
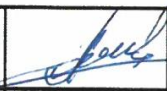
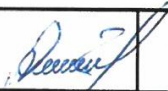





<b>CONTOURGLOBAL</b> Հիդրո կասկադ 		<b>TECHNICAL SPECIFICATION</b> Տեխնիկական բնութագիր			
		Document no. Փաստաթղթի №	էջ / Sheet 1- 52		
Project Նախագիծ	Design, manufacturing, supply and installation of a new transformers 125MVA- 13,8 / 220 kV			Security Index Անվտանգության ինդեքս	
Title Անվանումը	Design, manufacturing, supply and installation of 2 new transformers of 125MVA- 13,8 / 220 kV type for Shamb HPP of ContourGlobal Hydro Cascade				
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## 1. SCOPE OF WORK

This technical specification describes the minimum requirements for specified scope of works which includes, design, manufacturing, and delivery of two new 125 MVA, 13.8/220kV transformers, installation of all essential components and equipment, oil refill, complete factory tests, packaging, shipment, installation and on-site tests upon delivery, including commissioning and participation in 72-hours tests.

The transformer equipment, cooling system, control panel, instruments and sensors, terminals, expansion tank and all other tools and equipments supplied must be of high quality, newly produced by manufacturers of guaranteed origin, well-established in international and European markets. The Contractor is fully responsible for the quality and reliability of the new equipment. This technical specification and all its appendices define the basic parameters and the minimum requirements to be met, and constitute an integral part of the participants' agreement. The Contractor may offer same or better terms in their technical proposal.

All materials used in manufacturing must be new and of high quality.

All materials and equipment to be supplied and (or) included in the work must be approved by the Contracting Authorities. Contractor shall not use materials and equipment for temporary purposes in the manufacturing of the transformer without the written consent of the Client.


Contractor shall provide to Client all operational documents, all equipment and transformer oil certificates, test reports, inspection reports, etc.

Equipment specifications and plans submitted by the Contractor to the client company in the course of work, as well as technical documentation for the equipment, shall be accurate and complete.

## 2. GENERAL CONDITIONS OF THE SITE

**2.1** ContourGlobal Hydro Cascade consists of three hydropower plants located on the Vorotan River in the south-east of Armenia. The total installed capacity of ContourGlobal Hydro Cascade is 404.2MW. The key data on the Cascade's power stations is:

Table: Key data of ContourGlobal Hydro Cascade

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Hydropower Stations	Rated Capacity MW	Number & capacity of units, MW	Water storage, mill.m <sup>3</sup> total / live	Design Head m	Commissioning of the HPP
Spandaryan	76	2 x 38.0	257 / 218	300	1989
Shamb	171	2 x 85.5	96 / 80	267	1978
Tatev	157.2	3 x 52.4	13,6 / 1,8	552	1970

Shamb HPP and the dam are located in the Sisian area of the Syunik Marz.

## 2.1 GENERAL ENVIRONMENTAL CONDITIONS

- Max.ambient temperature in Shamb HPP + 40 ° C;
- Min. ambient temperature in Shamb HPP - 25 ° C;
- Average relative humidity: 73%

## 2.2 PRESENT STATE

At present, Shamb HPP has two generators with a capacity of 85.5 MW each. The station is connected to the power supply system via a 220 kV substation. Each generator is connected to a separate transformer unit through generator circuit breakers and busbar system.


The present unit transformers have been produced by the Transformer Plant of Zaporozhye in Ukraine.

## 3. DETAILED DESCRIPTION OF WORK

The work includes the following scope of activities:


- Design and production of transformer,
- Factory testing,
- Shipment,
- Demounting and transfer of working transformers to a storage area
- Filling in oil and oil circulation with degassing equipmet - Installation, commissioning and site testing of new transformer.

In the bidding documents, the Contractor shall list all the standards and norms that will be applied during transformer construction, supply of equipment, and testing.

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### Technical Specifications of the Present Transformer

ContourGlobal Hydro Cascade	Shamb HPP
Type	ТДЦ 125000 /220 – 71У1
Quantity of transformers	2
Transformer rated power	125 MVA
Nominal high-voltage side	242 kV
Nominal low-voltage side	13,8 kV
Frequency	50 Hz
Number of phases	3
Vector group	Ynd11
Rated HV/LV current	299/5229 A
High voltage bushing	ГКТИИ-60-252/2000 О1
Low voltage bushing	Uniform 20kV, 8 kA
Neutral bushing	ГКТП III-90-126/2000
Climatic modification	У1
Site elevation above sea level (mtr.)	1500
Seismicity on MSK scale	9
Ambient temperature, °C:	У1 (-45 °C to +40 °C)
Standard temperature rise of transformer parts from the ambient cooling temperature, °C, in winding	65
- in upper layers of oil	60
- HP	78
Internal insulation test voltage level	In accordance with GOST 1516.3
Winding material	Copper
Voltage converter	No voltage converter
Type of voltage converter	No voltage converter
Voltage regulation range	No voltage regulation
Cooling type (air blast cooling and forced oil circulation)	4 radiator, 8 fans, 4 oil pumps
Short circuit voltage HV <sub>nominal</sub> – LV U <sub>k.3</sub> .	11 % in case of 125000 kVA

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Complete short circuit losses HV - LV	391 kW in case of 125000 kVA
No-load losses	134 kW
No-load current $I_{x.x}$	0,53 %
Ambient temperature, maximum	40°C
Winding test voltage HV/LV	395/38 kV
Rated lightning impulse withstand voltage / neutral point (kV peak)	890/95/95
Type of connection HV side	Transmission line clamps
Type of connection LV side	Phase isolated bus ducts
Current transformers High voltage winding	1000/1(1000-750-600-400) 10P – 2 pcs.
High voltage winding neutral point	600/1(600-400-300-200) 10P – 2 pcs.

### 3.1 DESIGN


Design includes the complete detailed design of structure, magnetic system and windings, fastening of the active part of the transformer, as well as the selection of equipment and devices, in accordance with these technical specification and applicable standards.

Essential requirement is that the dimensions of the transformer, positions of HV, LV, HN and neutral terminals, heights, distances between domes, position of the expansion tank and connection dimensions be designed in such a manner that it has full compatibility and interchangeability, both mechanical and electrical, with the present transformer units.

The minimum service life of the transformer shall be 30 years.

The transformer and all its components must also be designed to resist potential seismic impacts specific to the region.



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Earthquake oscillations or seismic motions are transmitted through the base of the transformer to its structures, such as the core, windings, expansion tank, radiator, terminals, etc. As a rule, earthquakes induce inertial forces in the structure of a transformer, which must be designed to resist these forces, along with other loads, such as gravity, pressure, wind, and thermal loads. Particular attention should be paid to the withstand to various mechanical impacts on the terminals, taking into consideration their position, method of installation on the transformer, and the way they are connected.

Transformer must be designed in a way that no special requirements arise during the installation, and in such an event, they must be eliminated free of charge by the Contractor.

Normal dimentions should not exceed:

Length  
Width (see the diagram of the present transformer. Appendix)  
Height


At the time of shipment overall dimensions of the transformer body shall not exceed:

Length  
Width (see the diagram of the present transformer. Appendix)  
Height

The transformer must be designed and manufactured to be transported by rail and must have all the necessary equipment to be loaded on a water transport and securely fastened on it. In any case, the height and width of the transformer loaded on the ship shall not exceed the minimum size of a standard road tunnels and other above road obstructions.

The Contractor shall coordinate with the Client:

- The general and connecting dimensions of the transformer.
- The method and sequence of installation.
- Essential auxiliary equipment of transformer.
- Type and size of indicators of measuring gauges.
- Electrical circuit diagrams and configurations of the transformer cooling system,
- Measurement of output signals, alarm and protection signals.
- Quantity, type and dimensions of rods, external control terminals and power cables.
- Configuration diagrams for connecting terminals.

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### 3.1.1 TRANSFORMER STRUCTURE

The transformer consists of the following assembly units:

- Transformer frame
- Windings
- Bushings
- Tank with fittings
- Cooling system
- Expansion tank and the safety valve

#### 3.1.1.1 TRANSFORMER FRAME

Consists of a Three limb magnetic core.

The transformer core shall be designed and manufactured with high quality, low loss, cold rolled, with insulating coating of electrical transformer steel. Steel thickness 0.35 mm.


At normal frequency and voltage, the magnetic flux density in any part of the core shall not exceed 1.75T under the most unfavorable exploitation conditions. The selected transformer steel class, in case of 50 Hz of the type PBZF (V) curve, to be included in the tender package and design documents of the Contractor, shall also contain the name of the manufacturer.

