

## Conference Paper

# Problem Analysis and Design Solutions for Upgrading Software and Hardware Complex Test Stands N° 2, 3, 4

**A.V. Vychezhanin**

OOO Ural Diesel Engine Plant, Russia, 620017, Sverdlovsk region, Ekaterinburg, street front brigades, 18

### Abstract

The paper presents a model of effective interaction between the test and measuring devices and automation (I) and the automatic process control system (APCS). The "Upgrading software and hardware complex test stands N° 2, 3, 4" is directed on the efficiency and reliability of constituent equipment used in the operation of the test rig with diesel generator sets trials.

**Keywords:** Automatic control and industrial control systems, instrumentation and automation, upgrades, software and hardware.

Corresponding Author:

A.V. Vychezhanin  
 Spayder\_89@mail.ru

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## 1. Introduction

The LLC "UDMZ" conducted tests of a new family of engines DM 185 on test stands N° 2, 3, 4. The new family of engines scheduled for use in shipbuilding, and the shipbuilding industry, locomotive building, mining equipment and small power facilities.

For testing diesel - aggregates used software and hardware (PTC), which provides:

- machine (automatic start, stop, including alarm) - Diesel Control
- load control device;
- management of the electronic fuel injection system;
- working media control (temperature, pressure);
- the measurement and calculation of the parameters of the diesel aggregate and the working environments (air, oil, water, fuel, exhaust gases);
- Control unit diesel equipment and components stand in manual and automatic modes.

To understand the need for this project was explained downtime due to a malfunction automation systems and instrumentation, the analysis will be carried out on the basis of the test stand works Journal number 2. According to the results of the work log analysis chart (Figure 1) was drawn up. In the period under review were 100 hours of

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testing diesel unit. I note that the downtime for other reasons include downtime due to faults not related to equipment automation systems and the performance of operators of other types of work.

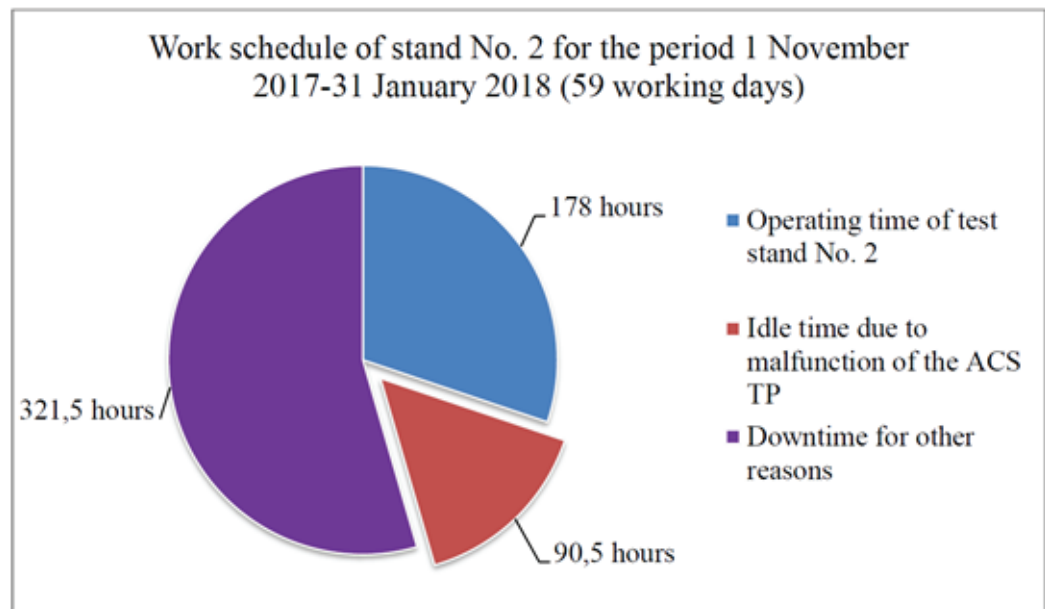


Figure 1: Schedule booth number 2

The main causes of downtime in terms of PCS and equipment were as follows: flawed system of technological protections and interlocks, no alarm system, no marking and cable products supply system design flaws in the manufacture of equipment, lack of backup software, no filtering system of analog signals, the absence of actual the state of the equipment, congestion interface. To prevent and pre-empt these causes of downtime analyze the project identified the problem and ways to overcome them in the field of instrumentation.[1-2]

### 1.1. Levels of automated process control systems

*Automatic control system(AMS)* - a set of hardware and software, as well as personnel for managing the various processes within the production process, production enterprises. There are three main levels in ACS, but we look at the field level, as he refers to a part of the main problems of instrumentation and automation (I) on test benches.

