wing is framed with EPDM sealing and rounded battens.
Three-sided EPDM sealing is placed within the doors.
The doors are supplied with anti-smoke brushes at the bottom of the wing.
All elements of these partitions must be attested to full sealing.
Within the stairways space on the roof of the object, it is necessary to perform certain interventions on the existing doors of technical premises and on the doors that lead to the roof. It is necessary to put sealing strips on the doors' wings in order to secure sealing.
Fire protection doors are installed on the first floor on laboratories that represent separate zones, on electrical cabinets and installation canals, as well as in the evacuation route where it is required due to fire protection regulations.
The fire protection doors are made of double both-sides lined steel tin sheets with thickness of d=1.5 mm with fire protection thermal insulation sandwich filling that can meet the fire-resistance requirements from F60 to F90 depending on the zone in which they're located and on the surface of the doors. The door sill is made of steel profiled tin sheet for installation of fire protection doors. The doorpost is metal fire protective made of steel profiled tin sheet with inserted fire protection strips suitable for fitting onto the door wings. Build in doorposts into the wall at minimum three spots by height and along the width of the lintel.

The wings are supplied with anti-smoke sealing. A strip is placed on the door which widens in contact with fire thus closing the openings which disables passage of the smoke.
Anti-corrosion protection of fire protection doors is provided by basic anti-corrosive coating, and the finishing is performed with two layers of synthetic lac in the colour required by the Beneficiary.
Doors are of standard design with locks, cylinders, three keys and a self-closing mechanism. The door wings should be supplied with minimum three hinges in height, depending on the weight of wings and required protection.
Fire protection doors with glazed wings comprise only 1/3 of the wings' surface.
Fire protection doors that are placed on the first floor within the evacuation route are designed to be permanently opened with the aid of magnets. The doors are connected to the system for automatic closing through the fire-control room.
The fire protection doors are not only resistant to fire, but are also completely toxicologically harmless.
Fire protection doors must have attestations on fire resistance control according to the standard SRPS U.J1.160.

23.6.2 INSTALLATIONS

In order to achieve sufficient pressure at the first floor level and for the needs of the network of hydrants, construction of a room for hydro-cylinders has been envisaged in the area of the storey at level -1, under the basement.
For the needs of mechanical installations – ventilation and air-conditioning on the lateral sides of the facade and on the chamfered cloths, installation canals are formed which serve for as leads for ventilation channels of premises and equipment towards the roof of the object. Canals are made of box profiles with dimensions of 100x100x5 mm which form the geometry of the canal fixed onto the concrete parapets and the floor structure. Towards the windows on the facade and for fire protection reasons, the canals are covered with facade fire protection trimo panels, and on the front side with aluminium grids along the entire length of the roof.
Also, on the roof of the object and for the needs of mechanical installations, three house-containers are envisaged for the protection of filters. The containers are made of thermal panels on the sub-structure of box profiles. The roof is also made of panels with the gradient of 10% with accompanying edging.
The floor is made of profiled tin sheet on the metal sub-structure of box profiles and "L" profiles.
The containers are placed on metal legs with possibility to regulate the height. They're fixed onto the roof slab.
There are several doors on each container depending on possibility with respect to the canals, which enable the access to the facility. The doors open to the outside and there are two grids on each of them in the lower and upper zones of the wing for better ventilation of the space.

23.6.3 FIRE PROTECTION

Reconstruction and adaptation of the object is provided in terms of fire protection, occupational safety and health of people. Hazard degree has been established for fire of the subject structure (or part of the structure that makes technical-safety whole) and harmonisation of resistance has been determined for fires of construction elements (walls, beams, roof structure, etc.) all according to SRPS U.J1.240. The fire protection design defines the materials for construction that need to be fire-resistant; it also defines the degree of the material fire-resistance, division of the object into fire sectors, estimation of the fire risk, properties of the floors, roof, doors, windows, evacuation routes as well as a possibility of access to the object. In accordance with the standard SRPS TP 21, the object is designed so that it enables safe evacuation in case of fire, i.e. evacuation routes for saving the life of people and property, along with preservation of the building's structure and bearing capacity even in the time of the fire-