The magnetic core and the fastening system must be isolated from each other and from other structural elements.

The magnetic core must be isolated from other structural elements of the transformer so as to withstand a test of 2.5 kV against grounded parts within 1 minute.

The justification of the magnetic circuit shall be carried out separately, featuring two checkpoints outside the specified points, in a place accessible through a convenient opening, which would allow to dismantle it for control measurements and inspections.

To reduce additional losses of the magnetic core, magnetic shunts are placed on the lower beam of the magnetic transmitter.

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### 3.1.1.2 WINDINGS

All transformer windings shall be made of copper with electrical and mechanical properties, shall at least be in compliance with or have higher properties than E-Cu F 20 which conforms to DIN/IEC standards, or be in compliance with equivalent international and/or European standards.

Winding conductors must be insulated with electrical insulation paper.

Fixation of Coils of high and low voltage windings from their installed position, and the relative position of the windings shall ensure maximum electromagnetic balance and electrodynamic withstand to possible short circuits which may occur in the transformer. In the design process, the windings must be properly fixed to avoid retraction or motion. The windings and the transformer structure system shall ensure stability of the windings during shipment, in all operational modes of the transformer, and during seismic shocks.

The electrodynamic withstand of the transformer is determined in accordance with EN 60076-5: 2006 - Power Transformers. Part 5. Ability to Withstand Short-Circuit (IEC 60076-5: 2006) (or equivalent international and/or European standard).

The line ends of the high voltage windings shall be terminated with bushings 220 kV Resin impregnated paper (RIP) with silicone insulator which size and cross-section must be corresponds to the of ГКТIII-60-252/2000 O1 bushing.

The connection of the X, Y, Z ends to the common point (neutral) is done inside the transformer. The neutral is removed through the RIP 110 kV bushing which size similar to ГКТП III-90- 126/2000 kV bushing.

The leads of low voltage windings are brought out directly through the ends of winding wires with copper bus bars. All windings, except the flexible joints, are insulated. The triangular connection of the windings is positioned under the cover of the transformer. The low-voltage winding leads are removed by three uniform insulation bushings 20 kV, 8 kA.


### 3.1.1.3 X- HARMONICS AND HIGH FREQUENCY DISTORTIONS

During transformer design special attention shall be paid to the suppression of harmonic voltage, especially to the 3rd, 5th and 7th harmonics, in order to eliminate waveform distortion and the effects of possible high frequency disturbances.

### 3.1.1.4 INSTALLATION AND FASTENING OF THE ACTIVE PART IN THE TANK

The active part is positioned on four studs welded to the bottom of the tank.

The active part is dismantled in transverse direction to the bottom of the tank with four screws fastened to the upper yoke beams.

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In longitudinal direction the active part is dismantled with screws on the edges of the upper and bottom yoke beams. The screws are tightened during operation. The screws can be accessed through an inspection hatch.

#### 3.1.1.5 TRANSFORMER TANK

The tank cover shall be made of both welded constructions and verified high-quality low-carbon steel.

The transformer tank is bell-shaped, rectangular, and is dismantled at the bottom yoke level.

The structure of the transformer tank must provide the necessary mechanical strength and hermeticity so that the transformer can be lifted or moved without permanent deformation and oil leaks.

All structures, beams, leads and lifting devices, consoles and permanent parts attached to the tank shall be welded and, if possible, double welded.


Mechanical strength of the transformer tank, its accessories, including the expansion tank and the coolers, must comply with relevant international and/or European standard.

- (p) increased pressure inside the tank indicates 1/2 of its height, which is 50 kPa higher than the normal oil pressure.
- (e) it must be measurable and must withstand full vacuum for a long time.

Elastic deformation in the middle of the tank shall not exceed 1/700<sup>th</sup> of its length. Permanent deformations are not allowed.

#### 3.1.1.6. TRANSFORMER TRANSPORTATION DEVICE

The transformer base must be equipped with railway wheels rotating in both directions, from the right angle or parallel to the main axis of the transformer, and enabling it to run along the railway lines at the factory in two mutually perpendicular directions. The distance between the rails in the longitudinal direction of the transformer platform (parallel to the main axis of the transformer) shall be 1524mm, (drawing ОББ 301.474 ПП) and in the transverse direction is 2x2000mm. The transformer moving device (the chassis) shall be designed to withstand all loads arising from operation, repair, or relocation of equipment along the current routes and sites. Contractor shall design and deliver all necessary equipment to ensure proper fastening of the transformer on site so that it withstands the specified seismic loads in all directions without any changes in the base.

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### 3.1.1.7. COOLING SYSTEMS

Transformer oil cooling occurs in the cooling systems through forced oil circulation and forced air flow.

The design and dimensions of coolers must comply with the requirements of EN 50216-6:2003 standard, or an equivalent international and/or European standard.

A pump is installed at the top of each cooling loop to circulate the oil. For cooling, a minimum of four coolers with two cooling fans each cooler ( least 4 radiators, 8 fans) are installed, fixed to the tank.

The coolers shall be separated from the tank by orifice valves so that, if necessary, the coolers can be removed without draining of oil from the transformer.

The valves must be oil tight, for preventing leakages in case that coolers are dismantled. .

The coolers shall be designed to have the necessary holes or lifting rings, and to allow easy disassembly and installation of each cooler separately.

The cooling system shall be fully automated, with an option to switch to manual mode.


The inner surfaces of the coolers must be properly treated to prevent corrosion, contamination, and oil damage. Their outer surface shall be pre-painted and painted for protective and decorative coating. It is recommended to use epoxy paints.

The total thickness of coating shall be  $\geq 220\mu\text{m}$ , and shall ensure anti-corrosion protection for at least 15 years. The color of exterior varnish coating shall be the same as all other metal parts, and shall be acid resistant.

Automated control and monitoring of the cooling system is carried out through automatic control cabinets installed on a separate base.

#### Automated control cabinets shall.

- be metallic, made of at least 1,4mm thick steel sheets or another metal of similar strength,
- be covered with high-quality powder coating for exterior and even surfaces of the same color as the core, with at least 15 years' of anti-corrosion protection,
- be positioned at a height suitable for maintenance and repair,

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- have a certain degree of protection IP54, and replaceable hermetic door sealing,
- have an additional cover (head cover) above the panel,
- have an additional metal screen on the door to prevent direct heat from the sun,
- be attached to rubber pads for vibration insulation,
- have adequate ventilation holes equipped with vents and removable dust filters. If securing the required level natural air circulation is impossible, fans must be installed, controlled by a forced cooling thermostat,
- cable ducts shall be placed on the panel in such a way that they occupy no more than 70%,
- maintain the required distances between the panel and the equipment as required by manufacturers, to ensure the essential level of cooling at the maximum anticipated ambient temperature and at full load during operation,
- all the wires of the panel must be marked with the numbers of the terminals to which they are connected,
- the door of the panel shall have an appropriate secure pocket for documents and plans,
- have a heater equipped with a thermostat to keep the temperature within acceptable limits,
- the panel must have a 230V AC, 10A socket and an internal lighting bulb,
- the panel of the cooler system must be equipped with an emergency stop button placed in an easily accessible section of the side wall,
- the cable ducts at the bottom of the panel must be of sufficient size and quantity - 10% minimum quantity, but no less than 1 piece of each size,
- the panels must have an RCD protection system.


### 3.1.1.8 EXPANSION/CONSERVATOR TANK

The expansion tank includes:

- expansion tank with its fittings,
- safety valve (for gas discharge),
- gas relay,
- oil level indicator.

The expander is connected to the transformer tank, which has a built-in gas relay.

Protection of the transformer against contact with oil to air should be membrane. This method allows to fully utilize the oil degassing effect and ensure that during transformer operation transformer oil properties are retained long-term. In addition, the oil processing technology is simplified, as the nitration process is eliminated, and the workload of the operational personnel decreases during transformer operation.

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To prevent transformer oil from coming into contact with the ambient air, a membrane protection is used - a flexible elastic membrane that is placed inside the expander and repeats its shape. When the expander is filled with oil, it floats. The air does not come into contact with the oil, because the air is in the membrane. The air enters the elastic membrane via an airbreather, which interacts with the atmosphere through an oil valve. The air is removed from the space between the walls of the oil-filled expander. When the oil level in the expander changes, the volume of the elastic membrane changes due to the suction or absorption of air from inside the membrane.

The oil level in the expander is determined by a pointer indicator (of special design), the lever of which rests on the surface of the membrane. Transformers with elastic membrane protection must be filled with degassed oil.

The elastic membrane is made of oil-resistant rubber fabric with low air and moisture permeability.

