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MAINTENANCE 2007

MAINTENANCE ADVISORY SYSTEM

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Key words:

- Maintenance
- Condition Monitoring
- PdM

ABSTRACT:

We review the BDES (Board of Diagnostic Expert System), the IFSS web based Information and Fault Statistic System, the Risk Analyzer complex software system dedicated for maintenance advisory function. We describe shortly the ThermoALERT, LeakageALERT, OilALERT, and FerroALERT interactive expert software, their applications and connection to SAP PM module.

INTRODUCTION

This paper shortly describes the results of software development, what was realized in the framework of MOL's (Hungarian Oil and Gas Company) On-line Diagnostic Project. The main goal of the project was the installation of on-line vibration monitoring systems for surveillance 100 strategically most important rotating machinery. The new on-line systems were integrated into one surveillance system, which means that, all of them work into one central database, placed on a central server computer in the server room of the Refinery Szazhalombatta.

Parallel to the on-line systems have been installed an off-line vibration monitoring system with two ExpertALERT automated asset management diagnostic software with two independent database. These databases are synchronized by replication.

The off-line and on-line databases of ExpertALERT contain the measured data, the results of data evaluation, the analysis results and the reports on the machines condition with machine faults, an estimation of fault severity, and recommendation for maintenance action.

GOAL OF SOFTWARE DEVELOPMENT

As the part of the on-line project the next software development goals were formulate:

- Develop specific expert systems for analysis the next diagnostic data: thermo images of rotating machines, oil analysis, ferrography and sealing leak detection.

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- Integrate the results of ExpertALERT and the newly developed expert software into a unique system
- Develop a software, handling the risk matrix for rotating machinery risk classification
- Develop a web-based information system for spreading the diagnostic information in the company's LAN
- Develop an interface between the diagnostic systems and the SAP PM module
- Develop a software module for scheduling of measurements
- Develop a machine registry database developing software

The next figure shows the schema of the developed software system:

