

"APPROVED"
Chief energy officer
LLC "Shurtan GCC"
X. Normuradov
"07" 02 " 2023 y.

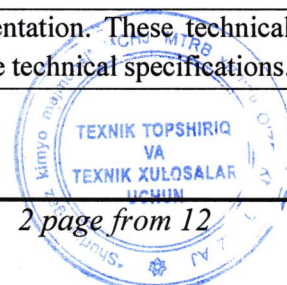
Reg. No.
074/_____

Terms of Reference

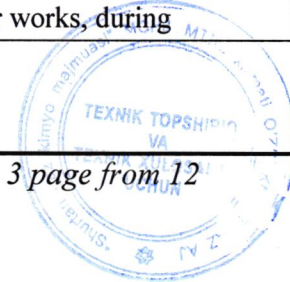
Supply, installation supervision and commissioning (turnkey) of
containerized diesel dynamic uninterruptible power supplies for
"Shurtan Gas Chemical Complex" LLC

SGCC 2023

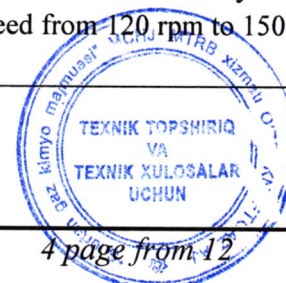
№	1. GENERAL INFORMATION		
1.1	Name	1. Containerised Diesel Dynamic Uninterruptible Power Supply (hereinafter referred to as DDUPS) with a capacity of 1000 kW. 2. Containerised Diesel Dynamic Uninterruptible Power Supply (hereinafter referred to as DDUPS) with a capacity of 630 kW.	
1.2	Reason and purpose for acquiring the equipment	Minutes №7 of the Scientific and Technical Council of "SGCC" LLC dated 05.12.2022. Application of production shops for connection of additional consumers to emergency panels powered from the diesel power plant.	
1.3	Information on novelty (year of manufacture/production of equipment)	The goods to be supplied must be new, no earlier than 2022 (not used, including unrecovered consumer properties).	
1.4	Stages of development/manufacturing	Name of stage	Type of supporting document
		1. Development by the Supplier of a set of manufacturer's design documentation (hereinafter referred to as "PDD") for the manufacture of the DDUPS	Set of CDs
		2. Approval of the design documentation and layout of the parts in the building by the customer. Handing over the Dkz package to the Customer.	Letter of approval from the purchaser
		3. Factory fabrication of the DDUPS in accordance with the requirements of this specification (hereinafter referred to as "ToR") and a set of design documentation agreed with the Customer;	Supplier notification letter
		4. Factory acceptance tests of the DDUPS with the obligatory participation of the Customer's representatives;	Factory acceptance test report
		5. Shipment of DDUPS after completion of factory acceptance test with a positive result;	Letter of notification of shipment with a set of shipping documents (consignment note, invoice, GTE, etc.)
1.5	Documents for design/manufacturing	Manufacturer's normative and design documentation. These technical specifications and the enclosed annexes of these technical specifications.	



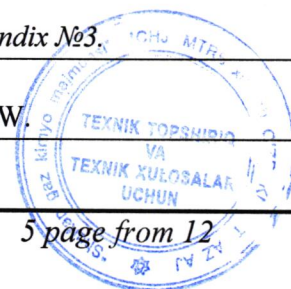
		Additional technical materials shall be made available by the Purchaser on request of the Supplier if necessary.
1.6	TN VED code and other international codes if applicable	According to the current STD.
1.7	Requirements for the Supplier	
		<p>The supplier shall be responsible for the design, technical coordination, supply, delivery, installation and testing of the entire switchgear, including any other ancillary equipment included in the supplier's scope of supply.</p> <p>Engineering coordination also includes responsibility for processing, expediting and delivering documents and drawings, including those relating to sub-suppliers' equipment.</p> <p>The supplier shall supply a quality product from the manufacturer or his official representative (distributor) producing the DDUPS with experience in manufacturing similar equipment. The potential supplier shall be experienced in supplying and installing the DDUPS. The potential supplier shall provide in its proposal relevant information confirming that the above requirement is met, including information on the technical characteristics of the previously supplied DDUPSs. Reference list of previous deliveries indicating date of delivery and contact details of these buyers.</p>
	2. AREA OF APPLICATION	
2.1	DDUPS systems protect against all power failures and will ensure uninterrupted and uninterrupted power supply to process areas of "Shurtan Gas Chemical Complex" LLC, and will ensure accident-free shutdown of process equipment in case of disconnection from external power supply. The DDUPSs are used for critical pumps and fans in premises, industrial sites and technological processes in explosion hazardous areas Zone 1 and Zone 2 according to "TOCT P 51330.9-99". Consumers of electric power of the indicated productions belong to Consumer Category I according to PUE.	
	3. OPERATING CONDITIONS	
3.1	General operating conditions	<p>3.1.1 System functionality requirements.</p> <p>Containers for the DDUPS should be manufactured in the climatic version UHL, category of placement 1 in accordance with "TOCT 15150-69" and are intended for operation under the following parameters of external ambient factors:</p> <ul style="list-style-type: none"> - temperature range from -30 °C to +49 °C; - humidity; 25÷75%; - rain, hoarfrost, snow, dew. - degree of atmospheric pollution; III - severe - wind head; V=32m/sec. - ice-covered district; II. - MSK-64 seismic scale; 8 points <p>There is no provision for service personnel to be permanently inside the container during normal operation of the unit.</p> <p>The permanent presence of maintenance personnel inside the container is only envisaged during maintenance and repair works, during</p>



		<p>preparation of the DDUPS for start-up and post-stop operations, as well as during periodic visual inspection of the DDUPS operation.</p> <p>The degree of protection against external influences of the enclosure and cabinets is at least IP42;</p> <p>Generator control panel: IP42</p> <p>Other rotating equipment: IP41</p>
3.2	Additional / special requirements	<p>Certificates of conformity to the following standards:</p> <p>EN-60034. Rotating electric machines.</p> <p>EN-50347. Three-phase asynchronous general-purpose induction motors in standard sizes and capacities - with size numbers from 56 to 315 and flange numbers from 65 to 740.</p> <p>IEC 60072-2. Dimensions and capacities for rotating electric machines - Part 2: Frame numbers from 355 to 1000 and flange numbers from 1180 to 2360.</p> <p>ISO-3046-1. Internal combustion piston engines - - - Performance - Part 1. Declaration of power, fuel and lubricating oil consumption and test methods. Additional requirements for general-purpose engines.</p> <p>ISO-8528-1. Internal combustion engine-driven alternating current generator sets - Part 1: Application ratings and performance.</p> <p>ISO-8528-5. Alternating current generating sets powered by reciprocating internal combustion engines - Part 5: Generating sets.</p> <p>ISO-15550. Internal combustion engines. Definition and method of engine power measurement. General requirements.</p> <p>ISO-8528-8. Internal combustion engine-driven generating sets for alternating current - Part 8: Requirements and tests for small power generating sets.</p> <p>EN-12601. Generating sets with reciprocating internal combustion engine. Safety.</p> <p>ISO 15. Rolling bearings - Radial bearings - Overall dimensions, general plan.</p> <p>ISO 281. Rolling bearings. Dynamic load carrying capacity and rated service life.</p> <p>ISO 1132-1. Rolling bearings. Tolerances. Part 1. Terms and definitions.</p> <p>ISO 1132-2. Rolling bearings. Tolerances. Part 2. Principles and method of measurement and inspection.</p> <p>ISO 1680. Acoustics - Test code for the measurement of airborne noise emitted by rotating electric machines.</p> <p>ISO 3744. Acoustics. Determination of sound power levels and sound energy from noise sources using sound pressure. Engineering methods for practically free field over a reflecting plane.</p> <p>ISO 10816-1. Mechanical vibration. Evaluation of machine vibration by measurement of non-rotating parts. Part 1. General instructions.</p> <p>ISO 10816-3. Mechanical vibration. Evaluation of machine vibration by measurement of non-rotating parts. Part 3. Industrial machinery with rated power greater than 15 kW and rated speed from 120 rpm to 15000 rpm when measured in situ.</p>