A gas collector is used to release air from the space between the elastic container and the expander. During operation, the collector, with the help of a relay which reacts to the formation of gas in it, controls the accuracy of the control device and the elastic container.

During operation, the collector, with the help of a relay which reacts to the formation of gas in it, also controls filling of the elastic membrane.

### 3.1.1.9 OVERPRESSURE PROTECTION


The transformer tank must be protected against increasing internal pressure by overpressure safety valves.

### 3.1.1.10 ANTI-CORROSION PROTECTION OF METAL PARTS OF THE TRANSFORMER AND STRUCTURES

Coating and anti-corrosion protection of metal surfaces, structures and transformer accessories must comply with the requirements of C3 environmental category of EN ISO 12944-5 (or equivalent) standard, and the durability of anti-corrosion coating must comply with category H of EN ISO 12944-1 (or equivalent) standard ensuring anti-corrosion protection for more than 15 years.

After cleaning and degreasing, three layers of coating must be applied: initial, intermediate, and final. The final coating of all surfaces must be AL RAL 7031 (or equivalent).

Any damage to the cover in the process of transformer shipment shall be recovered by the Contractor immediately upon on-site installation of the transformer.

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### 3.1.1.11 APPLICABLE STANDARDS AND REGULATIONS

The transformer shall be designed, manufactured, and tested in accordance with the requirements of the latest editions of the following European and international standards, regulations and other publications mentioned therein:

- EN 60076-1: 2011 - Power Transformers. Part 1. General (IEC: 60076-1: 2011) (or equivalent);
- EN 60076-3: 2013 – Power Transformers. Part 3 (IEC 60076-3: 2013) (or equivalent);
- EN 60076-2: 2011 – (or equivalent);
- EN 60076-3: 2013 / A1: 2018 – (IEC 60076-3: 2013 / A1: 2018) (or equivalent);
- EN 60076-4: 2003 – EN 60076-5: 2006 - (IEC 60076-5) (or equivalent);
- EN 60076-5: 2006 – (IEC 60076-5) (or equivalent);
- IEC 60076-7: 2012 - (or equivalent);
- IEC 60076-8: 2007 - (or equivalent);
- EN 60076-10: 2017 - (IEC 60076-10: 2016) (or equivalent);
- EN 60076-18: 2012 - (IEC 60076-18: 2012) (or equivalent);
- EN 60076-19: 2015 - (IEC / TS 60076-19: 2013, Revised) (or equivalent);
- IEEE 693-2005, EN 60137: 2008 - Insulated bushings for alternating voltages above 1000V (IEC 60137: 2008) (or IEC 60137: 2008);
- IEC/TS 61463 ed.2.0: 2016 - (or equivalent);
- EN 50216-1: 2003 - (or equivalent);
- EN 50216-6: 2003 - (or equivalent);
- EN 60296: 2012 - (IEC 60296: 2012) (or equivalent);
- IEC 3067-7: 1990 - (or equivalent);
- Commission Regulation No 548/2014 of 21 May 2014 on implementing Directive 2009/125/EC of the European Parliament and of the Council with regard to small, medium and large power transformers (or equivalent);
- There may also be national standards that are at least equivalent to European and / or international standards. Bids of the bidders must meet the standards defined by the Client in the technical specifications or other equivalent documents.


### 3.1.1.12 TECHNICAL REFERENCE REQUIREMENTS

The Contractor shall provide the Client with all plans and documents developed by the Contractor in the form of a complete technical design, as well as all information related to the implementation of the subject matter of this Technical Specification.

### 3.1.1.13 DOCUMENTATION AND INTEGRITY OF THE PROPOSAL

Contractor shall prepare a technical proposal containing all necessary technical information in Armenian or Russian and English, as described below.



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#### Content of the technical proposal:

1. Information about the participant company.
2. Technical description of transformer design.
3. A filled-in table with guaranteed technical parameters.
4. Description of materials used, equipment, accessories, certificates. The catalogue of data and operating instructions.
5. Transformer oil characteristics, certificates of quality and conformity.
6. Transformer type and overall dimensions with transformer sets - in shipping and operational conditions.
7. Information about the specialized laboratory where the special tests will be performed. Documents certifying that it is accredited in accordance with the requirements of BDS EN ISO/IEC 17025: 2006 (or equivalent) standard (Contractor certified copy of accreditation certificate)
8. Documents certifying that the proposed transformer shall be manufactures in accordance with the requirements of the relevant quality control system, as per EN ISO/IEC 17025: 2006 (or equivalent) standard (submit copy of certificates valid at the time of the tender).
9. Documents certifying that the proposed information will be prepared using an environmental management system in accordance with EN ISO-14001 (or equivalent) standard (copy of the certificate valid at the time of submission of bid package).
10. The logistic plan for transportation from the manufacturing plant to Shamb HPP, including information on the proposed route in case of road transportation, as well as the plan of unloading at Shamb HPP.
11. The list of vehicles, loading and unloading equipment and mechanisms, as well as their technical specifications.
12. Information on the offered warranty conditions.
13. The general work schedule containing start and end of work information on the implementation of the various stages of work described in paragraph 3 of this Technical Specification.
14. The Contractor's contractual statement on inspection of the site and familiarization with its specifics.

Before submitting the technical proposal, the Contractor must inspect the site to get familiarized with the specifics and requirements of this technical description.

#### 3.1.1.14 DOCUMENTS PROVIDED BY THE CONTRACTOR AFTER SIGNING THE CONTRACT

Upon accepting the order, the Contractor shall prepare a list of documents to be submitted, where each individual document will be listed in detail.

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Before starting the work, the Contractor, along with the application, shall submit the following documents to the Client.

- Schedule of works for transformer manufacturing, safety certificates for recommended materials and other proposed projects.
- The quality control and inspection plan. Quality control shall include control of materials and items, quality control and testing.

The design documents will be sent to the review and approval body of the Client in accordance with the approved schedule and the list of documents.

The Contractor shall promptly update the list of documents in case of any changes.

The Contractor shall send the amended documents to the Client for review and final approval.

Each document shall have a standard cover page (title page) that contains a standard table with the necessary data, the title of the document, the KKS number, and all the required fields filled in with relevant information.

The entire package of bidding documents, including drawings, must be submitted in hard copy and electronically, sealed and signed.


#### **Document formats and standards**

The paper size should be A4 and A3 respectively, according to ISO-A standard. Drawings must be in accordance with the following standards:

- EN ISO 5457 - (or equivalent);
- EN ISO 7200 - (or equivalent);
- EN ISO 128-20 - (or equivalent);
- EN ISO 128-21 - (or equivalent);
- EN ISO 216 - (or equivalent);

#### **File formats for electronic submission**

- MS Office (.doc, .xls, .ppt)
- AutoCAD (.dwg, .dxf)
- Adobe Acrobat (.pdf)
- Image formats (.Jpg, .Tiff)


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### 3.1.1.15 DOCUMENTS PROVIDED BY THE CONTRACTOR RELATED TO THE PROJECT

In addition to the documents described above, the Contractor shall prepare and submit to the Client the following documents:

- 1) Permits to enter and carry out works in the territory of the Shamb HPP of ContourGlobal Hydro Cascade
- 2) The plan and instructions for shipping the transformer to the transformer installation site, including information on transformer shipment and unloading.
- 3) Other documents, including:
  - Product quality and delivery documents.
  - 3D drawings of sizes and weights (and all necessary data to check the availability or design of the new base).
  - Description of transformer equipment.
  - The characteristics of the materials used (weights etc.), (including transformer oil).
  - Diagrams of transformer earthing and its separate parts.
  - Dimensions of the active parts compressing system, including the force of hermeticity.
  - Drawings showing all open parts of equipment where copper/aluminum parts or aluminum alloys are in contact with or close to other metals, and clearly describing what protection is used to prevent corrosion at any time.
  - Transformer operation and technical maintenance documents.
  - Transformer passport.
  - Set of records on the tests performed.
  - List of supplied transformer spare parts
- 4) The Contractor shall prepare transformer operation and maintenance instructions in Armenian or Russian and English, which will include all the details and specifics of individual elements, devices, and systems.

Contractor shall provide to Client with all the documents and drawings related to this technical specification in hard copy (3/three copies) and electronically (pdf, jpg, tiff), in Armenian or Russian and English languages, and, if necessary, in an editable version (MS OFFICE, AutoCAD, etc.).

