ВИБРО БИТ

INTEGRATED SYSTEMS

INTEGRATED SYSTEMS

- ☑ *Vibration monitoring*
- ☑ *Complex monitoring*
- ☑ *Dynamic balancing*
- ☑ *Automated diagnostics*

AUTHENTICITY

SAFETY

RELIABILITY

SPE “Vibrobit” LLC core business is development and manufacture of Condition and Vibration Monitoring Systems (CVMS), information-technology (IT) systems, intended for mechanical status parameters continuous fixed measurement and monitoring of steam and gas turbines, turbocompressors, centrifugal pumps and other machines during their operation.

Active cooperation with domestic and foreign turbine manufacturers: “Power machines” JSC, “Kaluga Turbine Plant” JSC, “Ural Turbine Works” CJSC, “Turboatom” JSC, “Nevsky Zavod” CJSC, “HMS group” JSC (“Nasosenergomash Sumy” JSC) etc. – makes an opportunity to manufacture optimum, fully compatible vibration monitoring systems CVMS “Vibrobit” considering mechanical and technical properties of monitored equipment.

Wide range of products and services provided by the company “Vibrobit” LLC enables to complete equipment status fixed vibration monitoring system with equipment of one Manufacturer:

- sensors, primary amplifiers and converters, installation mechanisms, accessories, test stands;
- measurement and auxiliary secondary units, service equipment;
- software and hardware complex (SHC) Integrated System of Vibration Monitoring (ISVM) “Vibrobit Web.Net.Monitoring”;
- SHC Automatic Vibration Diagnostics System (AVDS) “Vibrobit Web.Net.Diagnostics”;
- SHC Automatic Dynamic Balancing System (ADBS) “Vibrobit Web.Net.Balancing”;
- erection supervision and pre-commissioning works, personnel counseling and education, warranty and post-warranty service.

SPE «Vibrobit» LLC Director A.G. Dobryakov

Internet network infrastructure development, significant cost reduction of high-speed channels arrangement, modern data safety technologies when transferring over Internet network allows for implementing the equipment status remote vibration monitoring and diagnostics system based on advanced technologies.

SPE “Vibrobit” LLC has proven development and deployment experience of integrated monitoring and diagnostics systems of turbine-generator sets and CHPP (Central Heating and Power Plant), SDPP (State District Power Plant), NPP (nuclear power plant) auxiliary equipment in Russia, Ukraine, Belarus, Kazakhstan and other countries.

In 2014 SPE “Vibrobit” LLC obtained computer software registration certificate for ‘Vibobit Web.Net. Monitoring” software system.

Integrated systems

Technical solutions and information technologies suggested by SPE "Vibrobit" LLC in implementing complex information monitoring and diagnostics system of industrial facilities enable to:

- Increase industrial facilities operation safety due to implementing control-safety shutdown and signaling system, preventing production equipment mechanical breakdown.
- Assess compliance with industrial equipment operation technical discipline.
- Plan repair works according to equipment actual status, decreasing repair works budget.
- Reduce expenditures to carry out scheduled and repair works, considering equipment actual status.
- Control economical and production performance of affiliates in "real-time" mode.
- Analyze reporting functions operating efficiency to a high degree of accuracy without need to request data from company officials.
- Create data base reserve storage of monitored equipment technical status (with separation according to types) to revise and optimize early stage defect detection diagnostic algorithms.
- Create highly skilled technical diagnostics groups of industrial equipment assessment (according to equipment type) to systematize statistical information for early authentic defect development prevention.
- Carry out research scientific work to optimize production equipment operating modes to increase industrial equipment service life, to increase technical discipline.

CVMS “Vibrobit”

CVMS “Vibrobit” enables optimum design of equipment monitoring and protection systems, introduce new equipment into existing APCS (Automatic Process Control System) without significant expenditures, obtain different vibration parameter values during unit start-up and fixed operation, keep unit parameters statistics for the purposes of vibration alignment and vibration diagnostics.

CVMS “Vibrobit” provides:

- parameters monitoring, signaling and equipment protection;
- keeping archives of equipment vibration status and operator actions;
- CVMS connection to station or local network to arrange monitoring integrated system of main and auxiliary equipment;
- adaptation of diagnostic and expert software.

SPE “Vibrobit” LLC-manufactured sensors and converters with rated electrical characteristics allows for fully completing CVMS “Vibrobit” system with own-manufactured equipment.

Equipment vibration status control measurement types:

- Mechanical parameters:
  - rotor speed;
  - rotor axial offset;
  - relative rotor expansion;
  - cylinder absolute expansion;
  - cylinder inclination;
  - rotor bending (eccentricity).
- Vibration parameters:
  - rotor relative vibration displacement;
  - bearing supports absolute vibration.
- Process parameters:
  - overspeed trip pin protrusion;
  - controls position;
  - generator active and reactive power.
- Thermotechnical parameters:
  - temperature;
  - ressure;
  - discharge etc.

SPE “Vibrobit” LLC company manufactures a series of auxiliary assemblies and accessories, intended to mount sensors and converters, which design is agreed with leading manufacturers of turbines, pumps etc.

ISVM “Vibrobit Web.Net Monitoring”

Integrated System of Vibration Monitoring (ISVM) is intended to join Condition and Vibration Monitoring Systems (CVMS). ISVM reserves measurement results from all CVMS and provides access to any unit status in company local network to Internet network remote users. Implemented in ISVM are turbine-generator set shaft balancing modules, ESCP (Electrical Submersible Centrifugal Pump) pumps, TFP (Turbo Feed Pump) pumps and also automated vibration diagnostics functions.