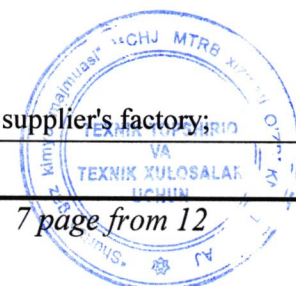
		<p>ISO 1940-1. Mechanical vibration. Balance quality requirements for rotors in a constant (rigid) state. Part 1. Specification and verification of balancing tolerances.</p> <p>IEC 60255. Measuring relays and protective equipment.</p> <p>IEC 61869. Measuring transformers.</p> <p>IEC 61850. Communication networks and automation systems for the power industry.</p> <p>IEC 60085. Electrical insulation. Thermal evaluation and marking.</p> <p>IEC 60529. Degrees of protection provided by enclosures (IP code).</p> <p>IEC 61000. Electromagnetic compatibility (EMC).</p> <p>IEC 60445. Standard rated currents.</p> <p>IEC 60439. Low-voltage switchgear and controlgear. Part 1. Type-tested and partially tested assemblies.</p> <p>Valid PUE RU.</p> <p>IEC 60947. Switchgear and controlgear.</p> <p>Each DDUPS system must be powered inside the container and installed outside, next to a suitable substation.</p> <p>The ability to maintain the load for a long time (up to 40 seconds) without starting the diesel engine.</p> <p>The power cables must be connected at the existing 0.4kV distribution panels (00-NG501E; 01-NG501E) at the critical load.</p> <p>The power transfer module panel, control system for the DDUPS, low voltage sections (from T-2 and generator), and chokes (to be specified during design) can be installed inside the existing substations (SS 00 and SS-01)</p> <p><i>A detailed additional requirement can be found in Appendices №3;4.</i></p> <p><i>Additional requirements for diesel engine and rotating equipment are given in annex №3</i></p>
3.3	Requirements for equipment operating costs	In accordance with the manufacturer's specifications. The supplier shall indicate in his TDS the list of consumables and spare parts required: based on a two-year service life of the equipment supplied.
4. TECHNICAL REQUIREMENTS		
4.1	Basic technical requirements	<p>1. Basic power: kW - 1000.</p> <p>2. Basic power: kW - 630.</p> <p>Nominal voltage ~ 400 VAC;</p> <p>Voltage tolerance - $\pm 5\%$</p> <p>Rated frequency, 50 Hz</p> <p>Protection class against electric shock: I</p> <p>The starting time of the diesel generator is instantaneous. Under normal conditions, the mains and the load breaker are closed and the consumers are supplied from the normal power supply. The synchronous alternator and flywheel operate through a choke at synchronous speed, parallel to the normal mains supply.</p> <p><i>The detailed requirement can be found in appendix №3.</i></p>
4.2	Main technical, economic and operational indicators	<p>According to STD.</p> <p>Loss at 100% ($\cos \varphi = 1$) load : not more: 60 kW.</p>



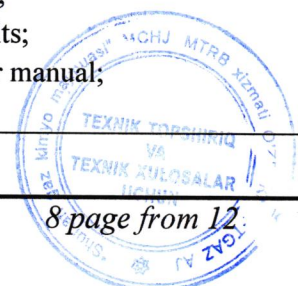
		<i>The detailed requirement can be found in appendix №3. Appendices №1, №2, №3, №4 shall form an integral part of these TOR.</i>
4.3	Reliability requirements	<ul style="list-style-type: none"> - Estimated time between failures, h, not less than 100,000; - The specified service life before overhaul, not less than 10 years; - Total lifetime, one year, not less than 25 years. <i>The detailed requirement can be found in appendix №3.</i>
4.4	Design requirements, installation and technical requirements	<p>Cable glands must be metallic, stainless steel for armoured cable entry for wires and cables. (Uninterruptible version with provision for kinetic energy storage)</p> <p><i>The detailed requirement is set out in appendices №3;4.</i></p>
4.5	Requirements for materials	<i>The detailed requirement can be found in the appendices.</i>
4.6	Stability and parameter requirements when exposed to environmental factors	Environmental factors shall not affect the nominal parameters of the DDUPS.
4.7	Power supply/power requirements	<p>~ 400 V, 50 Hz, $\pm 5\%$.</p> <p>Power factor ($\cos\phi$): 0,9-0,97</p> <p>Compliance with ISO 50001:2018.</p> <p>Consumers of electricity from the above-mentioned plants are classified as category I consumers according to the PUE.</p>
4.8	Requirements for instrumentation and automation	<p>According to the manufacturer's specifications.</p> <p><i>Detailed requirements are set out in Annex №4</i></p>
4.9	Requirements for constituent parts, raw materials/materials, inputs and outputs	<i>The detailed requirements are shown in the annexes to these TOR.</i>
4.10	Requirements for marking	<p>Labelling must comply with the requirements of the state standards of the Republic of Uzbekistan and not contradictory, not inferior to internationally accepted standards. Labelling of goods must contain deciphered name of equipment, name of manufacturer, address of manufacturer's location and date of issue.</p> <p>The marking shall include:</p> <ul style="list-style-type: none"> • The name of the manufacturer or his registered trademark; • Type designation of the electrical equipment; Serial number according to the manufacturer's numbering system, • Name or mark of the certification body and certificate number; • Electrical data producer: • Generator capacity: kW, kVA. • Model and serial number: • Year of issue: • Voltage, Phase, Hertz, Ampere: • Insulation class: • Enclosure protection: • Synchronous speed: • Type of cooling system: • Type of pathogen:



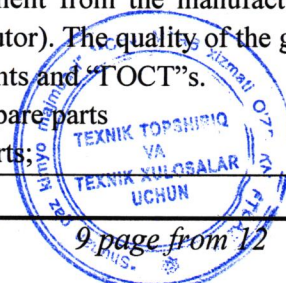
		<ul style="list-style-type: none"> • Charger: • Starting system/battery: Voltage, Battery type <p>The nameplate must be in English and Russian. The generator and control panel must be fitted with a nameplate containing at least the information specified above. If required, additional information must be stated on the nameplate.</p>
4.11	Dimension and packaging requirements	<p>Equipment and packagings shall be labelled in accordance with regulations. The supplier must ensure that the information on the equipment is available in the national language of the purchaser and in Russian in open, easily accessible places. The packaging must ensure the preservation of the goods during transport, handling and movement to the place of installation. Packaging must meet the requirements of the state standards of the Republic of Uzbekistan and internationally accepted standards. Packaging must strictly comply with the marking of the goods. Equipment damaged during transportation is subject to replacement for new one at Supplier's expense on the basis of act executed by Customer. Requirements for size, packaging, shipment of goods must meet "TOCT 14192-96" requirements for packaging and shipment and ensure safe and reliable delivery to the destination point. Packed goods shall be transported by any means of transport that protects the goods from solar radiation, temperature extremes, precipitation and dust and provides protection against mechanical influences.</p> <p>Loading, securing and transporting the equipment in vehicles must be carried out in accordance with the regulations in force for the transport of goods, taking into account the tare markings in accordance with "TOCT 14192-96".</p> <p>The equipment must be delivered in non-returnable packaging as a single transport unit.</p>
4.12	Requirements for spare parts and wear parts	<p>The spare parts inventory must be capable of operating for a period of two years, taking into account consumption rates and availability of wear parts in the design (specifying names and quantities in the technical proposal).</p> <p><i>The detailed requirement can be found in appendix №3.</i></p>
5. REQUIREMENTS FOR THE HANDOVER AND ACCEPTANCE RULES		
5.1	Handover and acceptance procedure	<p>The DDUPS shall be tested in functionally assembled form on the manufacturer's test equipment. On-site tests at the SGCC shall be carried out for at least 72 hours. The Supplier shall inform the Purchaser two weeks in advance of the estimated delivery date of the goods and shall notify the Purchaser of the commencement of shipment of the goods. The acceptance of the goods shall take place at the Purchaser's premises after the 72-hour test period has been completed satisfactorily. The electrical testing procedures of the DDUPS shall comply with the IEC 60034-1 standard. The following tests shall be carried out on the generator, motor, exciter and auxiliary devices:</p> <ol style="list-style-type: none"> 1. Visual inspection; 2. Size check; 3. Generator performance test; 4. Mechanical running test for 4 hours in the supplier's factory;