*Three basic levels of automation systems:*

*Field level.* The level of equipment. This level sensors, measuring devices, controlling controlled parameters, as well as actuators acting on the process parameters, to bring them in line with the job. At this level for adapting the sensor signals to the control inputs of the device, and commands generated by the actuators.

*Middle level.* Equipment management level. This is a level controller (PLC, Programmable Logic Controller).

*Top level.* The level of industrial servers, networking equipment, the level of operator and dispatcher stations.

The main objective of any test facilities is to collect technical information about the product and its properties. To solve this problem requires not only set the required parameters and test conditions Activity, but also to ensure the reliability, accuracy or completeness of the measured parameters, as well as the convenience of its further processing.

The purpose and objectives of the modernization of the stands:

- Increase the availability of the stand equipment APCS
- Reduce the time of diagnosis fault hardware and software complex 60 minutes (mean value) to 20 minutes
- Increase the resiliency of equipment in 2 times.
- Increase productivity by automating the operation of the equipment 1.5.
- Reduce the impact of human factors on the software system through the introduction of automated programs.
- Formulate an affordable and flexible interface.

## **1.2. Disadvantages of software and hardware complex and possible solutions**

This part deals with the shortcomings of the field level of PCS and possible solutions to problems that may be embedded in the company UDMZ. [1]

*Field level automation systems in terms of equipment.*

In this section, the shortcomings of the field level are provided. Shortcomings in the work of instrumentation and actuators are most commonly associated with the factory, design and operational errors.

Disadvantages of field level systems (see Figure 2.):

- no marking of cable products;
- use of cable products which are not intended for use at high temperatures;
- there is no system of cables to supply diesel generator sets;
- no system for installation of pressure sensors in the vicinity of the diesel unit to reduce the length of the impulse lines;

- the absence of a list of sensors capable of in terms of price / performance to replace foreign;
- the use of instrumentation, are not designed to operate at high values of vibration;
- no protection temperature sensors and pressure sensors in the sump from abrasion the cable in the ground inflection;
- use of secondary transducers to display parameters instead TCM complex;
- lack of standardization and unification of I / O signals.

At the moment, experts group ACS and diagnostic work is underway on the first five items in the list above, developed and implemented a range of measures to address these shortcomings.

To eliminate the cause of damage to the equipment due to high vibration values required secondary transfer inverter coolant pump and flow meter FAG, feeding lubricant to the induction motor bearings, on a test bench № 2 diesel unit to the stationary surface (e.g., wall).

To save money LLC "UDMZ" and reduce the burden on the operating personnel is necessary to avoid the use of secondary transducers temperature sensors, pressure, flow only necessary to display the current parameter values. Reducing the load on the operating personnel is achieved by lack of superfluous elements for maintenance and replacement as a result of reduced equipment downtime, resulting in cash savings of "UDMZ".

The use of silicone, heat-shrinkable tubing, a spring length of 40 to 80 mm will minimize the likelihood of mechanical damage to the cable temperature sensors and pressure sensors in said housing in areas of inflection.

Lack unify and standardize I / O signals increases the time of fault diagnosis and maintenance of the equipment, since require different approaches in dealing with them.

### **1.3. Ways to solve the problems identified test benches number 2,3,4**

To achieve the objectives of the modernization of stands, it is required to split them into several stages and to formulate them in the implementation of importance. [3]

*Step 1: (Marking of cable products and supply to the diesel unit)*

Problem: Due to lack of cable labeling, and impulse piping connection of measuring devices take a long time, so they had tinkled every line before connecting the sensor. The supply of electric cables creates a spider web, which prevents service personnel

carry out checks, measurements and other actions the installation of measuring devices. In connection with this problem, often pluck the wire that leads to the replacement of the cable line from the sensor to the module, and if the engine is in operation - that has to stop, and after troubleshooting, start the test again. (See. Fig. 5)

*Decision:* It is necessary to carry out the marking of cable products, implement a system for supplying electrical cables and impulse piping to the diesel unit.

