



AIR LIQUIDE

INGENIERIE

VÚJE

Customer: **AIR LIQUIDE.**
57, Ave Carnot - B.P. 313
94503 Champigny Cedex
FRANCE

Contractor: **AREVA ENERGIE TECHNIK, GmbH.**
Königsbrücker Straße 124
010 99 Dresden
GERMANY

Designer: **VÚJE, a.s., divízia 1200**
Okružná 5
918 64 Trnava
SLOVAKIA

Name of building

ASU No.9 -USS Košice/SK

Realization project Electricparts

Documentation:

PART G – ZERO TRANSFORMER, QUENCHING CHOKE,

Index:

A5

Annex No.

02

Designed:

Ing.Vladimír Kuchta

Approved:

Ing.Vladimír Kuchta

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TECHNICAL REPORT

2

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1. Subject and scope of Project

1.1 Subject of Project

Subject of the Project is assembly and connection of devices for compensation of grounding currents of transformers T1, T2 with output 40MVA.

1.2 Scope of Project

Scope of the Project involves placing of neutral transformers NT1, NT2 with power 400 kVA and voltage $3 \times 6,3$ kV, their connection from terminals T1, T2 and connection of tuning chokes ZT1, ZT2 with power 400 kVA and voltage $6,3/\sqrt{3}$ kV. The project also deals with cabling for tuning of chokes operation. Power scheme of the connection is stated in the drawing V 02-1240/2005/9738/G/05. This part involves also grounding wiring on surface for transformers and chokes.

1.3 Project doesn't deal with

The project doesn't deal with delivery and automatic tuning of chokes.

2. List of used Abbreviations

NT1, NT2	Neutral transformer for compensation of ground currents
STN	Slovak technical standard
T1, T2,	Power transformer 110/6,3 kV
ZT1, ZT2	Quenching choke

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 of electric stations
STN 33 2000-4-41	Electric systems of buildings Section 4: Safety assurance Chapter 41: Protection against electric shock injury
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 3240	Site of power transformers
STN 33 2000-3	Electric systems of buildings Section 3: Assignment of basic features
STN 33 3070	Electrical regulations. Compensation of capacitive ground currents in high-voltage networks



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 b) part III.

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

4.2 Distribution systems

- a) 3~50Hz 6 300 V/IT (input voltage of neutral transformers)
- b) 3/PEN~400/231V 50Hz/TN-C (supply voltage of quenching choke motor drive)
- c) 2 = DC 220 V/IT (voltage of tuning control coils)
- d) 2 = 48 V/TN (voltage for failure signalling)

4.3 Protection against electric shock injury

4.3.1. Protection during regular operation (active parts):

- it is specified by the constructional execution and set-up of active parts of 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 IT according to art. 413.1, 413.2 and national annex NC.3.3
 - overall cross-section of protective system must be min.240mm² FeZn
- b) Automatic disconnection of power supply in network TN according to art. 413.1, 413.1.2
- c) Automatic disconnection of power supply in network IT according to art. 413.1, 413.1.2
- 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

It is done with the brunch from secondary terminal 6,3 kV T1, T2.

4.6. Short-circuit data

We evaluate from short-circuit data of 6 kV substation:

$I_{ks} = 32,4 \text{ kA}$

$I_{km} = 109,9 \text{ kA}$

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4.7. Grounding

The grounding system must be checked periodically and touch voltage and step voltage mustn't be higher than 125V, or $125/\sqrt{t}$ V (t = switch time). By drop-ins will be connected to ground network following: frame of NT1, ZT1 and zero point (earth) ZT1. The same applies for NT2, ZT2.

Specification of a cross-section of a guard wire

$$S = I_{ke} \cdot \omega \cdot \sqrt{t_k} / k$$

$$S = 18\,400 \cdot 0,7 \cdot \sqrt{0,5} / 58,5$$

$$S = 155 \text{ mm}^2$$

I_{ke} - equivalent heating short-circuit current 18,4 kA

ω - coefficient of probability 0,7

t_k - duration of short circuit (protective time + cut off time)
0,5

k - coefficient for Fe and definite temperature 200°C
is 58,5

At the neutral transformers and quenching site must be used the guard wire
FeZn 2 x 30 x 4 mm.

4.8. Specification of types of surroundings

Surroundings of new area NT1, ZT1, NT2 and ZT2 is necessary to specify by commission in accordance with standards STN 33 0300 and STN 33 2000-3.

4.9. Protection against overloading and short-circuit

It is done by joint over-current protection T1 and T2 on the side EHV and it also protects against short-circuit the ELV side.

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.

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

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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. Supply cables dimensioning

Supply cables dimensioning from transformers terminals T1, T2 is done on allowed temperature rise at short circuit, and is stated on 120mm² Cu. This also applies for connection between NT1, ZT1 and NT2, ZT2.

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5.1.1. Proposal of connecting cable

a) proposal of cable according to transferred power :

$$I_p = Q / \sqrt{3} \cdot U \cdot \sin \varphi = 400 \cdot 10^3 / \sqrt{3} \cdot 6300 \cdot \sin 90^\circ = 36 \text{ A}$$

For transmission of this power is cable with Cu core 50mm² enough.

b) proposal of cable according to short circuit :

$I_{ke} = 35 \text{ kA}$ heating short circuit

$t_k = 0,2 \text{ s}$ off period of short circuit (protective time + cut out switch time)

$K = 135$ coefficient for Cu conductor, with respect of temperature before the short circuit and max temperature of conductor core in short circuit

$$S_{min} = I_{ke} \cdot \sqrt{t_k} / K = 35000 \cdot \sqrt{0,2} / 135$$

$$S_{min} = 115 \text{ mm}^2$$

It is necessary to use a cable with Cu core 120mm² for connection.

5.2. Layout of neutral transformers and quenching

Layout of neutral transformers and quenching chokes is obvious from the drawing

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5.3. Grounding of transformers and quenching

Grounding of transformers and quenching chokes will be done with two drop-ins from one set: container NT1, ZT1 and zero point ZT1 through testing terminal to joint grounding network. The same applies for NT2, ZT2.


5.4. Cabling

Cabling will be directed from 6kV bus bars of transformers 40MVA on cable racks on walls into the compensation room. The connections will be done with tree single-core cables 6-CYKCY 3x1x120 mm², zero terminal NT1-ZT1, NT2-ZT2 will be done with one cable 6-CYKCY1x 120mm².

5.5. Construction works concerning transformers and quenching

Construction works concerning transformers and quenching chokes must be done according to drawing V 02-1240/2005/9738/G/03.

In Trnava, 08/2005

Ing. Vladimír Kuchta 
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