Rovsing
DYNAMICS

Operator's Guide

OPENpredictor™

Version 2.8.0
for Windows

Predictive Maintenance
Information System

Issue 2.2

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Note: When using the electronic version of the Guide, the page number serves as a link to the section.

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1 Introduction

OPENpredictor™ provides information about a wide variety of machinery faults in order to minimise plant operation risk and prioritise maintenance activities. OPENpredictor™ executes AutoMonitoring, AutoDiagnosis™, AutoForecasting and AutoReporting, to inform the users of current and potential machine problems. The users can pre-define reporting both for the daily shift operators for short-term action and for maintenance management to prioritise activities.

Definitions and acronyms: see chapter 3 'Glossary'.

1.1 About this Operator's Guide

The contents of this document provide guidance to the plant operators about the actions they may need to execute with the OPENpredictor™ Predictive Maintenance Information System (PMIS).

Furthermore, the managers legally responsible for the use of the system must read and accept the content of section 1.3 Disclaimers and the 'Copyrights & Trademarks' notice above.

A comprehensive description for the total system, intended for the experienced Condition Monitoring expert, can be found in the 'User Manual'.

This manual covers all versions of the OPENpredictor™ system. If you for example have not bought the AutoDiagnosis™ module, these functions are not displayed in the OPENpredictor™ user interface. Please disregard them when reading the manual!

OPENpredictor™ contains functions that are accessible in this version but not described in any of the manuals delivered with the system. Such functions shall be regarded as non-existent, as they are only for use by the personnel of Rovsing Dynamics A/S, its distributors or service partners.

1.1.1 Conventions for this Guide

The character sequence: **'*menu Xxxx > Yyyy*'** means: click on menu item Xxxx and open submenu item Yyyy (= select menu Xxxx, submenu Yyyy).

- **Bulleted lists** indicate alternatives to be selected from (unless otherwise specifically indicated), – or simply a list.

1. **Numbered lists** represent a set of ordered steps to be followed, one-by-one.

[Button-name] represents a Windows button with the caption 'Button-name'.
½
'Key-name': The key 'Key-name' on the PC-keyboard.

'Field-name': The field 'Field-name' in a Windows window.

<descriptive text>: the <> field is to be replaced by the relevant text as described. Example: menu 'Filter Column' > '<column name>' could be
- menu 'Filter Column' > 'Value', or
- menu 'Filter Column' > 'State'.

1.2   About OPENpredictor™

OPENpredictor™ 2.8.0 is an automatic Predictive Maintenance Information System (PMIS), advancing traditional 'Condition Monitoring' (CM) to the next level for Predictive Maintenance. The system identifies and forecasts potential machinery problems on a wide range of rotating and stationary machinery components, typically encountered in power plants and other continuous operating process industries.

1.2.1   History and background

Historically, the experienced and skilled mechanic or engineer would listen to his machines, put his hand on the machines to sense its vibrations and kept an eye on simple parameters like flows and temperatures. He would then use his experience to judge the machine health and possibly diagnose an existing problem. No historic data was present so fault prediction was difficult. This created the need to record data in order to manually identify trends over time.

As technology developed this engineer was supported by 'Condition Monitoring' (CM) systems that provided registration of condition related measurements (typically vibration values) on paper rolls and providing basic alarming in the control system for shutdown actions. The tedious routine work to analyse enormous amounts of mostly redundant data was typically done by a vibration expert. Typically the data investigation was carried out when strange phenomena were encountered on routine plant inspections or when alerts or alarms were identified at the control system. Diagnostic analysis to investigate why a vibration was high was not integrated into the systems so (trans)portable vibration analysers were used to analyse vibration signals.

The next generation of CM systems integrated diagnostic measurements such as vectors, orbits and frequency spectra. When warnings occurred on basic condition parameters such as overall vibration levels, bearing temperatures and casing expansion the system would execute the diagnostic measurements. The vibration specialist used these diagnostic measurements for trouble shooting in order to explain why vibration was high. Later it became possible to periodically collect and store the diagnostic data, so trends of some fault phenomena could manually be retrieved from a database. The drawback of this 'traditional approach' was that not many machine faults (cause of problems) were being monitored, rather a range of derivative parameters (effect of problems) which resulted in late warnings and a limited number of machine faults actually being monitored. The term 'post mortem' analysis was created as typically the analyses were carried out after a machine had failed in order to investigate why it had happened.

The reliability of automatic warnings was therefore inadequate for early fault detection and fault forecasting, both prerequisites for Predictive Maintenance.

This therefore called for a new pro-active approach.

1.2.2   Present status

The present OPENpredictor™ Predictive Maintenance Information System (PMIS) Version 2.8.0 provides AutoDiagnosis™, which eliminates the need for periodical data analysis to be done by the Condition Monitoring specialist as the data-evaluation and interpretation, is completely automated. The tasks left to the CM specialists are reduced to system control, evaluation of warnings and AutoDiagnosis™ Messages with fault-predictions – and ultimately the maintenance planning. System operation can be taken over by the operators of the machinery. When an AutoDiagnosis™ Message appears on the PC-screen a machine problem is identified. For gradually developing problems the 'Predictive AutoDiagnosis™' Message identifies approximately when the problem will become serious, days, weeks or even months ahead. This makes it possible to plan corrective tasks on that specific component to the best economical period – or ultimately during a planned stop.

For changes in the dynamic behaviour of the machine where no experience exists yet, a warning will be issued without AutoDiagnosis™ Message in order to minimise operation risk. For vibration experts all the traditional tools for manual machine analysis are present such as, Multiple Trend Analysis, 3-D AS (AutoSpectrum) Waterfall plot, Nyquist analysis, Orbit and Shaft Centre Line analysis.

OPENpredictor™ automatically compares actual values and 'signatures' (i.e. vibration spectra and transient curves) with reference signatures measured under defined 'machine states': Run-up, Coast-Down, Idle, Low load, High Load, Full Load, etc. to identify fault symptoms. Data comparison is executed under pre-classified operation conditions to compensate for RPM, load, temperature, etc. variations. Classification by 'Machine State' is essential to avoid false warnings, improve fault identification sensitivity and create realistic forecasts. Identified changes in the machine behaviour are then automatically used as basis for AutoDiagnosis™ and AutoForecasting. An AutoDiagnosis™ prediction is based on complex calculations using many parameters from different sensors. Historic measurement data is also available for AutoDiagnosis™ verification and troubleshooting.

The measurement results can be presented graphically in real time, including *warning* levels ('Alert' and 'Alarm') for 'traditional' interpretation. All information may be included in *Shift Reports* for short-term actions and *Management Reports* for long-term maintenance planning.

In this way, OPENpredictor™ has automated machine fault identification and prediction, stating in clear text which machine problems have been identified and when inspection or maintenance is advised. OPENpredictor™ is consequently a very useful tool to identify operation risk and schedule corrective actions. The information is used to reduce
- Unforeseen breakdowns
- Scheduled downtime for time based maintenance tasks
- Repair and maintenance costs

For further information about the philosophies behind OPENpredictor™ and Condition Monitoring basics, etc. see the OPENpredictor™ User Manual chapter 2 "General system description" and 7 "Bibliography".

1.2.3 OPENpredictor™ main building blocks

The OPENpredictor™ PMIS system typically consists of:

- A variety of transducers mounted on/inside the machines converting physical parameters to electrical signals from which health information will be extracted. Existing transducers (pre)mounted on the equipment are used as far as possible.

- Signal Processing Units (SPU) for processing transducer signals into fault selective 'signatures'. The signal from a single transducer is often transformed into many dedicated 'signatures', for example amplitude and phase for harmonics, Autospectrum, Envelope Spectrum, etc., to enhance fault detection sensitivity and selectivity.
Identified changes in these signatures are transferred to the OPENpredictor™ Server for storage and automated interpretation by 'AutoDiagnosis™ Methods'.

- The OPENpredictor™ Server. This is a PC operating on Windows 2000 Pro, 2003 Server or XP Pro. It receives processed data from the SPUs. Data is saved in an Oracle relational database. The OPENpredictor™ system software runs on the Server in English.

- The User Interface Applications (UIA) running on Windows 2000 Pro, 2003 Server or XP. PC -workstations for displaying warnings, predictions and AutoDiagnosis™ Messages, etc. The UIA is available in different languages.

1.3   Disclaimers

The OPENpredictor™ system is only intended for providing information about machinery faults under development. Rovsing Dynamics A/S, its suppliers, distributors and subcontractors will under no circumstances accept any liabilities for any mental or physical injuries, any losses or any damage on anybody's property (incl. personal belongings, equipment and buildings and their surroundings in the widest sense) due to the use of any part of the system.

It is the full and sole responsibility of the corporation/organization/person in charge of the use of the equipment, to ensure that each person using OPENpredictor™ has been properly trained. This responsibility includes: -
- Giving sufficient instructions to all relevant persons concerning all safety related matters in general, and in particular as described in manuals for the equipment, on the equipment and in/on manuals, packages and safety sheets for consumables, incl. manuals and packages from third party suppliers.
- Ensuring that all safety related instructions given in manuals for the equipment, on the equipment and in/on manuals, packages and safety sheets for consumables – including the manuals and packages from third party suppliers – are followed carefully.
- Keeping all untrained persons – especially children – and animals safely away from all equipment and chemicals (to be) used for the OPENpredictor™ system.

Rovsing Dynamics A/S, its suppliers and subcontractors will under no circumstances accept any liability for any physical or mental injuries, any losses or any damage on anybody's property (incl. personal belongings, equipment, buildings and their surroundings in the widest sense) due to: -
- The use of the OPENpredictor™ system, including wrong fault diagnosis or any kind of transducer or transducer system fault and its consequences.
- Products manufactured by means of systems using the OPENpredictor™ system.
- The design and manufacturing of third-party equipment included in or connected to the OPENpredictor™ system.
- The (lack of) information contained in manuals for the OPENpredictor™ system and equipment manufactured by third parties, incl. safety related matters. The content – incl. safety related warnings and instructions – of manuals for equipment from third party manufacturers is solely the responsibility of the vendor/manufacturer of this equipment.
- Failure to follow or comply with any safety related instruction given in manuals for the equipment used for or connected to the OPENpredictor™ system, on the equipment and in/on manuals, packages and safety sheets for the consumables – incl. manuals and packages from third party suppliers.

2　　　How to use OPENpredictor™

The **user interface** is described in section 2.2. It gives access to a number of visualizing **tools**:

- **Warning messages**, see section 2.3. When a combination of measurements over time indicates, that a mechanical failure is on its way, a warning message appears on the user interfaces, either as an Auto-Diagnosis™ message window or as a flashing warning 'lamp' on the user interface main panel. The warning system is described in section 2.3.

- **Reports**, see section 2.4: Maintenance management reports, shift reports, plot reports, etc.

- **Mimics**, see section 2.5: Interactive graphics with selected measurements and alarms.

- **Browser**, see section 2.6: The browser gives access to the details about each item (plant, machine, transducer, etc.) and each measurement with links to plots, AutoDiagnosis™ per machine and configuration data. The Browser is mainly aimed at the 'condition monitoring' specialist.

- **Plot Manager**, see section 2.7. Data can be presented in a large variety of plots, mainly aimed at the 'condition monitoring' specialist.

Off-line data collection (optional) is described in section 2.8.

Restart of the on-line data-collection system is described in section 2.9.

Description of the hardware (the intelligent data-logger) is provided in section 2.10.

2.1 Opening the OPENpredictor™ User Interface Application

> **IMPORTANT: Before opening the OPENpredictor™ User Interface Application, all the OPENpredictor™ Servers top be used must be running if the User Interface is to be used online. (But the *OPEN-predictor™ User Interface Application* can run offline without the Servers.)**
>
> **About starting the Servers, etc., see section 2.9.**
>
> **The SPU (see section 2.10) may be restarted without restarting the Servers and the User Interface Application.**

1. Double-click the OPENpredictor icon to start the OPENpredictor™ User Interface Application. This opens a 'Work Console' window, from where the OPENpredictor™ User Interface Application is started. It may take a minute or more to start, depending of the number of warnings present.

   When completed the 'OPENpredictor login' window is displayed: -

2. Type your User ID, (for example 'John') and your Password (for example 'wàeY38.9u1'). Note: The Password is case sensitive.

   > **To change your Password:**
   >
   > 1. In the login window: *After entering a valid User ID + Password combination – but before clicking [OK]:* Click the ![icon] icon to open the 'User Configuration' window.
   >
   > 2. Enter the new password in 'Password' (max. 32 characters) and repeat it in 'Confirm Password'.
   >
   > 3. Click [OK] to change the Password.
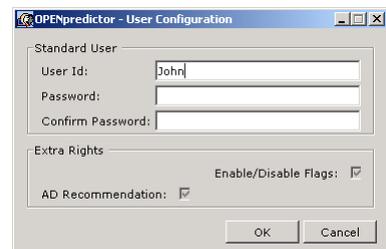
3. In the login window click [OK] to continue.

4. When the Password session has been completed correctly, the OPENpredictor™ **Menu Bar** opens (this may also take some time):

5. *Check for new measurement warnings* (see section 2.3.2): If any 'traffic lights' ar flashing, click ⁺E for opening the warning list.

6. *Check for new AutoDiagnosis™ messages* (see section 2.3.1): Select
   - 🖑 (menu 'Browse' > 'AutoDiagnosis list') for Predictive AutoDiagnosis™,

   AND
   - 🖑 (menu 'Browse' > 'Instantaneous AutoDiagnosis list') for Instantaneous AutoDiagnosis™.

   IMPORTANT:
   Autodiagnosis messages are not indicated trough the warning 'traffic lights'.

Tip:
To see a short explanation of an icon, hold the mouse pointer over the icon for a short time: -

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Important !

Do NOT close the 🖥 OPENpredictor 'Work Console' window (shown below), as this will terminate the OPENpredictor™ User Interface Application-tion. OPENpredictor™ uses – among other things – this window for display-ing system, log and error messages. It is however OK to minimise the window.
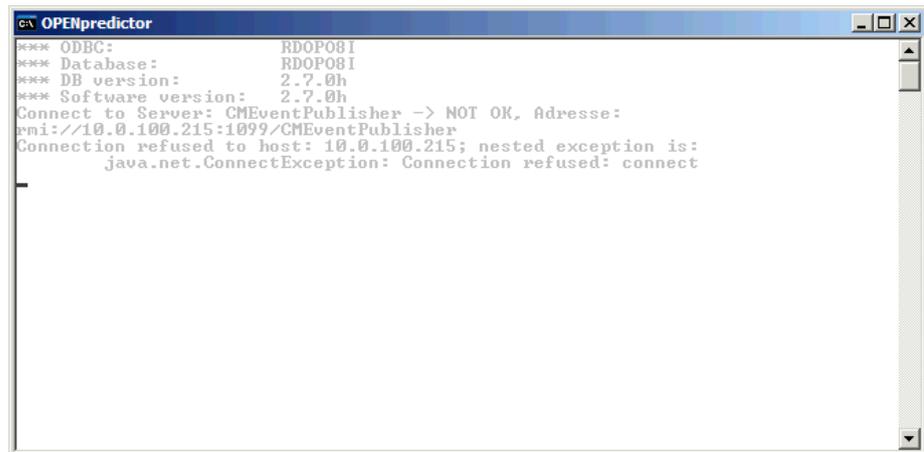
2.2   The OPENpredictor™ Menu Bar

The OPENpredictor™ Menu Bar is the basic control centre for the OPEN-predictor™ system. Measurement warnings (see section 2.3.2) are indicated here by a flashing warning 'lamp'. AutoDiagnosis™ warnings (see section 2.3.1) will pop-up as a separate window and are not indicated via these 'traffic lights'.

The buttons and warning lamp sections displayed are selected from the 'View' > 'Toolbars' menu.

To make sure the Menu Bar is always visible on the pc monitor screen, use the menu 'Tools' > 'Options' > 'Always on top'.

2.2.1   Menus and their related toolbar icons
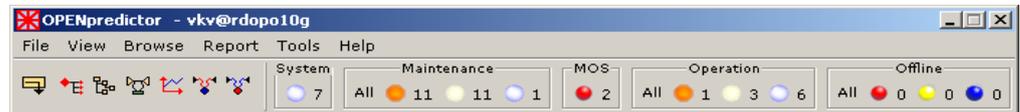
Note: Some menus and tools, available with certain specialist user login rights, are only shown in the 'User Manual' section 5.1. Menus related to special installation configurations could be mentioned here, but now shown.

Menu	Icon	Submenu	3rd level submenus and explanations
File	🖳	Exit	Close the OPENpredictor™ application.
View		Toolbars	Select/deselect the File, Browse, Tools, Warnings (> 'Operation', 'Maintenance', 'Performance', 'Offline', 'RDM', 'MOS', 'System' warning group) items to be displayed. See section 2.3.2.1.
–	⭑🗒		Toolbar icon: 'All Warnings' list.
Browse	⭑🗒	Warning History list	Menu: Complete Warning History List. Submenus: 'Performance', 'Maintenance', 'Operation', 'Offline', 'RDM', 'System', 'All'. Deeper submenu level, e.g., 'Alert', 'Alarm', 'System', 'All'. See section 2.2.1.1.
		AutoDiagnosis and Warning Browser	Opens the 'AutoDiagnosis and Warning Browser', see section 2.3.3.
	🖳	Browser	🖳 Open: Open the 'Browser', see section 2.6.
			🔍 Find: Open the Browser 'Find' window. When an item is selected, the Browser opens with the item selected.
	📺	Mimic Viewer	📺 Open: Open the 'Mimic Viewer'. See section 2.5.
			🔍 Find: Open the Mimic Viewer 'Find' window. When an item is selected, the Mimic Viewer opens with the item selected.
	📈	Plot Manager	Open the 'Plot Manager' window. The plot must then be selected. See section 2.7.
	🔱	AutoDiagnosis List	Open the Predictive Auto Diagnosis™ List. Contents: see section 2.3.1.5.

		Instantaneous AutoDiagnosis List	Open the Instantaneous Auto Diagnosis™ List. Contents: see section 2.3.1.5.
		MOS	Maintenance Override Switch list. Equivalent to clicking the MOS button in the Tool Bar, see section 2.2.1.1.
Report		📄 Shift Report	Open the Shift Report Generator. See section 2.4.1.
		📄 Manage-ment Report	Open the Management Report Generator. See section 0.
Tools		Import Oil Data	Used with the special module 'Oil analysis'. See the 'Operators Guide' section 2.4.6.
		Routes	Open the Route MMI for handling of Routes for off-line data collection. See section 2.8.
		Options	• 'Always on top': When checkmarked ☑, the 'MMI main panel' always stays on top of the screen in front of all other windows. • 'Beep when warning': Checkmark ☑ for making a beep in the PC loudspeaker in case of a new warning. • 'Beep when AutoDiagnosis message': Checkmark ☑ for making a beep in the PC loudspeaker in case of a new AutoDiagnosis™. • 'Display milliseconds': ☑ for displaying milliseconds in tables, mimics and plots. Else integer seconds are displayed. • 'OTA option' > 'Phase lead'/'Phase lag': Sign of phase in OTA measure-ments. Default: Phase lag. • 'Unit system': Select 'Metric', 'USA', 'Imperial', or 'SP' (SP = metric with acceleration in G, etc.).
Help		Contents	Open the on-line help (this manual).
		About	Display the window with information about the current version of OPENpredictor™.

If a menu is not enabled (grey text), or if it's not displayed, its function is currently not available.

2.2.1.1 Measurement warning List Menus, Icon and Lamps

Measurement warnings and how to work with them are described in section 2.3.2.

Icon	Menu	Submenus and explanations
	All	Click to open a list of all actual warnings. See section 2.2.2.1.
System ● 1	System	System = SPU System warning. An SPU has lost the connection. In the 'System' group click ● (blue) to display a list of all SPU system warnings.
Operation All ● 1 ● 3 ● 6	Operation	Warnings for problems that would require an action within a one or two shift period. In the 'Operation' group: All: Click 'All' to display a list of all Operation warnings. Alarm: Click ● (red) to display a list of all Operation Alarm warnings. Alert: Click ● (yellow) to display a list of all Operation Alert warnings. System: Click ● (blue) to display a list of all Operation System warnings.

