

Admission to presentation of
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Bachelor's graduate qualification work

Subject: “**DESIGN OF PROCESS CONTROL AND
MANAGEMENT SYSTEM OF BOOSTER COMPRESSOR
STATION AND COMPLEX GAS TREATMNET PLANT**”

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Introduction

Uzbekistan occupies third place in the CIS for the extraction of natural gas and is one of the major producers of energy resources in Central Asia. Modern oil and gas industry of Uzbekistan is one of the largest sectors of the economy, the most important energy base of the country. In recent years, it has been done a great job to improve the structure of the industry, its technological advancement and modernization. Increasing production of liquid hydrocarbons and natural gas resulted in the need for continuous improvement and innovation in achieving maximum operational safety of energy facilities, reducing the risks and factors that pose a potential threat to the health of personnel. The most effective method of ensuring safety of workers is the introduction of process automation by which people will be able to control the parameters of the process remotely.

In May 2008, Petronas and the government of Uzbekistan have signed a PSA to develop gas condensate fields, “Urga”, “Kuanysh” and Akcholak group located in Ustyurt. This work is a design decision concerning the complex of automated systems that reduce risks and damage to the health of working personnel and increase in reliability of the system as a whole.

Urga field has been developed since 1995. The maximum annual production of the field - 1500 m³ was achieved in 2000. In 2008 there were produced 310 million m³ of gas, including 4,9 thous. tons of condensate were extracted. For the whole period of development starting from 1995 to 2008 – were produced 11422 mln. m³ of gas and extracted 233 thousand tons of condensate.

For more intensive and complete extraction of hydrocarbons from Urga field, the construction of booster compression station (BCS) is required.

To ensure the quality of gas treatment after BCS, there is constructed complex gas treatment plant, where gas is treated though low temperature separation (LTS). BCS and CGTP will be located near existing PGTP with further dismantling of this PGPT. In project implementation, the end products will be natural gas, gas condensate.

The warrant for developing this project feasibility study is:

- The Resolution of President of Uzbekistan №III-854 dated 02.05.2008 «Measures on further cooperation with "PETRONAS" enterprise (Malaysia) in the area of exploration work, field development and construction, and development of oil-gas-chemistry industry»;
- The Resolution of President of Uzbekistan №III-1072 dated 12.03.2009 «The program of actions for execution of primary projects on modernization, technical and process upgrading of production for year 2009-2014»;
- The Resolution of President of Uzbekistan №III-1081 dated 26.03.2009 «Actions on implementation of Project Sharing Agreement regarding Urga, Kuanish fields and Akchalak group of Ustyurt region, Uzbekistan»;
- The Resolution of President of Uzbekistan №III-1121 dated 03.06.2009 «Implementation arrangements as per Project Sharing Agreement regarding Urga, Kuanish fields and Akchalak group of Ustyurt region, Uzbekistan».

The current graduate qualification work consists of introduction, four chapters, conclusion, reference list as well as attachment printed , and the power point presentation files.

The introduction briefly cascades the information regarding the actual importance of PMCS system in Oil and Gas industry. As a particular gas deposits regions the URGA field has been chosen.

First chapter is dedicated to current state of the subject area. Furthermore, the list of main methods that ensures the overall fail-safe operation is listed. It is also necessary to highlight the fact of capturing Process Flow Diagram picture where the advisors can easily see the principle of flow-chart.

The second chapter of current qualification work describes the software and hardware means to be implemented in this project. As a part of the main descriptive information it also highlighted the ACS firmware and software support.

The third chapter of this work is about Technical Task and the means of hardware, such as PLC type, interfacing methods and e.t.c. Apart of Technical Task current chapter reflects the structural diagram of designed PMCS with the implemented ESD module.

Fourth chapter, as a rule and habit of qualification work development, describes Safety of Living, or in another words its Health and Safety information. Nowadays HSE and SOL is number one priority in all disciplines of works implementation.

The attachment is enlarged version of Structural Diagram, described in 3rd chapter for clearer and deliberating view and understanding of the overall concept.

The power-point presentation file's intention is to present this qualification work in laconic manner.

List of authorized abbreviations

PMCS	– automatic process control system
ACS	– automatic control system
PMCS	– process monitoring and control system
CGTP	– complex gas treatment plant
BCS	– booster compression station
ESDU	– emergency shutdown unit
OM	– operating mechanism
OWS	– automated workstation
OS	– operations service
TMC	– technical means complex (hardware)
SHC	– software and hardware complex
PS	– program support
PLC	– programmable logic controller
ESD	– emergency shutdown (SIS)
AFFS	– automatic fire fighting systems
UPS	– uninterruptable power supply
SPTA	– spare parts tools and accessories
ICSS	– Automatic Instrumentation Control, Safeguarding and Fire and Gas system
F&G	– Fire and Gas system
SIL	– Safety Integrity System
HMI	– Human Machine Interface
PFD	– Process Flow Diagram
P&ID	– Piping and instrumentation diagram
UFD	– Utility Flow Diagram

Chapter 1. Theoretical data

1.1 Current state of subject area

This proposal includes the design of automation system of all CGTP facilities and automation system for BCS, consisting of three gas-engine-compressor reciprocating unit and station system of BCS.

The system is designed for permanent monitoring of process parameters and uninterrupted operation of CGTP and BCS in all operation modes.

Offered PMCS provides high performance, reliability of work and safety of equipment, improvement of operational comfort and information awareness of operators about process.

In order to provide fail-safety in offered ACS, it was implemented the following methods of improving reliability:

- application of backup units of stabilized power supply;
- application of backup controllers of ESD subsystem;
- application of backup digital communications network between controllers;
- application of system elements, data transmission and display devices with high level of reliability;
- application of advanced software;
- application of hardware and software extensive diagnostic system.

Automation objects are Complex Gas Treatment Plant and Booster Compressor Station of average pressure in Urga field. Process Flow Diagram of proposed unit is shown on Fig. 1.1. Gas condensate field is located under southern part of former Aral Sea. Administratively gas condensate field Urga located in Muynak region, Republic of Karakalpakistan. The nearest railway station is 180 km far from the field. There is a Bukhara-Ural main gas pipeline in 14 km to the field. Development of Urga field is offered to carry out by replacement of existing gas treatment equipment to new ones. This new equipment is designed for recovery/treatment of 30-50 millions of standard cubic feet (0,4 – 1,42 millions of

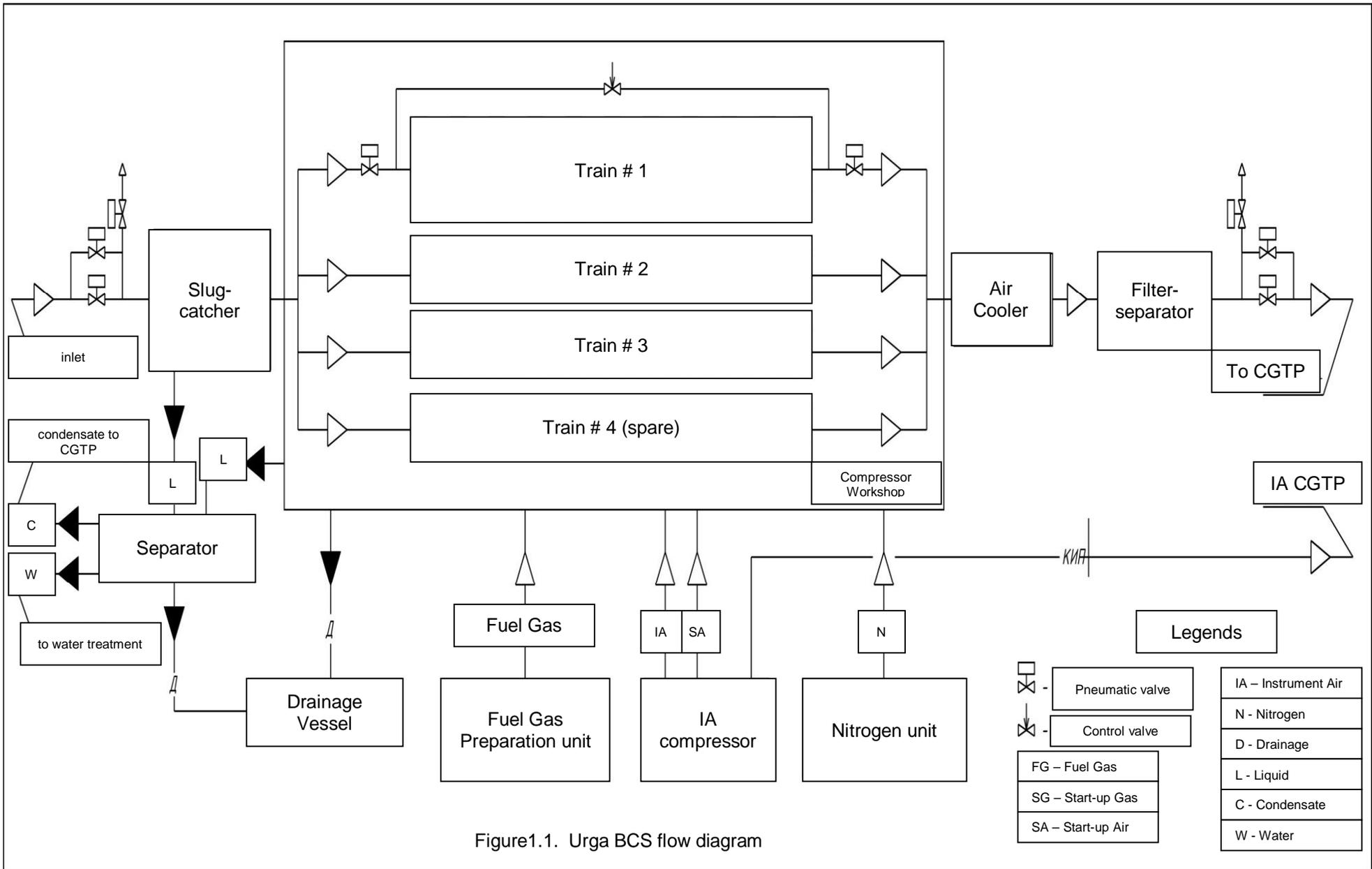


Figure 1.1. Block-diagram of Process Flow Diagram to be designed

standard cubic meters) of crude gas a day. Gas will be dehydrated, and hydrocarbon will be refined in dew point before transmitting it to the main pipeline. Separated and stabilized condensate will be stored in storage tank for truck transportation. Water will be discharged into evaporation pond.