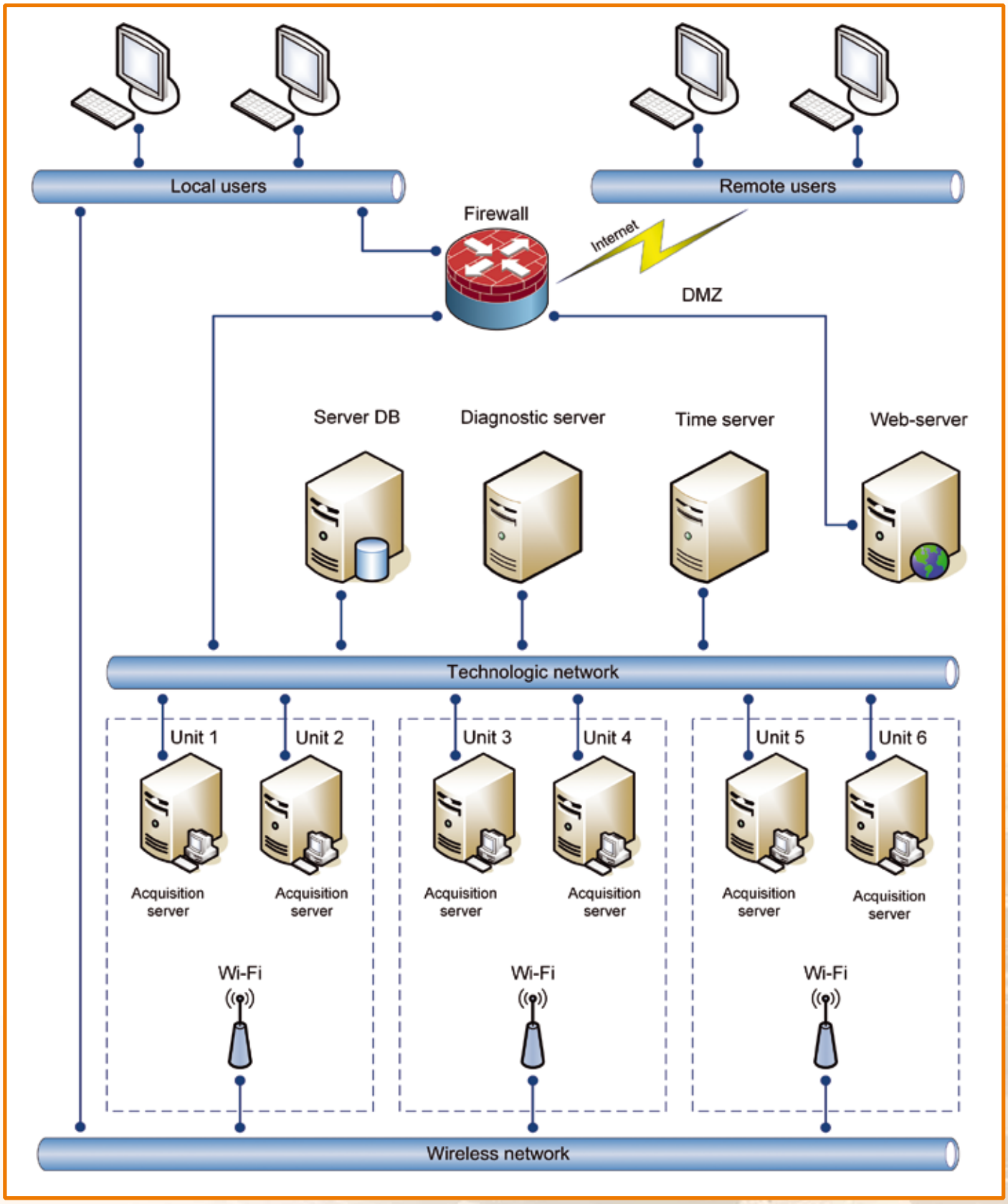
Users notwithstanding their location, address vibration monitoring web-server, using standard web-page browser. Upon passing authentication, user can select necessary equipment to be monitored. User can view equipment current status as tables, diagrams, mnemonic diagrams, reports etc.

Basic advantages of web-technologies implementation to provide equipment vibration status access:

- No need to purchase individual licenses for monitoring system client computers. Monitoring system clients can access monitoring data using standard web-browser installed on their computers (e.g. Chrome, Internet Explorer, Firefox) and do not depend on installed operating system (Windows, Linux etc.).
- Server software update do not require client software update .
- Implementation of monitored equipment full-scale monitoring system providing all possible reports, tables, graphs, diagrams etc.
- Arrangement of primary vibration diagnostics works without expert attendance need.
- Reliable built-in user authentication system, assigning access privileges to information and vibration monitoring system parameters control.
- Design and language settings flexible change system of user data presentation depending on user regional settings.
- Data transfer via standard Internet network protocols, requiring no network equipment configuration change of Internet network provides.

The system sends data over Internet network for remote analysis, equipment status accounting, carrying out diagnostic works. Additional setup allows for data exchange over OPC or Modbus protocol to company APCS system.

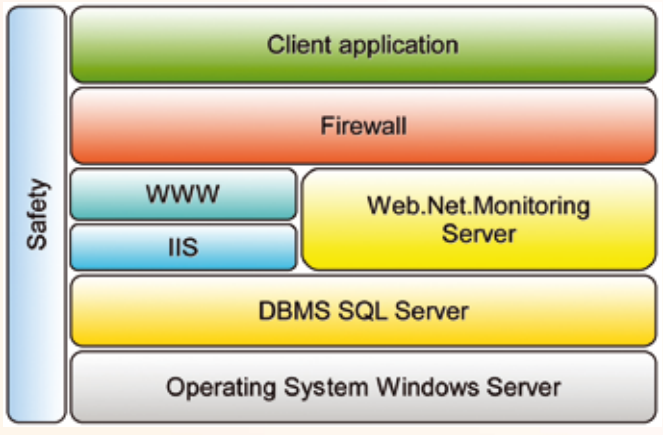
ISVM “Vibrobit Web.Net Monitoring” block schematic diagram



Safety

Safety – is one of the most important factors when designing modern vibration monitoring systems. Due regards are paid to ISVM "Vibrobit Web.Net.Monitoring" information safety at all system functioning levels.

Safety is provided on several levels, preventing unauthorized access to data and completely preventing external access to process servers and equipment.



Operating system level

Modern server operating system Microsoft Windows Server is used as operating system. Operating system security policy can be used to flexibly configure access rules and permissions for actions execution.

DBMS level

Microsoft SQL Server is used as Data Base Management System (DBMS). Safety is implemented as usernames, users, roles and diagrams.

Server-side applications level

Data acquisition service and archiving service are started at application level from system name and do not require additional system login at startup.

Microsoft Internet Integration Services (IIS) is used as web-server. IIS security consists of five main elements: authentication, access control, encryption, audit and certificates.

Data can be safely exchanged between server and client using encryption. Server certificates enable user to confirm web-site authenticity (web-server content authenticity warranty and connection safety system integrity).

Implemented in web-application are user authentication and access rights differentiation according to roles. All data entry forms undergo validity check, preventing such application attacks as XSS.

Firewall

Server and client software are separated with hardware firewall. Firewall controls and filters packets passing through it according to the established rules, effectively fighting different DDoS-attacks and vulnerabilities of different network protocols. Firewall prevents external access to process network, permitting only web-interface access.

Client applications level

From client side the software provides safety by checking user input data.

Information provision and mobile solutions

Information is provided to operator workstation of operator, vibration diagnostics engineer or any other expert using web-browser (e.g. Chrome, Internet Explorer, Firefox).

The following pages are generally provided:

- parameter tables
- mnemonic diagrams;
- histograms;
- signal oscillograms and spectrograms;
- polar diagrams;
- Nyquist plot and parameter dependence diagram;
- rotor and supports movement orbit;
- graphs;
- reports;
- defect identification window;
- shaft line additional balancing;
- event logs.

Current data presentation

ISVM “Vibrobit Web.Net.Monitoring” provides recording of:

- thermotechnical, mechanical and electrical parameters measurement results;
- warning and alarm setpoints overrange messages;
- current vibration velocity root mean square value of bearing housing by three components (vertical, transverse, axial);
- current amplitude values and rotor vibration displacement excursion in vertical and transverse directions;
- low frequency, high frequency vibration;
- vibration signals range;
- vibration step;
- measured parameters trends.

Refresh period is user-defined from 1 second and more.

Implemented in system is intuitive interface considering personal preferences of specific user and multi-language support. Therewith it is possible to use own interface language for every account.

