



AIR LIQUIDE

INGENIERIE

VÚJE

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Name of building

ASU No.9 -USS Košice/SK

Realization project Electricparts

Documentation:

PART A – SWITCHGEARS 110 KV –T01 AND T02

Index:

A5

Annex No.

02

Designed:

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Approved:

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Date:

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Sheets

12

TECHNICAL REPORT

Technology part

2

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1

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1. Subject and scope of Project

1.1 Subject of Project

Subject of the Project is fit out of 110 kV field No.15 of the substation T02 and field No.21 of the substation T01.

1.2 Scope of Project

The scope of project is following:

Switchgear T01 bay No. 21:

Building part

- assembling of new basis below the steel construction of equipments - includes building part of this project
- assembling of new steel construction below the equipments - includes building part of this project
- revision of existing steel construction below bus disconnector Q1 and Q2 - includes building part of this project
- assembling of cable conduit and putting cable shelter in bay No. 21 - includes building part of this project

Technological part

- building in of equipments on the steel constructions
- connecting of grounding steel constructions on the existing grounding network in bay
- power connecting of equipments from existing continuous bus bar 110kV W1, W2 a W5
- shoulder of control cabinet in existing house of protection (house is common for all bays No. 21 and 23) - Areva is a supplier of cabinets
- shoulder of measuring cabinet ASS 21 in existing house of protection - Areva is a supplier of cabinets
- shoulder of protecting cabinet ASR 21 in existing house of protection - Areva is a supplier of cabinets
- termination cabling of auxiliary current in bay No . 21
- continuous auxiliary cabling for continous currents into bay No. 19 and 23
- connecting of cabinets ASP21, ASS21, ASR21 from secondary switchgear 220V DC a 230V AC self-consumption, which are situated in existing house of protection
- connecting of 24 V current ASS21 from switchgear in control switchgear T01

Extra works compared with offer:

- shoulder of external terminal cabinet of voltage circuits SC5

For switchgear T02 bay No.15:

Building part

- building of base steel frame below steel constructions of equipments - includes building part
- building of new steel constructions below equipments - includes building part of this project

Extra works compared with offer

- building of auxiliary steel frame for electric drive of bus disconnecters Q1 and Q2

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Technological part

- building in of equipments on steel constructions
- connecting of grounding steel construction of equipments on existing grounding network in bay
- power connecting of equipments from existing continuous branch bars 110 kV, W1, W2
- shoulder of distribution board D15 in bay No. 15
- remilitarization of control panel A8 in control switchgear T02
- remilitarization of protective panel D in inoperative part of control panel T02
- remilitarization of measuring panel D in inoperative part of control panel
- cable trough in bay No. 15
- terminal cabling of auxiliary circuit in bay No. 15
- tie in auxiliary cabling for continuous circuit to bay No. 13 and No. 17
- connecting of control cabinet D15 from secondary distributors 220V DC and 230V AC self-consumption, which are situated next to the switchgear T02 below control cabinet of switchgear.
- protective, measuring and control panels will be connected from secondary circuit of each switchgear

Extra works compared with offer:

- disassembly of pneumatic drive of bus bar disconnectors Q1 and Q2
- delivery and assembly of electric drives from bus bar disconnectors Q1 and Q2
- delivery of new control cabinet D15

The project's scope is fit out of the field with power extra high voltage EHV devises, control box, steel constructions under these devices and power interconnections, including necessary apparatus and connecting terminals. To the project scope also belongs: completion of the manipulation switchgear of protections and the switchgear of measuring, including necessary auxiliary cabling. This part also involves grounding wiring on surface leading from extra high voltage devices and steel constructions.

1.3 Project doesn't deal with

The project doesn't deal with 110kV cable heads and cables, and theirs supporting structures (chairs).