		<ol style="list-style-type: none"> 5. Engine test in an engine shop in accordance with ISO 3046; 6. Excitation current; 7. Insulation resistance of the field winding and rotor; 8. Measuring the cold resistance of the rotor and the field winding; 9. Rotor winding resistance measurement; 10. Alternating generator phasing and voltage balance; 11. Short-circuit tests at low voltage to determine reactance. 12. Speed cut-off; 13. Temperature tests, see IEC 60034-29; 14. Dielectric tests and polarisation indexes; 15. Dielectric tests as described in IEC 60034-1 paragraph 9.2; 16. The generator rotor must be statically and dynamically balanced; 17. The exciter rotor must be balanced in the same way as the generator rotor; 18. Mechanical movement of the generator and rotating machinery; 19. All equipment must function satisfactorily when mechanically operated; 20. Vibration levels; 21. The reading equipment of the test bench; 22. Pipelines must be subjected to hydrostatic tests; 23. Load tests, including full load tests; 24. Overload test; 25. Functional check of the control panel; 26. The combined work test;
5.2	Requirements for the handover of technical and other documents to the customer when supplying equipment	<p>The customer shall be provided with the documentation of the goods in Russian or with a translation into Russian as part of it:</p> <p>The technical and operational documentation to be provided by the Supplier shall include</p> <ul style="list-style-type: none"> - technical description; - catalogue of parts and assembly drawings; - Instructions for installing, setting up, commissioning and putting into operation; - form; - passport; - label; - spare parts consumption rates; - material consumption rates; - a list of spare parts and accessories; - a list of operating documents; - a protocol for setting up the equipment; - equipment test report; - a certificate for the materials used; - wiring diagrams; - specifications and lists of equipment and materials with dimensional drawings and other technical specifications; - power supply and protective earthing circuits; - the unit's operating, maintenance and repair manual; - certificates on request.



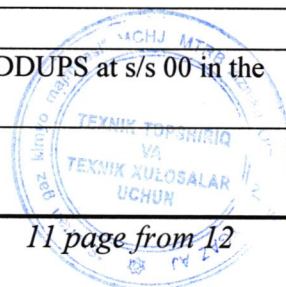
5.3	Equipment insurance requirements	The equipment must be insured according to the CIP supply conditions.
	6. TRANSPORT REQUIREMENTS	
6.1	Requirement for transporting equipment	According to "TOCT 23216" and "TOCT 14192". Delivery shall be made by the Supplier at his own expense. Take the weather conditions into account when transporting the goods. Damage and deterioration of goods due to improper transport is considered as a cause for non-acceptance of the goods.
	7. STORAGE REQUIREMENTS	
7.1	In accordance with the manufacturer's specifications. The storage period before commissioning is up to 12 months.	
	8. REQUIREMENTS FOR THE SCOPE AND/OR DURATION OF GUARANTEES	
	The goods shall be warranted for a minimum of 72 months from delivery or 60 months from commissioning. The warranty shall apply to all goods and to all parts (or components) constituting them. If the goods prove to be defective or not in conformity with the contract during the warranty period the Supplier (Seller) is obliged at his own expense to either repair the defects or to replace the defective goods with a new one of suitable quality within 30 days at the choice of the Purchaser. The warranty period shall be re-calculated for the repaired goods and the replaced defective goods. All guarantee requirements shall be entered in the contract of sale.	
	9. MAINTAINABILITY REQUIREMENTS	
	The design and components of the DDUPS shall be repairable. The same type of components and their parts must be interchangeable, in terms of their service life.	
	10. MAINTENANCE REQUIREMENTS	
10.1	Maintenance requirements	According to regulatory and technical documentation. The supplier must specify in his TKP all special tools required for installation, commissioning and routine maintenance, as well as any other recommended tools for special procedures. In the provided suitable box or in a lockable container. Special tools shall be included in the tender price.
10.2	Service requirements	If the supplier is not the manufacturer of the supplied equipment, he shall provide documentary evidence of the supplier's authority to supply, provide technical, warranty and post-warranty service of the equipment (contract or letter from the manufacturer). The supplier should have a service centre in CIS countries for prompt repair with replacement of components during the warranty period.
	11. ENVIRONMENTAL AND HEALTH REQUIREMENTS	
11.1	Environmental and health requirements	The goods supplied must comply with environmental and health regulations. ISO 14001.
	12. SAFETY REQUIREMENTS	
12.1	The equipment must not create hazardous and harmful workplace factors. Comprehensive special protective equipment for personnel shall be required. Exposure of workers to harmful factors must not exceed the hygiene standards set out in the relevant "TOCT", sanitary regulations.	
	13. QUALITY AND CLASSIFICATION REQUIREMENTS	
13.1	Quality and qualification requirements	The supplier must supply quality equipment from the manufacturer's plant or his official representative (distributor). The quality of the goods must comply with international requirements and "TOCT"s. The supplier shall identify the following spare parts - pre-start-up and commissioning spare parts;



		<ul style="list-style-type: none"> - Recommended spare parts list for two years of operation. <p>The supplier shall:</p> <ul style="list-style-type: none"> - sufficient personnel for supervising installation and commissioning work, with at least three (3) years' experience in the relevant field - to have in place the necessary production facilities, equipment and special machinery, fixtures and tools required to manufacture and deliver the equipment and components and to carry out the supervision and commissioning work. <p>If the Supplier does not have its own production facilities for the production of the equipment/components to be purchased, the Supplier shall submit letters of guarantee from equipment/component manufacturers. Such equipment/component manufacturers shall be subject to similar qualification requirements.</p> <p>Supplier's obligations:</p> <ul style="list-style-type: none"> - manufacture/purchase and delivery of the entire equipment package in full compliance with equipment/component specifications, technical specifications, building codes and regulations, and other applicable regulations; - A complete mutual integration of the technological parameters of the supplied equipment and accessories/materials to ensure functional and technical compatibility of the equipment; - supervising installation and commissioning during installation and commissioning of equipment and the facility as a whole; - carrying out individual tests of the installed equipment and participating in comprehensive testing together with the customer's representatives; - Providing the Customer with a complete set of technical documentation for the equipment/components in Russian in accordance with the requirements of the normative and technical documentation; - complete replacement of defective equipment/components if the defects cannot be rectified and proper functionality cannot be restored at the construction site; <p>The Supplier shall be entitled to sub-contract a third party/parties to supervise the installation and commissioning works. In any event, the Supplier shall be fully liable to the Purchaser for the non-performance or improper performance of the sub-contractors.</p>
	14. ADDITIONAL (OTHER) REQUIREMENTS	
14.1	The requirements of this specification shall be reflected in the contract for the supply of goods and shall be deemed to form an integral part of the contract for the supply of goods.	
	15. REQUIREMENTS FOR QUANTITY, EQUIPMENT, PLACE AND TIME (FREQUENCY) OF DELIVERY	
15.1	Requirements for quantity, equipment, place and time (frequency) of delivery	<ol style="list-style-type: none"> 1. DDUPS 1000 kW. (Diesel dynamic uninterruptible power supply container version) - 1 (one) set; 2. DDUPS 630 kW. (Diesel dynamic uninterruptible power supply container version) - 1 (one) set; 3. Power and control cables (length and cross-section to be specified during design).