Current data can be presented in the following variants:

- as tables;

Bearing support vibration. RMS (mm/s)

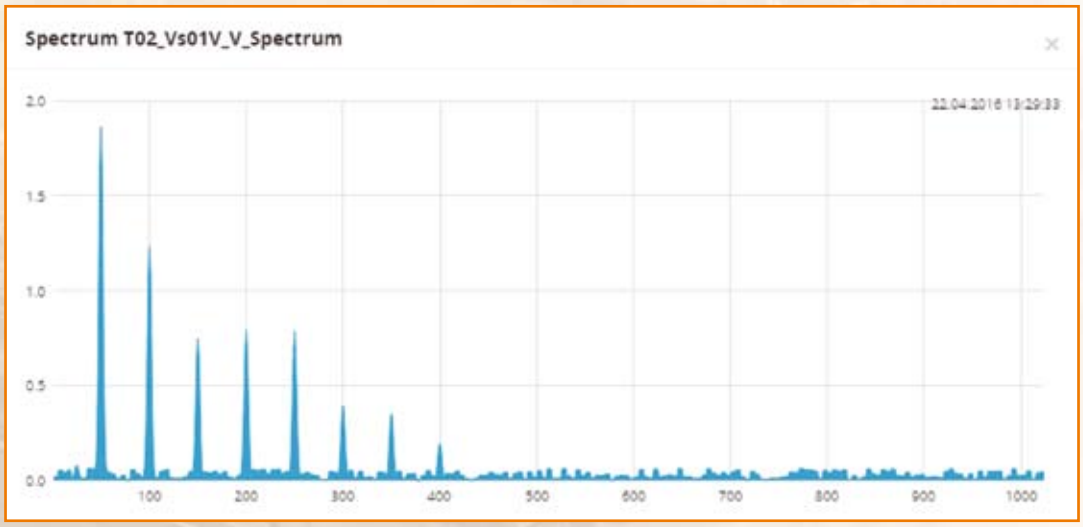
	01	02	03	04	05	06	07	08	09	10	11
V	2,55	2,61	2,56	2,68	2,54	2,63	2,58	2,56	2,70	2,51	2,60
T	2,50	2,70	2,65	2,54	2,56	2,66	2,63	2,61	2,59	2,58	2,65
A	2,68	2,64	2,55	2,60	2,56	2,62	2,53	2,69	2,59	2,55	2,59

- as histograms.

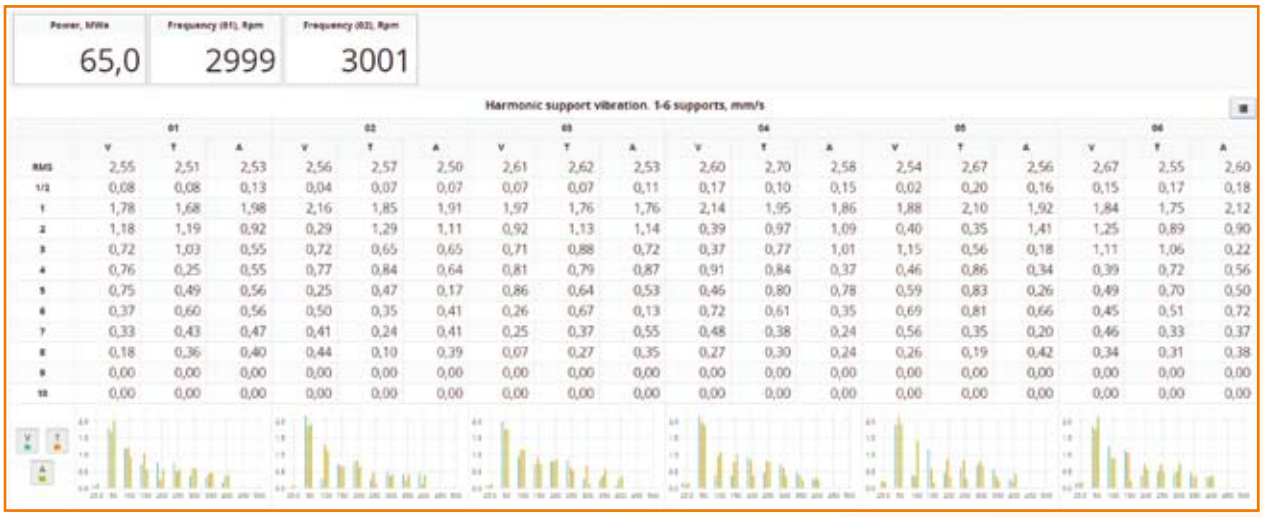
Parameter background has different color depending on setpoint importance level:

- red color - alarm setpoint;
- yellow color - warning setpoint;
- blue color - prepare setpoint.

Current vibration spectra can be presented as a graph.



Vibration harmonics can be presented as a table and using histograms.



Power, MWe	Frequency (01), Rpm	Frequency (02), Rpm
65,0	2999	3001

Harmonic support vibration. 1-6 supports, mm/s

	01			02			03			04			05			06		
	V	T	A	V	T	A	V	T	A	V	T	A	V	T	A	V	T	A
RMS	2,55	2,51	2,53	2,56	2,57	2,50	2,61	2,62	2,53	2,60	2,70	2,58	2,54	2,67	2,56	2,67	2,55	2,60
1/2	0,08	0,08	0,13	0,04	0,07	0,07	0,07	0,07	0,11	0,17	0,10	0,15	0,02	0,20	0,16	0,15	0,17	0,18
1	1,78	1,68	1,98	2,16	1,85	1,91	1,97	1,76	1,76	2,14	1,95	1,86	1,88	2,10	1,92	1,84	1,75	2,12
2	1,18	1,19	0,92	0,29	1,29	1,11	0,92	1,13	1,14	0,39	0,97	1,09	0,40	0,35	1,41	1,25	0,89	0,90
3	0,72	1,03	0,55	0,72	0,65	0,65	0,71	0,88	0,72	0,37	0,77	1,01	1,15	0,56	0,18	1,11	1,06	0,22
4	0,76	0,25	0,55	0,77	0,84	0,64	0,81	0,79	0,87	0,91	0,84	0,37	0,46	0,86	0,34	0,39	0,72	0,56
5	0,75	0,49	0,56	0,25	0,47	0,17	0,86	0,64	0,53	0,46	0,80	0,78	0,59	0,83	0,26	0,49	0,70	0,50
6	0,37	0,60	0,56	0,50	0,35	0,41	0,26	0,67	0,13	0,72	0,61	0,35	0,69	0,81	0,66	0,45	0,51	0,72
7	0,33	0,43	0,47	0,41	0,24	0,41	0,25	0,37	0,55	0,48	0,38	0,24	0,56	0,35	0,20	0,46	0,33	0,37
8	0,18	0,36	0,40	0,44	0,10	0,39	0,07	0,27	0,35	0,27	0,30	0,24	0,26	0,19	0,42	0,34	0,31	0,38
9	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
10	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00

