insideview

DGA Diagnostics

Inside View Features and Specifications

Software Version 3.0

MORGAN® SCHAFFER

Introduction

Inside View is a software system that was conceived and designed to identify warning events rapidly from large amounts of test data acquired automatically from equipment filled with dielectric fluids. It analyzes the test data and considers equipment characteristics to provide condition assessments and diagnostics for the state of the equipment. The results are presented in various formats that help users to diagnose equipment condition and manage malfunction risk: tables, graphics, indicators and industry standardized methods such as the Duval triangle.

Inside View is deployed on a local web server and only requires a web browser so it is easy to integrate, update and use.

Features and Specifications

Centralized and Integrated Data

Inside View integrates data from different sources and makes it accessible to each user from a centralized location. It provides efficient data drilling capabilities for comprehensive management of fluid analysis data; supervises it with alarms and compiles the data for diagnostic reporting. Whether the data is from lab analysis, mobile units or online monitoring systems, Inside View tracks the source and adapts its calculations according to the origin of the data. Inside View can also correlates data and flags measurement discrepancies.

Inside View stores and manages fluid analysis data including:

- **Dissolved Gas Analysis (DGA)**
- **Moisture Analysis**
- **Dielectric Strength**
- **Interfacial Tension (IFT)**
- **Acid Number**
- **Furans Analysis**
- **Oxidation Inhibitor**
- **Oil Power Factor**
- **Particles Count**
- **PCB Analysis**
- **Color**
- **Corrosive Sulfurs**
- **Metals and Trace Elements**
- **Passivation Number**
- **Pour Point**
- **Fire Point**

Automatic Data Management

Inside View can connect to online monitoring system through various protocols to automatically gather DGA data from the equipment. It can use native protocol to communicate with Morgan Schaffer equipment or it can

use a common connection to a data historian to import current values and historical data from any equipment. You can also enter data manually or import it from different sources.

The status of each asset is checked and automatically reevaluated for every value introduced into Inside View's database. It automatically supervises all the parameters you want to track and generates a notification for any asset that requires attention.

Data Source Support

Inside View is the ideal way to store fluid test data in a central place and make it available to every user as they need it. Inside View is able to acquire and manage data from the following sources:

- **Manual entry**: manual data entry
- **DGA and Lab data imported from Excel**: data imported using an Excel template file
- **OSIsoft® PI Historian**: connection to a PI historian to access data from any monitoring equipment
- **Native Calisto Series**: direct communication to Morgan Schaffer's C1, C2, C5, C9 and older equipment
- **Myrkos mobile DGA analyzer**: data integrated from Morgan Schaffer's mobile DGA chromatograph
- **Calisto Series Databank**: data imported from offline Calisto unit using a DNBX format
- **Native TOA4 Equipment**: data imported from an existing TOA database
- **OPC Historian and Data Server:** data connection to SCADA system using OPC connector to access data from any monitoring equipment (available Q1 2014)

Data Management and Analysis Tools

Inside View's powerful features allows users to find interesting data quickly and extract essential information from large amounts of data acquired from various sources.

Users have the freedom to find the best way to navigate through the data and display requested information. Tools and views adapt automatically to the visualized content. Data can be summarized for a day, a week, a month, or a year, and displayed with automatically-calculated average or maximum values. They can eliminate variations related to external factors by choosing to look at high-level periods.

Inside View provides several ways to make navigation through large amounts of data easier:

- **Navigation through summarized period of time (sample, day, week, month, year)**
- **Automatically-calculated average or maximum values for every high-level period**
- **Button to display Next Event**
- **Button to display Next Day**
- **Data source selection: display data from monitor, lab and manual entry; specific or combined views**.

Inside View offers various tools to visualize and analyze information. Every parameter, from the online monitor or lab analysis, can be plotted on screen. Users can use from the following tools to analyze selected data:

- **Dynamic Duval Triangle Interaction**: data selection of sample or summarized period and dynamic display of the results on the Duval triangle.
- **Detailed Duval Triangle Analysis**: complete Duval triangle analysis using Low Temperature Fault Triangle and performing evaluation based on the sample and the gas differential to highlight fault evolution.
- **Multi-Graph View:** side-by-side display of trends for each parameter, with alarm levels and customizable scale to ensure a harmonized visual reference.

- **Detailed Graph View**: stacked graph view to explore the detail of the signal and to evaluate correlations.
- **Nomograph**: gas levels and ratios analysis based on a Nomograph view (available Q1 2014).

Inside View includes a powerful tool to analyze a fleet of equipment and highlight outliers. It allows users to specify common characteristics and compute the equipment group's main statistical indicator. (The tool enhances the fleet monitoring with the ability to automatically generate an alarm set and assign it to the equipment group -available Q1 2014). Indicators include:

- **Mean, median and standard deviation for every selected parameter**
- **User specified targeted percentile**
- **Number of outliers compared to the targeted percentile**

Specific test samples and summarized periods can be selected to perform a complete analysis. Inside View includes the following reports:

- **DGA analysis report**: DGA analysis based on the online monitoring sample.
- **Asset status report**: Condition evaluation of the equipment based on the latest combined information from Lab data and online monitoring data.
- **Full analysis:** Complete condition evaluation regarding DGA, Oil quality, Moisture and Paper Degradation.