Because of natural (on-stream) exhaustion of Urga field (see Fig. 1.2 for Plot Plan of adjacent area and Urga group of fields) formation energy, derives a necessity for construction of facilities to provide the treatment and transportation of gas during output period. To solve the current problem is offered to construct Complex Gas Treatment plant designed for treatment of raw natural gas from liquids, contamination and for its dehydration till required dew point temperature. For operation of this Complex Gas Treatment Plant is required to construct Booster Compression Station of average pressure. Thus, project brief includes construction of following main processing facilities:

- Complex gas treatment plant - CGTP;
- Booster compressor station - BCS.

The aim of gas treatment is to extract heavy hydrocarbons and liquid to prevent their sweating in gas link during transportation of natural gas to tie-in point in Bukhara-Ural main gas pipeline (or to Ustyurt HC).

Since the gas treatment facility has to operate continuously during the entire calendar year without long stops in both summer and winter seasons, their accurate structuring in accordance with existing regulations as well as the application of the necessary backup equipments should be provided for main units and gas treatment and compression system.

Relatively low production of deposit (1,42 million m³/day), the high pressure in the process (50-72 bar), as well as small diameter of pipes (150-250 mm) and the equipment allow not to provide adequate backup by duplicating each of the numerous process units with the installation of shutoff valve at the inlet and outlet of each of them. Greatly simplifies the treatment system, reduces the cost of fittings and pipes, and simplifies maintenance of equipment, if the whole gas treatment unit is made in

delivery and installation of all components of spare parts in case of any malfunction of the unit.

1.2 Description of the information structure

Automated Process Control System (PMCS) - a set of hardware and software designed to automate the management of process equipment in the workplace.

Under the PMCS it is usually understood as a complex solution that provides automation of key process steps in manufacturing as a whole or some of its sites, which produces relatively complete product. The term automated unlike the term automatic emphasizes the possibility of human involvement in individual operations, both in order to maintain human control over the process and in the respect of complexity or practicability of the automation of individual transactions.

The constituent parts of PMCS may be separate automatic control system (ACS) and automated devices connected in a single complex. As a rule, PMCS has a single system of operator process control in the form of one or more remote controls, process information processing and archiving means, standard components of automation: sensors, controllers, operating mechanisms. Industrial network is used for communication between all subsystems.

Production and manufacturing processes automation

Automation is designed for process control. In the process, many operations, which are performed by a person, may be taken for the implementation of software and hardware complex consisting of a system of sensors, controlling elements, controllers and industrial computers. In production of work set on automation the number of people involved in the entire production process is dramatically reduced, the number of products is increased reducing the likelihood of defect products.

Technical advantages of automation are:

- the possibility of automatic efficient collection of technological information, operative centralized control and actuator control;

- automatic documentation and archiving of process with the ability to analyze any stage, including assessment of the actions of staff and provision of information in form that is convenient for the operator;
- the possibility to create objects control loops with time-varying characteristics, as well as systems of adaptive management and implementation of algorithms of fuzzy logic.

Economic benefits of using automation in the production come from technical advantages.

In the construction of modern industrial automation systems (usually in the form of PMCS), it is used a hierarchical information structure with use of different levels of computational resources of various capacities.

The overall modern structure of PMCS:

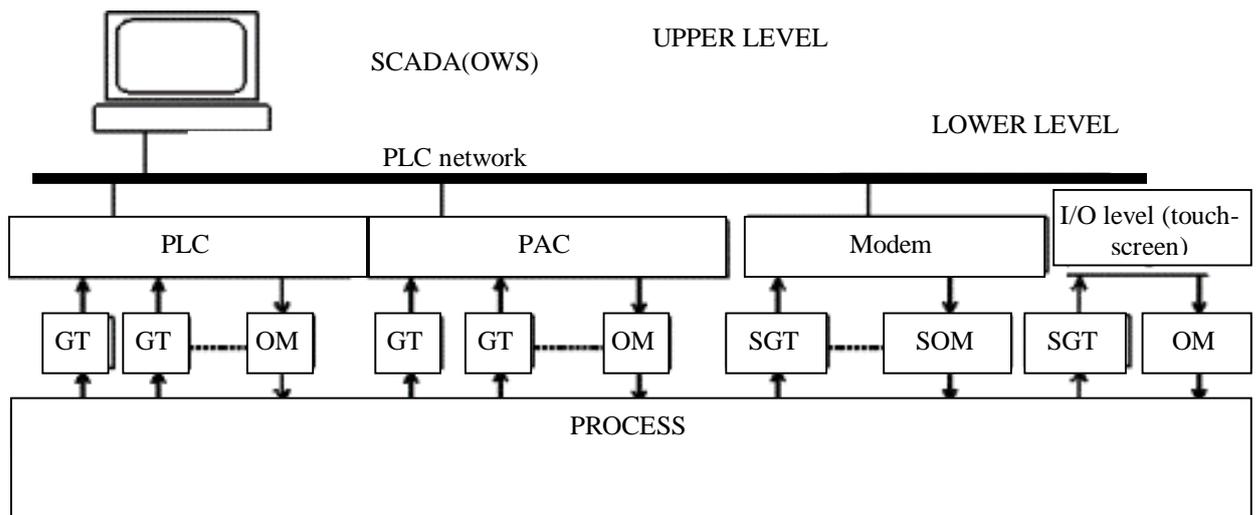


Figure1.3. Typical functional diagram of modern PMCS

Legends:

- GT gage transducer (sensors),
- OM operating mechanisms,
- PLC programmable logic controller,
- PAC programmable (adjustable) controller,
- SGT smart gage transducer,
- SOM smart operating mechanisms,
- Modem signal modulator-demodulator,

Levels of PMCS should represent the following:

– the lower level - the level of control instrumentation designed to obtain information about the object of management and implementation of control actions on the object. Level of control instrumentation includes transmitters, warning devices, analyzers, calculators, converters and operating mechanisms, as well as electrical and other drives that are installed directly on the process equipment, and in special areas;

– the average level - the level of programmed logic controllers (PLC), is designed to convert the information from lower level of control, its processing, generating control actions on operating equipments of the lower level, the preparing information to transfer it to the top level of control. The level of PLC includes local controllers and display facilities installed in control cabinets;

– the upper level - the level of visualization of process (HMI - a level of human-machine interface). This level is designed to obtain information from an average level, process and present operator-technology in a convenient form for a decision, as well as for remote process control through technical means of average level;

The upper level includes automated workstation (OWS) operators, reserving server for collecting and processing data, archive server.

1.3 Description of modern PMCS levels

1.3.1 Instrumentation equipment

- Instrumentation equipments. By way of information presentation, they are divided into:

- Indicating instrument - gage, giving only the reading counting of the measured values

- Recording instrument - a measuring instrument which records readings. Value recording can be implemented in analog or digital forms. There are self-registering and printing instrument

by the method of measurement:

- Direct-acting instrument - a measuring instrument, for example, pressure gauge, amperemeter in which happens the one or more transformations of the measured value and its value is no compared with a known direct value
- Comparator instrument - a measuring instrument designed for direct comparison of the measured value with a variable whose value is known

by the form of reading presentation:

- Analog instrument - a measuring instrument, the reading of which or the output signal is a continuous function of changes in measured value
- Digital instrument - a measuring instrument, indications of which are represented in digital form

by other features:

- Totalizing instrument - a measuring instrument, indications of which are functionally related to the sum of two or more value input through various channels
- Integrating instrument - a measuring instrument in which the value of the measured quantity is determined by its integration by different value
- by method of application and design (fixed, switchboard, panel, portable);
- by principle of operation considering the design (with moving parts and without moving parts);
- For devices with a mechanical part and by method of counter-torque creation (mechanical resistance, magnetic or based on electromagnetic forces);
- By the nature of the scale and position of the zero point (uniform scale, irregular, with one-sided, double-sided (symmetric and asymmetric), with a nonzero scale);

- By the design of the reading device (direct reading, with light indicator - a light spot, with a writing device, vibrating-reed frequency meter, with the scale on the optoelectronic effect - luminophor, LCD, LED);
- By the measurement accuracy (normalizable and nonnormalizable - indicators or indicators);
- by type of utilized energy (physical phenomenon) - electromechanical, thermal, electro-kinetic, electrochemical;
- by the nature of the measured value (voltmeters, ammeters, fluxmeter, frequency meter, varimeters, etc.)

1.3.2 Programmable Logic Controller (PLC)

Programmable logic controller - the electronic component of the industrial controller, a specialized (computer-based) devices used to automate manufacturing processes. As the main mode of sustained operation of PLC, often in adverse environmental conditions, come out its standalone use, without any serious maintenance and virtually without human intervention.

Sometimes computer numerical control system is build on the PLC.

PLC is device of real time.

- In contrast to the microcontroller (single-chip computer) chip of which is designated for controlling electronic devices, the application area of the PLC are usually automated processes of industrial production, in the context of the manufacturing enterprise;
- computers, PLC are designed to work with machines and have developed “computer-based” input-output signals of sensors and operating mechanisms, as opposed to human-oriented computer (keyboard, mouse, monitor, etc.);
- integrated systems - PLC is made as a independent product separate from the equipment controlled with its assistance.

The first logic controllers have appeared in the form of cabinets with a set of interconnected relays and contacts. This scheme was set firmly in the design phase and could not be changed further.

The first PLC in the world - MOdular DIgital CONtroller (Modicon) 084, having a memory of 4 KB, produced in 1968.

The first PLC, which came to replace the conventional logic controllers, is logic connections programmed with connection diagram LD (Ladder logic Diagram). The device had the same working principle, but the relay and contacts (except the input and output) are virtual, i.e., existed as a program running by PLC microcontrollers. Modern PLCs are “freely programmable”.

In the process facility control systems, logical command dominate over numerical operations, which allows comparative simplicity of the microcontroller (bus width of 8 or 16 bits), to have a powerful operating system in real time. In modern PLC, numerical operations are implemented on a par with logic ones. At the same time, unlike most of the computer processor, the PLC provides access to individual bits of memory.

1.3.3 Automated workstation (OWS)

- Software and hardware solution designed to automate the activities of a certain kind. Normally SCADA-system is used in developing OWS for process equipment control.

OWS combines software and hardware, providing human-computer interaction, provides an opportunity to input information (via the keyboard, computer mouse, scanner, etc.) and its display on monitor, printer, plotter, sound card - speakers or other output device. Typically, ARM is part of ACS.

OWS is designed for execution of job duties by operator by carrying out monitoring and process control.