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### 3.2 QUALITY MANAGEMENT SYSTEM

In terms of quality management, the proposal shall be prepared in accordance with the requirements of ED ISO 9001. 2015 (or an equivalent) standard and must be submitted to the client for approval

### 3.3 TRANSFORMER MANUFACTURING WILL INCLUDE, BUT NOT BE LIMITED TO THE FOLLOWING

1. The materials and auxiliary components of the supplied transformer (coolers, terminals, etc.) that are not produced by a transformer manufacturing factory must also comply with the requirements and standards specified in this technical specification.
2. Delivery/manufacturing of the expander, ladder, work platform, bars, handles (if necessary, for safe operation and maintenance), as well as provision of dome covers for terminals to ensure hermetic filling of holes in the process of shipping.
3. Supply/production of embedded power transformers.
4. Manufacturing of the transformer base and the bell.
5. Processing and painting of the base and inner surfaces.
6. Manufacturing of current transmitter.
7. Manufacturing of high voltage and low voltage windings.
8. Production and assembly of the active parts.
9. Drying of the active part.
10. Installation of the active part of the base.
11. Transformer closing.
12. Complete installation of transformer for factory testing.
13. Vacuum oil filling.


### 3.4 FACTORY TESTS

The proposed transformer shall undergo control, routine and special tests in a specialized laboratory accredited by EN ISO/IEC 17025:2006 (or an equivalent) standard.

Tests must be carried out in the presence of the Client's representatives in accordance with the requirements of EN 60076-1:2011 (or an equivalent) standard, or other equivalent requirements.

The transformer shall undergo complete tests (control, routine and special), the purpose of which is to check the quality of the structure, and to examine to what extent its main technical characteristics correspond to the technical conditions and design documents, as well as to determine if the transformer is ready for delivery, installation, and adjustment.


The tests must be carried out in accordance with a previously prepared plan by the Contractor which has been agreed with the Client at the technical proposal stage.

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The electrodynamic stability of transformer windings must be supported by calculations. The calculations shall be submitted to the Admissions Committee during special tests and shall be attached to the technical documentation.

The transformer tests must include at least the following:

1. Check the structure of the transformer.
2. Check the thickness of the anti-corrosion coating.
3. Overpressure test (leak test).
4. Mechanical withstand of the transformer to overpressure.
5. Mechanical withstand of the vacuumized transformer.
6. Complete chemical and physical analysis of the qualities of transformer oil and the content of mechanical mixtures in it.
7. Analyses of gas chromatography and transformer oil before starting thermal tests, high-voltage tests. Dielectric strength control of transformer oil.
8. Measurement of thermal insulation withstand of the magnetic circuit and the operational system.
9. Measurement of thermal insulation withstand of the magnetic transmitter and the magnetic circuit system.
10. Functional testing of the cooling system and accessories.
11. Determination of voltage conversion ratio, phase deviation limit and the connection group.
12. Short circuit impedance measurements and the **Short circuit withstand test** can be accepted by the type test and calculations.
13. Measurement of short circuit current loss.
14. Measurement of no-load losses.
15. Measurement of winding withstand with direct current.
16. Measurement of winding insulation stability.
17. Measurement of the dielectric loss angle ( $\text{tg } \delta$ ) of the insulation system.
18. Measurement of the capacity of windings in relation to the ground.
19. Measurement of terminal capacity and dielectric loss angle ( $\text{tg } \delta$ ).
20. Check the polarity of embedded current transformers and conversion ratios.
21. Measurement of magnetic balance.
22. Test with a separate AC voltage source.
23. Short duration induced AC voltage test.
24. Lightning pulse test LIC.
25. FRA/SFRA test (frequency response analysis).
26. Partial discharge measurement and analysis in accordance with IEC 60270 (or an equivalent) standard.
27. Thermal test and measurement of energy consumption of the cooling system.

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28. Noise and sound pressure measurement – in no-load mode and maximum induction flow (EN ISO 3744:2010 standard or equivalent, and BDS EN 60076-10:2017 standard or equivalent).

29. Determination of transformer outline characteristics in terms of vibration speed, motion (vibration amplitude) and vibration. These shall also be analyzed in the 50 ÷ 1000 Hz range.

Measurements shall be made at 3 levels - at the bottom, middle and upper parts of the transformer.

In any case, the measurements must show normal levels of ionizing radiation below the permissible rates. The Client may request ionizing radiation measurements to be repeated by a certified supervisory body at the Contractor's expense. In this case, the Contractor shall replace the non-compliant materials and parts at his own expense.

Upon completion of factory tests of the transformer, a report shall be prepared with all the protocols attached.

### 3.5 STORING BEFORE DELIVERING


Before agreeing the delivery schedule with the Client, the storage, maintenance and control of the transformer, its equipment and the oil is the responsibility of the Contractor.

### 3.6 TRANSFORMER DELIVERY

The scope of transformer delivery includes:

#### 3.6.1 TRANSFORMER PREPARATION FOR DELIVERY

- 1) Oil drainage.
- 2) Installation of the nitrogen system and the nitrides.
- 3) Dismantling of equipment and their preparation for delivery.
- 4) Packaging of dismantled components, including labeling, installation of hermetic seals, and compilation of packing lists.
  - Disassembled transformer components must be packed in such a way as to ensure their safety during shipment.
  - All accessories and spare parts must be packed in durable wooden, non-returnable packaging during delivery, to ensure safe passage in difficult sections of the road and in severe weather conditions.
  - Large components, which will be transported unpacked, must be protected from dust and moisture by proper covers, mufflers, compactors, and other similar fixtures.
  - Equipment or materials that may be damaged by the ingress of water, moisture or hazardous materials shall be fully sealed in tight plastic bags, and those which may be damaged by condensation shall be protected by using silicon gel or other approved chemical cleaners.
  - Packaging and storage of components must ensure a shelf life of at least one year.

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5) Identification and labeling:

- All individual parts and components must be marked with legible secure inscriptions and unique codes or numbers, which indicate their distinctive place during installation.
- For each scheduled delivery, the Contractor prepares a bill of lading with unique numbers and dates.
- Bill of lading (vehicle lists) with items and parts and their codes or numbers must be submitted to the Client prior to shipment. Bill of lading must also accompany each consignment, in waterproof files they must be affixed both to the inside and the outside of the package, as well as directly on the surfaces of parts if they are shipped unpacked.
- Each individual piece of equipment, material or item delivered to the installation site must be marked as follows:

Consignment number;

Buyer;

Contact number;

Shipper - name and address;

Contract number;

Supplier - name and address;

Manufacturer;

Country of origin;

Description and package number;

Gross Weight / Net Weight;


Package size / overall size;

Recipient's address;

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The label must be affixed to the two non-opposite sides of the package and to the top.

If the size, type and packaging of the supplied materials do not allow direct marking, then secure labels or inscribed metal sheets must be affixed to at least three sections of the load.

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The packaging must have standard markings for the top and bottom, the center of gravity, the lifting points and other symbols required by EN ISO 780 (or an equivalent) standard for transportation and storage of packages. For example:



Four copies of each bill of lading shall be sent to the Client prior to delivery of the equipment.

### 3.6.2 Delivery of Transformer and All Its Components, Equipment


The transformer and all its components shall be delivered from the Contractor's factory or warehouse to the transformer area of Shamb HPP. This includes all components of the transformer, including oil for filling and refilling. If transformer is transported empty without oil, measures should be taken for preserving the windings dry – filling with dry nitrogen and maintaining positive gas pressure for avoiding moisture ingress.

The scope of the Contractor's activities includes all types of transportation activities, and, if necessary, preparation, planning and inspection of routes, rental of equipment and accompanying vehicles.

The Contractor is fully responsible for the transportation of goods, including their insurance.

- 1) Transfer of the transformer oil by a specialized means of transport. During delivery, loading or unloading the oil must not be mixed with other liquids, oils, moisturizers or other contaminants. The accompanying documents must also contain the manufacturer's safety data sheets.
- 2) Conditions of shipping, and Installation of tracking and recording devices to control mechanical effects on the body of the transformer.
- 3) The body of the transformer is shipped to the transformer platform in the premises of Shamb HPP of ContourGlobal Hydro Cascade.
- 4) The scope of transportation includes all preparatory activities for loading, fastening, essential installation, and dismantling of the goods, including inspection works, route planning, and arrangement of accompanying vehicles. Vehicles that are visibly defective, with dirty or damaged tires are not allowed to enter the plant premises.



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5) The Contractor is responsible for insurance of the delivered goods.

6) All costs of delivery, storage, unloading, rental of unloading equipment, packaging, waste cleaning and disposal, as well as transit fees and other delivery-related fees in all sections of the route and on-site, are paid by the Contractor.

