COMPLEX OF MONITORING AND MANAGEMENT FOR OIL WELLS WITH ROD PUMP

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Modern approach to oil production process automation dictates severe requirements against rod pumping unit control and management hardware - software complexes. It is caused by depletion of oil bed resources, high cost of electricity, oil companies' tendency to reduce well repair costs and to use available resources more effective.

And today's informational technologies development stage ensures implementation of severe requirements enabling exstress of features of the complexes and provision of them with qualitatively new properties. Therefore, the problems of creating qualitatively new rod pumping unit-used well (RPUW) management and control hardware - software complexes is very urgent.

In [1], requirements against structure and executable functions of information complexes of measurement, monitoring, diagnostics and control of wells operated by rod bottom – pumping units are specified. Based on such requirements "Cybernetics" Special Constructor Bureau of ANAS Cybernetics Institute has developed RPUW control complex.

Such complex is installed in an oil and gas production workshop. A dynamometer and wattmeter card characterizing well pump performance is built at the level of deposit and diagnostic tasks [2-6] are met on the basis of joint analysis of the dynamometer and wattmeter card by using new technologies for analyzing noisy signals. A database consisting of well ratings and engineering information is created and thereby the procedure analysis base is prepared.

The complex has been designed to control process-dependent parameters and changes in operating conditions of wells provided with depth and rotary pumps. Structure chart of such complex is shown in figure 1.

Main components of the complex:

1. Inquiry and control unit (ICU):
- Computer with printer; communication device (CD); radio modification (RM);
- Telephone node (TN).

2. Communication facilities:
-Physical line; radio transmission.

3. Well control devices:
- For one well (WCD-01);
- For four wells (WCD-02).

4. Rod pump unit-used well control stations (RPUWCS):
- RPUMWCS - 01 for engines of up to 5.5 kWt capacity ;
- RPUMWCS - 02 for engines of up to 22 kWt;
- RPUMWCS - 03 for engines of up to 75 kWt.

5. Rod pump unit-used well gradual control stations (RPUWGCS):
- RPUWGCS - 01 for engines of up to 5.5 kWt capacity ;
- RPUWCGS - 02 for engines of up to 22 kWt;
- RPUWCGS - 03 for engines of up to 50 kWt
- RPUWCGS - 04 for engines of up to 75 kWt.

6. Group gage unit (GGU) control device:
- Trap control device (TCD-01);
- OZNA Satellite control device (SCD-01).

The ICU equipment is mounted in room conditions in the workshop planner's room, the

rest equipment is mounted in field conditions not far from wells and GGU, accordingly.