extinguishing intervention until its full engagement. Evacuation routes are defined, and the time required for evacuation of all persons that might be present in the object has been calculated as well as the capacity of evacuation routes. The type of protection of electrical devices and equipment were specifically defined. The fire protection design also defines the protection of the object from atmospheric discharge, executed protection grounding, backup source of power supply and installations for automatic detection, alarm and distinguishing of fire. The design gives the disposition of the fire-extinguishing equipment, lightning rod installation, arrangement of mobile equipment for fire-distinguishing, disposition of hydrants and evacuation routes.

TABLE OF FIRE PROTECTION SECTORS

NAME OF PREMISES:	**IIII Sector**	**Surface area [m^2]**
FIRST FLOOR		
Corridors, offices and laboratories	I	423,29
Repository of chemicals (pos. 3)	II	15,38
Rack cabinet (pos. 46a)	III	4,30
T O T A L:	**3**	**442,97**

Installation canal (pos. 34 on drawing 04) is vertical fire sector – the canal passes through all floors and is situated in the sanitary block. It is fire-protected towards the sanitary block by PP doors (fire-resistant F 90 min). Canals for ventilation in case of accident are partly lined with promat panels for protection of canals from fire, in the part which is situated from the central part of the corridor to the exit from the object (in the part of the corridor that belongs to the chemistry laboratory) i.e. from the beginning of the second fire-protection zone.
Classification of the building is made according to maximum number of people who reside in the building at some point in time (120-150 people), as well as maximum number of people in each fire sector (20 people in each), and by maximum size of the fire subsector surface area (492 m^2) where each floor is one fire sector and pursuant to Article 5, SRPS TP 21) is – **P4.**
As for the functional fire hazard, the object has the fire hazard category **K4** according to its accommodation properties with maximum (present at some point) of 120-150 people.

23.6.4 FIRE PROTECTION MEASURES FOR INSTALLATIONS

The installations designed are required for normal functioning in the object and fire protection of the building.
The following installations are designed for functioning of the building:

- ◊ Mechanical installations of heating and ventilation,
- ◊ Electrical installations of low and high voltage electric power,

Installations in the function of fire protection of the building are:

- ◊ Installation of interior hydrant network,
- ◊ Installation of exterior hydrant network,
- ◊ Mobile equipment for initial fire-extinguishing.

23.6.5 ELECTRICAL INSTALLATION OF HIGH VOLTAGE AND PROTECTION MEASURES

Technical documentation is prepared in a way to correspond to all requirements of the international standard ISO/IES 17025:2006. Installations must be executed in all according to the Main Design. For any variation, approval from the Supervisor is required. All equipment to be installed must be of first-class quality.
The features of the installed equipment were determined according to SRPS IEC 60364-5-51:
Class BD2 – The equipment must be made of the materials which holds back spreading of fire and smoke and poisonous gases.