OWS functions are:

- process control and monitoring of process equipment control;
- ensuring the exchange of information with the systems of higher level (if necessary);
- processing of event, accidents and other process data in real time;
- storage of process history;

- graphical representation of the process data;
- visualization of process;
- input of settings and data to the PLC;
- displaying alarms and warning messages;
- turning-on and acknowledgment of messages, and alarms;
- generation of unit control signals in remote mode;
- forming an archive of emergency messages;
- collecting data from input modules and subsystems of control;
- collection and storage of archival data;
- output of operational reports;
- presentation of data in the form of graphs, reports, and log messages;
- control of the availability of external power supply 220V at the input to the station control panel with alarm in the case of power failure and switch to UPS battery operation;
- control of battery discharge of uninterruptible power supply with alarm at discharge;
- control of the availability of power input / output channel of PLC controller by monitoring the voltage at source output 24VDC with alarm in the absence of power.

OWS components

OWS consists of the following equipment and software:

- system unit;
- uninterruptible power supply (UPS);
- Monitor;
- keyboard;
- “mouse”;
- connection cables of network and peripheral equipment;
- SCADA system.

SCADA (abbr. Supervisory Control And Data Acquisition) - a software package for collecting, processing, displaying, and archiving information on control object. Depending on the information richness of control object, SCADA is an optional part of the PMCS. This software is installed on industrial PMCS, and to communicate with an object often requires additional installation of server OPC. The code can be written in the programming language C + +, and generated in the design environment. The first approach requires highly skilled programmers and a considerable amount of time, the second approach is characterized by lower costs in time, but require the purchase of licensed software. The cost of software, in turn, varies greatly depending on the amount collected and processed information.

Screenshots of SCADA – system samples:

23.08.2007		Аналоговые сигналы				16:36:15					
		Значение Ниж.шк Верх.шк Ед.изм.				Значение Ниж.шк Верх.шк Ед.изм.					
AI_01	1.Т газа на вых. узла хоз. зам. 1 нит.	0	0	0	°C	AI_03	31.Расход очищенного газа зам. нитка 2	0	0	0	м3/ч
	2.Т газа на вых. узла хоз. зам. 2 нит.	0	0	0	°C		32.Р газа в разделителе Р-201	0	0	0	МПа
	3.Т газа на вых. узла хоз. зам.	0	0	0	°C		33. L конден. газа в разделителе Р-201	0	0	0	мм
	4.Р газа на вых. узла хоз. зам. 1 нит.	0	0	0	МПа		34. L пластовой воды в разделителе Р-201	0	0	0	мм
	5.Р газа на вых. узла хоз. зам. 2 нит.	0	0	0	МПа		35.Расход газа дегазации на вых. Р-201	0	0	0	м3/ч
	6.Р газа на вых. узла хоз. зам.	0	0	0	МПа		36.Расход конден. газа на вых. Р-201	0	0	0	кг/ч
	7.Т масла в корпусе Н-201/2	0	0	0	°C		37.Расход пластовой воды на вых. Р-201	0	0	0	кг/ч
	8.Т масла в корпусе Н-201/1	0	0	0	°C		38.Р в Д-201	0	0	0	МПа
	9.Р на нагнетания Н-201/1,2 в тех. Н конден.	0	0	0	МПа		39. L жидкости в Д-201	0	0	0	мм
	10.Р воздуха КИП	0	0	0	МПа		40.Р конден. газа в КТУ-201	0	0	0	МПа
	11.Расход конден. после Н-201/1	0	0	0	кг/ч		41. L конден. газа в КТУ-201	0	0	0	мм
	12.Расход конден. после Н-201/2	0	0	0	кг/ч		42.Расход конден. газа на вых. КТУ-201	0	0	0	м3/ч
	13. L ДЕГа в Е-401/1	0	0	0	мм		43.Р конден. газа в В-202	0	0	0	МПа
	14. L ДЕГа в Е-401/2	0	0	0	мм		44. L конден. газа в В-202	0	0	0	мм
	15. L ДЕГа в Е-401/3	0	0	0	мм		45.Р конден. газа в В-201	0	0	0	МПа
AI_02	16. L конден. в резервуаре Е-201/1	0	0	0	мм	AI_04	46. L конден. газа в В-201	0	0	0	мм
	17. L конден. в резервуаре Е-201/2	0	0	0	мм		47.Полож. ЗКР-1 поддерж. Р газа в Р-201	0	0	0	%
	18. L конден. в резервуаре Е-201/3	0	0	0	мм		48.Полож. ЗКР-2 поддерж. L конден. в Р-201	0	0	0	%
	19. L конден. в резервуаре Е-201/4	0	0	0	мм		49.Полож. ЗКР-3 поддерж. L жидкости в Р-201	0	0	0	%
	20. L конден. в резервуаре Е-201/5	0	0	0	мм		50.Полож. ЗКР-4 поддерж. Р газа в Д-201	0	0	0	%
	21. L конден. в резервуаре Е-201/6	0	0	0	мм		51.Полож. ЗКР-5 поддерж. L жидкости в Д-201	0	0	0	%
	22. dP в С-601	0	0	0	кПа		52.Полож. ЗКР-8 поддерж. Р газа в КТУ-201	0	0	0	%
	23. L в С-601	0	0	0	мм		53.Полож. ЗКР-9 поддерж. L конден. в КТУ-201	0	0	0	%
	24. L в дренаж. Е по конден. Е-202	0	0	0	мм		54.Полож. ЗКР-6 поддерж. Р газа в В-202	0	0	0	%
	25. L в дренаж. Е по ДЭГУ Е-302	0	0	0	мм		55.Полож. ЗКР-7 поддерж. L конден. в В-202	0	0	0	%
	26. L в дренаж. Е по факель. хоз. Е-601	0	0	0	мм		56.Полож. ЗКР-10 поддерж. Р газа в В-201	0	0	0	%
	27. L в дренаж. Е производ. дождевых стоков	0	0	0	мм		57.Полож. ЗКР-11 поддерж. L конден. в В-201	0	0	0	%
	28. L в дренаж. Е уловленного конден.	0	0	0	мм		58.Резерв	0	0	0	-
	29. L в дренаж. Е очищенных стоков	0	0	0	мм		59.Резерв	0	0	0	-
	30.Расход очищенного газа зам. нитка 1	0	0	0	м3/ч		60.Резерв	0	0	0	-
УКПГ	АНАЛ. СИГНАЛЫ – 1 стр.	АНАЛ. СИГНАЛЫ – 2 стр.	АНАЛ. СИГНАЛЫ – 3 стр.	ДИСКРЕТ. СИГНАЛЫ – 1 стр.	ДИСКРЕТ. СИГНАЛЫ – 2 стр.	ДИСКРЕТ. СИГНАЛЫ – 3 стр.					
	1 – ая ТЕХ. НИТКА	2 – ая ТЕХ. НИТКА	КОНДЕН. ВОДА – 1 стр.	КОНДЕН. ВОДА – 2 стр.	РАЗДЕ. И ВЫВЕТ. КОНДЕН.	ТЕПЛООБМЕННИКИ					
	ЕМКОСТЬ ПО КОНДЕНСАТУ	ЕМКОСТЬ ОЧИЩЕН. СТОКОВ	ЕМКОСТЬ УЛОВЛЕН. КОНДЕН.	ЕМКОСТЬ ПО ДЭГУ – 1 стр.	ЕМКОСТЬ ПО ДЭГУ – 2 стр.	ДЕГАЗАТОР					
	УСТАНОВКА ОР ДЭГ	КТУ	ОР ДЭГ	СКЛАД КОНДЕНСАТА	ПРОИЗВОД. ДОЖДЕ. СТОКОВ	УЗЕЛ ХОЗ. ЗАМЕРА ГАЗА					
	УПРАВЛЕНИЕ НАСОСОМ	ПЛОЩ. ФАКЕЛЬНОГО. СЕП.	СКЛАД ДЭГа	ТЕХ. НАСОСНАЯ КОНДЕН.	ТРЕНДЫ	СИГНАЛИЗАЦИИ					

Figure 1.4. List of analogue signals (subject of control – CGTP)

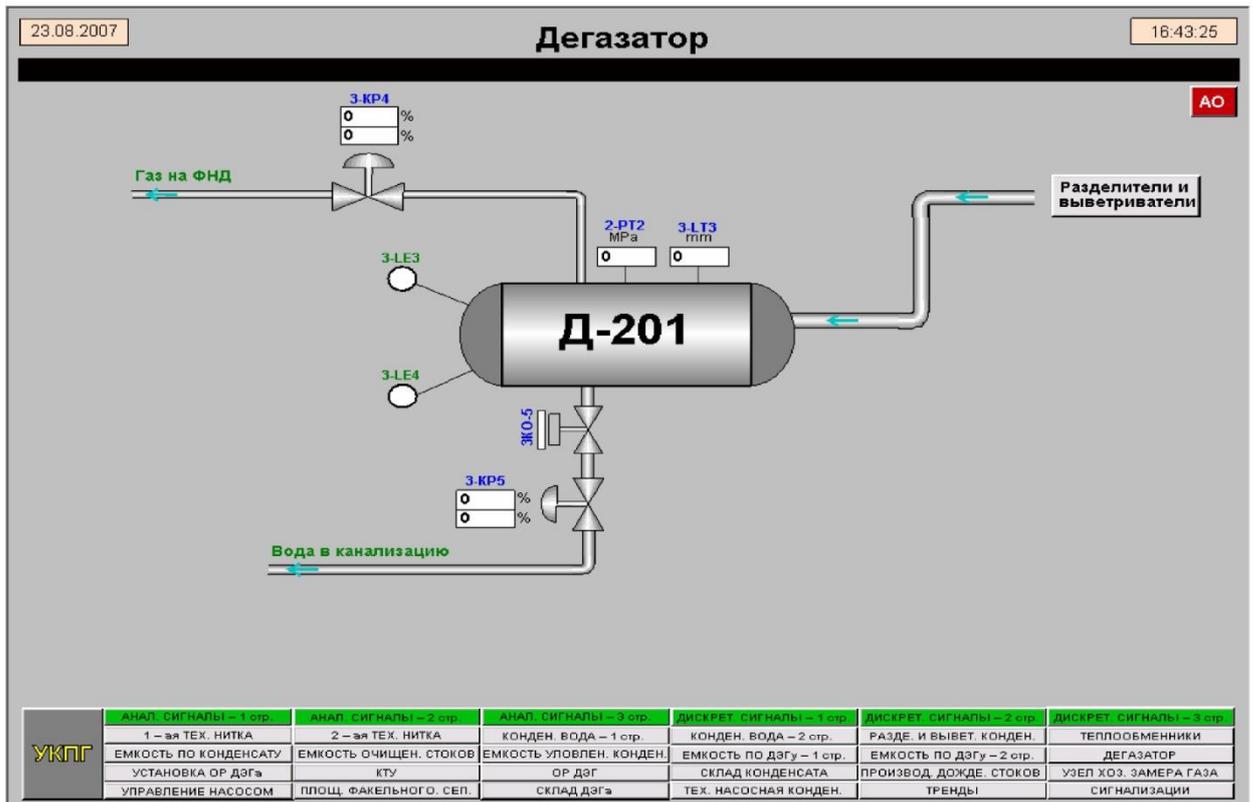


Figure 1.5. Mnemonic diagram of degasser (subject of control – CGTP)