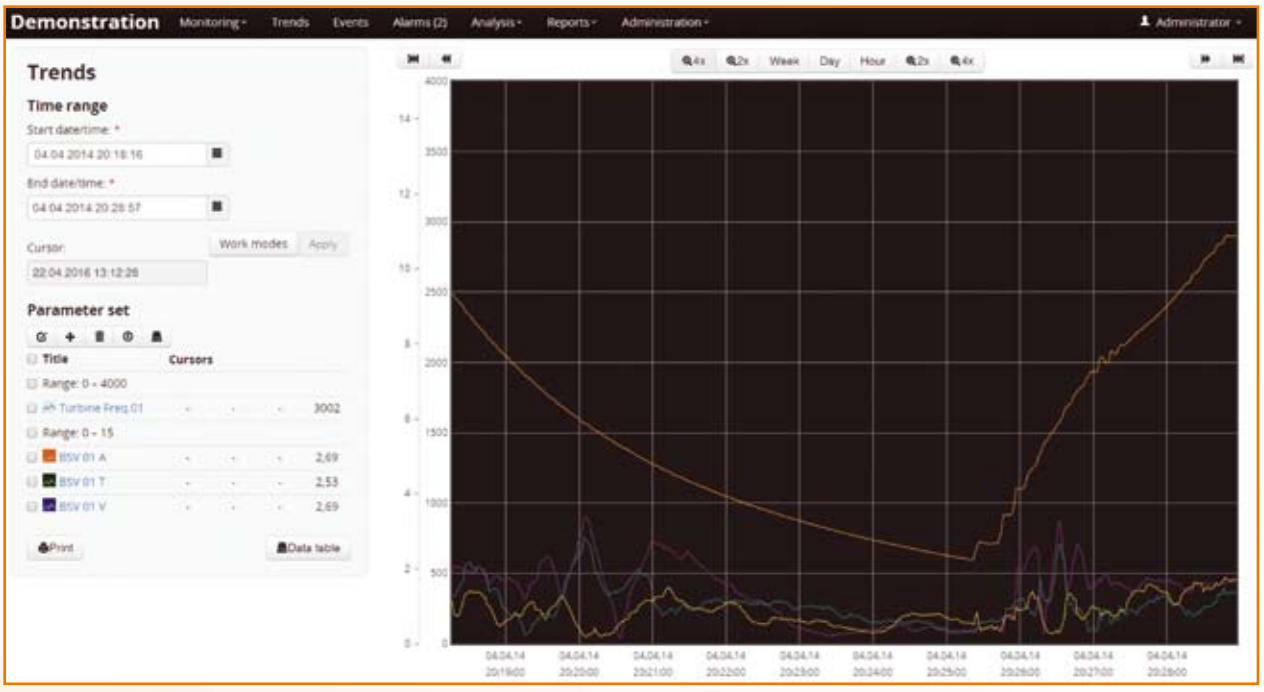
Any current data can be exported into CSV.

Archive data presentation

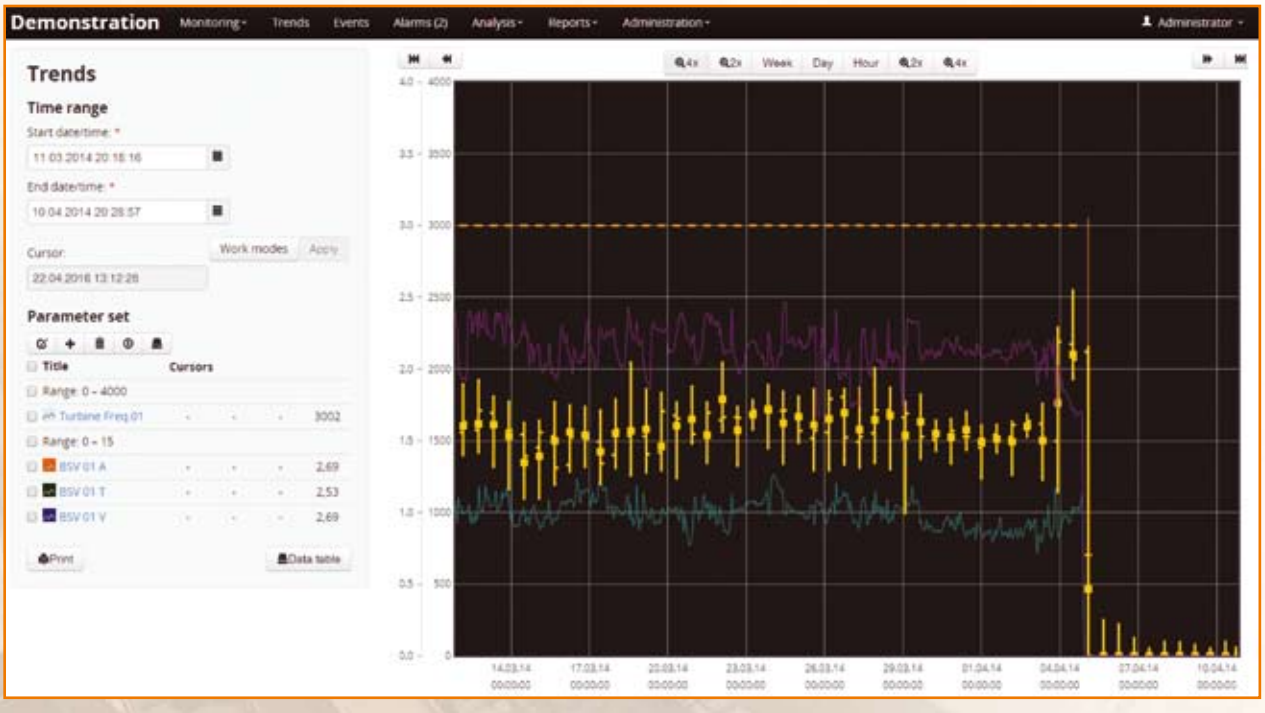
Archive data can be viewed in the same way as current data using retro-mode function. To this end specify date, time for viewing and data scrolling speed.

Besides above mention data presentation, offered is archive data presentation as graphs. The follwing presentation is possible:

- as lines;



- as candles.