2. List of used Abbreviations

A	Switching desk of T02
ASP21	Operation switchgear of field No.21 in house of protections in T01
ASS21	Switchgear of measurement of field No.21 in house of protections in T01
ASR21	Switchgear of protections of field No.21 in house of protections in T01
C3	Switchgear of measurement of T02
D	Switchgear of protections and measurement of T02
F	Overvoltage diverters 110kV in T01 and T02
Q0	Power switch 110kV in field No.15 for T02 and in field No.21 for T01
Q1, Q2	Bus disconnector 110kV in field No.15 for T02 and field No.21 for T01
Q3	Line disconnector 110kV in field No.15 for T02

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QE3	Grounding blades of line disconnector 110kV in field No.15 for T02
Q7	Disconnector 110kV of auxiliary bus W5 in field No.21 for T01
Q8	Grounding blades of line disconnector 110kV in field No.21 for T01
Q9	Line disconnector 110kV in field No.21 for T01
RIS	Controlling and information system
STN	Slovak technical standard
TA1	Instrument transformer of current in 110kV in T01 and T02
TV1	Instrument transformer of voltage in 110kV in T01 and T02
T01	External substation (switching station) 110 kV
T02	Internal substation (switching station) 110 kV
W1, 2	Main conductor bar 110kV in T01 and T02
W5	Auxiliary bus bar 110kV in T01

3. Regulations and Standards

The project documentation is processed according to regulations and STN standards in force at the time of this realization project elaboration.

There are particularly the following standards:

STN 33 3210	Distribution equipment
STN 33 3220	Common provisions for electric stations
STN 33 3230	Switchgears of voltage higher than 52 kV
STN 33 2000-4-41	Electric systems of buildings Section 4: Safety assurance Chapter 41: Protection against electric shock injury
STN 33 0300	Surroundings of electric equipment Identification of external impacts
STN 33 2000-5-54	Electric systems of buildings Section 5: Selection and erection of electric equipment Chapter 54: Grounding systems and protective conductors
STN 33 2000-3	Electric systems of buildings Section 3: Assignment of basic features

4. Basic operating data

4.1 Description of electric equipment according to health hazard margin

The electric devices are designed according to reg. No.718/2002 Coll. MPSVaR SR, technical electric equipment group A, section c) part III.

In terms of this reg. §11, this equipment is a subject of a first official testing.

4.2 Distribution systems

- 3~50Hz 110 000 V/TT (transformer voltage)
- 3/N~50Hz 100/√3/100/3V/TT (output voltage from PTN)

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- c) 3/PEN~400/230V 50Hz/TN-C (supply voltage of motor drives)
- d) 2 = DC 220 V/IT (voltage of control coils of disconnectors and switch 110kV)
- e) 2 = 48 V/TN (voltage from control room with isolated + pole) in substation T01
- f) 2 = 60 V/TN (voltage from control room with grounded + pole) in substation T02

4.3 Protection against electric shock injury

4.3.1. Protection during regular operation (active parts):

- it is specified by a constructional execution and set-up of active parts of the electrical equipment.

According to STN 33 2000-4-41 standard, following protective measures solve the protection:

- a) Positioning out of hand art.412.4 and national annex NC.2.3.
- b) Isolation of active parts art. 412.1, by guards and covers art. 412.2.
- c) Extra low voltage PELV art.411.1.

4.3.2. Protection in case of failure (inactive parts):

- a) Automatic disconnection of power supply in network TT according to art. 413 and national annex NC.3.2
 - overall cross-section of protective system must be min.300mm²
- b) Automatic disconnection of power supply in network TT according to art. 413.1, 413.1.2, 413.1.4
- c) Automatic disconnection of power supply in network TN according to art. 413.1, 413.1.2, 413.1.3
- d) Extra low voltage PELV art.411.1

4.4. Signification grade of electrical energy supply

The grade of signification of electrical energy supply is No.1

4.5. Methods of electric energy supply

Field of terminal No.15 110kV of substation T02 serves for feeding of transformer T02 with output 40MVA and ratio 110/6,3 kV. Field of terminal No.21 110kV of substation T01 serves for feeding of transformer T01 with output 40MVA and ratio 110/6,3 kV.