Maintenance All 🔴 0 🟡 0 🔵 0	Maintenance	Warnings for changes in machine behaviour related to maintenance activities. In the 'Maintenance' group: All: Click 'All' to display a list of all Maintenance warnings. Alarm: Click 🔴 (red) to display a list of all Maintenance Alarm warnings. Alert: Click 🟡 (yellow) to display a list of all Maintenance Alert warnings. System: Click 🔵 (blue) to display a list of all Maintenance System warnings.
Performance All 🔴 0 🟡 0 🔵 0	Performance	Warnings related to efficiency reduction or process problems of a machine. In the 'Performance' group: All: Click 'All' to display a list of all Performance warnings. Alarm: Click 🔴 (red) to display a list of all Performance Alarm warnings. Alert: Click 🟡 (yellow) to display a list of all Performance Alert warnings. System: Click 🔵 (blue) to display a list of all Performance System warnings.
Offline All 🔴 0 🟡 0 🔵 0	Offline	Warnings from offline measurements for Oil Analysis. In the 'Offline' group: All: Click 'All' to display a list of all Oil Analysis warnings. Alarm: Click 🔴 (red) to display a list of all Oil Analysis Alarm warnings.
RDM All 🟡 4655 🔵 0	RDM	RDM= Reliability Data Management. Alert: Click 🟡 (yellow) to display a list of all machine stops (scheduled and unscheduled). System: Click 🔵 (blue) to display a list of all RDM System warnings.
MOS 🔴 0	MOS	MOS = Maintenance Override Switch. Displays the number of transducers, where the 'MOS Flag' is set. In the 'MOS' group click 🔴 (red) to display a list of all MOS marked transducers. See section 2.3.5.
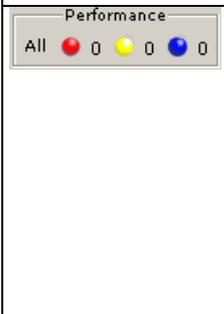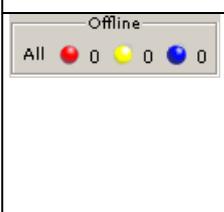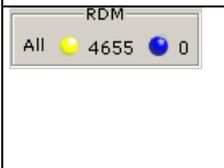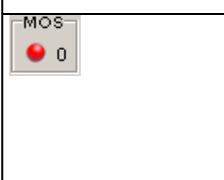
The number to the right of each warning 'lamp' is the number of actual warnings to be found in the Warning List for this group.

2.2.2 Customizing the OPENpredictor™ Menu Bar toolbars

To change which toolbars are displayed in a user interface window, select the menu View > Toolbars (there may be further levels). Then select or deselect the toolbars as desired.

The settings are saved per user (specified by the 'User ID'). This means that each user can have her or his own personal toolbar setting.

2.2.2.1 Moving the Warning Indicator toolbars in the OPENpredictor™ Menu Bar

The Warning Indicator Blocks can become individual windows: -

To transform a Warning Indicator Block into an individual floating window, click inside the group – except on any button – and drag the group out:

When released, it is a separate window and not any longer shown in the Menu Bar:

To put it back at *the end* of the Menu Bar: close the separate window by clicking its ⊠ button.

2.3 Warning systems

There are two types of warning indicators: -

- **AutoDiagnosis™ Messages**. See section 2.3.1.

- **'Measurement Warning' 'traffic light' type indicators** in the Menu Bar with links to Warning Lists, see section 2.3.2. Selected 'measurement warnings' may be shown in **Mimics**, too, see section 2.3.4.

An overview of AutoDiagnosis™ messages and measurement warnings is shown in the **'AutoDiagnosis™ and Warning Browser'**, see section 2.3.3.

IMPORTANT ! **AutoDiagnosis™ warnings are NOT signalled by the 'traffic light' system.** To check for them, click 🐞 and 🐞, or use the 'AutoDiagnosis™ and Warning Browser'

To send a beep to the PC loudspeaker at: -
- A new AutoDiagnosis™, checkmark the OPENpredictor™ main panel menu 'Tools' > 'Options' > Beep when AutoDiagnosis message'
- A new measurement warning, checkmark the OPENpredictor™ main panel menu 'Tools' > 'Options' > Beep when warning'

OPENpredictor™ identifies changes in the dynamic behaviour of machines using automated signature (see chapter 3) comparison. OPENpredictor™ will issue an AutoDiagnosis™ Message for identified changes incorporated into the AutoDiagnosis™ Fault Library.

For gradually developing faults a prediction will be given. This is called **Predictive AutoDiagnosis™**; see section 2.3.1.3.

For faults with an intermittent character no prediction can be specified so only the fault diagnosis will be available. This is called **Instantaneous AutoDiagnosis™**; see section 2.3.1.4.

To see a list of possible AutoDiagnosis™ (both types):
1. Open the Browser (click 🔳).
2. Right-click the unit (for example plant, machine or machine component).
3. Select the floating menu 'View AutoDiagnosis Messages' or 'View Instantaneous AutoDiagnosis Messages' to display a list of AutoDiagnosis™ for the unit selected.

For identified changes **not incorporated into the AutoDiagnosis™ Fault Library**, warnings will be issued via the **Measurement Warning Indicators** (the 'lamps' on the OPENpredictor™ main panel). These warnings have to be investigated manually. Rovsing Dynamics can offer this analysis as a remote service.

2.3.1 AutoDiagnosis™ Messages

2.3.1.1 How to react on a new AutoDiagnosis™ warning

AutoDiagnosis™ Message windows pop up automatically when a potential fault related to a defined AutoDiagnosis™ has been identified.

> The advised reaction is to follow the recommendation!
>
> **If no recommendation is given:** Inform – dependent on the type of fault reported – the Operation or Maintenance Department management and seek advice.

Note: the local person in charge of the OPENpredictor™ system can define the AutoDiagnosis™ 'Recommendation' messages. Consequently, neither Rovsing Dynamics A/S nor its local representative has any responsibility for the content of these messages.

There are two types of AutoDiagnosis™ messages:

- **Predictive AutoDiagnosis™ messages**: displayed when a gradually developing fault has been identified and reached a defined fault strength. Example: A specific vibration pattern during full load combined with a gear lubrication oil temperature. See section 2.3.1.3 for a detailed description.

- **Instantaneous AutoDiagnosis™ messages**: displayed when a specific parameter for a short period of time has exceeded the warning limit set. Example: Vibrations due to a rub. See section 2.3.1.4 for a detailed description.

For further details of how to read the fields see section 2.3.1.5.

2.3.1.2 Acknowledging and removing an AutoDiagnosis™

When an AutoDiagnosis™ is acknowledged it remains on the list until the AutoDiagnosis™ data moves into the next region of severity (Detected, Predicted, Action Required) – which causes a new AutoDiagnosis™.

When the data is back in the normal range (for example because the problem has been solved), the AutoDiagnosis™ system will automatically detect it and remove the *acknowledged* AutoDiagnosis™ messages for this fault.

2.3.1.3 Predictive AutoDiagnosis™ messages

Predictive AutoDiagnosis™ messages are labelled 'AutoDiagnosis messages'. They are per standard calculated every 24 hours based on the measurements from the last 24 hours compared with the development in the past. They are most often intended for the maintenance people.

To open the window with a list of all activated predictive AutoDiagnosis™ Messages select the menu 'Browse' > 'AutoDiagnosis List' on the OPENpredictor™ Menu Bar.
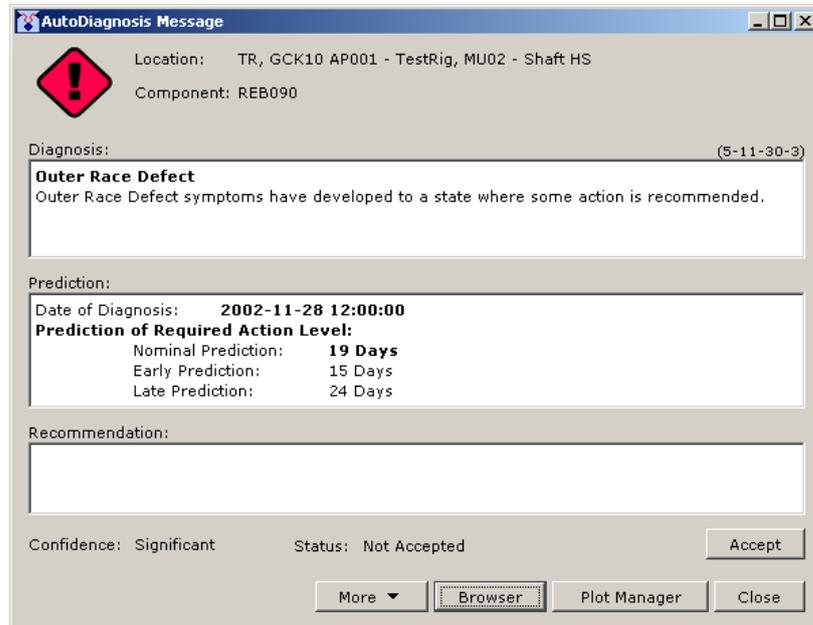
For details about the fields in the (predictive) AutoDiagnosis™ Message Window, see section 2.3.1.5. The information provided is: -

- '**Location**' and '**Component**' - identify *where* the fault has been diagnosed.

- '**Diagnosis**' - identifies *what* the fault is. The numbers in parentheses above the field are internal codes for the text strings displayed.
  ½
- '**Prediction**' - identifies
  - Date of Diagnosis: the date and time of this AutoDiagnosis™.
  - How soon the fault is predicted to become *serious*:
    - Nominal Prediction: The expected development of the fault using the standard extrapolation algorithm.
    - Early/Late Prediction: The variation to the best estimate using the standard confidence level for the forecast.

  The AutoDiagnosis™ Message is issued at three Symptom Strength levels indicated by the background colour of the icon:

Detected	As soon an incipient fault is detected by the Auto-Diagnosis™ system, the DETECTED message is issued. However, it's still too early to predict the date when the fault will become severe with a reasonable confidence.
Predicted	The Symptom Strength has developed to a level where • its history can provide a statistical model for future development, and • the date at which the fault strength will become severe can be predicted, the PREDICTED message is issued.
Action Required	The Symptom Strength for <value> or <acceptable predicted time to fault> has developed to a level, where ACTION REQUIRED warning is issued. At this level an action is required, for example an inspection and/or a preventive maintenance task.

- '**Recommendation**' - identifies for the user the particular fault and the actions that are required. Local users with 'AutoDiagnosis™ Recommendation' rights may edit the content of recommendation field.

- '**Confidence**' - identifies the certainty of the prediction: - 'None', 'Low', 'Significant' or 'High'.

- 'Status' – [**Accept**] – '**By**' - is used to identify that an AutoDiagnosis™ has been accepted (acknowledged), acknowledge it, and by whom. See section 2.3.1.2.

To view the symptom history and forecast, click on 'Plot Manager'. This launches the Default plot for the prediction.

To display/close a list of all the current predictive AutoDiagnosis™ Messages, click [More]/[Less]: -
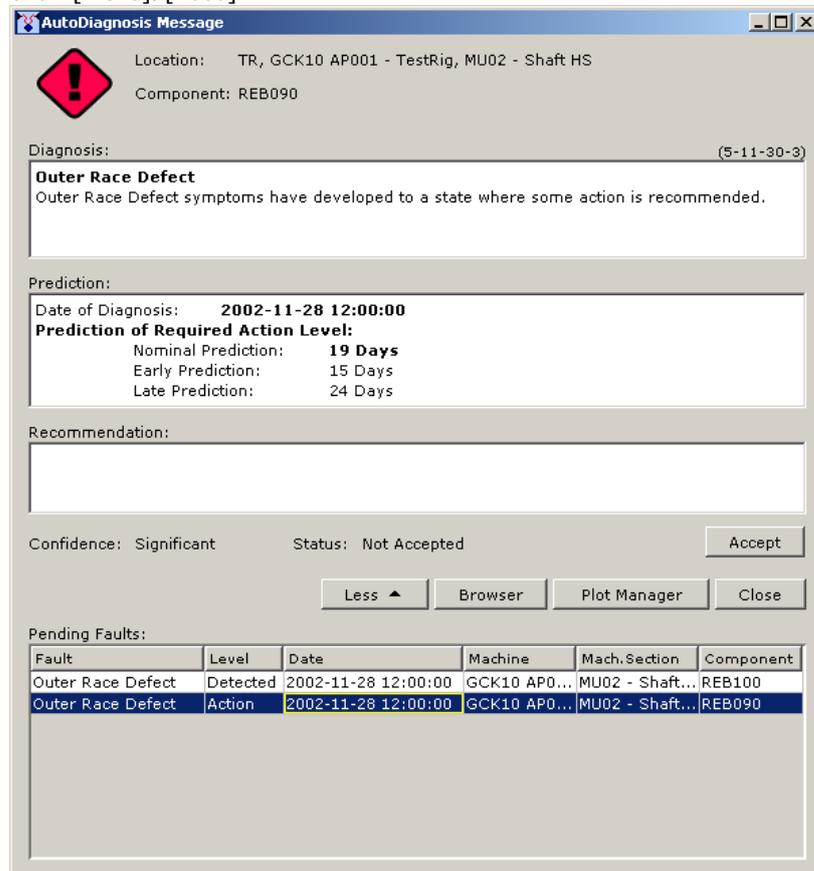
To display a specific AutoDiagnosis™ Message, select it by clicking it.

2.3.1.4 Instantaneous AutoDiagnosis™ (IAD) messages

Instantaneous AutoDiagnosis™ messages are calculated continuously whenever there is a change in the related parameter(s) at the relevant machine state(s). They are mainly intended for the operation people and they often require a fast response.

To open the window with a list of all activated Instantaneous AutoDiagnosis™ Messages select the menu 'Browse' > 'Instantaneous AutoDiagnosis List' on the OPENpredictor™ Menu Bar.

The instantaneous AutoDiagnosis™ message window has fewer fields than the Predictive AutoDiagnosis™ messages. The explanations to the fields are the same as for Predictive AutoDiagnosis™ messages except the 'Warning Level' field, which can have the following messages:

Detected 	As soon an incipient fault is detected by the Auto-Diagnosis™ system, the DETECTED message is issued.
Action Required 	If the Symptom Strength develops to this level, the ACTION REQUIRED warning is issued. At this level an action is required, for example an inspection and/or maintenance work.

The reason for creating this special type of AutoDiagnosis™ messages is the nature of the development of Instantaneous AutoDiagnosis™ faults, which makes predictions for the time of a serious breakdown impossible.
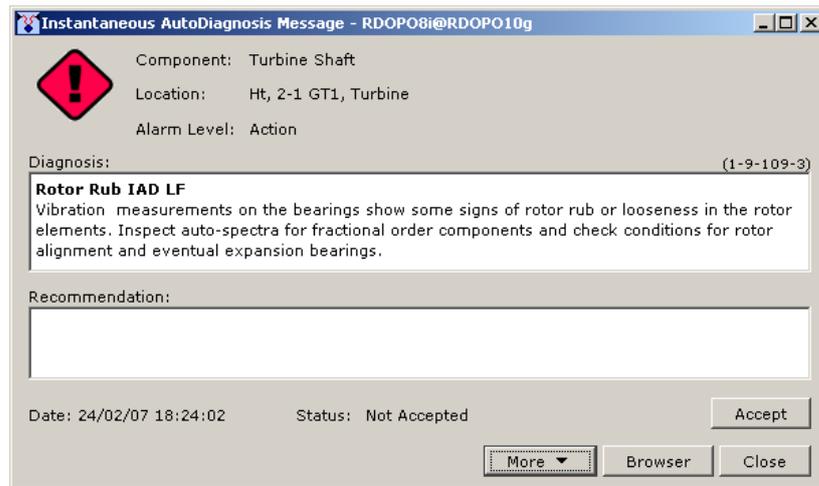
Like the Predictive AutoDiagnosis™ messages clicking [More]/[Less] will display/hide a list of all current Instantaneous AutoDiagnosis™ messages: -
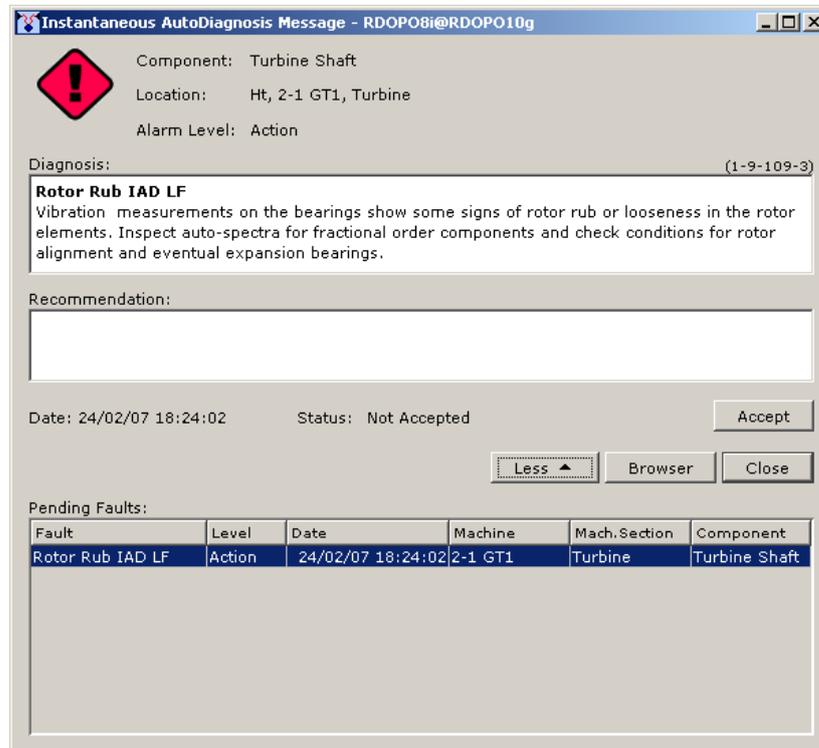
How to get a survey over **all AutoDiagnosis™ messages for a machine**, see section 2.6.2.1.

2.3.1.5 AutoDiagnosis™ message explanation
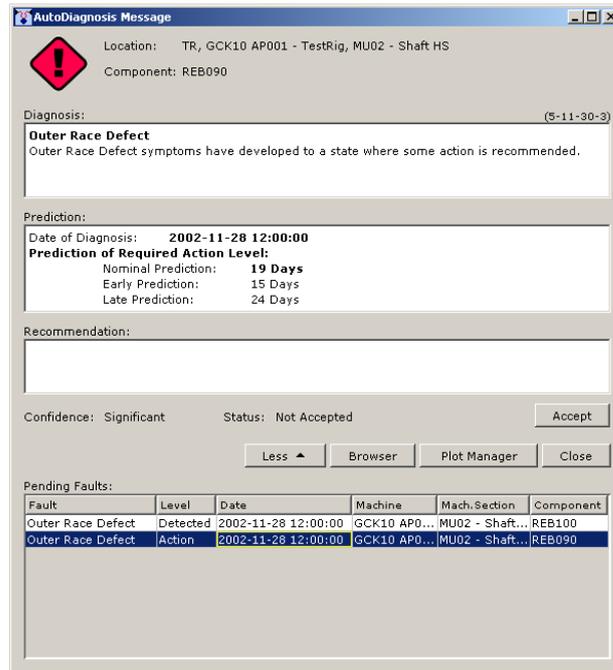
Predictive AutoDiagnosis™ window. The Instantaneous AutoDiagnosis™ window is similar with the differences specified below.

Fields/buttons – AutoDiagnosis™ message area: -

Field/button	Explanation
Location	Identification of the Machine (Section) with the pending fault
Component	Name of the Machine Component with the pending fault
Alarm level [2])	'Detected' or 'Action Required'. See section 2.3.1.4 for definitions.
Diagnosis	Description of the diagnosed fault
Prediction [1])	Line 1: The **date/time the diagnosis was made**. Line 2: Always: "Prediction of Required Action Level:" Line 3: If possible: The nominal **time from now** where the problem is predicted to become severe. Line 4: As line 3, but the earliest predicted time. Line 5: As line 3, but the latest predicted time. The earliest and latest time depends on the confidence level set for the calculation. The values may be negative!
Recommen-dation	The text in this field is user-defined, possibly entered by the local system administrator. The intention is to tell the plant operator which action to take in case of a specific fault diagnosis at a particular AutoDiagnosis™ Message level.
Confidence [1])	A statistical classification for the confidence of the diagnosis. Levels: • None • Low • Significant • High
Date [2])	The date/time the diagnosis was made.
Status:	'Accepted by User ID' of the person who accepted the message or 'Not accepted' (= not acknowledged).
Accept	Click to accept (= acknowledge) by the person logged in.
Browser	Click to display the Browser with the item selected, which initiated the AutoDiagnosis™.
Plot Manager	Click to display a plot showing the history of the symptom development and a prediction (with statistical confidence levels) of further development.
More / Less	Open/Close the 'Pending Faults' list, see below.
Close	Close the AutoDiagnosis™ window.

[1]) Only in the Predictive AutoDiagnosis™ window.

[2]) Only in the Instantaneous AutoDiagnosis™ window.

Columns – **'Pending Faults'** list: -

Field	Explanation
Fault	The problem.
Level	The severity level of the problem. Levels: • Detected • Predicted • Action Required For definitions see section 2.3.1.3.
Date	The date and time of the diagnosis.
Machine	Name of the machine with the pending fault.
Mach. Section	Name of the machine section with the pending fault.
Component	Name of the machine component with the pending fault.