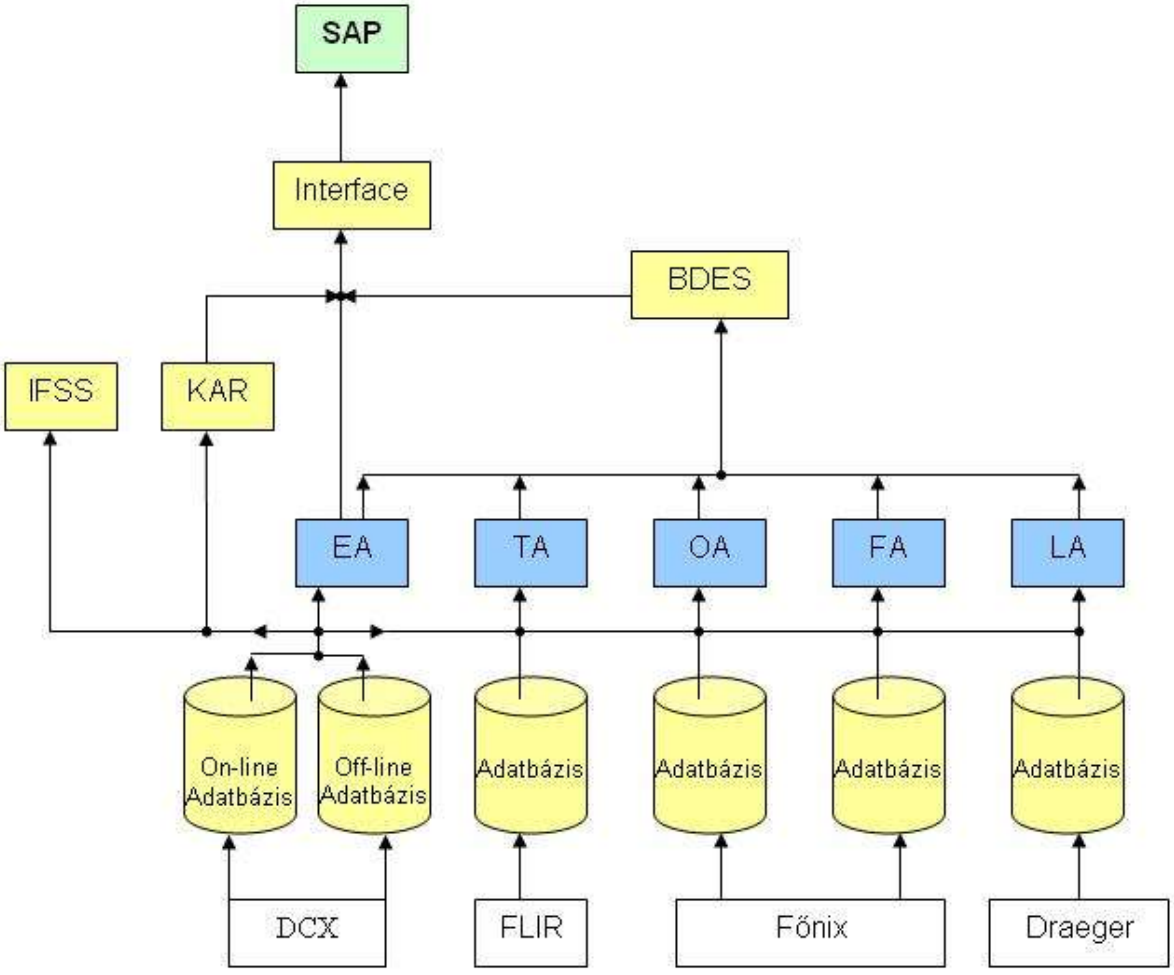

Figure 1. Schema of the software system developed for MOL Refinery

This schema do not contain the Machine Registry software, which is a stand alone software, what has a contact to the ExpertALERT database. The software module for scheduling measurement work is integrated into the SAP Interface.

CHARACTERISTICS OF THE SOFTWARE MODULES

In this chapter we describe in a short manner the main function of the software modules showing a few screen displays.

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ExpertALERT- SAP connection

- Controlled sending the reports from ExpertALERT database to SAP
- Automatic organization of measurement into routs depending on data in EA DB and parameters given by user and sending routs to the SAP
- Sending the actual risk values of machines to SAP, estimated by Risk Analyzer SW

Machines' Registry

- Machine registry DB developing and handling system with dinamic templates. Flexible datahandling and export
- Sincronization between ExpertALERT DB and Machine Registry DB is realized by an independent software module
- The basic data can be transfered from EA DB.

Risk Analyzer

- Site specific
- Can identify the risk rating of machines on the base of the result of automatic analysis made by ExpertALERT and categorization of experts at customers
- Example on the risk matrix