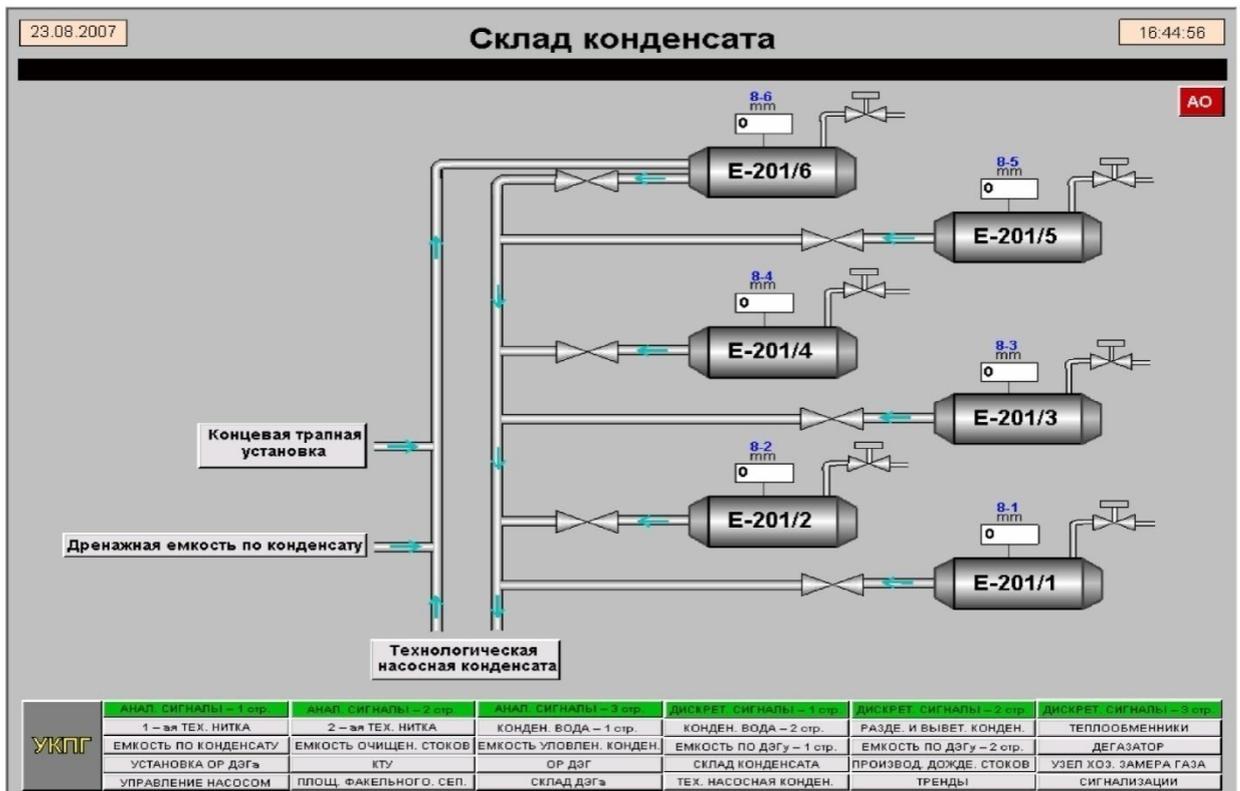


Figure 1.6. Mnemonic diagram of condensate tanks (subject of control – CGTP)

In conditions of rapid evolution and modernization of hardware and software complex and technical means complex special attention is paid to the introduction of new technologies in the design of PMCS in the oil and gas industry. Recently, the design organizations began actively introducing and using additional subsystems, mainly protection-oriented set of equipment. This work involves the presence of 2 of these systems, namely:

- F & G (Fire and Gas system)
- ESD (Emergency Shutdown System)

1.4 Task description

In accordance with selected technology of gas treatment, the ICSS includes:

Complex gas treatment unit (CGTP) - gas treatment system in the form of one line with 100% productivity, from inlet separator to the outlet to gas measuring station, including:

- "gas-gas" heat exchanger unit;
- Joule-Thompson valve;
- low-temperature separator unit with separator – system of treatment and stabilization of liquid (hydrocarbon condensate and water) in the form of single operating line with full productivity, as well as reserve tank for unstable condensate tank emergency weathering;
- DEG regeneration unit – system of hydrate inhibitor (glycol) regeneration, in the form of two unit with 100% productivity;
- condensate stabilization unit;
- condensate tank battery;
- tank to tank condensate transmission pump-house;
- condensate automatic loading unit;
- flare system – high and low pressure flares;
- drainage vessels;
- gas metering unit at outlet of CGTP

Booster compressor station (BCS) at the inlet of CGTP -

Compressor station (for gas compression between inlet separator and recuperative heat exchanger of treatment system) in the form of reciprocating compression units with gas engine in an amount of 2 operating and 1 standby. This number of equipments allows normal operation with both maximum possible gas flow and minimal productivity due to regulation of compressor supply. Application of small amount for large compressor units will provide small output of deposit gas production reduction:

- reciprocating compressor unit with gas-reciprocating drives – 3 PMCS.;
- fuel gas preparation unit – system fuel gas treatment for compressor station, power plant generators and other consumers of facility, in the form of single line with 100% productivity;
- compressed air compression unit – compressor station of compressed air for instrument air, repair air and power air of valve control, in the form of two units with 100% productivity;
- nitrogen receiving and distributing unit;
- gas air cooler at BCS outlet;
- separator at BCS outlet;
- slug catcher (separator) at BCS inlet.

Utilities

- gas-reciprocating power plants – 3 PMCS.;
- diesel power plant;
- pump station for production and fire purposes;
- vessels for production and fire purposes;
- boiler (skid mounted);
- water tank;

1.5 Conclusion of first chapter:

1. It is provided current state of subject area;

2. It is reviewed description of PMCS information structure;
3. It is presented description of main parts of operator automated work station;
4. It is provided task description.

Chapter 2. ACS software and hardware complex

2.1 Software and hardware means, composition and design features of ACS

Adjoining system for process monitoring and control system of CGTP (PMCS of CGTP) is control system of booster compression station (ACS of BCS) and local automatic control system delivered in the set of process equipments:

BCS

- ACS of instrument air compressor unit
- ACS of nitrogen preparation and distribution system

CGTP

- ACS of condensate loading system, condensate tank battery
- ACS of flare system
- ACS of emergency diesel power plant
- ACS of gas reciprocating power plant

Proposed System is built on basis of «ControlLogix» software and hardware of «Rockwell Automation (Allen-Bradley)» company production. System uses modules of «ControlLogix» integrated system with regulation algorithms of «Continuous Control Solutions Inc.»

ACS software and hardware provides:

- Operation with unified signals 4...20mA, 0-5V;
- Operation with temperature transmitters TXK, TSP (100P), TSM (50M);
- Operation with “dry contact” type discrete signals, 24VDC (1A max), 220VAC (2A max).

Input and output circuits of discrete signals have galvanic separation between transmitter circuits and actuators of processing equipment and internal control circuits of ACS equipment (by means of anticipated intrinsic safety barriers/galvanic separators and galvanic separation switches).

Software and hardware of proposed ACS include the following elements:

- Cabinets (block-boxes) for ACS of CGTP and ESD of CGTP, Cabinets (block-boxes) for ACS of train and control cabinet for ESD of BCS, where will be installed devices including:
- programmable logic controllers (including backup for ESD system), built on the basis of ControlLogix hardware that contain control modules, located on the chassis of ControlLogix:
- L556X – logical control processor units;
- 1756-ENBT/EN2T – communication modules Ethernet 10-100M;
- 1756-CNBR / CNB/ CN2R – communications modules (including duplicate one) of ControlNet network;
- MVI56-MCM –MODBUS communications modules;
- IF/OF – i/o modules of analog signals;
- IB/OB – i/o modules of discrete signals;
- PB75/PB75R – power units (including backup for ESD system, 24VDC), designed for all modules in chassis;
- Intrinsic safety barriers and galvanic separators of KFD2 series, "Pepperl+Fuchs" production for "field" sensor signals with unified i/o 4-20 mA and auxiliary galvanic separation switch of "Allen-Bradley" and "Phoenix Contact" production.
- backup stabilized power supply units 24VDC;
- Ethernet (SWITCH) communication device;
- Operator control panel, including:
- Main (six-sectional single-stage) and standby control panel with indicator and control keys;
- Servers (information and archival) redundant on the basis of personal computers, with 19" LCD display, keyboard, mouse, device for system configuration upload to the removable media, and with software;

- Engineer work stations based on personal computers, with 19" LCD display, keyboard, mouse, device for system configuration upload to the removable media, and with software;
- Operator work station based on personal computers, with 19" LCD display, keyboard, manipulator like “mouse” device for system configuration upload to the removable media and with software (4 units.);
- Network laser printer;
- Ethernet (SWITCH) communication device;
- Uninterruptable power supply for control panel equipment.

For interface between controllers and data transmission required for control tasks, as well as within ESD subsystem, in ACS will be used duplicated algorithmic ControlNet network.

10-100M Ethernet will serve as information network in ACS for communication between controllers, server, and operator/engineering work stations.

ACS is supplied as a package of completed units, which should be stationed in relevant premises or “field” block-boxes.

Major units constitute a built-up control cabinets (block-boxes), wherein installed chassis with controller, adapter modules, i/o modules, automatic circuit-breaker, power supply units, intrinsic safety barriers, interposing relay of galvanic separation , terminal adapters, perforated cable trays for signal cables layout.

As a structural basis for manufacturing instrument cabinets is a double-ended service cabinet of "Rittal" company production, with section size of 2000x800x800 and with 200 mm base.

Cabinet (block-box) will be equipped with built-in panels with normalizing transducers and IS barriers installed on them.

Linking external (field) cables is carried out through terminal block (fixed with bolt). Cable entry is performed through existing on the floor weather-strips.