		<p>4. If necessary, make insulated fuse boxes (to be specified during design). The number of overhead fuse boxes is the responsibility of the supplier.</p> <p>Both DDUPSs must be identical (differences in power only) and made by the same manufacturer (for better operation and repair).</p> <p>The quantity and specification of the goods shall be in accordance with the terms of reference.</p> <p>The scope of delivery must include:</p> <p>1) A set of spare parts for the warranty period in the scope stipulated by the manufacturer's specifications;</p> <p>2) A set of technical and shipping documentation to the extent specified in subsection 5.2 of these TOR.</p> <p>3) Relevant certificates.</p> <p>4. The following work will be excluded from the VENDOR's scope of work:</p> <p>1) Construction work.</p> <p>2) Moving and lifting equipment.</p> <p>3) Grounding.</p>
16. REQUIREMENT FOR ANCILLARY SERVICES WHEN SUPPLYING EQUIPMENT		
16.1	Requirements for the execution of project documentation	Execution of RP and PD to determine compliance of the DDUPS at the installation site.
16.2	Requirements for supervised installation	Wanted
16.3	Requirements for commissioning	Wanted
16.4	Requirements for customer training	Wanted
16.5	Other related services	By consensus
17. REQUIREMENT ON THE FORM OF THE INFORMATION TO BE PROVIDED		
	Documentation must be in the national language and duplicated in Russian and English, in hard copy, be original (have blue signatures and stamps). Priority shall be given to the Russian language. The documentation shall be handed over to the purchaser together with the equipment.	
18. LIST OF ACCEPTED ABBREVIATIONS		
	Abbreviation	Deciphering the abbreviation
	RD	Working documentation
	TKP	Technical and commercial proposal
	DP	Project documentation
	DES	Diesel power station
	ZIP	Spare parts, tools and accessories
	SanPiN	Sanitary rules and regulations
	TU	Specifications
	CIP	Carriage and Insurance Paid to
	DDUPS	Diesel dynamic uninterruptible power supply
19. LIST OF ANNEXES		
	Annexes №1	Preliminary wiring diagram of the projected DDUPS at s/s 00 in the process area of the SGCC



Annexes №2	Preliminary wiring diagram of the projected DDUPS at s/s 01 in the process area of the SGCC
Annexes №3	Detailed description of the electrical and mechanical parts of the DDUPS
Annexes №4	Detailed description of the I&Cs of the DDUPS

** Note: These Terms of Reference have been drafted in Russian and translated into English. In all cases any English version of these Terms of Reference or any part thereof has been prepared for information purposes only and in case of any discrepancy the Russian version shall prevail.*

*** Note: The developer is responsible for the correctness and incompleteness of the item.*

Agreed:

Chief metrologist:

Chief mechanic:

Developed:

The deputy head of the SGE:

Head of the NMS:

Head of CES:

CES engineer:

Head of ETL:

The lead engineer of the SGE:

Lead engineer of the UMTR service:

 **H. Makhmudov**

 **H. Allayorov**

 **M. Gapparov**

 **A. Kurbonov**

 **M. Bekmurodov**

 **F. Bozarov**

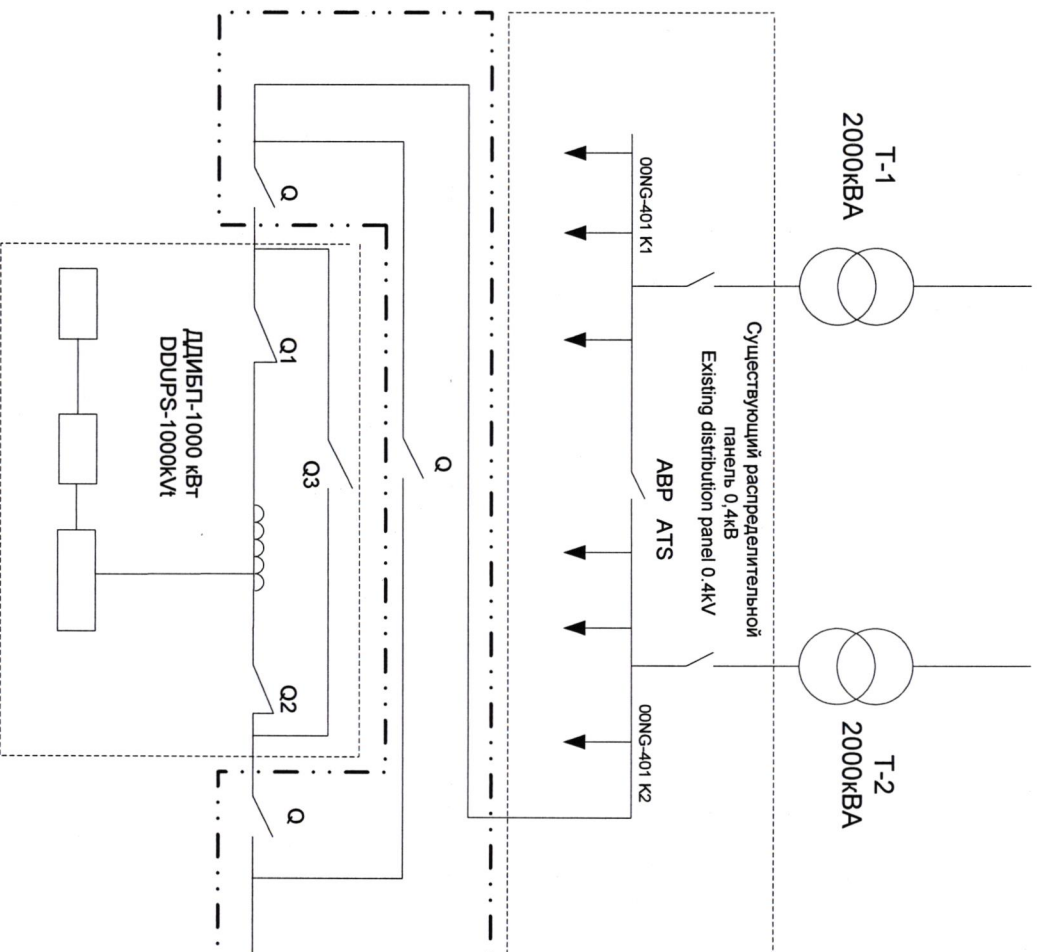
 **A. Pardaev**

 **P. Karomov**

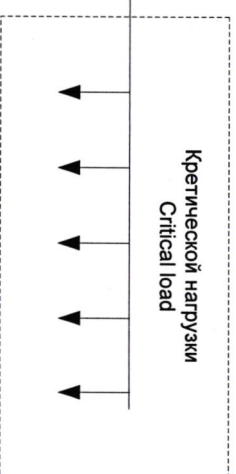
 **B. Boybachayev**



ПРИЛОЖЕНИЕ №1 Applications №1



«УТВЕРЖДАЮ»
Главный энергетик
ООО «Иркутский ГХК»
Х. Нормурадов
«07» 02 2022 г.