- The platform on which the transformer will be transported must be suitable for shipping this type of goods and must have the required carrying capacity and stability. Prior to shipment, the carrier must provide evidence that in the past 3 years it has shipped a transformer or other similar or larger items, and that it has the essential experience of carrying out such activities.
- Before loading the transformer, make sure that it is correctly positioned so as to avoid problems when unloading in the installation area.

The Client reserves the right to oversee and record the damage to the transformer and its spare parts during shipment, loading or unloading, and if the damage exceeds the permissible limit, the Client has the right to claim for replacement from the Contractor at the expense of the latter.

Customs clearance of the goods is carried out by the Client, under DPU conditions.


### 3.7 INSTALLATION AND TESTING AT SHAMB HPP

The Client decides in which unit of the station the new transformer shall be installed and when the works shall start.

All activities at the station, including dismantling of the existing transformer and installation of the new transformer, are planned and carried out in accordance with the annual maintenance plan of the station, agreeing them in advance with the "ELECTRIC POWER SYSTEM OPERATOR" CJSC.

#### 3.7.1 PREREQUISITES

- 1) Dismantle the low and high voltage connections and all electrical control cables of the present transformer unit, that need to be replaced with new ones.
- 2) Drain the oil from the transformer so that it can be easily moved along the rails of the transformer platform.
- 3) Dismantle the elements and equipment that may impede the movement of the transformer on the rails.
- 4) The dismantled parts of the present transformer block are transferred and stored in the area of the station.

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5) The dismantled transformer shall be transferred to a place assigned by the Client where it will not impede the movement and position of the new transformer replacing it.

6) Unloading of the new transformer from the shipping platform.

7) Setting up the transformer on the track (rails).

8) Setup of the new transformer on the rails at the installation site, including lifting and rotation of equipment when moving from one direction to another.


9) Installation, alignment and seismic fastening of the transformer in working position. The Contractor must supply the necessary equipment for transformer fastening in the installation site.

### 3.7.2 RESPONSIBILITIES OF THE CONTRACTOR

- Check, clean and repair any faults in the external anti-corrosion coating of the expansion tank, control panels, devices and transformer coolers.
- Any damage to the cover during shipping is recovered by the Contractor after installation at Shamb HPP.
- Complete installation of the transformer in high voltage, low voltage and neutral terminals, installation of all insulators, conservator, cooling system, control panels and all other components to prepare the transformer for on-site testing.
- The Contractor shall provide a testing program.
- Installation of oil-resistant, UV-resistant control and power cables.
- Fill the transformer with oil until it reaches the normal level in the expansion tank.
- Monitoring of transformer oil parameters. After filling, the oil shall be circulated through degassing equipment until the standard parameters are reached in accordance with the current norms and standards.
- Install high voltage, low voltage, and neutral connections.
- Connect all external control and power cables.
- General visual inspection after installation. It will be carried out in the presence of the representatives of the CLIENT and the Contractor, and a protocol will be compiled.
- All activities at Shamb HPP will be supervised, if necessary, with direct participation of the CLIENT's specialists.
- The Client is not obliged to provide bodies, covers, containers, or other storages for materials, tools or work areas.

### 3.7.3 POST-INSTALLATION TESTING AT SHAMB HPP

The Contractor shall carry out all measurements and tests in accordance with the manufacturer's operation manual and IET 62 (or equivalent) "Guide for Diagnostic Field Testing of Electric Power Apparatus: Oil Filled Power Transformers, Regulators, and Reactors", performing at least the following tests after installation of the transformer:

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- . Control of the dielectric strength, moisture content and physicochemical characteristics of the transformer oil in accordance with the requirements of EN 60422 (or an equivalent) standard.
- . Measurement of moisture content in solid insulation by recovery voltage (RVM) method.
- . Measurement of insulation withstand of windings.
- . Measurement of withstand of the windings with direct current.
- . No-load loss and current measurement with low voltage.
- . Short circuit loss and voltage measurement.
- . Magnetic balance measurement .
- . Measurement of the dielectric loss angle ( $\text{tg } \delta$ ) of the insulation system.
- . Measurement of the capacity of windings in relation to the ground (body).
- . Measurement of terminal capacity and dielectric loss angle ( $\text{tg } \delta$ ).
- . Check the polarity of the embedded current transformers and transformation coefficients.
- . Functional testing of auxiliary equipment and cooling system.

Upon completion of the tests a formal report shall be compiled on the condition of the transformer, and a conclusion shall be drawn based on a comparison of the results of all the test reports, and results of all factory tests of the transformer.


The transformer shall be put into commission after 72 hours of successful testing carried out with participation of the representatives of the Contractor and the CLIENT.

Nothing mentioned in this paragraph relieves the Contractor of any other obligations arising from a warranty or electronic transaction.

#### **3.7.4 TRANSFER OF THE OLD TRANSFORMER TO STORAGE AREA**

The Contractor will carry out all the following activities related to strategic storing, transfer, installation and long-term storage of the present transformer.


- Demount the old transformer (terminals, equipment, expansion tank etc)
- The oil must be drained and then transported to the transformer storage area.
- Transformer blockage on rails.
- Install all dismantled terminals, equipment and the expansion tank, change the seals .
- The oil is filled and circulated by a degassing device.

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#### 4. TECHNICAL SPECIFICATIONS OF THE NEW TRANSFORMERS

##### 4.1 KEY PARAMETERS

General Specifications		
Rated Power kVA		
HV	high voltage	125 000
LV	low voltage	125 000
Rated Voltage, kV		
HV	high voltage	242
LV	low voltage	13,8
Highest operating voltage HV winding, kV		252
Three-phase short-circuit power on the high voltage side of the network HV, MVA		25 000
Losses		
No-load loss, < kW		70
Maximum short-circuit losses kW		380
Specifications of Windings		
Withstand to short-circuit, thermal / dynamic	HV	Specify / Specify
	LV	Specify / Specify
Current density in windings A/mm <sup>2</sup>	HV	Specify
	LV	Specify
Permissible short-circuit current flux time, < sec.	HV	3
	LV	4
The manufacturer must have experience to successfully conduct routine short-circuit tests on 220 kV and higher		Yes, provide at least 1 test protocol


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voltage transformers/autotransformers, which have been manufactured using a technology that meets the required technical requirements (provide at least one protocol).	
<b>Magnetic System Specifications</b>	
Type of steel of the magnetic core	Specify
Losses per unit length of magnetic core steel	Specify
Magnetic core production technology	Specify
<b>Cooling System</b>	
Service life of the coolers in the transformer cooling system, no less than	30 years
All cabinets (automated transformer cooling cabinet and terminal cabinets) must be manufactured with IP-54 protection, temperature control, cabinet heating, and anti-corrosion coating	Yes
<b>Reliability Requirements</b>	
Service life, > years	30
Service life of the sealing rubber, > years	30
Frequency and scope of maintenance	Specify
Likelihood of working without malfunction	Specify
Warranty operational period after commissioning, months	18
The winding shall be fastened in such a way as to ensure that throughout the service life no technological need arises for further fastening of the windings and the magnetic circuit. Provide a system specifications at the bidding stage.	Yes, provide system description with photos
Magnetic transmitter grounding	Outside the tank / inside the tank
The manufacturer must have experience in the production of 125000 \ 220 type transformers.	Submit

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Confirm by providing a passport for a previously manufactured similar sample.	
At the bidding stage the manufacturer must provide a test report for a similar transformer	Required
<b>Cooling System</b>	
Model of the cooling system	OFAF
Type of the cooling system	Installed on the transformer tank
<b>Labling, Packaging, Shipping, Storage Conditions</b>	
Delivery of equipment to the site of installation, including:	Required – DPU Shamb
Shipping to the installation site	Yes
Unloading at the installation site	Yes
Customs clearance	Yes
<b>Requirements to the Manufacturer</b>	
The transformer manufacturing plant must have its own production base for manufacturing metal structures and tanks for oil transformers	Yes, provide description
<b>Equipment Sets</b>	
Thermosyphon filter	Yes, specify the manufacturer
Safety valve	Brand or analog, which does not concede in terms of functionality or quality
Gas analyzer connection output	Yes
Scaffolding for working at standing height	Provide description and drawings
Membrane protection	Yes
Operational manual in English and Russian	Yes, submit

Other parameters and specifications of the transformer are presented in the attached table "Technical Data and Technical Parameters of the Transformer" and in the present transformer drawings, where the dimensions of connections must be strictly maintained.

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Permissible deviation of the measured parameters from the guaranteed ones:

- . For transformation coefficient  $\pm 0.4\%$ ;
- . In case of BH/H short circuit:  $\pm 5\%$ ;
- . In case of recommended no-load and short circuit losses: in accordance with EN 60076-1 (or an equivalent) standard;
- . For total losses:
  - If  $\leq 10\%$ , the transformer is accepted, but a fine of 1,000 (one thousand) USD is paid per kW for exceeding the guaranteed losses
  - If higher than 10%, the transformer is not accepted .