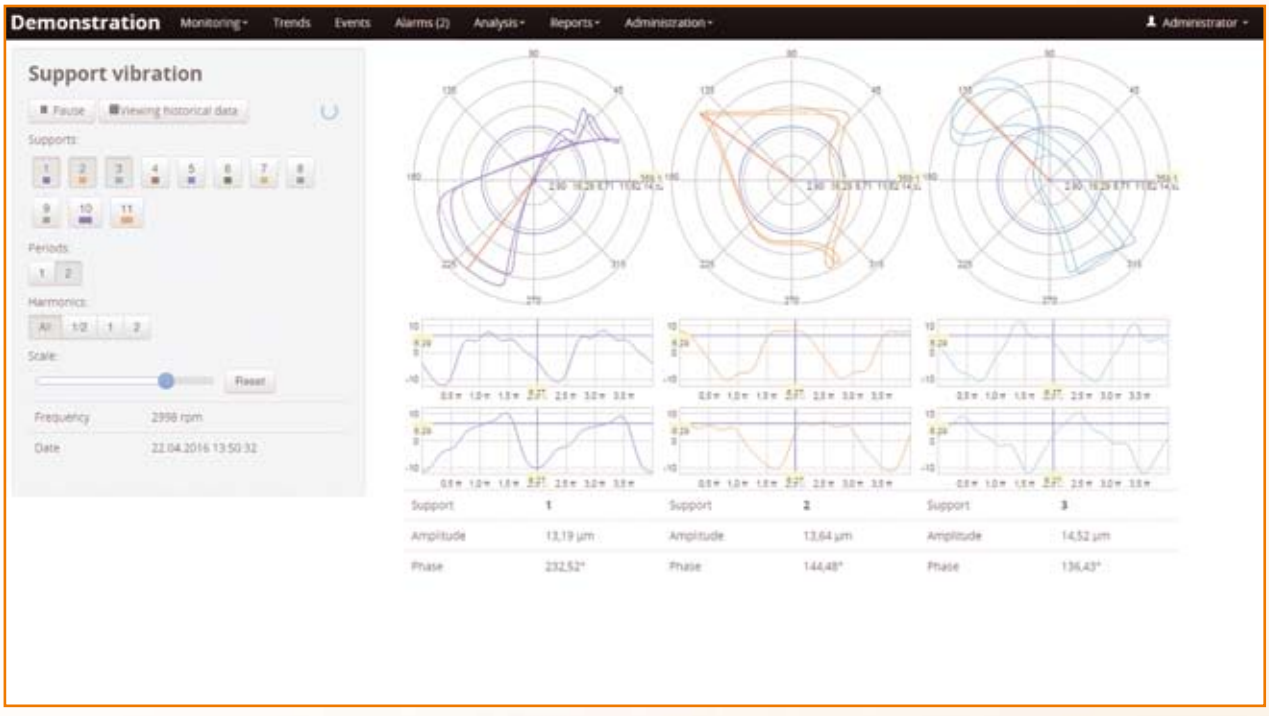


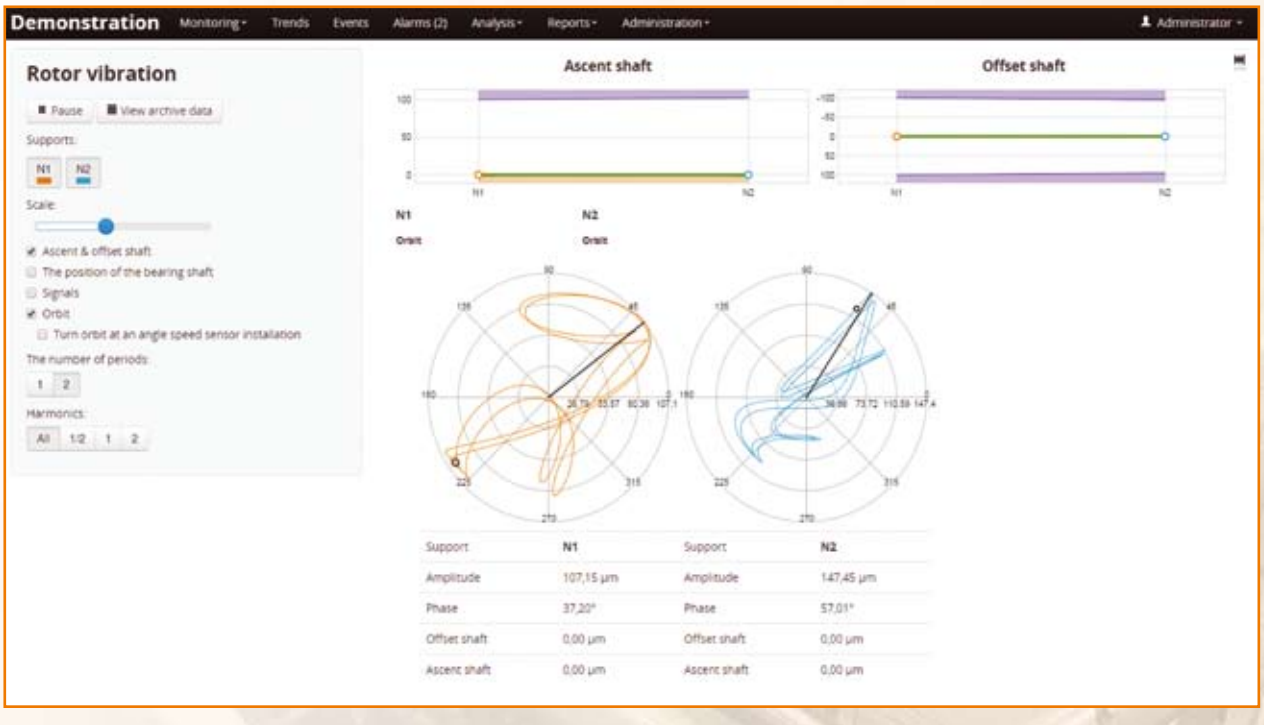
Parameters presentation on graph as candles enables to analyze parameter measured data over large time period.

Data analysis

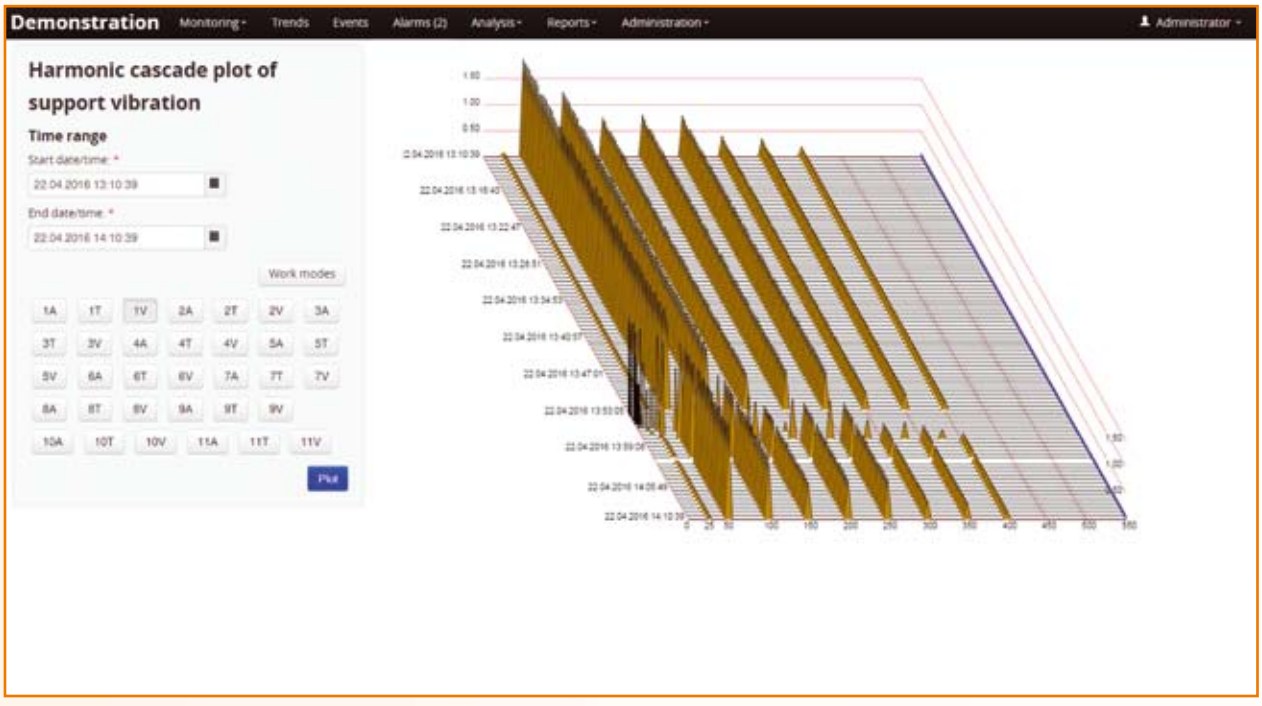
Vibrobit Web.Net.Monitoring" upper level SW provides vast capabilities to analyze measured data.

Calculated is movement orbit (precession) according to bearing support vibration sensors or according to shaft vibration sensors with calculating maximum deviation angle and signal oscillograms indication by vertical and transverse component, floating, displacement, shaft position in bearing.