Notifications and Alarm Management

Inside View's advanced notification system provides essential alerts without overwhelming the user. When acquiring data from an online monitoring system, an alert should not be generated for every sample. Inside View avoids false alarms and prevents repeating the same alarm when data is fluctuating around the trigger limit. Transformer data is not only monitored on threshold levels but also on variation levels and rate of change. Alarm notifications contain data that supports users in the decision process.

Alarms can be set at several monitoring levels for every numerical parameter and on calculated ratios, not only DGA gas measurements. Inside View offers the following alarm levels:

- **Critical alarm**
- **Warning alarm**
- **Low alarm**
- **Rate of change alarm**
- **Step change alarm**
- **7 days projection threshold**

Alarm levels are combined into an alarm set for an easy was to customize the monitoring of each asset according to its characteristics. An alarm set can model your specific standard and be associated with each of your assets.

Every time new data is added to the system, automatically or manually, the asset's status is reevaluated and updated. Inside View checks for alarms and for significant changes in the behavior and condition assessment of the equipment. The verification is performed for both data from DGA monitoring equipment and lab sample analysis.

Every time a significant change is detected, a notification is generated and sent to the users who choose to subscribe. Inside View's sophisticated notification system provides the following functionality:

- **Verification on New Data**: Inside View checks and reevaluates equipment status whenever new data is added to the database. Notifications are generated when a significant change is detected.
- **Single Alert**: When multiple alarms occur, Inside View synthesizes the information and generates only one notification.
- **Status Change Only**: Notification is sent only when a status change is detected.
- **System Level:** Asset supervision is performed at system level and resulting notifications are available for every user.
- **User Subscription**: User can subscribe to the type of notifications.
- **Detailed Alarm Information**: Notification includes detailed information related to the asset to allow the recipient to adopt the proper action.
- **Diagnostic Report Attachment**: Notification email includes an attached PDF diagnostic report.
- **DGA Data Monitoring**: Inside View checks for alarm threshold level for each DGA data, from online monitor, mobile analyzer and lab sample analysis.
- **Lab Data Monitoring:** Inside View checks for alarm threshold level for each numerical parameter from lab sample analysis.
- **Ratios Monitoring**: Inside View checks for alarm threshold level on calculated gas ratios.
- **Condition Assessment Monitoring**: Inside View checks for change of the current state for condition assessment method, such as Duval triangle or IEEE recommendation.
- **Downgrade Value**: Inside View can inform the user when a parameter is back to normal or when the current condition reaches a lower level.
- **Configurable Hysteresis Setting**: Inside View provides a hysteresis setting that defines a tolerance band before suppressing alarm alerts. The function prevents multiple alarm alerts if the reading oscillates around the specified threshold.
- **Displayed with Asset Status**. Notification information is included with the asset status in the Inside View Asset list.
- **Individual Acknowledgment**: User can consult each new notification in the Inside View dashboard and individually acknowledge each of them.
- **Daily Status**: User can choose to receive daily status information related to each asset with an abnormal condition without accessing Inside View.
- **New User Account:** Confirmation notification sent when a new user account is created.

Diagnostic Methods

Inside View includes several methods for assessing equipment condition, performing complex calculations and verifying each requirement to ensure proper use of each method. Users can corroborate the diagnosis of a sample by several methods at the same time by looking at the analysis results side by side.

Inside View has the capacity to perform the following calculations for DGA test results, and provide the data in an easy to understand report:

- **Duval calculations**: 15 Duval triangles that consider 9 oil types and 7 different equipment types
- **Rogers ratios**
- **IEC 60599 ratios**

- **Doernenburg ratios**
- **Key Gas analysis**
- **IEEE 57-104-2008 condition evaluation and recommendations**

Inside View compares results from lab data with online monitoring system results to ensure coherence with the values and highlight any discrepancies.

Inside View reviews oil quality parameters in relation to the voltage class of the equipment. The overall evaluation is performed by integrating the following parameters from lab analysis:

- **Dielectric strength**
- **Power factor**
- **Water content**
- **Interfacial tension**
- **Acid number**
- **Sediment and soluble sludge**
- **Oxygen inhibitor**
- **Visual exam**

Paper degradation is part of the analysis, which is achieved by evaluating different aspects of the DGA and oil test data, including:

- **CO and CO2 trends**
- **CO2/CO ratio**
- **Furans concentrations**
- **DP evaluation based on Chendong equation**

Ratio Calculations and Values

Inside View automatically calculates ratios commonly used by diagnostic methods to assess equipment condition. These ratios are also used to trigger alarms on specific equipment condition. Calculated ratios and values:

- **CH4/H2 (R1)**
- **C2H2/C2H4 (R2)**
- **C2H2/CH4 (R3)**
- **C2H6/C2H2 (R4)**
- **C2H4/C2H6 (R5)**
- **C2H2/C2H4**
- **C2H2/H2**
- **C2H4/CH4**
- **C2H6/CH4**
- **H2/C2H6**
- **CO2/CO**
- **O2/N2**
- **Total Furans**

Gassing Rate and Rate of Change Evaluation

Inside View integrates a sophisticated gassing rate evaluation by calculating the rate of change over several periods of time and estimating the overall behavior of this parameter.