#### 4.2 FILLING

All hoses used for filling the tank and the connected pipes must be made of an oil-resistant material of sufficient thickness and strength to ensure a solid structure and to prevent penetration of moisture, air and other contamination into the windings and the oil, as well as to avoid oil leakage in any conditions of transformer operation.


All studs, screws, bolts, pipes and threads, bolt heads and nuts must meet metric standards or equivalent technical standards.

All bolt and nut connections of the bell must have appropriate oil-resistant linings to ensure efficient hermeticity during full transformer operation. Place the bell on the base of the transformer.

During installation, use guide clamps that stretch around the entire perimeter of the connector. Attach the connector by pulling the nuts evenly on two diametrically opposite sides at the same time. The connector is attached when the gasket is compressed to 2/3 of its original thickness. Use safety spring washers in bolt and nut connections, in accordance with the requirements of the technical documents.

If possible, the screws shall be installed in such a way that in the event of a malfunction, if the nut falls off, the bolt will remain in place.

The outdoor carbon steel bolts and nuts must have anti-corrosion galvanization or be otherwise coated to provide such a level of protection.

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Appropriate precautions should be taken to prevent electrolyte exposure between different types of metals.

When bolts and nuts are used on outer horizontal surfaces susceptible to accumulation of water, measures must be taken to prevent penetration of moisture into the spiral.

Each bolt or stud must be fastened with a nut through at least one spiral, and a maximum of three spirals is recommended.

The length of the spiraled part of the bolts should be such that the edges of the bolts do not stick out in the area between the elements.

Protective washers of appropriate material shall be fixed on the front and back of the protective bolts.

#### 4.3 WIRING AND CABLING

All cables - power, control, metering, communication, etc., installed in accordance with the transformer specifics, must be flexible, resistant to oil and UV rays, and well protected from mechanical damage by shielding in protective metal sleeves, pipes, cable ducts, metal-reinforced hose, etc. The installation of these must be carried out in strict compliance with the manufacturer's instructions, such as those related to the radius of bending, the temperature, section preparation methods, proper installation of sockets, etc.

For cables going through walls, boxes, etc., appropriate metal tubes must be used, by type and size. Spare plugs are tightly blocked with a plug cover or an inserts.


Protective pipes and metal pipes must be protected from corrosion.

#### 4.4 CLEANING AND PAINTING METAL PARTS OF THE TRANSFORMER

The Contractor must submit and agree with the CLIENT the procedure for applying anti-corrosion coatings and paints.

The pre-painting and painting processes of soft structural steel parts must provide reliable protection against corrosion, climatic and other effects, and chemical damage during outdoor work on the transformer.



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All metal parts of the transformer must be cleaned with a sandpaper to the point of metallic sheen. Then they must be thoroughly degreased. The type and quality of the paint must be compatible with the specific effects of the vegetation area. The color of the top layer shall be RAL 7031 (or equivalent). The total thickness of the protective coating must be at least 220 microns.

Each layer should have a different color shade to allow for the necessary checks.

- Atmospheric corrosion category - in accordance with EN ISO 12944 (or equivalent): C4 - Industrial areas or coastal areas, chemical plants, high corrosion levels.
- The service life of the protective paint – in accordance with EN ISO 12944-1 (or an equivalent) standard. High intensity (H), 15 years.

The materials and the technology used must ensure the smooth effects of the coating against defects and corrosion for at least 5 years and 10 years, before it becomes necessary to take basic measures (as defined in ISO 12944-2).

#### 4.5 GROUNDING OF TERMINALS

The terminals shall be made of stainless steel with 2 holes  $\Phi 14$  located at a distance of 35mm between their axes.


The tank and the cover shall have two potential connections in front of their short sides.

All metal assemblies (expansion tanks, coolers, fans, pumps, terminals, valves, oil pipes) installed on the tank, as well as the mentioned individual parts, shall be connected to a grounded shield with potential connections.

#### 4.6 LABEL PLATE

The transformer shall have several separate or one combined signboard in a conspicuous place on the outer wall at a distance of 1.50 to 1.70 m from the site, containing at least the following information:

- . Basic technical data specified in EN 60076-1 point 8.2 (or and equivalent) standard.
- . The winding connections diagram, the voltage vector diagram, the voltage and the magnitude of the current, the exact location and labeling of the inlet terminals (terminals HH and BH).
- . The diagram of all deviations of embedded current transformers and the the markings of terminals.

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. Location and functions of all faucets, valves, fresh air and other devices.

The signboard shall be made of appropriate durable materials (metal) and technology (including engraving) to ensure withstand against all environmental impacts, and the indelibility of inscriptions. All texts on the signboard must be in Russian and English.

#### 4.7 TRANSITION DEVICES, DOMES AND TERMINALS

The transformer must be equipped with matching transitions in accordance with the requirements of EN 60137. 2008 or 11179. 1984 and 15442: 1990 (or equivalent) standards.

The installation of the supply connection on the cover of the transformer must correspond to the position and dimensions of the present transformer.

The high voltage HV side of the terminals must have appropriate domes for installation of embedded power transformers.

The low voltage LV side of the terminals must be fully sealed in appropriate metal boxes with side openings.


The domes of the high voltage terminal and the zero terminal can be dismantled during shipment by installing closers (blind joints) with sealings in their place, in proportion with the strength and durability requirements of the entire transformer tank.

(tan  $\delta$ ) tan delta of transformers bushings must be checked periodically until received.

#### 4.8 TRANSFORMER OIL AND HAZARDOUS MATERIALS

The transformer must be filled with fresh, dry, degassed mineral oil in accordance with the requirements of EN 60296:2012: Fluids for electrotechnical applications. Unused mineral insulating oils for transformers and switchgear (or equivalent). The content of inhibitory materials must be at least 0.3%.

The Contractor shall provide the Client with additional oil in the volume of up to 5% of the transformer oil for technological and operational needs.

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The Contractor must also provide safety data sheets for all hazardous materials used with the equipment. The Contractor must ensure that the supplied equipment does not contain any other classified hazardous materials.


The oils may not be supplied or used at any stage of production or testing without a certificate acceptable to the buyer testifying that the content of polychlorinated biphenyls is less than 2 mg/kg. THE Contractor is liable for the removal of such hazardous materials.

THE Contractor is also liable for any damages resulting from the use of hazardous materials, if these requirements are not met.

#### 4.9 ACCESSORIES

The transformer must be equipped with at least the following accessories, signs and protective devices:

- . Oil level indicator, the magnetic type for oil level expansion, designed to indicate the level of the field, with easily visible and legible color scale, with two normal open contacts for the minimum and maximum levels - the total amount of vacuum.
- . Dry air(s), depending on the volume of extension;
- . Gas transmission relay 3" from the ground level with a gas sampling device;
- . 3" oil valve with a gas transmitter for draining the oil from the expansion tank - 2 pieces;
- . 3" faucets for filling oil and connecting to a vacuum cleaner or an oil purifier.
  - On the cover of the tank – 1 piece;
  - On the bottom of the tank -1 piece;
- . A valve or a plug 2", for removing the mud amassed on the bottom of the tank.
- . Thermometer - 4 pieces.
- . A device for relieving overpressure resulting from damages inside the transformer - with detachable contacts - 2 pieces;
- . Install a 3" valve in the oil pipe of the expansion tank to insulate the expander in case of a transformer malfunction.
- . An oil temperature sensor in the upper layer (under the cover) with four self-adjusting switching contacts in the range of -20 to 130 °C, designed for connection of signals, cooling protection and electrical control circuits, system - 2 pieces, with anti-vibration suspension;
- . LV winding temperature sensor (WTI, combined in separate magnetic core) with four self-adjusting switching contacts, in the range of 0 to 150 °C, designed to control the cooling system, as well as a signal and a switch-off for the signal - 1 piece, with anti-vibration suspension;

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- The rubber bag pressure in the expansion tank to protect the oil from oxidation and moisture;
- A stationary ladder with protective rings and a connection device at the top for ensuring safe climbing on the upper steps while servicing the gas relay and other equipment, as well as for safely accessing the mentioned cover.
- A cabinet for the cooling system, the terminal, the protection and current transformers placed on the left side of the tank - the high voltage HV side.
- Signs and warning signs with the technical data of the transformer.
- Independent terminals with brake valves: additional upper and lower oil layer monitoring systems located at a distance of 40cm from the bottom of the transformer (for example, a terminal for online analysis of dissolved gas in oil);
- An independent valve for oil sampling.
- HV, LV and neutral terminal domes and boxes.
- Terminals and boards for HN (High Neutral) batch interconnection.
- Availability of sealings of the covers and blind joints of all edges and openings, including sealing of the cover of coolers, domes and boxes when dismantling transportation equipment.