4.6. Short-circuit data

Whereas the 110 kV substation exists, the data is taken from a project EZ-ELEKTROSYSTEMY Bratislava with aim to figure the field No.6 as follows:

for T02:

$I_{ks} = 17,8 \text{ kA}$

$I_{km} = 37,3 \text{ kA}$

for T01:

$I_{th} = 18,4 \text{ kA}$

$I_{dyn} = 46 \text{ kA}$

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4.7. Grounding

Grounding system remains unchanged. There will be completed: grounding of EHV devices, control box and supporting structures, which will be by the drop-ins directed to external grounding system. Because the substation is in continuous running and the system is checked regularly, touch voltage and step voltage mustn't be higher than 125 V, or $125/\sqrt{t}$ V (t = switch time).

4.8. Specification of types of surroundings

Whereas the concerned premises exist, their specification is valid according to the previous standard STN 33 0300 from 1989.

- art. 3.1.1.- basic:
- substation T02
 - auxiliary premises (control room, boxes of protections, measurement and control)
 - house of protections for field No.21 and No.23 in T01
- art.4.1.1 – external:
- substation T01

4.9. Protection against overloading and short-circuit

Terminal 110 kV on transformer 40 MVA is protected by over-current protection – 7SJ61 and differential protection – 7SD610.

Controlling, signalling circuits and PTN voltage circuits, as well as circuits of motive power circuit disconnecter and power switch are protected by the circuit-breakers that are sized according to current intensity of the respective circuit in relation to overloading, short-circuit, starting currents of motor drives and selectivity.

4.10. Metrological analyses

During testing and putting into operation it is necessary to use the measuring devices of category 2,5% at least.

4.11. Safety and protection of health at work

Requirements on qualification of personnel operating electric equipment

Personnel operating electric devices must be acquainted with regulations relating to their work, eventually to be trained for the respective type of work.

About safety regulations during operation and work with electric equipment deal the following standards: STN 34 3100, STN 34 3101 and the set of standards STN 33 2000 (mod IEC 60364). The designed electric equipment can operate personnel who have, at least, specialized qualification and who were instructed in accordance with §20 of reg. No.718/2002 Coll. Personnel acquaintance, training, first aid, warning and examination of their knowledge must be verified by a memorandum that must sign the worker in charge and also the instructed personnel.

Personnel that will operate electric equipment must be informed about operation and function of equipment.

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Operating personnel can only touch those parts that are designated for servicing. There must always be a free approach to the servicing parts. In case of the electric equipment damage or failure that could jeopardize safety or health of personnel, the person who such status identifies must make measures and provide prevention or reduction of risk of injury, fire or other risks.

Requirements on qualification of personnel working with electric equipment

Personnel working with electric devices must be acquainted with respective regulations. Working with electric equipments can only personnel with specialized skills in terms of §21 reg. No.718/2002 Coll. and with experience in terms of reg. No.718/2002 Coll., appendix No.11, art. d). The personnel must have finished specialized education and after their training they must take an exam in frame of the defined regulations. The company must provide examination of personnel at least once in tree years.

During inspection and work with EHV equipment as well as ELV equipment, equipment must be switched off, grounded and locked against a re-activation.

General requirements on safety and protection of health at work

The general operating regulations in force must be extended with local operating instructions of equipment, to which they are supposed to serve. During operating and work with electric equipment must be provided following measurements:

- safety schemes,
- safety and auxiliary tools,
- technically-organizing measures: works on directive B, securing workplace,
- protection against accidents.

Electrical equipment must be kept in a state that complies with manufacturer of equipment regulations and with electro-technical standards.

Operation and maintenance of equipment must be aimed towards error-free operation and protection of health at work, and consists of following actions:

- regular examination and inspection of physical state of equipment,
- regular inspection of functionality of equipment,
- regular maintenance.

