



MULTIFUNCTIONAL CONTROLLER

Naftamatika WellSim for oil well automatization

АГЕЕВ Евгений Сергеевич
Main specialist
ООО «Нафтаматика»

СЕВАСТЬЯНОВ Андрей Юрьевич
General director
Naftamatika s.r.o.



Slovakian company Naftamatika is specializing on projects and elaboration of rod pump controllers for rod pumping unit control and oil well monitoring. Nowadays, products of this company are used all around the world, for example in the USA and Canada. In 2013 one of the biggest oil production companies in Russia, Tatneft, has been using about 300 Nftamatika WellSim devices – intellectual controllers used for automation of acquisition, processing, storage and analysis of data for sucker rod pumps and distant control of the parameters via Web-interface, diagnostics, anti-malfunction control, fluid production and pump intake pressure measurement together with visualization of oil well state.

WellSim controller consists of a motherboard, adapter board, power supply, automatic switch, intrinsically safe barrier and electric motor starter control relay. In the devices and cables set there are: a polished rod load cell, load cell washers, polished rod position sensor, cables and mounting kit. Hall sensors or induction sensors are optional. WellSim controller is placed on the rod pumping units and is fully integrated with all the devices. That's why the WellSim device might be controlled distantly by a personal computer, SCADA system or via Internet. (See pictures 1. and 2.)

By requirements of Russian companies Well Sim is being manufactured in anti-vandal enclosure or within integrated control station. Controller in plastic enclosure is also available.

CONTROL FUNCTIONS

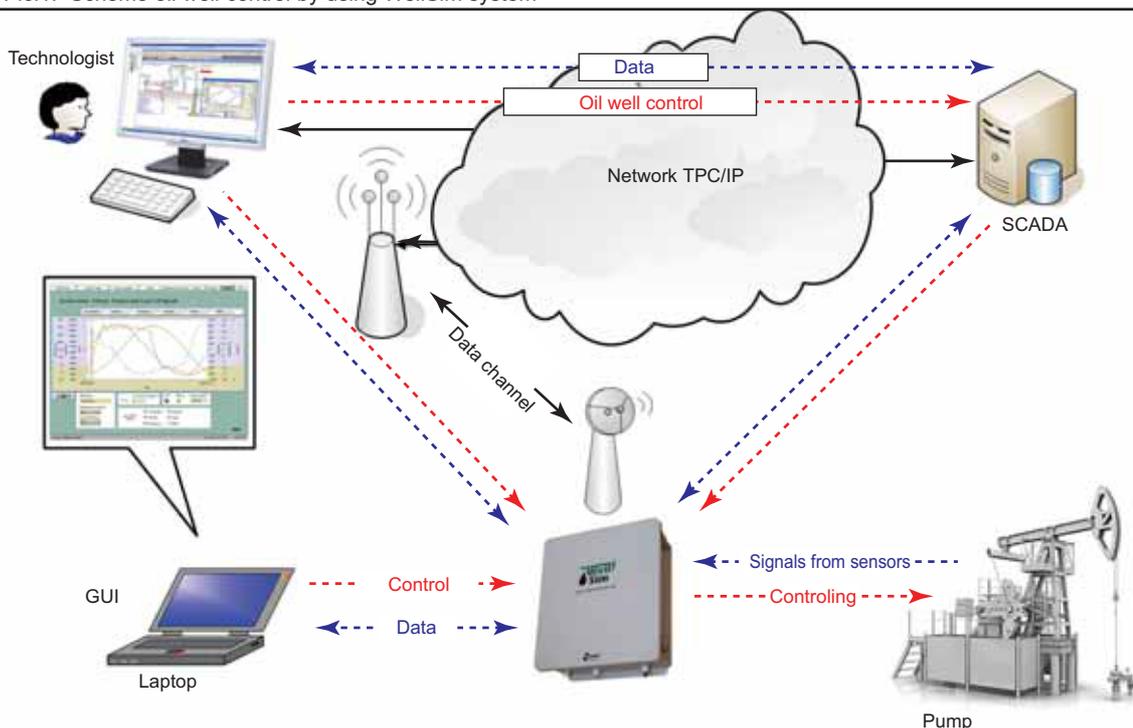
WellSim controller has both English and Russian rod pump visualization interface and graphic indication of the pump work.

WellSim can control the well in automated mode by pump fillage, pump intake pressure timer or by schedule (picture 7) however it can be operated manually from controller GUI or by SCADA system (for example XSPOC).

All control modes have a possibility to control the well also by anti-malfunction set points, for example minimal or maximal load, minimal fluid load, logic expressions (picture 8).