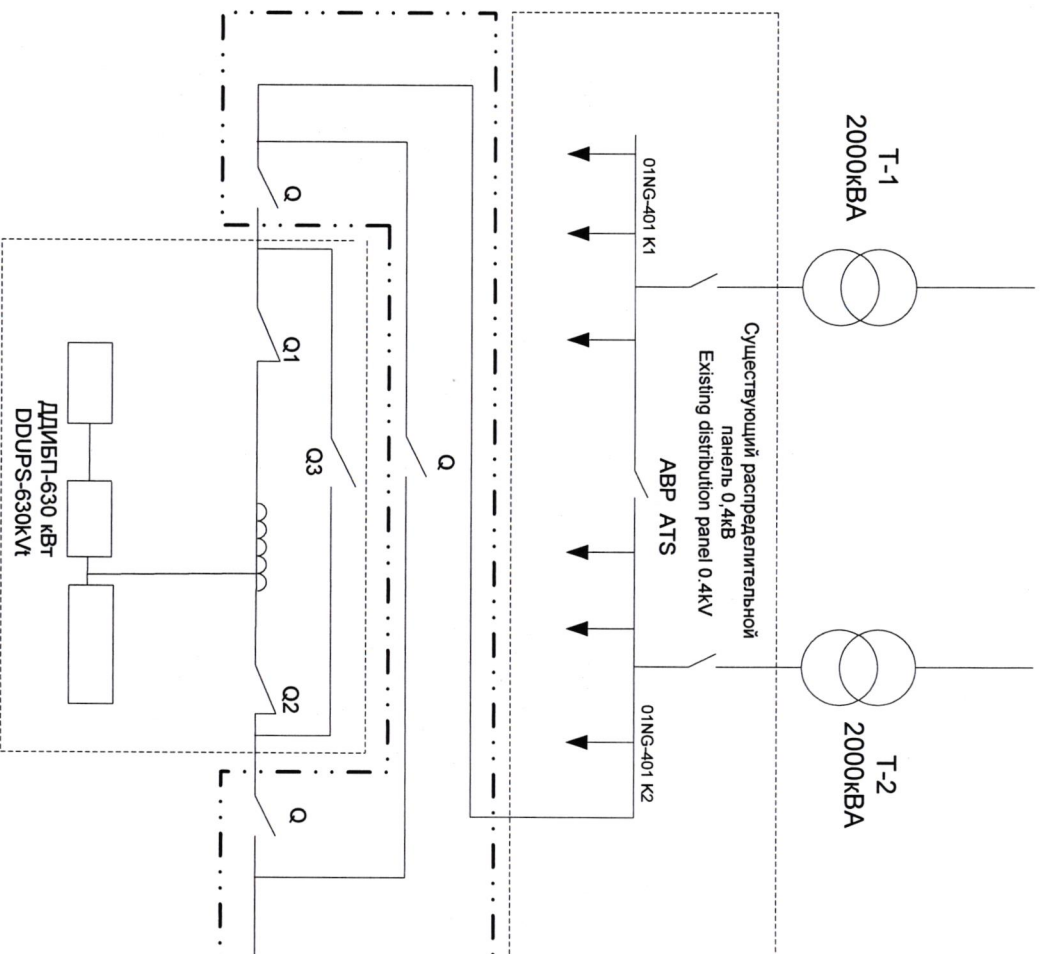


Аварийный существующей панель на п/ст 00
00NG-401E
Emergency existing panel in a substation 00 00
NG-401E

Примечания:
Изолированная байпас уточняется во время проектирования
Notes:
Isolated bypass to be specified during design

Технический:	М. Бекмуродов	Имя	Сана	Проектируемый ДДИБТ на п/ст 00 технологическая зона ШГХК		Лист	Масштаб	Масштаб
Число:	3. Бозоров	Дата	07.02.22			1	1	1
		Вариант				Вариант	Вариант	Вариант

ПРИЛОЖЕНИЯ №2 Applications №2



«УТВЕРЖДАЮ»
Главный энергетик
ООО «Цуртанский ГХК»
Х. Нормуродов
« 07 » 02 2022 г.

Критической нагрузки
Critical load

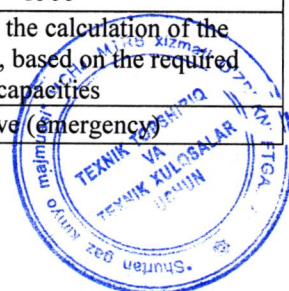
Аварийный существующей панель на п/ст 01
01NG-401E
Emergency existing panel in a substation 01 01
NG-401E

Примечания:
Изолированная байпас уточняется во время проектирования
Notes:
Isolated bypass to be specified during design

Текст:	М. Бекмуродов	Изо	Сана	Проектируемый ДДИБП	1	1
Число:	3. Бозоров			на п/ст 01 технологическая зона ШГХК		
					Варак	Варак

Appendix No. 3 to the terms of reference for the manufacture and supply of diesel dynamic uninterruptible power supplies for the production needs of "Shurtan GCC" LLC
No. _____

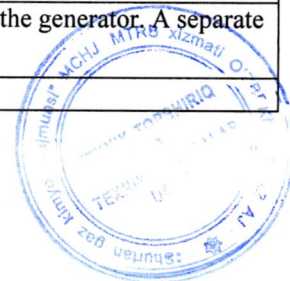
No.	Наименование требований / Name of requirements	Ед.изм. / Unit. meas-t	Требуемое количество или вид требований / Required number or type of requirements
1	Требуемое количество, комплект: / Required quantity, set:		
1.1	1000kw		1
1.2	630kw		1
2	Type DDUPS		Diesel dynamic source of batteryless power supply container version.
3	Electricity supply		Uninterrupted, long-term power supply to consumers without breaking the sinusoid.
4	Type of current		Variable three-phase
5	Rated voltage	V	0.4/0.23kV
6	Neutral state		deaf-earthed
7	Voltage:		
	Steady mode voltage regulation	%	±1
	Voltage fluctuations caused by load changes on:		
	10%	%	±1
	50%	%	±3
	100%	%	±5
	Temporary voltage fluctuations at:		
	power failure	%	±5
	return power supply	%	±1
	Voltage regulation at 25% unbalanced load	%	±2
8	Frequency:		
	Stable load frequency control	%	±0.2
	Frequency fluctuations caused by load changes on:		
	10%	%	±0.5
	50%	%	±1
	Temporary frequency fluctuations at:		
	mains power failure and 100% load acceptance	%	±1
	power return	%	±0.2
9	Minimum degree of protection:	not lower	Main generating set: IP 20
10	Short circuit current	kA	30.1
11	Maximum crest factor		Unlimited for harmonic loads
12	Phase angle (symmetrical load)		
	With balanced load	o	120±0
	With load unbalanced by 25%;	o	120±1
13	Symmetric linear load (Ph-Ph/Ph-N)	%	1.5/2.5
14	Overload capacity (normal operation)	%	1 hour - 10 2 minutes - 50
15	Efficiency (at 100% load, cos φ 1.0)	%	at least 96
	Generator insulation class		Not less than F
16	Ambient humidity (non-condensing)	%	0-95
17	Electromagnetic compatibility (IEC 62040-2)		Class C2 Class A according to EN 50091-2
18	Generator speed	rpm	1500
19	Diesel engine power	kW	according to the calculation of the manufacturer, based on the required capacities
20	Working mode		Reserve (emergency)