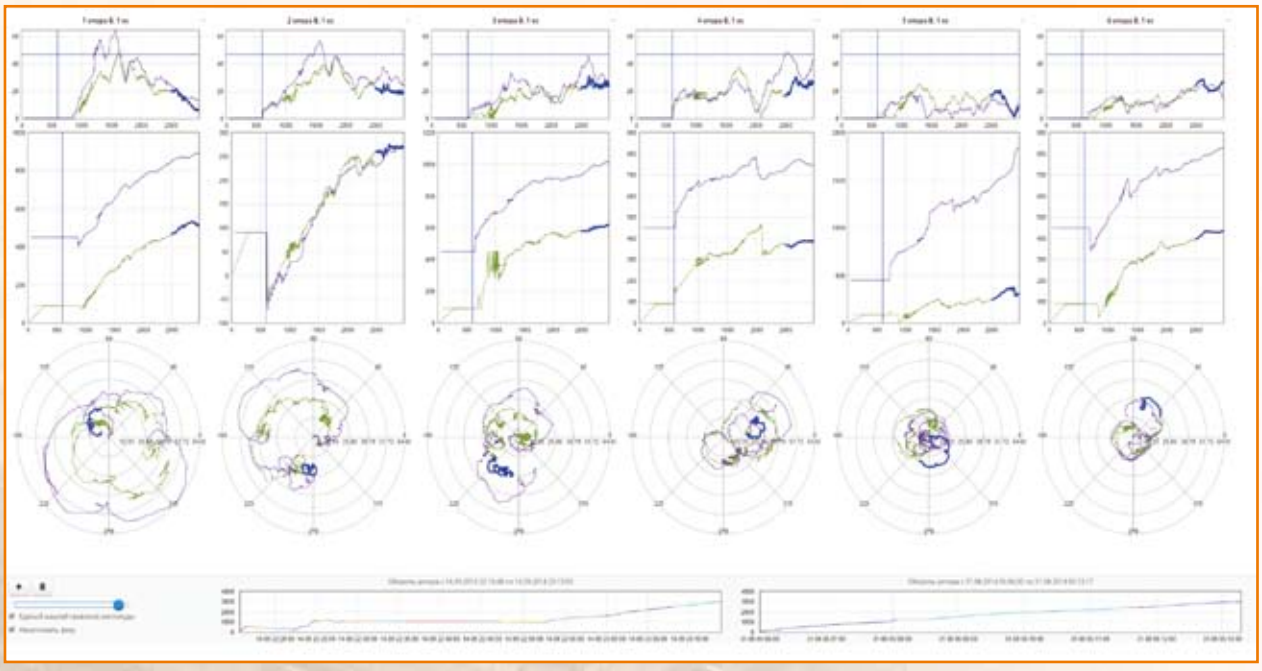




Cascade spectrum can be plotted to indicate archive spectra.



Nyquist plot can be analyzed to analyze starts and stops. Bode diagrams and Nyquist diagrams are indicated on Nyquist plot.



Events

ISVM “Vibrobit Web.Net.Monitoring” records actuation, confirmation and deactivation of all events.

Active events requiring operator confirmation are indicated as alarm table.

Archive events can be viewed using event log. Besides it is possible to generate event report for specified time period.

Mobile solutions

Equipment operation status can be monitored not only from traditional fixed operator AW, but also from mobile devices, e.g. from tablet PC.

When arranging wireless process Wi-Fi network, new service appears which was absent or hampered before – these are fixed system full-scale monitoring functions in close vicinity to monitored equipment.

Servicing personnel provided with full operation information on monitored object status when carrying out scheduled or repair works, can significantly decrease work completion time and increase their quality.

E.g. when carrying out vibration measurement channels serviceability check (verification), by comparison with reference portable measurement instrument or sensor installation on vibration stand, experts can monitor fixed vibration monitoring system readings, plot parameters measurement graphs, generate reports etc.

Another example. When carrying out balancing works, experts execute preliminary calculation of balancing loads placement on their work personal computer. When attending unit with a tablet they have the same software as on personal computer with electronic calculated data. In close vicinity to the unit, if necessary, it is possible to change balancing criteria, re-calculate (correct) loads placement and record introduced changes into the balancing data base, analyze executed balancing.

AVDS “Vibrobit Web.Net.Diagnostics”

AVDS “Vibrobit Web.Net.Diagnostics” is intended for mechanical status continuous fixed vibration diagnostics of steam and gas turbines, turbocompressors, centrifugal pumps and other bearing-mounted machines during their operation.

AVDS “Vibrobit Web.Net.Diagnostics” is based on ISVM “Vibrobit Web.Net.Monitoring” implementing vibration diagnostics algorithms of SPE “Vibrobit” LLC and outside experts on vibration diagnostics.

AVDS “Vibrobit Web.Net.Diagnostics” provides:

- turbine-generator set effective operation, safety level increase and technological processes fail-safety;
- timely submitting full and authentic information on production equipment status to operation personnel;
- preventing personnel faulty actions;
- timely detection of production equipment possible defects;
- vibration alignment works servicing;
- operation and equipment repair cost saving.

AVDS “Vibrobit Web.Net.Diagnostics” functions

AVDS “Vibrobit” implements the following functions:

- determining diagnosable defects and submitting recommendations to personnel;
- presenting information on diagnostic station still frames;
- information recording and documenting;
- archive logging;
- vibration alignment works support;
- provides information exchange with adjacent systems using digital protocols.

List of diagnosable defects

When processing current information on vibration and thermotechnical parameters considering turbine-generator set operating modes, AVDS “Vibrobit Web.Net. Diagnostics” detects the following defects:

- rotor crack;
- imbalance;
- rotor centering failure;
- rigid coupling connection defects (bent connection, axle break);
- bearing babbit wearing;
- support system weakness;
- front and radial interference;
- rotor journals ovality
- unexpected imbalance;
- low frequency oil vibration;
- steam low frequency vibration;
- tie bolts break;
- defects of mounting and roller bearings.

Besides listed above, the system is capable of diagnosing other defects typical to specific rotor equipment.

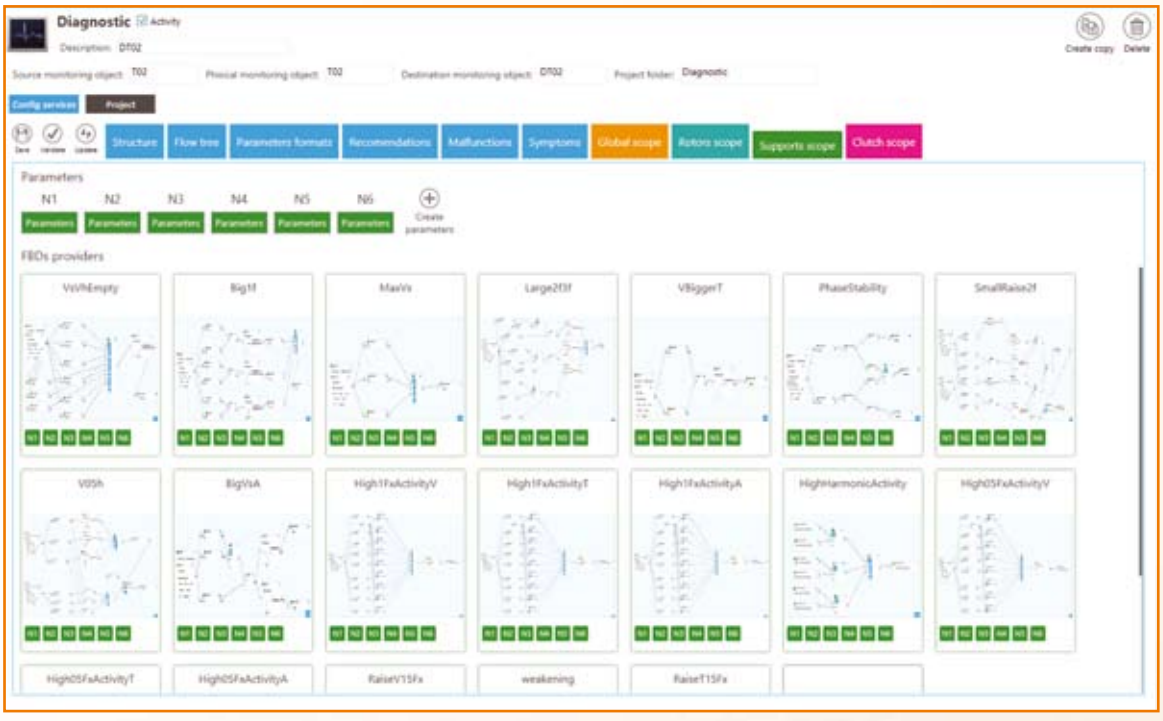
AVDS “Vibrobit Web.Net.Diagnostics” configuration