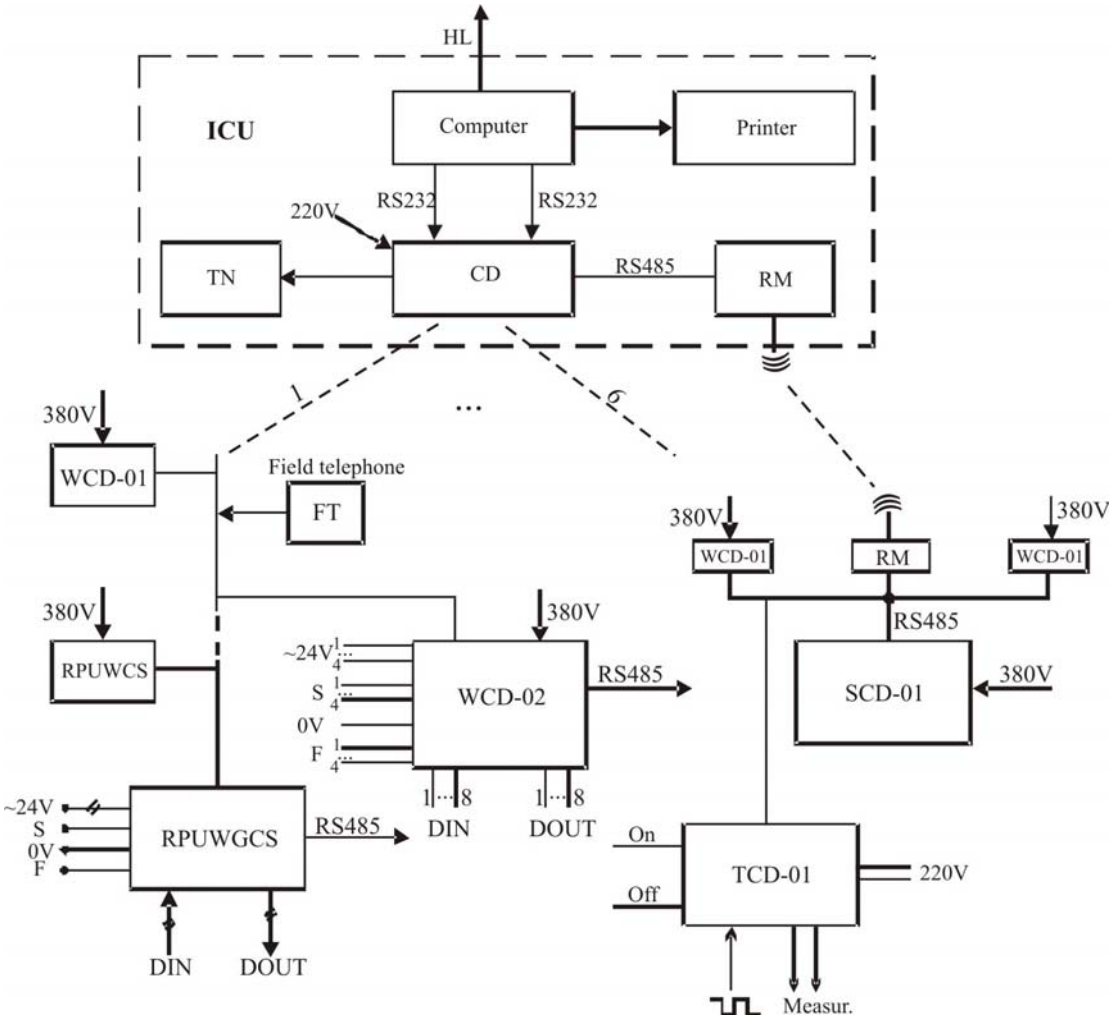

Figure 1. Structure chart of "Ayna" rod pump unit-used well control and management complex.

Computer with printer, communication device (CD); telephone node (TN); radio modification (PM); Well control device (WCD-01, WCD-02); trap control device (TCD-01); Field telephone (FT); rod pump unit-used well control stations (RPUWCS): rod pump unit-used well control stations (RPUWCS).

ICU software:

- automatic and manual inquiry of information of devices and stations connected to the complex is arranged;
- construction of well force and time-related motion characteristics graphs time - related force graph (dynamometer card) is provided;
- transfer of inquiries and control commands (for status scanning, pumping unit shutdown and start-up) and thereby defines well condition, controls actuating mechanism is provided;
- construction of graphs on engine power changes according to time, as well as depending on pumping unit (wattmeter card) is provided;
- by analyzing information received, downhole equipment malfunctions are diagnosed and approximate well production is defined;
- well-related information for last 10 days is kept and downtime is registered.

RPUWGCS functions:

- **Manual and automatic pumping unit engine management.**
- **The following is provided at every operation mode:**

- electric engine protection in the case of loss of phase, break of belts, rods, depth pumpfailures and maximum overload;
- electric engine shutdown at pressure going out beyond specified values in wellhead.

- **The following is provided in automatic mode :**

- gradual and group starting-up electric engines of the field pumping units;
- regular well operation;
- easy operation mode of electric engine till maximum permissible value in the case of loss of one of supply network phases;
- an opportunity of getting ground and deep (piston) dynamometer card of depth pumpperformance on the basis of data on the slope angle of the balance arm and force against the balance arm enabling analysis of depth pumpperformance;
- an opportunity of wattmetering all the unit on the basis of data on the slope angle of the balance arm and power consumption of electric engine;
- comparative analysis of dynamometering and wattmetering results for equipment state diagnostics;
- well production determination;
- optimal pumping cycle determination and settings depending on well production.

Well control stations and devices provide gathering and transmission of information of the DUP, DUI and modern sensing elements provided with standard outlet for ICU, as well as acceptance and execution of ICU control commands.

Positively characteristic features of the complex as compared with other complexes (CTP system, "Gilavar", Nur complexes):

- application of rod pump unit-used well gradual control stations highly (over 60%) reduces electric energy demand;
- application of rod pump unit-used well control stations enables reduction of expenditures for electric engine repairing;
- having high transmission velocity in addition to its traditional functions this complex executes equipment protection function;
- simplicity and high reliability;
- application of standard interface and information exchange protocol enables connecting devices and equipment of foreign companies (flowboss, ROC and etc.) to the complex and getting information from them;
- construction of piston (underground) dynamometer card of depth pump and, thereby, improvement of malfunction diagnostics;
- robust technology application for analysis of dynamometer cards and malfunction reason forecasting at early stage;
- available operations with combined communication and interface facilities.

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