Content of documentation accompanying technical equipment must be in terms of reg. No.: 718/2000 Coll., appendix No.:3

5. Technical description

5.1 Generaly

The switchgear T01 and T02 are existing switchgear and they are in the report f. USS Košice. There are reconstructed two bays in the frame of this project, which will be served for connection of

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transformers 110/6,3 kV marked T1 and T2 (the transformers are solving in part F, connecting cables 110 kv are solving in part I.) The transformers 110/6,3 supply the connecting for new build air unit.

5.2 External switchgear 110kV T01

The reconstruction of the reserve bay no. 21 is solving in the frame of existing switchgear.

5.2.1 T01.21 description of existing position

There is built in the reserve bay no. 21

- main branch bar 110kV marked W1 a W2
- auxiliary branch bar 110kV marked W5
- protection house - common for bays no. 21 and 23 (bay no. 23 is in service now)
- common earthing network
- steel construction under busbar disconnecters Q1 and Q2
- cable canal between main cable canal in the switchgear T01 and protection

Accessories of field No. 21 is going out from the conception, by which are other bays of switchgear T01 built. Disconnectors Q1, Q2, Q7, Q8, Q9 and bulkhead isolators I are embeded on the steel construction, which are protected against the touch of active parts by position. Others equipments breaker Q0, changers TA1, TV1 and voltage fence F1 are embeded on the low steel constructions. There is protection against the touch of active parts by prevention. There must be built railing around the site.

Field č.21 accommodate with following equipments

- bus disconnecters Q1, Q2, Q5 - air bus type D 300-12 with electric drive by firm Areva
- reeler disconnector with grounding knives Q8,Q9 - air bus type D300-12/E12 with electric drive by firm Areva
- power disconnector Q0 - type GL 311 with insulator volume SF 6 with electric drive by firm Areva
- measuring transformers of current TA1 type JOF 123 with three coils by firm Pfiffner
- measuring transformer of voltage TV1 - type EOF123 by firm Pfiffner
- lighting arrester - type SBK by firm Tridelta
- podperné izolatory I – rada C6-550 od fy.Elektrokeraamik
- spreader insulators I - type C6-550 by firm Elektrokeramik

Dimensioning vvn of equipments, connecting wiring, insulators and clamps of equipment terminals are made according to the short circuit in compliance with manufacture's catalogue data. Dimensioning of conneting wiring - AlFe hide are made in compliance with the other existing bays.

Dimensioning of EHV devises, connecting line, isolators and terminals mounting is done according to short-circuit currents in accordance with catalogue data of manufacturers. Dimensioning of connecting line (Al tubes and AlFe cables) is done in accordance with other existing fields.

5.3 Inside switchgear 110 kV T02

Reconstruction of reserve bay no. 15 in existing switchgear is solving in this project.

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5.3.1 T02.15 description of existing position

The existing switchgear is of internal realization with pneumatic control of isolators and breakers.
There is construct in bay no. 15:
bus isolator Q1, Q2 with pneumatic drive
foundations for shouldering of steel constructions of technological components
cable canal between main cable canal in switchgear T02 and control cabinet

5.3.2 Proposed position

We reflect on the electric control and electric drive of isolators within the reconstruction of the bay.
Some of the pneumatic drives and operating elements are not more producing (Blokör), so it is necessary to change the pneumatic drive to electric drive on existing isolators Q1, Q2.
Completion of equipment is according to conception used for other bays of switchgear T02.
Isolator Q3 is shouldering on the steel construction. There is a protection against touch of active parts secured by its position.
Other equipments breaker Q0, changers TA1, TV1 and surge arresters F are shouldered on the low steel constructions. There is protection against touch of active parts secured by block. It is necessary to build a railing around the site.