23.6.6 LOW VOLTAGE INSTALLATION

Energy supply distribution in the object has to be executed so that all the conditions dictated by the disposition, purpose and power of consumers are fulfilled.
In the area of the corridor on the first floor, floor distribution cabinets RT-1-M/I and RT-2-M/I that should be triplex cabinets: network, aggregate and uninterruptible power source (UPS) that supply the lighting and technology consumers in the object has to be installed.
The main distribution cabinets are equipped with switches that can be remotely switched off. On the doors of the network and aggregate parts, there will be "mushroom" push-button switches for emergency power off (EPO). Power supply of the distribution cabinets from the main distribution cabinet is direct. Thus greater energy reliability is achieved. In selection of power supply mains the following was taken into account: loading, manner of installation of cables, voltage sag and place of installation of cables, and all in accordance with the relevant regulations and standards from the given area and fire-protection requirements.
The power supply mains are in the corridor area, under the suspended ceiling and on the main route they partly go along the PNK carriers FR 120, and partly above the suspended ceiling with the aid of OBO BETERMAN FE 120 collars, and with a smaller part they're placed in the PVC pipes within the wall. Parts of technological consumers are supplied with cables placed in the protection pipes in the floor.
All distribution cabinets should have a mechanical protection degree IP-54, according to single-line diagrams. The cabinets should be made of steel tin sheets, painted in base and protection paint of POLYESTER powder and secured with doors and locks. Distribution cabinets are envisaged for mounting in the wall where they are placed at the height of 1.2 m from the finished floor.
Distribution of power from main distribution cabinets towards the floor RTs in the object is performed with cables of type PP00 that already exist and the newly designed cables for aggregate power supply are NHXHX-J of corresponding profile according to the expected maximum one-time installation tensile load of installations given in the graphic part of the design.
The cabinets should be made in all according to the given single-line diagrams in the design and so that the casing is the same for the network, aggregate and UPS voltage. The installed equipment should also be clearly and spatially separated. The distribution cabinets of the aggregate and UPS power supply must be physically separated from the distribution cabinets of the network and they must be adequately marked.
All distribution cabinets are supplied through high quality protection switches all according to the Main Design.
For the interior distribution, conductors are envisaged similar to cables – installation conductors of types NHXHX-J and NHXHX Fe180/E90, all according to the Main Design.

23.6.7 INSTALLATION OF LIGHTING AND CONNECTIONS

Installation of lighting has to be done according to the requirements from the Main Design and recommendations related to that area. All switches are placed at the height of 1.5 m. from the finished layer of floor unless stated otherwise in the Main Design.
Anti-panic light is envisaged in case of loss of voltage in the network, and it consists of lamps that have installed batteries with autonomy of work of min. 3 h. These lamps are planned for the corridors, stairways, at the exit from the object and on any other pedestrian exit route that serves as a safe passage and evacuation of people.
In the distribution cabinet, the electric circuits of the anti-panic light are marked separately.
There are green colour markings on the lights with inscription EXIT or with a sign "→" in the direction of evacuation.
Installation of the lighting is executed by conductors of NHXHX-J profile and the number of cords as given in the graphic part of the design.
Sanitary blocks will have lamps with the protection degree IP44, insulation class 2 (lamps with insulation caps). The lamps must not be mounted in the zone 1. Ei. Connection for lamps is executed at min. 60 cm from the lavatory edge.
The connections will be positioned in accordance with the Main Design, technological requirements and purposes of the premises.
Complete electrical installation of laboratories and offices is partly supplied with power from the UPS and aggregates, and partly from the network power supply (in accordance with the terms of reference), and laboratories are entirely supplied with power through the UPS (laboratory equipment).
For connection of computers, thermal and other mobile consumers, connectors have to have protection contacts and to be placed at the height of 50 cm from the floor elevation, unless otherwise stated in the Main Design.
The parapet distribution in laboratories is designed under the working surface of the table at the height of 60 cm, and some devices and computers are supplied with power through the opening on the working panel of the table. The entire parapet distribution which is mounted towards the facade walls is designed to be built in, because in that zone masks are executed that shield the radiators. Parapet distribution is installed into the masks according to the Main Design. In all interior walls, the parapet distribution is mounted directly onto the gypsum carton wall under the working panel of the table.
Installation of single-phase connections with grounding should be executed with conductors of type NHXHX-J 3x2, 5mm2. Installation of three-phase connections should be executed with cable of type NHXHX-J x 2,5mm^2. In some laboratories where the antistatic floor is designed and in sanitary blocks, installation of boxes is designed with a potential-equalizing bus bar. Cables that pass through the fire-protection walls are coated with isolation material (similar to "Plamal"), which has attestation that it does not transfer the fire for two hours, on both sides of fire-protection partitions and in the length of 1 m, while the space is filled with the same mixture.
The attests confirming these requirements have to be presented prior the sealing mass is applied.