#### 4.10 OTHER TERMS

The Contractor shall ensure the integrity of the transformer with all special devices, including mufflers, all terminal openings and domes, as well as closing valves during operation, inspection, and repair. The Contractor shall also provide all the necessary spare parts to ensure normal operation of the transformer for at least 5 years.

Requirement of availability of Contractor's qualified personnel: technical supervision engineer or engineers, who must be representatives of the manufacturing plant and must comply with the below requirements:

- During the process of dismantling and mounting of the power transformer, carry out supervision in accordance with the technical conditions.
- The supervising engineer must participate in the handover and acceptance of individual components as well as keep records of the measurement and mounting work.
- Compilation of regular reports on the performed work.

The personnel participating in the mounting work shall be determined by the Contractor and the approved list shall be submitted to the Client as part of the tender package.

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#### 4.11 SPARE PARTS

The Contractor must supply the remaining transformer equipment, and deliver the following spare parts, the price of which is included as separate item in the final tender offer:

- High voltage bushing - 1 piece;
- Neutral bushing - 1 piece;
- Low voltage bushings - 2 pieces.
- Transformer cooling fan - 2 pieces
- Oil temperature sensor – 1 pieces.

Spare parts must be new, of high quality, unused and of the same model and series as those for transformer installation.

The Contractor must offer (described in a separate specification) sufficient spare parts to ensure normal operation of the transformer for 5 years.

### 5. RESPONSIBILITIES, RESTRICTIONS AND EXCEPTIONS

#### 5.1 IMPLEMENTATION


The Contractor must carry out the works in accordance with the relevant rules and norms, technical, sanitary and fire regulations of the Republic of Armenia, as well as similar regulations of the Client organization.

In case of violation of the law or non-observance of the rules, the CLIENT has the right to refuse the entry of the violators to the area without compensation of the consequent losses.

The Contractor provides and maintains the necessary documents in accordance with the above rules.

In case of engaging subContractors, the Contractor shall ensure that the subContractors are clearly aware of these rules and comply with all the requirements.

In order to get acquainted with the site and the nature of the work before signing the contract, the Contractor conducts inspection jointly with the CLIENT.

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The Contractor shall be liable for violation or non-performance of the provisions of the contract in accordance with the provisions of the contract.

#### 5.1.1 ACTIVITIES

The Contractor's scope of work includes the following: all the activities described in item 3, as well as all the activities provided for by the Contract.

#### 5.1.2 START DATE

The Contractor starts the work upon signing the contract.

Dismantling and testing works of the new power transformers of the station units should be in accordance with the technical specification. Any deviation from the planned and approved activities at the station, including dismantling of the existing power transformer and installation of the new power transformer, should be done in accordance with the annual maintenance plan. The outage plan for Shamb HPP for the purpose of installation of the new power transformers (including the dismantling of the old one) is scheduled on February, May, April months of 2024 year. Any deviations should be agreed in advance with the Employer following approval of "ELECTRIC POWER SYSTEM OPERATOR" CJSC.

Replacement of power transformer N 1 of Shamb HPP in February 2024 and replacement of power transformer N 2 in March 2024.

#### 5.1.3 COMPLETION DATE


In accordance with the schedule provided by the Contractor and approved by the CLIENT.

#### 5.1.4 WORKING HOURS

The regular working day of the CLIENT' site is the day shift: from 9: 00 to 17: 45. Working during non-working hours is allowed only upon agreeing it with the Client.

If the Contractor intends to work on the site outside the specified hours, a relevant request must be submitted and the Client's written approval received (at least 24 hours in advance).

If it becomes obvious that the work is delayed or is likely to be delayed, the Client may instruct the Contractor to take the measures which the Client deems necessary or appropriate in the given circumstances. These measures may include, but are not limited to: extension of working hours, change of work, increase of labor force, etc. All associated costs are fully covered by the Contractor, after fulfilling the necessary additional requirements set by the CLIENT for entering the site area.

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### 5.1.5 WORK SCHEDULE

Before starting the work, the Contractor shall submit an updated work schedule detailing all activities, as well as information on the planned resources.

The schedule shall include information on the completion of all activities and the duration of each activity (task) as provided by the CONTRACT, which will be performed and will be linked to previous tasks on which they depend. Implementation of works, and their duration must be in compliance with the maintenance plan, and must be agreed with the Client at least 2 weeks prior to the start of works on the site.

To take into account that the CLIENT will not hand over a second transformer for replacement until the first new transformer has been successfully configured, commissioned and put into operation.

The Contractor shall regularly monitor the progress of the works and promptly update and send information to the CLIENT (at least on weekly basis).

### 5.1.6 WARRANTY


The Contractor shall guarantee the following:

- . Overall, the quality of the product, the activities performed, the equipment supplied, as well as the quality and durability of the materials used.
- . The data provided by the Contractor in the table of guaranteed technical parameters.
- . The warranty period for uninterrupted operation shall be 18 months from the date of commissioning

### 5.1.7 NOTIFICATION

The Contractor must notify the CLIENT about the factory tests in writing within a pre-agreed period, but at least 7 (seven) days prior to the test, and must send the CLIENT an invitation to participate in the factory tests performed by their specialists.

The Contractor shall promptly notify the CLIENT of any material circumstances, such as delays in work, or changes in the organization of work or the activities, as well as of any unforeseen circumstances that may have such effects.

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#### 5.1.8 MEETINGS

In the process of work, if necessary, the Contractor must participate in certain non-production functions:

- Safety induction for the CLIENT's personnel - initial and on site.
- On site security coordination and meetings.

Regular or extraordinary meetings may be held between the Parties to monitor progress and resolve any issues that may constrain the work.

#### 5.1.9 CLEANING

In the process of work, the Contractor must keep the workplace clean and tidy, must immediately remove all waste, including excess and discarded equipment, which it produces at the CLIENT's demand and in accordance with the requirements.

The Contractor must ensure that all waste generated during the work is transported only by appropriate means of transportation in accordance with local regulations. The Contractor must ensure that all waste is disposed of in a place pre-agreed with the municipality as provided for by the law.

The Contractor must bear in mind that all the metal waste generated in the area of the station belongs to the CLIENT, and the Contractor is responsible for their immediate disposal and transfer to the designated areas in the station.


The Contractor is responsible for the disposal or transportation of any other type of waste.

#### 5.1.10 ON-SITE FACILITIES

The Contractor is responsible for providing amenities to its employees and subContractors, if necessary, on top of those provided by the CLIENT.

A security system has been set up at the head office. The CLIENT provides entry and exit cards to all the employees working at the station.



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The Contractor must assign at least one staff member who is trained to provide first aid at the station during working hours, and must provide him/her with the basic essentials of first aid.

The Contractor must provide health insurance for his employees.

#### 5.1.11 CATERING

There are no catering facilities on site. If necessary, the Contractor must provide such for his employees at his own expense.

The Client does not provide a canteen, food preparation facilities, or other means of catering. All this must be provided by the Contractor for its employees and those of its subContractor.

The Contractor must meet all the additional requirements of its employees, including ensuring water and gas supply.

#### 5.1.12 ELECTRICITY SUPPLY

The Client shall provide power supply point, while all the facilities, equipment to be connected to the power supply shall be provided by the Contractor.


The power supply at the station has the following specifications: 230V/400V, 50 Hz.

The supply of essential electrical equipment/panels and power cables must be done at the expense of the Contractor and must meet the requirements of safe operation of the plant and production purpose.

1. All power supply devices must be equipped with current protection from damage, and with Euro industrial type of sockets/plugs.
2. The extension cords must be standard and must have a manufacturer's certificate.
3. Power cables and cable devices extend along the length of the old cable ducts.

Temporary interruption of these power supplies does not lead to a change in the field of activity. Recovery of power supply is carried out exclusively by the Contractor's personnel.

Unless otherwise instructed by the CLIENT, the Contractor must comply with the following requirements:

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1. The use of portable power devices or luminaires with a voltage higher than 110V is permitted only if the supply circuits have adequate ground protection/damage protection.

2. No electric stoves or open heating surfaces shall be used on site.

When part or all of the Contractor's electrical system is no longer needed for performing the contracted work, it will be removed from the area.

Open flames, matches or lighters shall not be used in the workplace.

#### 5.1.13 COMPRESSED AIR

If necessary, the Contractor must ensure compressed air.