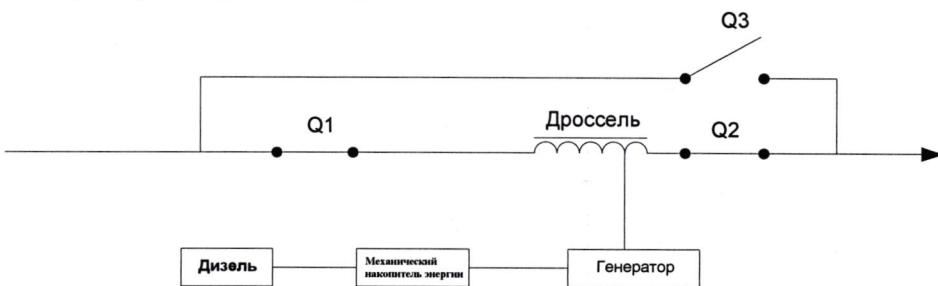


			(in parallel with mains supply, automatic start during emergency shutdown)
21	Required service life of the product, years		at least 25
22	Freewheel service life		At least 10 years (including at least 20 emergency start cycles per year)
23	Bearing life (constantly in operation)		At least 10 years
24	Cooling system		Remote radiator driven by an electric motor (liquid)
25	Fuel tank		The volume of fuel should be enough for 24 hours at maximum load (Possibility of topping up during operation of the equipment)
26	Diesel fuel		According to EN 590:2009 (O'z DSt 1134:2007)
27	Engine and generator mounts		Mounting bracket kit for non-drive and drive side of the motor
28	Generator Requirements		
28.1	The synchronous alternator must be designed as a low reactance brushless machine. The rotor must be equipped with a damper winding for unbalanced loads and for parallel operation, winding insulation of non-hygroscopic materials that do not allow trapping, withstand harsh thermal conditions.		
28.2	The generator and its excitation system must be designed to withstand 10% overload for 1 hour at rated voltage, speed and power factor without dangerous temperature rise, and to withstand 150% overcurrent for 15 seconds at rated excitation load. .		
28.3	The generator must be capable of continuous operation at rated load without exceeding the temperature specified in the applicable standards and regulations. Time limited operating capacity at 100% is limited to a maximum of 500 hours per year in accordance with ISO-8528-1. The generator must withstand a 1-minute overload set to excite the normal rated load in excess of 150% of the rated current for the maximum instantaneous current.		
28.4	The generator must withstand without damage a three-phase short circuit at its terminals when operated at rated kVA and a power factor at overvoltage of 5%.		
29	Diesel engine requirement		
29.1	Diesel engines must withstand a given overload to ensure long-term operation even in the harshest conditions. The engine must be equipped with a pressure lubrication system with piston cooling, an oil circulation pump with safety valve, a multi-stage oil filter and an oil heat exchanger. The lubrication system must have pressure control, including failure control. The clutch combines a frictionless standby system with smooth power transmission when running on diesel. The clutch must not be in motion, slip control and clutch control are carried out on the local control panel.		
30	Requirements for protections (Control system)		
30.1	The generator control panel must be provided with all the controls necessary for starting and running. Engine and generator control panels and battery charging equipment must be installed in separate compartments built into a freestanding cabinet.		
30.2	The control cabinet of the generator shall contain the controls of the automatic voltage regulator (AVR) system and the necessary equipment for the excitation system.		
30.3	Power cabinets must have input (Q1), output (Q2) and bypass (Q3) circuit breakers, a choke (indicator coil) and auxiliary equipment for protection and control.		
30.4	The generator control panel must have a programmable logic controller with a touch screen, switching devices, relays, protection devices, electronic circuit boards designed to control and monitor the operation of all system units.		
30.5	A selection of all current transformers (CT) and voltage transformers (VT) – if required – for the supplied protection relays or measuring devices will be included in the scope of delivery. To this end, the SUPPLIER shall provide a special calculation report to verify and confirm the actual performance of the selected CT and VT		
30.6	All control wiring must be neatly connected and labeled at both ends with labeled cable lugs. Adhesive wire labels are not acceptable. The terminals used for the control circuit must be crimp terminals and those used for the power circuit must be crimp terminals. Terminals must be provided by the manufacturer. The cross-sections of the cables of the main power circuits must correspond to those indicated in the technical data sheets in accordance with the nominal parameters.		
30.7	Terminals for cable connections must have the following terminal markings: Main AC power circuit: R (black), S (white), T (red) DC power circuit: P (red) and N (blue) Ground terminal: E (green-yellow) Control circuit: yellow		

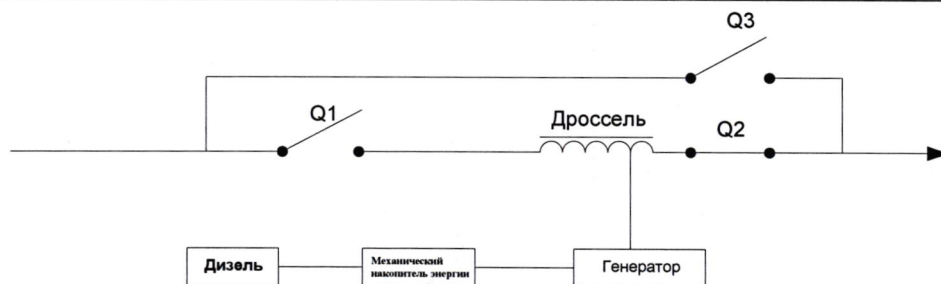


30.8	Each bidder must submit with their bid a recommended control scheme for their specific generator based on HPC requirements. The drawing should list and show all required relays, timers, pushbuttons and safety devices. Typical simple schemes are not acceptable. Detailed information must be provided.																																																								
30.9	<p>The DDUPS must, at a minimum, be equipped with safety devices that must operate in the event of the following emergencies:</p> <table border="1"> <thead> <tr> <th rowspan="2">В случае / In the case</th><th colspan="2">Trips (Trip Ann. (Bell))</th><th rowspan="2">Предупреждения (звуковой и световой) Alarm Ann. (Buzzer) / Warnings (sound and light) Alarm Ann. (Buzzer)</th></tr> <tr> <th>Остановка дизеля / Diesel stop</th><th>Отключения главного выключателя / Main switch trips</th></tr> </thead> <tbody> <tr> <td>Высокий обороты (Overspeed)</td><td>○</td><td>○</td><td>-</td></tr> <tr> <td>Overcrank</td><td>○</td><td>○</td><td>-</td></tr> <tr> <td>Нижний предел смазочного масла (Low lube oil pressure)</td><td>○</td><td>○</td><td>-</td></tr> <tr> <td>Повышении температуры охлаждающей жидкости (High cooling water temperature)</td><td>○</td><td>○</td><td>-</td></tr> <tr> <td>Нехватка охлаждающей жидкости. (Shortage of cooling water)</td><td>-</td><td>-</td><td>○</td></tr> <tr> <td>Уровень в топливном баке высокий или низкий. (L & H fuel level in fuel oil daily tank)</td><td>-</td><td>-</td><td>○</td></tr> <tr> <td>Сбой при запуске (Start failure) (1)</td><td>-</td><td>-</td><td>○</td></tr> <tr> <td>Перегрузка по току генератора (Generator overcurrent)</td><td>-</td><td>○</td><td>-</td></tr> <tr> <td>Обратный мощность (Reverse power) (2)</td><td>○</td><td>○</td><td>-</td></tr> <tr> <td>Защита заземления (Grounding)</td><td>-</td><td>○</td><td>-</td></tr> <tr> <td>Генератор перенапряжение Generator under voltage</td><td>-</td><td>○</td><td>-</td></tr> <tr> <td>Защита по частоте (с задержкой по времени) Under frequency (time delayed)</td><td>-</td><td>○</td><td>-</td></tr> </tbody> </table> <p>Notes: For automatic start For abnormal operation, provision must be made for sending a common signal to give an alarm or indication to an external circuit (one set of SPDT contacts).</p>			В случае / In the case	Trips (Trip Ann. (Bell))		Предупреждения (звуковой и световой) Alarm Ann. (Buzzer) / Warnings (sound and light) Alarm Ann. (Buzzer)	Остановка дизеля / Diesel stop	Отключения главного выключателя / Main switch trips	Высокий обороты (Overspeed)	○	○	-	Overcrank	○	○	-	Нижний предел смазочного масла (Low lube oil pressure)	○	○	-	Повышении температуры охлаждающей жидкости (High cooling water temperature)	○	○	-	Нехватка охлаждающей жидкости. (Shortage of cooling water)	-	-	○	Уровень в топливном баке высокий или низкий. (L & H fuel level in fuel oil daily tank)	-	-	○	Сбой при запуске (Start failure) (1)	-	-	○	Перегрузка по току генератора (Generator overcurrent)	-	○	-	Обратный мощность (Reverse power) (2)	○	○	-	Защита заземления (Grounding)	-	○	-	Генератор перенапряжение Generator under voltage	-	○	-	Защита по частоте (с задержкой по времени) Under frequency (time delayed)	-	○	-
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31	Noise																																																								
31.1	The total sound level generated with the equipment should not exceed 96 dB at a distance of 1.0 m from the surface of the equipment. Sound limits apply at all operating points within the normal operating range. The total noise level must include the main element of the rotating equipment, the transmission and all ancillary equipment, including any other noise-producing device included in the delivery. The supplier shall present the expected sound levels in dB in octave bands and the maximum sound power level of their power supply in the noise data sheets.																																																								
32	Heaters																																																								
32.1	The generator must be equipped with heaters sufficient to prevent condensation in the generator when it is not running. The heater wires must be routed to a separate terminal box from the main terminal box. An electrical diagram of the heater showing all connections, supply voltage and power output must be provided.																																																								
33	Winding temperature sensors																																																								
33.1	The generator shall be provided with six resistive type temperature sensors (Pt-100, 3 wire types), two per phase, embedded in the stator windings and evenly distributed around the circumference of the stator, for remote temperature measurement and monitoring. The terminal box for temperature sensors must be independent of the main power terminal box.																																																								
34	Bearing temperature monitoring																																																								
34.1	Motor, Generator and couplings with bearings must be provided with digital thermometers of the signal contact type and/or resistance type temperature sensors (Pt-100, 3-wire type), per bearing, to control and monitor the temperature of the bearings. The temperature of the bearings must be entered into the DRUPS control protection algorithm.																																																								
35	Differential protection																																																								
35.1	Three (3) current transformers for differential protection must be provided on each phase of the generator. A separate terminal box must be provided for the secondary connection of the current transformer.																																																								
36	TESTING AND VERIFICATION																																																								