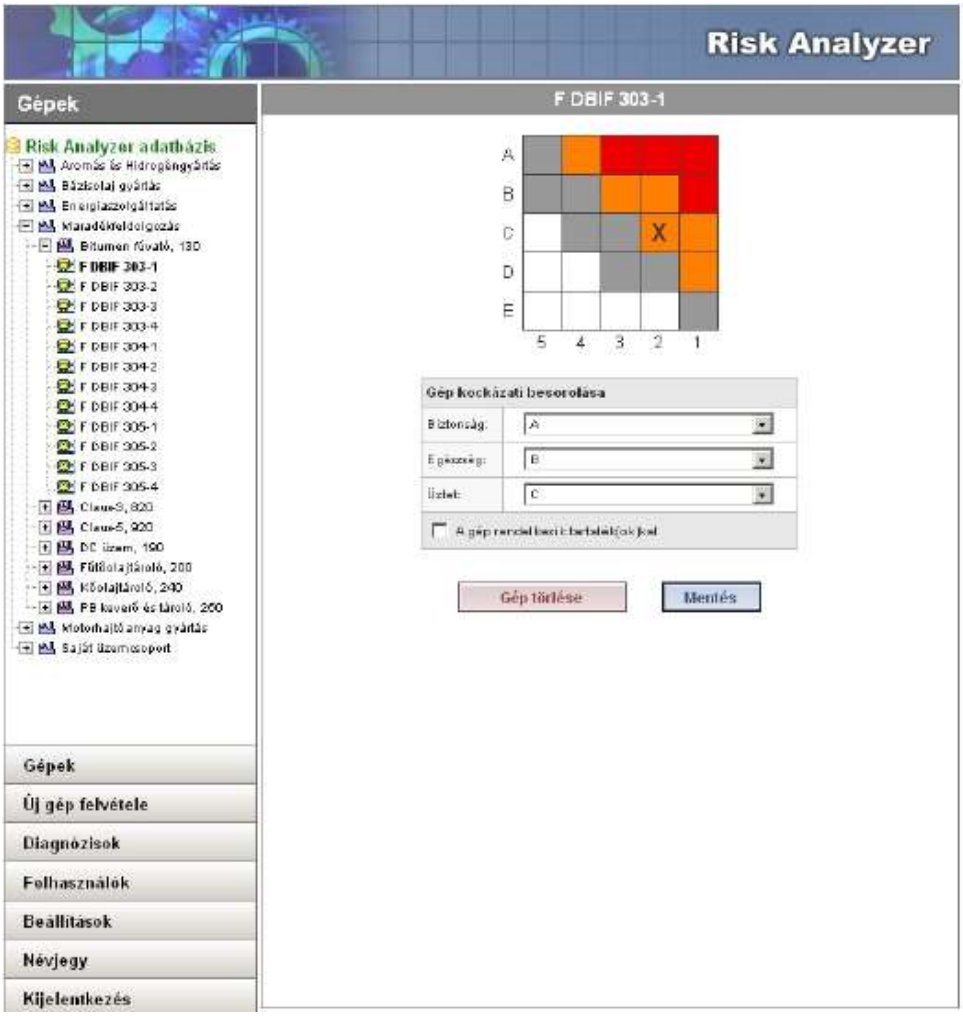

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Figure 2. Screen display of Risk Analyzer software module

ThermoALERT

- Systematic storage of thermographic images in a central database, their handling, and interactive report generation
- Retrieval of data
- Unified handling of thermo images – the photo (JPG files) and the thermographic data (CSV) are in different portfolio. It can analyze IR images made by devices of all IR camera producers
- drawing areas and lines
- histogram data
- Interactive analysis
- Confirmation of faults identified by ExpertALERT (getting automatically the results from database), that could be identified by thermography
- Identification of additional faults
- Writing additional faults into the report
- Handling measurement positions
- Creation templates to the measurement positions
- Creating trends from temperature data (all image, given areas)
- Archive – for control of the size of database