The structure of ACS allows hardware extension for processing additional i/o signals without replacement of hardware, with performance of logical control and safety functions of actuators and warning protection system.

The list of supplied ACS equipment is given in Form #5 of current BID offer. On the stage of signing a contract and/or after improvement of ACS technical requirements the list may be changed or updated according to Customer's requests and approved while signing a contract.

2.2 ACS system firmware

System firmware of programmable logic controller (PLC) is industrial-quality hardware.

System provides detection and processing I/O signals. The signals and their quantity stipulated in current BID offer.

PLC meets IEC 1131-3 requirements.

PLC is certified by TÜV international standard for ESD system till SIL2 level as per IEC 61508, RC 4 as per DIN V 19250.

PLC is filed in State Register of Measuring Equipment of Republic of Uzbekistan (certificate № 02.1898) and admitted for use in Republic of Uzbekistan.

PLC meets GOST R 51350-99 (IEC 61010-90) and GOST R 51522-99 requirements.

2.3 ACS software support

ACS software support provides performance of required functions and tasks for regulation control.

Systems are based on standard, licensed software and hardware and exclude the necessity of additional user configuration.

ACS software support includes built-in core and application-dependent software of controllers;

PLC software supports creating application-dependant software of IEC 61131-3 standard form in programming languages:

- Ladder Diagram;
- Sequential Function Chart;
- Function Block Diagram;
- Structured Text.

Except for logical management programs and PID control, the application-dependant software also includes individual software modules.

ACS application software is considered to be “open source” for performance of control and safety functions (logical software application) with possibility of expansion and making changes by Customer. Openness of software is limited by access control system for various access levels.

This software is completely integrated to the software environment of ControlLogix (processor module L556X). Complete integration allows providing the quick performance of regulation tasks.

For interface with controllers is used interconnect protocol, which constitutes an independent application.

For ACS control from the operator stations is anticipated the data exchange with upper level control systems through serial line communication ports with application of OPC - Ole for Process Control standard.

System software on the basis of ControlLogix includes the following Rockwell Software program support, particularly:

- software application RS Logix,
- software application RS Linx,
- software package "GENESIS", which performs the following functions:
- displaying real-time condition of operating procedure, process parameters;
- generation of warning protection signals;
- availability of configuration and adjustment of functional modules;

- operator access to process control in manual mode;
- data backup for further analysis of critical situation behavior and identification of their causes;
- displaying operational parameter trends

For backup server operation is used the special fail tolerant software package Marathon Fault Tolerant Software. For local panels in the backup control panel is used a software RSVIEW Studio Developed Software for RSVIEW Mashine Edition. System is supplied with all necessary software and licensed products for data and mathematical support, as well as configuration of all given in specification modules and devices.

2.4 Operator (shift engineer) work station

For allocation of operator station (OS), local displays and necessary network equipment is offered to use operator stand. Interface between operator stations and ACS is carried out through Ethernet local network.

For operator stand's power supply is recommended to use uninterruptable power supply with voltage not less than 3500 VA.

2.5 Conclusion of second chapter:

1. It has been described software complex, to be delivered as software for OWS;
2. It has been presented automation objects;
3. It has been presented requirement for OWS.

Chapter 3. Complex and technical structure of project – Technical task for software development and hardware selection

3.1 Technical Conditions for hardware selection

Environmental conditions of region

Observation materials of meteorological station of Muynak (located in height of 68m), Kungrad (situated in height of 60m), Karakalpakiya (positioned in height of 130m), Tigroviy (sited in the height of 52m) were used while preparing climatic characteristics.

Air temperature

Absolute maximal and minimal value of air temperature:

- absolute maximal air temperature is 44 0C;
- absolute minimal air temperature is minus 31 0C.

Maximal daily amplitude of air temperature is:

- in January 22,0 0C;
- in July 23,7 0C.

Average values

Annual average air temperature – 10,2 0C. Average temperature of hottest month (July) – 26,6 0C. Average temperature of coldest month (January) – minus 5,9 0C.

Average maximal temperature of hottest month is 31,8 0C, Average minimal temperature of coldest month is – minus 9,2 0C.

Characteristics of outdoor air

Dates of persistent change of air temperature by provided values:

- by temperature 0 °C – March 14 and December 2;
- by temperature 8 °C – April 10 and October 26;
- by temperature 12 °C – April 24 and October 11.

Duration of periods with daily mean temperature:

- below 0 °C includes 104 days;
- below 8 °C includes 167 days;
- below 12 °C includes 194 days.

Annual distribution of average monthly air temperature is shown in the figure 6.1 (Muynak meteo.st.).

Soil temperature

In most depth of soil freezing is equal to 72 cm (according to the observations of Kungrad meteo. st.).

The maximal depth of soil freezing that may occur once in 10 years is 117 cm, once in 50 years – 138 cm (Karakalpakiya meteostation).

Wind

Predominant direction of wind in a year is north-east, in January – north-east and east, and in July – north. The frequency of wind direction and zero wind are given in graph. 2 (Muynak meteostation).

Average monthly wind velocity in January is 4,1 m/s, in July 4,1 m/s. Average annual wind velocity equals to 4,5 m/s (Muynak meteostation).

The maximal wind velocity possible once in five years – 24 m/s, and once in ten years – 25 m/s.

Air humidity

Average annual relative air humidity is – 70%, in January – 83%, and in July – 58%. Annual distribution of humidity is given in Graph. 3. The Table 5 provides the information about air humidity conditions.

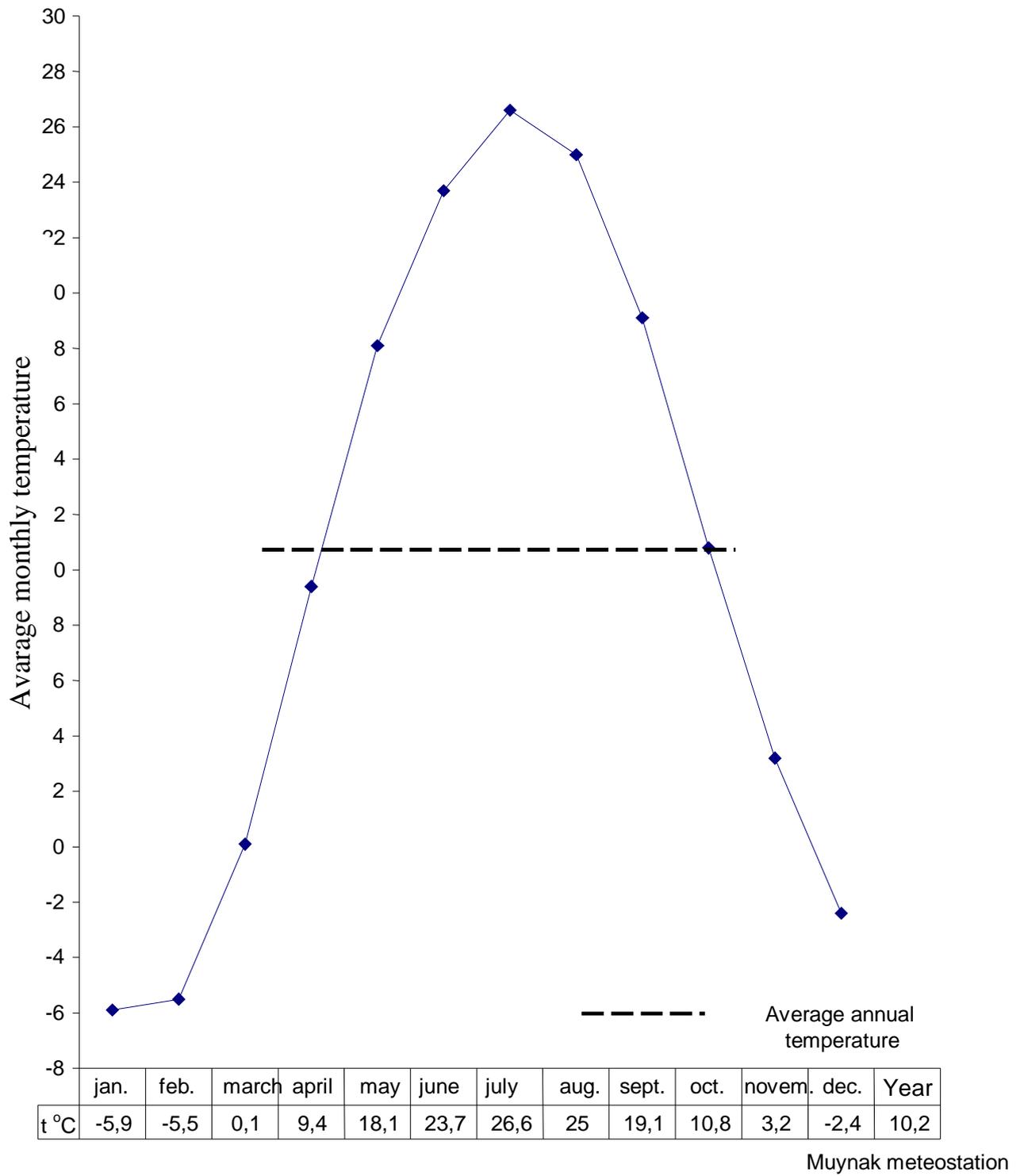


Figure 3.1 - Annual distribution of average monthly air temperature

Rainfall

The quantity of rainfall in a year is – 120,6 mm. The observed daily maximum of rainfall is 66 mm. (Muynak meteostation).

The highest quantity of precipitation occurs in March and April – 33 mm, which is 31% of annual precipitation. Annual distribution of precipitation is given in graph. 4 (Kungrad meteostation).

Snow cover

The highest decadic height of snow cover according to fixed staff is 18 cm.

Number of days with snow cover equals to 34. The average date of appearing the snow cover is – December 19, and its loss is – March 4 (Tigroviy meteostation).

Unfavorable atmospheric effects

The average number of days a year with dust storms and drifting dust is 57. Average number of days with storm is – 7, the maximum – 15. Average number of days with snow drift is 3, the maximum – 16. The most number of days with hail is – 1 (Muynak meteostation).

Solar radiation

Table 3.1 – Solar radiation (direct/sky) received in July on horizontal face W/m².

Hours before noon (according to solar time)								
	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12
Solar radiation (direct/sky)	9/7	77/49	181/84	349/102	509/112	621/126	718/131	761/133
Hours after noon								
	19-20	18-19	17-18	16-17	15-16	14-15	13-14	12-13

Total number a day MJ/(m² a day) - 23,22/5,33.