The rate of change is also calculated for every numerical parameter and is used to trigger alarms when required. Calculated rate of change:

- **24 hour rate of change (for online monitoring element)**
- **Weekly rate of change**
- **Monthly rate of change**
- **Yearly rate of change**

Asset Management

Inside View provides an easy way to navigate through your fleet of assets. Assets monitored by Inside View are displayed on a grid list that includes their main characteristics. This view allows the user to filter the displayed elements according to a number of different characteristics. The current status of each asset can be consulted rapidly; indicating equipment that may require attention.
Inside View allow users to create, edit and find equipment for oil-filled assets using the following functions:

- **Create and edit assets manually**
- **Import asset information from external sources**
- **Multi-field search to filter assets easily**

Use of Nameplate Data

Inside View adapts its analysis according to the information on the nameplate that describes the asset. It uses the asset characteristics in different calculations to evaluate the asset's condition in relation to DGA and oil quality. The system uses the following information:

- **Equipment type**
- **Oil type**
- **Voltage class**
- **Oil volume**
- **Oil preservation sealing system**
- **Paper type** (available Q1 2014)

Interface Optimization

Using a web browser to interface with Inside View allows users to easily adapt each view to the display resolution of their device. Inside View's optimized interface for tablets and small computers provides a better workflow while interacting with the information.

- **Automatic adjustment of the interface to screen resolution**
- **Optimized interface for Tablet devices**
- **Optimized interface and function for Myrkos mobile chromatograph**

Security Features

Inside View's security features can be configured to meet your infrastructure and IT requirements. Inside View does not require opening ports. The client workstation only needs a web browser with JavaScript and does not use Flash, ActiveX, and add-ons.

Access rights can be managed in two modes:

- **Windows mode**: account management is handled by an IT administrator using Windows account management
- **Form mode**: login creation and management are handled using the Inside View infrastructure

Inside View provides four privilege levels:

- **IT Administrator**: access to configuration elements to setup Inside View and verify its basic functionality.
- **Inside View Administrator**: access to and complete control of the system.
- **Normal User:** access to all functions except system management and delete functionality.
- **Read-only User**: access to all information but cannot modify any information.

Licensing Structure

Inside View licensing structure is designed to fit the size of your organization and to be adjusted to the use you will make of the software. Whatever level you select, Inside View comes with complete functionality regarding the analysis of the sample.

Inside View licensing is based on Transformer Access Licenses (TAL). The TAL is a validation key allowing the creation of equipment (a transformer) in Inside View. Inside View offers the following license level:

- **Myrkos TAL**: authorized use of Inside View installed on a Myrkos controller, ability to import and analyze DGA data from the PPMreport (Myrkos) sample database**.**
- **LAB TAL**: authorized use of Inside View installed on a server, ability to enter data manually or import complete Lab data from Excel sheets or another database (data source plug-in required, sold separately), and DGA data from Myrkos controller.
- **Detection Monitor TAL**: authorized use of Inside View installed on a server, ability to gather H2, CO and H2O data automatically from an online monitor. Includes entire Lab TAL functionality.
- **Multi-Gas Monitor TAL**: authorized use of Inside View installed on a server, ability to gather DGA data automatically from an online monitor. Includes entire Lab TAL functionality.

Installation Requirements

Inside View is installed on a web server on the client's existing intranet infrastructure. Users access Inside View with a web browser, without installing any add-ons. Access rights and privileges can be managed by your IT department using Windows security features or directly through Inside View.

Inside View Server requires the following elements:

- Information Services (IIS), version 7 or later or IIS Express, available from Microsoft IIS site. Normally, IIS 7.0 is included with Windows Server 2008 (or later) or with Windows 7 Pro (or later).Internet
- Microsoft .NET Framework v.4, available from Microsoft website.
- ASP.NET MVC 3, available from Microsoft website.
- An SQL database engine (SQL Server 2008 R2 or later, MySQL, PostgreSQL).

Inside View is compatible with mainstream browsers and is optimized for the following:

- Microsoft® Internet Explorer (version 9 or later)
- Google® Chrome (version 26 or later)
- Mozilla® Firefox (version 19 or later)