23.6.8 INSTALLATION OF UNINTERRUPTED POWER SOURCE - UPS

For the needs of laboratories and computers, two devices for uninterrupted power source will be installed (of 40KVA and 20KVA), both placed on the 2nd floor where the UPS devices are already placed for the needs of other laboratories.

Technical requirements for UPSs are:
For 40KVA, height of 150 cm, width of 52 cm, depth of 82 cm, and
For 20KVA, height of 152 cm, width of 35 cm and depth of 82 cm
Time of maintenance of standard parameters at nominal load is 10 min.
Input voltage is 3x380/220V, and the output voltage is also 3x380/220V.
In case of need, a possibility of extension by adding new batteries.

23.6.9 PROTECTION

The protection against excessive touch voltage is achieved through a TN-C-S system installed in the entire facility.
The protective conductor "Pe" and zero conductors "N" (bus) are connected in KPK, from which a special protective line in connecting cables of an appropriate cross-sectional area and mandatory yellow-green colour is fed. All metal equipment housings are attached to this protective line by the use of a specific screw.
The protection against breakdown is achieved through the installation of emergency stop buttons for turning off the overall power supply for related consumers of the distribution cabinet in case of emergency.
In the warehouse (3), where the Ex installation is envisaged, consumers are additionally protected via faulty current protection switches 25/0, 3A.
Protection by the use of certified coating should be applied when cables and cabinets pass through fire walls.
Upon the completion, tests for insulation resistance and the connection are done and the protective measures applied are inspected.
A test report is prepared and a test certificate is issued.
The Contractor provides the required certificates and warranty cards for all the equipment installed.

23.6.10 EXPLOSION HAZZARD ZONES AND PROTECTION

According to the Main Design and in respect of valid RS standards and requirements the following equipment has to be installed:
installation of surface-mounted lamps of type EXEN-236 of 2 x 36 W, with explosive tag CE Ex II 3GD EX nA II T4/T5- Ex tD A22-IP 60, same or better quality then produced by "CORTEM".
installation of surface-mounted lamps for panic-lighting of type EVF-18EX, with explosive tag CE Ex II 3GD Ex nA II T4/T5 – ExtDA 22-IP-60, same or better quality then produced by "CORTEM",
installation of protected sockets of type RY 216 V, of 16A, with explosive tag CE 0772 Ex II 2GDEx dIIC T5 -Ex tDA 21, IP 66, same or better quality then produced by "CORTEM".
installation of a plug for the given socket of type SPY 2116V, 16A, (1+N+E), with explosive tag CE 0772 Ex II 2GDEx dIIC T5 -Ex tDA 21, IP 66 same or better quality then produced by"CORTEM".
All has to be installed in accordance with the Main Design and laying of cables in the hazard zones has to be for NHXHX-J cables.
Since it is unknown what kind of digestor will be provided, the Contractor is supposed to provide pre-ventilation if it is needed within the digester according to the requirements from the supplier.

23.6.11 GROUNDING AND LIGHTNING PROTECTION INSTALLATION

According to SRPS IEC 60364-5-54, the following measures are taken in the facility:

- Main equipotential bonding,
- Additional equipotential bonding in the sanitary block.

The main equipotential bonding is achieved by the connection of metal masses to the facility earthling system, directly or through earthling buses in the main distribution cabinet (GRO) or the nearest distribution cabinets. The equipotential bonding installation comprises metal structures of all distribution boards and installation channels of PNK (perforated cable trays).

PNK channels are connected by 1x16 mm NHXHX-J cables to the earthling bus in the nearest distribution cabinet.
In sanitary blocks, boxes for equipotential bonding are envisaged, and they are connected to the protective busbar of the associated distribution cabinet via a 1x6mm^2 P/F cable. The equipotential bonding boxes are connected to metal masses (lavatory knee, flush tank, etc.) and in the kitchen, toilets, etc., by a 6mm^2 P/F conductor into PVC tubes of 013.5mm.
All the works should be executed in accordance with applicable technical regulations and materials satisfying appropriate SRPS standards, and qualified labour force.