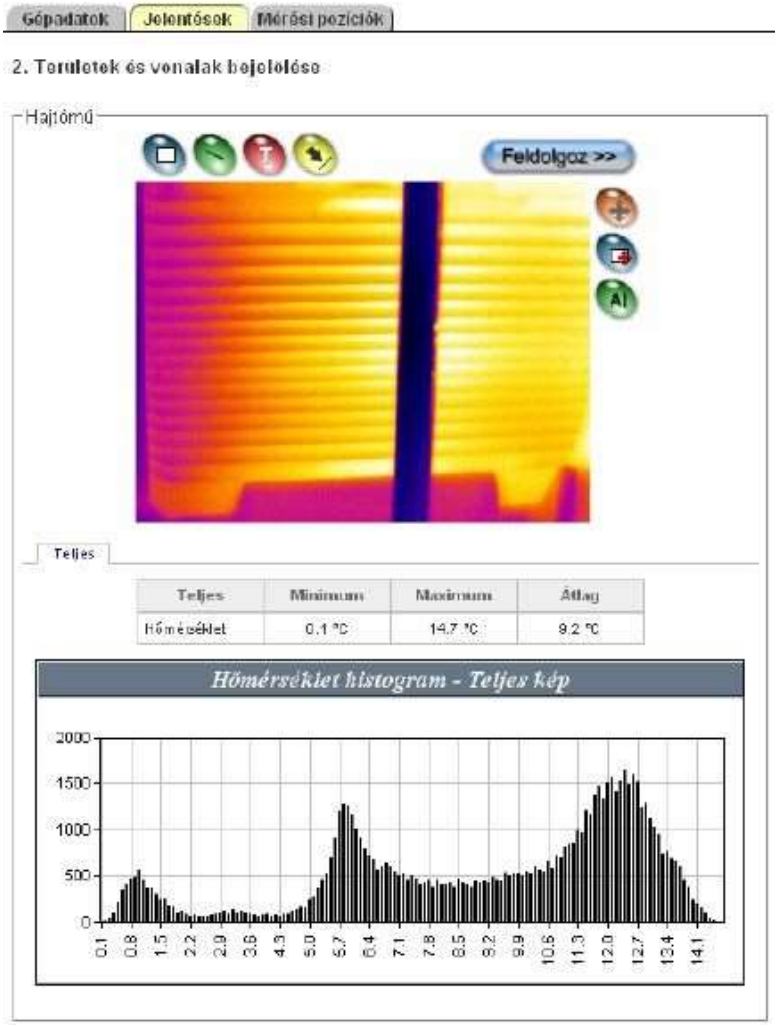

Figure 3. Screen display of ThermoALERT

LeakageALERT

- System for handling data leakage measuring instrument
- Centralized systematic storage of data
- Creating expert reports ont he base of measured data
- Confirmation of faults identified by EA (getting automatically the results from EA DB), that could be identified by measuring leakage
- Marking additional faults, that could be identified by leakage
- Writing additional faults into the report
- Automatic handling of test positions
- Trending the data

OilALERT

- Analysis and centralized storage of results of UOA
- Creation of expert reports ont he base of data
- Confirmation of faults identified by EA (getting automatically the results from EA DB), that could be identified by UOA
- Marking additional faults, that could be identified by UOA
- Writing additional faults into the report

- Automatic handling of test positions
- Trending the data

FerroALERT

- Analysis and centralized storage of results of Ferrography
- Creation of expert reports ont he base of data
- Confirmation of faults identified by EA (getting automatically the results from EA DB), that could be identified by Ferrography
- Marking additional faults, that could be identified by Ferrography
- Writing additional faults into the report
- Automatic handling of test positions
- Trending the data

Figure 4. Reports of expert systems

BDES (Board of Diagnostic Expert System)

- Integrated display of results of five expert systems
- Review of possible faults of machines and display of faults identified by different diagnostic methods
- Condition displays by color coded buttons, the reports popping up clicking to the buttons