Screenshots

Manage Samples view – Lab sample data

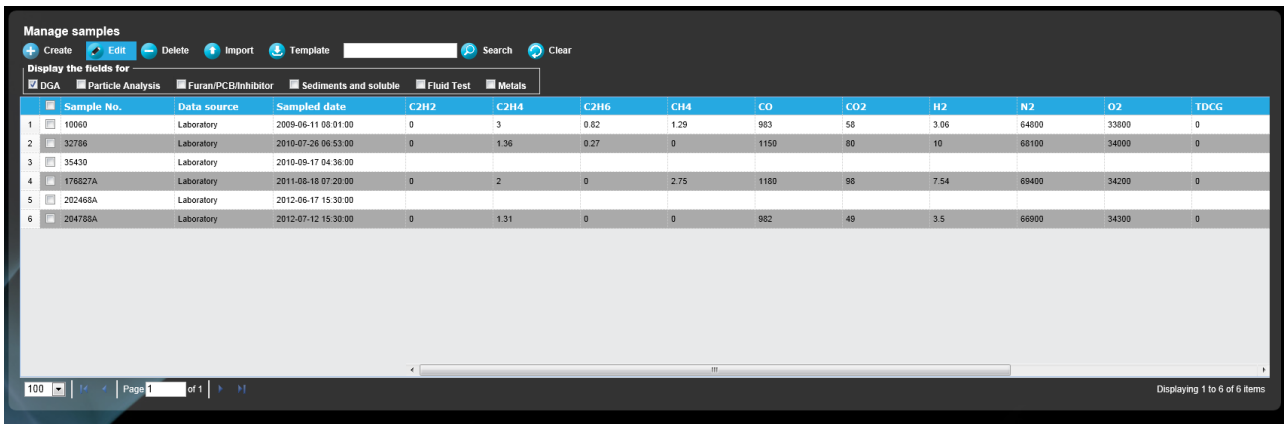


Figure 1 - Displaying DGA Section

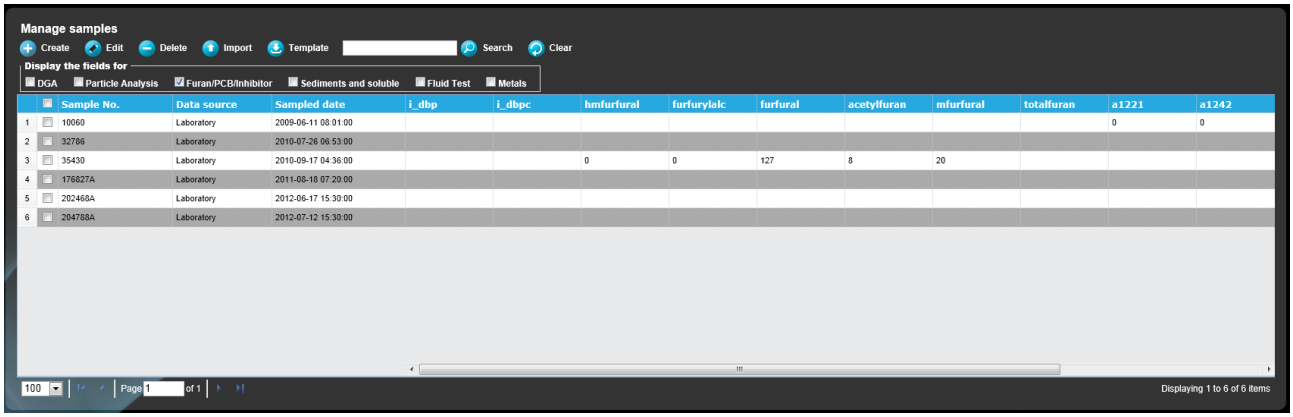


Figure 2 - Displaying Furans and Inhibitors Section

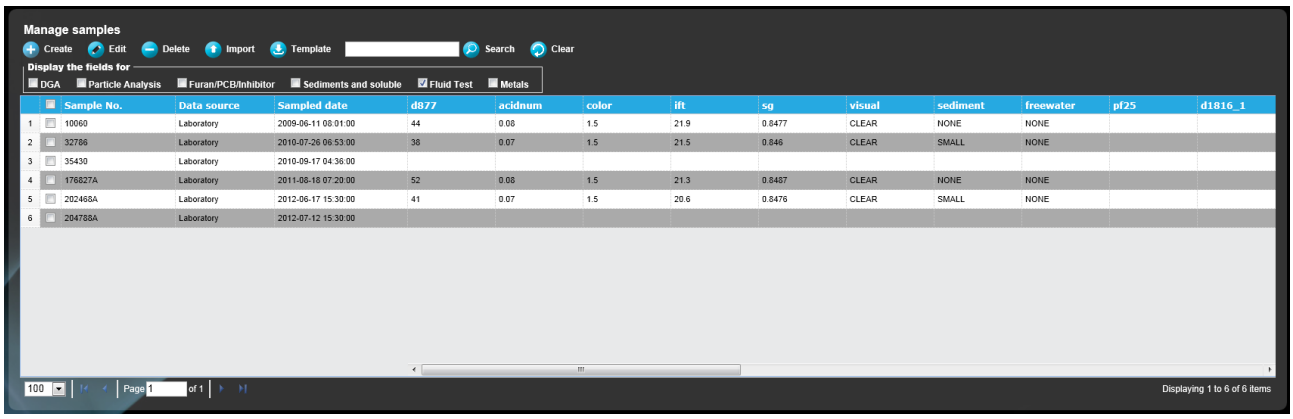


Figure 3 - Displaying Fluid Quality Section

Data Entry Configuration