2.3.2 Measurement warnings

Measurement warnings are shown by 'traffic light' indicators in the Menu Bar. The warnings may be investigated by means of Warning Lists giving directly access to the related measurement data. Some of these bars may be hidden, see section 2.2.2.

The flashing Warning Indicators shows that there are unacknowledged measurement warnings of the related type (System, Operation, Maintenance, Performance, Offline, RDM / Alarm, Alert, System), see section 2.3.2.1. The MOS indicator doesn't flash as it only warns for deactivated transducers.

The number to the right of a measurement Warning Indicator shows the actual number of different warnings in the Warning List from this particular group. The number at the MOS (Maintenance Override Switch) indicator shows the number of transducers in MOS or 'not Enabled' mode.

Clicking on a measurement Warning Indicator opens the related 'Actual Warning List' (see below). The 'Actual Warning List' shows only one – the most severe – alert or alarm *per measurement* and *per machine state* (run-up, idle, full load, etc.). An alert or alarm for a particular measurement can only be assigned to one group[1]. See also section 2.2.2.1.

2.3.2.1   Measurement warning 'types' and warning 'systems'

OPENpredictor™ has three **types** of measurement warnings with related colours: -

🔴 Red   **Alarm** ('Action Required') warnings: the 'alarm' limit has been passed.

🟡 Yellow   **Alert** warnings: the 'alert' limit has been passed.

🔵 Blue   **System** warnings: warning for system functionality, see 2.3.2.2.

Warnings are divided into five Warning Systems (groups):

System: General System warnings (only 🔵) that the connection to the SPU is lost.

Operation: Warnings for problems that require action within a one- or two-shift period.

Maintenance: Warning for long-term maintenance planning.

Performance: Warning about reduced machine efficiency or process problem.

RDM: Warnings about 'Reliability Data Management', which is a special module for certain applications. See section 2.4.6

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[1] For example: if measurement m_1 has an outstanding alert (yellow) and a more severe alarm (red) is encountered for the same measurement, the number of alerts in the Alert group will be decreased, and the number of alarms in the Alarm group will be increased.

Offline: Warnings originating from offline Oil Analysis measurements, which is a special module for certain applications. See section 2.4.5.

MOS: Maintenance Override Switch warnings (only 🔴): The 'Maintenance Override Switch' flag is set for one or more (the number) transducers. MOS warnings and how to handle them are described in more details in section 2.3.5.

In the OPENpredictor™ Menu Bar, the number of warnings in each group is displayed next to each warning 'lamp'.

2.3.2.2   Measurement warnings overview table:

Function	Alarm	Alert	System
System			The connection to the SPU has been lost.
Operation	Operator action required, improving operation and minimising risk. [AD]	Pre-warning for operator. [AD]	
Maintenance	Inspection or maintenance to be scheduled (action required). [AD]	Inspection or long-term maintenance to be defined. [AD]	The range limit for the transducer or the measurement has been passed, related to this function.
Performance	Performance pro-blem has passed the acceptable level (action required). [AD]	Performance problem to be investigated. [AD]	
RDM*) See section 2.4.6		Machine stops. RDM = Reliability Data Management	
Offline*). See section 2.4.5	Offline Oil Analysis data has reached an alarm level.	Offline Oil Analysis data has reached an alert level.	
MOS (Maintenance Override Switch)	The MOS flag is set for <the number> transducers		
—	Transducer Enabled flag NOT checked: NO open indication – NO measurements – NO warnings.		
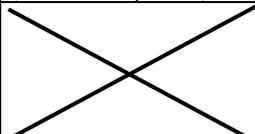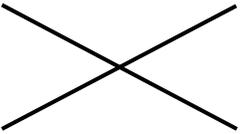
[AD]: Predictive and Instantaneous AutoDiagnosis™ messages may appear for this type of fault.

*: Only used and consequently shown with certain user applications.

> **IMPORTANT: SYSTEM warning measurements are not included in plots or in the calculation of AutoDiagnosis™ messages.**

2.3.2.3   How to react on a new Measurement warning

Indication: the related Warning Lamp on the Menu Bar starts flashing (example: [Operation All 🔴 1]) and the number next to the flashing lamp is increased by one or more.

1. **Check physically if the transducer with warning is under main-tenance**, but 'somebody' has forgotten to mark the transducer as

'Under maintenance' (set the 'MOS' flag) or disable the transducer (uncheck 'Enabled'). If the transducer is under maintenance and: -

- If you have 'Flag' rights: depending on the situation set the 'MOS' flag or uncheck 'Enabled' for the transducer. See section 2.3.5.
- If you do NOT have 'Flag' rights: Notify the person in charge of the system about the problem. See section 2.3.5.

2. If according to point 1 the warning is reliable:

- If the warning is an 🔴 (Alarm) for **OPERATION**: Action required. Immediately notify the person on watch in charge of the plant.
- If the warning is a 🔵 (System) warning: Immediately notify the person on watch in charge of the OPENpredictor™ system.

- Else: consider what to do. Normally no immediate action should be necessary. The warning will be reported automatically in the next Shift and/or Management Reports (see section 2.4).

See below about using Warning Lists and for more warning information incl. *when* and *how to* acknowledge a warning, and when a warning disappears from the Actual Warning Lists.

2.3.2.4   Opening a Warning List

There are three types of measurement warning lists:

- **Actual Warning Lists** (called 'Warning lists') only include details for the current measurement warnings to give a quick and accurate overview of the plant status. Any measurement may generate several warnings per state, but only the most severe warning per state will be shown in the Actual Warning List. The value causing the warning is shown in the Value field. The default setting is to list the latest warnings first. For access see below.

  A measurement will at most appear once per machine state. This means that when a measurement has generated warnings of different warning types in the same machine state, only the most severe warning type will be shown. The default sorting order is by time with the oldest warning first

- **Warning History Lists** are Warning Lists with details for all actual *and* historical measurement warnings. All measurements in the warning condition are displayed. Historical Warning Lists are for CM-specialist use. For details see section 2.3.2.6. For access use the menu 'Browse' > 'Warning History List'.

  IMPORTANT: Displaying the Warning History list may take quite some time depending of the number of historical warnings in the database.

- **MOS Warning list** is a list of transducers where the MOS (Maintenance Override Switch) flag is set. The MOS system is described in section 2.3.5.

Select the Actual Warning List to be displayed: -
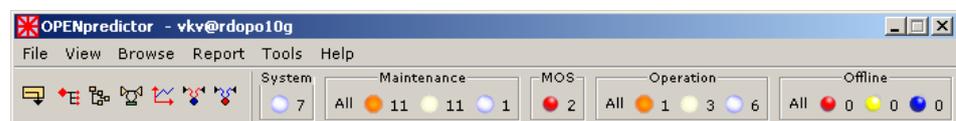
- To display all actual measurement warnings: click the 'All warnings' Warning List icon 🔳.

- To display all *actual measurement warnings in one of the five Warning Systems*: click the 'All' word (button): . Example: to display all Operation warnings, click 'All' in the Operation group.

- To display *all actual measurement warnings of a specific warning type in a warning system*: click its lamp. Example: To display all Operation Alarm warnings: click the red 'lamp' in the Operation warning group: .

This displays the related Warning list. For a full description see section 2.2.2.1.

In an Actual Warning List a warning will at most appear once per machine state. This means that when a measurement has generated warnings of different warning types in the same machine state, only the most severe warning type will be shown.

The title bar shows, which Warning List has been selected, here 'All Warnings'. The lamps indicate the selected warning levels (one or three lamps).

The Warning List is by default sorted by 'Meas. Time' with the *latest* warnings first. To sort it by any other parameter, click the heading for this parameter, e.g. click 'Severity' or 'Machine'. To reverse the sorting order, click the *selected* sorting heading once.

To investigate a specific warning: -
1. Select the warning: Click it. It is then marked with blue.
2. Right-click the warning to display the floating menu.

The floating menu (right (secondary) mouse button) has the following options: -

View Browser	Opens the Browser showing the measurement causing the warning.
View Warning Setting	For CM specialists only.
Acknowledge Selected	Acknowledge the warning(s) selected.
Plot Manager – add in measurements list	For CM specialists only.
Plot Manager – add in filters list	
<list of plots (plot scripts)>	Display the plot related. Use DEFAULT with the last 7 days of data as your first choice to display the Default plot for the measurement.

Double-clicking the warning will display the DEFAULT plot.

Consider in each case if any of these above floating menu options will give useful additional information to act upon. For the regular operator most often the answer is 'no' – except maybe 'View Browser' and 'Acknowledge selected'.

2.3.2.5 Acknowledging and removing a measurement warning

To acknowledge a measurement warning use the following procedure: In the Warning List window: -

1. Select the warning(s) to be acknowledged. To select more than one warning, hold down the Ctrl (add selected) or Shift (mark end of group) keys in the usual way while selecting.
2. Select the menu 'Edit' > 'Acknowledge selected' or the floating menu 'Acknowledge selected'.

Alternatively, all warnings can be acknowledged by selecting the menu 'Edit' > 'Acknowledge All'.

A measurement warning is automatically removed: -

*   When it is acknowledged.

AND

*   Its value is back within the accepted range
    OR
    the machine has moved to another machine state.

The warning data remains in the historical list. To see all current and removed warning data: select the menu 'Browse' > 'Warning History List'.

WARNING: The 'acknowledged mark' **cannot** be removed.

IMPORTANT: When a warning has been acknowledged the 'Value' field for a scalar measurement is no longer the worst data for the parameter. From now on the last data for the parameter of the related machine state is displayed in the 'Value' field.

2.3.2.6 Reading Warning list details

To display an **Actual Warning List**, either

*   Click the 'All warnings' icon 🔴. This displays the Actual Warning List window with all warnings except MOS warnings.
*   Click the text of the Warning Indicator Block, for example 'Operation'. This displays the Actual Warning List window with all warnings in the related Warning Indicator block.
*   Click the appropriate warning indictor lamp, for example 🔴. This displays the Actual Warning List window with all warnings of the related type, for example 'Operation' Alarm warnings.

For a better view, maximize the window.

To display the **Warning History List**: In the Menu Bar select the menu 'Browse' > 'Warning History List'. From here select the relevant list.

The title bar shows which Warning List has been selected, for example 'All Warnings' or 'Operation' Alarm Warnings. The 🔴 🟡 🔵 lamps below the menus indicate the selected warning types. The actually selected warning is highlighted in blue.

To display the parameter/signature which caused the warning: right-click the warning and select the floating menu 'Plot window - Add in measurements list'.

The data field columns of the Warning List are: -

Name	Explanation
Code	A unique number for the warning measurement.
Warning Type	System: An SPU has lost the connection. See 2.2.1.1. Operation: Operator Warning System Maintenance: Maintenance Warning system. Performance: Performance Warning System.
Severity	OVERLOAD/UNDERLOAD: Result out-of-range. SPU OVERLOAD: the transducer voltage output is out-of-range. Level names: *Alarm* High, Alert High II, Alert High I, Alert High - (normal) - Alert Low, Alert Low I, Alert Low II, *Alarm* Low. Examples: Severity=High II: Above High II level but below High level. Severity=Low I: Below Low I level but above Low II level.
Acknowledged	☐: Not acknowledged. ☑: Acknowledged. A warning is automatically removed from the Actual Warning List if it is acknowledged AND its measurement value is back in its non-warning range.
Measurement	Measurement code.
Description	Description of the measurement.
Value	Unacknowledged: the value measured for the warning. Acknowledged: the latest value measured for the machine state of the warning.
Meas.Time	The time of the measurement. The time stamp for a measurement executed by the SPU is given in the SPU. The time stamped data is transferred to the OPEN-predictor™ Server. The SPU time is synchronised to the OPENpredictor™ Server clock.
Machine	The name of the machine with the warning.
RPM	The primary tacho RPM value of the machine at the moment of the warning.
State	The name of the machine state at the moment of the warning. The names are different for all machines.
Type	For example 'Scalar', 'Spectral Band', 'Harmonic', 'Envelope', 'Profile'.
Info	Additional information: • The harmonic which initiated the error ('1xRPM Amplitude' or '3xRPM Phase'). • The number of 'lines' in a signature. • Spectral band identifier for spectral band warnings.

The columns may be moved by clicking the column header and then drag and drop it to a new position by means of the mouse.

Icons: -

🔴 🟡 🔵	Red: Alarm warnings are included. Yellow: Alert warnings are included. Blue: System warnings are included.

Menus: -

Menu level 1	Menu level 2	Explanation
File	Exit	Close the Warning List window.
Edit	Acknowledge All	Acknowledge all warnings.
	Acknowledge Selected	Acknowledge the warning(s) selected.
Filter Columns	<Column name>	Hide/display the column.

Right (secondary) mouse-button floating menus: -

View Browser	Opens the Browser showing the measurement causing the warning.
View Warning Setting	Opens the related window with the warning limit set-up for this measurement.
Acknowledge Selected	Acknowledge the warning selected.
Plot Window - Add in measurements list	For CM specialists only.
Plot Window - Add in filters list	

2.3.3 The AutoDiagnosis™ and Warning Browser

The 'AutoDiagnosis™ and Warning Browser' is used for getting an overview over *where* there currently are warnings, AutoDiagnosis and/or Instanta-neous AutoDiagnosis messages.

In order to open the 'AutoDiagnosis™ and Warning Browser' select the menu 'Browse' > 'AutoDiagnosis™ and Warning Browser'.

The basic layout is the same as for the normal Browser, but the information displayed for each item is here warning oriented.
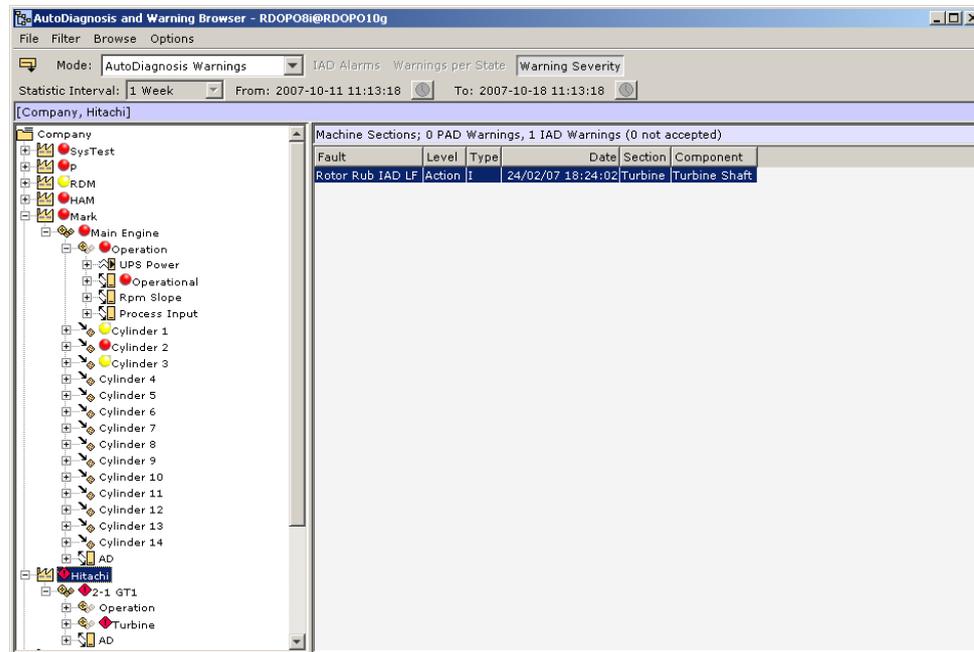
If the 'Warning Severity' button is activated, the worst warning condition of each item is displayed in front of the name of the item:

- Alarm / Alert / System: ● / ● / ●.½
- AutoDiagnosis™ or Instantaneous AutoDiagnosis™: ◆ / ◆ / ◆
  depending on severity, see 2.3.1.3 and 2.3.1.4.

You can track an alarm down from 'Plant' level to 'Machine Component' level which item the problems relates to by expanding the items (Click [+]).

To display the complete message for an AutoDiagnosis™ or Instantaneous AutoDiagnosis™ right-click the item, select the floating menu 'Browser', and then in the browser right-click the item.

To display the item in the normal Browser with access to graphics, etc. right-click the item and select the floating menu 'Browser'.

For further information about the other functions, please see the 'OPENpredictor™ User Manual' section 6.2.

2.3.4   Measurement warning indicators in Mimics
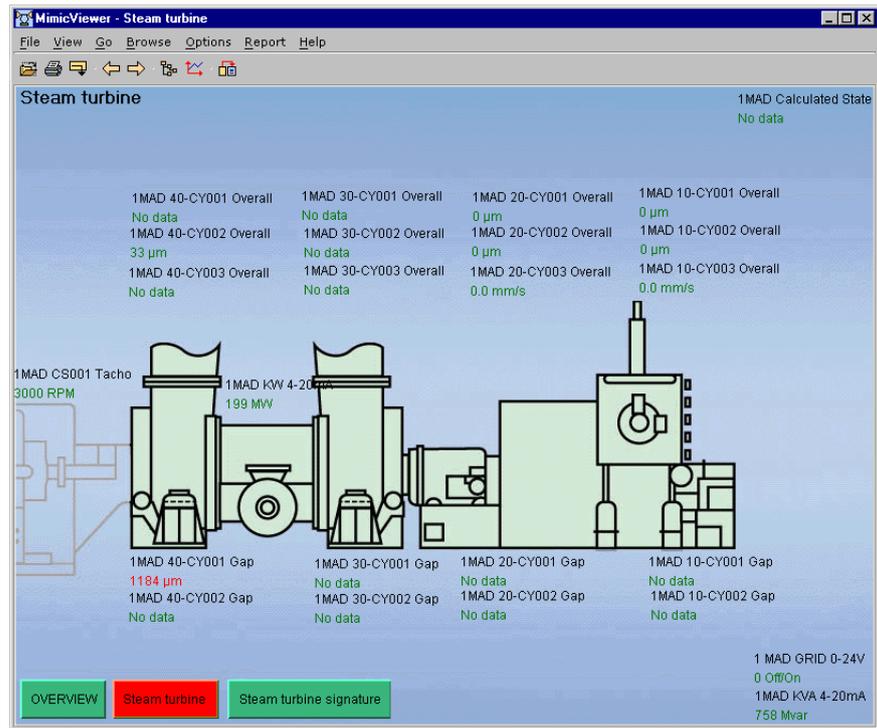
A Mimic is an image of a plant, machine or machine sections, which can be used as an informative background to display selected measurements and provide links, via active buttons, to related machinery and equipment for ease of use.

If a displayed measurement is in a warning condition the status is indicated by the colour for the warning type (red – yellow – blue, see section 2.3.2.1). See the example in the lower left corner of the Mimic viewer.

If the colour of a button is different from green, it relates to a Mimic with one or more measurement warnings at a more detailed Mimic level. The colour of the button indicates the worst warning type indicated on the related Mimic.

*Note: **Only warnings on scalar measurements** (e.g. Over-all vibration) are reflected in the colour of the buttons in the Mimics.*

Further information on Mimics – including Mimic warning indications – is found in section 2.5.

2.3.5   Maintenance Override Switch (MOS)

The number next to the MOS lamp indicates the number of transducers, which are marked for maintenance.

To display a list of transducers marked for maintenance click the 🔴 MOS 'lamp' or use the menu 'Browse' > 'MOS'.
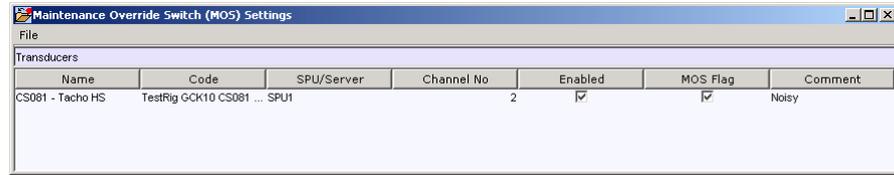
To display the transducer in the browser: right-click the transducer and select the floating menu 'View Browser'.

The Maintenance Override Switch (MOS) is used when measurements are irrelevant or unreliable. There are two levels of cutting-off a transducer: 'MOS' and 'not Enabled'.

2.3.5.1   The 'MOS' flag

The 'MOS' flag is used to avoid warnings from a machine or transducer under repair/maintenance *while the machine is running*.

When the 'MOS' flag is set (☑): -
- SPU relay functions will ignore warnings from measurement related to this transducer.
- AutoDiagnosis™ Messages are not generated for warnings from measurement related to this transducer.
- Measurement data is stored as usual.
- Alarms, alerts and system (overload) warnings are not recorded.

The 'MOS' flag should be set if: -
- The related machine under repair/maintenance/modification, whilst still running, may cause false warnings due to noise from tools.
- The related transducer loop is being tested for a fault.
- The related transducer loop is being tested or calibrated after repair.
- The related transducer loop is defective, but is still used and is to some extent reliable i.e. has a periodic fault.