Glaze

According to KMK 2.01.07-96, the object is located in 4th climatic region, in accordance with regional assignment of Uzbekistan by thickness of glaze. The average number of days with icing of all kinds is – 12, the maximum number – 26 (according to visual observations 32). Standard thickness of glaze with once in 5

years frequency is – 15 mm, once in 10 years – 20 mm.

3.2 General information about ControlLogix platform

ControlLogix is a distributed two-layer multistage system. The System structure is given in figure 3.1.

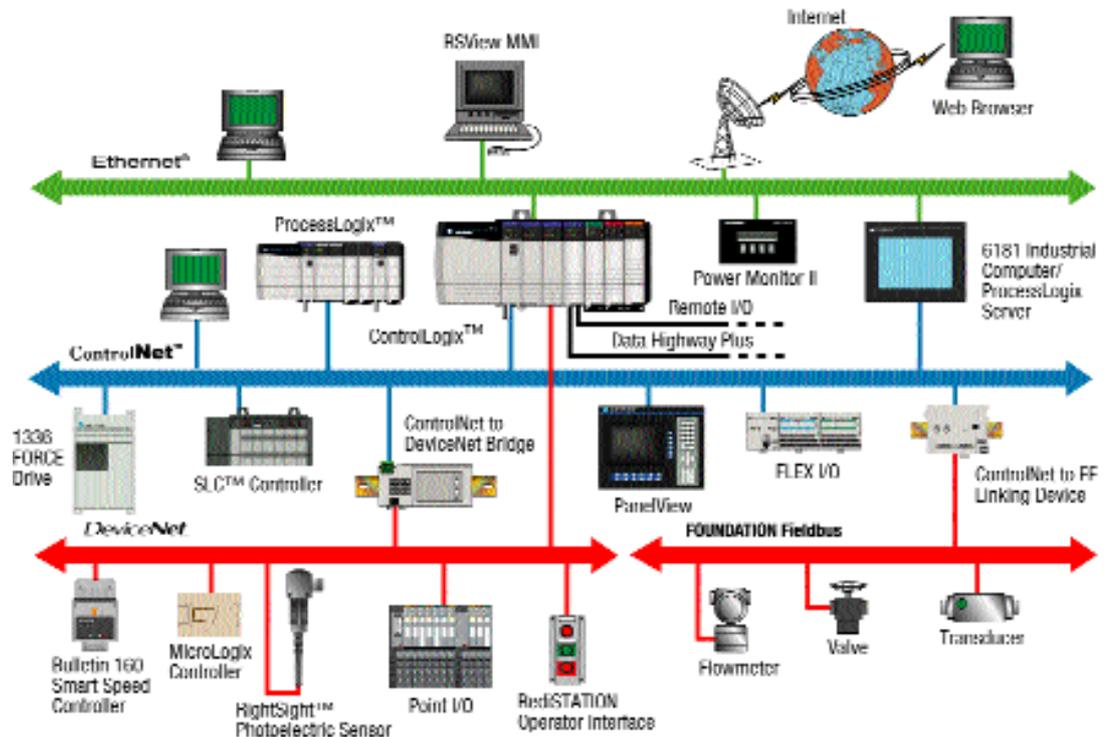


Figure 3.2 ControlLogix System structure

Architecture of «ControlLogix» system, providing the control of back-to-back and continuous processes combined with advanced communication interface, allows getting the compact and reliable System. «ControlLogix» platform has modular structure (whose base is module support – chassis), which enables the most effective designing, installation and modification of system in considerable cost cutout. Industrial version of hardware platform is conservative to vibrations, high temperatures and electric interference in severe production conditions.

3.3 Functions of ACS of BCS

Functions, performance of which is operated by ACS of BCS, are divided into 3 groups:

- Information function
- Control and monitoring function
- Emergency shutdown function

Suggested ACS ensures essential increase of effectiveness, reliability and economical efficiency of trains (reciprocating) and BCS.

3.3.1 Information function

Uninterrupted control over technical parameters including measuring and presenting the values of these parameters in units of physical quantities indicating the sign of the parameter on the screen of PC. The screen of PC indicates parameter limit (preventive and emergency).

Presented data on the screen of PC is performed by activation of operator in the form of table, scale and value in mnemocircuit – by the choice of operator.

Control of metrological performance of measurement channel shall be carried out with the help of standardized measuring devices.

Presentation of operating mechanism status on the screen of BCS PC (in the presence of appropriate signals);

Automatic detection, presentation on the screen of PC and audible warning:

- In the case of deviation of process parameters from specified limits;
- In the case of non-fulfillment of control command.

Scanning time of logic controller – not more than 200msec.

Memorization of signals, generating emergency shutdown of stations, as well as the values of process parameters, status of operating mechanisms and valves of the gas piping before and after the protection operation with the possibility of a retrospective analysis of BCS for the last 5 minutes before the accident, and within 5 minutes after the accident.

Formation of arrays of daily periodic archive in the form of continuously updated 24 files, each with 1 hour (dimensional resolution of 1 sec.) on measured parameters, operating modes, including the operator's commands and deviations. Files, which contain the current value of the measured parameters, preventive and emergency deviations, are generated for automatic reference of the station log in every 2 hours.

Information update time on the screen of PC is not more than 1 sec.

3.3.2 Control and monitoring function

ACS of BCS (workshop) performs following functions:

- Automatic verification of launch readiness, automatic control of operating mechanisms and valves of the gas piping of BCS by given algorithms;
- automatic software transfer of compressors from the mode “idle run” to the mode “operation” (operation of collector) and the withdrawal from the mode of “operation” in other words automatic software modes of loading and unloading;
- manual remote control (with remote controller) of operating mechanisms and valves of gas piping of the running BCS (if allowed by the algorithm), and not running BCS (during repair or commissioning);
- monitoring (maintaining) the main process alternating pressure (or flow) of gas in general shop collector (s) of discharge (suction) or other process alternating (as per the instructions of technological personnel);
- optimal distribution of load between units;
- station controller performs coordinated control of group of units, working together on a common consumer. The controller allows with required accuracy to maintain a given value of the main controlled parameter of group with simultaneous load distribution between units in a given ratio. This provides ultimate control of limited parameters:
- automatic ultimate control (limit);

- providing opportunities to the operator to set a task for the controlled parameter using the keyboard;
- providing opportunities to the operator to produce remote manual control of the control elements of compressors; providing that wrong actions of the operator (for example, which could lead to surge) cause block of ACS.

The followings can be used as main controlled parameter by the choice of Client:

- pressure in discharge collector of BCS;
- compression rate of BCS;
- volume or mass flow rate of CS in the presence of flow sensor.

Output signal of controller of the main parameters of BCS is formed on the digital PID algorithm. This output signal is received as a task simultaneously to the inputs of all the controllers, which are in operation of units.

Automatic restart of, with intervals of 3 seconds, mechanisms after short (1 ... 5s.) failure of voltage 380V, 50Hz.

Control System of BCS can operate in the mode of autonomous operation.

Mechanism control with electric motor:

- Control of auxiliary mechanisms with the help of electric motor will be carried out under the traditional scheme and standard algorithms to ensure protection of electrical equipment against overload and short circuit.
- The main mechanisms will be controlled at the place from a power panel and automatically by the command of CS control system. Selection of mechanism control mode shall be performed by switch on the power board. Selection of mechanism control mode (manual, remote or automatic) is produced from the automatic workstation of operator.

It is assumed that subsystem of each train (reciprocating) will be implemented on a separate controller. Also, subsystem of station (group) master controller of BCS

will be implemented on a separate controller. Master controller will interact with the “subordinate” modular controllers on digital (interface) channel.

3.3.3 Emergency shutdown functions

Implementation of ESD of BCS is supposed to be produced on a separate redundant controller using redundant power supply of controller chassis / unit chassis of input / output and redundant network of ControlNet.

Implementation of ESD system is supposed to be produced for CGTP, Low Temperature Separator Unit and Tank Battery on a separate redundant controller using redundant power supply of controller chassis / unit chassis of input / output and redundant network of ControlNet.

3.4 Structural diagram of Technical task for software development for automation unit control and monitoring.

Structural diagram of Technical task is reference material for software developers. This structure depicts connection of automation units of 3 levels (see Figure 3.2). CGTP and BCS structural diagram):

- lower level;
- middle level;
- higher level.