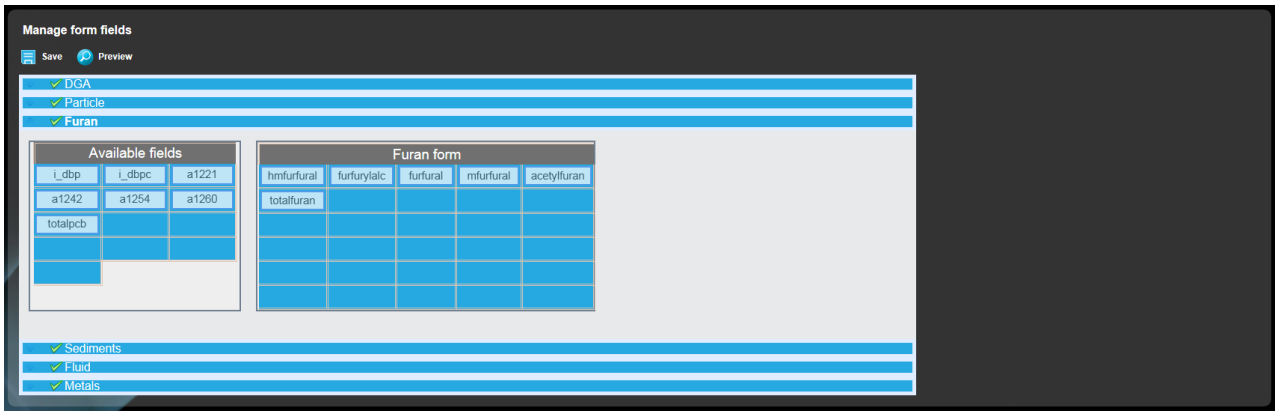


Figure 4 - Form Fill-in Configuration

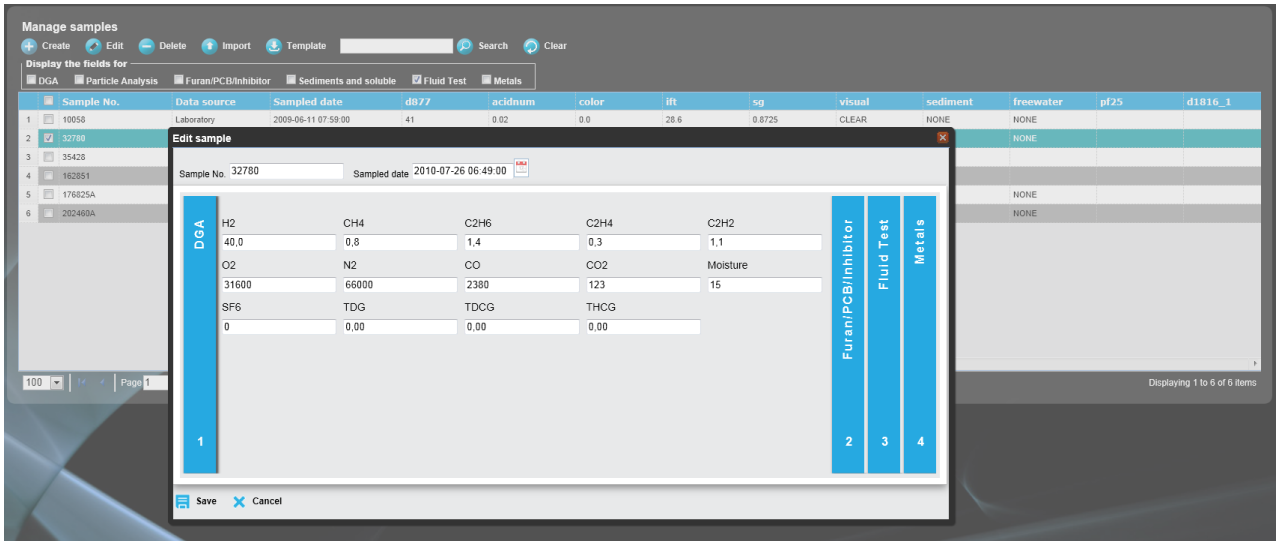


Figure 5 - Form Fill-in Example for Lab Samples (Furan/Inhibitor section)

Figure 6 - Form Fill-in Example for Lab Samples (Fluid quality section)

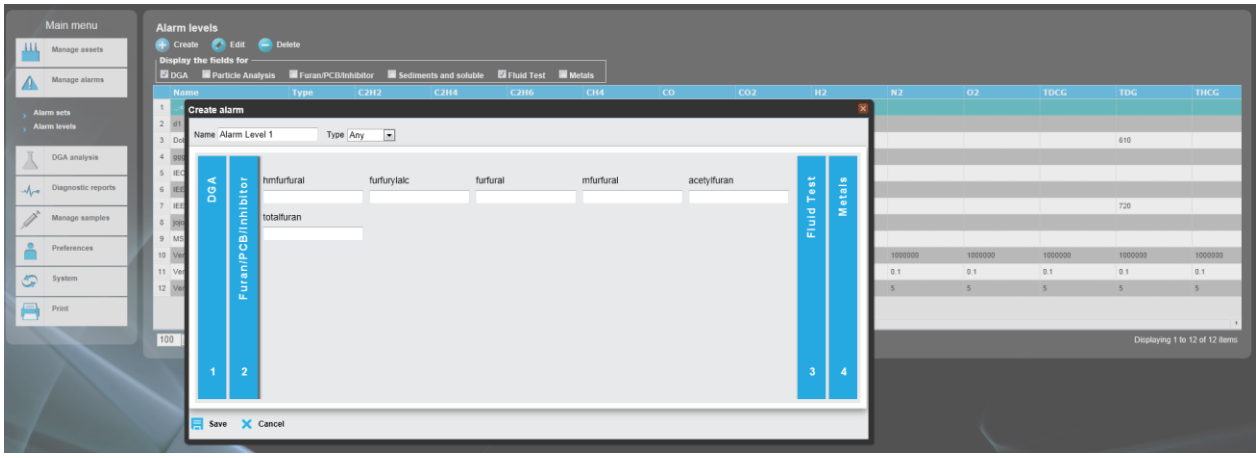
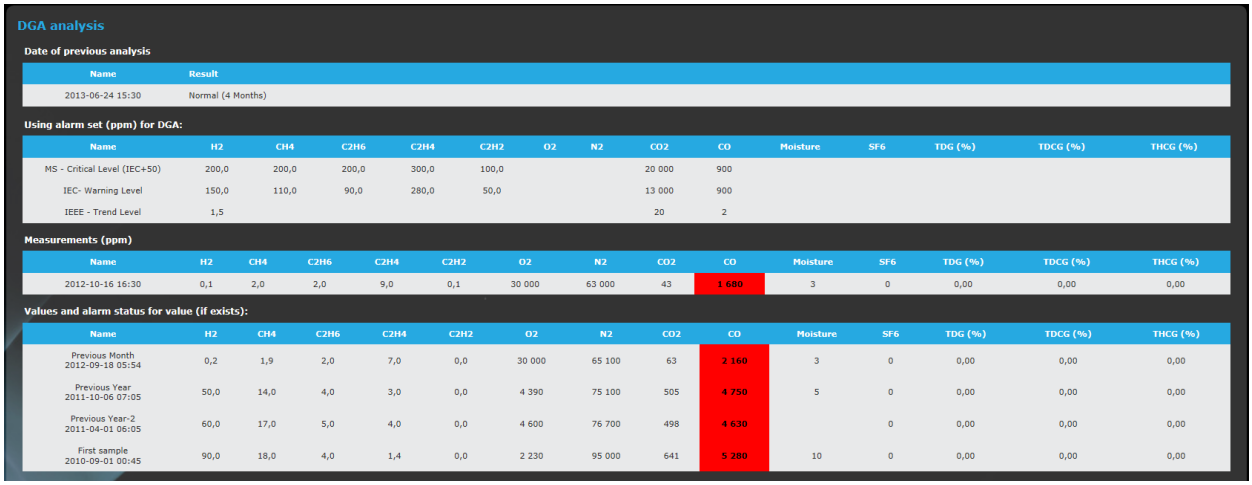