36.1	The factory test report shall be reviewed and approved together by the Customer's representatives. Representatives of the Customer must have free access to the manufacturer's plant at any time during the production or testing of the ordered equipment.
37	SPARE PARTS
37.1	The supplier must provide special tools for maintenance. Operational spares must be based on a diesel generator set that has been operated for 70% of 1 year and must include the required number of filter elements, fuses, lamps, etc., as well as any additional components that are considered normal maintenance items. Emergency parts should include items such as: fuel injectors, engine gasket kits, fuel pumps, water pumps, voltage regulators, electrical regulators, 1 relay of each type, 1 set of alternator rectifiers, freewheel kit, bearing kit, etc. A list of operational and emergency spare parts must be submitted with the commercial offer.
38	PACKAGING AND SHIPPING
38.1	Shipment preparation schedules must be agreed with the Customer. The equipment must be delivered fully assembled. If the equipment must be dismantled for transport, materials and instructions for reassembly must be provided. The equipment must be identified by the buyer's or seller's order number and any designations requested by the buyer in the shipping instructions. Supplier shall comply with any special handling and packaging requirements for shipping or long-term storage prior to installation and provide storage recommendations at the buyer's site. All shipments must include a packing list that fully states the number of individual items that must eventually be shipped by the manufacturer in order to meet the requirements of these specifications. Any partial or partial deliveries must be shown in general terms and separate packing lists included to fully describe the contents of each shipment. Packing lists must be in waterproof packaging.
39	ALGORITHM OF WORKING MODES
39.1	<p>NORMAL MODE (Operation with mains power present)</p> <p>During normal operation (when mains power is present), the diesel engine must be stopped (clutch open), the alternator shaft must rotate at 1500 rpm, the input (Q1) and output (Q2) switches must be closed, bypass (Q3) must be in the open position and the system will supply the critical loads (in normal operation, the diesel engine must be in a hot standby state). The synchronous generator must work as an electric motor.</p>  <p>During "normal" operation, the system DDUPS must do the following:</p> <ul style="list-style-type: none"> • Eliminate all microinterruptions. The DDUPS system eliminates all micro interruptions with a duration of at least 50 ms, even at 100% load, without starting the diesel engine. • System voltage needs to be adjusted. When voltage fluctuations occur, the electronic voltage regulation system must act on the excitation current of the synchronous generator. The applied voltage must be automatically maintained at the nominal value $\pm 1\%$. • Improve power factor. The overexcitation of the synchronous generator must ensure that the load consumes all the reactive power. • Filter transients. The "inductance - synchronous generator" system must separate the system and the load when fast or harmonic <p>DIESEL ENGINE START MODE:</p> <ul style="list-style-type: none"> • In case of loss of external power supply, the mechanical energy storage device must rotate, transferring the accumulated energy to the electric machine operating as a generator. • Input switch Q1 should open as soon as a mains failure is detected, the electric starter should automatically start cranking the diesel generator. • The clutch must close smoothly, thus ensuring the connection of the diesel engine with the generator. • The diesel engine must quickly accept the load, and the electronic speed controller will maintain a constant speed, providing the mechanical energy needed to produce the active power required by the load.





DIESEL STOP MODE:

After the mains supply is restored:

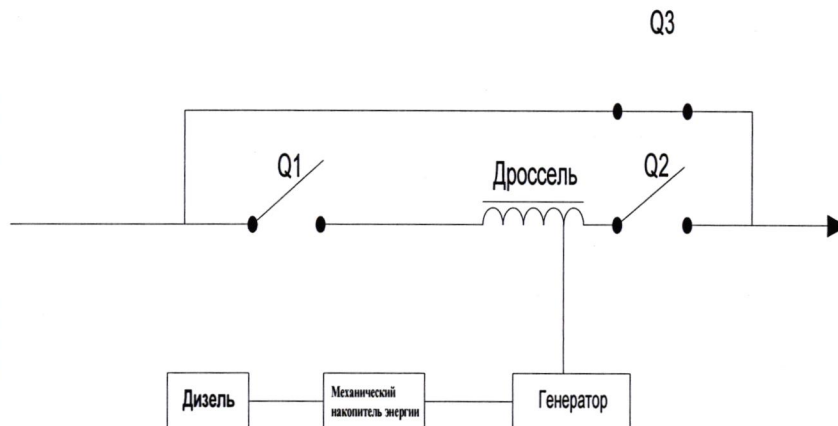
- Automatically synchronize the generator to the main power, after which the Q1 input switch should turn on and the clutch should disengage.
- As soon as the contacts of the switch Q1, supplying power from the input mains, are closed, the load is again powered from the input circuit.
- The diesel engine switches back to standby mode.
- The inertial battery is in standby mode.

EMERGENCY ENGINE START

In the event that the diesel engine does not start after opening the input switch Q1 (starter failure, battery failure, etc.), the clutch will automatically close and must mechanically connect the generator to the diesel engine. The kinetic energy accumulator then has to make the diesel engine start. The negative effects from this process should not affect the clutch or the diesel engine.

BYPASS OPERATION



In the event of maintenance, shutdown, or failure of the MDIBP, the automatic bypass switch must isolate the system.



- At a minimum, the following monitoring system should be provided
 - Engine condition monitoring
 - Management interfaces for remote monitoring
 - Battery charge control and monitoring system.
 - Voltage control system.
- The diesel generator must be equipped with a special engine protection system that minimizes damage in the event of a malfunction of the unit or the impact of an external malfunction. This should include:
 - Engine protection system including coolant temperature, oil pressure, etc.
 - Emergency stop operator push button system with emergency stop.
- The electrical protection system must operate on the main switches Q1 and Q2. Diesel generator protection shall include warnings and shutdowns, including but not limited to:
 - Overvoltage.
 - Over speed/frequency.
 - Insufficient speed/frequency.
 - Overcurrent and earth fault.
 - Differential.
 - Reverse power
 - Excess turbo boost speed (if applicable).
 - High oil temperature.
 - High coolant temperature.



	<ul style="list-style-type: none"> - Low oil pressure. - Low fuel level in the tank and alarms. - Alarm stimulator. - Temperature alarm.
40	Additional requirement:
	<ul style="list-style-type: none"> - Removable protective guards shall be provided for exposed moving parts of the DDUPS. - if necessary, a platform and a ladder for servicing a large generator should be provided. - lifting lugs must be provided for transportation, inspection and repair of the DDUPS. - for external control cables and power circuits (crimp or compression) terminals without soldering (120%) - provide a complete list of technical documentation (operation, installation and repair work, detailed drawings of the equipment and its individual parts. Technical parameters of the equipment, oil change cycle, scheduled preventive maintenance cycle, etc.) - The supplier of the equipment guarantees the provision of advisory services.
41	Container requirements.
	<ul style="list-style-type: none"> - a container for the installation of a special design DDUPS with an integrated ventilation system. - fire extinguishing and fire alarm systems. - system of an output of the fulfilled gases, coolings, heat supply. - heating and lighting system. - internal sound-absorbing and weather-resistant. - degree of protection of the container IP 55 - the container must be equipped with a lifting mechanism for carrying out repair work on the equipment


 Papgaev A

 Karagadav E.



Instrumentation and automation requirements Appendix No. 4.

Requirements CPU controller

Programmable controller designed to build medium to high complexity automation systems. Modular design, free-cooling operation, local and distributed I/O structures, extensive communication capabilities, numerous functions supported at operating system level, easy operation and maintenance provide cost-effective solutions for building automation control systems in various areas of industrial production.