23.6.12 PROTECTION AGAINST EXCESSIVE TOUCH VOLTAGE

Protection from hazardous touch voltage is envisaged by the use of the TN-C-S protection system. For that purpose, a galvanic connection of the protective and zero busbars is created in the main distribution cabinet GRO (a), and they are then separated within the facility.
In the main distribution cabinets GRO (m), installation of equipotential bonding busbars is envisaged, and protective conductors of high and low voltage installations, as well as equipotential bonding lines from wet rooms and toilets are connected to those busbars.
For the inspection of efficiency of the applied safety measures it is necessary to carry out the required measurements, tests and get the certificates from the competent authority.

23.6.13 INSTALLATION OF THE ELECTROMOTOR DRIVE AND AUTOMATIC CONTROL

According to standard SRPS IEC 60364-5-51, the facility belongs to class BD-2 in terms of the possibility of evacuation in case of fire emergency.

ELECTRICAL INSTALLATIONS OF THE ELECTROMOTOR DRIVE

According to the Main Design, in addition to the power supply from the network, an additional power source must be provided, and for that reason the overall electrical installation of the electromotor drive is connected to the aggregate supply GRO, which is provided for the needs of the first floor and placed next to the already existing diesel-aggregate.
For all electrical consumers, automatic control via time programs and manual control from the electrical cabinet door are envisaged. Signalling of operating and emergency conditions of all consumers of the air-conditioning, heating and cooling system is carried out by the use of LED diodes on the electrical cabinet door.

DISTRIBUTIONS CABINETS OF THE ELECTROMOTOR DRIVE

The electromotor drive and automatic control cabinets are free-standing or wall-mounted cabinets. The cabinets are made of twice pickled sheet, with a door, lock and key, with the lowest protection level IP 54, protected against corrosion and painted with finishing paint of type RAL 7035.
The cabinets are envisaged for cable entry from above, where a sufficient number of PVC cable glands should be stipulated for all the planned electrical lines and for a 20% reserve. The boards must be supplied with copper "N"-zero and "Pe"-protective busbars of appropriate cross-sectional area and with cable connecting terminals.
The mechanical project envisages installation of fire and smoke dampers with an electric actuator, fusible elements and end contacts. In case of failure of any fire damper in the system, the relevant system is turned off. Signalling of the position of all fire and smoke dampers is provided on cabinet doors, along with the buttons for testing the dampers by systems.

When temperature values are lower than +8°C behind the heaters in the air-conditioning chamber, the system is turned off, the heater pump is activated, and the control valve is maximally opened. Applied technical solution and corresponding requirements are described in the Main Design - mechanical part.

23.6.14 INCIDENTAL SITUATIONS

Incidental situations may occur in the following two cases:

- Incidental situation in case of occurrence of an explosive hydrogen gas in rooms where it is present,
- Incidental situation in case of splashing or spillage of certain chemicals in the floor or staff areas.

In case of occurrence of the explosive gas in certain rooms, the central gas alarm sends a signal to distribution cabinets RO-KS1 or RO-KS2 referring to the room in which the explosive gas has appeared. Based on micro location of the room in which the explosive gas has appeared, the relevant air-conditioning chamber is turned off, the relevant smoke damper is opened for the area in which the gas has appeared, and emergency ventilation is activated.

The assessment of the air-conditioning system reactivation in the endangered area is carried out by the user of the affected space, who reactivates the air-conditioning systems by pressing the "RESET" button on cabinets RO-KS1 or RO-KS2.

In case of incidental splashing or spillage of hazardous chemicals, whether on the equipment floor or staff in the endangered area, the affected person can immediately push the mushroom button to turn off the air-conditioning in the endangered area, where a particular smoke damper will be opened and emergency ventilation will be activated.

The assessment of air-conditioning reactivation in the area affected by the hazardous chemicals spillage will be carried out by the user of the affected space, who reactivates the air-conditioning system by pushing the "RESET" button on cabinets RO-KS1 or RO-KS2.