2.3.5.2   The 'Enabled' flag

If the 'Enabled' flag for a transducer is NOT check-marked (☐), no measurements are transferred to the database at all.

The 'Enabled' flag should be NOT check-marked if: -
- The related transducer has been removed or its cable is broken.
- The related transducer is defective and causes unreliable warnings.

WARNING:
Even if the 'Enabled' flag for a transducer is NOT check-marked, the transducer is NOT included in the MOS list of transducers marked for maintenance (see section 2.3.5). To see which transducers are not enabled see section 2.3.5.4.

2.3.5.3 Checking/changing the position of the 'MOS' and 'Enabled' flags

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To change the 'Enabled' flag setting you must have 'Flags' rights.

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1. In the 'Browser' right-click **the transducer** (or) related to the measurement ( ), and select the floating menu 'View Definition': -
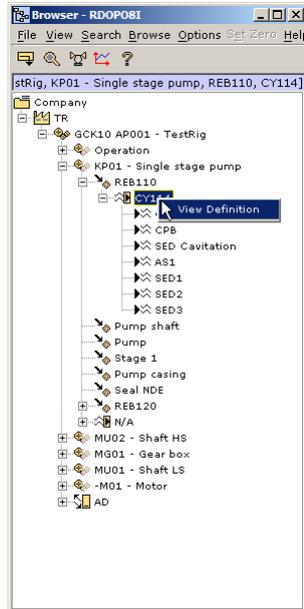
This displays the definition for the transducer, in the above case: -
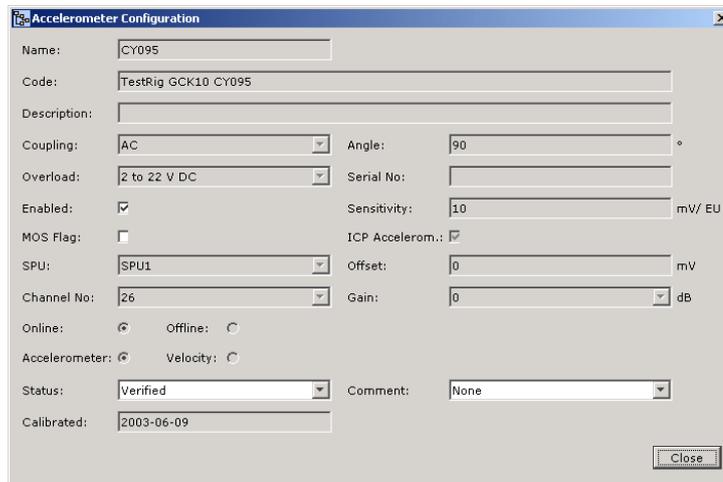
2. Check if the 'MOS' flag is check-marked .

IMPORTANT when you have changed a flag !!!
In order to activate the changed setting of a 'MOS' flag or 'Enabled' flag,
- the **SPU must be rebooted**, see section 2.9.4.
- the **Data Server must be stopped and restarted**, see section 2.9.5.

2.3.5.4 How to see which transducers are switched off

To see which transducers are switched off for maintenance by means of the Enabled or Maintenance (MOS) flags: -

1. In the 'Browser', select the menu 'View' > 'SPU Definition'. This opens the 'SPUs' window:

2. For each SPU (in the above case SPU1 and SPU2) check if any 'Enabled' flags are unchecked, or if any 'MOS flags' are set.

Note: It is also possible to see/change 'MOS' and 'Enabled' flags in the browser when
- The right part of the browser window is displayed, and
- The related Machine, Machine Section or Machine Part is displayed.

2.4   Reports

There are five types of main reports in the system: -

Shift Report	A report on the current problems i.e. for hand over to the next shift. The report covers faults to be dealt with within the next few hours or days. It is generated automatically at the end of each shift. The format is normally fixed, but can be changed. Each user can store their preferred report format under a unique name. Comments on the current status can be included. Procedures: see section 2.4.1.
Management Report	A report for the maintenance manager, focusing on predictions of future machine faults and the general health of the plant. The report is generated e.g. monthly. The format is normally fixed, but can be changed. Each user can store their preferred report format under a unique name. Comments on the current status can be included. Procedures: see section 0.
Diagnostic Report	An Excel file containing data for AutoDiagnosises and alarms.
Measurements Statistics report	A text file containing data for the number of measurements recorded in the specified period of time.
Oil Analysis (special module *)	Excel file containing oil data.
RDM reports (special module *)	RDM (Reliability Data Management) is a system reporting how often a machine is running and why it's stopped.
Single graph plot report	A report for a single plot in HTML format. The file contains the requested plot and all relevant data for evaluating the plot. Procedures: see section 2.7.1.
Multiple graph plots report	A report for all the plots within a 'Plot Manager' window. The HTML file contains all plots and all relevant data for evaluating the plots. Procedures: see section 2.7.2.
Mimic Report	A report from a Mimic in HTML format. The file contains a screen dump of the Mimic. Procedures: see section 2.5.3.

*) Special modules are not relevant for all applications, and may not be included in your installation.

All reports are in HTML format. The benefits of this are: -
- They can then be read and printed out by means of the generally well-known Microsoft Internet Explorer, which comes with Windows.
- In the Microsoft Internet Explorer you can use the Favourites (Ctrl+I) or History (Ctrl+H) facilities to display them.

The image below shows a typical layout of a Management or Shift report.

2.4.1 How to generate a Shift Report

A Shift Report is automatically generated at the end of each shift for handing over the status to the next shift. The intended receiver is the user of OPENpredictor™ on the next shift. The content selected should reflect the needs of the next shift.

The Shift Reports are generated at the times defined in scripts, which can be edited by the OPENpredictor™ system administrator.

To change the contents of the Shift Report, for example the 'Report comments':

1. In the OPENpredictor™ Menu Bar, select the menu 'Report' > 'Shift Report'.

2. In the Report drop down list, select the script for Shift Reports, in the above example 'Shift Report'.

3. (If needed, make amendments to the window settings, see below.)

4. Click [Save] to save the contents to the script selected in point 2.

5. Click [Close] to close the window.

To open the report use ![Start] > 'Documents', or – if that fails – open the file (defined in 'Html path' for example: c:\OPENpredictor\Reports\ ShiftReport.html) with the Internet browser (for example Microsoft Internet Explorer). They are always saved on the OPENpredictor™ Server.

2.4.1.1 Shift Report fields

Report	Displays the script-name of the current settings for the report. To enter a new setting name (e.g. 'ShiftReport2'), type it here.	
![trash icon]	Delete the currently selected script from the list of possible settings.	
(dropdown list)	List of selectable report settings (scripts). Select the report setting you want.	
Days	The report should cover warnings from the last <Days> days.	
Report comments	Here you can enter any comment to be added in the next reports.	
Report options	Comments	Any free text.
	Recommendations	Include AutoDiagnosis™ recommendations.
	AutoDiagnosis	Include AutoDiagnosis™ Message(s).
	Report only warnings not acknowledged	Report only warnings not acknowledged.
	Html Path	Relative path (ref: OPEN-predictor™ path) and the file name of the report (.html is omitted). Preferably use a path on the OPENpredictor™ Server.
	![folder icon]	Change the 'Html path'.
Report fields	Date	Include the date and time of the (AutoDiagnosis™) warnings.
	Operation/ Maintenance/ Performance/ RDM/ Offline/ System warnings	Include these warnings in the report.
	Machine code	Include machine code.
	Measurement	Include measurement code.
	Machine State	Include machine state.
	Measurement Value	Include measurement value of the warnings.
	Warning Settings	Include warning settings. Value examples: '0.4': The last warning limit passed. 'Normal': The value is now back in the normal range.
	Forecast Time	Include Min and Max forecasted time where the fault becomes critical. Value = 0: No forecast.
	Warning Status	Include warning status (for example: 'HIGH2').
	Acknowledges	☑: Acknowledged/Accepted. ☐: Not Acknowl./Accepted.
Save / ![save icon]	Save the settings selected.	

How to generate a Management Report

The Management Report is a report which may be generated e.g. monthly or after a serious warning. It is intended for maintenance management. The report contains the current warning history of the entire plant. The content selected should reflect the detailed needs of the plant maintenance management.

The report is saved in the directory specified as an .html format file. The directory should be on the OPENpredictor™ Server.

1. In the OPENpredictor™ Menu Bar select the menu 'Report' > 'Management Report'.
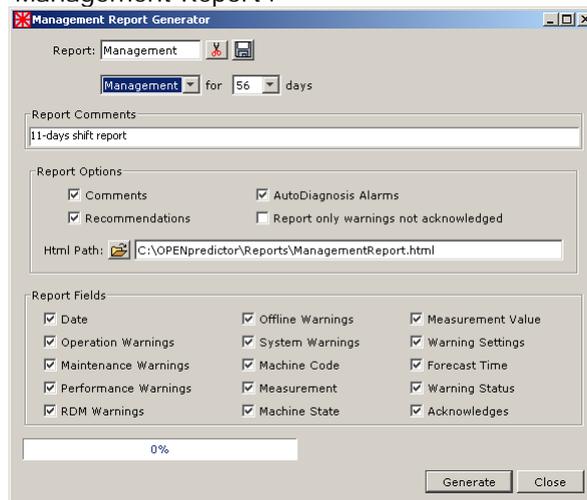
2. In the Report drop-down list ![Management dropdown], select the script for Management Reports, in the above example 'Management' (there may be several others, for example 'After fault'.)

3. Check/Select the number of days the report is to cover.

4. Insert the relevant 'Report comments'.

5. (If relevant, make other amendments to the window. For details about the fields, see section 2.4.1.1 'Shift Report Fields'.)

6. Click [Generate] to generate the report (and to save the list of contents to the script selected in point 2.) The progress of the generation is shown in the progress bar (here marked '0 %'.) The generation may take some time depending on the number of warnings and data to be included into the report.

7. Click [Close] to close the window.

To open the report use ![Start] > 'Documents', or – if that fails – open the file (defined in 'Html path' for example: c:\OPENpredictor\Reports\ ManagementReport.html) with the Internet browser (for example Microsoft Internet Explorer).

2.4.2 Diagnostic report

In the OPENpredictor™ menu bar select the menu 'Reports' > 'Diagnostic report' to save an Excel file with the following content:

It is used for giving an overview over the condition of a plant. The list contains specific fault data for each machine, one worksheet per machine.

2.4.3 Measurements Statistics report

In the OPENpredictor™ menu bar select the menu 'Reports' > 'Measurements Statistics'. This opens a box to open the file database-analysis.txt, placed in the OPENpredictor\reports directory.

The file is generated by a script, which is run as a 'Windows Service' at a specified time, typically daily. It shows how many data of each type, which have been added to the database.

The data are mainly used for trimming the system, but a significant change in the number of measurements is a good indicator, that something is wrong.

The data are shown in this window (Machine: ... = all machines):

To export the data to another text file, e.g. including the date in the file name (tip: use the yyyy.mm.dd format), click the Report Generate button

2.4.4   Note Reports

If using the 'Movipack' module for offline data collection (see section 2.8), 'Note Reports' displays stored standard notes, or notes typed in on the module.

'Note Reports' are accessible from the Browser: Right-click a Machine, Machine Part or Transducer and select 'View Note Reports' on the floating menu.

For a Machine or Machine Part, a 'Note Report' looks like this:
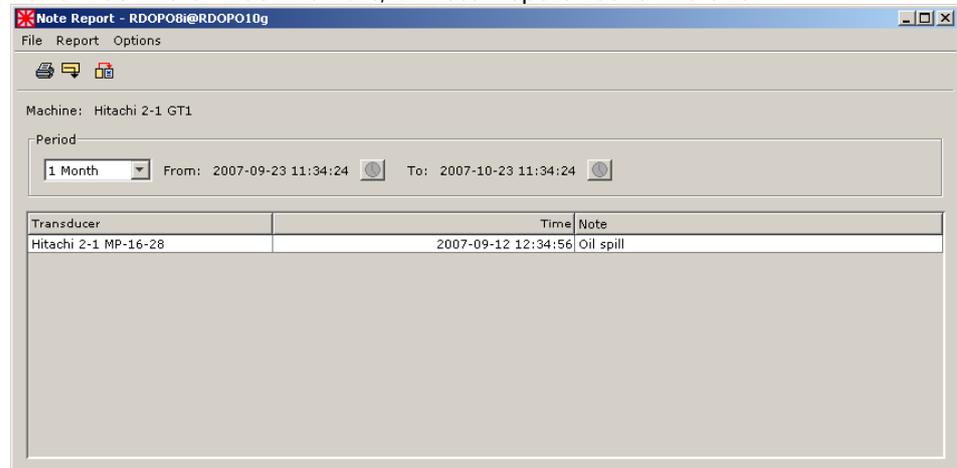
For a Transducer, a 'Note Report' looks like this:
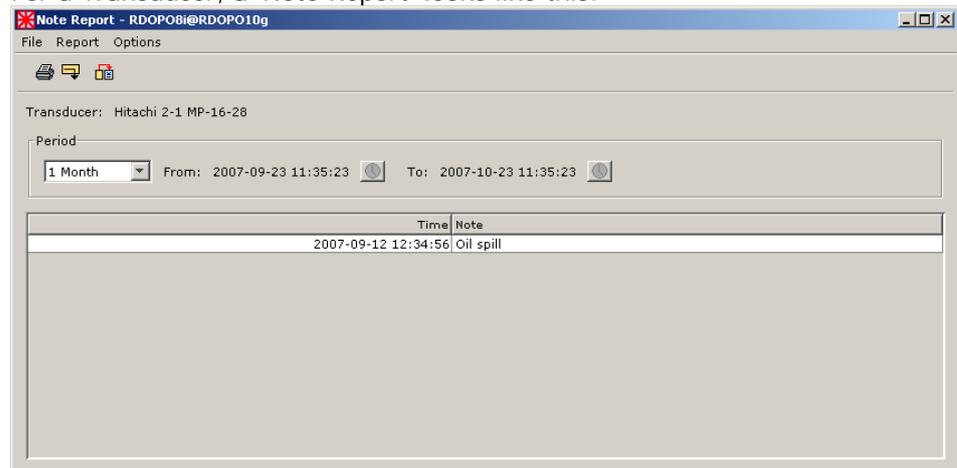
Click 🖶 to print the 'Note Report'.

Click 🗎 to save the 'Note Report' as an HTML-file.

By means of the 'Period' functions you can select the period for which the reports are displayed.

2.4.5 Oil Analysis (special module)

'Oil Analyses' is a tool used in some installations for reading and recording oil data.

The measurement is defined as a server source:
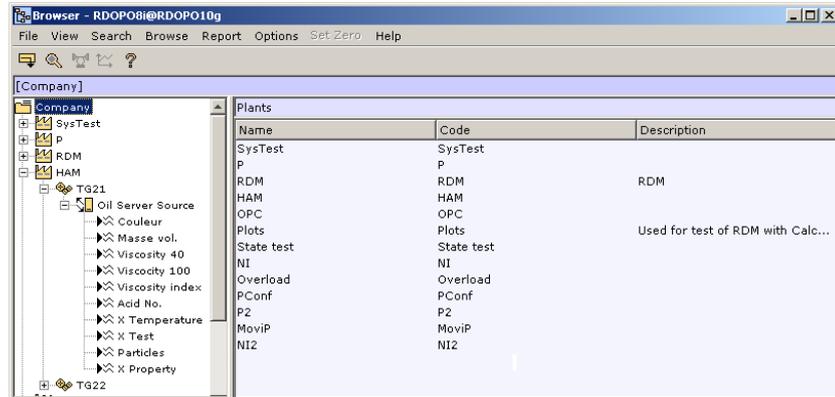
Each parameter has – as usual – a definition (right-click the parameter and select the floating menu 'View Definition'), e.g.:

Data may be measured automatically or entered manually. To enter the data manually and/or read the data:

1. Open the 'Oil Analyses' window: In the OPENpredictor™ menu bar, select the menu 'Reports' > 'Oil Reports':
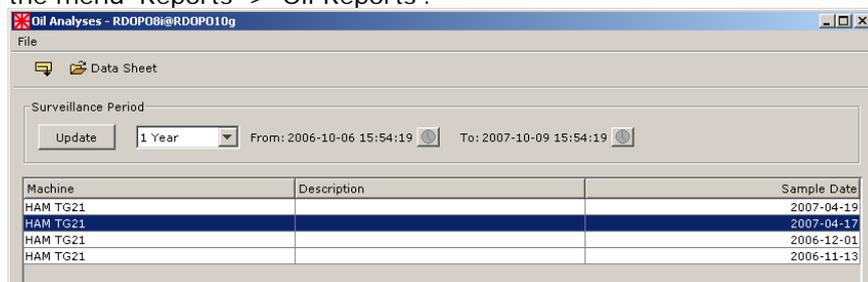
2. In this window, select the surveillance period, click [Update] if changed, and double click a record (one machine, one date) to display its data:
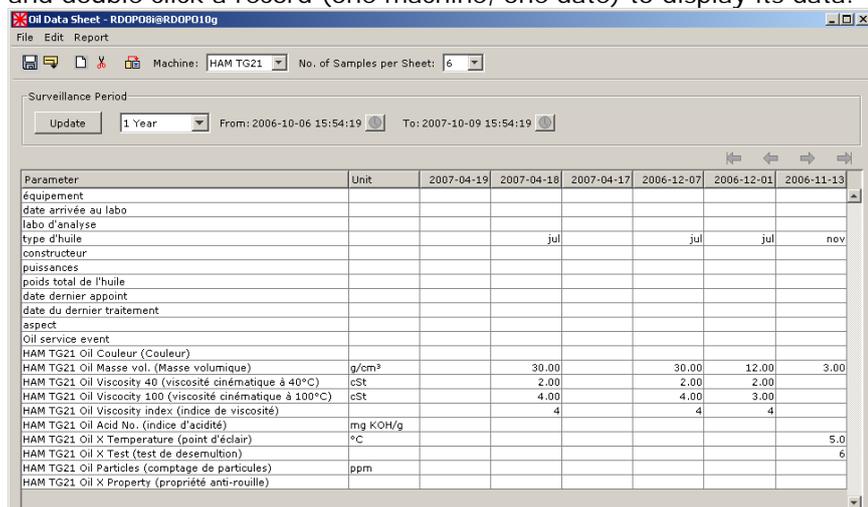
- To **insert** a **new** data column (date), select the menu 'Edit' > 'Insert Oil Report' (Ctrl-N) or click the ⬜ button. You will be prompted for a date.
- To **copy** a previous data column, select the menu 'Edit' > 'Copy Oil Report' (Ctrl-C). You will be prompted for a date and time. Please note the button [Now].
- To **delete** a new data column, select the menu 'Edit' > 'Delete Oil Report' (Ctrl-X). or click the 🔨 button, and select the date of the record to be deleted.
- To **export** all records to an Excel file, select the menu 'Report' > 'Generate' or click the 🔳 button.

All data fields except 'Parameter' and 'Unit' are freely editable.

3. After editing save the changes: Click 💾 or select the menu 'File' > 'Save' (Ctrl-S)

2.4.5.1 Importing Oil report data

To import oil report data, the data must have the same format as the export Excel file.

In the OPENpredictor™ Menu Bar, select the menu 'Tools' > 'Import Oil data', and then select the Excel file to import.

If the import fails, you will get an error message, which could be:
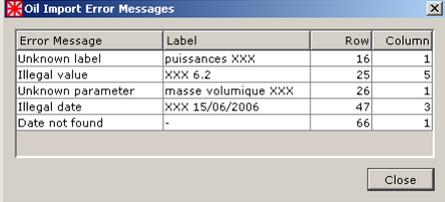
If the Data Server is not running, you will get an error message about that. In that case, start the server, see section 2.9.5.

The imported data will appear as a new line in the 'Oil Analysis' window, if the date is inside the 'Surveillance Period':
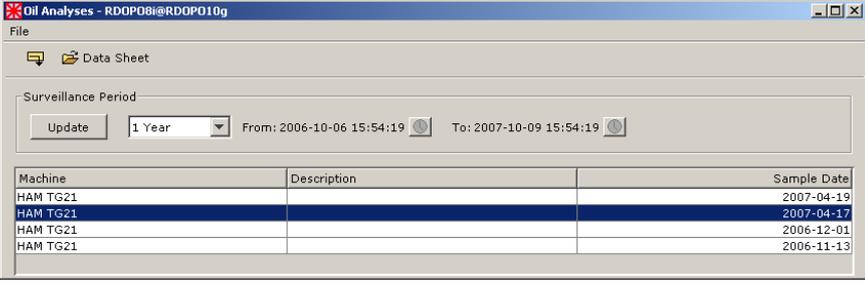
If the 'Sample Date' is the same as an existing 'Sample Date' the old data will be replaced.

2.4.6 Reliability monitoring (special module)

RDM (Reliability Data Management) is a system used in some installations reporting how often a machine is running and why it's stopped.