#### 5.1.14 SAFETY


The work must be carried out in accordance with the current rules and regulations of the Republic of Armenia on Health, Safety and Environment as well as in accordance with the current procedures and policy requirements of the Client on Health, Safety and Environment. (The attached link presents the CG Occupational Health&Safety standards.

<https://contourglobal.box.com/s/gvbm1cppwzm2q0mpa7pjbwip17ct63am> .

Before concluding a contract, the Contractor's representative shall submit to the Client the documents specified in the checklist related to Class A work risk (the checklist is attached).

Before starting the work, the Contractor shall provide evidence/proofs of compliance with the procedures and instructions required (employee qualification and training certificates, certificates of equipment to be used and inspection protocols, Health, Safety and Environmental risk assessment, work performance plan, emergency response plan, certificates of quality of personal protective equipment and other necessary documents).

During the works the Contractor must have a permanent Health, Safety and Environmental representative at the workplace.

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All activities must be carried out in accordance with Health, Safety and Environmental requirements of the Client organization.

#### 5.1.14.1 PERSONAL PROTECTIVE EQUIPMENT

The requirements for the use of PPE shall be set by the Client and the provision and proper application of PPE shall be carried out by the Contractor.

Protective work clothes, helmets, goggles, safety shoes must be worn in the workplace at all times, and the need for additional protective equipment depends on the nature of the work and must be consistent with the assessment of the risks associated with the work.

Initially ensure the availability of all the PPEs that are required for high risk activities as defined by risk assessment, regardless of whether the above mentioned activities will be carried out during a given working day or not.

The Contractor must comply with Health, Safety and Environmental rules approved by the Client, which include, but are not limited to the rules of environmental protection, safety and operation.


#### 5.1.14.2 GENERAL SAFETY RULES FOR MANUAL EQUIPMENT

Mobile power supply devices must be in accordance with the type of activity performed, technically in sound condition, in accordance with the manufacturer's instructions and shall be used by authorised and qualified persons to carry out the work as per the intended purpose.

The class of of hand-held power tools, portable light bulbs and portable transformers shall be appropriate for the environment in which they are being used.

#### IT IS PROHIBITED:

- To work with non-standard or defective hand tools, as well as devices that have not been regularly inspected.
- To use malfunctional, non-standard connections and extension cords

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#### 5.1.14.3 GENERAL RULES FOR SCAFFOLD INSTALLATION AND DISMANTLING

Ensure the use of scaffolds in accordance with current standards (EN 1004, EN 12810-1 and 2, EN 12811-1, EN 12812 and EN 1298) for providing access to repair works on the work site.

The scaffolds used at the work site must be accompanied by a document certifying its technical parameters, compatibility with the allowable load, valid expiration date, which must also be submitted to the Client.

The construction, operation and dismantling of scaffolds must be carried out in accordance with the Client's requirements for safe operation and use.

#### 5.1.14.4 GENERAL RULES ON ENSURING SAFETY IN FIRE AND EMERGENCY SITUATION

In case of fire in the workplace, act in accordance with the Client's operational instruction OI-01-028 on "Fire Rules".

The Contractor shall ensure the availability of essential fire-extinguishing equipment on the work site and relevant competent personnel authorised to use these tools. The required amount of fire response and emergency response equipment shall be defined in accordance with the H&S requirements of the Client as well as current legislative requirements of the RA.

#### 5.1.14.5 GENERAL SAFETY RULES FOR WELDING, CUTTING

Welding and cutting works shall be carried out at the work site with appropriate equipment, only by qualified specialists holding a relevant legal license.


Exclude the implementation of welding works in fire hazardous areas.

Areas where welding works are carried out must be equipped with fire extinguishers. Works must be carried out in accordance with Health & Safety procedures of the Client.

#### 5.1.14.6 USE OF CHEMICALS IN THE WORKPLACE

The use of chemicals in the work process must be carried out in accordance with the operating instructions of the Client and the risk assessment of the work process. Ensure the implementation of measures preventing environmental pollution in the workplace (ensure the availability of universal leakage collection kits as per the leakage risk of the work site).

When carrying out work with chemicals, ensure the availability of the Material Safety Data Sheets of the chemicals used at the work site.

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#### 5.1.14.7 WASTE MANAGEMENT

Storage and disposal of waste generated at the work site shall be carried out in accordance with the procedures of the Client. Ensure the availability of containers for hazardous and non-hazardous waste on the work site. Disposal of hazardous and non-hazardous waste shall be carried out by the relevant licensed organizations.

#### 5.1.14.8 VIOLATION OF HEALTH, SAFETY AND ENVIRONMENTAL REQUIREMENTS

In case the Contractor fails to comply with Health & Safety and Environmental requirements established by the Client during the entire course of the Works, the Client shall have the right to apply preventive measures including fines and penalties in the amount of 0.001% of the total value of the Contract for each documented violation, full compensation for the damage caused and elimination of the detected defect within a maximum of 48 hours (unless elimination of the defect requires longer time due to the circumstances).

In case of Health & Safety and Environmental violations, the terms of termination of works cannot be a basis for extending the term of works provided for by the contract.


#### 5.1.15 OTHER ISSUES

The proposed prices shall include:

- Assembly and installation works at the site.
- The device installation costs.
- Transportation and transfer of materials.
- Transportation costs of the Contractor's personnel to and from the workplace, including the cost of consumables.
- Rent.
- Rental of tools, elevators, cranes, etc.
- Storage.
- Temporary storage of items and equipment included or related to the scope of the contract, such as tools, consumables, etc.
- Dismantling and installation.

Temporary dismantling of equipment, structures, systems or their parts shall be viewed as part of the work activity. In particular, it should be reassembled after demounting.

All disassembly, reassembly and installation work is carried out by the contractor's employees.

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Workers

Services, activities and materials shall also include the employees required for implementation of the scope defined by the Contract.

#### DELIVERY OF OTHER MATERIALS

Delivery of auxiliary materials, consumables and accessories for thorough implementation of essential activities in accordance with the scope of activity and the Contract.

#### 5.2 THE CLIENT

Workplace power supply or on-site work.

The CLIENT will allow the Contractor to use electricity at the work area to carry out the assigned work.

Work area for the Contractor:

The CLIENT may provide the Contractor with premises in which the latter can place facilities such as a temporary tool cabinet or a van.

For this purpose the Contractor must submit a written statement describing the given temporary facilities.


#### 6. TESTS

Tests and (or) activities related to commissioning shall include:

- Factory tests;
- On-site tests.

The above mentioned points are accompanied by official documents, which can not be disputed.

Payment shall be made on the basis of relevant reports and protocols on successful on-site tests.

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## 7. REFERENCE DOCUMENTS

- Instructions for using PPE.
- "Technical Regulations, Safety Rules for Operation of Power Plants", approved by the RA Government Decision No. 1933-N of 2006.
- Health, Safety and Environmental procedures of CG.
- Occupational safety and labour protection rules for working in electric systems, electric and central heating stations, and electric networks.
- "Safety rules for performing wiring and adjustment works".
- Labour protection instructions for electric equipment installation specialist.
- Rules for the use and testing of protective equipment used in power plants, and related technical requirements.
- Fire safety rules during construction and installation works.
- Rules related to operation of electric equipment.
- Transformer operation instructions.
- Power oil transformers of general use, voltage class 220-750 kV.
- Specifications.
- Transformer manufacturing technology and equipment.
- Transformer shipping and storage.


### 7.1 TRAINING

The Contractor shall conduct a training for five employees on "Operation and Maintenance of Power Transformers". Contractor must provide training schedules.

## 8. REFERENCES

**Drawings of present transformer**

- 8.1 ББ 710. 943 СБ** Drawing of transformer assembly
- 8.2 ОББ 301.474 ГЦ** Drawing of tranformer dimensions
- 8.3 5ББ 809. 800 СБ** Transformer installation and fastening on a railway vehicle with a capacity of 150 t.  
Collective drawing plan.
- 8.4 ОББ, 350. 337** Scheme of transformer grounding.
- 8.5 ББ.** Magnetic transmitter

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#### 8.6 Collection of the operating transformer's pictures and plans

Fig. 1 The transformer from the high voltage side.

Fig. 2 The transformer from the low voltage side.

Fig. 3 The transformer transportation device.

Fig. 4 The transformer from the side of the expansion tank.

\* In case of inconsistencies in the translation of this technical specification, preference is given to the Armenian version of the document.




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Fig. 1 The transformer from the high voltage side




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Fig. 2 The transformer from the low voltage side


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Fig. 3 The transformer transportation device




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Fig. 4 The transformer from the side of the expansion tank