With crankshaft position sensors and RPM sensors It is also possible to detect all equipment failures, speed reduction or belt slip warnings (picture 9). Moreover, WellSim can calculate loadings on down hole and surface equipment (rods and gearbox) automatically (picture 10).

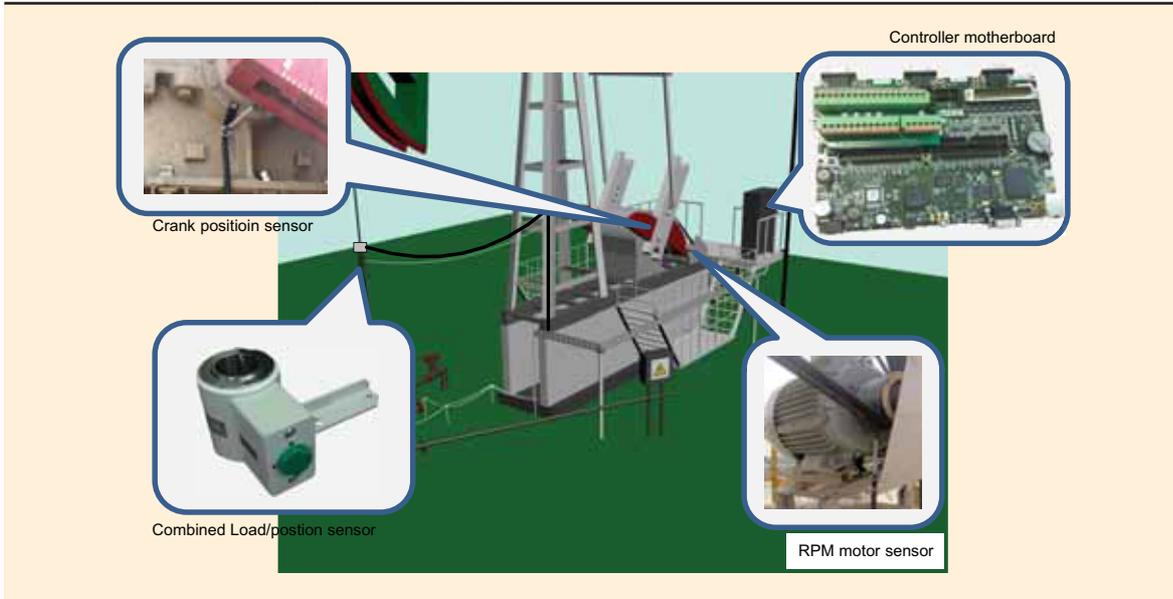
Pic.1. Scheme oil well control by using WellSim system





КУЧЕРЯВЫХ Иван Валерьевич
Main engineer
ООО «Нафтаматика»

Fig. 2. Scheme of WellSim system on the pump



There are three types of leakage calculation: manual percentage, dynamic calculation or valve check. Friction calculation is performed taking deviation survey into account. Controller also has a function against incorrect data entering and work correctly even on slow pumping units (for example 0,4 SPM).

DEVICE CHARACTERISTICS

Motherboard of the controller has 110 digital inputs and outputs (3.3 V), 30 analog inputs and 4 analog outputs (0-10 V), 31 digital input/output (24 V). You can add up to 3 additional modules if desired.

WellSim has two working interfaces (RS-232 and Ethernet) in standard set. It is possible to install additional Interfaces.

Our technology supports a few standard protocols including Modbus RTU and TCP/IP, that makes WellSim controller fully adapted for networking, it has password protection and perfectly suited for uploading software via web. It also has the ability to use different access rights for each user

Furthermore, WellSim fitted with 400mhz CPU, 128mb of RAM, 256mb flash memory and 40mhz 2mb FPGA. High performance of the device allows to record and store archive data without date limitations. For further processing and graphs drawing, all data exports in MS Excel format.