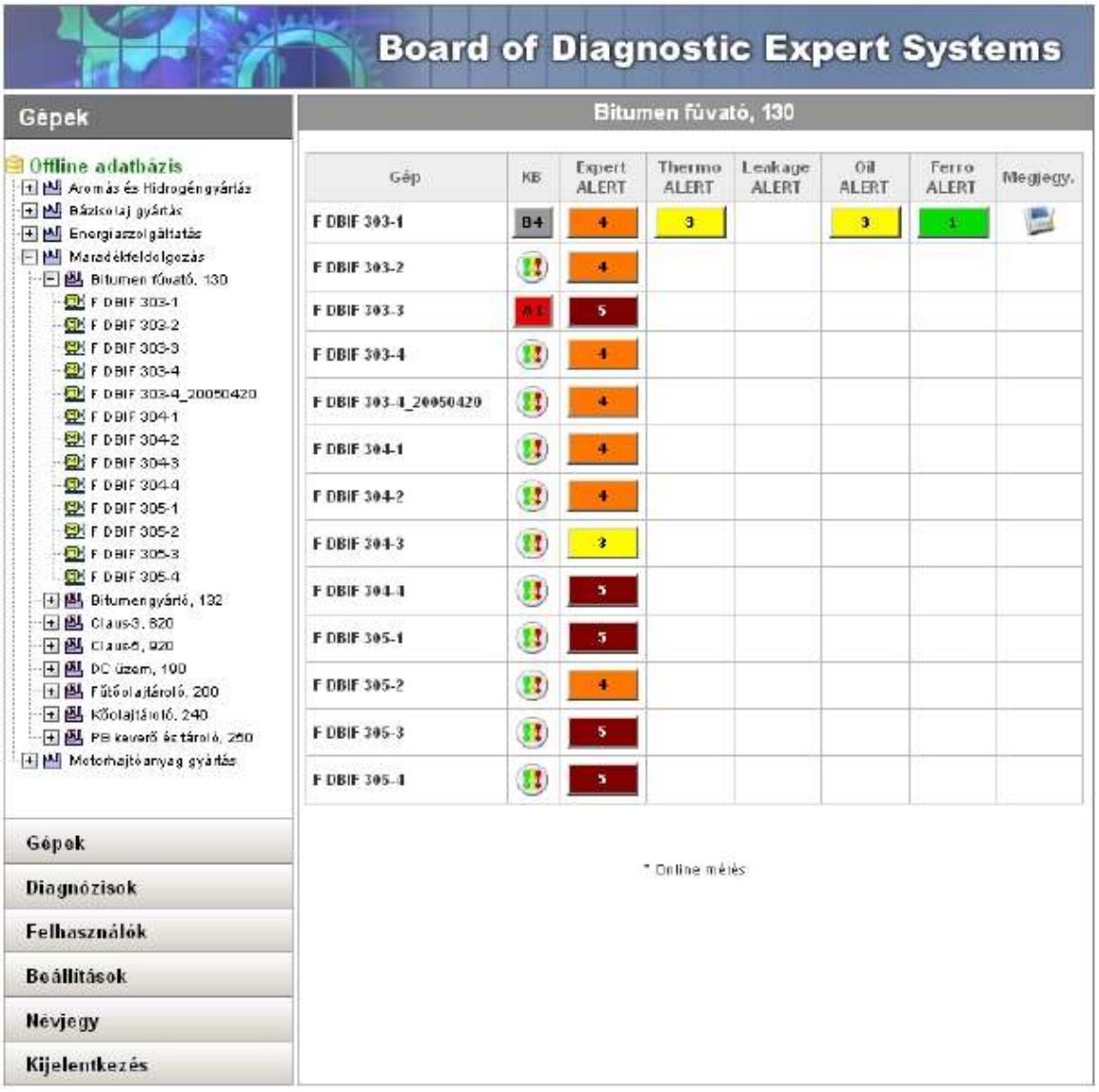

Figure 5. Screen display of BDES software

IFSS (Information & Fault Statistic System)

- Centralized software, the clients should run only the Internet Explorer
- It's basic function is to display the data from EA DB.
- It handles the off-line and on-line DBs
- It works with archive databases, and actual on-line and offline DB (more DB sin the same time)
- Separate, independent handling of users

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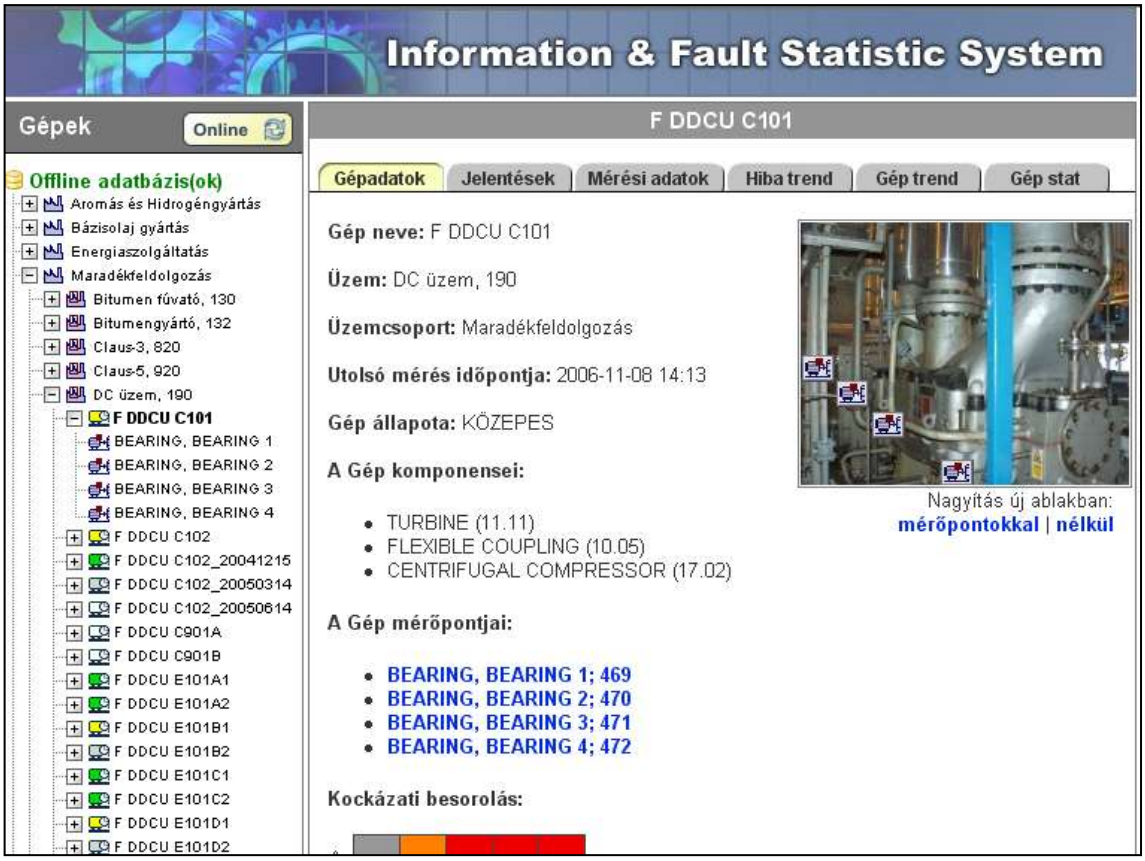