2.4.6.1 Menu Bar indicator

Whenever a machine is stopped, it causes a 'Reliability warning'. The number of machine stops can be shown in the Menu Bar: Select the menu View > Toolbars > Warnings > RDM.
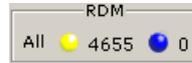
🟡 (yellow) is the number machine stops (scheduled and unscheduled).
🔵 (blue) is the number of RDM System warnings (no contact to the system).

2.4.6.2 The Downtime List

The 'Downtime list' is available
- directly from the Browser: Right click the 'Machine' icon and select the floating menu 'Downtime list'.
- by clicking the 'Downtime List' icon in the 'Machine Reliability Report' (see below).

Here you can edit four columns
- 'Type': Right-click the field to select any of the two standard causes:
  - Scheduled
  - Unscheduled
- 'Cause'. Right-click the field to select any of the three standard causes:
  - External (EXT)
  - Failed Whilst Running (FWR)
  - Failure To Start (FTS)
- 'Root Cause'. When 'Cause' has been selected, right-click to select a related 'Root Cause'.
- 'Comment': To enter/edit, double-click the field.

When a cause has been changed, click [Recalculate] to change the statistics bars accordingly.

If the 'Period' data have been changed, click [Update] to display the new list of stops.

2.4.6.3 The RDM Report

In the Menu Bar select the menu 'Report' > 'RDM Report' to open the RDM Report window giving a survey over the reliability of the machines included in the system.
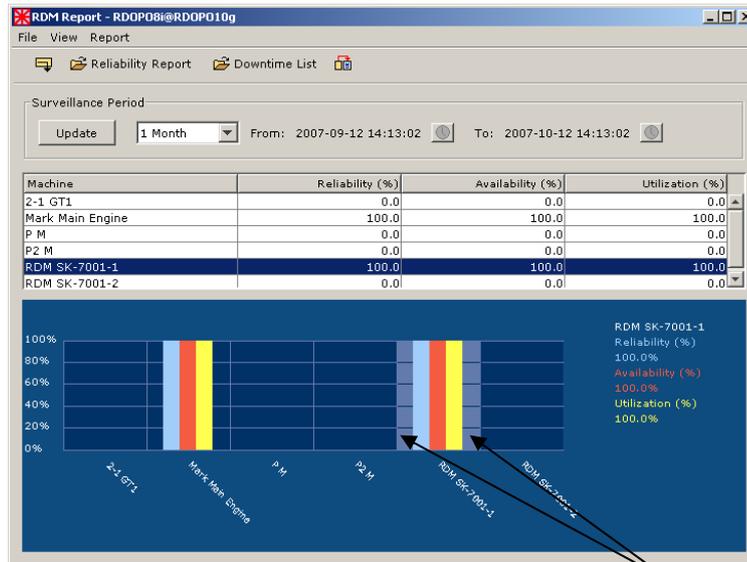
The bars for the machine selected are marked with a medium blue background.

The report displays for one or more machines
- Reliability (light blue bar): Uptime in %, where downtime is unscheduled downtime caused by the machine.
- Availability (red bar): Uptime in % no matter the cause of the stop.
- Utilization (yellow bar): Uptime in %, where downtime includes scheduled + unscheduled stops, only.

If the 'Surveillance Period' data have been changed, click [Update] to recalculate the bars.

Click ▦ to save the window as an HTML-report. You will be prompted for file name and directory.

2.4.6.4 The Machine Reliability Report

To get more details for the machine highlighted
- In the 'RDM Report' window click 'Reliability Report'.
- directly from the browser: Right click the 'Machine' icon and select the floating menu 'Reliability report'.
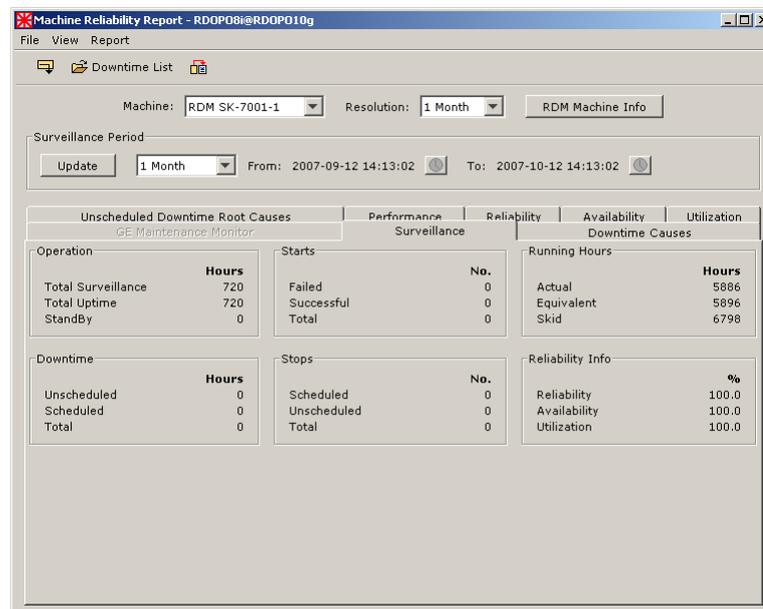
This window contains a number of tabs, on each of which you can read further details, for example about each stop.

To enter/edit data about each stop, in the 'RDM report' click the 'Downtime list' button.

2.4.6.5   RDM machine Info

In the 'Machine Reliability Report' or the 'Downtime List' (see below): click [RDM Machine Info] to open a window with basic RDM data and alarm/ alert settings for this machine:

For an explanation to the fields, see the OPENpredictor™ User Manual section 5.12.5.7.

2.5   Mimics

Mimics are interactive graphical user interface windows displaying: −
- Images of the system.
- Images of system components with selected measurements and warnings related to the items currently displayed.
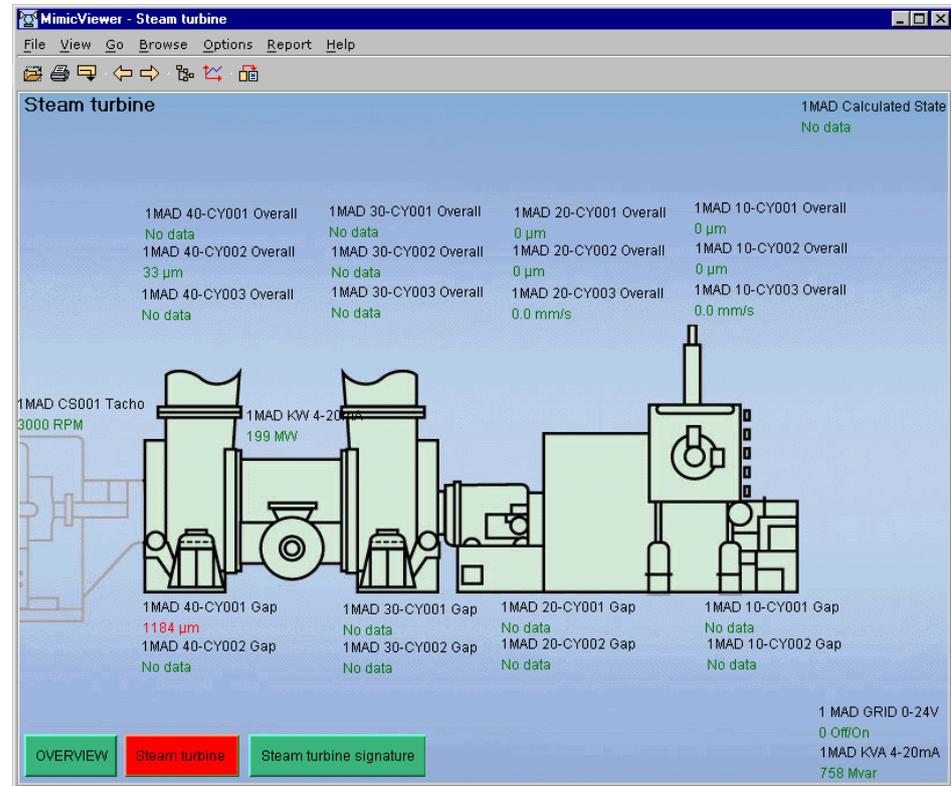
Data values without warning are green. If a measurement shown is in a warning condition, the colour of the measured value is the colour for the warning condition: red = Alarm, yellow = Alert.

Coloured buttons are links to other Mimics. The colour of the button indicates the colour of the worst measurement on the linked mimic.

TIPS:
- If holding the mouse pointer over a data field, the time for the measurement is displayed as a 'tool-tip-text'.
- For more information about a measurement, right-click the name of the measurement, see section 2.5.2.

2.5.1   Opening a Mimic

1.   In the OPENpredictor™ Menu Bar, click to select the Mimic Viewer:

If a default Mimic has been defined, this is immediately shown below the panel, see point 3 below.

2.   Click 📂 to open a Mimic. This opens the 'Mimic Viewer – Open' window:
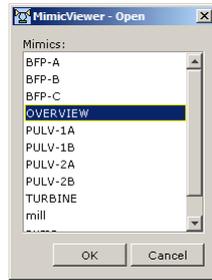
3.   Select (highlighted) the desired Mimic and click [OK].
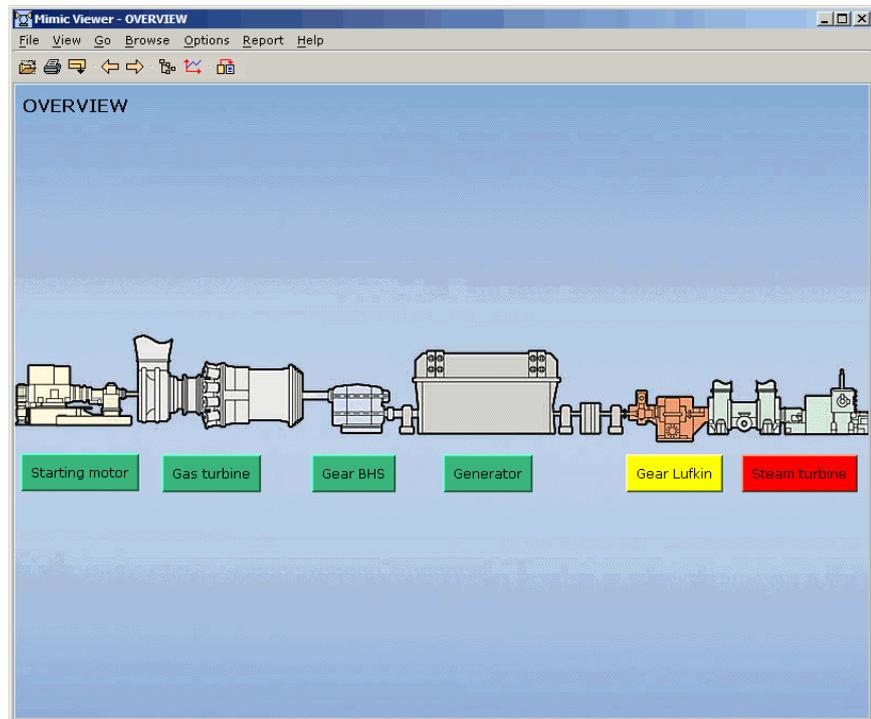
The image above shows a system overview without measuring values.

4.   To switch to another Mimic (alternative methods): -
   •   Click the link-button for the Mimic desired.
   •   Select the Mimic from the list (step 2-3 above).
   •   Click the ⇦ (back) or ⇨ (forward) icon to get the previous or next Mimic previously displayed.

2.5.2   Working with a Mimic
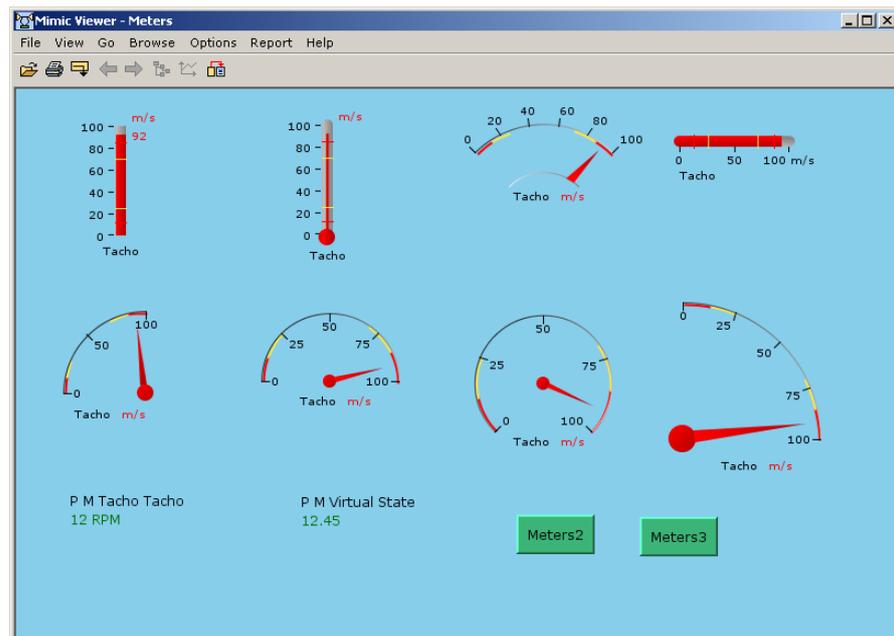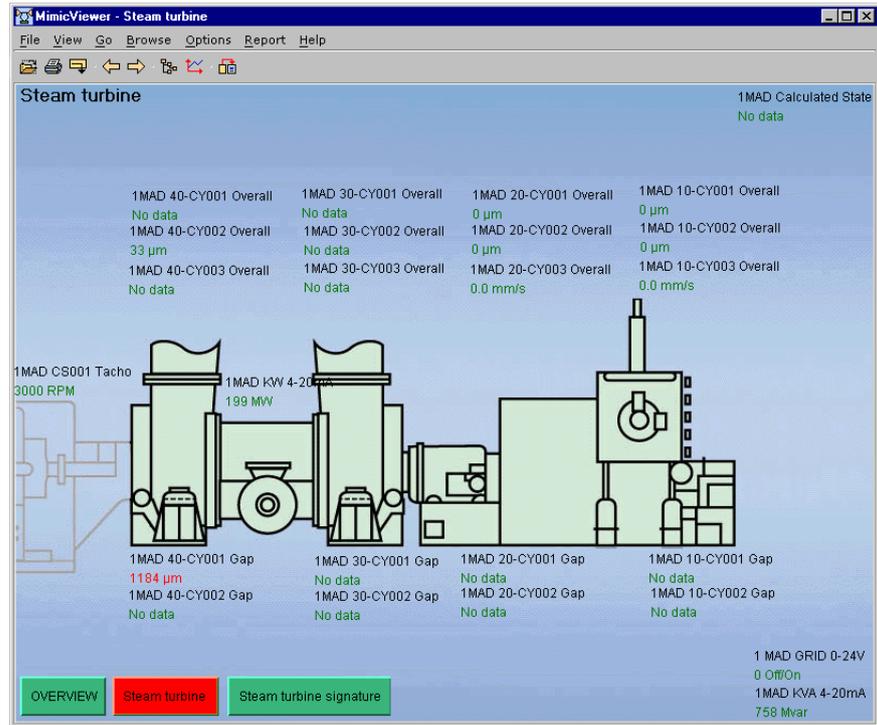
The images above are showing examples of detailed Mimics.

A measurement is shown as a leading text (normally the parameter name) + the actual value for the parameter. Values without warning are green. If in a warning condition, the measurement is shown in the colour of the warning condition (Alert: yellow, Alarm: red, System fault: blue).

Buttons are links to other mimics. If the colour of a button is different from green, it relates to a measurement with one or more warnings. The colour of the button indicates the worst warning level indicated on the related Mimic.

For more information on a specific measurement displayed: -

- Double-click the tag name, value or meter to display the Default Plot of the measurement.

or

- Select the measurement (click its label or value) and click:

- to display the Default Plot of the measurement.

- to display the measurement in the Browser. From there you can select any plot script related to the measurement.

or

- Right-click the measurement to open the 'Mimic Viewer – Select Measurement' window with all measurements for the transducer:
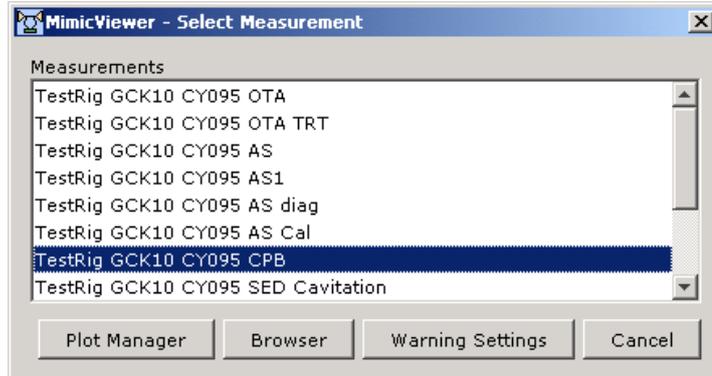
The buttons are
- [Plot Manager]: Open the DEFAULT plot for this measurement.
- [Browser]: Open the Browser with the measurement selected.
- [Warning Settings]: Open the warning settings window for this measurement.

2.5.3   How to make a Mimic Report

1. In the Mimic window, click the (Generate Report) icon and select a name and path for it. The name must end with '.htm' or '.html'.

2. To open the report use > 'Documents', or – if that fails – open the file ('Html path' for example: C:\OPENpredictor\Reports\xxxx.html) with the Internet browser (for example Microsoft Internet Explorer):
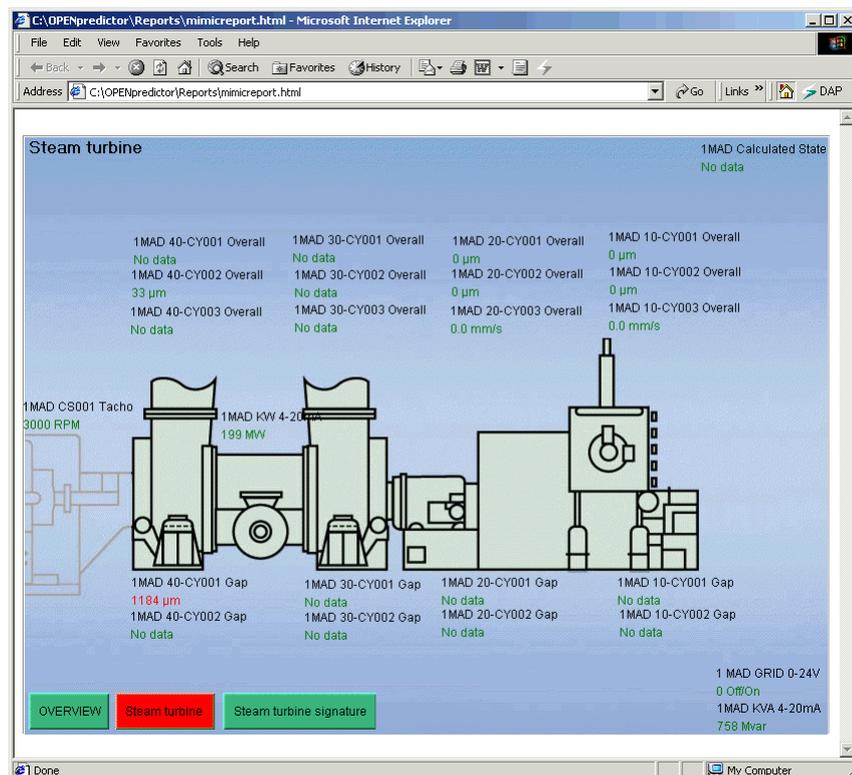
2.5.4 Mimic menus and related toolbar icons

Menu	Submenu	Explanation
File	📂 Open	Open the 'Mimic Viewer – Open' window to select which Mimic to open: MimicViewer - Open Mimics: BFP-A BFP-B BFP-C OVERVIEW PULV-1A PULV-1B PULV-2A PULV-2B TURBINE mill OK Cancel
	🖨 Print	Print the Mimic (screen dump – no additional text – landscape view).
	🖳 Exit	Exit the Mimic Viewer
View	Toolbars	☑ File ☑ Go ☑ Browse ☑ Report
Go	⬅ Back	Switch to previous Mimic (originally selected by link)
	➡ Forward	Switch to next Mimic (originally selected by link)
Browse	🗂 Browser	Open the Browser. If a measurement is selected this measurement is displayed in the Browser.
	📈 Plot manager	Open a Scalar Trend plot for the measurement selected.
Report	🔲 Generate	Creates an HTML report with the content of the Mimic window. '.HTML' is automatically added to the name typed.
Help	Content	Open the help file.
	About	Open the 'About OPENpredictor™' window.
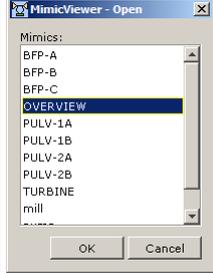
2.6   The Browser Window

The Browser is used for selecting measurements to be displayed, and for displaying details about plant and machine items and measurements.