Fig. 3. WellSim controller in metal box version



Fig. 4. WellSim controller with Power control station



Рис. 5. WellSim controller in plastic enclosure



Рис. 6. Graphical user interface

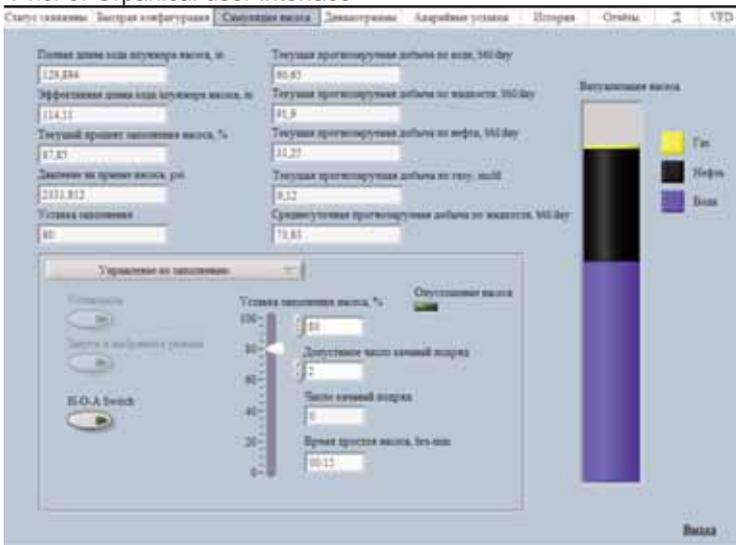
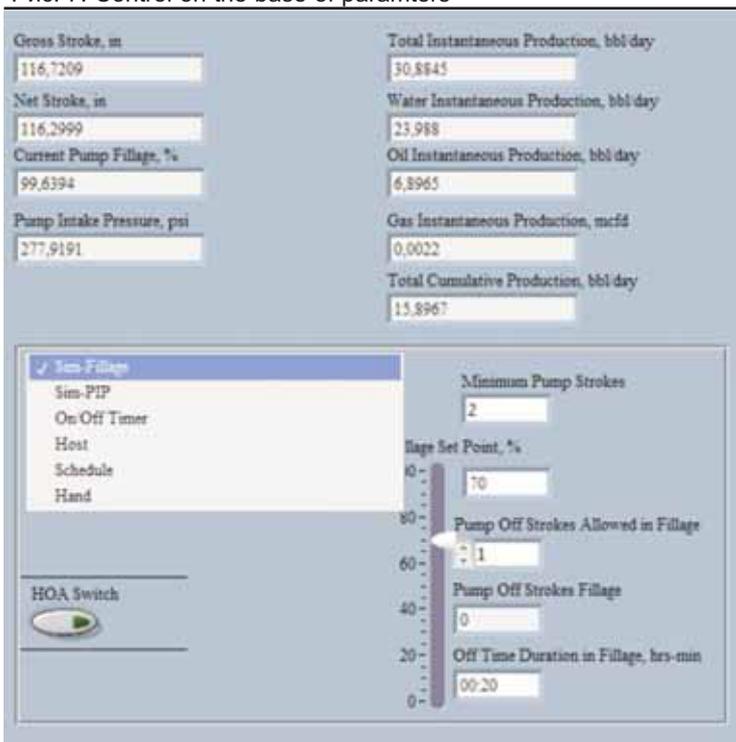


Рис. 7. Control on the base of paramters



CERTIFICATION

WellSim controller meets all safety requirements and requirements for measurement instruments. Our system has following certificates: CU TR* 020/2011 (electromagnetic compatibility of technical means), CU TR*004/2011 (safety of low-voltage equipment), CU TR*012/2011 (equipment safety for work in explosive environments). It also has means of measurement of crude oil certificate. Pump pressure measuring on input of the pump certification is in progress. Metro logically significant part of software is fully protected from unauthorized access in accordance with the Ministry of industrial trade of Russia order.

ECONOMIC EFFECT FROM CONTROLLERS IMPLEMENTATION

You can increase overhaul period and lower repair costs by installing WellSim. By optimization of well operation when using WellSim you can achieve 15% power saving, increase well production and save on flowmeters.

At this moment there are more than 450 WellSim controllers installed throughout the globe. Those companies are as follows: TATNEFT JSC, AB Lotos Geonafta, and Belorusneft.

Estimated annual savings in Tatneft JSC was 63 000 RUR per well, and flow meter savings were 80-120 RUR per well. AB Lotos Geonafta achieved 15% power consumption decrease using WellSim (without VFD).

FUTURE TECHNOLOGY DEVELOPMENT PLANS

We are planning a significant expansion of controller functionality by adding support for Modbus TCP; control through the surface dynamometer, outside temperature will be included in calculation of oil mass, flexible configuration of virtual and physical inputs, ability to set the maximum and minimum load set points for rod tapers.

We also have plans to develop the interface and controller functionality with universal channel configuration and universal control logic, as well as 3D visualization tools. Next generation of our devices will feature HTML5 support so it can work with Windows, Linux, Apple OS, and Android etc. Other than that we will integrate Danfoss VLT SALT and other types of variable frequency drives. Soon WellSim will feature digital data communication instead of analog. The data from load cell will turn digital in acceleration sensor digital board and will be transferred further to controller.

We develop a backup control algorithm that will use motor rotations information to be used for calculations. Nevertheless another way of development is using our own radio link, integrated with WellSim controller.