Figure 6. Screen display of IFSS software

- ***Displayed data:***
  - Machine data – master data, photos, location of test points
  - Reports, fast report, detailed report, severity charts
  - Measured data
  - Fault trend
  - Trend of machine's data
  - Test point data
  - Spectra at test point
  - Overall data (vibration RMS values)
  - ORBITs, if exists the necessary data
  - Axial movement of shaft, if exists the necessary data

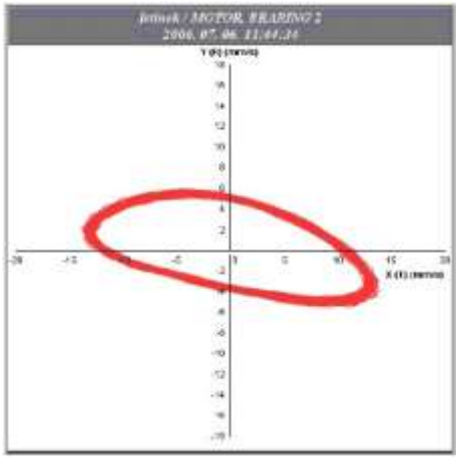

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Figure 7. Display of vibration data, orbit

- ***Statistics:***
  - Creating statistics – gathering data from more then one different DBs
  - Fault statistics
  - Quantity of faults (trend) in time
  - Statistics of conditions – distribution of condition
  - Occurrence of machine condition depending on the time
  - Fault severity trend – depending on the time
  - Number of faults – trend in the time (Fault prevalence trend)
  - Distribution of fault type – categories of faults and their display by categories
  - Occurrence of fault types – category depending on the time
  - Statistics of the measurements
  - Lack of measurements ☺
  - Machines in most critical condition – filter on the machine condition
  - Actual condition

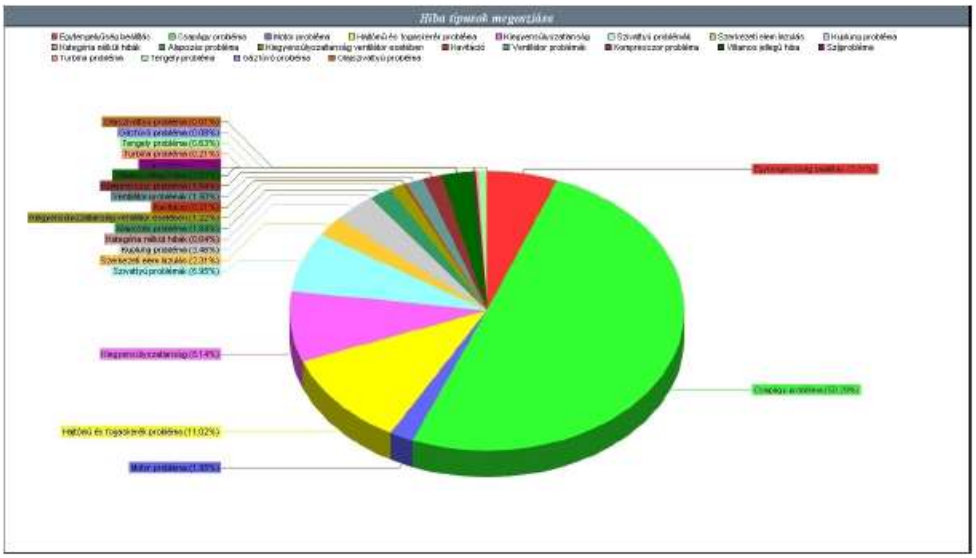

Figure 8. Display one of the result of IFSS software (fault statistics)

CONCLUSION

The software system was developed by Delta-3N Ltd. and integrated into one system. The whole software system was tested successfully and installed at MOL's refinery in the time of commissioning of on-line vibration monitoring systems. They are in operation.

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