ACS of BCS communication structural diagram

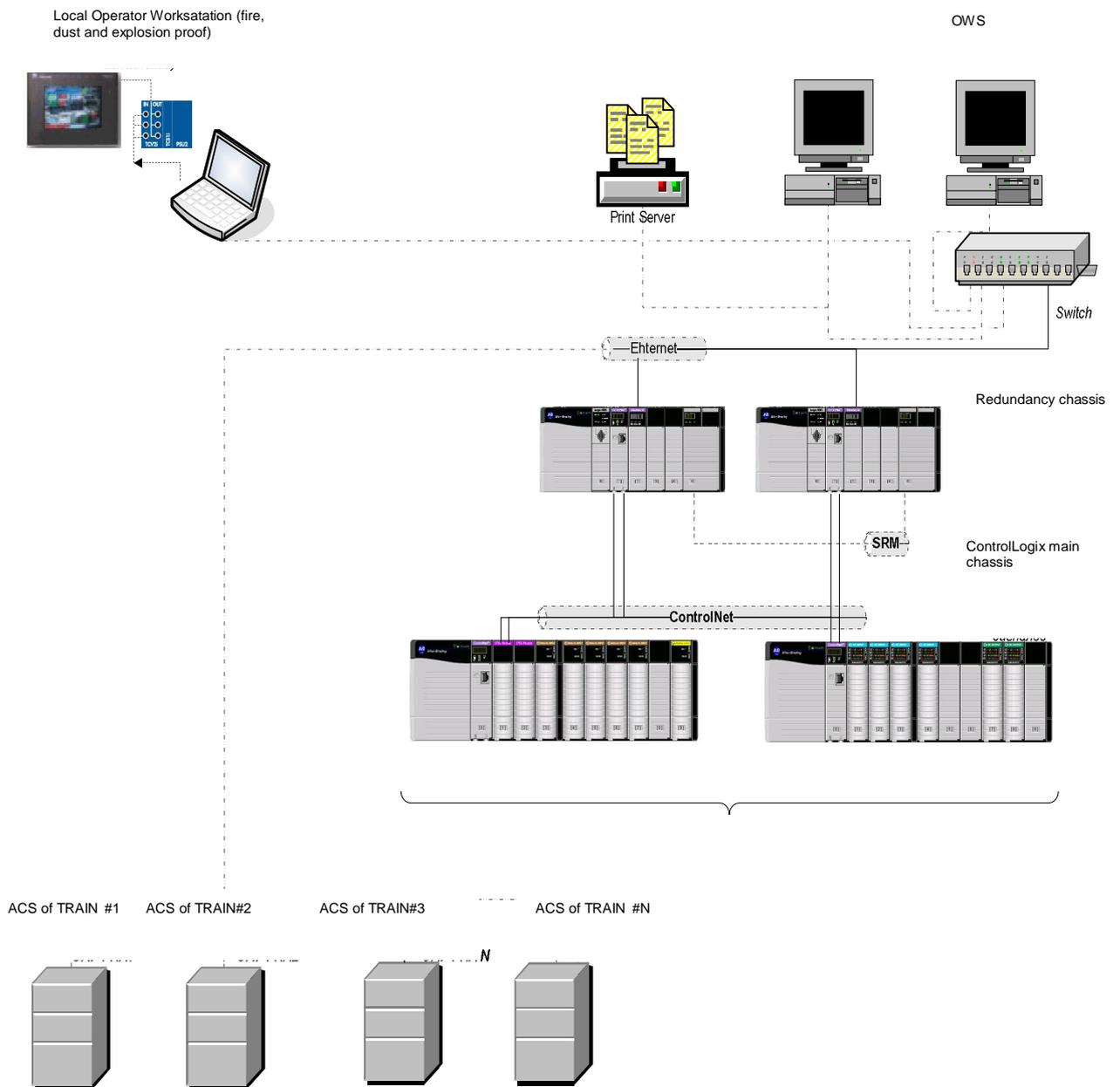


Figure 3.4. Structural bond of process equipments and OWS on the base of ControlLogix controllers

This diagram describes interconnection of GCU with OWS. At the lower level, it is provided binding of N number of gas-reciprocating units, which come with their primary and secondary elements of the instrumentation equipments. At the middle level, interfacing implementation is provided on the base of Control Logix controllers. With this alignment of TMC relationship of middle and higher level is realized by using the Ethernet protocol, which in its turn passes through the Switch, is

Alternative Structural Diagram of Urga

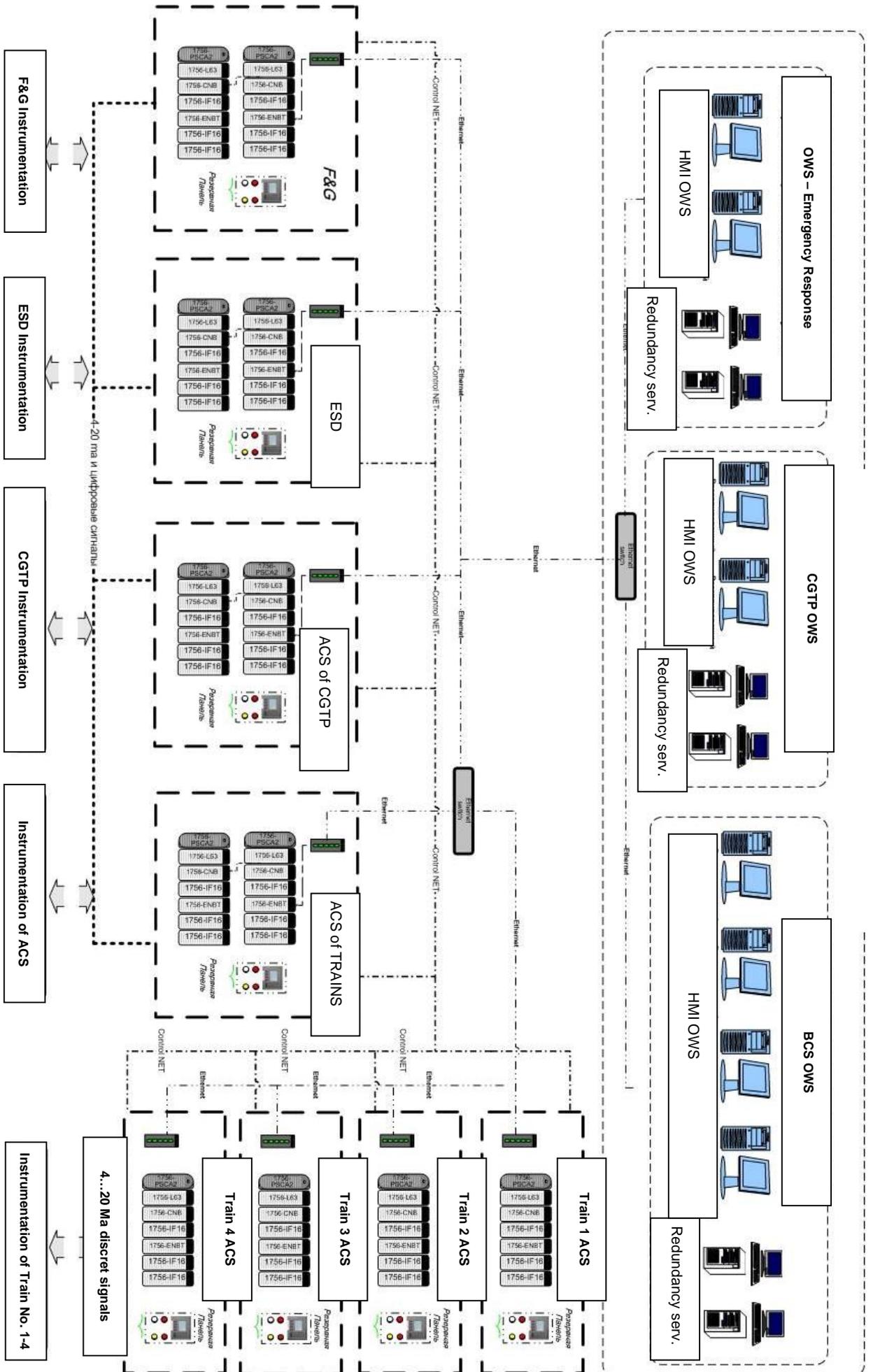


Figure 3.5. Alternative structure of Technical means complex

switched, and inputs to OWS. Finite element at the higher level is a workstation that is a special computer consisting of display, processing unit and I/O devices.

Alternative structure of TMC, indicated in Figure 3.5 is an analogue system of interconnection shown in Figure 3.3. This system also includes a system of ESD, PS and CP of PMCS and ACS. The system is based on an identical controller Control Logix, which provides both primary and backup interconnection of the higher, middle and lower levels. The main disadvantage of this structure is the lack of ESDU (emergency shutdown unit) modules, which serves as a manual override of any command received from PMCS.

The higher level has 8 work stations, from which information is duplicated on a standby server, which in turn provide additional protection against data loss.

In middle level, each of the subsystems has a local control panel.

Control by location makes it possible to set settings manually leaving out operator. Access to the control of both local and manual control panel by the status is equal.

3.5 Conclusion of third chapter:

- The Structural Diagram for BCS and CGTP interfacing has been developed;
- The alternative Structural Diagram for 4 train BCS and CGTP is provided;
- The Technical Conditions for hardware selection are stipulated;
- ACS of BCS diagram is shown.

Chapter 4. Labor safety and safety of life – Safety of Living

4.1 Arrangement of workplace equipped with computer.

Workplace layout has a great importance in creating optimal labor conditions which should meet the requirements of operational comfort, saving energy and time of operator.

Basically, continuous sedentary work is harmful for human because: worker stoops shoulders or perks so his spine is deformed, injuring bands; he lifts his shoulders and bends his hands, holding them on the stretch – and surely, they start aching. Constrained vessels shall lead to overstraining of heart; not mentioning chronic stains of hands and constant deterioration of vision. Posture, and thus the health depends on dimensions and design of workplace, after all.

Workspace.

Scientific arrangement of workspace (fig.4.1) is based on data of average radius of person's hand - 35-40 cm. Nearest zone shall include the area covering elbow pressed to the body, and the farthest zone – the outstretched arm area. Thin line shows the actual position of display on worker's desk – on the left corner of the table. This shall lead to considerable discomfort in work. Person should constantly turn his/her head to the left, which shall lead to exhaustion of cervical muscles.



Fig.4.1. Recommended position while working on computer

Recommended position while working on computer:

- Chair-seat must have possibility to be regulated;
- the distance to display – 60-70 cm;

- user should look at display from top to down under 10° corner from horizontal line;

- support for legs.

While arranging the workplace (fig.4.1), display must be installed on special table, so that its backside will face the wall (because around this part was observed the maximal level of electric field intensity), and display should not be in front of window or other direct light source, which may make glare on screen.

Internal space.

The area under desk has also significant factor. Height of the table used in organization meets general standards, and equals to 74 cm. Design of desk provide required space for legs.



Fig. 4.2. Required space for legs

Mutual arrangement of objects on workplace:

α_1 – vertical view angle, 35°

α_2 – slope angle of keyboard, 10°

h_1 – work surface height, 79 cm

h_2 – seat height, regulated individually

h_3 – distance from the edge of desk to keyboard, 10 cm

h_4 – distance from visual organs of operator to display, 65 cm

Person should look at display at right angle.

While arranging the workplace, it is necessary to remember that the most important tools must be located in the front and on the right side of person.

Keyboard is one of the most frequently used input device. Its zone parameters: angle - 70°, depth - 30-40 cm.

Other devices: angle - 130°, depth 70-80 cm.

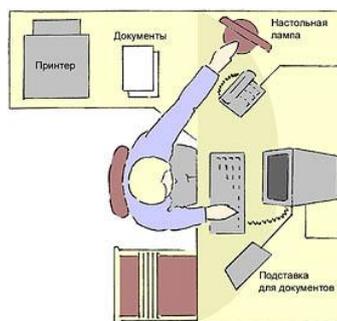


Fig.4.3. Comfortable workplace with L-shaped desk.

Load on eyes

The main load while working on computer falls on the eyes. Their tiredness in many ways depends not only on quality image, but also on ambient light of room. As per health standards, the light on desk surface and keyboard must be not less than 300 lux, and vertical illumination of screen – only 100-250 lux. The research of physiologists and hygienists have proved that semi-darkness, and excess of screen illumination leads to quick visual fatigue.

Computer is recommended to install in a way, so that light (natural or artificial) would fall from side, preferably from left, which will eliminate unnecessary shadows and will help to reduce the screen illumination. Incandescent lamps are better to use for localized lighting of working area (keyboard, book, and notebook).