Рис. 8. WellSim controller interface - malfunction tab

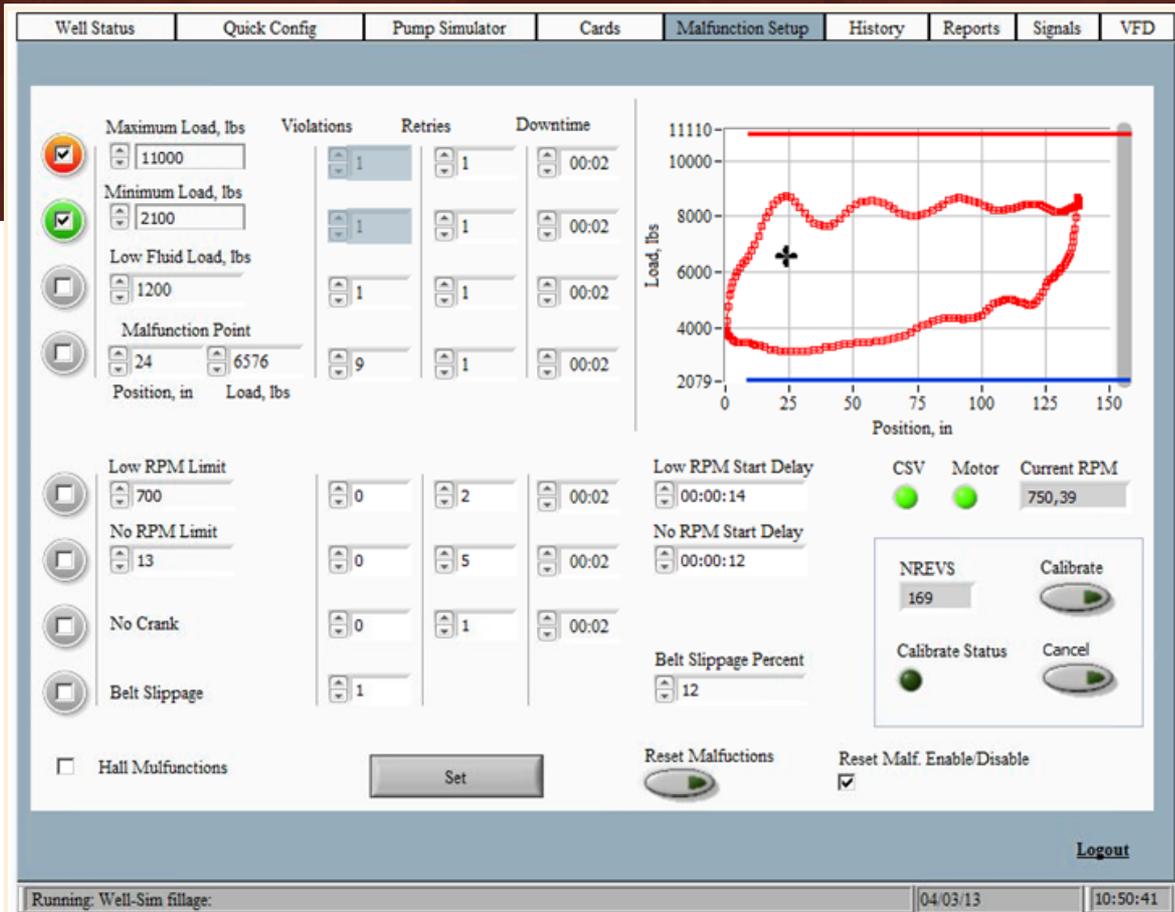


Рис. 9. Load and Position sensors

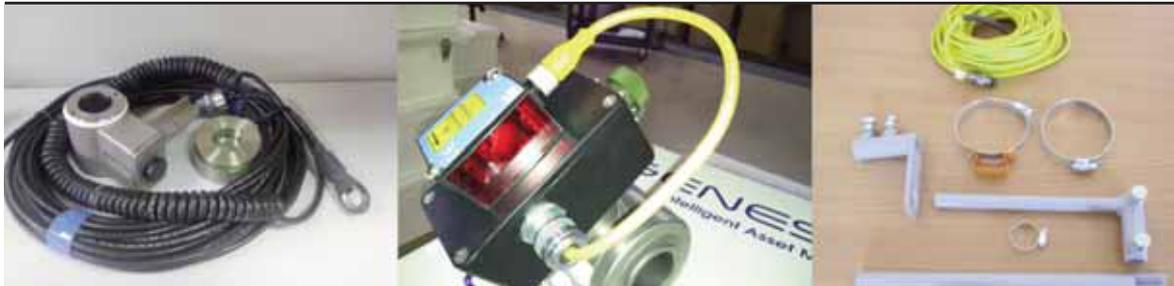


Рис. 10. Next WellSim possibilities