If you pay at the statistics downtime for 2018, it is almost 2 months of the year, when the stand is not working. It is planned to reduce downtime by 70%, so at the moment finding the right cable to the sensor with a pro-sounding takes about an hour, the time that will be required after the first stage of modernization, in 20 minutes. (See. Fig. 6)

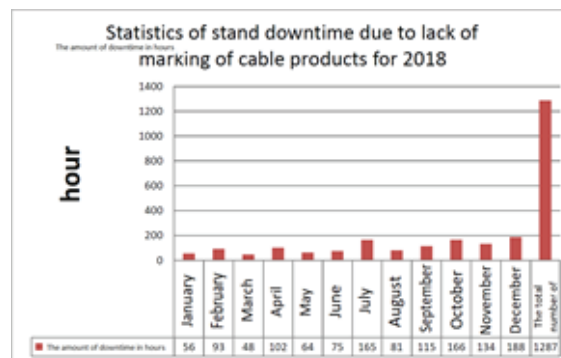


Figure 2: statistics to modernize standov.kolichestvo

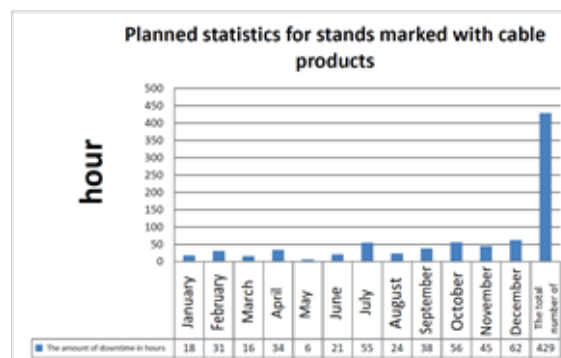


Figure 3: Statistics Planned stands after modernization.

*Step 2: (Replacement of cable products at high temperature cable).*

*Problem:* When testing the diesel unit at the booth, collectors often use cable products, which are not designed for high temperatures, which leads to the burning of the insulation and the credibility of the sensors measure engine parts. Which often have to look for the cause not the correct sensor readings, and stand in downtime.

*Solution:* Use a cable products designed to operate at high temperatures.

*Step 3: (Add the gain in ground sensor connection).*

Problem: temperature sensors, pressure, and other measuring instruments, no silicone seal, which prevents bending of the cable, leading to the chafing insulation and connection termination. This problem often leads to an emergency stop, because the sensor at break goes to the maximum value and the automation system goes into emergency mode. Service personnel have to perform on the spot soldering wires, which is time-consuming, and the operator to describe the cause of an emergency stop.

Solution: Use protective silicone tubing in areas of high mechanical impact on the sensor cable products.

*Step 4: (Selection of equipment with identical analog signals).*

Problem: Due to a variety of sensors connected to the module-output signal (4-20 mA, 0 to 5 mV, 0 to 10 mV et al.) Have to recheck the connection of each instrument or sensor. In the event of a failure and no ISP, it is necessary to order new sensor (average delivery 2-4 month and high cost). [3]

*Decision:* To standardize and unify the modules convert the sensor signals.

*Step 5: (Installation of equipment with anti-vibration).*

PRB: Installed devices on the test benches often fail because they have no protection against vibration, which is generated when running diesel unit. The importance of these devices is high, because they provide a complete package of information about fuel consumption, air, the presence of antifreeze and others. The cost of these devices is often high and the delivery of a long and out of one of the system can stop the stand for a few months.

*Decision:* Install instrumentation and actuators, which are not intended for use at high vibration on the stationary surface.

## 2. Conclusion

Implementation of measures specified in the project, does not exclude the occurrence of further faults in the control and instrumentation equipment, but reduces to a minimum the probability of their occurrence, reduce the human impact on the operation of the equipment.

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