Figure 7 - Form Fill-in Example for Alarm setting

Asset Status Report



DGA analysis

Date of previous analysis

Name	Result
2013-06-24 15:30	Normal (4 Months)

Using alarm set (ppm) for DGA:

Name	H2	CH4	C2H6	C2H4	C2H2	O2	N2	CO2	CO	Moisture	SF6	TDG (%)	TDCG (%)	THCG (%)
MS - Critical Level (IEC+50)	200,0	200,0	200,0	300,0	100,0			20 000	900					
IEC- Warning Level	150,0	110,0	90,0	280,0	50,0			13 000	900					
IEEE - Trend Level	1,5							20	2					

Measurements (ppm)

Name	H2	CH4	C2H6	C2H4	C2H2	O2	N2	CO2	CO	Moisture	SF6	TDG (%)	TDCG (%)	THCG (%)
2012-10-16 16:30	0,1	2,0	2,0	9,0	0,1	30 000	63 000	43	1 680	3	0	0,00	0,00	0,00

Values and alarm status for value (if exists):

Name	H2	CH4	C2H6	C2H4	C2H2	O2	N2	CO2	CO	Moisture	SF6	TDG (%)	TDCG (%)	THCG (%)
Previous Month 2012-09-18 05:54	0,2	1,9	2,0	7,0	0,0	30 000	65 100	63	2 160	3	0	0,00	0,00	0,00
Previous Year 2011-10-06 07:05	50,0	14,0	4,0	3,0	0,0	4 390	75 100	505	4 750	5	0	0,00	0,00	0,00
Previous Year-2 2011-04-01 06:05	60,0	17,0	5,0	4,0	0,0	4 600	76 700	498	4 630		0	0,00	0,00	0,00
First sample 2010-09-01 00:45	90,0	18,0	4,0	1,4	0,0	2 230	95 000	641	5 280	10	0	0,00	0,00	0,00