The bay no. 15 will be completed by other equipments:

- bus isolator Q1, Q2 - changing of the pneumatic drive to electric drive 220 V DC by f. SERW
- reeler isolator with earth tool Q3 - air-break isolator type D300-12/E12 with electric drive 220 V DC by AREVA
- circuit breaker Q0 - breaker type GL 311 with isolating medium SF6 with electric drive 220 V DC by AREVA
- measuring current transformers TA1 - type JOF 123 with three winding by f. Pfiffner
- measuring voltage transformer TV1 - type EOF 123 by f. Pfiffner
- lightning arrester F - type SBK by f. Tridelta

Dimensioning of vvn equipments, connecting line, isolators and holder of equipment terminal is made according to short circuit by manufacture's catalogue data. Dimensioning of connecting line - ALFe acre, are made according to other existing bays.

5.3.3 T02.15 Control and Signaling

New cabinet D15 serves for control and signaling, which will be imbeded in the bay T02.15.
By its proposal it was going out from the existing continuous circuit in the switchgear T02. Drives of breaker and isolators are connected by individual supply from reserve outlet of distributor 220V DC.
It is possible to control the equipments in bay T02.15

- local - by control components from the drive equipments cabinet bus bar disconnecter only with disconnected voltage 110 kV to protect against dangerous touch.
- local - from control cabinet D15, choice of local controlling, we use switch in panel D15 to remote controlling

remote controlling from the control panel DA7 - by the existing controlling components

Power switch is equipped by two stopping reels which will be controlling:

- 1. stopping reel - cotroling - local controlling

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- 2. stopping reel
- main protection
- back up protection

There is an adapter 220V AC and 400 V AC use for heating in cabinet D15 - these circuits are connected from the continuous circuit.

5.3.4 T02.15 protections and measurings

Digital protections and electrometers will be placed in the existing panel DD7, which is placed next to control of switchgear T02. Panel DD7 will be completely rereconstructed, there will be only the skeleton of the panel:

The panel DD7 will be equipped:

- distance protection 7SD610 by f. Siemens - as the main protection
- overcurrent protection 7SJ61 by f. Siemens - as the back up protection
- control switch 7XV75 by f. Siemens
- electrometers ZMD400 by f. Landis + Gyr
- input impulse rele of electrometers 7PAS01W by f. Landis + Gyr

Acquisition of three-core changers TA1

- 1.core - distance protection
- 2. core - overcurrent protection
- 3. core - measuring

The panel DA7

The panel is situated in the control cabinet of the switchgear T02 it serves for signalling and measuring of individual bays of switchgear T02. It is considering in the project: controlling and signalling of the bay No. 15 stay without any change measuring - completing of the measuring equipments MW, MVAR, A by f. Metra Blanko type Ma96.

Layout of power terminal No.15 with description of its devises is stated in the drawing V 02-1240/2005/9738/A/05.

Arrangement and positioning of EHV devises, including supporting structures and control box is stated in drawings V 02-1240/2005/9738/A/06.

Functional connection of motor drive, operation, status signalling, failure signalling, protection and measurement of auxiliary circuits of EHV devises is stated in the drawing V 02-1240/2005/9738/A/10 and in its respective sheets. In this drawing there are also precisely described functions of individual circuits.

Grounding line on surface in field No.15 is stated in the drawing V 02-1240/2005/9738/A/07, including drop-ins for joint ground network in earth.

Cabling in field No.15 that leads from EHN devises is placed in protective tubes that are directed towards the auxiliary cable channel in field, which leads under the control box and into the main cable channel. Placing of cables and their direction will be done according to list of cables. Protective tubes are subject of this project and their positioning will be stated during their assembly and according to an issue of fact.

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Construction works consist of building material delivery for bases of EHV devices, i.e. the power switch, PTP, PTN, overvoltage diverters and outgoing disconnectors. We assume that the cable channel is already built in the field. If is not, than it is necessary to build it with dimension 300/300 covered from the top, sideways from the placement of EHV devices, from the outgoing disconnector to the main cable channel.

In Trnava, 08/2005

Ing. Vladimír Kuchta

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