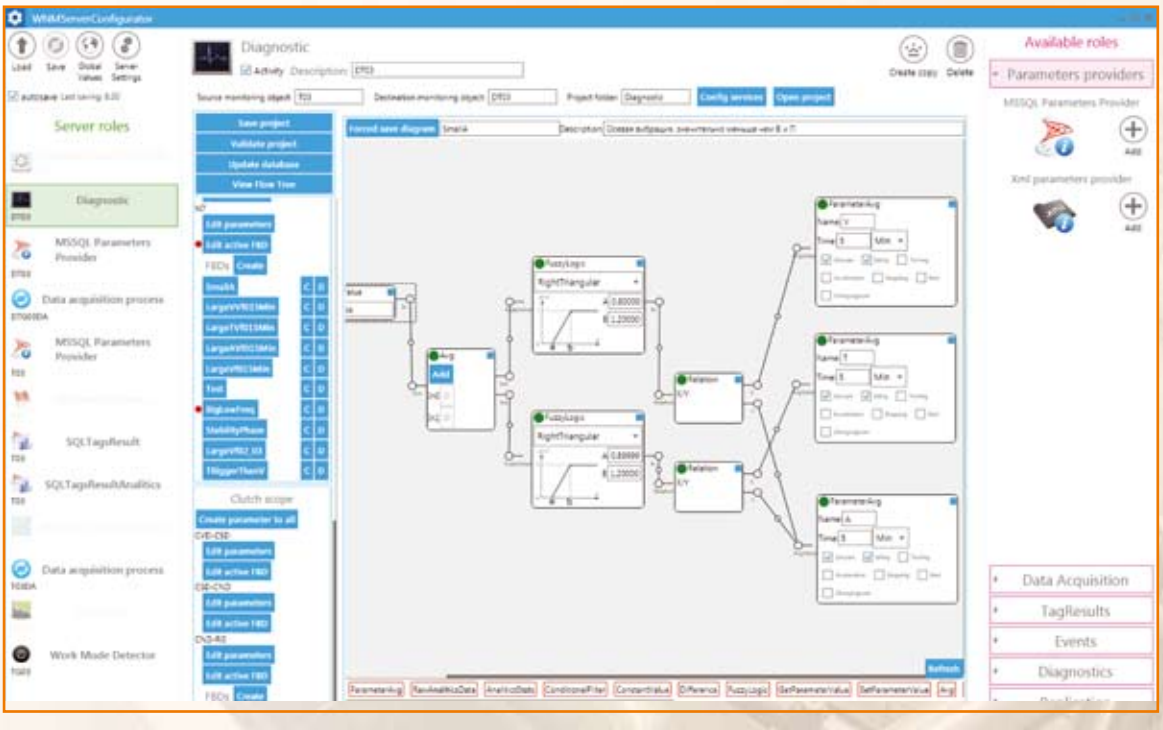
Vibration diagnostics experts can create own algorithms, correct and test them.

Diagnostics algorithm setup consists of creating fuzzy cognitive map, similar in appearance to algorithm block diagram.

First it is necessary to plot diagnostic model of diagnostics object. Describe possible places of defect occurrence.

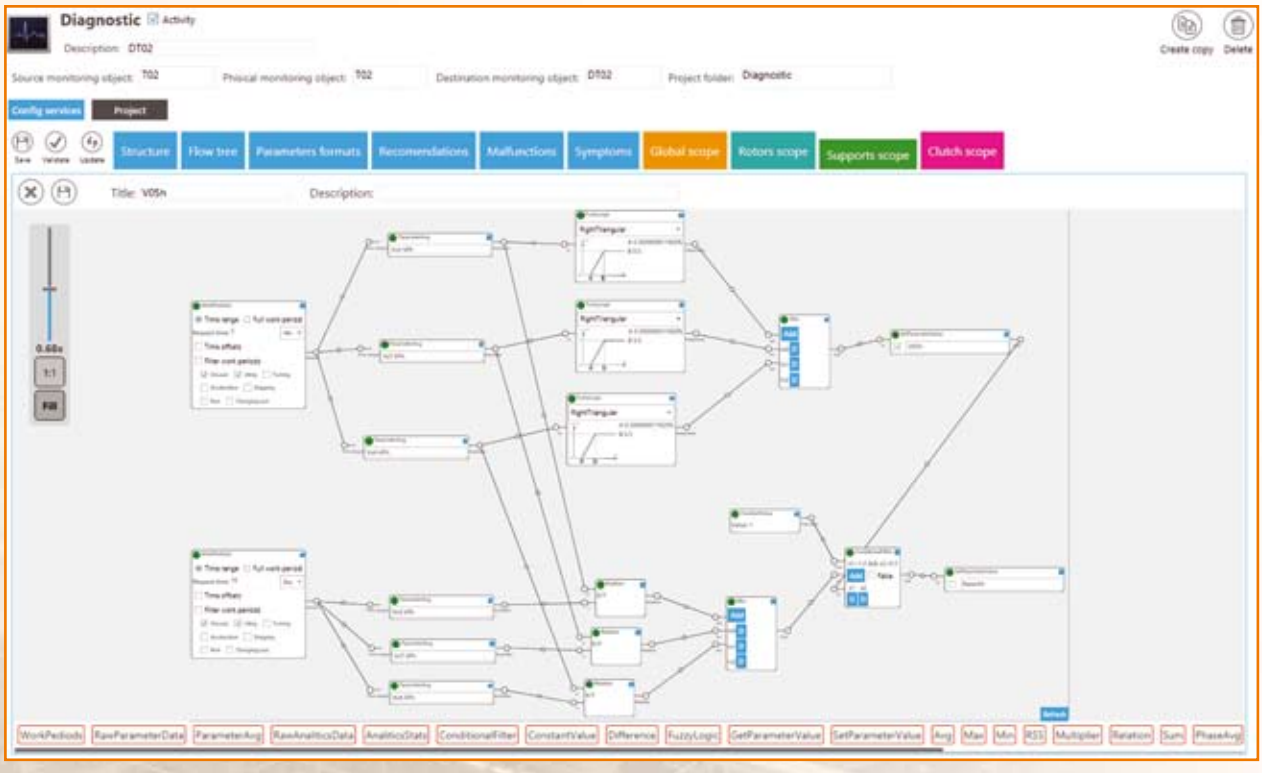
Then create and setup diagnostic projects. Each diagnostic project consists of tasks to determine specific diagnostic defects and object status as a whole.