To open: click the ▦ icon.

To open/close the **right side field with the details**, select menu 'Options' > 'Right Part of Browser visible'. This setting is stored.
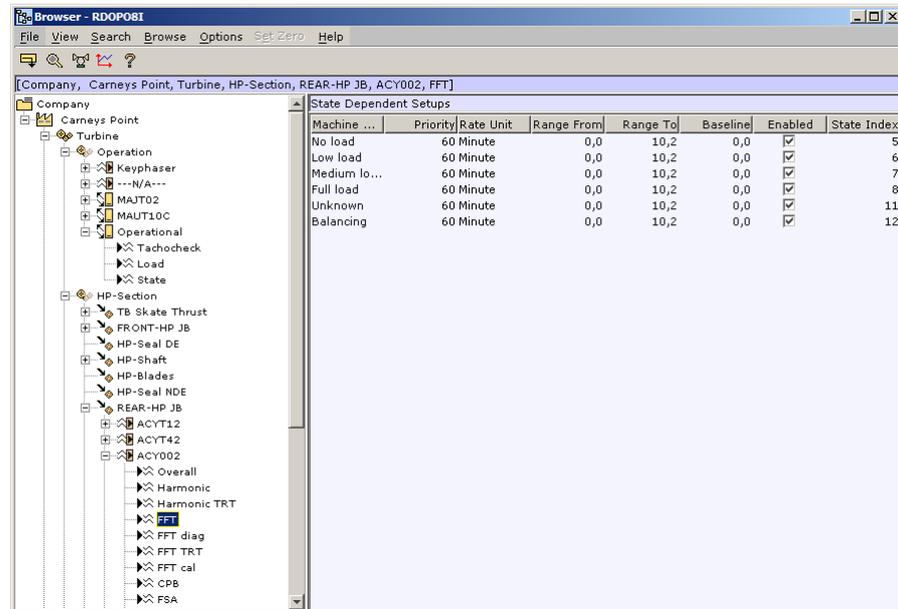
The window contains five areas below the title bar: -
- Menus.
- Toolbars.
- Item/measurement selected.
- Left field: Item/Measurement *selector*. See section 2.6.1.
- Right field (if displayed): Item/Measurement *data*.

To select an item click it with the left (primary) mouse button. You can use the arrow keys to navigate in the Browser window.

2.6.1   Item/Measurement Selector

Icons used in the left side field showing the hierarchical structure of the CM system:

▦	Company
▦	Plant
▦	Plant Section
▦	Machine
▦	Machine Section
▦	Machine Component
▦	Transducer
▦	Virtual transducer or AutoDiagnosis™ Server
▦	Measurement
⊞	Closed (default): Items/measurements in the next level(s) are hidden. Click to expand.
⊟	Open. Items/measurements in the next level(s) are displayed. Click to hide lower level contents.

The item/measurement displayed with blue background is the currently selected one. Its data is displayed in the right-hand data field (if displayed), and its name (full path) is displayed above the window.

2.6.2 Floating menu

Put the pointer over an item/measurement and right-click to activate the floating menu for that item. Floating menu example for a measurement: -
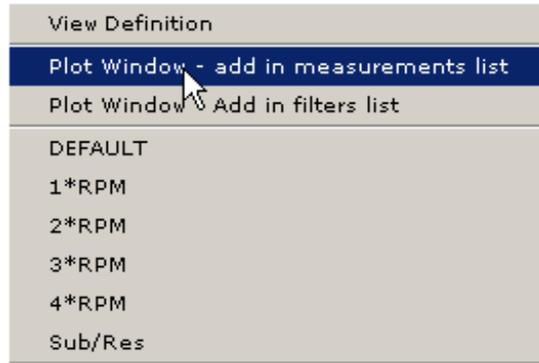
The menu selected is highlighted (blue background). The possible menus are:

Menu	Used with	Explanation
View Definition	All	Display the definition window for the item/measurement clicked.
View Note Reports	All except 🔀 Measurement	Display 'Note Reports', see section 2.4.4.
View AutoDiagnosis Configuration	📁 Company 📊 Plant 📈 Plant section 🔩 Machine 🔧 Machine section 🔨 Machine component	Opens the 'View AutoDiagnosis™ Configuration' window for the item selected. From here, you have an overview of the related possible Auto-Diagnosis™, and the AutoDiagnosis™ recommendation can be edited if you have the proper rights.
View RDM Report (RDM= Reliability Data Management)	📁 Company 📊 Plant 📈 Plant section 🔩 Machine	Display the 'RDM Reports' window, if RDM is installed for this item or any item below, see section 2.4.6.
View Reliability Report	🔩 Machine	Display the 'Reliability Report' window, if RDM is installed for this machine, see section 2.4.6.
View Downtime Report	🔩 Machine	Display the 'Downtime Report' window, if RDM is installed for this machine, see section 2.4.6.
View AutoDiagnosis Messages	🔩 Machine 🔨 Machine component	Displays the latest + a list of all Predictive AutoDiagnosis™ messages for this machine.
View Instantaneous AutoDiagnosis Messages	🔩 Machine 🔨 Machine component	Displays the latest + a list of all Instantaneous AutoDiagnosis™ messages for this machine.
View Machine States	🔩 Machine	Open the Machine States window with a list of machine states of the machine selected during the last week. You can change the display period by clicking the Time from/to icons and then click [Apply].

Set MOS Flag	All except	Set/Reset the MOS flag for the transducer /all transducers below this item. See section 2.3.5.1.
Reset MOS Flag	⋙ Measurement	
Plot Manager - Add in measurements list	⋙ Measurement	Add this measurement to the last opened Plot Manager window.
Plot Manager - Add in filters list	⋙ Measurement	Add the measurement to the Plot Manager 'Filters list'.
Clear Baseline	All	For specialists, only. See the OPEN-predictor™ 2.8.0 manual section 3.3 for details.
Set Baseline	🐝 Machine 🐝 Machine section 🐝 Machine component ⋙ Measurement	
DEFAULT	⋙ Measurement	The default plot-script for this parameter with default state if specified in its Range-Settings.
\<list of other plot scripts\>	⋙ Measurement	Other plot scripts for this parameter.

2.6.2.1 Displaying AutoDiagnosis™ messages for a machine (component)

From the browser you can display lists of AutoDiagnosis™ messages for a specific machine or machine component.

To open the AutoDiagnosis™ message window:
1. Open the Browser.

2. Select the machine or a machine component: Click its 🐝 or 🐝 icon.

3. Right-click the 🐝 or 🐝 icon to display the floating menu for the machine (component):

```
View Definition
View AutoDiagnosis Configuration
View AutoDiagnosis Messages
View Instantaneous AutoDiagnosis Messages
View Machine States
View Note Reports

Set MOS Flag
Reset MOS Flag
Clear Baseline
Set Baseline

Collapse All
Expand All
```
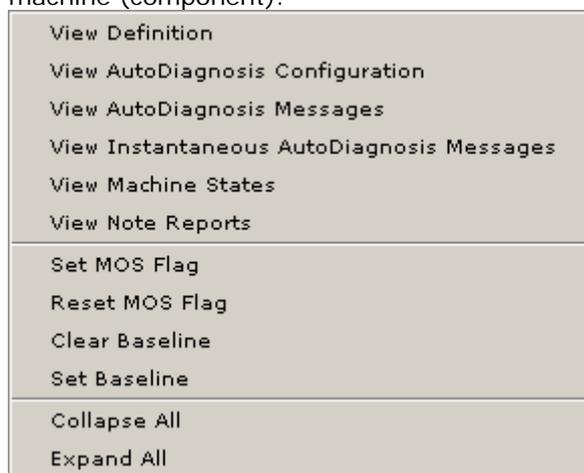
4. Select the menu 'View AutoDiagnosis Messages' or 'View Instantaneous AutoDiagnosis Messages'. This will open the related AutoDiagnosis™ list window, see section 2.3.1.5.

2.7 Working with predefined plots

Each measurement has an associated Default plot (called 'DEFAULT'). There are many ways to launch a Default plot as described in other sections of this chapter, and in section 2.7.4.

The most common Default plot is the 'Scalar Trend' plot shown below: -
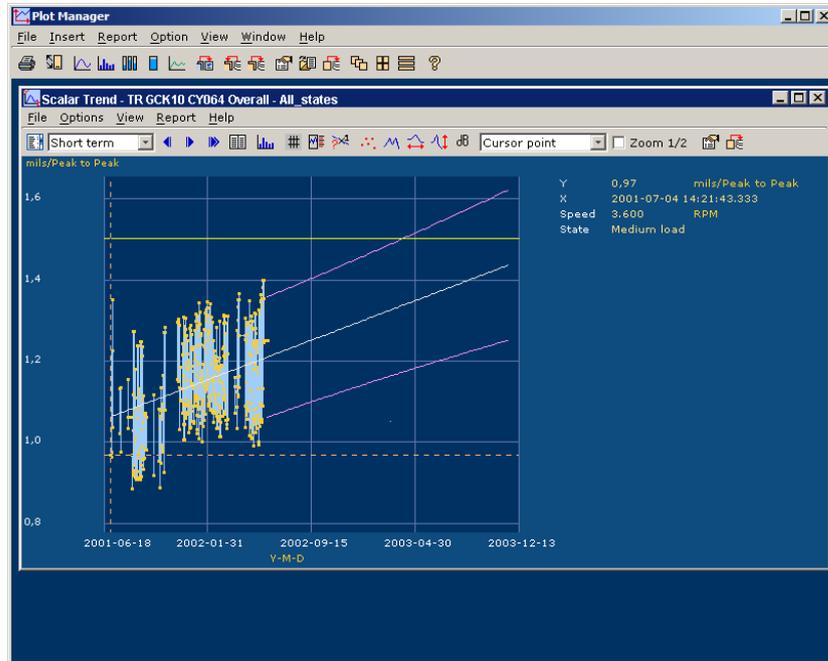
The Plot Manager with a Scalar Trend plot, where the yellow 'Alert' line is crossed by the upper prognosis confidence-range trend curve.

To copy the *active* (= top) plot in black-white, e.g. for using in a Word report, just press Ctrl-c (the standard Windows shortcut for Copy). For a colour copy press Ctrl-d.

2.7.1 How to make a Single Plot Report

The report is an HTML report for a single plot. The HTML file contains a plot and all relevant data for evaluating the plot.
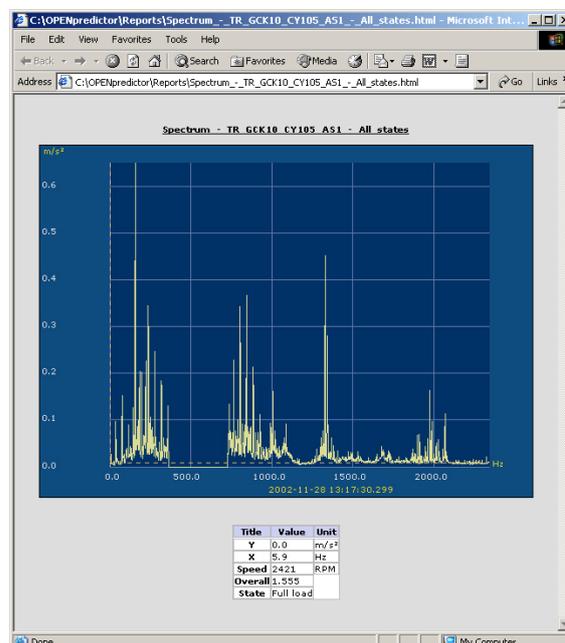
1. In the *individual plot window*,
    - Select the menu 'View' > 'Toolbars' > 'Report' and then click the icon
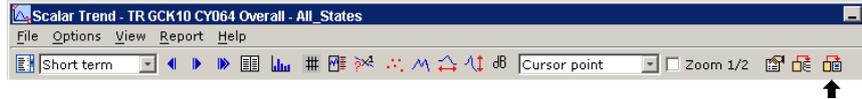
    or
    - use the menu '<u>R</u>eport' > 'Generate'. This opens a normal 'Save As' box.

2. In the 'Generate report – Save' box, select a name with the extension '.HTML' (normally accept the proposed name) and click [Save].

3. To open the report use > 'Documents', or – if that fails – open the file ('Html path' for example: C:\OPENpredictor\Reports\xxxx.html) with the Internet browser (for example Microsoft Internet Explorer).

2.7.2   How to make a Multiple Plot Report

The report is an HTML report for all the plots within the Plot Manager window. The HTML file contains all plots and all relevant data for evaluating the plots.
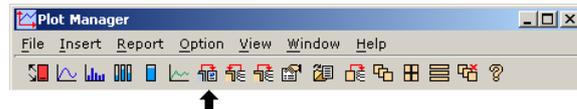
1. In the *Plot Manager main window* (not the individual plot),
    - Select the menu 'View' > 'Toolbars' > 'Advanced toolbar' and then click the icon.

    or
    - Select the menu '<u>R</u>eport' > 'Generate'.

    This opens a 'Save As' box.

2. In the 'Generate report – Save' box, select a name with the extension '.HTML' and click 'Save'.

3. To open the report use > 'Documents', or – if that fails – open the file ('Html path' for example: C:\OPENpredictor\Reports\xxxx.html) with the Internet browser (for example Microsoft Internet Explorer).

2.7.3   User defined plots

It is possible to create other predefined plots for easy data presentation. The CM specialist may have predefined 'Scripts' under a dedicated name to display measurement data e.g. 'Run-up Gas turbine'. This would present all Bode diagrams for all the bearings without having to request the data per bearing. Most predefined plots are used for advanced Condition Monitoring data analysis, to be made by the maintenance engineer or vibration specialist.

However, several types of plots are also useful for analysing plant operation, for example displaying actual load, output power and relationships between parameters, e.g. Load, temperature and efficiency.

Please ask your OPENpredictor™ system administrator to set-up the plots you need. The plots can then be found on your list of default plots, see 2.7.4.

2.7.4 How to open a user defined plot

To display a user defined plot: -
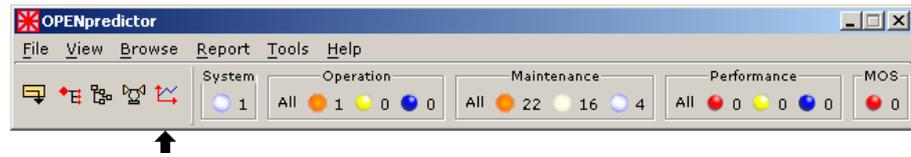
1. Open the Plot Manager window: In the OPENpredictor™ Menu Bar click .

2. If you want to work with icons in the Plot Manager window, select (check-mark) the menu 'View' > 'Toolbars' > '✓ Advanced toolbar'. This setting will be saved with your user profile.

3. Open the 'Open Data Selection' window: In the 'Plot Manager' window: -

   - Click the icon, or
   - Select the menu 'View' > 'Data selection' > 'Open'.
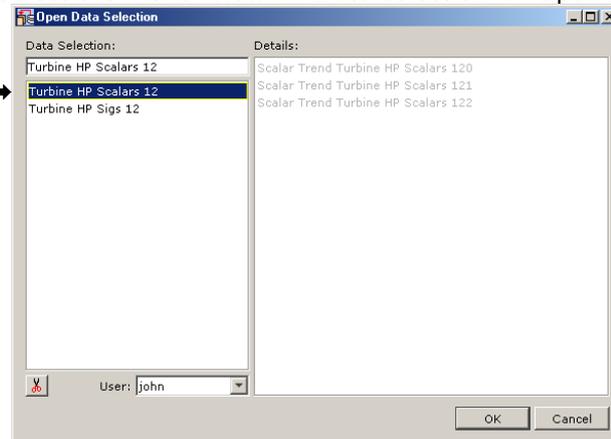
4. Select the desired stored plot settings, which may contain one or several plots, by clicking its name in the left field. The selected setting is shown in blue.
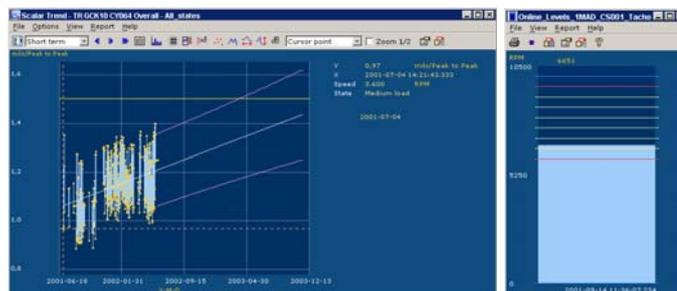
Examples of the results of different stored plot scripts

5. Click [OK]. Opening the plots may take quite some time depending on the amount of data to calculated and displayed. A progress bar is displayed.

If more than one plot is displayed in the same Plot Manager window, they may be cascaded (click), tiled (click) or tiled vertically (click). To close all plots click .

The plots may also be maximized, normalized, minimized and closed in the normal way using the ▬ ☐ ✕ buttons.

2.7.5 Navigation facilities of a plot

This section aims to give you the skills to work with pre-defined plots.

2.7.5.1 Zooming by selecting

Click and hold down the primary (left) mouse button while moving the pointer, to select the part of the plot to zoom-in. When the mouse button is released the zooming takes place: -
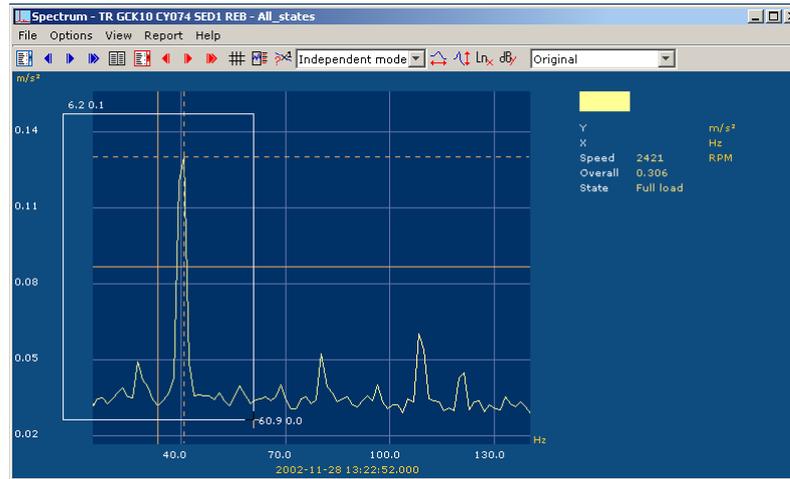
Please note:
- If the selection doesn't contain any curve points, no zoom is made. This can be used for cancelling the zooming.
- As shown above, going outside the borders includes an equivalent area outside the current selection.
- The co-ordinates of the starting point corner and the pointer are displayed at the selection.

2.7.5.2 Zooming, moving and scrolling using shortcuts

Shortcut keys	Function
←→	Move the point selected in the direction of the key.
Ctrl ←→↑↓	Scroll the window approx. one grid width in the direction of the key.
Num+	**Vertical** zoom **in** by a factor of 2. New centre at the point selected.
Num-	**Vertical** zoom **out** by a factor of 2. New centre at the point selected.
Ctrl Num+	**Horizontal** zoom **in** by a factor of 2. New centre at the point selected.
Ctrl Num-	**Horizontal** zoom **out** by a factor of 2. New centre at the point selected.

'Num' indicates the keys in the numeric pad section of the keyboard.

2.7.5.3 Zooming to fit to the actual data

Select the menu 'Options' > 'Fit to data' or use the buttons ⟷ and/or 🔺.

2.7.5.4   Zooming out by a factor of 1/2

Shortcut: *Right*-click inside the curve area of the plot.

Icon: ☑ Zoom 1/2

Access: select (☑-mark) the menu 'View' > 'Toolbars' > '☑ Zoom' in the appropriate plot sub-window.

☑ Zoom 1/2	Activated: clicking anywhere inside the plot will zoom out both axes by a factor of 2 keeping the centre point of the plot.
☐ Zoom 1/2	Deactivated. Clicking inside the plot leads to normal pointer functions. (The shortcut will still work.)