Workplace of people who use displays is preferable not to arrange directly near windows. On all occasions, display should be placed where it won't have glare, specifically – at an angle to window (close to straight one). Artificial light should not be very bright. However, beside common lamps that light the room, there should be local bright (at least 60 W) lamp with tight shade, which shall light the text the operator using. It should have possibility of changing direction and have brightness regulation device. Incandescent lamp is preferable than fluorescent, because the latter have undulating light, which in certain conditions intensify the glare on screen.

So the principle is clear: as low light as possible on the screen.

Before starting work the work, it is necessary to adjust the contrast and brightness of display using their buttons. They are adjusted individually, since low contrast and high brightness may lead to quick fatigue.

While choosing the light condition of display on workplace, it is necessary to consider that people older than 40 have age-related changes in vision system (myosis, yellowing of eye-lens, reduction of visual activity and contrast sensitivity of retinal). All of these require increasing the screen brightness and additional illumination of workplace (text on paper). Presbyopic spectacles of display users must be a little softer than reading spectacles, because person should see in them the display (60-70 cm from eyes), and text (30-35 cm from eyes). If adaptation does not exist at all, which is usual after 60, then it is reasonable to resolve on eye for working with display, and second – for working remotely.

For young people, during visually strenuous work, the most load bears the accommodative system of eyes, which is under constant tension during work. This may lead to asthenopic events, formation of accommodative system disorders and eventually, to formation and development of shortsightedness. To avoid it, distance between the screen and person must be at least 60-70 cm, since in this position the accommodation stress is minimal.

For elder people with short sight, who constantly wear glasses, the other type of glasses (for working on computer) are necessary only when they can hardly read in their own glasses the newspaper font from 60-70 cm (to display) and 30-33 cm (to hard copy). In case, if text cannot be read from both distances, those people shall need the bifocal spectacles.

Cleanliness

Dust on the display reduces its brightness, deteriorates visibility of image and leads to buildup of static electricity. It is better to every time – before starting work and after switching off the PC, wipe the screen with soft fluff-free cloth.

Premises with PC must have wet cleaning every day, so placing computers in rooms with carpets, carpet mat and cushioned furniture is not recommended.

4.2 Fire safety

Electrical safety.

To provide electrical safety in premises, following factors must be checked:

- compliance of line voltage to value to which PC is designed;
- availability of protective grounding;
- protective measures from voltage drops.

Devices located in the premises work in nominal voltage of 220V. In our case, was used the grounding with insulated neutral. Grounding is connected to grounding loop with 4 Ohm resistance. Grounding of displays is carried out through base unit of PC.

PC is connected to network with a help of three-core copper power cable with plug, which has grounding terminals. All cables in working area have specifications corresponding the current and voltage in network.

While using personal computer, there may occur the following emergency situations:

- short circuit;
- overloads;
- rise of transition resistance in electrical connections;
- high-voltage surge;
- surface-leakage currents.

Fire safety in operation with PC.

While working with personal computers, there may appear various types of fire hazard. Modern computers have very high electronic system component density, and wiring, data cables are located very close to each other. In current flow, they produce significant number of heat, which may lead to temperature rise of individual nodes from 80-100 °C. Thus, it may melt the insulation of cords, which shall lead to their

baring, and consequently, to short circuit, accompanied by sparking that lead to prohibitive overload of electronic components. Being overheated, they burn sparkling.

Ventilation and air-conditioning systems serve to remove excessive heat from PMCS. However, these systems constitute additional fire hazard for equipment room and other premises, because, on one side, air ducts provide oxygen supply, which serve as oxidizing agent, and on other hand – in case of fire, quickly spreads the fire and combustion products through all premises and equipment they are connected to.

Electric installations are supplied through cable lines, which constitute special fire hazard. Availability of combustible insulation materials, potential combustion sources in a form of electric sparks and arcs, branching and inaccessibility make cable lines as most possible areas for formation and development of fire.

Operation of PMCS is connected with need for carrying out maintenance, repair and preventive measures, in which case, shall be used various lubricating materials, highly inflammable liquids, be laid temporary power lines, be welded and cleaned individual nodes and details. Thus, arises the additional fire hazard that needs relevant fire safety measures. So, to prevent combustion, all types of cables must be laid in gas-filled metal pipes. In equipment rooms, cables lines are laid under process false floor, which are made of non-combustible or not easily combustible materials with at least 0,5 h fire-resistance rating.

In computer center rooms, fire cocks are installed in halls, on stair landings, at entrances. Portable CO₂ fire extinguishers are installed in rooms at the rate of one fire extinguisher for 40-50 m².

In case of fire, enables the automated fire suppression unit installed in rooms. Fire units are usually gaseous. They are equipped with light and sound alarm.

In order to prevent the fire from spreading to another part of building, there shall be provided fire separations like fire division walls, baffles, shutters, zones, airlocks, doors, windows, accesses, valves.

In case of fire, buildings are provided with at least two fire escapes; however, equipment rooms, which also have at least two fire escapes, should not be designed for having escape routes for workers of other units. In other production facilities, it is allowed to design one escape, if only the distance between the most remote areas does not exceed 25 m, and the quantity of workers in one shift should not be more than 25 people. Routes, halls and workplaces should not be cluttered with stock materials, paper. Escape routes shall have both natural and artificial illumination.

For storing data carriers shall be used metal safes, and doors to storage building must be fire-resistant.

Set of organizational and technical fire preventive arrangements help to prevent the fire, and in case of its development, provide the safety of people, stop it from spreading, and provide conditions for successful extinguishing of fire.

4.3 Conclusion of fourth chapter:

- The general safety rules described;
- The guideline how to properly sit in front of computer is stipulated
- Fire safety manners described.

Conclusion

The current qualification work is fully describes the requirements, terms and conditions, implementation methods and interfacing modes. As a result of this qualification record the design of automation system of all CGTP facilities and automation system for BCS, consisting of three gas-engine-compressor reciprocating unit and station system of BCS has been fulfilled.

The designed system is for permanent monitoring of process parameters and uninterrupted operation of CGTP and BCS in all operation modes.

The designed PMCS provides high performance, reliability of work and safety of equipment, improvement of operational comfort and information awareness of operators about process.

Following methods of improving reliability have been considered:

- application of backup units of stabilized power supply;
- application of backup controllers of ESD subsystem;
- application of backup digital communications network between controllers;
- application of system elements, data transmission and display devices with high level of reliability;
- application of advanced software;
- application of hardware and software extensive diagnostic system.

Apart from abovementioned, in 3rd chapter you can see the Technical Conditions for hardware selection. General TCs' are as follows:

Air temperature

Absolute maximal and minimal value of air temperature:

- absolute maximal air temperature is 44 0C;
- absolute minimal air temperature is minus 31 0C.

Maximal daily amplitude of air temperature is:

- in January 22,0 0C;
- in July 23,7 0C.

Soil temperature

- In most depth of soil freezing is equal to 72 cm (according to the observations of Kungrad meteo. st.).

Wind

- Average monthly wind velocity in January is 4,1 m/s, in July 4,1 m/s. Average annual wind velocity equals to 4,5 m/s (Muynak meteostation).

Having said above mentioned, it is also necessary to highlight the actuality of basic means of design requirements which are Lower Level, Middle Level and Upper Level of Process Control and Management System.

Reference Documents

1. EIC. Electric installation code, 7th edition – see p. 20;
2. GOST 12.1.030-81 Occupational Safety Standards. Electrical safety. Protective grounding, neutral earthing – see p. 46;
3. GOST 24.104-85 Unified system of standards for computer control systems. Computer control systems. General requirements – see p. 42;
4. GOST 24.701-86 Unified system of standards for computer control systems. Computer control systems. Reliability of computer control systems. General provisions - see p. 42;
5. GOST 26.011-80 Measuring and automation devices. Input and output current and voltage continuous signals - see p. 42;
6. GOST 26.013-81 Measuring and automation devices. Input and output electrical signals with discrete change of parameters see p. 42;
7. GOST 34.201-89 Information technology. Set of standards for automated systems. Types, sets and indication of documents for automated systems design - see p. 42;
8. GOST 34.602-89 Information technology. Set of standards for automated systems. Technical tasks for developing automated systems - see p. 42;
9. GOST 34.601-90 Information technology. Set of standards for automated systems. Automated systems. Design stages - see p. 42;
10. GOST 6651-09 State System for Ensuring Uniform Measurement. Resistive temperature transducer. Environmental specification and testing methods - see p. 42;
11. GOST 8.585-01. State System for Ensuring Uniform Measurement. Thermocouples. Nominal static conversion response - see p. 42;
12. GOST 8.586.1-05 State System for Ensuring Uniform Measurement. Changing flow and quantity of liquid and gases with a help of standard orifice plates. Parts 1,2,3,5. – see p. 32
13. GOST 30.852.0-02 Explosion-proof electrical equipment. General requirements - see p. 42;

14. GOST 30.852.0-02 Explosion-proof electrical equipment. «Intrinsically safe electrical circuit». Technical conditions and testing methods – see p. 42;
15. GOST R 50923-96 Displays. Operator workplace. General ergonomic and work space requirements. Measuring methods – see p. 32;
16. IEC 61508 Functional safety of electrical/electronic/programmed systems, connected with safety – see p. 47.
17. IEC 61511 Functional safety. Safety of instrument systems for production process – see p. 37;
18. IEC 60079 Electrical equipment for explosion-hazard gas environment – see p. 38;
19. WD 50-34.698-90 Automated systems. Content requirements – see p. 21.
20. Web-source: <http://www.pmcs.com/pcs> -see p. 11
21. Web-source: <http://www.arcweb.com> - see p. 12
22. Web-source: http://en.wikipedia.org/wiki/Process_control - see p.11
23. The Resolution of President of Uzbekistan №III-854 dated 02.05.2008 «Measures on further cooperation with "PETRONAS" enterprise (Malaysia) in the area of exploration work, field development and construction, and development of oil-gas-chemistry industry» - see p.6;
24. The Resolution of President of Uzbekistan №III-1072 dated 12.03.2009 «The program of actions for execution of primary projects on modernization, technical and process upgrading of production for year 2009-2014» - see p.6;
25. The Resolution of President of Uzbekistan №III-1081 dated 26.03.2009 «Actions on implementation of Project Sharing Agreement regarding Urga, Kuanish fields and Akchalak group of Ustyurt region, Uzbekistan» - see p.6;
26. The Resolution of President of Uzbekistan №III-1121 dated 03.06.2009 «Implementation arrangements as per Project Sharing Agreement regarding Urga, Kuanish fields and Akchalak group of Ustyurt region, Uzbekistan» - see p.6.