Every diagnostic task is developed from diagnostic units, such as:

- shaft line displacement and floating analysis units;
- detecting shaft position in bearing (detecting shaft position zone, relative and dynamic eccentricity);
- Nyquist plot analysis units of starts and stops;
- tracing amplitude change tendencies on critical frequencies;
- detecting process parameter value increase tendencies;
- spectra frequency analysis;
- vibration phases stability detection;
- phase difference analysis;
- analytical data provider;
- archive data provider;
- parameters ratio calculation;
- fuzzification;
- diagnostic values weight factor;
- conditional filtering and diagnostic values conversion;
- maximum value searching unit etc.



Upon units' connection between themselves, input and output parameters setup of every unit, diagnostic algorithm adapts to the extent possible to the specific diagnosed object.

AVDS “Vibrobit Web.Net.Diagnostics” information presentation

Window “Diagnostics” presents the following information:

- defects array;
- recommendation messages;
- diagnostic messages log.

Defects array

Defects array is a table, which line headers indicate list of diagnosable defects and their symptoms, and column headers – list of diagnosable object parts. Table cells contain a digital value of specific defect detecting precision or symptom for diagnostic object specific part.

Defects array provides diagnosing importance color graduation of specific defect or defect symptom.

- green – defect or symptom is not yet developed or renders immaterial effect at diagnosable object current vibration status;
- yellow – defect or symptom has positive dynamics or renders significant effect at diagnosable object current vibration status;
- red – defect or symptom shows dangerous emerging or developed processes, accompanied with vibration parameters increase

Diagnostic messages

“Diagnostics” window lower part indicates a list of active diagnostic messages. Diagnostic messages present user the following information:

- defects array values supplements or commentaries;
- detected dangerous tendencies of vibration processes;
- detected dangerous emerging processes;
- personnel actions recommendations;

Other diagnostic information enabling personnel to better determine studied unit current status and pointing at “places” to pay attention to. Some diagnostic messages contain additional description, containing message appearance reasons.

	N1	CVD	N2	CVD-CND	N3	CND	N4	CND-РГ	N5	RG	N6
Rotor displacement		73				25				0	
The prevalence of vertical and transverse vibration	93		100		0		0		0		0
The prevalence of 1X	0		100		0		100		0		0
Misalignment	25			17				34			
V > T 50%	0		0		0		43		0		0
The prevalence of 2X and 3X	97		0		100		15		100		100
Elbow coupling				23				19			
The stability of phases	100		100		100		100		100		100
Harmonics differ by 180 degrees				35				18			
Increase 2X	14		0		0		17		23		11
LF vibration	0		0		0		0		0		0
Rotor bending		25				75				32	
The prevalence of axial vibration	0		0		100		100		100		26
The prevalence of 1X	0		100		0		100		0		0

ADBS “Vibrobit Web.Net.Balancing”

Rotor machines technical status is determined in the first place by determining rotor (shaft line) dynamic balance. Imbalance dynamic forces are the most powerful exciting forces in a mechanism. Rotor mechanism dynamic balancing basis – vibration of bearing support decrease, providing unit safe operation.

Automatic Dynamic Balancing System “Vibrobit Web.Net.Balancing” is intended to balance machine rotor on own bearings. Balancing masses are calculated according to RD (Ruling document) 153-34.1-30.604-00 “Methodology instructions on balancing turbine-generator set multirotor bearing systems on power plants”.

ADBS “Vibrobit Web.Net.Balancing” supports the following functions:

- calculating masses and balancing load position depending on selected optimization criteria;
- calculation of resident vibration after balancing loads installation;
- dynamic influence coefficient array calculation and correction;
- reception of vibration parameter values from ISVM “Vibrobit Web.Net.Monitoring” and manual input;
- balancing works archive long-term storage;
- balancing works report generation;
- simultaneous operation with several balancing objects in multi-user mode;
- current balancing stage long-term storage;
- application of tablet PC and wireless communication to work in close vicinity to balancing object;
- balancing loads installation and removal log keeping.

Implemented in ADBS “Vibrobit Web.Net.Balancing” is intuitive interface allowing for convenient and high-quality balancing of rotors and shaft lines.

Integrated system configuration

Integrated system configuration is determined by monitored equipment content and specifications, available network and sever infrastructure, customer system requirements.

SPE “Vibrobit” LLC experts rely upon the following main factors when selecting integrated system implementation technical solution:

- List of monitored equipment, fixed CVMS type and configuration.
- Existing APCS specifications for process information exchange.
- Customer requirements for system specifications and equipment arrangement.
- Production equipment maintenance schedule.
- Providing process, information and commercial safety of automation object.
- Operator AW arrangement according to vibration diagnostics and dynamic balancing.
- Providing customer interested experts with information on monitored equipment technical status using web-interface without additional software installation on work computers.
- Providing customer experts with remote access to information on monitored equipment technical status using Internet network.
- Application of data encryption safe algorithms in Internet network, arranging VPN-tunnels (virtual private network).
- Providing SPE “Vibrobit” LLC documented confidentiality liabilities and responsibilities and taking steps to prevent 3-rd parties from obtaining automation object process information.

To implement integrated systems, SPE “Vibrobit” LLC uses highly reliable, acknowledged equipment:

- Cisco Systems, Inc. switching equipment.
- Hewlett-Packard server equipment.
- iRobo industrial computers.
- American Power Conversion (APC) uninterruptible power supply systems.
- Lenovo work stations and tablet PC.
- Rittal telecommunications cabinets.

Licenses and certificates


CERTIFICATE OF CONFORMITY


СВИДЕТЕЛЬСТВО


СВИДЕТЕЛЬСТВО


СВИДЕТЕЛЬСТВО


СВИДЕТЕЛЬСТВО


ЛИЦЕНЗИЯ


ЛИЦЕНЗИЯ


ЛИЦЕНЗИЯ


ЛИЦЕНЗИЯ

Information support

SPE “Vibrobit” LLC products detailed information is available in electronic form on official site www.vibrobit.ru:

- technical documentation (Maintenance Manuals, specifications etc.);
- information materials (news, publications, articles, copies of certificates and licenses);
- latest software versions;
- advertising materials (brochures, reference catalogs);
- contact information.

SPE “Vibrobit” LLC

8, Kapustina st., Rostov-on-Don, Russia, 344092
+7 863 218-24-75
+7 863 218-24-78
www.vibrobit.ru
info@vibrobit.ru

Representation offices

India

PADMAPAT ENGINEERS
102, Phase-II, City Centre, The Mall, Kanpur (U.P.)
+91 512 2332599
vijayantpatni@gmail.com

Russia

Tumen
Science and Production Association
“Grad” LLC
+7 3452 78-15-71
+7 3452 75-47-36

Novosibirsk
“E4-SibCOTES” CJSC
+7 383 227-60-00
+7 383 355-33-65

Yekaterinburg
“SNG – EK” LLC
+7 343 217-24-96
+7 922 223-52-38

Naberezhnye Chelny
Branch “KER – Engineering” LLC
“KER – Avtomatika”
+7 8552 39-53-54

St. Petersburg
“EnergoTekhMontazh” LLC
+7 812 387-99-43

Ukraine

Kiev
SPE “UKRVIBROBIT” LLC
+38 067 442-41-50

Kharkov
Joint Venture
“VIBROBIT-UKRAINE”
+38 057 370-11-00
+38 057 370-11-01

Kazakhstan

Karaganda
KNUAP
+7 7212-56-34-21

Ekibastuz
“Zheklen-EK” PLC
+7 7187 22-24-83

Belarus

Minsk
“Unimer” LLC
+7 375 17 210-54-29
+7 375 17 210-52-16