Several types of CPUs of varying performance, a wide range of digital and analogue I/Os, function modules and communication processors, all contribute to an efficient controller application.

PLC (Programmable Logic Controllers) and its components according to "TOCT P" IEC 61131-7-2017 (IEC 61131-7), IEC 61511-1:2003,

Standard protocols and information exchange channels are used for information exchange within the process control system and with external systems:

- Industrial Ethernet (using fibre-optic communication lines) for communication of servers, medium-level

Industrial Ethernet (using fibre-optic communication lines) is used to connect servers, PLC medium level and local ACS;

- Industrial Ethernet for communication of operator panels;

- Profibus-DP for communication of industrial controllers with I/O subsystems

- Modbus RTU, Modbus TCP/IP.

Communication facilities for communication with local ACSs and field equipment are also provided as part of the medium level of the ACS PTC.

I/O module requirements

Object Communication Devices (OCD) are a set of input/output modules that provide interfacing with various equipment (sensors, actuators and other devices) and allow receiving, processing, outputting signals of various types in a wide range of voltage, current, power, pulse widths while also performing other functions

The peripheral enables reception of the following signals: (must receive the following signals)

Analogue

- from transmitters with a unified 4...20 mA DC electrical output signal

- resistance thermometers

- thermocouples

Discrete:

- dry contact type;

- +24V;

- DC and AC 220V

Typical polling time of input signals in the mid-level PTK (polling cycle interval) of signal conversion channels:

- from pressure (differential pressure) sensors - not more than 0.1 s,

- temperature sensors, etc. - not more than 0.5 s,

- from sensors with discrete output signal - not more than 0,25 s.

ACS provides switching of electric circuits and generation of output (control) signals:

- Analog direct current 4 ... 20 mA HART.

- Discrete-type "dry contact" with switching of the following voltages (at ohmic load):

- 24 V DC voltage with current up to 5 A;

- DC 220 V with current up to 0.2 A;

Power supply requirements

The uninterruptible power supply ensures that the redundant operator station system can operate during a power failure for a period long enough to automatically shut down the stations, in order to maintain the integrity of the installed software and project files. The 24V power supply units are provided in a redundant version to supply both internal and external consumers.

Requirements for instrumentation and automation

System structure requirements:

A DT DT DDUPS control system that provides the automated collection and processing of information required to optimise the control of the technological facility should include:

The diesel generator must be fully automated and have its own set of software and hardware controls, based on modern microprocessor-based automation and provide

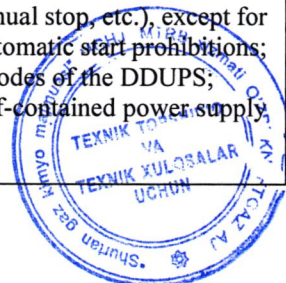
- ready for an automatic start at all times;

- predominance of the start command over other commands (normal stop, process cranking, manual stop, etc.), except for the emergency stop command. The diesel generator (DG) in standby mode must not have any automatic start prohibitions;

- Automatic maintenance of the generator output voltage within the set limits in all operating modes of the DDUPS;

- the start-up, control, protection, signalling and regulation circuits must be supplied from a self-contained power supply as part of the DDUPS;

- maintaining constant (within the control characteristic) shaft speed of the DDUPS;



- alarms in the event of deviations from the alarm values;
- a warning alarm in case of deviating operating parameters from the warning values;
- diesel engine protection;
- generator protection;

Automatic diagnostics of diesel generator hardware;

- Emergency stop of a diesel generator operating in normal (stand-alone) mode when:

- 1) oil pressure drops to the limit value;
- 2) Increasing the diesel engine crankshaft speed to the limit value;
- 3) Multiphase faults in the stator winding;
- 4) external phase-to-phase short-circuits.

The automatic control must be stable over the entire control range. The amount of control insensitivity must be such that fluctuations in the monitored parameters, which can occur under normal operating conditions of the controlled equipment, do not lead to instability in the control process.

Machines and installations for which an automatic or remote start is foreseen shall have means for disconnecting automatic or remote control at local control stations.

In the event of an automatic or remote control malfunction, local control must remain possible.

Alarm and warning system (AAS).

The alarm system must be independent of the control and safety systems, i.e. faults and damage to the latter must not affect the operation of the AAS.

The possibility of partially combining these systems is subject to special consideration by the Register in each case.

A self-monitoring of the LAS must be provided: at least in the event of faults such as short-circuits, open circuits and frame faults as well as power failure, the LAS must be signalled.

The alarm system must be capable of producing light and sound signals at the same time. It must be possible to signal more than one fault at the same time. The acknowledgement of one alarm must not prevent the acknowledgement of the other. Failure of one element (device) of the system must not cause failure of the entire alarm system.

The instrumentation must be resistant to the vibration effects possible at the installation site.

The components to be replaced that require adjustment and the test points (sockets, terminals) must be positioned so that they are easily accessible.

The adjustment elements must be protected against unintentional change of the adjustment made. This protection must not preclude the possibility of readjustment.

The actuators must not be designed to change their position unintentionally.

Sensors measuring the temperature of flammable, toxic and pressurised liquids, vapours and gases must be isolated from the controlled environment.

It shall be possible to check and calibrate the pressure sensors at their connection points without dismantling them.

All elements, devices and control points must be clearly and permanently marked, preferably beside them.

The location of the instrumentation should allow for maintenance, repair and replacement of defective sensors.

- the process control and management level (controller level);

The field level is the level of sensors, alarms and actuators associated with the process equipment. At this level the following are carried out:

- Measurement of process parameters;
- Providing information to the controller level.

The controller level is the level of the controller and I/O modules. This level is where the following activities are carried out:

- collection and processing of process level information;
- high-speed collection and logical processing of signals from primary sensors, generation of actions on actuators in accordance with control, protection, interlocking and alarm algorithms, information exchange with the operator station and bus, as well as self-diagnostics of faults.

REQUIREMENTS FOR AUTOMATION CABINETS

Automation cabinets are defined as cabinets other than cross and power distribution cabinets.

The control cabinets must be floor standing and the cables must be fed in from below through a protective seal.

The enclosure layout must meet the following requirements:

- Degree of protection at least IP65 for cabinets
- material of steel;
- mounting rack 40 U
- the cabinet must be locked with a key without a protruding handle;
- the cabinet is supplied in the manufacturer's standard colour;
- hoisting rings and loading/unloading

equipment must be provided on the cabinet;

- the electronic data processing cabinet must have one 220V AC 20A socket each;
- each cabinet must have a light and a document pocket, in active equipment cabinets a fan;
- the design of the cabinets must provide for interconnection and



adjustability of the cabinets; - all parts with voltages above 48V must be protected against direct contact and marked accordingly; - the controllers of the control system must be placed on panels and the terminals must be marked accordingly. -

Any part with voltage level higher than 48 V must be protected from direct contact and marked accordingly;

- Control system controllers should be placed on panels, and terminal boards of intermediate crossing and barriers;

- The number of cable connections between the cabinets should be minimized;

- The connection cables should be routed in a way that allows access to electronic equipment without separating the connections;

- Power supply terminal boards should be separated from other terminal boards. Preferably, Phoenix Contact ST 2.5 or similar in terms of specifications;

- The terminals intended for signal input/output with the "intrinsically safe circuit ia" type of protection must be blue (blue).

The other terminals must be grey.

- The cable between the system and the crossover must be included in the supply of the ACS.

- Reserve channels on each of modules of system are taken out on terminals; cross-country case, in succession with the involved, and from "field" party do not connect. Reserve conductors of trunk cables from the "field" are connected to separate terminals of the cross cabinet and are not connected on the system side;

Distribution of input/output channels on the cross cabinets should be performed according to the type of signal (analogue inputs, analogue outputs, discrete inputs, discrete outputs); installation of all equipment should be carried out only on the mounting plate, installation of equipment on the side walls of cabinets is not allowed.

→ S. Salilov 