23.6.15 INSTALLATION IN HAZARD ZONES

All perforated cable tray (PNK) channels in the floor area must have fire resistance of 90 min, while the PNK channels mounted vertically on facade sides and on the roof are standard perforated PNK channels with a cover. PNK channels should be installed in the lowered ceiling area in the corridor and rooms, and they are mounted onto the wall or the floor structure, with all the original equipment needed for fastening and suspension, as well as grounding. The PNK channel routes must be previously adjusted to the routes of mechanical, high and low voltage electrical installations, and the water supply system.

The route of the PNK channel with the cover, which is envisaged to be mounted on the facility façade, should follow the routes of the mechanical installation on the façade. The PNK channel route on the façade should be adjusted to mechanical installations to ensure a future possible access to the PNK channel for maintenance and other purposes. Cables with a voltage level of 24 V must be laid along a separate PNK channel, and it is also possible to use the PNK telecommunication channel, if there is sufficient space in this channel, in agreement with the supervisory body.

23.6.16 EXECUTIVE FUNCTIONS OF FIRE ALARM TERMINAL FOR ELECTRIC MOTOR DRIVE INSTALLATIONS

On the fire alarm signal in the first floor rooms from the fire alarm terminal, the electromotor drive and automatic control installation is ready to perform the following executive functions:

- to turn off the air-conditioning on the entire floor,

- to turn off the secondary ventilation on the floor,
- to turn off the ventilation of movable suction consoles on the floor,
- to turn of the digesters,
- to turn off the safety box devices,
- to turn off the redundant ventilation (internal units of the VRV system),
- to close all fire dampers,
- to open all smoke dampers,
- to turn on the overpressure ventilation in the elevator and staircase area. The overpressure ventilation of the elevator and staircase is constantly activated via a timer that turns it off in the period from 22.00 to 06.00, as decided by the user. In case that the ventilation is turned off, it turns on upon a fire alarm signal.
- to turn on the emergency ventilation via a suction ventilator mounted on the roof.

23.6.17 ELECTROMOTOR DRIVE INSTALLATION

For the distribution of electromotor system cables, cables of type NHXHX-J and J-H (St) H (halogen-free) are used. The cables are laid along PNK channels (fire resistant, E 90 min.), and from the trays to connecting points on each element the cables are protected by their laying through metal flexible tubes of an appropriate inner diameter. Cables for automatic control circuits with decreased voltage are laid along separate PNK channels (fire resistant, E 90). For parallel lying of those trays with cables of different voltage levels, a minimum distance should be 20 cm.
Since PNK channels for the needs of high voltage electrical installations in the facility have already been installed, it is possible to lay PNK channels for the needs of the electromotor drive on the same trays (one above/under the other), where applicable.
The cable distribution system in the facility is TN-C/S and, accordingly, automatic deactivation of the power supply source is envisaged as the protection against electric shocks (indirect contact), in accordance with the predefined voltage and time values. Further equipotential bonding is envisaged through connecting all metal masses to the existing main equipotential bonding busbar that is directly attached to the facility grounding device.

23.6.18 PROTECTION AGAINST FIRE EXPANSION THROUGH CABLES

In places where cables pass through fire walls it is necessary to apply at least two layers of fire protection mixture onto the cables, in the length of 2m on both sides of the fire wall. The same mixture should be used for sealing apertures in the fire wall through which the cables have passed.
For the material applied as protection against fire expansion through the cable insulation it is necessary to acquire a certificate showing its resistance to fire based on the SRPS.N.C0.075 standard for conducting relevant testing, while materials used for sealing of the apertures in walls should be in line with the SRPS.U.J1.090 standard. The sealing mixture for the apertures created by the penetration of cables through fire walls must have the same fire resistance as the wall through which the cables are passing.

23.6.19 PROTECTION AGAINST ELECTRIC SHOCKS RESULTING FROM INDIRECT CONTACT

The protection against electric shocks is achieved by automatic deactivation of the power supply source within the predefined voltage and time conditions for the applied TN C/S power supply system.