2.7.5.5   Scrolling the selection one grid-width using the mouse

Right-click (secondary mouse button) the plot sub-window ***out***side the curve area itself to scroll the plot approx. one grid-width in the direction of the arrow displayed (the direction away from the curve area). In the screenshot below, the arrow ╬ ➡ is shown to the right of the curve area: -
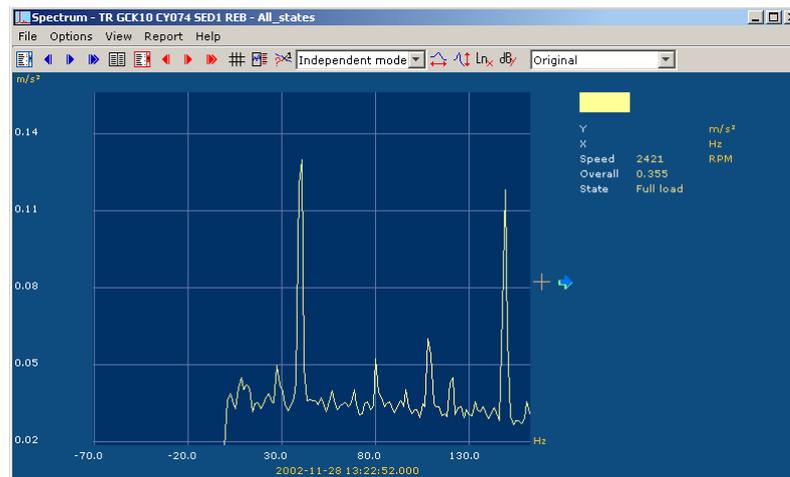
2.7.5.6   Cursor position readout

Right-click (secondary mouse button) the plot sub-window anywhere ***in***side the curve area to show the exact position of the + cursor in a small sub-field:
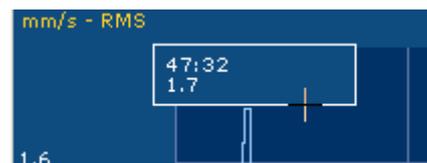
Line 1: x-axis position. For a time-axis date & time, see section 2.7.5.7.
Line 2: y-axis position.

2.7.5.7 The date & time format

The date & time format refers to the format displayed at the bottom of the window:
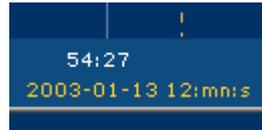
In this case the first part '2003-01-13 12:' is fixed for all points and therefore only the part 'mn:s' (min:sec) in this case '54:27' is displayed on axis, etc.

If for example the format was '2003-M-D ' the date & time stamp displayed would have been '01-13 (in this case no time).

If the plot shown is a signature, the time format text is replaced by the time of the signature.

2.7.5.8 Peak position readout

Left-click the plot sub-window *near a peak* to set the selected point to the nearest peak value. The position is indicated in the plot by border-to-border dotted orange lines, and the position data is shown in the data field to the right of the plot together with other important information about the measurement: -
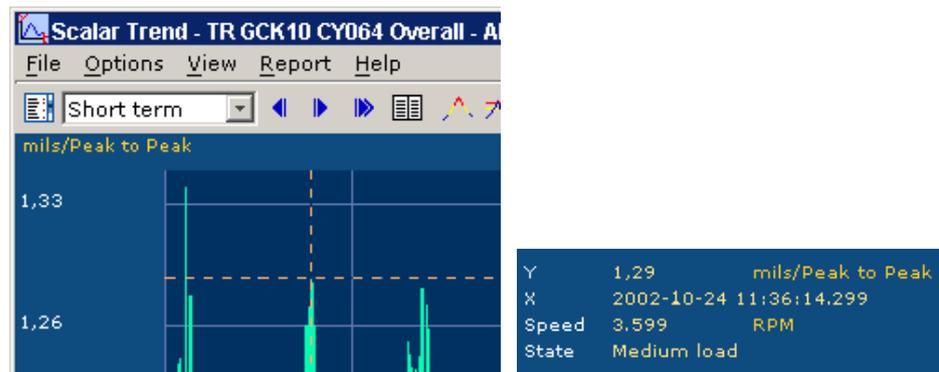
Note: the data field may be switched on/off by means of the icon.

2.7.5.9 Changing data-period for a scalar plot window
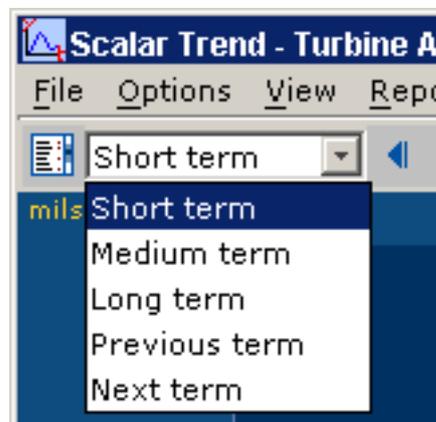
In the icon tool-bar of most scalar plot windows there is a drop-down list with five choices:

- **Short term**: Reloads the data using the period 'Short term' defined for the 'Plot Manager' (menu 'View' > 'Settings' > 'View settings', field 'Time Base').

- **Medium term**: Reloads the data using the period 'Medium term' defined for the 'Plot Manager'.

- **Long term**: Reloads the data using the period 'Long term' defined for the 'Plot Manager'.

- **Previous term**: Load the data of the period *prior to* the actual period and with the same length of period. In case of no more data, a message is displayed instead.

- **Next term**: Load the data of the period *just after* the actual period and with the same length of period.

The drop-down list may be hidden/displayed by (de)selecting the menu 'View' > 'Toolbars' > 'Selection'.

2.8   Off-line data collector (special module)

Some installations of the OPENpredictor™ system use off-line data collection by means of a hand-held 'data collector'. Various types are used. It could for example look like this:

For the handling of the data collector and the data collection procedures, please refer to the user manuals for the data collector.

Before collecting the data, the 'route' must be loaded into the data collector. The route data contains information about where to get which measurements and in which (suggested) order.

2.8.1   Uploading the route to the data collector

1. Connect the data collector to the PC-port specified, for example 'COM1:'. Make sure the battery is full and in good condition.

2. In the main window, select the menu 'Tools' > 'Routes'. This opens the 'Route MMI' window:

   (To display the route definition, double-click the Message field of the route.)

3. Select the route to be uploaded (even there is only one route.)

4. In the 'Route MMI' window select the menu 'DataCollector' > 'Upload to Data Collector'.

5. Wait until the data collector reports the route is loaded (for example: the progress bar disappears).

6. Disconnect the data collector from the PC.

2.8.2   Downloading the tour-data from the data collector

When the data has been collected do as follow:

1. Connect the data collector to the PC-port specified, for example 'COM1:'.

2. In the main window, select the menu 'Tools' > 'Routes'. This opens the 'Route MMI' window.

3. Select the route with the data to be downloaded.

4. In the 'Route MMI' window select the menu 'DataCollector' > 'Download from Data Collector'.

5. You are notified when the data has been downloaded. Then disconnect the data collector and make sure the battery is being recharged.

2.9 Bearing Wear Monitoring (special module)

OPENpredictor™ uses BDC (Bottom Dead Centre) measurements for Bearing Wear Monitoring (BWM) on piston engine bearings. A typical application is large ship diesel engines. Connected to the general ship alarm system, it can give an instant sound alarm for spontaneous bearing damage as well as early warning messages for slowly developing bearing wear.

2.9.1 Basic principles

The basic idea of the BDC measurements is – for each cylinder – to place a proximity sensor at the bottom of the crosshead guide just below the BDC point. (BDC for a piston engine is the position of the piston in which it is closest to the crankshaft.) When the wear of the bearings is growing, each stroke will become slightly longer because of the wear in the bearings at and below the crosshead. This means that the lowest position of the crosshead comes closer to this sensor, and the change in the data from the proximity sensor over time is a measure for the wear in the crosshead bearing, the crank bearing and the main bearings.
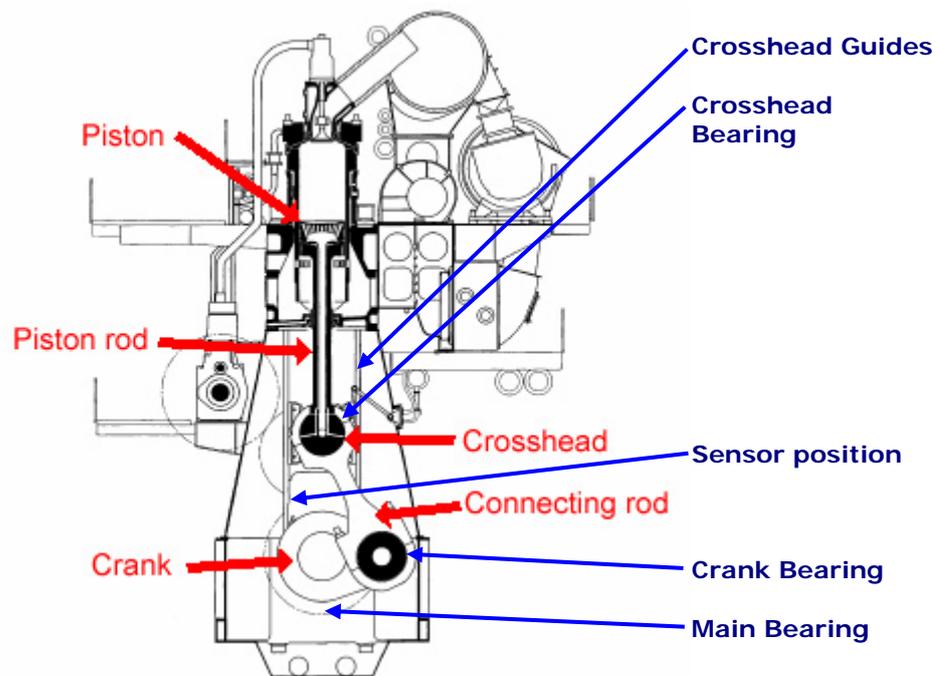
For a more reliable measurement, the OPENpredictor™ BDC measurement uses two sensors in each cylinder to measure tilting of the crosshead, too. The measurement values are influenced by and compensated for shaft speed (RPM).

The data can be displayed in two ways:

- On a graph, where it's easy to see if the wear is coming close to or has crossed the acceptable limits.

- On a mimic with a schematic drawing of the engine as background and e.g. a level bar with data and limit lines to display the actual situation. The level bar colour indicates the warning condition:
  - Green: OK.
  - Yellow: Alert.
  - Red: Alarm.
  - Blue: System error.
  - A white line inside the coloured column means that the measurement is under calibration: a temporary correction curve is used.

  If the measurement is out of the range displayed, this is indicated by a blue arrow (up or down).
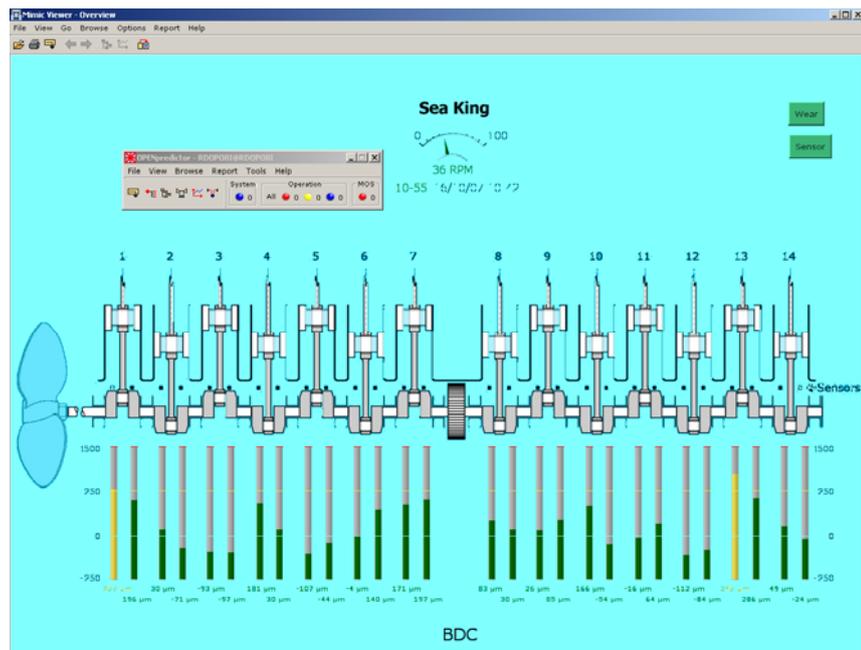
2.9.2   BDC baseline calibration

Whenever a bearing or a sensor has been replaced, repaired, moved or reassembled it is necessary to calibrate the baseline again. This automated procedure is described below.

2.9.2.1   Background

In order to convert the measured BDC to wear, a number of factors may influence the measurement. By far the most important factor is the actual RPM of the machine.

The 'BDC baseline' (normal values) includes the curve for correcting the BDC wear measurement for RPM. In theory, the faster the machine runs, due to the inertia of the piston, the deeper the piston at BDC will come down towards the crank. The BDC correction curve is used to correct the BDC for RPM to its RPM-compensated value, BDCc.

To compensate for tilting of the crosshead, OPENpredictor™ is using two transducers, one on each side of the crosshead guides. The final measured value is the average of these two measurements. However, if one transducer fails, the measured values from the other transducer will be used directly.

There are four types of BDC 'measurements' (in the Browser):
BDC: The raw measurement of each transducer.
BDCc: The measurement corrected for RPM (and other if relevant).
Wear: The average of BDCc for the two transducers of the cylinder minus the initial value. The initial value compensates for the placement of the sensors ('Initial wear', see below).
Position: Used for adjusting the sensor and sensor validation during operation. An 'Alert High' on a Position measurement indicates a faulty transducer.

'Initial wear': Initial wear is always zero for a new bearing. The 'Initial wear' of interest here is the wear at the time the 'Initial wear' is entered into the database.

If for some reason, which could be a severe mechanical problem, the crosshead comes too close (inserted limit value) to the transducer, an 'Alert High' on the BDC (raw) measurement is released. The machinery must then be inspected a.s.a.p. to find out if the alarm was caused by a transducer problem or a mechanical problem.

2.9.2.2   Reset Zero Gap / Recalculate BDC Baseline

Purpose: To clear the correction curve parameters and to initiate calculation of the parameters starting from a time entered by the user.

- **Reset Zero Gap** (the correction curve is calculated from new values, only) must be carried out each time a sensor or bearing part has been replaced or a sensor may have been moved.

- **Recalculate BDC Baseline** (the correction curve is calculated using old parameters as preliminary values) should only be carried out on recommendation from Rovsing Dynamics in case of too many false alarms.

In both cases an 'Initial wear' value may be inserted if known.

The time it takes to make the calculation of the correction curve and consequently the baseline depends a lot on the operation conditions of the machine. The system needs a certain amount of data at various different RPM value bands. It may take from a few hours to a few weeks.

1. In the Browser, right-click on a Machine, Machine Section, Machine Component or Transducer, and
    - Select the menu 'Reset Zero Gap' or 'Recalculate BDC Baseline' as indicated above.
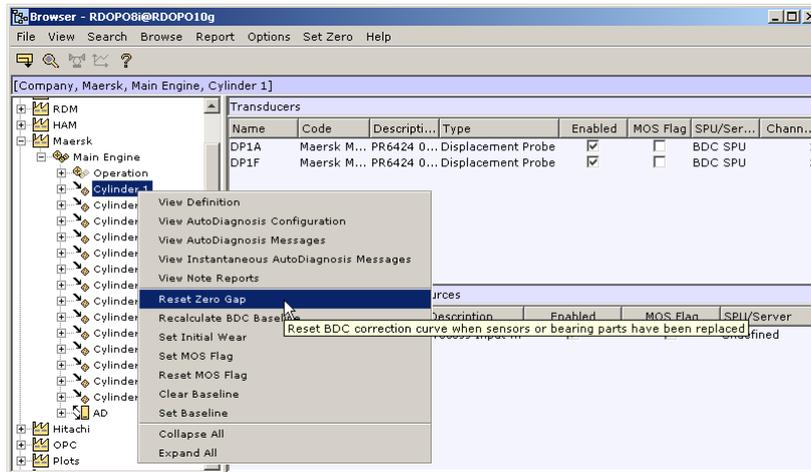
- If a **machine** is selected, all BDC transducers related to that machine is reset. This is typically used for a new installation (Reset Zero Gap) or if a main bearing has been replaced.
- If a **machine part**, for example a cylinder, is selected, all BDC transducers related to that machine part is reset. This is typically used if a crosshead or crank bearing has been replaced.
- If a **transducer** is selected, this transducer only is reset. This is typically used if a transducer has been replaced.

2. This message is displayed if 'Reset Zero Gap' is selected. The condition is only needed to be true when the [OK] button is clicked. Click OK to proceed, Cancel to quit.
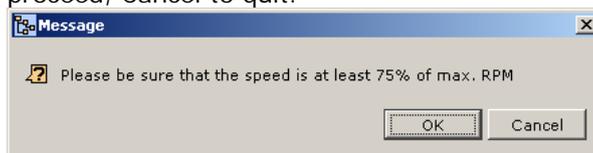
3. Set the start time for the baseline (correction curve parameters) calculation. BDC values, which are time stamped before this time, are not used in the calculation. If the correction curve has previously been calculated, this date is displayed (Previous Baseline Data). Default start time is the current time.
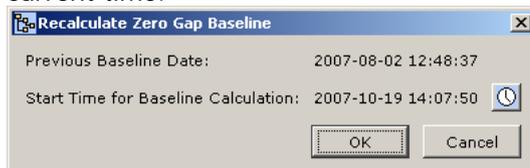
  a. If changing the start time, click on the calendar button , select a date and time as desired and click OK. The value should be set to the date and time, where reliable measurements with the current bearings and transducer installation started.

  b. Click [OK] to insert the new date and time. The 'Recalculate Zero Gap Baseline' window is now updated.

c. If a start time before the previous baseline date is selected you will get a warning message. Click [Cancel] to enter a new date and time.

Click [OK] on the 'Recalculate Zero Gap Baseline' window.

4. Answer this question.
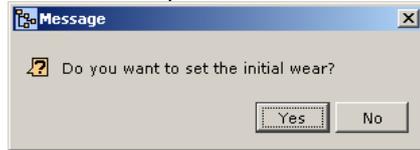
- If Yes: Continue at section 2.9.2.3. 'Set Initial Wear', step 2.
- If No: 'Initial wear' will be set to 0. Continue with step 5 below.

5. One of these messages is displayed:
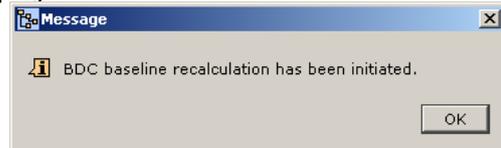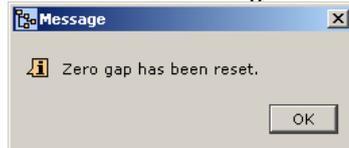
2.9.2.3 Set Initial Wear

Purpose: To insert the value of initial wear if known.

1. In the Browser, right-click on a Machine, Machine Section, Machine Component or Transducer, and select 'Set Initial Wear'.
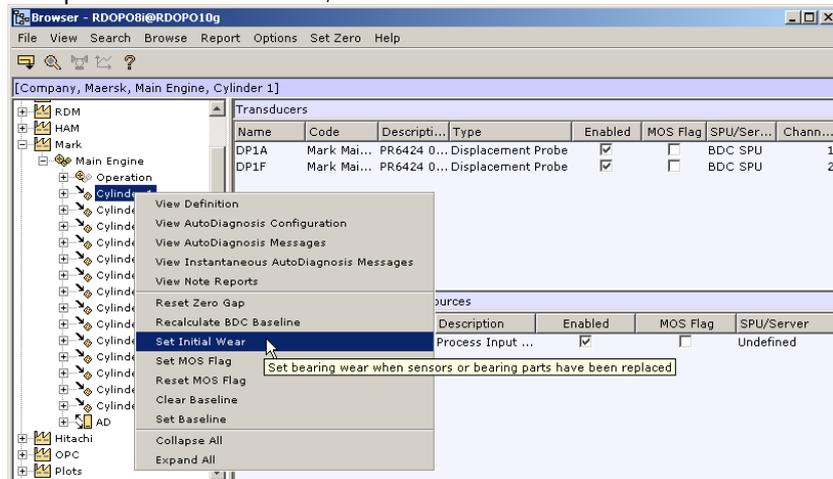
2. A table is displayed in which values of all Wear measurements under the selected component can be entered:

3. Enter manually the values for those measurements for which the value shall be changed and click OK.
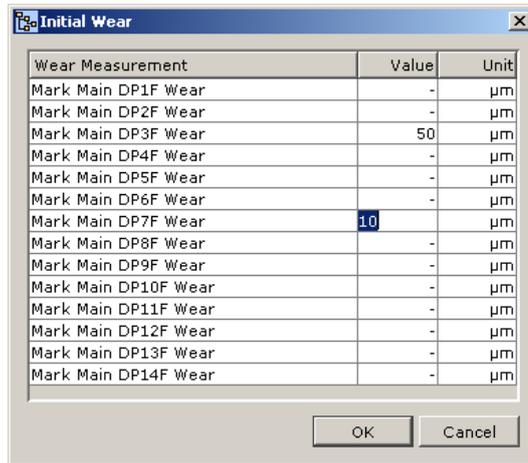
4. This message is displayed (in the above case the value of DP3F Wear will be set to 50 μm and DP7F Wear will be set to 10 μm).
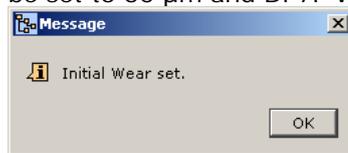
2.9.2.4   Explanation to the baseline calculations

The Baseline calculation takes typically from a few hours to weeks, where a sufficient number of BDC measurements must be made in certain defined RPM ranges. These ranges are defined in the 'BDC RPM Range Settings' window.