Figure 8 - Asset Status on DGA Values

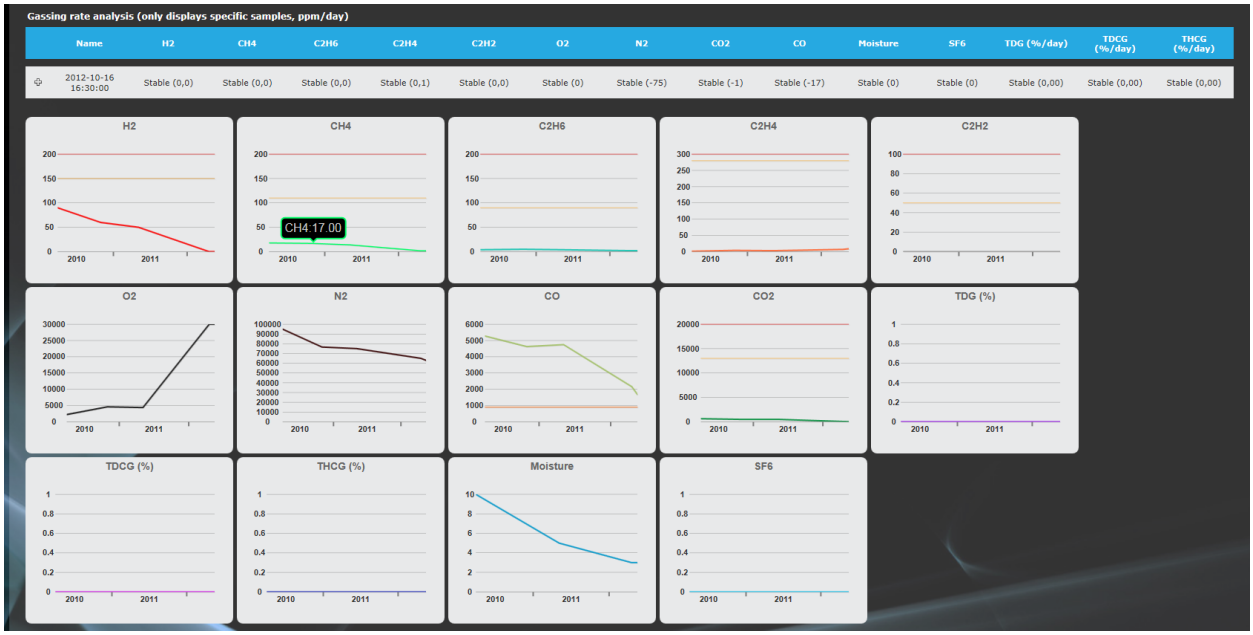
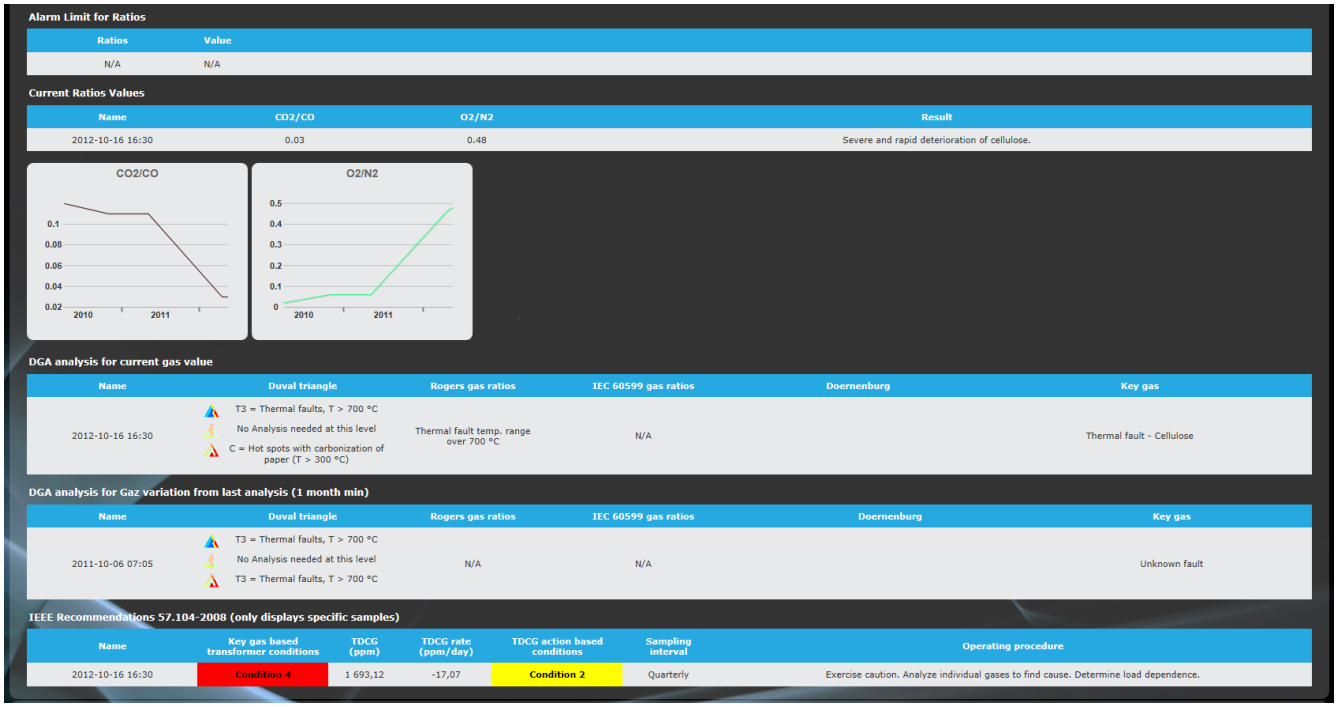


Figure 9 - - Asset Status on DGA Gassing Rate



Alarm Limit for Ratios

Ratios	Value
N/A	N/A

Current Ratios Values

Name	CO2/CO	O2/N2	Result
2012-10-16 16:30	0.03	0.48	Severe and rapid deterioration of cellulose.

DGA analysis for current gas value

Name	Duval triangle	Rogers gas ratios	IEC 60599 gas ratios	Doernenburg	Key gas
2012-10-16 16:30	T3 = Thermal faults, T > 700 °C No Analysis needed at this level C = Hot spots with carbonization of paper (T > 300 °C)	Thermal fault temp. range over 700 °C	N/A		Thermal fault - Cellulose