The main equipotential bonding busbar (GSIP) is installed in the proximity of the main distribution board and connected to the facility grounding device by a Fe-Zn tape.

The following metal masses are attached to it:

- water supply pipes and metal sewerage pipes
- Grounding of all the mechanical equipment in the first floor area is carried out through a 1x6mm2 NHXHX-J cable, while grounding of all the mechanical equipment on the roof is performed by the use of a 25x4mm2 Fe-Zn tape, from the existing tapes placed on the roof of the facility and used for equipotential bonding of all mechanical parts towards the roof of the facility (antenna masts, existing air-conditioning chambers, metal boxes, etc.). Patching all metal flanges with a 1x16mm2 P/Y cable (braid)

In rooms with a shower, further protection measures are envisaged through additional equipotential bonding, through which the metal masses are connected via protective lines and boxes for equipotential bonding to the protective busbar of the relevant distribution board.
Since on the roof of the facility there is an existing lightning protection installation onto which all the existing devices and equipment on the roof are connected, all newly installed mechanical installation equipment should be connected in the same manner by the use of a 25x4mm Fe-Zn tape. Upon completion of the tape laying and connecting, it is necessary to perform an inspection of the existing lightning protection installation and measure the grounding resistance, and to deliver an appropriate certificate of its functionality.
The installation has to be executed in accordance with the Main Design and applicable SRPS regulations for the execution of this type of installations. For the technical acceptance, the Contractor must prepare the certificates and results of measurements and inspections under Articles 193 to 198 of the "Rulebook on Technical Norms for Low Voltage Electrical Installations".

23.6.20 MOBILE FIRE EXTINGUISHING EQUIPMENT

Mobile fire extinguishing equipment is the basic standardized fire-fighting equipment. The mobile fire-fighting equipment implies manual and mobile fire extinguishers.
The fire extinguishing tools, type, capacity and number of extinguishers have been defined according to valid RS standards and their location is defined in the Main Design-fire protection.
Manual fire extinguishers have to be selected from the group of equipment, standardized according to Serbian (SRPS) standards. Imported equipment must have a certificate issued by an authorized and competent RS institution.
On the basis of the fire risk assessment and physical-chemical characteristics of the materials, possible fire classes in this building are A and B according to the "Fire classification" SRPS ICO 3941/94 standard.
On the basis of assessment of possible fire classes and selection of adequate fire extinguishers, the following manual fire extinguishers will be placed in the facility:

- dry powder fire extinguishers, marked with "S", manual extinguishers of S-9 capacity, adjusted to the SRPS 3. C2. 035 standards will be used.
- carbon dioxide fire extinguishers, marked with "CO2", manual extinguishers of the capacity of CO2-5kg, adjusted to the standard, will be used.

Technical characteristics of the adopted fire extinguishers are given in the following table.

Characteristics of the extinguisher	Fire extinguisher type						
	S-6	S-9	CO_2-3	CO_2-5	HL-1	HL-2	HL-3
Extinguishing agent quantity (kg)	6	9	3	5	1	2	3
Gross weight of the device (kg)	11	15,4	11,2	19,3	1,4	2,55	3,7
Jet range (m)	6	6	2-3	3-4	3	4	4
Operating pressure at 20°C (m)	12	12	56	56	8	8	10
Action time (sec.)	15	20	12	12	8	18	30
Extinguishes fire on electrical installations of up to (kV)	1	1	10	10	100	100	100

Fire extinguishers are arranged and placed on the places where fires are possible, and always in visible and accessible places.
All manual fire extinguishers are mounted onto the wall, at a height of 1 to 1.5 m to the top of the extinguisher, except for CO_2 extinguishers. The distance between fire extinguishers may not exceed 20 m. Fire extinguishers are arranged in the facility according to the fire protection design.
Upon completion of the works, the Contractor shall be liable to carry out all specified tests and measurements and submit written certificates in the form of attest to the Supervisor.