To open this window
1. Open the Browser 🗗.
2. Select the 'Main engine' 🐝.
3. Right-click the machine icon 🐝 or name, and select the floating menu 'View Definition'. This opens the 'Machine definition' window.
4. In the 'Machine definition' window click the [BDC Settings] button. This opens the 'BDC RPM Range Settings' window.
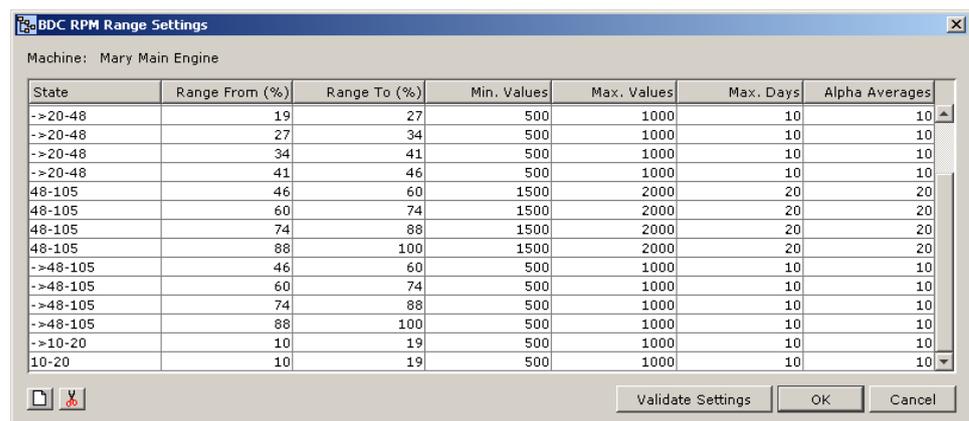
Warning: In this window it is possible to change the figures inserted except the 'State' definitions. Do NOT change these figures UNLESS you really know what you are doing and why!

Explanation to the fields:

Column 'State': Defines a number of RPM ranges where a defined number of measurements must be made. In the above case there are five states:
*   '20-48' (not shown): In this state the machine is running at a constant RPM between 20 and 48 RPM.
*   '->20-48': The RPM is changing in the 20-48 RPM range.

- '48-105': In this state the machine is running at a constant RPM between 48 and 105 RPM.
- '->48-105': The RPM is changing in the 48-105 RPM range.
- '10-20': In this state the machine is running at a constant RPM between 10 and 20 RPM.

Columns 'Range from (%)' and 'Range to (%)': 'Ranges' are sub-states defined in % of max. RPM for the machine, in the above case 105 RPM (defined in the Machine configuration window).

Column 'Min. Values': The minimum number of measurements in this speed range required for calculating the baseline in this state.

Column 'Max. Values': The maximum number of measurements in this speed range utilized for calculating the baseline in this state. If there is more than the maximum number required, the latest values are used.

Column 'Max. days': The maximum number of days where measurements are taken into consideration for calculation of the baseline in this state.

Column 'Alpha Averages': The minimum number of measurements needed in this state for the calculation of the preliminary correction curve in 'Reset zero gap'.

The baseline is calculated separately in each state. The RPM-ranges for each state depends on the design of the engine.

2.9.2.5   Reset zero gap/Recalculate BDC Baseline — what happens?

Reset zero gap	Recalculate BDC Baseline
1. A preliminary correction curve is calculated from the first 'Alpha average' number of measure-ments in each speed range.	1. Some of the old correction curve parameters are used for the preliminary correction curve.

2. Data are collected until there are enough data in all data ranges (see below) or the 'Max. Days' since the 'Start Time for Baseline Calculation' has expired.
 	
3. The final correction curve is calculated. Data used in each speed range:
• Too many data in a speed range: The most recent 'Max. Values' data.
• Enough data in a speed range (between 'Min. Values' and 'Max. Values': All data are used.
• Not enough data in some speed ranges within a machine state:
  • Enough data in 3+ ranges: Data from all ranges are used.
  • Enough data in 0-2 ranges, only: Wait until enough in 3 ranges, but not more than the highest value of 'Max. Days' days for each machine state. Afterwards: The correction curve is calculated best possible. Advice: contact Rovsing Dynamics!
  • No data: No calculation. OPENpredictor™ will try every hour to see if there are any data in the machine state range and calculate the correction curve if there are 2+ measurements. Advice: contact Rovsing Dynamics!	

Server starting and rebooting procedures

> **IMPORTANT:** The Server PC and the User Interface PCs must have the same time zone. Otherwise the time displayed may be wrong.

Starting and rebooting is normally a job for the system administrator. However it may be useful for the regular OPENpredictor™ user in an emergency situation.

The OPENpredictor™ Server Computer is responsible for: -
- All communication between the Server, the SPUs and the User Interface(s).
- All direct interfaces to the Distributed Control System (DCS), if used.
- Data storage.
- Warning generation.
- AutoDiagnosis™.

The OPENpredictor™ **Server** Computer must be operating continuously. The operating language of the Server software is always English. This is required to allow Rovsing Dynamics to support the users and to service the system via a remote link.

The OPENpredictor™ **User Interface Application** runs only on OPEN-predictor™ Client Computers, where local language versions can be used. The OPENpredictor™ User Interface Application should NOT be run on the OPEN-predictor™ Server Computer.

2.9.3 Starting/closing the OPENpredictor™ system

In case of a power failure: restart the system completely, starting with section 2.9.3.1, followed by rebooting the SPU (see section 2.9.4).

The *OPENpredictor™ User Interface* on the Client Computers may be started and stopped without restarting any other part of the system.

2.9.3.1 Start the Server Computer and software

Power up the OPENpredictor™ Server Computer and login. The servers are starting in the correct order as 'Services', which can be checked by means of Windows 'Control Panel' > 'Administrative tools' > 'Services'.

The last item started is the 'Server Watchdog', which: –
- checks continuously whether all Servers needed are running.
- restarts the Server (system) correctly in case any Server fails.

The Servers may be restarted without rebooting the SPU.

2.9.3.2 Closing down the system

Just close the Server PC the usual way, starting with closing Windows.

2.9.4   SPU rebooting procedures

The SPU is to be rebooted in three cases: -

- After changing the position of a 'MOS' flag or 'Enabled' flag; in order to activate the change.
- After downloading a new configuration.
- If instructed to do so by Rovsing Dynamics service personnel.

Before rebooting: make sure all Servers are running, see section 2.9.3.1 above.

The SPU may be rebooted without restarting the Servers (see 2.9.3.1).

2.9.4.1   Remote reboot of the SPU

To be able to carry out a remote reboot of the SPU, the SPU and the network must be running.

Make a Telnet connection to the SPU and send the Ctrl+x 'reboot' order: -

1. Open Telnet: Click the Windows Start button **Start** and select 'Run'.

2. In the dialog box 'Run' type 'telnet ' followed by the IP address of the SPU. This address can be found as follow: -

    a. In the OPENpredictor™ 'Browser', select the menu 'View' > 'SPU Definition'.
    b. The IP address is now found in the 'Host' column of the 'SPU' definition window.
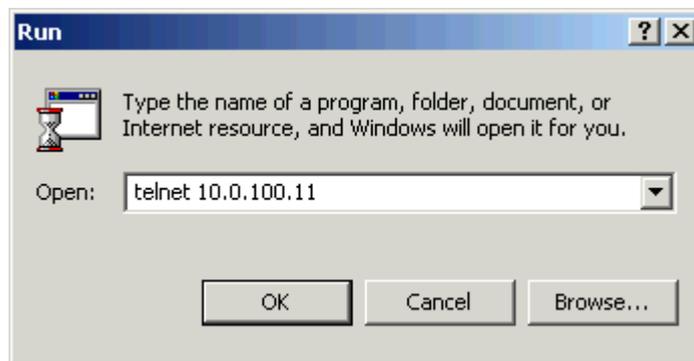
- If the system connects properly this opens a DOS window: -

- In the case of a failed connection (for example: network problems to your PC) the DOS window is not opened. Then use the on-site procedure described in section 2.9.4.2.

3. At the prompt, type Ctrl+x (press the Ctrl button and keep it down while pressing the 'X' key.) For some seconds, there will be no response. When the DOS window closes, the reboot procedure has been initiated.

2.9.4.2 On-site reboot of the SPU
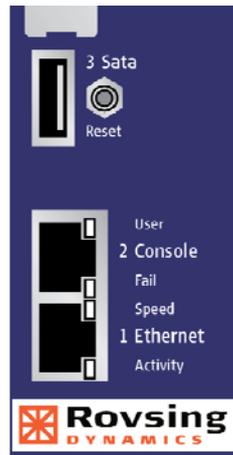
On the RO 2010 module(s) in the OPENpredictor™ rack press the **Reset** button.

Pressing the button more than **5 seconds** will reboot the SPU.

WARNING: While rebooting, no measurements will be performed.
It performs a hot boot of the built-in CPM equivalent to the CPM boot after a power failure.

2.9.4.3 On-site power cycling of the SPU

1. Switch off the power for the SPU.

2. Wait for the LED's to go off, and then wait another 10 seconds.

3. Switch on the power for the SPU.

2.9.5 Stopping and restarting the Data Server only

This procedure is used; for example, when a 'MOS' flag or 'Enabled' flag has been changed, see section 2.3.5.3.

1. On the OPENpredictor™ server, start 'Work Console' by clicking its icon on the desktop, or in the line with the Windows [Start] button.

2. Close the Watchdog: At the prompt (normally c:\work>), type
   `op-services stop watchdog` and press [Enter].

3. Close the Data Server: At the next prompt type
   `op-services stop data` and press [Enter].

To restart the data server:
1. Start the Data Server: At the prompt type
   `op-services start data` and press [Enter].

2. Start the Watchdog: At the next prompt type
   `op-services start watchdog` and press [Enter].

2.9.6 How to verify that the System is operating properly

The SPU operation may be verified as follow: -

3. On the OPENpredictor™ *Server*, display the 'Data Server' window (click the Data Server in the Windows [Start] button line): -
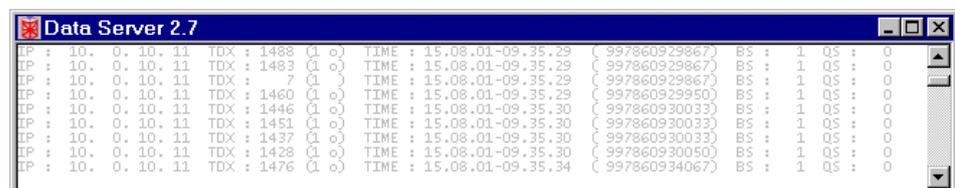
4. If new data lines are added regularly, the SPU operates and transmits data to the system. Please note that if the machines are stopped the measurement intervals are long (minutes).

If the connection between the SPU and the Server doesn't work properly the blue System-Warning Lamp will flash.

2.10 OPENpredictor™ System Hardware

There are two versions of the electronics hardware:

- A 19-inch rack containing the electronics described below.
- National Instruments cRIO data acquisition unit (Basic Bearing Wear Monitoring Systems, only.) See the manuals for this unit.

The electronics convert the analogue signals from the transducers into digital data, which is transferred to a database on the Server PC.

2.10.1 The RO2000 Signature Processing Unit (SPU)

The RO2000 SPU is the heart of the system as it executes all measurements and data transfer to other parts of the system. Up to three SPUs can be located in a standard instrumentation rack. Each RO2000 contains:

- 1 pcs. RO2010 Communication Processor Module (CPM), see section 2.10.2.
- 1 to 10 pcs. RO2020 Signal Processing Module (SPM), see section 2.10.3.
- 1 pcs. Integrated Power Supply, placed on the rear panel behind the motherboard. It is fused with one 230V/10 Amp T (slow) fuse placed on the rear panel of RO2000 in a small drawer below the power inlet connector. The normal maximum power consumption is 6 Amps.
- A separate Cooling Unit mounted below each RO2000 Unit with 3 fans and a 'Power' lamp. The 'Power' lamp is connected to +12VDC from the RO2000 power supply, which also powers the fans.
- Various installation dependent accessories: Cable terminal blocks, relays, galvanic isolators, etc.

(1): RO 2000 with one RO 2010 and one to ten RO 2020.

(2): Cooling unit with 'Power' lamp.
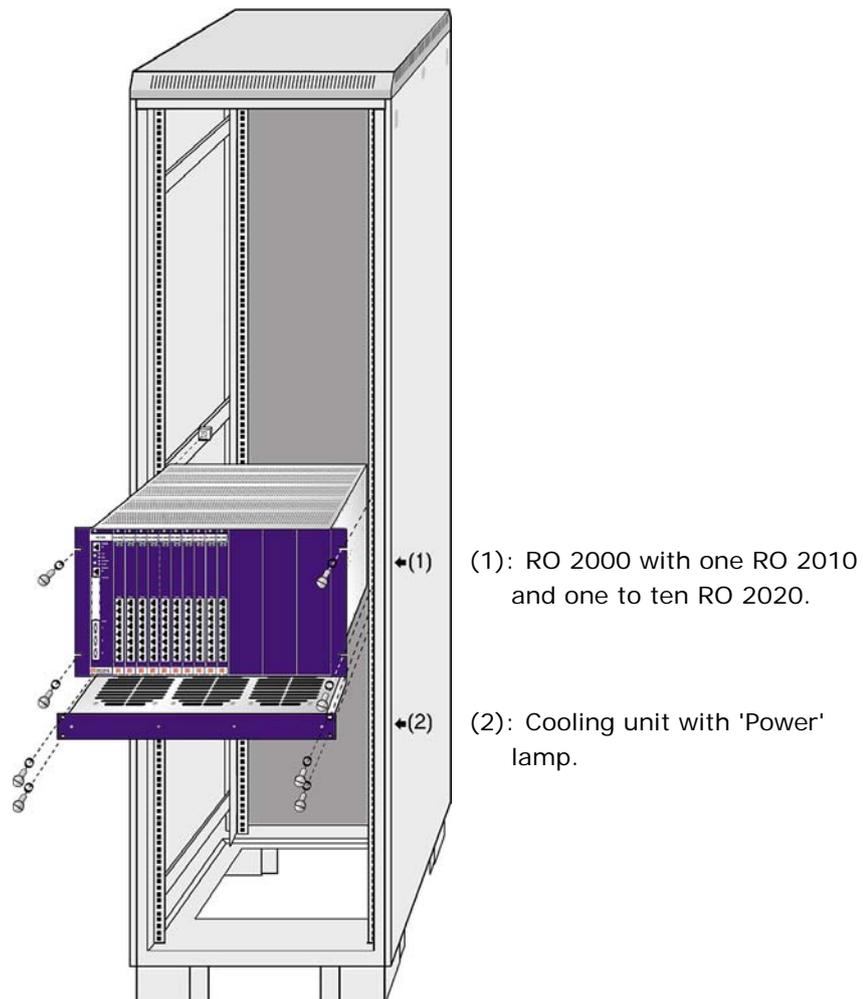
19" OPENpredictor™ rack with one RO2000.

Rebooting the SPU is described in section 2.9.4.

2.10.2   The RO2010 Communication Processor Module (CPM)

The RO2010 CPM controls all internal and external data communication from and to the SPU. It controls the data communication between the RO2020 Signal Processing Modules (SPM) and the OPENpredictor™ Server.

Each RO2010 contains: -
- Ethernet port.
- Port to control external relays.
- Slots for expansion of memory and number of ports.
- LED's for operation indication, Reset button.

The lamps, controls and inputs are: -

Ethernet (1)	Standard 10/100 Mb/s Ethernet connector.
Console (2)	Service connector used by Rovsing Dynamics A/S personnel when setting-up the system.
SATA(3)	Serial ATA interface
'Auxiliary' module (4-6, reserved)	Optional module card position. May be used for a second serial port module (see below) or e.g. a PCMCIA card docking station.
'Serial' module (7-9)	Optional module card position for a RO2021 Serial Port Upgrade with 3 RS232/RS485 serial ports: Serial 9: RS232. Serial 7 & 8: RS485. (There is one more unused port on the rear panel). There are several possible applications, but the ports are typically used for • control of a Warning Relay Unit. • receiving data from a PLC using the Modbus Interface.
Reset button	Pressing the button more than **5 seconds** will reboot the SPU – see section 2.9.4.2. **WARNING:** While rebooting, no measurements will be performed. It performs a hot boot of the built-in CPM equivalent to the CPM boot after a power failure.
Activity	Off: No activity Blinking Green: Activity proportional to bandwidth utilization.
Speed	Off: No link Yellow: 10/100Base-T operation Green: 1000Base-T operation
Fail	Yellow: Board has a failure. After Power On or reset this LED is ON until extinguished by firmware or software.
User	Green: Board is running and status is OK.

2.10.3   The RO2020 Signal Processor Module (SPM)

The RO2020 SPM executes all defined measurements and transfers results internally to the RO2010 CPM.

- Each RO2020 contains:
    - 8 Analogue inputs
    - Power supply for transducers
    - LED's for operation indication

The lamps and inputs are: -

'Power' lamp (left lamp)	Lights when the module receives power.
'Run' lamp (right lamp)	Lights/flashes due to data activity on any of the inputs.
8 pcs. analogue 'Input' connectors	Each analogue input is connected to a fast A/D converter. The SPM has its own on-board signal-processing units, which also calculates signatures defined in the measurement set-up, e.g. FFT, FRF, STA calculations. Digital transducer signals like tachometer-pulses are handled as analogue voltages.

3 Glossary

AutoDiagnosis™	**Auto**matic **Diagnosis** methodology developed by Rovsing Dynamics A/S. It is used for automatically diagnosing potential machinery problems and predicting the time of the final fault.
BDC	**B**ottom **D**ead **C**entre. See section 2.9.
CM	**C**ondition **M**onitoring. See section 1.2.1.
CPM	**C**ommunication **P**rocessor **M**odule. RO2010 Module in SPU to control internal and external data communication.
	Abbreviation for the frequency unit **C**ycles **P**er **M**inute. 1 Hz = 60 CPM.
CPU	**C**entral **P**rocessing **U**nit. The data processing part of a computer.
DCS	**D**istributed **C**ontrol **S**ystem. The control system architecture of many large plants.
Event	An 'event' is any measurement where its value has passed its 'Event Window' (see below). The measurement result is time stamped. Storage of the 'event' is in the OPENpredictor™ database.
Event Window	An Event Window is the acceptance range for variations of a parameter, where no data transfer or storage is required. If the actual measured value stays within the window, no data transfer will take place between the SPU and Server. The aim of the event principle is to reduce the quantity of redundant data to be transferred and stored. Hence only values (events) with a significant difference are stored. Each event has its own timestamp.
HTML	**H**yper**T**ext **M**arkup **L**anguage. The standard code language for Internet webpages.
Measurement	Signal processing algorithm, for example OTA, Overall, Tacho, CPB, FFT, Etc. A measurement is defined in a 'measurement configuration' specifying the parameters of the measurement. The SPU will perform the measurements repeatedly. A measurement is only stored in the database if the 'Event' criteria for the measurement are met, see 'Event'.
Mimic	Interactive image of e.g. a plant or machine, e.g. showing the position of the transducers and their main data.
MOS	**M**aintenance **O**verride **S**witch: Shows transducers where warning is temporarily disengaged. Measurement data still can be viewed.
OPENpredictor™ User Interface	The application programme described in this manual, used to operate the OPENpredictor™ system.
Parameter	Item in a measurement configuration, for example Lower Frequency, Number of Lines or Gain.
Plot	Graphical presentation of measurement result(s).
PMIS	**P**redictive **M**aintenance **I**nformation **S**ystem.
RPM	**R**evolutions **P**er **M**inute.
Scalar	One-dimensional measuring value, e.g. a temperature or over-all vibration value.
Script	A named user-accessible sub-programme.
Signature	A set of data taken at a specified (starting) time, describing physical parameter properties in time, frequency, transient and process domain. Examples: • A spectrum (amplitude versus frequency). • A time domain curve for a short-time incident, for example Orbit or FSA. • A vector measured for example during a run-up.
SPM	**S**ignal **P**rocessing **M**odule. RO2020 with 8 transducer inputs.
SPU	**S**ignature **P**rocessing **U**nit. RO2000 19" frame for 1 pcs. RO2010 CPU unit + 1 to 10 pcs. RO2020 SPM modules.
System	System warning. The connection to an SPU is lost.
Vector	Multi-dimensional measuring value, e.g. the amplitude and phase of a vibration, or the x- and y-position of a rotor relative to a fixed centre line. In OPENpredictor™ vectors are handled as multiple scalars.

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Bold page number = Major information about the subject.

Document information

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Issue	Date	Modified sections	Reason for change
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1.0	2001-Nov-1	All	Updates following review.
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