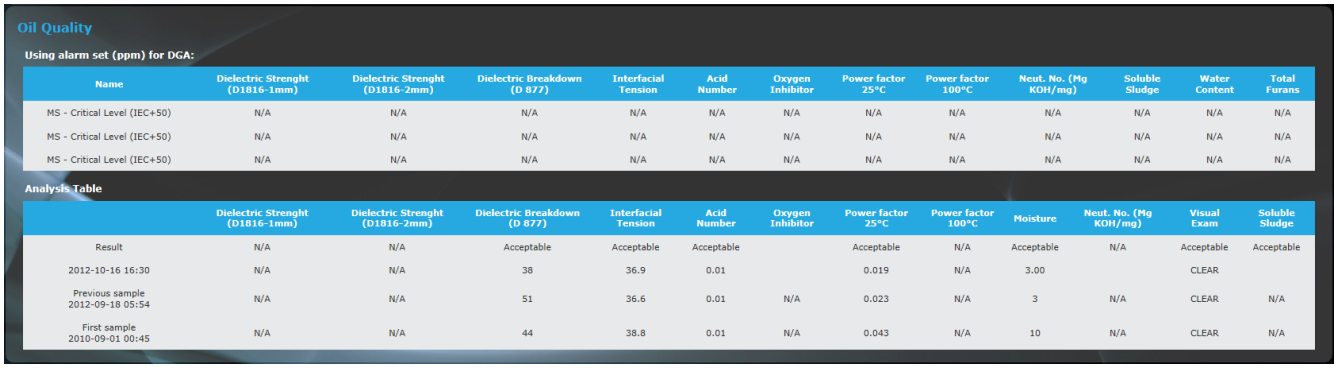
DGA analysis for Gaz variation from last analysis (1 month min)

Name	Duval triangle	Rogers gas ratios	IEC 60599 gas ratios	Doernenburg	Key gas
2011-10-06 07:05	T3 = Thermal faults, T > 700 °C No Analysis needed at this level T3 = Thermal faults, T > 700 °C	N/A	N/A		Unknown fault

IEEE Recommendations 57.104-2008 (only displays specific samples)

Name	Key gas based transformer conditions	TDCG (ppm)	TDCG rate (ppm/day)	TDCG action based conditions	Sampling interval	Operating procedure
2012-10-16 16:30	Condition 4	1 693,12	-17,07	Condition 2	Quarterly	Exercise caution. Analyze individual gases to find cause. Determine load dependence.

Figure 10 - Asset Status on DGA with condition assessment



Oil Quality

Using alarm set (ppm) for DGA:

Name	Dielectric Strenght (D1816-1mm)	Dielectric Strenght (D1816-2mm)	Dielectric Breakdown (D 877)	Interfacial Tension	Acid Number	Oxygen Inhibitor	Power factor 25°C	Power factor 100°C	Neut. No. (Mg KOH/mg)	Soluble Sludge	Water Content	Total Furans
MS - Critical Level (IEC+50)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
MS - Critical Level (IEC+50)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
MS - Critical Level (IEC+50)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Analysis Table

	Dielectric Strenght (D1816-1mm)	Dielectric Strenght (D1816-2mm)	Dielectric Breakdown (D 877)	Interfacial Tension	Acid Number	Oxygen Inhibitor	Power factor 25°C	Power factor 100°C	Moisture	Neut. No. (Mg KOH/mg)	Visual Exam	Soluble Sludge
Result	N/A	N/A	Acceptable	Acceptable	Acceptable		Acceptable	N/A	Acceptable	N/A	Acceptable	Acceptable
2012-10-16 16:30	N/A	N/A	38	36.9	0.01		0.019	N/A	3.00		CLEAR	
Previous sample 2012-09-18 05:54	N/A	N/A	51	36.6	0.01	N/A	0.023	N/A	3	N/A	CLEAR	N/A
First sample 2010-09-01 00:45	N/A	N/A	44	38.8	0.01	N/A	0.043	N/A	10	N/A	CLEAR	N/A

Figure 11 - Asset Status on Oil Quality Data

Notification and Asset Status Example

Asset Information

Name	An Asset
Equipment number	
Substation name	
Location	

Messages
• CO (3) rate of change reaches the trend limit (2).

Alarm Set

Name	H2	CH4	C2H6	C2H4	C2H2	O2	N2	CO2	CO	Moisture	SF6	TDG	TDCG	THCG
IEC- Warning Level	150.0	110.0	90.0	280.0	50.0			13000	900					
MS - Critical Level (IEC+50)	200.0	200.0	200.0	300.0	100.0			20000	900					
IEEE - Trend Level	1.5							20	2					

DGA Limits Statuses

Samples	Date	H2	CH4	C2H6	C2H4	C2H2	O2	N2	CO2	CO	Moisture	SF6	TDG	TDCG	THCG
Latest	11/3/2013 2:59:36 PM	**564.0**	**548.0**	**110.0**	**325.0**	**53.4**	0	77000	11400	**1030**	3		9.00	0.00	2.00
Yesterday	11/2/2013 3:59:35 PM	**561.0**	**552.0**	**111.0**	**329.0**	**54.2**	0	78000	11400	**1030**	5		9.00	0.00	2.00
7 days ago	**No Available Data**														

Rate of change (ppm/day)

H2	CH4	C2H2	C2H4	C2H6	O2	N2	CO2	CO	Moisture	SF6	TDG	TDCG	THCG
0.9	**0.8**	**0.2**	**1.8**	**0.6**	**-184**	**-50**	47	3	**0**	**N/A**	**-0.04**	**0.00**	**0.00**

DGA analysis

Duval triangle	Rogers gas ratios	IEC 60599 gas ratios	Doernenburg	Key gas
DT = Mixtures of electrical and thermal faults	Unknown fault	Unknown fault: partial or mixture of faults – mainly thermal faults	Fault not identifiable	Unknown fault

IEEE Recommendations 57.104-2008

Key gas based transformer conditions	TDCG (ppm)	TDCG rate (ppm/day)	TDCG action based conditions	Sampling interval	Operating procedure
Condition 4	2630	7.19	**Condition 3**	Monthly	Exercise extreme caution. Analyze for individual gases. Plan outage and advise the manufacturer.